Appendices

CALAM MONTEREY PENINSULA WATER SUPPLY PROJECT

Final Environmental Impact Report/ Environmental Impact Statement

Prepared for
California Public Utilities Commission and
Monterey Bay National Marine Sanctuary

March 2018

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APPENDICES

The appendices in this Final EIR/EIS have not been made fully compliant with Section 508 of the Rehabilitation Act of 1973. For help with this data or information, please contact Monterey Bay National Marine Sanctuary at (831) 647-4201 and reference the Final EIR/EIS for the Monterey Peninsula Water Supply Project, dated March 2018.

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APPENDIX A
NOP and NOI Scoping Report

APPENDIX A

Notice of Preparation (NOP) and Notice of Intent (NOI) Scoping Report

1. Introduction to Scoping Report

The California Public Utilities Commission (CPUC) and Monterey Bay National Marine Sanctuary (MBNMS) are preparing a Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the California American Water Company (CalAm) Monterey Peninsula Water Supply Project (MPWSP or proposed project) in accordance with California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) requirements. The Draft EIR/EIS will assess the potential impacts of the proposed action on the environment. The CPUC formally began the process of determining the scope of issues and alternatives to be evaluated in the Draft EIR (a process called "scoping") when it issued a Notice of Preparation (NOP) of an EIR for the proposed action on October 10, 2012. In accordance with Section 102(2)(C) of NEPA, the NOAA Office of National Marine Sanctuaries published a Notice of Intent (NOI) to prepare an EIS for the proposed project on August 26, 2015 (80 Fed. Reg. 51787).

This joint NOP/NOI Scoping Report outlines the scoping processes undertaken by the CPUC and MBNMS and provides summaries of comments received. A copy of the NOP is included as Attachment A, and the NOI is included as Attachment B.

2. Purpose of Scoping Process

This report summarizes and documents the comments received during the scoping period for the NOP and NOI. It includes verbal and written comments received during the scoping periods (CEQA scoping closed on November 9, 2012; NEPA Scoping closed on October 2, 2015). Scoping is the process of early consultation with the affected agencies and public prior to completion of a Draft EIR/EIS. The comments provided by the public and agencies during the scoping process help the CPUC and MBNMS identify pertinent issues, methods of analyses, and level of detail that should be addressed in the EIR/EIS. The scoping comments also assist the CPUC and MBNMS in developing a reasonable range of feasible alternatives to be evaluated in the EIR/EIS. The scoping comments augment the information developed by the project proponents, the CPUC and MBNMS, and the EIR/EIS preparers, which includes specialists in each of the environmental subject areas covered in the EIR/EIS. This combined input results in an EIR/EIS that is both comprehensive and responsive to issues raised by the public and regulatory agencies, and that satisfies all CEQA/NEPA requirements.

Scoping is not conducted to resolve differences concerning the merits of a project or to anticipate the ultimate decision on a proposal. Rather, the purpose of scoping is to help ensure that a comprehensive EIR/EIS will be prepared that provides an informative basis for the decision-making process.

3. Overview of Scoping Process for MPWSP EIR/EIS

3.1 NOP Notification and Scoping Meetings

Hardcopies of the NOP were mailed to all federal, state, responsible, and trustee agencies involved in approving or funding the project, as well as relevant local agencies and special districts with jurisdiction in the project area. The mailing list also included organizations, members of the public, and local, regional, and state agencies who commented on, or were involved in, the CalAm Coastal Water Project Draft EIR (State Clearinghouse No. 2006101004, concerning the predecessor proposed project to the MPWSP), or who have expressed interest in participating in the CEQA process for the MPWSP. In addition, although not required by CEQA, Property owners and occupants of parcels located within 300 feet of proposed project components were identified and sent NOP postcards with information about the project, scoping period, and opportunities for submitting comments. The NOP was also made available at 13 local libraries and was published in local newspapers and legal advertisements.

The CPUC held a total of three scoping meetings, each of which was open to the general public:

- Wednesday, October 24, 2012
  6:30 p.m. – 8:30 p.m.
  Rancho Canada Golf Club, 860 Carmel Valley Road, Carmel, CA 93923

- Thursday, October 25, 2012 1:30 p.m. – 3:30 p.m.
  Oldemeyer Center, Blackhorse Room, 986 Hilby Avenue, Seaside, CA 93955

- Thursday, October 25, 2012 6:30 p.m. – 8:30 p.m.
  Oldemeyer Center, Laguna Grande Hall, 986 Hilby Avenue, Seaside, CA 93955

Information regarding the CPUC scoping process can be viewed here:

http://www.cpuc.ca.gov/environment/info/esa/mpwsp/index.html.

3.2 NOI Notification and Scoping Meeting

In addition to publishing the NOI in the Federal Register, the NOI was posted on the MBNMS home page, advertised in two local newspapers, and a community announcement of the NOI was sent to the following MBNMS listserves, which include federal, state, regional, and local agencies and interested organizations:

- Public Relations
- Sanctuary Advisory Council
- Conservation Working Group
- Sanctuary Education Panel
- Research Activity Panel

The community announcement included a summary of the project, noticed the comment deadline and public meeting date, provided submission and scoping meeting information, and MBNMS personnel contact information.

The MBNMS held one scoping meeting open to the general public:

- Thursday, September 10, 2015 2:00 p.m.
  Sally Griffin Active Living Center, 700 Jewell Avenue, Pacific Grove, CA 93950

Information regarding the MBNMS scoping process can be viewed here:

https://www.regulations.gov/docket?D=NOAA-NOS-2015-0105.

4. Summary of NOP/NOI Scoping Comments

4.1 NOP Scoping Comments

During the scoping meetings held on October 24 and 25, 2012, participants commented on the proposed project. Written comments were also collected throughout the public comment period. Forty-one written letters were received during the scoping period. Commenting parties and summaries of the comments received are provided below.

Comment letters received during the scoping period were reviewed, bracketed, and coded. Each comment letter was given a unique letter code that corresponds to the type of commenter (i.e., Federal Agency [F], State Agency [S], Local Agency [L], Group [G], Individual [I], or Scoping Meeting [ScopingMTG]); an acronym for the agency or organization (or, in the case of individuals, their last name); and the sequentially numbered, bracketed comment from that commenter. These comment identifiers are used as a cross-reference to the topical codes. The individual comments were then summarized by topical areas. The following individuals and parties in **Table 1** submitted comments on the scope of the EIR. These comments are organized by affiliation.

Summary of NOP Scoping Comments

EIR/EIS staff reviewed all of the scoping comments, and prepared a summary of each comment to provide an overview of the range of comments provided, and to facilitate consideration of the comments by analysts during preparation of the EIR/EIS. The comment summaries seek to capture the essence of every comment in a way that is meaningful for EIR/EIS preparers such that the comment can be addressed in the EIR/EIS.

Issues to Be Considered

Water Demand

- Water demand estimates for the Monterey District should consider non-residential water use (associated with hospitality and tourism) following economic recovery. [L_MPWMD-08]

- Future demand estimates should consider proposed development projects in the City of Seaside. [G_SPG-02]

TABLE 1
PARTIES SUBMITTING COMMENTS DURING
THE MONTEREY PENINSULA WATER SUPPLY PROJECT EIR SCOPING PROCESS

Affiliation	Name	Date/Received Date	Comment Letter Code
Federal Agencies			
NOAA Monterey Bay National Marine Sanctuary	Paul Michel	November 9, 2012	F_MBNMS
U.S. Fish and Wildlife Service	Diane K. Noda	November 9, 2012	F_USFWS
State Agencies			
Division of Ratepayer Advocates California Public Utilities Commission	Diana S. Brooks	November 9, 2012	S_CPUC_DRA
California State Lands Commission	Cy R. Oggins	November 13, 2012	S_CSLC
Local and Regional Agencies			
County of Monterey Department of Public Works	Raul Martinez	November 14, 2012	L_CoMontereyPW
Monterey Bay Unified Air Pollution Control District	Amy Clymo	November 6, 2012	L_MBUPCD
Monterey County Resource Management Agency	Jacqueline R. Onciano	November 9, 2012	L_MCRMA
Monterey County Water Resources Agency	Robert Johnson	November 9, 2012	L_MCWRA
City of Monterey	Fred Meurer	October 25, 2012	L_Monterey
Monterey Peninsula Water Management District	David Stoldt	November 8, 2012	L_MPWMD
City of Pacific Grove	Thomas Frutchey	November 8, 2012	L_PacGrove
Group			
Ag Land Trust	Molly Erickson	November 9, 2012	G_AgLandTrust
California American Water Company	Tim Miller	November 9, 2012	G_CalAm
Coalition of Peninsula Businesses	Bob McKenzie and John Narigi	November 9, 2012	G_CPB
Citizens for Public Water	George Riley and Ed Mitchell	November 8, 2012	G_CPW
LandWatch Monterey County	John H. Farrow	October 1, 2012	G_LandWatch
Monterey Peninsula Taxpayer Association	Tom Rowley	October 25, 2012	G_MPTA
Planning and Conservation League	Jonas Minton	October 24, 2012	G_PCL
Sustainable Pacific Grove	Karin Locke	October 24, 2012	G_SPG
Surfrider Foundation	Gabriel Ross and Edward Schexnayder	November 9, 2012	G_Surfrider
Salinas Valley Water Coalition	Nancy Isakson	October 2, 2012	G_SVWC1
Salinas Valley Water Coalition	Nancy Isakson	November 11, 2012	G_SVWC2
WaterPlus and LandWatch Monterey County	Ron Weitzman	October 4, 2012	G_WaterPlus1
WaterPlus	Dick Rotter	October 25, 2012	G_WaterPlus2
WaterPlus	Ron Weitzman	October 31, 2012	G_WaterPlus3
WaterPlus	Ron Weitzman	November 9, 2012	G_WaterPlus4
WaterPlus	Dick Rotter	November 6, 2012	G_WaterPlus5
Individuals			
Individual	John and Marion Bottomley	November 2, 2012	I_Bottomley
Individual	George Brehmer	November 9, 2012	I_Brehmer
Individual	Bill Carrothers	October 29, 2012	I_Carrothers

TABLE 1 (Continued)
PARTIES SUBMITTING COMMENTS DURING
THE MONTEREY PENINSULA WATER SUPPLY PROJECT EIR SCOPING PROCESS

Affiliation	Name	Date/Received Date	Comment Letter Code
Individuals (cont.)			
Individual	Roger J. Dolan	November 6, 2012	I_Dolan
Individual	Ken Ekelund	November 2, 2012	I_Ekelund
Individual	Manuel and Janine Fierro	November 8, 2012	I_Fierro
Individual	Mike Fillmon	October 24, 2012	I_Fillmon
Individual	Ray M. Harrod Jr.	November 8, 2012	I_Harrod
Individual	Chris Herron	October 24, 2012	I_Herron
Individual	Christina W. Holston	October 24, 2012	I_Holston
Individual	Hebard and Peggy Olsen	October 19, 2012	I_Olsen
Individual	Robert Siegfried	October 24, 2012	I_Siegfried1
Individual	Robert Siegfried	October 27, 2012	I_Siegfried2
Individual	Robert Siegfried	October 27, 2012	I_Siegfried3
Individual	Roy L. Thomas	November 15, 2012	I_Thomas
Scoping Meeting Comments			
Not Given	Unknown verbal commenter	October 24, 2012	ScopingMTG1
Not Given	Unknown verbal commenter	October 25, 2012	ScopingMTG2
Not Given	Unknown verbal commenter	October 25, 2012	ScopingMTG3

- The demand estimates should consider conservation and demand offset. [G_SPG-09]
- The EIR should consider rainwater harvesting and greywater systems for demand management and supplemental sources of supply. [I_Brehmer-01]
- The EIR should address whether the proposed project would supply Clark Colony or whether Clark Colony would need to purchase other supplies. [ScopingMTG1-06]
- Further consideration should be given to the size of conveyance facilities given the potential reduction in CalAm Carmel River diversions below their existing entitlements (i.e., if Los Padres Dam were removed). The EIR should evaluate whether the conveyance pipelines would need to be increased in capacity. [ScopingMTG1-08]
- The EIR should evaluate whether there is enough capacity to pump from Carmel River to aquifer storage and recovery. Additionally, the EIR should evaluate the capacity of the pipeline system. [ScopingMTG1-10]
- The EIR should properly identify the demand the project is intended to serve. The EIR should evaluate the impacts of downsizing and upsizing the capacity. [ScopingMTG2-19]
- The EIR should consider that the per capita demand is declining and that tiered rates have had a significant effect on the elasticity of water. If the proposed project assumes today's demand, it will be off. [ScopingMTG2-21]
- The EIR should evaluate the implementation of larger pipelines and additional water treatment capacity for the growing needs on the Peninsula. [ScopingMTG2-42]

- The EIR should address the maintenance of the facilities and the examination of water leaks in the system. [ScopingMTG2-45]

Project Description

- The MPWSP will need to receive approvals from CSLC for all project components within CSLC jurisdiction. [S_CSLC-01]

- The Project Description in the EIR should be as precise, thorough, and complete as possible to facilitate meaningful environmental review. [S_CSLC-02]

- The EIR should clearly explain the relationship between the Coastal Water Project and the MPWSP, and the relationship between the MPWSP and the Deepwater Desal Alternative and the People's Moss Landing Desal Alternative. [S_CSLC-03]

- The EIR should provide a detailed evaluation of the pre-treatment and post-treatment systems of desalination so that the impact analyses can evaluate any associated environmental effects. [S_CSLC-07]

- Production capacity should be based on the replacement water supplies associated with the legal restrictions on CalAm’s Carmel River and Seaside Groundwater Basin supplies, while providing sufficient capacity and flexibility for replenishment of the Seaside Groundwater Basin, economic recovery, and water system reliability. [L_MPWMD-06]

- The proposed desalination plant should be designed with sufficient redundancy to meet outages and required maintenance activities, and to satisfy peak day and peak month demand. [L_MPWMD-09]

- Although the production capacity for the MPWSP should be based on replacement supply needs, conveyance facilities should be sized to accommodate future growth, general plan build out, and unforeseen changes in the availability of CalAm’s existing water supplies. [L_MPWMD-10]

- The EIR should clearly describe the location and composition of the proposed project facilities. [L_PacGrove-02]

- The MPWSP should provide CalAm with the flexibility to deliver MPWSP water supplies to the Ryan Ranch, Bishop, and Hidden Hills distribution systems (located outside of the Monterey District service area). [G_CalAm-05]

- It is likely that CalAm will be required to cease pumping in the Laguna Seca subarea under the Court’s adjudication of the Seaside Groundwater Basin. As a result, the MPWSP should include the provision of water supplies to these areas. [G_CalAm-06]

- The EIR should evaluate pipeline alignments that would facilitate the delivery of water to the Ryan Ranch, Bishop, and Hidden Hills distribution systems. [G_CalAm-07]

- The availability of Carmel River supplies for injection into the ASR system is unreliable given that these supplies rely exclusively on “excess winter flows” in the Carmel River. Therefore, the CPUC should not depend on ASR product water for meeting customer demand. [G_CPB-02]

- The proposed desalination plant should be sized such that it can meet customer water needs when operated at 80 percent of capacity. [G_CPB-04]

- The EIR should describe how brine from the desalination plant would be discharged. The EIR should also evaluate available capacity in the MRWPCA ocean outfall for brine discharges. [G_CPW-09]
- The EIR should describe the project purpose and need as it relates to the region. [G_CPW-11]
- The EIR should state the maximum volume of water that would be drawn via the proposed slant wells, and evaluate the environmental impacts of these withdrawals on marine resources. [G_CPW-23]
- The MOU between MRWPCA and the MCWD states that MCWD has the right to use a portion of the MRWPCA outfall capacity. [G_CPW-39]
- The EIR should describe the sustainability and annual reliability of the proposed improvements to the ASR system. [G_MPTA-01]
- The EIR should clarify the advantages of slant wells over other intake technologies. [G_SPG-03]
- The project objectives should be tailored to facilitate the evaluation of a broad range of alternatives capable of meeting the Peninsula's water supply needs. [G_Surfrider-07]
- The EIR should be clear about the project purpose and need, and specify whether the project would be limited to replacement supplies or if the project would also provide additional water supplies. In addition, the EIR should include a map of the Monterey District service area. [G_SVWC2-01]
- The EIR should specify the nature and frequencies of maintenance activities associated with the proposed facilities, and as a condition of project approval, require that CalAm conduct these maintenance activities to avoid excessive costs to ratepayers associated with failing infrastructure. [G_WaterPlus5-02]
- The EIR should consider a variety of energy sources and configurations to reduce the cost of operating the proposed desalination plant. [I_Dolan-04]
- The MPWSP should include additional water supplies to serve lots of record. [I_Harrod-01]
- The desalination plant should be designed to facilitate future increases in production capacity. [I_Siegfried3-04]
- The MPWSP project area should be expanded to encompass the entire CalAm service area. [I_Siegfried3-05]
- Further consideration should be given to the size of conveyance facilities given the potential reduction in CalAm Carmel River diversions below their existing entitlements (i.e., if Los Padres Dam were removed). The EIR should evaluate whether the conveyance pipelines would need to be increased in capacity. [ScopingMTG1-08]
- The EIR should evaluate whether there is enough capacity to pump from Carmel River to aquifer storage and recovery. Additionally, the EIR should evaluate the capacity of the pipeline system. [ScopingMTG1-10]
- The project area should include the entire existing CalAm service area as it relates to the degradation of soils, water quality, and salt balance/salinity. [ScopingMTG1-11]

- The EIR should include a discussion of the electric power (PG&E) transmission lines and associated construction impacts. [ScopingMTG2-01]
- The EIR should address all of the required federal permitting. [ScopingMTG2-04]
- In terms of project, governance; keep the County in control. [ScopingMTG2-08]
- The slant wells would require coordination with the City of Marina as to its Local Coastal Program. [ScopingMTG2-15]
- Would the test wells be transitioned into production? [ScopingMTG2-17]
- The footprint of the slant wells on the beach should be included in the EIR. The EIR should address open space, beach access, and a reduced footprint to minimize intrusion in beach areas. The EIR should examine future zoning conflicts. [ScopingMTG2-22]
- The EIR should evaluate discharge in anticipation of future/expected regulations. [ScopingMTG2-27]
- The EIR should examine the potential to expand facilities and increase water availability without increasing the project footprint. [ScopingMTG2-29]
- The appearance of injection wells and buildings need City Planning approval. [ScopingMTG2-40]
- The EIR and proposed project should include the use of sustainable design elements. [ScopingMTG2-47]

Surface Water Hydrology and Water Quality

- The EIR should evaluate the effects of mixing brine with wastewater effluent and ensure that effluent concentrations are consistent with the SWRCB Ocean Plan requirements. [F_MBNMS-04]
- The EIR should address the potential for the MPWSP to change the interfaces and mixing zones for saltwater, brackish water, and freshwater. [S_CPUC_DRA-03]
- The EIR should address impacts to water quality. [G_AgLandTrust-06]
- The EIR should evaluate project consistency with water quality regulations. [G_AgLandTrust-12]
- The alternatives analysis should consider direct and cumulative impacts to marine resources associated with brine discharge from alternative desalination projects. [G_CPW-26]
- The EIR should identify the waste discharge requirements for brine disposal. [G_SPG-07]
- The EIR should evaluate impacts associated with brine discharge, including impacts within the zone of initial dilution as well as long-term impacts from brine accumulation in the far-field benthic environment. [G_Surfrider-03]
- The EIR should evaluate the effects of irrigating with desalinated product water on soil infiltration rates in the CalAm service area. [I_Siegfried1-01]

- The project area should include the entire existing CalAm service area as it relates to the degradation of soils, water quality, and salt balance/salinity. [ScopingMTG1-11]

- The EIR should evaluate the effects of irrigating with desalinated product water on terrestrial biological resources and soil infiltration rates in the CalAm service area. [I_Siegfried3-06]

Groundwater Resources

- The EIR should evaluate the potential for the proposed slant wells to exacerbate seawater intrusion. [S_CPUC_DRA-01]

- The EIR should specify the methodology used to evaluate seawater intrusion impacts. [S_CPUC_DRA-02]

- The EIR should address the potential for the proposed slant well configuration to affect freshwater and seawater gradients in the aquifer. [S_CPUC_DRA-04]

- The EIR should evaluate how the injection of desalination product supplies into the Seaside Groundwater Basin would affect groundwater quality. [S_CSLC-08]

- The EIR should require the development and implementation of a monitoring well network to evaluate project effects on seawater intrusion and the Salinas Valley Groundwater Basin. [L_MCWRA-01]

- The EIR should address Salinas Valley Groundwater Basin groundwater rights as they relate to operation of the proposed MPWSP slant wells. [L_MCWRA-02; G_CPW-06; G_CPW-16; G_CPW-18; G_CPW-19; G_CPW-21; G_MPTA-03]

- The MCWRA requests that any modeling data and supporting information that is developed for the groundwater analysis be provided to MCWRA. [L_MCWRA-05]

- The EIR should evaluate how the injection of desalination product supplies into the Seaside Groundwater Basin would affect groundwater quality. [L_MPWMD-12]

- The EIR should evaluate the seawater intrusion and groundwater quality effects associated with extracting banked ASR water supplies via the ASR injection/extraction wells versus from CalAm production wells at different locations. [L_MPWMD-13]

- The EIR should address Salinas Valley Groundwater rights as they relate to the West Armstrong Ranch (owned by Ag Land Trust). [G_AgLandTrust-01]

- The EIR should acknowledge that groundwater cannot be pumped from the Salinas Valley Groundwater Basin without prescription. [G_AgLandTrust-02]

- The EIR should provide a detailed analysis of Salinas Valley Groundwater Basin water rights issues, including an analysis of existing water rights and impacts to agricultural land associated with the transfer of water rights to CalAm. [G_AgLandTrust-03]

- The EIR should evaluate potential impacts related to seawater intrusion. [G_AgLandTrust-09]

- The EIR should evaluate impacts associated with screening the proposed slant wells in the Sand Dunes aquifer, as proposed in CalAm’s contingency plan. [G_AgLandTrust-10]

- The EIR should clearly state the volume of water that would be drawn from the slant wells under various scenarios, and the anticipated percentage of freshwater versus saltwater under each scenario. [G_AgLandTrust-19]

- It is likely that CalAm will be required to cease pumping in the Laguna Seca subarea under the Court's adjudication of the Seaside Groundwater Basin. As a result, the MPWSP should include the provision of water supplies to these areas. [G_CalAm-06]

- The MPWSP EIR should consider the Monterey County Superior Court's ruling on the CWP EIR, which determined that water rights were not adequately addressed in the CWP EIR. [G_CPW-01]

- The EIR should specify the volume of water that would need to be returned to the Salinas Valley Groundwater Basin. [G_CPW-07]

- The EIR should evaluate the potential for operation of the proposed slant wells to exacerbate seawater intrusion in the Seaside Groundwater Basin and adversely affect up-gradient wells. [G_CPW-20]

- The EIR should quantify the amount of groundwater that must be returned to the Salinas Valley Groundwater Basin and evaluate the potential adverse effects of borrowing/returning such water. [G_CPW-22]

- The EIR should evaluate the potential for operation of the proposed slant wells to exacerbate seawater intrusion in the Seaside Groundwater Basin. [G_CPW-24]

- The EIR should evaluate the potential for operation of the proposed slant wells to adversely affect up-gradient wells. [G_CPW-25]

- The EIR should provide a clear explanation of the updated groundwater modeling efforts used to evaluate project impacts. [G_SPG-06]

- As part of EIR preparation, the CPUC should develop an updated groundwater model that accurately represents the hydrogeologic setting and baseline conditions, and simulates future conditions with project implementation. [G_SVWC2-02]

- The EIR should address the direct impacts to Salinas Valley Groundwater Basin associated with operation of the proposed slant wells, and the utilization of desalinated product water that is returned to the CSIP storage pond. [G_SVWC2-03]

- The EIR should evaluate impacts to agricultural lands associated with any adverse effects on water rights held by agricultural water users. [G_SVWC2-04]

- The EIR should consider potential reliability and sustainability issues associated with groundwater replenishment and aquifer storage and recovery. Such issues include the potential to exacerbate seawater intrusion, the reliability of Carmel River diversions for injection into ASR, and the availability of reclaimed wastewater for groundwater replenishment. [G_WaterPlus3-01]

- The EIR should evaluate project consistency with the Agency Act, which prohibits the exportation of groundwater from the Salinas Valley Groundwater Basin, as well as the potential for the project to exacerbate seawater intrusion. [G_WaterPlus4-01]

- The EIR should include an assessment of the percent saltwater versus freshwater that would be drawn from slant wells at the CEMEX property. [I_Dolan-01]

- The EIR should evaluate project impacts related to seawater intrusion, groundwater levels, and effects on non-CalAm groundwater production wells. [I_Herron-01]

- The EIR should evaluate the potential for the injection of desalinated product water into the Seaside Groundwater Basin to degrade water quality in the aquifer. [I_Siegfried3-01]

- The EIR should evaluate the effects of injecting desalinated product water into the ASR system on boron concentrations in the CalAm water supply. [I_Siegfried3-03]

- The EIR should consider Salinas Valley groundwater issues. [ScopingMTG1-01]

- The EIR should clearly identify the difference between fresh versus brackish groundwater. [ScopingMTG2-12]

- The EIR should consider the amount of water that will be taken out of the Seaside aquifer, because the aquifer leaks. The EIR should evaluate the use of the aquifer by multiple projects. Examination of the rate at which water is being lost from the aquifer and how long water will be stored should be included in the EIR. [ScopingMTG2-31]

- The Ghyben-Herzbergt theory should be considered. [ScopingMTG3-01]

Marine Resources

- The MBNMS has developed guidelines (Desalination Action Plan) for the siting, design, and operation of desalination plants along the sanctuary. In addition, the sanctuary has three regulations relevant to desalination projects: (1) it is prohibited to discharge or deposit any material within sanctuary boundaries, (2) it is prohibited to discharge material outside of sanctuary boundaries that will subsequently enter the sanctuary and negatively impact marine resources, and (3) it is prohibited to alter submerged lands of the sanctuary. [F_MBNMS-01]

- The EIR should evaluate the effects of mixing brine with wastewater effluent and ensure that effluent concentrations are consistent with the SWRCB Ocean Plan requirements. [F_MBNMS-04]

- The EIR should evaluate potential impacts to the sanctuary associated with installation of the proposed slant wells. [F_MBNMS-05]

- The EIR should address the potential for the MPWSP to change the interfaces and mixing zones for saltwater, brackish water, and freshwater. [S_CPUC_DRA-03]

- The EIR should evaluate the potential for project construction and operations to generate underwater noise or vibration that has the potential to impact marine biological resources. [S_CSLC-06]

- The EIR (and the NEPA document for the MPWSP) should evaluate impacts to the Monterey Bay National Marine Sanctuary. [G_AgLandTrust-18]

- The EIR should state the maximum volume of water that would be drawn via the proposed slant wells, and evaluate the environmental impacts of these withdrawals on marine resources. [G_CPW-23]

- The alternatives analysis should consider direct and cumulative impacts to marine resources associated with brine discharge from alternative desalination projects. [G_CPW-26]
- The EIR should evaluate the long-term effects of brine discharge on marine resources and habitats. [G_SPG-01]
- The EIR should evaluate potential effects on marine resources and coastal ecosystems related to brine discharge, the proposed seawater intake system, and greenhouse gas emissions associated with powering the desalination plant. [G_Surfrider-01]
- The EIR should evaluate impacts associated with brine discharge, including impacts within the zone of initial dilution as well as long-term impacts from brine accumulation in the far-field benthic environment. [G_Surfrider-03]
- The EIR should include well-defined mitigation measures to prevent erosion and preserve sensitive coastal habitat. [G_Surfrider-05]
- The EIR should consider the effects of salt removal associated with desalination on marine organisms. [I_Olsen-05]
- The EIR should evaluate the cumulative impacts of brine from many desalination plants in the Monterey Bay region. [ScopingMTG1-17]
- The EIR should evaluate whether higher salinity would produce more red tide and algal blooms. [ScopingMTG1-18]
- The commenter states that the diffusion of brine would be complicated by addition of Marina Coast outflow. [ScopingMTG2-10]
- The EIR should address the impacts slant wells could have on marine biological species, including birds and seals and their migratory habitat and variable habitat by season and year. [ScopingMTG2-23]
- The EIR should examine the impacts of the concentration of brine discharge. Questioned if the EIR would have a comparative study of brine discharges at existing plants? [ScopingMTG2-24]
- Commenter questioned whether there are relevant studies to be able to evaluate the effects of discharge. [ScopingMTG2-30]

Terrestrial Biological Resources

- The EIR should evaluate impacts to Smith's blue butterfly, Menzies' wallflower, Monterey gilia, Western snowy plover, and Monterey spineflower associated with installation and maintenance of the proposed slant wells. [F_USFWS-01]
- The EIR should evaluate cumulative impacts to Western snowy plover associated with the proposed seawater intake system and CEMEX mining activities. [F_USFWS-02]
- The EIR should address impacts to California red-legged frog associated with construction, operation, and maintenance of the proposed desalination plant. [F_USFWS-03]
- The EIR should evaluate impacts to federally listed species resulting from construction of proposed conveyance pipelines. [F_USFWS-04]

- The EIR should present responses from CDFG, CNDDB, and USFWS that identify any special-status plant and wildlife species that may occur in the project area. [S_CSLC-05]

- The EIR should evaluate the effects of irrigating with desalinated product water on terrestrial biological resources and soil infiltration rates in the CalAm service area. [I_Siegfried3-06]

- The EIR should evaluate impacts on snowy plover. [ScopingMTG1-12; ScopingMTG2-13; ScopingMTG2-14]

Geology, Soils, Seismicity

- The EIR should evaluate potential impacts related to sea level rise. [S_CSLC-13]

- The project area should include the entire existing CalAm service area as it relates to the degradation of soils, water quality, and salt balance/salinity. [ScopingMTG1-11]

- The EIR should address the longevity of wells relative to corrosion and whether the wells must be moved often. [ScopingMTG1-13]

- The EIR should evaluate whether well intake would erode or move soil. [ScopingMTG1-14]

Hazards and Public Health and Safety

- The EIR should evaluate the public health and safety risk of private ownership of the MPWSP. [ScopingMTG2-25]

- The EIR should evaluate the safety of the Fort Ord area and its use for park and residential uses. Commenter recommends developing Terminal Reservoir area as park space. The EIR should coordinate with FORA on the status, schedule, and extent of cleanup efforts. [ScopingMTG2-39]

- The EIR should address the timeframe of cleanup of Fort Ord relative to construction of the Terminal Reservoir (area is currently not planned for cleanup for some time). [ScopingMTG2-41]

Land Use and Recreation

- The EIR should discuss the potential for project implementation to affect land use and recreational resources. The EIR should also describe how the CPUC and CalAm will notify the public about activities happening in the project area that could affect land use and recreational resources. [S_CSLC-09]

- The EIR should evaluate the needs and benefits to pedestrian and bicycle facilities. [L_CoMontereyPW-08]

- The EIR should evaluate land use impacts associated with facility siting and the annexation of land. [G_AgLandTrust-08]

- The footprint of the slant wells on the beach should be included in the EIR. The EIR should address open space, beach access, and a reduced footprint to minimize intrusion in beach areas. The EIR should examination future zoning conflicts. [ScopingMTG2-22]

- The EIR should consider the road construction in Seaside (La Salle Avenue, Hilby Avenue). Including road repaving, not just patching. [ScopingMTG2-32]

- The EIR should address staging and parking areas for construction workers as parking is an issue for the neighborhoods south of La Salle Avenue. There is the potential to use local school parking lots during summer (first week in June to first week in August; no summer school sessions). [ScopingMTG2-33]

- The EIR should address access for residents during construction. [ScopingMTG2-35]

- The EIR should address the aesthetics impacts of the Terminal Reservoir. The Terminal Reservoir should be set back off of General Jim Moore Boulevard and be partially submerged underground. [ScopingMTG2-36]

- The EIR should incorporate a detention basin in the design for the overflow capacity for the Terminal Reservoir. The City of Seaside worked with CalAm on a park conceptual design for area around Terminal Reservoir to integrate park space and address aesthetic impacts. Bureau of Land Management owns land behind the Terminal Reservoir site. [ScopingMTG2-37]

- The EIR should evaluate the City of Seaside General Plan for conflicts with zoning and land use designation. [ScopingMTG2-38]

- CalAm would need a right of entry permit from Fort Ord Reuse Authority (FORA) for access. The EIR should evaluate the safety of the Fort Ord area and its use for park and residential uses. Commenter recommends developing Terminal Reservoir area as park space. The EIR should coordinate with FORA on the status, schedule, and extent of cleanup efforts. [ScopingMTG2-39]

- The EIR should address the timeframe of cleanup of Fort Ord relative to construction of the Terminal Reservoir (area is currently not planned for cleanup for some time). [ScopingMTG2-41]

Traffic

- The EIR's mitigation measures should conform to regional planning documents. [L_CoMontereyPW-01]

- The EIR methods by which the Level of Service is calculated should be consistent with the methods in the latest editions of the Highway Capacity Manual. [L_CoMontereyPW-02]

- The EIR's Traffic Studies should identify mitigation measure for all traffic circulation impacts on County roads. [L_CoMontereyPW-03]

- The EIR should address all impacts on county, regional, and city roadways. [L_CoMontereyPW-04]

- The EIR cumulative scenarios should be consistent with regional traffic model projections. [L_CoMontereyPW-05]

- The EIR should evaluate existing conditions, background and cumulative project scenarios. [L_CoMontereyPW-06]

- The EIR should include a pavement condition analysis. The EIR should evaluate impacts from the amount of heavy truck traffic. [L_CoMontereyPW-07]

- The EIR should evaluate the needs and benefits to pedestrian and bicycle facilities. [L_CoMontereyPW-08]

- The traffic reports should include access points and analyze the impacts on county, cities, and regional roadways. [L_CoMontereyPW-09]

- The EIR should consider the road construction in Seaside (La Salle Avenue, Hilby Avenue). Including road repaving, not just patching. [ScopingMTG2-32]

- The EIR should address staging and parking areas for construction workers as parking is an issue for the neighborhoods south of La Salle Avenue. There is the potential to use local school parking lots during summer (first week in June to first week in August; no summer school sessions). [ScopingMTG2-33]

- The EIR should evaluate emergency response times for the Seaside Fire Department (station at Yosemite and Broadway, Seaside). [ScopingMTG2-34]

- The EIR should address access for residents during construction. [ScopingMTG2-35]

Air Quality

- The EIR should use the MBUAPCD's 2008 CEQA Guidelines to evaluate air quality impacts. [L_MBUAPCD-01]

Greenhouse Gases

- The EIR should evaluate impacts to GHG levels. The evaluation should identify a threshold of significance, provide an estimate of GHGs that would be emitted as a result of project construction and operations, and determine the significance of those GHG emissions. [S_CSLC-12]

- The EIR should address the energy needs related to increased pipeline conveyance and the associated effects on carbon footprint. [L_MPWMD-11]

Noise and Vibration

- The EIR should evaluate the potential for project construction and operation to generate underwater noise or vibration that could potentially impact marine biological resources. [S_CSLC-06]

Public Services and Utilities

- The EIR should describe how brine from the desalination plant would be discharged. The EIR should also evaluate available capacity in the MRWPCA ocean outfall for brine discharges. [G_CPW-09]

- MOU between MRWPCA and the MCWD states that MCWD has the right to use of a portion of the MRWPCA outfall capacity. [G_CPW-39]

- The EIR should evaluate emergency response times for the Seaside Fire Department (station at Yosemite and Broadway, Seaside). [ScopingMTG2-34]

- The EIR should evaluate the reduction in wastewater volume going to the recycling facility. [ScopingMTG2-43]

Aesthetics

- The EIR should address the aesthetics impacts of the Terminal Reservoir. The Terminal Reservoir should be set back off of General Jim Moore and be partially submerged underground. [ScopingMTG2-36]
- The EIR should incorporate detention basin in the design for the overflow capacity for the Terminal Reservoir. The City of Seaside worked with CalAm on a park conceptual design for area around Terminal Reservoir to integrate park space and address aesthetic impacts. The Bureau of Land Management owns land behind the Terminal Reservoir site. [ScopingMTG2-37]

Cultural Resources

- The EIR should evaluate impacts to cultural resources, including shipwrecks and any submersed archaeological sites or historic resources that have remained in State waters for more than 50 years. [S_CSLC-11]

Agriculture and Forestry

- The EIR should provide a detailed analysis of Salinas Valley Groundwater Basin water rights issues, including an analysis of existing water rights and impacts to agricultural land associated with the transfer of water rights to CalAm. [G_AgLandTrust-03]
- The EIR should evaluate impacts to agricultural lands resulting from facility siting. [G_AgLandTrust-04]
- The EIR should evaluate impacts to preserved agricultural lands. [G_AgLandTrust-15]
- The EIR should evaluate impacts to agricultural lands associated with any adverse effects on water rights held by agricultural water users. [G_SVWC2-04]

Energy

- The EIR should address the energy needs related to increased pipeline conveyance and the associated effects on carbon footprint. [L_MPWMD-11]
- The EIR should evaluate the beneficial/negative effects of reclaimed methane gas as an energy source. [G_CPW-10]
- The EIR should consider the use of “green” or sustainable energy sources for operation of desalination facilities. [G_SPG-08]
- The EIR should include a discussion on the electric power (PG&E) transmission lines and associated construction impacts. [ScopingMTG2-01]

Cumulative Impacts

- The EIR should evaluate cumulative impacts to Western Snowy Plover associated with the proposed seawater intake system and CEMEX mining activities. [F_USFWS-02]
- The EIR should consider public participation proposals for small water projects that have been submitted to the CPUC, both with respect to potential cumulative impacts and as project alternatives. [L_PacGrove-05]

- The EIR should describe all proposed desalination projects in the area, including the status of environmental review, associated impacts, and the status of mitigations adopted. [G_AgLandTrust-05]
- The EIR should evaluate cumulative impacts. [G_AgLandTrust-14]
- The cumulative analysis should consider the effects of the proposed MPWSP desalination plant in combination with other future desalination projects in the Monterey Bay area. [G_SPG-05]
- The EIR cumulative analysis should address the impacts of both the MPWSP and the People's Project being approved (cumulative, growth inducing). [ScopingMTG1-05]
- The EIR should address cumulative projects and actions impacts. [ScopingMTG1-09]
- The EIR should evaluate the cumulative impacts of brine from many desalination plants in the Monterey Bay area. [ScopingMTG1-17]
- The EIR should address cumulative effects of incremental projects like Groundwater Replenishment, ASR, and others. [ScopingMTG2-20]

Alternatives

- Project alternatives should be evaluated at a sufficient level of detail to accurately determine the relative environmental impacts associated with each alternative. [F_USFWS-03]
- The alternatives analysis should provide a full comparative analysis of the effects of each alternative on federally listed species. [F_USFWS-05]
- The EIR should consider locational alternatives that would place all facilities outside of Western Snowy Plover habitat. [F_USFWS-06]
- The EIR should clearly explain the relationship between the Coastal Water Project and the MPWSP, and the relationship between the MPWSP and the Deepwater Desal Alternative and the People's Moss Landing Desal Alternative. [S_CSLC-03]
- The EIR should evaluate a full range of project alternatives. [L_Monterey-01]
- The EIR should evaluate project alternatives at the same level of detail as the proposed project. [L_Monterey-03; L_MPWMD-02; L_PacGrove-06; G_CPW-02]
- The descriptions of project alternatives in the EIR should be based on the most current information available. [L_MPWMD-03]
- The alternatives analysis should identify and consider the environmental impacts and benefits associated with groundwater replenishment. [L_MPWMD-05]
- If it is determined that CalAm's current allocation of Seaside Groundwater Basin supplies still exceeds the safe yield of the groundwater basin, these supplies could be further reduced to prevent seawater intrusion. The EIR should consider project alternatives that would provide sufficient supplies to serve customers and allow for aquifer recovery in the event CalAm is required to cease all pumping from the Seaside Groundwater Basin. [L_MPWMD-07]

- The EIR should evaluate the seawater intrusion and groundwater quality effects associated with extracting banked ASR water supplies via the ASR injection/extraction wells vs. from CalAm production wells at different locations. [L_MPWMD-13]

- The EIR should consider public participation proposals for small water projects that have been submitted to the CPUC, both with respect to potential cumulative impacts and as project alternatives. [L_PacGrove-05]

- The EIR should evaluate a locational alternative that would site the desalination plant at the former National Refractories site in Moss Landing. [G_AgLandTrust-17]

- The alternatives analysis should evaluate the commercial project alternatives (i.e., People's Moss Landing Desal, DeepWater Desal) but without mention of the commercial ventures. In addition, the EIR should evaluate a variety of design alternatives (i.e., facility locations, brine discharge facilities, pipeline alignments) that could be mixed and matched to address environmental impacts, project costs, and schedule considerations. [G_CalAm-03]

- The alternatives analysis should consider the modified design options and locational alternatives presented in CalAm's Contingency Plan dated November 1, 2012. [G_CalAm-04]

- To expedite permitting and project construction, the EIR should evaluate alternative alignments for the Monterey Pipeline and transfer pipeline that would move these pipelines outside of the Coastal Zone. [G_CalAm-08]

- The EIR should evaluate a project alternative sized with sufficient production capacity to meet future water demand under general plan build-out conditions. Future demand under the "general plan build-out" alternative should account for: (a) existing legal lots of record; (b) increased demand resulting from general plan build-out; and (c) non-residential (associated with hospitality and tourism) water use under recovered economic conditions. [G_CPB-01]

- Alternatives involving groundwater replenishment may not be feasible given lack of funding and concerns related to water rights. [G_CPB-03]

- As part of the MPWSP EIR efforts, the CPUC should conduct the environmental studies necessary for implementation of a "general plan build-out" alternative. [G_CPB-05]

- The descriptions of project alternatives in the EIR should be based on the most current information available. The CPUC should give the proponents of project alternatives a deadline for providing up to date alternatives information for incorporation into the EIR. [G_CPW-03]

- The description of the People's Moss Landing Desalination project presented in the NOP should be updated to reflect the most recent project information. Commenter is in favor of People's Moss Landing Desalination project. [G_CPW-04]

- Project alternatives involving groundwater replenishment may not have a reliable source of reclaimed water during all water year types. [G_CPW-08]

- The EIR should evaluate project alternatives with respect to required approvals and overall feasibility. [G_CPW-12]

- The alternatives analysis should describe the desalination technologies proposed by each alternative. [G_CPW-13]
- The alternatives analysis should consider the impacts of the various intake structures/technologies proposed by each alternative. [G_CPW-14]
- The alternatives analysis should consider drought reliability. [G_CPW-15]
- The alternatives analysis should consider direct and cumulative impacts to marine resources associated with brine discharge from alternative desalination projects. [G_CPW-26]
- The alternatives analysis should consider the technical feasibility, implementation schedule, and overall risk associated with alternative projects. [G_CPW-27]
- The alternatives analysis should consider the likelihood for the desalination alternatives to be legally challenged in court. [G_CPW-28]
- The EIR should compare the cost of implementing the alternative desalination projects, as well as the degree of regional economic benefit associated with each. [G_CPW-29]
- The Moss Landing alternatives would result in different significant environmental impacts, avoid significant legal challenges, and result in cost savings for ratepayers when compared to the MPWSP. [G_CPW-32]
- The EIR should assess the near- and long-term regional economic benefits associated with each project alternative. [G_CPW-35]
- The alternatives analysis should provide a comparison of the MPWSP and the desalination alternatives based on: infrastructure feasibility, environmental impacts associated with the seawater intake/brine discharge, feasibility/risk comparison, rough order of magnitude cost comparison, and overall project comparison. [G_CPW-36]
- The EIR should consider locational alternatives for the proposed seawater intake system that are outside of the Salinas Valley Groundwater Basin. [G_LandWatch-01; G_SVWC1-01; G_SVWC2-06; G_WaterPlus1-01]
- The feasibility of the Groundwater Replenishment alternative is speculative due to uncertainties regarding reclaimed water availability. [G_MPTA-02]
- The evaluation of the No Project Alternative should address compliance with the SWRCB’s Cease and Desist Order. [G_PCL-01]
- Commenter expressed support for alternatives that involve Groundwater Replenishment. [G_SPG-03]
- Commenter expressed support for project alternatives that include publicly owned and operated water supply infrastructure. [G_SPG-10; I_Fierro-01]
- The alternatives analysis should evaluate entrainment and impingement impacts associated with open water intakes, and evaluate the level of mortality of marine resources associated with each desalination alternative. [G_Surfrider-02]

- The EIR should evaluate the environmental impacts of CalAm's contingency options so that these options can move forward in the event that the MPWSP and other desalination alternatives are determined to be infeasible. [G_Surfrider-06]

- Commenter expressed support for alternatives that would reduce the capacity of the desalination plant and/or that would meet water needs without desalination. [G_Surfrider-08]

- The alternatives analysis should evaluate a stand-alone conservation alternative that would meet water needs by implementing strategies such as grey water systems, rainwater collection, landscape modifications, and water audits that reduce demand for potable water supplies. [G_Surfrider-09]

- Commenter expressed support for alternatives that involve reclaimed wastewater and groundwater replenishment. [G_Surfrider-10]

- The EIR should consider a reduced-capacity desalination alternative that incorporates maximum achievable conservation measures. [G_Surfrider-11]

- The EIR should evaluate the potential impacts to groundwater associated with the installation of shallower seawater intake wells that are screened in the sand-dune aquifer, as described in CalAm's contingency plan. [G_SVWC2-05]

- The EIR should consider potential reliability and sustainability issues associated with groundwater replenishment and aquifer storage and recovery. Such issues include the potential to exacerbate seawater intrusion, the reliability of Carmel River diversions for injection into ASR, and the availability of reclaimed wastewater for groundwater replenishment. [G_WaterPlus3-01]

- Commenter expressed support for project alternatives that include facilities that are publicly owned and operated. [G_WaterPlus3-03]

- The EIR should consider rainwater harvesting and greywater systems for demand management and supplemental sources of supply. [I_Brehmer-01]

- The alternatives analysis should consider open water intakes and shallow horizontal collectors (i.e., Ranney collectors) as design alternatives to the proposed seawater intake system. [I_Dolan-02]

- The EIR should consider a variety of energy sources and configurations to reduce the cost of operating the proposed desalination plant. [I_Dolan-04]

- The EIR should confirm the applicability/feasibility of the lower cost energy sources associated with the Deepwater Desalination project. [I_Dolan-05]

- The EIR should include a thorough evaluation of the project alternatives proposed by other entities, including hybrid alternatives that incorporate some of the design aspects of the competing alternatives. [I_Ekelund-01]

- The EIR should clearly describe how the CPUC intends to address the various permitting obstacles and regulatory hurdles, and consider project alternatives that circumvent these issues so that the project can move forward. [I_Ekelund-02]

- Commenter expresses support for the People's Moss Landing Desalination project. [I_Olsen-04]
- EIR should consider an alternative involving desalination by the Carmel Area Wastewater District (CAWD). If an alternative project involving desalination by CAWD appears feasible, CalAm should be obligated to purchase water from CAWD or make the CalAm distribution system available to CAWD for delivery of potable water to Carmel and the Carmel Valley. [I_Siegfried2-01]
- The EIR should examine of the No Project Alternative and identify potential impacts of implementing the No Project Alternative, including vegetation loss, housing, agriculture, water supply, employment/hospitality, vehicle miles traveled. [ScopingMTG1-02]
- Coordination with other CEQA Lead agencies, i.e. Pacific Grove and DeepWater Desalination should be conducted. [ScopingMTG1-03]
- The EIR cumulative analysis should address the impacts of both the proposed project and the People's Moss Landing Project being approved (cumulative, growth inducing). [ScopingMTG1-05]
- The EIR analysis should compare alternative projects. [ScopingMTG1-07]
- Further consideration should be given to recycled water so desalinated water does not have to be used. [ScopingMTG1-16]
- The EIR should include an accurate description of People's Moss Landing Project. Commenter is concerned about the available water to North County. [ScopingMTG2-02]
- The EIR should include an accurate description of the DeepWater Desalination Project. [ScopingMTG2-03]
- The EIR should evaluate all alternatives at the highest level of detail so those projects do not have to go through the CEQA process again. [ScopingMTG2-06]
- The EIR should include the Marina Coast Water District 1.5 – 3.0 MGD desalination plant. [ScopingMTG2-09]
- The EIR should rename "People's Project" to Pacific Grove Project. [ScopingMTG2-11]
- Further consideration should be given to well and treatment plant relocations in Seaside to reduce pipeline length. [ScopingMTG2-44]
- The EIR should evaluate better/more effective use of CalAm's existing systems. [ScopingMTG2-46]
- The EIR should evaluate a solution to reduce water consumption to 4,500 acre-feet. [ScopingMTG3-02]
- The EIR should address the pros and cons of each alternative, using parameters like technical feasibility, cost, and location. [ScopingMTG3-03]
- The EIR should evaluate an alternative that involves a water transfer from the Central Valley. [I_Thomas-01]

Growth Inducing Effects

- Although the production capacity for the MPWSP should be based on replacement supply needs, conveyance facilities should be sized to accommodate future growth, general plan build out, and unforeseen changes in the availability of CalAm's existing water supplies. [L_MPWMD-10]

- Further consideration should be given to the size of conveyance facilities given the potential reduction in CalAm Carmel River diversions below their existing entitlements (i.e. if Los Padres Dam were removed). The EIR should evaluate if the conveyance pipelines would need to be increased in capacity. [ScopingMTG1-08]

- The EIR should identify the demand the project is intended to serve. The EIR should evaluate the impacts of downsizing and upsizing the capacity. [ScopingMTG2-19]

- The EIR should evaluate the implementation of larger pipelines and additional water treatment capacity for the growing needs on the Peninsula. [ScopingMTG2-42]

- The EIR should address the maintenance of the facilities and the examination of water leaks in the system. [ScopingMTG2-45]

CEQA/NEPA Process

- The MBNMS would like to meet with CPUC and all pertinent regulatory agencies to identify roles and responsibilities related to oversight and permitting, including NEPA requirements. [F_USFWS-02]

- Mitigation measures should be feasible, specific, and enforceable, or should be presented with specific performance standards that can be accomplished in more than one specified way. [S_CSLC-04]

- The MPWMD will rely on the certified MPWSP Final EIR when considering the amendment to CalAm's water distribution permit for the MPWSP. [L_MPWMD-01]

- The CPUC should determine NEPA requirements early in the environmental review process. [L_MPWMD-04]

- The CPUC should confirm the appropriate level of CEQA environmental review (i.e., project-level EIR versus Programmatic EIR). [L_Monterey-02]

- The EIR should be clear about the NEPA requirements relevant to the MPWSP. If NEPA environmental review is required, the CPUC should prepare a joint CEQA/NEPA document to minimize schedule delays. [L_Monterey-04; L_PacGrove-03]

- The NOP should have been more explicit about the environmental effects of the MPWSP; this would allow responsible and trustee agencies to provide more meaningful comments. [L_PacGrove-04]

- It is imperative that the CEQA environmental review process stay on schedule in order to meet the SWRCB's Cease and Desist Order. [G_CalAm-01]

- MPWSP EIR should consider the Monterey County Superior Court's ruling on the CWP EIR, which determined that water rights were not adequately addressed in the CWP EIR. [G_CPW-01]

- The descriptions of project alternatives in the EIR should be based on the most current information available. The CPUC should give the proponents of project alternatives a deadline for providing up to date alternatives information for incorporation into the EIR. [G_CPW-03]

- CEQA requires the evaluation of feasible project alternatives and the consideration of economic benefits and costs associated with a project and its alternatives. [G_CPW-37]

- The EIR should coordinate with the Monterey Bay National Marine Sanctuary during the NEPA process. [ScopingMTG1-04]

- The commenter questioned if the environmental review is a “program” and “project” level. [ScopingMTG2-05]

- The EIR should address impacts related to NEPA. The National Marine Sanctuaries representative is Brad Damitz and was part of State Desal Task Force. [ScopingMTG2-16]

- The EIR should include a NEPA evaluation since the slant wells are within National Marine Sanctuaries jurisdiction. The appropriate NEPA lead agency should be identified early in the EIR process to avoid project delay. [ScopingMTG2-18]

- Timing of the NEPA lead agency determination is relevant to the timing of EIR preparation. [ScopingMTG2-26]

Consistency with Plans and Polices

- The EIR should evaluate conflicts with plans and policies related to the MBNMS and Marine Protected Areas. [S_CSLC-10]

- The EIR should evaluate project consistency with the Monterey County General Plan and the Monterey County Local Coastal Program. [L_MCRMA-01]

- The EIR should evaluate project consistency with the Agency Act. [L_MCRMA-03]

- The EIR should evaluate the MPWSP’s consistency with the Coastal Act, North County Land Use Plan, Coastal Implementation Plan, Monterey County General Plan, and plans and policies related to farmland preservation, water quality, and contamination of potable water supplies. [G_AgLandTrust-07]

- The EIR should evaluate project consistency with land use zoning. [G_AgLandTrust-13]

- The EIR should address the legal feasibility of the proposed project in light of the Monterey County ordinance prohibiting the private ownership of desalination facilities. [G_CPW-05]

- The EIR should evaluate project consistency with North County Local Coastal Plan. [G_CPW-17]

General Comments

- The CPUC should require the development of a contingency plan in the event the slant wells are not viable. [L_MCWRA-04]

- Commenter requests that the CPUC provide a list of the specific non-environmental issues that will be addressed in the CPCN process. [L_PacGrove-01]
- The EIR should map all areas that would be potentially affected by the proposed project. [G_AgLandTrust-11]
- The CPUC should require that CalAm conduct a water supply assessment for the MPWSP. [G_AgLandTrust-20]
- Mitigation measures should be clearly described, measurable, and achievable. [G_AgLandTrust-21]
- Commenter requests that measurements of water be provided in acre feet. [G_AgLandTrust-22]
- Commenter requests that EIR tables be formatted with numbers vertically aligned. [G_AgLandTrust-23]
- The EIR should evaluate project impacts as early as possible. [G_AgLandTrust-24]
- The EIR should address the environmental issues identified by the Ag Land Trust in its briefing to the Monterey Superior Court with regard to the Coastal Water Project Final EIR. [G_AgLandTrust-25]
- The CPUC should consider that diluting brine with wastewater effluent affects the ability to reuse the effluent as an alternative water source. [G_Surfrider-04]
- A substantial amount of water is lost through leaks in the CalAm water system. These losses could be avoided if CalAm maintained the system properly. [G_WaterPlus2-01]
- Comment unclear - please refer to comment letter. [I_Olsen-06]
- The EIR should include numeric values of water in acre-feet per year, in addition to description of million gallons, so there are comparable units of measurement. [ScopingMTG2-07]

Issues Not Analyzed under CEQA

The EIR/EIS will be used to guide decision-making by the CPUC by providing an assessment of the potential environmental impacts that may result from the proposed project. The weighing of project benefits (environmental, economic, or otherwise) against adverse environmental effects is outside the scope of the CEQA process (Public Resources Code Section 21100; CEQA Guidelines Section 15002(a)). Furthermore, scoping comments regarding support or opposition to the proposed project are noted, but are not addressed in the EIR/EIS. When the CPUC meets to decide on CalAm’s application for the proposed project, the CPUC will consider the EIR/EIS (which will disclose potential environmental effects of the proposed project and the Project Alternatives) along with other, non-environmental considerations. Then it will decide whether or not to approve or deny the proposed project.

Pursuant to CEQA, comments regarding water rates or potential economic impacts are not required to be considered. However, NEPA requires analysis of socioeconomic issues and therefore the EIR/EIS contains an evaluation of both socioeconomic and environmental justice issues. Further, economic considerations will be taken into account by the CPUC as part of its decision-making process for the application.

Water Rates

- The EIR should evaluate impacts on water prices. [ScopingMTG1-15]
- The commenter questioned how the capital cost (and subsequent rates) will be affected by not having a power source near the desalination plant site. [ScopingMTG2-28]

Drinking Water Quality

- The EIR should evaluate any potential health risks associated with drinking desalinated product water. [I_Siegfried3-02]

Economics[1]

- The EIR should evaluate secondary economic impacts associated with loss of agricultural land. [G_AgLandTrust-16]
- The EIR should provide cost information for each project component, including the costs associated with mitigation measures. [G_ CPW-30]
- CalAm should establish cost controls and performance incentives and disincentives advantageous to the ratepayer. The MPWSP EIR should avoid costly legal challenges. [G_ CPW-31]
- The Moss Landing alternatives would result in different significant environmental impacts, avoid significant legal challenges, and result in cost savings for ratepayers when compared to the MPWSP. [G_CPW-32]
- The EIR should assess the regional economic benefits of the MPWSP, not only for Marina, the Monterey Peninsula, and Carmel, but also for coastal communities in northern Monterey County located east of the Salinas River. [G_ CPW-34]
- The EIR should assess the near- and long-term regional economic benefits associated with each project alternative. [G_CPW-35]
- The Division of Ratepayer Advocates provided comments on the Settlement Agreement suggesting that the agreement failed to address costs and risks to ratepayers. [G_ CPW-38]
- The EIR should describe project cost and financing. [G_WaterPlus3-02]
- CalAm should improve maintenance of its water supply infrastructure to better manage ratepayer costs. [G_WaterPlus5-01; I_Olsen-02]
- CalAm unfairly requires that ratepayers pay for costly improvements to CalAm infrastructure that benefits only a small portion of the service area. [I_Holston-01]

[1] To the extent that these topics are considered socioeconomic issues under NEPA, they are addressed in the EIR/EIS Section 4.20, Socioeconomics and Environmental Jusice.

- CalAm should conduct public surveys to identify the types of water supply projects that have public support and better manage ratepayer costs. [I_Olsen-01]

Opinions on the Proposed Project

- The information developed for the Coastal Water Project Final EIR, when updated to reflect current conditions and legal requirements, serves as a good basis for preparation of the MPWSP EIR. [G_CalAm-02]
- Neither the Regional Water Project nor the MPWSP consider regional solutions that include a diverse group of beneficiaries, not just CalAm ratepayers. [G_CPW-33]
- Commenter is opposed to the MPWSP project. [G_MPTA-04]
- CalAm should improve maintenance of its water supply infrastructure to better manage ratepayer costs. [G_WaterPlus5-01; I_Olsen-02]
- Commenter expressed concern regarding the MPWSP implementation schedule and CalAm's ability to meet the SWRCB's Cease and Desist Order. [I_Bottomley-01; I_Olsen-03]
- Commenter expressed doubts about the efficiency of the project review process, project implementation schedule, the potential for legal challenges to the MPWSP, and increased costs for ratepayers. [I_Bottomley-02]
- Commenter encourages responsible and trustee agencies, local government agencies, agricultural interests, and decision makers to assist in developing supplemental supply solution and streamlining the project review process. [I_Bottomley-03]
- Commenter expressed support for MPWSP. [I_Carrothers-01; I_Fillmon-01]
- Commenter encourages CalAm to consider expanding the MPWSP to include water supplies for CalAm customers in the Toro basin, a tributary basin to the Salinas Valley Groundwater Basin, and that these customers pay the full production cost of the water. [I_Dolan-03]
- CalAm unfairly requires that ratepayers pay for costly improvements to CalAm infrastructure that benefit only a small portion of the service area. [I_Holston-01]
- CalAm should conduct public surveys to identify the types of water supply projects that have public support and better manage ratepayer costs. [I_Olsen-01]

4.2 NOI Scoping Comments

During the EIS scoping meeting held on September 10, 2015, five participants commented publically on the proposed project. Twelve written comments were received throughout the public comment period. Commenting parties, summaries of the oral and written comments received, and responses, or where the issues are addressed in the EIR/EIS, are provided below in **Table 2**. The complete written comments are available for review at: https://www.regulations.gov/docket?D=NOAA-NOS-2015-0105.

TABLE 2
SUMMARY OF COMMENTS RECEIVED DURING THE
MONTEREY PENINSULA WATER SUPPLY PROJECT EIS SCOPING PROCESS

Affiliation/Name	Date	Summary of Comment	Response & EIR/EIS Section Where Comment is Addressed
Monterey Bay Aquarium, Margaret Spring	10/01/15	Supportive of desalination because of need for water from hospitality perspective	Comment noted; the purpose and need for the proposed project is addressed in Chapter 1; a portion of the proposed project water supply would be provided for the hospitality industry, as noted in Chapter 2, Water Demand, Supplies, and Water Rights.
		Ensure appropriate mitigations to protect the ocean and minimize greenhouse gas (GHG) emissions	Mitigation measures are identified throughout EIR/EIS Chapter 4 to protect ocean resources; see EIR/EIS Section 4.11 regarding GHG.
Water Plus, Ron Weitzman	09/28/15	Comments on alleged data tampering with regard to groundwater modeling. This comment was also submitted on the April 2015 DEIR and is noted in the introduction to Section 4.4, Groundwater Resources.	The groundwater model has been revised by a new independent hydrogeologist; see Appendix E2. The information from the revised modeling is incorporated into the analysis in Section 4.4.
Water Plus, Ron Weitzman	09/08/15	10 attachments commenting on the April 2015 DEIR and other topics, ranging from the viability of slant well technology, water rights, Monterey pipeline alternatives, alternative sites for the desalination plant, GWR only alternative, conflict of interest, water demand determination, test well purpose/results, groundwater modelling and consideration of the Peoples' project as an alternative. Many of these comments were submitted during the public review of the April 2015 DEIR and as such, are summarized at the beginning of each relevant topical section of Chapter 4.	• The viability of the test well and data collection is addressed in Section 4.4, Groundwater, and Appendix E2. • See Section 2.6 regarding Salinas Valley water rights. • The Monterey Pipeline is no longer part of the proposed project, as it has been reviewed and approved under a separate process. • Alternatives, including alternative desalination sites, were assessed in the screening analysis in Section 5.3. • The GWR project has been approved after undergoing a separate environmental review process. • Slant well conflict of interest is not a NEPA issue, comment noted. • Existing water demand determination - see Chapter 2. • Peoples' and DeepWater Desal - see Chapter 5 where both of these alternatives are analyzed. • Test well purpose and results - see Section 4.4 Groundwater, and Appendix E2. • Model evaluation - the groundwater model has been revised. See Section 4.4, Groundwater, and Appendix E2. • Peoples' Project – this alternative is fully evaluated in the EIR/EIS; see Chapter 5.
Jane Haines	09/29/15	Concerned with the efficiency of slant wells versus open ocean intakes with regards to GHG emissions.	The potential off-gassing of GHG associated with slant wells is addressed in section 4.11.
Kai Forlie	09/04/15	California is overpopulated and has not done enough to conserve water. No desalination project.	Comment noted regarding opposition to the project. Water conservation efforts are addressed in Chapter 2, Water Demand.

**TABLE 2 (Continued)
SUMMARY OF COMMENTS RECEIVED DURING THE
MONTEREY PENINSULA WATER SUPPLY PROJECT EIS SCOPING PROCESS**

Affiliation/Name	Date	Summary of Comment	Response & EIR/EIS Section Where Comment is Addressed
Marina Coast Water District (MCWD), Keith Van Der Maaten	10/02/15	Clearly state source water origination	See Chapter 3, Project Description and Section 4.4, Groundwater for details on the length of the slant wells and the aquifers from which water would be extracted.
		Need to consider groundwater rights and replenishment	See Section 2.6, Water Rights
		Address impacts on MCWD pipelines	See Section 4.13, Public Services and Utilities, for analysis of impacts on existing utilities, including MCWD pipelines.
		Snowy plover habitat; need for alternatives that are not within habitat area.	See Section 4.6, Terrestrial Biology for a full description of habitat in the study area and potential impacts on snowy plover habitat. See Chapter 5 for analysis of alternative locations for the slant wells, particularly Alternative 1, which is fully evaluated.
		Slant wells are unproven technology, longevity of wells	See Appendix C3 regarding the bore hole technical memo; operation of the test well demonstrates technical feasibility, particularly at the proposed project site (CEMEX), and is also discussed in Section 4.4, Groundwater.
		Concerned about Monterey Regional Water Pollution Control Agency (MRWPCA) outfall capacity	See section 4.13, Public Service and Utilities; the outfall has sufficient capacity to accommodate the proposed project brine discharge.
		Provide accurate groundwater resources description, model, volumes extracted, mitigation, monitoring well network, water quality degradation	See Section 4.4 Groundwater, for details on existing groundwater resources and aquifer characteristics, groundwater modeling and impact assessment results, monitoring and mitigation measures; see Appendix E2 for details on the revised groundwater model.
		Concerned about impacts on MCWD service area, supplies, and wells	See Section 4.4, Groundwater
		Need to address cumulative: water conservation, other desalination plants, groundwater supply, Groundwater Replenishment Project (GWR), Regional Urban Water Augmentation Project (RUWAP)	These projects and issues are considered in the cumulative impacts assessment. See Section 4.1.7, Table 4.1-2 and Figure 4-1 for a description of the cumulative impacts scenario and assumptions about these projects. Cumulative impacts of the proposed project are analyzed in each issue area in Chapter 4.
		• Need for comprehensive alternatives analysis	See Chapter 5, which provides a detailed alternatives screening analysis and full evaluation of 5 project alternatives.
		• Consider list of study resources in preparing the EIR/EIS	The listed studies have been reviewed and considered in the EIR/EIS analysis.
Water Plus, Ron Weitzman	10/01/15	Motion to dismiss proceeding because of alleged data tampering with regard to groundwater.	The groundwater analysis has been revised. See Section 4.4, Groundwater.

TABLE 2 (Continued)
SUMMARY OF COMMENTS RECEIVED DURING THE
MONTEREY PENINSULA WATER SUPPLY PROJECT EIS SCOPING PROCESS

Affiliation/Name	Date	Summary of Comment	Response & EIR/EIS Section Where Comment is Addressed
Michael Baer	09/08/15	Provided 2 documents that were submitted during the public review of the April 2015 DEIR; comments received on the DEIR are summarized at the beginning of each relevant topical section of Chapter 4. • Slant wells are not a proven technology • The location of the slant wells is flawed because they will exacerbate sea water intrusion in the Salinas Valley Groundwater Basin	• See Section 4.4, Groundwater, and Appendix E2
		The DEIR is inadequate and/or inaccurate in the following areas: • Brine discharge volume • Outfall pipe length • Diffuser length • Diffusion calculations • Detailed bathymetric mapping at outfall pipe • Biological baseline of benthic and planktonic life in brine mixing zone (squid egg sack) • Salinity monitoring	See Section 4.3, Surface Water Hydrology and Water Quality, and Appendix D1 for details on brine discharge volume, outfall and diffuser dimensions, diffusion calculations, impact assessment and monitoring; see Section 4.5, Marine Biological Resources, regarding baseline information and discussion of impacts in brine mixing zone.
Robert Evans	09/29/15	Water supply should not degrade environment; recycling would be best	See Chapter 4 for analysis of impacts of the proposed project on the environment, and Chapter 5, Alternatives, for discussion of water recycling options.
		Concerned with pipeline along Recreation Trail and Del Monte Blvd	See Section 4.8, Land Use and Recreation for analysis of impacts on the recreational trail.
		Supports Project Variant	Comment noted; the Project Variant is now addressed as Alternative 5a in Section 5.4, 5.5 and 5.6
Surfrider Monterey Chapter, Staley Prom	10/02/15	Required NEPA components of environmental review	An EIR/EIS has been prepared in full compliance with CEQA and NEPA.
		Address ocean/marine resource impacts	See Section 4.5, Marine Biological Resources.
		Address sea level rise impacts	See Section 4.2 for analysis of sea level rise impacts.
		Need to consider feasible alternatives	Alternatives and the alternatives screening process are addressed in Chapter 5. A reduced-size project is fully evaluated in Alternative 5.
		Identify significant impacts and mitigation measures	Each section of Chapter 4 identifies impacts and their significance, as well as mitigation measures to the extent that they are feasible.
		Explain, clarify, and substantiate the method for brine discharge and dilution, the anticipated discharge volumes, and where the brine will be discharged; estimate potential volume of discharge and impacts from project and alternatives; assess compliance with Ocean Plan	Brine discharge and Ocean Plan compliance is addressed in Section 4.3, Surface Water Hydrology and Water Quality; Section 4.5, Marine Biological Impacts, addresses brine impacts on marine resources; Chapter 5 addresses discharge alternatives.

TABLE 2 (Continued)
SUMMARY OF COMMENTS RECEIVED DURING THE
MONTEREY PENINSULA WATER SUPPLY PROJECT EIS SCOPING PROCESS

Affiliation/Name	Date	Summary of Comment	Response & EIR/EIS Section Where Comment is Addressed
Surfrider Monterey Chapter, Staley Prom (cont.)		Evaluate cumulative projects, including other desalination projects	Cumulative impacts are fully assessed in each issue area in Chapter 4.
		Evaluate slant wells impacts on marine life and on erosion; provide details on intake pipeline	The details of the intake pipelines are in Chapter 3. Marine life impacts are assessed in Section 4.5. Erosion impacts, including coastal erosion, are addressed in Section 4.2, Geology, Soils and Seismicity.
		Quantify and evaluate energy use and GHG emissions; develop mitigation measures for energy use and GHG emissions.	See Sections 4.18 and 4.11, which address energy use impacts and GHG emission impacts.
		Address compliance with Marine Life Protection Act (MLPA), National Marine Sanctuaries Act of 1972 (NMSA), Monterey Bay National Marine Sanctuary regulations, Elkhorn Slough National Estuarine Research Reserve, California Ocean Plan	See Section 4.5 for discussion of Elkhorn Slough Reserve and assessment of compliance with the MLPA, NMSA and MBNMS regulations; Ocean Plan compliance is assessed in Section 4.3, Surface Water Hydrology and Water Quality; Section 6.4 provides analysis of compliance with MBNMS Desalination Guidelines.
United States Environmental Protection Agency, Carter Jessop	10/01/15	All reasonable alternatives that fulfill the project need and purpose should be evaluated	See Chapter 5, Alternatives, for details on the alternatives screening analysis and assessment of alternatives' ability to satisfy project purpose and need.
		Regulatory framework, permits	See Section 3.5 for a summary of all required permits for the proposed project; also, each issue area in Chapter 4 includes a regulatory framework subsection.
		Need to prepare Waters of the United States delineation for project and alternatives	See Section 4.6, Terrestrial Biology
		Consider air quality impacts: existing, construction, operation, quantify, emission sources, mitigation measures	See Section 10, Air Quality, for a discussion of existing air quality conditions and proposed project construction and operation emissions and associated impacts.
		Address climate change: GHG emissions, affected environment section, environmental consequences section	See Section 4.11, GHG, for details on the existing conditions and proposed project GHG emissions and associated impacts.
		Cumulative should involve other potential desalination projects	Other desalination projects are considered in the cumulative impacts scenario; see Section 4.1.7 and Table 4.1-2. Cumulative impacts are assessed in each issue area in Chapter 4.
		Evaluate fate and transport model of saltwater brine plume, biological significance	See Section 4.3 and Appendix D1 regarding brine dispersion modeling and results; see Section 4.5 for impacts on marine biological resources.
		Users of water, supply, pipelines	See Chapter 2 regarding water supply and demand; see Chapter 3 regarding proposed pipelines.
Jeff Alford	09/04/15	The Project will create a water monopoly and it should be a public project.	Comment noted.

TABLE 2 (Continued)
SUMMARY OF COMMENTS RECEIVED DURING THE
MONTEREY PENINSULA WATER SUPPLY PROJECT EIS SCOPING PROCESS

Affiliation/Name	Date	Summary of Comment	Response & EIR/EIS Section Where Comment is Addressed
Sustainable Pacific Grove, Karin Locke	09/10/15	Speaker: concerned with brine discharge	See Sections 4.3, Surface Water Hydrology and Water Quality, and Appendix D1 for a detailed analysis of brine discharge and modeling of brine concentrations; see Section 4.5, Marine Biological Resources for impacts of brine discharges on marine resources.
Circular Sea Initiative, Francis Jeffrey	09/10/15	Speaker: concerned with ocean health	
Broadcaster, Hebard Olsen	09/10/15	Speaker: concerned with brine	
Ohlone/Costanoan – Esselen Nation, Louise Miranda Ramirez	09/10/15	Speaker: concerned with brine and the cumulative impacts of 2 desalination plants	See Section 4.1.7 for summary of cumulative impact scenario and Sections 4.3 and 4.5 for analysis of cumulative brine impacts
Planet Earth, Michael Baer	09/10/15	Speaker: concerned about pipeline routes and traffic	Alternative pipeline routes were considered as a result of comments on the DEIR; note that the Monterey Pipeline is no longer part of the proposed project and has been approved through a separate process.

4.3 Consideration of Issues Raised in Scoping Process

A primary purpose of this Scoping Report is to document the process of soliciting and identifying comments from interested agencies and the public. The scoping process provides the means to determine those issues that interested participants consider to be the principal areas for study and analysis for purposes of preparation of the MPWSP EIR/EIS. Every issue that has been raised during the scoping process that falls within the scope of CEQA/NEPA is addressed in the EIR/EIS.

4.4 Scope of Alternatives Analysis

One of the most important aspects of the scoping process and subsequent environmental review is the identification and assessment of the environmental impacts of reasonable alternatives. In addition to mandating consideration of the No Project/No Action Alternative, both the CEQA Guidelines (14 Cal. Code Regs. § 15126.6(d)) and the NEPA Regulations (40 CFR § 1502.14) emphasize the selection of a reasonable range of alternatives that meet the purpose and need of the proposed action, and the comparative assessment of the impacts of the alternatives to allow for public disclosure and informed decisionmaking. The EIR/EIS describes the development and screening of potential project alternatives, presents the selected project alternatives, evaluates the alternatives for consistency with stated project objectives, and fully analyzes and compares the environmental impacts and trade-offs of the alternatives, in order to identify the environmentally superior alternative for purposes of CEQA and the environmentally preferred alternative for purposes of NEPA.

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ATTACHMENT A
Notice of Preparation

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PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
SAN FRANCISCO, CA 94102-3298

NOTICE OF PREPARATION

Environmental Impact Report for the CalAm Monterey Peninsula Water Supply Project

Introduction

In accordance with the provisions of the California Environmental Quality Act (CEQA) and the CEQA Guidelines, the California Public Utilities Commission (CPUC), as CEQA Lead Agency, is preparing an Environmental Impact Report (EIR) for the California American Water Company's (CalAm) proposed Monterey Peninsula Water Supply Project (MPWSP or proposed project). The MPWSP is comprised of various facilities and improvements, including: a seawater intake system; a 9-million-gallons-per-day (mgd) desalination plant; desalinated water storage and conveyance facilities; and expanded Aquifer Storage and Recovery (ASR) facilities. If the Groundwater Replenishment Project proposed by the Monterey Regional Water Pollution Control Agency (MRWPCA) is timely approved and implemented, CalAm's proposed desalination plant would be sized at 5.4 mgd. This document serves as the Notice of Preparation (NOP) for the EIR and solicits relevant comments on the scope of environmental issues as well as alternatives and mitigation measures that should be explored in the Draft EIR. The 30-day public scoping period begins on October 10, 2012 and closes at 5pm on November 9, 2012. This NOP provides background information on prior CalAm planning efforts to meet the water supply needs of the Monterey Peninsula, and describes the proposed project, its location, and anticipated environmental effects.

Background

In 2004, CalAm filed Application A.04-09-019 seeking a Certificate of Public Convenience and Necessity from the CPUC for the Coastal Water Project. The Coastal Water Project (CWP) was intended to replace existing Carmel River water supplies for the CalAm Monterey District service area that are constrained by legal decisions (see discussion under the heading, Project Purpose, for more information regarding the legal decisions). In general, the previously proposed CWP involved the production of desalinated water supplies, increased yield from the Seaside Groundwater Basin ASR system, and additional storage and conveyance systems to move the replacement supplies to the existing CalAm distribution system. The CWP proposed project (also referred to as the Moss Landing Project) was sized to meet existing water demand and did not include supplemental supplies to accommodate growth. The CWP was previously proposed to use the existing intakes at the Moss Landing Power Plant to draw source water for a new 10-mgd desalination plant at Moss Landing, construct conveyance and storage facilities, and facility improvements to the existing

Seaside Groundwater Basin ASR system.[1] On January 30, 2009, the CPUC published a Draft EIR analyzing the environmental impacts of the previous CWP, as well as the environmental impacts of two project alternatives—the North Marina Project[2] and the Regional Project.[3] The CPUC published the Coastal Water Project Final EIR (SCH No. 2006101004) in October 2009 and certified the EIR in December 2009 (Decision D.09-12-017). A year later, in Decision D.10-12-016, the CPUC approved implementation of the Regional Project alternative.

Subsequent to approval of the Regional Project, CalAm withdrew its support for the Regional Project in January 2012.[4] As a result, in April 2012, CalAm submitted Application A.12-04-019 to the CPUC for the Monterey Peninsula Water Supply Project (MPWSP). The MPWSP is intended to secure replacement water supplies for the Monterey District associated with legal decisions affecting existing supplies from both the Carmel River and the Seaside Groundwater Basin (see discussion under the heading, Project Purpose, for more information). The MPWSP includes many of the same elements previously analyzed in the CWP EIR; however, key components, including the seawater intake system and desalination plant, have been relocated and/or modified under the current proposal.

Pursuant to CEQA Guidelines Section 15162, the CPUC has determined that preparation of a Subsequent Environmental Impact Report is the appropriate level of CEQA review for the MPWSP.[5] Although the MPWSP EIR will qualify as a "Subsequent EIR" under CEQA, there are

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[1] The existing Seaside Groundwater Basin ASR system includes several injection/extraction wells, and storage and conveyance facilities to store Carmel River water supplies during the wet season in the groundwater basin, and recover the banked water during the dry season for consumptive use.

[2] The North Marina Project alternative included most of the same facilities as the previously proposed CWP and, like the previously proposed CWP, would only provide replacement supplies to meet existing demand. The key differences between this alternative and the previously proposed CWP were that the slant wells and desalination plant would be constructed at different locations (Marina State Beach and North Marina, respectively), and the desalination plant would have a slightly greater production capacity (11 mgd versus 10 mgd).

[3] The Regional Project alterative was intended to integrate several water supply sources to meet both existing and future water demand in the CalAm service area. The Regional Project would have been implemented jointly by CalAm and Marina Coast Water District (MCWD).The Regional Project was to be implemented in phases and included vertical seawater intake wells on coastal dunes located south of the Salinas River and north of Reservation Road; a 10-mgd desalination plant in North Marina (Armstrong Ranch); product water storage and conveyance facilities; and expansions to the existing Seaside Groundwater Basin ASR system. This alternative would also develop supplemental supplies from the Salinas River by expanding an existing diversion facility and treatment plant in North Marina; expand the Castroville Seawater Intrusion Project (CSIP) by constructing additional storage and conveyance facilities; and expand the Seaside Groundwater Basin Replenishment Project by providing advanced water treatment for recycled water supplies generated at the MRWPCA Regional Wastewater Treatment Plant for injection into the groundwater basin.

[4] The CPUC subsequently closed the CWP proceeding in Decision D.12-07-008 (July 12, 2012).

[5] Per CEQA Section 21166 a Subsequent EIR would be required if: (1) Substantial changes are proposed in the project which will require major revisions of the previous EIR due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; (2) Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous EIR due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; or (3) New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous EIR, was certified as complete was adopted, shows any of the following: (a) The project will have one or more significant effects not discussed in the previous EIR or negative declaration; (b) Significant effects previously examined will be substantially more severe than shown in the previous EIR; (c) Mitigation measures or alternatives previously found not to be feasible would in fact be feasible, and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative; or (d) Mitigation measures or alternatives which are considerably different from those analyzed in the previous EIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

no special procedural requirements that apply to a Subsequent EIR; therefore, for simplicity we will simply call this new document an EIR. The MPWSP EIR will provide a comprehensive description and evaluation of all proposed components (including the new proposed elements and previously analyzed components) as the "whole of the action". The MPWSP EIR may evaluate alternatives not previously considered in the CWP EIR. The CWP EIR will not in itself be incorporated by reference into the MPWSP EIR. However, the MPWSP EIR will utilize relevant data that was developed for the CWP EIR, and update the data and prior analyses as appropriate to address the effects of the current proposal. Environmental review of the MPWSP will have no effect on the certified CWP EIR or related approvals.

While it is not yet known whether the MPWSP would have additional or more severe impacts than the alternatives analyzed in the previous CWP EIR or whether new feasible alternatives or mitigation measures are available, the changes to the CWP EIR would not be so minor as to qualify for a supplemental EIR under CEQA Guidelines 15163. Therefore, the CPUC has determined that a Subsequent EIR is the most appropriate CEQA documents to evaluate the MPWSP. To assist in funding the MPWSP, CalAm is applying for a loan under the Clean Water State Revolving Fund (CWSRF) administered by the State Water Resources Control Board (SWRCB). For this reason, the MPWSP EIR will be prepared in compliance with the SWRCB's CWSRF Guidelines and "CEQA-Plus" requirements. If it is determined through the scoping process that additional federal review is required, CPUC will coordinate with the appropriate agency to comply with the National Environmental Protection Act (NEPA).

Documents or files related to the MPWSP are available for review at the CPUC administrative offices in San Francisco, by appointment, during normal business hours. This information can also be obtained by visiting the CPUC website (http://www.cpuc.ca.gov/PUC/energy/Environment/Current+Projects/esa/mpwsp/index.html).

CPUC Process

The CPUC is a constitutionally created state agency charged with the regulation of investor-owned public utilities within California. Consistent with its broad scope of authority, the CPUC regulates the construction and expansion of water lines, plants, and systems by private water service providers pursuant to Certificates of Public Convenience and Necessity (CPCN) (Public Utilities Code Section 1001) and authorizes water service providers to charge their customers "just and reasonable" rates for the provision of water services (Public Utilities Code Sections 451 and 454). The project proponent, CalAm, is a public utility under the CPUC's jurisdiction and has applied to the CPUC for a CPCN under Public Utilities Code Section 1001 to build, own, and operate all elements of the MPWSP, and also for permission to recover present and future costs for the project through short-term rate increases. The CPUC administrative law judge will review the Final EIR and prepare a proposed decision for consideration by the CPUC regarding certification of the MPWSP EIR and approval of the MPWSP. In addition to the environmental impacts addressed during the CEQA process, the CPCN process will consider any other issues that have been established in the formal record, including but not limited to economic issues, social impacts, and the need for the project. During this process, the CPUC will also take into account testimony and briefs from parties who have formally intervened in Proceeding A.12-04-019,[6] as well as formal records of all project-related hearings held by the administrative law judge.

Project Purpose

The primary purpose of the MPWSP is to replace existing water supplies that have been constrained by legal decisions affecting the Carmel River and Seaside Groundwater Basin water resources. SWRCB Order 95-10 requires CalAm to reduce surface water diversions from the Carmel River in excess of its legal entitlement of 3,376 acre-feet per year (afy), and SWRCB Order 2009-0060 ("Cease and Desist Order") requires CalAm to develop replacement supplies for the Monterey District service area by December 2016. In 2006, the Monterey County Superior Court adjudicated the Seaside Groundwater Basin, effectively reducing CalAm's yield from the Seaside Groundwater Basin from approximately 4,000 afy to 1,474 afy. A secondary purpose of the MPWSP is to provide adequate supplies for CalAm to meet its duty to serve customers in its Monterey District, as required by Public Utilities Code Section 451.

Proposed Project

The proposed MPWSP would be comprised of the following facilities:[7]

- Seawater intake system consisting of eight 750-foot-long subsurface slant wells extending offshore into the Monterey Bay, and source water conveyance pipelines
- Desalination plant and appurtenant facilities, including source water receiving tanks; pretreatment, reverse osmosis, and post-treatment systems; chemical feed and storage facilities; brine storage and discharge facilities; and associated non-process facilities
- Desalinated water conveyance facilities, including pipelines, pump stations, clearwells, and a terminal reservoir
- Improvements to the existing Seaside Groundwater Basin ASR system, including two additional injection/extraction wells, a pump station, a product water pipeline, a pump-to-waste pipeline, and pump-to-waste treatment

The proposed MPWSP would include a 9-mgd desalination plant and facility improvements to the existing Seaside Groundwater Basin ASR system to provide replacement water supplies to meet existing demand for the approximately 40,000 customers in CalAm's Monterey District

6 Proceeding No. A.12-04-019, *Application of California-American Water Company (U210W) for Approval of the Monterey Peninsula Water Supply Project and Authorization to Recover All Present and Future Costs in Rates* (Filed April 23, 2012).

7 Several facility components of the proposed MPWSP are similar or identical to facilities evaluated in the CWP EIR, including the product water storage and conveyance facilities and improvements to the existing ASR system. The primary difference between the desalination facilities proposed under the MPWSP and those described under the previously proposed CWP and CWP project alternatives are the site locations for the seawater intake system and desalination plant. The Regional Project alternative that was approved by the CPUC was envisioned as a joint project between CalAm, Monterey County Water Resources Agency and Marina Coast Water District (MCWD); at this time it is anticipated that the facilities and improvements proposed under the current MPWSP proposal would be owned and operated entirely by CalAm.

service area.[8] See **Figure 1** for an overview of MPWSP area. As an alternative to the 9-mgd desalination plant, CalAm's application also includes a 5.4-mgd desalination plant coupled with a water purchase agreement for 3,500 afy of product water from the MRWPCA's proposed Groundwater Replenishment Project. For purposes of the environmental analysis, this alternative is discussed below under the heading Alternatives to the Project.

The subsurface slant wells would extend offshore into the Monterey Bay and draw seawater from beneath the ocean floor for use as source water for the proposed desalination plant. Approximately 20 to 22 mgd of source water would be needed to produce 9 mgd of desalinated product water. The preferred site for the subsurface slant wells is a 376-acre coastal property located north of the city of Marina and immediately west of the CEMEX active mining area. New pipelines would convey the seawater (or "source water") from the slant wells to the MPWSP desalination plant.

The MPWSP desalination plant and appurtenant facilities would be located on a 46-acre vacant parcel near Charles Benson Road, northwest of the Monterey Regional Water Pollution Control Agency's (MRWPCA) Regional Wastewater Treatment Plant and the Monterey Regional Environmental Park. Facilities proposed at the MPWSP desalination plant include pretreatment, reverse osmosis, and post-treatment systems; chemical feed and storage facilities; a brine storage basin; and an administrative building. Brine produced during the desalination process would be conveyed to an existing MRWPCA ocean outfall and discharged to the Monterey Bay. Approximately 9,006 afy of potable water supplies would be produced by the proposed desalination facilities.

Desalinated product water would be conveyed south via a series of proposed pipelines to existing CalAm water infrastructure and customers in the Monterey Peninsula. Up to 28 miles of conveyance pipelines and water mains would be constructed under the MPWSP. In addition, if it is determined that the MPWSP needs to return water to the Salinas Valley Groundwater Basin, water could be conveyed southeast via a new pipeline to the existing Castroville Seawater Intrusion Project (CSIP) pond at the MRWPCA Regional Wastewater Treatment Plant for subsequent distribution to agricultural users in the Salinas Valley.

The primary function of the two additional ASR wells and the proposed improvements to the conveyance system is to allow desalinated water to be injected into the Seaside Groundwater Basin for subsequent distribution to customers. These improvements would also.provide redundant injection capacity and improve the long-term reliability and efficiency of the ASR system for injecting Carmel River water into the Seaside Groundwater Basin. Improving the efficiency of the ASR system to inject Carmel River water into the Seaside Groundwater Basin when there is significant rainfall (wet and extremely wet years) increases the long-term annual yield from the ASR system to 1,920 afy.

A preliminary project facilities map is provided in **Figure 2**. Construction of the MPWSP is anticipated to occur over approximately three years.

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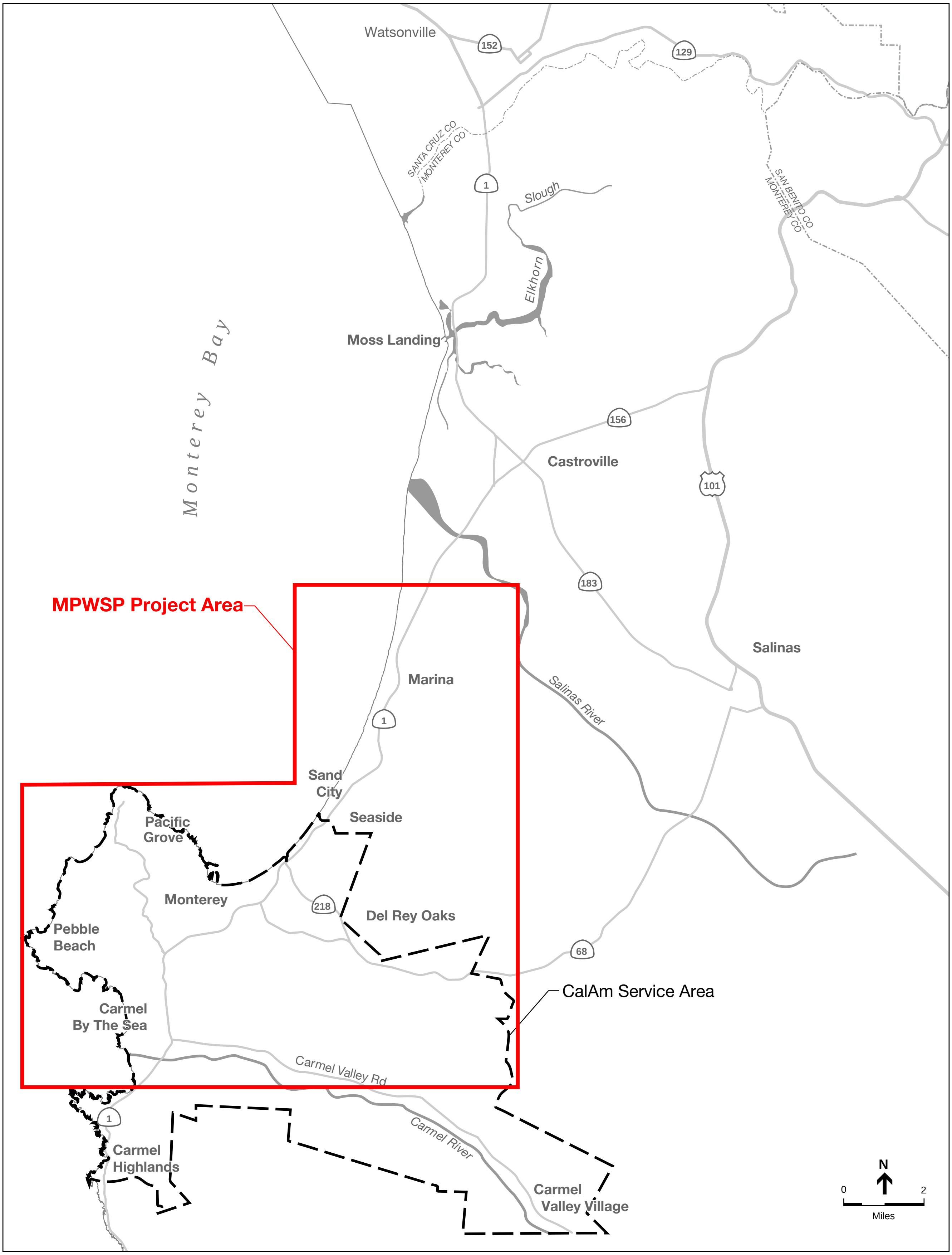
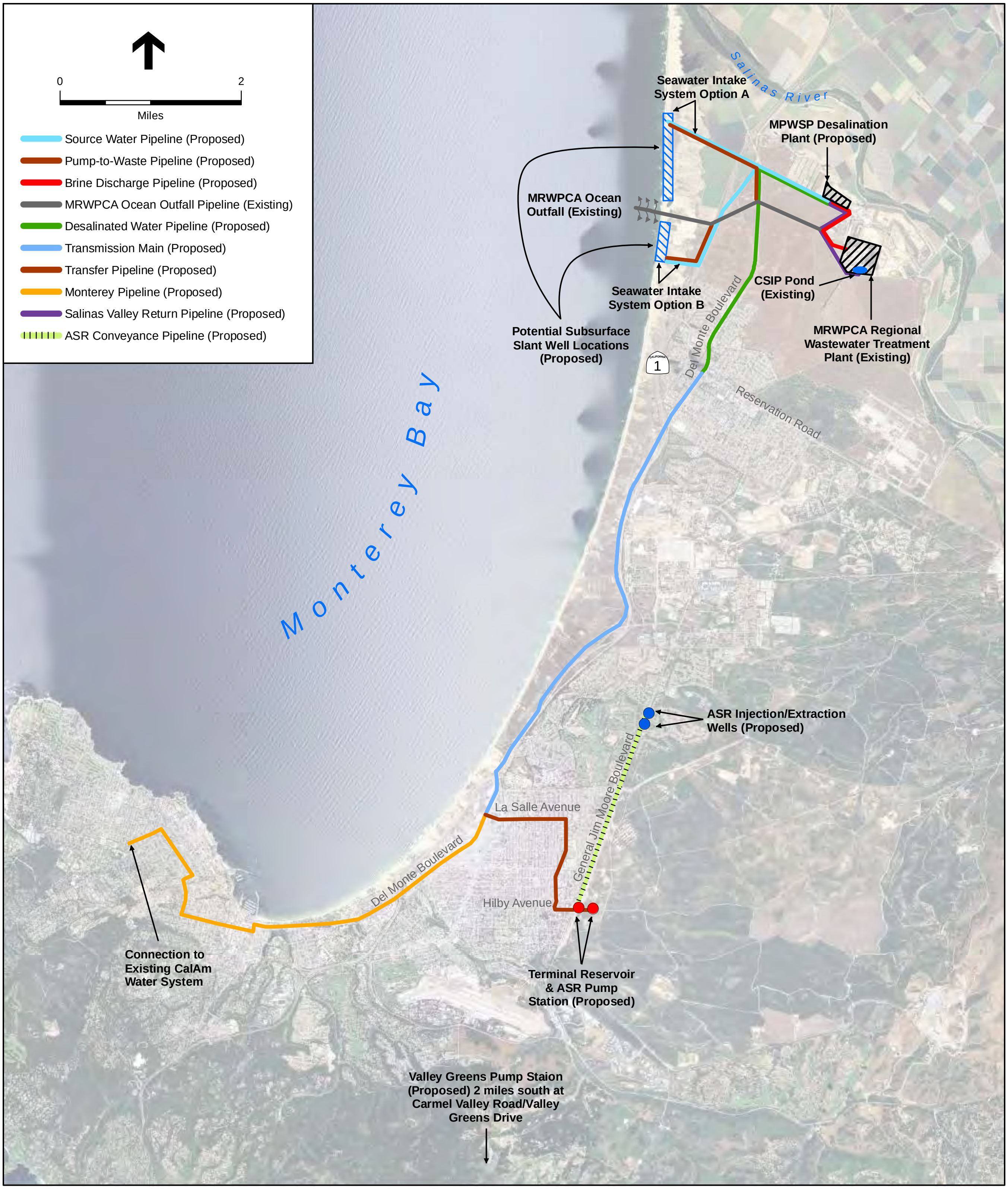
8 CalAm's Monterey District service area encompasses most of the Monterey Peninsula, including the cities of Carmel-by-the-Sea, Del Rey Oaks, Monterey, Pacific Grove, Sand City, and Seaside, and the unincorporated areas of Carmel Highlands, Carmel Valley, Pebble Beach, and the Del Monte Forest.



SOURCE: ESA, 2012

Monterey Peninsula Water Supply Project . 205335.01

Figure 1
Project Location Map



SOURCE: ESA, 2012

Monterey Peninsula Water Supply Project . 205335.01

Figure 2
Preliminary Project Facilities Map

Issues to be Addressed in the EIR

This NOP is not accompanied by an Initial Study that screens out environmental topics; the MPWSP EIR will include an analysis for all topics identified in Appendix G of the CEQA Guidelines. The MPWSP EIR will address potential impacts associated with project construction, operation, and maintenance activities. The analysis will include, but will not be limited to, the following issues of potential environmental impact:

- **Surface Water Hydrology and Water Quality** – Construction and operation of the MPWSP could increase soil erosion and adversely affect water quality in receiving waterbodies. Project operations would generate brine, maintenance and cleaning solutions, and other effluents that would be discharged to the Monterey Bay, stormwater system, and sanitary sewer. The MPWSP EIR will evaluate impacts to surface water quality as a result of project construction and operations; changes to existing drainage patterns resulting in increased erosion or runoff; potential impacts related to the capacity of the existing MRWPCA ocean outfall; and potential adverse effects of brine discharges on offshore water quality.

- **Groundwater Resources** – Updated groundwater modeling will be used to evaluate potential impacts to groundwater levels and groundwater quality associated with slant well operations, including any effects on the seawater/freshwater interface. Water rights issues will be addressed as needed to evaluate project feasibility and project effects on groundwater.

- **Marine and Terrestrial Biological Resources** – The EIR will evaluate project impacts on terrestrial special-status animal and plant species, sensitive habitats, mature native trees, and migratory birds associated with facility siting and project-related construction activities. Particular attention will be given to the coastal dune habitat in the vicinity of the proposed subsurface slant wells. Potential impacts on marine resources to be evaluated include salinity changes at the MRWPCA ocean outfall from brine discharges and any related effects on benthic and pelagic organisms and environments. The EIR will also evaluate any potential conflicts with applicable plans, policies, and plans related to the protection of marine and terrestrial biological resources.

- **Air Quality and Greenhouse Gases** – The EIR will analyze construction-related and operational emissions of criteria air pollutants. Emissions estimates will be evaluated in accordance with all applicable federal, state, and regional ambient air quality standards. Potential human health risks at nearby sensitive receptors from emissions of diesel particulate matter and toxic air contaminants during project construction and operations will be addressed. The EIR will also estimate greenhouse gas (GHG) emissions associated with project construction and operations, and compare these to applicable plans and policies related to reducing GHGs.

- **Mineral and Energy Resources** – The EIR will evaluate potential impacts to mineral resources associated with facility siting. The MPWSP's energy requirements, particularly the energy needs for desalination, will be evaluated to reflect the proposed plant capacity, specifications, and operations.

- **Geology and Soils** – The EIR will review site-specific seismic, geologic, and soil conditions and evaluate project-related impacts. The analysis will address the potential for project construction activities to result in increased soil erosion or loss of topsoil, as well as potential slope instability issues associated with facility siting and construction. Particular attention will be given to potential increases in coastal erosion rates resulting from project implementation, as well as damage to the slant wells and other facilities in the coastal zone resulting from natural erosion.

- **Hazards and Hazardous Materials** – The EIR will summarize documented soil and groundwater contamination cases within and around the project area, and evaluate the potential for hazardous materials to be encountered during construction. Inadvertent releases of hazardous construction chemicals, and contaminated soil or groundwater into the environment during construction will be addressed. The analysis will also consider the proper handling, storage, and use of hazardous chemicals that would be used during operations.

- **Noise** – The EIR will evaluate construction-related noise increases and associated effects on ambient noise levels, applicable noise standards, and the potential for indirect impacts to nearby land uses.

- **Transportation and Traffic** – Project construction activities would generate construction trucks and vehicles, resulting in a temporary increase in traffic volumes along local and regional roadways. The installation of pipelines along or adjacent to road right-of-ways could result in temporary land closures and traffic delays. Impacts to vehicular traffic, traffic safety hazards, public transportation, and other alternative means of transportation will be evaluated. Traffic increases associated with project operations will also be addressed.

- **Cultural Resources** – The EIR will evaluate potential impacts on historic, archaeological, and paleontological resources, and human remains. It is anticipated that any potential impacts to cultural resources would be limited to project construction and/or facility siting.

- **Land Use** – The EIR will evaluate potential conflicts with established land uses as a result of facility siting and during project construction. Potential conflicts with applicable plans and policies will also be evaluated. Particular attention will be given to consistency with the Coastal Plan.

- **Agricultural Resources** – Agricultural land uses are present within and around the project area. The EIR also evaluate potential impacts to designated farmland and Williamson Act contracts.

- **Utilities and Public Services** – The EIR will evaluate potential conflicts with existing utility lines during project construction, including potential service interruption. Particular attention will be paid to “high-priority” utilities that could pose a risk to workers in the event of an accident during construction. Potential impacts related to landfill capacity associated with the disposal of spoils and debris generated during project construction will be described. Project consistency with federal, state, and local waste diversion goals will also be considered.

- **Aesthetic Resources** – Project facilities would be sited along the coastal zone and Highway 1, a designated scenic highway. The EIR will evaluate visual impacts related to the new/proposed facilities.

- **Cumulative Impacts** – The environmental effects of the MPWSP, in combination with the effects of past, present, and future foreseeable cumulative projects in the vicinity, could result in significant cumulative impacts. Potential cumulative projects include the future expansion of the Salinas Valley Water Project, a desalination plant for the Marina Coast Water District/Fort Ord area, and the Groundwater Replenishment Project (if groundwater replenishment is not made part of the proposed project or an alternative). The EIR will evaluate the project’s contribution to any identified cumulative impacts.

The MPWSP EIR will describe water supply and demand in the CalAm service area and the relationship of the proposed project (including facility sizing and capacities) to such supply and demand. The potential for implementation of the MPWSP to result in growth-inducing effects will be evaluated.

To comply with the CEQA-Plus requirements under the CWSRF Guidelines, the EIR will include information to support federal agency consultations under Section 106 of the National Historic Preservation Act, Section 7 of the Federal Endangered Species Act, the Federal Clean Air Act General Conformity Rule,[9] and any other applicable federal consultations. If it is determined through the scoping process that additional federal review is required, CPUC will coordinate with the appropriate federal agency to comply with NEPA.

Where feasible, mitigation measures will be proposed to avoid or reduce any identified environmental impacts attributable to the project.

Comments received during the EIR scoping period will be considered during preparation of the MPWSP EIR. Public agencies and interested organizations and persons will have an opportunity to comment on the Draft EIR after it is published and circulated for public review.

Scoping and Draft EIR Schedule

During this NOP review period, the CPUC is soliciting comments on the scope of environmental issues as well as reasonable alternatives and mitigation measures that should be explored in the Draft EIR.[10] Written scoping comments may be submitted by hand, mailed, faxed, or sent by email during the NOP review period, which closes at 5:00 p.m. on November 9, 2012. Please include a name, address, and telephone number of a contact person to receive future correspondence on this matter. Please send your comments to:

Andrew Barnsdale
California Public Utilities Commission
c/o Environmental Science Associates
550 Kearny Street, Suite 800
San Francisco, CA 94108
Fax: 415.896.0332
Or email to: MPWSP-EIR@esassoc.com

Scoping Meetings

CEQA Statute Section 21083.9 mandates that a scoping meeting be held for projects of statewide, regional or area-wide significance. Given the high level of interest in and the importance of this proposed project to the Monterey County region and to ensure that the public and regulatory

9 The General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality. As of March 30, 2012, the North Central Coast Air Basin (NCCAB) meets all National Ambient Air Quality Standards and is not subject to a maintenance plan with conformity obligations. Therefore, the MPWSP EIR will describe why the General Conformity Rule would not apply to the MPWSP.

10 Publication of the Draft EIR is scheduled for summer 2013.

agencies have an opportunity to ask questions and submit comments on the scope of the EIR, a series of scoping meetings will be held during the NOP review period. The scoping meetings will start with a brief presentation providing an overview of the proposed project and the project alternatives identified to date. Subsequent to the presentation, interested parties will be provided an opportunity to interact with technical staff. Participants are encouraged to submit written comments, and comment forms will be supplied at the scoping meetings. Written comments may also be submitted anytime during the NOP scoping period to the mailing address, fax number, or email address listed above. The locations and dates of the scoping meetings are listed below:

October 24, 2012	**October 25, 2012**	**October 25, 2012**
6:30 p.m. to 8:30 p.m.	1:30 p.m. to 3:30 p.m.	6:30 p.m. to 8:30 p.m.
Rancho Canada Golf Club	Oldemeyer Center	Oldemeyer Center
4860 Carmel Valley Road	Blackhorse Room	Laguna Grande Hall
Carmel, CA 93923	986 Hilby Avenue	986 Hilby Avenue
	Seaside, CA 93955	Seaside, CA 93955

Preliminary List of Alternatives to the Project

In accordance with CEQA Guidelines Section 15126.6, the EIR will describe a reasonable range of potentially feasible alternatives to the MPWSP, or to the location of the project, that would achieve most of the basic objectives of the project while avoiding or substantially lessening any of the significant effects of the project, and will also evaluate the comparative merits of the alternatives. Alternatives to the proposed MPWSP are briefly introduced below. The alternatives set forth below comprise a preliminary list of potentially feasible alternatives. This list will be refined, and may be expanded or contracted, as warranted based upon comments received and data gathered as part of the EIR preparation process on such topics as feasibility (as well as economic, environmental, legal and social factors), ability to avoid significant effects of the project, and ability to meet the basic objectives of the project.

5.4-mgd Desalination Plant with Groundwater Replenishment

As an alternative to the proposed 9-mgd desalination plant, CalAm would implement a 5.4-mgd desalination plant and enter into a water purchase agreement with the Monterey Peninsula Water Management District (MPWMD) to purchase up to 3,500 afy of product water from the Groundwater Replenishment Project. CalAm has entered into a Memorandum of Understanding with the MRWPCA and Monterey Peninsula Water Management District to collaborate on development of the Groundwater Replenishment Project. The MRWPCA currently owns and operates two plants that treat wastewater influent from the Monterey Peninsula and Salinas Valley service area: the Regional Wastewater Treatment Plant treats community wastewater for discharge to the ocean; also, in the mid-1990s, the MRWPCA constructed and now operates a tertiary treatment plant known as the Salinas Valley Reclamation Project, which treats water for agricultural irrigation that is distributed via the Castroville Seawater Intrusion Project.[11]

[11] The Salinas Valley Reclamation Project and the Castroville Seawater Intrusion Project are projects being operated in partnership with the Monterey County Water Resources Agency and growers in the Salinas Valley.

The Groundwater Replenishment Project would include replenishment of the Seaside Groundwater Basin with wastewater treated at a proposed advanced water treatment plant to be located at the Regional Treatment Plant. The Groundwater Replenishment Project would convey the treated water into the Seaside Basin for dilution and storage. Replenishment could occur at either inland or coastal locations and could include vadose zone wells and/or injection wells. Vadose zone wells would be used for recharge of the unconfined Paso Robles Aquifer, and injection wells would directly replenish the confined Santa Margarita Aquifer. The Groundwater Replenishment Project could be operated during the winter months and during other non-peak months. Extraction from the Seaside Groundwater Basin can occur later, at any time of the year.

DeepWater Desal Alternative

DeepWater Desal LLC is proposing the DeepWater Desal Alternative, a 25-mgd seawater reverse osmosis desalination facility that would serve Santa Cruz, San Benito, and Monterey Counties. The desalination facility would be constructed at Capurro Ranch on a leased 8.14-acre property located on Highway 1 near Moss Landing. This site is immediately north of the Moss Landing harbor in Santa Cruz County, and approximately 1 mile from the proposed seawater intake to be located at the Sandholdt pier, which would be rebuilt under this alternative.[12] The intake and brine discharge pipes would be anchored to the Sandholdt pier. Approximately 50 million gallons of raw seawater per day would be drawn via a passive[13] open-water intake at a depth of about 100 feet through an existing pipeline and easement[14] located on the edge of the Monterey Submarine Canyon. The desalination system would use some existing facilities at the Moss Landing Power Plant. Approximately 25 mgd of brine discharge would be diluted in the Moss Landing Power Plant's cooling water discharge and returned to the ocean. The desalination system would include pretreatment facilities and onsite storage tanks and would utilize an electrical power-source mix. The DeepWater Desal Alternative could qualify for tax-free municipal bond financing. DeepWater Desal LLC anticipates that municipal agencies within the Monterey Bay area would form a joint powers authority to assume ownership of the DeepWater Desal Alternative.[15] No details are available at this time regarding the infrastructure needed to convey product water to the Monterey Peninsula or other service areas.

People's Moss Landing Water Desalination Project (People's Project) Alternative

The People's Project would be a 10-mgd desalination facility located at the Moss Landing Green Commercial Park, adjacent to the Moss Landing Power Plant on the former National Refractories & Minerals Corporation site. The proposed 200-acre site is currently zoned for light and heavy industrial use, and approximately 25 acres would be designated for the desalination plant. The People's Project would consist of the following major components: screened, passive open-water

12 Construction of the DeepWater Desal Alternative would include the reconstruction of the Sandholdt Pier on its historical site.
13 "Passive intake" means that the maximal velocity of seawater being drawn in through the "wedge-wire" screen will never exceed 1 foot per second.
14 DeepWater Desal LLC intends to lease this pipeline easement from Dynegy.
15 DeepWater Desal LLC, "Our Location" and "Our Approach." Available online at http://deepwaterdesal.com/. Accessed August 2012. Updated 2011.

intake (existing, located at the former National Refractories and Minerals Plant site); outfall pipeline (existing); intake pump station (existing); pretreatment media filtration system; 10-mgd seawater desalination system; 45-mgd onsite product water storage tanks; post-treatment facilities; product water pump station; solids handling system; electrical and solar power supply and energy recovery system; and approximately 13 miles of transmission and/or distribution pipeline to convey product water to the Monterey Peninsula. The transmission pipeline would be constructed in paved and unpaved areas and would require crossings at Mojo Cojo Slough, Tembladero Slough, and the Salinas River. The City of Pacific Grove has agreed to serve as the lead public agency for The People's Moss Landing Water Desalination Project.[16]

Conservation Alternative

As an alternative to the proposed project, CalAm would implement water reduction efforts and other conservation measures to reduce demand on the existing water supply. The Monterey Peninsula Water Management District currently works with CalAm to provide education and encourage water conservation in an effort to protect water resources in the community. These conservation efforts include: conservation billing rates, limited watering schedule, free water audits, free water-saving devices, rebates on high-efficiency appliances, rebates for low water landscaping, and turf removal. This alternative, which would further expand conservation programs, could set stricter conservation requirements for residential and commercial customers. Under this alternative, CalAm would reduce system water loss via leakage control zones, pressure control, acoustic monitoring, transmission main testing, and main replacement programs. CalAm would use tiered rates to reduce water use. CalAm would also work with customers to promote water-wise landscaping and turf replacement, graywater use, plumbing retrofits, and other best management practices. It is yet to be determined if the Conservation Alternative would be a project alternative, or if the Conservation Alternative, implemented in conjunction with desalination, would enable the proposed MPWSP desalination plant to be reduced in size.

Locational Alternatives

The MPWSP EIR will also consider locational alternatives to the MPWSP preferred project, including alternative desalination plant locations and sizes (capacity); alternate pipeline alignments; and alternate intake well locations and configurations (i.e. open water intake; vertical wells; Ranney collector wells; etc.).[17]

16 The People's Moss Landing Water Desal Project, "The Project." Available online at http://www.thepeopleswater.com/theproject.html. Accessed August 2012. Updated March 2012.

17 A Ranney well is a radial arrangement of screens that form a large infiltration gallery with a single central withdrawal point used to extract water from an aquifer with direct connection (caisson constructed in the sand) to surface water.

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ATTACHMENT B
Notice of Intent

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5. Identify the mechanisms of climate impacts on ecosystems, living marine resources and resource-dependent human communities.

6. Track trends in living marine resources and resource-dependent human communities and provide early warning of change.

7. Build and maintain the science infrastructure needed to fulfill NOAA Fisheries mandates with changing climate conditions.

Implementing the Strategy is crucial for fulfilling NOAA Fisheries mandates, reducing climate-related impacts and increasing the resilience of living marine resources and resource-dependent communities in a changing climate. The Strategy recommends specific near- and medium-term actions that address common information needs across NOAA Fisheries mandates and regions.

The draft Climate Science Strategy underwent public review from January thru March 2015 (80 FR 3558, January 23, 2015) and received approximately 35 stakeholder comments from fishery management councils, states, tribes, academics, Non-Governmental Organizations and members of the public. The comments were generally positive with agreement on the need for action and support for both the content of the strategy and its implementation.

The Strategy is designed to be customized and implemented through Regional Action Plans that focus on building regional capacity and partnerships to address the Strategy's seven objectives. In 2015–2016, NOAA Fisheries Science Centers and Regional Offices will develop Regional Action Plans to identify strengths, weaknesses, priorities, and actions to address the Strategy over the next 5 years. Development of the Regional Action Plans will include opportunity for input from science and management partners and others. The Strategy is a key part of NOAA Fisheries efforts to respond to growing demands for information to help reduce impacts and increase the resilience of living marine resources and the communities that depend on them in a changing climate.

Dated: August 21, 2015.

Ned Cyr,

Director, Office of Science and Technology, National Marine Fisheries Service.

[FR Doc. 2015–21172 Filed 8–25–15; 8:45 am]

BILLING CODE 3510–22–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

Proposed Monterey Peninsula Water Supply Project; Intent To Prepare a Draft Environmental Impact Statement; Scoping Meeting

AGENCY: Office of National Marine Sanctuaries (ONMS), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA).

ACTION: Notice of intent to prepare environmental impact statement; Scoping meeting.

SUMMARY: A permit application has been submitted by California American Water Company (CalAm) to Monterey Bay National Marine Sanctuary (MBNMS) to construct and operate a seawater reverse osmosis (SWRO) desalination facility project (Project) in Monterey County, California. The permit review process will be conducted concurrently with a public process conducted pursuant to the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*). NOAA is soliciting information and comments on the range of issues and the significant issues to be analyzed in depth related to the Project proposed within MBNMS boundaries.

DATES: Comments must be received by October 2, 2015. A public meeting will be held as detailed below:

Date: September 10, 2015.

Location: Sally Griffin Active Living Center.

Address: 700 Jewell Avenue, Pacific Grove 93950.

Time: The meeting will begin at 2:00 p.m.

ADDRESSES: Comments may be submitted by either of the following methods:

- *Electronic Submissions:* Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov/#!docketDetail;D=NOAA-NOS-2015-0105,* click the ''Comment Now!'' icon, complete the required fields and enter or attach your comments.
- *Mail:* MBNMS Project Lead for CalAm Desalination Project, 99 Pacific Ave., Bldg. 455a, Monterey, CA 93940.

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered by NOAA. All comments received are a part of the public record and will generally be posted for public viewing on *www.regulations.gov* without change. All personal identifying information (*e.g.,* name, address, etc.), confidential business information, or otherwise sensitive information submitted voluntarily by the sender will be publicly accessible. ONMS will accept anonymous comments (enter ''N/A'' in the required fields if you wish to remain anonymous).

FOR FURTHER INFORMATION CONTACT: Karen Grimmer at 99 Pacific Ave., Bldg. 455a, Monterey, CA 93940 or *mbnms.comments@noaa.gov.*

SUPPLEMENTARY INFORMATION:

Background Information

I. Background

A permit application has been submitted by CalAm for construction and operation of its proposed Monterey Peninsula Water Supply Project (MPWSP or Project). The purpose of the MPWSP is to replace existing water supplies for CalAm's Monterey District service area.

The MPWSP comprises various facilities and improvements, including: A sub-surface seawater intake system; a 9.6-million-gallons-per-day (mgd) seawater reverse osmosis (SWRO) desalination plant; desalinated water storage and conveyance facilities; and expanded Aquifer Storage and Recovery (ASR) facilities.

The desalination facility would be capable of producing 10,627 acre-feet per year (AFY) of potable water on a 46-acre site located north of the City of Marina on unincorporated Monterey County property. The MPWSP proposes ten subsurface slant wells to draw seawater from beneath the ocean floor in Monterey Bay to produce the source water for the desalination plant. The subsurface slant wells would be located primarily within the City of Marina, in the active mining area of the CEMEX sand mining facility. The slant wells would be approximately 700 to 1000 feet in length, with well tips located at approximately 200 to 220 feet below mean sea level. Up to 24.1 mgd of source water would be needed to produce 9.6 mgd of desalinated product water.

The desalination plant would generate approximately 13.98 mgd of brine, including 0.4 mgd of decanted backwash water. The brine would be discharged into Monterey Bay via a 36-inch diameter pipeline to a new connection with the existing Monterey Regional Water Pollution Control Agency's (MRWPCA) outfall and diffuser located at the wastewater facility.

II. Need for Action

This notice of intent (NOI) to prepare a draft environmental impact statement and conduct scoping is published in accordance with: Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969, as amended; and the White House Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (CEQ NEPA Regulations).

The Project was subject to a Draft Environmental Impact Report (EIR), under the provisions of the California Environmental Quality Act (CEQA), published by the California Public Utilities Commission (CPUC) in April 2015. The NEPA environmental documentation will include an Environmental Impact Statement (EIS), which may be issued as a stand-alone document or as a joint draft CEQA/NEPA (EIR/EIS) document with the CPUC.

The environmental document will identify and assess potential environmental impacts associated with the proposed Project and a range of alternatives. Federal agencies would use the EIS to consider related permits or other approvals for the Project as proposed. Possible alternatives could include not approving the Project, approving a reduced size Project, or approving the Project with additional modifications identified as part of the terms and conditions of a permit or other approval.

Publication of this notice initiates the public scoping process to solicit public and agency comment, in writing or at the public meeting, regarding the full spectrum of environmental issues and concerns relating to the scope and content of the EIS, including:

- Analyses of the human and marine resources that could be affected;
- the nature and extent of the potential significant impacts on those resources;
- a reasonable range of alternatives to the proposed action; and
- mitigation measures.

III. Process

This NOI is published by NOAA/MBNMS, the lead federal agency. MBNMS has requested CPUC to re-issue the Project EIR as part of a joint draft CEQA/NEPA document. If the CPUC, as CEQA lead agency, determines that a joint CEQA/NEPA document is appropriate, the two agencies will prepare a joint draft EIR/EIS after completion of the federal scoping process. The NEPA scoping session begins at 2:00 p.m., on Thursday, September 10, 2015 at Sally Griffin Active Living Center in Pacific Grove, CA.

IV. Federal Consultations

This notice also advises the public that NOAA will coordinate its consultation responsibilities under section 7 of the Endangered Species Act (ESA), Essential Fish Habitat (EFH) under the Magnuson Stevens Fishery Conservation and Management Act (MSA), section 106 of the National Historic Preservation Act (NHPA, 16 U.S.C. 470), and Federal Consistency review under the Coastal Zone Management Act (CZMA), along with its ongoing NEPA process including the use of NEPA documents and public and stakeholder meetings to also meet the requirements of other federal laws.

In fulfilling its consultation responsibility under the ESA, MSA, NHPA, CZMA and NEPA, NOAA intends to identify consulting parties and involve the public in accordance with NOAA's NEPA procedures, and develop in consultation with identified consulting parties alternatives and proposed measures that might avoid, minimize or mitigate any adverse effects on endangered species, essential fish habitat, historic properties, or coastal zone management issues, and describe them in any environmental assessment or draft environmental impact statement.

Authority: 16 U.S.C. 1431 *et seq.*

Dated: August 20, 2015.

John Armor,

Acting Director for the Office of National Marine Sanctuaries.

[FR Doc. 2015–21133 Filed 8–25–15; 8:45 am]

BILLING CODE 3510–NK–P

DEPARTMENT OF DEFENSE

Office of the Secretary

[Docket ID: DoD–2015–OS–0088]

Proposed Collection; Comment Request

AGENCY: Office of the Assistant Secretary of Defense for Personnel and Readiness, DoD.

ACTION: Notice.

SUMMARY: In compliance with the *Paperwork Reduction Act of 1995,* the Office of the Assistant Secretary of Defense for Personnel and Readiness announces a proposed public information collection and seeks public comment on the provisions thereof. Comments are invited on: (a) Whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information shall have practical utility; (b) the accuracy of the agency's estimate of the burden of the proposed information collection; (c) ways to enhance the quality, utility, and clarity of the information to be collected; and (d) ways to minimize the burden of the information collection on respondents, including through the use of automated collection techniques or other forms of information technology.

DATES: Consideration will be given to all comments received by October 26, 2015.

ADDRESSES: You may submit comments, identified by docket number and title, by any of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments.
- *Mail:* Department of Defense, Office of the Deputy Chief Management Officer, Directorate of Oversight and Compliance, Regulatory and Audit Matters Office, 9010 Defense Pentagon, Washington, DC 20301–9010.

Instructions: All submissions received must include the agency name, docket number and title for this **Federal Register** document. The general policy for comments and other submissions from members of the public is to make these submissions available for public viewing on the Internet at *http://www.regulations.gov* as they are received without change, including any personal identifiers or contact information.

Any associated form(s) for this collection may be located within this same electronic docket and downloaded for review/testing. Follow the instructions at *http://www.regulations.gov* for submitting comments. Please submit comments on any given form identified by docket number, form number, and title.

FOR FURTHER INFORMATION CONTACT: To request more information on this proposed information collection or to obtain a copy of the proposal and associated collection instruments, please write to the Deputy Assistant Secretary of Defense, Military Community and Family Policy, ATTN: Casualty Affairs, 4000 Defense Pentagon, Washington, DC 20301–4000.

SUPPLEMENTARY INFORMATION:

Title; Associated Form; and OMB Number: Questionnaire of Local Inhabitants, DD Form 1074; Disposition of Civilian Remains, DD Form 3004; OMB Control Number 0704–XXXX.

Needs and Uses: The information collection requirement is necessary to obtain and document information from local inhabitants on the location and circumstances surrounding the death of U.S. personnel for whom the Department has responsibility to recover

APPENDIX A1

Draft and Final EIR/EIS Distribution List

The January 13, 2017 Draft EIR/EIS, in either CD format or hard copy, was distributed to the agencies, organizations, and individuals listed below in the Draft EIR/EIS Distribution List. Wide public notification of the website containing the Draft EIR/EIS for download, and locations of hard copies for public review, was also made through direct mailing to all property owners and residences within 300-feet of any proposed facility, in the media, and in the Federal Register. The Final EIR/EIS distribution list includes those agencies, organizations, and individuals listed below in the Draft EIR/EIS distribution list, plus those agencies, organizations, and individuals who commented on the Draft EIR/EIS, listed in Section 8.1.2. The Final EIR/EIS was distributed as a CD to all public agencies that commented on the Draft EIR/EIS. All other agencies, organizations, and individuals who received a copy of, or who commented on the Draft EIR/EIS, were mailed a letter with a notification of the website containing the Final EIR/EIS and Appendices for download, and a contact for requesting a CD of the Final EIR/EIS.

Draft EIR/EIS Distribution List

Charissa L. Villanueva ....Adams Broadwell Joseph & Cardozo
Cody Elliott ....Adams Broadwell Joseph & Cardozo
Laura Horton ....Adams Broadwell Joseph & Cardozo
Rita I. Chavez ....Adams Broadwell Joseph & Cardozo
Marc Del Piero ....Ag Land Trust of Monterey County
Jan Driscoll, Attorney...............................Allen Matkins Leck Gamble Mallory Natsis
Dane Hardin ....Applied Marine Sciences
Maura F. Twomey, Executive Director....Association of Monterey Bay Area Governments
Jeff Coffman...Bauer International Corporation
Bruce Stevbry ....Benchmark Resources
Jean Shoaf...BHFS
Scott Blaising, Attorney ....Braun Blaising McLaughlin & Smith, P.C
James Brezack ....Brezack & Associates Planning
Caitlin K. Malone.....................................Brownstein Hyatt Farber Schreck, LLP
Russell McGlothlin...................................Brownstein Hyatt Farber Schreck, LLP
Ryan Drake...Brownstein Hyatt Farber Schreck, LLP
Anna Shimko..Burke Williams & Sorensen
Congressman Sam Farr ....CA Central Coast (CA-20)
Tom Luster ....CA Coastal Commission
Trish Chapman ....CA Coastal Conservancy
Elizabeth Areizaga ....CA Department of Fish & Wildlife
Terry Palmisano ....CA Department of Fish & Wildlife
Kevan Urquhart ....CA Department of Fish & Wildlife
Brandon Sanderson...................................CA Department of Fish & Wildlife
Craig Bailey..CA Department of Fish & Wildlife
Eric Wilkins..CA Department of Fish & Wildlife

Jan R. Sweigert..CA DPH, Health and Human Services Agency
Matt Rodriquez..CA EPA
John Laird..CA Natural Resources Agency
Jennifer Lucchesi, Executive Officer ....CA State Lands Commission
Cynthia Herzog..CA State Lands Commission
Cy R. Oggins, Chief ....CA State Lands Commission
Jill Poudrette..CA State Parks
Matt Fuzie..CA State Parks
Steve Bachman ....CA State Parks
Kathryn Tobias, Senior Staff Counsel......CA State Parks
Senator Dianne Feinstein ....CA United States Senator
Corporate Counsel...................................CalAm
Anthony Cerasuolo..................................CalAm
David Sousa...CalAm
Kevin Tilden..CalAm
Rich Svindland ....CalAm
Rob MacLean ....CalAm
Sherrene Chew ....CalAm
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Phil Hammer	Central Coast Regional Water Quality Control Board
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Gail Morton, City Council	City of Marina
Layne Long, City Manager	City of Marina
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Debra Daniels	City of Marina Planning Commission
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Gene Doherty	City of Marina Planning Commission
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Jessica Clark	City of Monterey
Clyde Roberson	City of Monterey
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Cyndi Dawson..Monterey Bay Sanctuary Advisory Council
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Steve McShane..Monterey Bay Sanctuary Advisory Council
Dr. John Hunt..Monterey Bay Sanctuary Advisory Council
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Brent Marshall...Monterey Bay Sanctuary Advisory Council
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Katherine O'Dea.......................................Monterey Bay Sanctuary Advisory Council
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Manuel and Janine Fierro
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Jane Haines
Vicki Williams
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APPENDIX B1

MPWSP Plant Sizing Data: Various Five- and Ten-Year Normal, Dry, and Maximum Month Demand Scenarios

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Exhibit CA-30
(A.12-04-019)

Provided by California American Water
CPUC Evidentiary Hearing
December 2, 2013

MPWSP – PLANT SIZING DATA

5 Year:

Normal Year - with SB, LOR, PB, TBB

Supply		Demand	
Item	**(AFY)**	**Item**	**(AFY)**
Desal Plant	9,752	5 year Avg Demand	13,291
Carmel River	3,376	Lots of Record	1,180
Sand City	94	Pebble Beach	325
ASR	1,300	Tourism Bounce back	500
Seaside Basin	774	Total	15,296
Total	15,296	Deficit	-

Exh. CA-6, *Direct Testimony of Richard C. Svindland*, dated April 23, 2012 ("Svindland Direct"), pp. 16-18 (desal plant size, ASR), 22 (lots of record), Attachment 3, p. 3 (5-Year Average Demand), 7-8 (Carmel River), 8 (Sand City); Exh. CA-12, *Supplemental Testimony of Richard C. Svindland*, dated January 11, 2013 ("Svindland Supplemental"), pp. 4-5 (Seaside Basin, Tourism Bounce Back, Pebble Beach, 5 year avg demand), Attachment 1, pp. 3 (5 Year avg Demand), 4 (Lots of Record, Pebble Beach, Tourism Bounce Back), 9 (Sand City, Seaside Basin); Exh. CA-21, *Rebuttal Testimony of Richard C. Svindland*, dated March 8, 2013 ("Svindland Rebuttal"), p. 16 (Desal Plant); RT 988:10 - 989:21 (Svindland/CAW [Normal 5 year avg demand); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

Dry Year at Start of Desal Operation with SB, LOR, PB, TBB

Supply		Demand	
Item	**(AFY)**	**Item**	**(AFY)**
Desal Plant	9,752	5 year Avg Demand	13,291
Carmel River	3,376	Lots of Record	1,180
Sand City	94	Pebble Beach	325
ASR	-	Tourism Bounce back	500
Seaside Basin	774	Total	15,296
Total	13,996	Deficit	1,300
		System Demand for No Impact	11,991

Exh. CA-6, Svindland Direct, pp. 16-18 (desal plant size), 22 (lots of record), Attachment 3, p. 3 (5-Year Average Demand), 7-8 (Carmel River), 8 (Sand City); Exh. CA-12, Svindland Supplemental, pp. 4-5 (Seaside Basin, Tourism Bounce Back, Pebble Beach, 5-year avg demand), Attachment 1, pp. 3 (5 year avg demand), 4 (Lots of Record, Pebble Beach, Tourism Bounce Back), 9 (Sand

City, Seaside Basin); Exh. CA-21, Svindland Rebuttal, p. 16 (Desal Plant); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

Max Demand Year at Start of Desal Operation with SB, LOR, PB, TBB

Supply		Demand	
Item	**(AFY)**	**Item**	**(AFY)**
Desal Plant	9,752	5 year Max Demand	14,644
Carmel River	3,376	Lots of Record	-
Sand City	94	Pebble Beach	325
ASR	1,300	Tourism Bounce back	500
Seaside Basin	774	Total	15,469
Total	15,296	Deficit	173
		System Demand for No Impact	14,471

Exh. CA-6, Svindland Direct, pp. 16-18 (desal plant size), Attachment 3, pp. 7-8 (Carmel River supply), 8 (Sand City); Exh. CA-12, Svindland Supplemental, pp. 4 (Seaside Basin, Tourism Bounce Back, Pebble Beach), Attachment 1, p. 4 (Pebble Beach, Tourism Bounce Back), 9 (Sand City, Seaside Basin); Exh. CA-21, Svindland Rebuttal, p. 16 (Desal Plant); RT 990:15 - 991:7 (Svindland/CAW); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

Max Demand Year at Start of Desal Operation - DRY Year, with SB, PB, TBB

Supply		Demand	
Item	**(AFY)**	**Item**	**(AFY)**
Desal Plant	9,752	5 year Max Demand	14,644
Carmel River	3,376	Lots of Record	-
Sand City	94	Pebble Beach	325
ASR		Tourism Bounce back	500
Seaside Basin	774	Total	15,469
Total	13,996	Deficit	1,473
		System Demand for No Impact	13,171

Exh. CA-6, Svindland Direct, pp. 16-18 (desal plant size), Attachment 3, pp. 7-8 (Carmel River supply), 8 (Sand City); Exh. CA-12, Svindland Supplemental, pp. 4 (Seaside Basin, Tourism Bounce Back, Pebble Beach), Attachment 1, p. 4 (Pebble Beach, Tourism Bounce Back), 9 (Sand City, Seaside Basin); Exh. CA-21, Svindland Rebuttal, p. 16 (Desal Plant); RT 990:15 - 991:7 (Svindland/CAW); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

Max Demand Year at Start of Desal Operation - DRY Year, PB, TBB, no SB

Supply		Demand	
Item	(AFY)	Item	(AFY)
Desal Plant	9,752	5 year Max Demand	14,644
Carmel River	3,376	Lots of Record	-
Sand City	94	Pebble Beach	325
ASR		Tourism Bounce back	500
Seaside Basin	1,474	Total	15,469
Total	14,696	Deficit	773
		System Demand for No Impact	13,871

Exh. CA-6, Svindland Direct, pp. 16-18 (desal plant size), Attachment 3, pp. 7-8 (Carmel River supply), 8 (Sand City, Seaside Basin); Exh. CA-12, Svindland Supplemental, pp. 4 (Seaside Basin, Tourism Bounce Back, Pebble Beach), Attachment 1, p. 4 (Seaside Basin, Pebble Beach, Tourism Back Back), 9 (Sand City, Seaside Basin); Exh. CA-21, Svindland Rebuttal, p. 16 (Desal Plant); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

<u>10 Year:</u>

Plant Needed to meet 10 year Max Demand & LOR, PB, TBB, SB

Supply		Demand	
Item	(AFY)	Item	(AFY)
Desal Plant	11,623	10 year Max Demand	15,162
Carmel River	3,376	Lots of Record	1,180
Sand City	94	Pebble Beach	325
ASR	1,300	Tourism Bounce back	500
Seaside Basin	774	Total	17,167
Total	17,167	Deficit	-

Exh. CA-6, Svindland Direct, p. 22 (lots of record), Attachment 3, pp. 7-8 (Carmel River supply), 8 (Sand City); Exh. CA-12, Svindland Supplemental, pp. 4 (Seaside Basin, Tourism Bounce Back, Pebble Beach), Attachment 1, p. 4 (Seaside Basin, Lots of Record, Pebble Beach, Tourism Back Back), 9 (Sand City, Seaside Basin); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

10 year Max Demand - with 9.6 MGD Plant & SB but no LOR, PB, TBB

Supply		Demand	
Item	(AFY)	Item	(AFY)
Desal Plant	9,976	10 year Max Demand	15,162
Carmel River	3,376	Lots of Record	
Sand City	94	Pebble Beach	
ASR	1,300	Tourism Bounce back	
Seaside Basin	774	Total	15,162
Total	15,520	Deficit	(358)

Exh. CA-6, Svindland Direct, Attachment 3, pp. 7-8 (Carmel River supply), 8 (Sand City); Exh. CA-12, Svindland Supplemental, pp. 4 (Seaside Basin), Attachment 1, p. 4 (Seaside Basin), 9 (Sand City, Seaside Basin); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

10 year Max Demand - with 9.6 MGD Plant DRY Year

Supply		Demand	
Item	(AFY)	Item	(AFY)
Desal Plant	9,976	10 year Max Demand	15,162
Carmel River	3,376	Lots of Record	
Sand City	94	Pebble Beach	
ASR		Tourism Bounce back	
Seaside Basin	774	Total	15,162
Total	14,220	Deficit	942

Exh. CA-6, Svindland Direct, Attachment 3, pp. 7-8 (Carmel River supply), 8 (Sand City); Exh. CA-12, Svindland Supplemental, pp. 4 (Seaside Basin), Attachment 1, p. 4 (Seaside Basin), 9 (Sand City, Seaside Basin); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

10 year Max Demand - with 9.6 MGD Plant DRY Year & No Basin Payback

Supply		Demand	
Item	**(AFY)**	**Item**	**(AFY)**
Desal Plant	9,976	10 year Max Demand	15,162
Carmel River	3,376	Lots of Record	
Sand City	94	Pebble Beach	
ASR		Tourism Bounce back	
Seaside Basin	1,474	Total	15,162
Total	14,920	Deficit	242

Exh. CA-6, Svindland Direct, Attachment 3, pp. 7-8 (Carmel River supply), 8 (Sand City, Seaside Basin); Exh. CA-12, Svindland Supplemental, pp. 4 (Seaside Basin), Attachment 1, p. 4 (Seaside Basin), 9 (Sand City, Seaside Basin); RT 990:15 - 991:7 (Svindland/CAW [Seaside Basin]).

Max Month:

Maximum Month - 5 yr Avg

Supply		Demand	
Item	**(AF)**	**Item**	**(AFY)**
Desal Plant	813	5 year Average	1,388
Carmel River	100	Lots of Record	113
Sand City	8	Pebble Beach	31
ASR (Extraction)	433	Tourism Bounce back	48
Seaside Basin	370	Total	1,580
Total	1,724	Deficit	(143)

Exh. CA-6, Svindland Direct, p. 17 (maximum demand months/days).

Maximum Month - 5 yr High

Supply		Demand	
Item	(AF)	Item	(AFY)
Desal Plant	813	5 year Max	1,532
Carmel River	100	Lots of Record	113
Sand City	8	Pebble Beach	31
ASR (Extraction)	433	Tourism Bounce back	48
Seaside Basin	370	Total	1,724
Total	1,724	Deficit	1

Exh. CA-6, Svindland Direct, p. 17 (maximum demand months/days).

Maximum Month - 10 yr High

Supply		Demand	
Item	(AF)	Item	(AFY)
Desal Plant	813	10 year Max	1,709
Carmel River	200	Lots of Record	113
Sand City	8	Pebble Beach	31
ASR (Extraction)	433	Tourism Bounce back	48
Seaside Basin	448	Total	1,901
Total	1,902	Deficit	(0)

Exh. CA-6, Svindland Direct, p. 17 (maximum demand months/days).

Maximum Month - 10 yr High - DRY Year at Plant Start Up

Supply		Demand	
Item	(AF)	Item	(AFY)
Desal Plant	813	10 year Max	1,709
Carmel River	200	Lots of Record	113
Sand City	8	Pebble Beach	31
ASR (Extraction)		Tourism Bounce back	48
Seaside Basin	448	Total	1,901
Total	1,469	Deficit	433

Exh. CA-6, Svindland Direct, p. 17 (maximum demand months/days).

SVRG:

Desal Plant Size		Customer Demand	SV Return	Available	Remaining for Operations	Excess Availablity
MGD	AFY	AFY	AFY	AFY	AFY	%
9.6	10,752	9,752	880	1,000	120	1.1%
6.9	7,728	6,752	590	976	386	5.0%
6.4	7,168	6,252	550	916	366	5.1%

Exh. CA-12, Svindland Supplemental, pp. 11 (Desal Plant Size and Demand); Exh. CA-21, Svindland Rebuttal, p. 16 (Desal Plant).

APPENDIX B2

State Water Board Final Analysis of the Monterey Peninsula Water Supply Project

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Edmund G. Brown Jr.
Governor

Matthew Rodriquez
Secretary for Environmental Protection

State Water Resources Control Board

TO: Paul Clanon
Executive Director
Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102-3298

FROM: Michael Buckman
Senior Environmental Scientist
DIVISION OF WATER RIGHTS

DATE: JUL 31 2013

SUBJECT: FINAL REPORT ON ANALYSIS OF MONTEREY PENINSULA WATER SUPPLY PROJECT PROPOSED IN APPLICATION 12-04-019 BY CALIFORNIA AMERICAN WATER COMPANY

Enclosed is the State Water Resources Control Board's (State Water Board) final report on an analysis of California American Water Company's (Cal-Am) proposed Monterey Peninsula Water Supply Project (MPWSP). The California Public Utilities Commission (Commission) requested that the State Water Board assist the Commission in reviewing whether Cal-Am has the legal right to extract desalination feedwater for the proposed MPWSP.

On December 21, 2012, the State Water Board provided the Commission an initial draft of the report and on February 14, 2013, the Commission provided the State Water Board comments on the initial draft report. The Commission's February 14, 2013 correspondence also contained additional information for the State Water Board to evaluate, specifically, a revised design of the feedwater intake system for the MPWSP.

On April 3, 2013, the State Water Board released a revised report as well as a notice of opportunity for public comment. Staff received six timely letters from commenters and made revisions to the draft.

On June 4, 2013, the State Water Board held a public workshop in Monterey to allow for local stakeholder input. At the workshop staff presented a review of the revised draft report and received feedback. Following the public workshop, State Water Board staff made minor amendments and finalized the report.

If you have any questions regarding this matter, you may contact me at (916) 341-5448 (mbuckman@waterboards.ca.gov) or Paul Murphey at (916) 341-5435 (pmurphey@waterboards.ca.gov). Written correspondence should be addressed as follows:

State Water Resources Control Board
Division of Water Rights
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P.O. Box 2000
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Enclosure

STATE WATER RESOURCES CONTROL BOARD

FINAL REVIEW OF CALIFORNIA AMERICAN WATER COMPANY'S MONTEREY PENINSULA WATER SUPPLY PROJECT

July 31, 2013

EXECUTIVE SUMMARY

Introduction

The California Public Utilities Commission (Commission) asked the State Water Resources Control Board (State Water Board) whether the California American Water Company (Cal-Am) has the legal right to extract desalination feedwater for the proposed Monterey Peninsula Water Supply Project (MPWSP). Cal-Am proposes several approaches that it claims would legally allow it to extract water from the Salinas Valley Groundwater Basin (SVGB or Basin) near or beneath Monterey Bay without violating groundwater rights or injuring groundwater users in the Basin. The purpose of this report is to examine the available technical information and outline legal considerations which would apply to Cal-Am's proposed MPWSP.

Technical Conclusions

There are gravity and pumped well designs proposed for the MPWSP, with several well locations proposed. Well design and location tests will be needed for complete technical and legal analysis. The conditions in the aquifer where MPWSP feedwater would be extracted could be either confined or unconfined, however, there is currently not enough information to determine what type of conditions exist at the location of the MPWSP wells. Effects from confined aquifer pumping would be observed over a larger area than if extraction occurred from an unconfined aquifer. Previous groundwater modeling studies for one of the proposed MPWSP well locations indicated there would be an approximate 2-mile radius for the "zone-of-influence" of the extraction wells, if groundwater was pumped from an unconfined aquifer. It is unknown what the effects would be if water was pumped from a confined aquifer with different hydrogeologic conditions.

The aquifers underlying the proposed extraction locations have been intruded with seawater since at least the 1940's. The impairment means that beneficial uses of the water in the intruded area are limited; however the actual extent of water use is not known. Groundwater quality in the Basin will be a key factor in determining the effects of extraction on groundwater users in the Basin, assessing any potential injury that may occur, and measures that would be necessary to compensate for it.

Legal Conclusions

To appropriate groundwater from the Basin, the burden is on Cal-Am to show their project will not cause injury to other users. Key factors will be: (1) how much fresh water Cal-Am extracts as a proportion of the total pumped amount, (to determine the amount of water, that after treatment, would be considered desalinated seawater available for export as developed water); (2) whether pumping affects the water table level in existing users' wells, (3); whether pumping affects seawater intrusion within the Basin (4) how Cal-Am returns any fresh water it extracts to the Basin to prevent injury to others; and (5) how groundwater rights might be affected in the future if the proportion of fresh and seawater changes in the larger Basin area or the immediate area around Cal-Am's wells.

If overlying groundwater users are protected from injury, appropriation of water consistent with the principles discussed in this report may be possible. To export water outside the Basin, Cal-Am must show 1) the desalinated water it produces is developed water, 2) replacement water methods to return water to the Basin are effective and feasible, and 3) the MPWSP can operate without injury to other users. A physical solution could be employed to assure all groundwater users rights are protected.

Recommendations

Additional information is needed to accurately determine MPWSP impacts on current and future conditions of the Basin regardless of whether the extraction occurs from pumped or gravity wells. First, specific information is needed on the depth of the wells and aquifer conditions. Studies are needed to determine the extent of the Dune Sand Aquifer, the water quality and water quantity of the Dune Sand Aquifer, the extent and thickness of the Salinas Valley Aquitard, and the extent of the 180-Foot Aquifer.

Second, the effects of the MPWSP on the Basin need to be evaluated. Specifically, a series of test boring/wells are needed to assess the hydrogeologic conditions at the site.

Aquifer testing is also needed to determine the pumping effects on both the Dune Sand Aquifer and the underlying 180-Foot Aquifer. Pre-project conditions should be identified prior to aquifer testing. Aquifer tests should mimic proposed pumping rates. To avoid unnecessary delays in development of the final system configuration, it is advisable that Cal-Am conduct similar testing, concurrently, at the other potential alternative locations for the extraction wells.

Third, updated groundwater modeling is needed to evaluate future impacts from the MPWSP. Specifically, modeling scenarios are necessary to predict changes in groundwater levels, groundwater flow direction, and changes in the extent and boundary of the seawater intrusion front. Additional studies are also necessary to determine how any extracted fresh water is replaced, whether through re-injection wells, percolation basins, or through existing recharge programs. It may also be necessary to survey the existing groundwater users in the affected area. The studies will form the basis for a plan that avoids injury to other groundwater users and protects beneficial uses in the Basin. To ensure that this modeling provides the best assessment of the potential effects of the MPWSP, it is important that any new information gathered during the initial phases of the groundwater investigation be incorporated into the groundwater modeling studies. In addition, modeling should include cumulative effects of the MPWSP, the Castroville Seawater Intrusion Project, and the Salinas Valley Water Project on the Basin.

1. Introduction

In a letter dated September 26, 2012, the California Public Utilities Commission (Commission) asked the State Water Resources Control Board (State Water Board) whether the California American Water Company (Cal-Am) has the legal right to extract desalination feedwater for the proposed Monterey Peninsula Water Supply Project (MPWSP). The Commission, lead agency under the California Environmental Quality Act (CEQA) for the proposed project, did not request that the State Water Board make a water rights determination, rather it requested an opinion on whether Cal-Am has a credible legal claim to extract feedwater for the proposed MPWSP in order to inform the Commission's determination regarding the legal feasibility of the MPWSP.

In a letter dated November 16, 2012, the State Water Board informed the Commission that State Water Board staff would prepare an initial report for the Commission. On December 21, 2012, the State Water Board provided the Commission an initial draft of the report and on February 14, 2013, the Commission provided the State Water Board comments on the initial draft report. The Commission's February 14, 2013 correspondence also contained additional information for the State Water Board to evaluate, specifically, a revised design of the feedwater intake system for the MPWSP. State Water Board staff reviewed the additional information and prepared a revised draft. The revised draft was then noticed to the public for comment on April 3, 2013, and additional information included with the comment letters received was considered and used to revise the report where appropriate.

Cal-Am proposes several approaches it claims would legally allow it to extract water from the Basin near or beneath Monterey Bay without violating groundwater rights or injuring other groundwater users in the Basin. The purpose of this report is to examine the available technical information and outline legal considerations which would apply to Cal-Am's proposed MPWSP.

This paper will (1) examine the available technical information[1] and that provided by the Commission; (2) discuss the effect the proposed MPWSP could have on other users in the Basin; (3) discuss the legal constraints and considerations that will apply to any user who proposes to extract water from the Basin; and (4) outline information that will be necessary to further explore MPWSP's feasibility and impacts. Ultimately, whether a legal means exists for Cal-Am to extract water from the Basin, as described in its proposal outlined in the CEQA Notice of Preparation[2] (NOP) document and in the additional information provided, will depend on developing key hydrogeologic information to support a determination based on established principles of groundwater law.

2. Background

In 2004, Cal-Am filed Application A.04-09-019 with the Commission seeking a Certificate of Public Convenience and Necessity for the Coastal Water Project. The primary purpose of the Coastal Water Project was to replace existing water supplies that have been constrained by legal decisions affecting the Carmel River and Seaside Groundwater Basin water resources. The Coastal Water Project proposed to use existing intakes at the Moss Landing Power Plant to draw source water for a new desalinization plant at Moss Landing. In January 2009, the Commission issued a Draft Environmental Impact Report (EIR) for the Coastal Water Project and two project alternatives – the North Marina Project and the Monterey Regional Water Supply Project (Regional Project). In October 2009, the Commission issued the Final EIR[3] (FEIR) and in December 2009, it certified the FEIR. In December 2010, the Commission approved implementation of the Regional Project.

In January 2012, Cal-Am withdrew its support for the Regional Project and subsequently submitted Application A.12-04-019 to the Commission for the proposed MPWSP as described in their September 26, 2012 letter. In October 2012, the

[1] Please see Appendix C for a list of references relied upon and considered in this report.
[2] California Public Utilities Commission, Notice of Preparation, Environmental Impact Report for the Cal-Am Monterey Peninsula Water Supply Project, October 2012.
[3] Cal-Am, Coastal Water Project, FEIR, October, 2009.

Commission issued a NOP for a Draft EIR for the proposed MPWSP. The Commission requested in their September letter that the State Water Board prepare an initial staff report by December 2012. The short timeframe for the initial report was necessary to inform written supplemental testimony due in January 2013 for Cal-Am and written rebuttal testimony from other parties due February 2013. The State Water Board completed and transmitted its initial draft report to the Commission on December 21, 2012.

In a memo dated February 14, 2013, the Commission expressed its appreciation to the State Water Board for the initial draft report. Additionally, the Commission included comments and questions regarding the draft report and requested the State Water Board evaluate new and additional information in its final report. State Water Board staff reviewed the additional information and prepared a revised draft.[4]

The revised draft was then noticed to the public for comment on April 3, 2013. At the conclusion of the public comment period on May 3, 2013, six comment letters had been received on the Draft Report.[5] Comments that pertain to the State Water Board's report generally fell into the following categories: 1) State Water Board's role and objective in preparing the Report; 2) sources of information used in preparing the Report (including adequacy of the environmental document for the previously proposed Coastal Water Project and use of previously developed groundwater model); 3) concerns about injury to other legal users of water (including potential impacts on existing efforts to control seawater intrusion); 4) legal issues related to the exportation of water from the Basin; 5) the need for better information about the hydrogeology of the proposed project location and the effects the proposed project would have on groundwater in the Basin; and 6) legal interpretation of groundwater appropriation law and concepts discussed within the Draft Report. We have modified the report to be responsive to the comments received,

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[4] Commission correspondence to State Water Board, February 14, 2013. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M047/K304/47304686.pdf

[5] Monterey County Farm Bureau (Norman Groot), LandWatch Monterey County (Amy L. White), the Salinas Valley Water Coalition (Nancy Isakson), Ag Land Trust (Molly Erickson of the Law Offices of Michael W. Stamp), Water Plus (Ron Weitzman), and Cal-Am (Rob Donlan of Ellison, Schneider, & Harris L.L.P)

where appropriate. Additionally, we have included summary responses to the above general categories as Appendix A to this report.

3. Monterey Peninsula Water Supply Project Description

When the Commission requested the assistance of the State Water Board in September 2012, the most current information available on the MPWSP was the description in the NOP for a forthcoming Draft EIR. State Water Board staff analyzed the NOP and how closely the new description matched the alternatives in the December 2009 FEIR completed for the Coastal Water Project. Of the two project alternatives in the FEIR, the North Marina Project more closely resembled the proposed MPWSP described in the NOP. For this reason, State Water Board staff assumed most of the information, including the slant well construction and operation as described in the FEIR – North Marina Project Alternative[6], was applicable to the proposed MPWSP. However, because the configuration and location for the proposed extraction well system has not yet been studied, direct comparison of the findings from the previous environmental reviews to the system that is currently being considered is not possible.[7]

On February 14, 2013, the Commission provided comments on an initial draft of this report and requested that State Water Board staff make revisions to address ambiguities while also considering new and additional information concerning modifications to the design and configuration of the MPWSP. The new information provided to the State Water Board by the Commission includes: an updated project description, changes in the location and configuration of the extraction well system, new information about the nature of the 180-Foot Aquifer, timing of implementation for

[6] Cal-Am, Coastal Water Project, FEIR, Section 3.3 – North Marina Project, October, 2009.
[7] The use of the Cal-Am Coastal Water Project FEIR in this report was informative in creating a broad picture of the potential impacts to groundwater resources in the Basin. The FEIR was not used to arrive at specific conclusions of the definite impacts that would result from the MPWSP. The analysis provided in this report can and should be applied in the context of a future EIR. It is anticipated that additional information gained from the studies recommended in our report will assist the Commission in determining the impacts of the MPWSP on the Salinas Valley Groundwater Basin.

certain compensation measures, and supplemental testimony from Richard Svindland of Cal-Am.[8]

The Commission requested that the State Water Board evaluate two possible alternatives for the MPWSP; (1) the "Proposed Project" (preferred alternative) with slant wells located at a 376-acre coastal property owned by the CEMEX Corporation and illustrated by the yellow dots on Figure "SWRCB 1", and; (2) "Intake Contingency Option 3" with a slant well intake system at Portrero Road north of the Salinas River as shown in the top center of Figure "SWRCB 2" by the small green dots. Figure "SWRCB 3" shows the approximate locations of the alternatives in the greater geographic area. The preferred alternative would consist of 7 to 9 slant wells that would draw water from under the ocean floor by way of gravity for delivery to the desalination plant. Intake Contingency Option 3 would consist of 9 wells extracting water from beneath the ocean floor by use of submersible pumps. For both alternatives, approximately 22 million gallons of water per day (mgd) would be extracted from the wells to produce 9 mgd of desalinated water. The design of these options is further described in Section 5 of this report.

Information provided to the State Water Board to date does not allow staff to definitively address the issue of how the proposed project would affect water rights in the Basin. Currently, it is unknown which aquifer(s) the wells will extract water from, and further complicating the analysis, the relationship of the aquifers in the well area to surrounding low-permeability aquitards is uncertain. Given these significant unknowns, this State Water Board report assumes, for the purposes of this preliminary evaluation, that the MPWSP hydrogeologic characteristics and effects to the SVGB would be similar to the North Marina Project alternative analyzed in the FEIR, inclusive of the design modifications described in the Commission's February 2013 correspondence. The State Water Board provides recommendations for additional studies that are necessary to clarify the hydrogeologic conditions that would allow for a more complete review.

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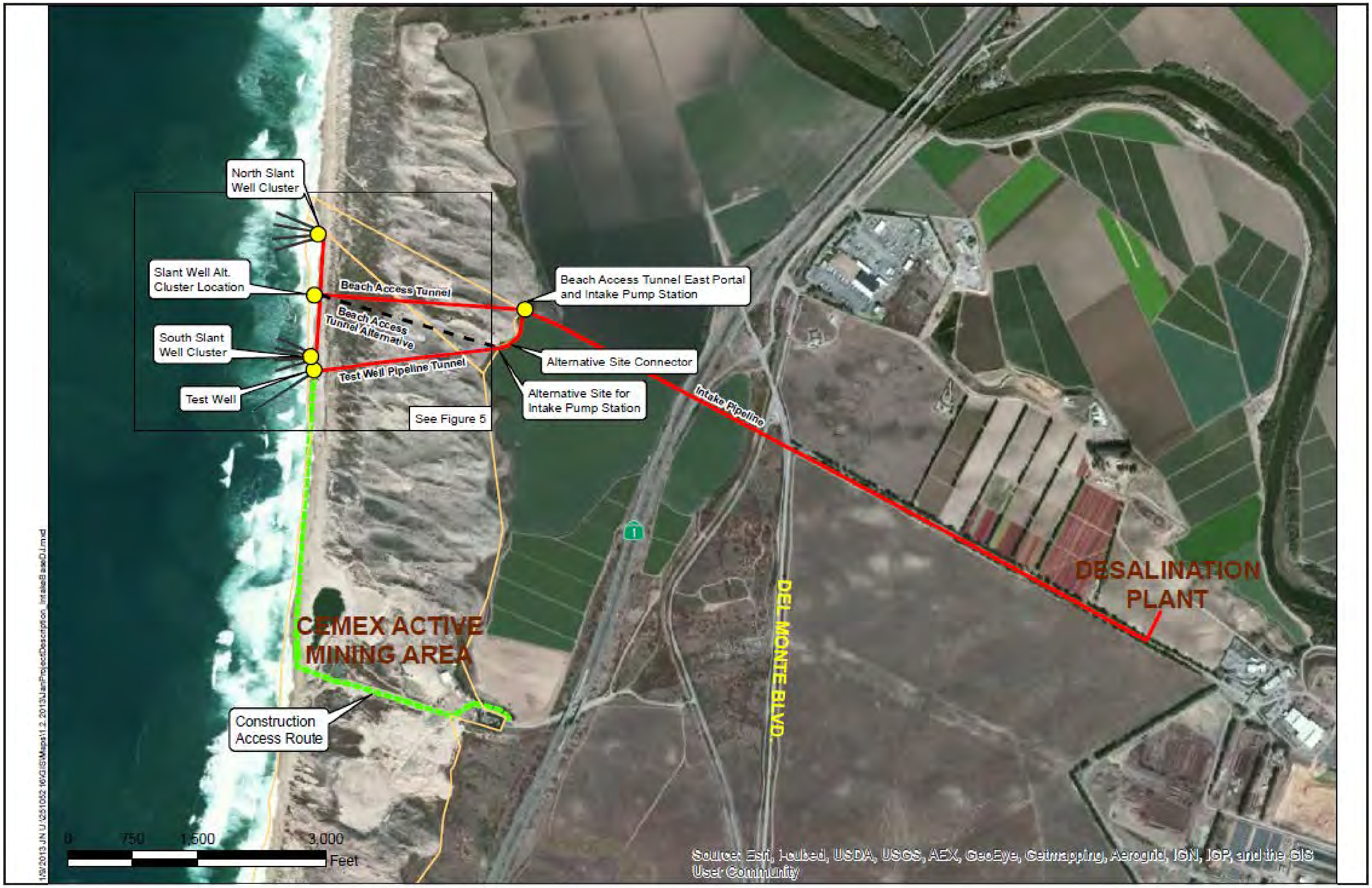
[8] Commission correspondence to State Water Board, February 14, 2013. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M047/K304/47304686.pdf

Figure SWRCB 1



CALIFORNIA AMERICAN WATER

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Monterey Peninsula Water Supply Project

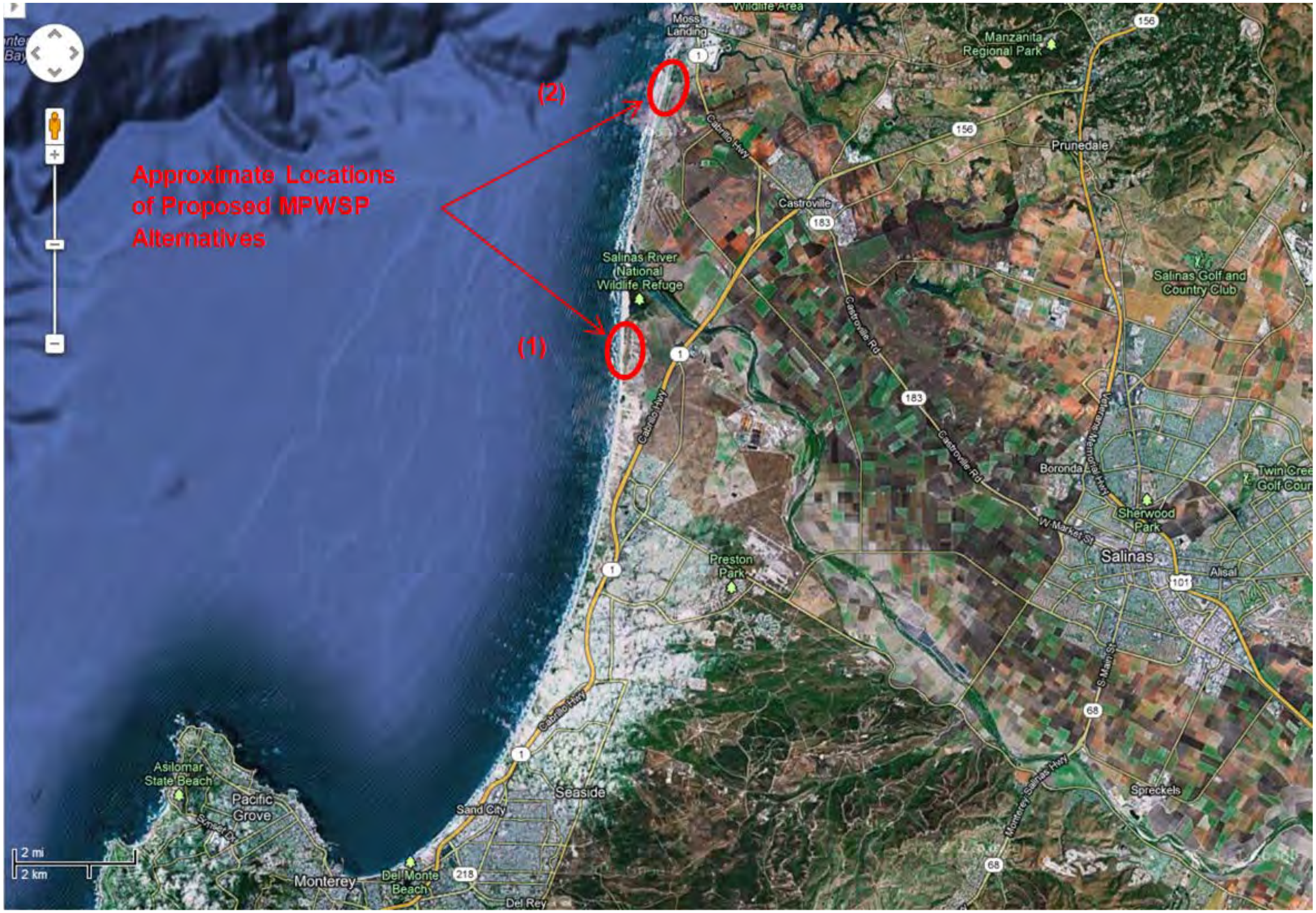
Intake Facilities

Figure 4

Figure SWCRB 2

Figure - 4 Intake Contingency Option 3

Figure SWRCB 3



4. Physical Setting

This section contains a discussion of the physical setting of the SVGB that includes a description of the hydrogeologic characteristics, groundwater quality, movement and occurrence of groundwater, and groundwater modeling results. It is important to understand the physical characteristics of the Basin to accurately determine the effects the MPWSP will have on the Basin.

4.1 Groundwater Aquifers

Knowledge of the hydrogeologic characteristics in the area of the proposed MPWSP wells is important in determining the impacts of the proposed project. As shown by the dark blue line in Figure "SWRCB 4", the SVGB extends approximately 100 miles from Monterey Bay in the northwest to the headwaters of the Salinas River in the southeast. Major aquifers in the SVGB are named for the average depth at which they occur. The named aquifers from top to bottom include the 180-Foot Aquifer, the 400-Foot Aquifer and the 900-Foot or Deep Aquifer. A near-surface water-bearing zone comprised of dune sands, commonly referred to as the "Dune Sand Aquifer", also exists but is considered a minor source of water due to its poor quality.[9] The Dune Sand Aquifer is not regionally extensive and is not a recognized subbasin within the SVGB.[10] The extent and the amount of groundwater in storage in the Dune Sand Aquifer are unknown. Figure "SWRCB 5" is a cross-section taken from the FEIR for the Coastal Water Project that shows the relationship of aquifers and aquitards. The estimated extent of the Dune Sand Aquifer and its relation to the 180-Foot Aquifer can be seen in the upper left hand corner of Figure "SWRCB 5". Figure "SWRCB 6" shows the westerly portion of the cross-section in the vicinity of the project area. The proposed slant wells will either extract water from the 180-Foot Aquifer subbasin and/or the Dune Sand Aquifer.

[9] California Department of Water Resources, California's Groundwater, Bulletin 118, Central Coast Hydrologic Region, SVGB, February 2004.
[10] Cal-Am, Coastal Water Project, FEIR, Section 4.2, Groundwater Resources, p. 4.2-5, October 2009.

The 180-Foot Aquifer is generally confined by the overlying Salinas Valley Aquitard (SVA). The SVA is a well-defined clay formation with low permeability that retards the vertical movement of water to the underlying 180-Foot Aquifer. The SVA extends vertically from the ground surface to approximately 100 to 150 feet below mean sea level (msl) and extends laterally from Monterey Bay to 10 miles south of Salinas. Based on information from logs of two wells located approximately ½ mile south and ½ mile northeast from the proposed MPWSP slant wells, the top of the SVA is between 150 to 180 feet below msl. The well logs show the top of the underlying 180-Foot Aquifer at approximately 190 to 220 feet below msl.[11]

Studies have shown that in some areas the SVA thins enough to create unconfined conditions in the 180-Foot Aquifer.[12] It is unknown if these unconfined conditions exist in the proposed MPWSP well area. Determination of the existence of the SVA, and thus the conditions of the aquifer at the location of the proposed MPWSP wells will be critical in determining the area of impact of the project as discussed at greater length in Section 5 of this report.

[11] Cal-Am, Coastal Water Project, FEIR, Section 4.2 – Groundwater Resources, Figure 4.2-3, October, 2009.

[12] Monterey County Water Resources Agency, Monterey County Groundwater Management Plan, Chapter 3 – Basin Description, pp. 3.7 & 3.8, May 2006.

Figure SWRCB 4

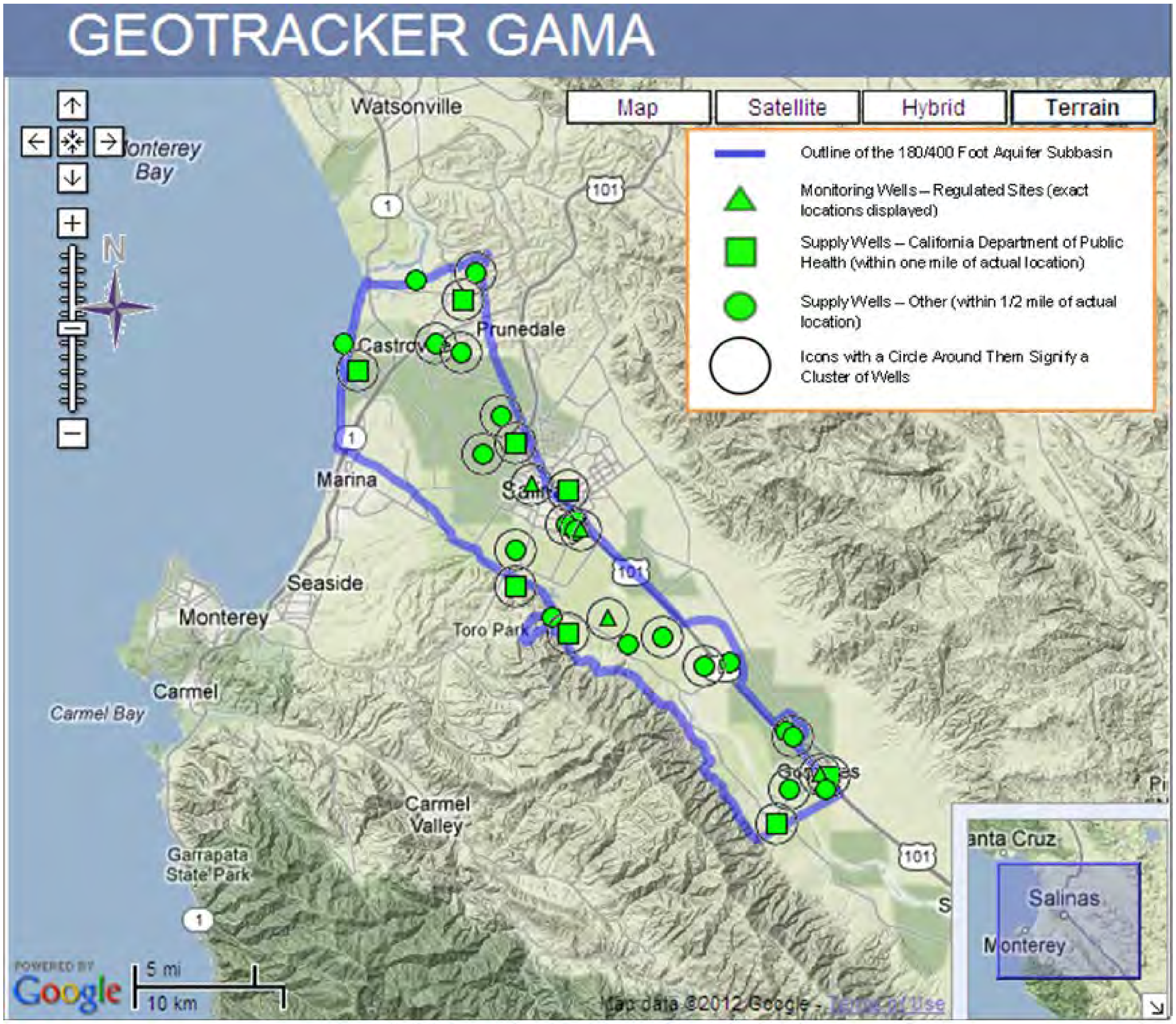
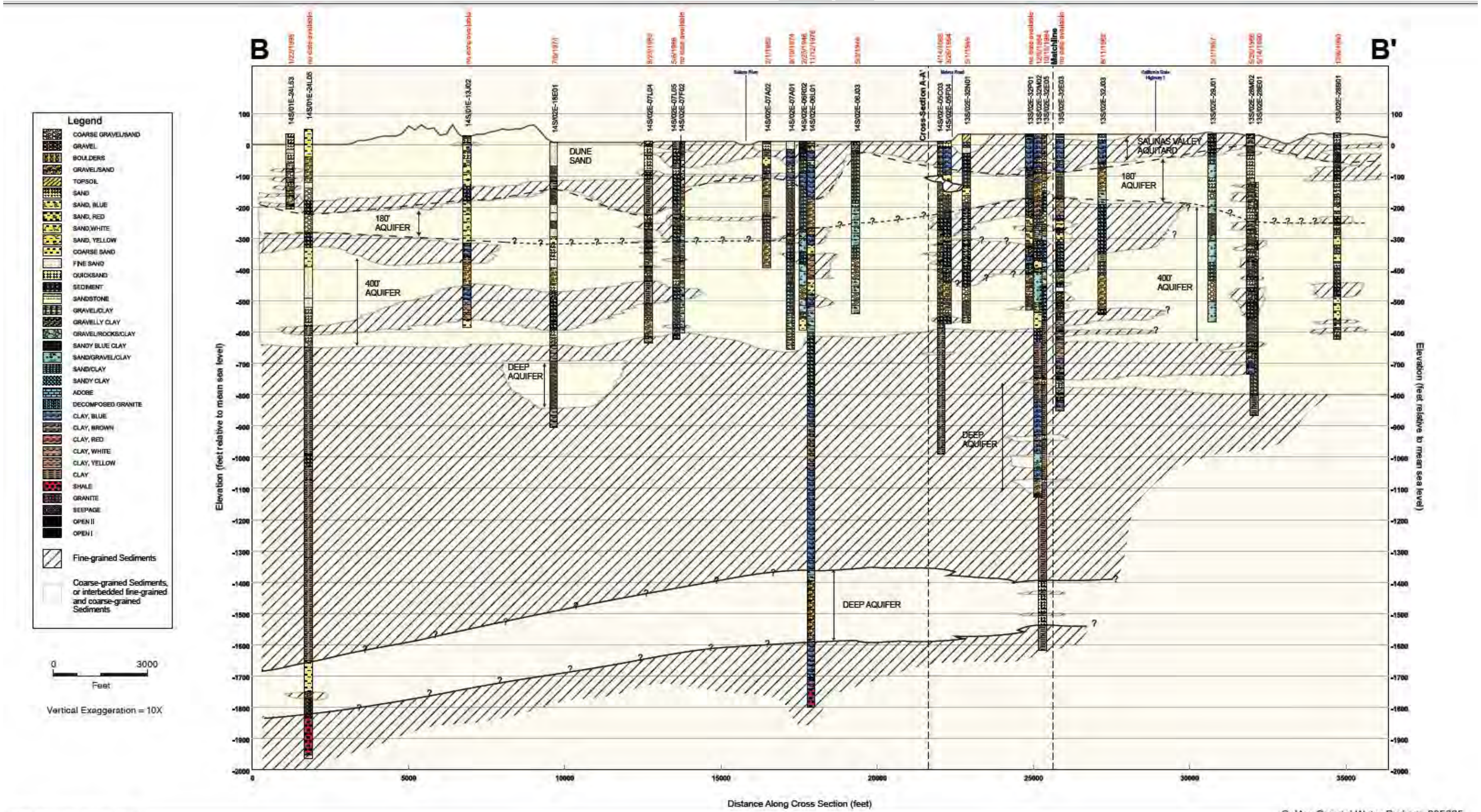


Figure SWRCB 5



SOURCE: Kennedy/Jenks, 2004

CalAm Coastal Water Project . 205335
Figure 4.2-3
Cross-Section B-B'

Figure SWRCB 6

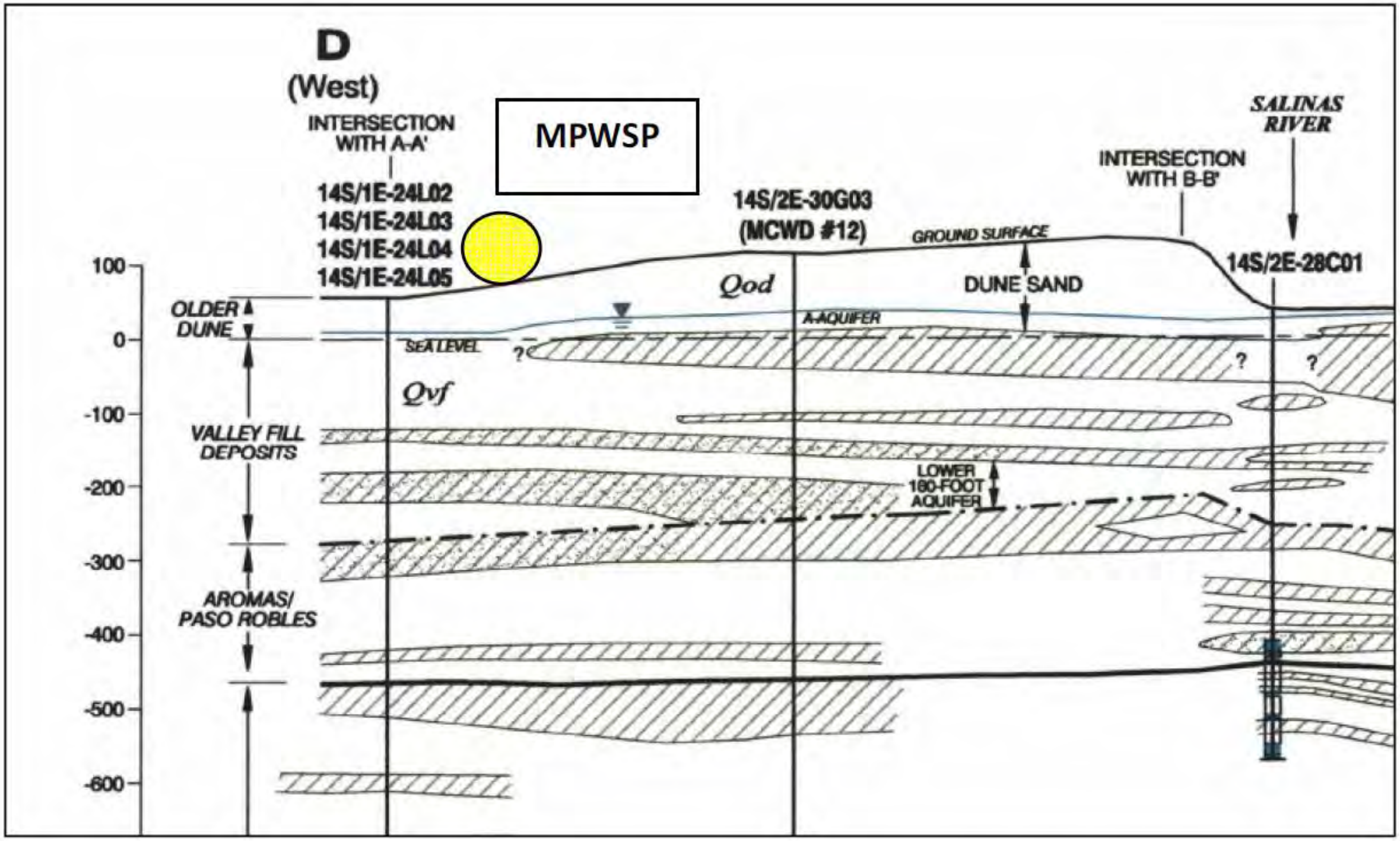


Figure 13. Geologic Cross-Section (Portion of Plate 6 from HLA, 2001)

4.2 Groundwater Quality & Seawater Intrusion

Groundwater quality at the site of the proposed MPWSP wells will play an important role in determining the effects of extraction on the other users in the Basin. Historic and current pumping of the 180-Foot Aquifer has caused significant seawater intrusion, which was first documented in the 1930s.[13] Seawater intrusion is the migration of ocean water inland into a fresh water aquifer. This condition occurs when a groundwater source (aquifer) loses pressure, allowing the interface between fresh water and seawater to move into the aquifer. A common activity that induces intrusion is pumping of the groundwater basin faster than the aquifer can recharge.[14]

The Monterey County Water Resources Agency (MCWRA) uses the Secondary Drinking Water Standard upper limit of 500 milligrams per liter (mg/L) concentration for chloride to determine the seawater intrusion front. The MCWRA also uses the Secondary Drinking Water Standard to determine impairment to a source of water. MCWRA uses 100 mg/L of chloride as a threshold value for irrigation.[15] Standards are maintained to protect the public welfare and to ensure a supply of pure potable water. MCWRA currently estimates seawater has intruded into the 180-Foot Aquifer approximately 5 miles inland as shown on Figure "SWRCB 7". The increasing trend of inland movement of seawater intrusion is also important and provides qualitative data on future trends in the Basin. This seawater intrusion has resulted in the degradation of groundwater supplies, requiring numerous urban and agricultural supply wells to be abandoned or destroyed. In MCWRA's latest groundwater management plan (2006), an estimated 25,000 acres of land overlies water that has degraded to 500 mg/L chloride. The amount of 500 mg/L chloride water that

[13] California Department of Water Resources, California's Groundwater, Bulletin 118, Central Coast Hydrologic Region, SVGB, 180/400 Foot Aquifer subbasin, February 2004.
[14] MCWRA, Monterey County General Plan Final Environmental Impact Report, pp. 4.3-25, March 2012,
[15] Ibid.

enters the Basin was reported to be as high as 14,000 acre-feet per annum (afa) or 4.5 billion gallons.[16]

The Central Coast Regional Water Quality Control Board's Basin Plan lists designated beneficial uses and describe the water quality which must be attained to fully support those uses.[17] The Basin Plan states that water for agricultural supply shall not contain concentration of chemical constituents in amounts which adversely affect agricultural beneficial use. Table 3-3 of the Basin Plan provides guidelines for interpretation of the narrative water quality objective and indicates that application of irrigation water with chloride levels above 355 mg/L may cause severe problems to crops and/or soils with increasing problems occurring within the range of 142-355 mg/L.[18]

The MCWRA and the Central Coast Regional Water Quality Control Board show impairment in the intruded area for drinking and agricultural uses. Since this groundwater is reportedly impaired, it is unlikely that this water is, or will be put to beneficial use. However, if groundwater use is occurring in the intruded area, MPWSP effects that cause injury to legal users will need to be determined.[19] Conditions in the Basin will need to be monitored to determine the level of water quality impairment and any changes that occur as a result of the MPWSP.

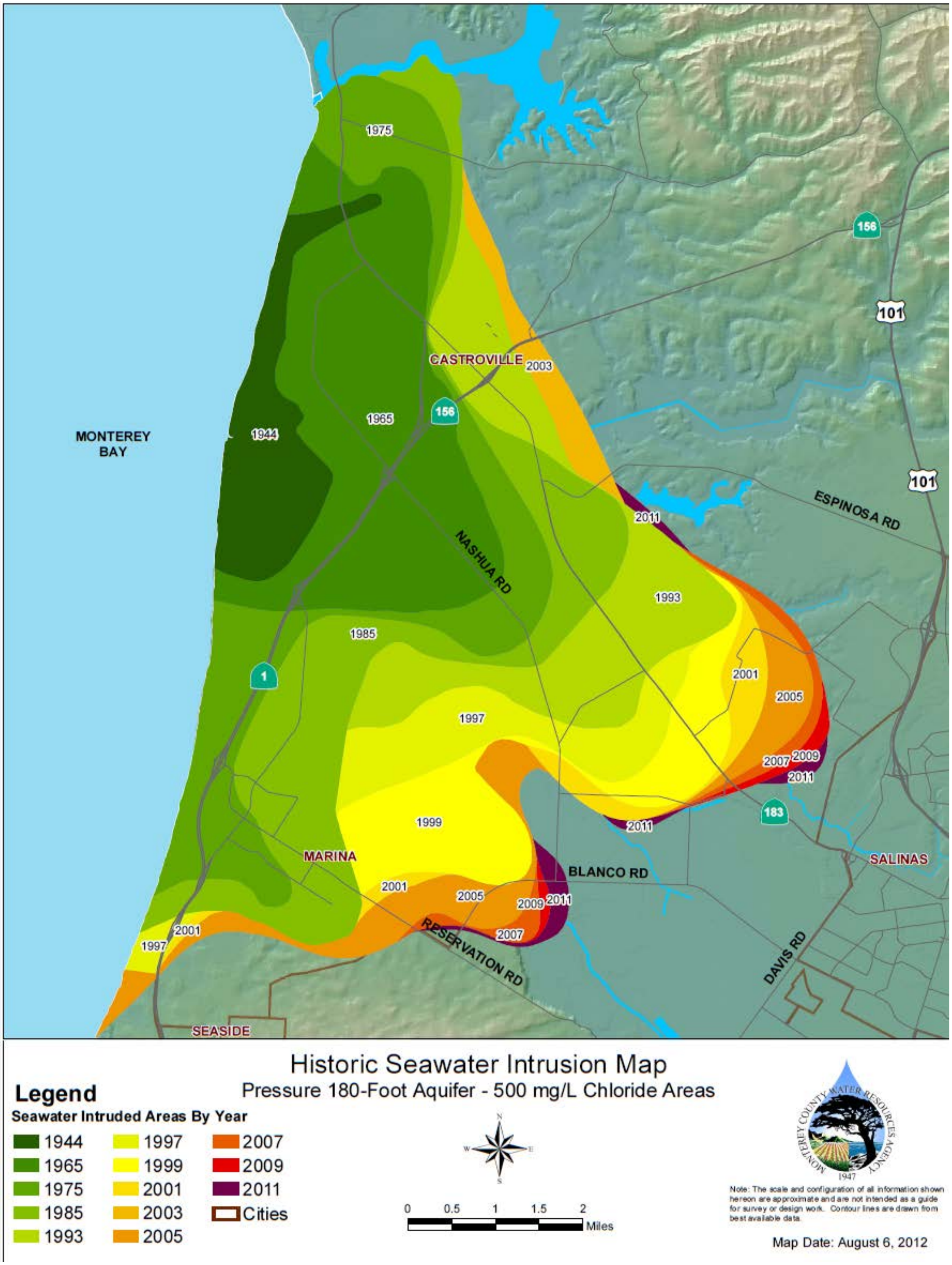
Local agencies have taken steps to reduce the rate of seawater intrusion and enhance groundwater recharge in the SVGB. To address the seawater intrusion problem, the MCWRA passed and adopted Ordinance No. 3709 in September 1993.[20] Ordinance No. 3709 prohibits groundwater extractions and installation of new groundwater extraction facilities in certain areas within the seawater intrusion zone. To enhance groundwater recharge, efforts have also been made

[16] MCWRA, Monterey County Groundwater Management Plan, Chapter 3 – Basin Description, pages 3.14 & 3.15, May 2006.
[17] Water Quality Control Plan for the Central Basin, Regional Water Quality Control Board, Central Coast Region. Page I-1, June 2011.
[18] CCRWQCB, Basin Plan, pp. III-5 and III-8.
[19] A comment letter submitted by Law Offices of Michael W. Stamp on behalf of Ag Land Trust on May 3, 2013, states that a well on the Armstrong Ranch, adjacent to the CEMEX site, is being used to irrigate more than one acre of seed stock.
[20] Monterey County Water Resources Agency, Ordinance No. 3709, September 14, 1993.

to increase fresh water percolation through the Castroville Seawater Intrusion Project (CSIP) which was completed in 1998.[21] The CSIP is a program operated by the Monterey County Water Pollution Control Agency that reduces groundwater pumping from seawater intruded areas and distributes recycled water to agricultural users within the SVGB. The program provides a form of groundwater recharge by effectively reducing groundwater extraction in those areas of the Basin that are part of the CSIP area and providing some recharge through deep percolation of applied irrigation water. The Salinas Valley Water Project (SVWP) was initiated in 2000 to address seawater intrusion and provide other benefits. The main components of the project involve reservoir reoperation, modifications to the Nacimiento Dam spillway, and installation of a rubber dam on the Salinas River in the northern part of the Salinas Valley to increase summer flows and provide agricultural water to offset the use of groundwater.[22] Despite these and other efforts, seawater intrusion continues an inland trend into the Basin.[23]

[21] Cal-Am, Coastal Water Project, FEIR p. 4.2-17, October, 2009.
[22] Although several components of the SVWP have been implemented and future phases of this project are being considered, any potential implications the SVWP may have for development of the MPWSP are unknown.
[23] MCWRA, Monterey County General Plan Final Environmental Impact Report, March 2012, concludes on page 4.3-33 that without the SVWP and the associated development of additional water supplies to augment existing groundwater supplies, both existing and future water needs would result in further basin overdraft and seawater intrusion.

Figure SWRCB 7



4.3 Groundwater Recharge and Discharge

An understanding of groundwater recharge and discharge in a groundwater basin is important in determining whether a basin is in overdraft. Basins that have overdraft (i.e. more discharge than recharge) experience a reduction in the amount of available groundwater. This shortage may lead to a reduction in the amount of water a legal user may extract under their water right.

Groundwater recharge in the lower portion of the Salinas Valley is largely by infiltration along the channel of the Salinas River and its tributaries. This accounts for approximately 50 percent of the total recharge within the SVGB. Approximately 40 percent of the total recharge is from irrigation return water with the remaining 10 percent due to precipitation, subsurface inflow and seawater intrusion. [24]

Approximately 95 percent of outflow from the Basin is from pumping with the remaining 5 percent due to riparian vegetation evapotranspiration. Groundwater withdrawal outpaces groundwater recharge of fresh water, resulting in overdraft conditions.[25]

Historically, groundwater flowed seaward to discharge zones in the walls of the submarine canyon in Monterey Bay.[26] This seaward flow of groundwater prevented seawater from intruding landward into the SVGB. In much of the area, groundwater in the 180-Foot Aquifer and 400-Foot Aquifer is confined beneath extensive clay layers, and the hydraulic head in the aquifers is influenced by the elevation of the water table in the upgradient recharge areas where the aquifer materials are near the surface. When a well is drilled through these confining layers, this hydraulic head, or pressure head, forces water in wells to rise above the top of the aquifer; such aquifers are called confined aquifers. With increased pumping, groundwater head elevations in the 180-Foot and 400-Foot Aquifers have declined creating large pumping depressions in the aquifer pressure

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[24] MCWRA, County Groundwater Management Plan, Chapter 3 – Basin Description, pp. 3-10, May 2006
[25] Ibid
[26] DWR, Bulletin 118.

surface. These cause the groundwater gradient to slope landward, reversing the historic seaward direction of groundwater flow. The pressure surface for the water in these aquifers is now below sea level in much of the inland area and flow is now dominantly northeastward from the ocean toward the pumping depressions.[27] This northeastward flow gradient has allowed seawater to intrude into the SVGB, thereby degrading groundwater quality in the 180-Foot and 400-Foot Aquifers.

The Department of Water Resources calculated that total water inflow into the 180-Foot and 400-Foot Aquifers is approximately 117,000 afa. Urban and agriculture extractions were estimated at 130,000 afa and subsurface outflow was estimated at 8,000 afa.[28] Therefore, there is currently a net loss or overdraft of approximately 21,000 afa in the 180-Foot and 400-Foot Aquifers. Basin overdraft has averaged approximately 19,000 afa during the 1949 to 1994 hydrologic period with an average annual seawater intrusion rate of 11,000 af.[29] The overdraft condition is important because it limits the availability of fresh water supplies to Basin users.

4.4 Groundwater Gradient

Based on the occurrence of large pumping depressions in inland areas, it can be reasonably assumed that there is a strong landward gradient (slope) of groundwater flow, at least within the 180-Foot Aquifer.[30] However, because the degree of confinement of the 180-Foot Aquifer and the degree of connection between this aquifer and the overlying Dune Sand Aquifer are not known it is not possible to accurately predict what the effects of the landward gradient of groundwater flow will be for various extraction scenarios. However, if present, this landward gradient in the 180-Foot Aquifer would be a factor in determining the effects of the groundwater extraction, regardless of whether the aquifer is

[27] Cal-Am, Coastal Water Project, FEIR, Section 4.2, p. 4.2-9, October 2009.
[28] DWR, Bulletin 118.
[29] Monterey County Groundwater Manage Plan, p. 3-10, May 2006
[30] Monterey County Water Resources Agency Groundwater Informational Presentation, August 27, 2012 (http://www.mcwra.co.monterey.ca.us/Agency_data/Hydrogeologic%20Reports/GroundwaterInformationalPresentation_8-27-2012.pdf)

confined or unconfined in this area. It is important to understand the groundwater gradient in the area of the proposed MPWSP because it will influence the amount of water extracted from the landward side versus the seaward side of the basin. More investigation will be needed to verify the degree of the gradient and determine its effects on the MPWSP.

4.5 Groundwater Modeling

A groundwater model that accurately reflects the hydrogeologic characteristics of the Basin is critical in providing insight to the effects the MPWSP would have on the Basin. As part of the FEIR for the Coastal Water Project, a local groundwater flow and solute transport model (Model) was developed to determine the effects that pumping would have on groundwater levels and seawater intrusion in the area. [31] This Model was constructed using aquifer parameters, recharge and discharge terms, boundary conditions and predictive scenarios developed for a regional groundwater model called the Salinas Valley Integrated Groundwater and Surface Model (SVIGSM). The Model was developed to specifically focus on the North Marina area and has a much finer cell size than the SVIGSM, allowing for improved resolution in the vicinity of the proposed MPWSP. The Model can model seawater intrusion, a capability that the SVIGSM does not have.

The Model consists of six layers. The layers represented from top to bottom are the following: (1) a layer directly beneath the ocean that allows direct connection from the ocean to the aquifers; (2) the 180-Foot Aquifer and overlying Dune Sand Aquifer;[32] (3) an unnamed aquitard; (4) the 400-Foot Aquifer; (5) an unnamed aquitard; and (6) the Deep Aquifer. It should be noted the Model does not include a layer that represents the SVA. [33] Therefore, the Model assumes that

[31] Cal-Am, Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects, July and September 2008.
[32] Cal-Am, Coastal Water Project, FEIR, Section 4.2, p. 4.2-47, October 2009.
[33] Cal-Am, Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects, p. 19, July 2008.

the 180-Foot Aquifer is unconfined and in hydraulic connection with the Dune Sand Aquifer.

The Model's aquifer parameters such as depth, hydraulic conductivity, storativity, and effective porosity were obtained from the SVIGSM. In addition, monthly data for recharge and discharge values were obtained from the SVIGSM. The North Marina predictive scenario was run for a 56-year period from October 1948 through September 2004. This is the same period used in the SVIGSM predictive scenarios.

Two potential projects were evaluated with the Model: (1) the North Marina Project; and (2) the Regional Project. In both of these alternatives, the 180-Foot Aquifer was modeled as an unconfined aquifer. It is not known if the MPWSP wells would indeed be in unconfined conditions. Consequently, the alternative's results discussed below may or may not be predictive of the MPWSP. In addition, the groundwater model did not include the Portrero Road alternative. Therefore, an updated groundwater model that accurately reflects the most current understanding of local hydrogeologic conditions for all alternatives is needed in order to estimate the effects the MPWSP would have on the Basin and groundwater users.

5. Proposed Monterey Peninsula Water Supply Project

On March 8, 2013, the Commission requested that the State Water Board evaluate two possible alternatives for the MPWSP; a preferred alternative consisting of gravity well design and a secondary alternative consisting of a pumping well design. This section contains a discussion on the intake design of both alternatives and potential effects each would have on the SVGB.

5.1 Gravity Well Design

The preferred alternative has two options for the feedwater intake system: a 6.4 mgd system consisting of seven slant wells and a 9.6 mgd system consisting of nine slant wells. This report focuses on the 9.6 mgd system since it has the potential to have a greater effect on the groundwater basin. The 9.6 mgd system will consist of eight slant wells and one test slant well. Results of the test well will dictate final well design and will determine whether the wells would extract water from the Dune Sand Aquifer and/or the 180-Foot Aquifer. The proposed location of the gravity intake system is adjacent to the 376-acre parcel of land owned by the CEMEX Corporation (Figure “SWRCB 1”). The well system consists of two four-well clusters (North Cluster and South Cluster) plus the test well. Each well is thirty inches in diameter and up to approximately 630 feet in length with up to 470 feet of screen. The wells are designed as gravity wells without the requirement for submersible well pumps. The output of each slant well is estimated at approximately 1,800 gpm. Each slant well has an 8-foot diameter vertical cassion, which is connected to a 36-inch diameter beach connector pipeline via an 18-inch diameter gravity connector. Feedwater flows by gravity from the slant well to the gravity connector and to the beach connector pipeline where it enters a 23 mgd intake pump station. The intake pump system pumps the feedwater to the desalination plant using four 250-horsepower pumps. The total well capacity required is approximately 23 mgd to meet the feedwater requirement for a 9.6 mgd desalination plant operating at an overall recovery of 42 percent.

The gravity well design is a new alternative presented to the State Water Board for evaluation at the CEMEX owned property. Groundwater modeling for an earlier pumping well alternative at the CEMEX site indicated that the pumped wells would have an impact to groundwater users within a 2–mile radius of the wells due to the lowering of groundwater levels. Since modeling has not been done for the gravity well alternative, State Water Board staff is unable to accurately predict impact to existing users and the Basin from the gravity wells.

5.2 Pumping Well Design

As described in the Commission’s February 14, 2013 correspondence, the secondary alternative (Intake Contingency Option 3) includes a feedwater intake system consisting of nine pumped slant wells extending offshore into the Monterey Bay. The slant wells would extract 23 mgd of water from the Dune Sand Aquifer and convey the water via a 36-inch diameter connector pipeline to a 23 mgd intake pump station and finally to the desalination plant. The slant wells would be installed at the parking lot on the west end of Portrero Road along the roadway that parallels the beach north of the parking lot (Figure "SWRCB 2").

The potential impacts from the pumping wells at this site cannot yet be determined since groundwater modeling has not been done for this location. Until a more detailed groundwater model is developed for this area, State Water Board staff is unable to determine the extent of impacts to existing water users. Staff recommends that the groundwater modeling include evaluation of potential alternative Project locations that may be under consideration for meeting the water supply needs of this area.

5.3 Groundwater Capture Zone Delineation

For aquifers with a substantial gradient (slope) in the direction of groundwater flow, there is an important distinction between the cone of depression around the pumping well (area where the water surface or pressure head is lowered) and the capture zone for water that flows to the pumping well. Where there is an existing slope to the water table or pressure surface of the groundwater system, not all the water in the cone of depression flows to the pumping well, and much of the water the pumping well intercepts is far outside the cone of depression in the upgradient direction.[34] The practical effect of this situation is that, with a landward gradient of groundwater flow, more of the water captured by the pumping well comes from the upgradient direction (in this case from the seaward direction) and a much smaller proportion of the water captured by the pumping well is from downgradient (inland) direction. Water captured from the seaward direction would likely be seawater. Water captured from the landward side could potentially have a greater likelihood of capturing some portion of fresh water; however, groundwater in this area is expected to be highly impacted by seawater intrusion. Therefore, because the gradient means more water will be captured from the seaward direction and the groundwater in the area is likely impacted by seawater intrusion there is a reduced possibility that the wells will capture fresh

[34] C.W. Fetter. 1994, Applied Hydrogeology 3rd Edition, p. 501

water. At this time it is unclear how many operational wells are in the immediate vicinity of the proposed location for the extraction well system. Because more seawater will be drawn into the extraction well system from offshore areas than water flowing toward the wells from inland areas, any wells located in close proximity to the extraction system could experience increased water quality degradation due to complex flow paths within the capture zone of the extraction well system. If there are wells currently in use within this area, Cal-Am would need to monitor the situation and compensate[35] the well users if they are injured by the decreased water quality or lower water levels.

The extraction wells are not predicted to draw water equally from seaward and landward areas. In a system that has no gradient of flow, extraction wells would draw water equally from seaward and landward directions, but this is not true in the proposed MPWSP area because there is a significant gradient of groundwater flow from the seaward areas toward the inland pumping depressions. In the long-term, the situation may be altered and the source of the water drawn from the extraction well system would need to be reevaluated under the following conditions: (1) if pumping of water from inland areas is reduced to the point that the groundwater system is in equilibrium, and (2) the pumping depressions are reduced such that there is no longer a landward gradient.

The FEIR groundwater modeling studies conducted for the proposed extraction of groundwater from the 180-Foot Aquifer included an evaluation of groundwater elevations and gradients. The modeling evaluated the effects the landward gradient of groundwater flow could have in determining the source of water that would be captured by the extraction well system. As more information about the groundwater system becomes available, a more detailed evaluation of the capture zone for the extraction system will be possible. This type of capture zone analysis will be important in evaluating the long-term effects of the

[35] Compensation could be in the form of monetary payment or other forms to make the injured user whole.

extraction well system and any potential impacts on existing water users and the Basin.

5.4 Extraction Scenarios

There are three likely scenarios in which Cal-Am would extract groundwater for its MPWSP: (1) extraction from gravity wells from an unconfined aquifer or a confined aquifer; (2) pumping from an unconfined aquifer; or (3) pumping from a confined aquifer.

5.4.1 Extraction of Feedwater by Gravity Wells

Cal-Am has proposed to construct a slant test well and collect data that will determine if the gravity well alternative is feasible. If water is extracted using gravity wells, the hydraulic effects on the aquifer would be the same for either pumped wells or the proposed gravity wells as long as the amount of drawdown in the wells is the same. Likewise, if the wells were completed in either a confined or an unconfined aquifer, the effects on those aquifers would be the same if the level of drawdown in the wells were the same. However, if a pumping well had a greater drawdown than a gravity well, there would be more of an effect to the aquifer from the pumping well. The important factor is not what mechanism induces flow from the wells but the actual drawdown produced in the groundwater system.

The gravity well system would limit the maximum amount of drawdown from the extraction wells. Drawdown would be limited to the head differential between sea level and the depth of the intake pump station that the gravity wells drain into. This would add a level of protection against drawing more water from the shoreward direction because it would preclude the larger drawdowns that could result with submersible pumps in the wells. The cone of depression (zone of influence) for the extraction well system would be limited by the fixed head differential established by the depth of the intake pump station. This configuration will also likely prevent the operator from being able to maintain maximum flow rates from the extraction well system because there is no ability to increase pumping rates should tidal effects become a factor. The obvious potential problem with the gravity well scenario is that if the flow to the wells is limited by lower permeability zones or well efficiency problems, the operator cannot increase pumping rates to obtain the quantities of water the system is designed to achieve.

5.4.2 Pumping from Unconfined Conditions

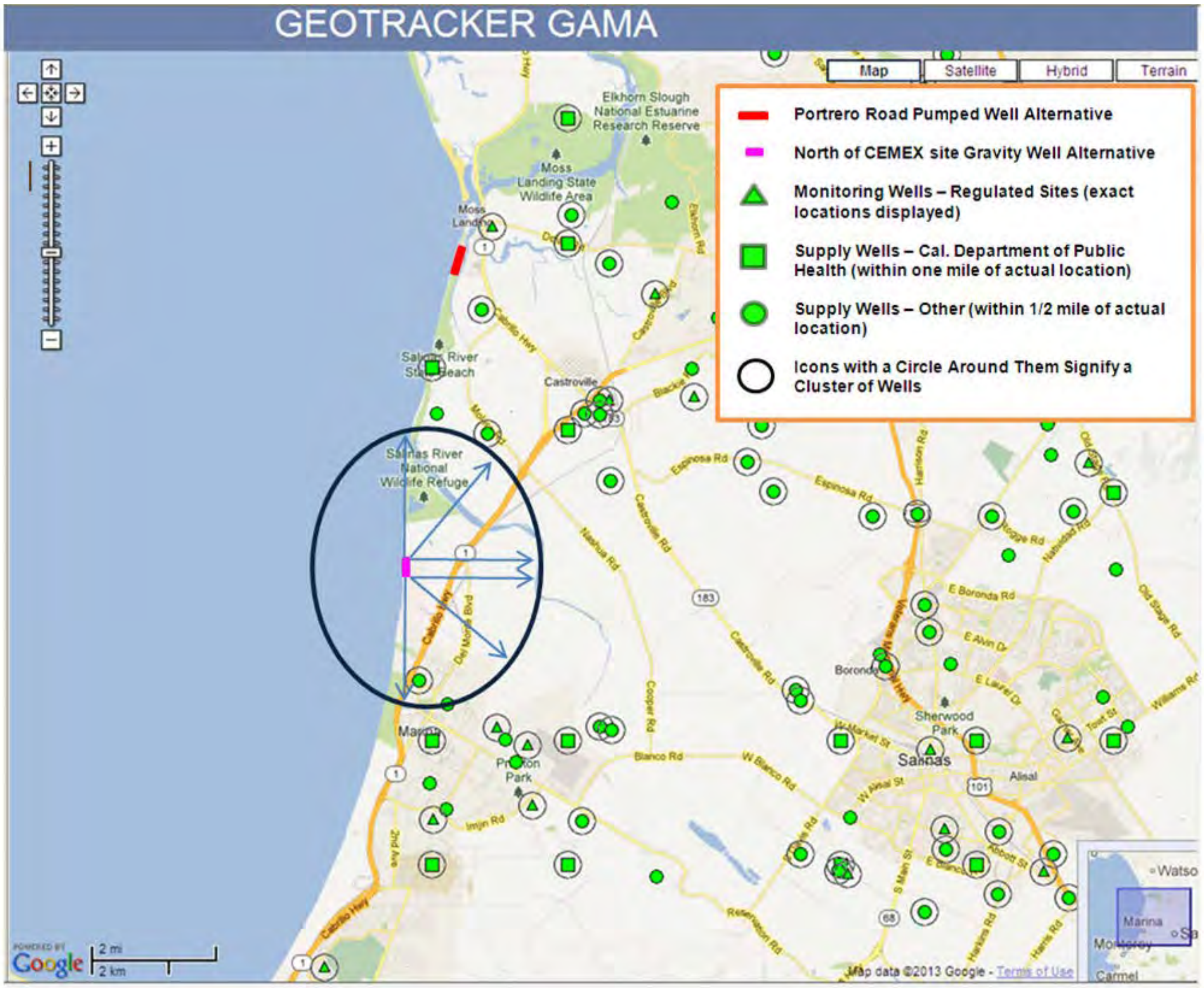
If pumping were to occur under unconfined conditions, water would be extracted either from the Dune Sand Aquifer or from the 180-Foot Aquifer (if the SVA is not present at the proposed well-site). In general, when water is pumped from an unconfined aquifer, water is removed from the aquifer and the water table in the aquifer is lowered as water drains by gravity from the pore spaces in the aquifer. This lowering or drawdown of the water table causes a cone of depression that is greatest close to the well and gets smaller in all directions as the distance from the well increases.[36] Modeling results of the North Marina Project show that pumping would cause a decline in groundwater elevations at the slant wells of approximately 15 feet. There would be about a 2-foot decline in groundwater levels approximately one mile from the slant wells decreasing to less than 0.5 feet about 1.5 miles away.[37] The lowering of groundwater levels approximately 2 miles from the slant wells likely would be negligible. If the final design calls for gravity wells at the north Marina site, then modeling would be needed to estimate the effects from the gravity wells. Since modeling was not done for the Portrero Road site the effects from pumping at that location are unknown. Once the zone of influence is estimated for each location and each pumping scenario, it will be possible to determine whether any wells in the vicinity would be affected by project pumping.

[36] Driscoll, 1986, Groundwater and Wells, pp. 63-64.
[37] Cal-Am, Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects, p. 21 (E-28), July 2008.

According to information from the State Water Board's GAMA database, approximately 14 wells are within 2 miles of the proposed MPWSP (Figure "SWRCB 8"). All of these wells are within the seawater-intruded portion of the Basin. Currently, the predominant groundwater flow direction in the 180-Foot Aquifer is toward the northeast. Project pumping would likely change the flow direction to more of a southwest to westerly direction within the zone of influence. Outside the zone of influence there would be little if any change to groundwater flow direction; however, the rate of flow in the original direction (northeast) would be reduced. Therefore, the MPWSP would slow the rate of seawater intrusion in a landward direction from the wells. The GAMA database may not include all groundwater wells, so it is not clear how many other wells are located in this area, or at what depths the wells are screened.[38] Cal-Am's investigations should include an inventory of existing wells near the MPWSP extraction well location. Where "Well Completion Reports" are available, information from those reports should be evaluated and considered for inclusion in development of the groundwater model. If legal users of groundwater in this area are found to be impacted by the groundwater extraction system, either through a reduction in the water table level or the amount of fresh water available at their wells, those impacts would need to be addressed by Cal-Am.

[38] A comment letter submitted by Law Offices of Michael W. Stamp on behalf of Ag Land Trust on May 3, 2013, states that a well on the Armstrong Ranch, adjacent to the CEMEX site, is being used to irrigate more than one acre of seed stock.

Figure SWRCB 8



As mentioned above, groundwater flow to the MPWSP extraction wells would initially be from all directions in a radial pattern. Because the ocean provides a constant source of nearby recharge to the extraction wells, the zone of influence for the extraction wells cannot expand much farther than the distance between the extraction wells and the ocean, or in the case of confined aquifer conditions, the distance between the extraction wells and the undersea outcrop of the confined aquifer. While a portion of the water flowing to the well does come from the less saline water on the shoreward side, the relative percentage of water drawn from the shoreward side of the wells will depend on various factors, including the gradient of groundwater flow toward inland pumping depressions. If the North Marina Project model is applicable, then approximately 87 to 97 percent of the water pumped (approximately 21,400 to 23,938 afa) would come from the ocean side of the wells and approximately 3 to13 percent of the water (approximately 762 to 3,250 afa) would come from the landward side of the wells.[39]

It is unlikely that pumping from an unconfined aquifer would extract fresh groundwater since the seawater intrusion front within the 180-Foot Aquifer is approximately 5 miles landward from the proposed pumps. Because the Model shows that the seawater intrusion front remains basically the same with or without the North Marina Project, it is likely that the amount of water extracted from the eastern portion of the aquifer will be seawater intruded. Although this brackish[40] water may be of substantially better quality than seawater, it is likely degraded to the point that it is, with few

[39] Cal-Am, Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects p. 22 (E-29), July and September 2008.
[40] Brackish water in this report is defined as groundwater within the seawater intrusion zone that contains chloride levels greater than 500 ppm. Water with chloride concentrations less than 500 mg/L is considered fresh water.

exceptions[41], not suitable for any beneficial use other than feedwater for desalination purposes.

5.4.3 Pumping from Confined Conditions

If pumping were to occur under confined conditions, water would be extracted from the confined 180-Foot Aquifer. When a confined aquifer is pumped, the loss of hydraulic head occurs rapidly because the release of the water from storage is entirely due to the compressibility of the aquifer material and the water.[42] This zone of influence in a confined aquifer is commonly several thousand times larger than in an unconfined aquifer.[43] Therefore, the effects from MPWSP pumping on the groundwater pressure head would occur more rapidly and over a much larger area than the effects seen in an unconfined aquifer. Modeling in the FEIR did not predict the effects of pumping from a confined condition, so there are no estimates on the extent of potential impacts. Generally speaking, the pressure head would be lowered in wells much further inland and the long-term effects on groundwater flow direction would be felt over a wider area. Since pumping from a confined condition would affect a much larger area, there would be a greater likelihood of the MPWSP affecting groundwater users at greater distances from the project location.

5.4.4 Potential Pumping Effects on Seawater Intrusion

The seawater intrusion front, as defined by the 500 mg/L chloride limit, currently extends approximately five miles inland from Monterey Bay. Efforts to control seawater intrusion though implementation of the SVWP and CSIP projects and various administrative actions have slowed but not stopped the advance of the seawater intrusion front, and there is concern that the implementation of the proposed MPWSP may hinder the efforts to

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[41] A commenter reported that there is a well in this general area used for a small agricultural plot, however there is no information about the well location or depth, and further investigation would be necessary to determine whether this well could be impacted by the proposed extraction wells.
[42] Driscoll, 1986, Groundwater and Wells, pp. 64-65.
[43] United States Geologic Survey, Sustainability of Groundwater Resources, Circular 1186. Section A, p. 2.

restore water quality in the intruded areas. To the extent that the MPWSP will generate new water that will be returned to the Basin as wastewater return flows, any potential impacts on the seawater intrusion control efforts may be lessened. Groundwater modeling conducted for the previously studied North Marina Project indicated that the recession of the seawater intrusion front would be affected positively during the first 13 years of implementation of that project and that thereafter the project would have little or no effect on the efforts to reverse the advancing front of seawater intrusion. [44]

Within the zone of influence of the MPWSP extraction wells, seawater would be drawn into the aquifers from the seaward direction, and brackish water from within the seawater intruded portion of the aquifers would also be drawn toward the extraction well system. As discussed in Section 5.3, the relative percentages of off-shore seawater and on-shore brackish water extracted from the wells would depend on the local groundwater gradient of flow and other factors.

Based on our current understanding of the groundwater system, a greater volume of seawater, relative to brackish water, would be drawn into the extraction well system. For groundwater wells that may be located in close proximity to the extraction wells, i.e., within the capture zone for the extraction wells, groundwater elevations would be lowered and water quality may be adversely affected by the extraction well system.[45]

5.5 Summary of Impacts

There are three types of potential impacts the proposed extraction wells could have on inland water users. First, the inland groundwater users may experience a reduction in groundwater levels in their wells, with associated increases in pumping costs. This type of effect could be reasonably evaluated with

[44] Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects, p. 21 (E-28), July 2008.
[45] C.W. Fetter. 1994, Applied Hydrogeology 3rd Edition, p. 501

groundwater modeling. Until the degree of confinement and connection between the Dune Sand Aquifer and the 180-Foot Aquifer has been more thoroughly studied, the potential for injury to inland water users due to reduced groundwater elevations and diversion of water from the aquifer cannot be conclusively determined. As discussed in the above sections, however, the incremental effect at any particular location would be relatively slight. Staff estimates, based on currently available data cited in this report, that effect would be on the order of less than a 0.5 foot decline in wells located 1.5 miles from the extraction well system.[46] This impact alone would not likely be sufficient to take any currently known operating production wells out of service.

The second type of effect the extraction well system could have on in-Basin groundwater users is a reduction in the quantity of fresh water that is available for their future use. The quantity would depend on a variety of factors as discussed in the preceding sections. For users outside the capture zone this effect would not be felt immediately; thus, replacement water could be provided after the MPWSP has been in operation and modeling information becomes available to evaluate the actual quantity of fresh water that needs to be returned to the system.[47] One measure to address potential injury to those users would be to supply replacement water to the existing CSIP system for delivery to groundwater users in the affected area.[48] Since the capture zone for the extraction well system will likely be limited to areas already heavily impacted by seawater intrusion, it would not be appropriate to inject or percolate desalinated water in this intruded area, as the water would essentially be wasted. For any users within the capture zone of the MPWSP wells, Cal-Am would be required to assess and compensate for any injury caused by a reduction in the quantity of fresh water that is available for their use. Because injury could occur at the time

[46] Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects, July 2008. p. 21 (E-28)

[47] A comment letter submitted by LandWatch Monterey County on April 28, 2013, expresses concern for impacts to the groundwater users in the North County area who do not received CSIP water. Impacts from the proposed project would need to be evaluated on a site specific basis.

[48] The CSIP may not be a viable method to address injury at the Portero Road location if the users affected by the MPWSP are outside of the CSIP recharge zone.

of pumping for those users in the capture zone, a supply replacement method such as the CSIP would not be appropriate, and other measures may be necessary.

The third type of effect the extraction well system could have on in-Basin groundwater users is limited to groundwater users in close proximity to the extraction wells. These users could experience additional degradation in the quality of water drawn from their wells. This effect should be isolated to a very localized area within the capture zone of the extraction wells system.

6. Legal Discussion of Proposed Extraction Wells in Basin

Although the Basin is in a condition of overdraft, the Basin has not been adjudicated and water withdrawals by the Basin's users are not quantified by court decree. Water users assert that the Basin's water is managed through cooperative agreements reached by the Basin's groundwater users.[49] Users claim that Cal-Am's proposed Project would disrupt the agreements within the Basin, lead to a costly adjudication, and are barred by principles of groundwater law.[50]

Cal-Am needs no groundwater right or other water right to extract seawater from Monterey Bay. Based on the information provided, however, the proposed MPWSP could extract some fresh water from within the Basin. An appropriative groundwater right is needed to extract water from the Basin for use outside the parcel where the wells are located.[51] To appropriate groundwater from the Basin, Cal-Am will have to demonstrate that the MPWSP will develop a new source of water that is surplus to the needs of groundwater users in the Basin and that operating the Project will not result in injury to other users. This includes showing that the Project will not adversely affect the seawater intrusion front. Because the Basin is in a condition of overdraft, to

[49] *Salinas Valley Water Coalition*, Letter to State Water Board Chair, Charles Hoppin, (December 3, 2012).
[50] See generally, Application 12-04-019 before the California Public Utilities Commission, *Opening Brief of LandWatch Monterey County Regarding Groundwater Rights and Public Ownership*, July 10, 2012; *Opening Brief of Various Legal Issues of Monterey County Farm Bureau*, July 10, 2012, available at: www.cpuc.ca.gov.
[51] An appropriative groundwater right is not necessary to recover water injected or otherwise used to recharge the aquifer, where the water used for recharge would not recharge the aquifer naturally.

appropriate water for non-overlying uses, MPWSP will have to account for any reduction in the amount of fresh water that is available to legal groundwater users in the Basin, and Cal-Am will need to replace and compensate for any reduction.[52]

6.1 General Principles of Groundwater Law

Groundwater rights may generally be classified as overlying, prescriptive or appropriative.[53] Overlying users of groundwater have correlative rights which are rights similar to riparian users' rights, and an overlying user can pump as much water as the user can apply to reasonable and beneficial use on the overlying parcel so long as other overlying users are not injured. (*City of Barstow v. Mojave Water Agency* (2000) 23 Cal.4th 1224, 1240 (*Mojave*).) In times of shortage, pumping must be curtailed correlatively, to provide each overlying user a reasonable share of the available supply. (*Id.* at 1241.)

Prescriptive rights are acquired through the taking of water that is not surplus or excess to the needs of other groundwater users. Similar to other prescriptive property rights, if the elements of prescriptive use are met—the use is actual, open, notorious, hostile, adverse to the original owner, continuous and uninterrupted for the statutory period of five years—a user may acquire a prescriptive right. (*California Water Service Co. v. Edward Sidebotham & Son* (1964) 224 Cal.App.2d 715, 726.)

Appropriative groundwater rights apply to users who extract groundwater other than those described above. (*Mojave, supra,* 23 Cal.4th at p.1241.) Appropriative groundwater rights are not to be confused with appropriative rights that apply to surface waters or subterranean streams administered by the State Water Board. Unlike appropriative water rights that are permitted by the State Water Board, appropriative groundwater rights are any rights to pump

[52] Additionally, the Monterey County Water Resources Act, (Stats. 1990 ch. 52 § 21, West's Ann. Wat. Appen. § 52-21 (1999 ed.).) prohibits water from being exported outside the Salinas Valley Groundwater Basin.

[53] Groundwater rights referenced in this report apply to percolating groundwater only.

groundwater that do not fall into either the overlying or prescriptive category.[54] No permit is required by the State Water Board to acquire or utilize appropriative groundwater rights.

Because Cal-Am proposes to export water from the Basin to non-overlying parcels in the Monterey Region, an appropriative groundwater right is required. To appropriate groundwater, a user must show the water is “surplus” to existing uses or does not exceed the “safe yield” of the affected basin. (*City of Los Angeles v. City of San Fernando* (1975) 14 Cal.3d 199, 214.) The appropriator must show the use will not harm or cause injury to any other legal user of water. The burden is on the appropriator to demonstrate a surplus exists. (*Allen v. California Water and Tel. Co.* (1946) 29 Cal.2d 466, 481.) But if, after excluding all present and potential reasonable beneficial uses,[55] there is water wasted or unused or not put to any beneficial uses, “the supply… may be said to be ample for all, a surplus or excess exists… and the appropriator may take the surplus or excess…” (*Peabody v. City of Vallejo* (1935) 2 Cal.2d 351, 368-369 (*Peabody*).) As discussed previously, because groundwater in the Basin is in a condition of overdraft, the only way to show there is surplus water available for export to non-overlying parcels is for a user to develop a new water source.

Cal-Am’s proposed MPWSP would pump seawater, brackish water, and possibly a fresh water component. The exact composition is yet to be determined, but the proposed source water is substantially degraded by seawater intrusion and other natural factors. Estimates based on the North Marina Project description are that 3 to 13 percent of the total water pumped through the proposed wells could be attributed to the landward portion of the Basin and 87 to 97 percent could come from the seaward direction relative to the pump locations.

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[54] This is generally true. There are other types of rights, including pueblo rights, federal reserved rights, and rights to recover water stored underground pursuant to surface water rights. These other types of rights are not discussed in detail in this report.

[55] Potential overlying uses are often inherently implicated in determining whether a long-term surplus actually exists. Where a basin is not in overdraft, however, there may be temporary surplus where probable future overlying uses have not yet been developed.

Based on data currently available, the State Water Board is unable to estimate what percentage or proportion of water extracted from the Basin landward of the proposed well location could be attributed to fresh water sources. It is known, however, that the Basin's waters are degraded some distance landward from the proposed wells. MCWRA currently estimates that seawater has intruded into the 180-Foot Aquifer approximately 5 miles inland. It is unknown whether seawater has intruded the Dune Sand Aquifer, but the reported poor water quality of the Dune Sand Aquifer likely limits beneficial uses of its water.[56] However, if the groundwater is being used in this intruded area an evaluation of the effects to the wells by the MPWSP will be needed to determine any potential injury to the users.

6.2 Developed Water

Water an appropriator pumps that was not previously available to other legal users can be classified as developed or salvaged water.[57] "[I]f the driving of tunnels or making of cuts is the development of water, as it must be conceded it is, we perceive no good reason why the installation of a pump or pumping-plant is not equally such development." (*Garvey Water Co. v. Huntington Land & Imp. Co.* (1908) 154 Cal. 232, 241.) Further, it is generally accepted that whoever creates a new source of water should be rewarded by their efforts. (See generally *Hoffman v. Stone* (1857) 7 Cal. 46, 49-50.)

If Cal-Am shows it is extracting water that no Basin user would put to beneficial use, Cal-Am could show its proposed desalination MPWSP develops new water in the Basin, water that could not have been used absent Cal-Am's efforts to

[56] California Department of Water Resources, California's Groundwater, Bulletin 118, Central Coast Hydrologic Region, SVGB, February 2004.

[57] The concepts of developed and salvaged waters are closely related and the legal concepts are the same. Technically, salvaged waters usually refers to waters that are part of a water supply and are saved from loss whereas developed waters are new waters that are brought to an area by means of artificial works. (See Hutchins, The California Law of Water Rights (1956) p. 383.) For purposes of this report, the distinction is largely irrelevant and the term developed waters will be used throughout for consistency.

make it potable. Of course, this does not apply to any source water that is considered fresh water and would not be considered developed water.

Making use of water before it becomes unsuitable to support beneficial uses or is “wasted,” is supported both by statute, case law, and the California Constitution, which in part states: “the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable…and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof.” (Cal. Const., art. X, § 2; see also *City of Lodi v. East Bay Municipal Utility District* (1936) 7 Cal.2d 316, 339-341 (*Lodi*); [salvaged water that would otherwise be wasted should be put to beneficial use].)

The key principle of developed waters is if no lawful water user is injured, the effort of an individual to capture water that would otherwise be unused should be legally recognized. As the court determined in *Cohen v. La Canada Land and Water Co.* (1907) 151 Cal. 680 (*La Canada*), if water would never reach or be used by others there can be no injury. (*Id.* at p. 691.) In *La Canada*, waters which were secured by the construction of tunnels could be considered developed waters as the waters were determined to trend away from the direction of the natural watershed and would never have reached it and would be lost if left to percolate in their natural flow. (*Ibid.*)

> Under these circumstances, as the waters developed by the tunnels were not waters which would have trended towards or supported or affected any stream flowing by the land of appellant,…she was not injured as an adjoining proprietor or as an appropriator, and hence could not complain or insist upon the application of the rule announced in the cases cited to prevent the respondents from taking such developed waters to any lands to which they might see fit to conduct them.

(*La Canada, supra*, 151 Cal. at p. 692.)

“[F]ull recognition is accorded of the right to water of one who saves as well as of one who develops it.” (*Pomona Land and Water Co. v. San Antonio Water Co.* (1908) 152 Cal. 618, 623-624 (*Pomona*) citing *Wiggins v. Muscupaibe Land & Water Co.* (1896) 113 Cal. 182, 195 (*Wiggins*).)

> [I]f plaintiffs get the one half of the natural flow to which they are entitled delivered, unimpaired in quantity and quality, through a pipe-line, they are not injured by the fact that other water, which otherwise would go to waste…was rescued. Nor can they lay claim to any of the water so saved.

(*Pomona*, *supra,* 152 Cal. at p. 631.)

In summary, if there is no injury, a user should be able to develop all water available:

> The plaintiff could under no circumstances be entitled to the use of more water than would reach his land by the natural flow of the stream, and, if he receives this flow upon his land, it is immaterial to him whether it is received by means of the natural course of the stream or by artificial means. On the other hand, if the defendant is enabled by artificial means to give to the plaintiff all of the water he is entitled to receive, no reason can be assigned why it should not be permitted to divert from the stream…and preserve and utilize the one hundred inches which would otherwise be lost by absorption and evaporation.

(*Wiggins*, *supra,* 113 Cal. at p. 196.)

As discussed above, in developing a new water source Cal-Am must establish no other legal user of water is injured in the process. Even if Cal-Am pumps water unsuitable to support beneficial uses, the water could not be considered developed water unless users who pump from areas that could be affected by Cal-Am's MPWSP are protected from harm.

Cal-Am proposes a replacement program for the MPWSP water that can be attributed to fresh water supplies or sources in the Basin. If Cal-Am can show all users are uninjured because they are made whole by the replacement water supply and method of replacement, export of the desalinated source water would be permissible and qualify as developed water. In the future, this developed water, under the above described conditions, would continue to be available for export even if there are additional users in the Basin. Developed waters are available for use by the party who develops them, subject to the "no injury" standard discussed previously.

Cal-Am could use one or more of several possible methods to replace any fresh water it extracts from the Basin. Cal-Am could return the water to the aquifer through injection wells, percolation basins, or through the CSIP. Cal-Am would need to determine which of those methods would be the most feasible, and would in fact, ensure no harm to existing legal users. The feasibility analysis would depend on site-specific geologic conditions at reinjection well locations and at the percolation areas. These studies need to be described and supported in detail before Cal-Am can claim an appropriative right to export surplus developed water from the Basin.

The Monterey County Water Resources Agency Act (Agency Act) an uncodified Act adopted in 1990 sets out the role and jurisdiction of MCWRA in administering the Basin's waters.[58] In furtherance of the Agency Act, MCWRA adopted Ordinance 3709 (Ordinance) which applies to groundwater extractions after 1995. The Ordinance essentially finds that seawater intrusion is a threat to beneficial uses and the Ordinance prohibits extractions within the northern Salinas Valley from a depth of 0 msl to -250 feet msl. The Ordinance provides a variance procedure for a user to request relief from a strict application of the Ordinance.

Section 21 of the Agency Act acknowledges that the Agency is developing a project that will establish a balance between extraction and recharge in the Basin. To preserve that balance, the Agency Act provides (with limited exception) that "no groundwater from that Basin may be exported for any use outside that basin...." "Export" is not defined in the Agency Act. In the water rights context, limitations on export ordinarily are not interpreted to apply to situations where the conveyance of water to areas outside a watershed or stream system is accompanied by an augmentation of the waters in that area, so there is

[58] The applicability of the Agency Act to the MPWSP is unclear. As currently proposed, the project would use slanted wells and have screened intervals located seaward from the beach. Although the project would serve areas within the territory of the MPWSP, the points of diversion for these proposed wells may be located outside the territory of MCWRA as defined by the Agency Act. (See Section 4 of the Agency Act, Stats. 1990, ch. 1159, West's Ann. Wat. Appen., § 52-4 (1999 ed.); Gov. Code, § 23127 [defining boundaries as following the shore of the Pacific Ocean].)

no net export.[59] An interpretation based on the net effect of the project also appears to be consistent with the purposes of the Agency Act. Section 8 of the Agency Act states that one of the objectives and a purpose of the Agency Act is to "provide for the control of the flood and storm waters of the Agency, and to [control] storm and flood waters that flow into the Agency, and to conserve those waters for beneficial and useful purposes…" In reference to groundwater, the Agency Act states the Agency's purpose is to prevent the waste and diminution of the water supply in the Agency's jurisdiction, including controlling groundwater extractions as required to prevent or deter the loss of usable groundwater through intrusion of seawater. Another purpose of the Agency Act is to provide for the replacement of groundwater through development and distribution of a substitute water supply.

Based on the State Water Board's analysis, as reflected in the Report, the Project as proposed would return any incidentally extracted usable groundwater to the Basin. The only water that would be available for export is a new supply, or developed water. Accordingly, it does not appear that the Agency Act or the Ordinance operate to prohibit the Project. The State Water Board is not the agency responsible for interpreting the Agency Act or MCWRA's ordinances. It should be recognized, however, that to the extent the language of the Agency Act and Ordinance permit, they should be interpreted consistent with policy of article X, section 2 of the California Constitution, including the physical solution doctrine, discussed below.

6.3 Physical Solution Discussion

To operate the MPWSP, Cal-Am must ensure the MPWSP will not injure other legal users in the Basin. This could require implementation of a "physical solution."

[59] See, e.g. SWRCB Decision 1594 (1984) [interpreting the priority of needs for beneficial use in the watershed of origin over exports by the Central Valley Project and the State Water Project not to apply to waters imported to the watershed by the projects].)

A physical solution is one that assures all water right holders have their rights protected without unnecessarily reducing the diversions of others. "The phrase 'physical solution' is used in water-rights cases to describe an agreed upon or judicially imposed resolution of conflicting claims in a manner that advances the constitutional rule of reasonable and beneficial use of the state's water supply." (*City of Santa Maria v. Adam* (2012) 211 Cal. App. 4th 266, 286 (*City of Santa Maria*).) A physical solution may be imposed by a court in connection with an adjudication of a groundwater basin where rights of all parties are quantified, as part of a groundwater management program, or as part of a water development project.[60] One important characteristic of a physical solution is that it may not adversely impact a party's existing water right. (*Mojave*, *supra,* 23 Cal.4th 1224, 1251.) Physical solutions are frequently used in groundwater basins to protect existing users' rights, maintain groundwater quality, allow for future development, and implement the constitutional mandate against waste and unreasonable use. (See *California American Water v. City of Seaside* (2010) 183 Cal.App.4th 471, 480.)

From the standpoint of applying the State's waters to maximum beneficial use, and to implement Article X, section 2 of the California Constitution, physical solutions can and should be imposed to reduce waste.[61] (See, e.g., *Lodi, supra,* 7 Cal.2d 316, 339-341, 344-345; *Hillside Memorial Park and Mortuary v. Golden State Water Co.* (2011) 205 Cal.App.4th 534, 549-550.) In *Lodi*, a physical solution was imposed to limit the wasting of water to the sea. The defendant appropriator was required to keep water levels above levels that would injure the senior user or to supply equivalent water to the plaintiff. (*Lodi, supra,* 7 Cal.2d 316, 339-341, 344-345.)

Agreement of all parties is not necessary for a physical solution to be imposed. (See *Lodi, supra,* at p.341, citing *Tulare Irrigation District v. Lindsay Strathmore*

[60] Sawyer, State Regulation of Groundwater Pollution Caused by Changes in Groundwater Quantity or Flow (1998) 19 Pacific. L.J.1267, 1297.
[61] Additionally, Water Code section 12947 states the general policy of promoting saline water conversion to fresh water in the State.

Irrigation District (1935) 3 Cal.2d 489, 574.) In addition, a basin need not be determined to be in a condition of overdraft for a physical solution to be instituted. "Although we may use physical solutions to alleviate an overdraft situation, there is no requirement that there be an overdraft before the court may impose a physical solution." (*City of Santa Maria, supra,* 211 Cal.App.4th, 266, 288.) Likewise, a physical solution can also be imposed in a basin that is determined to be in a condition of overdraft. (See generally *Pasadena v. Alhambra* (1949) 33 Cal.2d 908 [in a situation of continued overdraft, the court imposed limits on all users].)

Under the physical solution doctrine, although the Basin continues to be in a condition of overdraft, to maximize beneficial use of the state's waters Cal-Am may be allowed to pump a mixture of seawater, brackish water, and fresh water and export the desalinated water to non-overlying parcels. As a subsequent appropriator, the burden is on Cal-Am to show its operations will result in surplus water that will not injure users with existing legal rights. (See *Lodi, supra*, 7 Cal.2d at p.339.) To avoid injury to other users and protect beneficial uses of the Basin's waters, Cal-Am would have to show it is able to return its fresh water component to the Basin in such a way that existing users are not harmed and foreseeable uses of the Basin water are protected.

Modeling of the North Marina Project, which may be similar to the MPWSP, indicates that approximately 762 to 3,250 afa could be extracted from the landward direction of the slant wells, or approximately 3 to 13 percent of the total water extracted could be water that is contained or sourced from the Basin rather than seawater derived from Monterey Bay. The percentage of this water that is fresh or potable would have to be determined and the proportion of fresh water that is extracted for the desalination facility would have to be replaced. The exact method for replacing the fresh water extracted will be a key component of any legally supportable project. Replacement methods such as injection to recharge wells, delivery to recharge basins, or applying additional water through the CSIP program would need to be further examined to implement a physical solution that ensures no injury to other legal users. Cal-Am would need to determine which of those methods would be the most feasible and result in returning the Basin to pre-project conditions.

One possibility raised by interested parties is that Basin conditions may change in the future, for reasons independent of MPWSP operation. If the seawater intrusion front were to shift seaward, Cal-Am might extract a higher proportion of fresh water from its wells and reach a limit where it would be infeasible for it to return a like amount of fresh water back to the Basin and still deliver the amount of desalinated water needed for off-site uses. Based on the current project design and location of the extraction wells, it is highly unlikely that in the foreseeable future Cal-Am will draw an increased percentage of fresh water from wells with intake screens located several hundred feet offshore. If pumping within the Basin remains unchanged, it is projected that the MPWSP would not pump fresh water within a 56-year period if pumping occurred in an unconfined aquifer.[62] Since modeling has not been done simulating confined conditions, the extent of the impact on fresh water supply or wells is unknown in this situation. If, however, Basin conditions do change and Cal-Am's fresh water extractions increase, several scenarios could develop.

One possible scenario is that Cal-Am could show that (1) but-for the MPWSP, new fresh water would not be available in the Basin, and (2) as Cal Am continues to operate the MPWSP, the increased amount of fresh water available is developed water that would have previously been unavailable both to it and to other users. If this increased fresh water available to Basin users alleviates seawater intrusion issues, as well as provides for a new supply in excess of what would otherwise be available in the Basin, a physical solution could be imposed that would apportion the new water supply and allow continued pumping.

As discussed above, it is unlikely that Basin conditions would improve independent of MPWSP operation. If there is increased fresh water availability in

[62] North Marina Project modeling showed that if pumping occurred in an unconfined aquifer over a 56 year period, then pumping would have little to no effect on the movement of the seawater intrusion front FEIR July 2008, Appendix E p. 21 (E-28).

the Basin that cannot be attributed to the MPWSP and Cal-Am's fresh water extractions exceed what it can return to the Basin, Cal-Am may have to limit its export diversions to ensure that other legal users are not injured. Alternatively, it is possible that Cal-Am could implement modifications to the groundwater extraction system to offset any impacts on fresh water sources[63].

Based on historical uses of water in the Basin and despite efforts to reduce groundwater pumping in seawater intruded areas through enactment of Ordinance 3709 and efforts to increase recharge through the CSIP, there is no substantial evidence to suggest that Basin conditions will improve independent of the MPWSP without a comprehensive solution to the overdraft conditions. Although implementation of the SVWP has reportedly contributed to a reduction in the rate of seawater intrusion, there are still very large pumping depressions in the Basin, and these pumping depressions provide a significant driving force for sustained seawater intrusion which will likely continue for many decades.

There is expected to be minimal impact to fresh water sources at start-up and for the first several years of operation as water will certainly be sourced from the intruded portion of the aquifer. The magnitude and timing of the effect on other users would have to be determined to allow for a design solution to avoid or compensate for the impact of continued operation. (See *Lodi*, 7 Cal.2d 316, 342; ["the fact that there is no immediate danger to the City of Lodi's water right is an element to be considered in working out a proper solution."] The physical solution doctrine could allow for an adjustment of rights, so long as others legal rights are not infringed upon or injured. "[I]f a physical solution be ascertainable, the court has the power to make and should make reasonable regulations for the use of the water by the respective parties…and in this connection the court has the power to and should reserve unto itself the right to change and modify its orders…" (*Peabody, supra,* 2 Cal.2d at pp. 383-384.)

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[63] For example, active groundwater barrier systems, or other means of isolating the extraction wells from the groundwater system could be implemented.

Ongoing monitoring of the impacts of the MPWSP will be necessary to determine whether, and to what extent, changes to the Basin's conditions occur. If and when impacts to fresh water resources in the Basin are identified, any fresh water injection wells would have to be designed to ensure water is injected in areas not already degraded. Alternatively, or in conjunction with injection wells, Cal-Am could ensure an adequate supply of replacement water is maintained within the CSIP program. Initial studies would be needed to determine the most suitable location based on soil permeability for additional percolation basins, if necessary. As with injection wells, percolation basins would need to be located where the underlying aquifer does not contain degraded water.

Based on the information provided in the FEIR, North Marina Project modeling suggests a zone of influence of approximately 2 miles from the proposed extraction wells.[64] According to the State Water Board's GAMA database, there are approximately 14 known water wells within this zone. These 14 wells are within the seawater intruded portion of the Basin. The current use of these wells is unknown; however, it is unlikely the MPWSP would injure users of these wells as the wells are within a zone where water quality is significantly impacted from seawater intrusion and may not serve beneficial uses. Within this 2-mile radial zone, the three foreseeable injuries that overlying users could experience are: (1) a reduction in the overall availability of fresh water due to possible incidental extraction by the MPWSP; (2) a reduction in water quality in those wells in a localized area within the capture zone; and, (3) a reduction in groundwater elevations requiring users to expend additional pumping energy to extract water from the Basin.

If the MPWSP wells are located where unconfined aquifer conditions exist, Project pumping likely would extract both seawater and brackish groundwater. Other than seawater, the majority of the source water would be from within the seawater-intruded portion of the Basin as the seawater intrusion front extends

[64] Cal-Am, Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects p. 21 (E-28), July and September 2008.

approximately 5 miles landward from the proposed well locations. If the MPWSP receives source water from a confined aquifer it would affect a much larger area in the Basin, but without test wells and data showing operations under confined aquifer conditions, it is not possible to determine what percentage of fresh water would be pumped under confined conditions. Staff concludes, however, that the potential for injury is greater if the source water is pumped under confined conditions.

6.4 Summary of Legal Analysis

In summary, to appropriate groundwater from the Basin, the burden is on Cal-Am to show no injury to other users. Key factors will be the following: (1) how much fresh water Cal-Am is extracting as a proportion of the total pumped amount and how much desalinated seawater is thus available for export as developed water; (2) whether pumping affects the water table level in existing users' wells and whether Cal-Am can avoid injury that would otherwise result from any lowering of water levels through monetary compensation or paying for upgraded wells; (3) whether pumping affects water quality to users' wells within the capture zone and whether Cal-Am can avoid or compensate for water quality impacts.(4) how Cal Am should return any fresh water it extracts to the Basin to prevent injury to others; and (5) how groundwater rights might be affected in the future if the proportion of fresh and seawater changes, both in the larger Basin area and the immediate area around Cal-Am's wells.

As discussed in this report, additional data will be necessary to ensure that continued operation of the MPWSP, under different source water extraction scenarios, will not injure other legal groundwater users.

Both near and long-term, a new water supply from desalination, or the implementation of a physical solution could ensure an adequate water supply for all legal water users in the Basin and provide an assured supply of groundwater to the Basin's users.[65] Even if overdraft conditions continued in the Basin following imposition of the solution, Cal-Am possibly could continue pumping brackish water legally so long as the quantity was not detrimental to the conditions in the Basin and other Basin users' rights. "When the supply is limited public interest requires that there be the greatest number of beneficial uses which the supply can yield." (*Peabody, supra*, 2 Cal.2d at p. 368.)

So long as overlying users are protected from injury, appropriation of water consistent with the principles previously discussed in this report should be possible. (See generally *Burr v. MacClay Rancho Water Co*. (1908) 154 Cal. 428, 430-31, 438-39 [if an appropriator does not exceed average annual replenishment of groundwater supply, lower users' water levels in wells or restrict future pumping, the appropriator's use is not adverse to other users].). Additional support is found in *City of San Bernardino v. City of Riverside* (1921) 186 Cal. 7, 20; "No injunction should issue against the taking of water while the supply is ample for all. But the respective priorities of each water right should be adjudged, so that if in the future the supply falls below the quantity necessary for all, he who has the prior right may have his preferred right protected."

Cal-Am must show any desalinated water it produces is developed water; a new supply to the existing groundwater resources in the Basin. It must show replacement water methods are effective and feasible, and the MPWSP can operate without injury to other users. As discussed earlier, if the MPWSP pumps

[65] Some parties argue an adjudication of the Basin's rights would be needed for the MPWSP to proceed. While adjudication could provide some benefits to the Basin's users it is not necessary for a physical solution to be imposed. For reference, there are three general procedures by which an adjudication or rights to use groundwater in the Basin could be quantified and conditioned: 1) civil action with no state participation; 2) civil action where a reference is made to the State Water Board pursuant to Water Code section 2000; or 3) a State Water Board determination, pursuant to the outlined statutory procedure that groundwater must be adjudicated in order to restrict pumping or a physical solution is necessary to preserve the quality of the groundwater and to avoid injury to users. (Wat. Code, § 2100 et seq.) Whether Cal-Am could force an adjudication of water rights is beyond the scope of this report but will be briefly discussed. As applied in *Corona Foothill Lemon Co. v. Lillibridge*, (1937) 8 Cal. 2d 522, 531-32, "an exporter cannot force an apportionment where it is conclusively shown that no surplus water exists and there is no controversy among overlying owners." But a conclusive showing that there is no water available for export does not appear to be the case here. Water that is currently unusable, both due to its location in the Basin and corresponding quality, could be rendered usable if desalinated and would thus be surplus to current water supplies in the Basin.

source water from an unconfined aquifer, there may be no injury to other users outside of a 2-mile radius, with the exception of possibly slightly lower groundwater levels in the seawater-intruded area. Based on current information we do not know the exact effects on other users if source water is pumped from a confined aquifer, but the effects in general will be amplified.

7. Conclusion

The key determination is whether Cal-Am may extract water from the SVGB while avoiding injury to other groundwater users and protecting beneficial uses in the Basin. If the MPWSP is constructed with gravity wells or pumping wells the effects on the aquifer would be the same as long as the amount of drawdown in the wells is the same. But in the case of a pumped well, the operator has the ability to induce greater drawdown than they would in the gravity wells. In this case, there would be a greater effect to the aquifer. Since modeling has not been completed for the gravity well scenario, it is unknown at this time the total effect the gravity wells would have on the Basin and other groundwater users.

If the MPWSP is constructed as described in the FEIR for the North Marina Project, the slant wells would pump from the unconfined Dune Sand Aquifer. If groundwater is pumped from an unconfined aquifer and the modeling assumptions in the FEIR for the North Marina Project are accurate, there will be lowering of groundwater levels within an approximate 2-mile radius. Since seawater intrusion occurs in this area, this water developed through desalination is likely new water that is “surplus” to the current needs of other users in the Basin. Based on the information available, it is unlikely any injury would occur by the lowering of the groundwater levels in this region. Nevertheless, Cal-Am must show there is no injury and if the MPWSP reduces the amount of fresh water available to other legal users of water in the Basin or reduces the water quality so that users are no longer able to use the water for the same beneficial use, such impacts would need to be avoided or compensated for.

If the proposed slant wells are determined to be infeasible, and the project is instead designed to extract groundwater with conventional pumping wells, the potential impacts could be greater, but they would not necessarily result in injury that could not be avoided or compensated through appropriate measures. Impacts on other water users in the form of increased groundwater pumping costs could be eliminated through financial compensation within a reasonable time frame from when the costs are incurred. Impacts on the availability of fresh water could be determined through modeling and any replacement of fresh water would have to be returned in an area that is not already degraded by seawater intrusion. Impacts on users in the form of decreased water quality could be compensated through the replacement of water with similar quality to the pre-project conditions.

Modeling for the North Marina Project does not predict that Basin users' fresh water supplies would be affected if its wells pump from an unconfined aquifer, which we assume to also be true for the MPWSP. If however, further exploratory testing shows water is removed from a confined aquifer, water levels would be lowered in a larger area and the effect on groundwater flow direction would be greater. Although pumping from a confined condition affects a much larger area of the Basin, the quantity of fresh water extracted from the aquifer would not necessarily be greater because the capture zone for the extraction wells would be greatly influenced by existing groundwater gradients. Additional studies are needed to determine whether the revised MPWSP configuration could cause injury to other groundwater users in the Basin that would require additional measures to avoid or compensate for that injury.

Cal-Am could legally pump from the Basin by developing a new water supply through desalination and showing the developed water is surplus to the existing supply. If Cal-Am's extractions are limited to water that currently serves no beneficial use; for example, it is entirely derived from brackish or seawater sources, and Cal-Am returns all incidental fresh water to the Basin in a method that avoids injury to other users, it is likely the MPWSP could proceed without violating other users' groundwater rights. A no injury finding would have to be shown through monitoring, modeling, compensation, project design or other means

A physical solution could be implemented to ensure all rights are protected while maximizing the beneficial uses of the Basin's waters. Such an approach is consistent with the general policy in California Constitution article X section 2, and case law provides guidance on solutions to address complex groundwater issues where supply is constrained. The ongoing development of solutions tailored to the specific conditions that apply to a given groundwater basin reflects the understanding that California waters are too valuable not to be utilized to the maximum extent possible if beneficial uses and other legal users' rights are maintained.

8. Recommendations

Additional information is needed to accurately determine MPWSP impacts on current and future Basin conditions regardless of whether the extraction occurs from pumped or gravity wells. First, specific information is needed on the depth of the wells and aquifer conditions. Specifically, studies are needed to determine the extent of the Dune Sand Aquifer, the water quality and quantity of the Dune Sand Aquifer, the extent and thickness of the SVA and the extent of the 180-Foot Aquifer.

Second, the effects of the MPWSP on the Basin need to be evaluated. Specifically, a series of test boring/wells would be needed to assess the hydrogeologic conditions at the site. Aquifer testing is also needed to determine the pumping effects on both the Dune Sand Aquifer and the underlying 180-Foot Aquifer. Pre-project conditions should be identified prior to aquifer testing. Aquifer tests should mimic proposed pumping rates.

Third, updated groundwater modeling will be needed to evaluate future impacts from the MPWSP. Specifically, modeling scenarios will need to be run to predict changes in groundwater levels, groundwater flow direction, and changes in the extent and boundary of the seawater intrusion front. Additional studies also will be necessary to determine how any extracted fresh water is replaced, whether through re-injection wells, percolation basins, or through existing recharge programs. It may also be necessary to survey the existing groundwater users in the affected area. The studies will form the basis for a plan that avoids injury to other groundwater users and protects beneficial uses in the Basin. To ensure that this modeling provides the best assessment of the potential effects of the MPWSP, it is important that any new information gathered during the initial phases of the groundwater investigation be incorporated into the groundwater modeling studies as well as all available information including current activities that could influence the groundwater quality in the Basin.

APPENDIX A: RESPONSES TO COMMENT LETTERS RECEIVED

State Water Resources Control Board (State Water Board) staff received six comment letters on the Draft Review of California American Water Company's (Cal-Am's) Monterey Peninsula Water Supply Project (MPWSP) (Report). Parties commenting on the Report included the Monterey County Farm Bureau, Norman Groot (Groot); LandWatch Monterey County, Amy L. White (White); the Salinas Valley Water Coalition, Nancy Isakson (Isakson); Ag Land Trust, Molly Erickson of the Law Offices of Michael W. Stamp (Erickson); Water Plus, Ron Weitzman (Weitzman), and Cal-Am, Rob Donlan of Ellison, Schneider, & Harris L.L. P (Donlan). State Water Board staff appreciates the time and consideration taken by the commenters. Staff reviewed and used the comments and additional information included with the comment letters to enhance the accuracy and completeness of the Report. Specifically, staff amended the Report to include: 1) additional emphasis and direction on recommended studies; 2) discussion potential injury that could occur to those users in close proximity to the MPWSP wells; 3) clarification on the information relied upon in the Report; 4) expanded discussion on the Monterey County Water Resources Agency (MCWRA) Act (Agency Act) and Ordinance No. 3709; 5) discussion of the Salinas Valley Water Project; and 6) a new section on potential Project effects on seawater intrusion. Additionally, staff has prepared a categorical response to comments below.

Comments that pertain to the State Water Board's Report generally fell into the following categories: 1) State Water Board's role and objective in preparing the Report; 2) sources of information used in preparing the Report (including adequacy of the environmental document for the previously proposed Coastal Water Project and use of previously developed groundwater model); 3) concerns about injury to other legal users of water (including potential impacts on existing efforts to control seawater intrusion); 4) legal issues related to the exportation of water from the Salinas Valley Groundwater Basin (Basin); 5) the need for better information about the hydrogeology of the proposed project location and the effects the proposed project would have on groundwater in the Basin; and 6) legal interpretation of groundwater appropriation law and concepts discussed within the Report.

1. <u>Does the State Water Board have authority to review the proposed Project? If so, what is the State Water Board's role in preparing the Report? (Responds to comments received from: Erickson, p. 2)</u>

   The California Public Utilities Commission (Commission) is the lead agency under the California Environmental Quality Act (CEQA) for approval of the proposed project. The Commission requested that the State Water Board provide an opinion on the legal and technical considerations implicated in Cal-Am's proposal to extract desalination feed water for the MPWSP. As stated in the Report, the purpose is to examine the technical information and outline legal considerations which would apply to the proposed MPWSP. State Water Board staff is acting in an advisory role in developing the Report and providing an opinion on whether the proposed project, many aspects of which have not yet been finalized, could be implemented without violating groundwater rights or resulting in injury to the Basin users.

   State Water Board staff prepared the Report in an advisory role only, as requested by the Commission. We have considered and addressed all comments that pertain to the contents of the Report. Many comments go beyond the scope of the Report and the State Water Board's role in its development. The Report is an advisory opinion from State Water Board regarding certain legal and technical issues related to the extraction of saline groundwater for a proposed desalination project. It is not binding on any party or entity, and is in no way a substitute for the public processes and environmental documentation that will occur and be produced as part of the Commission's role in evaluating the proposed project.

2. <u>Is it appropriate for State Water Board staff to consider information included in the Environmental Impact Report (EIR) that was vacated by the Monterey County</u>

Superior Court in developing the Report? (Responds to comments received from; Erickson, pp. 9, 13, 14; White , pp. 3-4)

State Water Board staff considered technical information and groundwater modeling that was conducted as part of the environmental and technical review for the previously studied Coastal Water Project. In the Report, we qualify our assessment of likely potential impacts. We also note that additional investigations are needed to provide the information necessary to develop a better understanding of the effects that pumping from the proposed extraction wells would have on groundwater resources in the Basin. The Report, however, states that we assume for the purposes of preliminary evaluation that the hydrogeologic characteristics and effects to the groundwater system would be similar to the North Marina Project alternative analyzed in the previously considered Final EIR. The State Water Board staff reviewed the technical information contained in the FEIR and relied on its analysis when it prepared the Report because it was the best information available. The Report notes that there are many unanswered questions about the nature of the subsurface geology, and how the implementation of the proposed project will affect subsurface water conditions. These questions can only be addressed by proceeding with subsurface investigations and developing a more detailed and comprehensive groundwater model. The final project design and location will be part of the formal environmental review process conducted by the Commission. The Commission staff indicates that during environmental review, the public will have additional opportunity to comment on the adequacy of the technical aspects of the project that the Commission examines. We have included a list of references as an appendix to the Report.

3. Legal issues related to the exportation of groundwater from the Basin (Responds to comments received from: Erickson, pp. 17, 19; White, p. 2; Groot, p. 2; Isakson, pp. 4-5; Donlan, p. 5; Weitzman, p. 1)

The Report discusses the need for the MPWSP to account for potential injury to overlying users of groundwater in the Basin that may result from groundwater export to non-overlying parcels. Several commenters note that the Agency Act prohibits export of groundwater from the Basin. The Commission did not request that the State Water Board interpret the Agency Act. MCWRA, not the State Water Board, is the agency responsible for interpreting and enforcing its enabling legislation. Consistent with the legal principles applicable to California water rights, however, interpreting the export prohibition to apply even if there is no net export from the Basin, under circumstances where injury to other legal users of water is avoided, does not appear to be a reasonable interpretation of the Agency Act.

4. Would legal users of groundwater in the Basin be injured by the implementation of the proposed Project? (Responds to comments received from: Erickson, pp. 2-6, 11, 14, 17-20; White, pp. 2-4; Groot, pp. 1-2; Isakson, p. 2; Donlan, pp. 1-5)

The State Water Board's Report discusses potential injury from the proposed extraction wells. It concludes that further technical studies are necessary to determine whether water can be extracted without harming existing legal groundwater rights. Some of the commenters point to the importance of developing a more detailed groundwater model, but also oppose constructing the test well(s) and conducting the investigations necessary to obtain the information required to develop such a model because of the assertion that injury will occur immediately as a result of the test wells. Our Report concludes that it is necessary for Cal-Am to conduct groundwater investigations in order to collect the information needed to refine the groundwater model. Without this additional information, the State Water Board cannot conclude whether the project could injure any legal user of groundwater in the Basin.

5. <u>What would be the impact on current or future efforts to address the severe seawater intrusion problems in the Basin, and is it appropriate to conduct the initial phase of investigation for the proposed Project before developing a more definitive groundwater model? (Responds to comments received from: Erickson, pp. 7-10, 12, 15, 16, 21; White, pp. 4-5; Isakson, pp. 3-6; Donlan, p. 4)</u>

The State Water Board used the best available information to characterize the current extent of seawater intrusion. The Report recognizes the efforts embodied in the Salinas Valley Water Project and the Castroville Seawater Intrusion Project to address seawater intrusion and staff concludes that despite these and other efforts, seawater intrusion continues its inland trend into the Basin. One commenter criticizes this assessment stating, "[t]he MCWRA position, affirmed recently, is that seawater intrusion has not worsened." The State Water Board has received no information from MCWRA indicating that its current position is that seawater intrusion has been effectively halted and is no longer advancing. Our characterization that seawater is continuing its inland trend is consistent with the current information published by the MCWRA. Whether the seawater intrusion efforts will be assisted by the implementation of the proposed project, or hindered by it, is a question that can only be answered through further investigation. These investigations are proposed as a component of the MPWSP. Accordingly, the Report makes no finding on the issue. Although outside the scope of the Report, we anticipate that the project proponents will coordinate their activities with those of the MCWRA to ensure that both the desalination project and the efforts to address seawater intrusion are compatible.

It is necessary to conduct the studies proposed for the initial stage of the investigation in order to develop the required groundwater model. State Water Board staff believes that this investigation can be conducted without adversely affecting Basin water users. The investigation should ascertain whether any groundwater users have wells in close proximity to the proposed test well, and any concerns about the use of that well during the investigation phase should be addressed.

6. <u>Legal interpretation of Groundwater Law. (Responds to specific comments from Erickson and Donlan. Page citations listed below.)</u>

The State Water Board notes that several parties, notably Ag Land Trust, question the State Board's interpretation of the legal principles that apply to the proposed project. Staff has reviewed the comments and confirms that the Report is consistent with its interpretation of legal precedent applicable to the Project. In some instances, comments appeared to focus on selected passages and did not consider the entire context in which the statements were made or the purpose for which the legal precedent was cited. In other instances, it appears the commenters' questions or concerns were later addressed in subsequent sections. Without responding to each legal argument raised, for clarification purposes, staff would like to respond to the following legal points raised by the following parties:

1) Erickson:

a. Comment on page 17 questions the statement in the Report that, "No permit is required by the State Water Board to acquire or utilize appropriative groundwater rights." The comment claims the statement is misleading and the "State Water Resources Control Board has no right to require any permit for an appropriative right."

Response: With respect to the first comment, the State Water Board believes this is an accurate statement—no permit is required by the State Water Board for the acquisition of appropriative groundwater rights in the Basin. Nor is it misleading. As indicated by the extensive discussion of principles of groundwater law, the Report does not suggest that the inapplicability of state permitting requirements is sufficient to establish a right to divert and use percolating groundwater.

b. Comment on page 2 states, “The SWRCB has no authority over percolating groundwater that is being put to beneficial use.” The comment questions why the State Water Board would express view on issues concerning groundwater rights, and states that the Report should include a discussion of the State Water Board’s authority.

Response: The State Water Board is the state agency with primary responsibility for the regulatory and adjudicatory functions of the state in the field of water resources. (Wat. Code, § 174.) The water right permitting and licensing system administered by the State Water Board is limited to diversions from surface water channels and subterranean streams flowing through known and definite channels. (See *id.*, § 1200.) But the State Water Board has other authority that applies to all waters of the state, surface or underground. This includes the State Water Board’s water quality planning authority, which extends to any activity or factor affecting water quality, including water diversions. (*Id.*, §§ 13050 subds. (e) & (i).), 13140 et seq., 13240 et seq.; see 44 Ops. Cal. Atty. Gen. 126, 128 (1964).)

The State Water Board has broad powers to exchange information with other state agencies concerning water rights and water quality, and more specific authority to evaluate the need for water-quality-related investigations. (Wat. Code, §§ 187, 13163, subd. (b).) The State Water Board also has authority to conduct or participate in proceedings to promote the full beneficial use of waters of the state and prevent the waste or unreasonable use of water. (*Id.,* § 275.) This authority includes participation in proceedings before other executive, legislative, or judicial agencies, including the Commission. (*Ibid.*) And the State Water Board’s authority to promote the full beneficial use of water and prevent waste or unreasonable use applies all waters the state, including percolating groundwater. (See, e.g. SWRCB Decision 1474 (1977.)

The Water Code includes procedures for court references to the State Water Board, under which the State Water Board prepares a report on water right issues before the court. (Wat. Code, §§ 2000 et. seq., 2075 et seq.; see *National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419, 451 [these procedures are designed to enable courts to "to make use of the experience and expert knowledge of the board."]; *San Diego Gas & Electric Co. v. Superior Court* (1996) 13 Cal.4th 893, 914-15 [the Commission has broad authority including judicial powers].)

Thus, it is well within the State Water Board's authority and consistent with the execution of its statutory responsibilities to report to the Commission on matters related to rights to diversion and use of water, including diversions of percolating groundwater. The conclusions and recommendations in this Report are not binding on the Commission, but provide a means for the Commission to make use of the knowledge and expertise of the State Water Board.

c. Comment on page 19 states, "Exportation of groundwater is prohibited by state law and case law. There is no provision for this 'replacement and export' scheme absent adjudication."

Response: See Report pages 38-39. A "physical solution" can be imposed without adjudication. "The phrase 'physical solution' is used in water-rights cases to describe an agreed upon or judicially imposed resolution of conflicting claims in a manner that advances the constitutional rule of reasonable and beneficial use of the state's water supply." (*City of Santa Maria v. Adam* (2012) 211 Cal. App. 4th 266, 286 (*City of Santa Maria*).) See also, Hutchins (1956) The California Law of Water Rights pp. 351-354; 497-498.

2) Donlan:

a. Comment page 3, Cal-Am interprets the Report as concluding that effects on wells within the zone of influence will not likely rise to the level of “legal injury” requiring remedial action or a physical solution unless there is a substantial impact to the use of those wells for beneficial purposes citing *Lodi v. East Bay Municipal Utilities District* (1936) 7 Cal.2d 316, 341.

Response: The comment correctly notes the physical solution doctrine does not require that minor inconvenience or other insubstantial impacts be avoided. As the Report notes, further studies are necessary to determine whether Project effects on wells would rise to the level of “legal injury”.

APPENDIX B: RESPONSES TO LATE COMMENT LETTERS RECEIVED

State Water Board staff received two late comment letters on the Draft Review of the Monterey Peninsula Water Supply Project: 1) from Steve Shimek representing the Otter Project; and 2) from Molly Erickson representing Ag Land Trust. Mr. Shimek's comments focused on the condition of the Salinas Valley Groundwater Basin, seawater intrusion, the need to improve water conservation measures, and the role of the Monterey County Water Resources Agency. Since Mr. Shimek's comments did not directly pertain to the Draft Review, staff will not provide a response to the comments. Ms. Erickson's comment's pertained to statements made by State Water Board staff during the presentation of the Draft Review at the Board meeting held in Monterey on June 4, 2013. Ms. Erickson claimed that staff had erroneously stated that the Environmental Impact Report (EIR) for the Regional Desal Project was challenged in Monterey County Superior Court on legal issues only and not on technical issues. Ms. Erickson claims the court invalidated the EIR on both legal and technical issues. Following is State Water Board staff's response to Ms. Erickson's comments.

1. The court remanded the EIR on technical and legal grounds.

   The court found that Marina Coast Water District abused its discretion by proceeding as a responsible agency rather than as a lead agency under CEQA. In the court's statement of decision and order, the court stated in general terms that Marina Coast abused its discretion by failing to properly and adequately identify, discuss, and address environmental impacts of the project, including but not limited to: water rights, contingency plan, assumption of constant pumping, exportation of groundwater, brine impacts, impacts on overlying and adjacent properties, and water quality. The court's decision noted the lack of data and analysis presented by Marina Coast Water District to support its claims that groundwater was available for export and the impacts of pumping on the physical environment. The court stated there was "no dispute" that the project as proposed would extract water from the 180-Foot Aquifer. The court's statement of decision did not invalidate studies or data, rather the court found the analysis of environmental impacts of the proposed project was incomplete for CEQA purposes.

2. <u>The Board should not rely on any information in the EIR.</u>

   Please see Response to Comment 2, Appendix A:

3. <u>If the Board decides to use the EIR, then staff should identify specific language in the EIR that was used in the report.</u>

   State Water Board staff cited instances where the report used information contained in the EIR. Additionally, staff created a reference list (Appendix C) of those references relied upon and considered in the report. Although our report goes to great lengths to explain the data gaps that exist and the need for additional information, a footnote was added to the report on page 4 to respond to the comment. Footnote 7 further clarifies staff's use of the EIR. The footnote states, "The use of the Cal-Am Coastal Water Project FEIR in this report was informative in creating a broad picture of the potential impacts to groundwater resources in the Basin. The FEIR was not used to arrive at specific conclusions of the definite impacts that would result from the MPWSP. The analysis provided in this report can and should be applied in the context of a future EIR. It is anticipated that additional information gained from the studies recommended in our report will assist the Commission in determining the impacts of the MPWSP on the Salinas Valley Groundwater Basin.

APPENDIX C: REFERENCES

References Relied Upon (in text legal citations omitted):

Application 12-04-019 before the California Public Utilities Commission, Opening Brief of LandWatch Monterey County Regarding Groundwater Rights and Public Ownership, July 10, 2012.

California American Water Company, Coastal Water Project, FEIR, Appendix E, Geoscience, North Marina Groundwater Model Evaluation of Projects, July 2008.

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California American Water Company, Coastal Water Project Final Environmental Impact Report, October 30, 2009.

California Department of Water Resources, California's Groundwater, Bulletin 118, Central Coast Hydrologic Region, SVGB, February 2004.

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Driscoll, F.G. 1986, Groundwater and Wells.

Fetter C. W. 1994, Applied Hydrogeology 3rd Edition.

Monterey County Water Resources Agency, Ordinance No. 3709, September 14, 1993.

Monterey County Water Resources Agency, Monterey County Groundwater Management Plan, Chapter 3 – Basin Description, May 2006.

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Monterey County Water Resources Agency Groundwater Informational Presentation, August 27, 2012.
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Opening Brief of Various Legal Issues of Monterey County Farm Bureau, July 10, 2012.

Salinas Valley Water Coalition, Letter to State Water Board Chair, Charles Hoppin, December 3, 2012.

Sawyer, State Regulation of Groundwater Pollution Caused by Changes in Groundwater Quantity or Flow (1998) 19 Pacific. L.J.1267, 1297.

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Administrative Law Judge's Directives to Applicant and Ruling on Motions Concerning Scope, Schedule and Official Notice, August 29, 2012. http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M026/K469/26469814.PDF

Ag Land Trust letters to CPUC, November 6, 2006 and April 15, 2009.

Amy White, LandWatch, letter to Andrew Barnsdale, CPUC, November 24, 2009

Amy White, LandWatch, letter to California Coastal Commission, August 4, 2011.

Evidentiary Hearing Transcript, April 9, 2012 (cross-examination of Timothy Durbin) and Direct Testimony of Timothy Durbin of Behalf of the Salinas Valley Water Coalition, Before the Public Utilities Commission of the State of California, April 23, 2012.

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Fugro, North Monterey County Hydrogeologic Study, Volume II -- Critical Issues Report And Interim Management Plan FINAL REPORT, May 1996.

Johnson, Jim. *Desal EIR dealt blow*, Monterey County The Herald, February 4, 2012.

Paul Findley, RBF Consulting, Memorandum: MPWSP Desalination Plant Sizing Update, January 7, 2013.

Reply Brief of LandWatch Monterey County regarding Groundwater Rights, July 25, 2012. http://docs.cpuc.ca.gov/PublishedDocs/EFILE/BRIEF/171861.PDF

Richard C. Svindland, Supplemental Testimony Before the Public Utilities Commission of the State of California, April 23, 2012 (with attachments).

Timothy Durbin, Technical Memorandum to Salinas Valley Water Coalition, December 3, 2012.

Timothy Durbin, Technical Memorandum to Salinas Valley Water Coalition, February 21, 2013.

U.S. EPA Ground Water Issue EPA/540/S-97/504, Design Guidelines for Conventional Pump-and-Treat Systems, September 1997.

APPENDIX D: TIMELY COMMENT LETTERS RECEIVED

LandWatch monterey county

Post Office Box 1876, Salinas, CA 93902
Email: LandWatch@mclw.org
Website: www.landwatch.org
Telephone: 831-759-2824
FAX: 831-759-2825

April 25, 2013

Paul Murphey
Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: Draft Review of California American Water Company Monterey Peninsula Water Supply Project (MPWSP)

Dear Mr. Murphey:

LandWatch Monterey County has reviewed the referenced document (the "Draft Review") and has the following comments:

1. We concur with the recommendation for additional studies to determine the extent of the Dune Sand Aquifer, the water quality and quantity of the Dune Sand Aquifer, the extent and thickness of the Salinas Valley Aquitard and the extent of the 180-Foot Aquifer and the effects of the proposed Monterey Peninsula Water Supply Project (MPWSP) on the Basin.

   In particular, we believe it is critical that the additional studies recommended by Mr. Timothy Durbin in testimony before the CPUC be conducted, including the following:

   - a hydrogeologic investigation to determine subsurface formations in the vicinity of the site, including adequate boreholes and geophysical studies;
   - a geochemical investigation to determine mechanisms of seawater intrusion in the vicinity of the site;
   - a large-scale aquifer test through a test well; and

- groundwater modeling, including consideration of density-drive effects and long-term effects after the end of the project.[1]

As Mr. Durbin explains, it is critical that the investigation proceed in this sequence because the results of the hydrogeologic investigation, the geochemical investigation, and the aquifer testing are essential to informing the groundwater modeling.[2]

Unfortunately, under the current schedule, the groundwater modeling, which is to be provided through the CEQA process, will predate the aquifer testing, which will not occur until after the CPUC is scheduled to decide whether to issue a Certificate of Public Convenience and Necessity ("CPCN") for the MPWSP.[3] The SWRCB should encourage the CPUC to make provision for additional modeling work and decision points on the MPWSP source water intake method and location after the aquifer test, because the actual impacts may not be understood with sufficient certainty at the time the CPUC issues the CPCN.

2. In addition, Cal-Am has proposed groundwater wells at the Potrero Road site as an alternative source water intake. Since this site is also within the Salinas Valley Groundwater Basin (SVGB), the SWRCB should encourage the CPUC to require Cal-Am to undertake at least a preliminary hydrogeologic investigation of the adequacy of this site concurrently with its consideration of its preferred intake site at the Cemex site. Cal-Am is constrained by SWRCB Order 95-10 and the Cease and Desist Order to limit its use of Carmel River water expeditiously. Cal-Am already projects that it will not meet the CDO deadline due to problems with permitting a test well at the Cemex site. Serial investigations of infeasible intake options will only further delay compliance.

3. The Draft Review's legal analysis does not directly address the prohibition against exporting groundwater from the SVGB per the Monterey County Water Resources Agency Act. The sole reference to this prohibition is contained in footnote 32 at page 28. We believe that this prohibition constitutes an independent statutory constraint on the MPWSP, which the SWRCB should acknowledge.

4. The Draft Review acknowledges that Cal-Am has the burden to demonstrate that the MPWSP will not result in injury to any groundwater user. The draft review identifies two

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1 A12-04-019, Evidentiary Hearing Transcript, April 9, 2013, pp. 1067-1073 (cross-examination of Timothy Durbin) and Direct Testimony of Timothy Durbin on Behalf of the Salinas Valley Water Coalition, Exhibit SV-3, Technical Memorandum No. 2 by Timothy Durbin, February 21, 2013, pp. 6-7.

2 A12-04-019, Evidentiary Hearing Transcript, April 9, 2013, p. 1073 (cross-examination of Timothy Durbin).

3 A12-04-019, Administrative Law Judge's Directives To Applicant And Ruling On Motions Concerning Scope, Schedule And Official Notice, August 29, 2012, pp. 8-9.

types of potential impacts: reduction of groundwater levels in wells and reduction in the quantity of fresh water available for future use. The Draft Review acknowledges that the magnitude and geographic extent of the reduction in fresh water is indeterminate at this point because the fresh water capture zone is not delineated and there has been no determination whether the source water aquifer is confined or unconfined.

The Draft Review proposes, apparently by way of example, that injury might be avoided or adequately compensated through the return of pumped fresh water to the Basin via the Castroville Seawater Intrusion Project ("CSIP") or via injection wells, or through monetary compensation for groundwater users who must deepen wells and/or incur higher pumping costs. It is not clear without further analysis that these methods of avoiding or compensating injury would suffice for all impaired groundwater users. For example, users not benefitting from the CSIP project and who are upgradient from injection well sites may not benefit from the proposed methods to return pumped freshwater. And users in marginal pumping locations whose wells run dry may not be made whole by monetary compensation.

We are particularly concerned that Cal-Am be required to evaluate potential impacts to groundwater users in the North County area who do not receive CSIP water. As LandWatch has previously explained, the Coastal Water Project ("CWP") EIR for the previously proposed Regional Water Project and its alternatives failed to evaluate the effects of project pumping on the upgradient North County aquifer.[4] LandWatch identified the following defects in the previous CWP EIR's analysis and proposed mitigation of groundwater impacts to North County:

- The North Monterey County Hydrogeologic Study (Fugro West, Inc., 1995) establishes that
  - North County groundwater is hydrologically connected and interdependent with the Salinas Valley Groundwater Basin ("SVGB"),
  - North County groundwater is up-gradient from the SVGB,
  - Increased pumping in the SVGB depletes available groundwater in North County
- None of the wells upon which projected groundwater elevations were modeled in the CWP EIR are located in the up-gradient subareas of North County. Thus the projected groundwater contours in the CWP EIR are not well founded.

[4] Amy White, LandWatch, letter to Andrew Barnsdale, CPUC, Nov. 24, 2009; Amy White, LandWatch, letter to California Coastal Commission, August 4, 2011. Both documents are available at http://www.coastal.ca.gov/meetings/mtg-mm11-8.html, see link to additional correspondence under August 12, 2011 item 6a, Application No. E-11-019 (Monterey County Water Resources Agency, Marina Coast Water District, California-American Water Company, Monterey Co.)

- The CWP EIR admits that monitoring wells are inadequate to support its conclusions, but proposes that this defect can be remedied after the project is constructed by augmenting the monitoring network in North County. This will not establish baseline conditions.

- No meaningful, measureable, or enforceable mitigation was proposed in the CWP EIR if future monitoring identified impacts.[5]

Given the history of inadequate analysis in the CWP EIR, the SWRCB should urge the CPUC to ensure adequate analysis of North County groundwater users. If additional monitoring wells are required to establish baseline conditions before the MPWSP commences, the CPUC should require Cal-Am to make provision for them now.

5. The Draft Review acknowledges that future impacts must be evaluated, in part because it is critical to protect foreseeable uses of the SVGB. A central consideration in this evaluation is whether current and future efforts to halt and/or reverse sea water intrusion will be successful. LandWatch is concerned that the Draft Report provides little clarity on this topic.

Although it mentions the CSIP program and the MCWRA Ordinance No. 3709 as efforts to address sea water intrusion, the Draft Review unaccountably fails to mention the Salinas Valley Water Project ("SVWP"), which is the latest and most comprehensive effort to address sea water intrusion in the SVGB. Opinions differ significantly regarding the efficacy of the SVWP as planned, the likelihood of its complete implementation, and the prospects of a second phase of the project.[6] However, the SVWP must be considered in the evaluation of future impacts from the MPWSP.

Previous modeling of groundwater impacts from coastal wells for desalination source water in the Coastal Water Project EIR projected a reversal of sea water intrusion due to the assumed

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[5] A 12-04-019 Reply Brief of LandWatch Monterey County regarding Groundwater Rights, July 25, 2012, pp. 8-9.

[6] LandWatch has consistently advocated a more careful evaluation of the adequacy of efforts to address overdrafting and sea water intrusion than has occurred to date. In this regard, LandWatch has presented evidence in connection with the adoption of the Monterey County 2010 General Plan and in connection with environmental review of various development projects that the SVWP may have been oversold as a solution to overdraft and sea water intrusion conditions in the SVGB. For example, although the SVWP EIR concluded that seawater intrusion would be halted based on the assumption that irrigated agricultural acreage and agricultural water use would decline from 1995 to 2030, the Monterey County 2010 General Plan EIR admitted that irrigated acreage actually increased substantially between 1995 and 2008 and projected that irrigated acreage will increase even more by 2030. LandWatch has identified a number of additional problems with analyses of the efficacy of the SVWP and is currently pursuing litigation seeking adequate analysis of SVGB water resource impacts through Monterey County Superior Court Case No. M109434. Regardless whether the SVWP has been oversold, the CPUC should not assume that the County will not eventually address sea water intrusion.

success of the SVWP and CSIP, but projected that this reversal would be slower with the Regional Project than without it.[7] Increased duration of degraded groundwater conditions may constitute injury to groundwater users and should be evaluated by Cal-Am.

Notwithstanding the previous modeling that projected reversal of sea water intrusion and even though it admits that "the extent of the impact on fresh water supply or wells is unknown in this situation," the Draft Review appears to dismiss the possibility that the MPWSP would draw an increased percent of freshwater as "highly unlikely."[8] Again without any reference to the SVWP, the Draft Review also states that "there is no evidence to suggest that Basin conditions will improve independent of the MPWSP without a comprehensive solution to the overdraft conditions."[9]

The Draft Review does acknowledge that success in reversing sea water intrusion would result in a higher percentage of fresh water pumping by the MPWSP. The Draft Review considers two possible causal scenarios for the possible reversal of sea water intrusion. First it suggests that Cal-Am may be able to show that the MPWSP is the "but-for" cause of this improvement, in which case Cal-Am might be entitled to a portion of the new water supply.[10] Alternatively, the Draft Review acknowledges that SVGB conditions might improve independent of the MPWSP, in which case Cal-Am may have to limit its export diversions.

Because these two different outcomes have diametrically opposite consequences with respect to the viability of the MPWSP itself, it is critical that the CPUC decision be informed by the best assessment of the likely future success of efforts to halt or reverse sea water intrusion and the effect of the MPWSP on those efforts. However, the Draft Review appears to suggest that the issue can be deferred simply because "[t]here is expected to be minimal impact to freshwater sources at start-up and for the first several years of operation as water will certainly be sourced from the intruded portion of the aquifer."[11] The Draft Review suggests that measures can be taken "[if] and when impacts to freshwater resources in the Basin are observed . . .."[12] However, if Cal-Am were required to limit export diversions because the MPWSP were pumping more freshwater than may legally be exported, the MPWSP may not remain viable for its projected life. LandWatch submits that the CPUC cannot prudently defer analysis of this possibility in approving a long-lived capital project.

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7 Id., p. 9.

8 Draft Review, p. 36.

9 Id., p. 37.

10 Id., p. 36.

11 Id., p. 37.

12 Id.

Thus, analysis and modeling should be required that would determine the probable success of efforts to halt or reverse sea water intrusion, including MCWRA Ordinance 3709, the CSIP, and the SVWP. This analysis and modeling should project future outcomes both with and without the MPWSP.

Thank you for the opportunity to comment on the Draft report.

Sincerely,

Amy L. White
Executive Director

From:	Ron Weitzman
To:	Unit, Wr_Hearing@Waterboards
Subject:	Comments on MPWSP Draft Report
Date:	Wednesday, May 01, 2013 4:39:01 PM

RECEIVED
5-1-13
SWRCB Hearing Unit

Paul Murphey
Division of Water Rights
State Water Resources Control Board

Dear Mr. Murphey:

Both draft responses by your agency to the CPUC request for your opinion on water rights refer minimally to the state Agency Act (Monterey County Water Resources Act, (Stats. 1990 ch.52 § 21. West's Ann. Cal. Water Code App.), which explicitly prohibits the exportation of groundwater from the Salinas Valley River Basin. Both your draft responses describe this prohibition as follows: "… prohibits water from being exported outside the Salinas Valley Groundwater Basin." This description refers to groundwater as simply water, which is not what the act itself specifies. In the act, the term groundwater is used in contrast to surface water, the prohibition applying only to groundwater. The CPUC, Cal Am, and your agency persistently and incorrectly refer to groundwater as "water" having the meaning of fresh water. Your draft responses concentrate on the question of whether the exportation of groundwater from the Salinas Valley Groundwater Basin would do harm to current users of that water. That question is irrelevant, however, in view of the Agency Act's prohibition of any groundwater, of whatever composition, from the Salinas Valley Groundwater Basin. Although I am not an attorney, my general understanding of the law is that a specific rule takes precedence over a general one. Therefore, regardless of the harm demonstrated to be done or not done to current Salinas Valley water users, the Agency Act specifically prohibits the exportation of groundwater from the basin. Water Plus, the ratepayer organization that I represent, has repeatedly been saying that for months. In this regard, please view the uncontested Water Plus testimony to the CPUC, attached, particularly Section III. Water Plus understands the request by the CPUC to your agency for an opinion on water rights as an attempt by the CPUC to involve you in the current Cal Am water-supply project to an extent that might motivate you to relax your Cease-and-Desist Order, particularly since Cal Am's project cannot now meet the current CDO deadline. Water Plus urges you not to relax the CDO. If you do, your agency will lose all credibility regarding any future CDO deadlines you may set. The Cal Am project is not the only one proposed to provide the water needed to ease the stress on the Carmel River. At least two other proposals have been developed, one of them backed by a considerable investment by its developer. If your agency truly seeks to help resolve our local water problem, Water Plus believes the most effective action you could take would be to require the Monterey Peninsula Water Management District to develop the needed new water supply project. The district has the authority to do that, and if now immediately began the process in conjunction with the partially developed People's project it could likely meet your current CDO deadline. Proceeding in this direction would also save local ratepayers hundreds of millions of dollars, as documented in Section III of the Water Plus CPUC testimony and on the Water Plus Web site, top of the center column.

Thank you for your consideration of these comments.

Respectfully,

Ron Weitzman
President, Water Plus

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

Application of California-American Water Company (U210W) for Approval of the Monterey Peninsula Water Supply Project and Authorization to Recover All Present and Future Costs in Rates.	A.12-04-019 (Filed April 23, 2012)

REVISED TESTIMONY OF RON WEITZMAN

ON BEHALF OF WATER PLUS

Ron Weitzman

23910 Fairfield Place

Carmel, CA 93923

Telephone: (831) 375-8439

Facsimile: (no facsimile)

Email: ronweitzman@redshift.com

Dated February 22, 2013

President, Water Plus

Revision: March 21, 2013

Table of Contents

I. Witness Information.

Q. Please tell me your name and provide some biographical information relevant to this proceeding, if you will?

A. Yes, I would be glad to do that. My name is Ron Weitzman. I am married and the father of two daughters, one deceased. I was born and began school in Chicago and completed my pre-college education in Los Angeles. I have a B.A. and an M.A. degree from Stanford University and a Ph.D. from Princeton University in mathematical psychology. I have been on the faculties of a number of universities throughout the United States and elsewhere in the world, including the Middle East, the site of numerous desalination plants. I have taught many dozens of courses in psychology and statistics and published many dozens of articles and technical reports on mental test theory and survey analysis, a good portion of them involving mathematical modeling. You can say that asking questions has been my field of specialization, and so I feel comfortable with the Q & A format of this prepared testimony. Throughout my work life and since retirement, I have been involved as a volunteer and an activist in numerous charitable and civic activities involving social services, performing arts, historic preservation, environmental protection, and consumer interests. That now includes Water Plus, a non-profit public-benefit corporation that meets weekly and that I have served as president since founding it in September of 2010.

II. Purpose of Testimony.

Q. What is the purpose of this testimony?

A. I am presenting this testimony as a representative of Water Plus, a party to this proceeding, pursuant to Rules 1.7(b) and13.8 of the Rules of Practice and Procedure of the California Public Utilities Commission (“CPUC”). Water Plus seeks to represent the ratepayers served by California-American Water’s Monterey County District (“Cal Am”) in this proceeding. Our concern is ratepayers will foot the bill for yet another failed Cal-Am water-supply project.

III. The Current Cal Am Water Supply Project is Doomed to Failure.

Q. You say that the currently proposed Cal Am water-supply project is doomed to failure. Why?

A. The state Agency Act prohibits the exportation of groundwater from the Salinas Valley Groundwater Basin,[1] which is precisely what the Cal Am project proposes to do.[2]

Q. Supporters of the Cal Am project claim that the exportation prohibition applies only to the fresh-water component of the groundwater and that the project includes plans to return that component to the basin. How would you respond to that claim?

A. The Agency Act makes no distinction between fresh water and salt or brackish water. The only distinction it makes is between surface water and groundwater, and the Act's prohibition applies exclusively to groundwater, of whatever mix.

Q. That being the case, then why did the Salinas Valley farming community not invoke the Agency Act to prevent the now-dead Regional Desalination Project from exporting groundwater from the basin?

A. The farming community did not then invoke and has not even now invoked the Agency Act because it is a measure of last resort that can serve as a useful bargaining tool for farmers to share in the revenue obtained from any water-supply project that involves the exportation of groundwater from the Salinas Valley Groundwater Basin.

Q. What foundation, if any, do you have for that statement?

A. The issue concerning the farmers is that they have spent and are continuing to spend a great deal of money on stemming the intrusion of saltwater into the

[1] Monterey County Water Resources Agency Act ("Agency Act"), Stats. 1990, c. 1159, Section 21.

[2] .12-04-019: *Application of California-American Water Company (U210W) for Approval of the Monterey Peninsula Water Supply Project and Authorization to Recover All Present and Future Costs in Rates*, April 23, 2012 ("A.12-04-019").

Salinas Valley Groundwater Basin. So money is the basic issue. Any water-supply project that could satisfy the farmers would have to provide them with at least enough money to remediate whatever increase in saltwater intrusion the project might produce. Because the farmers have rights to the basin water, they can also add an extra charge for the use of their rights that may be sufficient to cover the costs they have incurred to date in addressing saltwater intrusion.

Q. Has this sort of negotiation ever occurred in other aspects of the Regional Desalination Project or in the current project, as far as you know?

A. Yes, in at least three. First, when Cal Am pulled out of the regional project, the county owed several million dollars to Cal Am, as well as to itself in money borrowed from internal programs unrelated to the project. To recover this money, the county made an agreement with Cal Am to exempt the company from a county ordinance that would have forbidden it from owning a desalination plant in the county.[3] Very likely, Cal Am will use ratepayer revenue to cover the county's debt.[4] Second, in the current project, a deal is pending between Cal Am and the Monterey Peninsula Regional Water Authority involving a trade-off between the establishment of a local project governance committee and a prohibition of support for public ownership. I am going to talk about this deal later in the testimony. Third, in the regional project, the Ag Land Trust drafted a rental agreement to allow the project to draw its groundwater from land owned by the trust. (I have a hard copy of a draft of this agreement.) This agreement never came to fruition because the Marina Coast Water District board believed it was neither a necessary nor an appropriate expenditure for the project to go forward. As a result, the Ag Land Trust sued and prevailed in Superior Court.[5] An impediment to the regional project, the suit is now under appeal.

Q. Why would Cal Am make such an agreement with Monterey County when the CPUC has voted to exempt the company from the county ordinance permitting only a public agency to own and operate a desalination plant in the county?

[3] Monterey County Ordinance 10.72.030(B).
[4] Monterey County Herald, December 5, 2012, front page.
[5] Ruling by Monterey County Superior Court Judge Lydia Villarreal, February 2, 2012.

A. A number of parties to the proceeding have requested a rehearing on the preemption decision by the CPUC. The agreement between the county and Cal Am is Cal Am's insurance against a possible reversal of the CPUC decision.

Q. If the state Agency Act is determinative, then why did an advisory letter from the State Water Resources Control Board to the CPUC[6] fail to consider it and instead indicated that the only hurdle involving water rights that Cal Am had to overcome was to show that its project would do no harm to the farmers or others who had the rights?

A. The advisory letter was solicited by the CPUC as an effort to obtain cover for Cal Am's project in the event that it should fail on the water-rights issue. The solicitation letter from the CPUC loaded its argument in favor of Cal Am's project by interpreting groundwater as meaning fresh water, and the study summarized in the advisory letter adopted that interpretation, contrary to the Agency Act. The 30-page study report in fact referred only once in a footnote on p. 17 to the Agency Act, and that reference incorrectly used the word "water" instead of "groundwater", presumably in an attempt to obscure the intent of the act. In short, rather than resolving the determinative water-rights issue, the advisory letter succeeded only in circumventing it.

Q. Do you have any further observations to make about this advisory letter?

A. Yes. In a decision to preempt the Monterey County desalination ordinance so that Cal Am could go forward with the approval process for its project, the CPUC claimed that seawater is just another form of source water comparable to water drawn from riparian wells so that, In drawing seawater from wells for desalination, Cal Am would just be doing business as usual.[7] The advisory letter interestingly made the opposite claim. Rather than simply filtering water, desalination is a process that produces it. That being the case, the exportation of desalinated water from the Salinas Valley would not be the exportation of existing groundwater but the exportation of something entirely new. Whichever

[6] Letter from Michael Buckman to Paul Clanon, December 21, 2012.
[7] D.12-10-030, October 31, 2012, pp.15-16.

interpretation is correct, if either, they cannot both be correct. Support for the Cal Am project lies on an anything-but-solid foundation.

IV. The CPUC has Subverted its Mission by Discouraging Competition among Water Supply Projects.

Q. You claim that the CPUC has subverted its mission by discouraging competition among water-supply projects? What do you mean by that?

A. A principal reason the CPUC exists is to protect the public from possible abuses by privately-owned public utilities that would otherwise be unregulated monopolies. The mission statement of the CPUC restricts its authority to apply solely to monopolies by requiring it to encourage competition wherever possible.[8] In addition to the Cal Am project, private interests have proposed two other projects designed to meet local water needs. The Monterey Peninsula Regional Water Authority has in fact commissioned a study to compare these two projects with Cal Am's, but the CPUC has encouraged neither of their proponents to apply alongside Cal Am for a CPUC certification of public convenience and necessity.

Q. The intent of both these alternative projects is to be owned and operated by a public agency in compliance with the county desalination ordinance, but the CPUC has jurisdiction only over private companies. Why then would you expect the CPUC to act otherwise?

A. Neither of these other two projects has as yet acquired a public partner, and so currently each of their proponents is a private entity seeking to provide water for conveyance to members of the public. As such, they are currently subject to CPUC authority. Knowing of their existence, the CPUC should not only invite them, it should require them, to apply for a certification of public convenience and necessity alongside Cal Am. Cal Am has no more local history in the water-supply business than the proponents of these other two projects do.

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[8] According to its mission statement, the CPUC is to "regulate utility services, stimulate innovation, and promote competitive markets, where possible, in the communications, energy, transportation, and water industries."

Q. The administrative law judge assigned to this proceeding has indicated that time is too short for it to include other projects. The state cease-and-desist-order deadline is less than four years away. What do you have to say about that?

A. At the initial preconference hearing for this proceeding last June, I, as a representative of Water Plus, requested that in the interest of time the CPUC consider all currently proposed projects simultaneously in a "horse race" rather than sequentially.[9] If time were the true issue, that is the course that the proceeding should have taken from the beginning. Now, if Cal Am's project fails, as I am confident that it will, we are going to have to start all over, just as we have done following the failure of the Regional Desalination Project. As long as the CPUC has not certified any single project, it is not too late to include other projects in the proceeding.

Q. Cal Am is an experienced water purveyor with an existing investment in the community. What investment does either of these other two proponents have?

A. I cannot speak for both of them, but I can speak for one, who has to date invested some $34 million in his project. By contrast, Cal Am investors have risked not an iota of capital on their project. The CPUC has no excuse but to include the other two projects in the proceeding.

Q. How can you say that? Where do you think the money that Cal Am has spent on its project to date has come from?

A. That money is an internal company loan recorded in a memorandum account for recovery from ratepayers when the proceeding is over, regardless of whether the project goes forward.

Q. That is not automatically the case. The CPUC can decide not to approve the recovery. So Cal Am investors are also risking capital, is that not so?

A. Either on its own or via its two erstwhile public partners, Cal Am has spent about $40 million on the Regional Desalination Project, and, despite that project's

[9] Transcript of Preconference Hearing for A.12-04-019 on June 6, 2012, p. 45, l. 25 – p. 46, l. 15; p. 61, l. 1 – l. 14; p. 67, l. 12 – p. 68, l. 15.

failure, the CPUC has already approved the recovery of at least $32 million from ratepayers, while its approval of the remainder is pending.[10] So Cal Am has every reason to expect the CPUC to approve the recovery from ratepayers of all its expenses on the current project. Ratepayers, Water Plus included, have no reason to expect otherwise. If the CPUC does not include these other two projects in the current proceeding, all the capital their investors have risked will be lost. That does not constitute a level playing field. That does provide Cal Am an unfair monopolistic advantage in contravention of the CPUC mission to encourage competition.

Q. So what action are you proposing?

A. I am proposing that the CPUC invite the proponents of the other two projects to apply to it alongside Cal Am for a certification of public convenience and necessity. If either of these two decline, then the CPUC need not consider that project further. Otherwise, it should consider the projects of all applicants equally.

Q. How can a private party other than Cal Am apply to the CPUC to build, own, and operate a desalination plant in Monterey County when the county will enforce its ordinance preventing it from doing so while permitting Cal Am to circumvent the ordinance?

A. Rather than exempting Cal Am from the ordinance based on the merits of its project, the CPUC based its exemption of Cal Am solely on it as a private applicant.[11] Simply stated, the CPUC exempted the applicant, not the project. That being the case, the CPUC exemption should apply equally to other applicants, as well, regardless of the merits of their projects. Because the CPUC exemption takes precedence over the county ordinance, that ordinance cannot stand in the way of applications submitted to the CPUC by any private party, not solely Cal Am.

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[10] Monterey County Herald, July 19, 2012, front page.

[11] D.12-10-030 does not refer to any specifics of the Cal Am proposal in A.12-04-019, and so it does not authorize the project; it merely authorizes the applicant as a private company to go forward with processing its project application in prospective contravention of Monterey County Ordinance 10.72.030(B).

Q. Different from the proponents of the other two projects, Cal Am does not intend to sell its project to a public agency. Doesn't that make a difference?

A. No. As along as the other two projects are privately owned, they are no different in that regard from Cal Am's. Intentions can change. The CPUC should require all private proponents of water-supply projects to submit applications to it and ignore only the ones that fail to do so. Speaking for Water Plus, that is my strong recommendation.

V. Any New Water Supply Project for the Monterey Peninsula Cannot Rely on the Use of Treated Sewer Water.

Q. The mayors' Monterey Peninsula Regional Water Authority, the Monterey Peninsula Water Management District, and Citizens for Public Water, among others, support the so-called three-legged stool, which includes processing sewer water for drinking along with aquifer storage and recovery and desalination. Why does Water Plus not support the sewer-water leg of this stool?

A. Treating sewer water to make it potable sounds like a good idea when first considered because it can contribute to the conservation of natural resources. On occasion, it may well be a good idea, but not everywhere and particularly not here on the Monterey Peninsula, for two reasons: cost and reliability.

Q. How can that be so? Elsewhere, reliability has not been a problem, and cost has been used as a reason to support the process.

A. Let me deal with reliability first. Locally, the pollution control agency would submit sewer water already treated for agricultural use to further treatment to make it potable. Farmers in the Salinas Valley and the Marina Coast Water District own the rights to the initially-treated water because they paid, and are continuing to pay, for the treatment facilities. Agriculture in the valley needs this water throughout the year except possibly for the winter months. Only then could water be available for further treatment and then only in wet years. The frequency of such years is likely to decrease with the progression of global warming. In a dry winter, when farmers will need their treated water, they will not be able to give permission to the agency to treat it further for use elsewhere. So dependence on treated sewer water as part of the overall Monterey Peninsula water supply would make that supply extremely unreliable.

Q. What about cost?

A. The cost of treating sewer water to make it drinkable is especially high here in Monterey County. One reason is that, if available at all, the water for treatment would be available only during the four winter months. That means that the capacity of the treatment facility would have to be three times greater than normal for the yield of a specific amount of drinkable water each year. Whatever the reasons, however, the cost of treating sewer water is much greater than desalinating seawater locally. In fact, a study commissioned by the Monterey Peninsula Regional Water Authority showed that for Cal Am's project a combination of desalinated and treated sewer water costs $1,000 per acre-foot more here than the cost of desalinated water alone. [12]

Q. So, is Water Plus against any use of treated sewer water on the Monterey Peninsula?

A. No. Water Plus is not against the use of treated sewer water as a supplementary or emergency water supply. We are just against its use as part of a water supply that our community would depend on.

Q. Does that mean that Water Plus could support its use on the Monterey Peninsula?

A. No. Although we would not be against its use as a supplement, we could not support it either.

[12] Separation Processes, Inc. & Kris Helm Consulting: Evaluation of Seawater Desalination Projects: Final Report Update, January 2013, Table ES 1-2, p. ES-6. This table shows desalinated water would cost $1,000 less per acre-foot when obtained from Cal Am's large desalination plant versus its small one, which would require supplementation by treated sewer water to provide the total amount of potable water needed. The supplementary treated sewer water, according to pollution control agency head Keith Israel in the March 15, 2012, Monterey County Weekly, would cost about $1,000 more per acre-foot than desalinated water obtained from the large desalination plant proposed by either of the other two projects described in the SPI table.

Q. Why?

A. Many people have phobias, such as the fear of heights or public speaking. Similarly, many people have a fear of drinking treated sewer water. They find the very idea to be repulsive. Mixing treated sewer water in the only water supply available to them would be inhumane, regardless of how other people, including Water Plus, may feel about it.

Q. Do you have any other reason why Water Plus does not support the local use of treated sewer water?

A. Yes. Our local economy depends on tourism. Using treated sewer water could hardly contribute to our community's attractiveness as a tourist destination.

Q. In view of all these arguments against the use of treated sewer water, do you know of any reason other than conservation that some people may have to support its use locally?

A. Yes. People who oppose further growth on the Monterey Peninsula support the three-legged stool because it could provide a cap on desalination, which they fear, if unfettered, could open the floodgates to development.[13] Water is essential to life. Water Plus believes that Its supply is an end in itself and should not be used as a means to achieve other ends.

VI. A Large Desalination Plant Is Preferable to a Small One for the Monterey Peninsula.

Q. You seem to by saying that Water Plus favors a large desalination plant over a small one. Is that true?

A. Yes, at least with respect to cost. A large desalination plant may cost more than a small one to build, but the opposite is true for the water they produce. Each unit of water costs less, often much less, when produced by a large

[13] An example is the local chapter of the League of Woman Voters. Its president had a letter in The Carmel Pine Cone on February 8, 2013, taking just this position.

desalination plant than by a small one.[14] So, except for providing a bulwark against development, building a small desalination plant in a community in short supply of water like ours does not make sense. Why pay more for less?

Q. Are you aware of other reasons favoring a large over a small desalination plant locally?

A. Yes. Our community has thousands of lots of records that lack water, and a number of our cities need additional water to meet the requirements of their development plans, particularly for their downtowns. This need exists especially in Monterey, Seaside, and Pacific Grove, whose downtowns are dying. People who want to add a bathroom to their homes are not able to do so, and the scarcity of water is constantly increasing its cost on the Monterey Peninsula, where we are paying several thousand dollars per acre-foot for it when the national average is less than $900.[15] This is especially unfortunate because many local residents are retirees who live on a limited income and because our hotels, vital to our tourist industry, must be competitive in price with hotels elsewhere. This challenge to competitiveness extends to our local military institutions, which, like tourism, are a mainstay of our economy. The ever-escalating cost of water escalates the cost of everything eventually to the point where a budget-constrained Pentagon may have to move our local military institutions to communities where the cost of living is lower. For all these reasons, both the local hospitality industry and the Monterey Peninsula Chamber of Commerce have publicly supported a large over a small desalination plant.[16] Water Plus joins them in that support.

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[14] This relationship between size and cost is due at least in part to economies of scale. The Division of Ratepayer Advocates presented a graph showing this relationship to support its request that the Regional Desalination Project cap the cost per acre-foot of product water to $2,200, shown on the graph as a high-end value for a 10,000 acre-foot desalination plant. The graph was based on empirical data.

[15] Cal Am's Monterey Peninsula water-supply revenue is now about $50 million annually. For 11,000 acre-feet of current annual usage, that amounts to more than $4,500 per acre-foot. In the nearby, publicly-owned Marina Coast Water District, it is about half that amount, according to its Comprehensive Annual Financial Report dated June 30, 2012. The current national average, as reported in Wikipedia, is $886 per acre-foot.

[16] In a Monterey County Herald commentary on December 1, 2012, Dale Ellis and Bob McKenzie, representing the Coalition of Peninsula Businesses (including the local hospitality industry), recommended a desalination plant having a capacity of nearly a 20,000 acre-feet per year, and in a November 26, 2012, advertisement in the same

VII. Open-ocean Intake Is Superior to Intake from Slant Wells Almost Generally and Particularly in Monterey County.

Q. Cal Am has proposed to use slant wells terminating under the ocean floor as a source of water for desalination. Hydrologists for and against this proposal have recently submitted reports refuting each other's positions. Are you sure you want to chime in on this dispute among experts?

A. Yes, but not as a hydrologist, which I am not. Both sides agree that the proposed wells will draw groundwater rather than surface water and that the Salinas Valley Groundwater Basin extends under the ocean. Their only significant disagreement seems to be whether at the well site an aquitard may exist above the 180-foot aquifer that could prevent the seepage of ocean water through the ocean floor down to the aquifer.[17] This is the aquifer from which Cal Am initially proposed that its slant wells would draw source water. Acknowledging a possible problem here, Cal Am has now modified its proposal so that withdrawing water from this aquifer would be its fallback choice. Cal Am's currently preferred choice for its groundwater source is the so-called Sand Dunes aquifer, which lies above the disputed aquitard.[18] In either case, Cal Am would be drawing source water from the Salinas Valley Groundwater Basin, an action specifically prohibited by the state Agency Act.

Q. That might justify your claim that the use of slant wells is a bad idea in Monterey County, but you also claim that it is almost generally a bad idea. How would you defend that claim?

A. Different from open-ocean intake, which is the local alternative, slant wells have no history of anything other than experimental use. Aside from a possibly

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newspaper the Monterey Peninsula Chamber of Commerce president recommended one having a capacity of 15,000 acre-feet per year.

[17] GEOSCIENCE: Technical Memorandum, February 6, 2013, a response solicited by the CPUC to Timothy J. Durbin: California-American Water Company – Comments on Proposal to Pump Groundwater from the Salinas Valley Groundwater Basin.

[18] Monterey County Weekly, November 15, 2012, "Cal Am Files Contingency Plans for Desal Roadblocks" by Kera Abraham.

less adverse impact on sea life than open-ocean intake, they have minimal justification. The very existence of a dispute among experts regarding their local viability indicates that geological conditions varying along the shoreline can compromise their usefulness. Not being an expert in this case, I would assign a 50% chance that each side is right. If I were a farmer, that is a chance that I would not like to take. As a ratepayer, that is certainly a chance that I would not like to take. Neither would Cal Am if its shareholder money were at risk. Certainly, investors facing a risk like that would be extremely reluctant to purchase bonds to support the project.

Q. The risk may be 50-50 or even worse, but if the CPUC certifies the project, investors may never know about that risk. What do you have to say about that?

A. That question goes to the difference between the world of law and the world of science, but, as you suggest, it is practical question, not just a philosophical one. Let me try to answer the philosophical question first. A joke among philosophers aptly describes this situation: ""Well yes, it works in practice, but will it work in theory?" The dispute among hydrologists is about the validity of different models of local geology. Models are theories having limited and specific applications. So, in this sense, acting in a legal world, the CPUC is seeking to find in favor of one theory as opposed to another. All the CPUC needs is a finding to move the project forward.

Q. And the practical question?

A. A finding is not a fact. The consequences of making an incorrect finding just to move the project forward can be devastating. Responsibility to both Cal Am customers and prospective project investors requires that the CPUC be risk-averse in making its findings.

Q. Do you have anything further to say on this issue?

A. Yes. A recent white paper I read by experts not involved in the local dispute over slant wells identified a number of problems with them that may not be merely site-specific.[19] Examples: The accumulation of sedimentation that could clog the intake pipes may make the operation of slant wells costlier and less reliable than open-ocean intake. Further increasing cost and compromising reliability, suction of source water through the ocean floor could deplete its oxygen and intensify its particulate content to the point that aeration, filtration, and other expensive pre-processing such as temperature elevation would be necessary to prevent the destruction of the membranes involved in the reverse osmosis to remove the salt. Based on these and other problems, the paper concludes that, in general, open-ocean intake is superior to the use of slant wells as a source of water for desalination. Now I have a question. Shouldn't the recommendation of independent experts take precedence over a recommendation made by experts hired to favor either party to a dispute?

VIII. Financing Can Cost Ratepayers Hundreds of Millions of Dollars Less if the Project is Owned by a Public Agency rather than by Cal Am.

Q. Water Plus has been claiming for years that public ownership of a desalination plant could be significantly less costly than ownership by Cal Am. How specifically can you substantiate that claim?

A. All you have to do is Google a mortgage calculator to see that for yourself. Cal Am has for years obtained from ratepayers a return of investment on capital-improvement projects of between 8% and 9%. This return is determined by a formula involving about 6.5% interest charged to ratepayers on debt and about 10% profit on equity. By contrast, a public agency can borrow money now for less than 3.5% interest, with no profit add-on chargeable to ratepayers. These percentages are not the only differences between Cal Am and a public agency affecting the cost of capital to ratepayers. SPI, the mayors' consultant, estimated the capital cost of each of the projects at close to $200 million, but Cal Am's own estimate for its project is about twice that amount, the difference accountable as Cal Am shareholder equity (based on a $200 million debt and a 50-50 debt-to-

[19] WaterReuse Association: Overview of Desalination Plant Intake Alternatives: White Paper, June, 2011.

equity ratio).[20] Entering 8.25% with $400 million for Cal Am and 3.5% with $200 million for a public agency into the mortgage calculator for a 30-year loan yields total costs of approximately $1.08 billion for Cal Am and $323 million for a public agency. That is a savings of public over Cal Am ownership of about $757 million, well over a half-billion dollars. And that does not even include taxes and the cost of doing business with the CPUC, expenses that a public agency does not have.

Q. If that is the case, as it appears to be, then why have the local mayors and others supported the Cal Am project?

A. Obviously, money is not their sole or even their principal concern. Yet, the difference is so large that even they cannot ignore it. So both they and Cal Am have proffered a number of possible offsets that are, unfortunately, unlikely to work in practice.

Q. What are these possible offsets and why do you claim that they are unlikely to work in practice?

A. A February 12, 2013, commentary in the Monterey County Herald by two of the mayors listed these possible offsets: (a) a partial "contribution" (of about $100 million) to the project by a public agency, (b) an interest-free $99 million surcharge proposed by Cal Am, (c) at least partial financing via the state revolving fund under the federal Clean Water Act, and (d) decreased electricity costs.[21] These options are either likely to fail to materialize or if they did they would also be available to a public agency that could lower its costs by the same or even a greater amount.

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[20] See Footnotes 2 and 12 for reference to this information. These estimates exclude Cal-Am only facilities such as the pipeline from the desalination site to Seaside. Since Cal Am filed its application on April 23, 2012, it has increased the capacity of its larger proposed desalination plant to be close to 10,000 acre-feet per year so that its estimated debt-plus-equity cost to ratepayers will now likely be well over $400 million. The ratio currently proposed by Cal Am for its project is 47-53, and so 50-50 is a conservative prediction of what this ratio will actually turn out to be.

[21] These four possible offsets represent an evolution of five originally proposed in an October 1, 2012, letter sent to Cal Am's president, Robert MacLean, by Monterey mayor Charles Della Sala and Monterey County supervisor David Potter. This letter also contains suggestions for a local governance structure to provide oversight on Cal Am's project. The word "contribution" is in quotes because it is not a true contribution, or grant, but a loan to be repaid with interest..

Q. Now why do you claim that the first offset might not work out?

A. In their commentary, the mayors did not specify any public agency they might have in mind, but since the water management district general manager was a principal author of their proposal the most likely candidate would be that district. This appears to be the behind-the-scenes deal worked out between the authority and the district. The problem is that Cal Am has no incentive to go along with it. The company had a public partner in the Marina Coast Water District and pulled out of the partnership in favor of the current project precisely because this project would offer its shareholders a much greater profit.[22] The mayors' hope apparently is that the CPUC will force Cal Am to accept their deal.

Q. Why wouldn't the CPUC do that?

A. The CPUC has no control over the water management district but is responsible for the safety and reliability of our local water supply. The district has no history of running a water-supply project on its own, and its possible involvement with Cal Am in a complex financial partnership would involve too many uncertainties for the CPUC to take the risk. For the same reason, financing the project would also be at risk.

Q. What about the surcharge?

A. Local ratepayers are extremely upset about even the idea of a surcharge, which, according to the mayors' consultant's data, could amount to almost half the capital cost of the project. Normally, in a capital-improvement project like desalination that requires a loan, the public would pay the interest on the loan and Cal Am would pay the principal out of the profits its shareholders make on the project. A surcharge is entirely different. The ratepayers would pay all the capital costs, and Cal Am shareholders would pay nothing and yet have complete ownership.[23] In ordinary life, that would be called robbery. Aside from getting an

[22] Reinforcing this claim is the CPUC filing by Cal Am on October 26, 2012, opposing public ownership of a desalination plant, reported in The Monterey County Herald, November 11, 2012, front page.

[23] Accountants may have a different view of this transaction if it takes the form of a so-called Mirror CWIP (Construction Work in Process): During construction, ratepayers pay costs treated as debt matched by equity earning shareholder profits used to pay ratepayers back in the form of relatively reduced bills following

early start on rate increases to avoid skyrocketing-rate shock later on, which payback on a partial-project loan could also do, the only excuse for the surcharge is that it would save ratepayers the cost of interest and some profits, a cost that could be substantial. That is the excuse. The reason is something else: Cal Am is unable to secure open-market financing on the beginning of a project that has such an uncertain outcome. The surcharge may be the only money available for the project to get going. Why else would Cal Am choose to forgo a large portion of its possible profit on the project? At the same time, on the other side, why should ratepayers take the risk? They already have lost between $30 million and $40 million on Cal Am's failed regional project.[24] The CPUC must think long and hard before it approves the surcharge.

Q. What about money from the state revolving fund?

A. That is a pie in the sky if ever there was one. Only public agencies or non-profit organizations are eligible for legislatively-defined low-interest funding from this source, and non-profits only when their projects are designed to eliminate at least some non-point-source pollution.[25] The funding is also quite limited and usually distributed in relatively small amounts. Since the desalination component of Cal Am's project is not designed to eliminate non-point-source pollution, the applicant for funding must be a public agency. Again, the mayors in their commentary are unclear about the identity of this agency, and again a good bet is the water management district, which has been working hand-and-glove with the mayors. That being the case, what the mayors likely have in mind is funding for a partial public "contribution" to the project, their first cost-reduction proposal. To be effective, that might require public ownership, which the mayors have failed to specify, Cal Am would resist, and the CPUC likely disapprove.[26]

Q. And reduced electrical rates?

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construction. Whatever the accounting treatment, however, ratepayers would bear all the risks and make all actual payments while Cal Am owns the paid-for project components regardless of whether the entire project reaches completion. This is of especial concern to Water Plus members, who believe the project is going to fail.

[24] See Footnote 10.

[25] This fund is administered by the state Water Resources Control Board under the federal Clean Water Act.

[26] Without public ownership, Cal Am may have to consider the loan to be *its* debt that, matched by equity, would render the public "contribution" ineffectual in reducing ratepayer bills.

A. Like a partial public “contribution”, a surcharge, and revolving-fund financing, this is a cost-saving measure available at least as much to a public agency as to Cal Am.[27] This suggestion, like the previous one, amounts to no more than a public-relations ploy.

Q. Do you have anything else to say about the financing proposals of the mayors?

A. Yes. The mayors base their entire financing argument on the capital cost of Cal Am’s project estimated by SPI, the consulting firm they engaged to compare project costs. That estimate, around $200 million, is about half of Cal Am’s own estimate, which includes shareholder equity as well as debt.[28] To determine the total cost to ratepayers of Cal Am’s project, SPI correctly used a percentage charged to ratepayers of between 8% and 9% but incorrectly applied it to its $200 million rather than Cal Am’s $400 million estimate (approximate figures).[29] The mayors fail to take this obvious discrepancy into account in their project comparisons. This failure provides additional impetus to the suspicion that the principal concern of the mayors is something other than cost to ratepayers and that their cost-offset proposals amount to little, if anything, more than a smoke-screen obscuring their principal concern.

Q. What do you believe this principal concern might be?

A. The mayors are politicians. The concern that appears most strongly to motivate them is re-election. They have not even obtained the approval of their city councils for their cost-offset proposals, to say nothing of their endorsement of Cal Am’s project. The Monterey City Council recently voted unanimously in favor of public ownership,[30] and yet the mayor of Monterey voted on the authority board to endorse Cal Am, a private owner. The Pacific Grove mayor did likewise though his city council has voted to work on the acquisition of one of the

[27] Both of the two alternative projects, in fact, involve the use of solar energy to help offset the cost of electricity.
[28] See Footnote 20.
[29] See Footnote 12 for reference to the SPI report.
[30] The Monterey City Council adopted that resolution at its January 2, 2013, meeting as a contingency in the event that Cal Am’s currently proposed project fails. The resolution did not give the mayor permission to vote for the Cal Am project on the Monterey Peninsula Regional Water Authority board.

two alternative projects as a public owner.[31] The mayors' support of Cal Am hardly has any demonstrable support in the public other than among politically active no-growth groups like the League of Women Voters.[32] As laudable as the goals of these groups might be, they do not include the best interests of ratepayers, particularly with respect to the size of their monthly water bills.

IX. The Pending Deal between Cal Am and the Monterey Peninsula Mayors Costing Ratepayers Hundreds of Millions of Dollars Stands on a Shaky Legal Foundation.

Q. Why would the Monterey Peninsula mayors make a deal with Cal Am that could cost local ratepayers hundreds of millions of dollars? Surely the mayors must realize that their making a deal like that could eventually have an adverse political effect on them.

A. The cease-and-desist-order deadline is just over the horizon, December 31, 2016,[33] and local political leaders are getting jittery about it. In contrast to the local proponents of the alternative projects, the mayors perceive Cal Am as part of a national megalith having the strong financial assets needed to go forward with its project. The mayors fear taking a risk on a local project. That fear dominates any concern they may have over costs.

Q. What does that fear have to do with a deal between the mayors and Cal Am?

A. That fear is compounded by another one that strengthens the cost-benefit mindset of the mayors favoring the Cal Am project despite its cost to ratepayers.

Q. What is this other fear?

A. Five of the six mayors comprising the Monterey Peninsula Regional Water Authority or their representatives also sit on the Monterey Regional Water Pollution Control Agency board. These five have voted on the agency board to

[31] The Pacific Grove City Council took that action at its meeting on April 18, 2012.
[32] See Footnote 13.
[33] California Water Resources Control Board Order WR 2009-0060, based on WR 95-10

spend sewer ratepayer money on plans for converting sewer to drinking water for Cal Am water ratepayers, a possible misappropriation of funds in violation of Proposition 218. In 2008, the agency's attorney admonished the agency to terminate that expenditure of funds, then amounting to $700,000.[34] Now, despite that admonition, the expenditure has risen to over $2 million.[35] The mayors' support of the deal with Cal Am depends on the acceptance by Cal Am of the governance structure proposed by the mayors that gives them the authority to decide whether to include the conversion of sewer to drinking water in Cal Am's project, an inclusion that would allow the agency to recover the misappropriated funds.[36] In this exploitation of their authority in one agency to favor another on whose board they also sit, the mayors may be in violation of a Section 1099 conflict of interest. That is in addition to their possible Proposition 218 violation.

Q. What is Cal Am's position on this deal?

A. The deal that Cal Am made with Monterey County, which involves the forgiveness of county debt to Cal Am in exchange for the exemption of Cal Am from the county's desalination ordinance, also prohibits the county from supporting public ownership in opposition to Cal Am.[37] The deal between Cal Am and the Monterey Peninsula Regional Water Authority makes the same prohibition.[38] These deals are good for Cal Am, Monterey County, and the mayors' water authority, as well as no-growth special-interest groups. Unfortunately, they are not good for Monterey Peninsula ratepayers who, as indicated earlier, may lose hundreds of millions of dollars because of them.

Q. Is that the end of your testimony?

---

[34] Letter from attorney Rob Wellington to Keith Israel, general manager of the pollution control agency, dated January 22, 2008.

[35] This information comes from an agency table titled "Urban Reclamation Projects: Summery of Total Costs" and dated March 31, 2011.

[36] Two of the three voting members of the proposed governance committee that would have this explicit authority are members of the mayors' regional water authority. The third is a member of the water management district board, which also seeks the inclusion of treated sewer water in Cal Am's project.

[37] See Footnotes 3 and 4.

[38] These prohibitions need not be explicit because the deals would make no sense without them.

A. Yes, with just one additional observation. On February 11, 2013, the Monterey Regional Water Pollution Control Agency board voted to use up to $750,000 more of sewer ratepayer funds to support a study of the conversion to drinking water of not only sewer water but also Salinas agricultural and urban run-off water for use by water ratepayers on the Monterey Peninsula.[39] Although the inclusion of run-off water enabled members of the board opposed to the use of sewer water to go along with the vote, the expenditure still may represent a violation of Proposition 218. Conflict of interest may sully the current Cal Am project at least as much as it did the previous one, toward the same ultimate fate.[40]

February 22, 2013 Respectfully submitted,

Revision: March 21, 2012

WATER PLUS

By:

President, Water Plus

[39] The addition of run-off to sewer water literally poisons the well because the resulting brew will contain contaminants like DDT that cannot be removed to the extent required to make the treated water potable.

[40] David Potter is another example of conflict of interest involved in the current project. The mayors' proposed governance committee consists of a single voting representative from each of three public agencies. Mr. Potter sits on the boards of all three of these agencies and has been appointed to be the representative of one of them on the committee.

FARM BUREAU MONTEREY

May 3, 2013

RECEIVED
5-3-13
SWRCB Hearing Unit

Mr. Paul Murphey
Division of Water Rights,
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812

VIA: Email to Wr_Hearing.Unit@waterboards.ca.gov

RE: Comments on draft review of California American Water Company's Peninsula Water Supply Project

Dear Mr. Murphey:

Monterey County Farm Bureau represents family farmers and ranchers in the interest of protecting and promoting agriculture throughout our County. We strive to improve the ability of those engaged in production agriculture to provide a reliable supply of food and fiber through responsible stewardship of our local resources.

We appreciate the opportunity to make comments on the Draft Review document ('Draft Review') of the proposed water supply project for the Monterey Peninsula ('MPWSP') by California American Water Company ('Applicant').

Since the identification of seawater intrusion into the Salinas Valley groundwater basin, farmers and ranchers have worked with each other to develop water projects that have led to the slowing of further degradation of this basin. Specific projects (the two reservoirs at the south end of the basin, the Castroville Seawater Intrusion Project, the Salinas Valley Water Project, and the Salinas Valley Reclamation Project) have been funded by the Salinas Valley landowners through self-assessments; present day value for the costs of these projects is around $352 million. In addition, Monterey County enacted an ordinance in 1992 prohibiting groundwater pumping the 180' aquifer in the coastal area between Salinas and Castroville. Together, these measures are working to slow, and hopefully halt, the advancement of seawater into the groundwater basin.

Jeopardy for the Salinas Valley groundwater basin comes from the proposed MPWSP due to the location of the source water intakes, which are currently placed directly

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over the western portion of the basin. As noted in your Draft Review, circumstances of the exact impacts and harm to the basin are not fully understood or adequately documented.

Further studies should be undertaken to determine the full extent of the shallow or sand dunes aquifer for water quality and quantity. These studies should include a determination of the thickness of the Salinas Valley groundwater basin aquitard in the proposed source water project area. Specific hydro geologic investigations are required to make these determinations and include geophysical studies of the immediate area surrounding the source water intakes, as well as boreholes that sufficiently characterize the subsurface formations.

The mechanics of salt water intrusion need to be fully understood before proceeding forward with any project that will remove substantial amounts of source water from the sand dunes aquifer. This requires the development of groundwater models that will assess the long-term impacts to the groundwater basin and conductivity of any waters between the water layers.

We fully support the assessment of hydrologist Tim Durbin and his suggestions for additional hydro geological studies beyond the installation of a source water test well, as proposed by the Applicant for this project. Timing is critical to make these assessments prior to any development of reporting required under the CEQA process, mainly the Environmental Impact Report. An accurate decision cannot be made about impacts and harm to the Salinas Valley groundwater basin without results of these additional tests; to issue an environmental assessment of this project without fully testing these resources is not acceptable. We encourage the State Water Resources Board to engage the Public Utilities Commission to allow a provision in their process that will ensure that results of these additional studies can be included in the fully realized Environmental Impact Report that will ultimately be considered for approval.

The Draft Review does not include any legal analysis of the prohibition against exporting water from the Salinas Valley groundwater basin that is defined by law in the Monterey County Water Resources Agency Act of 1947. This should be considered as one of the major hurdles that this project must overcome in order to adequately obtain source water for the Applicant's desalination plant. We interpret this to include any brackish water incidentally included in the source water extracted, as that is not true seawater by content. Specific water rights held within this Agency Act must be paramount when considering all exportation issues.

An alternative site north of the Salinas River, along Potrero Road, is noted for possible source water intake. This location is also over the Salinas Valley groundwater basin and would have the same constraints, study requirements, and legal issues with exportation of water as the primary site. If this is indeed a serious alternative site, we would suggest that these same studies and analysis be conducted in parallel with the primary site, to provide consistency and economies of scale. We believe that the best possible uses of scientific information to guide these approvals are required for all contingencies.

Monterey County Farm Bureau asserts that not enough hydro geological information is known about how the Salinas Valley groundwater basin will respond to desalination source water intakes as presently proposed; indeed, all causation of possible harm and possible degradation must be investigated prior to approving the MPWSP in its present iteration.

It is of greater concern that the prior constructed projects funded by farming operations in the Salinas Valley could be at risk if further harm or degradation does occur due to unintended consequences of the MPWSP.

Your consideration of these concerns is appreciated.

Sincerely,

Norman C. Groot
Executive Director

Salinas Valley Water Coalition
P.O. Drawer 2670 • Greenfield, CA 93927
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Transmitted via Email

Mr. Paul Murphey
Division of Water Rights
State Water Resources Control Board
P. O. Box 2000
Sacramento, Ca 95812-2000

May 3, 2013

RECEIVED
5-3-13
SWRCB Hearing Unit

Re: Comments on MPWSP Draft Report (Draft Report)

Dear Mr. Murphey;

Salinas Valley Water Coalition (SVWC) has operated 20 years to specifically address our local water issues. SVWC and its members have actively supported the development of water projects within the Salinas Valley. Two reservoirs, the Castroville Seawater Intrusion Project, the Salinas Valley Reclamation Project and the Salinas Valley Water Project (SVWP) have all been approved and funded (over $352,000,000.00) by the Salinas Valley landowners and ratepayers, in an effort to sustain and manage our basin's water resources and to address its overdraft problem and resultant seawater intrusion problem.

We have worked with our neighbors and other organizations to resolve our differences so these projects could be successfully financed and implemented. We have made significant progress on our basin's water problems, but we are not finished – we still have an overdrafted basin and seawater intrusion continues to advance into the Salinas Valley Groundwater Basin (SVGB). The overdraft is stable; additional intrusion is substantially reduced. However, the Monterey Peninsula Water Supply Project (MPWSP) as proposed threatens that stability and the security of these water resources and water rights. The northern part of our SVGB still has significant water resource problems and these needs must be addressed and not further exacerbated.

The Salinas Valley Groundwater Basin is an overdrafted basin in which coastal farming enterprises are already threatened by saltwater intrusion. There is no "surplus" of groundwater available for appropriation by Cal-Am for the MPWSP, and pumping by Cal-Am from the 180-foot aquifer for its proposed project would harm the overlying water users with superior claims. It would export water from the Salinas Valley Groundwater Basin for use elsewhere, in contravention of both California groundwater law and Monterey County Water Resources Legislative Act (California Water Code Chapter 52, Section 21).

We appreciate the opportunity to comment on the SWRCB's Draft Report on the MPWSP, and we appreciate your review of the issues and recognition of the potential harm this project could have on the SVGB.

Mission Statement: The water resources of the Salinas River Basin should be managed properly in a manner that promotes fairness and equity to all landowners within the basin. The management of these resources should have a scientific basis, comply with all laws and regulations, and promote the accountability of the governing agencies.

Technical Comments:

A. We agree with you that "additional information is needed to accurately determine MPWSP impacts on current and future Basin conditions regardless of whether the extraction occurs from pumped or gravity wells."[1]

We also agree with you in that specific information is needed on the depth of the wells and aquifer conditions; studies are needed to determine the extent of the Dune Sand Aquifer, the water quality and quantity of the Dune Sand Aquifer, the extent and thickness of the SVA and the extent of the 180-foot aquifer, and the effects/impacts of the proposed MPWSP on the SVGB. The direct testimony of Mr. Timothy Durbin on behalf of the SVWC to the Public Utilities Commission[2] said that the uncertainty surrounding the MPWSP must be reduced by conducting a thorough hydrologic investigation. He further stated that such an investigation would consist of five parts as follows:

1. Additional site-specific work is needed to define the thickness and extent of the 180-foot aquifer, overlying aquitard, and dune deposits. Especially important are identifying the onshore and offshore extent, thickness, and continuity of the aquitard overlying the 180-foot aquifer, and defining the hydraulic connections among the 180-foot aquifer, overlying aquitard, and dune deposits. The hydrogeologic investigation will require the compilation and analysis of existing hydrogeologic information, the construction of new boreholes, and perhaps conducting geophysical surveys. The number of boreholes must be sufficient to construct at least three hydrogeologic cross section perpendicular to the Monterey Bay shore: through the project site, immediately north of the site, and immediately south of the site. At least nine boreholes into the 180-foot aquifer would be required. Whether the proposed pumping from the 180-foot aquifer or the dune deposits will have adverse impacts will depend largely on the details of the actual hydrogeologic setting.

2. An understanding of the seawater-intrusion mechanisms must be developed. Historical seawater intrusion has occurred by some combination of the mobilization of naturally occurring seawater within the groundwater system, pumping-induced vertical leakage from Monterey Bay into the groundwater system, extrusion of naturally occurring seawater within the aquitards deposited as lagoonal sediments, and other mechanisms. The collection and analysis of geochemical and other information will be required to identify details of the seawater-intrusion processes. Whether the proposed pumping from the 180-foot aquifer or the dune deposits will have adverse impacts may depend significantly on the actual processes that will be activated by the proposed pumping.

3. Large-scale aquifer tests will be needed to supplement the hydrogeologic and seawater-intrusion investigations. As long as wells in both the dune deposits and 180-foot aquifer are considered as primary or contingency water supplies, separate tests must be conducted with pumping from the 180-foot aquifer and the dune deposits. The tests need to include monitoring wells within the 180-foot aquifer, the overlying aquitard, and the dune deposits. The pumping rates and test durations must be sufficient to identify processes that will be activated by the full implementation of the proposed water-supply

[1] SWRCB Draft Review of MPWSP, dated April 3, 2013, pg 42
[2] PUC Evidentiary Hearings, SVWC Exhibit SV-3: Technical Memorandum No. 2 by Timothy Durbin, February 21, 2013.

Mission Statement: The water resources of the Salinas River Basin should be managed properly in a manner that promotes fairness and equity to all landowners within the basin. The management of these resources should have a scientific basis, comply with all laws and regulations, and promote the accountability of the governing agencies.

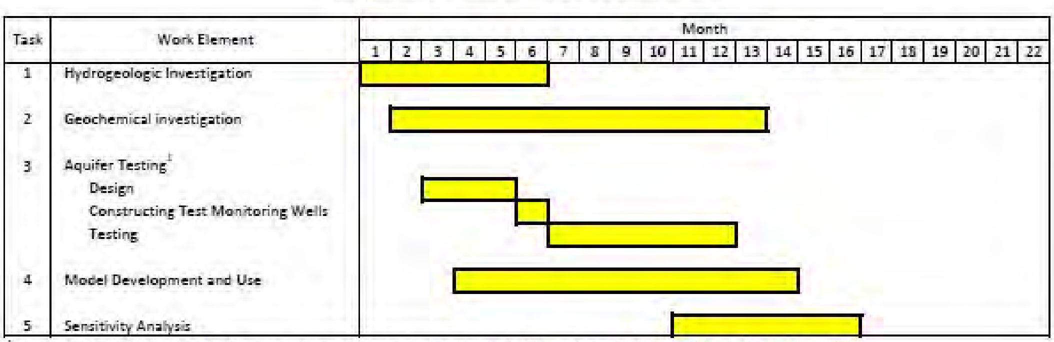
pumping. This could involve pumping for a year or more. However, a shorter duration might be sufficient for pumping from the dune deposits. The tests should be designed with respect to pumping rates, observation-well placement, and test duration using a groundwater model to predict the expected response of the groundwater system during the test and to evaluate the identifiability of critical hydraulic characteristics of the groundwater system.

4. A local groundwater model must be developed that represents the essential elements of the groundwater system onshore and offshore along Monterey Bay. The model must simulate both groundwater flow and solute transport. The model must represent the hydrologic setting, including the thickness and extents of the dune deposits, 180-foot aquifer, 400-foot aquifer, and deep aquifer, and the intervening aquitards. The model must represent the hydraulic characteristics of the groundwater system, and it must represent the seawater-intrusion process active within the groundwater system. The development of an adequate model may require simulating the effects of water density on the hydrodynamics of the groundwater system. The boundary and initial conditions for the local model should be derived from SVIGSM. However, the simulation run on the SVIGSM must represent a realistic representation of baseline conditions. The appropriate baseline condition is for the continued operation of the CSIP project without additional acreage. An expansion of CSIP is not in place or envisioned at this time, and it is not an appropriate or realistic depiction of baseline conditions for analyzing the potential impacts of the CalAm proposal. The proposed CalAm pumping must be simulated for a finite period, and an extended post-project period must be simulated.

5. The modeling results for both the primary and contingency proposal must be subjected to a thorough sensitivity analysis. The modeling results will unavoidably always contain uncertainty, even though the objective of the modeling exercise and supporting investigations described above will be to minimize the uncertainty. The sensitivity analysis will quantify how the modeling results might change with different assumptions about the hydrogeologic setting, seawater intrusion processes, and the hydraulic characterization of groundwater system.

We believe your recommendation in the Draft Report is consistent with these proposed five steps. During his cross-examination, Mr. Durbin also discussed a proposed 'work plan' and schedule for completing the investigations, as shown below:

Study Schedule for Work Described in Durbin Exhibit SV-3



[1]Aquifer test duration will be 1-12 months depending on duration required to identify process that will be activated by project. Schedule shows a 6-month testing period. If a different period is required, the schedule would be adjusted accordingly.

Mission Statement: The water resources of the Salinas River Basin should be managed properly in a manner that promotes fairness and equity to all landowners within the basin. The management of these resources should have a scientific basis, comply with all laws and regulations, and promote the accountability of the governing agencies.

These studies must be completed to provide a thorough analysis of the potential impacts to the SVGB, its landowners and ratepayers. These studies must be completed regardless of where in the SVGB the proposed wells will be located and whether the extraction will be from pumped or gravity wells. This issue is a ‘fatal flaw’ for the MPWSP and must be identified as quickly and efficiently as possible.

Cal-Am has proposed some alternatives, such as the Potrero Road site, should their proposed location at the Cemex site not work. The Potrero Road site is still within the SVGB and therefore, the same level and extent of hydrologelogic investigation discussed above must be completed in order to show the level of potential impact to the SVGB.

B. Legal Comments:

We support your legal conclusion that “the burden is on Cal-Am to show no injury to other users.”[3] However, we believe the discussion pertaining to your legal conclusions fails to adequately consider two key legislative enactments specific to the Salinas Valley Groundwater Basin. These must be considered when determining any impacts to current and future Basin conditions and users. In order for Cal-Am to prove no injury to current and future users, these enactments must be included in that evaluation:

1. MCWRA Agency Act, Water Code Chapter 52, Section 21.

“Sec. 21. Legislative findings; Salinas River groundwater basin extraction and recharge. The Legislature finds and determines that the Agency is developing a project which will establish a substantial balance between extraction and recharge within the Salinas River Groundwater Basin. For the purpose of preserving that balance, no groundwater from that basin may be exported for any use outside the basin, except that use of water from the basin on any part of Fort Ord shall not be deemed such an export. If any export of water from the basin is attempted, the Agency may obtain from the superior court, and the court shall grant, injunctive relief prohibiting that exportation of groundwater.”

This legislation was established to give Monterey County and particularly the Salinas Valley tools and resources to address water resource issues; most particularly the chronic problem of salt water intrusion in the Salinas Valley Groundwater Basin that was and continues to be a decades-long issue of major local, regional and statewide concern. This legislation specifically prohibits the export of ANY groundwater from the Salinas Valley. This legislative act and expression of protection for the SVGB underscores the need that any proposed action/project must be consistent with protection of the Salinas Valley Groundwater Basin – AND must show that there is no exportation of groundwater from the SVGB.

2. Monterey County Water Resources Agency Ordinance No. 3709[4].

This Ordinance, which is attached for your convenient reference, was adopted by MCWRA on September 14, 1993. The ordinance ***prohibits the extraction of groundwater*** from groundwater extraction facilities that have perforations between zero feet mean sea level and -250 feet and are located within the territory between the City of Salinas and Castroville. It also prohibits the drilling of ***any new wells*** with perforations between zero feet mean sea level and -250 feet in the portion of the pressure Area north of Harris Road to the Pacific Ocean.

[3] SWRCB Draft Review of MPWSP, dated April 3, 2013, pg ii
[4] Attachment #4

Mission Statement: The water resources of the Salinas River Basin should be managed properly in a manner that promotes fairness and equity to all landowners within the basin. The management of these resources should have a scientific basis, comply with all laws and regulations, and promote the accountability of the governing agencies.

This Ordinance remains in place today and is known as the ordinance that prohibits pumping in the ***180 foot aquifer***. This is an important piece of information for the SWRCB's record and for the public to understand, as it shows that no well in the northern part of the SVGB can legally pump water from the 180 foot aquifer, and demonstrates the existing public policy of protecting Salinas Valley's 180 foot aquifer. And yet, this is potentially what Cal-Am is proposing to do – something that is prohibited to legal overlying landowners.

The ordinance includes the attached map delineating the boundary of the territories subject to the prohibition. It should be noted that the Ordinance was adopted in 1993, three years prior to the annexation of certain lands that have subsequently been recognized as part of the SVGB and are now included as such as part of Zone 2C.

Zone 2C was defined based on geological conditions and hydrologic factors, which defined and limited the benefits derived from the reservoirs and the proposed changes to the operations, storage, and release of water from the reservoirs. As the Map[5] shows, Zone 2C is essentially the Salinas Valley Groundwater Basin (SVGB) extending from the most southern Monterey County border up to the Monterey Bay. It also includes all of the former Ft. Ord area and up to the Elkhorn Slough in Moss Landing.

This area is critical to any hydrological analysis and consideration of the potential impacts to the SVGB, and proof of no injury to water users within the Basin. Cal-Am's proposed slant well sites are located just adjacent to the southern and northern coastal boundary – just on the 'other side' of the line. Their proposed well sites may not technically be subject to this Ordinance, but they remain within the SVGB and Zone 2C, and have the potential to affect them.

As your Draft Report notes, Basin conditions may change in the future so that the seawater intrusion front moves seaward. If this occurs the MPWSP may then be extracting a higher proportion of freshwater from its wells. Any legal or technical analysis must also consider this potential future impact to the SVGB and its water users, including impacts to landowners' ability to utilize their overlying groundwater rights.

The Salinas Valley Groundwater Basin is an overdrafted basin in which coastal farming enterprises are already threatened by saltwater intrusion. There is no "surplus" of groundwater available for appropriation by Cal-Am, and pumping by Cal-Am from the 180-foot aquifer for its proposed project would harm the overlying water users with superior claims. It would export water from the Salinas Valley Groundwater Basin for use elsewhere, in contravention of both California groundwater law and Monterey County Water Resources Legislative Act (California Water Code Chapter 52, Section 21).

SVWC wants the Peninsula to be successful in securing its water needs. But those needs cannot be met at the expense of degradation to the Salinas Valley Groundwater Basin. Those who steward the SVGB--water right holders, users and ratepayers—will diligently work to assure that the basin's resources are conserved. The communities and ratepayers of the Salinas Valley have spent over $352,000,000.00 to build two reservoirs as well as the

[5] Attachment #5 Map as shown in Engineers Report To Support an Assessment for The Salinas Valley Water Project of the Monterey County Water Resources Agency, RMC, January 2003

Mission Statement: The water resources of the Salinas River Basin should be managed properly in a manner that promotes fairness and equity to all landowners within the basin. The management of these resources should have a scientific basis, comply with all laws and regulations, and promote the accountability of the governing agencies.

Castroville Seawater Intrusion Project, the Salinas Valley Reclamation Project and the Salinas Valley Water Project to solve the basin's water problems. Stakeholders have worked as neighbors to resolve their differences so these projects could be successfully financed and implemented.

Cal-Am's proposed project for the Monterey Peninsula puts a 'straw' into the Salinas Valley Basin and potentially in the 180-foot aquifer, which is the aquifer most vulnerable to seawater intrusion. They should not be allowed to put the stability and security of these water resources and water rights at risk. We ask the State Water Resources Control Board to acknowledge the validity of our concerns and to support our request that Cal-Am move its pumping out of the Salinas Valley Groundwater Basin.

We thank you for your consideration of our concerns.

Sincerely,

President, Salinas Valley Water Coalition

W/ Attachments

Mission Statement: The water resources of the Salinas River Basin should be managed properly in a manner that promotes fairness and equity to all landowners within the basin. The management of these resources should have a scientific basis, comply with all laws and regulations, and promote the accountability of the governing agencies.

Monterey County
Water Resources Agency

Ordinance No. 3709

AN ORDINANCE OF THE MONTEREY COUNTY WATER RESOURCES AGENCY PROHIBITING GROUNDWATER EXTRACTIONS AND THE DRILLING OF NEW GROUNDWATER EXTRACTION FACILITIES IN CERTAIN PORTIONS OF THE PRESSURE 180 FOOT AQUIFER AFTER JANUARY 1, 1995

County Counsel Summary

After January 1, 1995, this ordinance prohibits the extraction of groundwater from groundwater extraction facilities that have perforations between zero feet mean sea level and -250 feet and are located within the territory between the City of Salinas and Castroville, bounded by Highway 183 and the dividing line between the Pressure Area and the East Side Area. After January 1, 1995, it also prohibits the drilling of new wells with perforations between zero feet mean sea level and -250 feet in the portion of the Pressure Area north of Harris Road to the Pacific Ocean. It provides a variance procedure in case of hardship and penalties for violations.

The Board of Supervisors of the Monterey County Water Resources Agency ordains as follows:

SECTION 1. The following provisions are hereby enacted:

PART I -- INTRODUCTION

1.01.00 AUTHORITY

Under the Monterey County Water Resources Agency Act (Stats. 1990, Chap. 1159), the Agency has jurisdiction over matters pertaining to water within the entire area of the County of Monterey, including both incorporated and unincorporated areas. Under the Act, the Agency is authorized to conserve water in any manner, to prevent the waste or diminution of the water supply within the territory of the Agency, to conserve water for the present and future use within the territory of the Agency, and to prevent groundwater extractions which are determined to be harmful to the groundwater basin. The Agency may further adopt, by ordinance, reasonable procedures, rules, and regulations to implement the Act, and may specify in any ordinance that a violation of the ordinance is an infraction. The Board further has power to perform all other acts necessary or proper to accomplish the purposes of the Act.

1.01.01 FINDINGS

A. Groundwater supplies in the Salinas Valley basin are being diminished in both quantity and quality. This inability to maintain a constant, usable water supply is due to historical overdraft, increases in demand, lack of new water supplies, and contamination of the existing supply.

B. Increases in demand have come from all sectors of the Salinas Valley -- agricultural, residential, industrial, commercial, and others. These increases in demand, coupled with the recent six year drought, have exacerbated water quality impacts and significantly accelerated overdraft.

C. Even without drought, overdraft of the groundwater basin is a constant problem; it depletes the existing water supply and contributes to the intrusion of seawater into the basin along the coast.

D. The location of the seawater intrusion front poses an imminent threat to the municipal water supply for the City of Salinas and to farming operations in the lower Salinas Valley. Restrictions on groundwater pumping are necessary in order to reduce the rate of seawater intrusion and allow recharge to raise groundwater levels. Seawater intrusion is most extensive in the Pressure 180 Foot Aquifer and threatens to contaminate lower aquifers which supply drinking water to thousands of Salinas Valley residents. Because of the extent of seawater intrusion in and near these areas, further extraction of groundwater from the water-bearing strata between zero feet mean sea level and -250 feet, within the territory defined in Section 1.01.03.D of this ordinance, would be harmful to the groundwater basin.

1.01.02 PURPOSE

It is the purpose of this ordinance to prohibit groundwater extractions from extraction facilities located in the northern Salinas Valley with perforations between zero feet mean sea level and -250 feet as of January 1, 1995, so as to reduce the rate of seawater intrusion and allow recharge to raise groundwater levels.

1.01.03 DEFINITIONS

A. AGENCY shall mean the Monterey County Water Resources Agency.

B. GROUNDWATER EXTRACTION FACILITY ("Facility") shall mean a groundwater well or facility for the extraction of groundwater which employs a motor-driven pump for the extraction of groundwater and which has a discharge pipe with an inside diameter equal to or greater than 3 inches.

C. PERSON shall mean an individual; a sole proprietorship, corporation, partnership, association, trust, or any other form of business or non-profit entity; or a city, county, state, the United States, or any other federal, state, local or foreign government entity.

D. TERRITORY A shall mean that portion of the northern Salinas Valley bounded by Highway 183 (beginning at Blackie Road) to Davis Road to Laurel Drive to Highway 101 to the Pressure-East Side boundary to Blackie Road back to Highway 183, as more particularly described in Attachment A. The boundary between the Pressure and East Side Areas is described on a map on file with the Clerk of the Board of Supervisors and in the office of the Monterey County Water Resources Agency.

E. TERRITORY B shall mean that portion of the northern Salinas Valley bounded by Highway 183 (beginning at Blackie Road) to Davis Road to Laurel Drive to Sanborn Road to Highway 101 to Harris Road to Zone 2A boundary to Potrero Road to Highway 1 to Highway 183 to Blackie Road, as more particularly described in Attachment B.

F. WATER REPORTING YEAR shall be from November 1 to October 31 of the following year.

G. WATER SUPPLIER shall mean a person who owns or operates a groundwater extraction facility.

H. WATER USER shall mean a person who receives water from a groundwater extraction facility for consumptive use.

PART II -- PROVISIONS

1.01.10 GROUNDWATER EXTRACTIONS PROHIBITED IN TERRITORY A

After January 1, 1995, no person may cause, suffer, or permit the extraction of groundwater from any groundwater extraction facility located in territory A, as defined in Section 1.01.03.D, with perforations between zero feet mean sea level and -250 feet.

1.01.11 NEW GROUNDWATER EXTRACTION FACILITIES PROHIBITED IN TERRITORY B

After January 1, 1995, no person may construct within territory B, as defined in Section 1.01.03.E, any groundwater extraction facility with perforations located between zero feet mean sea level and -250 feet.

1.01.12 REPORTING REQUIREMENTS IN TERRITORY A

Under Agency Ordinance No. 3663, every water supplier must submit to the Agency an annual groundwater extraction report, following the close of each water reporting year during any part of which the water supplier maintained an operational groundwater extraction facility. The annual report for the 1994-95 water reporting year submitted by each water supplier extracting water from territory A, regardless of the depth from which the water is extracted, shall show extractions for that part of the 1994-95 water reporting year prior to January 1; for that part of the 1994-95 water reporting year after January 1, the report shall accurately reflect no groundwater extractions from between zero feet mean sea level and -250 feet in territory A, as defined in Section 1.01.03.D.

1.01.15 VARIANCES

A. Any person may, at any time, apply in writing for a variance from the strict application of this ordinance. The application for the variance shall be filed with the Agency. The General Manager may dispense with the requirement of a written application upon finding that an emergency condition requires immediate action on the variance request.

B. The applicant shall submit an action plan within 30 days after the variance request is filed, describing how and when the applicant will comply with this ordinance without the need for a variance. Compliance with this plan, as presented by the applicant or as modified by the General Manager, shall be a condition of granting the variance.

C. The General Manager may grant a variance to the terms of this ordinance upon making the finding that the strict application of the ordinance would create an undue hardship, or an emergency condition requires that the variance be granted.

D. In granting a variance, the General Manager may impose any conditions in order to ensure that the variance is consistent with the overall goals of this ordinance. Variances may be granted for a limited period of time. The variance and all time limits and other conditions attached to the variance shall be set forth in writing, and a copy of the written variance shall be provided to the applicant.

E. The decision of the General Manager on an application for a variance may be appealed as provided in the section of Ordinance No. 3539, as now in effect or as subsequently amended or superseded, pertaining to appeals.

F. No person shall operate or maintain a groundwater extraction facility or water distribution system for which a variance has been granted hereunder, or use water therefrom, in violation of any of the terms or conditions of the variance.

1.01.20 PENALTIES

A. Any person who violates any provision of this ordinance is guilty of an infraction.

B. Any violation of this ordinance is hereby declared to be a public nuisance.

C. Any violation which occurs or continues to occur from one day to the next shall be deemed a separate violation for each day during which such violation occurs or continues to occur.

D. Any person who violates this ordinance shall be assessed a fine of $100 for each violation.

E. Any person who violates this ordinance shall be liable for the cost of enforcement, which shall include but need not be limited to:

1. Cost of Investigation
2. Court Costs
3. Attorney Fees
4. Cost of Monitoring Compliance

PART II -- CONCLUDING PROVISIONS

1.01.22 SEVERABILITY

If any section, subsection, paragraph, sentence, clause, or phrase of this ordinance is for any reason held to be invalid or unconstitutional by a decision of a court of competent jurisdiction, it shall not affect the validity of the remaining portions of this ordinance, including any other section, subsection, sentence, clause, or phrase therein.

SECTION 2. EFFECTIVE DATE. This ordinance shall take effect 30 days after its final adoption by the Board of Supervisors.

PASSED AND ADOPTED this 14th day of Sept., 1993, by the following vote:

AYES: Supervisors Salinas, Shipnuck, Perkins, Johnsen & Karas
NOES: None
ABSENT: None

BARBARA SHIPNUCK, Chairwoman
Board of Supervisors

ATTEST:

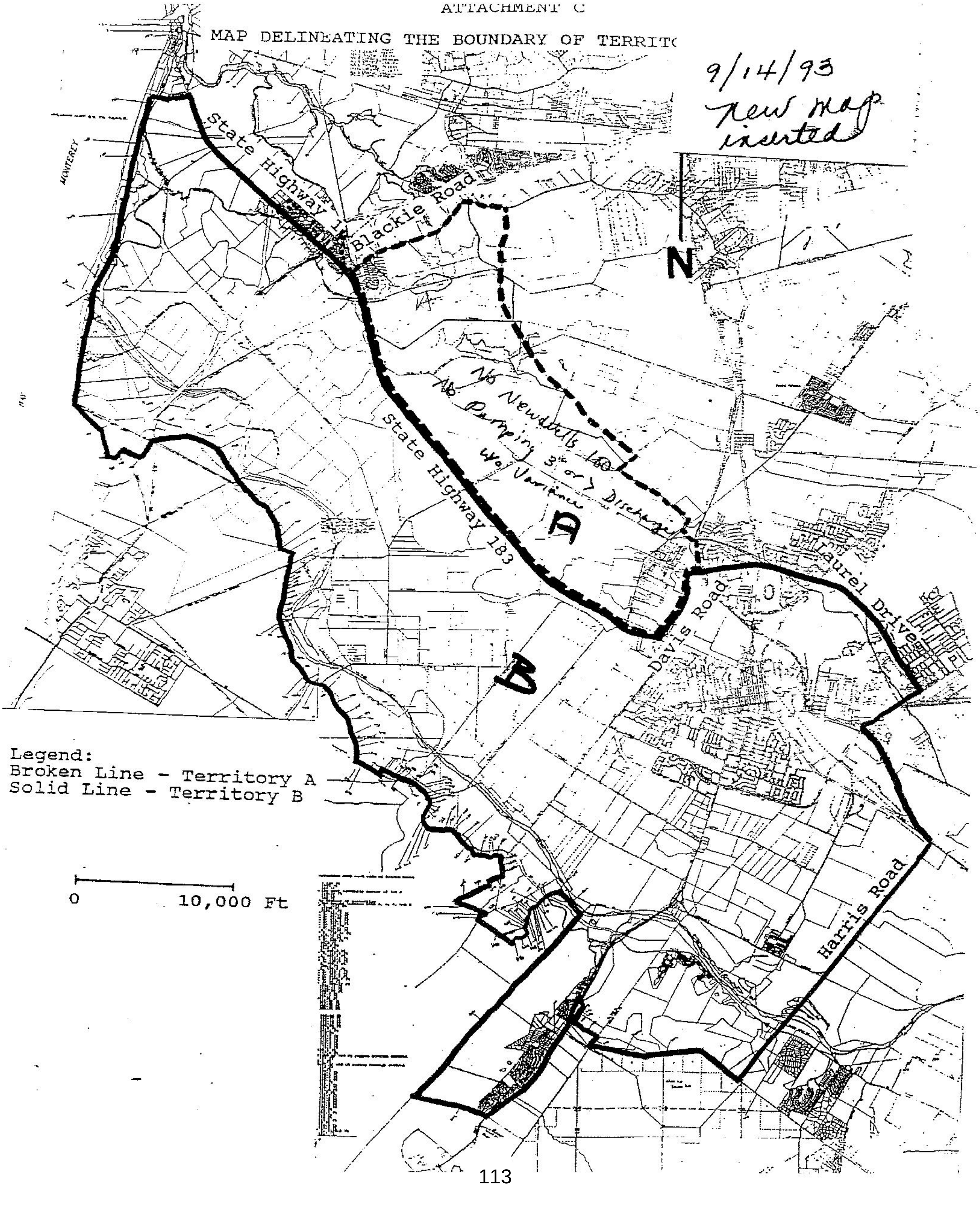
ERNEST K. MORISHITA
Clerk of the Board

By ______________________
Deputy

(NOMO180.ORD -- 9/14/93)

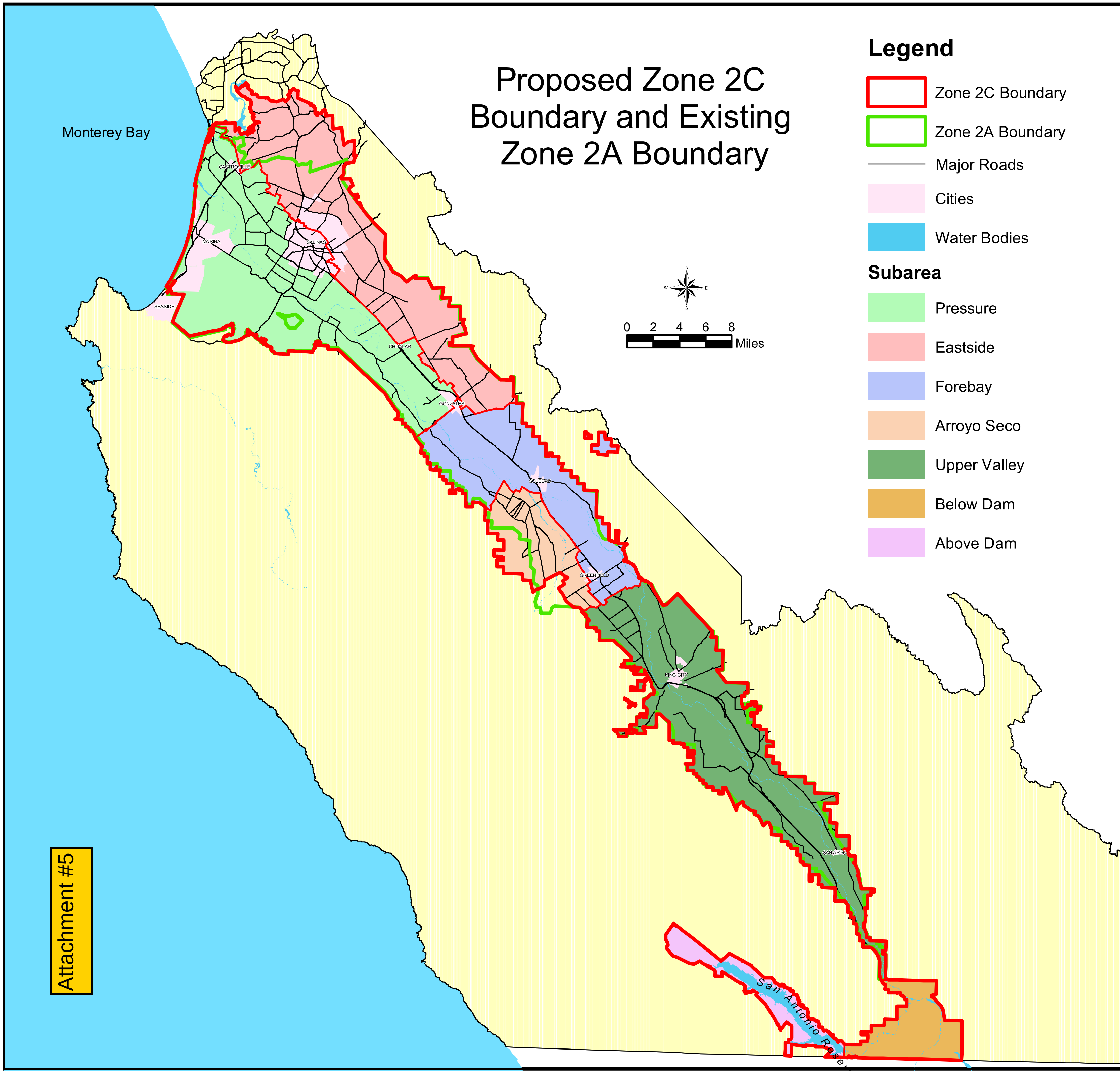
ATTACHMENT C

MAP DELINEATING THE BOUNDARY OF TERRITO



Attachment #5

Proposed Zone 2C Boundary and Existing Zone 2A Boundary



Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guidefor survey or design work.

Map Date: January 24, 2003

LAW OFFICES OF
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RECEIVED
5-3-13
SWRCB Hearing Unit

May 3, 2013

Via Email Wr_Hearing.Unit@waterboards.ca.gov
Paul Murphey
Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

Subject: SWRCB staff document entitled "Draft Review of California American Water Company's Monterey Peninsula Water Supply Project" Notice of Opportunity for Public Comment dated April 3, 2013

Dear Mr. Murphey:

We represent Ag Land Trust, which makes the following comments on the "Draft Review of California American Water Company's Monterey Peninsula Water Supply Project."

Interest of Ag Land Trust

Ag Land Trust is a not-for profit public benefit corporation. Its mission is the preservation of agricultural land in the Salinas Valley. Ag Land Trust has preserved more than 25,000 acres of farmland in Monterey County. Ag Land Trust owns prime agricultural land, as defined by the California Department of Conservation, in the area known as Armstrong Ranch. This productive agricultural property is adjacent to the proposed slant well site for the new Cal-Am project. Ag Land Trust has water rights in the Salinas Valley Groundwater Basin arising from its ownership of the prime agricultural land.

Over the last decade, the Ag Land Trust has commented repeatedly to the California Public Utilities Commission (CPUC) raising concerns about water rights and water quality. From the "Draft Review," it appears that the SWRCB staff may not have received all the relevant documents in the CPUC's possession. We attach some of the Ag Land Trust's written comments to the CPUC, starting in 2006.

In Superior Court, Ag Land Trust challenged the reliance upon the EIR called the "Coastal Water Project Environmental Impact Report." The Superior Court found in favor of Ag Land Trust, and found that the EIR was flawed in seven material ways, including an inadequate water rights analysis. We attach the judgment of the Superior Court.

SWRCB authority in this matter

The SWRCB has no authority over percolating groundwater that is being put to beneficial use. (Water Code, § 1200 et seq.) The Courts of the State of California have jurisdiction over nonadjudicated percolated groundwater basins in the state. (*Los Angeles v. Pomeroy* (1899) 124 Cal. 597; *Katz v. Walkinshaw* (1903) 141 Cal. 116.)

The Salinas Valley Groundwater Basin is a percolated groundwater basin. The unadjudicated basin is in overdraft.

The SWRCB's Notice of Opportunity for Public Comment states that "The [California Public Utilities] Commission requested an assessment from the State Water Board on whether Cal-Am has the legal right to extract groundwater for the Project." Under the circumstances, including the SWRCB's lack of authority, the lack of reliable information provided to the SWRCB, and the highly controversial nature of the issues, Ag Land Trust wonders why the SWRCB would want to extend an opinion "on whether Cal-Am has the legal right to extract groundwater for the Project."

For that reason, any "assessment" by the SWRCB is an opinion. If the SWRCB pursues this effort, any SWRCB "assessment" should include a description of the SWRCB's authority and limitations. To date, the CPUC's many years of environmental and review of the Cal-Am projects have failed to adequately account for Salinas Valley water rights. Cal-Am has sought to build additional projects because of its lack of adequate water rights in the Carmel Valley (SWRCB Order 95-10) and the recently adjudicated Seaside groundwater basin. The SWRCB should reject any effort by the CPUC to set up the SWRCB for blame if this project fails, as prior Cal-Am projects have failed.

Comments on the "Draft Review"

For ease of review, we provide excerpts of the SWRCB staff "Draft Review" document in indented quotes, followed by our comments.

> "Cal-Am proposes several approaches that it claims would legally allow it to extract water from the Salinas Valley Groundwater Basin (SVGB or Basin) near or beneath Monterey Bay without violating groundwater rights or injuring other groundwater users in the Basin." (p. i.)

In an overdrafted, percolated groundwater basin, California groundwater law holds that the doctrine of correlative overlying water rights applies (*Katz v. Walkinshaw* (1903) 141 Cal. 116), whereby no surplus water is available for new groundwater appropriators, except by prescription. In an overdrafted basin, as a junior appropriator, there is no water available for Cal-Am to appropriate. (*Pasadena v. Alhambra* (1949)

33 Cal.2d 908.) Any groundwater extraction by Cal-Am would constitute a violation of the groundwater rights of existing water rights holders.

> "The conditions in the aquifer where MPWSP feedwater would be extracted could be either confined or unconfined however; there is currently not enough information to determine what type of conditions exist at the location of the MPWSP wells." (p. i.)

Ag Land Trust agrees with this statement. The statement emphasizes the need to have a comprehensive and reliable model of the basin, including the projects that have been implemented in the basin to slow or halt seawater intrusion. The model should be completed and provided for public review and analysis prior to any drilling or pumping of a test well.

> "Effects from confined aquifer pumping would be observed over a larger area than if extraction occurred from an unconfined aquifer. Previous studies done in the one of [sic] proposed MPWSP well locations indicate that there would be an approximate 2-mile radius zone-of-influence if groundwater was pumped from an unconfined aquifer. It is unknown what the effects would be if water was pumped from a confined aquifer with different hydrogeologic conditions." (p. i.)

The community of Castroville is within a 2-mile radius of the proposed well site. Castroville has a largely minority and underprivileged population. Cal-Am is proposing to pursue a project that would cause harm to the users of the potable aquifer. There is transference from the 180 to the 400 aquifer, which is why the County of Monterey has adopted well closure ordinances. The County of Monterey and the local farmers have deliberately refrained from pumping from the coastal 180-aquifer, in order to try to prevent further harm to the aquifer. Now Cal-Am is proposing to implement the same detrimental conduct that the farmers and the County have largely ceased. The environmental justice issues here are significant, and State policies prohibit the disproportionate effect upon the underprivileged populations.

> "The aquifers underlying the proposed extraction locations have been intruded with seawater since at least the 1940's. The impairment means that there is little or no beneficial use of the water in the intruded area." (p. i.)

This is not accurate. Ag Land Trust is actively using water from its onsite well. Within 100 feet of the Cemex property, the Ag Land Trust is currently using its well and well water from and on the Armstrong Ranch to grow vetch grass, rye grass, and native dune poppy crops for the production and development of native seed stock for Ag Land Trust's dune stabilization and recovery program. The well water is pumped from the recovering aquifer.

More than one acre of Ag Land Trust property has been planted and is being irrigated with groundwater from the Ag Land Trust well. This is an existing and on-going "beneficial use" of Ag Land Trust's existing potable groundwater rights that will be directly and permanently compromised by Cal-Am's intentional contamination of the 180 foot aquifer from the proposed project. The SWRCB staff conclusion that the aquifers near the proposed Cal-Am wells are irretrievably contaminated and not usable is conclusory and unsupported. Ag Land Trust reports that from 2004 to 2010, the CPUC staff did not contact local landowners, and did not provide notice as mandated by CEQA to landowners affected by the original Cal-Am project The SWRCB staff opinion apparently relies upon an EIR that was overturned by the Superior Court in early 2012. Existing use of the groundwater for existing and recognized beneficial uses by overlying landowners has been ignored by Cal-Am, the CPUC and the now-discredited EIR.

The existing beneficial use of the groundwater by Ag Land Trust means that the project's reduction in the quantity of available fresh water would be felt immediately on in-Basin groundwater users, contrary to the conclusory statements in the Draft Review (e.g., pp. 27-28, 37).

> "To appropriate groundwater from the Basin, the burden is on Cal-Am to show injury to other users. Key facts will be the following: (1) how much fresh water Cal-Am is extracting as a proportion of the told pumped amount, to determine the amount of treated water considered as desalinated sea water, available for export as developed water . . ." (p. ii.)

The statement is not accurate. The burden is on Cal-Am to prove there will not be any injury to other users. Ag Land Trust has asserted since 2004 that the proposed wells would cause injury to Ag Land Trust and to other water rights holders in the basin.

> "(3) how Cal-Am should return any fresh water it extracts to the Basin to prevent injury to others . . ." (p. ii.)

The injury of illegal appropriation occurs at extraction. The injury cannot be repaired. By virtue of taking the water out without legal right, Cal-Am would cause injury to holders of existing water rights. The extraction of fresh water from beneath an overlying property owner by a junior appropriator in an overdrafted basin would violate the law.

> "Both near and long-term, a physical solution that protects legal users in the Basin from harm would permit Cal-Am to extract groundwater. Even if overdraft conditions continued in the Basin following imposition of the solution, Cal-Am could legally continue pumping brackish water so long as the quantity and method of extraction are not detrimental to the conditions in the Basin and other Basin users' rights, taking into account replacement water provided as part of the project." (p. ii.)

The statements are not accurate. Physical solutions to slow or halt seawater intrusion in the Salinas Valley Groundwater Basin have been approved by public elections of the voters, and have been constructed expressly for the purposes of slowing or halting seawater intrusion. Ag Land Trust and hundreds of its neighbors have paid, and continue to pay, many millions of dollars for assessments for multiple Monterey County public projects to address seawater intrusion. Perhaps the CPUC has failed to inform the SWRCB of the expenditure of the public monies and the construction and ongoing operation of the publicly owned facilities for the benefit of the public. This has created the current situation that Cal-Am hopes to exploit. Cal-Am has not paid into these public facilities.

> "Cal-Am should have the opportunity to show any desalinated water it produces is surplus to the current needs of the Basin, replacement water methods are effective and feasible, and the MPWSP can operate without injury to other users." (p. ii.)

There is no basis in case law for this conclusion, absent adjudication of the Salinas Valley Groundwater Basin. If SWRCB staff intends to recommend adjudication, which is implied by the Draft Review's lengthy discussion in section "6.3 Physical Solution Discussion" at pages 33 to 38, SWRCB staff should do so publicly and as early as possible in the process.

> "Studies are needed to determine the extent of the Dune Sand Aquifer, the water quality and quantity of the Dune Sand Aquifer, the extent and thickness of the Salinas Valley Aquitard and the extent of the 180-Foot Aquifer." (p. iii.)

Ag Land Trust agrees. These studies, using a comprehensive hydrologic model, are needed before any test wells are drilled and the aquifers are further intruded with seawater thereby causing harm to overlying landowners.

> "Specifically, a series of test boring/wells would be needed to assess the hydrogeologic conditions at the site. Aquifer

> testing would also be needed to establish accurate baseline conditions to determine the pumping effects on both the Dune Sand Aquifer and the underlying 180-Foot Aquifer. Aquifer tests should mimic proposed pumping rates." (p. iii.)

The proposed test wells will cause irreparable harm to the groundwater supply and groundwater rights of the Ag Land Trust. The proposed test wells are approximately 400 feet from Ag Land Trust property. The proposed test wells would fulfill Cal-Am's desire to deliberately pollute the aquifer. The pollution would be detrimental to in-basin overlying land owners and water rights holders.

> "The studies will form the basis for a plan that avoids injury to other groundwater users and protects beneficial uses in the Basin." (p. iii.)

See above comments regarding adjudication. This statement presumes that it is possible to avoid injury. Under *Pasadena v. Alhambra*, *supra*, there is a presumption that appropriation of groundwater from an overdrafted basin by a junior appropriator with no existing rights will cause injury to senior groundwater users and existing beneficial uses in the basin.

> "In a letter dated September 26, 2012, the California Public Utilities Commission (Commission) asked the State Water Resources Control Board (State Water Board) whether the California American Water Company (Cal-Am) has the legal right to extract desalination feedwater for the proposed Monterey Peninsula Water Supply Project (MPWSP). The Commission stated it is not asking for a determination of water rights, but is instead requesting an opinion as to whether Cal-Am has a credible legal claim to extract feedwater for the proposed MPWSP, in order to inform the Commission's determination regarding the legal feasibility of the MPWSP." (p. 1.)

The SWRCB has no jurisdiction over percolated groundwater basins. More troubling is the fact that the CPUC apparently failed to disclose to the SWRCB ten years of correspondence from senior water rights holders in the Salinas Valley advising the CPUC that Cal-Am has no groundwater rights and cannot acquire groundwater rights absent deliberate contamination of the groundwater or pursuing adjudication of the groundwater basin. (E.g., see attached correspondence from Ag Land Trust.)

> "This paper will (1) examine the readily available technical information and that provided by the Commission" (p. 1.)

The term "readily available technical information" is not defined. It raises serious concerns as to the adequacy of the information that will be considered. The SWRCB should clearly state what information the SWRCB staff considers to be "readily available." The SWRCB should investigate and pursue all needed information.

The Monterey County Water Resources Agency is not a reliable source of information, because under a 2012 settlement agreement with Cal-Am the Agency is prohibited from speaking freely about the current Cal-Am project. This settlement was made to resolve a lawsuit filed by Cal-Am against Monterey County Water Resources Agency. The lawsuit and settlement agreement are public records.

> "In January 2009, the Commission issued a Draft Environmental Impact Report (EIR) for the Coastal Water Project and two project alternatives – the North Marina Project and the Monterey Regional Water Supply Project (Regional Project). In October 2009, the Commission issued the Final EIR (FEIR) and in December 2009, it certified the FEIR. In December 2010, the Commission approved implementation of the Regional Project." (p. 2.)

> "State Water Board staff analyzed the NOP and how closely the new description matched the alternatives in the December 2009 FEIR completed for the Coastal Water Project." (p.3.)

> "Of the two project alternatives in the FEIR, the North Marina Project more closely resembled the proposed MPWSP described in the NOP. For this reason, State Water Board staff assumed most of the information, including the slant well construction and operation as described in the FEIR – North Marina Project Alternative, was applicable to the proposed MPWSP." (p. 3.)

Reliance on the EIR is not merited. The EIR was found to be inadequate by the Monterey County Superior Court. The EIR may have relied on information from the former chairman of the Monterey County Water Resources Agency board of directors, who resigned and is facing more than 30 felony counts, including two counts for conflicts of interest violations arising from his work for the Regional Desalination Project while on the Water Resources Agency board. The other counts allegedly arise from his work for one of the coastal agricultural interests.

> "The new information provided to the State Water Board includes: an updated project description, changes in the location and configuration of the extraction well system, new

> information about the nature of the 180-Foot Aquifer, timing of implementation for certain mitigation measures, and supplemental testimony from Richard Svindland of Cal-Am." (p. 3.)

Please state who provided "the new information." It appears to have come solely from Cal-Am and/or the CPUC. There has not been an opportunity for landowners to meet with SWRCB staff and express their concerns regarding the proposed project.

> "The preferred alternative would consist of 7 to 9 slant wells that would draw water from under the ocean floor by way of gravity for delivery to the desalination plant." (p. 4.)

Due to cones of depression, Cal-Am would be taking fresh water. Pumping from beneath the Monterey Bay National Marine Sanctuary would violate the 1992 Memorandum of Agreement to which the SWRCB is a signatory through the California Environmental Protection Agency. Such pumping would violate the Sanctuary rules regarding removal and exploitation of Public Trust resources within the Sanctuary, including fresh water seeps.

> "A near-surface water-bearing zone comprised of dune sands, commonly referred to as the "Dune Sand Aquifer", also exists but is considered a minor source of water due to its poor quality. The Dune Sand Aquifer is not regionally extensive and is not a recognized subbasin within the SVGB. The amount of groundwater in storage in the Dune Sand Aquifer is unknown." (p. 8.)

There is no current pumping from the so-called Dunes aquifer. To the limited extent the aquifer exists, its sources of recharge are solely rainfall and irrigation water. The amount of storage is highly variable based on recharge. The aquifer is currently largely fresh water because it has not been pumped for years due to efforts by land owners to reverse seawater intrusion and the County prohibition on wells in the coastal area in question. The SWRCB staff conclusion that the so-called aquifer is a contaminated water source does not change the fact that the proposed project would wrongfully allow Cal-Am to intentionally induce seawater into a recovering potable water formation and compromise many years of efforts of local land owners to reverse seawater intrusion in the Salinas Valley.

At pages 8 and 18, the draft SWRCB staff document refers to the "Deep Aquifer." The SWRCB staff may not be aware that the preferred reference is to the "Deep Aquifers" because there are more than one. The Deep Aquifers provide the sole potable water supply for the City of Marina and most of the former Fort Ord. The technical studies report that the volume of storage in the Deep Aquifers is small, the

Deep Aquifers are not sustainable, and the recharge to the Deep Aquifers is insignificant.

> "The 180-Foot Aquifer is generally confined by the overlying Salinas Valley Aquitard (SVA). The SVA is a well-defined clay formation with low permeability that retards the vertical movement of water to the underlying 180-Foot Aquifer." (p. 9.)

The draft report fails to acknowledge the existence of old, largely hand-dug wells into the shallow aquifer, which were closed some fifty or more years ago. The wells were closed with dirt, instead of with a solid impermeable material like concrete. The dirt allows seawater-intruded water in the shallow aquifer to flow down the well casing to the 180-foot aquifer. There is transference between the shallow aquifer and the 180-foot aquifer and the 400-foot aquifer. To the extent that the proposed Cal-Am wells will cause further seawater intrusion of the shallow aquifer, seawater will exacerbate seawater intrusion into the 180-foot aquifer. The 180-foot aquifer is currently widely used for potable and agricultural uses.

> "Based on information from logs of two wells located approximately ½ mile south and ½ mile northeast from the proposed MPWSP slant wells, the top of the SVA is between 150 to 180 feet below msl. The well logs show the top of the underlying 180-Foot Aquifer at approximately 190 to 220 feet below msl." (p. 9.)

Please reveal the sources of the information, so the public can comment meaningfully. To the extent that the SWRCB staff is relying on information provided by Cal-Am or in the EIR, those sources may not be accurate. The SWRCB staff should consider all necessary information. The presence of old wells and gaps in the aquitard would affect the analysis.

> "Studies have shown that in some areas the SVA thins enough to create unconfined conditions in the 180-Foot Aquifer. It is unknown if these unconfined conditions exist in the proposed MPWSP well area. Determination of the existence of the SVA, and thus the conditions of the aquifer at the location of the proposed MPWSP wells will be very important in determining the area of impact of the project as discussed at greater length in Section 5 of this report." (p.9.)

> "The amount of 500 mg/L chloride water that enters the Basin was reported to be as high as 14,000 acre-feet per annum (afa) or 4.5 billion gallons." (p. 13.)

These claims further demonstrate that comprehensive modeling must be performed to provide accurate information.

> "The MRWRA and the Central Coast Regional Water Quality Control Board show impairment to the water in the intruded area for drinking and agricultural uses. Since this groundwater is impaired, it is unlikely that this water is or will be put to beneficial use." (p. 14.)

The conclusion is not accurate. One example of this is the beneficial use to which Ag Land Trust is putting groundwater from and on its Armstrong Ranch site, adjacent to the Cemex site. Separately, we are not familiar with an agency called "MRWRA." Please clarify if the State means MCWRA, which is the Monterey County Water Resources Agency.

> "Local agencies have taken steps to reduce the rate of seawater intrusion and enhance groundwater recharge in the SVGB. To address the seawater intrusion problem, the MCWRA passed and adopted Ordinance No. 3709 in September 1993." (p. 14.)

Cal-Am's proposed project would violate both state statutes and the mandates of the California Constitution, and unlawfully interfere with and compromise the express intent, purpose, and financing of the Salinas Valley Water Project (including the Rubber Dam) that was voted upon by land owners of the Salinas Valley Groundwater Basin over a decade ago. The multi-million dollar "Rubber Dam" project and its voter-approved assessment district were proposed and placed on the ballot in Monterey County for the purpose of reversing and curing the seawater intrusion issues in the basin. This assessment district for this public funded capital project was placed on the ballot pursuant to article XIIID of the California Constitution (Prop. 218). The purpose of the project (the property related service) was and remains the provision of potable water, in part, to reverse seawater intrusion and restore the damaged but still viable potable aquifers near the coast and throughout the lower basin.

Article XIIID, section 6(b)(1), requires that "Revenues derived from the fee or charge shall not exceed the funds required to provide the property related service." Article XIIID section 6(b)(4) prohibits a fee or charge except where the property related service is actually used by the parcel owner. The SVWP Rubber Dam is a publicly owned and publicly funded capital project to which Cal-Am has contributed nothing. Cal-Am has no right or entitlement to water from the overdrafted Salinas aquifers and the SVWP Rubber Dam. The assessments levied only upon in-basin property owners and overlying water rights holders are expressly for the benefit of overlying properties (and the beneficial uses of water thereon) that receive the paid-for "service" of that project. Neither the SWRCB nor the CPUC has demonstrated the authority or right to interfere with that provision of these constitutionally mandated services, nor may they support any action that would undermine or interfere with the repayment of the public funding sources (certificates of participation and loans) that have been used to construct these publicly owned capital facilities. Cal-Am's project would directly interfere with this multi-million dollar project intended to restore the aquifers that Cal-Am wants to pollute and exploit in violation of the SWRCB Non-Degradation Policy. The CPUC and Cal-Am have ignored this insurmountable impediment to Cal-Am's intention to illegally and wrongfully "take" water from the overdrafted Salinas basin to which Cal-Am has no claim of right.

The CPUC and Cal-Am have failed to explain how they also intend to ignore or circumvent the MCWRA statutory prohibition on the export of "any" groundwater from the Salinas Valley basin. The offer to somehow "return the fresh groundwater" that Cal-Am would be illegally and wrongfully "taking" through their slant wells ignores the injury and is legally insufficient.

In spite of repeated objections and a lawsuit by the Ag Land Trust, the CPUC and Cal-Am have failed to address how they can "whitewash" Cal-Am's proposed illegal taking of water from the aquifers of the Salinas Valley so as to cure Cal-Am's illegal taking of underflow from the Carmel River.

> "The CSIP is a program operated by the Monterey County Water Pollution Control Agency that reduces groundwater pumping from seawater intruded areas and distributes recycled water to agricultural users within the SVGB."
>
> "The program provides a form of groundwater recharge by effectively reducing groundwater extraction in those areas of the Basin that are part of the CSIP area." (p. 14.)

Using funds of the local farmers, the CSIP has recharged the Sand Dune Aquifer. Cal-Am was not the intended beneficiary of that action.

> "Despite these and other efforts, seawater intrusion continues its inland trend into the Basin." (p. 14.)

The SWRCB staff conclusion is inconsistent with the position taken by the MCWRA and its legal counsel. The MCWRA position, affirmed recently, is that seawater intrusion has not worsened. Please respond, clearly state the SWRCB position, and address the inconsistency with the MCWRA position.

> "Additionally the past data provides insight into future conditions which could be expected absent the MPWSP." (p. 14.)

The conclusion is not supported. As one example, past data does not include the results of the Salinas Valley Water Project, a Proposition 218 project funded by Salinas Valley property owners. MCWRA is the project sponsor. All components of the Salinas Valley Water Project (SVWP) only recently became operable. The MCWRA has repeatedly stated that it will take at least ten years – after full operations began – before results of the SVWP can start to be known. The SVWP may significantly change future conditions.

> "Groundwater recharge in the lower portion of the Salinas Valley is largely by infiltration along the channel of the Salinas River and its tributaries. This accounts for approximately 50 percent of the total recharge within the SVGB. Approximately 40 percent of the total recharge is from irrigation return water with the remaining 10 percent due to precipitation, subsurface inflow and seawater intrusion." (p. 16.)

The Salinas Valley Water Project may materially affect the unsupported groundwater recharge conclusions made by SWRCB staff. A comprehensive hydrologic model is needed, and would include the Salinas Valley Water Project operations.

> "Based on the occurrence of large pumping depressions in inland areas, it can be reasonably assumed that there is a strong landward gradient (slope) of groundwater flow, at least within the 180-Foot Aquifer. However, because the degree of confinement of the 180-Foot Aquifer and the degree of connection between this aquifer and the overlying Dune Sand Aquifer are not known it is not possible to accurately predict what the effects of the landward gradient of groundwater flow will be for various extraction scenarios." (p. 17.)

These statements are largely speculation. They fail to adequately account for recharge from the operation of the dams (Nacimiento and San Antonio) and publicly funded projects (Castroville Seawater Intrusion Program and Salinas Valley Water Project). The conclusions are based on outdated information that was produced prior to the Salinas Valley Water Project.

> "A groundwater model that accurately reflects the hydrogeologic characteristics of the Basin is critical in providing insight to the effects the MPWSP would have on the Basin. As part of the FEIR for the Coastal Water Project, a local groundwater flow and solute transport model

> (Model) was developed to determine the effects that pumping would have on groundwater levels and seawater intrusion in the area." (p. 18.)

The EIR was found to be inadequate by the Superior Court. Among the issues raised by Ag Land Trust were assumptions made about the EIR model, including the effects of pumping, the nature of pumping, and the percentage of seawater in the water to be pumped. Ag Land Trust pointed out material inconsistencies in the EIR analysis. Ag Land Trust also raised concerns about the inconsistencies between the EIR model and the known causes of seawater intrusion.

> "The gravity well design is a new alternative presented to the State Water Board for evaluation at the CEMEX owned property. State Water Board staff previously evaluated a pumping well alternative at the CEMEX site and found that the pumped wells would have an impact to groundwater users within a 2–mile radius of the wells. Since modeling has not been done for the gravity well alternative, State Water Board staff is unable to accurately predict impact to existing users from the gravity wells." (p. 20.)

What can be accurately predicted is that the well would result in permanent contamination of Ag Land Trust's well, the loss of groundwater rights, and the permanent loss of potable water supply.

> "The potential impacts from the pumping wells at this site cannot be yet be determined since groundwater modeling has not been done. Until an accurate groundwater model is developed for this area, State Water Board staff is unable to determine the extent of impacts to existing water users." (pp. 20-21.)

Ag Land Trust agrees that the full severity of impacts cannot be predicted without an accurate and comprehensive groundwater model. Ag Land Trust's position is that the proposed wells would cause the permanent contamination of the Ag Land Trust well and groundwater on Ag Land Trust property adjacent to the Cemex site, and that injury can be accurately predicted now, at this stage. New slant wells being pumped continuously by Cal-Am predictably will reverse progress made toward protecting and improving the water quality of the Salinas Valley aquifers.

The Draft Review relies extensively on vague references to the EIR documents, including modeling done for the EIR, which is largely unsupported by reference to any document and page (e.g., Draft Review, p. 35). For example, the Draft Review section "5.3 Groundwater Capture Zone Delineation" (pp. 21-22) is unsupported by any reference to specific documents and pages. The sole reference in the text is a general reference to “the FEIR groundwater modeling studies” without any specific citation. The studies were prepared by the applicant, and have not been adequately peer reviewed.

The Ag Land Trust litigation challenged assumptions made in the EIR modeling, including assumptions of continuous pumping for 56 years, and the percentages of seawater and fresh water that would be in the groundwater. The Superior Court overturned the EIR and ordered that the environmental analysis be redone. Before the SWRCB relies on the FEIR or any studies done by the applicant, the SWRCB first should require expert peer review and provide the results to the public. Separately, as the Draft Review acknowledges, the EIR modeling did not explore some proposed scenarios. (E.g., p. 27 [“Modeling in the FEIR did not predict the effects of pumping from a confined condition, so there are no estimates on the extent of potential impacts.”].) The proposed conclusions are unsupported and inconsistent with hydrogeologic evidence and with the actions of local agencies. To the extent that the conclusions are predicated on a continuing increase of the cone of depression, they are unsupported.

To the extent that Section 5.3 assumes certain gradients and what the proposed wells will or will not capture (e.g., p. 21), those assumptions are unproven and unsupported, and contradict many years of hydrologic research.

The Draft Review section “5.4 Extraction Scenarios” (pp. 22-27) is conclusory and unsupported. The section is speculative, and it fails to acknowledge the limited authority of the SWRCB in these matters. The section lacks citation to evidence, except for a couple of references to the discredited EIR, and a couple of references to a general groundwater treatise that is not helpful in light of the facts here, which include a well in an overdrafted basin immediately adjacent to an ocean, where the pressure from the ocean water exceeds the pressure from the inland fresh groundwater. This section is another example of inappropriate reliance on the discredited EIR.

> “The lowering of groundwater levels approximately 2 miles from the slant wells likely would be negligible.” (p. 24)

The conclusion is not accurate or supported. The proposed pumping of some 25,000 AFA would remove a very large volume of groundwater from the aquifer. That would cause a change in the water quality and water levels. The EIR models did not adequately take the volume of water into account.

> “According to information from the State Water Board’s GAMA database, approximately 14 wells are within 2 miles of the proposed MPWSP (Figure SWRCB 8). All of these wells are within the seawater-intruded portion of the Basin. The MPWSP drawdown would change the groundwater

> gradient within the zone of influence causing a radial flow of groundwater toward the extraction wells. Currently, the predominant groundwater flow direction in the 180-Foot Aquifer is toward the northeast. Project pumping would likely change the flow direction to more of a southwest to westerly direction within the zone of influence. Outside the zone of influence there would be little if any change to groundwater flow direction; however, the rate of flow in the original direction (northeast) would be reduced. Therefore, the MPWSP would slow the rate of seawater intrusion in a landward direction from the wells." (p. 24)

The Draft Review's conclusion that pumping the slant wells "would slow the rate seawater intrusion in a landward direction" is inconsistent with the fact that pumping is what has caused seawater intrusion. It is not clear why the Draft Review thinks the Cal-Am wells would have a different result from what has been proven to be true in the Salinas Valley and elsewhere.

As a separate problem, the Draft Review does not identify the depth of the wells within a 2-mile radius. The conclusion that "All of these wells are within the seawater-intruded portion of the Basin" is not supported. Some of the wells may be in non-intruded aquifers.

As a separate problem, the Draft Review's conclusions are inconsistent with the Monterey County Board of Supervisors' recent adoption of revised General Plan policy PS-3.1 which provides the assumption that all development within Zone 2C has a long term sustainable water supply. Zone 2C includes much of the Salinas Valley floor, including the coastal areas that would be affected by the proposed wells. In other words, Monterey County has taken the position that the aquifers provide potable and usable water. Monterey County made that conclusion on the basis of the new Salinas Valley Water Project. Zone 2C is an assessment district to which landowners are paying millions of dollars. Zone 2C assessments fund the SVWP which is purportedly a remedy for seawater intrusion now and in the future.

> "While a portion of the water flowing to the well does come from the less saline water on the shoreward side, the relative percentage of water drawn from the shoreward side of the wells will depend on various factors, including the gradient of groundwater flow toward inland pumping depressions." (p. 26.)

Cal-Am does not have a right to this groundwater. The Draft Review's reliance on a 87% seawater/13% fresh water proportion is not appropriate. The unreliable EIR data is from the 180-aquifer, and showed that the proportion changed over time to 60%

seawater/40% fresh water. The mention of 3,250 AFA of fresh water (assumed to be 13%) improperly minimizes the impact of that pumping. It would be a huge illegal appropriation.

> "It is unlikely that pumping from an unconfined aquifer would extract fresh groundwater since the seawater intrusion front is approximately 5 miles landward from the proposed pumps." (p. 26.)

The Draft Review's implied conclusion that the unconfined Dunes aquifer is intruded is not supported. Other than Cemex, it is believed that the local landowners have refrained from pumping the Dunes Aquifer. The SWRCB should research the facts on the ground.

> "the inland groundwater users may experience a reduction in groundwater levels in their wells, with associated increases in pumping costs." (p. 27.)

The first paragraph of section 5.5 shows that there would be an illegal taking of groundwater. The paragraph fails to acknowledge that increased coastal pumping causes increased seawater intrusion.

> "This effect would not be felt immediately and would depend on a variety of factors. Since the capture zone for the extraction well system will likely be limited to areas already heavily impacted by seawater intrusion, it would not be appropriate to inject or percolate desalinated water in this intruded area, as the water would essentially be wasted." (pp. 27-28.)

The statements are inaccurate. The effects would be felt immediately by the nearby Ag Land Trust well, from which water is being used for overlying beneficial uses. The Ag Land Trust groundwater would be impacted, the Ag Land Trust water rights would be taken, and the Ag Land Trust storage would be taken. The Draft Review has not cited to proof that the Dunes Aquifer is heavily impacted. The increased pumping foreseeably could counteract or eliminate any benefits from the SVWP (Rubber Dam) for the assessed property owners who are paying for the SVWP. Injected water would not be wasted unless the overlying landowners had been deprived of their groundwater rights by adjudication.

> "The reduction in the availability of fresh water would not be felt immediately." (p. 28)

The statement is inaccurate. The effects would be felt immediately by the nearby Ag Land Trust well, from which water is being used for overlying beneficial uses.

> "the proposed MPWSP could extract some fresh water from within the Basin." (p. 28.)

It is misleading to say "could" when the whole point of the Cal-Am wells is to extract fresh water. The SWRCB should say "will extract" instead of "could extract."

> "To appropriate groundwater from the Basin, Cal-Am will have to demonstrate that the MPWSP will extract water that is surplus to the needs of groundwater users in the Basin and injury to those users will not result. Because the Basin is in a condition of overdraft, to appropriate water for non-overlying uses, any fresh water that Cal-Am pumps will have to be replaced." (p. 28; similar comments at p. 33.)

The second sentence has no support, and is inconsistent with California law. As stated above, in an overdrafted basin, there is no water available for Cal-Am, as a junior appropriator, to appropriate. (*Pasadena v. Alhambra* (1949) 33 Cal.2d 908.) Any groundwater extraction by Cal-Am would constitute a violation of the groundwater rights of existing water rights holders. There is no law that allows Cal-Am to pump water illegally, and then to remedy that violation by "replacing" the water, in a post-injury effort to make other users "whole" (p. 33). Further, the sentence in question makes a distinction between groundwater and fresh water. The distinction is not appropriate and it not supported. Under the circumstances, withdrawal of water from the groundwater basin will cause further seawater intrusion that harms existing users. Replacement of only the "fresh water" portion of the withdrawn volume of water would not reverse the harm. Exportation of groundwater from the Salinas Valley Groundwater Basin is prohibited under State legislation (the MCWRA Act) and case law.

> "An appropriative groundwater right is not necessary to recover water injected or otherwise used to recharge the aquifer, where the water used for recharge would not recharge the aquifer naturally." (p. 28, fn. 31.)

The claim is not supported by citation. The claim is not accurate unless the basin is adjudicated.

> "No permit is required by the State Water Board to acquire or utilize appropriative groundwater rights." (p. 29.)

The statement is misleading. The State Water Resources Control Board has no right to require any permit for an appropriative right.

> "Cal-Am's proposed MPWSP would pump brackish water." (p. 30.)

The statement is misleading. The water would only be brackish because the pumping will illegally take fresh water supplies.

> "Estimates based on the North Marina Project description are that 13 percent of the total water pumped through the proposed wells could be attributed to the landward portion of the Basin and 87 percent could come from the seaward direction relative to the pump locations." (p. 30.)

These estimates were challenged by the Ag Land Trust, because the EIR technical appendices showed that up to 40% of the water would be fresh water, which is more than three times the claimed 13%. The EIR that relied on the 13% estimate was rejected by the Superior Court.

> "It is unknown whether seawater has intruded the Dune Sand Aquifer, but the reported poor water quality of the Dune Sand Aquifer likely limits beneficial uses of its water." (p. 30.)

The statement is inconsistent with the statements elsewhere in the Draft Review that the water to be pumped by Cal-Am is brackish (see, e.g, p. 30). If the Dunes Aquifer is not intruded, then the proposed pumping would deliberately cause intrusion. The Draft Review should state who "reported" the "poor quality," when, and exactly what was "reported." The term "poor quality" should be clarified. Poor quality is not the same as marginally degraded, recovering, or unusable.

> "Water an appropriator pumps that was not previously available to other legal users can be classified as developed or salvaged water." (p. 31.)

There is no salvage water here, and the doctrines of salvage and developed water have no place here. Groundwater is being used for beneficial purposes by Ag Land Trust on the property adjacent to the proposed well site.

> "if water would never reach or be used by others there can be no injury." (pp. 31-32.)

Water is being pumped and put to beneficial use by Ag Land Trust on the property adjacent to the proposed well site. The proposed project would injure Ag Land Trust in multiple ways.

> "If Cal-Am can show all users are uninjured because they are made whole by the replacement water supply and method of replacement, export of the desalinated source water would be permissible and qualify as developed water." (p. 33.)

The statement is not accurate. Exportation of groundwater is prohibited by state law and case law. There is no provision for this "replacement and export" scheme absent adjudication.

> "This could require implementation of a 'physical solution.'" (p. 33.)

There is no "physical solution" necessary if Cal-Am does not take Salinas Valley groundwater.

> "A physical solution is one that assures all water right holders have their rights protected" (p. 34.)

This is misleading. Cal-Am does not hold any water rights. There are no available groundwater rights to be appropriated in an overdrafted basin. (*Katz v. Walkinshaw* (1902) 141 Cal. 116.) A "judicially imposed resolution of conflicting claims" (p. 34) requires adjudication.

> "One important characteristic of a physical solution is that it may not adversely impact a party's existing water right. *(Mojave, supra*, 23 Cal.4th 1224, 1251.)" (p. 34.)

This is correct. Cal-Am's project would adversely affect the water rights held by Ag Land Trust. Ag Land Trust is using its groundwater for beneficial uses on the prime agricultural land adjacent to the proposed well site.

> "Under the physical solution doctrine, although the Basin continues to be in a condition of overdraft, to maximize beneficial use of the state's waters Cal-Am may be allowed to pump a mixture of seawater and fresh water and export the desalinated water to non-overlying parcels. To avoid injury to other users and protect beneficial uses of the Basin's waters, Cal-Am would be required to return its fresh water component to the Basin in such a way that existing users are not harmed and foreseeable uses of the Basin water are protected." (p. 35.)

The suggested approach would require adjudication of the Basin. The first sentence is not accurate and is not supported by reference to legal authority. Please state who would "require" Cal-Am to "return" fresh water, who would enforce the requirement, and who would pay for Cal-Am's production of fresh water that would be returned to the Salinas Valley Groundwater Basin.

> "According to information from the State Water Board's GAMA database, approximately 14 wells are within 2 miles of the proposed MPWSP (Figure SWRCB 8)." (p. 24.)

Figure SWRCB 8 (p. 25) does not appear to be accurate or complete. As one example, Figure SWRCB 8 does not show the 14 wells that Draft Review claims are within a 2-mile radius of the proposed wells. Only one well is shown within the 2-mile radius. The SWRCB should show or otherwise identify the 14 wells that the SWRCB claims are within the 2-mile radius. Without that information, the public cannot meaningfully comment on the figure or SWRCB's discussion of the data. Ag Land Trust reports that at least three wells in the 2-mile radius, including the Ag Land Trust well, are not shown on Figure SWRCB 8. There are likely other inaccuracies in the figure. To the extent that the Geotracker GAMA database has limitations and infirmities, those should be disclosed. Similarly, the water well information in the EIR (see, e.g., p. 38 of the Draft Review) may also be materially unreliable.

To the extent that the "Draft Review" attempts to rely on seawater intrusion data from the MCWRA, as the "Draft Review" currently does throughout the document, the SWRCB should diligently research the location of the monitoring wells from which the MCWRA data is gathered, because that information affects the reliability of the claims about the intrusion in general and as to this project in particular.

The Draft Review's reference to "the parties" (e.g., p. 36) is unclear. Please identify which "parties" the SWRCB is referring to, and in what context. The SWRCB does not have a proceeding for this Cal-Am project.

> "If pumping within the Basin remains unchanged, it is projected that the MPWSP would not pump fresh water within a 56-year period if pumping occurred in an unconfined aquifer." (p. 36.)

The statement is not accurate. The premise of the proposed project is that the wells would pump groundwater that includes fresh water. The overturned EIR stated that up to 40% fresh water would be pumped. The EIR assumptions – including the assumption that pumping would last for 56 years continuously, without stopping – are deeply flawed, and render the studies unreliable.

> "but-for the MPWSP, new fresh water would not be available in the Basin," (p. 36.)

This possible scenario contradicts the premise of the Salinas Valley Water Project Rubber Dam component, which is to make new fresh water available in the Basin. The SWRCB Draft Review's discussion of this and other scenarios shows that the SWRCB is arguing for Cal-Am and its project, despite inadequate information and inadequate investigation of the issues.

> "Based on historical uses of water in the Basin and despite efforts to reduce groundwater pumping in seawater intruded areas through enactment of Ordinance 3709 and efforts to increase recharge through the CSIP, there is no evidence to suggest that Basin conditions will improve independent of the MPWSP without a comprehensive solution to the overdraft conditions." (p. 37)

The statement is not supported. The SWRCB staff lacks information on existing uses and activities in the Basin. This statement fails to consider the Salinas Valley Water Project (SVWP), which had as its purpose the halting of seawater intrusion. The SVWP was a Proposition 218 project funded by Salinas Valley property owners. The SVWP EIR stated that the SVWP would not have effect until all components of the SVWP were fully operational. That was achieved in approximately 2012.

> "Both near- and long-term, a physical solution could ensure an adequate water supply for all legal water users in the Basin and provide an assured supply of groundwater to the Basin's users." (p. 39.)

How? Please explain a physical solution that meets that description.

> "a conclusive showing that there is no water available for export does not appear to be the case here." (p. 39, fn. 41)

Please provide the evidence that there is water available for export. Please explain whether it is the SWRCB's position that intruded groundwater can be exported from the Basin in violation of the State legislation (MCWRA Act). Please explain what water the SWRCB considers "currently unusable" (p. 39, fn. 41).

As to various comments in the Draft Review about the impacts of the proposed extraction, the SWRCB may not be aware of the North County Land Use Plan, which contains policies that affect and protect the water quality and water supply. This project is within the boundaries of the North County Land Use Plan. The North County Land Use Plan is part of the Local Coastal Program certified by the California Coastal

Commission. The SWRCB should honor and consider the state-certified plan if the SWRCB seeks to proceed with the CPUC-requested "assessment."

The proposed project violates several policies of that plan. The plan designates the land use of the local property, including Ag Land Trust property, as Agricultural Preservation. Under the plan policies, such land shall be preserved for agricultural use to the fullest extent possible. Development of Agricultural Preservation lands is limited to accessory buildings for farm uses and other uses required for agricultural activities on that parcel. The lack of water rights for the proposed project may threaten the agricultural viability of the protected agricultural lands. Further, the project violates Land Use Plan policies on water supply and water quality, including policies 2.5.3.A.1 though 2.5.3.A.3, and policy 2.5.3.B.6. For example, by using coastal groundwater supplies for uses other than coastal priority agricultural uses, the project would violate policy 2.5.3.A.1. The County has failed to determine the long term safe yield of the area aquifers. We urge you to review the Coastal Commission comments on the draft EIR.

Conclusion

For each and every of the reasons described above, the "assessment" requested by the CPUC would be premature at this stage. At the very least, if the SWRCB staff chooses to pursue its effort to provide the CPUC with a document, the SWRCB staff should revisit the approach used in the Draft Review, and make a diligent investigation of the current facts. The EIR should not be relied upon. The Draft Review should be rewritten with more complete information due to the factual inaccuracies. The revised document should be circulated for public comment for at least 30 days.

Thank you for the opportunity to provide comments on the Draft Review.

Request

Please put this Office on the distribution list for future reports, letters, and notices for this project. For email distribution, please send materials to me at Erickson@stamplaw.us.

Very truly yours,

LAW OFFICES OF MICHAEL W. STAMP

Molly Erickson

Exhibits:

A. Ag Land Trust letters to CPUC (November 6, 2006 and April 15, 2009).
B. Herald Article (February 4, 2012).
C. Final Judgment in *Ag Land Trust v. Marina Coast Water District* (Monterey Superior Court Case No. M105019).

EXHIBIT A

`MONTEREY COUNTY AGRICULTURAL AND HISTORICAL LAND CONSERVANCY

P.O. Box 1731, Salinas CA 93902

November 6, 2006

Jensen Uchida
c/o California Public Utilities Commission
Energy and Water Division
505 Van Ness Avenue, Room 4A
San Francisco, Ca. 94102
FAX 415-703-2200
JMU@cpuc.ca.gov

SUBJECT: California-American Water Company's Coastal Water Project EIR

Dear Mr. Uchida:

I am writing to you on behalf of the Monterey County Agricultural and Historic Lands Conservancy (MCAHLC), a farmland preservation trust located in Monterey County, California. Our Conservancy, which was formed in 1984 with the assistance of funds from the California Department of Conservation, owns over 15,000 acres of prime farmlands and agricultural conservation easements, including our overlying groundwater rights, in the Salinas Valley. We have large holdings in the Moss Landing/Castroville/Marina areas. Many of these acres of land and easements, and their attendant overlying groundwater rights, have been acquired with grant funds from the State of California as part of the state's long-term program to permanently preserve our state's productive agricultural lands.

We understand that the California-American Water Company is proposing to build a desalination plant somewhere (the location is unclear) in the vicinity of Moss Landing or Marina as a proposed remedy for their illegal over-drafting of the Carmel River. On behalf of our Conservancy and the farmers and agricultural interests that we represent, I wish to express our grave concerns and objections regarding the proposal by the California-American Water Company to install and pump beach wells for the purposes of exporting groundwater from our Salinas Valley groundwater aquifers to the Monterey Peninsula, which is outside our over-drafted groundwater basin. This proposal will adversely affect and damage our groundwater rights and supplies, and worsen seawater intrusion beneath our protected farmlands. We object to any action by the California Public Utilities Commission (CPUC) to allow, authorize, or approve the use of such beach wells to take groundwater from beneath our lands and out of our basin, as this would be an "ultra-vires" act by the CPUC because the CPUC is not authorized by any law or statute to grant water rights, and because this would constitute the wrongful approval and authorization of the illegal taking of our groundwater and overlying groundwater rights. Further, we are distressed that, since this project directly and adversely affects our property rights, the CPUC failed to mail actual notice to us, and all other superior water rights holders in the Salinas Valley that will be affected, as is required by the California Environmental Quality Act (CEQA). The CPUC must provide such actual mailed notice of the project and the preparation of the EIR to all affected water rights holders because California-American has no water rights in our basin.

Any EIR that is prepared by the CPUC on the proposed Cal-Am project must included a full analysis of the legal rights to Salinas Valley groundwater that Cal-Am claims. The Salinas Valley percolated groundwater basin has been in overdraft for over five decades according to the U.S. Army Corps of Engineers and the California Department of Water Resources. Cal-Am, by definition in California law, is an appropriator of water. No water is available to new appropriators from overdrafted groundwater basins. The law on this issue in California was established over 100 years ago in the case of Katz v. Walkinshaw (141 Calif. 116), it was repeated in Pasadena v. Alhambra (33 Calif.2nd 908), and reaffirmed in the Barstow v. Mojave Water Agency case in 2000. Cal-Am has no groundwater rights in our basin and the CPUC has no authority to grant approval of a project that relies on water that belongs to the overlying landowners of the Marina/Castroville/Moss Landing areas.

Further, the EIR must fully and completely evaluate in detail each of the following issues, or it will be flawed and subject to successful challenge:

1. Complete and detailed hydrology and hydrogeologic analyses of the impacts of "beach well" pumping on groundwater wells on adjacent farmlands and properties. This must include the installation of monitoring wells on the potentially affected lands to evaluate well "drawdown", loss of groundwater storage capacity, loss of groundwater quality, loss of farmland and coastal agricultural resources that are protected by the California Coastal Act, and the potential for increased and potentially irreversible seawater intrusion.
2. A full analysis of potential land subsidence on adjacent properties due to increased (365 days per year) pumping of groundwater for Cal-Am's desalination plant.
3. A full, detailed, and complete environmental analysis of all other proposed desalination projects in Moss Landing.

On behalf of MCAHLC, I request that the CPUC include and fully address in detail all of the issues and adverse impacts raised in this letter in the proposed Cal-Am EIR. Moreover, I request that before the EIR process is initiated that the CPUC mail actual notice to all of the potentially overlying groundwater rights holders and property owners in the areas that will be affected by Cal-Am's proposed pumping and the cones of depression that will be permanently created by Cal-Am's wells. **The CPUC has an absolute obligation to property owners and the public to fully evaluate every** reasonable alternative to identify the environmentally superior alternative that does not result in an illegal taking of third party groundwater rights. We ask that the CPUC satisfy its obligation.

Respectfully,

Brian Rianda

Brian Rianda, Managing Director

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To: California Public Utilities Commission
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April 15, 2009

Comments on Coastal Water Project Draft EIR

Dear Commissioners:

On behalf of the Monterey County Ag Land Trust, we hereby submit this comment letter and criticisms of the draft EIR that your staff has prepared for the Coastal Water Project located in Monterey County. Herewith attached is our letter to your commission dated November 6th, 2006. We hereby reiterate all of our comments and assertions found in that letter as comments on the Draft Environmental Impact Report.

The Draft EIR is fatally flawed because of your staff's intentional failure to address the significant environmental and legal issues raised in our November 6th 2006 letter. The project as proposed violates and will results in a taking of our Trust's groundwater rights. Further, although we have requested that these issues be addressed, it appears that they have been ignored and it further appears that the CPUC is now advancing a project (preferred alternative) that constitutes an illegal taking of groundwater rights as well as violations of existing Monterey County General Plan policies, existing certified Local Coastal Plan policies and Monterey County Environmental Health code.

The EIR must be amended to fully address these issues that have been intentionally excluded from the draft. Further, the EIR must state that the preferred alternative as proposed violates numerous Monterey County ordinances, and California State Groundwater law. Failure to include these comments in the EIR will result in a successful challenge to the document.

Respectfully,

Virginia Jameson
Ag Land Trust

EXHIBIT B

SATURDAY SERVING THE MONTEREY PENINSULA AND SALINAS VALL
Monterey County The Herald
A MediaNews Group NEWSPAPER
Saturday, February 4, 2012
www.montereyherald.com

Review failed to consider water rights, judge rules

Desal EIR dealt blow

By JIM JOHNSON
Herald Staff Writer

In an amended ruling, a Monterey County Superior Court judge found the environmental review for the failed regional desalination project neglected to properly consider a number of issues, including water rights.

The revised ruling, which amends a tentative decision issued by Judge Lydia Villarreal in December, deals a severe blow to any thoughts California American Water may have had about using the project's environmental impact report on an alternative desal project.

It could raise questions about whether the EIR is adequate under the California Environmental Quality Act for Cal Am to go ahead with its portion of the regional project.

The revision was released Thursday, about six weeks after Villarreal ruled Marina Coast Water District should have prepared

Please see **Desal page A9**

Desal

From **page A1**

the EIR as the lead agency under state environmental law. The revision did not change that stance.

Ag Land Trust sued Marina Coast in March 2010, arguing Marina Coast should have been the lead agency on the project instead of the state Public Utilities Commission.

Attorney Molly Erickson, representing Ag Land Trust, said Villarreal's amended ruling found in favor of all of the organization's environmental claims, in particular its argument the EIR contained an inadequate discussion of water rights.

"Ag Land Trust has been raising the issue of water rights since at least 2006," Erickson said. "For more than five years, the Marina Coast Water District and the Monterey County Water Resources Agency ignored Ag Land Trust. In the end, the rule of law was more powerful than the backroom deals.

"This issue is particularly important because the regional project proposed to pump water from the overdrafted Salinas Valley groundwater basin," she said.

Cal Am spokeswoman Catherine Bowie said company officials hadn't seen the ruling and couldn't comment on it.

She said the exact nature of an alternative water supply project, and any environmental review, has yet to be determined. She said Cal Am's bid to construct its part of the regional project will be decided by the PUC, and the company will rely on the commission to decide how to comply with state environmental law.

When Cal Am announced last month that it was withdrawing support from the regional project, it pointed to a lack of progress on the work because of unresolved issues, including conflict of interest charges and permitting and financing challenges. Villarreal's tentative ruling on the EIR was considered a source of delay.

The company must find a replacement source of water for the Peninsula by 2016 because of a state order to reduce pumping from the Carmel River.

Despite its complaints, Cal Am suggested that "a lot of valuable work" was accomplished that could be applicable to an alternative desal project.

Late last month, at a PUC conference, Cal Am announced its intention to submit an application for an alternative water supply project within 90 days. The company indicated it would seek a modification of the regional project permit to capitalize on the efforts so far, presumably including the completion and PUC approval of the environmental impact report.

In her revised ruling, Villarreal found the EIR failed to address issues surrounding availability of groundwater for the desal project and the potential environmental impact, especially after the county Water Resources Agency admitted it still needed to acquire groundwater rights for the project.

The EIR's assumption that those rights didn't need to be addressed, because they would be "perfected" in the future, was impermissible because it did not meet the goal of allowing full public review of potential consequences, according to the ruling.

The ruling found that Marina Coast, as lead agency on the EIR, would need to address water rights, a contingency plan, the assumption of constant pumping, the exportation of groundwater from the Salinas Valley basin, brine impacts, effects on adjacent properties and water quality.

Jim Heitzman, general manager of the Marina Coast Water District, did not return a phone call from The Herald.

But the district's outside legal counsel, Mark Fogelman, argued at the PUC conference last month that Villarreal's tentative ruling in December did not represent a major impediment to moving forward with the regional project. He urged the commission to order Cal Am to meet its obligations under the project agreements.

Fogelman said the district would appeal if the final ruling remained unchanged from the tentative decision.

County Counsel Charles McKee said he hadn't seen the amended ruling and couldn't comment, but the county's outside legal counsel, Dan Carroll, cited the December ruling in arguing at the PUC conference that the project was subject to considerable uncertainty.

Jim Johnson can be reached at jjohnson@montereyherald.com or 753-6753.

EXHIBIT C

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Ag Land Trust

FILED
APR 17 2012
CONNIE MAZZEI
CLERK OF THE SUPERIOR COURT
DEPUTY
CARMEN B. OROZCO

SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF MONTEREY

AG LAND TRUST,

Petitioner and Plaintiff,

v.

MARINA COAST WATER DISTRICT, and DOES 1 to 100,

Respondents and Defendants.

Case No. M105019
Filed April 5, 2010
First Amended Petition and Complaint filed April 6, 2010
CEQA Hearing: October 27, 2011
Intended Decision: December 19, 2011
Amended Intended Decision: February 2, 2012

~~[PROPOSED]~~ JUDGMENT GRANTING FIRST AMENDED PETITION FOR WRIT OF MANDATE (CALIFORNIA ENVIRONMENTAL QUALITY ACT) AND ORDERING ISSUANCE OF PEREMPTORY WRIT OF MANDATE

Dept: 15
Judge: Hon. Lydia M. Villarreal

The First Amended Petition for Writ of Mandate (California Environmental Quality Act) came on regularly for hearing on October 27, 2011, in Department 15 of this Court, located at 1200 Aguajito Road, Monterey, California 93940. Michael W. Stamp and Molly Erickson appeared on behalf of petitioner Ag Land Trust. Mark Fogelman and Ruth Muzzin appeared on behalf of respondent Marina Coast Water District.

The Court has reviewed and considered the record of proceedings in this matter, the briefs submitted by the parties, the arguments of counsel, and the post-hearing briefs of the parties. The First Amended Petition for Writ of Mandate (California

Environmental Quality Act) was submitted for decision on October 27, 2011. On December 19, 2011, the Court issued its Intended Decision. On February 2, 2012, the Court issued its Amended Intended Decision. On February 29, 2012, the Court issued its Order denying Marina Coast Water District's objections and adopting the Amended Intended Decision as the Statement of Decision, final for all purposes.

IT IS ORDERED, ADJUDGED, and DECREED that:

1. The First Amended Petition for Writ of Mandate (California Environmental Quality Act) brought by petitioner Ag Land Trust against respondent Marina Coast Water District is GRANTED in favor of Ag Land Trust and against Marina Coast Water District.

2. A peremptory writ of mandate directed to respondent shall issue under seal of this Court, in the form specified in Exhibit A. The Court FINDS AND DETERMINES that Marina Coast Water District prejudicially abused its discretion and failed to proceed in the manner required by law in making its approvals of the Regional Desalination Project on March 16, 2010 and April 5, 2010, by proceeding as a responsible agency rather than as a lead agency, by failing to properly analyze the environmental impact report as a lead agency under CEQA, and by failing to properly and adequately identify, discuss, and address the environmental impacts of the project, including but not limited to water rights, contingency plan, assumption of constant pumping, exportation of groundwater from the Salinas Valley Groundwater Basin, brine impacts, impacts on overlying and adjacent properties, and water quality, as required here for a lead agency under CEQA.

3. The Court's final statement of decision (the Amended Intended Decision) is attached hereto as Exhibit B and is incorporated herein.

4. Respondent Marina Coast Water District shall set aside its approvals of the Regional Desalination Project, and is restrained from taking further actions to approve the project until respondent fully complies with CEQA.

5. The Court reserves jurisdiction over Ag Land Trust's claim for an award of private attorney general fees and costs pursuant to Code of Civil Procedure section 1021.5. Any motion for said fees and costs shall be filed and served within 60 days of the filing of the notice of entry of this Judgment.

6. Petitioner is awarded its costs of suit.

Dated: APR 17 2012

LYDIA M. VILLARREAL

Hon. Lydia M. Villarreal
Judge of the Superior Court

EXHIBIT A

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Attorneys for Petitioner and Plaintiff
Ag Land Trust

SUPERIOR COURT OF THE STATE OF CALIFORNIA

COUNTY OF MONTEREY

AG LAND TRUST, Petitioner and Plaintiff, v. MARINA COAST WATER DISTRICT, and DOES 1 to 100, Respondents and Defendants. _______________________________/	Case No. M105019 Filed April 5, 2010 First Amended Petition and Complaint filed April 6, 2010 CEQA Hearing: October 27, 2011 Intended Decision: December 19, 2011 Amended Intended Decision: February 2, 2012 **[PROPOSED]** **PEREMPTORY WRIT OF MANDATE**

A Judgment Granting First Amended Petition for Writ of Mandate (California Environmental Quality Act) and Ordering Issuance of Peremptory Writ of Mandate having been entered in this proceeding, ordering that a peremptory writ of mandate be issued from this Court,

IT IS ORDERED that, immediately on service of this writ, respondent Marina Coast Water District shall:

1. Vacate and set aside its March 16, 2010 and April 5, 2010 approvals of the Regional Desalination Project, and each step approved by respondent pursuant to Public Resources Code section 21168.9, subdivision (a). Further action to approve the project beyond setting aside and vacating these approvals by respondent shall not be taken, except in accordance with the Judgment Granting First Amended Petition for

Writ of Mandate (California Environmental Quality Act) and Ordering Issuance of Peremptory Writ of Mandate.

Having found in petitioner's favor on the issues raised in the first amended petition, the Court finds that the following action is necessary under Public Resources Code section 21168.9, subdivision (b) to comply with the provisions of CEQA: respondent to set aside and vacate its approvals, and to prepare, circulate and consider a legally adequate environmental impact report and otherwise to comply with the California Environmental Quality Act in any subsequent action taken to consider approval of the project and/or approve the project. Under Public Resources Code section 21168.9, subdivision (c), this Court does not direct respondent to exercise its lawful discretion in any particular way.

Under Public Resources Code section 21168.9, subdivision (b), this Court retains jurisdiction over respondent's proceedings by way of a return to this peremptory writ of mandate until the Court has determined that respondent has complied with the provisions of CEQA.

The return date on the writ in this action shall be 60 days, subject to extension by the Court for cause.

Dated:________________ ______________________________

Hon. Lydia M. Villarreal
Judge of the Superior Court

EXHIBIT B

FILED

FEB 02 2012

CONNIE MAZZEI
CLERK OF THE SUPERIOR COURT
Sally Lopez DEPUTY

SUPERIOR COURT OF CALIFORNIA

COUNTY OF MONTEREY

AG LAND TRUST, Plaintiff/Petitioner, vs. MARINA COAST WATER DISTRICT, Defendant/Respondent	Case No.: M105019 Amended Intended Decision

Ag Land Trust's (Ag Land) petition for a writ of mandamus came on for court trial on October 27, 2011. All sides were represented through their respective attorneys. The matter was argued and taken under submission. This amended intended decision resolves factual and legal disputes, and shall suffice as a statement of decision as to all matters contained herein.

Background

Ag Land's petition challenges respondent Marina Coast Water District's (Marina Coast) March and April 2010 actions taken on behalf of the Regional Desalination Project (Regional Project).

California American Water Company pumps water from the Carmel River and in 1995 was ordered by the State Water Resources Control Board to find an alternative source of water. In 2008, an adjudication of water rights ordered California American Water Company to reduce its pumping from the Seaside Basin.

California American Water Company applied to the California Public Utilities Commission (Cal PUC) in February 2003 for a certification of Public Convenience and Necessity for a desalination plant in Moss Landing (Moss Landing Project or Coastal Water Project), and also concurrently proposed an alternative project in an unincorporated area north of the City of Marina (North Marina Project), in response to the 1995 order.

The Cal PUC decided that it would be the lead agency for the two projects and would prepare an environmental impact report (EIR) in compliance with the California Environmental Quality Act (CEQA). (Public Resources Code, § 21000 et seq.) The Cal PUC released a Notice of Preparation for an EIR in September 2006 for the two projects.

The Regional Project was proposed in 2008 by Marina Coast and the Monterey County Water Resources Agency (Water Resources Agency). California American Water Company would distribute the water from the Regional Project.

The Cal PUC thereafter included the Regional Project in the EIR and on December 17, 2009, certified a Final EIR that looked at all three projects, but did not identify a preferred project.

Marina Coast issued a notice of intent to prepare an EIR in September 2009 to acquire and annex the East Armstrong Ranch (Ranch) property for the siting of the Regional Project, and approved and annexed the Ranch on March 16, 2010. Marina Coast filed a Notice of Determination on March 17, 2010. (California Code of Regulations, title 14, § 15094 (Guidelines).)

On April 5, 2010, Marina Coast approved the Regional Project relying on the Cal PUC Final EIR and an addendum dated March 24, 2010. Marina Coast's resolution included findings, a mitigation monitoring program and a statement of overriding considerations.

Ag Land contends that (1) Marina Coast is the CEQA lead agency for the Regional Project; (2) Marina Coast did not proceed in a manner required by law because (a) there is no discussion in the EIR of the reliability of desalination plants; (b) the EIR did not include a contingency plan; (c) the discussion of water rights is inadequate; (d) the assumption of constant pumping is unreasonable, (e) the Regional Project will illegally export groundwater from the Salinas Valley Groundwater Basin; (f) the EIR did not adequately investigate and disclose impacts to overlying and adjacent property, and (g) failed to adequately investigate and disclose the project's violation of the State Water Resources Control Board's Anti-Degradation Policy; and (3) the statement of overriding consideration is not supported by substantial evidence.

Administrative Record

The administrative record (AR) was admitted into evidence.

Judicial Notice

Marina Coast makes reference in its opposition brief to Marina Coast's request for judicial notice that was filed with a demurrer, and asks this Court to take judicial notice of multiple documents. The Court denies the request for judicial notice of the duplicative, extra-record and irrelevant evidence. (Evid. Code, §§ 452, subd. (c), 459; Code Civ. Proc., §§ 909, 1094.5, subd. (e); *Sierra Club v. California Coastal Com.* (2005) 35 Cal.4th 839, 863; *Western States Petroleum Assn. v. Superior Court* (1995) 9 Cal.4th 559, 573, fn.4; *In re Zeth S.* (2003) 31 Cal.4th 396, 405.)

Discussion

(I). Lead agency issue

Ag Land contends that Marina Coast became the lead agency with the "principal responsibility for carrying out or approving a project" when Marina Coast acted to approve the Regional Project. (Pub. Resources Code, § 21067; Guidelines, § 15051; *Citizens Task Force on Sohio v. Board of Harbor Commissioners* (1979) 23 Cal.3d 812 (*Sohio*).)

Marina Coast argues that the Cal PUC is the lead agency because Cal PUC (1) determined it was the lead agency; (2) prepared the Final EIR; (3) is the agency with the greatest responsibility for the Regional Project; (4) was the first agency to act; and (5) the criteria for a change in lead agency is not met.

Guidelines section 15015 provides:

"Criteria for Identifying the Lead Agency[.] Where two or more public agencies will be involved with a project, the determination of which agency will be the lead agency shall be governed by the following criteria:

(a) If the project will be carried out by a public agency, that agency shall be the lead agency even if the project would be located within the jurisdiction of another public agency.

(b) If the project is to be carried out by a nongovernmental person or entity, the lead agency shall be the public agency with the greatest responsibility for supervising or approving the project as a whole.

(1) The lead agency will normally be the agency with general governmental powers, such as a city or county, rather than an agency with a single or limited purpose such as an air pollution control district or a district which will provide a public service or public utility to the project.

(2) Where a city prezones an area, the city will be the appropriate lead agency for any subsequent annexation of the area and should prepare the appropriate environmental document at the time of the prezoning. The local agency formation commission shall act as a responsible agency.

(c) Where more than one public agency equally meet the criteria in subdivision (b), the agency which will act first on the project in question shall be the lead agency.

(d) Where the provisions of subdivisions (a), (b), and (c) leave two or more public agencies with a substantial claim to be the lead agency, the public agencies may by agreement designate an agency as the lead agency. An agreement may also provide for cooperative efforts by two or more agencies by contract, joint exercise of powers, or similar devices."

(A). Marina Coast's April 5, 2010 Resolution.

Marina Coast's April 5, 2010 Resolution No. 2010-20s purpose was to "conditionally" approve Marina Coast's "participation in a Regional Desalination Project through a Water Purchase Agreement by and among" Marina Coast, the Water Resources Agency, and California American Water Company. The Resolution also would approve a Settlement Agreement in Cal PUC proceeding A.04-09-019. (AR 1.)

"Under the Water Purchase Agreement, [the Water Resources Agency] would construct, own, and operate a series of wells that would extract brackish water and a portion of a pipeline and appurtenant facilities [] that would convey the brackish water to a desalination plant and related facilities that would be owned and operated by [Marina Coast]." (AR 2.)

"The [Marina Coast] Facilities would include a pipeline and connection to discharge brine from the desalination plant to connect the regional outfall facilities owned and operated by the Monterey

Regional Water Pollution Control Agency [Pollution Control Agency] [], pursuant to an 'Outfall Agreement' dated January 20, 2010, between [Marina Coast and the Pollution Control Agency]." (AR 2.)

"In Decision D.03-09-22, the [Cal PUC] designated itself as the lead agency for environmental review of the Coastal Water Project under CEQA." (AR 4.)

"On January 30, 2009, the [Cal PUC], acting as Lead Agency under CEQA in A.04-09-019, issued a Draft [EIR] [] analyzing the potential environmental impacts of project designated the 'Coastal Water Project' and alternatives to it. The [Cal PUC] duly received and analyzed extensive public comment on the [Draft EIR]. [Marina Coast, the Water Resources Agency, and California American Water Company] provided comments on the [Draft EIR]." (AR 4.)

"On December 17, 2009, in Decision No. 09-12-017 which was issued in Application 04-09-019, the [Cal PUC], as Lead Agency, duly certified a Final [EIR] which includes a description and analyzes the environmental impacts of an alternative project variously referred to in that Final [EIR] as the 'Regional Alternative' and the 'Regional Project' and 'Phase I of the Regional Project.' The principal element of that alternative project is a regional desalination water supply project, with other smaller elements." (AR 4.)

"On March 24, 2010, an addendum to the Final [EIR] [] was released, which responds to comment letters that had been inadvertently omitted from the Final EIR and includes an errata to the Final EIR. The term 'Final EIR' as used in this resolution includes the addendum." (AR 4.)

"The Final EIR designates [Marina Coast] as a responsible agency under CEQA." (AR 4.)

"The Directors [of Marina Coast] have reviewed and considered the Final EIR and Addendum in their entirety and the entire record of proceedings before [Marina Coast], as defined in the Findings attached hereto as Attachment A, and find that the Final EIR and Addendum are adequate for the purpose of approving [Marina Coast's] approval and implementation of the Regional Desalination Project pursuant to the Water Purchase Agreement and Settlement Agreement, and [Marina Coast] hereby relies upon the contents of those documents and the CEQA process for its CEQA compliance." (AR4-5)

"[Marina Coast] intends to conduct all future activities under the Water Purchase Agreement and the Settlement Agreement in accordance with the Final EIR; or alternatively, and if needed to comply with CEQA, [Marina Coast] would amend, supplement or otherwise conduct new environmental review prior to directly or indirectly committing to undertake any specific project or action involving a physical change to the environment related to the implementation of the Regional Desalination Project pursuant to the Water Purchase Agreement and the Settlement Agreement." (AR 5.)

"At the direction of the Directors, [Marina Coast] has made written findings for each significant effect associated with the [Marina Coast] Facilities and prepared a Statement of Overriding Considerations, which explains that the benefits of the [Regional] Project outweigh any significant and unavoidable impacts on the environment and has prepared a Mitigation Monitoring and Reporting Plan [Mitigation Plan], which includes all mitigation measures designed to substantially lessen or eliminate the adverse impact on the environment associated with construction and operation of the [Marina Coast] Facilities, as well as a plan for reporting obligations and procedures by parties responsible for implementation of the mitigation measures. A copy of the Findings and Statement of Overriding Considerations is attached to this resolution as Attachment A. A copy of the [Mitigation Plan] is attached to the Findings." (Boldface omitted.) (AR 5.)

"By this resolution, the Directors make and adopt appropriate Findings, Statement of Overriding Considerations and a Mitigation Monitoring and Reporting Plan and conditionally approve [Marina Coast's] participation in the Regional Desalination Project pursuant to a Water Purchase Agreement between [Marina Coast, the Water Resources Agency, and California American Water Company], and a Settlement Agreement between [Marina Coast, the Water Resources Agency, and California American Water Company] and various other interested parties to settle California Public Utilities Commission Proceeding A.04-09-019, 'In the Matter of the Application of California American Water Company (U 210 W) for a Certificate of Public Convenience and Necessity to Construct and Operate its Coastal Water Project to Resolve the Long-Term Water Supply Deficit in its Monterey District and to Recover All Present and Future Costs in Connection Therewith in Rates.'" (AR 5-6.)

"NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors of the Marina Coast Water District adopt the foregoing findings; and

1. The Directors hereby certify, pursuant to CEQA Guidelines §§ 15050(b) and 15096(f), that they have reviewed and considered the Final EIR as certified by the [Cal PUC] on December 17, 2009 in Decision D.09-12-017 and the Addendum that was released on March 24, 2010.

2. The Directors hereby approve and adopt the Findings attached hereto as Attachment A, which are incorporated herein, pursuant to CEQA Guidelines §§ 15091 and 15096(h).

3. The Directors hereby approve and adopt the Mitigation Monitoring and Reporting Plan identified in the Findings and attached to the Findings, pursuant to CEQA Guidelines § 15096(g).

4. The Directors hereby conditionally approve [Marina Coast's] participation in the Regional Desalination Project pursuant to the Water Purchase Agreement and the Settlement Agreement, contingent on final approval by the [Cal PUC].

5. The Directors hereby authorize the President and the General Manager and Secretary to execute the Water Purchase Agreement and the Settlement Agreement pursuant to this resolution and conditional approval substantially in the form presented to the Board at the April 5, 2010, meeting, and direct the General Manager and staff to take all other actions that may be necessary to effectuate and implement this resolution and Conditional Project Approval.

PASSED AND ADOPTED on April 5, 2010, by the Board of Directors of the Marina Coast Water District...." (AR 6.)

(B). Marina Coast's April 5, 2010 Resolution Attachment A: Findings for Marina Coast Facilities for Phase I of the Regional Project.

"As described in the Final EIR, Phase I of the Regional Project contemplates the development, construction, and a regional desalination water supply project. The Final EIR envisions that [Marina Coast, the Water Resources Agency, and California American Water Company], would own and operate various project components. [Marina Coast, the Water Resources Agency, and California American

Water Company], have negotiated terms and conditions, as set forth in a proposed 'Water Purchase Agreement,' to implement the regional desalination project element of the project described and analyzed as Phase I of the Regional Project in the Final EIR. The other elements of Phase I, including recycled water and aquifer storage and recovery, will be coordinated with the desalination element but are not part of the Water Purchase Agreement. The project which is the subject of the Water Purchase Agreement and the focus of these findings is referred to as the 'Regional Desalination Project.' Under the Water Purchase Agreement, [the Water Resources Agency] would design, construct, own and operate, in consultation with [Marina Coast and California American Water Company], a series of wells ('Source Water Wells') that would extract brackish source water for conveyance to the desalination plant and a portion of the pipeline and appurtenant facilities (collectively, 'Intake Facilities') that would convey the brackish water to a desalination plant that would be owned and operated by [Marina Coast]. [Marina Coast] would own and operate the Brackish Source Water Receipt Point Meter and a portion of the Brackish Source Water Pipeline, the Desalination Plant, the [Marina Coast] Meter, the [California American Water Company] Meter, the [Marina Coast] pipeline, the [Marina Coast] Product Water Pipeline, the [Marina Coast] Outfall Facilities [] and any related facilities. The components of the Regional Desalination Project that would be owned and operated by [Marina Coast] are herein after referred to as the '[Marina Coast] Facilities'. The remainder of the project components would be constructed by [California American Water Company]." (AR 8-9.)

"The [Regional] Project Facilities include components owned by three public agencies; [Marina Coast, the Water Resources Agency, and the Pollution Control Agency]. In addition to the Project Facilities, the [California American Water Company] facilities shall serve as distribution facilities to serve the [California American Water Company] Service Area and be owned by [California American Water Company]." (AR 12.)

"[Marina Coast]-Owned Facilities. The [Marina Coast]-Owned Facilities include the Brackish Source Water Receipt Point Meter and a portion of the Brackish Source Water Pipeline, the Desalination Plant, the [Water Resources Agency] Meter, the [California American Water Company] Meter, the

[Marina Coast] Product Water Pipeline, the [Marina Coast] Outfall Facilities, and any related facilities." (Underscoring omitted.) (AR 13.)

"[California American Water Company]-Owned Facilities. The [California American Water Company] Facilities include the distribution system needed to convey the Product Water from the Delivery Point downstream of the [California American Water Company] Meter to the [California American Water Company] distribution system, plus other in-system improvements. None of the facilities owned by [California American Water Company] and downstream of the [California American Water Company] Meter are part of the Project Facilities." (Underscoring omitted.) (AR 16-17.)

"As a responsible agency under the Coastal Water Project Final EIR, [Marina Coast] intends to rely upon the Final EIR in its decision whether or not to approve a Settlement Agreement and certain other agreements from the proceedings of the [Cal PUC] consideration of Application A.04-09-019. Pursuant to Section 15096 of the CEQA Guidelines, the process for a responsible agency does not require certification of the Final EIR. [Marina Coast] has chosen to rely on the Final EIR as the basis of the findings, herein." (AR 17.)

"IX. Findings Regarding Alternatives [.] [Marina Coast] is a responsible agency and, as such, only has approval authority over a portion of the [Regional] Project. [Marina Coast] does not have approval authority over an aspect of the Moss Landing Power Plant or the North Marina Alternative. Thus, these Findings are limited to those aspects of the Project over which [Marina Cost] has approval authority and do not evaluate the various alternatives indentified in the Final EIR." (Boldface and some capitalization omitted.) (AR 83.)

(C). Marina Coast's April 5, 2010 Resolution: Settlement Agreement

"On April 5, 2010, [Marina Coast], and on April 6, 2010, [Water Resources Agency], each acting as a Responsible Agency under CEQA, and having fully considered all relevant environmental documents, including the [Final] EIR, approved the regional desalination project that is described in the Water Purchase Agreement ('WPA'), which is attached hereto as Attachment 1, subject to Commission approval. That project is referred to as the 'Regional Desalination Project.'" (AR 119.)

"The Parties to this Settlement Agreement, subject to the Approval Condition Precedent hereinafter discussed, have agreed to the development of the Regional Desalination Project. The Regional Desalination Project will consist of three primary elements. [The Water Resources Agency] will own, install, operate, and maintain wells through which brackish source water will be extracted and transported to a desalination plant. [Marina Coast] will own, construct and operate the desalination plant and transport desalinated Product Water to a delivery point, where some of the Product Water will be received by [California American Water Company] and some will be received by [Marina Coast]. [Marina Coast will utilize the Product Water delivered to it for its existing customers, and in the future may utilize some of the Product Water to serve customers in the former Ford Ord. [California American Water Company] will distribute its portion of the Product Water through facilities it owns for which the Commission should grant a CPCN. Operations of all project facilities shall be conducted so that all Legal Requirements are met, including but not limited to the requirements of the Agency Act. Greater detail regarding the design, construction, and operation of the Regional Desalination Project is found in two agreements, the [Water Purchase Agreement] and the Outfall Agreement (together referred to as the 'Implementing Agreements') discussed in Article 7 of this Settlement Agreement. Greater detail regarding the cost and ratemaking treatment of the Regional Desalination Project and the facilities that [California American Water Company] will own in connection with the Regional Desalination Project is contained in this Settlement Agreement and the Attachments hereto." (Underscoring omitted.) (AR 119.)

"The Parties to this Settlement Agreement believe that the development, construction, and operation of the Regional Desalination Project does and will serve the present and future public convenience and necessity, and that the Commission should grant [California American Water Company] a CPCN [certificate of public convenience and necessity] to construct and operate the distribution pipeline and aquifer storage and recovery facilities portion of the Regional Desalination Project that [California American Water Company] proposes to own []." (AR 120.)

"The Parties acknowledge the legal requirement that [California American Water Company] customers be charged rates that are just and reasonable. In light of that acknowledgement, with respect to the ratemaking treatment for the [California American Water Company] Facilities set forth in Article 9 of this Settlement Agreement, the cost recovery mechanism set forth in Article 9 represents an effort to strike a balance between minimizing costs of the [California American Water Company] Facilities and assuring [California American Water Company] ratepayers only pay for actual necessary expended capital investment...." (AR 120.)

(D). Marina Coast's April 5, 2010 Resolution: Water Purchase Agreement

"On January 30, 2009, the [Cal PUC], acting as Lead Agency under CEQA, issued a Draft [EIR] analyzing the potential environmental impacts of a project designated the 'Coastal Water Project' and alternatives to it. The [Cal PUC] duly received and analyzed extensive public comment on the [Draft] EIR. [Marina Coast, the Water Resources Agency, and California American Water Company] provided comments on the [Draft] EIR." (AR 140-141.)

"On December 17, 2009, in Decision No. 09-12-017 which was issued in Application 04-09-019, the [Cal PUC], as Lead Agency, after considering all relevant environmental documents, duly certified a Final [EIR]. The Final [EIR] described and studied three alternative projects which are being considered for approval by the Commission in the proceeding - the Moss Landing Project, the North Marina Project, and a third alternative project variously referred to as the 'Regional Alternative' and the 'Regional Project' and 'Phase I of the Regional Project.' The principal element of that latter alternative project is a regional desalination water supply project, with other smaller elements. This Agreement does not contemplate or address any elements other than 'Phase I of the Regional Project.'" (AR 141.)

"On April 5, 2010, [Marina Coast], and on April 6, 2010, [Water Resources Agency], each acting as a Responsible Agency under CEQA, and having fully considered all relevant environmental documents, including the Final [EIR], approved this Agreement for a regional desalination project subject to [Cal PUC] approval, as more specifically described in Article 3 (the 'Regional Desalination Project')." (Underscoring omitted.) (AR 141.)

"The Regional Desalination Project contemplates the development, construction and operation of a regional desalination water supply project as described and analyzed in the [Final] EIR. (AR 141.)

[Marina Coast, the Water Resources Agency, and California American Water Company], individually and collectively, have determined and found that the Regional Desalination Project is the least costly of the proposed alternative projects, the most feasible of those projects, and is in the best interests of the customers served by each of [Marina Coast and California American Water Company] and that the Regional Desalination Project as implemented by this Agreement serves the public interest and is consistent with the Agency Act. The Parties have also determined that the Regional Desalination Project best conserves and protects public trust assets, resources and values impacted by providing a water supply." (AR 141.)

[California American Water Company] has determined that purchasing Product Water from [Marina Coast] will allow [California American Water Company] to provide its customers in [California American Water Company's] Service Area with Product Water at a significantly lower cost than by means of any of the other proposed alternative projects described in the [Final] EIR." (AR 141.)

[Marina Coast, the Water Resources Agency, and California American Water Company], as part of a settlement of issues pending in Application 04-09-019, as set forth in that certain Settlement Agreement to be filed with the [Cal PUC] in Application 04-09-019 (the 'Settlement Agreement'), have negotiated this Agreement and certain other agreements contemplated by the Settlement Agreement." (Underscoring omitted.) (AR 141)

"The Parties intend that the development, construction and operation of the Regional Desalination Project occur in accordance with the [Final] EIR and that [Marina Coast and the Water Resources Agency] each act as a Responsible Agency in accordance with CEQA to implement the Regional Desalination Project." (AR 141.)

(E). Notice of Determination Filed with County Clerk on March 17, 2010

"Project Title: Acquisition of 224-acres (+/-) of Armstrong Ranch Land and Appurtenant Easements relying upon the California Public Utilities Commission, California American Water Company, Coastal Water Project Final EIR (certified December 17, 2009) []." (Boldface omitted.) (AR 1083.)

"Project Description: The project consists of the acquisition of the Site by [Marina Coast], pursuant to an agreement between [Marina Coast] and the Armstrong Family entered into in 1996 and subsequently supplemented and amended (1996 Agreement). The 1996 Agreement limits use of the Site to the production, storage, or distribution of treated water (tertiary treatment or its equivalent) or potable water. The acquisition of the Site and appurtenant easements are intended to potentially allow development of infrastructure for water production and treatment, storage and distribution in accordance with the 1996 Agreement, and for future annexation of the Site to [Marina Coast]. Only the property acquisition is proposed. Future projects at the Site proposed by [Marina Coast] for water supply and other public facility infrastructure are conditioned upon CEQA compliance. [¶] The California Public Utilities Commission certified a relevant Final EIR for the California American Water Company, Coastal Water Project on December 17, 2009; however, have (sic) not taken action on the Coastal Water Project or alternatives. [¶] This notice is to advise that on March 16, 2010, the Board of Directors of the [Marina Coast] (Board) approved Resolution No. 2010-18 to Make CEQA Findings, Approve and Adopt Addendum to the Final EIR and Approve the Acquisition of 224-acres (+/-) of Armstrong Ranch Land and Appurtenant Easements. Resolution No. 2010-18, including attachments, made the following determinations regarding the Armstrong Ranch Property Acquisition and appurtenance Easements:" (Boldface omitted.) (AR 1084.)

(F). Resolution No. 2010-18

"... [Marina Coast] desires to own property in the area north of the City of Marina and south of land owned by the [Pollution Control Agency] (and the Monterey Regional Waste Management District [] to provide land for future construction, operation and maintenance of water supply infrastructure to produce, treat, store, and distribute water; and," (AR 1726.)

"WHEREAS, CEQA Guidelines Sections 15004 (b)(2)(A) provides that "agencies may designate a preferred site for CEQA review and may enter into land acquisition agreements when the agency has conditioned the agency's future use of the site on CEQA compliance," and the California Supreme Court's decision in *Save Tara v. City of West Hollywood* (2008) 45 Cal.4th 116, at 134, states that the Guidelines' exception for land purchases is a reasonable interpretation of CEQA; and,

"WHEREAS, this Resolution conditions the District's future use of the Site on CEQA compliance; and,

"WHEREAS, in accordance with CEQA Guidelines Section 15050(b) and 15096, [Marina Coast] has reviewed, considered, and relies upon the information in two existing, certified EIRs, the [Cal PUC] EIR and the [Regional Urban Water Augmentation Project] EIR as discussed in the [Cal PUC] EIR as hereinafter described, and related entitlements and approvals, to (1) thoroughly disclose and consider all relevant publicly available information on potential future activities that could occur at the Site and that may be indirectly enabled by the Acquisition, and (2) comprehensively identify all indirect environmental impacts of the Acquisition, thereby, evaluating the 'whole of the action' and avoiding piece-mealing or segmenting the analysis; and" (AR 1728.)

" WHEREAS, the [Cal PUC] EIR identified significant impacts of the [California American Water Company] Coastal Water Project alternatives and provided mitigation to reduce most of the significant impacts to a less-than-significant level with several environmental impacts remaining significant with mitigation, as summarized in the Executive Summary in Attachment A to this resolution; and,

"WHEREAS, pursuant to CEQA Guidelines Sections 15096, 15162, 15164 and 15063, and in consultation with other affected agencies and entities, [Marina Coast], as a responsible agency for approval of the Coastal Water Project alternatives, has prepared an Addendum to the [Cal PUC] EIR supported by an Initial Study (the Armstrong Ranch Property Acquisition Addendum in Attachment B) and finds the following related to the required CEQA compliance for the Acquisition:

• Acquisition of the Site, in and of itself, is merely a property transfer that would not directly have any significant effects on the environment,

• Future potential projects with components proposed to be located at the Site were described and evaluated previously in certified EIRs and those projects would result in significant environmental effects, including significant but potentially mitigable impacts,

• Although the decision to acquire the Site is not approval of a project under CEQA, [Marina Coast] is choosing to act as a responsible agency and to use a previously prepared and certified EIR, specifically the [Cal PUC] EIR, to support acquisition of the Site; and,

"WHEREAS, the action under consideration is approval of the Acquisition of the Site, which approval constitutes one of many actions necessary to implement the Coastal Water Project alternatives and would not by itself result in any significant impacts as described in the Armstrong Ranch Property Acquisition Addendum (Attachment B to this resolution); and,

"WHEREAS, the Directors have reviewed and considered the [Cal PUC] EIR and the Armstrong Ranch Property Acquisition Addendum (Attachment B) in their entirety and find that the [Cal PUC] EIR and the Armstrong Ranch Property Acquisition Addendum are adequate for the purpose of approving the [Marina Coast's] Acquisition of the Site, and [Marina Coast] hereby relies upon the contents of those documents and the CEQA process for its CEQA compliance; and,

"WHEREAS, [Marina Coast] intends to conduct all future activities at the Site in accordance with the [Cal PUC] EIR and with the [Regional Urban Water Augmentation Project] EIR as amended as discussed in the [Cal PUC] EIR; or, alternatively, and if needed to comply with CEQA, [Marina Coast] would amend, supplement or otherwise conduct new environmental review subsequent to approval of a project and adoption of findings by the [Cal PUC] and prior to directly or indirectly committing to undertake any specific project or action involving a physical change to the environment related to the Acquisition of the Site, including but not limited to a project or action involving any element of Phase I of the [Moss Landing] Alternative or the North Marina Alternative; and,

"WHEREAS, [Marina Coast's] General Manager, as [Marina Coast's] designated negotiator, recommends that the Board approve the Acquisition for execution in the form presented to the Board in open session on March 16, 2010.

"NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors of the Marina Coast Water District adopt the foregoing findings; and,

"BE IT FURTHER RESOLVED, that the Board of Directors of the Marina Coast Water District certify, pursuant to CEQA Guidelines §§ 15050(b) and 15096(t), that they have reviewed and considered the Final EIR as certified by the [Cal PUC] on December 17, 2009 in Decision D.09-12-017; and,

"BE IT FURTHER RESOLVED, that the Board of Directors of the Marina Coast Water District approve and adopt the Armstrong Ranch Property Acquisition Addendum to the [Cal PUC] EIR; and,

"BE IF FURTHER RESOLVED, that the Board of Directors of the Marina Coast Water District hereby approve the Acquisition and authorize the General Manager and Secretary and the President to take the actions and execute the documents necessary or appropriate to exercise [Marina Coast's] right to acquire the Site in accordance with the 1996 Agreement, as supplemented and amended, and this Resolution, and to accept the Site; and,

"BE IT FURTHER RESOLVED, that the General Manager is authorized and directed to prepare and file an appropriate Notice of Determination for approval of the Acquisition; and,

"BE IT FURTHER RESOLVED, that [Marina Coast's] use of the Site after acquisition is conditioned upon CEQA compliance and that [Marina Coast] by determining to acquire and acquiring the Site does not foreclose analysis of any alternative or any mitigation measure in considering uses of the Site.

"PASSED AND ADOPTED on March 16, 2010, by the Board of Directors of the Marina Coast Water District by the following roll call vote: ..." (AR 1731-1732.)

(G). Cal PUC EIR

"Both the Moss Landing and North Marina Projects are analyzed in Chapter 4 of the EIR. [California American Water Company] would be the owner and operator of either of these two projects, and the [Cal PUC], as the Lead Agency under [CEQA], will use this document to approve one of the two projects to be implemented in the in the [Coastal Water Project]." (AR 2788-2789.)

"As proposed in the Regional Project, [Marina Coast] would be the owner of the regional desalination facility and the surface water treatment plant. In order for the Regional Project to be implemented, it is assumed in this EIR that [Marina Coast] would use this EIR in considering approval of some of the Regional Project facilities." (AR 2789.)

"The [Cal PUC] has no jurisdiction over [Marina Coast]. Thus as discussed below, the [Cal PUC] would not have authority over any element of the [Coastal Water Project] that ultimately is undertaken by [Marina Coast]…." (AR 4532.)

"… [Marina Coast] would permit, construct, own and operate the regional desalination facility and would sell water to [California American Water Company]; [California American Water Company] would construct, own and operate the proposed storage and conveyance facilities. Thus, for the Regional Project, the [Cal PUC] would have jurisdiction over [California America Water Company's] portion, but not [Marina Coast]." (AR 4534-4535.)

"For the Regional Project to be implemented, the EIR assumes that [Marina Coast] would rely on the EIR in acting on the regional desalination facility over which it has jurisdiction … the [Cal PUC] would rely on the EIR before approving a [Certificate of Public Convenience and Necessity] for the storage and conveyance facilities proposed by [Californian American Water Company] and before approving a rate increase to allow [California American Water Company] to recover its costs." (AR 4335.)

"If the Phase 1 Regional Project is selected, [Marina Coast], as owner and operator of the desalination plant, would approve the plant itself (and any associated facilities that it would own) and would apply the EIR to that decision, including adopting findings and imposing mitigation measures. From a CEQA standpoint, it is immaterial which option is selected and which agency or agencies have primary authority or act first since each body must consider the EIR prior to acting on the project, adopt appropriate CEQA findings applying the EIR and impose relevant mitigation measures. Further, approval of a desalinate option by any agency would not commit that agency or any other agency to approval of any other component of the Phase 1 Regional Project, or of the Phase 2 Regional Project." (AR 4537.)

"The Regional Project examines a broad array of projects that could satisfy regional water supply needs in the near term and longer term. While this analysis will inform the [Cal PUC] decision-making process with respect to a potential desalination plant and how such plant could function in concert with other water supply components within the region, the [Cal PUC] would have jurisdiction over, and thus formally act on, only elements of the desalination plant requiring a [Certificate of Public Convenience and Necessity], and rate-making for [California American Water Company] actions. Thus, contrary to the suggestion of some commenters, the [Cal PUC] will neither consider adoption of the Regional Project in its entirety nor consider adoption of all projects composing the Phase 1 Regional Project. (AR 4537-4538.)

(H). This Court's lead agency determination

Guidelines section 15051 subdivision (a): "If the project will be carried out by a public agency, that agency shall be the lead agency even if the project would be located within the jurisdiction of another public agency."

From the evidence set forth above, Marina Coast choose to purchase property for siting their desalination plant, made CEQA findings concurrent with a statement of overriding considerations and including mitigation measures to carry out the Regional Project.

Marina Coast's argument is that the 2010 Regional Project decision was conditional, because it was part of Resolution 2010-20 that included the Settlement Agreement and Water Purchase Agreement, and Guidelines section 15051 is not applicable.

"Under CEQA, when a project involves two or more public agencies, ordinarily only one agency can serve as the lead agency. (Guidelines, §§ 15050, 15051.) CEQA thus distinguishes lead agencies from responsible agencies: whereas the lead agency has "principal responsibility" for the project, a responsible agency is "a public agency, other than the lead agency, which has responsibility for carrying out or approving a project." (Pub. Resources Code, §§ 21067, 21069.) Regarding this distinction, the CEQA guidelines provide that when a project involves two or more public agencies, the agency "carr[ying] out" the project "shall be the lead agency even if the project [is] located within the jurisdiction of another public agency." (Guidelines, § 15051, subd. (a).) [¶] Under these principles, courts have concluded that the public agency that shoulders primary responsibility for creating and implementing a project is the lead agency, even though other public agencies have a role in approving or realizing it. (*Eller Media Co. v Community Redevelopment Agency* (2003) 108 Cal.App.4th 25, 45–46 [133 Cal. Rptr. 2d 324] [community agency charged with responsibility for redevelopment measures within designated area was lead agency regarding billboard placement, even though city issued building permits for billboards]; *Friends of Cuyamaca Valley v. Lake Cuyumaca Recreation & Park Dist.* (1994) 28 Cal.App.4th 419, 426–429 [33 Cal. Rptr. 2d 635] [state agency that determined duck hunting policy, rather than wildlife district that enforced it, was lead agency regarding duck hunting policy]; *City of Sacramento v. State Water Resources Control Bd.* (1992) 2 Cal.App.4th 960, 971–973 [3 Cal. Rptr. 2d 643] [state agency that created pesticide pollution control plan, rather than water district that enforced it, was lead agency regarding plan].)" (*Planning and Conservation League v. Castaic Lake Water Agency* (2009) 180 Cal.App.4th 210, 239.)

Cal PUC was the lead agency for the Coastal Water Project. However, the Regional Project was proposed by the various public entities and Marina Coast was the first to approve the Regional Project by its actions of March 16 and 17, 2010, and April 5, 2010, and Marina Coast became the lead agency for the Regional Project. (*Sohio, supra,* 23 Cal.3d 812.)

"'Approval' means the decision by a public agency which commits the agency to a definite course of action in regard to a project intended to be carried out by any person." (*Save Tara v. City of West Hollywood* (2008) 45 Cal.4th 116, 129.)

The argument that Marina Coast could conditionally approve the Regional Project is belied by the approval of the resolution, the findings of approval with mitigation measures, a statement of overriding considerations, and the filing of a Notice of Determination. These actions clearly demonstrate that Marina Coast is responsible for carrying out the project. (Pub. Resources Code, § 21067; Guidelines, § 15352.)

The fact is, the Cal PUC could approve a different project, or none at all, and the Regional Project could go forward with Cal PUC's limited approval of a Certificate of Public Convenience and Necessity for California American Water Company's limited role in the Regional Project.

CEQA does not provide for a "conditional" Notice of Determination. If Ag Land had not challenged Marina Coast's approvals, the 30-day limitations period to challenge Marina Coast's Notice of Determination would have foreclosed a challenge to the Regional Project.

Any CEQA compliance by Marina Coast must be done under the auspices of its role as the lead agency.

Ag Land contends that the EIR was deficient in its discussion of 1) water rights; 2) contingency plan; 3) the assumption of constant pumping; 4) the exportation of groundwater from the Salinas Valley Groundwater Basin; 5) brine impacts on the outfall; 6) impacts on overlying an adjacent properties; and 7) water quality.

As noted in *Planning and Conservation League v. Department of Water Resources* (2000) 83 Cal.App.4[th] 892, 920, once Marina Coast has been found to be the lead agency, this Court "need not ... address [all] the other alleged deficiencies in [the] EIR[] (Pub. Resources Code, § 21005, subd. (c))[, because Marina Coast] ... may choose to address those issues in a completely different and more comprehensive manner."

(II). CEQA issues

Administrative mandamus is the appropriate avenue of review because the decision came after a hearing during which evidence was taken (Code Civ. Proc., § 1095.5, subd. (a).) A trial court may issue a writ of administrative mandate if: (1) the agency acted in excess of its jurisdiction; (2) the petitioner was denied a fair hearing; or (3) the agency prejudicially abused its discretion. (Code Civ. Proc., § 1094.5, subd. (b).) "A prejudicial abuse of discretion is established if the agency has not proceeded in a manner required by law, if its decision is not supported by findings, or if its findings are not supported by substantial evidence in the record. [This Court] may neither substitute [its] views for those of the agency whose determination is being reviewed, nor reweigh conflicting evidence presented to that body." (*San*

Franciscans Upholding the Downtown Plan v. City and County of San Francisco (2002) 102 Cal.App.4th 656, 674, citations omitted.)

The "failure to comply with the law subverts the purposes of CEQA if it omits material necessary to informed decisionmaking and informed public participation. Case law is clear that, in such cases, the error is prejudicial." *(Sunnyvale West Neighborhood Association v. City of Sunnyvale City Council* (2012) 190 Cal.App.4th 1351, 1392.)

(A). Water Rights

Ag Land argues that CEQA requires details of water rights, including ownership if it affects the water supply, and the EIR must address foreseeable impacts of supplying water to the project. (*Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 421, 431, 434.) Ag Land contends that the Salinas Valley basin is overdrafted and California groundwater law holds that the doctrine of correlative overlying water rights applies when no surplus water is available for new appropriators except by prescription, and Marina Coast had to address this issue. (AR 2257.) Ag Land states that Monterey County admitted that it does not have water rights for the wells that are projected to be used for the Regional Project and it is possible that Monterey County may have to initiate groundwater adjudication of the entire Salinas Valley. (AR 817-819.) Ag Land contends that the Cal PUC has no authority over water rights or public water agencies and cannot grant or approve such rights and Marina Coast was required to address the claims and issues under a CEQA analysis, including the extraction of water from the basin.

Marina Coast argues that 1) Monterey County has never admitted it does not have water rights; 2) Mr. Weeks, Monterey County Water Resources Agency, said that the Water Agency and the County are organizations that can pump from the Salinas Basin and that every drop will stay in the Basin, and 3) as a responsible agency, Marina Coast is not required to analyze water right claims over which Marina Coast has no authority.

(B). Excerpts from Administrative Record regarding water rights

(1). Ag Land letter, in part, to Marina Coast dated April 5, 2010.

"The Regional Project would require the use of water rights which the project proponents do not own. The Salinas Valley Groundwater Basin is in very serious overdraft, and has been acknowledged to be in serious overdraft since the 1950s. The proposed Salinas Valley Water Project [SVWP] is not operational. All of the various components of the Salinas Valley Water Project must be fully operational for years before it can be effective or before its early results are known with any reliability. The SVWP is not operational. Even after its operations begin, it will take years before it would have any effect on the tens of thousands of acre feet of annual overpumping in the Salinas Valley Groundwater Basin. Further, even if in the future the Basin's recharge is ever in balance with the pumping from the Basin, which is highly in doubt and cannot be accurately measured, the seawater intrusion would remain. Technical experts agree that seawater intrusion is generally not reversed. Further, the SVWP under construction is significantly smaller than the project evaluated in the SVWP EIR. The project was significantly downsized after the cost projections from the original project came in far over budget. [¶] The County Water Resources Agency does not measure or maintain accurate or detailed records of cumulative basin pumping, cumulative basin water usage, or overpumping. At best, the Agency merely estimates amounts of recharge, pumping and seawater intrusion. The Agency records are vague on these important issues." (AR 596-597.)

"The environmental review to date does not include any consideration of the potential use of eminent domain to acquire any property interests for the Regional Project. Such use is clearly contemplated by the project proponents, because, for example, the proponents do not own and have not yet obtained water rights for the project or property rights for the proposed wells. The staff report for the Monterey County Water Resources Agency Board of Supervisors' meeting of April 6, 2010, states that project proponents 'will obtain, through purchase or other legal means, all easements or other real property interests necessary to build, operate and maintain' the proposed wells. The contemplated use of 'other legal means' includes eminent domain, which is a project under CEQA and which must be evaluated in the environmental review." (AR 601.)

(2). November 2, 2009 letter, in part, from Ag Land to Marina Coast in response to the Notice of Preparation of an EIR for the Armstrong Ranch acquisition and annexation.

"These comments are intended to help Marina Coast Water District determine the scope of the EIR and ensure an appropriate level of environmental review. The Ag Land Trust asks the Water District to review carefully the following potential environmental issues and impacts in the EIR.

• The water rights on the project site and water rights anticipated to be used for future projects involving the project site. Water rights are correctly researched at this EIR stage. *(Save Our Peninsula Committee v. County* of *Monterey* (2001) 87 Cal.App.4th 99,131-134.) The project site is in the overdrafted Salinas Valley groundwater basin.

• The EIR should acknowledge that, under California law, no new groundwater may be appropriated legally from the overdrafted Salinas basin, except by prescription. The EIR should include a discussion and analysis of the status of water rights in the basin, and the specific water rights held by [Marina Coast] and all other entities who could or would be involved in future water supply projects.

• As to each entity, the EIR should categorize the water rights as to type, identified as used or unused, the applicable seniority of the rights, and the supporting documentation for each claim should be provided.

• The EIR should investigate the legal justification for any groundwater rights claimed by [Marina Coast], because in an overdrafted basin new appropriative rights cannot be acquired except through prescription, which has not occurred here.

• The EIR should disregard any claimed groundwater rights held by [Monterey County Water Resources Agency], because [Monterey County Water Resources Agency], does not have such rights. If the EIR asserts otherwise, it should investigate and provide supporting documentation for its assertion.

• The water rights of the Monterey County Water Resources Agency (MCWRA) should be carefully reviewed, because [Marina Coast] and the [Monterey County Water Resources

Agency], have MOUs in place that indicate that [Monterey County Water Resources Agency], involvement on the project site for water supply purposes is foreseeable. The impacts on neighboring properties of the project and the future projects that would be enabled by the project. For example, the Ag Land Trust has large holdings in the areas of Moss Landing, Castroville, and Marina which would be affected directly by the various proposed water projects and alternatives of the proposed projects. Many of Ag Land Trust's acres of land and easements, and their attendant overlying groundwater rights, have been acquired with grant funds from the State of California as part of the State's long-term program to permanently preserve our state's productive agricultural lands. The Ag Land Trust believes that the agricultural operations, the agricultural potential, the water rights, the water systems, and the viability of its property in general would be negatively impacted by the project(s) being evaluated in the EIR." (AR 895-896.)

(3). Ag Land letter to Marina Coast dated March 16, 2010, in relevant part:

"On November 6, 2006, and again on April 15, 2009, the Ag Land Trust notified the Public Utilities Commission of certain key flaws in the Coastal Water Project EIR. Specifically, the first full paragraph on page two of the Trust's November 6, 2006 letter (identified as 'G_AgLTr-3' in the FEIR) states that Cal-Am, a water appropriator under California law, has no groundwater rights to appropriate water from the overdrafted Salinas Groundwater Basin. In an overdrafted, percolated groundwater basin, California groundwater law clearly and definitely holds that the doctrine of correlative overlying water rights applies *(Katz v. Walkinshaw* (1903) 141 Cal. 116), whereby no surplus water is available for new groundwater appropriators.

"The FEIR response claims that an analysis of water rights is not necessary because 'CalAm claims no rights to groundwater' and that 'no Salinas Valley groundwater will be exported from the Basin.' The FEIR attempts to bypass a central issue - the EIR's failure to analyze legal water rights - by claiming that the issue does not exist. On the contrary, the issue of legal water rights exists and should be analyzed.

"Because the extracted water would be composed of both saltwater and groundwater, Cal-Am (under the North Marina project) or Monterey County (under the Regional Project) would be extracting groundwater from the overdrafted Salinas Valley Groundwater Basin. Those actions would represent an illegal appropriation of water. The EIR claims that water can be appropriated from under privately owned land in the overdrafted basin, so long as it promises to return the same amount of pumped groundwater to the basin. That claim is not enforceable, not subject to oversight and does not change the fact that the extraction of the water would be an illegal appropriation. In essence, the Cal Am North Marina desalination project and the Regional Project would rely on illegal extraction and appropriation of groundwater from the basin. The EIR does not analyze the significant impact of an illegal taking of groundwater from overlying landowners. Instead, the FEIR accepts as unquestionably true the flawed rationale that a purported return of a portion of the water somehow allows the illegal extraction of groundwater from the overdrafted basin. This deficiency in the EIR must be addressed, and the EIR should identify mitigations for the adverse impacts and proposed illegal actions and takings.

"The principle is established that the water supply in a source may be augmented by artificial means. (See *Pomona Land & Water* Co. *v. San Antonio Water Co. (1908)* 152 Cal. 618.) We do not question that general statement of law. However, when getting to the specifics of the abilities and limitations in regard to the augmented or developed water proposed for the Project, the EIR defaults on the necessary discussion. Instead of addressing the entire doctrine of water rights applicable here, the FEIR (14.1-94, n. 4) defers entirely to the MCWD's legal counsel for the discussion of the essential factors. From page 14.1-94 to 14.1-96, MCWD's legal argument is presented without critical analysis or further comment as the FEIR's discussion. There is no independent review or investigation of the legal argument, as required under CEQA.

"California law on the ability of an agency to claim the right to salvage any or all of any developed water in the circumstances here, and any limits on that claim, has not yet been defined by the Courts. The citations in the FEIR overstate the situation, and do not point to any California court case where the analysis presented in the FEIR has been upheld by the Court. The two cases relied upon by the

MCWD's counsel (and therefore the FEIR) are cited in footnote 10 of FEIR page 14.1-96: *Pajaro Valley Water Mgt. Agency v. Amrhein* (2007) 150 Cal.App.4th 1364, 1370 and *Lanai Company, Inc. v. Land Use Commission* (S. Ct. Ha. 2004) 97 P.2d 372,376. The citations in both cases are to portions of the introductory factual recitations in the cases, and not to Court holdings or legal analysis, and thus are not fairly considered precedents or statements of settled law. Other FEIR citations are to legal claims asserted in a staff report by the head of the Monterey County Water Resources Agency, who is not an attorney.

"Here, the CPUC's EIR defined the project too narrowly. The EIR never evaluated the existence or nonexistence of water rights on which the Regional Project would rely. At the very least, the FEIR was required to evaluate the claims of MCWD and MCWRA, test them analytically, and provide the decisionmakers and the public with the analysis. Without the reasoned good faith analysis, the EIR fails as an informational document. (See, e.g., *Santa Clarita Organization for Planning the Environment v. County of Los Angeles* (2003) 106 Cal.App.4th 715, 722.) 'It is not enough for the EIR simply to contain information submitted by the public and experts.' In particular, water 'is too important to receive such cursory treatment.' *(Id.)* CEQA requires a detailed analysis of water rights issues when such rights reasonably affect the project's supply. Assumptions about supply are simply not enough. *(Id.,* at p. 721; *Save Our Peninsula Committee v. County of Monterey* (2001) 87 Cal.App.4th 99, 131- 134, 143 [EIR inadequate when it fails to discuss pertinent water rights claims and overdraft impacts]; see also, *Cadiz Land* Co. *v. Rail Cycle* (2000) 83 Cal.App.4th 74, 94-95 [groundwater contamination issues].) The reasoning of the Court in *Cadiz* would also apply to the proper analysis of the rights associated with the overdraft here.

"At the very least, the determinations of safe yield, surplus, the rights of the MCWRA, and of 'persons with land in the zones of benefit for the projects' must be identified, discussed and analyzed. The analysis must be independent, and cannot simply be 'extracted' (FEIR, p. 14.1-94, n. 4) from the argument of the attorney for the MCWD, a proponent of the Regional Project and potential owner of the desalination plant component of that project. Whether the project may take salvaged or developed water originating from onsite supplies depends on whether injury will result to existing lawful users or those who hold vested rights. The FEIR response to comments does not fairly consider or investigate the actual on-the-ground issues.

"Neither the MCWD nor the MCWRA has groundwater rights that would support the drilling of the proposed intake wells for the Regional Project. On March 3, 2010, this Office made a California Public Records Act request to the County of Monterey and Monterey County Water Resources Agency seeking the records that support a MCWRA claim that the MCWRA or the MCWD have water rights for the proposed Regional Project. To date, the County has not provided any documents that support those claims." (AR 1127-1129.)

(4). Salinas Valley Water Coalition letter dated April 15, 2009 addressed to Mr. Barnsdale regarding the Coastal Water Project.

The Salinas Valley Water Coalition asked about water rights for groundwater pumping and surface diversion. (AR 4413.)

The EIR contains a response to these concerns. In part, the EIR refers to Master Response 13.6 and states that because "[i]t is CEQAs intent to identify and analyze potential impacts of the project on the environment; water rights are not considered an environmental issue. Groundwater extracted for the Coastal Water Project would be covered under the right held by the entity that owns and operates the wells … Details of the water rights is beyond the scope of CEQA because the acquisition of water rights does not determine the feasibility of this project." (AR 4973, 4974.)

Master Response 13.6 noted that some "comments asserted that the project could not legally withdraw and export water from the [Salinas Valley Groundwater Basin] to other areas on the Monterey Peninsula." Master Response 13.6 was "intended to clarify and enhance information brought to light in the Draft EIR regarding the quantity, use of, and replacement of water that would be drawn from the [Salinas Valley Groundwater Basin] and used by the proposed project." (AR 4547.) The Master Response notes in passing that "hydrologic modeling analyses undertaken to date indicate that extraction of brackish water at the coast will cause no injury to the rights of overlying landowners or other water users." (Footnote omitted.) (AR 4550.) The Master Response concludes that "the Regional Project would extract intruded groundwater that would otherwise be of no use to municipal or agricultural users and would treat that water for potable uses. The source of this water is the 180-foot aquifer that has been intruded by seawater since the 1940s. The proposed extraction wells would be located along the coast and, depending on whether they are slant wells at the coast or vertical wells slightly inland, both configurations would withdraw ocean water with some lesser fraction of intruded groundwater from within the [Salinas Valley Groundwater Basin].... The fraction of feedwater determined to be [Salinas Valley Groundwater Basin] water, which is extracted from the wells, would not be exported out of the basin, rather, it would be conveyed for agricultural proposes (North Marina Project) or delivered to the Marina Coast Water District for municipal supply (Regional Project)." (AR 4556-7.)

(5). The Open Monterey Project sent a letter to Mr. Barnsdale on April 15, 2009 with comments on the Draft EIR.

The Open Monterey Project comments are very similar to those made by Ag Land. In general, The Open Monterey Project notes that specific water rights are not indentified or discussed, that using water without water rights has an environmental impact, and provides at length and in some detail the rational for the questions about water rights. (AR 4415.)

The response to these comments provided in the Final EIR provides "refer to comment rezones G_SVWC-10 and PSMCSD-2." (AR 4978.)

(6). Pajaro/Sunny Mesa Community Services District sent a letter to the Cal PUC on April 15, 2009 with comments on the Draft EIR.

Pajaro/Sunny Mesa Community Services District noted that California American Water Company, the Cal PUC, and any potential public agency partner lacked any appropriative percolated groundwater rights in the Salinas Valley Groundwater Basin and it would be illegal to take water, and the Draft EIR's failure to acknowledge this deficiency must be addressed. (AR 4125-4126.)

The specific issue of water rights is never addressed in the response to this comment. (AR 4729-4731.)

(7). Letter from David Kimbrough (Chief of Administrative Services, Finance Manager for Monterey County) dated March 24, 2010 to Ms. Molly Erickson.

In relevant part: "Further, [Monterey County Water Resources Agency] intends to acquire an easement, including rights to ground water, from the necessary property owner(s)to install the desalination wells. These rights have not been perfected to date, hence no records can be produced. [¶] As to [Marina Coast Water District], it was previously annexed into Zones 2 & 2A and as such has right to ground water." (AR 817.)

(C). Analysis

"It has been held that an EIR is inadequate if it fails to identify at least a potential source for water. In *Stanislaus Natural Heritage Project v. County of Stanislaus* (1996) 48 Cal. App. 4th 182 [55 Cal. Rptr. 2d 625], for example, the failure to identify a source of water beyond the first five years of development rendered the EIR inadequate, although the developer was pursuing several possible sources. It also has been held that an EIR is inadequate if the project intends to use water from an existing source, but it is not shown that the existing source has enough water to serve the project and the current users. (*Santiago County Water Dist. v. County of Orange* (1981) 118 Cal. App. 3d 818 [173 Cal. Rptr. 602].) On the other hand, it has been held that an EIR is not required to engage in speculation in order to analyze a 'worst case scenario.' (*Towards Responsibility in Planning v. City Council* (1988) 200 Cal. App. 3d 671 [246 Cal. Rptr. 317] (hereafter *TRIP*).) In that case, the court held that an EIR was not required to analyze the effects that would result from the construction of a sewage treatment facility, when (1) all indications suggested that the facility would never be needed, and (2) the facility--if it was constructed--would be subjected to its own environmental review." (*Napa Citizens for Honest Government v. Board of Supervisors* (2001) 92 Cal.App.4th 342, 372-373.)

Not until the day of trial did Marina Coast assert that the EIR addressed the issue of water rights.

There is no dispute that the water that will be pumped from the wells will contain some proportion of groundwater from the 180-foot aquifer.

As set forth above, the final EIR does not contain a discussion of the issues surrounding the availability of groundwater for the Regional Project and the impacts on the physical environment in light of Monterey County Water Resources Agency's admission in March 2012 that it "intends to acquire an easement, including rights to ground water, from the necessary property owner(s)to install the desalination wells [and t]hese rights have not been perfected to date."

The EIR assumes that groundwater rights will be perfected in the future and that such rights do not need to be addressed in an EIR.

"Such an assumption, however, is impermissible, as it is antithetical to the purpose of an EIR, which is to reveal to the public 'the basis on which its responsible officials either approve or reject environmentally significant action,' so that the public, 'being duly informed, can respond accordingly to action with which it disagrees.' (Laurel Heights, supra, 47 Cal.3d at p. 392.) As another court observed, '[t]o be adequate, the EIR must include sufficient detail to enable those who did not participate in its preparation to understand and 'meaningfully' consider the issues raised by the proposed project.' (SCOPE, supra, 106 Cal.App.4th at p. 721; see also *Concerned Citizens of Costa Mesa, Inc. v. 32nd Dist. Agricultural Assn.* (1986) 42 Cal.3d 929, 935 [231 Cal. Rptr. 748, 727 P.2d 1029] (*Concerned Citizens*) ['[t]o facilitate CEQA's informational role, the EIR must contain facts and analysis, not just the agency's bare conclusions or opinions'].) This standard is not met in the absence of a forthright discussion of a significant factor that could affect water supplies. The EIR is devoid of any such discussion." (*California Oak Foundation v. City of Santa Clarita* (2005) 133 Cal.App.4th 1219, 1237.)

As the lead agency, Marina Coast will need to address this prejudicial abuse of discretion including, but not limited to, 1) water rights; 2) contingency plan; 3) the assumption of constant pumping; 4) the exportation of groundwater from the Salinas Valley Groundwater Basin; 5) brine impacts on the outfall; 6) impacts on overlying an adjacent properties; and 7) water quality.

(III). Marina Coast's defenses

Marina Coast raises a number of defenses that are predicated, in part, on the issue of lead agency which was resolved above.

Marina Coast contends that this Court is without jurisdiction because (1) the relief sought by Ag Land is preempted by the Public Utilities and Public Resources Codes; (2) the Petition is not ripe; (3) Ag Land has not exhausted its administrative remedies before the Cal PUC; and (4) Ag Land is precluded from challenging Cal PUC's orders because of res judicata. At trial, the Court permitted Marina Coast to amend its answer to include an affirmative defense of failure to join indispensible parties.

Marina Coast also argues that this Court lacks primary jurisdiction and must apply the three-part test set out in *San Diego Gas & Electric Co. v. Superior Court* (1996) 13 Cal.4th 893 (*Covalt*).

(A). Preemption

There is no preemption issue. The issue is one of jurisdiction and is addressed below.

(B). Ripeness

The Court has found that the Petition is ripe for review to the extent that Marina Coast is the lead agency. (*Security National Guaranty, Inc. v. California Coastal Com.* (2008) 159 Cal.App.4th 402, 418.)

The fact that the Cal PUC might or might not approve the Regional Project does not change the fact that Marina Coast acted first and filed a Notice of Determination. Marina Coast must now comply with CEQA in its role as the lead agency for the Regional Project.

(C). Exhaustion

The Cal PUC is not a party to this action and Ag Land raised the lead agency issue, amongst others, in its letter with attached exhibits dated March 16, 2010 that was directed to Marina Coast. (AR 1106-1134.) Ag Land also sent a letter with numerous exhibits to Marina Coast on April 5, 2010, and spoke at the April 5, 2010 public hearing. (AR 595-601, 591-592.) (Pub. Resources Code, §21177.)

Ag Land has exhausted its administrative remedies before Marina Coast.

(D). Res judicata

There is no final litigated prior decision on the merits regarding what public entity is the lead agency for the Regional Project and res judicata does not apply. (*Mycogen Corp. v. Monsanto Co.* (2002) 28 Cal.4th 888, 896-897.)

Res judicata applies if "(1) the decision in the prior proceeding is final and on the merits; (2) the present proceeding is on the same cause of action as the prior proceeding; and (3) the parties in the present proceeding or parties in privity with them were parties in the prior proceeding." (*Federation of Hillside Canyon Assns. v. City of Los Angeles* (2004) 126 Cal.App.4th 1180, 1202.)

(E). *Covalt* – Jurisdiction

Public Utilities Code section 1759 provides: "Jurisdiction of courts to review orders or decisions of commission; Writ of mandamus[.] [¶] (a) No court of this state, except the Supreme Court and the Court of Appeal, to the extent specified in this article, shall have jurisdiction to review, reverse, correct, or annul any order or decision of the commission or to suspend or delay the execution or operation thereof, or to enjoin, restrain, or interfere with the commission in the performance of its official duties, as provided by law and the rules of court. [¶] (b) The writ of mandamus shall lie from the Supreme Court and from the Court of Appeal to the commission in all proper cases as prescribed in Section 1085 of the Code of Civil Procedure."

The *Covalt* "decision set forth a three-part inquiry for determining whether the action would interfere with the [Cal] PUC in the performance of its duties and thus was precluded by [Public Utilities Code] section 1759(a): (1) whether the [Cal] PUC possessed the authority to formulate a policy regarding any public health risk related to electric and magnetic fields arising from the powerlines of regulated utilities, or a policy regarding what actions, if any, the utilities should have taken to minimize any such risk; (2) whether the [Cal] PUC had exercised that authority to adopt such policies; and (3) whether the superior court action filed by private persons against the utility would hinder or interfere with those policies." (*People ex rel. Orloff v. Pacific Bell* (2003) 31 Cal.4th 1132, 1145.)

Here, the Cal PUC has authority to regulate California American Water Company. It has no authority to regulate or dictate to Marina Coast, or any other public agency, regarding the approval and development of the Regional Project. This action does not hinder the Cal PUC's ability to regulate California American Water Company, and this Court has jurisdiction.

(F). Indispensible parties

Marina Coast contends that Ag Land had to name the Water Resources Agency and California American Water Company as real parties in interest because they were parties to the Water Purchase Agreement and the Settlement Agreement.

The Water Purchase Agreement requires that the Water Resources Agency pump water that will be delivered to the Regional Project and after desalination at the Marina Coast facilities, the water will be distributed by California American Water Company to its customers. The Settlement Agreement determined the ownership of certain facilities, and the parties to the Settlement Agreement agreed to protect the Salinas Valley Groundwater Basin.

This action and the Court's decision do not interfere with either agreement, and if it could be construed that the decision touches on either agreement, the Court finds that the Water Resources Agency and California American Water Company do not qualify as indispensable parties.

"The determination of whether a party is indispensable is governed by Code of Civil Procedure section 389, which first sets out, in subdivision (a), a definition of persons who ought to be joined [in an action] if possible (sometimes referred to as 'necessary' parties). Then, subdivision (b) sets forth the factors to follow if such a person cannot be made a party in order to determine whether in equity and good conscience the action should proceed among the parties before it, or should be dismissed without prejudice, the absent person being thus regarded as *indispensable.* [] The subdivision (b) factors are not arranged in a hierarchical order, and no factor is determinative or necessarily more important than another. (*County of San Joaquin v. State Water Resources Control Bd.* (1997) 54 Cal.App.4th 1144, 1149.) [¶] In a CEQA action like the one before us, Public Resources Code section 21167.6.5 provides that any recipient of an approval that is the subject of [the] action must be named as a real party in interest. (Pub. Resources Code, § 21167.6.5, subd. (a) (section 21167.6.5(a)).) Thus, section 21167.6.5(a) makes any such recipient a necessary party in a CEQA action, just as those persons described in subdivision (a) of Code of Civil Procedure section 389 are necessary parties. But a recipient of an approval, while a necessary party, is not necessarily an indispensable party, such that the CEQA action must be dismissed in the absence of that party. Instead, if a court finds that unnamed parties received approvals, [the court must] then consider whether under Code of Civil Procedure section 389, subdivision (b) [the unnamed parties] qualify as indispensable parties, requiring dismissal of the action. (*County of Imperial v. Superior Court*, *supra*, 152 Cal.App.4th at p. 31.)." (*Quantification Settlement Agreement Cases* (2011) 201 Cal.App.4th 758, 848, some quotation marks omitted, italics in original.)

The Court has found Marina Coast to be the lead agency and that finding does not "impair or impede" the Water Resources Agency or California American Water Company's ability to protect their interests, nor will either entity suffer prejudice by the Court's lead agency determination and any resolution of CEQA issues (see Section III below), the judgment here is adequate, and Ag Land would not have an adequate remedy if the action were dismissed. (Code Civ. Proc., § 389 subd. (a) and (b); Pub. Res. Code, § 21167.6.5 subd. (a).)

Disposition

Ag Land's request for relief is granted as set forth above.[1]

Lydia M. Villarreal

Dated: FEB 0 2 2012

HON. LYDIA M. VILLARREAL

Judge of the Superior Court

[1] Marina Coast counsel has argued the importance and dire need of procuring a reliable water source for the Monterey Peninsula. The Court wishes to point out to counsel that the Court's authority is limited to reviewing compliance with CEQA by those agencies responsible for procuring a reliable water source.

CERTIFICATE OF MAILING

C.C.P. SEC. 1013A

I do hereby certify that I am not a party to the within stated cause and that on FEB 0 2 2012 I deposited true and correct copies of the following documents: ORDER in sealed envelopes with postage thereon fully prepaid, in the mail at Salinas, California, directed to each of the following named persons at their respective addresses, as hereinafter set forth:

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Monterey, CA 93940

Mark Fogelman, Esq.
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Salinas, CA 93902-2510

Dated: FEB 0 2 2012

CONNIE MAZZEI Clerk of the
Monterey County Superior Court

By Sally Lopez, Deputy Clerk

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May 3, 2013

RECEIVED
5-3-13
SWRCB Hearing Unit

Mr. Paul Murphey
Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

RE: **Comments on MPWSP Draft Report**

Dear Mr. Murphey:

On behalf of the California American Water Company (Cal-Am), we would like to thank you and your colleagues for preparing the detailed and thoughtful *Draft Review of California American Water Company's Monterey Peninsula Water Supply Project*, dated April 3, 2013 ("Draft Review"). Overall, the Draft Review is consistent with Cal-Am's water rights position for the Monterey Peninsula Water Supply Project ("Project" or "MPWSP"), and comports with Cal-Am's understanding of the initial technical information concerning the potential effects of the Project. Cal-Am agrees that additional technical information, to be developed through the proposed test well and related study and monitoring program, is necessary to confirm and verify existing analysis and increase the certainty that the slant wells are not likely to adversely impact the Salinas Valley Groundwater Basin (SVGB) or cause injury to SVGB pumpers. This letter provides Cal-Am's comments on the Draft Review for your consideration. Our comments are intended to amplify or clarify points raised in the Draft Review.

General Comments:

- The primary recommendations in the Draft Review are for a robust study and monitoring program to determine aquifer conditions in the vicinity of the MPWSP, aquifer testing and hydrogeologic analysis, groundwater modeling, and monitoring. See Draft Review, pp. iii and 42-43. Cal-Am is proposing to undertake all of these analyses and investigations, and is currently in the process of obtaining permits and authorizations to complete this necessary work. Cal-Am also has an agreement with the Monterey County Water Resources Agency to implement and carry out a long-term monitoring plan associated with the MPWSP.

- The Draft Review notes that the "Dune Sand Aquifer" is a "near-surface water-bearing zone" that is "not regionally extensive" and is "poor quality" (due primarily to its direct influence from Monterey Bay). See Draft Review, p. 8. For these reasons, and in response to requests from certain stakeholders, Cal-Am is evaluating the feasibility and cost of completing the slant wells in the Dune Sand Aquifer, either partially or completely. This evaluation will be performed as part of Cal-Am's testing and monitoring program.

- The Draft Review (page 21) discusses the important distinction between the cone of depression (or zone of influence) and the capture zone that contributes water to a pumping well: "…not all the water in the cone of depression flows to the pumping well…." In particular, where significant boundary conditions exist – such as horizontal flow from a subsea aquifer outcropping and/or vertical leakage from the seabed – the boundary condition may provide an overriding factor relative to direction of groundwater flow in determining the dimensions of a capture zone and source(s) of water flowing to a well. (See also, Draft Review pp. 17-18). The recharge boundary conditions would also tend to affect (in this case, significantly increase) the proportion of seawater flowing to the project wells under existing landward gradients.

- The Draft Review (page 24) makes the point that the MPWSP project would appear to have the consequence of reducing the flow of seawater intrusion into the Salinas Valley. Related to this point, the term "capture zone" may be more accurate than "zone of influence" in describing the anticipated hydrogeologic effects of the MPWSP in the following sentence: "The MPWSP drawdown would change the groundwater gradient within the zone of influence causing a radial flow of groundwater toward the extraction wells."

- The Draft Review (page 26) does a good job of explaining one of the key and fundamental hydrogeologic concepts pertaining to the proposed MPWSP: "Because the ocean provides a constant source of nearby recharge to the extraction wells, the zone of influence for the extraction wells cannot expand much farther than the distance between the extraction wells and the ocean, or in the case of confined aquifer conditions, the distance between the extraction wells and the undersea outcrop of the confined aquifer."

- The Draft Review (page 28) states: "The reduction in the availability of fresh water would not be felt immediately; thus, replacement water could be provided after the MPWSP has been in operation and modeling information becomes available to evaluate the actual quantity of fresh water that needs to be returned to the system." The above concept is further discussed and developed on page 37 of the Draft Review. This is an important observation and the concept informs Cal-Am's commitment to return to the SVGB, through the Castroville Seawater Intrusion Project, any fresh water that is extracted by the MPWSP slant wells. This concept will also inform the development of Cal-Am's testing and monitoring plan.

- The Draft Review (page 38) states with respect to existing groundwater wells that have been identified in the general vicinity of the Project: "…it is unlikely the MPWSP would injure users of these wells as the wells are within a zone where water quality is significantly impacted from seawater intrusion." This is another key observation in the Draft Review and will help design the development of the study and monitoring plan and any mitigation measures that may be required for the MPWSP.

- The Draft Review mentions potential groundwater level "impacts" that may result from the MPWSP: "…pumped wells would have an impact to groundwater users within a 2-mile radius of the wells." (Draft Review, p. 20; see also, Draft Review, p. 24: "Once the zone of influence is estimated for each location and each pumping scenario then any wells within the zone of influence would be affected by project pumping and possibly cause injury"). The groundwater level effect described in this section of the Draft Report refers to the modeled drawdown estimates from the MPWSP; approximately 2.0 feet within one mile of the slant wells, less than 0.5 feet 1.5 miles from the well, and negligible influence at 2.0 miles and beyond. Elsewhere, the Draft Review acknowledges that the seawater intrusion front has extended more than five miles inland in the 180 foot aquifer (e.g., Draft Review p. 13), and that only 14 groundwater wells exist within a two mile radius of the proposed slant well location. The Draft Review further states that all of these wells are located within the seawater intruded zone, and on that basis concludes that "it is unlikely that the MPWSP would injure users of these wells…." (Draft Review, p. 38) Thus, Cal-Am interprets the Draft Review to conclude that groundwater level drawdown within the zone of influence attributable to the MPWSP wells may "affect" wells within that zone of influence, but such affects will not likely rise to the level of "legal injury" requiring remedial action or a physical solution unless there is a substantial impact to the use of those wells for beneficial purposes. See *Lodi v. East Bay Municipal Utilities District* (1936) 7 Cal.2d 316, 341. This is particularly true as it relates to wells that may be completed in the long-existing seawater intruded area of the SVGB.

- The Draft Review makes use of several terms to describe the water quality characteristics of the feed water that may be developed by the MPWSP, but does not provide precise definitions of those terms. In particular, the Draft Review uses the terms "seawater," "brackish" water, and "fresh" water. Based on the context in which these terms are used in the Draft Review, Cal-Am has discerned the following meanings:

  - "Seawater" appears to mean water that originates from the Pacific Ocean and Monterey Bay, and having the same general constituency of ocean waters found in Monterey Bay. See, e.g., Draft Review p. 28.
  - "Fresh" water appears to mean groundwater inland of the seawater intrusion front, which the Monterey County Water Resources Agency defines as the upper limit of the Secondary Drinking Water Standard, or 500 milligrams per liter (mg/L) concentration for chloride.[1] See, e.g., Draft Review, pp. 13-14 for definitional guidance, and e.g., pp. 28, 30, and 36-37 for usage.

[1] The Draft Review further cites to the Central Coast Regional Water Quality Control Board's Basin Plan, which states that water for agricultural use shall not contain concentrations of chemical constituents in amounts adversely

- "Brackish" water appears to mean (and include) all groundwater in the SVGB having a chloride level higher than "fresh" water (i.e., >500 mg/L concentration for chloride), and lower than the chloride and salinity levels in "seawater."

Based on these inferred definitions, Cal-Am questions the accuracy of the first part of the following statement on page 26 of the Draft Review (Cal-Am agrees with the second part of the statement): "Although this brackish water is of substantially better quality than seawater, it is likely degraded to the point that it is not suitable for any beneficial use other than feed water for desalination purposes." It is likely that brackish water in close enough proximity to be drawn into the proposed MPWSP slant wells would have salinity and chloride levels very similar to those levels found in "seawater." See also, Geoscience, September, 2008, attached. Conversely, brackish waters closer to the "fresh" water line in the SVGB are likely to have constituencies more similar to fresh waters.

- Page 38 of the Draft Review states: "If the MPWSP wells are located where unconfined aquifer conditions exist, project pumping likely would extract brackish groundwater. The majority of the source water would be from within the seawater-intruded portion of the Basin as the seawater intrusion front extends approximately 5 miles landward from the proposed well locations." Cal-Am interprets this statement to mean that, if the MPWSP source wells are located in an "unconfined" area of 180-foot aquifer of the SVGB, then the inland source of water, if any (because the vast majority of water would be sourced from the ocean), is likely to be "brackish" groundwater as opposed to "fresh" groundwater. Elsewhere the Draft Review acknowledges that in an "unconfined" aquifer – and Cal-Am submits the same would be true in a "semi-confined" aquifer – the vast majority of the source water to the proposed MPWSP will come from Monterey Bay/seawater. See Draft Review, p. 26. Under these conditions, "[i]t is unlikely that pumping from an unconfined aquifer would extract fresh groundwater since the seawater intrusion front is approximately 5 miles landward from the proposed pumps." See Draft Review, p. 26.

- Conversely, the Draft Review states that the inland groundwater level drawdown caused by the MPWSP is likely to be greater in a "confined" aquifer. See Draft Review, pp. 26-27. Cal-Am agrees with this basic hydrogeologic principle, but points out that even in a confined aquifer, "the zone of influence for the [slant] wells cannot expand much farther [inland] than the distance between…the extraction wells and the undersea outcrop of the confined aquifer." The distance between the undersea outcrop and the proposed MPWSP wells is 1.5 to 2 miles. See Draft Review, p. 26.

- The Draft Review cites a July 2008 Geoscience Report for the proposition that 87% of the water developed by the slant wells will come "from the ocean side wells," and 13% from the landward side. There is some uncertainty about the precise ratio of seawater that will be

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affecting the agricultural beneficial use. This standard is interpreted to exclude irrigation waters with chloride levels above 355 mg/L. (See Draft Review, pp. 13-14).

extracted by the MPWSP, as compared to brackish water. For example, a subsequent Geoscience report, dated September, 2008, concludes that approximately 96-97% of the water developed by the slant wells is seawater, and only 3-4% brackish water (see attached report, p. 23). The ratio of seawater vs. brackish water (vs. fresh water) that may be extracted by the proposed MPWSP will be better understood through the proposed aquifer testing and hydrogeologic analyses, groundwater modeling, and monitoring program that is described herein.

- Cal-Am believes that the MPWSP, as proposed, will not cause or result in injury to users of groundwater from the SVGB. As noted above, Cal-Am is developing and will implement an extensive study, testing, modeling and monitoring program for the proposed MPWSP wells, as recommended in the Draft Review. This information, together with the information developed by the California Public Utilities Commission in its comprehensive Environmental Impact Report for the MPWSP, will address the anticipated effects of the MPWSP on pumpers in the SVGB, and will provide substantial evidence to support the CPUC's approval of the Project. Cal-Am fully expects that the results of these analyses will confirm no significant unmitigated impact to the SVGB and SVGB pumpers; to the extent impacts may result to legal users of the SVGB from the MPWSP, such impacts will be addressed consistent with the physical solution principles discussed in the Draft Review. Any party that might challenge the MPWSP on the basis of injury to water rights in the SVGB would then have the burden of proving how such rights will be injured. See *City of Lodi v. East Bay Mun. Util. Dist.* (1936) 7 Cal.2d 316, 339; *Tulare Irr. Dist. v. Lindsay-Strathmore Irr. Dist.* (1935) 3 Cal.2d 489, 535.

- Several parties have suggested that the MPWSP is inconsistent with Section 21 of the Monterey County Water Resources Agency Act. These comments misinterpret the Agency Act. The MPWSP has been proposed consistent with the Agency Act. The "anti-export" language in Section 21 of the Agency Act is qualified by the statement "for the purpose of preserving [the] balance [in the SVGB resulting from the Agency's projects to balance extraction and recharge]." The MPWSP would, in a worst case scenario, incidentally extract relatively small quantities of contaminated brackish water from the SVGB without negatively affecting the balance of recharge and extraction of basin groundwater (and possibly it will improve that balance). To the extent the Project may in the future affect fresh groundwater resources, Cal-Am has proposed to return such water to the SVGB through the Castroville Seawater Intrusion Project, as noted in the Draft Review. Moreover, to the extent the statute may apply to the Project, the Agency Act vests sole discretion in the Monterey County Water Resources Agency to pursue appropriate remedies. Contrary to the assertions of several parties, the statute does not operate as an affirmative bar to the export of SVGB groundwater that may be enforced by third parties. Rather, the Agency would need to exercise its judgment and discretion to bring an action for injunctive relief, and only if the conditions for such injunction are present (i.e., a proposed export of groundwater upsetting the balance of recharge and extraction resulting from the Agency's projects).

Conclusion

On behalf of the California American Water Company, we thank the State Water Board for its thorough and thoughtful review of the technical and legal considerations concerning the proposed source water plan for the Monterey Peninsula Water Supply Project. As noted herein, Cal-Am fundamentally agrees with the overall conclusions reached in this Draft Review, and hopes that the above information assists the State Water Board in its efforts to finalize the Draft Review report. We would be pleased to provide the State Water Board with additional information, and certainly will keep the Board apprised of the development of the MPWSP.

Sincerely,

Robert E. Donlan

Robert E. Donlan

cc: Felicia Marcus, Chair, SWRCB
Fran Spivey-Weber, Vice Chair, SWRCB
Tam Dudoc, SWRCB
Steven Moore, SWRCB
Dorene D'Adamo, SWRCB
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Robert MacLean, President, California American Water
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North Marina Groundwater Model

Evaluation of Potential Projects

Prepared for: California American Water

CALIFORNIA AMERICAN WATER

September 26, 2008

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NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

CONTENTS

CONTENTS
(Continued)

FIGURES

FIGURES

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

1.0 INTRODUCTION

California American Water (CAW) faces a regulatory-driven need to replace most of its existing water supply, in order to meet long-term water demands of its Monterey Peninsula customers. The Monterey County Water Resources Agency (MCWRA) has a statutory obligation to reduce seawater intrusion in the lower Salinas Valley (see Figure 1). Thus, in order to respond to these water resource challenges, three potential projects have been proposed, the second and third of which are being jointly evaluated by CAW, MCWRA, Marina Coast Water District and Monterey Regional Water Pollution Control Agency, as alternatives to be included in CAW's Coastal Water Project (CWP) environmental impact report (EIR). The first CWP alternative is CAW's North Marina slant-well seawater desalination project. The second alternative is the Monterey Regional Water Supply Project Scenario 3a. The third alternative is the Monterey Regional Water Supply Project Scenario 4b. As part of assessing the feasibility and potential impacts of these three projects on groundwater levels and groundwater quality (i.e., seawater intrusion), groundwater modeling has been conducted. GEOSCIENCE was contracted by CAW to develop a groundwater flow and solute transport model to evaluate the various projects. The results of the modeling work will provide technical input for the CWP environmental impact report being prepared by ESA for the California Public Utilities Commission (CPUC), which is scheduled to be completed by December 2008.

In summary, the three CWP alternative projects evaluated in this modeling analysis are:

1. CAW's Coastal Water Project (CWP) is a plan to develop new water supplies to replace approximately three-fourths of its historical diversions from the Carmel River and Seaside Groundwater Basin. A central feature of the CWP is a proposed desalination

plant co-located at the Moss Landing electric power generation station that would use reverse osmosis (RO) to convert seawater into potable water. Because the California Environmental Quality Act (CEQA) requires that project alternatives be studied for inclusion in EIRs, CAW has also proposed for CPUC's consideration a seawater desalination facility with the feedwater intake system being six slant wells constructed at the Marina Coast Water District's former desalination well site on the north side of the Marina State Beach (see Figure 2).

2. The Monterey Regional Water Supply Project Scenario 3a is proposed to meet CAW's regulatory replacement and long-term regional water needs, improve seawater-intruded Salinas Basin groundwater, and expand agricultural deliveries. One component of the project would be a well field extraction system that pumps both saline and brackish water from the 180-Foot aquifer. The saline water wells will be located in a line approximately 1,000 ft away from and parallel to the coast, with the brackish water wells located approximately 2,600 ft inland of the saline water wells (see Figure 2).

3. The Monterey Regional Water Supply Project Scenario 4b is also proposed to meet CAW's regulatory replacement and long-term regional water needs, improve seawater-intruded Salinas Basin groundwater, and expand agricultural deliveries. The Monterey Regional Project Scenario 4b is a coastal well field extraction system (see Figure 2) as a source of both saline and brackish water from the 180-Foot Aquifer of the Salinas Valley Groundwater Basin for a regional desalination facility.

2.0 PURPOSE AND SCOPE

The purpose of this investigation was to evaluate impacts of potential water supply projects on groundwater levels and groundwater quality (i.e., seawater intrusion) using a calibrated groundwater flow and solute transport model. The effort included integrating the aquifer parameters, recharge and discharge terms, boundary conditions and predictive scenarios from the regional Salinas Valley Integrated Ground Water and Surface Model (SVIGSM) with the focused model. This method ensured that both regional impacts (using the SVIGSM) as well as detailed impacts (using the North Marina Model) could be evaluated.

To accomplish this, GEOSCIENCE worked closely with Water Resources & Information Management Engineering, Inc. (WRIME), RBF and RMC to ensure that the North Marina model mirrored the SVIGSM and provided the same overall results. However, the focused model included improved simulation of groundwater level changes (due to the finer model cell size), and capability for solute transport modeling (i.e., modeling of seawater intrusion). Specifically, the work included:

- Development of a focused, 100 ft square cell size MODFLOW groundwater flow and MT3D solute transport model based on inputs from the SVIGSM model;
- Evaluation of impacts from pumping six low angled subsea slant wells as a desalination feedwater intake supply as part of CAW's Coastal Water Project (CWP); and
- Evaluation of impacts from the Monterey Regional Water Supply Project as source water for a desalination plant at Armstrong Ranch.

The purpose of this report is to document the construction of the focused groundwater flow model (North Marina model) which included input and compatibility with the SVIGSM, and to present results of various predictive scenarios.

3.0 GEOHYDROLOGY

The Salinas Valley is filled with Tertiary and Quaternary marine and terrestrial sediments that include up to 2,000 ft of saturated alluvium (DWR, 2003). Groundwater recharge of the lower Salinas Valley is primarily from underflow originating in the upper valley. This is due to the existence of the Salinas Valley Aquitard which limits areal recharge of aquifers beneath. Seawater intrusion is an additional and more recent source of recharge to the groundwater basin (DWR, 2003).

Historically, groundwater flow was towards the ocean and discharged in the walls of the Monterey Submarine Canyon (see Figure 2). With increased pumping in the groundwater basin since the 1970's, groundwater flow is dominantly northeastwards (DWR, 2003). Overpumping of the shallow aquifers, largely for agricultural use, has caused significant seawater intrusion.

3.1 Groundwater Basin Boundaries

The proposed projects are located at the northwestern boundary of the Salinas Valley Groundwater Basin (see Figure 1). The Salinas Valley Groundwater Basin extends approximately 100 miles from headwaters in the southeast to Monterey Bay in the northwest.

3.2 Aquifer Systems

Water-bearing materials in the vicinity of North Marina from oldest to youngest consist of:

- Pliocene marine Purisima Formation,
- Plio-Pleistocene Paso Robles Formation,
- Pleistocene Aromas Red Sands, and
- Holocene Valley Fill materials (Green, 1970).

In the Salinas Valley Groundwater Basin, the Valley Fill, Aromas Sands, and Paso Robles Formation comprise an upper aquifer system from 0 to 1,000 ft below ground level (bgs). The Pliocene Purisima Formation contains a deep aquifer system from approximately 1,000 to 2,000 ft bgs (Hanson et. al., 2002).

180-Foot, 400-Foot and Deeper Aquifers

Aquifers in the Salinas Valley Groundwater Basin have been named for the average depth at which they occur. The "180-Foot Aquifer" lies at an approximate depth of 50 to 250 ft, and has a thickness of 50 to 150 ft (Green, 1970). The 180-Foot Aquifer may correlate in part with older portions of Quaternary terrace deposits or the upper Aromas Red Sands, and underlies blue clay confining layer known as the Salinas Aquitard (DWR, 2003). The Salinas Aquitard varies in thickness from 25 ft to more than 100 ft thick near Nashua Road, 5 miles west of Salinas (DWR, 1973, Montgomery Watson, 1994). Zones of discontinuous aquifers and aquitards approximately 10 to 70 ft thick underlie the 180-Foot Aquifer (DWR, 1973). The 400-Foot Aquifer lies at an approximate depth of 270 to 470 ft bgs, has a thickness of 25 to 200 ft, and may correlate with the Aromas Red Sands and the upper part of the Paso Robles Formation (Green, 1970). The 400-Foot Aquifer is present as three beds near Castroville, two of which are 25 ft thick and one which is 100 ft thick (DWR, 1973). A deeper aquifer, also referred to as the "900-Foot Aquifer," is separated from the overlying 400-Foot Aquifer by a blue marine clay aquitard (DWR, 2003).

Existing published reports contain geohydrologic cross sections of varying detail and applicability to the proposed site – such as those available in Green (1970), DWR (1973), DWR (1977), Johnson (1983), Harding ESE (2001), Hanson (2003), Feeney and Rosenberg (2002), and Kennedy/Jenks Consultants (2004).

3.3 Water Quality and Seawater Intrusion

The 180-Foot aquifer, when not impacted by seawater, is a calcium sulfate to sodium bicarbonate sulfate groundwater (DWR, 2003). Where the aquifer has been intruded by seawater it typically changes to a sodium chloride to calcium chloride type water. Total dissolved solids (TDS) values range from 223 to 1,103 mg/L, with an average of 478 mg/L (DWR, 2003). TDS concentrations in the 400-Foot aquifer are generally lower than in the 180-Foot aquifer. The aquifers below the 180-Foot, 400-Foot and deeper aquifers can have high salinity that may be related to dissolution of salts from the saline marine clays (Hanson, et al., 2002).

In the North Marina area, seawater has intruded approximately 3 ¾ to 7 miles landward within the 180-Foot Aquifer, and ¼ to 3 ¼ miles landward within the 400-Foot Aquifer (see Figure 3)[1]. Seawater intrusion in the 180-Foot and 400-Foot Aquifers was estimated to be 8,900 acre-ft/yr in 1995 (MCWRA, 2001). It has been reported that between 1970 and 1992 the seawater intrusion was 11,300 acre-ft/yr in the 180-Foot Aquifer, 4,600 acre-ft/yr in the 400-Foot Aquifer, and 800 acre-ft/yr in the “Deep” Aquifer (Montgomery Watson, 1994).

The main sources of seawater intrusion are subsea outcrops of the 180-Foot and 400-Foot Aquifers on the bottom of Monterey Bay, discovered by the U.S. Geological Survey in 1970 (see Figure 2). There are also areas of active erosion along the south wall of the Monterey Submarine Canyon (see Figure 2) where the outcrops are located, representing new entrances for seawater intrusion (DWR, 1973; Green, 1970).

[1] http://www.mcwra.co.monterey.ca.us/SVWP/01swi180.pdf; http://www.mcwra.co.monterey.ca.us/SVWP/01swi400.pdf , Accessed 6-Jun-08.

4.0 POTENTIAL PROJECTS

The three potential projects that are the subject of this report include CAW's Coastal Water Project (CWP) North Marina Alternative (NMA) seawater slant-wells project, and Monterey Regional Water Supply Project (RWSP) Scenario 3a, and Regional Water Supply Project Scenario 4b. The NMA and RWSP both involve extraction of saline water as feedwater for desalination plants. These projects are described in more detail in the following sections.

Summary of Potential Projects

Potential Project	Project Purpose	Agency	Primary Project Facilities	Project Location
CAW Slant Well Desalination Feedwater Supply Project	Develop new water supplies to replace historical diversions from Carmel River	California American Water Company	Desalination plant using RO. Six slant wells to provide a feedwater supply of 22 mgd	Marina Coast Water District Facility (north end of Marina State Beach)
Monterey Regional Water Supply Project Scenario 3a	Meet regional needs, improve salinated groundwater and expand agricultural deliveries	Consortium of Several Agencies	Desalination plant at Armstrong Ranch using ten vertical wells extracting both saline and brackish water from the 180 ft aquifer at a total rate of 23.4 mgd	North and south of the Salinas River adjacent to the coast
Monterey Regional Water Supply Project Scenario 4b	Meet regional needs, improve salinated groundwater and expand agricultural deliveries	Consortium of Several Agencies	Desalination plant at Armstrong Ranch using five vertical wells extracting both saline and brackish water from the 180 ft aquifer at a total rate of 17.8 mgd	North and south of the Salinas River adjacent to the coast

4.1 CAW Slant Well Desalination Feedwater Supply Project

CAW's NMA is a CWP alternative project proposed to develop new water supplies in order to replace most of CAW's historical diversions from the Carmel River and Seaside Basin. A central feature of the NMA is a proposed desalination plant that would use reverse osmosis (RO) to convert seawater into potable water, with the feedwater intake system consisting of six slant wells[2] (RBF, 2008). The slant wells would be constructed on the site of Marina Coast Water District's former desalination intake wells on the north side of Marina State Beach at 11 Reservation Road, Marina, CA (see Figure 2). RBF's design for the CAW slant well project comprises six wells that would radiate out in three clusters of two wells per cluster towards and beneath the ocean (see Figure 4). The layout described above is a later refinement of the slant well layout that was modeled using the North Marina Model (see Section 6.0 for details of the modeled layout). Modeling results and impacts will not be expected to be much different between the two layouts. However, of the two layouts, the modeled layout represents a worst-case scenario due to shorter well lengths and steeper angle of the wells. The steeper angled wells and shorter lengths result in less ocean water extraction due to the greater distance between the ocean floor and screened interval. The combined amount of water that would be pumped by the slant wells for each layout would be the same, i.e., 22 mgd.

4.2 Monterey Regional Water Supply Project 3a

The RWSP Scenario 3a is designed to meet regional water supply needs, improve seawater intruded groundwater, and expand agricultural deliveries. There are a number of components that comprise the project, with regional desalination being one of them. Feedwater for a desalination plant at Armstrong Ranch will be obtained from a vertical well field extraction system that pumps both saline and brackish water from the 180-Foot aquifer. The saline water wells will be located in a line approximately 1,000 ft away from and parallel to the coast, with the brackish water wells located approximately 2,600 ft inland of the saline water wells (see Figure 2).

Initially, twelve wells were considered and modeled as Scenario 2e. These wells had variable pumping schedules that ranged from approximately 1.5 mgd to 3.1 mgd. Ultimately, based on

[2] Each well will be 20 degrees below horizontal, 700 lineal feet and completed with 12-inch diameter casing and perforated interval.

regional modeling by WRIME, a most likely scenario (3a) was developed. Under scenario 3a, the well field will produce saline water from five coastal or seaward wells, and brackish water from five inland wells. The five seaward wells would each pump constantly at 1,549 gpm, and the five inland wells each pump constantly at 1,697 gpm, for a combined total of 23.4 mgd

4.3 Monterey Regional Water Supply Project 4b

The RWSP Scenario 4b is also designed to meet regional water supply needs, improve seawater intruded groundwater, and expand agricultural deliveries. There are a number of components that comprise the project, with regional desalination being one of them. Feedwater for a desalination plant at Armstrong Ranch will be obtained from a vertical well field extraction system that pumps both saline and brackish water from the 180-Foot aquifer. Under Scenario 4b, five desalination (i.e., extraction) wells would each pump constantly at approximately 2,480 gallons per minute (gpm), for a combined total of approximately 17.8 million gallons per day (mgd).

5.0 NORTH MARINA GROUNDWATER FLOW AND SOLUTE TRANSPORT MODEL

5.1 General Description and Purpose of Model

The purpose of the North Marina groundwater flow and solute transport model (North Marina Model) was to evaluate impacts of various water supply projects on groundwater levels and seawater intrusion. Due to the established use of the regional model (SVIGSM) for groundwater management in the Salinas Valley, the focused North Marina Model was constructed by integrating the SVIGSM aquifer parameters, recharge and discharge terms, boundary conditions and predictive scenarios to ensure consistency between the two models. The North Marina model developed to specifically focus on the North Marina area has a much finer cell size to improve resolution in the vicinity of the proposed projects. It also includes a water quality component that the SVIGSM does not have.

5.2 Description of Model Codes

MODFLOW and MT3DMS are the model computer codes used for the North Marina Model. MODFLOW is a block-centered, three-dimensional, finite difference groundwater flow model developed by the USGS for the purpose of modeling groundwater flow. MT3DMS is a modular three-dimensional multispecies transport model for simulation of advection, dispersion, and chemical reactions of contaminants in groundwater systems (Zheng and Wang, 1998). The SEAWAT[3] program was also used to compare the results from the MODFLOW and MT3DMS. In general, MODFLOW and MT3DMS yield a very similar result compared to the SEAWAT with slight differences in water level elevation (approximately one foot).

3 The SEAWAT program was developed by the United States Geologic Survey (Guo and Langevin, 2002) to simulate three-dimensional, variable density, groundwater flow and solute transport in porous media. The source code for SEAWAT was developed by combining MODFLOW and MT3DMS into a single program that solves the coupled flow and solute transport equations.

5.3 Use of the Salinas Valley Integrated Ground Water and Surface Water Model

The SVIGSM is a regional model encompassing the entire Salinas Valley (approximately 650 square miles). It is a finite element model, with an average element size of approximately 0.4 square miles (Montgomery Watson, 1994). The North Marina Model is a detailed model with cell size of 200 ft by 200 ft covering an area of approximately 149 square miles (see Figure 5). Since the SVIGSM encompasses the entire North Marina Model, calibrated SVIGSM model data including the aquifer parameters, recharge and discharge terms, and boundary conditions in the North Marina model area were used to construct the North Marina Model. This procedure is similar to the telescopic mesh refinement method (Anderson and Woessner, 1992). The SVIGSM with its coarse grid network is the "Regional Model" and is used to model a large problem domain bounded by the physical limits of the aquifer system. The SVIGSM solution is used to define the "Local Model" (i.e., North Marina Model) boundaries, which define the smaller (focused) problem domain.

The pre-processing software "Groundwater Vistas"[4] was used to construct the MODFLOW groundwater flow model based on SVIGSM groundwater model files, and MT3DMS solute transport model. The recharge and discharge terms and water level data used for the boundary conditions cover the period from October 1979 to September 1994 on a monthly basis. This same period was used for the North Marina Model transient model calibration. For the model predictive scenarios, the monthly data from the SVIGSM for the period from October 1948 through September 2004 was used for the North Marina Model predictive scenarios.

[4] Environmental Simulations, Inc., 2005. Groundwater Vistas, Version 5.

Comparison of Focused North Marina Groundwater Model with Regional Groundwater Model

Groundwater Model	Model Purpose	Type of Model	Model Area, sq. mi.	Cell or Element Size	No of Layers	Total Model Layer Thickness (Average, ft)
Focused North Marina Model	Evaluate detailed projects in the vicinity of the North Marina coastal area- groundwater levels and quality	Flow and Solute Transport Finite Difference MODFLOW 2000, MT3DMS, SEAWAT 2000	149	Cell Size = 200 ft x 200 ft	6	1,570
Regional Groundwater Model (SVIGSM)	Evaluate regional projects and impacts on regional groundwater levels in the entire Salinas Valley	Finite Element Groundwater Flow Model – Groundwater and Surface Water	650	Element Size = 0.4 sq. mi.	3	1,570

5.4 Conceptual Model

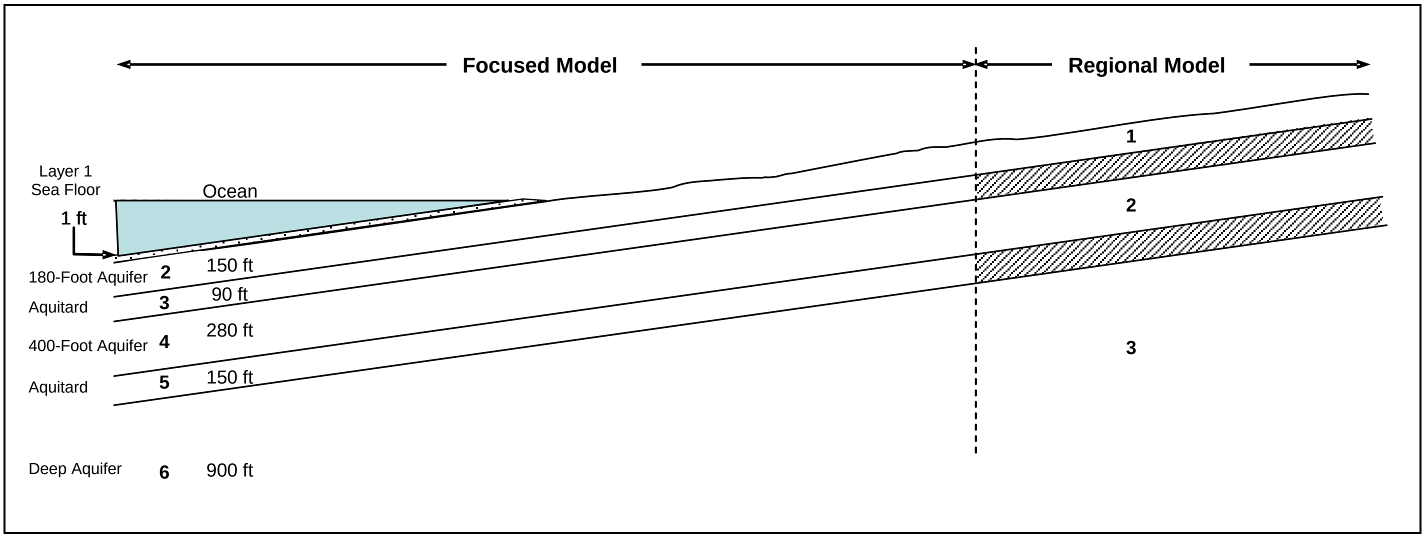
The North Marina Model was developed for the upper approximately 1,000 ft of unconsolidated to semi-consolidated sediments within the North Marina area of the Salinas Valley Groundwater Basin. This conceptual model is the same as that used for the SVIGSM (Montgomery Watson, 1994). The groundwater model consists of six model layers as summarized in the table below.

Summary of North Marina and SVIGSM Model Layers

Model Layer	North Marina Model	SVIGSM
1	Only active beneath the ocean and is assumed to be 1 ft thick[5]	Constant head boundary of Model Layer 1
2	180-Foot Aquifer	Model Layer 1
3	Aquitard	NA
4	400-Foot Aquifer	Model Layer 2
5	Aquitard	NA
6	Deep Aquifer	Model Layer 3

5 The sole purpose of Model Layer 1 is to allow vertical leakage from the ocean into underlying aquifers.

**Schematic Diagram Showing Focused and Regional Model Layers
Showing Average Layer Thickness**



By definition, a boundary condition is any external influence or effect that either acts as a source or sink, adding to or removing water from the groundwater flow system. The boundary conditions used in the model are no-flow, constant head, river and general head boundary. No-flow cells were assigned to the non-alluvial or bedrock portions and portions of the open water of the Pacific Ocean of the model area. The constant head boundary of 0 ft above mean sea level (amsl) and constant TDS concentration of 35,000 mg/L were specified only in Model Layer 1 between the shoreline and the exposure of 180-Foot aquifer to allow vertical leakage from the ocean into the 180-Foot Aquifer (Model Layer 2). Similarly, the River Package was used to simulate the vertical leakage from the ocean into 400-Foot Aquifer (Model Layer 4). The eastern, northern, and southern edges of the active model area represent subsurface underflow and were simulated using the general head boundary package with a specified head based on the model simulated groundwater elevation from the SVIGSM.

5.6 Aquifer Parameters

The top and bottom elevations for Model Layer 2 through 6 were based on data from the SVIGSM. The top elevations for Model Layer 1 were assumed to be 1 ft above the top elevation of Model Layer 1 to allow vertical leakage from the ocean into the 180-Foot Aquifer (Model Layer 2).

Horizontal hydraulic conductivity for Model Layers 2 (180-Foot Aquifer), 4 (400-Foot Aquifer) and 6 (Deep Aquifer) and vertical hydraulic conductivity for Model Layers 3 and 5 (aquiclude) were obtained from SVIGSM. The vertical hydraulic conductivity for Model Layers 2, 4 and 6 was estimated assuming 1/20 of the horizontal hydraulic conductivity for Model Layers 2, 4 and 6 (i.e., ratio of horizontal hydraulic conductivity/vertical hydraulic conductivity = 20). The horizontal hydraulic conductivity for Model Layers 3 and 5 was estimated assuming 500 of the vertical hydraulic conductivity for Model Layers 3 and 5 (i.e., ratio of horizontal hydraulic conductivity/vertical hydraulic conductivity = 500). Typically, the ratios of horizontal hydraulic conductivity/vertical hydraulic conductivity fall in the range of 2 to 10 for alluvium and up to 100 or more occur where clay layers are present (Todd, 1980). A horizontal hydraulic conductivity of 500 ft/day and a vertical hydraulic conductivity of 25 ft/day was used for Model Layer 1 based on model calibration results.

The specific storativity and effective porosity values for Model Layers 2 through 6 were based on the SVIGSM. A specific yield (i.e., effective porosity) of 0.25 was used for Model Layer 1 based on the model calibration results. During the transport model calibration, in order to match the observed seawater intrusion front, the effective porosity of 0.06 for Model Layer 4 was increased to 0.1.

Longitudinal dispersivity was estimated initially from the relationship between longitudinal dispersivity and scale of observation (Zheng and Bennett, 2002) and adjusted during model calibration. A longitudinal dispersivity of 20 ft results in a good match between model-calculated and the observed seawater intrusion front. The ratio of horizontal transverse dispersivity to longitudinal dispersivity was assumed to be 0.1, while the ratio of vertical transverse dispersivity to longitudinal dispersivity was assumed to be 0.01.

The following table summarizes aquifer parameters used in the North Marina model.

Summary of Aquifer Parameters Used in the North Marina Groundwater Model

Model Layer	Horizontal Hydraulic Conductivity [ft/day]	Vertical Hydraulic Conductivity [ft/day]	Specific Storativity [ft^{-1}]	Specific Yield (Effective Porosity)	Dispersivity		
					Horizontal		Vertical
					Longitu-dinal [ft]	Transverse [ft]	Transverse [ft]
1	500	25	-	0.25	20	2	0.2
2 (180-Foot Aquifer)	25 to 250	1.25 to 12.5	0.000008 to 0.00006	0.08 to 0.16	20	2	0.2
3 (Aquiclude)	0.02 to 6.8	0.00004 to 0.0136	0.0000001 to 0.00005	0.02	20	2	0.2
4 (400-Foot Aquifer)	5 to 100	0.25 to 5	0.000001 to 0.00007	0.1	20	2	0.2
5 (Aquiclude)	1.8	0.0036	0.00000006 to 0.00002	0.02	20	2	0.2
6 (Deep Aquifer)	20 to 25	1 to 1.25	0.00000002 to 0.000005	0.06	20	2	0.2

5.7 Recharge and Discharge

Monthly data for deep percolation from precipitation and applied water (including return flow), stream recharge and groundwater pumping in the North Marina Model area for the model calibration period October 1979 to September 1994 were obtained from the SVIGSM. In addition, model simulated groundwater elevations during the same period of time in the north, south and east North Marina Model boundaries were also obtained from the SVIGSM. This allowed for calculation of subsurface inflow and outflow across the North Marina Model boundaries using a General Head Boundary Package. Vertical leakage from the ocean into Model Layer 2 (180-Foot Aquifer) and Model Layer 4 (400-Foot Aquifer) was simulated using a constant head boundary in Model Layer 1 and a River Package in Model Layer 4, respectively.

5.8 Model Calibration

5.8.1 Calibration Methodology

Model calibration was performed in order to compare model-simulated water levels and TDS concentrations to field-measured values. The method of calibration used by the groundwater model was the industry standard "history matching" technique. In this method, a transient calibration period from October 1979 to September 1994 were used based on the data obtained from the SVIGSM. The transient model calibration was simulated with a monthly stress period[6] for a total of 180 stress periods (i.e., 15 years).

Since the North Marina Model was developed based on the calibrated SVIGSM, the model calibration mainly focused on matching the observed seawater intrusion front in the 180-Foot Aquifer and 400-Foot Aquifer over time. The trial-and-error method was used to calibrate aquifer parameters. These aquifer parameters included horizontal hydraulic conductivity, vertical hydraulic conductivity, effective porosity and dispersivity.

5.8.2 Initial Conditions

Initial conditions for the transient calibration of the North Marina Model include groundwater elevations and TDS concentrations for October 1979. Groundwater elevation in October 1979 generated from the SVIGSM was provided by WRIME and was imported into the model using Groundwater Vistas. The initial TDS concentrations were estimated based on the observed seawater intrusion (500 mg/L chloride contour from Monterey County Water Resources Agency maps) and measured TDS concentration in wells. TDS concentration of seawater was assumed to be 35,000 mg/L. An empirical relationship between chloride and TDS for seawater (GEOSCIENCE, 1993) was used to convert estimated chloride contours to initial TDS contours.

[6] Stress period is the time length used to change model parameters such as groundwater pumping and stream recharge.

5.8.3 Calibration Results

For the model calibration, historical groundwater level data for 14 wells within the North Marina Model area were obtained from WRIME and compared with model-generated groundwater levels. Of the 14 wells, two wells are screened in the 180-Foot Aquifer (Model Layer 2), eight wells are screened in the 400-Foot Aquifer (Model Layer 4), and four wells are screened in the Deep Aquifer (Model Layer 6). The same 14 wells were also used for the SVIGSM calibration. Figures 6 through 8 show hydrographs of model-generated water levels compared to measured levels for the wells screened in the 180-Foot Aquifer, 400-Foot Aquifer, and Deep Aquifer, respectively. In general, the pattern of the model-generated and measured water levels are similar in that the model appears to capture the long- and short-term temporal trends in groundwater levels in most parts of the North Marina Model area.

A histogram of water level residuals (measured water level less model-generated water level) is shown on Figure 9. The histogram shows a bell shape with most of the residual[7] water level being in the range of +/- 10 ft (68% of 2,152 water level measurements), indicating an acceptable model calibration.

In order to evaluate the solute transport model calibration, the model-generated seawater intrusion front for the 180-Foot Aquifer and 400-Foot Aquifer in years 1985 and 1994 were plotted and compared to the observed seawater intrusion front (see Figures 10 and 11). In general, the model-generated seawater intrusion front matches the observed seawater intrusion front. The model-generated migration rate of the seawater intrusion front agrees with the rate estimated from observed data as can be seen by comparing the movement of the seawater intrusion front between 1985 and 1994.

[7] The residual is the difference between measured water levels and model-generated levels.

6.0 MODEL PREDICTIVE SCENARIOS

Four model predictive scenarios were run for a 56-year period from October 1948 through September 2004 with monthly stress periods. This hydrologic period is also the model calibration period for the SVIGSM and has been previously used for predictive scenarios for purposes of basin management.

The three predictive scenarios that were run using the North Marina model included:

- Baseline (developed by WRIME),
- Slant Well Desalination Feedwater Supply,
- Regional Project Scenario 3a (developed by WRIME), and
- Regional Project Scenario 4b (developed by WRIME).

The Baseline and Regional Project scenarios 3a and 4b were developed and run using the SVIGSM by WRIME. The recharge and discharge terms and model simulated water level elevations from each of the SVIGSM predictive scenarios for the period from October 1948 through September 2004 were used for North Marina Model predictive scenarios.

Initial groundwater elevations for the model predictive scenarios were the same as the SVIGSM and were provided by WRIME. The initial TDS concentrations were estimated based on the observed seawater intrusion (500 mg/L chloride contour) and TDS concentrations in wells measured in 2005.

Summary of Groundwater Model Predictive Scenarios Run Using the North Marina Model

Predictive Scenario	Initial and Boundary Conditions	Project Facilities
Baseline Scenario (No Project)	Baseline Boundary Conditions provided by Regional Model	Land and water use reflect estimated 2030 conditions
Slant Well Desalination Feedwater Supply	Baseline Boundary Conditions provided by Regional Model	Five slant wells producing 2,696 gpm ea. One Test Well producing 1,797 gpm for a total production of 22 mgd.
Regional Project 3a	Scenario 3a Boundary Conditions provided by Regional Model	Five seaward wells in the 180-Foot aquifer pump at a constant rate of 1,549 gpm ea. Five inland wells pump at constant rate of 1,697 gpm ea.. Total production from the 10 wells = 23.4 mgd
Regional Project 4b	Scenario 4b Boundary Conditions provided by Regional Model	Five seaward wells in the 180-Foot aquifer pump at a constant rate of 2,480 gpm ea. Total production from the 5 wells = 17.8 mgd

Assumptions made for each of the model scenarios are provided below:

1. Baseline
   - Boundary conditions were provided by WRIME,
   - Land use and water use indicative of 2030 conditions (WRIME, 2008), and
   - Refined version of the Future Conditions Baseline utilized by the EIR/EIS for the Salinas Valley Water Project (WRIME, 2008).

2. CAW Slant Well Desalination Feedwater Supply Project
   - Boundary conditions were the same as those provided by WRIME for the Baseline,
   - Five slant wells are constructed at 22 degrees from horizontal with a length of 600 lineal ft, and one test well is constructed at 36 degrees from horizontal with a length of 360 lineal ft. The wells do not extend deeper than 180 ft below sea level,

- Five full scale wells would produce approximately 2,696 gpm (3.88 mgd each), and the one test well would produce approximately 1,797 gpm (2.59 mgd) for a total production of 22 mgd, and
- Given the angle of the slant wells from the land surface (22 degrees), the length of the slant wells was limited so that they would be completed in the dune sand deposits and would remain above the theoretical 180-Foot aquifer (i.e., above 180 ft below sea level). However, in the vicinity of the slant wells, Model Layer 2 (180-Foot aquifer) comprises both the dune sand deposit and the 180-Foot aquifer as there is no Salinas Aquitard above the 180-Foot Aquifer (see Harding ESE cross-section D-D', Plate 6). Although the slant wells are supposed to be pumping from above the theoretical 180-Foot aquifer, due to the vertical distribution of the model layers, lithology, and cross-sections (WRIME, 1994), the model has the wells extracting water from both the dune sand deposits and 180-Foot aquifer (i.e., Model Layer 2).

3. <u>Regional Project Scenario 3a</u>
   - Boundary conditions were provided by WRIME,
   - Five seaward wells each pump constantly at 1,549 gpm,
   - Five inland wells each pump constantly at 1,697 gpm,
   - The combined total production for the well field would be 23.4 mgd, and
   - Wells are screened completely in the 180-Foot aquifer. Note: as the 180-Foot aquifer is one complete model layer, there is no discretization that would allow for apportioning extraction from a specific portion of the aquifer, as such, the model allows for an even distribution of pumping throughout the depth of the aquifer.

4. <u>Regional Project Scenario 4b</u>
   - Boundary conditions were provided by WRIME,
   - Five extraction wells each pump constantly at 2,480 gpm,
   - The combined total production for the well field would be 17.8 mgd, and
   - Wells are screened completely in the 180-Foot Aquifer.

7.0 GROUNDWATER FLOW AND SOLUTE TRANSPORT MODEL RESULTS

7.1 CAW Slant Well Desalination Feedwater Supply Project

The Slant Well scenario shows that the six slant wells pumping continuously would cause a slight change in groundwater flow directions and hydraulic gradients compared to Baseline (or No Project) conditions. Figures 12 and 13 show the difference in groundwater levels between Baseline (No Project) and the Slant Well Project. The general differences between scenarios are summarized below:

- In normal hydrologic years (precipitation is close to the long-term average), groundwater flow caused by the Slant Well Project remains similar to if there was no project (southwest to northeast), with the exception of the flattening out the northeastwards flow of groundwater and the development of a localized cone of depression that is up to 15 ft below sea level in close proximity to the slant wells.

- Under wet hydrologic conditions (precipitation is well above average), the effects of the Slant Well Project causes a slight steepening of the hydraulic gradient towards the slant wells. However, flow directions generally remain the same as Baseline flow directions outside of the slant well cone of depression[8]. Increased recharge to the 180-Foot aquifer from infiltration of precipitation and streamflow percolation during wet years allows for more groundwater outflow to the ocean.

- In dry years (precipitation well below average), the groundwater elevations in the model area for the Slant Well Project are very similar to Baseline (No Project) conditions. Flow is from the west to the east, with a localized depression formed around the slant wells.

[8] Due to complex spatial variations of the ground water elevation contours in the model area, a quantitative description of the difference between scenarios cannot be provided. Figures 12 and 13, however, show a direct comparison of contours for each scenario.

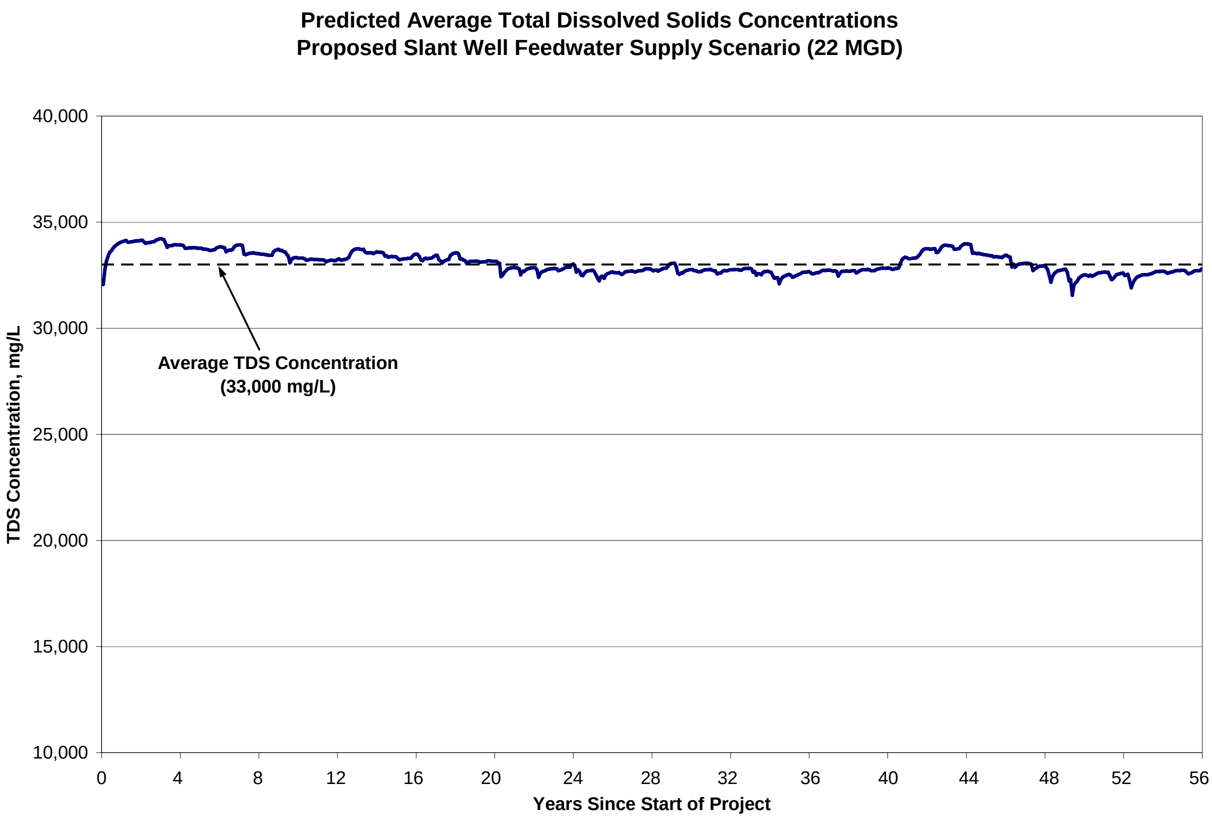
- After 56 years of operating the Slant Well Project, the inland groundwater elevations in the 180-Foot aquifer northeast of the slant wells would be slightly lower than under No Project conditions. For example, there is an approximate 1 ft lowering of groundwater levels in Marina Coast Water District Well 2 located one mile away from the slant wells after 56 years (see Figure 14). Groundwater flow directions would be similar to normal hydrologic year flow directions.

Selected hydrographs showing the Baseline (No Project) and Slant Well Project groundwater elevations over the 56 years of the predictive model are provided on Figure 14. It is shown that the decline in groundwater elevations at the slant well will be approximately 15 ft. The closest production well, Marina Coast Water District Well 2 would have just less than a 2 ft decline in levels due to the project (i.e., 5.3 ft amsl for baseline conditions less 3.4 ft amsl under project conditions). At 1.5 miles to the north, the impacts of water levels will cause less than a 0.5 ft decline (see location labeled 11 on Figure 14), with differences in water levels decreasing with distance from the slant wells.

Figure 15 shows the 500 mg/L chloride limit of the seawater intrusion in the 180-Foot aquifer at selected times over the 56 year model period. In general, the intrusion reduces at the same rate as No Project conditions, with the exception of the area in close proximity to the slant wells where the intrusion front reduces slightly slower than if the slant wells were not in operation.

The predicted TDS concentration for each of the six slant wells is shown on Figure 16. As can be seen, with the exception of the southernmost slant well and test slant well, the wells are extracting water with a concentration close to the assumed ocean water TDS of 35,000 mg/L. The test slant well has a lower TDS due to its larger angle from horizontal (i.e., 36 degrees) which results in more onshore groundwater being extracted because of its deeper depth below the sea floor. The southernmost slant well also has a lower TDS which indicates that it intercepts natural groundwater flow which moves from the southeast to the northwest (see Figure 12). In effect, this southernmost slant well protects the other wells from being recharged by onshore groundwater.

Over the 56 years, the blended TDS concentration of the feedwater extracted by the six slant wells will average approximately 33,000 mg/L. The chart below shows the modeled TDS concentrations over time.



The predicted TDS concentration of 33,000 mg/L for the feedwater extracted by the six slant wells is approximately 94 to 97 percent of the TDS concentration of seawater (34,000 to 35,000 mg/l). As the modeled layout represents a worse-case scenario (due to the steeper well angles), the most recent layout (six 700 ft wells with a 20 degree angle proposed by RBF, 2008) would most likely result in an even higher percentage of seawater in the extracted water.

The water budget presented in the table bellow shows all the model inflow and outflows as calculated using the model's cell-by-cell-budget. As can be seen in the table, operation of the slant wells as feedwater for the desalination plant generally increases the amount of ocean water flowing into the model and reduces the amount of groundwater flowing out into the ocean. Along the inland model boundaries (second column of the table, i.e., general head boundary), there will be a 762 acre-ft increase in the amount of water flowing into the model area from inland areas. This amount represents approximately 1 percent of total inflow to the model area (columns 2 through 4 in the table below), and as such would not have much of an impact on surface or groundwater resources outside of the focused model area. The amount of 762 acre-ft also represents only 3 percent of the project slant well pumping (column 6 in table below), which supports the mass balance estimation of the amount of groundwater being extracted by the slant wells.

Summary of Water Budget – Baseline and Three Project Scenarios
Annual Average Values for Hydrologic Year 1949-2004

Scenario	INFLOW			OUTFLOW				Change in Groundwater Storage
	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	Ocean Inflow	Non-Project Groundwater Pumping	Project Groundwater Pumping	Stream Discharge	Ocean Outflow	
	[acre-ft/yr]	[acre-ft/yr]	[acre-ft/yr]	[acre-ft/yr]	[acre-ft/yr]	[acre-ft/yr]	[acre-ft/yr]	[acre-ft/yr]
Baseline (No Project)	12,398	36,783	4,032	35,850	0	1,971	15,220	172
Slant Well Project	13,160	36,783	23,938	35,850	24,631	1,971	11,643	-214
Regional Project Scenario 3a	11,809	34,958	22,363	27,643	26,200	1,676	13,429	182
Regional Project Scenario	11,005	34,033	19,302	27,779	20,000	2,270	13,976	315

7.2 Regional Project Scenario 3a

The Regional Project Scenario 3a shows that the ten seaward and inland wells pumping continuously in the 180-Foot aquifer would create an extraction barrier or trough parallel to the coast. This feature is formed as a result of seawater flowing inland towards the seawater wells (the five wells closest to the ocean, see Figure 17), while brackish water from seawater intruded groundwater flows seaward towards the five inland wells. Operating the wells continuously in this manner will maintain a barrier that would prevent future seawater intrusion of the 180-Foot aquifer.

Other changes in groundwater levels between Baseline (No Project) and the Regional Project Scenario 3a within the focused model area are shown on Figure 17 and summarized below:

- In normal hydrologic years (precipitation is close to the long-term average), groundwater flow caused by the Regional Project Scenario 3a remains similar to if there was no project (south west to northeast), with the exception of the pumping trough developed around the Regional Project Scenario 3a desalination wells. This locally alters the groundwater flow by drawing down groundwater by 10 ft more than would have occurred under No Project conditions near the coast.

- Under wet hydrologic condition (precipitation is well above average), the effects of the Regional Project Scenario 3a are less than under normal hydrologic conditions. In general, groundwater flow direction for No Project and Project conditions are quite similar, flowing southwest to northeast with a component also flowing towards the ocean. Although the pumping trough is still present, it has less of an effect south and east of the desalination wells compared to No Project conditions. Increased recharge to the 180-Foot aquifer from infiltration of precipitation and streamflow percolation during wet years allows for more groundwater outflow to the ocean.

- In dry years (precipitation well below average), the groundwater elevations east of the Regional Project Scenario 3a wells are higher than under Baseline (No Project) conditions. There is a strong component of groundwater flow from west to east (i.e., inland flow), which is reversed from flow in wet conditions (i.e., towards the ocean). The pumping trough developed by the Regional Project Scenario 3a in dry years will reduce the hydraulic gradient towards the east compared to No Project conditions. In effect, the Regional Project Scenario 3a would reduce the rate of seawater intrusion which would normally be more prevalent during dry years under No Project conditions.

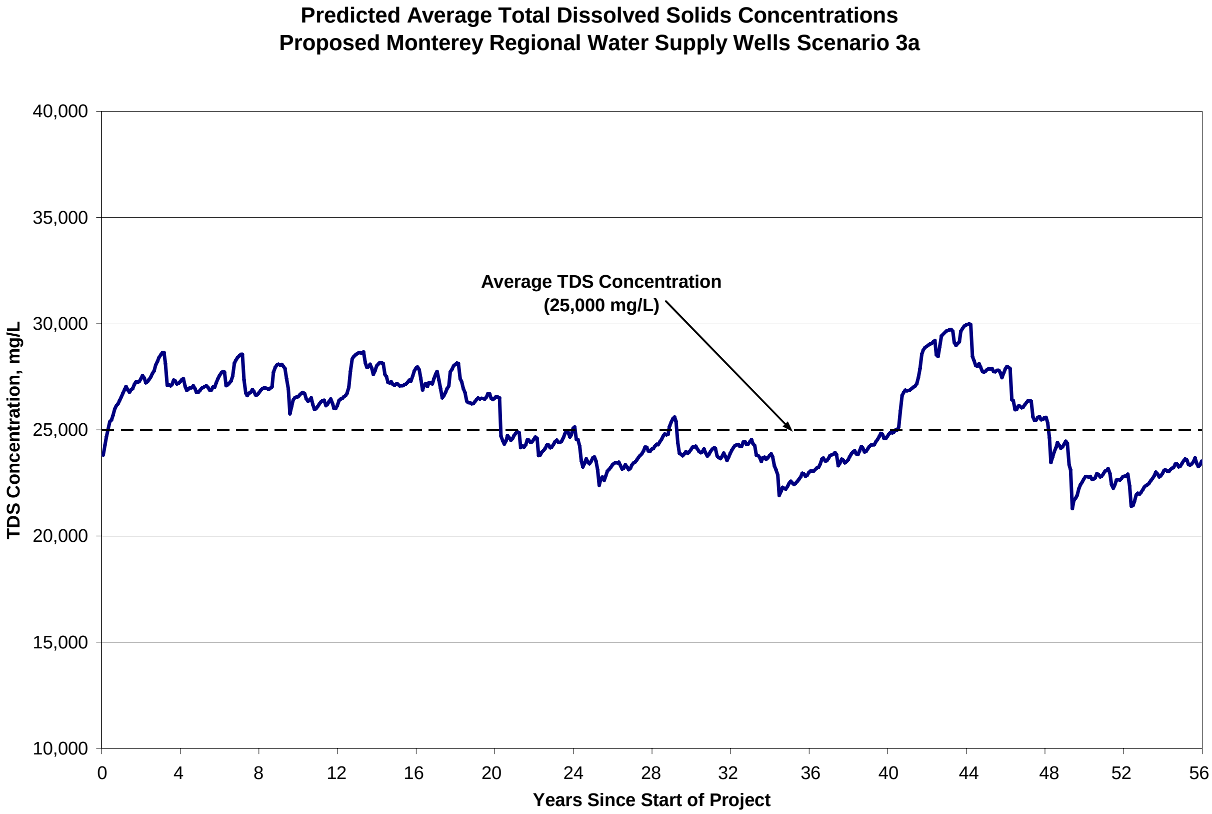
- After 56 years of operating the Regional Project Scenario 3a, the inland groundwater elevations in the 180-Foot aquifer would be higher than under No Project conditions. The area around the Project wells would have lower groundwater elevations due to the trough developed by continuous pumping. Groundwater flow directions would be similar to normal hydrologic year flow directions.

Selected hydrographs showing the Baseline (No Project) and Regional Project Scenario 3a groundwater elevations over the 56 years of the predictive model are provided on Figure 18. In general, the desalination wells of the Regional Project Scenario 3a show a decline in groundwater levels of approximately 10 ft or less. Inland of the Project wells, differences in groundwater levels between Baseline (No Project) and Project are minimal (less than 4 ft). This includes wells completed in the 400-Foot aquifer and Deep Aquifer underlying the 180-Foot aquifer. These deeper aquifers show almost no impacts from the Regional Project Scenario 3a pumping in the 180-Foot aquifer.

Figure 19 shows the 500 mg/L chloride limit of the seawater intrusion in the 180-Foot aquifer at selected times over the 56 year model period. In general, the intrusion is reduced at a faster rate when the Regional Project Scenario 3a is operating compared to Baseline (No Project) conditions. Only the area just south of the Salinas River mouth remains intruded longer than if there was no project. This is due to the trough that is designed to extract mostly seawater from the seawater wells of the Regional Project Scenario 3a.

The predicted TDS concentration from the ten extraction wells is shown on Figure 20. As can be seen, the seaward wells (1, 3, 4 and 5) all produce water with a TDS close to the assumed seawater concentration of 35,000 mg/L. The southernmost seaward extraction well has more fluctuating TDS concentrations, but still produces close to the 35,000 mg/L concentration. The TDS concentration of the inland wells indicates that the wells are producing a mixture of seawater and onshore groundwater. This suggests that the inland wells are effectively forming a barrier to onshore groundwater flowing towards the ocean (i.e., they intercept before it gets to the seaward wells). Thus, the seaward wells are able to extract more seawater than if the inland wells were not there.

Over the 56 years, the blended TDS concentration of the feedwater extracted by the ten Regional Project Scenario 3a wells will average approximately 25,000 mg/L. The chart below shows the modeled TDS concentrations over time. The predicted TDS concentration of 25,000 mg/L for the feedwater extracted by the ten Project wells is approximately 70 to 73 percent of the TDS concentration of seawater (34,000 to 35,000 mg/L).



The water budget (see Table in Section 7.1) for the Regional Project Scenario 3a shows that similarly to the CAW slant well scenario, there will be increased ocean water inflow and decreased outflow of onshore water to the ocean compared to the No Project (Baseline) conditions. However, due to changes in regional pumping (non-project pumping) and use of surface water for this scenario there would be a 589 acre-ft/yr decrease in the amount of water flowing into the model from the northern, eastern and southern model boundary areas as compared to No the Project (see column 2 of table in Section 7.1). This decrease in groundwater inflow would have a beneficial impact on groundwater resources outside of the focused model area (i.e. less impact on groundwater elevations). Inside the focused model area, the change in groundwater storage for the Regional Project Scenario 3a would increase 10 acre-ft/yr as compared to the No Project Scenario (see column 9 of table in Section 7.1). This would be a beneficial impact to groundwater resources within the focused model area.

7.3 Regional Project Scenario 4b

The Regional Project Scenario 4b shows that the five extraction wells pumping continuously in the 180-Foot Aquifer would create an extraction barrier or trough parallel to the coast. This feature is formed as the extraction wells pull in seawater (inland flow direction) and brackish water from the seawater-intruded Salinas Valley aquifer (seaward flow direction) (see Figure 21). Operating the wells continuously in this manner will maintain a barrier that would prevent future seawater intrusion of the 180-Foot Aquifer.

Other changes in groundwater levels between Baseline (No Project) and the Regional Project Scenario 4b within the focused model area are shown on Figure 21 and are summarized below:

- In normal hydrologic years (precipitation is close to the long-term average), groundwater flow caused by the Regional Project Scenario 4b remains similar to if there was no project (southwest to northeast), with the exception of the pumping trough developed around the Project extraction wells. This locally alters the groundwater flow by drawing down groundwater by 7 ft more than would have occurred under No Project conditions near the coast.

- Under wet hydrologic condition (precipitation is well above average), the effects of the Regional Project Scenario 4b are less than under normal hydrologic conditions. In general, groundwater flow direction for No Project and Project conditions are quite similar, flowing northwest to northeast with a component also flowing towards the ocean. Although the pumping trough is still present, it has less of an effect south and east of the desalination wells compared to No Project conditions. Increased recharge to the 180-Foot Aquifer from infiltration of precipitation and streamflow percolation during wet years allows for more groundwater outflow to the ocean.

- In dry years (precipitation well below average), the groundwater elevations east of the Project wells are higher than under Baseline (No Project) conditions. There is a strong component of groundwater flow from west to east (i.e., inland flow), which is reversed from flow in wet conditions (i.e., towards the ocean). The pumping trough developed by the Regional Project Scenario 4b in dry years will reduce the hydraulic gradient towards the east compared to No Project conditions. In effect, Scenario 4b would reduce the rate of seawater intrusion which would normally be more prevalent during dry years under No Project conditions.

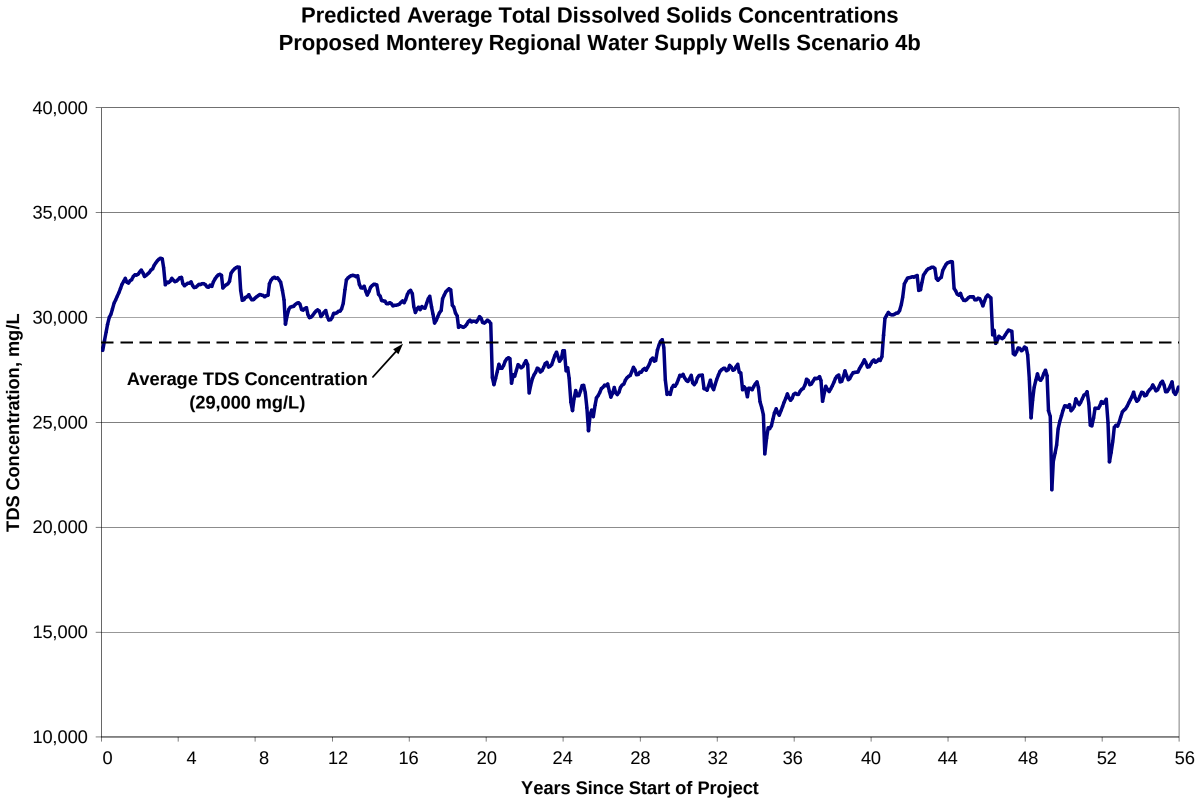
- After 56 years of operating the Regional Project Scenario 4b, the inland groundwater elevations in the 180-Foot Aquifer would be higher than under No Project conditions. For example, there is an average 0.5 ft rising of groundwater levels in the Observation Well No. 9 located four miles east from the Project wells during the 56 years model simulation period (see Figure 22). The area around the Project wells would have lower groundwater elevations due to the trough developed by continuous pumping. Groundwater flow directions would be similar to normal hydrologic year flow directions.

Selected hydrographs showing the Baseline (No Project) and Regional Project Scenario 4b groundwater elevations over the 56 years of the predictive model are provided on Figure 22. In general, the extraction wells of the Regional Project Scenario 4b show a decline in groundwater levels of approximately 10 ft or less. Inland of the Project desalination wells, differences in groundwater levels between Baseline (No Project) and Project are minimal (less than 7 ft). This includes wells completed in the 400-Foot Aquifer and Deep Aquifer underlying the 180-Foot Aquifer. Except for Observation Well 14, these deeper aquifers show almost no impacts from the Regional Project Scenario 4b pumping in the 180-Foot Aquifer.

Figure 23 shows the 500 mg/L chloride limit of the seawater intrusion in the 180-Foot Aquifer at selected times over the 56-year model period. In general, the intrusion is reduced at a faster rate when the Regional Project Scenario 4b is operating under Scenario 4b compared to Baseline (No Project) conditions. Only the area just south of the Salinas River mouth remains intruded longer than if there was no project. This is due to the trough that is designed to extract mostly seawater from the desalination wells of the Regional Project Scenario 4b.

The predicted TDS concentration from the five extraction wells is shown on Figure 24. As can be seen, the wells all produce water with fluctuating TDS concentrations (ranging from approximately 22,000 milligrams per liter (mg/L) to 33,000 mg/L) throughout the 56-year period. However, the TDS concentration is closer to the assumed seawater concentration of 35,000 mg/L during both normal and dry years than during wet years. The southernmost extraction well (Well 11) has more fluctuating TDS concentrations, but at times still produces close to the 35,000 mg/L concentration. During wet years, the TDS concentration of the extraction wells indicates that the wells are producing a mixture of seawater and onshore groundwater. This is due to the increase of groundwater, derived from infiltration of precipitation and streamflow percolation, flowing towards the ocean.

Over the 56 years, the average TDS concentration of the desalination feedwater extracted by the five Regional Project Scenario 4b wells will average approximately 29,000 mg/L. The chart below shows the modeled TDS concentrations over time. The predicted TDS concentration of 29,000 mg/L for the feedwater extracted by the five Project wells is approximately 82 to 85 percent of the TDS concentration of seawater (34,000 to 35,000 mg/L).



The water budget (see Table in Section 7.1) for the Regional Project Scenario 4b shows that similarly to the CAW slant well scenario, there will be increased ocean water inflow and decreased outflow of onshore water to the ocean compared to the No Project (Baseline) conditions. However, due to changes in regional pumping (non-project pumping) and use of surface water for this scenario there would be a 1,393 acre-ft/yr decrease in the amount of water flowing into the model from the northern, eastern and southern model boundary areas as compared to No the Project (see column 2 of table in Section 7.1). This decrease in groundwater inflow would have a beneficial impact on groundwater resources outside of the focused model area (i.e. less impact on groundwater elevations). Inside the focused model area, the change in groundwater storage for the Regional Project Scenario 4b would increase 143 acre-ft/yr as compared to the No Project Scenario (see column 9 of table in Section 7.1). This would be a beneficial impact to groundwater resources within the focused model area.

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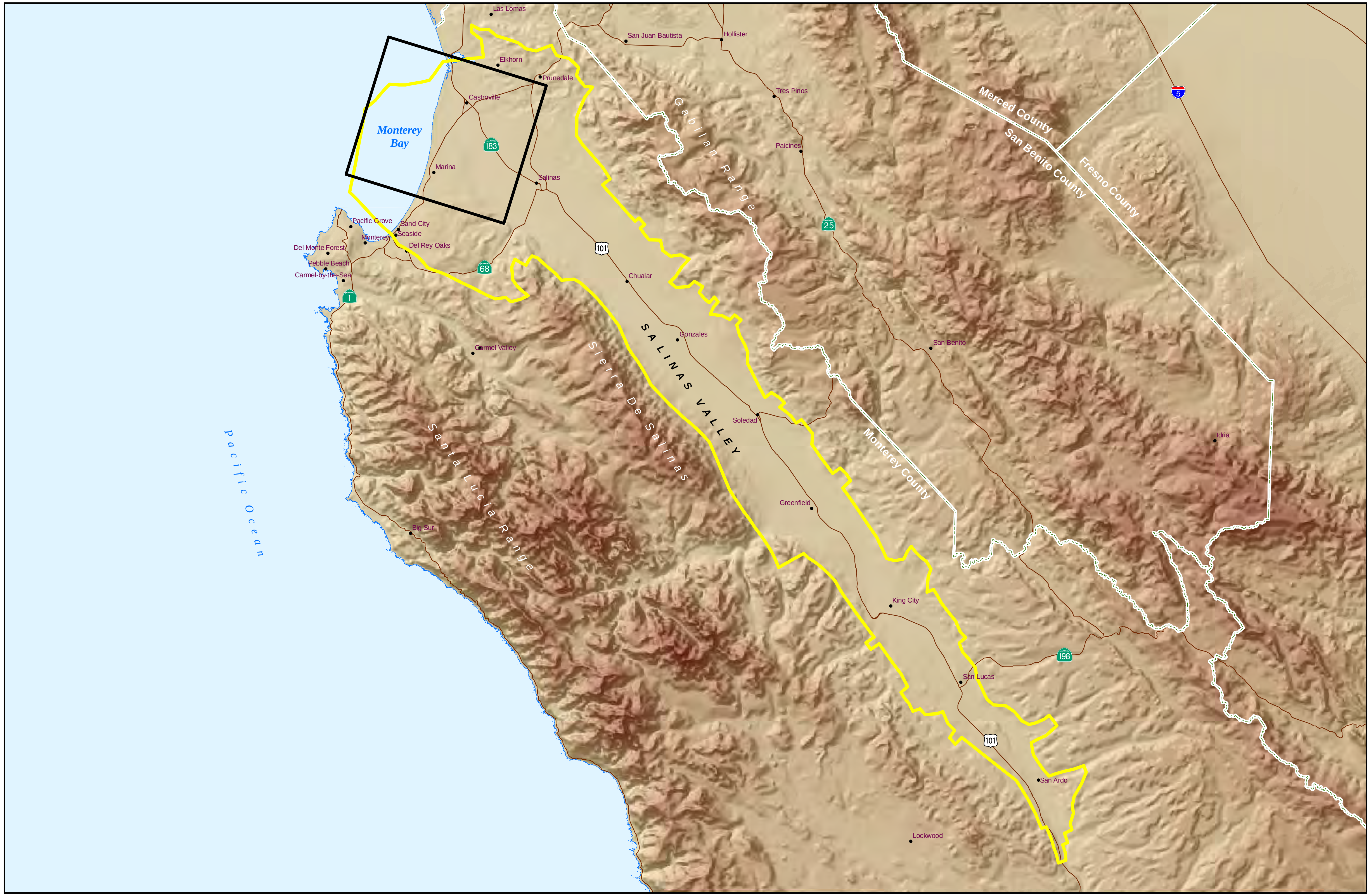
FIGURES

GEOSCIENCE Support Services, Inc.

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

GENERAL PROJECT LOCATION



EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Salinas Valley Integrated Groundwater and Surface Water Model (SVIGSM) Boundary

County Boundary

Highway

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 10 20 Miles

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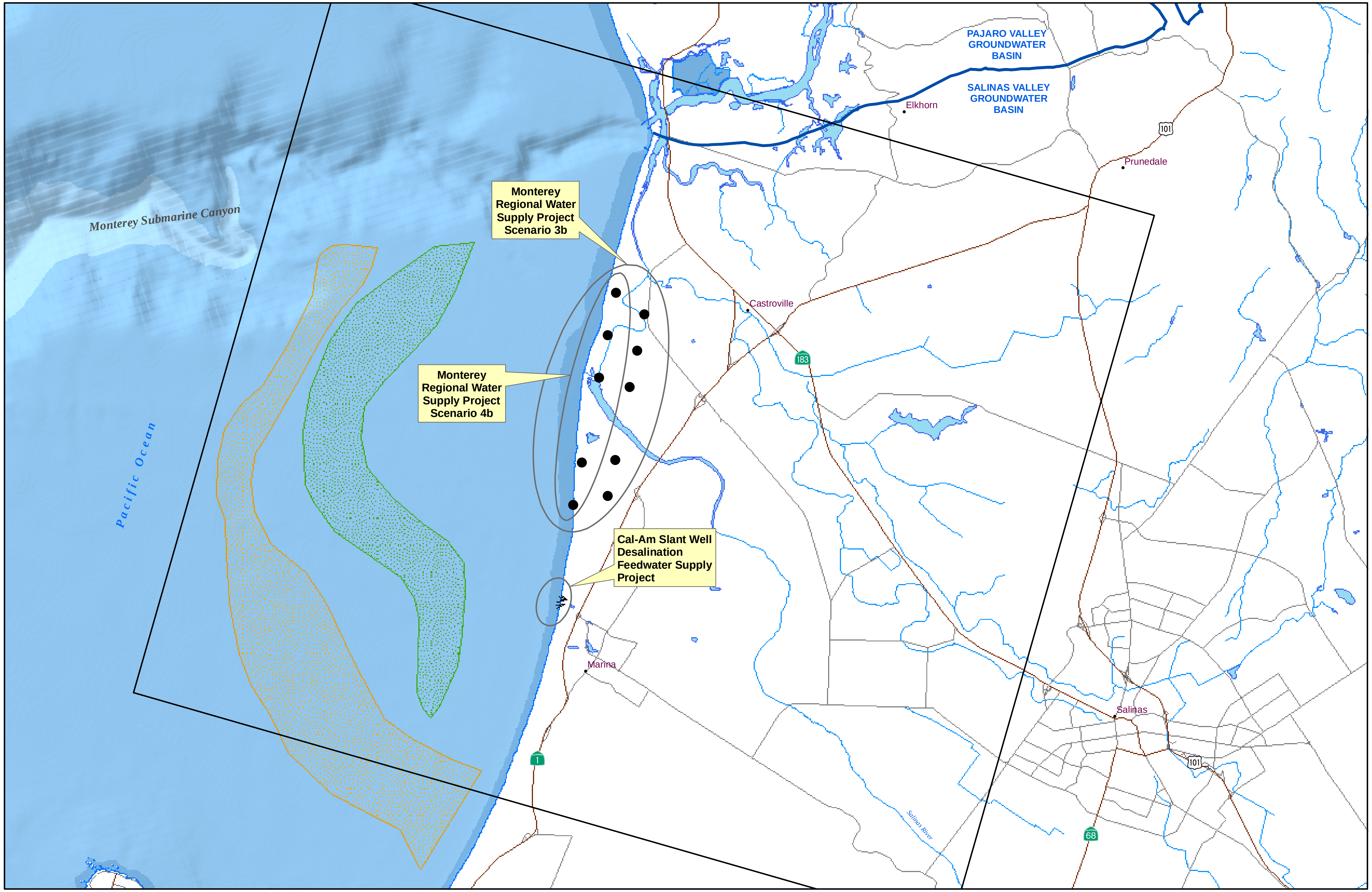
Figure 1

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_1_Slant_Wells_180ft_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



POTENTIAL PROJECTS

EXPLANATION

- Monterey Regional Project Well
- GEOSCIENCE Groundwater Model Boundary
- Groundwater Basin Boundary (DWR, 2003)
- Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)
  - 180-Foot Aquifer
  - 400-Foot Aquifer
- Slant Well
- Highway
- Major Roads
- Rivers and Creeks

NOTE:
Scenario 3b = 10 wells
Scenario 4b = 5 wells

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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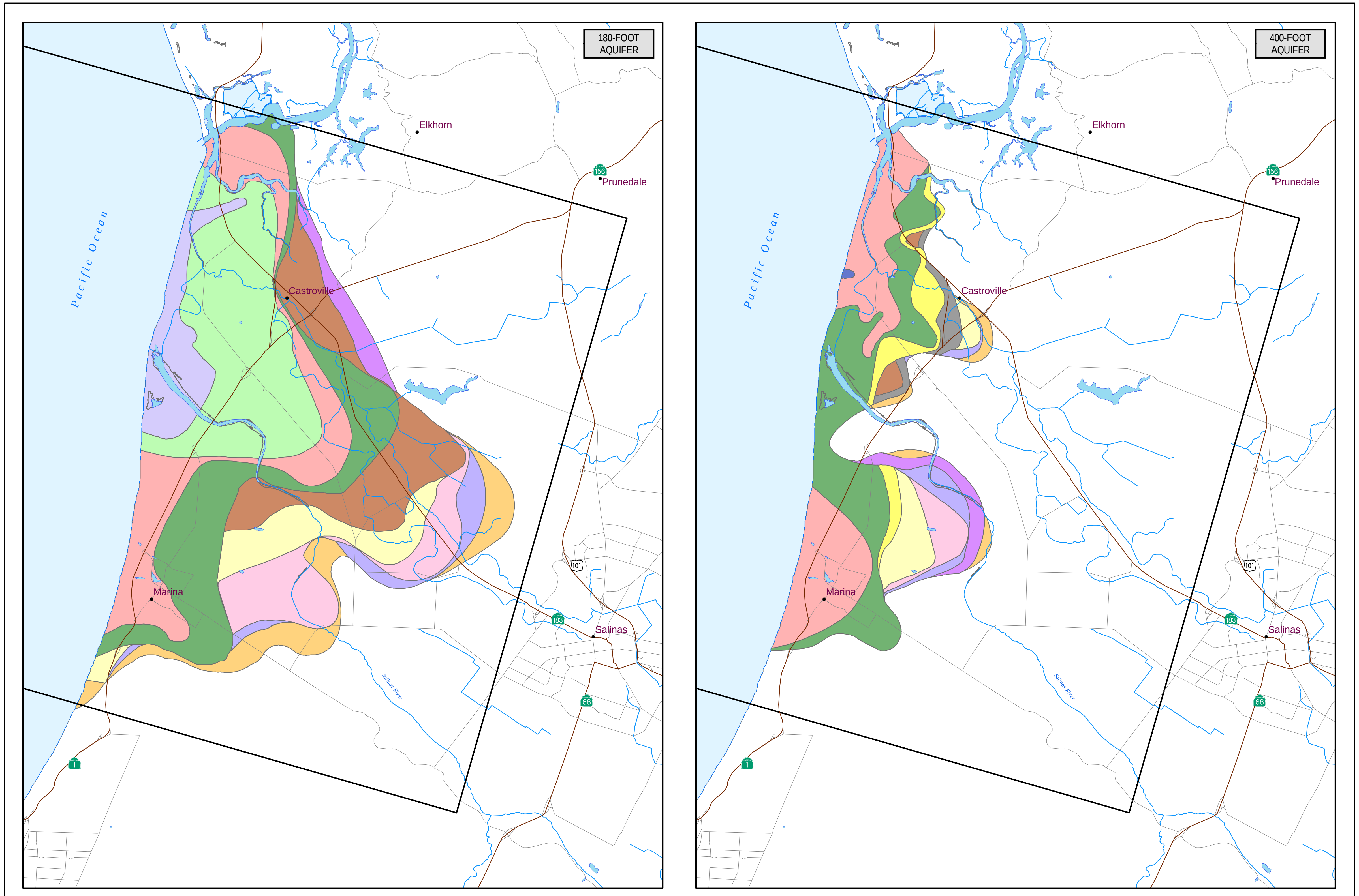
Figure 2

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_2_proposed_projects_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



HISTORICAL SEAWATER INTRUSION 180-FOOT AND 400-FOOT AQUIFERS

EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Highway

Major Roads

Rivers and Creeks

Seawater Intrusion by Year (Source: MCWRA, 2005)

1944, 1959, 1965, 1975, 1985, 1990, 1993, 1995, 1997, 1999, 2001, 2003, 2005

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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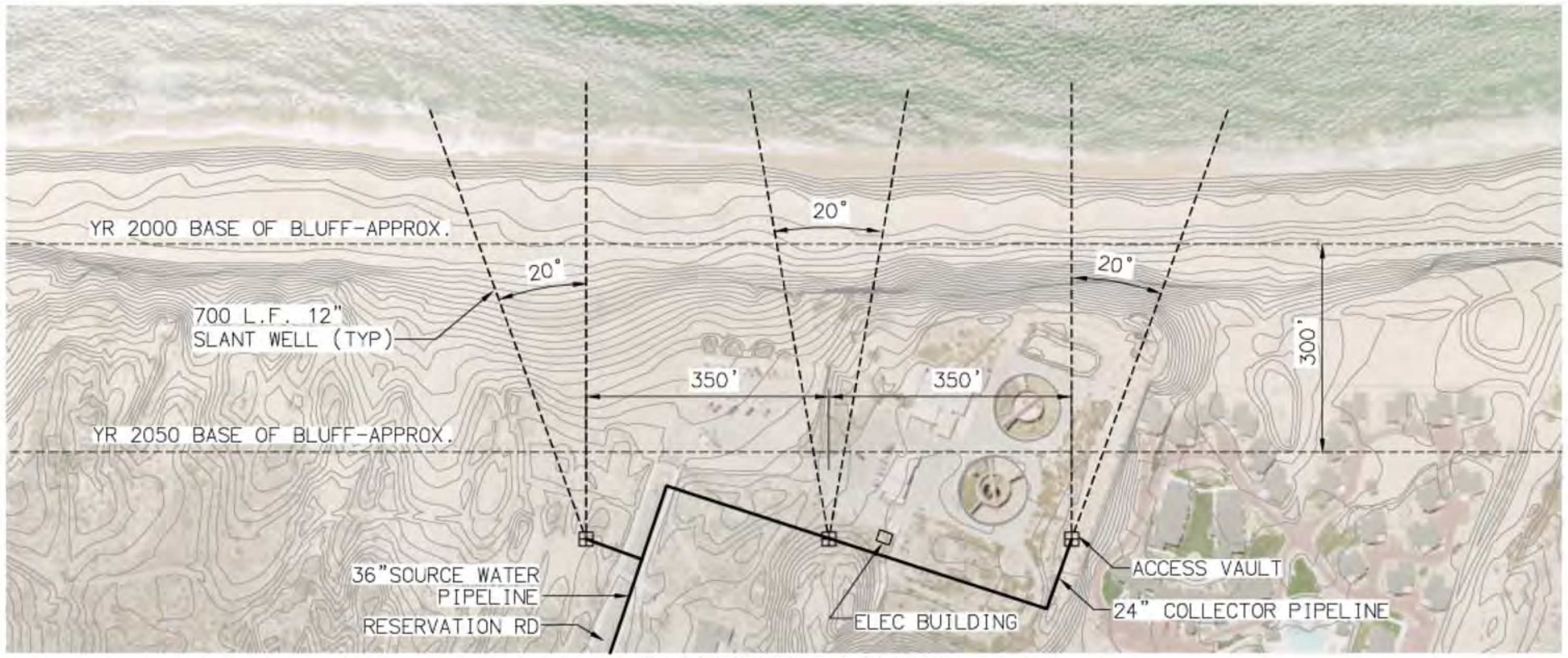
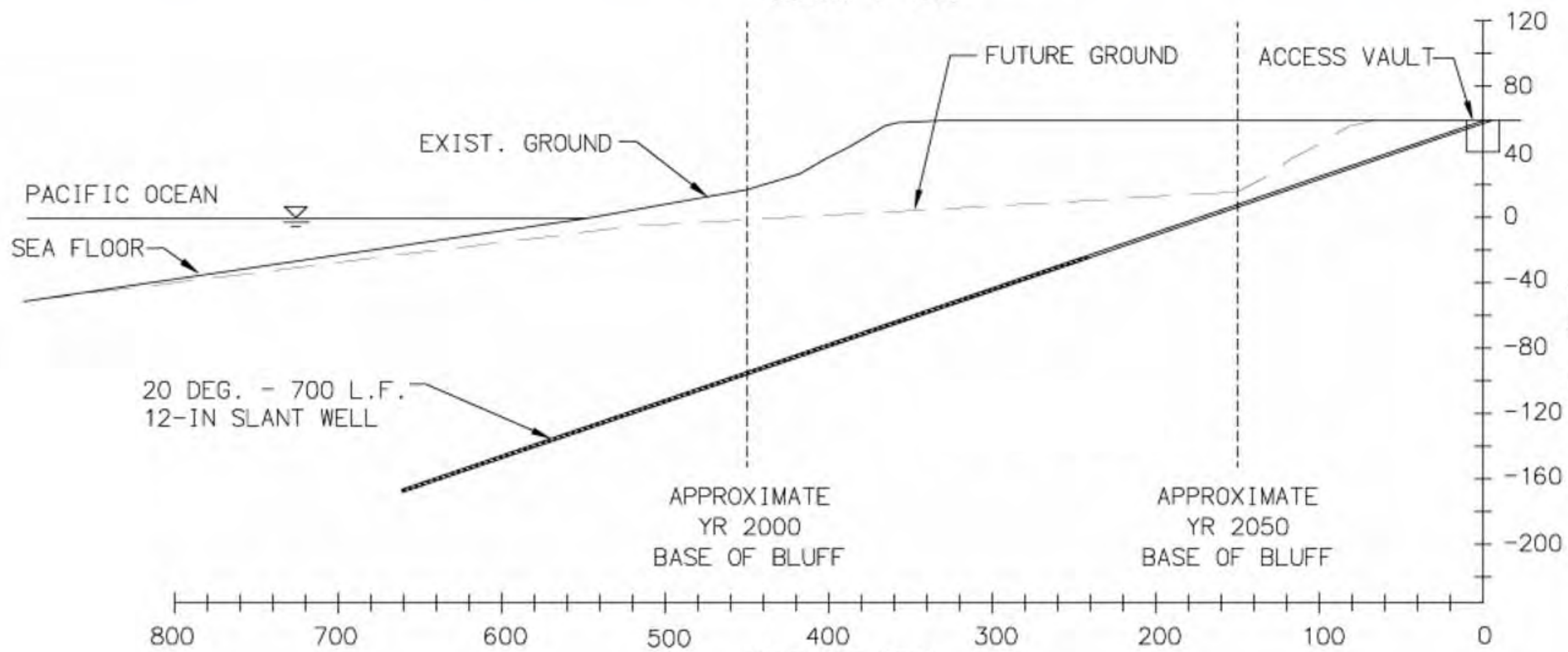
Figure 3

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_3_historic_swi_180ft_400ft_9-08.mxd

This layout was developed after model runs were completed. However, groundwater impacts are not expected to be much different between this layout and the layout modeled.



SLANT WELL LAYOUT
SCALE: 1"=200'



SLANT WELL PROFILE
SCALE: 1"=100'

COASTAL WATER PROJECT

FIGURE 3
SLANT WELL SITE LAYOUT
NORTH MARINA ALTERNATIVE

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CALIFORNIA AMERICAN WATER

SLANT WELL LAYOUT

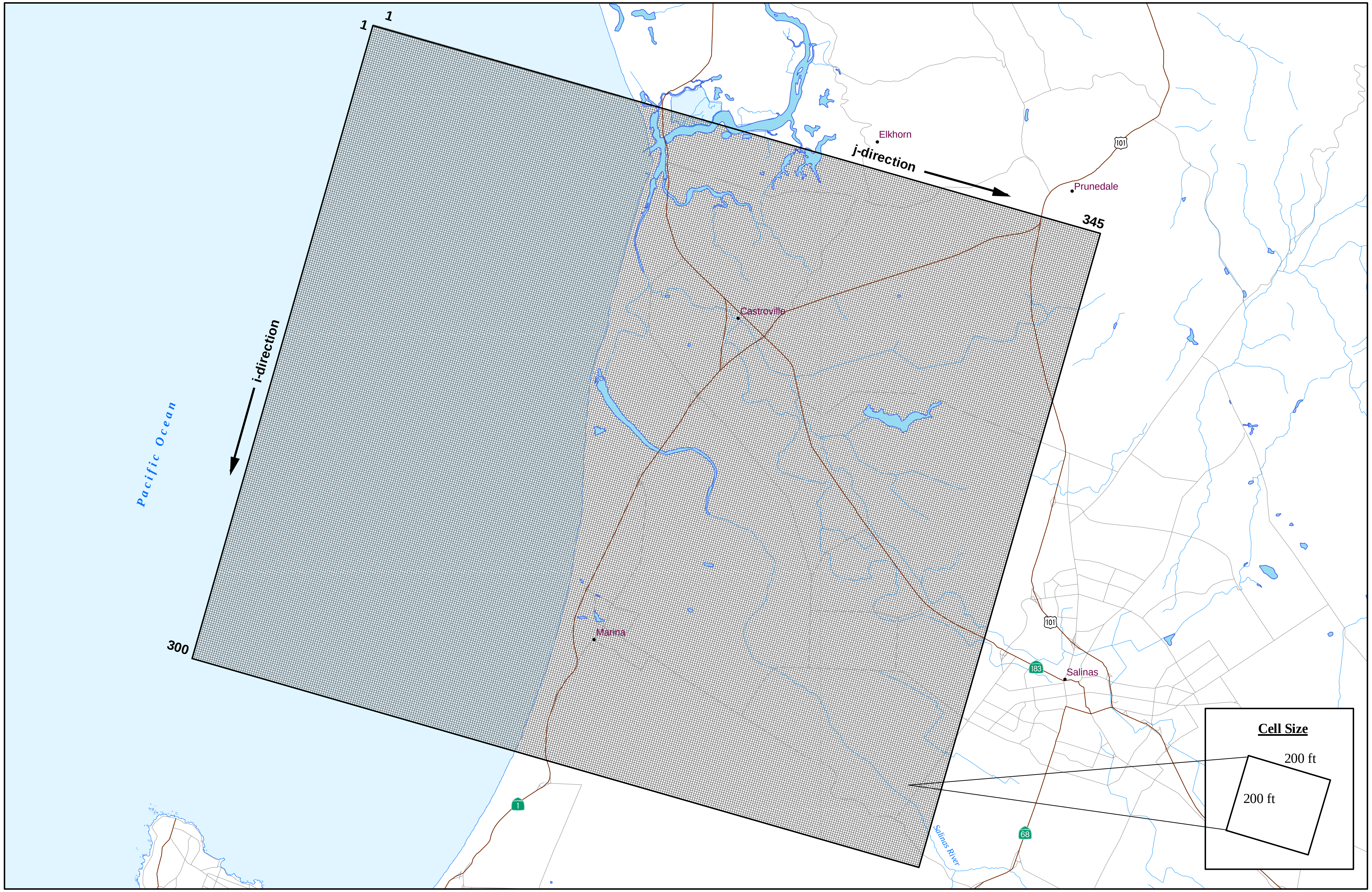
Drawn:
Checked:
Approved:
Date: 26-SEP-08

Figure 4

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

NORTH MARINA GROUNDWATER MODEL BOUNDARY



EXPLANATION

- GEOSCIENCE Groundwater Model Boundary
- Model Cell Size (200 ft x 200 ft)
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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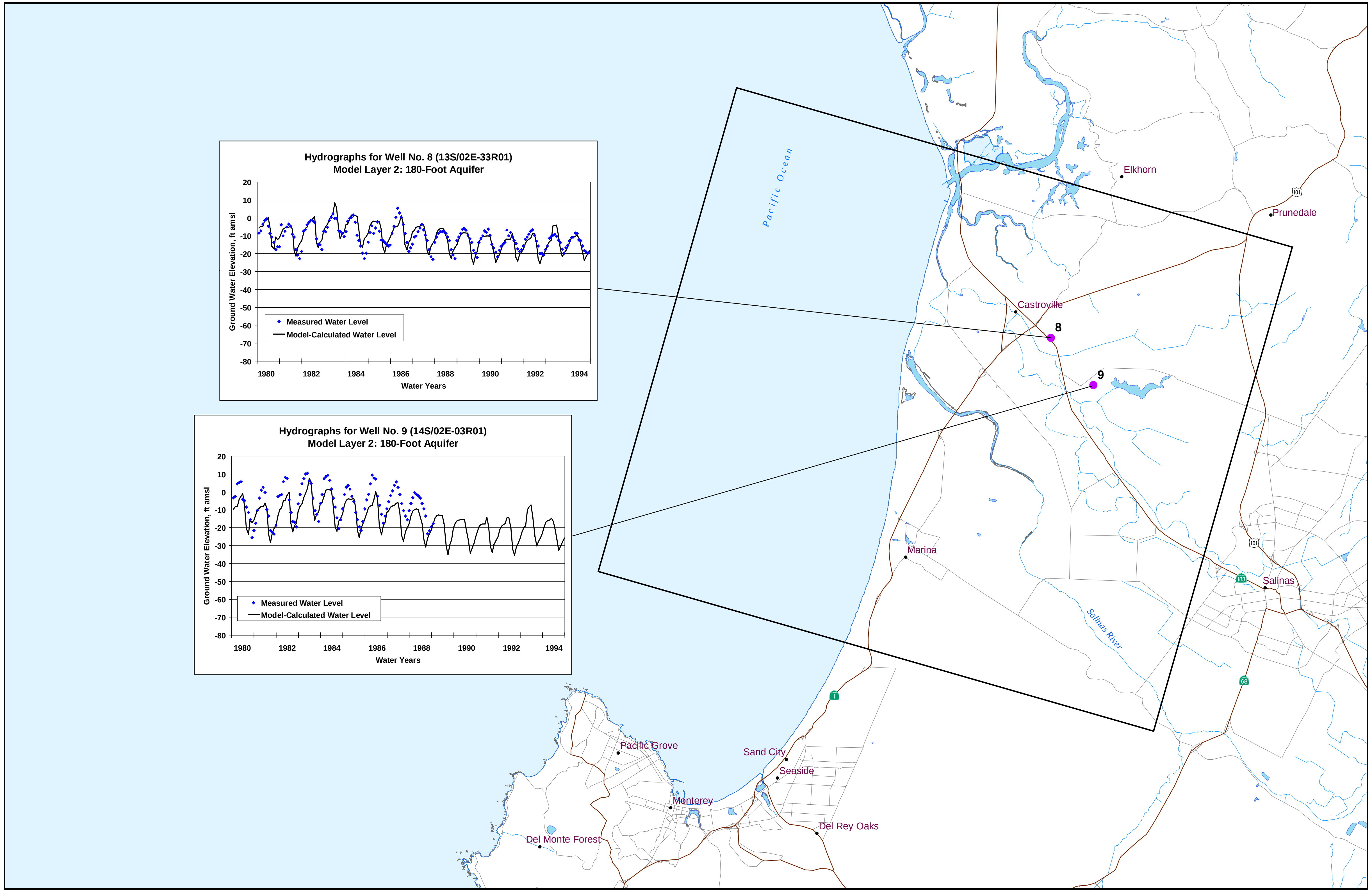
Figure 5

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_5_Model_Bouneary_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

FLOW MODEL CALIBRATION HYDROGRAPHS 180-FOOT AQUIFER



EXPLANATION

- WRIME Calibration Well
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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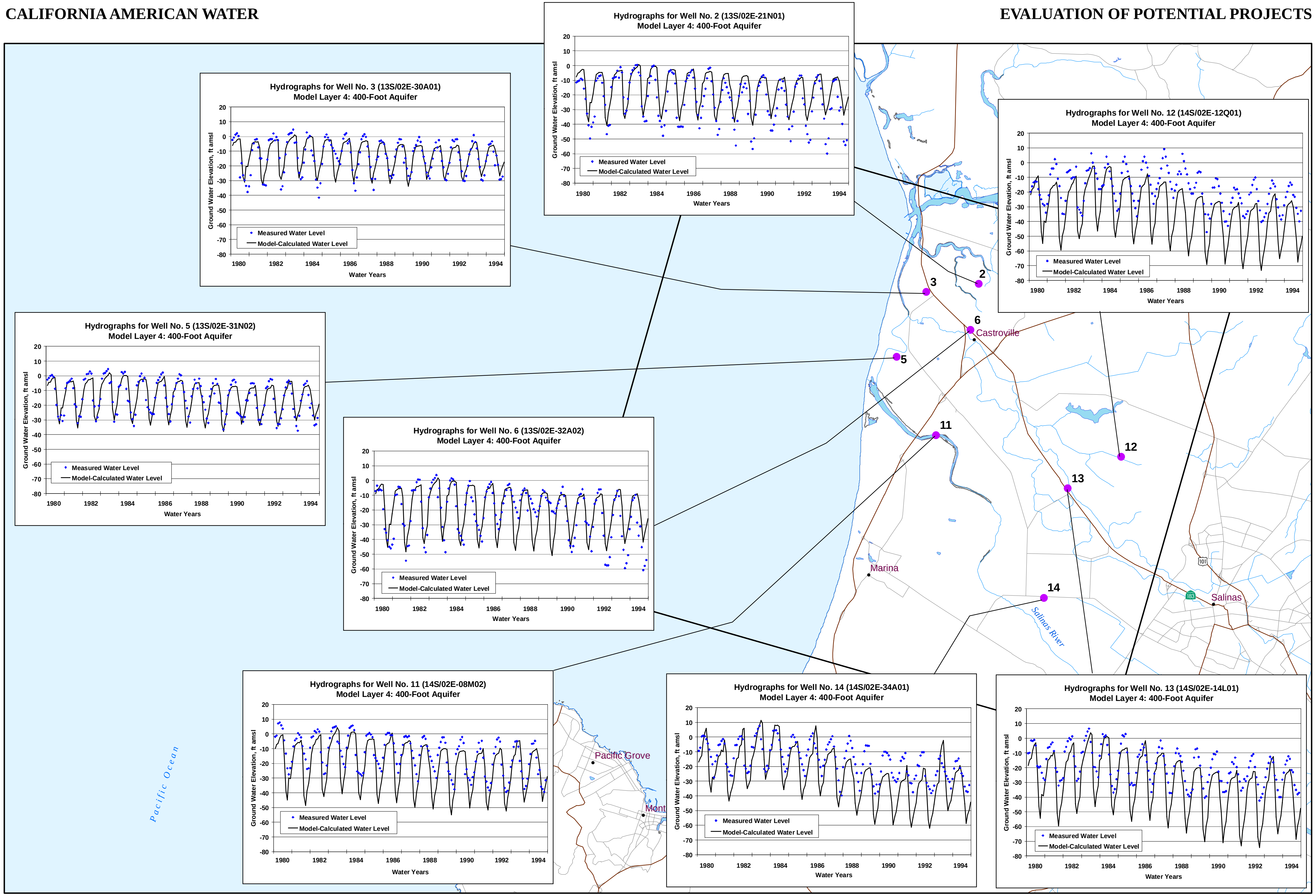
Figure 6

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_6_Hydrographs_180ft_aquifer_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

FLOW MODEL CALIBRATION HYDROGRAPHS 400-FOOT AQUIFER



EXPLANATION

- WRIME Calibration Well
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

NORTH

0 2 4 Miles

Map Projection:
State Plane 1983, California Zone IV

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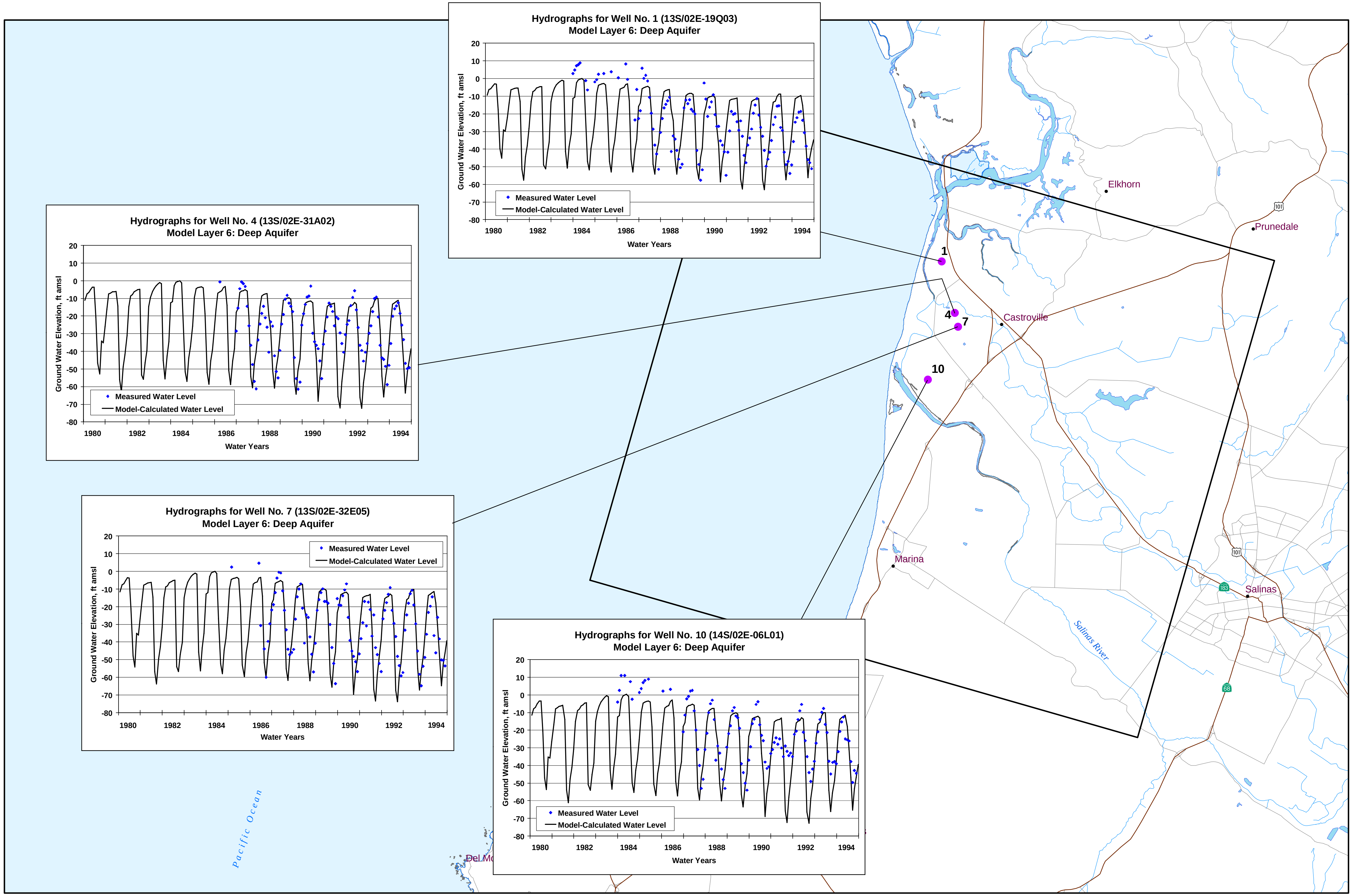
Figure 7

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_7_Hydrographs_400ft_aquifer_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

FLOW MODEL CALIBRATION HYDROGRAPHS DEEP AQUIFER



EXPLANATION

- WRIME Calibration Well
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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Figure 8

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_8_Hydrographs_deep_aquifer_9-08.mxd

California American Water
North Marina Groundwater Model
Evaluation of Potential Projects

Histogram of Groundwater Level Residuals* - Transient Model Calibration

(Model Calibration Period October 1979 Through September 1994)

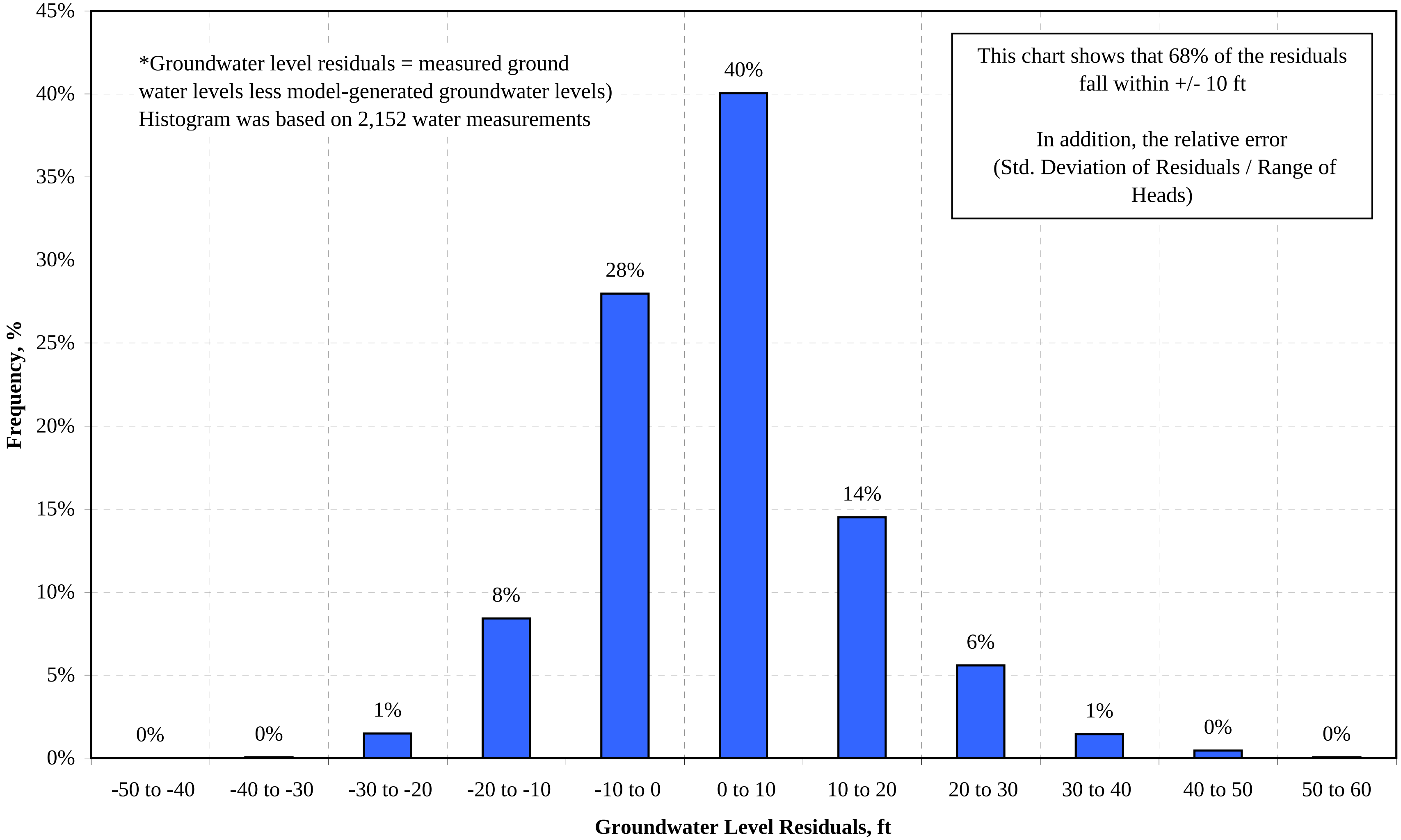


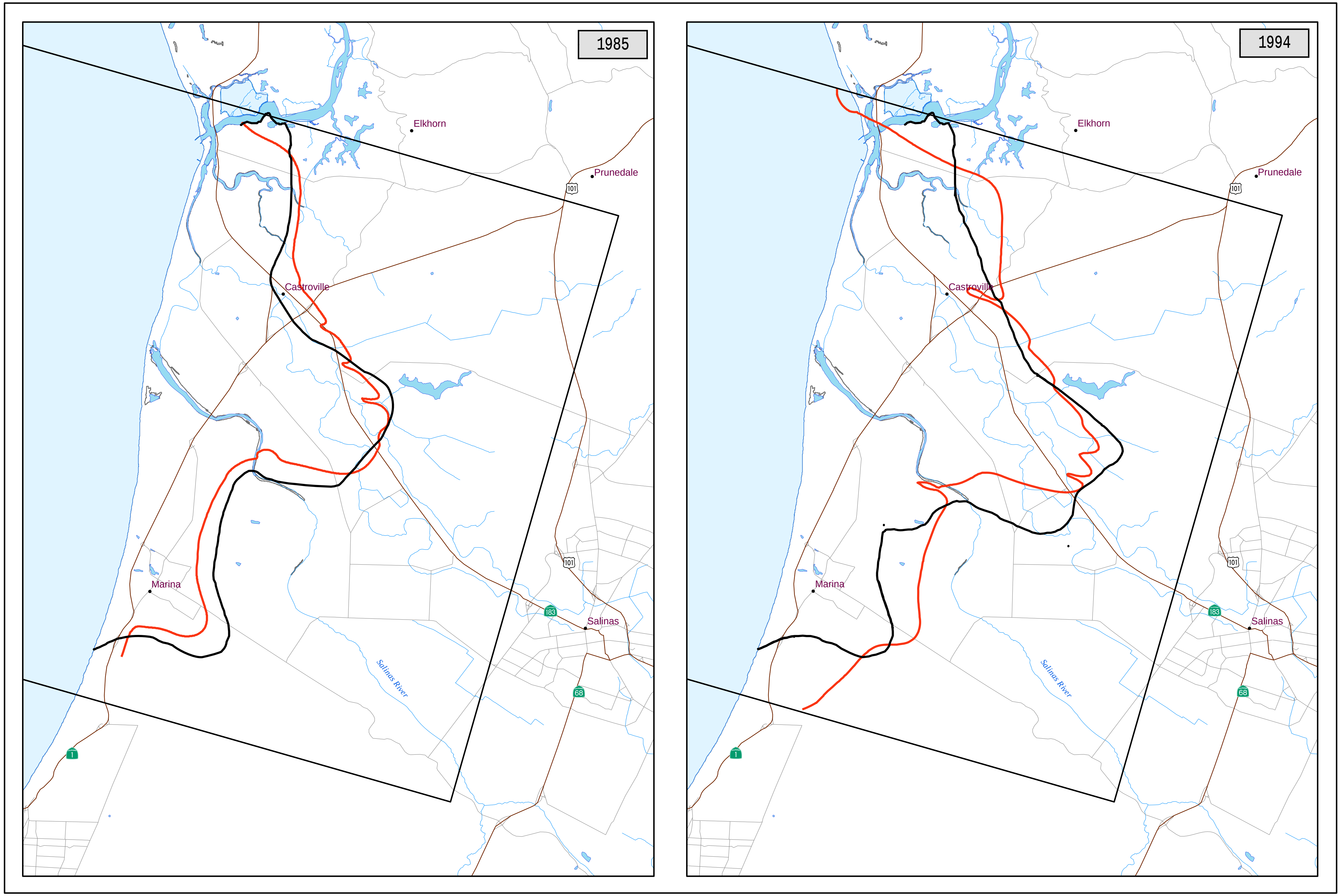
Figure 9

26-Sep-08

GEOSCIENCE Support Services, Inc.

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



TRANSPORT MODEL CALIBRATION OF SEAWATER INTRUSION 180-FOOT AQUIFER

EXPLANATION

- GEOSCIENCE Groundwater Model Boundary
- MCWRA Seawater Intrusion Line (Chloride = 500 mg/L) (MCWRA, 2005)
- Model-Generated Seawater Intrusion Line (Chloride = 500 mg/L)
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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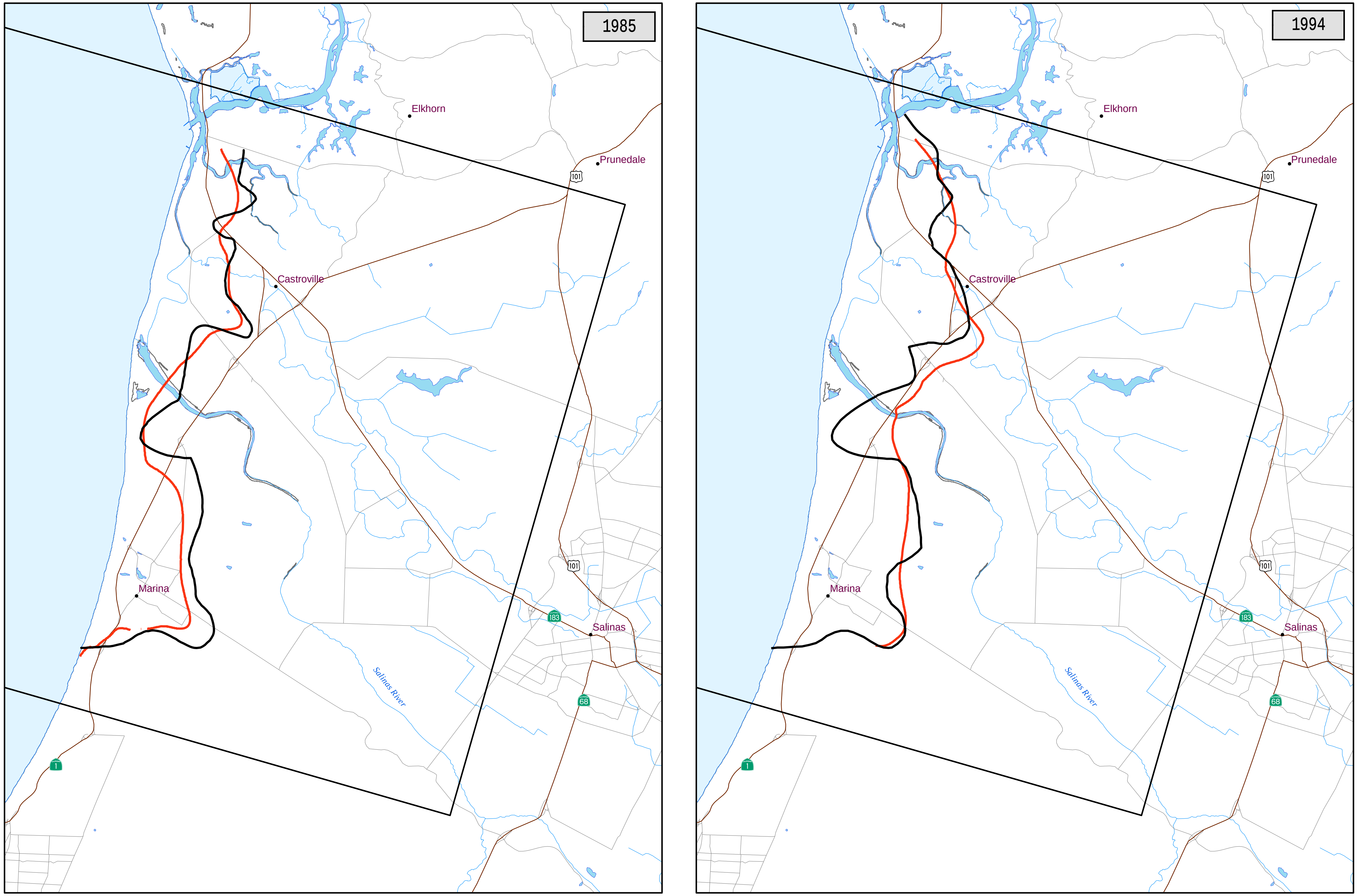
Figure 10

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_10_calibration_swi_180ft_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



TRANSPORT MODEL CALIBRATION OF SEAWATER INTRUSION 400-FOOT AQUIFER

EXPLANATION

GEOSCIENCE Groundwater Model Boundary

MCWRA Seawater Intrusion Line (Chloride = 500 mg/L) (MCWRA, 2003)

Model-Generated Seawater Intrusion Line (Chloride = 500 mg/L)

Highway

Major Roads

Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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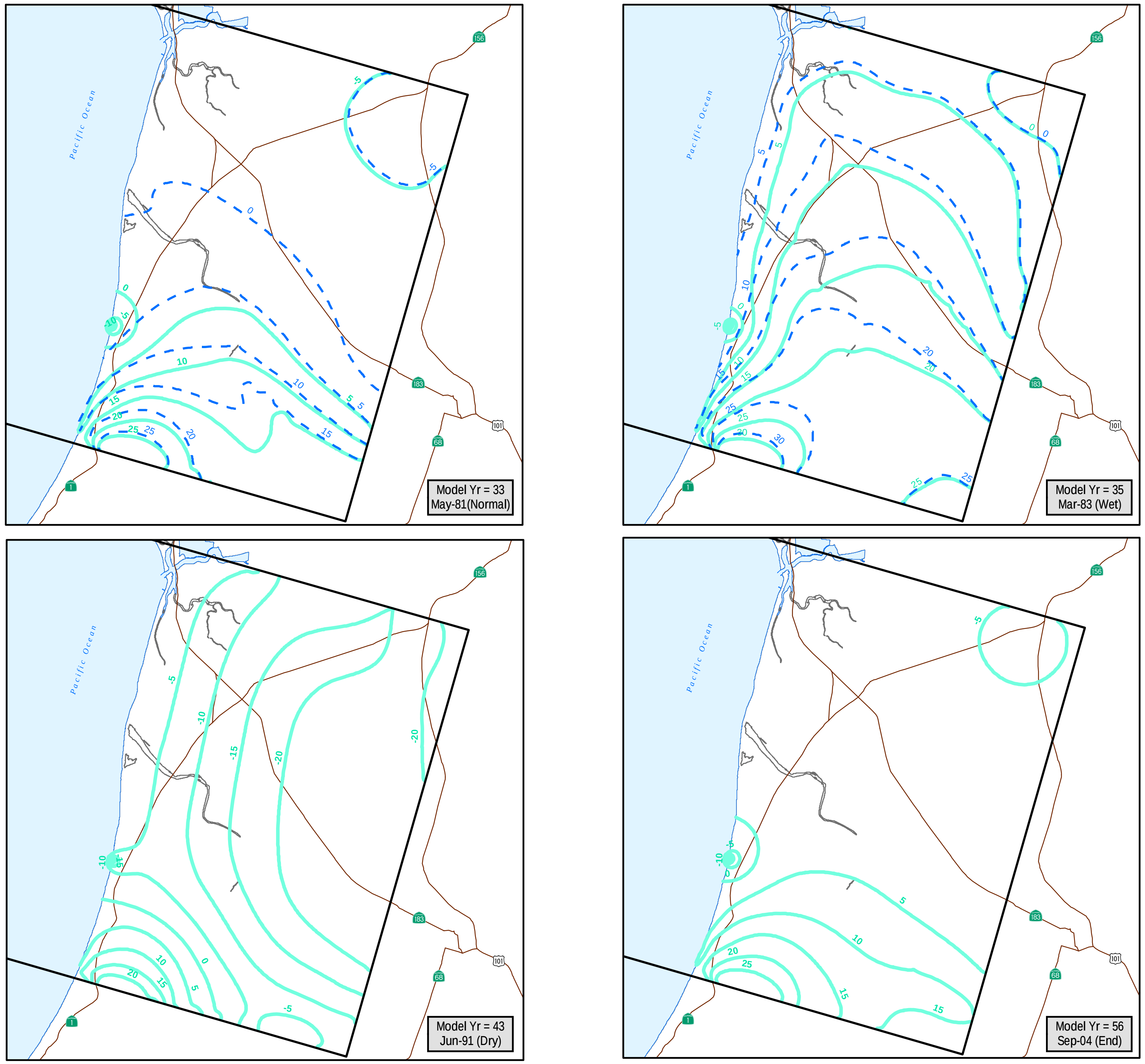
Figure 11

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_11_calibration_swi_400ft_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

180-FOOT AQUIFER BASELINE vs. SLANT WELL FEEDWATER SUPPLY SCENARIO (22 MGD) GROUNDWATER ELEVATIONS



EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Baseline Groundwater Elevation, ft amsl

Slant Well Scenario Groundwater Elevation, ft amsl

Highway

Model Yr = 13 Jun-1961 (Dry) — Predictive Model Year* Hydrologic Year

* Years Since Start of Model Scenario

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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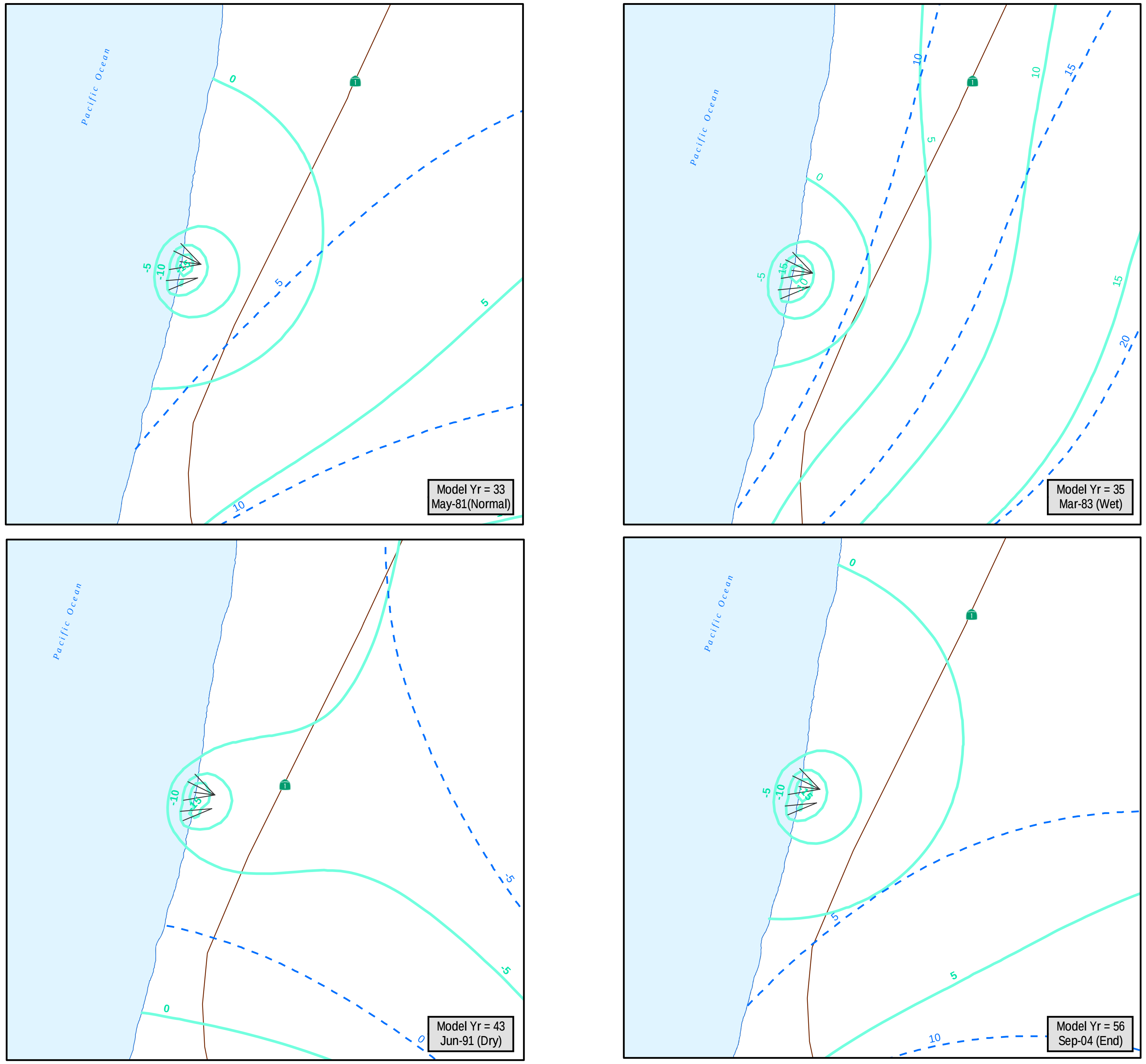
Figure 12

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_12_Slant_Wells_180ft_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



180-FOOT AQUIFER BASELINE vs. SLANT WELL FEEDWATER SUPPLY SCENARIO (22 MGD) GROUNDWATER ELEVATIONS (Close-Up)

EXPLANATION

Baseline Groundwater Elevation, ft amsl

Slant Wells

Slant Well Scenario Groundwater Elevation, ft amsl

Highway

Model Yr = 13 Jun-1961 (Dry) — Predictive Model Year* Hydrologic Year

* Years Since Start of Model Scenario

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2,000 4,000 Feet

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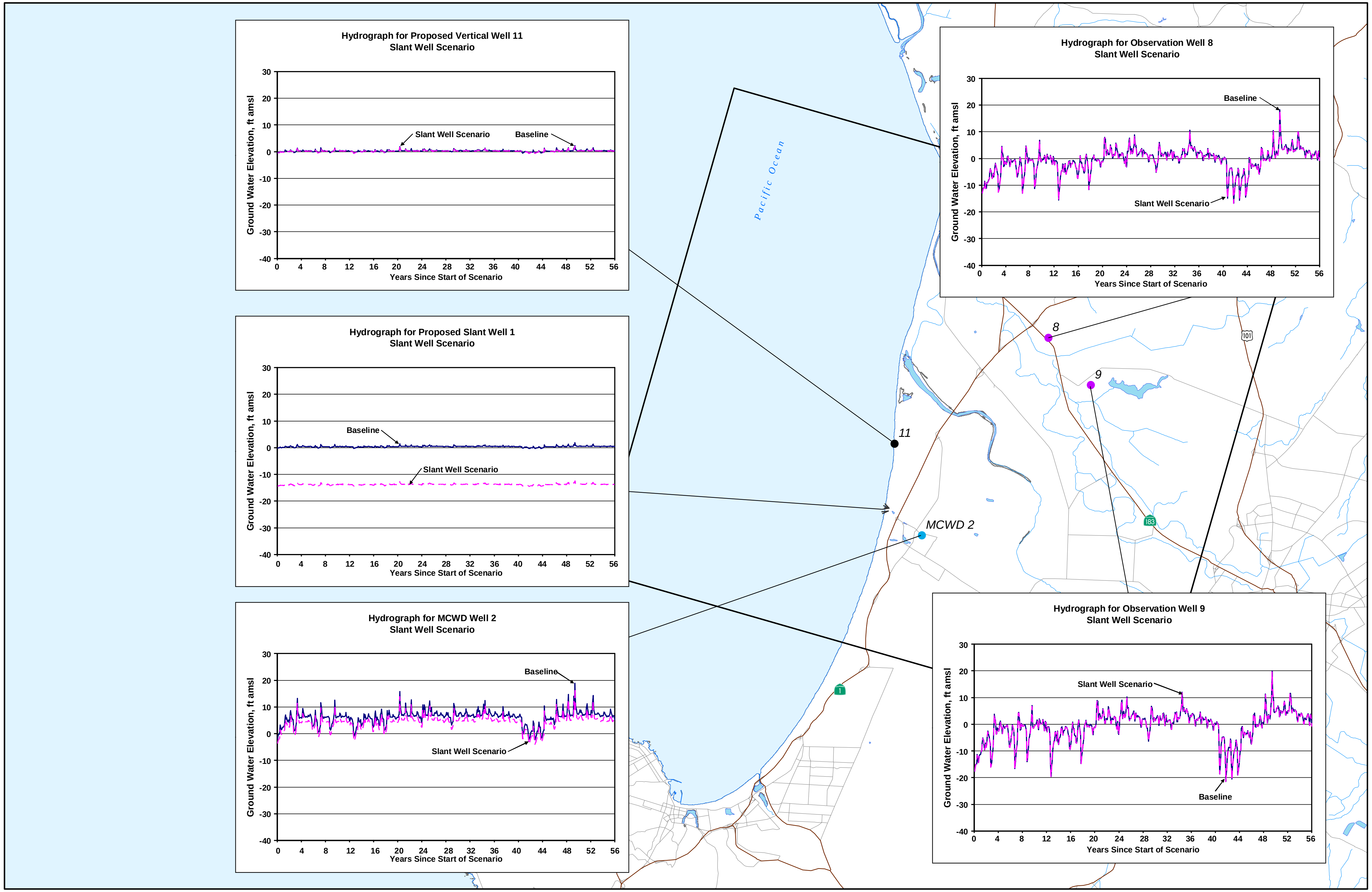
Figure 13

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_13_Slant_Wells_180ft_ZOOM_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

180-FOOT AQUIFER SLANT WELL FEEDWATER SUPPLY SCENARIO (22 MGD) HYDROGRAPHS



EXPLANATION

- Monterey Regional Project Well
- WRIME Calibration Well
- MCWD Well
- Slant Well
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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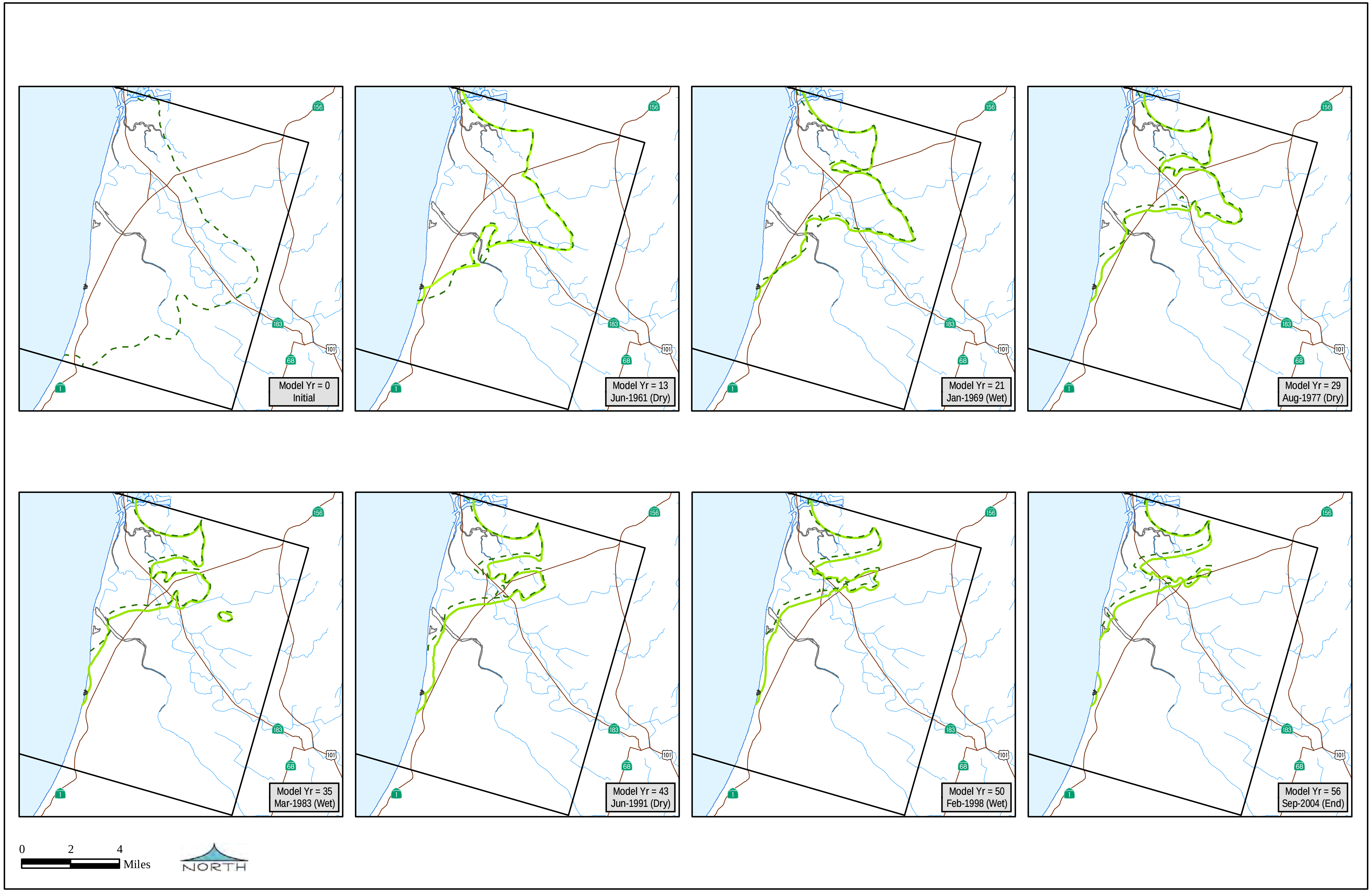
Figure 14

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_14_Slant_wells_Hydrographs_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



180-FOOT AQUIFER BASELINE vs. SLANT WELL FEEDWATER SUPPLY SCENARIO (22 MGD) SEAWATER INTRUSION

EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Baseline Seawater Intrusion Chloride = 500 mg/L

Slant Well Scenario Seawater Intrusion, Chloride = 500 mg/L

Slant Well

Highway

Rivers and Creeks

Model Yr = 13 Jun-1961 (Dry) — Predictive Model Year* Hydrologic Year

* Years Since Start of Model Scenario

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

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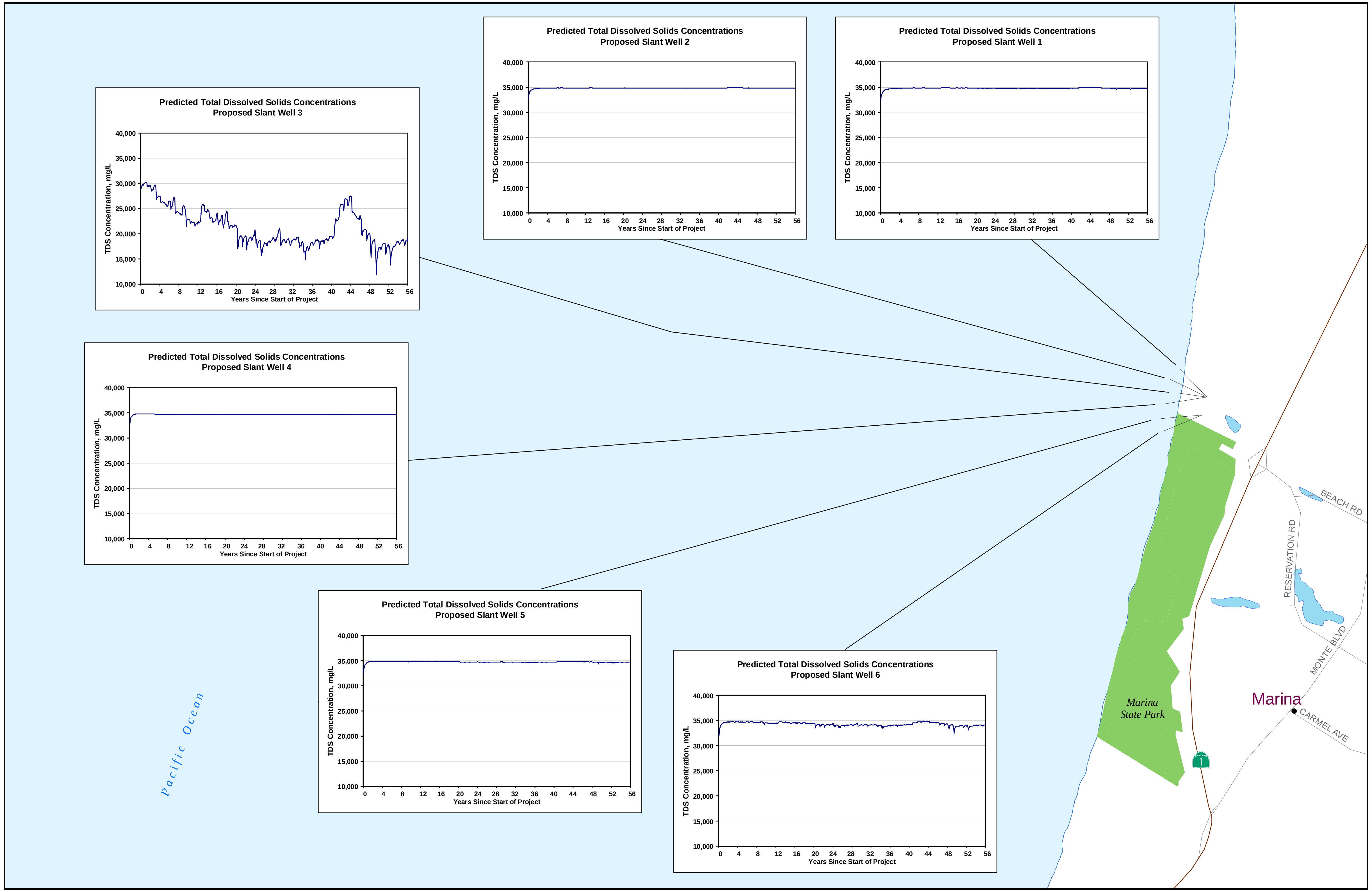
Figure 15

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



PREDICTED TDS CONCENTRATIONS FROM REGIONAL PROJECT SLANT WELLS

EXPLANATION

- Slant Wells
- Marina State Park
- Highway
- Major Roads

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2,000 4,000 Feet

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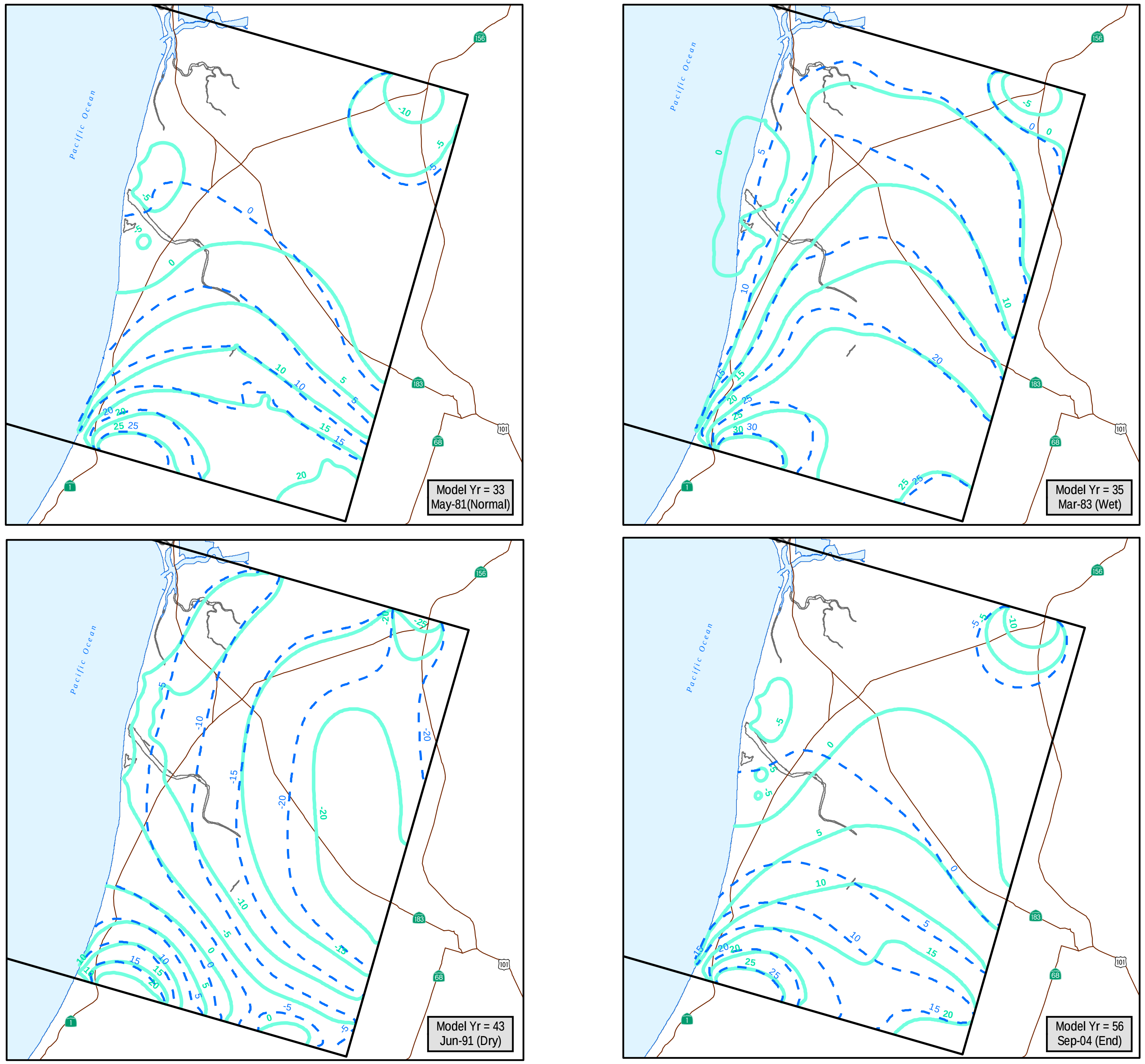
Figure 16

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_16_TDS_graphs_slant_9-08.mxd

180FT AQUIFER BASELINE vs. REGIONAL PROJECT SCENARIO 3a GROUNDWATER ELEVATIONS



EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Baseline Groundwater Elevation, ft amsl

Regional Project Scenario Groundwater Elevation, ft amsl

Highway

Model Yr = 13
Jun-1961 (Dry)
Predictive Model Year*
Hydrologic Year

* Years Since Start of Model Scenario

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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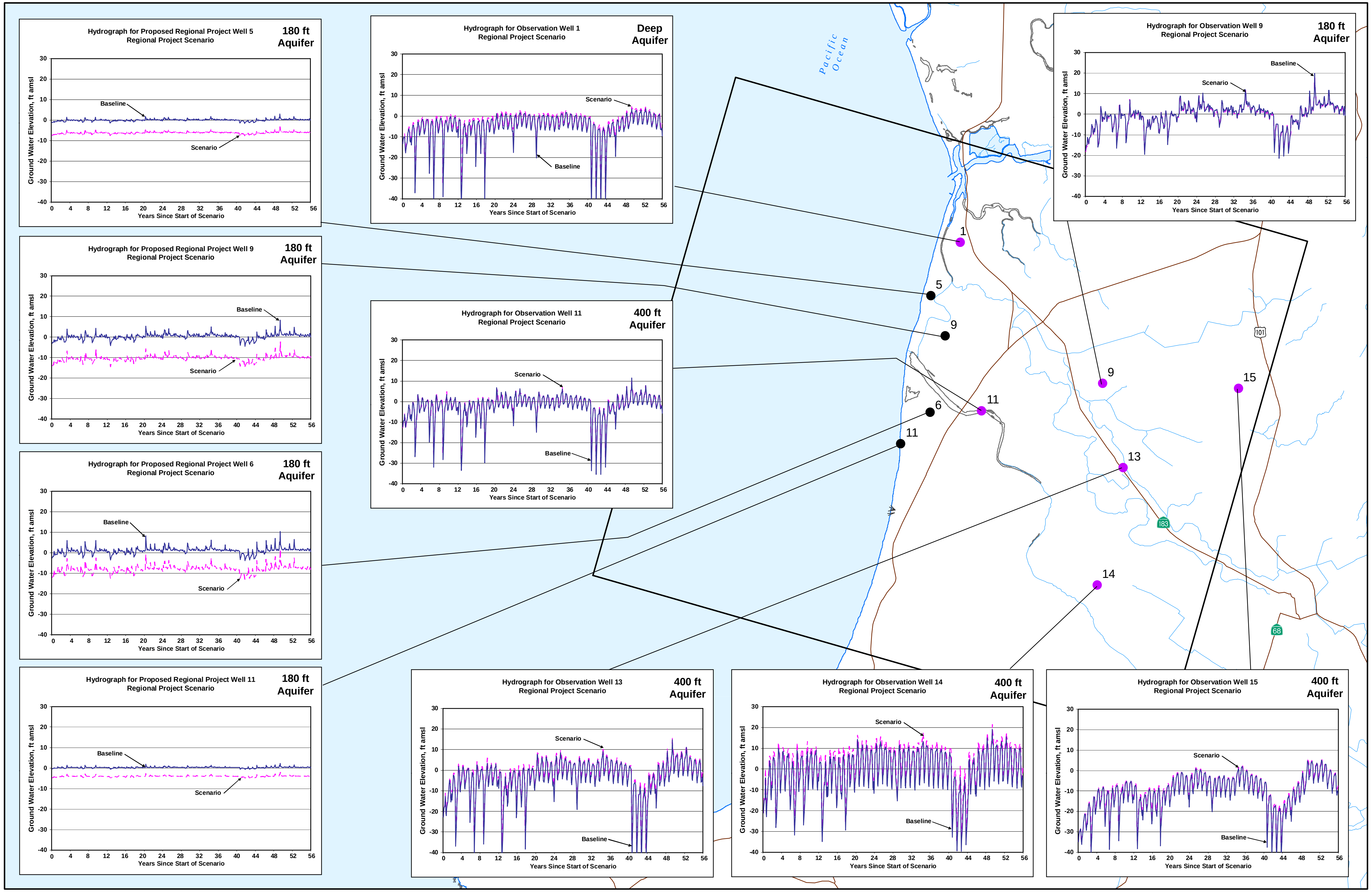
Figure 17

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_17_reg_proj_180ft_9-08.mxd

REGIONAL PROJECT SCENARIO 3a HYDROGRAPHS



EXPLANATION

Well Hydrograph Locations

- Monterey Regional Project Well
- WRIME Calibration Well
- Slant Wells
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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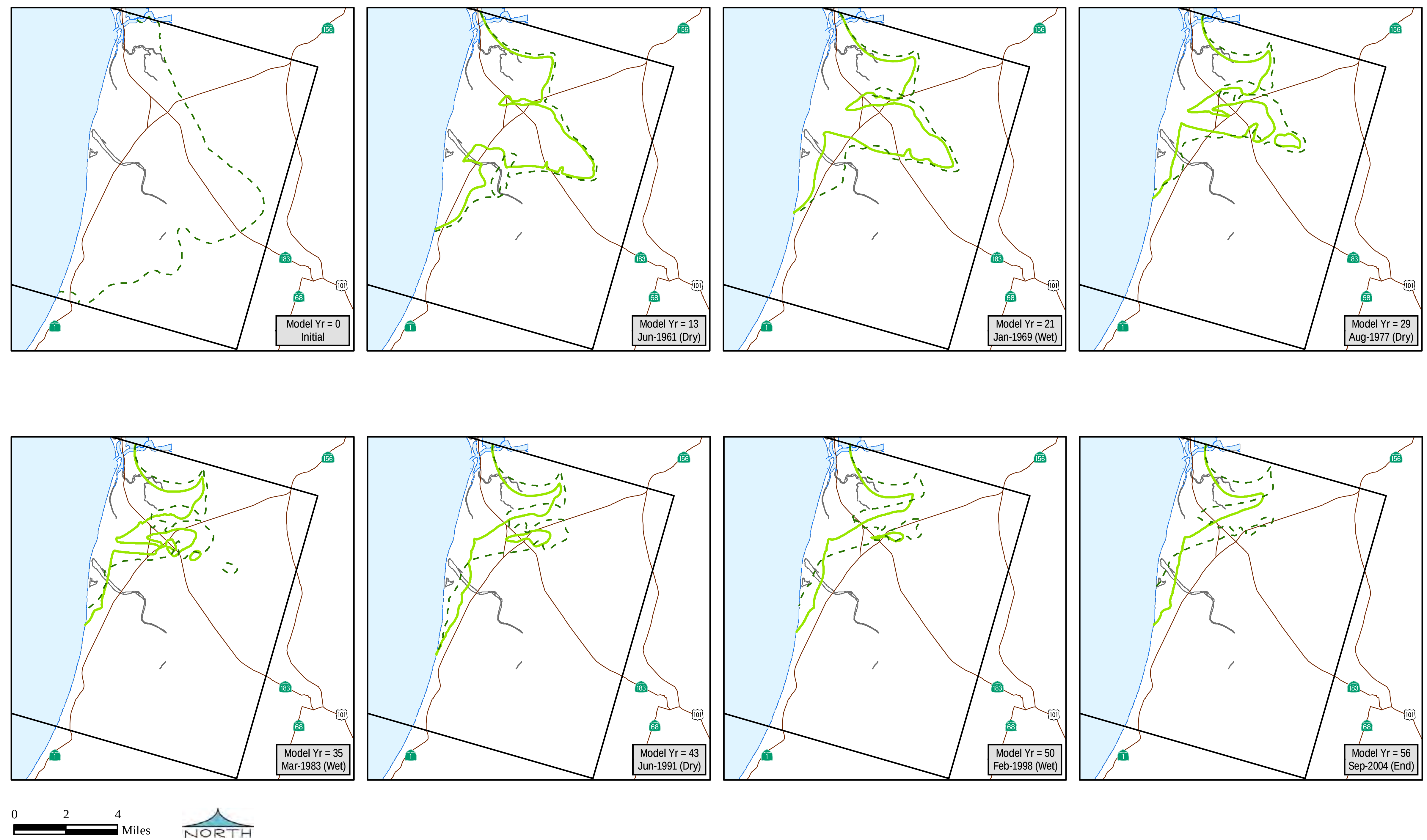
Figure 18

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_18_3a_reg_proj_Hydrographs_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

180-FOOT AQUIFER BASELINE vs. REGIONAL PROJECT SCENARIO 3a SEAWATER INTRUSION



EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Baseline Seawater Intrusion Chloride = 500 mg/L

Regional Project Scenario Seawater Intrusion, Chloride = 500 mg/L

Highway

Model Yr = 13 Jun-1961 (Dry) — Predictive Model Year* Hydrologic Year

* Years Since Start of Model Scenario

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

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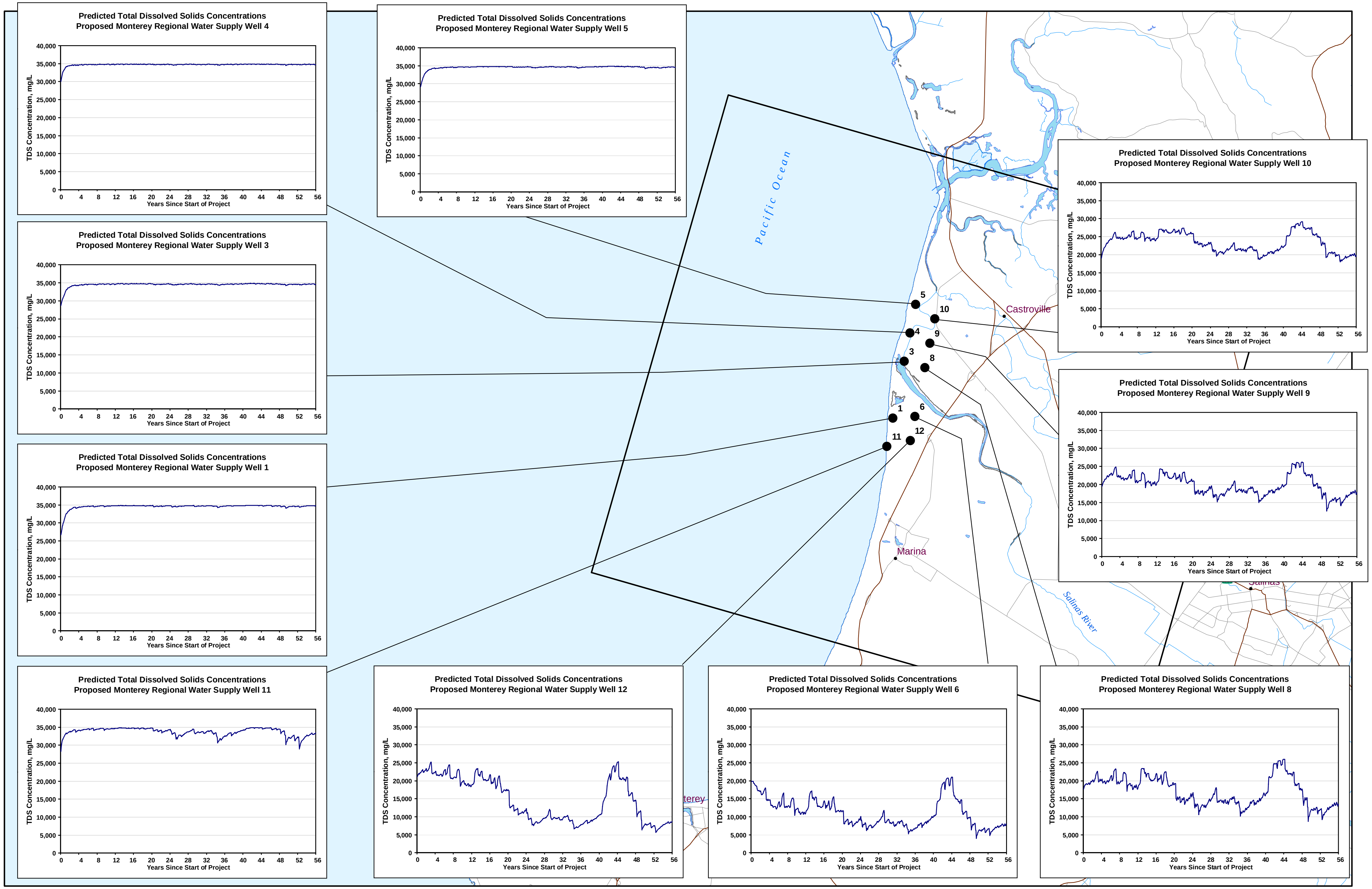
Figure 19

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_19_3a_reg_proj_180ft_SWI_9-08.mxd

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

CALIFORNIA AMERICAN WATER

PREDICTED TDS CONCENTRATIONS FROM REGIONAL PROJECT EXTRACTION WELLS



EXPLANATION

- Monterey Regional Project Well
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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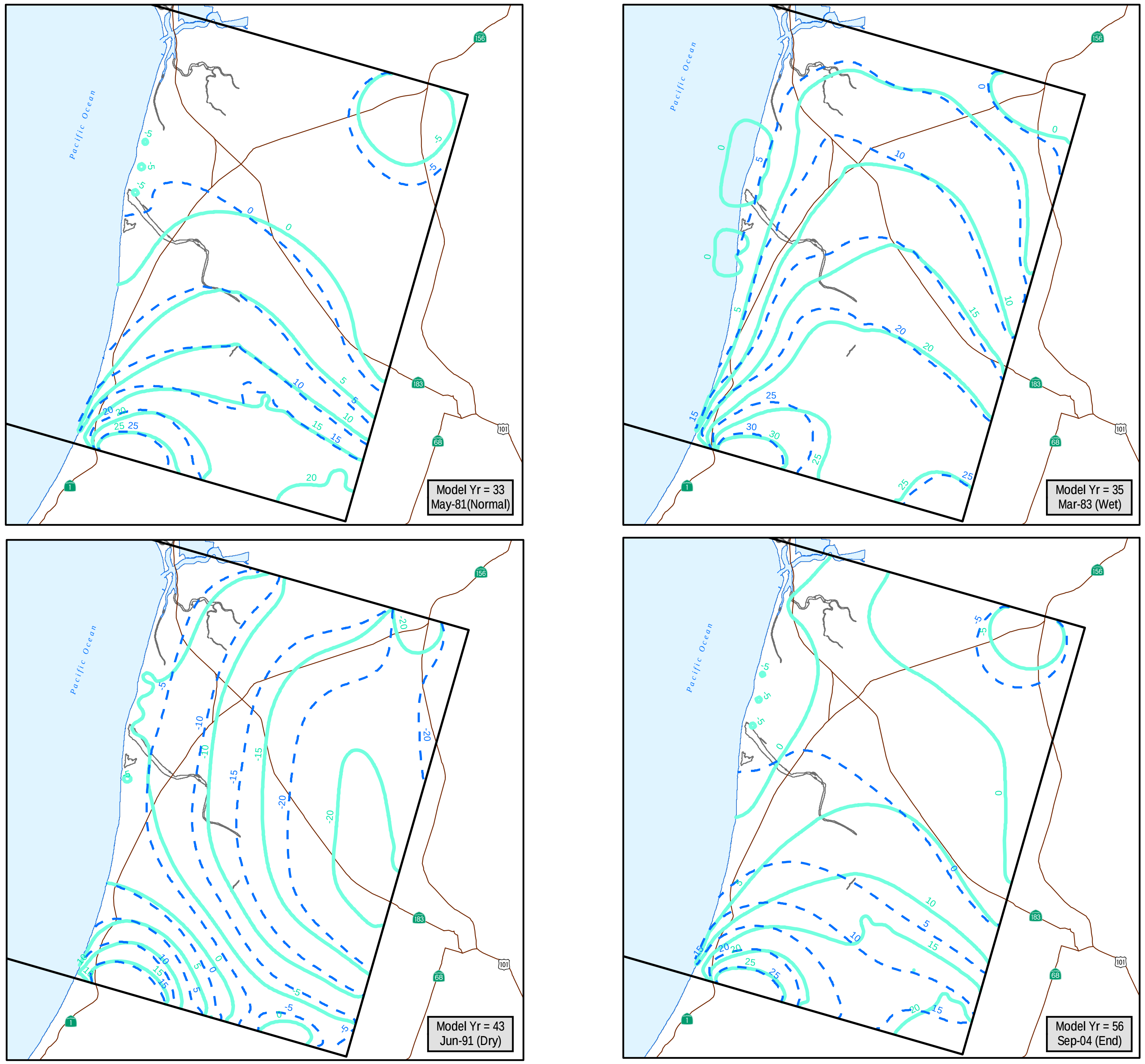
Figure 20

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_20_TDS_graphs_regional_9-08.mxd

180-FOOT AQUIFER BASELINE vs. REGIONAL PROJECT SCENARIO 4b GROUNDWATER ELEVATIONS



EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Baseline Groundwater Elevation, ft amsl

Regional Project Scenario 4b Grounwater Elevation, ft amsl

Highway

Model Yr = 13 Jun-1961 (Dry) — Predictive Model Year* Hydrologic Year

* Years Since Start of Model Scenario

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH

0 2 4 Miles

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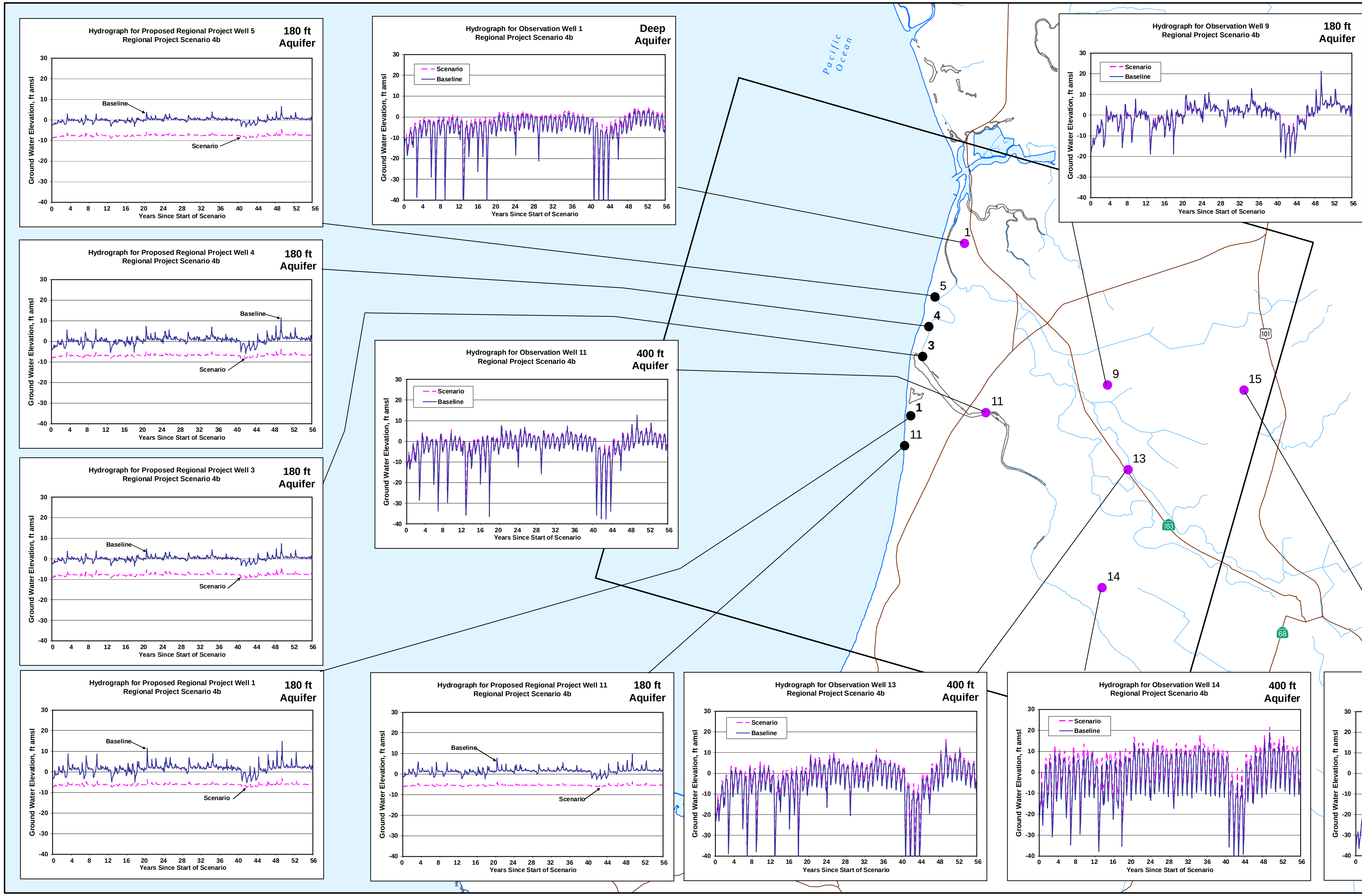
Figure 21

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_21_4a_reg_proj_180ft_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

REGIONAL PROJECT SCENARIO 4b HYDROGRAPHS



EXPLANATION

Well Hydrograph Locations

- Monterey Regional Project Well
- WRIME Calibration Well
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

NORTH

0 2 4 Miles

Map Projection:
State Plane 1983, California Zone IV

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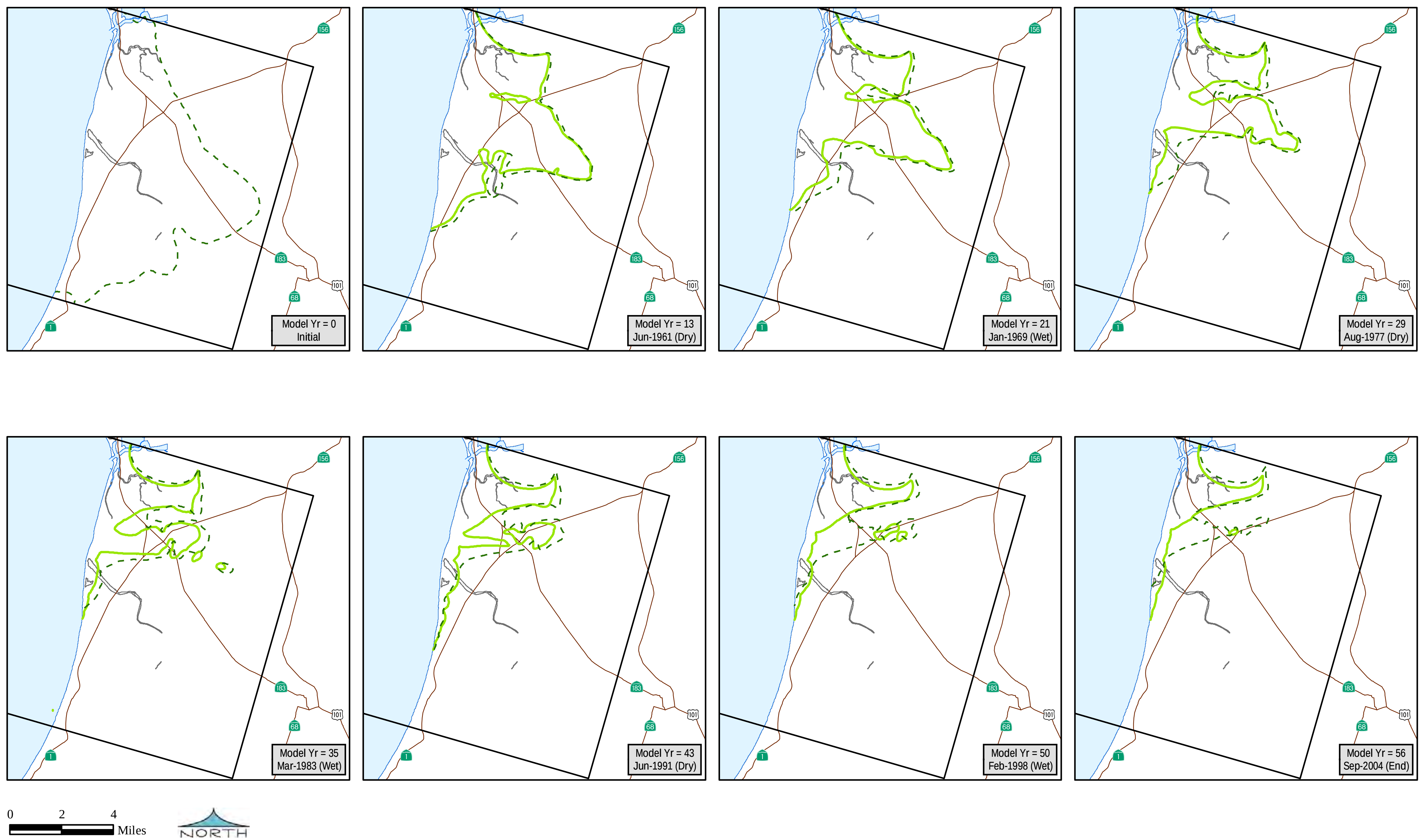
Figure 22

GIS_proj/cal_am_north_marina_modeling_9-08//0_Fig_22_4a_reg_proj_Hydrographs_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS

180-FOOT AQUIFER BASELINE vs. REGIONAL PROJECT SCENARIO 4b SEAWATER INTRUSION



EXPLANATION

GEOSCIENCE Groundwater Model Boundary

Baseline Seawater Intrusion Chloride = 500 mg/L

Regional Project Scenario Seawater Instrusion, Chloride = 500 mg/L

Highway

Model Yr = 13 Jun-1961 (Dry) — Predictive Model Year* Hydrologic Year

* Years Since Start of Model Scenario

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

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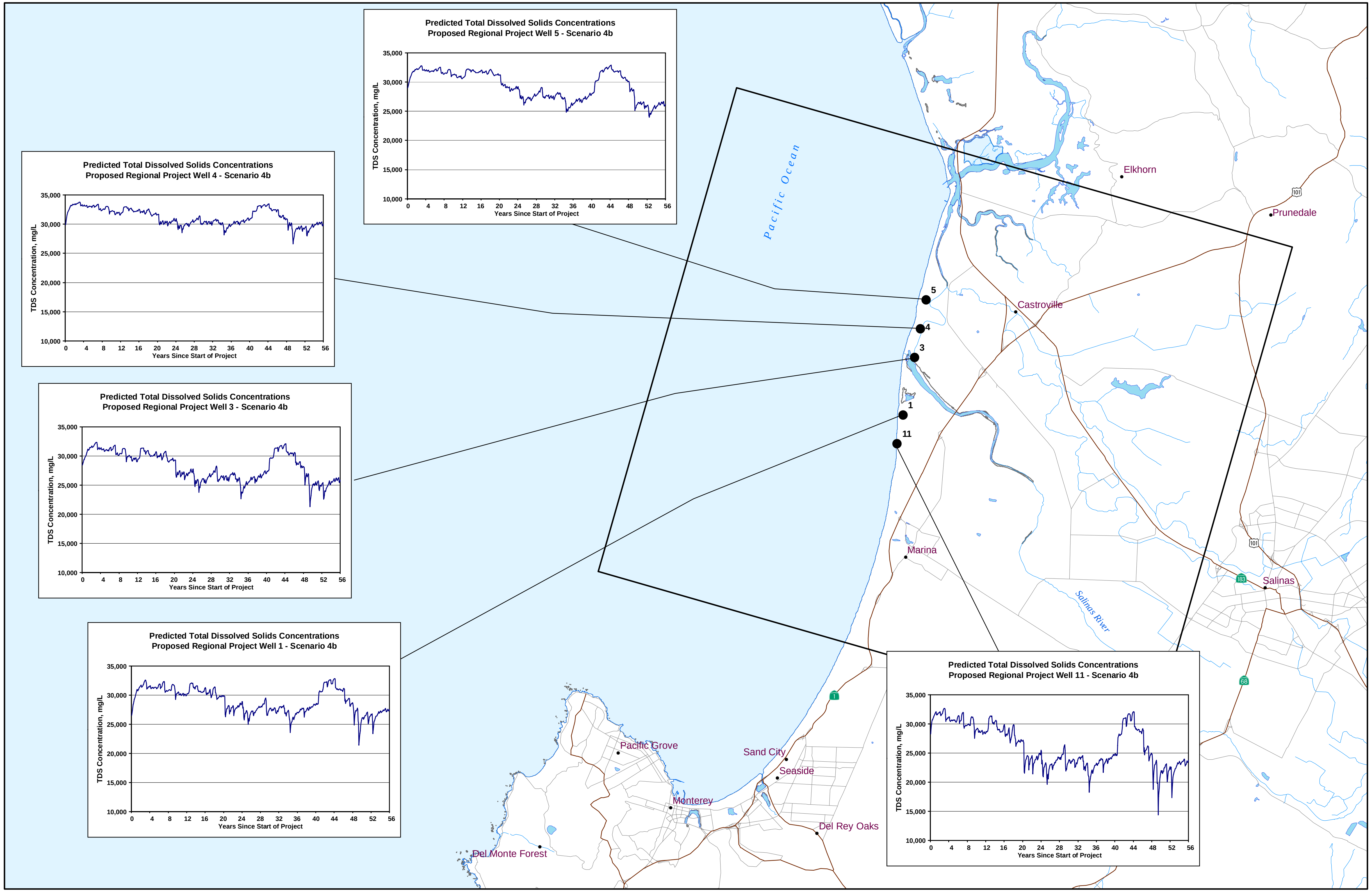
Figure 23

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_3_4a_reg_proj_180ft_SWI_9-08.mxd

CALIFORNIA AMERICAN WATER

NORTH MARINA GROUNDWATER MODEL
EVALUATION OF POTENTIAL PROJECTS



PREDICTED TDS CONCENTRATIONS FROM REGIONAL PROJECT SCENARIO 4b EXTRACTION WELLS

EXPLANATION

- Monterey Regional Project Well
- GEOSCIENCE Groundwater Model Boundary
- Highway
- Major Roads
- Rivers and Creeks

26-Sep-08

Prepared by: DWB

Map Projection:
State Plane 1983, California Zone IV

NORTH
0 2 4 Miles

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Figure 24

GIS_proj/cal_am_north_marina_modeling_9-08/0_Fig_24_TDS_graphs_regional_9-08.mxd

APPENDIX E: LATE COMMENT LETTERS RECEIVED

LAW OFFICES OF
MICHAEL W. STAMP

Michael W. Stamp
Molly Erickson
Olga Mikheeva
Jennifer McNary

479 Pacific Street, Suite One
Monterey, California 93940

Telephone (831) 373-1214
Facsimile (831) 373-0242

LATE COMMENT

June 10, 2013

RECEIVED
6-10-13
SWRCB Clerk

Felicia Marcus, Chair and Members of the Board
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Subject: June 4, 2013 Board Meeting/Hearing/Workshop
Item 7 – Workshop on revised draft report to CPUC on Cal Am's Desalination Project

Dear Chair Marcus and Members of the Board:

This Office represents Ag Land Trust. This letter follows up on my oral comments to you at your June 4, 2013 Board meeting held in Monterey. This letter addresses the lack of reliability of the Environmental Impact Report (EIR) for the Regional Desalination Project. We urge the State Board to reject the Board staff document that relies on information in that EIR.

<u>Board Staff Statements at June 4, 2013 Board Meeting</u>

At the Board meeting, Board staff presented Agenda Item 7, a workshop on Board staff's "revised Draft Report that examines the legal and technical considerations" associated with Cal Am's new desalination project proposal. In the oral introduction, Board staff stated[1] as follows:

> As to the sources of information used to prepare our report, Board staff used the most available information that was out there. We did rely on the EIR for the proposed Regional Desal Plant. I know that EIR was challenged in court, but it was only challenged on legal aspects of the EIR, not from a technical standpoint. So we used the technical aspects of the EIR to prepare our report.

The Board staff's statement that the challenge to the EIR was "only" on "legal aspects" and not "technical" issues is not accurate. Also, the Board staff's confusing separation of the EIR problems into "legal aspects" and "technical aspects" is not helpful. The Board staff also did not state whether, in its opinion, water rights are a legal issue or technical issue. Ag Land Trust believes that the water rights analysis in this case should involve legal and technical considerations.

---

[1] Rough transcription prepared by our Office. The official recording is not yet available.

Ag Land Trust's position is that any reliance on the Regional Desalination Project EIR is inappropriate, and that reliance on the EIR would undermine the factual disclosure purposes and legislative intent of CEQA. With regard to the challenge to the EIR, we provide a brief overview here, to assist the Board.

The Litigation Challenged the EIR on Seven Substantive Grounds

In April 2010, Ag Land Trust challenged the Marina Coast Water District's Regional Desalination Project approvals made in reliance on the Regional Desalination Project EIR. The lawsuit resulted in an April 2012 judgment by the Monterey County Superior Court in favor of Ag Land Trust. That judgment has been appealed. The appeal is pending before the Sixth District Court of Appeal.

In the California Environmental Quality Act (CEQA) litigation, Ag Land Trust argued that the EIR was legally insufficient due to substantive errors in seven broad categories. We very briefly and generally summarize Ag Land Trust's arguments.

1. Water Rights. The EIR failed to identify water rights for the feedwater that would supply the desalination plant. The Draft EIR did not address water rights. The Salinas Valley Water Coalition asked "Under what water right, and whose, will groundwater be pumped and surface water diverted? On what basis?" (FEIR, comment G-SVWC-10 [no FEIR page number].) The FEIR response was: "[W]ater rights are not considered an environmental issue." (FEIR, p. 14.5-198.)

2. Assumptions about Groundwater Pumping. The EIR relied on a groundwater model that assumed 56 years of constant pumping of the coastal feedwater wells, which led to the EIR's conclusion that the pumping would create a groundwater "trough" that would prevent seawater intrusion. This assumption is not realistic because of the known operational problems of desalination plants and coastal wells. Relying on the model, the EIR claimed that the project's coastal pumping would halt seawater intrusion. That claim is inconsistent with purposes behind the Monterey County prohibitions on pumping from the coastal 180-foot aquifer, which were enacted to halt seawater intrusion.

3. Violations of the Monterey County Water Resources Agency Act. The Act prohibits exportation of groundwater from the Salinas Valley Groundwater Basin. The EIR assumed that the feedwater for the desalination plant would be 80% seawater and 20% fresh water. This assumption was inconsistent with an EIR appendix that stated that over time the seawater portion would fall to 60% and the

fresh water – from the Salinas Valley Groundwater Basin – would grow to 40%, which was double the EIR's assumption of 20%.

4. Impacts of Brine. After the Final EIR was released, and before the Regional Project was approved, the Monterey Regional Water Pollution Control Agency received a report that said that the brine would cause increased corrosion of the existing outfall pipeline that would significantly decrease the expected life of the pipeline. A separate problem is that the outfall pipeline does not have available capacity during peak periods. Neither issue was addressed adequately in the EIR.

5. Impacts to Overlying and Adjacent Properties. Ag Land Trust and other overlying agricultural and residential owners of water rights would be harmed by the exacerbation of seawater intrusion that the EIR assumed would take place around the intake wells.

6. Degradation of Groundwater Quality under the SWRCB's Anti-Degradation Policy. The operation of the intake wells would degrade the groundwater in the area, including the North County water supply that is protected by the Local Coastal Plan certified by the California Coastal Commission.

7. Mandatory Contingency Plan. Monterey County requires a desalination plant to have a contingency plan to provide an alternate water supply. The EIR did not address or identify the requirement for a contingency plan. Ag Land Trust later discovered documentation that the contingency plan was to pump water from the overdrafted Carmel River and the adjudicated Seaside Basin – the very harm that the desalination plant was intended to avoid.

It cannot be disputed that these are serious technical issues. This list demonstrates that it is inaccurate for Board staff to claim that the EIR was challenged only on legal aspects, not on technical aspects.

Ag Land Trust provided the Superior Court judgement to the Board staff as Exhibit C to Ag Land Trust's May 3, 2013 comments on the Board staff's draft report. Ag Land Trust's letter is at pages 118 to 191 of the 262-page "Draft Final Review of California American Water Company's Monterey Peninsula Water Supply Project," dated May 22, 2013.

The Superior Court determined that the EIR was inadequate in its analysis of water rights (April 17, 2012 Judgment, Ex. B, at pp. 29-30), and that "As the lead agency, Marina Coast will need to address this prejudicial abuse of discretion including, but not limited to, 1) water rights; 2) contingency plan; 3) the assumption of constant pumping; 4) the exportation of groundwater from the Salinas Valley Groundwater Basin; 5) brine impacts on the outfall; 6) impacts on overlying [and] adjacent properties; and 7) water quality." (*Id.* at p. 30.)

Ag Land Trust's challenge to the EIR included one critical procedural issue, which was the issue of proper lead agency. The Superior Court determined that Marina Coast Water District was the proper lead agency for Marina Coast's approvals, not the CPUC. (*Id.* at p. 19.)

Under CEQA, when an EIR is prepared by the wrong lead agency, if the Court finds one or more significant and prejudicial defect in the EIR, the Court is to reject the EIR. (*Planning and Conservation League v. Department of Water Resources* (2000) 83 Cal.App.4th 892, 920.) In view of the Court's conclusion that a different agency must serve as lead agency under CEQA and that the EIR was defective in at least one significant and prejudicial aspect, the Court held that the proper lead agency may choose to address issues differently than the way those issues had been addressed in the EIR prepared by the wrong lead agency. (*Ibid.*) Once a Court has determined that a new EIR should be prepared by the proper lead agency, the Court "need not address the other alleged deficiencies" in the EIR. (*Ibid.*) In other words, ordering the correct lead agency to prepare a new EIR gives a fresh start to the EIR efforts.

Ag Land Trust Is Using Groundwater For Beneficial Uses

Ag Land Trust's position is that the Regional Desalination Project EIR did not adequately consider the issue of groundwater use by adjacent landowners. Ag Land Trust raised this issue prior to and during the EIR process. No adjacent land owners were contacted by the EIR preparers in spite of the objections.

Cal Am currently proposes to place its desalination intake wells on the coastal CEMEX site north of Marina. Ag Land Trust owns prime agricultural property adjacent to the CEMEX site. The Ag Land Trust property is in active agricultural production. Ag Land Trust is using its groundwater for beneficial uses. Ag Land Trust is irrigating native plants onsite as part of its dune restoration program. Ag Land Trust's position is that pumping by Cal Am's wells would harm the groundwater quality and would cause the unlawful contamination of the coastal aquifers, which would result in an unlawful taking of Ag Land Trust's groundwater resources.

Request

The Board should not rely on the Regional Desalination Project EIR for any purpose. The EIR analysis is not "the best information available," contrary to the claim of State Water Board staff ("Draft final review of California American Water Company's Monterey Peninsula Water Supply Project," dated May 22, 2013, p. 53).

If the Board chooses to provide a report to the CPUC on water rights, the Board should direct Board staff to rewrite the draft report without any reliance on the EIR, and recirculate the revised document for public comment.

If the Board decides to allow the Board staff to rely on the EIR, the Board should instruct staff to (1) annotate the draft report by identifying the specific language of the EIR that Board staff relied on, and (2) recirculate the annotated document for public comment.

Thank you.

Very truly yours,

LAW OFFICES OF MICHAEL W. STAMP

Molly Erickson

cc: Thomas Howard, Executive Director

Public Comment
MPWSP Draft Report
Deadline: 5/3/13 by 12 noon

The Otter Project
www.otterproject.org

LATE COMMENT

RECEIVED
5-30-13
SWRCB Clerk

P.O. Box 269
Monterey, CA 93942
831/663-9460

May 30, 2013

State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Re: 6/4/13 BOARD MEETING, Agenda Item 7, WORKSHOP ON STATE WATER BOARD REVISED DRAFT REPORT THAT EXAMINES THE LEGAL AND TECHNICAL CONSIDERATIONS ASSOCIATED WITH CALIFORNIA AMERICAN WATER COMPANY'S PROPOSAL TO EXTRACT DESALINATION FEEDWATER FOR THE MONTEREY PENINSULA WATER SUPPLY PROJECT

Dear Board Members and Staff:

Thank you for the opportunity to provide information and comment on this important item. The following comments are made on behalf of The Otter Project and our water quality program Monterey Coastkeeper and our 3000 members. I want to acknowledge that the official comment period for this item has closed and that this information is meant to add detail to my comments that will be made June 4th.

The information sheet for this item states: "Cal-Am must show any desalinated water it produces is developed water that is surplus to the current uses in the Basin." The Salinas Valley is perhaps the most poorly managed surface and groundwater basin in the State of California. The lack of water in the basin is not because of water scarcity, it is because of the unrestrained thirst of agriculture in the basin and because agricultural use so pollutes the water that it becomes unavailable for reuse without expensive treatment.

The Salinas Basin is one of the first places in California where over-extraction and desalination were documented. As early as the 1930's Salinas Valley farmers were forced to drill deeper to find potable water because of salt water intrusion. A commissioned State Department of Health Study, published as Bulletin 52 in 1946, recommended a series of measures to slow and eventually eliminate the intrusion. One outcome was a legislative act that created a management agency, the Monterey Flood Control and Water Conservation District, endowed with "special" powers to control saltwater intrusion. The Monterey Flood Control and Water Conservation District became the Monterey County Water Resources Agency (MCWRA) of today. MCWRA has created a labyrinth of engineered water supply projects including:

- Nacimiento Dam and Lake built in 1961;
- San Antonio Dam and Lake built in 1965;
- The Salinas Valley Water Project including an inflatable dam and water diversion on the Salinas River completed in 2010.

The intent of these projects to halt and reverse sea water intrusion has not been realized. As shown in Attachment One, sea water intrusion continues to creep inland and one front of intrusion is now 11 miles inland and nearly underlying the City of Salinas (Attachment One).

Salinas Valley agriculture and MCWRA have touted and documented apparent progress in water conservation including efforts to reduce flood and furrow irrigation and encourage drip. With all this additional water supply and water conservation, why has sea water intrusion not been reversed?

The answers are threefold:

1. The move to drip reflects crop type and not water conservation. The lower Valley now grows water loving strawberries and the upper valley now grows grapes, both irrigated with drip.
2. MCWRA's focus has drifted away from water quality and flood control to simply a water supply agency.
3. The shift towards water supply has resulted in MCWRA ignoring its regulatory abilities and mandate to constrain water extraction as a means to reverse saltwater intrusion.

Despite all of the touted and documented water "savings" resulting from the shift from furrow to drip irrigation the net water use by agriculture has remained essentially the same over the past decade (see Attachment Two – Monterey County Water Extraction).

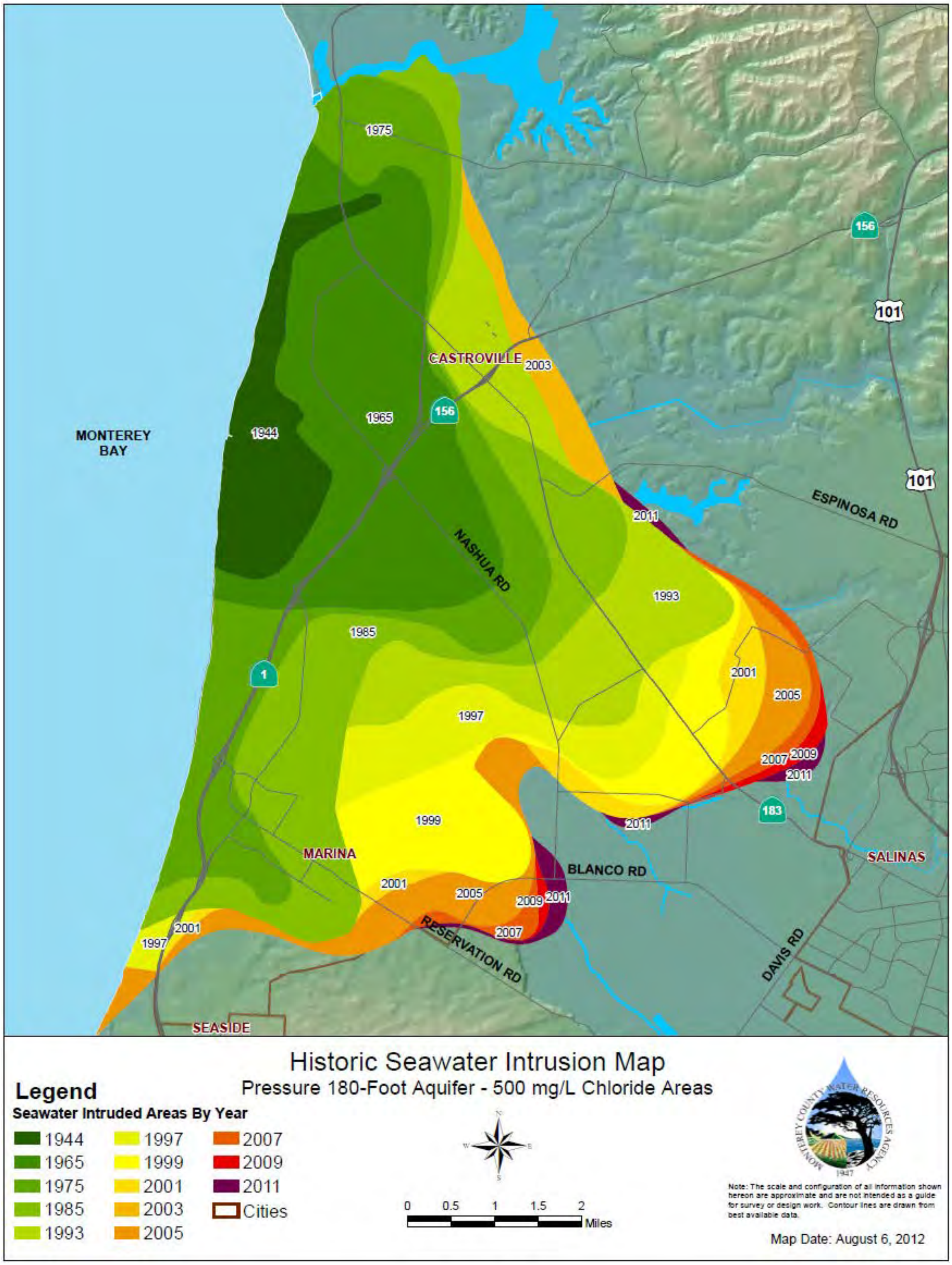
Water supply to solve seawater intrusion, environmental degradation, and the water supply problems of the Monterey Peninsula are dependent on agriculture showing restraint and MCWRA embracing its mandate to solve water quality (and flooding) problems instead of simple supplying more and more water to agricultures unquenchable thirst.

Sincerely,

Steve Shimek
Chief Executive

Attachments (2)

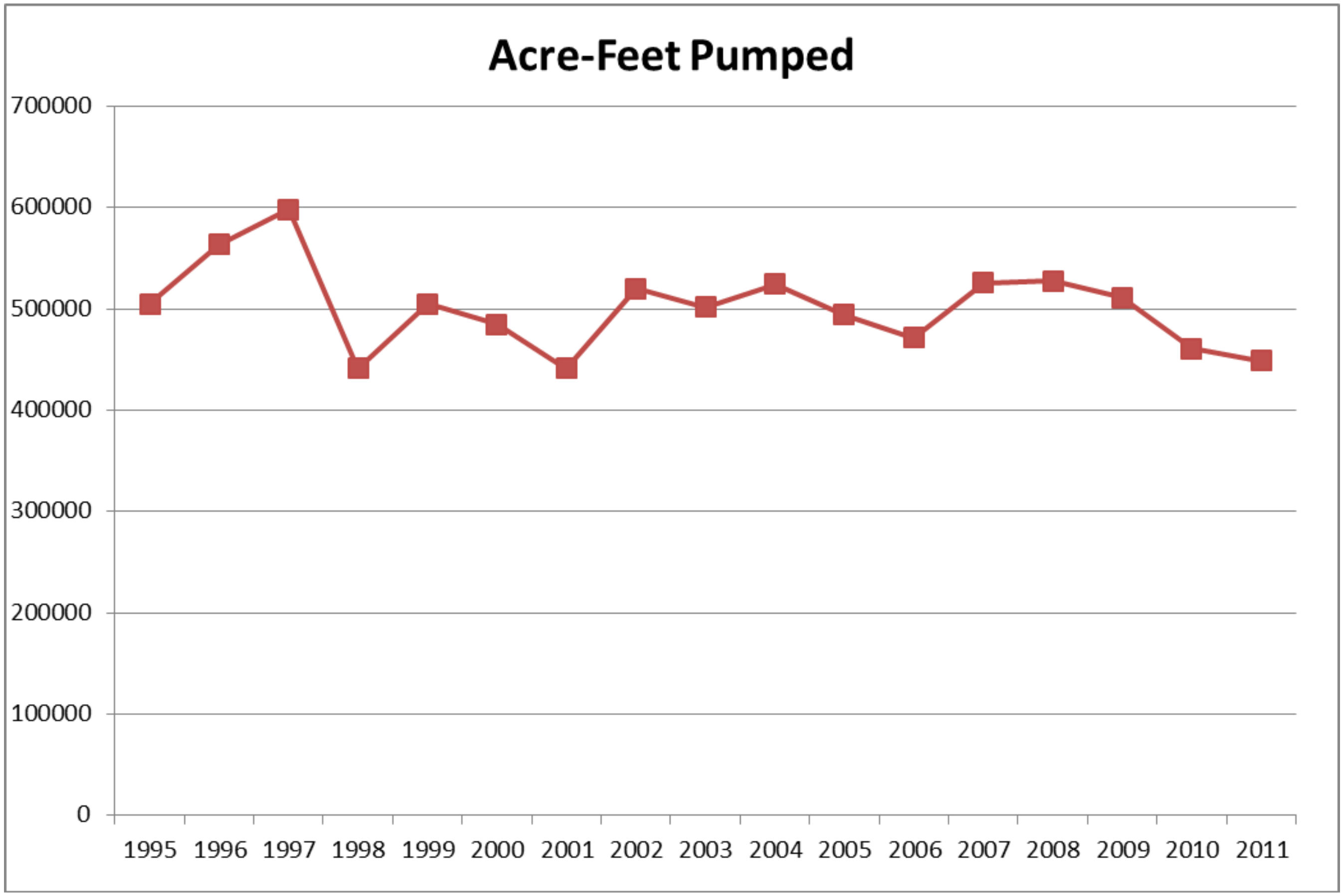
Attachment One



Attachment Two – Monterey County Groundwater Extraction

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total Water Pumped	504512	563438	598139	441048	504567	484354	441276	520202	501336
Ag Percentage	91.7	92.4	92.3	90.6	92	91.3	91.5	91	90
Urban Percentage	8.3	7.6	7.7	9.4	8	8.7	8.5	9	10

Year	2004	2005	2006	2007	2008	2009	2010	2011
Total Water Pumped	524114	494046	471240	525595	527171	511224	460443	448584
Ag Percentage	89.9	89.8	89.5	90.4	90.5	91.1	90.4	90.1
Urban Percentage	10.1	10.2	10.5	9.6	9.5	8.9	9.6	9.9



APPENDIX C1

Coastal Water Elevations and Sea Level Rise Scenarios

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memorandum

date April 2, 2013

to Michael Burns, ESA

from Doug George, ESA PWA

subject Monterey Peninsula Water Supply Project: Coastal Water Elevations and Sea Level Rise Scenarios

Introduction

The purpose of this memo is to provide a set of coastal water elevations under three sea level rise scenarios that the Monterey Peninsula Water Supply Project study will use for modeling groundwater. The scenarios are summarized in Table 1 and the application of these scenarios is presented below.

Table 1: Sea Level Rise Scenarios

Scenario #	Scenario Name	Sea Level Rise	Additional Assumptions in Scenario
1	Average of Models, High	65.5 in by 2100	Existing wave conditions & continued CEMEX sand mining
2	Projection	36.2 in by 2100	Existing wave conditions & continued CEMEX sand mining
3	Average of Models, Low	16.7 in by 2100	Existing wave conditions & continued CEMEX sand mining

The work described in this memorandum was completed by Doug George, Elena Vandebroek, Louis White and David Revell, PhD, with oversight by Bob Battalio, PE.

Sea Level Rise

Climate change is likely to result in increases in temperature with associated changes in precipitation, more extreme storm events, including rainfall intensity and droughts, as well as increases in sea level and other consequences. Rising sea levels associated with global warming result from both thermal expansion of water (e.g. warmer water occupies more volume) and increasing ice melt. This sea level rise is expected to contribute to an increase in the severity and duration of flooding and an acceleration of shoreline erosion.

Existing Sea Level Trends

Local rates of sea level rise can be estimated as a result of two components – a regional rate of sea level rise associated with the nominal global rate of sea level rise and a local component controlled by local or regional processes, such as tectonics, subsidence and changes to local wind fields. The combination of these two components lead to a rate of relative sea level rise as it combines changes in the both the sea and land elevations. If sea level rises and the shoreline rises or subsides, the relative rise in sea level could be lesser or greater than the global sea level rise. Vertical land movement can occur due to tectonics (earthquakes, regional subsidence or uplift), sediment compaction, isostatic readjustment and groundwater depletion (USACE, 2011).

The Monterey tide gage has a 30-year long period of record and a mean historic local sea level trend of 5.3 inches per century ± 5.3 inches per century (Table 2) (NOAA 2009).

Table 2: Existing Sea Level Trends

Source	Location	Period of Record	Local Mean Sea Level Trend	Est. Vertical Land Movement
IPCC, 2007	Global	1961 - 2003	7.1 inches per century	N/A
NOAA, 2009 & Gill, 2011	Monterey tide gage	1973 - 2006	5.3 ± 5.3 inches per century	1.3 inches per century
NRC, 2012 Table 4.6	San Francisco	1930 - 1980	7.1 – 7.6 inches per century	
NRC, 2012 Table 5.3	San Andreas Region			-6 ± 5 inches per century

Note: Positive values indicate upward movement.

Table 2 reports the vertical land movement as estimated using a recently developed NOAA methodology (Gill, 2011) and as published in a recent National Research Council (NRC) report (NRC, 2012). Rates of estimated vertical land movement vary depending on the study, showing a difference in both magnitude and direction. The NRC rate is a rough estimate that doesn't take into account localized variations in vertical land motion due to shallow subsidence and local tectonic movement. Accurate, long-term trends in vertical land motion are difficult to obtain for specific sites. However, as rates of global sea level continue to increase with climate change, at some point, the rate of vertical land movement will become less significant in determining the impact of sea level rise.

Future Projections and Guidance on Sea Level Rise

In March 2011, the OPC published a resolution recommending that state agencies incorporate the risks posed by sea level rise into project and program plans (OPC, 2011). The resolution was targeted towards state agencies and non-state entities implementing projects or programs funded by the state or on state property (OPC, 2011). The OPC (2011) provides the following guidance on which SLR projections to use:

- Assess vulnerabilities over a range of SLR projections, including analysis of the highest SLR values presented in the state guidance document;
- Avoid making decisions based on SLR projections that would result in high risk; and
- Coordinate and use the same SLR projections when working on the same project or program.

The State of California provided interim guidance via the OPC on SLR projections and requested that the NRC establish a committee to assess sea-level rise to inform the state efforts. The states of Washington and Oregon, the U.S. Army Corps of Engineers, the National Oceanic and Atmospheric Administration, and the U.S. Geological Survey subsequently joined California in sponsoring the NRC study to evaluate sea-level rise in the global oceans and along the coasts of California, Oregon, and Washington for 2030, 2050, and 2100. The NRC released their final report in June 2012 and in March 2013, the OPC revised the interim guidance to incorporate the report findings (OPC, 2013).

In the NRC recently released results, regional sea level rise (which includes an allowance for vertical land motion) for San Francisco (the regional estimate nearest to Monterey Bay) is predicted to be 4.8 to 24.0 inches by 2050 and 16.7 to 65.5 inches by 2100 relative to 2000 (Table 3). The San Francisco projection incorporates a 5.9 inches/century rate of subsidence.

Table 3: San Francisco Sea-Level Rise Projections (in inches) Relative to Year 2000 (from Table 5.3, NRC 2012)

2030		2050		2100	
Projection	Range	Projection	Range	Projection	Range
5.7 ± 2.0	1.7 to 11.7	11.0 ± 3.6	4.8 to 24.0	36.2 ± 10.0	16.7 to 65.5

Note: NRC 2012 projections include a vertical subsidence of 5.9 ± 5.1 inches/century.

Coastal Water Elevations

Groundwater modeling for the MPWSP requires considering the influence of additional seawater volume above the aquifer. A curve was fit to the four data points provided in the NRC 2012 report (2030, 2050, 2070, 2100) for each scenario to generate an annual time series of sea level rise between 2012 to 2073. The values were normalized to 2012 by subtracting the projected sea level rise at 2012 from all annual sea level rise values (Figure 1). Table 4 contains annual sea level rise projections for each scenario.

Figure 1. Monterey Bay Sea Level Rise Curves for 2012 to 2073.

Note: The values are normalized to 2012 after subtracting the change in sea level from 2000-2012.

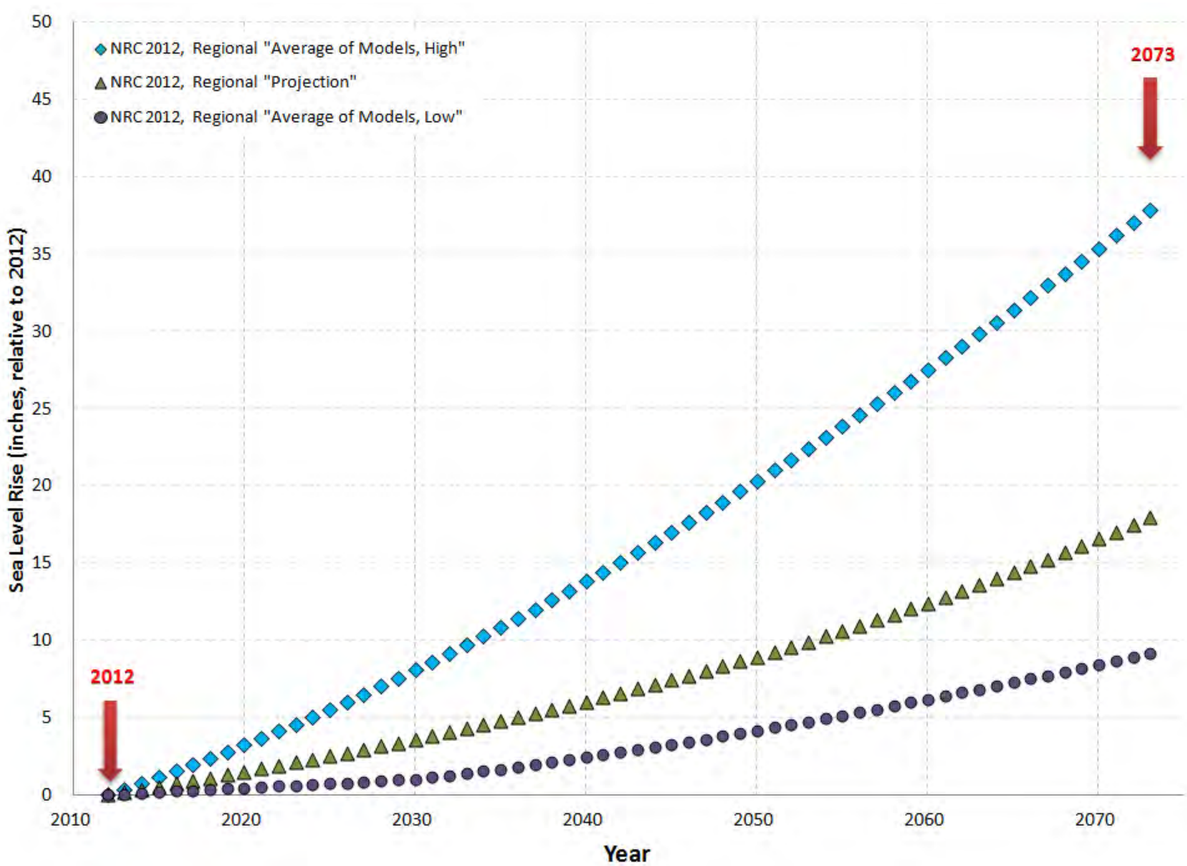

Table 4: Projected Annual Sea Level Rise for Monterey Bay

Year	Sea Level Rise Relative to 2012 (inches)			Incremental Sea Level Rise (inches)		
	High Range of Models	Projection	Low Range of Models	High Range of Models	Projection	Low Range of Models
2012	0.0	0.0	0.0	--	--	--
2013	0.4	0.2	0.1	0.368	0.181	0.056
2014	0.7	0.4	0.1	0.378	0.182	0.056
2015	1.1	0.5	0.2	0.388	0.184	0.056
2016	1.5	0.7	0.2	0.398	0.186	0.056
2017	1.9	0.9	0.3	0.407	0.188	0.056
2018	2.4	1.1	0.3	0.417	0.190	0.056
2019	2.8	1.3	0.4	0.427	0.192	0.056
2020	3.2	1.5	0.5	0.436	0.195	0.056
2021	3.7	1.7	0.5	0.446	0.197	0.056
2022	4.1	1.9	0.6	0.455	0.200	0.056
2023	4.6	2.1	0.6	0.464	0.202	0.056
2024	5.1	2.3	0.7	0.473	0.205	0.056
2025	5.5	2.5	0.7	0.482	0.208	0.056
2026	6.0	2.7	0.8	0.491	0.211	0.056
2027	6.5	2.9	0.8	0.500	0.214	0.056
2028	7.0	3.2	0.9	0.509	0.217	0.056
2029	7.6	3.4	1.0	0.518	0.220	0.056
2030	8.1	3.6	1.0	0.527	0.224	0.056
2031	8.6	3.8	1.1	0.535	0.227	0.124
2032	9.2	4.1	1.3	0.544	0.231	0.128
2033	9.7	4.3	1.4	0.552	0.235	0.132
2034	10.3	4.5	1.5	0.561	0.238	0.136
2035	10.8	4.8	1.7	0.569	0.242	0.139
2036	11.4	5.0	1.8	0.577	0.246	0.143
2037	12.0	5.3	2.0	0.586	0.251	0.146
2038	12.6	5.5	2.1	0.594	0.255	0.150
2039	13.2	5.8	2.3	0.602	0.259	0.153
2040	13.8	6.0	2.4	0.610	0.264	0.157
2041	14.4	6.3	2.6	0.617	0.268	0.160
2042	15.1	6.6	2.7	0.625	0.273	0.163
2043	15.7	6.9	2.9	0.633	0.278	0.167
2044	16.3	7.1	3.1	0.640	0.283	0.170
2045	17.0	7.4	3.3	0.648	0.288	0.173
2046	17.6	7.7	3.4	0.655	0.293	0.176
2047	18.3	8.0	3.6	0.663	0.298	0.179
2048	19.0	8.3	3.8	0.670	0.303	0.182
2049	19.6	8.6	4.0	0.677	0.309	0.185
2050	20.3	8.9	4.2	0.684	0.314	0.188
2051	21.0	9.3	4.4	0.692	0.320	0.190
2052	21.7	9.6	4.5	0.699	0.326	0.193

2053	22.4	9.9	4.7	0.705	0.332	0.196
2054	23.1	10.3	4.9	0.712	0.338	0.199
2055	23.9	10.6	5.1	0.719	0.344	0.201
2056	24.6	11.0	5.3	0.726	0.350	0.204
2057	25.3	11.3	5.6	0.732	0.356	0.206
2058	26.1	11.7	5.8	0.739	0.363	0.209
2059	26.8	12.0	6.0	0.745	0.369	0.211
2060	27.5	12.4	6.2	0.751	0.376	0.213
2061	28.3	12.8	6.4	0.758	0.382	0.216
2062	29.1	13.2	6.6	0.764	0.389	0.218
2063	29.8	13.6	6.8	0.770	0.396	0.220
2064	30.6	14.0	7.1	0.776	0.403	0.222
2065	31.4	14.4	7.3	0.782	0.410	0.224
2066	32.2	14.8	7.5	0.788	0.418	0.226
2067	33.0	15.2	7.7	0.794	0.425	0.228
2068	33.8	15.7	8.0	0.799	0.432	0.230
2069	34.6	16.1	8.2	0.805	0.440	0.232
2070	35.4	16.6	8.4	0.811	0.448	0.234
2071	36.2	17.0	8.7	0.816	0.456	0.235
2072	37.0	17.5	8.9	0.821	0.463	0.237
2073	37.9	18.0	9.1	0.827	0.471	0.239

Additional Information

The uncertainty in these projections is large (NRC, 2012) and the probability of a particular sea level rise occurring at a particular date is not known (USACE, 2011). Hence, each project design should consider the risk of sea level changes to the project and environment, with risk typically considered the product of the likelihood of an impact and the consequences of that impact (NRC, 2012). Other work by Flick and others (2003) have suggested that tidal ranges are increasing with sea level rise. In particular, the increase of the high tides was observed to be larger than that of the mean and low tides, which has implications for setting the mean higher high water (MHHW) line in the future. In addition, the values provided above do not address any local vertical land motion that could affect the relative sea level rise at the site. Subsidence or settlement of the land will increase relative sea level rise. Such local vertical land lowering can be induced by consolidation of subsurface soils due to groundwater extraction and additional vertical loads such as fill. Vertical land motions can be estimated based on elevation surveys of benchmarks over time. The data in Table 4 implicitly assume that vertical land motions at the project site(s) are small relative to the values of future sea level rise and uncertainty but evaluation of vertical land motions is beyond the scope of the work performed. Also, these computations do not include wave-driven dynamics and coastal geomorphic responses which may affect ground water levels.

Attachment

SLRScenarios_data_final.xls - Table 4: Projected Annual Sea Level Rise for Monterey Bay

References

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APPENDIX C2

Analysis of Historic and Future Coastal Erosion with Sea Level Rise

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Memorandum

date July 21, 2016

to Insert to Appendix C2, Draft Environmental Impact Report/Environmental Impact Statement

from Project Team

subject Use of Coastal Erosion Technical Memorandum Titled:
Analysis of Historic and Future Coastal Erosion with Sea Level Rise dated March 19, 2014

In support of the April 2015 Draft Environmental Impact Report (EIR) for the Monterey Peninsula Water Supply Project (MPWSP), ESA analyzed sea level rise and coastal erosion for the Monterey Bay coastline. The purpose was to describe coastal processes that could be relevant to assessing the environmental impacts of the MPWSP and its alternatives, and to identify potential damages to infrastructure from coastal erosion. The ESA report *Analysis of Historic and Future Coastal Erosion with Sea Level Rise*, dated March 19, 2014, was included in Appendix C2 of the 2015 Draft EIR. As discussed in the April 2015 Draft EIR, some of the project components would be affected by coastal erosion within the project lifetime and a mitigation measure was proposed to reduce the impact to less than significant.

Subsequently, the proposed action for the MPWSP was revised and is analyzed in this Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS). The proposed locations of some project components have been relocated. The results of the coastal erosion study are still applicable because the change in project component locations does not change the coastal erosion anticipated to occur in response to sea level rise. The updated locations of the proposed action components were compared to the anticipated extent of coastal erosion as shown on Figures 4.2-7 and 4.2-8, presented in Section 4.2, Geology, Soils, and Seismicity.

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memorandum

date March 19, 2014

to Michael Burns and Eric Zigas

from Elena Vandebroek, David Revell and Doug George

project Monterey Peninsula Water Supply Project (205335.01)

subject Analysis of Historic and Future Coastal Erosion with Sea Level Rise

1 Purpose and Scope

The Monterey Peninsula Water Supply Project (Project) proposes infrastructure that is located near or along the Monterey Bay coastline (Figure 1). Sea level is predicted to rise over the next century and could affect some of these project components. Coastal erosion, an ongoing issue in Southern Monterey Bay, is also expected to increase with accelerating sea level rise. The primary focus of this memo is to describe coastal processes that could be relevant to assessing the environmental impacts of the Project and the viability of Project alternatives, and to identify potential damages to Project infrastructure from coastal erosion. This memo is organized as follows:

Section 2 – Historic and existing erosion processes in Southern Monterey Bay
Section 3 – Future erosion in the face of accelerating sea level rise

2 Historic and Existing Erosion Processes

The following section summarizes the existing and historic processes affecting coastal erosion. These processes include Wave Climate and Storm Characteristics, Historic Shoreline Change Trends, Sand Mining, and Rip Embayments.

2.1 Wave Climate and Storm Characteristics

The coast of Monterey Bay is exposed to high energy waves throughout the year, with seasonal differences resulting in waves approaching from many directions. Wave data measured by offshore wave buoys show these seasonal and annual differences (Storlazzi and Wingfield 2005). The largest waves typically occur in the late fall and winter and are associated with wave generation in the Gulf of Alaska. These winter waves have long wave periods (12 to 14 seconds), large significant waves heights (~9 ft on average), and come from the northwest (310°) (Storlazzi and Wingfield 2005). In the spring, smaller wave heights and shorter wave periods result from strong northwest winds. In the summer, the coast is exposed to long period south swells. Point Piños partially shelters the coast from these waves, especially farther south in the bay, toward the City of Monterey. Estimates of recurrence intervals for large wave events can be statistically derived from a time series of wave data. For example, a 100-year wave event at the Monterey wave buoy (NDBC #46042) is projected to have an offshore significant wave height of 40 ft OR a dominant wave period of 32 seconds (Storlazzi and Wingfield 2005)[1]. This

[1] A swell period of 32 seconds is not expected to govern at the 100-year recurrence level because the associated wave height would be much smaller than the 100-year wave height of 40'. For this and a range of reasons beyond the scope of this memo, a shorter wave period would be associated with the governing 100-year swell.

means that every year, there is a 1% chance that waves will achieve the above combination of significant wave height and dominant period. Similar calculations can be made for more frequent storm events, such as 10-yr or 25-yr occurrences, which reflect the 10% and 4% annual probabilities respectively.

Large waves are not the only contributing factor to coastal erosion. A common indicator of coastal erosion is the *total water level*, which is the sum of tides, wave runup on the beach, and other atmospheric conditions which affect ocean water levels. When all of these constituents are added together, the resulting total water elevation provides a useful measure for projecting coastal erosion (Ruggiero et al 1996, Revell et al 2011). Historically, some of the most damaging wave erosion events have occurred during El Niño events, when wave directions shift more to the south and west and come less impeded into Monterey Bay. This more direct wave energy coupled with elevated ocean water levels (on the order of one foot[2]) can cause dramatic and often devastating erosion along the Monterey Bay coast.

The ideal situation to minimize damage to the desalination infrastructure is to avoid the dynamic beach environment, which will migrate inland over time from sea level rise. The storm waves discussed above drive the episodic erosion events that are typical in Monterey Bay, and periodically threaten existing development. Following these storm events, beaches can sometimes recover over a season or a few years. Other parts of the Bay are experiencing continuous erosion without full recovery, especially in southern Monterey Bay (see section 2.2).

2.2 Historic Shoreline Change Trends

It is essential to understand historic shoreline change trends in order to accurately project future erosion. Shoreline change data was compiled from a variety of sources and is summarized in Figure 2. This figure shows the locations of the MPWSP representative profiles shown on Figure 1 (discussed in detail later in this technical memorandum) and other landmarks relative to the historic accretion or erosion rates. Table 1 summarizes each of the datasets plotted in Figure 2. For the erosion analysis, we combined the updated shoreline change rates (#2) with the Thornton et al 2006 dune erosion rates (#1), where available. Thornton et al 2006 estimated recent erosion rates based on dune crest recession, which is a more robust estimate of erosion than shoreline change.

TABLE 1
EROSION RATE DATA SOURCES FOR SOUTHERN MONTEREY BAY

#	Dataset	Timespan	Notes
1	Thornton 2006, dune crest recession rate	1984 – 2002	This was the most detailed study available for erosion rates in the study area. Erosion was measured at 6 locations in Southern Monterey Bay. Erosion rates were interpolated between these measurements for this analysis.
2	Analysis by ESA for this study: short-term linear regression erosion rate calculated based on the 1933, 1998, and 2010 shorelines.	1932 – 2010	The 1932 and 1998 shorelines were obtained from Hapke et al 2006 and updated with a 2010 shoreline, extracted from a high resolution LiDAR DEM (NOAA 2012, collected in May/June 2010).
3	Hapke et al 2006, shoreline change rate	1945 – 1998	Not used in this analysis, included for context only.
4	Hapke et al 2007, soft bluff recession rate	1933 – 1998	Not used in this analysis, included for context only. This study was for the entire California coast, while Thornton 2006 focused on this study area.
5	Analysis by ESA for this study: long-term linear regression erosion rate calculated based on the 1852, 1933, 1998, and 2010 shorelines.	1852 – 2010	The 1852, 1932 and 1998 shorelines were obtained from Hapke et al 2006 and updated with a 2010 shoreline. Because sand mining, which started in 1906, plays such a large role in coastal erosion, these rates were not used in this analysis.

[2] Tide stations have recorded an increase in average winter water levels of about one foot during the strong 1982-3 and 1997-8 El Niños, and individual deviations above predicted tides of over 2’ during El Niño storms.

2.3 Sand Mining

The mining of sand can increase erosion rates, modify shoreline orientation, and change sand transport rates. Thornton et al (2006) suggests that the alongshore variation in dune recession rates is a function of wave energy and sand mining. Southern Monterey Bay has been mined intensively for sand for more than a century. Sand mining near the mouth of the Salinas River started in 1906, and expanded to six commercial sites: three at Marina and three at Sand City. Five of these operations closed by 1990, leaving the Pacific Lapis Plant in Marina (owned by CEMEX) as the only active sand mining operation.

2.4 Rip Embayments

Rip embayments have been correlated with dune erosion in Monterey Bay (Thornton et al, 2007). Also known as beach mega-cusps, rip embayments are localized narrowing and deepening of the beach. They are caused by the erosive action of cross-shore rip currents. The beach is the narrowest at the embayment, allowing swash and wave run-up to reach the toe of the dune and cause erosion during coincident high tides and storm wave events. In Monterey Bay, these embayments are on the order of 200 feet wide (alongshore and cross-shore), and occur at approximately 600-foot along-shore spacing intervals (MacMahan et al, 2006, Thornton et al, 2007). Rip currents are highly dynamic, migrating up to 12 feet per day (Thornton et al, 2007). Field observations of rip channels in Monterey Bay between Wharf II in Monterey and Sand City found that typical rip channels are 5 feet deeper than the adjacent beach face.

3 Projecting Future Erosion

Future erosion was analyzed at six locations along the study area (Figure 1) and assessed using two methods. The first was to look at the aerial extent of potential erosion. Coastal erosion hazard zones, which delineate areas potentially at risk from coastal erosion, are described and discussed in Section 3.1. The second method considers erosion on a vertical profile. Profiles were selected at locations of key infrastructure (Figure 1) and projected into the future. The methods and results of this analysis are described in Section 3.2.

3.1 Coastal Erosion Hazard Zones[3]

Coastal erosion hazard zones were developed using methods described in PWA 2009 and Revell et al 2011. A coastal erosion hazard zone represents an area where erosion (caused by coastal processes) has the potential to occur over a certain time period. This does not mean that the entire hazard zone is eroded away; rather, any area within this zone is at risk of damage due to erosion during a major storm event. Actual location of erosion during a particular storm depends on the unique characteristics of that storm (e.g. wave direction, surge, rainfall, and coincident tide). As sea level rises, higher mean sea level will make it possible for wave run-up to reach the dune more frequently, undercutting at the dune toe and causing increased erosion. This analysis used a sea level rise projection of 15 inches by 2040 and 28 inches by 2060, relative to 2010. These projections are based on a 2012 study by the National Research Council (NRC) which provided regional sea level rise estimates for San Francisco (the closest projection to the Project). The 2040 and 2060 values were derived by fitting a curve to the "Average of Models, High" projections for 2030, 2050, and 2100 published in the NRC study (NRC 2012).

[3] The coastal erosion hazard zones are being developed by ESA PWA as part of the ongoing Monterey Bay Sea Level Rise Vulnerability Study (anticipated completion in early 2014). The zones presented here are preliminary and are subject to change in the final maps delivered to the Monterey Bay Sanctuary Foundation (the client). However, particular attention was given to the Project focus locations. Therefore any final modifications are expected to be minimal at these locations.

Coastal Hazard Zone Model Development

The coastal hazard zones are developed from three components: historic erosion, additional erosion due to sea level rise, and the potential erosion impact caused by a large storm wave event (e.g. 100-year). The most important variables in the hazard zone model address these components (Table 2).

TABLE 2
COASTAL HAZARD ZONE MODEL COMPONENTS AND PRIMARY VARIABLES

Coastal Hazard Zone Component	Primary Variables
historic erosion	historic erosion trend
erosion due to sea level rise	backshore toe elevation, shoreface slope, sea level rise curve
erosion impact caused by a large storm wave event	storm total water level, beach slope, backshore toe elevation

This section gives a brief description of the erosion hazard zone methods. For more details about the methods please see the Pacific Institute study (PWA, 2009 and Revell et al, 2011).

The historic erosion rate is applied to the planning horizon (2010 through 2060 at 10 year increments) to get the baseline erosion, which is an indirect means to account for the sediment budget. Section 2.2 explains how historic erosion rates were selected for each location. The erosion model does not account for other shore management actions, such as sand placement, that could mitigate future shore recession. In this region, where beaches are controlled in part by sand mining, we assumed that there are no changes to existing sand mining practices.

The potential inland shoreline retreat caused by sea level rise and the impact from a large storm event was estimated using the geometric model of dune erosion originally proposed by Komar et al (1999) and applied with different slopes to make the model more applicable to sea level rise (Revell et al, 2011). This method is consistent with the FEMA Pacific Coast Flood Guidelines (FEMA, 2005). Potential erosion accounts for uncertainty in the duration of a future storm. Instead of predicting storm specific characteristics and response, this potential erosion projection assumes that the coast would erode or retreat to a maximum storm wave event regardless of duration. This is considered to be a “conservative” approach to estimating impact of a 100-year storm event because larger erosion estimates are produced.

Results

Figure 3 presents the coastal hazard zones, with detailed maps for each analysis location. These plan view maps do not represent the vertical extent of erosion, which is relevant to most of the proposed Project infrastructure which will be buried. As a result, the plan view maps indicated a more robust cross-shore profile analysis was needed to elucidate how Project infrastructure may be affected by coastal erosion.

3.2 Representative Coastal Profiles

The coastal profile analysis developed a set of representative profiles that show how the shoreline is likely to evolve from the present (2010) to 2040 and 2060, and the locations of selected Project components relative to those profiles. As previously discussed, the Monterey Bay shoreline is affected seasonally by localized erosion (rip currents), long term erosion, and sea level rise. Each of these factors is important in defining the horizontal and vertical elements of a profile shape and location through time. For this reason, we identify a projected future profile and an extremely eroded profile (lower envelope) for each future time horizon. The profiles contain both horizontal and vertical erosion. As described below, the future profile is the current profile eroded horizontally at the historic rate, with added erosion caused by sea level rise. The lower profile envelope represents a highly eroded condition, which could occur from a combination of localized erosion (rip currents), a large winter storm, and seasonal changes. The upper envelope (a highly accreted profile) was not analyzed because a key Project concern is the exposure of buried project components in the future.

Methods and Assumptions

Topographic and bathymetric data, summarized in Table 3, was compiled in the vicinity of the representative profiles specified by the ESA Project team (Figure 1). Three recent LiDAR profiles and one bathymetric survey were available. The locations of the Thornton representative profile envelopes (dataset #6 in Table 3), which were developed for a previous study (ESA PWA 2012), are located in the vicinity of the Project profiles at Sand City and to the east of Wharf II perpendicular to Del Monte Ave in Monterey.

TABLE 3
BATHYMETRY AND TOPOGRAPHY DATA USED TO DEVELOP REPRESENTATIVE PROFILES

#	Dataset	Date Collected	Elevation Limits (Approximate)	Source
1	Hydro-flattened bare earth digital elevation model (1 meter resolution)	May/June 2010	Minimum of ~0 ft NAVD	NOAA Digital Coast – CA Coastal Conservancy Coastal LiDAR Project
2	Bathymetry in offshore Monterey Bay (2 meter resolution)	Sept/Oct/Nov 2009	Maximum of -8 to -12 ft NAVD	California State University, Monterey Bay – Seafloor Mapping Lab
3	Bathymetry within Moss Landing Harbor (1 meter resolution)	June 2011	Maximum of -25 to -45 ft NAVD	California State University, Monterey Bay – Seafloor Mapping Lab
4	LiDAR topography (3 meter resolution)	April 1998 (post El Nino winter)	Minimum of ~0 ft NAVD	NOAA Digital Coast – Airborne LiDAR Assessment of Coastal Erosion Project (NOAA/NASA/USGS)
5	LiDAR topography (3 meter resolution)	Fall 1997 (pre El Nino winter)	Minimum of ~0 ft NAVD	NOAA Digital Coast – Airborne LiDAR Assessment of Coastal Erosion Project (NOAA/NASA/USGS)
6	Representative profiles and profile envelopes at Marina, Sand City, and Del Monte	Unknown – based on several surveys.	N/A	Published in ESA PWA 2012, originally Ed Thornton, unpublished data. Shown in Figure 4.

The raw profile data were processed as follows to develop a representative profile and a corresponding "highly eroded" profile for existing conditions:

1. A representative profile was created by combining the June 2010 LiDAR onshore with the 2009 fall California State University Monterey Bay (CSUMB) bathymetry offshore. The 2009 – 2010 winter was a minor El Nino year, resulting in a relatively eroded starting beach profile. A linear profile was interpolated between the offshore bathymetry and the terrestrial LiDAR. It is unlikely that the profile is linear, and more likely has a concave shape with one or more sand bars, depending on season and other factors. The surf and swash zone is highly dynamic and hence judgment is required to select a design profile. In this study, we account for this uncertainty in the eroded profile by using an envelope of possible shapes, based on perturbations from the estimated profile, as described in the following steps.
2. The Thornton envelopes (Figure 4) were horizontally aligned with the representative profiles using the backshore toe location as a reference feature, which is easily identified in all datasets. Since the profiles were not collected at exactly the same location and time as the representative profiles, some of profiles do not align as well in the upland areas. Since upland areas are much more static than the beach (the profile variability is much smaller), we do not focus on these areas in the profile evolution model, unless erosion through upland is expected.
3. As discussed above, rip currents can contribute to significant (~5 feet) lowering of the beach profile through the rip channel. The Thornton profiles were typically measured away from localized rip embayments. The profile envelope was adjusted to include uncertainty associated with rip channels by narrowing and

lowering the nearshore elevations. The beach berm was shifted shoreward by 50 feet or the distance between the berm crest and the dune toe (whichever was smaller), and the profile was lowered by 5 feet at MLLW. This adjustment assumes that the rip current would mainly impact the swash zone.

4. The profile envelope was lowered in any areas where the LiDAR or bathymetry data fell below the lower Thornton envelope. However, measured profile envelopes were unavailable for Profiles 1, 2, and 3. An envelope of shore profile elevation was created using Thornton's "Del Monte" profile (the most variable profile envelope located near Wharf II in Monterey). The vertical variability of the Del Monte profile was tabulated as a function of distance from shore, and then the elevations in Profiles 1, 2 and 3 were lowered accordingly.

Once a representative profile and lower profile envelope were identified for existing conditions, an equilibrium profile approach was used to shift the existing conditions profile and envelope based on projected erosion, which includes the historic erosion trend and future sea level rise (see Section 3.1). For profiles 1, 2, and 3, which show a historic trend in accretion, we include only the erosion due to sea level rise (setting the historic trend to 0). Detailed erosion rates were not available for these profiles, so erosion was calculated based on four shorelines (June 2010, April 1998, July 1952, and May 1933). The overall linear regression shows accretion, but the shorelines have fluctuated historically, and the most recent shoreline (spring 2010) is more eroded than the spring 1998 post-El Nino LiDAR. For this reason, we conservatively do not include the accretion signal.

The profiles were shifted horizontally inwards by the projected erosion and raised by the projected sea level rise. The existing dune elevations were held as maximums even though the profile shift would imply dune "growth" in some locations. The shifted profiles were truncated at the back beach location where the toe of dune starts. From this location, the profile was drawn sloping upward at the approximate angle of repose of loose sand, and truncated when the existing dune profile was intersected. The slope so drawn is an approximation of the eroded dune face extending from the beach to the top of the existing dune profile. An angle of 32 degrees was assumed for these locations (PWA, 2009). We did this because most of southern Monterey Bay shore is receding landward, erosion is cutting into relict dunes, and the steep dune faces and narrow beaches impede dune growth (Thornton et al 2006). Dune migration and other changes have not been modeled and dune elevations may change whether the shore is accreting or eroding due to changes in vegetation, other disturbance, etc. North of the Salinas River, the shore is accreting and dune growth appears to be occurring but accretion was neglected in these locations as well.

The lower profile envelopes do not necessarily encompass the full range of possible profile configurations. The profiles are not statistically defined or associated with a specific return interval. The profile construction did consider historic erosion, which includes a pre-El Nino shoreline and two post- El Nino shorelines, accelerated erosion from sea level rise, and an additional buffer factor associated with rip currents. The lower envelope for these profiles does not reflect potential dune erosion that could happen during a major (e.g. 100-year) storm event. This type of event could contribute as much as 100 feet of dune erosion. The representative profile may accrete or experience less erosion than projected, which would result in more sand covering the project components. This analysis is configured to provide estimates of the downward and inland extent of erosion, with the assumption that higher elevations are not a concern or are addressed by others.

Results

Figure 5 through Figure 11 show the existing (2010) and future (2040 and 2060) profiles and lower envelopes at each location. There are two profile/envelope combinations for each time step: one to represent long-term profile evolution (consisting of historic erosion and accelerated erosion from sea level rise) and a second that adds potential erosion from a 100-year erosion event, which could be as high as much as 125 feet, to the long-term profile.

Approximate locations and other descriptors of proposed Project infrastructure are shown on profiles where pipes or outfalls cross the profile. These data were provided by the applicant (California American Water Company) and are shown as a spatial reference to aid in the interpretation of the profiles. The geometry was not proposed by this study and may be revised based on this study and for other reasons beyond the scope of this document.

- At Moss Landing Harbor (Profile 1, Figure 5b), ongoing erosion is relatively low. The dune erosion envelopes extend inland 105 feet by 2060, with another 68 feet possible with a 100-year erosion event.
- Sandholdt Road (Profile 2, Figure 6). The dune erosion envelopes extend inland 105 feet by 2060, with another 65 feet possible with a 100-year erosion event.
- At Potrero Road (Profile 3, Figure 7). The dune erosion envelopes extend inland 120 feet by 2060, with another 30 feet possible with a 100-year erosion event.
- At the CEMEX Pacific Lapis sand mining plant (Profiles 4a and b, Figure 8 and Figure 9). The greatest uncertainty for these lies in the effects of sand mining, which are not explicitly addressed but may be implicitly addressed by the use of historic erosion rates. The dune erosion envelopes extend inland 300 feet by 2060, with another 130 feet possible with a 100-year erosion event.
- At Sand City (Profile 5, Figure 10). The dune erosion envelopes extend inland 180 feet by 2060, with another 40 feet possible with a 100-year erosion event.
- In the City of Monterey (Profile 6, Figure 11). The dune erosion envelopes extend inland 65 feet by 2060, with another 110 feet possible with a 100-year erosion event.

Assessment of methodology and accuracy of erosion envelopes

The methodology uses historic data and applied geomorphology methods generally consistent with coastal engineering and geology practice. There are sufficient data available to have confidence in the results. In general, we believe that the projections of potential erosion envelopes to be on the more conservative side and actual erosion may be less. The methodology addresses wave driven processes only, and assumes that historic changes are representative of future changes, and historic changes can be adjusted based on the rate of sea level rise. This analysis is consistent with our interpretation of the draft guidance recently published by the Coastal Commission[4]. It is important to note that actual sea level rise and the effects are not known, and that relatively high values were used in this study. Also, interventions may change shore recession.

Alternative estimates could be developed by computer-aided modeling of sand transport. For example, XBEACH and other available software can provide estimates of storm-induced profile erosion (USGS, 2009)[5]. Also, GENESIS and other available software can provide estimates of future shoreline positions[6]. Such further analysis may enhance the ability to assess the likelihood of shore recession estimates presented herein.

[4]California Coastal Commission's Public Review Draft, Sea-Level Rise Policy Guidance, dated October 14, 2013
[5] http://oss.deltares.nl/web/xbeach/
[6] http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=Software;34

List of Figures

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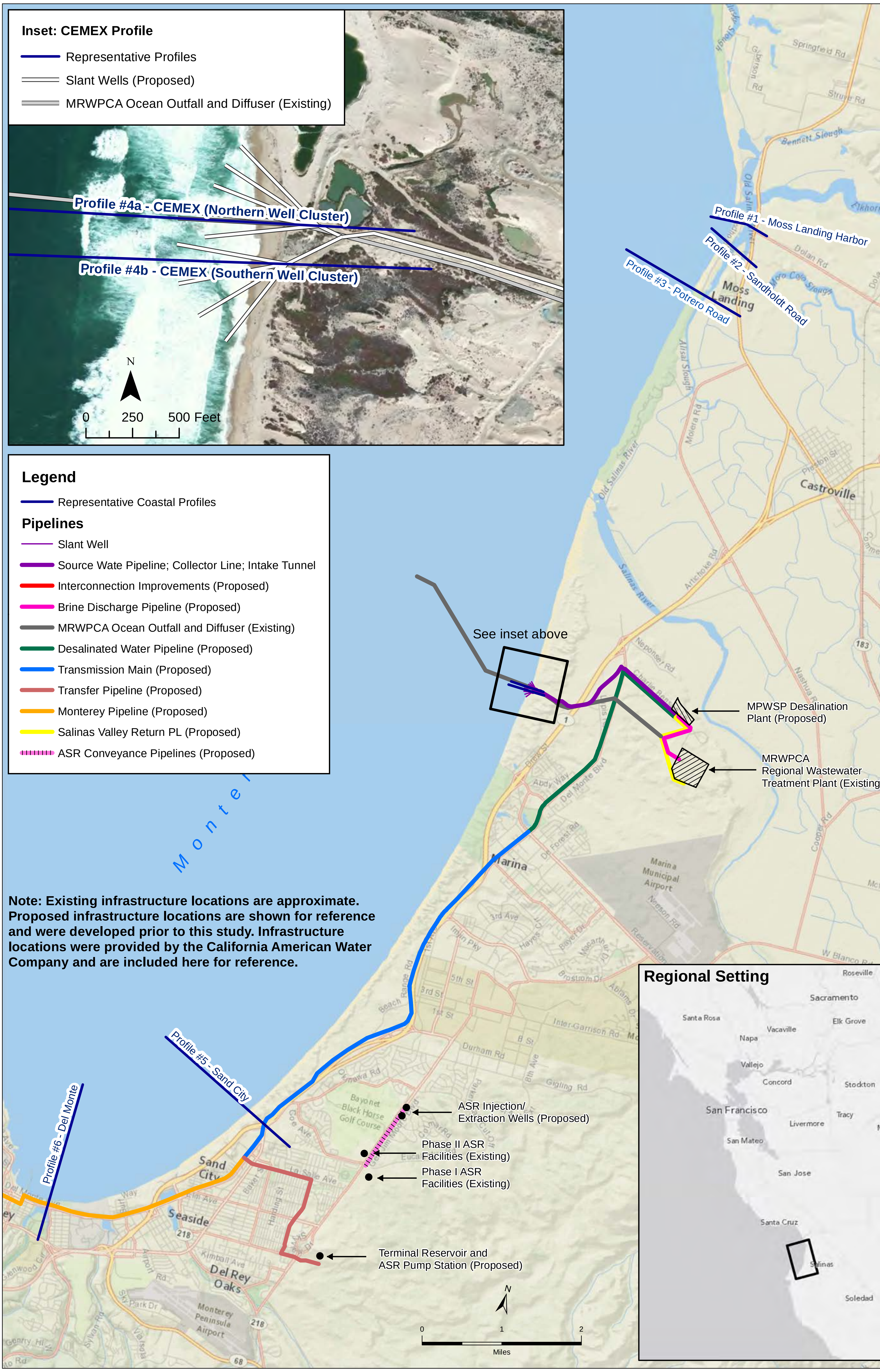
Figures



Basemap National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

U:\GIS\GIS\Projects\205xxx\205335_Water\Tasks\Cal_Am_2012\CoastalErosion\Figure X - Profile Locations v2.mxd
3/17/2014

Monterey Peninsula Water Supply Project . 205335.01

Figure 1
Regional Map of Analysis Profiles

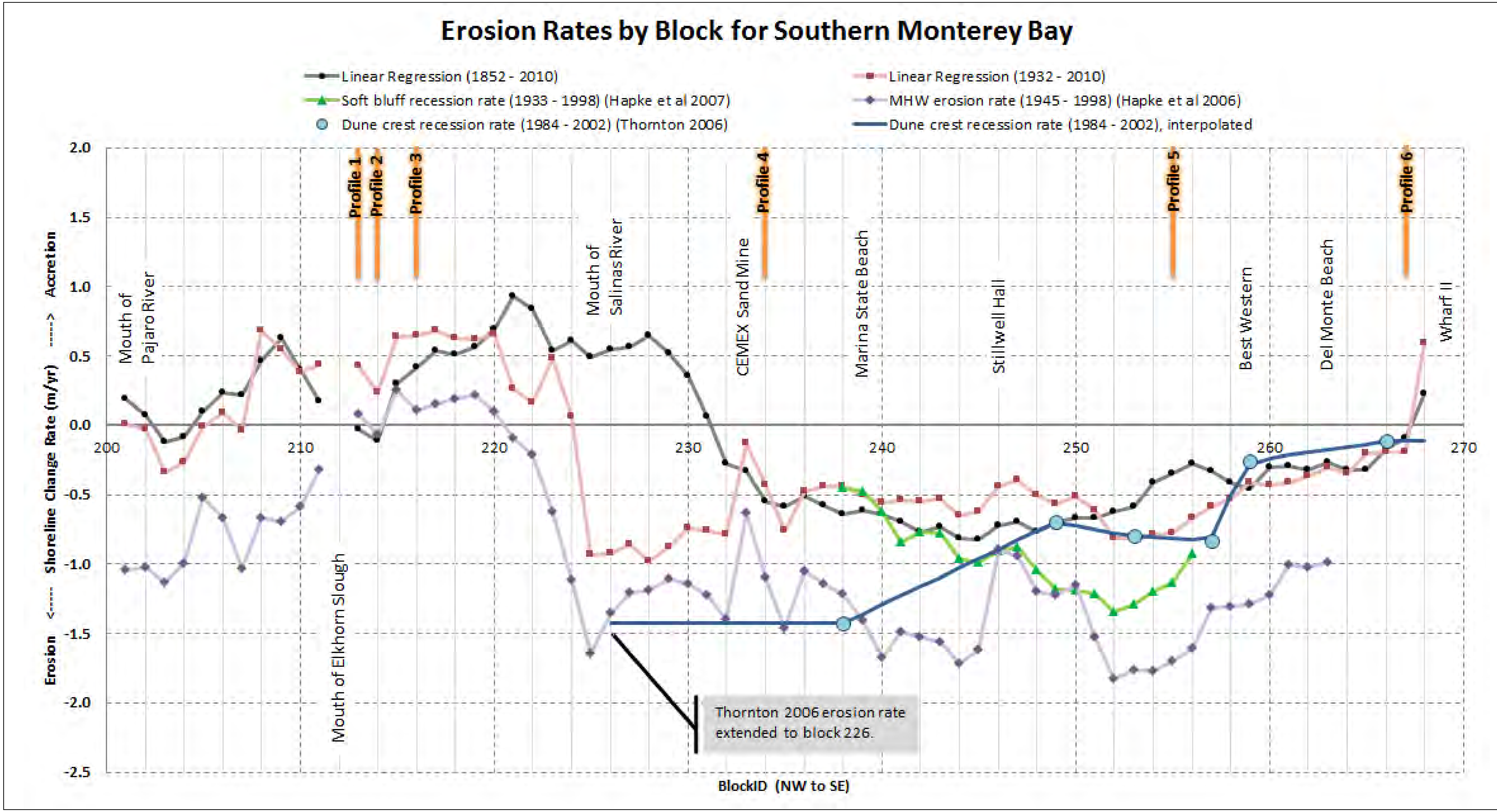
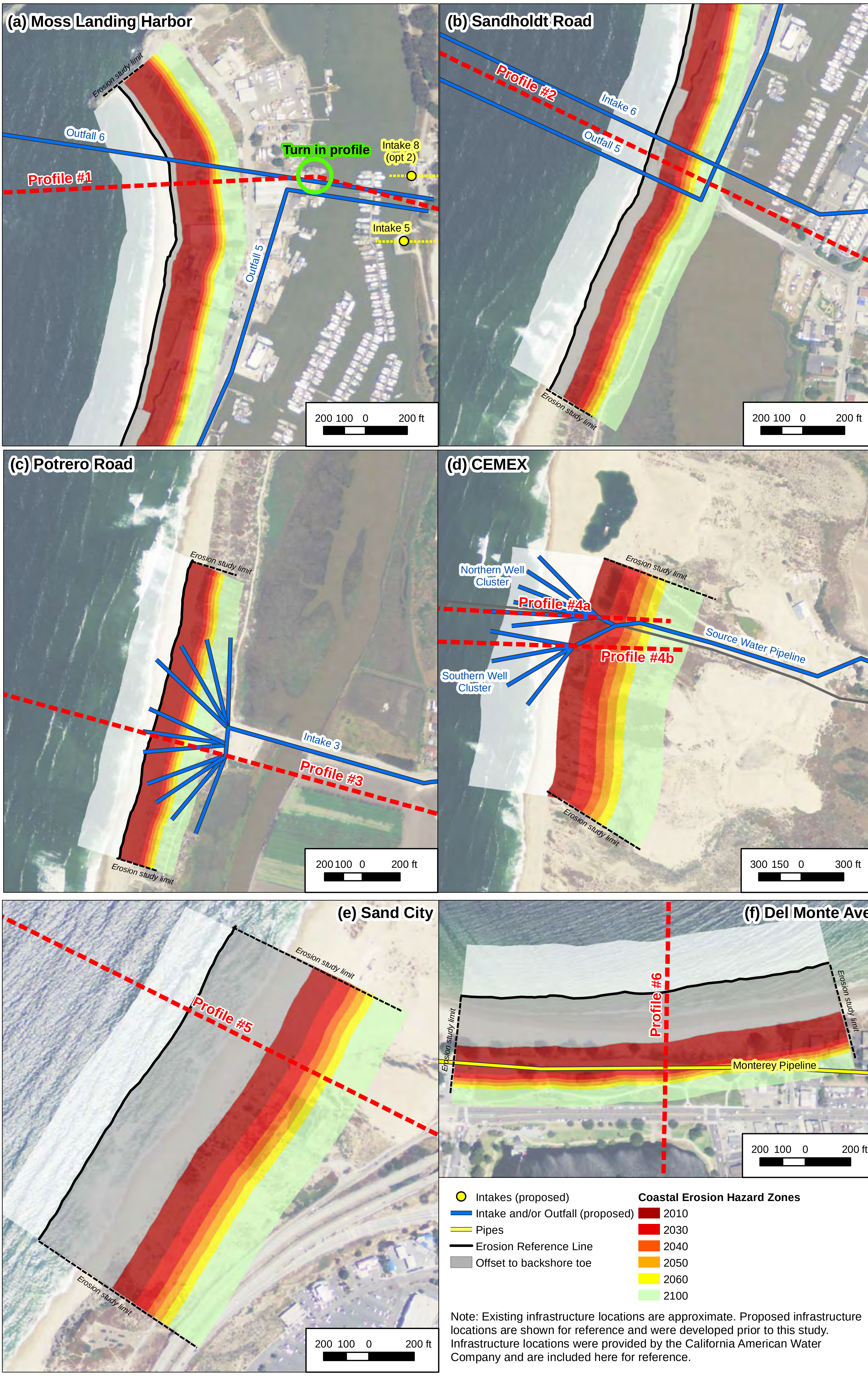


Figure 2. Historic Erosion Rates in Monterey Bay



Monterey Bay Sea Level Rise Assessment . 211906.00

Figure 3

Coastal Erosion Hazard Zones

Data Source: ESA PWA 2013 hazard zone analysis, NAIP 2012 imagery

Please see Figure 1 for regional map of profile locations.

N

These hazard zones show coastal **erosion** hazard areas, with the inland limit representing the potential future dune crest. Flood hazards may be more extensive, especially if the area is low-lying compared to the potential wave run-up and flood water levels. Future erosion through dunes has the potential to flood low-lying areas that are currently protected by high dunes.

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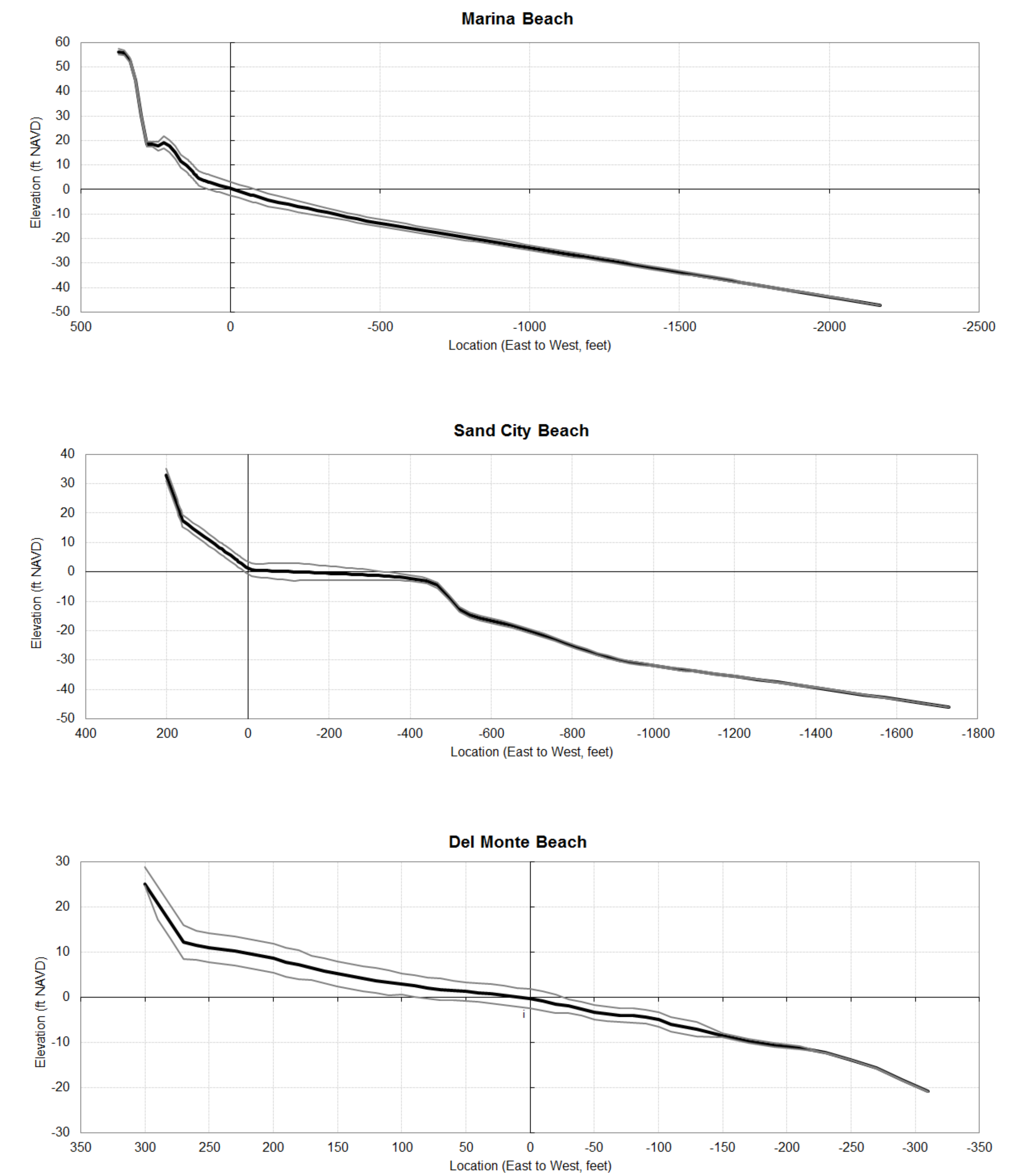
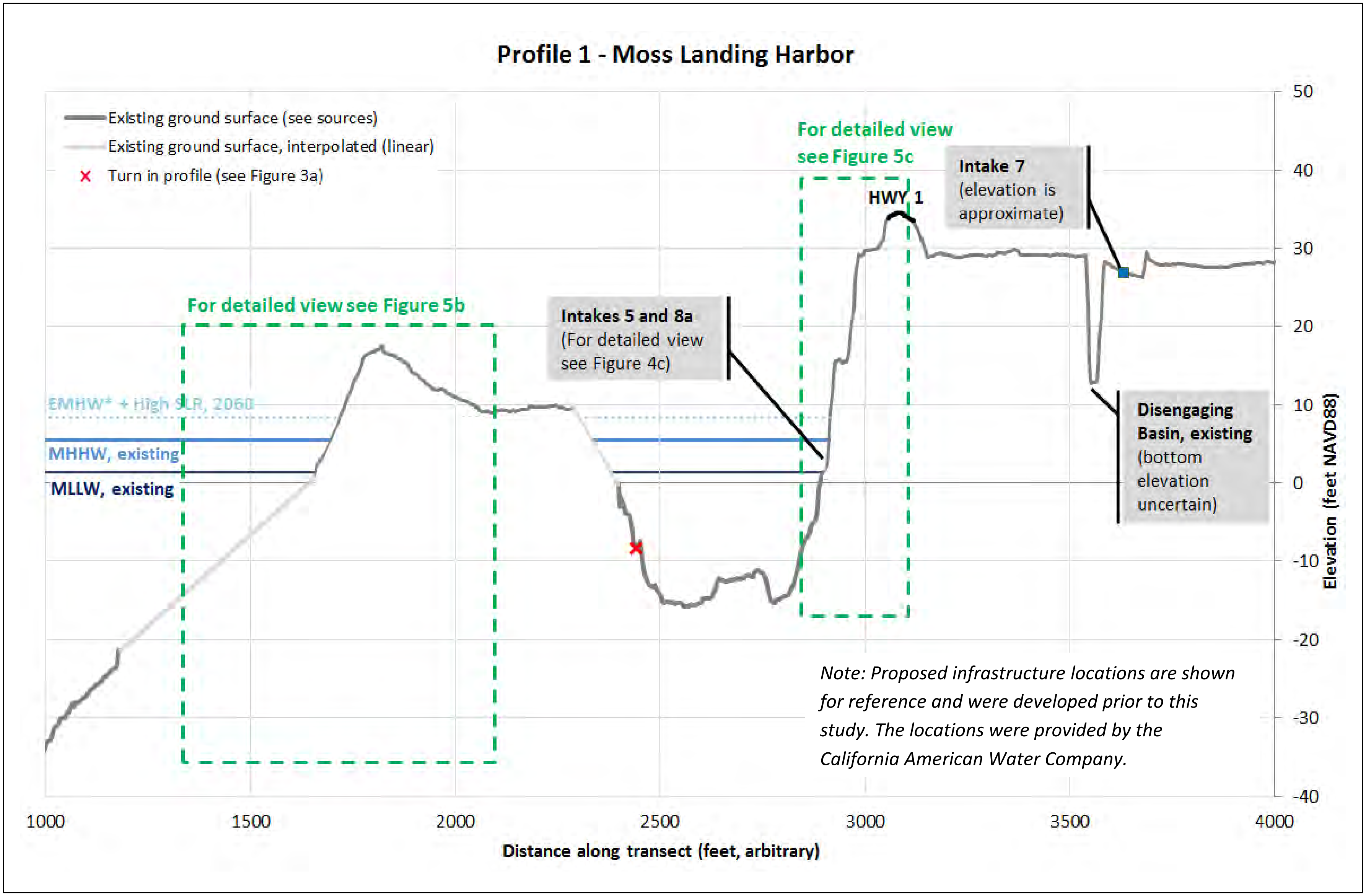
3/17/2014



SOURCE: Data from Thornton, unpublished.
Figures published in ESA PWA 2012.

Monterey Peninsula Water Supply Project. 205335.01

Figure 4
Representative Profiles and Envelopes by Ed Thornton, unpublished



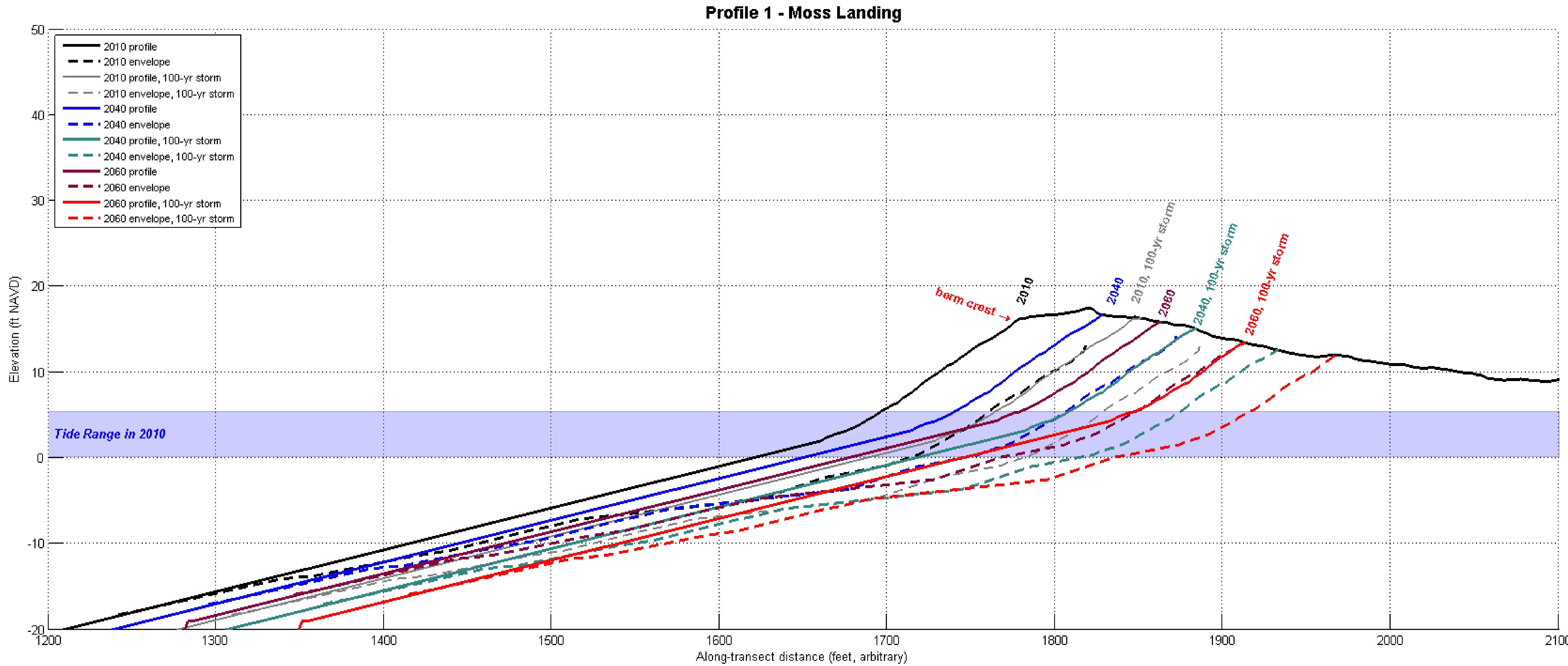
Sources: Topography from CA Coastal Conservancy LiDAR Project (collected in June 2010).
Bathymetry from the CSUMB Seafloor Mapping Lab (collected in September 2011).

** EMHW = Extreme Monthly High Water. This is, on average, the highest tide level that occurs each month.*

Monterey Peninsula Water Supply Project. 205335.01

Figure 5a

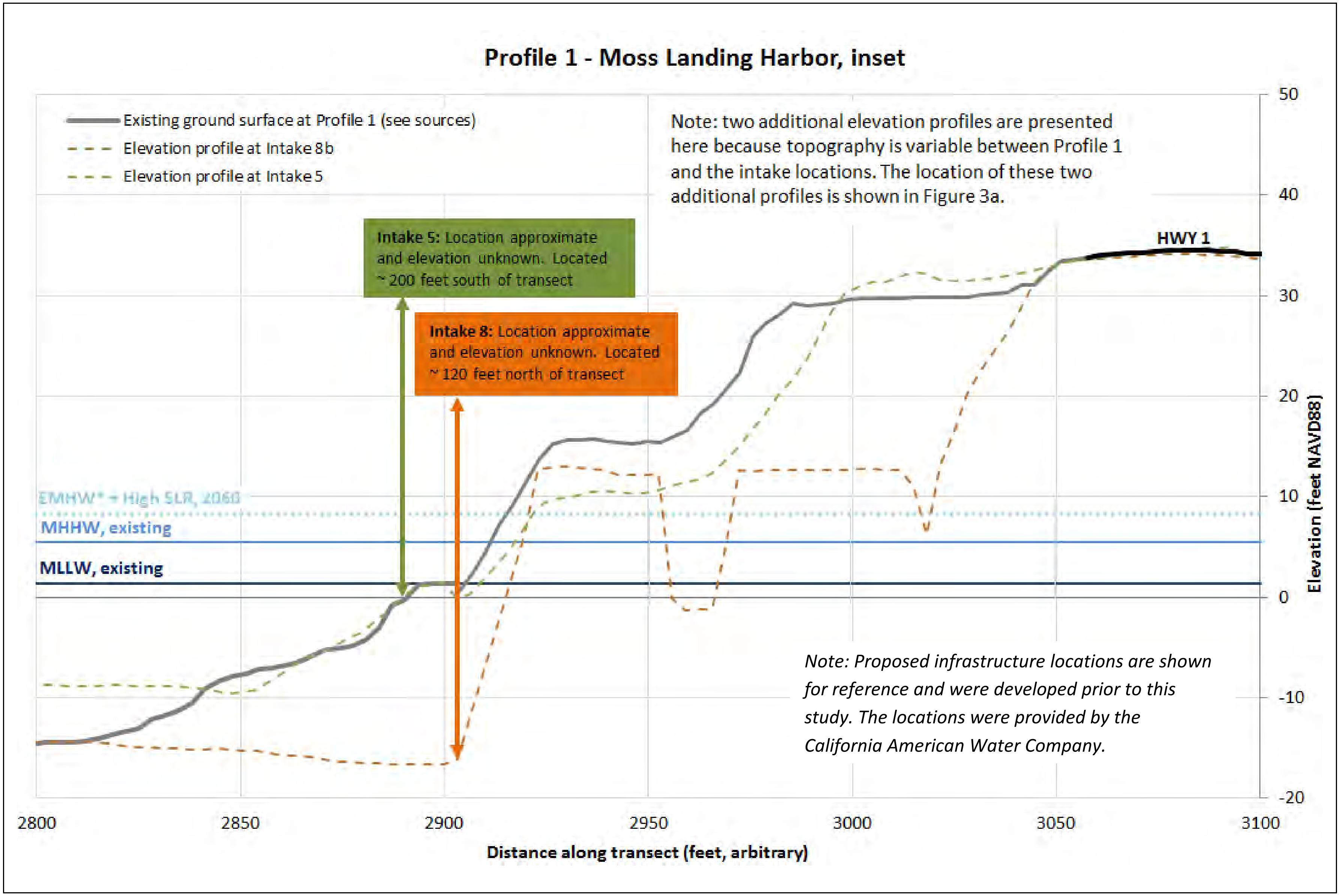
Profile 1 Overview



Notes:

1. These envelopes of erosion consider seasonal changes in beach width, localized erosion (rip currents), long-term erosion, and accelerated erosion caused by sea level rise.
2. The profile shape is linearly interpolated between the bathymetry data and the topography data (between x = 1181 ft and x = 1657 ft).

Figure 5b. Representative Profile #1 at Moss Landing Harbor



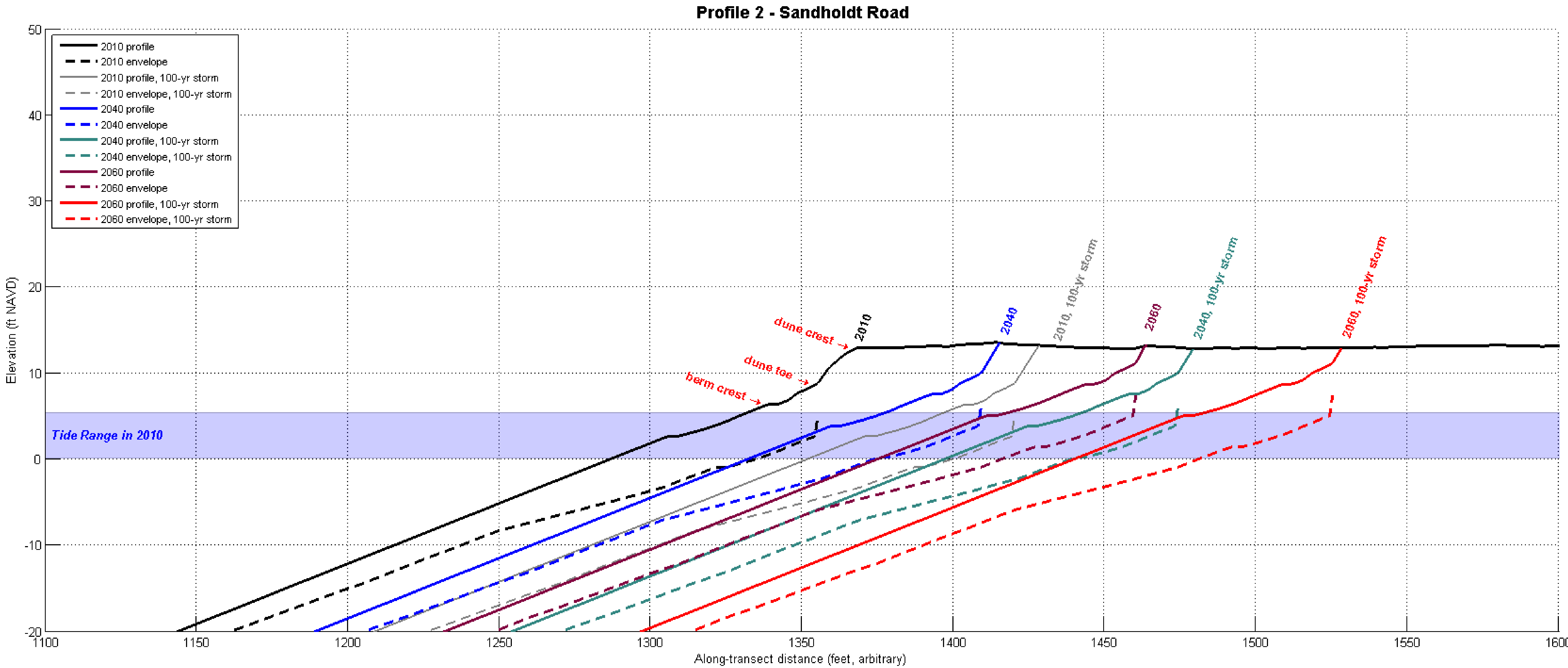
Sources: Topography from CA Coastal Conservancy LiDAR Project (collected in June 2010).
Bathymetry from the CSUMB Seafloor Mapping Lab (collected in September 2011).

** EMHW = Extreme Monthly High Water. This is, on average, the highest tide level that occurs each month.*

Monterey Peninsula Water Supply Project. 205335.01

Figure 5c

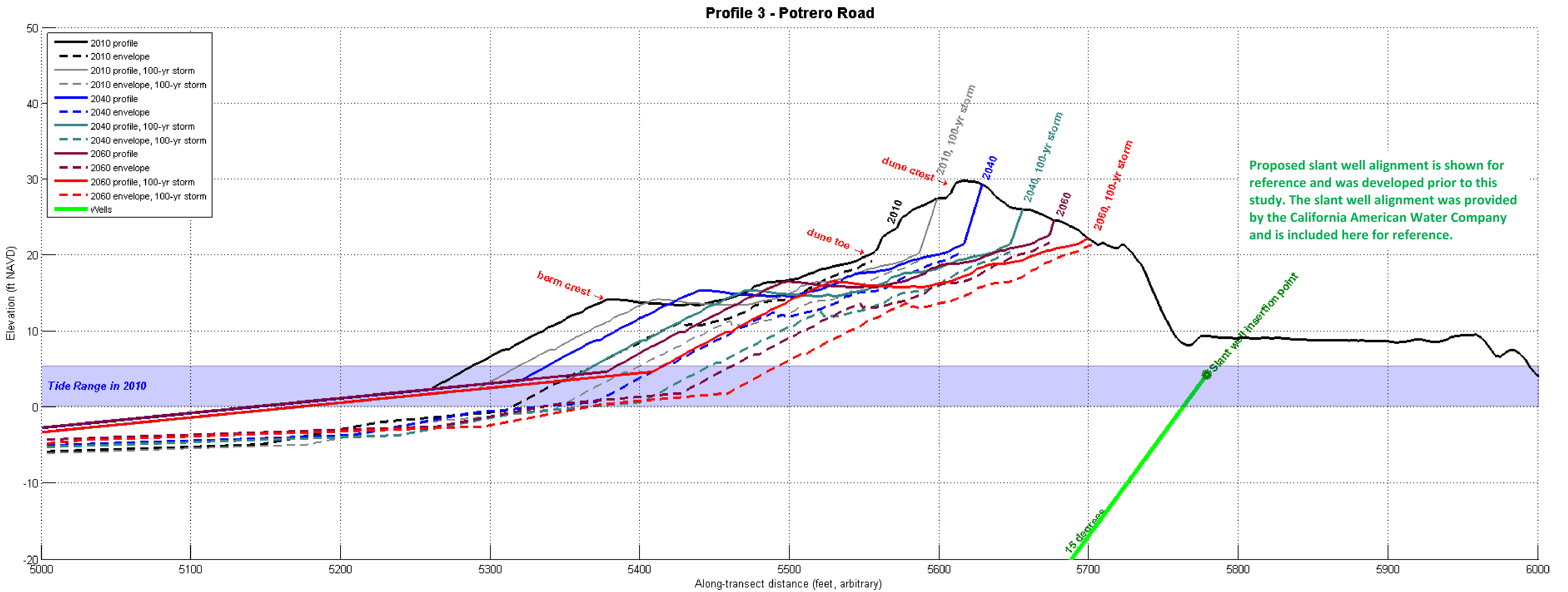
Profile 1 - Inland Inset



Notes:

1. These envelopes of erosion consider seasonal changes in beach width, localized erosion (rip currents), long-term erosion, and accelerated erosion caused by sea level rise.
2. The profile shape is linearly interpolated between the bathymetry data and the topography data (between x = 958 ft and x = 1299 ft).
3. This profile crosses the shore-parallel portion of Outfall 5 at x = 1648 ft (see Figure 3). This portion of the outfall does not fall within the erosion hazard zones through 2060. Location of Outfall 5 provided by California American Water Company. Vertical location of the shore-perpendicular portion of Outfall 5 and Intake 6 were not available and therefore are not shown in this profile view.

Figure 6. Representative Profile #2 at Sandholdt Road

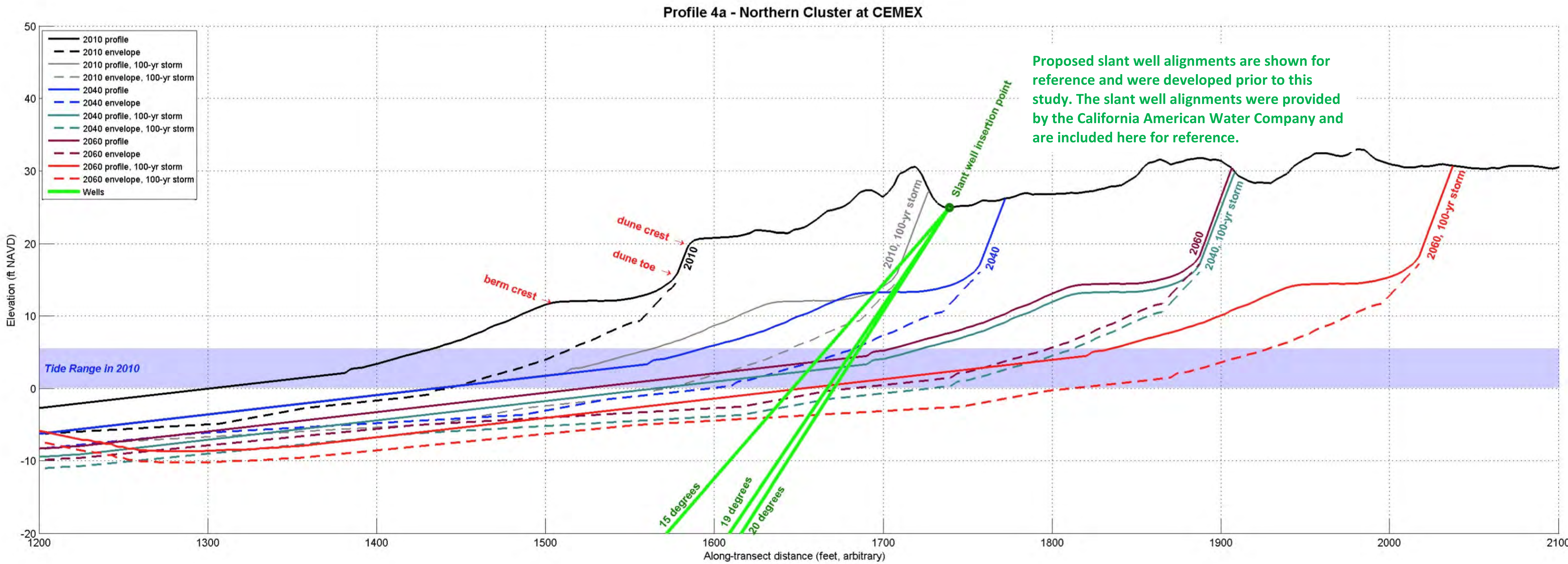


Notes:

1. These envelopes of erosion consider seasonal changes in beach width, localized erosion (rip currents), long-term erosion, and accelerated erosion caused by sea level rise.
2. The profile shape is linearly interpolated between the bathymetry data and the topography data (between x = 4777 ft and x = 5259 ft).
3. Pumped well location is based on the “Potrero Rd Pumped Wells Test Well” Google Earth map provided by CalAm on September 27, 2013.
4. This profile assumes the pumped well is perpendicular to shore.
5. The well input parameters in the table to the right were developed prior to this study and provided by the California American Water Company.

Potrero Road Parameters		Notes
type of well	Pumped Well	
inputs		
angle (degrees from horizontal)	15	
depth of insertion pt (ft)	5	
depth change (ft)	149	
insertion pt elevation (feet NAVD)	4.3	
insertion point loc (feet, arbitrary)	5778	
calculations		
length (feet)	576	
intake elevation (feet NAVD)	-145	
intake loc (feet, arbitrary)	5221	
Bed elevation at intake (ft NAVD)	1.60	*linearly interpolated btwn bathy and topo data*
Depth of sediment above intake (ft)	146	*difference between bed and intake elevation*

Figure 7. Representative Profile #3 at Potrero Road

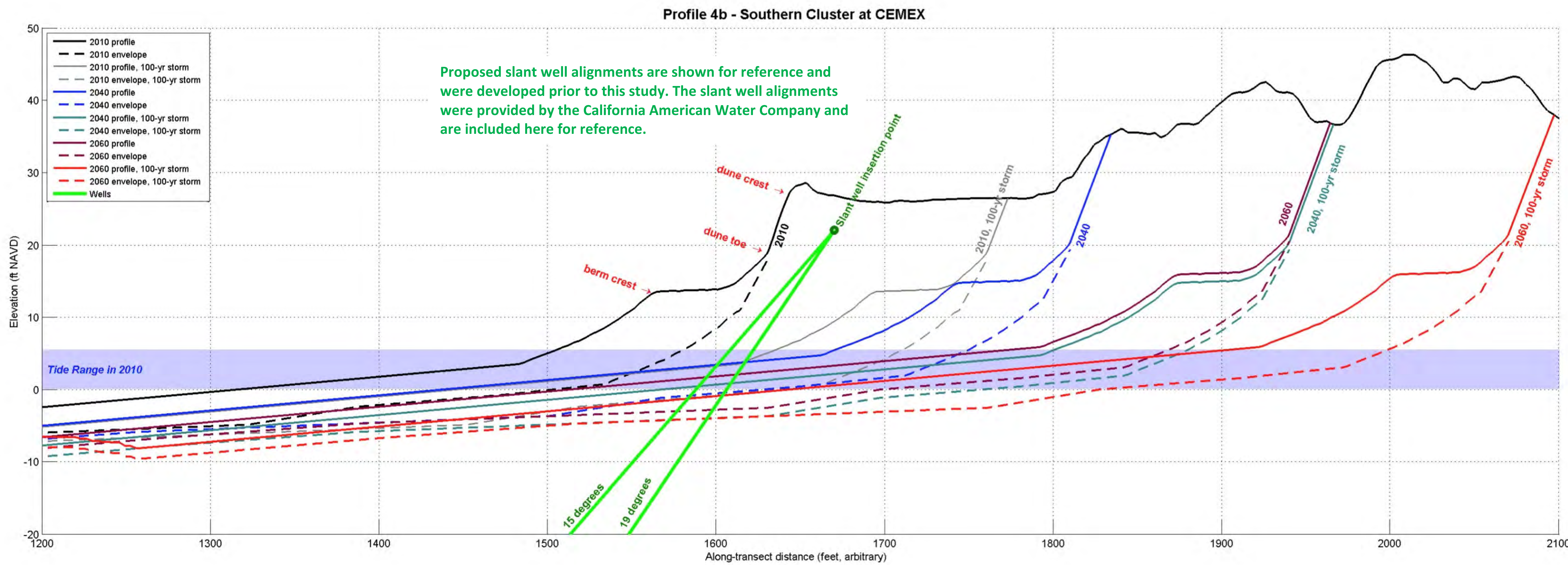


Notes:

1. These envelopes of erosion consider seasonal changes in beach width, localized erosion (rip currents), long-term erosion, and accelerated erosion caused by sea level rise.
2. The profile shape is linearly interpolated between the bathymetry data and the topography data (between x = 919 ft and x = 1385).
3. This profile is located immediately south of the CEMEX Pacifica Lapis sand mining plant. No data is available to quantify the uncertainty in adjacent beach and dune erosion related to sand mining activities. The potential for fluctuations in beach width associated with sand mining were not considered in this analysis.
4. Slant well location and angle are based on the "Test Slant Well Alignment" and "Test Slant Well Cross-Section" drawings provided by Geoscience on July 30, 2013.
5. The well input parameters in the table to the right were developed prior to this study and were provided by the California American Water Company.

Northern Cluster Parameters				Notes
type of well	Production	Production	Test	
inputs				
angle (degrees from horizontal)	15	19	20	
length (feet)	800	800	800	
insertion pt elevation (feet NAVD)	24.0	24.0	24.0	AMSL to NAVD 88 conversion: 2.97 ft
insertion point loc (feet, arbitrary)	1739	1739	1739	
calculations				
intake elevation (feet NAVD)	-183	-236	-250	
intake loc (feet, arbitrary)	966	982	987	
Bed elevation at intake (ft NAVD)	-9	-9	-8	*linearly interpolated btwn bathyand topo data*
Depth of sediment above intake (ft)	174	228	241	*difference between bed and intake elevation*

Figure 8. Representative Profile #4a at CEMEX

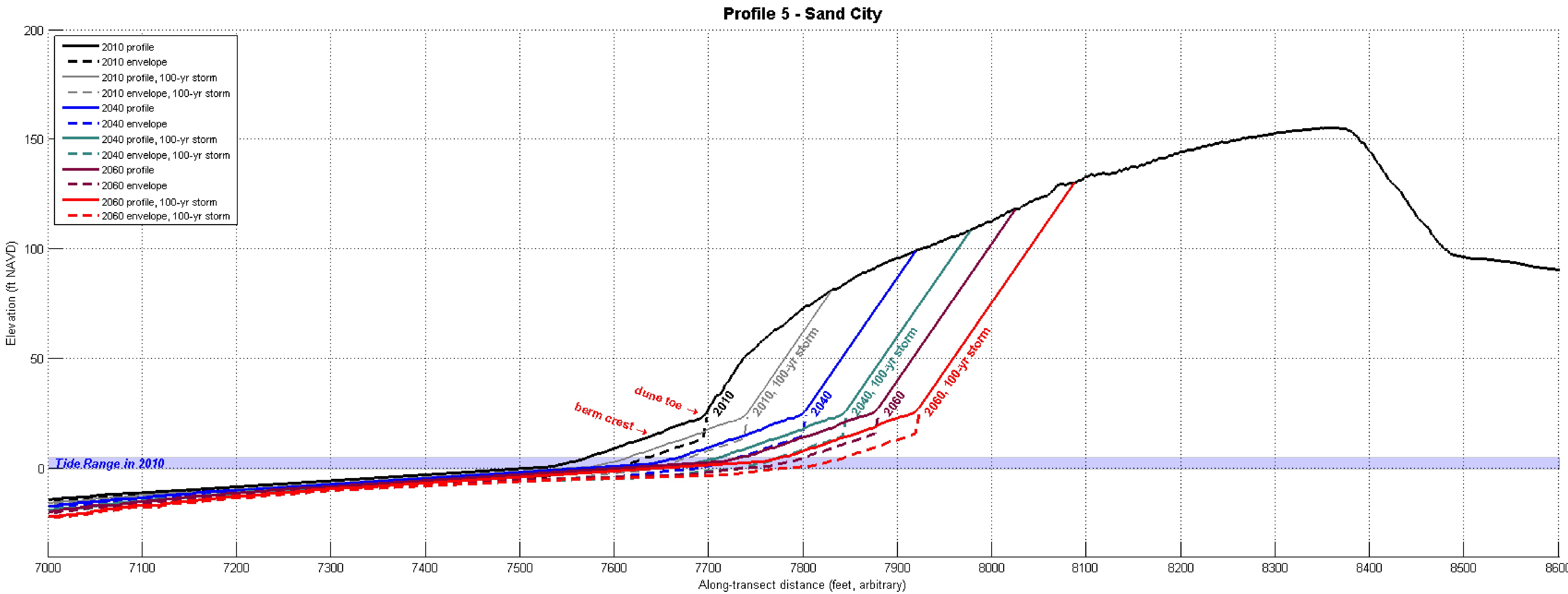


Notes:

1. These envelopes of erosion consider seasonal changes in beach width, localized erosion (rip currents), long-term erosion, and accelerated erosion caused by sea level rise.
2. The profile shape is linearly interpolated between the bathymetry data and the topography data (between x = 820 ft and x = 1480).
3. This profile is located immediately south of the CEMEX Pacifica Lapis sand mining plant. No data is available to quantify the uncertainty in adjacent beach and dune erosion related to sand mining activities. The potential for fluctuations in beach width associated with sand mining were not considered in this analysis.
4. Slant well location and angle are based on the "Well 3 Alignment" and "Well 3 Cross-Section" drawings provided by Geoscience on July 30, 2013.
5. The well input parameters in the table to the right were developed prior to this study and were provided by the California American Water.

Southern Cluster Parameters			Notes
type of well	Production Well	Production Well	
inputs			
angle (degrees from horizontal)	15	19	
length (feet)	800	800	
insertion pt elevation (feet NAVD)	22.0	22.0	AMSL to NAVD 88 conversion: 2.97 ft
insertion point loc (feet, arbitrary)	1670	1670	
calculations			
intake elevation (feet NAVD)	-185	-238	
intake loc (feet, arbitrary)	897	914	
Bed elevation at intake (ft NAVD)	-9	-9	*linearly interpolated btwn bathy and topo data*
Depth of sediment above intake (ft)	176	230	*difference between bed and intake elevation*

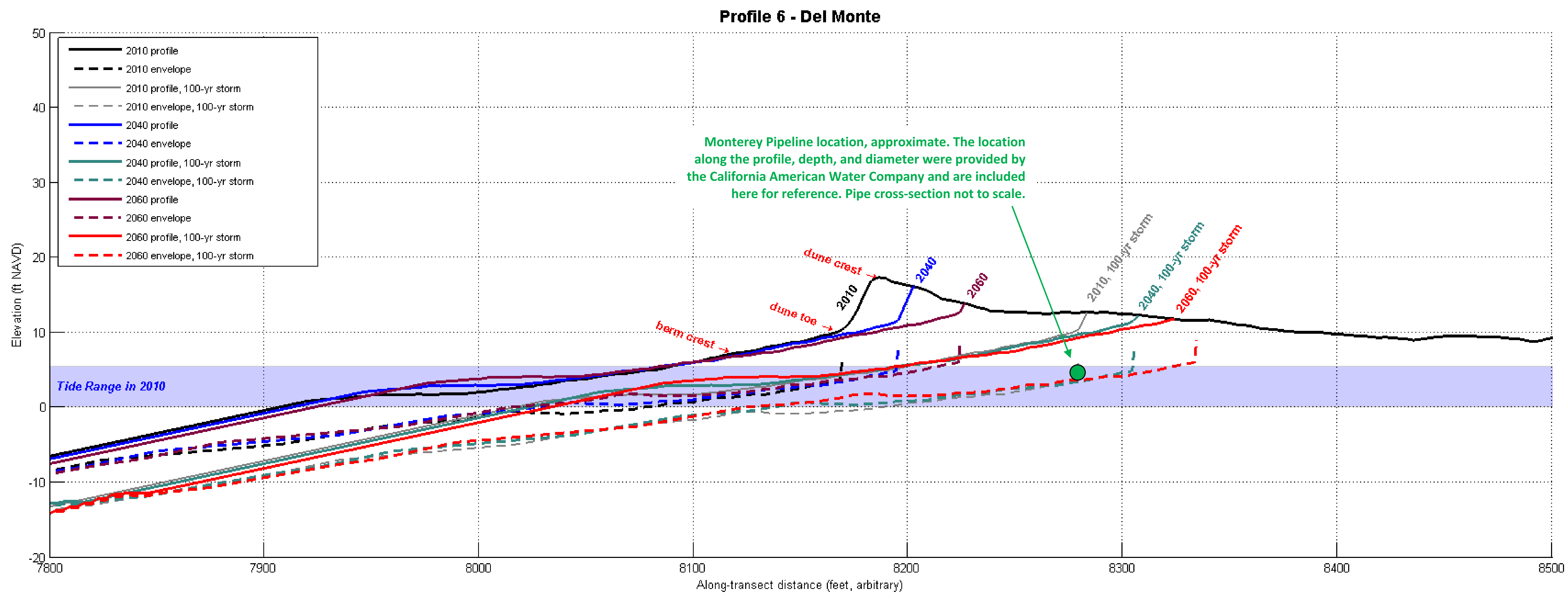
Figure 9. Representative Profile #4b at CEMEX



Notes:

1. These envelopes of erosion consider seasonal changes in beach width, localized erosion (rip currents), long-term erosion, and accelerated erosion caused by sea level rise.
2. The profile shape is linearly interpolated between the bathymetry data and the topography data (between x = 7127 ft and x = 7533 ft).
3. This profile does not intersect any proposed desalination infrastructure.

Figure 10. Representative Profile #5 at Sand City



Notes:

1. These envelopes of erosion consider seasonal changes in beach width, localized erosion (rip currents), long-term erosion, and accelerated erosion caused by sea level rise.
2. The profile shape is linearly interpolated between the bathymetry data and the topography data (between x = 7960 ft and x = 7920 ft).
3. Approximate horizontal and vertical location of the Monterey Pipeline provided by California American Water Company.

Figure 11. Representative Profile #6 at Del Monte

APPENDIX C3
Exploratory Borehole Results

See Appendix E3, HWG Hydrogeologic Investigation Technical Report, Part 2 of 2: Appendices (Appendix C, Monterey Peninsula Water Supply Project Hydrogeologic Investigation Technical Memorandum (TM-1) – Summary of Results – Exploratory Boreholes).

APPENDIX D1

Modeling Brine Disposal into Monterey Bay – Supplement, Final Report

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Modeling Brine Disposal into Monterey Bay – Supplement

Philip J. W. Roberts, PhD, PE
Consulting Engineer
Atlanta, Georgia, USA

Final Report

Prepared for
ESA | Environmental Science Associates
San Francisco, California

September 22, 2017

CONTENTS

EXECUTIVE SUMMARY

Additional dilution simulations are presented for the disposal of brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. The report is a supplement to Roberts (2016) and addresses new flow scenarios and other issues that have been raised.

It has been suggested to replace the opening in the end gate of the diffuser with a check valve. A 6-inch valve was proposed, and analyses of the internal hydraulics of the diffuser and outfall were conducted. The check valve had minimal effect on the flow distribution between the diffuser ports and minimal effect on head loss. The flow from the end gate was reduced slightly and the exit velocity considerably increased. The effect of the valve orientation on dilution of brine discharges was investigated. It was found that any upward angle greater than about 20° would result in dilutions that meet the BMZ salinity requirements. The optimum angle to maximize dilution is 60°.

Dilutions were computed for all new flow scenarios assuming the 6-inch check valve was installed in the end gate.

The effect of currents on the brine jets was addressed. Dilutions were predicted using the mathematical model UM3 for the pure brine discharges for various anticipated current speeds. Jets discharging into the currents were bent back and dilutions were increased by the current. Jets discharging with the current were swept downstream and impacted the seabed farther from the diffuser. All dilutions with currents were greater than those with zero current, and all impact points were well within the BMZ.

It has been suggested to orient the nozzles along the diffuser upwards (from their present horizontal angles) to increase the dilution of dense effluents. This would decrease the dilution of buoyant effluents, however. Dilutions were predicted for dense and buoyant effluents. For dense effluents, increasing the nozzle angle increased dilution considerably; for buoyant effluents, the dilutions reduced slightly.

List of Figures

List of Tables

1. INTRODUCTION

It is proposed to dispose of the brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. Discharge will be through an existing outfall and diffuser usually used for domestic wastewater disposal. Because of varying flow scenarios, the effluent and its composition vary from pure secondary effluent to pure brine. Sixteen scenarios, with flows ranging from 9.0 to 33.8 mgd (million gallons per day) and densities from 998.8 to 1045.2 kg/m^3, were previously analyzed in Roberts (2016). The internal hydraulics of the outfall and diffuser were computed and dilutions predicted for flow scenarios resulting in buoyant and dense effluents. It was found that, for all dense discharge conditions, the salinity requirements in the new California Ocean Plan were met within the BMZ (Brine Mixing Zone).

Since that report was completed, new flow scenarios have been proposed that include higher volumes of brine and GWR effluent, the inclusion of hauled brine, and situations where the desalination plant is offline. It has been requested to analyze dilutions for many more flow combinations for typical and variant cases. And it is proposed to replace the opening in the diffuser's end gate, which allows some brine to be released at a low velocity and therefore low dilution, with a check valve that would increase the exit velocity and therefore increase dilution. The check valve would be angled upwards, further increasing dilution. Finally, it has been suggested to replace the horizontal 4-inch check valves along the diffuser with upwardly oriented valves that would increase the dilution of dense effluents.

The specific tasks addressed in this report are:

- Analyze internal hydraulics accounting for the effect of the new proposed end gate check valve;
- Compute dilutions for new scenarios with dense and buoyant flow effluents accounting for the effect of the valve;
- Assess the effects of currents on dense discharges;
- Compute the dilution of dense discharges from the end gate;
- Analyze the effect of varying the nozzle angle on the dilution of dense and buoyant effluents.

2. MODELING SCENARIOS

2.1 Introduction

To address the additional concerns and issues that have been raised, the revised dilution analyses will include the following:

- End-Gate: The outfall hydraulics will be revised assuming the end-gate has been replaced with one Tideflex valve. The assumed end-gate configuration may be modified depending on the California Ocean Plan (COP) compliance analysis results.
- Effluent Water Quality: The salinity and temperature of the secondary effluent and GWR effluent shall remain unchanged from prior analyses presented in the 2017 Draft EIR/EIS.
- Ocean Conditions: Dilution analyses shall incorporate conditions related to the ocean seasons consistent with previous analyses. Worst-case conditions shall be assessed and presented.
- Mitigation: Preliminary assessments of the impact of diffuser nozzle orientation on dilution of dense and buoyant effluents will be made.
- Currents: The effects of currents on the advection and dispersion of dense effluents will be assessed.

All revised discharge scenarios will incorporate consideration of a modified end-gate on outfall diffuser hydraulics and dilution.

Model analyses will be done for typical and high brine discharge scenarios with a range of secondary and GWR effluent flows. Modeling the highest RO concentrate flow expected follows the conservative approach previously used on COP compliance evaluations for this project. Also, scenarios involving high flows of secondary effluent will be assessed for typical operations of the Variant both with and without GWR effluent. In addition, it has been requested that discharge scenarios where brine is absent be included in dilution model analyses to cover times when the desalination plant is offline.

2.2 Environmental and Discharge Conditions

In the previous report, Roberts (2016), oceanographic measurements obtained near the diffuser were discussed. Traditionally, three oceanic seasons have been defined in Monterey Bay: Upwelling (March-September), Oceanic (September-November), and Davidson (November-March). Density profiles were averaged by season to obtain representative profiles for the dilution simulations. The profiles are shown in Figure 1 and are tabulated in Appendix A. The salinities and temperatures near the depth of the diffuser were averaged seasonally as summarized in Table 1.

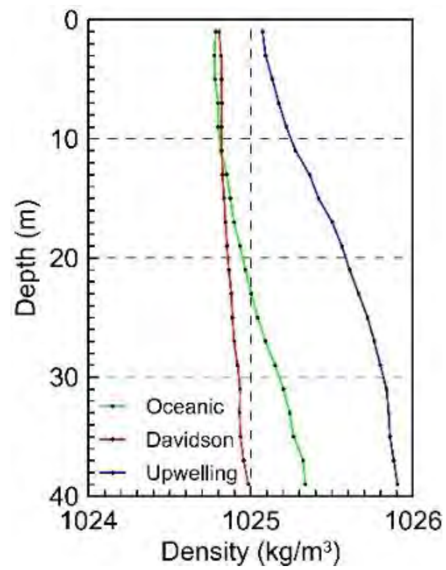


Figure 1. Seasonally averaged density profiles used for dilution simulations.

Table 1. Seasonally Averaged Properties at Diffuser Depth

Season	Temperature (°C)	Salinity (ppt)	Density (kg/m^3)
Davidson	14.46	33.34	1024.8
Upwelling	11.48	33.89	1025.8
Oceanic	13.68	33.57	1025.1

The assumed constituent properties are summarized in Table 2.

Table 2. Assumed Properties of Effluent Constituents

Constituent	Temperature (°C)	Salinity (ppt)	Density (kg/m^3)
Secondary effluent	20.0	0.80	998.8
Brine	9.9	58.23	1045.2
GWR	20.0	5.80	1002.6
Hauled brine	20.0	40.00	1028.6

2.3 Discharge Scenarios

Following publication of the 2017 MPWSP Draft EIR/EIS, the MRWPCA commented on several concerns related to the impact analysis regarding Ocean Plan and NPDES compliance. Specifically, discharge scenarios involving higher volumes of desalination brine (following a shut down for repair or routine maintenance) had not been assessed. Also, it was requested that higher resolution model analysis be conducted for scenarios involving low and moderate flows of secondary effluent for all project alternatives. Additionally, the MRWPCA requested that increased GWR effluent flows be assessed as part of planning for an increased capacity PWM project. Finally, it was requested that hauled brine be included in the dilution analysis for the Proposed Project.

It is proposed that revised model analysis be completed for typical and high brine discharge scenarios with secondary effluent flows ranging from 0 to 10 mgd and with the inclusion of hauled brine. Additionally, scenarios involving high flows of secondary effluent (15 and 19.78 mgd) will be assessed for typical operations. In addition, MPWPCA has requested that discharge scenarios where brine is absent be included in dilution model analyses to cover times when the desal plant is offline and to revise dilution model estimates based on the modified end-gate which may alter the outfall diffuser hydraulics.

Table 3 details the revised discharge scenarios for dilution model analysis of the Proposed Project (full size desalination facility and no implementation of GWR/PWM).

Table 4 details revised discharge scenarios for dilution model analysis of the Variant (MPWSP Alternative, reduced capacity desalination facility with PWM/GWR).

Table 3. Modeled Discharge Scenarios – Project (no GWR)

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
T1	SE Only	0.00	19.78	0	0.1	19.88	1.00	999.0
T2	Brine only	13.98	0.00	0	0.1	14.08	58.10	1045.1
T3	Brine + Low SE	13.98	1.00	0	0.1	15.08	54.30	1042.0
T4	Brine + Low SE	13.98	2.00	0	0.1	16.08	50.97	1039.4
T5	Brine + Low SE	13.98	3.00	0	0.1	17.08	48.04	1037.0
T6	Brine + Low SE	13.98	4.00	0	0.1	18.08	45.42	1034.9
T7	Brine + Moderate SE	13.98	5.00	0	0.1	19.08	43.08	1033.0
T8	Brine + Moderate SE	13.98	6.00	0	0.1	20.08	40.98	1031.3
T9	Brine + Moderate SE	13.98	7.00	0	0.1	21.08	39.07	1029.7
T10	Brine + Moderate SE	13.98	8.00	0	0.1	22.08	37.34	1028.3
T11	Brine + Moderate SE	13.98	9.00	0	0.1	23.08	35.76	1027.1
T12	Brine + High SE	13.98	10.00	0	0.1	24.08	34.30	1025.9
T13	Brine + High SE	13.98	15.00	0	0.1	29.08	28.54	1021.2
T14	Brine + High SE	13.98	19.78	0	0.1	33.86	24.63	1018.1
T15	High Brine only	16.31	0.00	0	0.1	16.41	58.12	1045.1
T16	High Brine + Low SE	16.31	1.00	0	0.1	17.41	54.83	1042.5
T17	High Brine + Low SE	16.31	2.00	0	0.1	18.41	51.89	1040.1
T18	High Brine + Low SE	16.31	3.00	0	0.1	19.41	49.26	1038.0
T19	High Brine + Low SE	16.31	4.00	0	0.1	20.41	46.89	1036.1
T20	High Brine + Moderate SE	16.31	5.00	0	0.1	21.41	44.73	1034.3

Table 4. Modeled Discharge Scenarios – Variant

Case ID	Scenario	Constituent Flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
V1	Brine only	8.99	0.00	0	0.0	8.99	58.23	1045.2
V2	Brine + Low SE	8.99	1.00	0	0.0	9.99	52.48	1040.6
V3	Brine + Low SE	8.99	2.00	0	0.0	10.99	47.78	1036.8
V4	Brine + Low SE	8.99	3.00	0	0.0	11.99	43.86	1033.6
V5	Brine + Low SE	8.99	4.00	0	0.0	12.99	40.55	1030.9
V6	Brine + Moderate SE	8.99	5.00	0	0.0	13.99	37.70	1028.6
V7	Brine + Moderate SE	8.99	5.80	0	0.0	14.79	35.71	1027.0
V8	Brine + Moderate SE	8.99	7.00	0	0.0	15.99	33.09	1024.9
V9	Brine + High SE	8.99	14.00	0	0.0	22.99	23.26	1017.0
V10	Brine + High SE	8.99	19.78	0	0.0	28.77	18.75	1013.3
V11	GWR Only	0.00	0.00	1.17	0.0	1.17	5.80	1002.6
V12	Low SE + GWR	0.00	0.40	1.17	0.0	1.57	4.53	1001.6
V13	Low SE + GWR	0.00	3.00	1.17	0.0	4.17	2.20	999.9
V14	High SE + GWR	0.00	23.70	1.17	0.0	24.87	1.04	999.0
V15	High SE + GWR	0.00	24.70	1.17	0.0	25.87	1.03	999.0
V16	Brine + High GWR only	8.99	0.00	1.17	0.0	10.16	52.19	1040.3
V17	Brine + High GWR + Low SE	8.99	1.00	1.17	0.0	11.16	47.59	1036.6
V18	Brine + High GWR + Low SE	8.99	2.00	1.17	0.0	12.16	43.74	1033.5
V19	Brine + High GWR + Low SE	8.99	3.00	1.17	0.0	13.16	40.48	1030.9
V20	Brine + High GWR + Low SE	8.99	4.00	1.17	0.0	14.16	37.67	1028.6
V21	Brine + High GWR + Moderate SE	8.99	5.00	1.17	0.0	15.16	35.24	1026.6
V22	Brine + High GWR + Moderate SE	8.99	5.30	1.17	0.0	15.46	34.57	1026.1
V23	Brine + High GWR + Moderate SE	8.99	6.00	1.17	0.0	16.16	33.11	1024.9
V24	Brine + High GWR + Moderate SE	8.99	7.00	1.17	0.0	17.16	31.23	1023.4
V25	Brine + High GWR + High SE	8.99	11.00	1.17	0.0	21.16	25.48	1018.7
V26	Brine + High GWR + High SE	8.99	15.92	1.17	0.0	26.08	20.82	1015.0
V27	Brine + Low GWR only	8.99	0.00	0.94	0.0	9.93	53.27	1041.2
V28	Brine + Low GWR + Low SE	8.99	1.00	0.94	0.0	10.93	48.47	1037.3
V29	Brine + Low GWR + Low SE	8.99	3.00	0.94	0.0	12.93	41.09	1031.4
V30	Brine + Low GWR + Moderate SE	8.99	5.30	0.94	0.0	15.23	35.01	1026.4
V31	Brine + Low GWR + High SE	8.99	15.92	0.94	0.0	25.85	20.95	1015.1
V32	High Brine only	11.24	0.00	0.00	0.0	11.24	58.23	1045.2
V33	High Brine + Low SE	11.24	0.50	0.00	0.0	11.74	55.78	1043.3
V34	High Brine + Low SE	11.24	1.00	0.00	0.0	12.24	53.54	1041.4
V35	High Brine + Low SE	11.24	2.00	0.00	0.0	13.24	49.55	1038.2
V36	High Brine + Low SE	11.24	3.00	0.00	0.0	14.24	46.13	1035.5
V37	High Brine + Low SE	11.24	4.00	0.00	0.0	15.24	43.16	1033.0
V38	High Brine + Moderate (5) SE	11.24	5.00	0.00	0.0	16.24	40.55	1030.9
V39	High Brine + GWR only	11.24	0.00	1.17	0.0	12.41	53.29	1041.2
V40	High Brine + GWR + Low SE	11.24	0.50	1.17	0.0	12.91	51.25	1039.6
V41	High Brine + GWR + Low SE	11.24	1.00	1.17	0.0	13.41	49.37	1038.0
V42	High Brine + GWR + Low SE	11.24	2.00	1.17	0.0	14.41	46.00	1035.3
V43	High Brine + GWR + Low SE	11.24	3.00	1.17	0.0	15.41	43.07	1033.0
V44	High Brine + GWR + Low SE	11.24	4.00	1.17	0.0	16.41	40.49	1030.9
V45	High Brine + GWR + Moderate SE	11.24	5.00	1.17	0.0	17.41	38.21	1029.0

3. OUTFALL HYDRAULICS

3.1 Introduction

The outfall and diffuser is described in Roberts (2016) (see Figure 1 in that report) as follows:

The Monterey Regional Water Pollution Control Agency (MRWPCA) outfall at Marina conveys the effluent to the Pacific Ocean to a depth of about 100 ft below Mean Sea Level (MSL). The ocean segment extends a distance of 9,892 ft from the Beach Junction Structure (BJS). Beyond this there is a diffuser section 1,406 ft long. The outfall pipe consists of a 60-inch internal diameter (ID) reinforced concrete pipe (RCP), and the diffuser consists of 480 ft of 60-inch RCP with a single taper to 840 ft of 48-inch ID. The diffuser has 171 ports of two-inch diameter: 65 in the 60-inch section and 106 in the 48-inch section. The ports discharge horizontally alternately from both sides of the diffuser at a spacing of 16 ft on each side except for one port in the taper section that discharges vertically for air release. The 42 ports closest to shore are presently closed, so there are 129 open ports distributed over a length of approximately 1024 ft. The 129 open ports are fitted with four inch Tideflex "duckbill" check valves (the four inch refers to the flange size not the valve opening). The valves open as the flow through them increases so the cross-sectional area is variable. The end gate has an opening at the bottom about two inches high. The hydraulic characteristics of the four-inch valves and the procedure to compute the flow distribution in the diffuser with the end gate opening was detailed in Roberts (2016) Appendix A.

It is proposed to replace the end gate opening with a Tideflex check valve. A suitable valve is a 6 inch Tideflex check valve, Hydraulic Code 355. The hydraulic characteristics of this valve are shown in Figure 2.

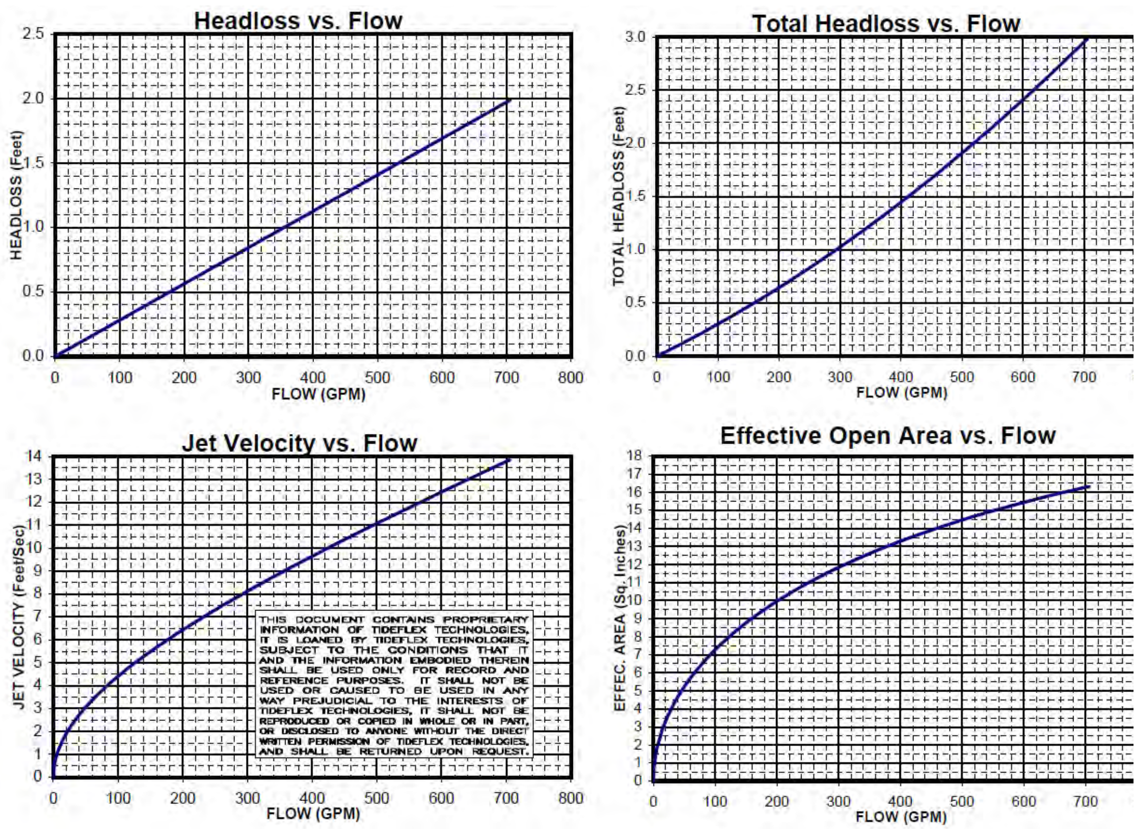


Figure 2. Characteristics of 6-inch TideFlex check valve Hydraulic Code 355.

The same methodology to compute the internal hydraulics as outlined in Roberts (2016) was used. For the purposes of the hydraulic computations, the relationship between the total head loss across the valve, E' and the flow Q of Figure 2 was approximated by:

$$Q = -28.24E'^2 + 319.8E' \quad (1)$$

The calculation procedure followed that in Roberts (2o16) except that the open end gate relationship was replaced by Eq. 1.

Typical flow variations with and without the end gate valve are shown in Figure 3. This shows Case T1, mostly secondary effluent with a total flow of 19.88 mgd, density 999.0 kg/m^3, and case T2, almost pure brine with a flow of 14.08 mgd, density 1045.1 kg/m^3. The flow distributions with and without the Tideflex valve are virtually indistinguishable. The flow exiting from the end gate is reduced slightly from 4% to 3% of the total for T1 and from 5% to 4% for T2. The velocity from the end gate is increased significantly by the check valve, from 6.7 to 10.7 ft/s for T1 and from 6.1 to 9.7 ft/s for T2. The additional total head loss through the outfall due to the check valve is negligible, about 0.01 ft.

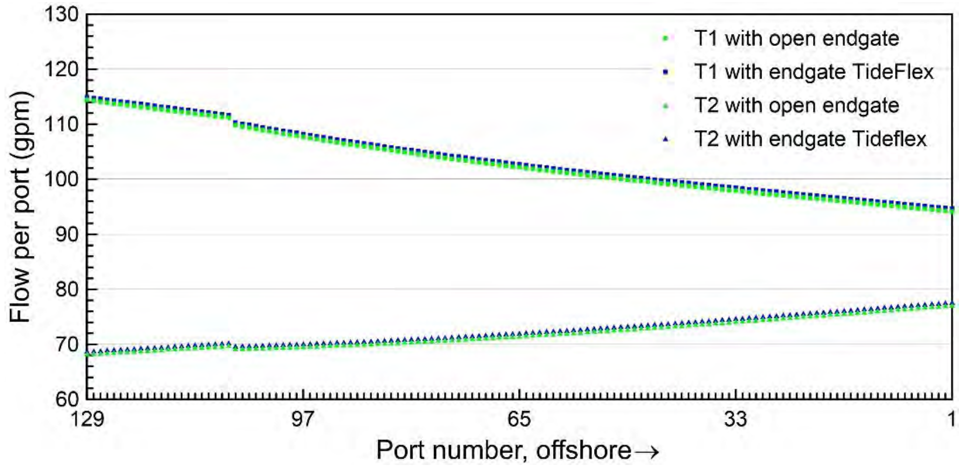


Figure 3. Typical port flow distributions with and without the endgate check valve for cases T1 and T2.

3.2 Effect of End Gate Valve on Dilution

The end gate check valve decreases the flow from the end gate and increases the flow from the two-inch ports. The dilution calculations later in this report assume the check valve is in place. To assess the effect of the valve on dilution from the main diffuser, dilutions were calculated for cases T1 and T2.

For T1, the total flow through the two-inch ports increased from 19.1 to 19.2 mgd (0.5%) and the port diameter increased from 2.00 to 2.01 inches. This had no effect on dilution (when rounded to a whole number).

For T2, the total flow through the two-inch ports increased from 13.4 to 13.5 mgd (0.8%) and the port diameter was unchanged at 1.84 inches. This had no effect on dilution (when rounded to a whole number).

4. Dense Discharge Dilution

4.1 Introduction

The calculation procedure was similar to that in Roberts (2016), where dilutions were predicted by two methods. First was the semi-empirical equation due to Cederwall (1968) (Eq. 3 in Roberts, 2016):

$$\frac{S_i}{F_j} = 0.54\left(0.66 + 0.38\frac{z}{dF_j}\right)^{5/3} \tag{2}$$

where S_i is the impact dilution, F_j the jet densimetric Froude number, and z the height of the nozzle above the seabed. Second, the dilution and trajectories of the jets were predicted by UM3, a Lagrangian entrainment model in the mathematical modeling suite Visual Plumes (Frick et al. 2003, Frick 2004, and Frick and Roberts 2016).

First, the internal hydraulics program was run to determine the flow variation along the diffuser. Dilutions were then computed for the flow and equivalent nozzle diameter for the innermost and outermost nozzles and the lowest dilution chosen. Worst-case oceanic conditions were assumed, which corresponds to the lowest oceanic density, the "Davidson" condition (Table 1), i.e. salinity = 33.34 ppt, density = 1024.8 kg/m^3.

4.2 Results

The results for the Project scenarios (Table 3) are summarized in Table 5, and for the Variant (Table 4) in Table 6. For large density differences, the Cederwall equation gives the lowest dilutions but as the effluent density approaches the ambient density, UM3 gives lower dilutions. To be conservative, the lowest of the two model predictions was chosen, as shown in last columns of Tables 5 and 6. The increase in dilution from the impact point to the edge of the BMZ was assumed to be 20% as discussed in Roberts (2016).

All dense discharges meet the Ocean Plan requirement of a 2 ppt increment in salinity at the edge of the BMZ.

Table 5. Summary of Dilution Simulations for Dense Effluent Scenarios – Project (no GWR)

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt
T2	14.08	58.10	1045.1	77.8	1.88	9.0	28.5	15.4	16.2	10.2	15.4	1.61	18.5	1.34
T3	15.08	54.30	1042.0	82.8	1.91	9.3	31.6	16.0	16.1	10.4	16.0	1.31	19.2	1.09
T4	16.08	50.97	1039.4	80.8	1.89	9.2	34.5	16.8	17.6	11.6	16.8	1.05	20.1	0.88
T5	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	17.7	18.5	12.7	17.7	0.83	21.2	0.69
T6	18.08	45.42	1034.9	91.6	1.95	9.8	43.4	18.8	19.5	13.8	18.8	0.64	22.5	0.54
T7	19.08	43.08	1033.0	97.1	1.98	10.1	49.2	20.1	20.9	15.3	20.1	0.48	24.2	0.40
T8	20.08	40.98	1031.3	103.1	2.01	10.4	56.5	21.9	22.2	16.8	21.9	0.35	26.3	0.29
T9	21.08	39.07	1029.7	108.7	2.02	10.9	67.4	24.8	24.9	19.2	24.8	0.23	29.7	0.19
T10	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	28.2	27.5	21.9	27.5	0.15	33.0	0.12
T11	23.08	35.76	1027.1	119.8	2.07	11.4	103.3	34.2	27.7	22.3	27.7	0.09	33.2	0.07
T12	24.08	34.30	1025.9	125.3	2.10	11.6	150.4	46.7	39.2	33.0	39.2	0.02	47.0	0.02
T15	16.41	58.12	1045.1	82.4	1.90	9.3	29.3	15.5	16.3	10.5	15.5	1.60	18.6	1.33
T16	17.41	54.83	1042.5	87.8	1.93	9.6	32.3	16.1	16.9	11.3	16.1	1.34	19.3	1.11
T17	18.41	51.89	1040.1	93.3	1.96	9.9	35.4	16.7	17.5	12.1	16.7	1.11	20.1	0.92
T18	19.41	49.26	1038.0	98.7	1.99	10.2	38.9	17.5	18.4	13.1	17.5	0.91	21.0	0.76
T19	20.41	46.89	1036.1	104.8	2.01	10.6	43.6	18.6	19.3	14.2	18.6	0.73	22.3	0.61
T20	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	19.6	20.4	15.4	19.6	0.58	23.6	0.48

Table 6. Summary of Dilution Simulations for Dense Effluent Scenarios – Variant

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
V1	9.0	58.23	1045.2	51.6	1.68	7.5	23.9	15.7	16.0	8.6	15.7	1.59	18.8	1.32
V2	10.0	52.48	1040.6	55.8	1.72	7.7	28.9	16.3	16.9	9.6	16.3	1.17	19.6	0.98
V3	11.0	47.78	1036.8	54.9	1.71	7.7	33.1	17.4	18.1	10.5	17.4	0.83	20.8	0.69
V4	12.0	43.86	1033.6	61.5	1.76	8.1	40.3	18.8	19.8	12.4	18.8	0.56	22.6	0.47
V5	13.0	40.55	1030.9	67.3	1.81	8.4	49.2	20.9	21.6	14.4	20.9	0.35	25.0	0.29
V6	14.0	37.70	1028.6	73.4	1.85	8.8	64.3	24.6	24.9	17.5	24.6	0.18	29.5	0.15
V7	14.8	35.71	1027.0	76.8	1.87	9.0	86.0	30.3	29.4	21.4	29.4	0.08	35.3	0.07
V8	16.0	33.09	1024.9	76.3	1.87	8.9	382.9	110.2	67.6	51.4	67.6	0.00	81.1	0.00
V16	10.2	52.19	1040.3	56.8	1.72	7.8	29.7	16.5	17.3	9.9	16.5	1.14	19.8	0.95
V17	11.2	47.59	1036.6	56.1	1.72	7.8	33.6	17.4	18.3	10.8	17.4	0.82	20.9	0.68
V18	12.2	43.74	1033.5	63.5	1.79	8.1	40.1	18.7	19.3	12.3	18.7	0.56	22.4	0.46
V19	13.2	40.48	1030.9	68.3	1.81	8.5	50.3	21.1	21.8	14.5	21.1	0.34	25.4	0.28
V20	14.2	37.67	1028.6	73.8	1.85	8.8	65.0	24.8	24.9	17.5	24.8	0.17	29.8	0.15
V21	15.2	35.24	1026.6	80.9	1.89	9.3	97.2	33.2	31.7	23.5	31.7	0.06	38.0	0.05
V22	15.5	34.57	1026.1	79.8	1.89	9.1	114.2	37.7	34.3	25.6	34.3	0.04	41.2	0.03
V23	16.2	33.11	1024.9	83.3	1.91	9.3	395.8	113.5	68.5	53.5	68.5	0.00	82.2	0.00
V27	9.9	53.27	1041.2	55.3	1.71	7.7	28.5	16.3	16.9	9.5	16.3	1.22	19.6	1.02

Table 6. Summary of Dilution Simulations for Dense Effluent Scenarios – Variant

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
V28	10.9	48.47	1037.3	59.3	1.75	7.9	33.1	17.1	17.8	10.7	17.1	0.88	20.6	0.74
V29	12.9	41.09	1031.4	67.0	1.80	8.5	48.1	20.6	21.1	13.9	20.6	0.38	24.7	0.31
V30	15.2	35.01	1026.4	78.3	1.88	9.1	100.6	34.1	32.6	24.1	32.6	0.05	39.1	0.04
V32	11.2	58.23	1045.2	63.3	1.78	8.2	26.5	15.4	16.1	9.3	15.4	1.61	18.5	1.34
V33	11.7	55.78	1043.3	57.1	1.73	7.8	27.0	15.8	16.5	9.2	15.8	1.42	19.0	1.18
V34	12.2	53.54	1041.4	67.3	1.81	8.4	29.9	16.1	16.8	10.3	16.1	1.26	19.3	1.05
V35	13.2	49.55	1038.2	66.4	1.80	8.4	33.3	16.9	17.8	11.0	16.9	0.96	20.3	0.80
V36	14.2	46.13	1035.5	72.7	1.84	8.8	38.8	18.1	19.0	12.4	18.1	0.71	21.7	0.59
V37	15.2	43.16	1033.0	78.9	1.88	9.1	45.3	19.6	20.3	13.9	19.6	0.50	23.5	0.42
V38	16.2	40.55	1030.9	85.0	1.92	9.4	53.7	21.5	22.0	15.8	21.5	0.33	25.9	0.28
V39	12.4	53.29	1041.2	61.5	1.76	8.1	29.5	16.2	17.0	10.0	16.2	1.23	19.5	1.02
V40	12.9	51.25	1039.6	64.5	1.79	8.2	31.3	16.5	17.3	10.5	16.5	1.09	19.8	0.91
V41	13.4	49.37	1038.0	67.6	1.81	8.4	33.7	17.0	17.8	11.1	17.0	0.95	20.4	0.79
V42	14.4	46.00	1035.3	73.9	1.85	8.8	39.1	18.1	18.8	12.4	18.1	0.70	21.7	0.58
V43	15.4	43.07	1033.0	80.0	1.89	9.2	45.6	19.6	20.2	14.0	19.6	0.50	23.5	0.41
V44	16.4	40.49	1030.9	85.8	1.92	9.5	54.4	21.7	22.3	16.0	21.8	0.33	26.1	0.27
V45	17.4	38.21	1029.0	90.3	1.95	9.7	66.0	24.7	24.7	18.4	24.7	0.20	29.6	0.16

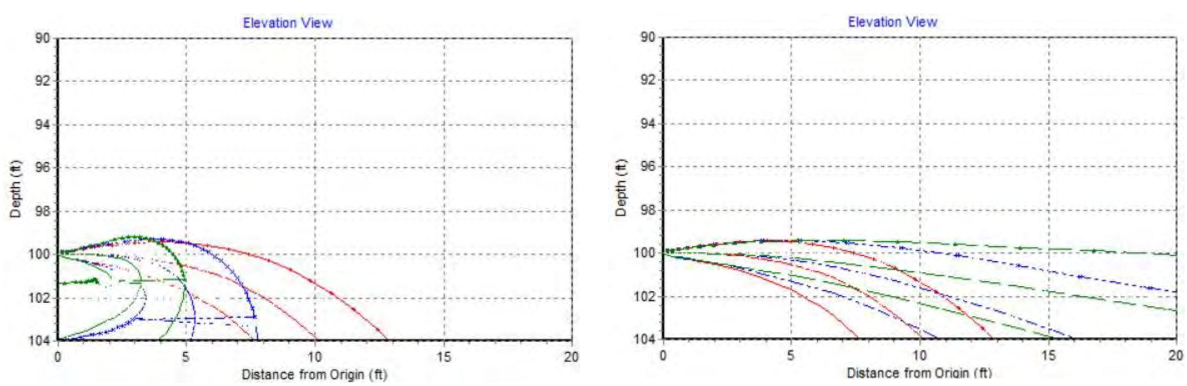
4.3 Effect of Currents

The effect of currents on the dynamics of dense jets has been questioned. All simulations have been done with zero current speed, as this is usually the worst case that results in lowest dilutions. According to the Research Activity Panel of the Monterey Bay National Marine Sanctuary, currents in the vicinity of the diffuser are commonly 5 to 10 cm/s and can reach 20 cm/s.

The effect of currents on dense jets is determined by the dimensionless parameter $u_r F_j$ (Gungor and Roberts 2009) where $u_r = u_a/u$ is the ratio of the ambient current speed, u_a, to the jet velocity, u. If $u_r F_j \ll 1$ the current does not significantly affect the jet; if $u_r F_j \gg 1$ the jet will be significantly deflected by the current and dilution increases significantly. Gungor and Roberts (2009) investigated the effects of currents on vertical dense jets; experiments on multiport diffusers with 60° nozzles were reported by Abessi and Roberts (2017).

There are no known experiments on horizontal dense jets in flowing currents so we investigated the phenomenon using the UM3 model in Visual Plumes. We simulated the pure brine case, T2 (Table 3) at current speeds of zero, 5, 10, and 20 cm/s. Because of the orientation of the MRWPCA diffuser (see Figure 1 of Roberts 2016) the predominant current direction is expected to be perpendicular to the diffuser axis. The nozzles are perpendicular to the diffuser, so the current direction relative to the individual jets is either counter-flow (jets directly opposing the current), or co-flow (jets in the same direction as the currents.

UM3 was run for all cases. Screen shots of the jet trajectories for counter- and co-flowing jets are shown in Figure 4.



a) Counter-flow **b) Co-flow**

Figure 4. Screen shots of UM3 simulations of dense jet trajectories (Case T2) in counter- and co-flowing currents. Red: zero current; Blue: 10 cm/s; Green: 20 cm/s.

In counter flowing currents, the jets are bent backwards and impact the seabed closer to the diffuser. In co-flowing currents, the jets are advected downstream and impact the seabed farther from the diffuser. The numerical results are summarized in Table 7.

Table 7. UM3 Simulations of Case T2 with Current

Current	Counter-flow		Co-flow	
Speed (cm/s)	Dilution	Impact distance (ft)	Dilution	Impact distance (ft)
0	16.2	10	16.2	10
5	17.3	8	22.6	13
10	18.9	5	38.4	16
20	32.6	0	78.0	27

It can be seen that the effect of the currents is to increase dilution compared to the zero current case. The maximum impact distance from the diffuser occurs with co-flowing currents and increases as the current speed increases. In this case, the maximum impact distance (for u_a = 20 cm/s) is 27 ft (8.2 m). Clearly, this is much less than the distance to the edge of the BMZ (100 m) so we conclude that neglecting the effect of currents is indeed conservative, and the Ocean Plan regulations will be met for all anticipated currents.

4.4 Dilution of End Gate Check Valve

As discussed in Section 3, it has been proposed to replace the opening in the end gate with a 6-inch Tideflex check valve. We simulated the dilution of this valve for various nozzle angles for the worst case of pure brine, T2 (Table 3). The flow distributions along the diffuser for this case were shown in Figure 3. The exit velocity from the end gate check valve is 9.7 ft/s and the equivalent round diameter is 4.1 inches, yielding a densimetric Froude number, F_j = 20.7.

The effect of nozzle angle on the dilution of dense jets is discussed in Section 6.2. Using Figure 6, the impact dilutions for various angles were calculated. The results are summarized in Table 8.

The corresponding dilution for the main diffuser nozzles is 15.4 (Table 5). It is therefore apparent that any nozzle angle greater than about 20° will result in dilutions greater than the main diffuser and will meet the BMZ requirements. Dilution is maximized for a 60° nozzle.

Table 8. Effect of Nozzle Angle on Impact Dilution for Flow from End Gate Check Valve for Case T2 (14.08 mgd, 1045.1 kg/m^3).

Nozzle angle (Degrees)	Impact dilution
0	8.9
10	12.3
20	18.9
30	25.6
40	31.6
50	35.7
60	36.9

5. BUOYANT DISCHARGE DILUTION

5.1 Introduction

The same procedures and models discussed in Roberts (2016) were used except that all three seasonal profiles were used for each flow scenario to determine the worst-case condition. Inspection of Tables 3 and 4 show that there are 14 cases of buoyant discharges, i.e., the effluent density is less than the receiving water density. Three are for the Project and 11 for the Variant. Two models in the US EPA modeling suite Visual Plumes were used: NRFIELD and UM3. Zero current speed was assumed in all cases.

5.2 Results

The following procedure was used: The internal hydraulics program was first run for each scenario and the average diameter and flow for each nozzle was obtained. UM3 and NRFIELD were then run for each oceanic season.

As was observed in Roberts (2016), for very buoyant cases, the average dilution predicted by UM3 is close to the minimum (centerline) dilution predicted by NRFIELD. They diverge as the effluent becomes only slightly buoyant (i.e. the effluent density approaches the ambient density), with UM3 dilutions being considerably higher.

NRFIELD is based on experiments conducted for parameters typical of domestic wastewater discharges into coastal waters and estuaries. For this situation, dilution and mixing are mainly dependent on the source buoyancy flux with momentum flux playing a minor role. As the effluent density approaches the background density, buoyancy becomes less important and the mixing becomes dominated by momentum. In that situation, NRFIELD continues to give predictions but issues a warning that "The results are extrapolated" when the parameters are outside the range of the original experiments. Table 9 summarizes the results; NRFIELD predictions are only given when they fall within the experimental range on which it is based.

The plume behavior depends strongly on the shape of the density profile (Figure 1) but dilutions are generally very high. The Upwelling profile always gives deepest submergence and lowest dilutions. The plumes are always submerged with the Upwelling and Oceanic profiles but some plumes surface with the weak Davidson stratification. Dilutions are very high for surfacing plumes, up to 842 (Case V12) when the flow is very low.

Table 9. Summary of Dilution Simulations for Buoyant Effluent Scenarios – Project and Variant

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height (centerline) (ft)	Minimum dilution	Rise height (centerline) (ft)	Rise height (top) (ft)
T1	Upwelling	19.88	1.00	999.0	103.7	2.01	10.5	27.9	188	57	179	41	57
	Davidson								327	100	349	100	100
	Oceanic								239	80	238	50	72
T13	Upwelling	29.08	28.54	1021.2	151.6	2.18	13.0	80.6	93	28			
	Davidson								127	57			
	Oceanic								94	27			
T14	Upwelling	33.86	24.63	1018.1	176.4	2.25	14.2	66.7	99	36			
	Davidson								147	76			
	Oceanic								104	41			
V9	Upwelling	22.99	23.26	1017.0	119.6	2.10	11.1	50.3	110	37			
	Davidson								172	75			
	Oceanic								116	42			
V10	Upwelling	28.77	18.75	1013.3	149.9	2.18	12.9	48.3	118	44	100	39	41
	Davidson								202	96	215	97	100
	Oceanic								132	58	134	57	59
V11	Upwelling	1.17	5.80	1002.6	6.5	0.71	5.3	25.4	495	30			
	Davidson								974	48			
	Oceanic								549	35			
V12	Upwelling	1.57	4.53	1001.6	8.4	0.81	5.2	23.1	457	31	385	25	32
	Davidson								842	50	652	33	45
	Oceanic								520	37	460	28	36

Table 9. Summary of Dilution Simulations for Buoyant Effluent Scenarios – Project and Variant

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height (centerline) (ft)	Minimum dilution	Rise height (centerline) (ft)	Rise height (top) (ft)
V13	Upwelling	4.17	2.20	999.9	21.7	1.24	5.8	19.9	324	39	301	30	40
	Davidson								547	66	687	51	74
	Oceanic								376	47	378	35	47
V14	Upwelling	24.87	1.04	999.0	129.6	2.11	11.9	30.9	174	60	165	56	59
	Davidson								290	100	301	67	100
	Oceanic								223	86	235	55	81
V15	Upwelling	25.87	1.03	999.0	134.8	2.13	12.1	31.4	172	60	163	57	59
	Davidson								281	100	293	67	100
	Oceanic								221	87	232	56	82
V24	Upwelling	17.16	31.23	1023.4	89.3	1.94	9.7	87.3	91	20			
	Davidson								131	46			
	Oceanic								91	18			
V25	Upwelling	21.16	25.48	1018.7	109.8	2.03	10.9	56.2	107	33			
	Davidson								159	65			
	Oceanic								111	37			
V26	Upwelling	26.08	20.82	1015.0	135.6	2.13	12.2	49.7	115	41			
	Davidson								191	89			
	Oceanic								124	49			
V31	Upwelling	25.85	20.95	1015.1	134.4	2.13	12.1	49.5	115	41			
	Davidson								191	89			
	Oceanic								124	49			

6. Dilution Mitigation – Effect of Nozzle Angle

6.1 Introduction

Orienting the nozzles upwards from horizontal will increase the dilution of brine mixtures that are more dense than the receiving water. For buoyant effluents, it will decrease dilution slightly. In this section, we investigate the effect on dilution of varying nozzle orientations for dense and buoyant effluents.

6.2 Dense Effluents

The effect of nozzle angle on dense jets has been recently investigated by Abessi and Roberts (2015). Figure 5 shows central plane tracer concentrations (inverse of dilution) obtained by laser-induced fluorescence for dense jets with angles ranging from 15° to 85°. For very shallow angles, e.g. 15°, the jet impacts the bed quickly, reducing dilution. For steep angles, e.g. 85°, the trajectory is also truncated and the jet falls back on itself, which also reduces dilution.

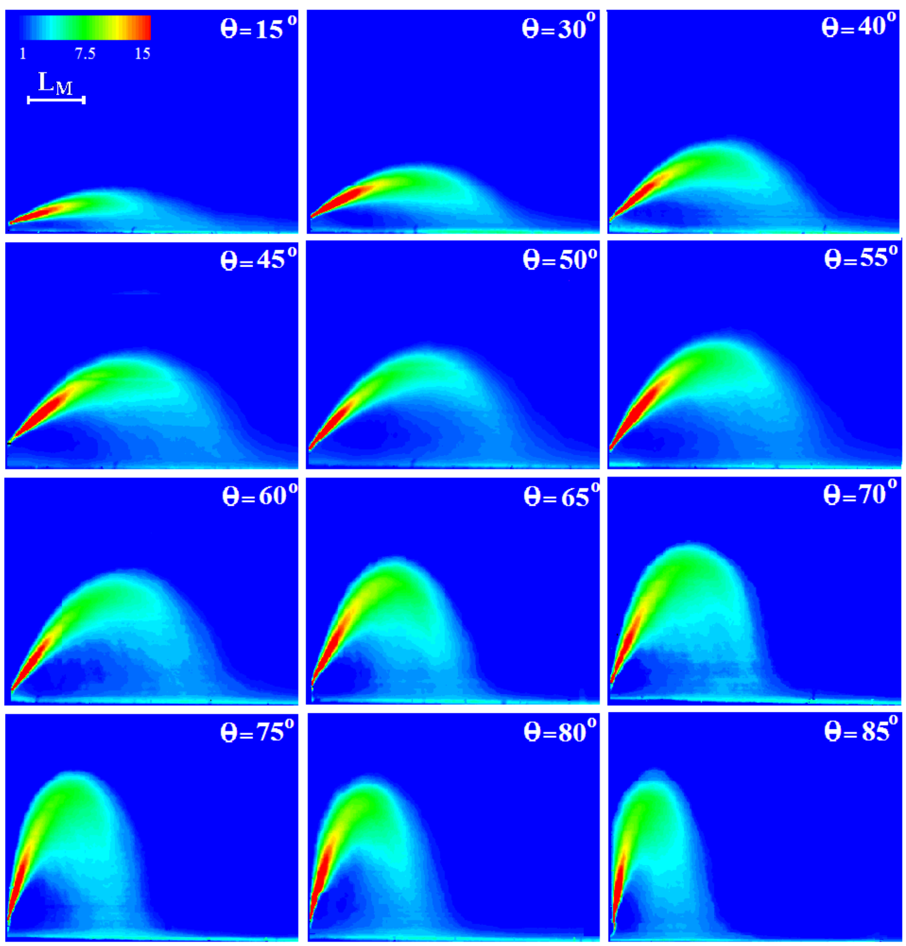


Figure 5. Central plane tracer concentrations for dense jets at various nozzle angles from 15° to 85°. After Abessi and Roberts (2015).

The optimum angle for dilution is 60°. This is illustrated by Figure 6, which shows the variation with nozzle angle on normalized impact dilution (S_i/F_j) and near field dilution (S_n/F_j) for single jets.

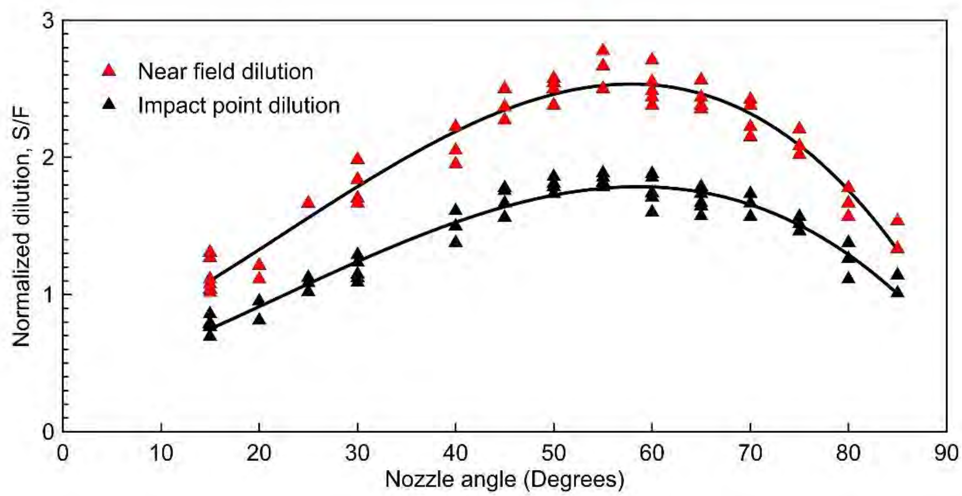


Figure 6. Effect of nozzle angle on normalized dilution of dense jets. After Abessi and Roberts (2015).

Impact dilutions were computed for the "worst-case" of brine only (T2, for conditions, see Table 3) using Figure 6. The results are tabulated in Table 10 and plotted in Figure 7. The effect of the height of the nozzle above the seabed, z, is determined by the dimensionless parameter z/dF_j, where d is the nozzle diameter. For Monterey, the nozzles are four feet above the seabed, so for case T2 we have $z/dF_j \approx 0.93$. The experiments of Abessi and Roberts were done with nozzles closer to the bed, with h/dF_j ranging from 0.12 to 0.39, so actual dilutions are expected to be higher than predicted in Table 10.

Dilution calculations with UM3 are also shown for completeness with other simulations. However, it is known that UM3 considerably underestimates dilutions for inclined jets (Palomar et al. 2012), therefore only the Abessi and Roberts results are used.

Table 10. Effect of Nozzle Angle on Dense Jets Case T2.
(for conditions, see Table 3)

Case ID	Nozzle angle	Dilution predictions				At impact		At BMZ	
		Cederwall	Abessi and Roberts (2015a)		UM3	Dilution	Salinity increment	Dilution	Salinity increment
	(deg)	Impact	Impact	Near field	Impact		(ppt)		(ppt)
T2	0	15.4	-	-	16.1	15.4	1.61	18.5	1.34
	10	-	16.9	25.2	18.7	16.9	1.47	20.3	1.22
	20	-	25.9	37.8	20.9	25.9	0.95	31.1	0.80
	30	-	35.3	50.8	22.8	35.3	0.70	42.3	0.59
	40	-	43.4	62.3	24.3	43.4	0.57	52.1	0.48
	50	-	49.0	70.0	24.5	49.0	0.50	58.9	0.42
	60	-	50.7	71.9	24.4	50.7	0.49	60.9	0.41

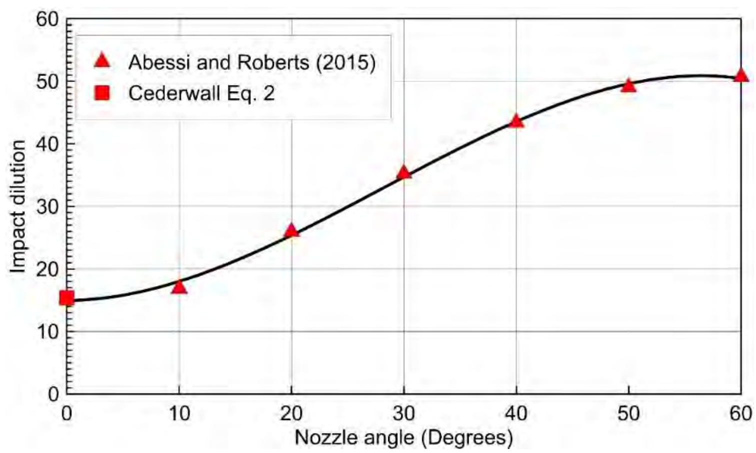


Figure 7. Effect of nozzle angle on dilution of dense jets, case T2.

Increasing the angle from horizontal (0°) to 60° increases dilution considerably, from 15 to 51. A 30° angle more than doubles the dilution compared to the horizontal jets.

The dilution at the BMZ is computed as 120% of the impact dilution. Note that in Table 10 the increase in dilution from the impact point to the end of the near field is more than 20%. This result, however, is for a single jet, and the increase for merged jets is less than this, and is conservatively assumed to be 20%, as explained in Roberts (2016).

6.3 Buoyant Effluents

Diffusers for buoyant effluents are usually designed with horizontal nozzles to maximize the length of the jet trajectory up to the terminal rise height, and therefore maximize dilution. Inclining the nozzles upwards will usually reduce dilution, although for very buoyant discharges in deep water the effect may be minimal. This is because the dynamics are then buoyancy dominated and the effect of momentum flux and therefore nozzle orientation is unimportant.

For very buoyant discharges, NRFIELD is the preferred model. NRFIELD, however, assumes the nozzles to be horizontal, so UM3 was used to assess the effect of nozzle orientation.

Simulations were run with UM3 for selected cases to bracket the expected results. The chosen cases were for the project scenarios (Table 3): T1 (mainly pure secondary effluent) and T13 (brine plus high secondary effluent). The latter case is only slightly buoyant and resulted in the lowest dilution of the buoyant cases. The simulations were run only for the oceanic conditions that gave the highest dilutions (Upwelling) and lowest dilutions (Davidson).

The results are summarized in Table 11 and plotted in Figure 8.

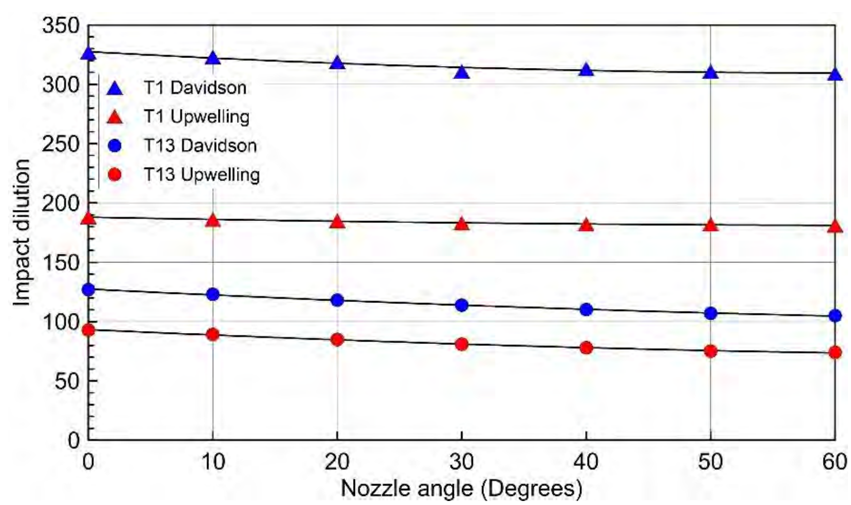


Figure 8. Effect of nozzle angle on dilution for selected buoyant discharge scenarios.

The results are insensitive to nozzle angle, especially for the very buoyant case of mainly pure secondary effluent (T1). Changing the nozzles from horizontal to 60° for the Davidson condition reduces dilution from 327 to 309, and for Upwelling condition from 188 to 181. For case T13 the corresponding reductions are from 127 to 105 and from 93 to 75. The percentage reductions for T13 are greater due to the increased effect of momentum flux, and therefore nozzle angle. More modest changes in orientation result in lesser effect; for a 30° nozzle the dilution reductions range from 3 to 13%.

Table 11. Effect of nozzle Angle on Dilution for Selected Buoyant Effluent Scenarios

Case ID	Oceanic Season	Effluent conditions			Nozzle angle	UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density	(deg)	Average dilution	Rise height (centerline) (ft)
T1	Upwelling	19.88	1.00	999.0	0	188	57
					10	186	58
					20	185	58
					30	183	59
					40	182	60
					50	182	61
					60	181	61
T1	Davidson	19.88	1.00	999.0	0	327	100
					10	323	100
					20	319	100
					30	311	100
					40	313	100
					50	311	100
					60	309	100
T13	Upwelling	29.08	28.54	1021.2	0	93	28
					10	89	29
					20	85	30
					30	81	31
					40	78	33
					50	75	35
					60	74	37
T13	Davidson	29.08	28.54	1021.2	0	127	57
					10	123	57
					20	118	57
					30	114	58
					40	110	60
					50	107	61
					60	105	63

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APPENDIX A. DENSITY PROFILES

The seasonally averaged density profiles assumed for modeling purposes are summarized below.

Depth (m)	Density (kg/m^3)		
	Upwelling	Davidson	Oceanic
1	1025.1	1024.8	1024.8
3	1025.1	1024.8	1024.8
5	1025.1	1024.8	1024.8
7	1025.2	1024.8	1024.8
9	1025.2	1024.8	1024.8
11	1025.3	1024.8	1024.8
13	1025.4	1024.8	1024.9
15	1025.4	1024.8	1024.9
17	1025.5	1024.8	1024.9
19	1025.6	1024.9	1024.9
21	1025.6	1024.9	1025.0
23	1025.7	1024.9	1025.0
25	1025.7	1024.9	1025.0
27	1025.8	1024.9	1025.1
29	1025.8	1024.9	1025.1
31	1025.8	1024.9	1025.2
33	1025.9	1024.9	1025.2
35	1025.9	1024.9	1025.3

APPENDIX B. ADDITIONAL SCENARIOS

In a memorandum from Trussell Technologies, Inc. dated July 21, 2017, dilution simulations for some additional scenarios were requested. They were contained in table 9 of that memo, which is reproduced below.

Table 9 –Proposed Flow Scenarios for Additional Modeling

No.	RTP Secondary Effluent	Hauled Waste	GWR Concentrate	Desal Brine	Ocean Condition[1]
MPWSP with high Desal Brine flow					
1	6	0	--	16.31	All
2	7	0	--	16.31	All
3	8	0	--	16.31	All
4	9	0	--	16.31	All
5	10	0	--	16.31	All
6	12	0	--	16.31	All
7	14	0	--	16.31	All
8	16	0	--	16.31	All
Variant with Desal Off					
9	8	0	1.17	0	All
Variant with GWR Concentrate off and high Desal Brine flow					
10	6	0	--	11.24	All
11	7	0	--	11.24	All
12	8	0	--	11.24	All
13	9	0	--	11.24	All
14	10	0	--	11.24	All
15	12	0	--	11.24	All
16	14	0	--	11.24	All
17	16	0	--	11.24	All
Variant with high Desal Brine flow					
18	6	0	1.17	11.24	All
19	7	0	1.17	11.24	All
20	8	0	1.17	11.24	All
21	9	0	1.17	11.24	All
22	10	0	1.17	11.24	All
23	12	0	1.17	11.24	All
24	14	0	1.17	11.24	All
25	16	0	1.17	11.24	All

1: All ocean conditions should be modeled when using the UM3 and NRFIELD models. For dense plumes that are modeled with Cederwall and UM3, the worst-case ocean condition should be used.

The flow conditions for these additional scenarios are summarized in Table B1. Dilutions were simulated according to the same procedures as outlined in Sections 4 and 5. The results for dense discharges are summarized in Table B2 and for buoyant discharges in Table B3.

Table B1. Additional Modeled Discharge Scenarios

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
AT1	MPWSP with high desal brine flow	16.31	6.00	0.00	0.0	22.31	42.78	1032.7
AT2		16.31	7.00	0.00	0.0	23.31	40.98	1031.3
AT3		16.31	8.00	0.00	0.0	24.31	39.33	1030.0
AT4		16.31	9.00	0.00	0.0	25.31	37.81	1028.7
AT5		16.31	10.00	0.00	0.0	26.31	36.40	1027.6
AT6		16.31	12.00	0.00	0.0	28.31	33.89	1025.6
AT7		16.31	14.00	0.00	0.0	30.31	31.70	1023.8
AT8		16.31	16.00	0.00	0.0	32.31	29.79	1022.2
AV9	Variant with desal off	0.00	8.00	1.17	0.0	9.17	1.44	999.3
AV10	Variant with GWR concentrate off and high desal brine flow	11.24	6.00	0.00	0.0	17.24	38.24	1029.1
AV11		11.24	7.00	0.00	0.0	18.24	36.19	1027.4
AV12		11.24	8.00	0.00	0.0	19.24	34.35	1025.9
AV13		11.24	9.00	0.00	0.0	20.24	32.69	1024.6
AV14		11.24	10.00	0.00	0.0	21.24	31.19	1023.4
AV15		11.24	12.00	0.00	0.0	23.24	28.58	1021.3
AV16		11.24	14.00	0.00	0.0	25.24	26.38	1019.5
AV17		11.24	16.00	0.00	0.0	27.24	24.50	1018.0
AV18	Variant with high desal brine flow	11.24	6.00	1.17	0.0	18.41	36.18	1027.4
AV19		11.24	7.00	1.17	0.0	19.41	34.36	1025.9
AV20		11.24	8.00	1.17	0.0	20.41	32.71	1024.6
AV21		11.24	9.00	1.17	0.0	21.41	31.22	1023.4
AV22		11.24	10.00	1.17	0.0	22.41	29.87	1022.3
AV23		11.24	12.00	1.17	0.0	24.41	27.48	1020.4
AV24		11.24	14.00	1.17	0.0	26.41	25.46	1018.7
AV25		11.24	16.00	1.17	0.0	28.41	23.73	1017.3

Table B2. Summary of Dilution Simulations for Dense Additional Scenarios

Case ID	Effluent conditions			Port conditions				Predictions			At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Impact distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
AT1	22.3	42.78	1032.7	116.0	2.06	11.2	57.9	22.1	21.4	16.6	21.4	0.42	25.7	0.35
AT2	23.3	40.98	1031.3	120.7	2.08	11.4	60.7	22.8	22.8	18.1	22.8	0.34	27.4	0.28
AT3	24.3	39.33	1030.0	125.5	2.10	11.6	69.2	25.0	24.5	19.8	24.5	0.24	29.4	0.20
AT4	25.3	37.81	1028.7	130.3	2.11	12.0	81.4	28.2	27.2	22.3	27.2	0.16	32.6	0.14
AT5	26.3	36.40	1027.6	135.1	2.13	12.2	97.8	32.5	30.2	25.3	30.2	0.10	36.2	0.08
AT6	28.3	33.89	1025.6	144.7	2.16	12.7	195.3	58.6	44.9	39.0	44.9	0.01	53.9	0.01
AV10	17.2	38.24	1029.1	89.4	1.94	9.7	66.0	24.7	24.6	18.2	24.6	0.20	29.5	0.17
AV11	18.2	36.19	1027.4	93.6	1.96	10.0	86.1	30.0	28.8	22.0	28.8	0.10	34.6	0.08
AV12	19.2	34.35	1025.9	98.4	1.99	10.2	133.0	42.4	37.4	29.7	37.4	0.03	44.9	0.02
AV18	18.4	36.18	1027.4	94.7	1.97	10.0	86.4	30.0	28.7	22.0	28.7	0.10	34.4	0.08
AV19	19.4	34.36	1025.9	99.5	1.99	10.3	135.0	42.9	37.6	29.8	37.6	0.03	45.1	0.02

Table B3. Summary of Dilution Simulations for Buoyant Additional Scenarios

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height centerline (ft)	Minimum dilution	Rise height centerline (ft)	Rise height top (ft)
AT7	Upwelling	30.31	31.70	1023.8	157.8	2.20	13.3	123.3	88	19			
	Davidson								120	45			
	Oceanic								90	17			
AT8	Upwelling	32.31	29.79	1022.2	179.2	2.26	14.3	98.6	90	26			
	Davidson								118	53			
	Oceanic								88	23			
AV9	Upwelling	9.17	1.44	999.3	55.9	1.72	7.7	22.4	244	48	234	35	48
	Davidson								467	100	584	67	100
	Oceanic								309	66	315	42	60
AV13	Upwelling	20.24	32.69	1024.6	108.9	2.03	10.8	133.6	91	17			
	Davidson								100	15			
	Oceanic								138	41			
AV14	Upwelling	21.24	31.19	1023.4	114.9	2.06	11.1	96.5	88	20			
	Davidson								124	47			
	Oceanic								88	18			
AV15	Upwelling	23.24	28.58	1021.3	126.9	2.08	12.0	76.2	96	28			
	Davidson								133	55			
	Oceanic								95	26			
AV16	Upwelling	25.24	26.38	1019.5	138.7	2.11	12.7	68.1	100	32			
	Davidson								144	64			
	Oceanic								104	35			
AV17	Upwelling	27.24	24.50	1018.0	151.1	2.15	13.4	63.6	103	36			
	Davidson								155	73			
	Oceanic								109	41			

Table B3. Summary of Dilution Simulations for Buoyant Additional Scenarios

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height centerline (ft)	Minimum dilution	Rise height centerline (ft)	Rise height top (ft)
AV20	Upwelling	20.41	32.71	1024.6	110.1	2.02	11.0	136.9	92	17			
	Davidson								139	41			
	Oceanic								101	15			
AV21	Upwelling	21.41	31.22	1023.4	116.1	2.02	11.6	102.6	91	20			
	Davidson								126	64			
	Oceanic								91	18			
AV22	Upwelling	22.41	29.87	1022.3	116.4	2.06	11.2	81.3	93	24			
	Davidson								128	51			
	Oceanic								90	21			
AV23	Upwelling	24.41	27.48	1020.4	134.0	2.10	12.4	71.8	98	30			
	Davidson								138	59			
	Oceanic								101	31			
AV24	Upwelling	26.41	25.46	1018.7	145.8	2.14	13.0	65.4	101	34			
	Davidson								149	68			
	Oceanic								106	38			
AV25	Upwelling	28.4	23.73	1017.3	157.6	2.17	13.7	62.3	105	37			
	Davidson								161	78			
	Oceanic								110	43			

APPENDIX C. EFFECT OF NOZZLE ANGLE ON DILUTION

In order to further investigate the effect of nozzle angle on dilution for various scenarios, additional model runs were undertaken for horizontal and 60° nozzles. Most were previously analyzed cases, whose flow properties are given in Tables 3 and 4. Table C1 summarizes the properties of the new cases.

Dilutions were simulated according to the same procedures as outlined in Sections 4 and 5. Table C2 summarizes the results for dense discharges. For the buoyant cases, only Upwelling and Davidson conditions were run to bracket the expected results. Because NRFIELD only allows for horizontal nozzles, only results for UM3 are shown in Table C3.

Table C1. Further Modeled Discharge Scenarios

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
1	GWR only	0.00	0.00	1.17	0.0	1.17	5.80	1002.6
5		0.00	0.40	1.17	0.0	1.57	4.53	1001.6
7		0.00	0.60	1.17	0.0	1.77	4.11	1001.3
12		0.00	2.00	1.17	0.0	3.17	2.65	1000.2
16		0.00	4.00	1.17	0.0	5.17	1.93	999.7
17		0.00	4.50	1.17	0.0	5.67	1.83	999.6
18		0.00	5.00	1.17	0.0	6.17	1.75	999.5
32		0.00	23.40	1.17	0.0	24.57	1.04	999.0
New	Variant with normal flows and GWR offline	8.99	10.00	0.00	0.0	18.99	27.99	1020.8
New2		8.99	6.50	1.17	0.0	16.66	32.14	1024.1
New3		8.99	7.00	1.17	0.0	17.16	31.23	1023.4

Table C2. Summary of Dilution Simulations for Dense Scenarios

Case ID	Nozzle angle (deg)	Effluent conditions			Port conditions				Impact dilution predictions			At impact (ZID)		AT BMZ	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (in.)	Velocity (ft/s)	Froude no.	Cederwall	Abessi & Roberts 2015a	UM3	Dilution	Salinity incr-ement (ppt)	Dilution	Salinity incr-ement (ppt)
T5	0	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	17.7	-	18.5	17.7	0.83	21.2	0.69
	60	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	-	68.9	-	68.9	0.21	82.6	0.18
T10	0	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	28.2	-	27.5	27.5	0.15	33.0	0.12
	60	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	-	143.7	-	143.7	0.03	172.4	0.02
T20	0	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	19.6	-	20.4	19.6	0.58	23.6	0.48
	60	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	-	85.7	-	85.7	0.13	102.8	0.11
AT6	0	28.31	33.89	1025.6	144.7	2.16	12.7	194.0	58.3	-	44.9	44.9	0.01	53.9	0.01
	60	28.31	33.89	1025.6	144.7	2.16	12.7	194.0	-	345.6	-	345.6	0.00	414.8	0.00
V2	0	9.99	52.48	1040.6	55.8	1.72	7.7	28.9	16.3	-	16.9	16.3	1.17	19.6	0.98
	60	9.99	52.48	1040.6	55.8	1.72	7.7	28.9	-	51.5	-	51.5	0.37	61.9	0.31
V4	0	11.99	43.86	1033.6	61.5	1.76	8.1	40.3	18.8	-	19.8	18.8	0.56	22.6	0.47
	60	11.99	43.86	1033.6	61.5	1.76	8.1	40.3	-	71.8	-	71.8	0.15	86.1	0.12
V6	0	13.99	37.70	1028.6	73.4	1.85	8.8	64.3	24.6	-	24.9	24.6	0.18	29.5	0.15
	60	13.99	37.70	1028.6	73.4	1.85	8.8	64.3	-	114.6	-	114.6	0.04	137.5	0.03
V8	0	15.99	33.09	1024.9	76.3	1.87	8.9	382.9	110.2	-	67.6	67.6	0.00	81.1	0.00
	60	15.99	33.09	1024.9	76.3	1.87	8.9	382.9	-	682.3	-	682.3	0.00	818.8	0.00
V16	0	10.16	52.19	1040.3	56.8	1.72	7.8	29.7	16.5	-	17.3	16.5	1.14	19.8	0.95
	60	10.16	52.19	1040.3	56.8	1.72	7.8	29.7	-	52.9	-	52.9	0.36	63.5	0.30
V17	0	11.16	47.59	1036.6	56.1	1.72	7.8	33.6	17.4	-	18.3	17.4	0.82	20.9	0.68
	60	11.16	47.59	1036.6	56.1	1.72	7.8	33.6	-	59.9	-	59.9	0.24	71.9	0.20
V19	0	13.16	40.48	1030.9	68.3	1.81	8.5	50.3	21.1	-	21.8	21.1	0.34	25.4	0.28
	60	13.16	40.48	1030.9	68.3	1.81	8.5	50.3	-	89.6	-	89.6	0.08	107.6	0.07
V22	0	15.46	34.57	1026.1	79.8	1.89	9.1	114.2	37.7	-	34.3	34.3	0.04	41.2	0.03
	60	15.46	34.57	1026.1	79.8	1.89	9.1	114.2	-	203.5	-	203.5	0.01	244.2	0.01
V23	0	16.16	33.11	1024.9	83.3	1.91	9.3	395.8	113.5	-	68.5	68.5	0.00	82.2	0.00
	60	16.16	33.11	1024.9	83.3	1.91	9.3	395.8	-	705.4	-	705.4	0.00	846.5	0.00

Table C2. Summary of Dilution Simulations for Dense Scenarios

Case ID	Nozzle angle (deg)	Effluent conditions			Port conditions				Impact dilution predictions			At impact (ZID)		AT BMZ	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (in.)	Velocity (ft/s)	Froude no.	Cederwall	Abessi & Roberts 2015a	UM3	Dilution	Salinity incr-ement (ppt)	Dilution	Salinity incr-ement (ppt)
V32	0	11.24	58.23	1045.2	63.3	1.78	8.2	26.5	15.4	-	16.1	15.4	1.61	18.5	1.34
	60	11.24	58.23	1045.2	63.3	1.78	8.2	26.5	-	47.2	-	47.2	0.53	56.6	0.44
V36	0	14.24	46.13	1035.5	72.7	1.84	8.8	38.8	18.1	-	19.0	18.1	0.71	21.7	0.59
	60	14.24	46.13	1035.5	72.7	1.84	8.8	38.8	-	69.1	-	69.1	0.19	82.9	0.15
AV10	0	17.24	38.24	1029.1	89.4	1.94	9.7	65.9	24.7	-	27.5	24.7	0.20	29.6	0.17
	60	17.24	38.24	1029.1	89.4	1.94	9.7	65.9	-	117.4	-	117.4	0.04	140.9	0.03
AV12	0	19.24	34.35	1025.9	98.4	1.99	10.2	132.4	42.2	-	37.4	37.4	0.03	44.9	0.02
	60	19.24	34.35	1025.9	98.4	1.99	10.2	132.4	-	235.9	-	235.9	0.00	283.1	0.00
V39	0	12.41	53.29	1041.2	61.5	1.76	8.1	29.5	16.2	-	17.0	16.2	1.23	19.5	1.02
	60	12.41	53.29	1041.2	61.5	1.76	8.1	29.5	-	52.6	-	52.6	0.38	63.1	0.32
V43	0	15.41	43.07	1033.0	80.0	1.89	9.2	45.6	19.6	-	20.2	19.6	0.50	23.5	0.41
	60	15.41	43.07	1033.0	80.0	1.89	9.2	45.6	-	81.2	-	81.2	0.12	97.5	0.10
V45	0	17.41	38.21	1029.0	90.3	1.95	9.7	66.0	24.7	-	18.4	18.4	0.26	22.1	0.22
	60	17.41	38.21	1029.0	90.3	1.95	9.7	66.0	-	117.7	-	117.7	0.04	141.2	0.03
AV19	0	19.41	34.36	1025.9	99.5	1.99	10.3	134.4	42.8	-	37.6	37.6	0.03	45.1	0.02
	60	19.41	34.36	1025.9	99.5	1.99	10.3	134.4	-	239.4	-	239.4	0.00	287.3	0.00

Table C3. Summary of Dilution Simulations for Buoyant Further Scenarios

Case ID	Season	Effluent conditions			Port conditions					UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Nozzle angle (deg)	Flow (gpm)	Diam. (inch)	Velocity (ft/s	Froude no.	Average dilution	Rise height (centerline) (ft)
New	Upwelling	18.99	27.99	1020.8	0	98.5	1.99	10.2	62.8	101	28
					60					82	34
	Davidson				0					145	55
					60					123	58
V25	Upwelling	21.16	25.48	1018.7	0	109.8	2.03	10.9	56.2	107	33
					60					91	39
	Davidson				0					159	65
					60					141	70
AV14	Upwelling	21.24	31.19	1023.4	0	114.9	2.06	11.1	96.5	88	20
					60					66	28
	Davidson				0					124	47
					60					94	49
AV21	Upwelling	21.41	31.22	1023.4	0	116.1	2.02	11.6	102.6	91	20
					60					68	30
	Davidson				0					126	64
					60					96	49
1	Upwelling	1.17	5.80	1002.6	0	6.8	0.71	5.5	26.6	499	29
					60					488	30
	Davidson				0					987	S
					60					949	S
5	Upwelling	1.57	4.53	1001.6	0	8.1	0.79	5.3	23.7	461	31
					60					447	32
	Davidson				0					853	50
					60					817	50
7	Upwelling	1.77	4.11	1001.3	0	9.3	0.85	5.3	22.6	443	32
					60					428	33
	Davidson				0					800	S
					60					768	S

Table C3. Summary of Dilution Simulations for Buoyant Further Scenarios

Case ID	Season	Effluent conditions			Port conditions					UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Nozzle angle (deg)	Flow (gpm)	Diam. (inch)	Velocity (ft/s	Froude no.	Average dilution	Rise height (centerline) (ft)
12	Upwelling	3.17	2.65	1000.2	0	16.5	1.11	5.5	20.1	359	36
					60					347	37
	Davidson				0					609	59
					60					586	59
16	Upwelling	5.17	1.93	999.7	0	26.9	1.35	6.0	19.9	300	51
					60					291	41
	Davidson				0					517	S
					60					507	S
17	Upwelling	5.67	1.83	999.6	0	29.6	1.40	6.2	19.9	290	S
					60					282	S
	Davidson				0					509	S
					60					504	S
18	Upwelling	6.17	1.75	999.5	0	32.3	1.44	6.4	20.2	282	S
					60					274	S
	Davidson				0					506	S
					60					510	S
32	Upwelling	24.57	1.04	999.0	0	128.0	2.10	11.9	30.9	175	S
					60					168	S
	Davidson				0					291	S
					60					276	S
New2	Upwelling	16.66	32.14	1024.1	0	86.1	1.92	9.5	103.5	92	18
					60					65	26
	Davidson				0					131	43
					60					95	46
New3	Upwelling	17.16	31.23	1023.4	0	89.0	1.94	9.7	87.0	91	20
					60					69	29
	Davidson				0					131	46
					60					102	48

Modeling Brine Disposal into Monterey Bay

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Final report

Prepared for
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July 6, 2016

CONTENTS

EXECUTIVE SUMMARY

It is proposed to dispose of brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. The disposal will be through an existing outfall and diffuser usually used for domestic wastewater. Previous analyses of the mixing characteristics and dilution of the effluent are updated to account for new flow scenarios, new research on the dynamics of dense jets, the internal hydraulics of the outfall, revision of the California Ocean Plan, and potential mortality of organisms due to jet-induced turbulence.

The California Ocean Plan (SWRCB, 2015) contains new requirements on concentrate disposal, in particular the definition of a brine mixing zone (BMZ) at whose boundary salinity increment limitations must be met and within which salinity must be estimated. It also requires estimates of the effect of velocity shear and turbulence on the mortality of larvae and other organisms that are entrained into the high velocity diffuser jets. New flow scenarios consisting of various combinations of brine and treated domestic effluent have also been proposed, and new data on density stratification around the diffuser have been obtained. Finally, no detailed computations of the internal flow hydraulics of the diffuser have previously been made to address the variation of flow along the diffuser and its effect on dilution.

The outfall diffuser consists of "duckbill" check valves whose opening varies with changing flow rate and it has a fixed opening in the end gate for flushing purposes. An iterative procedure was used that accounts for the flow characteristics of the valves, friction losses, and density head. The total head loss in the outfall and the flow distribution between the various ports were computed for the various flow scenarios. For dense discharges, the flow per port increases towards the diffuser end; for buoyant discharges the flows decrease. Flow variations were generally less than about ±7% from the average flow. About 5% of the total flow exits from the end gate opening. These flow variations were accounted for in the dilution simulations.

Several flow and environmental scenarios were analyzed. They consist of various combinations of brine and brine blended with secondary effluent and GWR effluent. The flow combinations occur at different times of the year and the environmental conditions that correspond to each scenario was analyzed. The most important ambient characteristics that affect dilution are the density stratification in the water column and the ambient density at the discharge depth. Density data obtained for the project (Figure 2) were analyzed and seasonal profiles obtained. The final combinations of flow and ambient conditions that were analyzed are summarized in Table 6. Zero current speed was assumed for all dilution calculations.

Dilutions for brine solutions resulting in dense effluents were first computed. For each flow scenario, the internal hydraulics were computed and the maximum and minimum flows per port and their corresponding equivalent port diameters were computed. Dilutions were calculated for each and the lowest dilution adopted. Dilution was calculated by a semi-empirical equation due to Cederwall and by the UM3 module of the US EPA model suite Visual Plumes (Table 7). The results were in close agreement and the Cederwall predictions were adopted as the most conservative. Minimum (centerline) dilutions on the seabed were generally greater than 16:1 at distances of about 10 to 30 ft from the diffuser. The salinity requirement of the Ocean Plan that the salinity increment be less than 2 ppt over natural background within 100 m from the diffuser was met in all cases. Increases in salinity are highest on the seabed, and will only be above background for a few meters above the seabed. They will be zero throughout most of the water column.

Discharges of flows that are positively buoyant were analyzed separately. Dilution and plume rise height were modeled by the modules UM3 and NRFIELD of Visual Plumes. NRFIELD is the most appropriate model and its predictions of minimum dilution were in good agreement with UM3 predictions of *average* dilution. The results are summarized in Table 8. Dilutions are generally very high, always exceeding 100:1, and the plume is usually trapped below the water surface by the ambient stratification.

For some dense flow cases, particularly when small volumes of secondary effluent are added to the brine, it is possible that dilutions may not be sufficient to achieve water quality standards. Mitigation schemes to enhance dilution for these cases were considered and analyzed, including:

1. Increase the jet velocity and decrease the density difference between the effluent and receiving water by augmenting the discharges with treated freshwater from the GWR or desalination facility.

   The effect of adding freshwater on dilution for the problematical cases are shown in Figure 18. Small additions do not substantially increase dilution. As the effluent density approaches background levels, dilution increases exponentially. The water quality requirements for these cases could be achieved by adding about 2 to 4 mgd of freshwater.

2. Vary the flow per port by either temporarily storing on site in a storage basin and pumping briefly at higher flow rates, by closing off some ports, or by opening some closed ports.

   The effect of varying the flow per port is shown in Figure 20. The dilution is relatively insensitive to flow rate. As the flow increases, the jet velocity increases and entrainment increases. However, the check valves also open offsetting this increase. The flow and heads needed to meet the water quality requirements are excessive. Varying the flow rate is not an effective strategy for increasing dilution.

3. Discharge through upwardly inclined nozzles either by retrofitting the existing horizontal nozzles or by constructing a new dedicated brine diffuser.

   Discharge through upwardly inclined jets increases the length of dense jet trajectories and increases dilution. Jets at 60° to the horizontal (the de facto standard) were evaluated. The results are shown in Table 16. The inclined nozzles increase dilution of dense discharges substantially. All dilution requirements, including the problematical cases, would be met. The effect of retrofitting the nozzles on the dilution of positively buoyant discharges was also evaluated. The effect was small, dilutions were reduced by less than 10% compared to horizontal nozzles.

The 2015 California Ocean Plan requires an evaluation *of "...mortality that occurs due to shearing stress resulting from the facility's discharge..."* It has been suggested that planktonic organisms entrained into the high velocity turbulent jets could be subject to possibly fatal injury. Experimental evidence suggests that the main effect occurs to organisms whose size is about the same as the small-scale turbulent eddies, known as the Kolmogorov scales, which subject them to high strain rates and viscous shear stresses. The effects vary by organism; the relevant literature is summarized in Appendix C. Surveys of plankton in the vicinity of the diffuser were made and are summarized in Figure 9. As precise estimates of plankton mortality due to turbulence are not presently possible several approaches to this problem are taken.

The turbulence characteristics of jets are reviewed and turbulent length scales estimated for the various brine discharge scenarios (Table 10). The Kolmogorov scales range from about 0.012 mm near the nozzle to 2.5 mm at the jet edges at seabed impact. Exposure of larvae to jet turbulence ranges from a few seconds to minutes. The scales are smaller than or comparable to the smallest organisms of interest (Table 9) so some effects may be anticipated. The scales are somewhat smaller than those due to natural turbulence in the ocean, which is about 1 mm. Therefore, the Kolmogorov scale of the ocean is also comparable to larvae size and may cause natural mortality. The major issue is then incremental mortality due to the jets.

The total volumes in the jets where turbulent intensities are greater than background effects were computed (Table 10). They are almost infinitesimally small compared to the volume of the BMZ, ranging from 0.006% to 0.4%.

The fraction of the ambient flow passing over the BMZ that is entrained by the diffuser, and therefore the fraction of larvae that is entrained, was estimated (Table 10). For the brine discharges, it ranges from 1.7% to 6.4%.

Not all of the organisms that are entrained by the diffuser will die. The fraction of organisms passing over the diffuser that die is estimated to be less than 0.23%. As discussed, this is believed to be a very conservative estimate. Total incremental mortality was also estimated in Table 11.

The volumes entrained into the brine discharges are compared to that for the present baseline domestic wastewater discharge case (P1). They are much lower, ranging from 7 to 22%. This is mainly because the dilutions for the domestic discharges are much higher. Therefore, organism mortality for the brine discharges would also be expected to be about 7 to 22% of the baseline case.

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Study Purpose

It is proposed to dispose of the brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. The disposal will be through an existing outfall and diffuser usually used for domestic wastewater disposal. Previous analyses of the mixing characteristics and dilution of the effluent were made by Flow Science (2008), and updated in 2014 (Flow Science, 2014) to accommodate new flow scenarios. The 2014 analysis used the same procedures as the 2008 report although new research on the dynamics of dense jets has been reported since 2008 and reviews and testimony have raised new questions. In addition, water quality requirements for concentrate discharges around the world and the literature on the environmental impacts of brine discharges were reviewed in SCCWRP (2012), leading to the revision of the California Ocean Plan (SWRCB, 2016) to include brine discharges. These revisions include new requirements on concentrate disposal, in particular the definition of a brine mixing zone (BMZ) at whose boundary salinity increment limitations must be met and within which salinity must be estimated. New issues were also raised, particularly the effect of velocity shear and turbulence on the mortality of larvae and other organisms that are entrained into the high velocity diffuser jets. New flow scenarios consisting of various combinations of brine and treated domestic effluent have also been proposed, and new data on density stratification around the diffuser have been obtained. Finally, no detailed computations of the internal flow hydraulics of the diffuser have been made to address the variation of flow along the diffuser and its effect on dilution.

The purpose of this report is to analyze the internal hydraulics of the outfall and diffuser, to update the analyses of the dynamics and mixing of various discharge scenarios, and to address the new issues raised, particularly the effects of velocity shear and jet turbulence.

Specific tasks are:

- Compute outfall and diffuser internal hydraulics and flow distribution accounting for the effects of check valves;
- Recompute dilutions for various scenarios of flow and effluent density;
- For dense discharges, compute salinity within the BMZ and at its boundary;
- Estimate regions where salinity exceeds 2 ppt;
- For buoyant discharges, compute dilutions and plume behavior for the new oceanic density stratification data;
- Address shear and turbulence mortality;

- Discuss mitigation, i.e. modifications to the diffuser if improvements to mixing are indicated.

The ambient receiving water conditions and new data are discussed in Section 2.1, and the discharge scenarios are discussed in Sections 2.2 and 2.3 and summarized in Section 2.4. Details of the outfall and diffuser are presented in Section 3 and results of the hydraulics analyses are summarized. The calculation procedure is detailed in Appendix A.

1.2 California Ocean Plan

The 2015 California Ocean Plan (SWRCB, 2016, revised and effective January 28, 2016), contains new requirements to address brine discharges. The most relevant of these to the present report are contained in Section III.M.3, "Receiving Water Limitation for Salinity" which states that:

"Discharges shall not exceed a daily maximum of 2.0 parts per thousand (ppt) above natural background salinity measured no further than 100 meters (328 ft) horizontally from each discharge point. There is no vertical limit to this zone...

the Brine Mixing Zone is the area where salinity may exceed 2.0 parts per thousand above natural background salinity, or the concentration of salinity approved as part of an alternative receiving water limitation. The standard brine mixing zone shall not exceed 100 meters (328 feet) laterally from the points of discharge and throughout the water column...

The brine mixing zone is an allocated impact zone where there may be toxic effects on marine life due to elevated salinity...

For operational mortality related to discharges, the report shall estimate the area in which salinity exceeds 2.0 parts per thousand above natural background salinity or a facility-specific alternative receiving water limitation (see chapter III.M.3). The area in excess of the receiving water limitation for salinity shall be determined by modeling and confirmed with monitoring. The report shall use any acceptable approach approved by the regional water board for evaluating mortality that occurs due to shearing stress resulting from the facility's discharge, including any incremental increase in mortality resulting from a commingled discharge."

2. Modeling Scenarios

2.1 Environmental Conditions

The discharges are to be made through the existing Monterey Regional Water Pollution Control Agency (MRWPCA) wastewater outfall offshore of Marina, California, shown in Figure 1. The dynamics and mixing of the discharges depend on the receiving water density structure and ocean currents. The analyses presented here assume zero current speed, which is the worst-case condition in terms of dilution, so the main environmental parameter is the receiving water density structure. Particularly important is the density difference between the effluent and receiving water, and, for buoyant discharges, the density stratification over the water column.

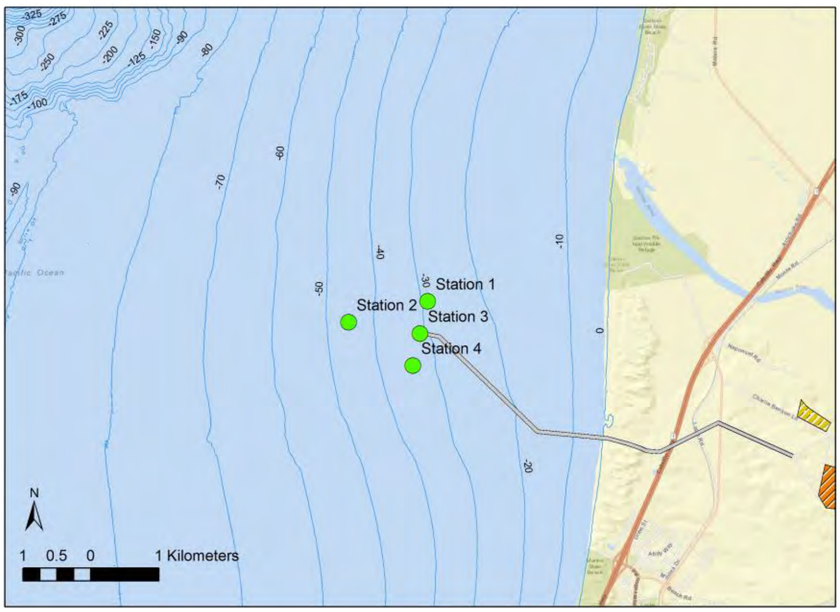


Figure 1. MRWPCA outfall near Marina, CA., and sampling locations for water column profiles. Bathymetry is in meters.

Monthly measurements of CTD (conductivity-temperature-depth) were made by Applied Marine Sciences (AMS, 2016) over the water column at the four locations shown in Figure 1. The objective of the monitoring was to gather data over a two-year period that reflected ocean conditions during this time period around the MRWPCA outfall. Monthly data were collected between February 2014 and December 2015.

Traditionally, three oceanic seasons have been defined in Monterey Bay: Upwelling (March-September), Oceanic (September-November), and Davidson (November-March). Therefore, the profiles were assessed with consideration given to these seasons, as well as over the entire sampling period.

It was found that there was little variation between the profiles taken at the four sites in any one day, so they were averaged together; they are plotted by season in Figure 2. The Upwelling season showed the most variable vertical structure in temperature and density. The Oceanic and Davidson seasons showed weak stratifications with essentially well-mixed temperature profiles with the oceanic season somewhat cooler than Davidson. Salinity was fairly uniform over depth so density was often controlled by temperature. The Upwelling season showed the strongest stratifications over the water column, and the profiles separate into two distinct groups with stratification for the other seasons being generally quite weak. Density differences over the water column ranged from zero (homogeneous) in December 2012 to 1.17 kg/m^3 in August 2014. For most of the profiles the density differences over the water column ranges from 0.11 to 0.65 kg/m^3.

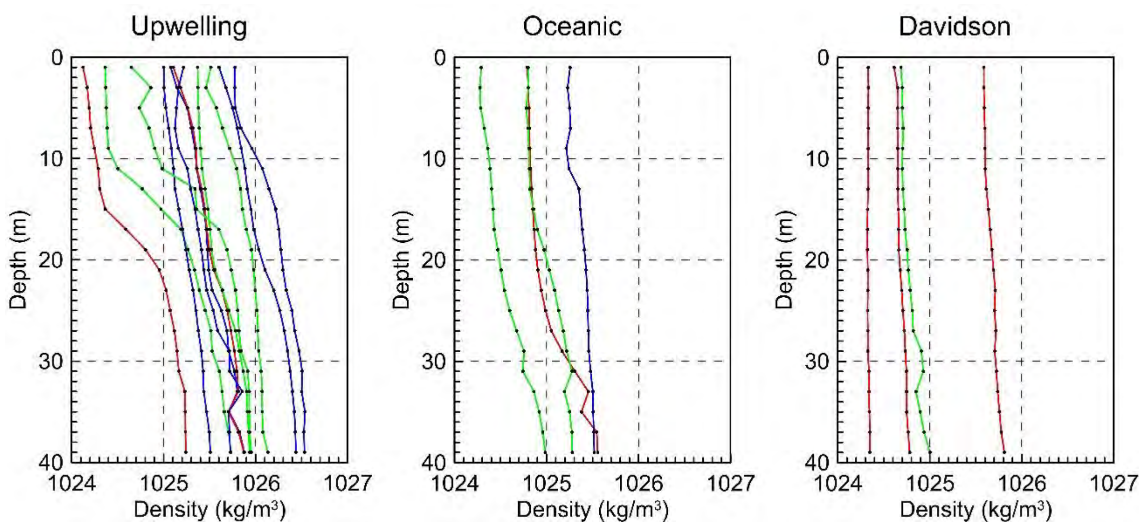


Figure 2. Seasonal density profiles at the sites shown in Figure 1.

The profiles within each season were then averaged to obtain representative profiles for the dilution simulations. The profiles are shown in Figure 3 and are tabulated in Appendix B.

Monthly variations of salinity near the depth of the diffuser (assumed to be the measurements around 27 to 29 m) are shown in Figure 4. The salinities vary seasonally, but little between the sites or the chosen depths. The bottom salinities and temperatures were averaged seasonally as summarized in Table 1.

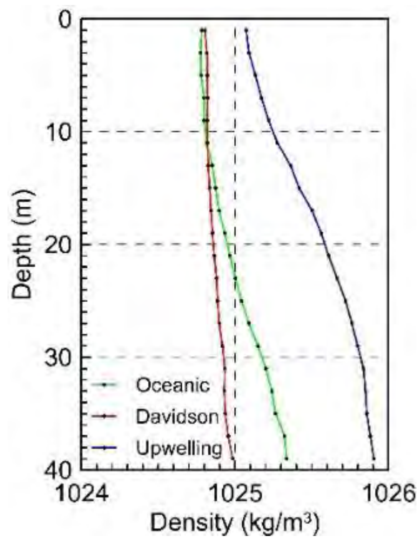


Figure 3. Seasonally averaged density profiles.

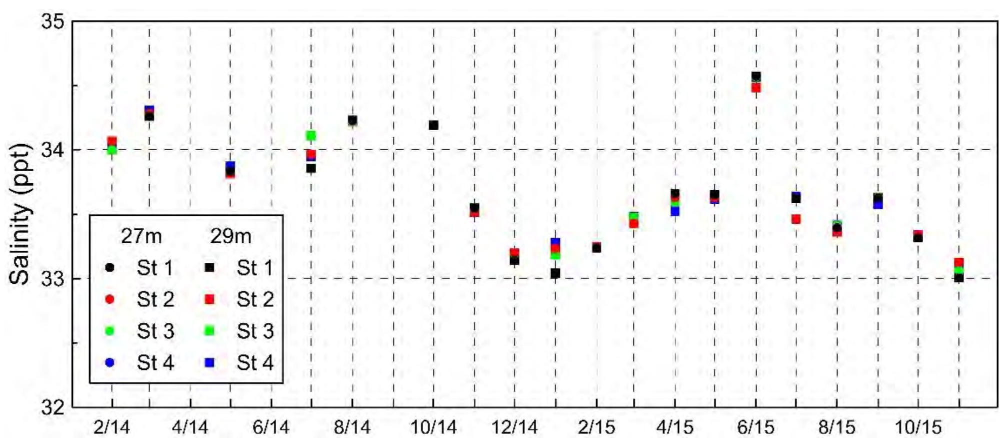


Figure 4. Monthly salinity variations at 27 and 29 m depths.

Table 1. Seasonal Average Properties at Diffuser Depth

Season	Temperature (°C)	Salinity (ppt)	Density (kg/m^3)
Davidson	14.46	33.34	1024.8
Upwelling	11.48	33.89	1025.8
Oceanic	13.68	33.57	1025.1

2.2 Discharge Scenarios Under Proposed Project

The Monterey Peninsula Water Supply Project (MPWSP) Desalination Plant would treat the source oceanic water at a 42 percent recovery rate to produce 9.5

mgd of desalinated product water. Approximately 14 mgd of brine would be generated, consisting of concentrates from the pretreatment and reverse osmosis (RO) processes as well as waste effluent produced during routine backwashing and operation and maintenance of the pretreatment filters. The brine generated in the desalination process would be discharged into Monterey Bay through the MRWPCA's existing ocean outfall. The outfall consists of an 11,260-foot-long pipeline terminating in a diffuser with 129 operational ports at a depth of approximately 100 feet. The outfall and diffuser and their internal hydraulics are discussed further in Section 3.

During certain times of the year, the brine would be blended with treated wastewater (when available) from the MRWPCA Regional Wastewater Treatment Plant, forming a combined discharge. Table 2 (Table 4.3-8 from the DEIR) shows the monthly projected brine flows from the MPWSP Desalination Plant and the average monthly wastewater flows from MRWPCA.

Table 2. Monthly Average Flows of Secondary Wastewater from the MRWPCS Treatment Plant (mgd) (1998–2012) and Estimated Brine Flows Under the MWPWSP

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Brine-Only	*13.98*	13.98	13.98	13.98	13.98	13.98	*13.98*	13.98	*13.98*	13.98	13.98	13.98
Treated Wastewater from MRWPCA	*19.78*	18.41	14.68	7.02	2.40	1.89	0.90	1.03	2.79	9.89	17.98	19.27
Combined Discharge (Brine+wastewater)	*33.76*	32.39	28.66	21.00	16.38	15.87	14.88	15.01	16.77	23.87	31.96	33.25

NOTE: Shaded cells represent the seasonal discharge scenarios used in the analysis of operational water quality impacts.

Numbers in *italics* represent the flow rates used in the modeling analysis of salinity (discussed in Impact 4.3-5), the results of which were used to analyze other constituents in the brine and combined discharges (discussed below in this impact analysis). In the case of the combined discharge, the modeling analysis also used low wastewater flow rates of 0.25, 0.5, 1, and 2 mgd and a moderate flow of 9 mgd.

SOURCES: MRWPCA, 2013; Trussell Technologies, 2015 in DEIR Appendix D4.

As shown in Table 2, the treated wastewater flow varies throughout the year, with the highest flows observed during the non-irrigation season (November through March) and the lowest flows during the irrigation season (April through October), when the treated wastewater is processed through the SVRP for tertiary treatment and distributed to irrigators through the Castroville Seawater Intrusion Project (CSIP).

During the irrigation season, on some days, all of the wastewater flows could be provided to irrigators, and only the project brine would be discharged into Monterey Bay through the outfall. The analysis presented in the DEIR assumed that the brine would be discharged without dilution during the entire irrigation season (dry months), reflected in scenario 2 in Table 3.

During the non-irrigation season (wet months), the analysis presented in the DEIR assumed that a combined discharge (i.e. brine blended with treated wastewater) would be released. For the combined discharge scenario, the data analysis accounted for different wastewater flows ranging from 19.78 mgd in the winter/Davidson season (when higher discharge flows are anticipated) to lower flows of 1 and 2 mgd (Table 3). Scenarios 3 through 6 reflect the proposed combined project discharges during the non-irrigation season as well as during the irrigation season when a low volume of secondary effluent is discharged.

Table 3. Proposed Project Discharge Scenarios

No.	Scenario	Discharge flows (mgd)	
		Secondary Effluent	Desal Brine
1	Baseline	19.78[a]	0
2	Desal only	0	13.98
3	Desal and low SE[b]	1	13.98
4	Desal with low SE	2	13.98
5	Desal with moderate SE	9	13.98
6	Desal with high SE	19.78	13.98

[a] All model scenarios involving high secondary effluent flows used for assessing impacts related to the proposed and variant project conditions use the maximum documented average wet season wastewater flow of 19.78 mgd.
[b] Secondary effluent

2.3 Discharge Scenarios Under Project Variant

Under the Project Variant, the MPWSP Desalination Plant would treat 15.5 mgd of source water at a 42 percent recovery rate. Approximately 8.99 mgd of brine would be generated, consisting of concentrates from the pretreatment and reverse osmosis (RO) processes as well as waste effluent produced during routine backwashing and operation and maintenance of the pretreatment filters. The brine generated in the desalination process would be discharged through the MRWPCA ocean outfall as with the Proposed Project (above).

The Project Variant would also include operation of the proposed Groundwater Replenishment Project (GWR) Project, which would involve RO treatment of a minimum of 3.9 mgd of source water to produce 3.2 mgd of product water and 0.73 mgd of effluent[1]. Operation of the Project Variant would result in discharge scenarios that would include brine from the MPWSP Desalination Plant,

[1] A minimum of 4,320 acre-feet per year (AFY) of source water would be treated to produce 3,500 AFY of product water. At the time of this analysis, the available data for the GWR Project, i.e., 0.73 mgd of GWR effluent flow was used for the modeling analysis (also see Flow Science, Inc., 2014).

and/or effluent from the proposed GWR project, and/or treated wastewater from the existing MRWPCA wastewater treatment plant. Depending on the operational scenario, the following discharges (also summarized in Table 4) would be released into Monterey Bay through the MRWPCA outfall:

Variant Scenario 1, Brine-only: 8.99 mgd of brine would be generated at the Desalination Plant and discharged alone through the MRWPCA outfall. This operating scenario would occur if the GWR Project comes on line after the MPWSP Desalination Plant, or the GWR Project periodically shuts down.

Variant Scenarios 2 through 5, Brine-with-Wastewater: 8.99 mgd of brine would be discharged with varying volumes of treated wastewater from the MRWPCA Regional Wastewater Treatment Plant. This operating scenario would occur when treated wastewater is available and if the GWR Project comes on line after the MPWSP Desalination Plant, or the GWR Project periodically shuts down.

(Previously modeled, no update needed) GWR-only discharge: 0.94 v of effluent generated under the MRWPCA-proposed GWR Project would be discharged alone through the MRWPCA outfall. This operating scenario would occur if the GWR Project comes on line before the MPWSP Desalination Plant, or the MPWSP Desalination Plant periodically shuts down.

Variant Scenario 6, Blended discharge: 8.99 mgd of brine generated from the MPWSP Desalination Plant would be blended with 0.94 mgd of GWR-effluent. This operating scenario would typically occur in the irrigation season.

Variant Scenarios 7 through 10, Combined discharge: The blended discharge (brine and GWR effluent) would be combined with varying volumes of treated wastewater from the MRWPCA Regional Wastewater Treatment Plant. This operating scenario would typically occur in the non-irrigation season.

Not Modeled, GWR-with-Wastewater: 0.94 mgd of GWR-effluent would be discharged with varying volumes of treated wastewater from the MRWPCA Regional Wastewater Treatment Plant without brine generated from the MPWSP Desalination Plant. This operating scenario would occur when treated wastewater is available and if the GWR Project comes on line before the MPWSP Desalination Plant, or the MPWSP Desalination Plant periodically shuts down. These scenarios have been modeled and impacts assessed and documented in the Final EIR for the Pure Water Monterey GWR Project (MPWPCA, 2015).

Table 4. Variant Project Discharge Scenarios

No	Scenario	Discharge flows (mgd)		
		Secondary Effluent	Desal Brine	GWR
1	Desal only	0	8.99	0
2	Desal and low (1) SE	1	8.99	0
3	Desal and low (2) SE	2	8.99	0
4	Desal and moderate SE	5.8 (Davidson)	8.99	0
5	Desal and high SE	19.78	8.99	0
6	Desal and GWR	0	8.99	0.94
7	Desal and GWR and low (1) SE	1	8.99	0.94
8	Desal and GWR and low (2) SE	3	8.99	0.94
9	Desal and moderate SE and GWR	5.3 (Upwelling)	8.99	0.94
10	Desal and high SE and GWR	15.92	8.99	0.94

Notes:

[a] All model scenarios involving high secondary effluent flows used for assessing impacts related to the proposed and variant project conditions use the maximum documented average wet season wastewater flow of 19.78 mgd.

2.4 Updated Model Scenarios

The assumed effluent characteristics for the three seasonal scenarios are summarized in Table 5.

Table 5. Assumed Effluent Characteristics

Season	Brine[1]		Secondary Effluent[1]		GWR	
	Salinity (PPT)	Temp (°C)	Salinity (PPT)	Temp (°C)	Salinity [2] (PPT)	Temp[1] (°C)
Upwelling	58.23	9.9	0.8	24	5.8	24.4
Davidson	57.40	11.6	0.8	20	5.8	20.2
Oceanic	57.64	11.1	0.9	24	5.8	24.4

[1]FlowScience (2014), Table C3 and C6 (p.C-7 and C-17), Appendix C.

[2]Pure Water Monterey Groundwater Replenishment Project Consolidated FEIR (2016): "The discharge of reverse osmosis concentrate would not involve high salinities because the concentrate would be far less saline than ambient ocean water (5,800 mg/L of TDS compared to 33,000 to 34,000 mg/L). The secondary effluent (approximately 1,000 mg/L of TDS) and GWR reverse osmosis concentrate (approximately 5,000 mg/L of TDS) are relatively light and would rise when discharged."

Note: Salinity value of 4 PPT for GWR effluent estimated in Flow Science (2014).

Using the discharge scenarios in Table 3 for the Proposed Project and in Table 4 for the Project Variant, previous model analyses will be updated as follows:

Revise the near-field brine discharge modeling by adjusting the number of open ports (129 versus 120 used prior), the height of the ports off the ocean floor (4 feet versus 3.5 feet used prior), and flow scenarios (Table 2 for the Project and Table 3 for the Variant).

Using the revised modeling for each scenario, compute dilution ratios, calculate the volume of ocean water that exceeds 2 ppt above ambient, plot the gradient of salinity between the port and the edge of the Zone of Initial Dilution ZID, calculate the eddy size and velocity of the plume and determine marine losses due to shear stress, if any. Also calculate the salinity beyond the ZID but within the regulatory mixing zone (100 m from the port).

Combining the assumed environmental conditions from Table 1, the flows from Tables 3 and 4, and the assumed effluent conditions from Table 5, we arrive at 16 possible flow scenarios. Their conditions are summarized in Table 6. The Proposed Project scenarios are labeled P1 though P6 and the Project Variant scenarios are Labeled V1 through V10.

Table 6. Modeled Discharge Scenarios

Case No.	Season	Background			Brine			Secondary effluent			GWR			Combined discharge		
		Temp. (°C)	Salinity (ppt)	Density (kg/m^3)	Flow (mgd)	Temp. (°C)	Salinity (ppt)	Flow (mgd)	Temp. (°C)	Salinity (ppt)	Flow (mgd)	Temp. (°C)	Salinity (ppt)	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
P1	Baseline	-	-	-	-	-	-	19.78	20.0	0.8	0	20.0	5.8	19.78	0.80	998.8
P2	Upwelling	11.48	33.89	1025.8	13.98	9.9	58.23	0	24.0	0.8	0	24.4	5.8	13.98	58.23	1045.2
P3	Davidson	14.46	33.34	1024.8	13.98	11.6	57.40	1.00	20.0	0.8	0	20.2	5.8	14.98	53.62	1041.2
P4	Davidson	14.46	33.34	1024.8	13.98	11.6	57.40	2.00	20.0	0.8	0	20.2	5.8	15.98	50.32	1038.5
P5	Davidson	14.46	33.34	1024.8	13.98	11.6	57.40	9.00	20.0	0.8	0	20.2	5.8	22.98	35.23	1026.4
P6	Davidson	14.46	33.34	1024.8	13.98	11.6	57.40	19.78	20.0	0.8	0	20.2	5.8	33.76	24.24	1017.6
V1	Upwelling	11.48	33.89	1025.8	8.99	9.9	58.23	0	24.0	0.8	0	24.4	5.8	8.99	58.23	1045.2
V2	Upwelling	11.48	33.89	1025.8	8.99	9.9	58.23	1.00	24.0	0.8	0	24.4	5.8	9.99	52.48	1040.5
V3	Upwelling	11.48	33.89	1025.8	8.99	9.9	58.23	2.00	24.0	0.8	0	24.4	5.8	10.99	47.78	1036.6
V4	Davidson	14.46	33.34	1024.8	8.99	11.6	57.40	5.80	20.0	0.8	0	20.2	5.8	14.79	35.20	1026.4
V5	Upwelling	11.48	33.89	1025.8	8.99	9.9	58.23	19.78	24.0	0.8	0	24.4	5.8	28.77	18.75	1012.7
V6	Upwelling	11.48	33.89	1025.8	8.99	9.9	58.23	0	24.0	0.8	0.94	24.4	5.8	9.93	53.27	1041.1
V7	Davidson	14.46	33.34	1024.8	8.99	11.6	57.40	1.00	20.0	0.8	0.94	20.2	5.8	10.93	47.78	1036.5
V8	Davidson	14.46	33.34	1024.8	8.99	11.6	57.40	3.00	20.0	0.8	0.94	20.2	5.8	12.93	40.52	1030.6
V9	Upwelling	11.48	33.89	1025.8	8.99	9.9	58.23	5.30	24.0	0.8	0.94	24.4	5.8	15.23	35.01	1026.1
V10	Davidson	14.46	33.34	1024.8	8.99	11.6	57.40	15.92	20.0	0.8	0.94	20.2	5.8	25.85	20.67	1014.7

3. Outfall Hydraulics

The Monterey Regional Water Pollution Control Agency (MRWPCA) outfall at Marina, shown in Figure 5, conveys the effluent to the Pacific Ocean to a depth of about 100 ft below Mean Sea Level (MSL). The ocean segment extends a distance of 9,892 ft from the Beach Junction Structure (BJS). Beyond this there is a diffuser section 1,406 ft long. The outfall pipe consists of a 60-inch internal diameter (ID) reinforced concrete pipe (RCP), and the diffuser consists of 480 ft of 60-inch RCP with a single taper to 840 ft of 48-inch ID. The diffuser has 171 ports of two-inch diameter: 65 in the 60-inch section and 106 in the 48-inch section. The ports discharge horizontally alternately from both sides of the diffuser at a spacing of 16 ft on each side except for one port in the taper section that discharges vertically for air release. The 42 ports closest to shore are presently closed, so there are 129 open ports distributed over a length of approximately 1024 ft. The 129 open ports are fitted with four inch Tideflex "duckbill" check valves (the four inch refers to the flange size not the valve opening). The valves open as the flow through them increases so the cross-sectional area is variable. The end gate has an opening at the bottom about two inches high. The effect of the valves on the flow distribution in the diffuser is discussed in Appendix A.

Figure 5. The MRWPCA outfall

The diffuser section sits on rock ballast as shown in Figure 6. The ports are approximately six inches above the rock ballast and nominally 54 inches above the sea bed, although this varies. For the dilution calculations, they are assumed to be 4 ft above the bed. The diffuser is laid on a slope of about 0.011 and the depths of the open ports range from about 98 to 110 ft below MSL.

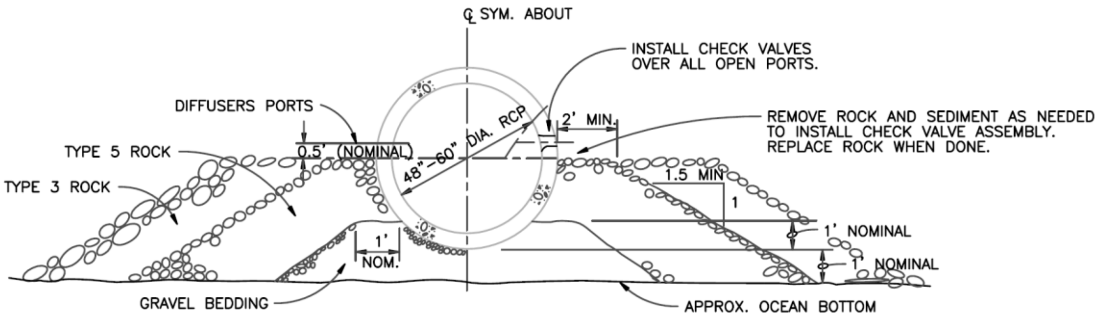


Figure 6. Typical diffuser cross section

The procedure for analyzing the internal hydraulics of the outfall and diffuser is discussed in Appendix A. Using these procedures, the head losses and the flow distribution between the ports and the end gate port were computed for the various flow scenarios of Table 6. Some typical distributions of flow among the ports, for scenarios P1 (19.78 mgd of secondary effluent), P2 (13.98 mgd of pure brine), and P6 (33.76 mgd of brine and secondary effluent) are shown in Figure 7.

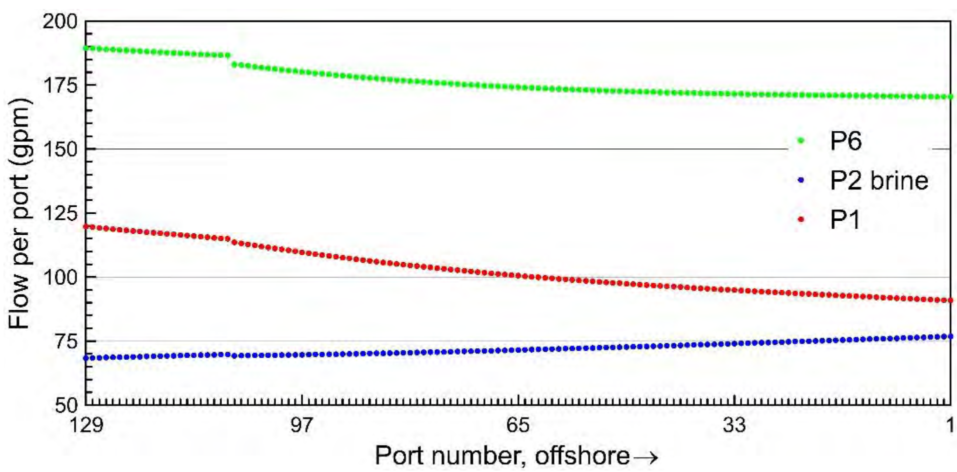


Figure 7. Typical port flow distributions.

For the pure brine discharge P2 (density greater than seawater) the flow per port increases in the offshore direction because of the density head. For the buoyant discharges P1 and P6 (less dense than seawater) the flow decreases in the offshore direction. The port discharges vary by about ±7% from the average, and about 5% of the flow exits from the opening in the end gate. These flow variations are accounted for in the dilution simulations, and the worst cases for dilution are chosen.

4. Dense Discharge Dilution

4.1 Introduction

Discharges that are more dense than the receiving seawater result in a sinking plume that impacts the sea floor at some distance from the nozzle as shown in Figure 8. The jet, because of its high exit velocity, entrains seawater that mixes with and dilutes the effluent.

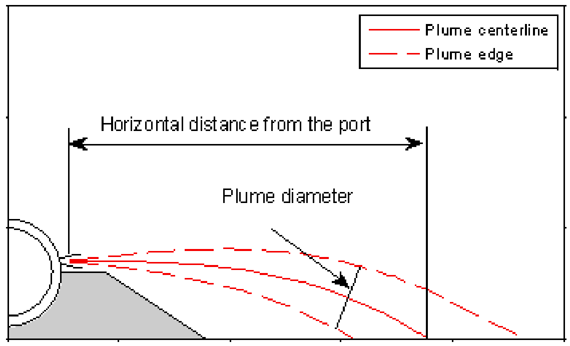


Figure 8. Horizontal dense jet dynamics (DEIR, Appendix D2).

Three-dimensional laser-induced fluorescence (3DLIF) images of a horizontal negatively buoyant jet similar to those considered here are shown in Figure 9. The images are obtained by scanning a laser sheet horizontally thought the flow to which a small amount of fluorescent dye has been added. The fluoresced light is captured and converted to tracer concentrations and dilution and imaged by computer graphics techniques as described in Tian and Roberts (2003). The left image shows the outer surface of the jet in gray scale and the right image shows the outer surface as semi-transparent with tracer concentrations in false color in a vertical plane through the jet centerline.

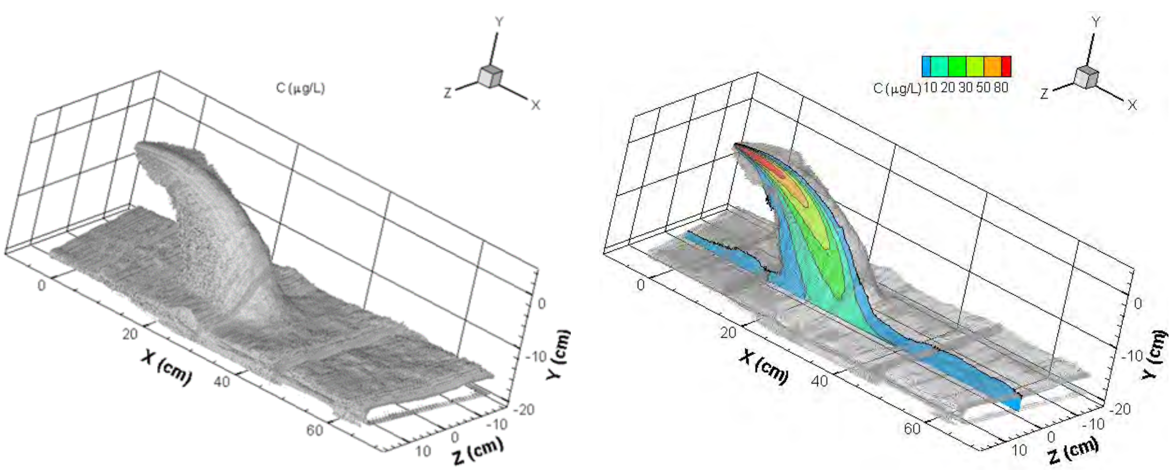


Figure 9. 3DLIF images of horizontal dense jet (Nemlioglu and Roberts, 2006).

It can be seen that high tracer concentrations (i.e. salinity) are confined to a relatively small volume near the nozzle and attenuate rapidly with distance from the nozzle. The highest salinity on the floor occurs where the jet centerline impacts it, and it is the dilution and salinity at this point that is computed here.

In the Flow Science (2014) report, they analyze this situation using a semi-empirical method and also the mathematical model UM3 in the US EPA model suite Visual Plumes. In the semi-empirical method, the jet trajectory and impact point are predicted by an analysis due to Kikkert et al. (2007) and dilution was then predicted by assuming it to occur from jet-induced entrainment. Although the Kikkert analysis can be applied, it was derived primarily for upwardly-inclined dense jets rather than horizontal, as occur here, and the dilution analysis neglects any effects of buoyancy on entrainment. Furthermore, the Flow Science report considers the centerline dilution predictions of the entrainment model UM3 to be unreliable due to a study by Palomar at al. (2012a, 2012b) which concluded that UM3 (and other entrainment models) underestimated impact dilutions by 50-65%. They therefore used UM3 *average* dilutions as estimates of *centerline* dilutions. The observations of Palomar et al., however, only applied to jets inclined upwards at 30° to 60° to the horizontal, where mixing is greater due to gravitational instabilities. For small fractional density differences, the dynamics of horizontal dense jets are the same as for positively buoyant jets (with a change in the sign of the density difference). Therefore, a simpler semi-empirical analysis can be applied, and UM3, which is well-tested and validated for such situations, is also applicable. The new analysis and application of UM3 are described below.

For the jet situation shown in Figures 8 and 9 it can be shown that the centerline dilution S_m at any vertical distance z from the nozzle is given by (Roberts et al. 2010):

$$\frac{S_m}{F_j} = f\left(\frac{z}{dF_j}\right) \tag{1}$$

where F_j is the densimetric Froude number of the jet:

$$F_j = \frac{u_j}{\sqrt{g_o' d}} \tag{2}$$

u_j is the jet velocity, $g_o' = g\left(\rho_a - \rho_o\right)/\rho_o$ is the modified acceleration due to gravity, g is the acceleration due to gravity, ρ_a and ρ_o are the ambient and effluent densities, respectively, and d the (round) nozzle diameter. Experimental measurements of the centerline dilutions plotted according to Eq. 1 are shown in Figure 10.

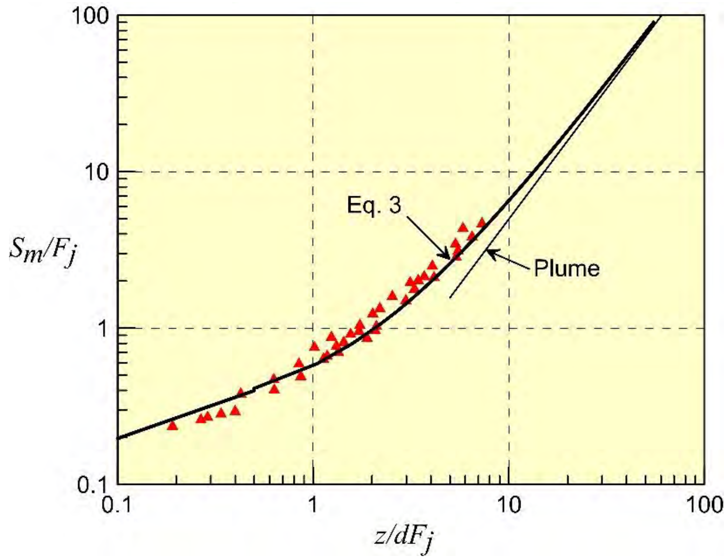


Figure 10. Centerline dilution of a horizontal buoyant jet into a stationary homogeneous environment (Roberts et al. 2010).

A fit to these data for $z/dF_j > 0.5$ has been suggested by Cederwall (1968):

$$\frac{S_m}{F_j} = 0.54\left(0.66 + 0.38\frac{z}{dF_j}\right)^{5/3} \qquad (3)$$

which is plotted on Figure 10. This equation is used to predict dilutions below.

The dilution and trajectories of the jets can also be predicted by UM3. UM3 is a Lagrangian entrainment model described in Frick (2003, 2004).

4.2 Results

The following procedure was followed to determine the dilutions for dense discharges. First the internal hydraulics program (Section 3) was run for each case summarized in Table 6 to determine the flow distribution between the ports. Because the flow varies between the ports and because the effective port diameter varies with flow rate, it is not immediately obvious where along the diffuser the lowest dilution will occur. Therefore, dilutions were computed for the innermost and outermost ports. Depending on flow and density, the innermost ports would sometimes discharge the lowest flow, and sometimes the highest. The conditions resulting in lowest dilutions were chosen; sometimes this would occur at the innermost port and sometimes the outermost.

A typical jet trajectory output from UM3 (for the pure brine case, P2) is shown in Figure 11. For this case, the jet centerline impacts the seabed about 10 ft from the nozzle and the jet diameter is about 5 ft. Similar simulations were run for all dense scenarios, and the results, using the Cederwall formula and UM3, are summarized in Table 7.

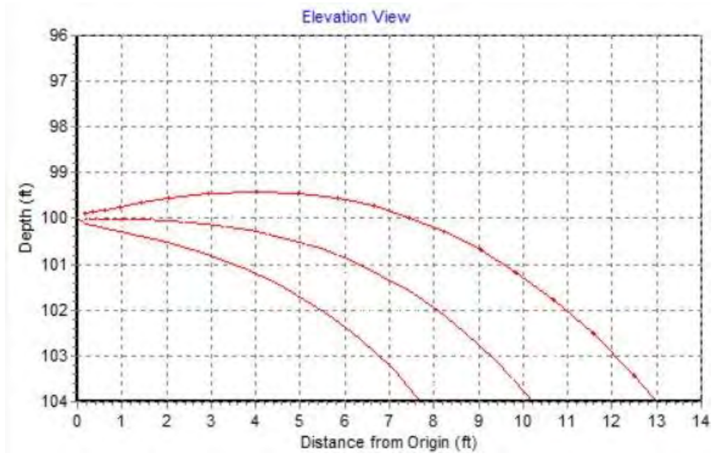


Figure 11. Typical graphics output of jet trajectory from UM3: Pure brine case, P2.

It is remarkable how close the dilution predictions of UM3 and Cederwall are. Cederwall's are generally more conservative, so these values are adopted. Jet impact distances from UM3 are also shown in Table 7. Jet diameters are generally much less than the port spacing of 16 ft, so no merging is expected before bottom impaction. The results are comparable to the Flow Science semi-empirical method.

The worst case, as expected, is the pure brine case, P2. For this case, the minimum centerline dilution is 15.5 and the salinity increment is 1.6 ppt, well within the BMZ limit of 2 ppt. The distance up to the impact point can be interpreted as the Zone of Initial Dilution (ZID). In all cases, the salinity limit is met within the ZID, whose length ranges from about 9 ft for scenario V1 up to 42 ft for scenario V9, where the density difference is much less and the jet trajectory is much flatter.

The jets will continue to dilute and will ultimately merge beyond the ZID. The increase in dilution up to the edge of the BMZ is difficult to estimate as there are no experiments available for these horizontal dense jet flows. Some guidance can be obtained from experiments on buoyant jets and inclined dense jets, however. Roberts et al. (1997) estimates a dilution increase of about 60% from the impact point to the end of the near field for single (non-merging) 60° inclined jets. For merged jets or plumes the increase in dilution is less; Abessi and Roberts (2014) reported a dilution increase of about 22% from impact point to the end of the near field. This is in keeping with the differences in dilution between non-merged and merged positively buoyant jets impacting water surfaces reported in Tian et al. (2004). The spacing between the individual jets on each side of the diffuser is 16 ft therefore it is conservatively assumed that they will merge within the BMZ and the increase in dilution from the impact point to the BMZ is 20%. This increase is used to predict the BMZ dilutions in Table 7.

Table 7. Summary of Dilution Simulations for Dense Effluent Scenarios

Case No.	Background conditions		Effluent conditions		Port conditions						Cederwall formula			UM3		Cederwall at BMZ	
												Salinity					
	Salinity (ppt)	Density (kg/m^3)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (in)	Height (ft)	Velocity (ft/s)	Froude no.	z_o/dF	Dilution	At impact (ppt)	Incre-ment (ppt)	Dilution	Impact distance (ft)	Dilution	Salinity incre-ment- (ppt)
P1	-	-	0.80	998.8	-	-	-	-	-	-	-	-	-	-	-	-	-
P2	33.89	1025.8	58.23	1045.2	76.3	1.87	4.0	8.9	29.0	0.89	15.6	35.45	1.56	16.3	10.3	18.7	1.30
P3	33.34	1024.8	53.62	1041.2	75.0	1.86	4.0	8.9	31.4	0.82	16.2	34.60	1.25	16.9	10.7	19.4	1.04
P4	33.34	1024.8	50.32	1038.5	80.8	1.89	4.0	9.2	35.5	0.72	17.0	34.34	1.00	17.8	11.8	20.5	0.83
P5	33.34	1024.8	35.23	1026.4	117.8	2.07	4.0	11.2	120.3	0.19	38.7	33.39	0.05	35.3	29.0	46.5	0.04
P6	33.34	1024.8	24.24	1017.6	188.5	2.28	4.0	14.8	71.5	-	-	-	-	-	-	-	-
V1	33.89	1025.8	58.23	1045.2	50.8	1.67	4.0	7.4	25.6	1.12	15.9	35.42	1.53	16.3	8.7	19.0	1.28
V2	33.89	1025.8	52.48	1040.5	54.3	1.70	4.0	7.7	30.1	0.94	16.7	35.00	1.11	17.4	9.8	20.0	0.93
V3	33.89	1025.8	47.78	1036.6	54.6	1.71	4.0	7.6	34.7	0.81	17.7	34.67	0.78	18.5	10.9	21.3	0.65
V4	33.34	1024.8	35.20	1026.4	77.9	1.88	4.0	9.0	102.0	0.25	34.5	33.40	0.05	32.5	24.0	41.4	0.04
V5	33.89	1025.8	18.75	1012.7	160.8	2.21	4.0	13.5	48.9	-	-	-	-	-	-	-	-
V6	33.89	1025.8	53.27	1041.1	54.3	1.70	4.0	7.7	29.5	0.96	16.6	35.06	1.17	17.2	9.7	19.9	0.98
V7	33.34	1024.8	47.78	1036.5	58.3	1.74	4.0	7.9	34.2	0.81	17.4	34.17	0.83	18.2	10.9	20.9	0.69
V8	33.34	1024.8	40.52	1030.6	66.5	1.80	4.0	8.4	50.6	0.53	21.3	33.68	0.34	22.1	14.7	25.5	0.28
V9	33.89	1025.8	35.01	1026.1	77.8	1.88	4.0	9.0	260.5	0.10	77.1	33.90	0.01	55.4	42.1	92.5	0.01
V10	33.34	1024.8	20.67	1014.7	143.3	2.16	4.0	12.6	52.6	-	-	-	-	-	-	-	-

Finally, note that the computed salinities occur only along the seabed. Salinities decrease with height and will only be above ambient within the spreading layer on the bottom. For most of the water column, incremental salinities will be much less than the values in Table 7.

4.3 Other Considerations

The increase in dilution beyond the impact point, or ZID, above is the increase in dilution up to the end of near field, defined as (Abessi and Roberts, 2014) the point where the turbulence induced by the discharge collapses under the influence of its self-induced density stratification. Again, there are no direct experiments to estimate this distance for this horizontal flow case, but Abessi and Roberts (2014) estimate the ratio of the near field length to the impact distance to be about 3:1. The impact distances in Table 7 range from about 9 to 42 ft, so, assuming the ratio of 3:1 to apply here, the end of the near field will always be within the BMZ distance of 100 m (328 ft). The assumption that dilution stops at the end of the near field is a conservative one as further dilution will occur due wave effects and entrainment as the gravity current flows down the bottom slope.

The dilution calculations assume the discharges to be from round nozzles whose area is the same as the effective opening of the check valves. There are no models to predict the dilution from elliptically-shaped check valves but experiments (Lee and Tang, 1999) show that the centerline dilutions from elliptical nozzles are greater than from equivalent round nozzles due to the larger surface area available for entrainment and that the dilutions asymptotically approach those of equivalent round nozzles at about 12 equivalent jet diameters from the nozzle.

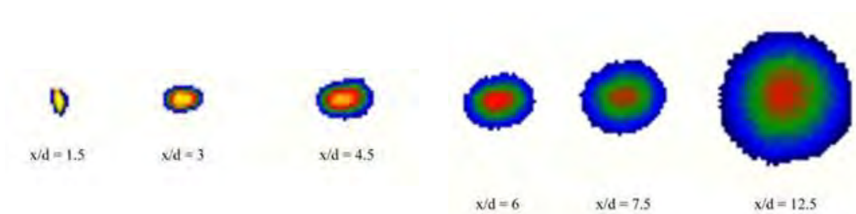


Figure 12. Cross sections of a jet from a check valve illustrating the transition from elliptical to round shapes. From Lee and Tang (1999).

Mixing of horizontal dense jets can also be affected by proximity to the local boundary which may cause a Coanda attachment. Some experiments on this phenomenon have been reported by Shao and Law (2011); a figure from their paper is shown in Figure 12. They find that the flow transitions to a wall-dense-jet with momentum continuing to play a role in mixing. They investigated Coanda attachment of the jet to the lower boundary and found that none occurred for a parameter which they defined as: $z_o/l_M > 0.12$. This parameter is essentially the same as z_o/dF shown in Table 7. Only case V9 is close to this value and the dilutions for this cases are very high. It is therefore concluded that Coanda attachment will not have any effect on the dynamics or mixing of the brine jets. And furthermore, because of the strong mixing and entrainment in the wall jet region, it is expected that the additional dilution beyond the impingement point will be actually much greater than the 20% assumed above.

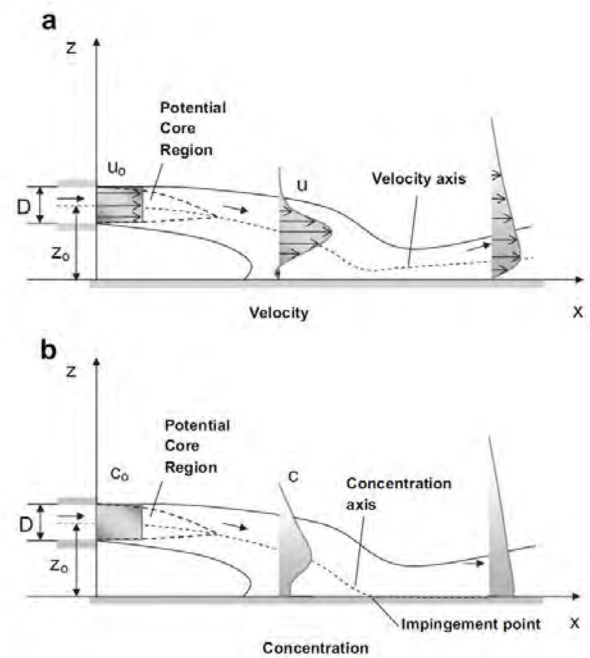


Figure 13. Dense jet impacting a local boundary. From Shao and Law (2011).

5. BUOYANT DISCHARGE DILUTION

5.1 Introduction

Positively buoyant (or just buoyant) discharges, i.e. that have densities less than the receiving seawater, require different procedures than for negatively buoyant ones. Inspection of Table 6 shows there are only four positively buoyant scenarios; P1, the baseline with pure secondary effluent, P6, high volumes of brine and secondary effluent, and V5 and V10, Project Variants with moderate brine volumes and high secondary effluent and GWR volumes. Positively buoyant effluents rise in the water column and are either trapped by the ambient density stratification if it is strong enough, or reach the water surface if it is weak. A laboratory photograph of a buoyant discharge from a multiport diffuser into a stationary stratified environment is shown in Figure 13.

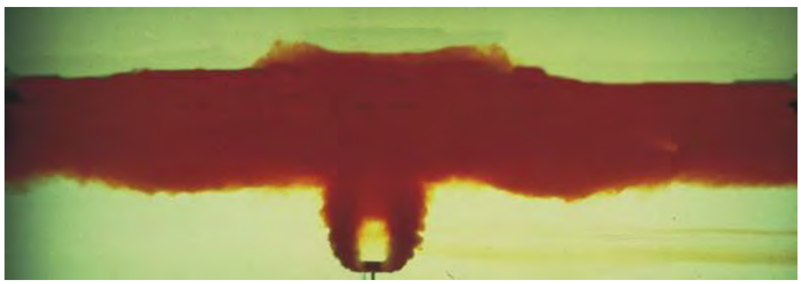


Figure 14. Trapped buoyant plume from multiport diffuser in stratified environment, from Roberts et al. (1989).

The plume dynamics are simulated with two models in Visual Plumes: UM3 and NRFIELD. UM3 is an entrainment model that was previously described. NRFIELD is based on the experiments on multiport diffusers discharging from two sides described in Roberts et al. (1989) and subsequently updated with the new experimental data of Tian et al. (2004) and others. NRFIELD is specifically designed for conditions typical of very buoyant discharges of domestic effluent from multiport diffusers into stratified oceanic waters so is judged most appropriate here. It also includes the lateral spreading after the terminal rise height and subsequent turbulent collapse at the end of the near field. The primary outputs from NRFIELD are the minimum (centerline) dilution, the plume rise height, and wastefield thickness at the end of the near field.

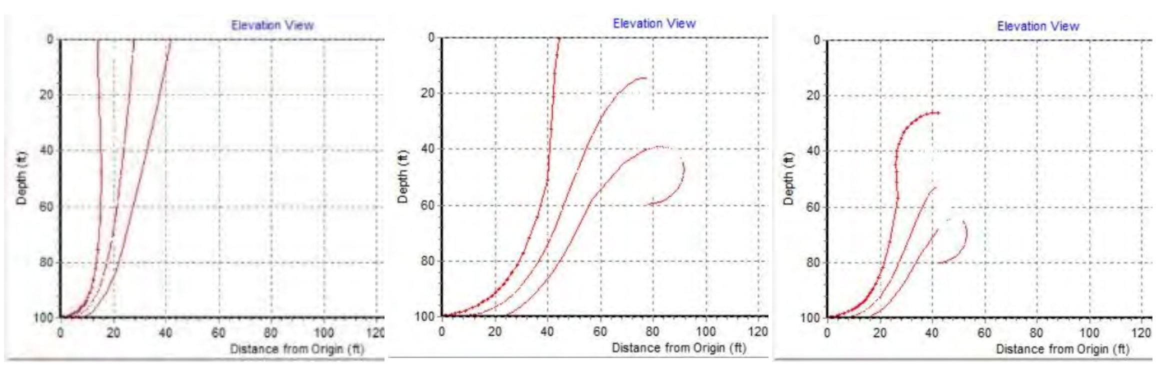
The following procedure was used for the dilution simulations. The internal hydraulics program, Section 3, was first run for each of the three scenarios. The average port diameter and flows were then obtained. UM3 and NRFIELD were then run for the chosen flow and ambient combination scenarios summarized in Table 6: P1 with Upwelling, Davidson, and Oceanic conditions; P6 with Davidson, and V5 with Upwelling. The seasonal average density stratifications that were discussed in Section 2.1 and plotted in Figure 3 were used and zero current speed was assumed. UM3 assumes the discharges are from one side so the usual assumption was used that the diffuser consists of 129 ports spaced 8 ft apart. NRFIELD assumes the correct configuration of ports on either side spaced 16 ft apart; the correction is made internally in Visual Plumes.

5.2 Results

The results are summarized in Table 8 and some graphical jet trajectories from UM3 are shown in Figure 14. For UM3 the average dilutions at the terminal rise height are given along with the centerline rise heights, for NRFIELD the near field (minimum) dilution is given along with the height of the near field (centerline) dilution and the height to the top of the spreading wastefield layer.

Table 8. Summary of Dilution Simulations for Buoyant Effluent Scenarios

No.	Flow rate (mgd)	Effluent density (kg/m^3)	Port diam. (in)	Ocean condition	UM3 simulations		NRFIELD simulations		
					Average dilution	Rise height (center-line) (ft)	Minimum dilution	Rise height (center line) (ft)	Rise height (top) (ft)
P1	19.78	998.8	2.00	Upwelling	191	58	186	59	42
P1	19.78	998.8	2.00	Davidson	327	100 (surface)	351	100	100
P1	19.78	998.8	2.00	Oceanic	240	82	239	50	72
P6	33.76	1017.6	2.25	Davidson	154	86	163	86	89
V5	28.77	1012.7	2.18	Upwelling	122	47	105	41	43
V10	25.85	1014.7	2.13	Davidson	195	100 (Surface)	221	100	100



a) P1 Davidson **b) P6 Davidson** **c) V5 Upwelling**

Figure 15. Graphics outputs from UM3 simulations.

It can be seen that the *average* dilution predicted by UM3 is very close to *minimum* (centerline) dilution predicted by NRFIELD. Similar observations were made by Isaacson et al. (1983) in connection with physical model studies on the San Francisco outfall. The reason is apparently that the increase in mixing and dilution in the transition from vertical to horizontal flow and merging of the plumes from both sides, neither of which are incorporated into UM3, are accounted for in the ratio of average to minimum dilutions. Therefore, we use the average dilution predicted by UM3 but interpret it as the minimum centerline dilution. Similar observations are reported in model comparisons by Frick and Roberts (2016). The near field dilution is synonymous with the initial dilution in the ZID as defined in the California Ocean Plan.

Dilutions are generally high: The lowest is 105 for scenario V5 which was run with strong (Upwelling) stratification. The highest dilution was 351 for scenario P1 (pure secondary effluent) with weak (Davidson) stratification which resulted in a surfacing plume. Generally speaking, strong stratification results in lower dilutions and reduced rise height, and weak stratification result in higher dilutions and increased rise height. All of the scenarios resulted in submerged plumes except for case P1 with Davidson conditions.

Note that all the simulations were run for zero current, as specified in the Ocean Plan. More realistic simulations with currents would predict higher dilutions and deeper submergences.

The lower density difference and therefore relatively greater influence of source momentum flux results in flatter jet trajectories, as seen in Figure 14ab, cases P6 and V5.

6. SHEAR AND TURBULENCE EFFECTS

6.1 Introduction

The 2015 California Ocean Plan contains the following requirement for mitigation of marine life or habitat lost due to a desalination facility:

> *"For operational mortality related to discharges, the report shall estimate the area in which salinity exceeds 2.0 parts per thousand above natural background salinity or a facility-specific alternative receiving water limitation (see chapter III.M.3). The area in excess of the receiving water limitation for salinity shall be determined by modeling and confirmed with monitoring. The report shall use any acceptable approach approved by the regional water board for evaluating mortality that occurs due to shearing stress resulting from the facility's discharge, including any incremental increase in mortality resulting from a commingled discharge."*

The purpose of this section is to evaluate mortality due to the discharge. In particular, it has been suggested that planktonic organisms entrained into the high velocity turbulent jets could be subject to injury, possibly mortality, due to the effects of turbulence and shear. This is difficult to estimate, so only approximate orders of magnitude can be made. Somewhat similar concerns arise due to entrainment into water intakes, for example Tenera (2014), although the considerations for jets are different and somewhat more complex.

Experimental evidence suggests that the main turbulence effect is caused by small-scale eddies, known as the Kolmogorov scales, and that most damage may occur when they are comparable to the size of the organisms. These small eddies subject the organism to high strain rates and viscous shear stress that may cause injury or death whereas larger eddies mainly translate the organisms without causing significant shear. The effects vary by organism, and a number of studies on the effects of flow and turbulence on marine and freshwater organisms have been reported. They are summarized in Appendix C.

Most relevant here are the studies of Rehmann et al. (2003) and Jessop (2007). Rehmann et al. performed laboratory experiments in which zebra mussel veligers were subject to controlled turbulence in beakers. The turbulence intensity was such that the Kolmogorov scale, $L_k \sim 0.1$ mm. They found that mortality increased sharply to about 65% when the size of the larvae was about 90% of the Kolmogorov scale. Jessop (2007) measured survival rates in a highly turbulent tidal channel with $0.06 < L_k < 0.25$ mm. Survival rates varied with species; thin-shelled veligers showed significant mortality of 45% to 64%, but some taxa showed no mortality.

These and other results are difficult to translate to jet turbulence for a number of reasons. In the laboratory experiments, the organisms were subject to fairly homogeneous turbulence for long periods: 24 hours. In the field experiment the turbulence was variable during the organisms' transit through the channel. The duration of exposure to high turbulence is unknown but was probably a few minutes and the variation of conditions during transit are also unknown.

In contrast, the turbulence in jets is not homogeneous: it varies along the centerline and also laterally across the jet. Kolmogorov scales are smallest near the nozzle and increase along the trajectory; they are shortest on the centerline and increase towards the jet edges. Also, transit times of entrained organisms within the jets are short, of the order of seconds, and vary according to where along the trajectory they are entrained and how they wander within the jet.

In the following we take several approaches to this problem. In Sections 6.3 and 6.4 we discuss turbulence characteristics of jets and estimate turbulence length scales for the various brine discharge scenarios. We estimate the total volumes where effects may be expected and express it as a fraction of the total volume of the BMZ. Then we estimate the fraction of the ambient flow that passes over the diffuser that is entrained, and therefore the fraction of larvae entrained. Finally, in Section 6.5, we estimate the total numbers of organisms entrained by the diffuser and the number that may be subject to mortality.

6.2 Plankton Field Data

In order to estimate planktonic levels, seawater samples were taken on May 14, 2016 along the three towed transects shown in Figure 16. The results are summarized by taxonomic group and size ranges in Table 9.

Figure 16. Transect lines for plankton samples 5/14/16.

Table 9. Summary of Plankton Tows Monterey May 14, 2016

Taxonomic Group		Size (mm)	Count (#/m^3)
Copepods	Copepod_unid	0.3 - 5.0	33.73
	Calanoid	1.0 - 5.0	3052.72
	Oithona_sp	0.5 - 2.0	369.85
	Corycaeus_sp	0.3 - 1.5	64.31
	Copepod_nauplii	0.1 - 0.2	77.69
		Copepod total	3598.29
Other	Euphausiid_nauplii	0.35 - 0.5	13.99
	Euphausiid_Calyptopis	0.8 - 2.2	613.94
	Euphausiid_furcilia	1.0 - 5.6	79.68
	Cirripedia_nauplii	0.35 - 0.5	13.83
	Pleurobrachia_sp	2.0 - 10.0	3.93
	Cladocera_podon	0.2 - 3.0	2.83
	Salp	1.0 - 10.0	79.46
	Appendicularia_unid	1.0 - 1.5	58.04
	Oikopleura_unid	1.0 - 1.5	13.83
	Chaetognath_unid	4.0 - 10.0	29.69
	Isopod_unid	0.4 - 1.0	1.97
	Polychaete_unid	0.5 - 5.0	4.71
	Polychaete_trochophore	0.2 - 0.8	2.67
	Decapod_zoea	2.0 - 5.0	4.40
	Gastropod_larvae	0.8 - 3.0	3.30
	Bivalve_veliger	0.75 - 1.0	4.08
	Siphonophore	1.0 - 5.0	7.07
	Hydromedusa	0.5 - 10	1.41
		Other total	938.82
		Overall total	4537.11

6.3 Jet Turbulence and Entrainment

The turbulence generated by the diffuser is discussed below, in particular the spatial variations of turbulence intensity and length scales (eddy sizes) of the turbulence. The diffuser discharges are initially horizontal and have relatively flat trajectories (Figures 8, 9, and 11) so it reasonable to analyze them as pure jets (i.e. flows driven by momentum only).

The properties of jets are well known, and summarized for example in Fischer et al. (1979). An LIF image of a jet and a depiction of its main features are shown in Figure 17. Closer to the nozzle the jet is more fine-grained but the turbulent scales increase along its trajectory. External flow is entrained into the jet (and dilutes it) and the jet width increases linearly with distance from the nozzle.

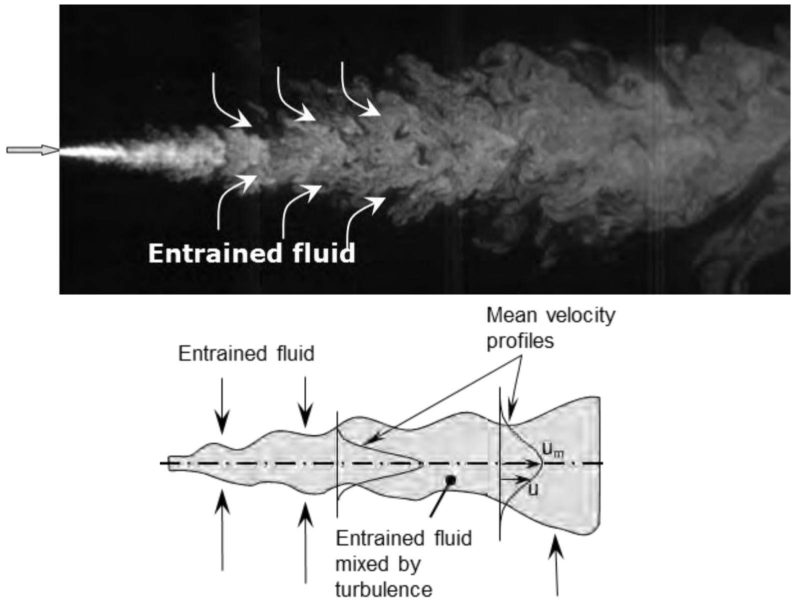


Figure 17. LIF image and main properties of a jet

Beyond the zone of flow establishment, which is about 6*d* long, the centerline velocity u_m decreases rapidly with distance *x* according to:

$$u_m = 6.2u\frac{d}{x} \tag{4}$$

where *u* is the jet velocity and *d* the diameter. The half-width of the jet *w,* defined as two standard deviations of a Gaussian velocity distribution, increases linearly with distance according to:

$$w = 0.15x \tag{5}$$

Combining Eqs. 4 and 5, we see that the average mean shear in the jet $d\overline{u}/dr$ where $\overline{u}$ is the local velocity and *r* the radial distance is:

$$\frac{d\overline{u}}{dr} \approx \frac{u_m}{w} \approx 41\frac{ud}{x^2} \tag{6}$$

So it decreases even more rapidly than velocity with distance from the nozzle. Note that the mean shear on the jet centerline is zero.

The turbulence properties in the jet can be estimated from the experimental data of Webster et al. (2001). They show that the relative turbulence intensity on the centerline, $\tilde{u}/u_m \approx 0.3$ where $\tilde{u}$ is the rms value of the turbulent velocity fluctuations. The intensity decreases with radial distance to zero at the edge of the jet, defined approximately by Eq. 5.

The size of the small-scale (Kolmogorov) eddies η can be estimated from:

$$\eta \sim \left(\frac{\nu^3}{\varepsilon}\right)^{1/4} \tag{7}$$

where ν is the kinematic viscosity of seawater and ε the energy dissipation rate, that can be approximated as:

$$\varepsilon \sim \frac{\tilde{u}^3}{l_L} \tag{8}$$

where l_L is a measure of the largest (energy containing) eddies in the jet. According to Wygnanski and Fiedler (1969) these length scales also increase linearly with distance from the nozzle and vary radially across the jet. On the centerline, $l_L \sim 0.016x$, i.e. about 1/12 of the jet width.

Finally, combining the above equations we find:

$$\frac{\eta_c}{x} = 0.24\,\mathrm{Re}^{-3/4} \tag{9}$$

where $\mathrm{Re} = ud/\nu$ is the jet Reynolds number and η_c the size of the Kolmogorov eddies on the jet centerline. The Kolmogorov scale therefore increases linearly along the jet trajectory.

The radial variation of turbulence intensity and turbulent length scales across the jet is now considered. Near the jet edge, $l_L \sim 0.03x$ according to Wygnanski and Fiedler, i.e. about 1/25 of the jet width, and the turbulence intensity is about $\tilde{u}/u_m \approx 0.04$ according to Webster et al. (2001). Combining Eqs. 7 and 8 we can estimate the ratio of the Kolmogorov scale on the centerline to that at the jet edge as:

$$\frac{\eta_c}{\eta_e} = \left\{\frac{(\ell_c/\ell_e)}{(\tilde{u}_c/\tilde{u}_e)^3}\right\}^{1/4} \approx 0.2 \tag{10}$$

where the subscripts *c* and *e* refer to the jet centerline and edge, respectively. Eq. 10 indicates that the Kolmogorov scales at the jet edge are about five times larger than on the centerline.

Travel times of entrained larvae along the jet trajectory will vary, depending on where along the trajectory they enter the jet and whether they mainly travel on the centerline, on the edge, or in between. On the centerline, the velocity decreases according to Eq. 4 so the travel time along the trajectory to the impact point is given approximately by:

$$t = \int_0^L \frac{dx}{u_m} = \int_0^L \frac{x}{6.2ud}dx = \frac{L^2}{12.4ud} \tag{11}$$

where *L* is the length of the trajectory from the nozzle to the seabed impact point.

As previously discussed, the jet properties were predicted by UM3 (Table 7). In addition, the diameters of the jets at impact d_j were obtained and the volumes of the 129 jets computed, assuming them to be conical up to impact:

$$V_j = 129 \times \frac{d_j^2 L}{12} \tag{12}$$

This volume was computed as a fraction of the water volume in the BMZ, V_{BMZ}, computed from:

$$V_{BMZ} = L \times w_{BMZ} \times H + \pi \left(\frac{w_{BMZ}^2}{4} \right) \times H = 10^8 \quad \text{ft}^3 \tag{13}$$

where L = 1024 ft is the diffuser length, w_{BMZ} = 656 ft (200 m) is the width of the brine mixing zone, and H = 104 ft is the average water depth at the diffuser.

In desalination projects, the word entrainment arises in two contexts. It refers to flow drawn into intakes, and, in the jets and plumes that arise in brine diffusers, it refers to the flow induced by velocity shear at the edge of the jet (see Figure 17). This flow, commonly referred to as entrained flow, mixes with and dilutes the effluent stream. Below we consider the magnitude and spatial variation of the entrained velocity and the magnitude of the entrained flow expected to be subjected to significant shear and turbulence effects.

The velocity at which flow is entrained into the jet is directly proportional to the local centerline velocity and is given by:

$$u_o = \alpha u_m \tag{14}$$

where u_o is the entrainment velocity at a radial distance $r = b_w$ from the jet centerline and b_w is defined from the usually assumed radial velocity variation:

$$\frac{u_r}{u_m} = \exp\left\{ -\frac{r^2}{b_w^2} \right\} \tag{15}$$

where u_r is the entrainment velocity at radial distance r. The length scale b_w grows linearly with x according to (Fischer et al. 1979):

$$b_w = 0.107x \tag{16}$$

The variation of the entrained velocity u_e with radial distance r beyond the edge of the jet can be determined by continuity:

$$u_o 2\pi b_w = u_e 2\pi r$$

or

$$u_e = u_o \frac{b_w}{r} \tag{17}$$

i.e. the entrained velocity decreases rapidly with distance from the jets in inverse proportion to the distance *r*.

Combining Eqs. 4, 13, 15, and 16, we find:

$$u_e = 6.2 \times 0.107 \alpha \frac{ud}{r}$$

Assuming α = 0.0535 (Fischer et al., 1979), this becomes:

$$u_e = 0.035 \frac{ud}{r} \qquad (18)$$

In other words, the entrainment velocity is constant with *x*, the distance along the jet, but decreases rapidly away from the jet in the radial direction. The entrainment velocity at any location depends only on the source momentum flux of the jet, which is proportional to *ud*.

Now we apply this result to case P2. From Table 7, u = 8.9 ft/s, and d = 1.87 in, yielding:

$$u_e = \frac{0.049}{r} \quad \text{ft/s} \qquad (19)$$

So, at a distance of 3 ft from the jet centerline, the velocity has fallen to about 0.02 ft/s (0.5 cm/s), already much smaller than typical oceanic velocities.

The total volume entrained into the jets is directly related to dilution. It is given by (Fischer et al. 1979):

$$Q_E = Q \times S_a \qquad (20)$$

where Q is the source discharge rate and S_a the average dilution. The average dilution $S_a = 1.4 S_m$ where S_m is the minimum centerline dilution. So a centerline dilution of 16:1 requires entraining about 22 times the source flow rate.

The total flux of water passing over the diffuser and BMZ can be estimated from:

$$Q_{BMZ} = \bar{U} \times \left(L + 2 w_{BMZ} \right) \times H \qquad (21)$$

where $\bar{U}$ is the mean oceanic drift speed. The ADCP measurements of Tenera (2014) at a depth of 30 m near the mouth of the Monterey Canyon imply a mean drift speed of about 5 cm/s.

6.4 Results and Discussion

The main flow properties for the various dense discharge scenarios of Tables 6 and 7 were computed according to Eqs. 9 through 21. The results are summarized in Table 10 where the kinematic viscosity ν was assumed to be 1.2×10^{-5} ft^2/s and the mean oceanic drift speed $\bar{U} = 5$ cm/s. In addition, estimates of scales, dilution and entrainment for the baseline domestic wastewater discharge (Case P1, 19.78 mgd) are also shown.

For case P2 (pure brine), the Kolmogorov scale on the centerline ranges from about 0.012 mm near the nozzle to 0.14 mm at the impact point. At the jet edge it therefore ranges from about 0.06 mm near the nozzle to about 0.7 mm. The mean shear rates range from about 57 sec^{-1} near the nozzle to 0.4 sec^{-1} at the impact point.

The maximum centerline travel time is about 8 seconds. The mean velocity profiles of Webster et al. (2001) show that the jet velocity is greater than about 20% of the maximum over about 80% of the jet width. Therefore, closer to the jet edges, travel times will be around 40 seconds. Organisms entrained and traveling near the jet edges will undergo lower intensities (larger eddies) but for longer times.

Clearly, the Kolmogorov scales in the jet will be smaller to or comparable than the smallest organisms of interest (Table 9). They range from 0.012 to 2.5 mm. These are mostly somewhat smaller than the Kolmogorov scale due to natural turbulence in the ocean which in Monterey is about 1 mm (Walter et al. 2014). Therefore, the Kolmogorov scale of the natural turbulence is also comparable to larvae size and may cause natural mortality. The incremental mortality due to the jets are estimated below.

In turbulence, there is a continuous spectrum of eddy sizes and turbulent kinetic energy from the smallest (Kolmogorov) to the largest (energy-containing) eddies. For case P2, they range from about 0.01 mm to 0.24 m, so there will be some eddies of size comparable to the organism sizes that may affect them. It should be noted, however, that the strain rates (and shear stresses) are maximum at the Kolmogorov scale and decrease as the eddy size increases.

The volume of water in the jets where turbulent intensities are greater than background is almost infinitesimally small compared to the volume of the BMZ. It ranges from 0.006% for case P2 to 0.4% for case V9.

For the brine discharges, only a small fraction of the water passing over the diffuser is entrained. It ranges from 1.7% for case P2 to 6.4% for case V9. This estimate depends on the assumed value of the oceanic drift speed, conservatively assumed to be 5 cm/s. For higher speeds it would be less.

The area of high shear impacted by the diffusers is relatively small and transit times through this region relatively short. Thus, it seems reasonable to expect that, while the larvae that experience the highest shear may experience lethal damage, the overall increase in mortality integrated over the larger area will be low.

The volumes entrained into the brine discharges are much less than into the baseline (P1) case. This is mainly because the dilutions for the baseline case is much higher. For the brine discharges the entrainment rates range from 7 to 22% of those for the baseline case. Therefore, organism mortality for the brine discharges would also be expected to be about 7 to 22% of the baseline case.

Table 10. Summary of Turbulence and Entrainment Calculations

Case No.	Effluent		Port conditions			UM3 predictions					Travel time center-line	Total volume as % of BMZ	Kolmogorov scales		Entrained flows	
	Flow	Density	Velocity	Diam.	Reynolds number (x10^{-5})	Dilution	Impact distance	Diam-eter	Traj-ectory	Volume			At 1 ft	At impact	Volume	As % of BMZ flux
	(mgd)	(kg/m^3)	(ft/s)	(in)			(ft)	(in)	(ft)	(ft^3)	(sec)		(mm)	(mm)	(mgd)	
P1	19.78	998.8	10.0	1.96	1.36	191	-	-	-	-	-	-	0.01	-	5290	28.5
P2	13.98	1045.2	8.9	1.87	1.16	16.3	10.3	49	12.0	52.4	8.4	0.0064	0.012	0.140	319	1.7
P3	14.98	1041.2	8.9	1.86	1.14	16.9	10.7	51	12.5	59.1	9.1	0.0073	0.012	0.146	354	1.9
P4	15.98	1038.5	9.2	1.89	1.21	17.8	11.8	56	13.6	78.3	10.2	0.0096	0.011	0.153	398	2.1
P5	22.98	1026.4	11.2	2.07	1.62	35.3	29.0	140	31.9	1137.0	42.3	0.1397	0.009	0.290	1136	6.1
P6	33.76	1017.6	14.8	2.28	2.35	-	-									
V1	8.99	1045.2	7.4	1.67	0.86	16.3	8.7	41	10.4	31.7	8.5	0.0039	0.015	0.152	205	1.1
V2	9.99	1040.5	7.7	1.70	0.91	17.4	9.8	46	11.5	43.6	9.9	0.0054	0.014	0.161	243	1.3
V3	10.99	1036.6	7.6	1.71	0.91	18.5	10.9	50	12.7	58.4	11.9	0.0072	0.014	0.177	285	1.5
V4	14.79	1026.4	9.0	1.88	1.18	32.5	24.0	116	26.5	644.3	40.2	0.0792	0.012	0.305	673	3.6
V5	28.77	1012.7	13.5	2.21	2.07	-	-									
V6	9.93	1041.1	7.7	1.70	0.91	17.2	9.7	46	11.4	44.0	9.7	0.0054	0.014	0.160	239	1.3
V7	10.93	1036.5	7.9	1.74	0.95	18.2	10.9	52	12.7	61.7	11.3	0.0076	0.014	0.171	278	1.5
V8	12.93	1030.6	8.4	1.80	1.05	22.1	14.7	70	16.6	147.1	17.7	0.0181	0.013	0.208	400	2.2
V9	15.23	1026.1	9.0	1.88	1.17	55.4	42.1	204	46.1	3473.9	121.5	0.4268	0.012	0.531	1181	6.4
V10	25.85	1014.7	12.6	2.16		-	-									

6.5 Plankton Entrainment and Mortality

Estimated rates of organism entrainment into the jets were computed as a product of the entrained volumes from Table 10 and organism concentrations in in Table 9. The results are shown in Table 11, sorted by organism size from smallest to largest. Although the absolute numbers of entrained organisms are high, they represent only a small fraction of those passing over the diffuser, which is similar to the fraction of water entrained: about 2 to 6% according to Table 10.

Because the natural Kolmogorov scale near the diffuser is about 1 mm, it is argued that incremental mortality due to the jets will only occur for regions where the Kolmogorov scale is shorter than this and by organisms smaller than 1 mm. We assume no incremental mortality for organisms larger than 1 mm. Organisms smaller than 1 mm comprise only 27% of the total, and the fraction of them that actually die is uncertain. According to the literature it could be anywhere from zero to about 50%; we assume the conservative upper limit of 50%. The results are summarized in Table 11.

We emphasize that 50% is most probably a very conservative upper limit to the fractional mortality. As discussed, organisms in a jet are subject to its turbulence for only brief periods of seconds and the turbulence intensity decreases rapidly as they travel through the jet.

It is useful to combine these estimates to obtain an upper bound for the fraction of entrained organisms passing over the diffuser that may be subject to mortality. For case P2, we have, from Tables 10 and 11.

$$\begin{pmatrix}\text{Fraction of}\\ \text{BMZ flux}\\ \text{entrained}\end{pmatrix}\times\begin{pmatrix}\text{Fraction of}\\ \text{organisms}\\ < 1\text{ mm}\end{pmatrix}\times\begin{pmatrix}\text{Fraction}\\ \text{mortality}\end{pmatrix}=0.017\times0.266\times0.50=0.0023=0.23\%$$

Note that similar calculations are made for intakes. For example, Tenera (2014) estimated larvae entrainment into a proposed intake near the head of the Monterey Canyon. Because intakes are essentially point sinks, the concept of water flux passing over them is meaningless so the methods used here do not apply. They use the ETM (Empirical Transport Model) approach whereby the proportional mortality of larvae in the source water population is estimated. They estimate the highest estimated proportional mortality to be of order 0.1% for a 63 mgd intake. For the diffuser, the volumes entrained for dilution are about 5 to 20 times this amount so if the same approach were used here approximately 0.5 to 2.0% of the source flow would be subject to mortality, similar to that estimated in Table 10. The difference of course is that 100% mortality of entrained organisms is assumed for intakes whereas a much smaller fraction, if any, larvae die in passing through the jets.

Table 11. Estimates of entrainment and mortality. Organisms sorted by size, small to large. Case P2

Taxonomic Group		Size (mm)	Count (#/m³)	% of total	Cumulative %	Entrainment (#/day)	Incremental mortality (#/day)
Copepods	Copepod_nauplii	0.1 - 0.2	77.69	1.71	1.71	114,680,910	57,340,455
Other	Cladocera_podon	0.2 - 3.0	2.83	0.06	1.77	4,172,099	2,086,050
Other	Polychaete_trochophore	0.2 - 0.8	2.67	0.06	1.83	3,940,942	1,970,471
Copepods	Copepod_unid	0.3 - 5.0	33.73	0.74	2.58	49,790,726	24,895,363
Copepods	Corycaeus_sp	0.3 - 1.5	64.31	1.42	3.99	94,933,608	47,466,804
Other	Euphausiid_nauplii	0.35 - 0.5	13.99	0.31	4.30	20,649,175	10,324,588
Other	Cirripedia_nauplii	0.35 - 0.5	13.83	0.30	4.61	20,409,510	10,204,755
Other	Isopod_unid	0.4 - 1.0	1.97	0.04	4.65	2,902,172	1,451,086
Copepods	Oithona_sp	0.5 - 2.0	369.85	8.15	12.80	545,978,077	272,989,039
Other	Polychaete_unid	0.5 - 5.0	4.71	0.10	12.91	6,953,004	3,476,502
Other	Hydromedusa	0.5 - 10	1.41	0.03	12.94	2,086,050	1,043,025
Other	Bivalve_veliger	0.75 - 1.0	4.08	0.09	13.03	6,026,992	3,013,496
Other	Euphausiid_Calyptopis	0.8 - 2.2	613.94	13.53	26.56	906,316,100	453,158,050
Other	Gastropod_larvae	0.8 - 3.0	3.30	0.07	26.63	4,868,389	2,434,194
Copepods	Calanoid	1.0 - 5.0	3052.72	67.28	93.91	4,506,487,870	0
Other	Euphausiid_furcilia	1.0 - 5.6	79.68	1.76	95.67	117,622,706	0
Other	Salp	1.0 - 10	79.46	1.75	97.42	117,305,750	0
Other	Appendicularia_unid	1.0 - 1.5	58.04	1.28	98.70	85,679,028	0
Other	Oikopleura_unid	1.0 - 1.5	13.83	0.30	99.01	20,418,019	0
Other	Siphonophore	1.0 - 5.0	7.07	0.16	99.16	10,430,248	0
Other	Pleurobrachia_sp	2.0 - 10	3.93	0.09	99.25	5,804,344	0
Other	Decapod_zoea	2.0 - 5.0	4.40	0.10	99.35	6,492,125	0
Other	Chaetognath_unid	4.0 - 10	29.69	0.65	100.00	43,832,517	0
		Totals	4537.11			6,697,780,360	891,853,877

7. DILUTION MITIGATION

7.1 Introduction

This section explores methods to increase dilution for dense discharges (brine, and brine comingled with secondary and GWR effluents). In particular, it has been suggested that some combinations of effluents may not achieve sufficient dilution to meet the water quality requirements of the Ocean Plan. Particularly troublesome may be ammonia levels when low to moderate volumes of secondary effluent are added to brine. Trussell (2016) identifies some cases, reproduced in Table 12, where the dilutions predicted from Tables 7 and 8 are insufficient to achieve the target goals of 80% of the compliance limit. Note that the dilution D_m used in Table 9 is $D_m = S_m - 1$ where S_m is the dilution in Tables 7 and 8 to agree with the definition of dilution used in the Ocean Plan. It can be seen that cases V6, V7, and V8 may not achieve sufficient dilution.

Table 12. Minimum Dms required for Variant Project with GWR concentrate flow (Trussell, 2016)

Case No.	Minimum required Dm for compliance				Modeled Dm		
	WW flow (mgd)	50% of Dm required	80% of Dm required	100% of Dm required	Cederwall	UM3	NRFIELD
V6	0.0	69	37	30	15.6	16.2	-
V7	1.0	65	41	32	16.4	17.2	-
V8	3.0	73	46	37	21.6	22.2	-
V9	5.3	80	50	40	76.6	55.0	-
V10	15.9	96	60	48	-	194	220

Several possible mitigation strategies have been suggested to increase dilution:

1. Augment the discharges by adding treated RO water to the brine from the GWR or desalination facility. This would increase the jet velocities and decrease the density difference between the effluent and receiving water, both of which will increase dilution.
2. Increase the flow per port by either temporarily storing on site in a storage basin and pumping briefly at higher flow rates, or by closing off some ports. Both would increase the jet velocity and increase dilution.
3. Discharge through upwardly inclined nozzles either by retrofitting the existing horizontal nozzles or by constructing a new dedicated brine diffuser.

These options are analyzed in this section, focusing on cases V6, V7, and V8. In addition, the effect of retrofitting upward nozzles on the MRWPCA diffuser on the dilution of positively buoyant discharges is discussed along with some engineering issues.

7.2 Flow Augmentation

In this scenario, flows with densities close to freshwater are added to the brine and secondary effluent mixtures to increase jet velocity and decrease the density difference between the combined effluent and the receiving water.

The following procedure was followed to analyze this scenario. A quantity of water was added to the base flow and the new flow rate and effluent density were computed. The internal hydraulics program was then run and the variations in effective port diameter and flow per port along the diffuser were obtained. The calculations account for the variation of port opening with flow as explained in Appendix A. Dilution calculations were then performed for the ports with highest and lowest flows and the lowest value of dilution chosen. The dilution calculations were performed using the Cederwall equation (Eq. 3), and UM3 was also run for some cases to determine jet trajectories.

The results are plotted as functions of flow added in Figure 18 and are summarized in Table 13. The effect of added flow on the jet trajectories predicted by UM3 is shown in Figure 19 for two typical cases: V6.10 and V6.14.

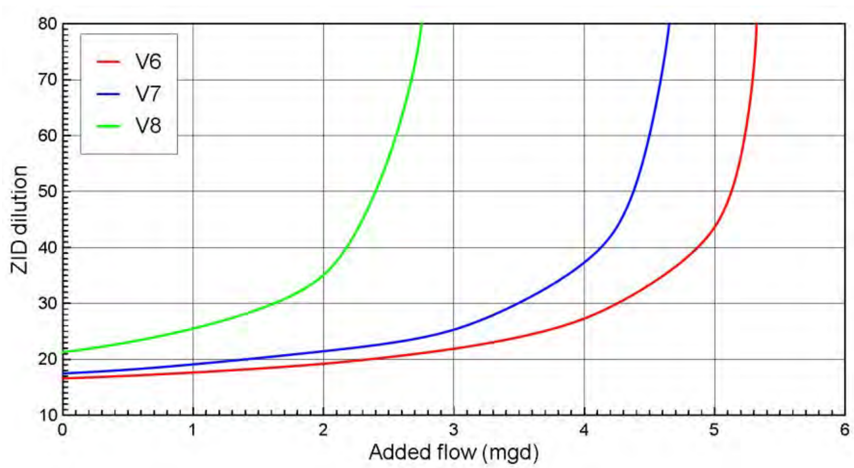


Figure 18. Effect on dilution of added freshwater flows to cases V6, V7, and V8.

Table 13. Effect of added flow on dilution for selected scenarios

Case No.	Background density	Makeup Flow	Combined flow		Port conditions							Dilution by Cederwall formula
			Flow	Density	Flow		Diam.	Height	Velocity	Froude no.	y/dF	
	(kg/m³)	(mgd)	(mgd)	(kg/m³)	(gpm)	(cfs)	(in)	(ft)	(ft/s)			
V6.10	1025.8	0.0	9.9	1041.1	54.3	0.121	1.70	4.0	7.7	29.5	0.96	16.6
V6.11	1025.8	0.5	10.4	1039.0	56.3	0.126	1.72	4.0	7.8	32.0	0.87	17.0
V6.12	1025.8	1.0	10.9	1037.2	58.8	0.131	1.74	4.0	7.9	34.9	0.79	17.6
V6.13	1025.8	2.0	11.9	1033.9	58.6	0.131	1.74	4.0	7.9	41.3	0.67	19.2
V6.14	1025.8	3.0	12.9	1031.1	63.9	0.142	1.78	4.0	8.2	52.6	0.51	21.9
V6.15	1025.8	4.0	13.9	1028.7	72.4	0.161	1.84	4.0	8.7	74.3	0.35	27.3
V6.16	1025.8	5.0	14.9	1026.7	76.3	0.170	1.87	4.0	8.9	136.2	0.19	43.7
V6.17	1025.8	5.3	15.2	1026.1	77.8	0.173	1.88	4.0	9.0	243.6	0.10	72.6
V7.10	1024.8	0.0	10.9	1036.5	58.3	0.130	1.74	4.0	7.9	34.2	0.81	17.4
V7.11	1024.8	0.5	11.4	1034.8	57.2	0.128	1.73	4.0	7.8	36.7	0.76	18.1
V7.12	1024.8	1.0	11.9	1033.2	60.2	0.134	1.75	4.0	8.0	41.0	0.67	19.1
V7.13	1024.8	2.0	12.9	1030.5	66.5	0.148	1.80	4.0	8.4	51.2	0.52	21.4
V7.14	1024.8	3.0	13.9	1028.2	67.3	0.150	1.81	4.0	8.4	66.3	0.40	25.3
V7.15	1024.8	4.2	15.1	1025.8	77.3	0.172	1.87	4.0	9.0	129.8	0.20	42.0
V7.16	1024.8	4.6	15.5	1025.1	78.8	0.176	1.88	4.0	9.1	241.4	0.11	72.0
V7.17	1024.8	4.75	15.7	1024.8	78.8	0.176	1.88	4.0	9.1	1283.9	0.02	353.5
V8.10	1024.8	0.0	12.9	1030.6	66.5	0.148	1.80	4.0	8.4	50.6	0.53	21.3
V8.11	1024.8	0.5	13.4	1029.4	69.3	0.155	1.82	4.0	8.6	57.8	0.46	23.0
V8.12	1024.8	1.0	13.9	1028.3	72.6	0.162	1.84	4.0	8.8	67.5	0.39	25.5
V8.13	1024.8	2.0	14.9	1026.3	76.3	0.170	1.87	4.0	8.9	104.1	0.25	35.1
V8.14	1024.8	2.5	15.4	1025.3	78.3	0.175	1.88	4.0	9.1	182.6	0.14	56.1
V8.15	1024.8	2.8	15.7	1024.8	78.3	0.175	1.88	4.0	9.1	1291.0	0.02	355.4

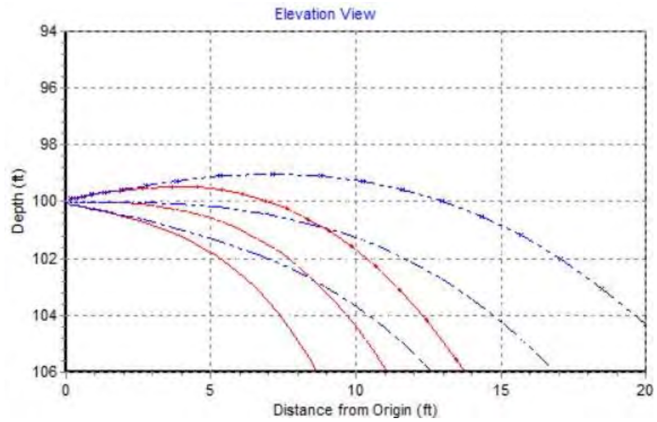


Figure 19. Jet trajectories predicted by UM3 for flow cases V6.10 (red) and V6.14 (blue).

The higher jet velocity and smaller density differences leads to a flatter and longer trajectory and therefore higher dilution. Of these, the main effect is due to the decreased density difference because the ports open as the flow increases, offsetting the increased jet velocity that would occur for a fixed office.

For low added volumes the effect on dilution is small. As the flow increases to where the density of the combined effluent approaches that of the background, i.e. the flow becomes neutrally buoyant, the dilution increases exponentially. It becomes theoretically infinite as for this case the jet trajectory is then horizontal and the jet centerline does not impact the seabed. For the three cases considered, the additional volumes required to satisfy the dilution requirements of Table 12 and the volumes for neutral buoyancy are summarized in Table 14.

Table 14. Effect of added freshwater volumes

Case No.	Base flow	For 80% compliance		Additional flow for neutral buoyancy
		Dilution needed	Additional flow	
	(mgd)		(mgd)	(mgd)
V6	9.9	38	4.8	5.5
V7	10.9	42	4.2	4.8
V8	12.9	47	2.3	2.8

Note that the actual volumes required to achieve the water quality requirements would be slightly less than those given in Table 14 due to "in-pipe" dilution by the added flow that will reduce the source concentrations.

7.3 Varied Port Flow

This mitigation technique varies the flow per port. This can be accomplished either by holding the effluent temporarily in a storage basin and then pumping intermittently at higher flow rates or by closing some of the open ports or opening some of the closed ports. More port flow increases the jet exit velocity which increases entrainment and increases the jet trajectory length thereby increasing dilution. Because these strategies are essentially identical in terms of their effect on dilution, only the former case is analyzed here. The results can also be used to estimate the effects of opening or closing ports. There are presently 129 open ports and 42 closed ports. So opening all ports would result in a reduction in the flow per port by 25%. This case is included below.

The procedure is similar to that of the previous section. A pumping rate was assumed and the internal hydraulics program was run. The highest and lowest port flows and their diameters were obtained and dilution calculations run for both. The lowest was chosen. For each pumping rate, the composition of the effluent, i.e. its density, was assumed constant and equal to that of the base cases.

The resulting dilutions are plotted as a function of pumping rate in Figure 20 and summarized in Table 15. The effect of increased flow on jet trajectory predicted by UM3 is shown for two typical cases in Figure 21.

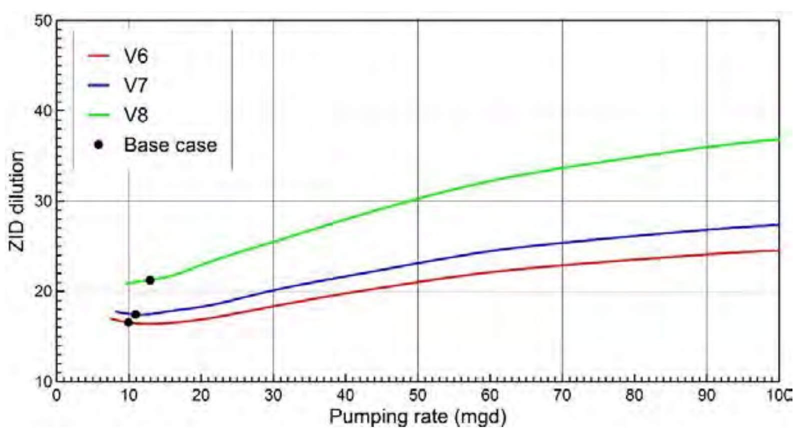


Figure 20. Effect of pumping rate on dilution for flow cases V6, V7, and V8.

The increased jet velocity leads to a longer and flatter trajectory leading to increased dilution at the impact point. However, as the flow increases, the port opening also increases, offsetting the increased jet velocity.

The dilution increases quite slowly in response to increased flow rate and the required dilutions cannot be achieved for flows below about 100 mgd, where the head required would exceed 50 ft. Note that the effect on dilution of closing ports is the same and can be readily estimated. For example, a doubling of the pumping rate is equivalent to closing half the ports.

Table 15. Effect of added flow on dilution for selected scenarios

Case No.	Background density	Effluent		Port conditions							Dilution by Cederwall formula
		Flow	Density	Flow		Diam.	Height	Velocity	Froude no.	y/dF	
	(kg/m³)	(mgd)	(kg/m³)	(gpm)	(cfs)	(in)	(ft)	(ft/s)			
V6.20	1025.8	9.9	1041.1	54.3	0.121	1.70	4.0	7.7	29.5	0.96	16.6
V6.21	1025.8	12.0	1041.1	64.8	0.145	1.79	4.0	8.3	30.9	0.87	16.4
V6.22	1025.8	15.0	1041.1	75.1	0.167	1.86	4.0	8.9	32.6	0.79	16.5
V6.23	1025.8	20.0	1041.1	103.3	0.230	2.01	4.0	10.5	36.9	0.65	16.9
V6.24	1025.8	30.0	1041.1	160.5	0.358	2.21	4.0	13.4	45.2	0.48	18.3
V6.25	1025.8	40.0	1041.1	207.8	0.463	2.32	4.0	15.8	51.8	0.40	19.8
V6.26	1025.8	60.0	1041.1	308.3	0.688	2.52	4.0	19.8	62.5	0.30	22.1
V6.27	1025.8	100.0	1041.1	505.3	1.127	2.87	4.0	25.1	74.1	0.23	24.5
V7.20	1024.8	10.9	1036.5	58.3	0.130	1.74	4.0	7.9	34.2	0.81	17.4
V7.21	1024.8	12.0	1036.5	59.4	0.132	1.75	4.0	7.9	34.3	0.80	17.4
V7.22	1024.8	15.0	1036.5	76.0	0.169	1.86	4.0	9.0	37.7	0.68	17.7
V7.23	1024.8	20.0	1036.5	105.3	0.235	2.02	4.0	10.6	42.5	0.56	18.3
V7.24	1024.8	30.0	1036.5	161.4	0.360	2.21	4.0	13.5	52.0	0.42	20.1
V7.25	1024.8	40.0	1036.5	206.8	0.461	2.32	4.0	15.7	59.1	0.35	21.7
V7.26	1024.8	60.0	1036.5	307.3	0.685	2.52	4.0	19.8	71.4	0.27	24.5
V7.27	1024.8	100.0	1036.5	609.7	1.360	3.08	4.0	26.3	85.7	0.18	27.3
V8.20	1024.8	12.9	1030.6	66.5	0.148	1.80	4.0	8.4	50.6	0.53	21.3
V8.21	1024.8	15.0	1030.6	77.8	0.173	1.88	4.0	9.0	53.1	0.48	21.6
V8.22	1024.8	20.0	1030.6	105.9	0.236	2.02	4.0	10.6	60.4	0.39	22.9
V8.23	1024.8	30.0	1030.6	154.8	0.345	2.19	4.0	13.2	72.1	0.30	25.5
V8.24	1024.8	40.0	1030.6	205.3	0.458	2.32	4.0	15.6	82.8	0.25	28.0
V8.25	1024.8	60.0	1030.6	305.8	0.682	2.52	4.0	19.7	100.3	0.19	32.2
V8.26	1024.8	100.0	1030.6	500.8	1.117	2.86	4.0	25.0	119.7	0.14	36.8

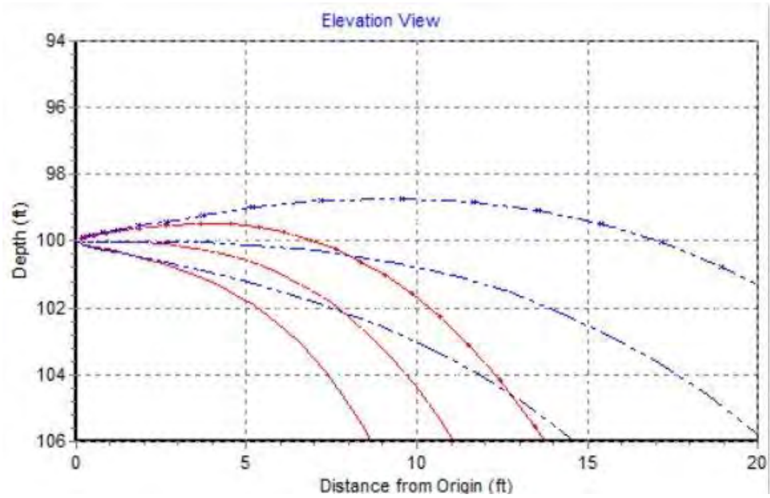


Figure 21. Jet trajectories predicted by UM3 for flow cases V7.10 (red) and V7.14 (blue).

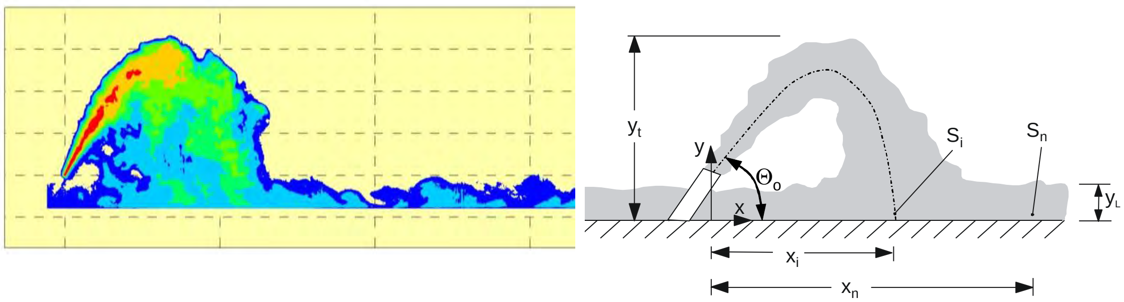
The reason for this seemingly paradoxical result is that the dilution for these cases is primarily a result of jet-induced entrainment. For a pure jet (i.e. a flow with neutral buoyancy) from a fixed orifice the flow, jet velocity, and entrained flow all increase in direct proportion to each other. The dilution at any distance from the nozzle, which is the ratio of the entrained flow to the source flow, therefore remains constant and is dependent only on the nozzle diameter (Fischer et al. 1979). In other words, increasing the flow for a pure jet does not increase dilution at a fixed point.

Dilution at the seabed does increase for the present cases as the flow increases, however, due to the longer jet trajectory before impacting the seabed as shown in Figure 21. The effect is again mitigated, however, by the variable opening of the nozzles: as the flow increases, the increase in jet velocity is much less than for a fixed orifice. Similarly, reducing the flow per port by opening closed ports does not result in a significant change in dilution. A fixed orifice would result in longer trajectories and higher dilutions than found above, but the head required would probably be prohibitive. It is clear that varying the flow per port either by pumping at a higher rate or opening or closing ports is not an effective strategy for increasing dilution.

7.4 Effect of Inclined Nozzles

7.4.1 Introduction

Diffusers for discharging dense effluents normally consists of nozzles that are inclined upwards. The optimum angle to the horizontal is 60° (Roberts and Abessi, 2014) as this maximizes the jet path length and dilution at the impact point. Such jets have been extensively studied and a typical flow image is shown in Figure 22. As shown in the definition diagram, the jet reaches a terminal rise height y_t and then falls back to the seabed. The impact dilution, S_i, interpreted here as the ZID dilution, is where the jet centerline intersects the seabed.



LIF image **Definition diagram**

Figure 22. Laser Induced Fluorescence (LIF) image of a 60° jet and definition diagram.

Inclined jets can be achieved either by retrofitting the existing check valves with upwardly inclined nozzles or by building a dedicated brine outfall and diffuser. The analyses are similar and both are considered below. Also discussed is the effect on dilution of positively buoyant effluents of retrofitting with inclined jets.

7.4.2 Diffuser Retrofit

The nozzle designs with check valves are shown in Figure A-3 in Appendix A. For the present analysis it was assumed that valves with similar hydraulic characteristics (Figure A-2) were installed but inclined upwards at 60°.

The dilution S_i of a single 60° jet and the terminal rise height y_t can be estimated from (Roberts et al. 1997):

$$\frac{S_i}{F_j} = 1.6 \tag{22}$$

and

$$\frac{y_t}{dF_j} = 2.2 \tag{23}$$

where F_j is the jet densimetric Froude number (Eq. 2) and d the effective nozzle diameter. These equations have been widely used for brine diffuser designs.

The dilutions and jet rise heights for all the base cases with dense discharges were computed and the results are summarized in Table 16, which can be compared to Table 7. The hydraulics was assumed to be the same as for the horizontal jets.

It is apparent that the inclined jets increase dilution substantially. Dilution for the base case, P2 pure brine, increases from 16:1 to 46:1. All of the required dilutions for cases V6, V7, and V8 are also met and exceeded. The rise heights of the jets are all less than 100 ft so the jets will always be submerged.

7.4.3 Dedicated Diffuser

A dedicated diffuser for brine discharges would probably consist of multiple nozzles inclined upwards at 60° to the horizontal. (Not vertical as implied in the settlement agreement as vertical jets result in impaired dilution). The nozzles would be either distributed along the sides of the diffuser or clustered in rosette risers as shown in Figure 23.

Figure 23. A brine diffuser with multiport rosettes.

The analysis for the diffuser would be similar to that for the inclined jets above, but it is noted that the outfall and diffuser could be much shorter than the existing outfall. Assuming that the outfall is only used for brine discharges (with all secondary effluent through the MRWPCA outfall), the peak flow would be about 14 mgd, requiring an outfall diameter of around 24 inches. The outfall need not be as long as the MRWPCA outfall as shoreline impact is not a major concern and deep water is not required for dilution. For example (although further analyses would be needed to optimize the outfall and diffuser lengths and nozzle details), the rise height of the jets for the pure brine case in Table 13 is about 10 ft, so the discharge could be into relatively shallow water. Costs for similar outfalls vary widely, but Roberts et al. (2012) quote a median price range for installed outfalls of 24 inch diameter of about $3,700 per meter with a range from $1,000 to $8,000 per meter.

Table 16. Effect of discharge through 60° nozzles

Case No.	Background conditions		Effluent conditions		Port conditions							Equations 4 and 5 at ZID			
												Dilution	Salinity		Rise height
	Salinity	Density	Salinity	Density	Flow		Diam.	Height	Velocity	Froude no.	y/dF		At impact	Incr-ement	
	(ppt)	(kg/m^3)	(ppt)	(kg/m^3)	(gpm)	(cfs)	(in)	(ft)	(ft/s)				(ppt)	(ppt)	(ft)
P1			0.80	998.8											
P2	33.89	1025.8	58.23	1045.2	76.3	0.170	1.87	4.0	8.9	29.0	0.89	46.3	34.41	0.53	9.9
P3	33.34	1024.8	53.62	1041.2	75.0	0.167	1.86	4.0	8.9	31.4	0.82	50.3	33.75	0.40	10.7
P4	33.34	1024.8	50.32	1038.5	80.8	0.180	1.89	4.0	9.2	35.5	0.72	56.8	33.64	0.30	12.3
P5	33.34	1024.8	35.23	1026.4	117.8	0.263	2.07	4.0	11.2	120.3	0.19	192.5	33.35	0.01	45.7
P6	33.34	1024.8	24.24	1017.6	188.5	0.420	2.28	4.0	14.8	71.5	-	-	-	-	-
V1	33.89	1025.8	58.23	1045.2	50.8	0.113	1.67	4.0	7.4	25.6	1.12	40.9	34.48	0.59	7.8
V2	33.89	1025.8	52.48	1040.5	54.3	0.121	1.70	4.0	7.7	30.1	0.94	48.1	34.27	0.39	9.4
V3	33.89	1025.8	47.78	1036.6	54.6	0.122	1.71	4.0	7.6	34.7	0.81	55.6	34.14	0.25	10.9
V4	33.34	1024.8	35.20	1026.4	77.9	0.174	1.88	4.0	9.0	102.0	0.25	163.1	33.35	0.01	35.1
V5	33.89	1025.8	18.75	1012.7	160.8	0.359	2.21	4.0	13.5	48.9	-	-	-	-	-
V6	33.89	1025.8	53.27	1041.1	54.3	0.121	1.70	4.0	7.7	29.5	0.96	47.2	34.30	0.41	9.2
V7	33.34	1024.8	47.78	1036.5	58.3	0.130	1.74	4.0	7.9	34.2	0.81	54.7	33.61	0.26	10.9
V8	33.34	1024.8	40.52	1030.6	66.5	0.148	1.80	4.0	8.4	50.6	0.53	80.9	33.43	0.09	16.7
V9	33.89	1025.8	35.01	1026.1	77.8	0.173	1.88	4.0	9.0	260.5	0.10	416.7	33.89	0.00	89.8
V10	33.34	1024.8	20.67	1014.7	143.3	0.320	2.16	4.0	12.6	52.6	-	-	-	-	-

7.4.4 Effect of Inclined Nozzles on Buoyant Flows

Diffusers for positively buoyant discharges usually have horizontal nozzles (as in the MRWPCA diffuser) as this maximizes jet trajectory and dilution and helps promote submergence. Inclining the nozzles upwards may reduce dilution somewhat. In order to investigate this effect, dilutions for the buoyant discharge scenarios (P1, P6, V5, and V10) of Table 8 were recomputed but with 60° inclined nozzles. The same hydraulic conditions were assumed. Dilution simulations were done with the model UM3 only as NRFIELD assumes horizontal nozzles. The results are summarized in Table 17.

Table 17. Summary of UM3 Dilution Simulations for Buoyant Effluent Scenarios with Horizontal and 60° Nozzles

Case No.	Flow rate (mgd)	Effluent density (kg/m^3)	Port diam. (in)	Ocean condition	Horizontal		60°	
					Average dilution	Rise height (center-line) (ft)	Average dilution	Rise height (center line) (ft)
P1	19.78	998.8	2.00	Upwelling	191	58	184	62
P1	19.78	998.8	2.00	Davidson	327	100 (surface)	310	100 (surface)
P1	19.78	998.8	2.00	Oceanic	240	82	247	91
P6	33.76	1017.6	2.25	Davidson	154	86	142	93
V5	28.77	1012.7	2.18	Upwelling	122	47	111	53
V10	25.85	1014.7	2.13	Davidson	195	100 (surface)	185	100 (surface)

For buoyant discharges of essentially freshwater into fairly deep water the dilution is primarily effected by the buoyancy flux, so the source momentum flux, and therefore the nozzle orientation, is relatively unimportant. This effect is shown in the trajectories predicted by UM3 for case P1 in Figure 24. The trajectory lengths are similar with a slightly higher rise for the inclined jets. The results show small reductions in dilution of about 5% for this case as the trajectory reduction is offset by the increased plume rise height. For case P1 with the Oceanic density profile, the results actually imply a slight increase in dilution with the inclined nozzles due to the increased rise height. For cases P6, V5, and V10 (buoyant discharges with the density difference reduced due to blending with brine), the momentum flux is slightly more important, but even here the dilution reduction is less than 10%

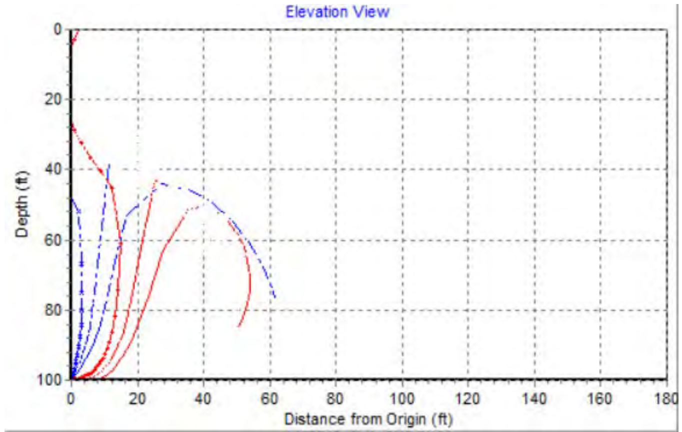


Figure 24. UM3 predicted trajectories for horizontal (red) and 60° inclined (blue) nozzles for case P1 with upwelling density profile.

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APPENDIX A. DIFFUSER HYDRAULICS WITH CHECK VALVES

1. Introduction

The calculation procedure to predict the internal hydraulics and flow distribution for diffusers with ports equipped with check valves is described below.

2. Check Valves

Typical check valves similar to those installed on the MRWPCA outfall are shown in Figure A-1. As the flow though the valve increases, the opening area increases, up to some limit. The valves attached to the MRWPCA outfall are four-inch flange TideFlex TF-2, Series 35, Hydraulic Code 61. The characteristics of the valves were provided by the manufacturer, TideFlex, Inc. and are shown in Figure A-2. The main characteristics are total head loss, jet velocity, and effective opening area as functions of flow rate.

Figure A-1. Typical "Duckbill" Check Valves

The relationship $E' = f(Q_j)$ between the total head, E' and flow Q_j of Figure A2 over the flow range 50 to 300 gpm can be closely approximated by the linear relationship:

$$E' = 0.020Q_j - 0.276 \qquad \text{(A1)}$$

where E' is the head in feet, and Q_j the flow rate in gpm. Similarly, the jet velocity (in ft/s) can be approximated by:

$$V_j = -4.71\times10^{-5}Q_j^2 + 6.49\times10^{-2}Q_j + 4.28 \qquad \text{(A2)}$$

The effective nozzle area A_j is then given by:

$$A_j = \frac{Q_j}{V_j}$$

and the diameter of an equivalent round nozzle, d_e by:

$$d_e = \sqrt{\frac{4A_j}{\pi}} \tag{A3}$$

Therefore, only the relationship between head and flow, Eq. A1, and flow and velocity, Eq. A2, are needed and all other properties can be calculated from them. Alternatively, the equivalent diameter can be calculated from the flow and head assuming a discharge coefficient of one.

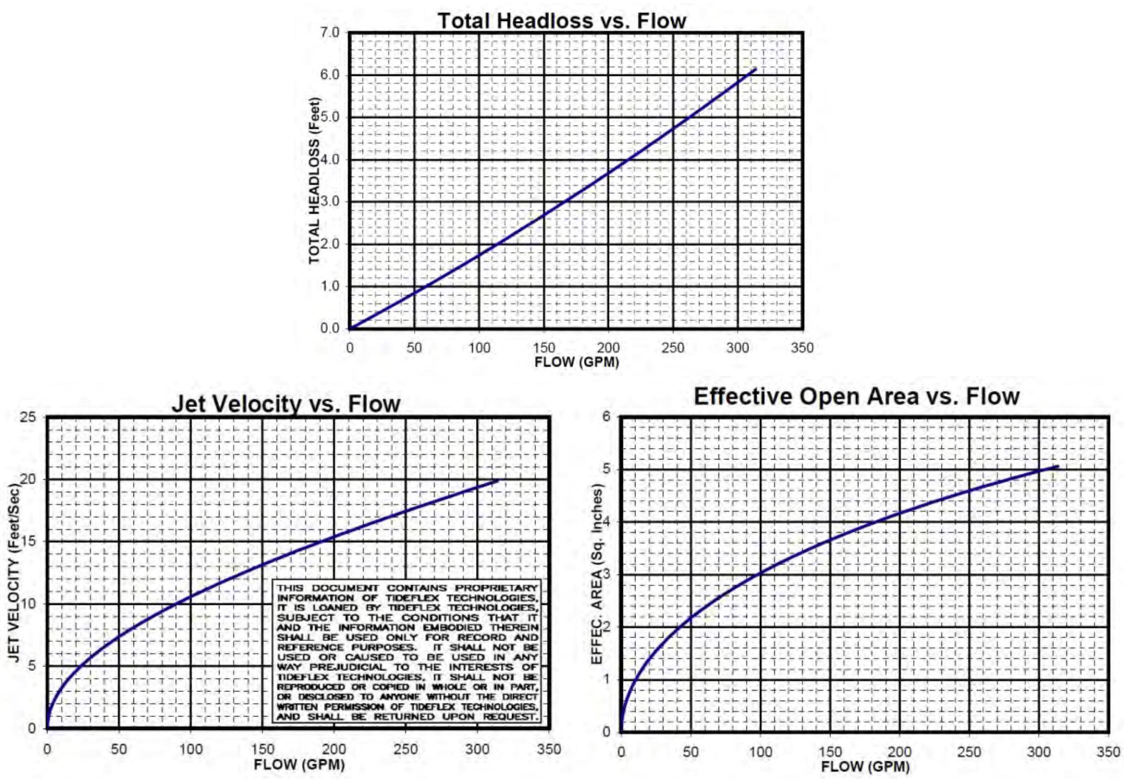


Figure A-2. Characteristics of 4" wide bill TideFlex check valve Hydraulic Code 61

3. Port Head Loss

According to the outfall design drawings (Figure A-3), the check valves are fastened over existing two-inch diameter ports. The entrances to the ports are gradually tapered bell mouths.

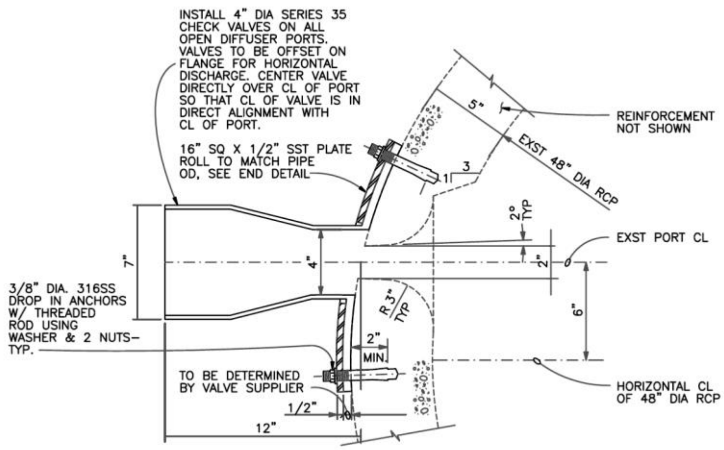


Figure A-3. Port and check valve arrangement

The head loss in the entrance from the diffuser to the port (entrance loss) can be approximated by:

$$h_f' = x_{en} \frac{V_d^2}{2g} \tag{A4}$$

where x_{en} is an entrance loss coefficient and V_d the velocity in the diffuser pipe at the port. The value of x_{en} is not known exactly, but experiments on Tee fittings reported by Ding et al. (2005) give loss coefficients for 6, 8, and 10 inch pipes with branching flows. For the larger Tees the loss coefficients ranging from about 0.43 to 0.63 depending on the ratio of flow in the branch to the main pipe. We assume a constant value of x_{en} = 0.63. Because the port entrances are rounded, and most of the head loss is in the jet velocity head, however, the results are not sensitive to the value of x_{en}.

Applying the Bernoulli equation to the flow through the port and valve and combining Eqs. A1 and A4 yields for the head at the port:

$$\begin{aligned} E &= \text{Entrance loss} + \text{Valve loss} \\ &= x_{en} \frac{V_d^2}{2g} + 0.020 Q_j - 0.276 \end{aligned}$$

which can be rearranged as:

$$Q_j = \frac{E - x_{en}\left(V_d^2/2g\right) + 0.276}{0.02} \tag{A5}$$

4. End Gate Port

The end gate of the diffuser has an opening at the bottom as shown in Figure A-4. It is approximately 2 inches high in a 48-inch diameter pipe which corresponds to an area of 25.8 in^2, equivalent to a round opening of 5.73 inch diameter.

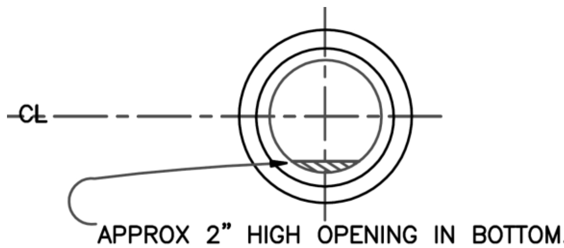


Figure A-4. End gate opening.

We approximate the discharge though this opening as being equivalent to a round sharp-edged orifice:

$$Q = C_D A\sqrt{2gE} \tag{A6}$$

where C_D is the discharge coefficient assumed equal to 0.62, A is the opening area and E the total head in the pipe just upstream of the end gate.

5. Diffuser and Pipe Head Loss

The head loss due to friction in the diffuser and outfall pipe can be approximated by the Darcy-Weisbach equation:

$$h_f = f\frac{L}{D}\frac{V_d^2}{2g} \tag{A7}$$

where L is the pipe length, D the pipe diameter, and f the pipe friction factor, given by:

$$f = f\left(\mathrm{Re}, \frac{k}{D}\right) \tag{A8}$$

where Re is the Reynolds number, $\mathrm{Re} = V_d D/\nu$ where ν is the kinematic viscosity and k the equivalent roughness height. The friction factor can be obtained from the Moody diagram, but for computational purposes it is more convenient to estimate it from:

$$f = \frac{0.25}{\left[\log\left(\frac{k/D}{3.7} + \frac{5.74}{\mathrm{Re}^{0.9}}\right)\right]^2} \tag{A9}$$

Generally accepted values of *k* for concrete pipe range from 0.012 to 0.12 inches. We assume an average value of *k* = 0.066 inches.

6. Calculation Procedure

The calculation procedure is a problem in manifold hydraulics and is iterative, similar to that described in described in Fischer et al. (1979) or Roberts et al. (2010). It follows this procedure:

1. Assume a value of the head just upstream of the end gate, E_1. Then compute the flow Q_1 through the end opening from Eq. A6.
2. Compute the velocity in the diffuser pipe just upstream.
3. Compute the pipe friction factor from Eq. A9.
4. Compute the head in the diffuser pipe at the next upstream port from:

$$E_2 = E_1 + f\,\frac{s}{D}\frac{V_d^2}{2g} + \frac{\Delta\rho}{\rho}\Delta z \tag{A10}$$

where *s* is the port spacing, $\Delta\rho = \rho_a - \rho_o$ is the density difference between the receiving water and the discharge, ρ the receiving water density, and Δz the height difference between the ports (positive if the inshore port is higher, i.e. the diffuser is sloping downwards). Note that for a dense discharge, $\Delta\rho$ is a negative number.

5. Compute the flow from the next upstream port, Q_2, from Eq. 1.
6. Add the flows Q_1 and Q_2 to get the flow in the diffuser just upstream of the port.
7. Repeat steps 2 through 6 for each port until the innermost port is reached.

Finally, the head loss in the rest of the outfall pipe up to the headworks is computed from

$$E = E_n + f\,\frac{L}{D}\frac{V_d^2}{2g} + \text{density head}$$

where E_n is the head at the innermost port, *n,* and *L* is the outfall length (excluding the diffuser).

The total flow and head loss in the outfall are not known ahead of time, so the assumed head is Step 1 is then adjusted iteratively until the desired flow is achieved. An Excel spreadsheet was written to accomplish these calculations. A typical page from the spreadsheet for scenario P2 (pure brine) follows. For this example, the flow per port increases in the offshore direction due to the negative density head (dense brine discharge).

The total head for this case is essentially zero. This seemingly counterintuitive result is because the density head essentially offsets the losses due to friction and jet velocity.

Compute port flow distribution and total headloss with check valves
Tideflex Series TF-2, 35

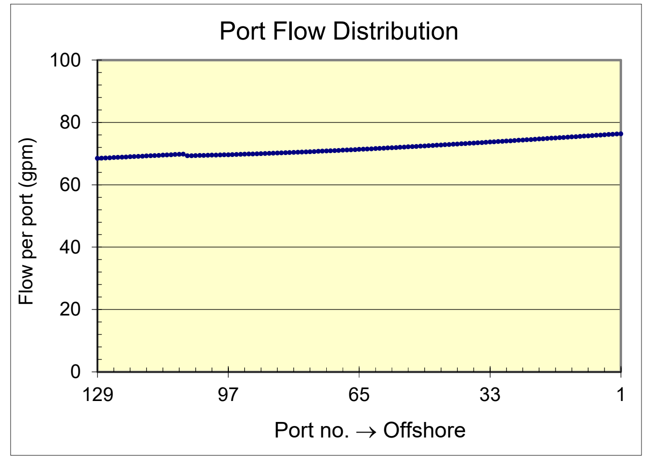
Inputted variables

No. ports per riser, Nr =	**1**
Port spacing, Sr (ft) =	**8**
Depth of end port, Hend (ft) =	**107**
Slope of diffuser, Sl =	**0.0110**
Entrance loss coeff, xen =	**0.63**

Outfall pipe length, L (ft) =	**10,274**
Roughness height, ks (in) =	**0.066**
Gravity, g (ft2/s) =	**32.2**
Ambient density (kg/m3)	**1025.8**
Effluent density (kg/m3)	**1045.2**
Density difference, Drho/rho =	**-0.019**
Kinematic viscosity, nu (ft2/s) =	**1.2E-05**

Head at end:	1.26	ft
Target flow:	**14.0**	mgd
Computed flow:	**14.0**	mgd

Outfall friction headloss:	0.81	ft
Diffuser headloss:	1.11	ft
Density head:	-1.81	ft
Total outfall head:	**0.11**	ft



Pipe segment	Pipe ID	Port number	Distance from end	Depth	Total head	Flow Per port	Flow Per riser	Flow Cumulative	Flow Cumulative	Velocity Pipe	Velocity Jet	Equivalent round port Diam.	Equivalent round port Froude	Reynolds no.	Friction factor	Friction loss
	(in)	n	(ft)	(ft)	(ft)	(gpm)	(gpm)	(gpm)	(ft3/s)	(ft/s)	(ft/s)	(in)				(ft)
End port					1.26	457	457	457	1.0	0.1	5.7	5.73	10.5			
1	48	1	0	107.0	1.26	76.3	76	533	1.2	0.1	9.0	1.87	29.1	3.1E+04	0.027	0.000
		2	8	106.9	1.26	76.3	76	609	1.4	0.1	9.0	1.87	29.1	3.6E+04	0.026	0.000
		3	16	106.8	1.26	76.2	76	686	1.5	0.1	9.0	1.87	29.1	4.0E+04	0.026	0.000
		4	24	106.7	1.26	76.1	76	762	1.7	0.1	8.9	1.86	29.1	4.5E+04	0.026	0.000
		5	32	106.6	1.25	76.0	76	838	1.9	0.1	8.9	1.86	29.1	4.9E+04	0.025	0.000
		6	40	106.6	1.25	75.9	76	914	2.0	0.2	8.9	1.86	29.1	5.4E+04	0.025	0.000
		7	48	106.5	1.25	75.8	76	990	2.2	0.2	8.9	1.86	29.0	5.8E+04	0.025	0.000
		8	56	106.4	1.25	75.8	76	1065	2.4	0.2	8.9	1.86	29.0	6.2E+04	0.025	0.000
		9	64	106.3	1.25	75.7	76	1141	2.5	0.2	8.9	1.86	29.0	6.7E+04	0.024	0.000
		10	72	106.2	1.25	75.6	76	1217	2.7	0.2	8.9	1.86	29.0	7.1E+04	0.024	0.000
		11	80	106.1	1.24	75.5	76	1292	2.9	0.2	8.9	1.86	29.0	7.6E+04	0.024	0.000
		12	88	106.0	1.24	75.4	75	1367	3.0	0.2	8.9	1.86	29.0	8.0E+04	0.024	0.000
		13	96	105.9	1.24	75.3	75	1443	3.2	0.3	8.9	1.86	29.0	8.5E+04	0.024	0.000
		14	104	105.9	1.24	75.3	75	1518	3.4	0.3	8.9	1.86	29.0	8.9E+04	0.024	0.000
		15	112	105.8	1.24	75.2	75	1593	3.6	0.3	8.9	1.86	29.0	9.3E+04	0.024	0.000
		16	120	105.7	1.24	75.1	75	1668	3.7	0.3	8.9	1.86	28.9	9.8E+04	0.024	0.000
		17	128	105.6	1.23	75.0	75	1743	3.9	0.3	8.9	1.86	28.9	1.0E+05	0.024	0.000
		18	136	105.5	1.23	74.9	75	1818	4.1	0.3	8.9	1.86	28.9	1.1E+05	0.023	0.000

APPENDIX B. DENSITY PROFILES

The seasonally averaged density profiles assumed for modeling purposes are summarized below.

Depth (m)	Density (kg/m^3)		
	Upwelling	Davidson	Oceanic
1	1025.1	1024.8	1024.8
3	1025.1	1024.8	1024.8
5	1025.1	1024.8	1024.8
7	1025.2	1024.8	1024.8
9	1025.2	1024.8	1024.8
11	1025.3	1024.8	1024.8
13	1025.4	1024.8	1024.9
15	1025.4	1024.8	1024.9
17	1025.5	1024.8	1024.9
19	1025.6	1024.9	1024.9
21	1025.6	1024.9	1025.0
23	1025.7	1024.9	1025.0
25	1025.7	1024.9	1025.0
27	1025.8	1024.9	1025.1
29	1025.8	1024.9	1025.1
31	1025.8	1024.9	1025.2
33	1025.9	1024.9	1025.2
35	1025.9	1024.9	1025.3

APPENDIX C. TURBULENCE EFFECTS ON ORGANISMS

Summary of lab and field data (and some models) regarding the effects of turbulence on organisms (from Foster et al. 2013).

Organism	Shear stress or turbulence	Method of generating shear/turbulence	Magnitude of critical shear/turbulence	Effect	Reference	Additional notes
Sea urchin S. purpuratus larvae (3 day; prism)	Laminar shear	Couette flow[1], short term (30 min)	No deleterious effect with $\varepsilon \leq 1$ cm^2/s^3	Change in prey encounter rate	Maldonaldo and Latz (2011)	Neg eff cd be due to erosion of hydromech signal, or if local velocity faster than catch speed, reaction time. Mortality was 19% for the 0.1 cm^2/s^3, 22% for the 0.4 cm^2/s^3, and 53% for the 1 cm^2/s^3 flow treatments compared to 5% for the still control.
		Couette flow Long term (8 days of 12 h on, 12 h off)	$\varepsilon < 0.1$ cm^2/s^3	Excessive mortality		
Sea urchin L. pictus larvae (3 day, 4 arm pluteus)	Laminar shear	Couette flow[1], short term (30 min)	No deleterious effect with $\varepsilon \leq 1$ cm^2/s^3	Change in prey encounter rate	Maldonaldo and Latz (2011)	
		Couette flow Long term (8 days of 12 h on, 12 h off)	No deleterious effect with $\varepsilon \leq 1$ cm^2/s^3	Some mortality, but not much		
Sea urchin S. purpuratus	Shear stress	Couette flow (short term: 2 min)	No deleterious effect with $\varepsilon < 200$ cm^2/s^3	Fertilization and development to blastula	Mead and Denny 1995, Denny, Nelson and Mead 2002	
Zebra mussel Dreissena polymorpha veliger	Turbulence	Bubble plume for 24 hours, then 24 feed before mortality measured	Mortality increases when d* > 0.9 (eddy similar in size to larva (no sig eff when d*<0.9)	Mortality	Rehmann et al. 2003	

Organism	Shear stress or turbulence	Method of generating shear/turbulence	Magnitude of critical shear/turbulence	Effect	Reference	Additional notes
dinoflagellate Alexandrium fundyense	Laminar shear	Couette flow for 1-24 hours/day	Shear stress τ = 0.003 N/m^2 ; ε = 10^{-5} cm^2/s^3 ; only 1 level	Growth rate decreased when exposed to τ for more than 2 hours/ day	Juhl et al. 2001	Growth rate = 0 when shear 12 h/d; negative when 16-24 h/day
dinoflagellate Alexandrium fundyense	Laminar shear and turbulence	Couette flow 1 h/d 5–8 d and shaken flasks	Shear stress τ = 0.004 N/m^2 (not quantified for shaken flasks	Growth rate decreased in both	Juhl et al. 2000	Most sensitive last hour of dark phase, under lower light conditions
dinoflagellate Lingulodiniu m polyedrum.	Shear (steady and unsteady)	Couette flow; constant or changing speeds/direction; 2 h/d (change ev 2 min)	smallest ε = 0.04 cm^2/s^3; all had effect (very very high)	Growth rate decreased in all cases; often catastrophicall y (near 100%)	Latz et al. 2009	Unsteady flow had more of an effect than steady, even when mean was lower; poss mechanism: mechanical energy of the flow alters membrane biophysical properties, activates signal transduction pathway involving GTP, [ca2+]I, poss. Also involves cyclin-dep kinases, as in endothelial cells
Copepod Acartia tonsa	Turbulence	model	Starts dropping at ε = 10^{-3} cm^2/s^3	Decrease in prey capture success	Kiørboe and Saiz 1995	Copepods that set up feeding currents are largely independent of ambient fluid velocity for prey encounters, while ambush-preying copepods can benefit substantially
Copepod Acartia tonsa	Turbulence	Oscillating grid			Saiz & Kiørboe 1995	
Herring larvae	Turbulence	model	Starts dropping at ε = 10^{-3} cm^2/s^3	Decrease in prey capture success	Kiørboe and Saiz 1995	
Cod larvae	Turbulence	model	Starts dropping at ε = 10^{-5} cm^2/s^3	Decrease in prey capture success	Kiørboe and Saiz 1995	

Organism	Shear stress or turbulence	Method of generating shear/turbulence	Magnitude of critical shear/turbulence	Effect	Reference	Additional notes
Cod Gadus morhua (5-6 mm)	Turbulence	Oscillating grid; observations start after 10 min shaking	ε = 7.4 x 10^{-4} cm^2/s^3)	Increase in "attack position rate" at all conc	MacKenzie and Kiørboe 1995	Cod benefit more from turb (pause-travel)
Cod Gadus morhua (8.7-12.3 mm)	Turbulence -more intermitten t	Oscillating grid, observations start after a few min shaking	ε = .2, 2 x 10^{-4} cm^2/s^3)	While encounter rate up, pursuit success down	MacKenzie and Kiorboe 2000	Decrease in pursuit success at higher ε; general downward trend with increased rel vel; smaller fish larvae affected more
Herring Clupea harengus (8-9 mm)	Turbulence	Oscillating grid; observations start after 10 min shaking	ε = 7.4 x 10^{-4} cm^2/s^3)	Increase in "attach position rate" only at low conc; v messy data	MacKenzie and Kiorboe 1995	Herring benefit less (cruise)
Juvenile rainbow trout and steelhead Oncorhynchus mykiss, Chinook salmon O. tshawytscha, American shad Alosa sapidissima	Shear stress	Forced entry directly into submerged jet in flume having exit velocities of 0 to 21.3 m/s	No effect at 168/s 341/s; LC-10 estimated at 495/s	Torn opercula, missing eyes	Nietzel et al. 2004	LC-10 =affects 10% of population Juvenile fish 83-232 mm fork length
Water flea Daphnia pulex	Turbulence	Vibrating 0.5 cm grid	ε = 0.05 cm^2/s^3 (as compared to calm)	Heart rate increased 5-27%	Alvarez et al. 1994	HR reflects increase in metabolic rate?
Copepod Calanus gracilis	Turbulence	Vibrating 0.5 cm grid	ε = 0.05 cm^2/s^3 (as compared to calm)	Heart rate increased 93%	Alvarez et al. 1994	Other species too including crab larvae (increase HR 9%)
Copepod Acartia tonsa	Turbulence	Oscillating grid	ε = 0.001 cm^2/s^3 (as compared to calm)	Decreases predator sensing ability	Gilbert and Buskey 2005	

Organism	Shear stress or turbulence	Method of generating shear/turbulence	Magnitude of critical shear/turbulence	Effect	Reference	Additional notes
Copepod Acartia tonsa	Turbulence (field)	Boat wake (field); plankton tow inside/ outside wake	ε =310 cm^2/s^3 at a distance of 50 propeller diam. behind 20 mm diam, scale-model boat propeller running at 3000 rpm	More dead inside wake (5-25% increase, over 2-12% background)	Bickel et al. 2011	Stain w neutral red
Copepod Acartia tonsa		Mini stirrer w paddles (lab)	ε = 0, 0.035, 1.31, 2.24 cm^2/s^3		Bickel et al. 2011	ε = 0.035 cm^2/s^3 did not show negative effect
Various	Turbulence (field)	Rapids (samples collected above and below rapids	ε = 3-742 cm^2/s^3	Effects dep on species: sign. mortality in Littorina littorea, Mytilus edulis, and Aporrhais pespelicant	Jessop 2007	Mytilus membranipora, Electra pilosa, polychaete trochophores and Lamellaria perspicua had zero mortality

ε = energy dissipation rate (cm^2/s^3)

Couette flow: two concentric cylinders, outer one rotates shearing volume of fluid between cylinders at known rate

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APPENDIX D2
Brine Discharge Diffuser Analysis

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Flow Science Incorporated
48 S. Chester Ave., Suite 200, Pasadena, CA 91106
(626) 304-1134 • FAX (626) 304-9427

DRAFT TECHNICAL MEMORANDUM

DATE: August 29, 2014

TO: Environmental Science Associates (ESA)

FROM: Gang Zhao, Ph.D., P.E., Aaron Mead, P.E., E. John List, Ph.D., P.E.

SUBJECT: **MRWPCA Brine Discharge Diffuser Analysis**
FSI 134032

1. Introduction

As part of the EIR preparation process for the Monterey Peninsula Water Supply Project, Flow Science Incorporated (Flow Science) was retained to analyze the effect that discharging desalination brine through the existing Monterey Regional Water Pollution Control Agency (MRWPCA) ocean outfall would have on ocean water quality adjacent to the outfall.

In August 2014, Flow Science performed a modeling analysis of four discharge scenarios for the Monterey Peninsula Water Supply Project, as summarized in **Table 1**. For each scenario, effluent dilution was analyzed for zero ocean current conditions.

Table 1 – Diffuser scenarios modeled

Scenario No.	Scenario Name	Discharge Rate (mgd*)
1	Upwelling (July), Brine Only	13.98
2	Davidson (Jan.), Brine Only	13.98
3	Davidson (Jan.), Brine and Wastewater	33.76 (= 13.98+ 19.78)
4	Oceanic (Sept.), Brine Only	13.98

*mgd = million gallons per day.

This Technical Memorandum (TM) summarizes the analyses Flow Science completed for the four scenarios presented in **Table 1** and describes the input data, results, and methods Flow Science used to analyze the proposed discharges. Analyses for additional discharge scenarios were also completed by Flow Science,and the TM for these additional discharge scenarios is attached as **Appendix C**.

2. Analysis Input Data

Diffuser Configuration

The existing MRWPCA diffuser has 172 ports. Half of the ports discharge horizontally from one side of the diffuser and half discharge horizontally from the other side of the diffuser in an alternating pattern. Since Visual Plumes does not have the capability to model ports on alternating sides of a diffuser, all ports were modeled to be on one side of the diffuser. This simplification has no effect on the dilution of negatively buoyant plumes because all modeled negatively buoyant plumes (Scenarios 1,2 and 4) did not overlap or interact before reaching the ocean floor—i.e., within the zone of initial dilution (ZID). For the positively buoyant cases (Scenario 3) the model results are conservative because the plumes from individual ports overlap more quickly under modeled conditions than in reality, and so modeled effluent dilutions for the positively buoyant scenarios are somewhat lower than would be reflected in reality.

According to MRWPCA, the fifty-two (52) ports nearest to the shore (i.e., the shallowest ports) are currently closed. In this analysis, Flow Science calculated plume concentrations for effluent discharged through the 120 open ports. A typical section of the current diffuser is shown in **Figure 1**, although the actual cross-sectional profile of the pipe ballast may have changed over time. The ports are approximately 6 inches above the rock bedding of the diffuser pipeline, and drawings[1] (see **Figure 1**) indicate that they are located a minimum of approximately 3.5 feet above the seafloor. The gravel bedding dimensions are nominal, as shown in **Figure 1**, and therefore, the port height above the seafloor is not known with high accuracy. Momentum of the effluent is a key factor in determining the dilution within the ZID. Toward the end of the ZID, the plume slows down and mixing is not as strong as at the beginning of the ZID. Therefore, the dilution results are not likely to change by much if the port height is not precisely known and, considering the overall uncertainty in the analysis, it is not critical to determine the diffuser port height with high accuracy. In this analysis, it was assumed that effluent plumes do not interact with the ballast, which is supported by the plume dimensions computed. Details of the current diffuser configuration are summarized in **Table 2**.

[1] Section F, Drawing P-0.03, Contract Documents Volume 1 of 1: Ocean Outfall Contract No. 2.1, January 1982 by Engineering Science for MRWPCA.

Table 2 – Current diffuser configuration.

Parameter	Value
Diffuser length	1368 feet (417 m*)
Depth of diffuser ports	95 to 109 feet below MSL
Number of open ports	120
Port spacing	8 feet (2.44 m*)
Port diameter	2 inches (0.051 m*)
Port exit condition	Tideflex Series 35 4-inch duckbill valves
Port vertical angle	0° (horizontal)
Port elevation above sea floor	3.5 feet (1.07 m*)

*m = meters

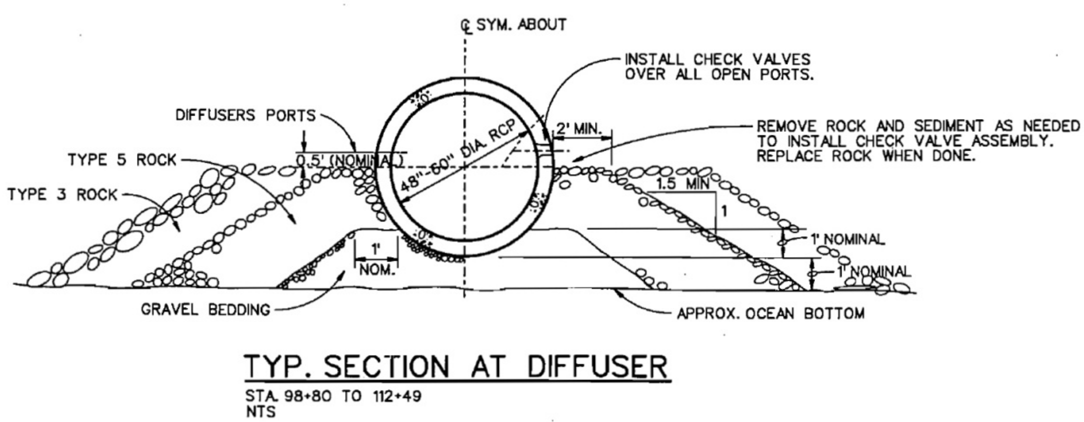

Figure 1. Typical diffuser section (currently in place).

The 120 ports that are currently open are fitted with Tideflex "duckbill" check valves, as shown in **Figure 2**. The shape of the duckbill valve opening is elliptic and the area of the opening depends on the discharge flow rate. The valve opening area in this analysis was determined from an effective open area curve provided by Tideflex Technologies (included as **Appendix A**). Although the ports were modeled as round openings with the same opening area as the "duckbill" valves, because of the oblateness of the actual port opening, the actual dilution will be slightly higher than the dilution computed assuming circular ports. This is because the perimeter of ellipse, which is where the entrainment of diluting water occurs, is larger than that of a circle.

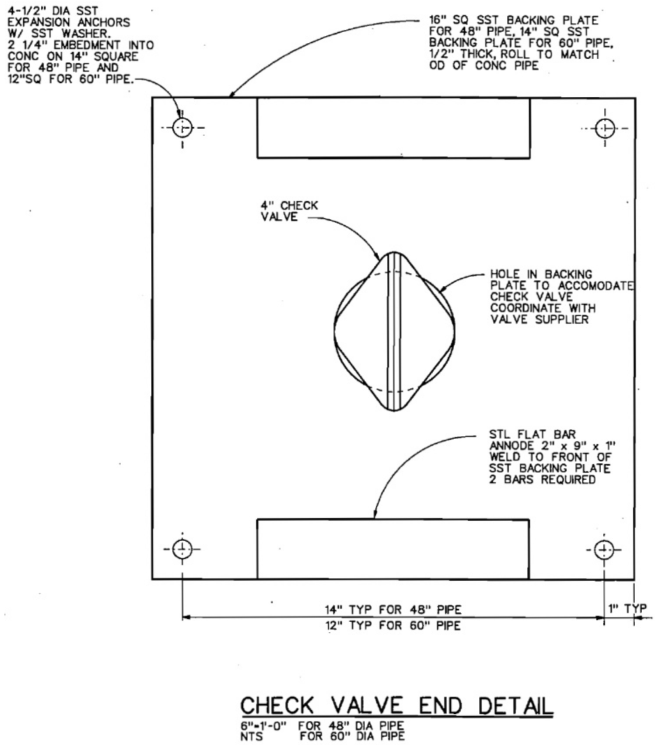

Figure 2. Typical "duckbill" valve detail (shown closed, i.e., with no flow).

Discharge Characteristics

Salinity (or total dissolved solids [TDS]) and temperature data for the brine (Scenarios 1 through 4) and the MRWPCA wastewater (Scenario 3) have been provided by ESA. TDS is a measure of water salinity, and salinity and temperature are used to calculate the density of the effluent and ambient ocean water, which are important parameters in dilution analyses.

As summarized in **Table 1**, ESA selected three seasonal ocean conditions for analysis: Upwelling (July), Davidson (January), and Oceanic (September). Therefore, discharge rate, temperature, and salinity/TDS data for these months, presented in **Table 3**, were used in the analysis. For the combined brine and wastewater flow scenario (Scenario 3), the desalination brine was assumed to be fully mixed with the wastewater. Thus, the temperature and salinity of the combined flow were calculated as the flow-weighted average temperature and salinity of the brine and wastewater.

The analyses completed as part of this study are summarized in **Table 3**. All scenarios were analyzed for zero ocean current velocity conditions, which represent worst-case conditions since any ocean current only increases dilution. Ocean currents increase the amount of dilution that occurs because they increase the flow of ambient water past the diffuser (i.e., increase the amount of ambient water available for mixing with the discharge). Although ocean currents increase effluent dilution, the California Ocean Plan (State Water Resources Control Board, SWRCB, 2009) requires that the no-current condition should be used in initial dilution calculations.

Table 3 – Summary of analyses for Scenarios 1 through 4.

Scenario	Analysis Number	Effluent Flow (mgd)	Effluent Salinity (ppt*)	Effluent Temp. (^oC)	Seasonal Condition	Diffuser Port Angle	Effective Port Diameter (in)
1	1.1	13.98	58.23	9.9	Upwelling (July)	0°	1.86
2	2.1	13.98	57.40	11.6	Davidson (Jan.)	0°	1.86
3	3.1	33.76	24.23	16.5	Davidson (Jan.)	0°	2.29
4	4.1	13.98	57.64	11.1	Oceanic (Sept.)	0°	1.86

* ppt = parts per thousand.

Receiving Water Profiles

ESA provided Flow Science with representative ocean receiving water profile data (temperature and salinity) for the three months corresponding to the selected discharge scenarios (July, January, and September). Receiving water profile data were collected by the Monterey Bay Aquarium Research Institute (MBARI) at station C1 at the head of Monterey Canyon, approximately five miles northwest of the MRWPCA wastewater ocean outfall (see **Figure 3**). This location has been occupied since 1988 by MBARI. Monthly conductivity, temperature, and depth (CTD) profiles have been collected since 2002. The proximity of the location to the MRWPCA ocean outfall and the long data record make this the most appropriate and useful data set to characterize the ambient conditions for the brine discharge analysis. Vertical profiles of temperature and salinity were analyzed for the upper 50 meters of the water column for the years 2002-2012, and a single representative profile was selected for each of the three ocean seasons. For the July model run, temperature and salinity profiles from 2011 were selected. For the September model run, profiles from 2004 were selected. For the January model runs, a temperature profile from 2004 and a salinity profile from 2011 were selected. Profile data are shown in tabular form in **Appendix B**. Maximum and minimum values for each profile are shown in **Table 4**.

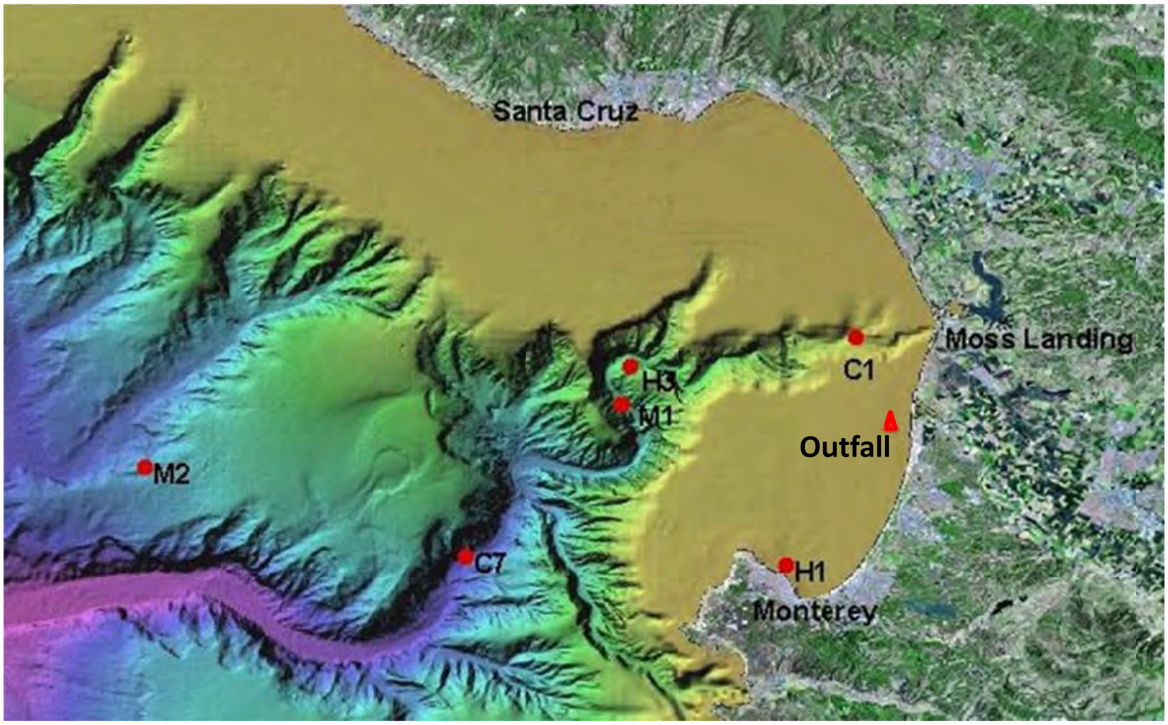

Figure 3. Location map, MBARI ocean monitoring stations and MRWPCA outfall.

Table 4 – Maximum and minimum ocean profile data.

Parameter	Season	Minimum	Maximum
Salinity (ppt)	Upwelling (July)	33.7	33.9
	Davidson (January)	33.2	33.5
	Oceanic (September)	33.5	33.6
Temperature (C^o)	Upwelling (July)	10.0	13.0
	Davidson (January)	10.7	12.7
	Oceanic (September)	10.6	15.8

Source: ESA (2013); Appendix B.

Receiving water flow conditions

As detailed in **Figure 1**, the existing diffuser ports are located just above the mid-point of the outfall pipe (i.e., below the crown of the outfall pipe), about 6 inches above the top of the ballast used to anchor the diffuser to the seafloor. Because the outfall rises above the seafloor, it will influence the patterns of currents (receiving water flow velocity) at the ports, and the current velocity at each individual port will be a complex function of the local geometry. Local field data collection would be required to characterize the actual current conditions at the diffuser ports, which was beyond the scope and budget of this analysis. To simplify the analysis, effluent dilution was analyzed for a uniform 0.0 fps current, which amounts to a "worst case," stagnant (no current) receiving water condition. Stagnant conditions are typically used as the basis for developing NPDES permits, and the California Ocean Plan (SWRCB, 2009) requires the no-current condition be used in initial dilution calculations.

3. Negatively Buoyant Plume and ZID

The effluent and ocean profiles data presented in **Tables 3** and **4** indicate the effluent is negatively buoyant for Scenarios 1, 2 and 4. A sketch of the trajectory of a negatively buoyant jet is shown in **Figure 4**, where θ_0 is the port angle, d is the port diameter, s is distance in the direction of the port centerline, n is distance in the direction perpendicular to the port centerline, z_{me} is the maximum rise of the plume, M_0 is the initial momentum flux at the point of discharge, and M_b is the buoyancy-generated momentum flux. The impact point is the location where the plume centerline returns to the port height level, and x_{0R} is the distance between the port and the impact point.

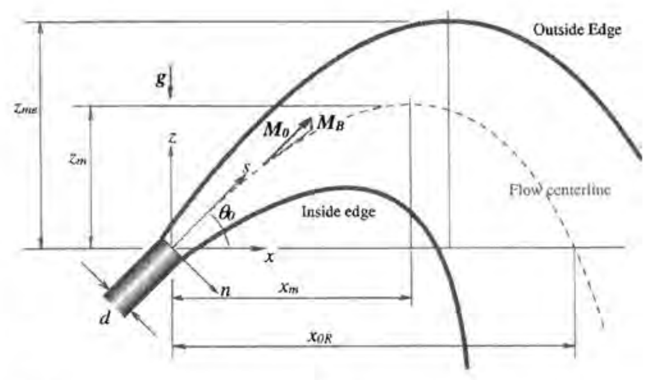

Fig. 1. Schematic diagram of the generic discharge configuration

Figure 4. Definition schematic for negatively buoyant jet (Kikkert, et al., 2007).

The methods described in the next section calculate the size of the plume and dilution of the discharged effluent within the "Zone of Initial Dilution" or ZID. The ZID is defined as the zone immediately adjacent to a discharge where momentum and buoyancy-driven mixing produces rapid dilution of the discharge. In this analysis, the ZID ends at the point where the discharge plume impacts the seafloor for a dense (sinking) plume; and for a positively buoyant (rising) effluent, the ZID ends at the point where the effluent plume reaches the water surface or attains a depth level where the density of the diluted effluent plume becomes the same as the density of ambient water (i.e., the "trap" level).

Typically, within the ZID, which is limited in size, constituent concentrations are permitted to exceed water quality standards. A discharge is generally required to meet the relevant water quality standards at the edge of the ZID.

Beyond the point where the plumes reach the seafloor, some additional mixing will occur, and the discharged brine (now diluted) will travel along the seafloor as a density current. Based on the bathymetry near the diffuser, which steadily slopes out to sea, there is no "bowl" in which effluent could accumulate indefinitely. Rather diluted effluent driven by gravity would flow downslope and gradually disperse. Estimation of the spreading of the plume on the seafloor would require detailed bathymetry data near the diffuser and use of additional analysis methods, such as a three-dimensional model or a physical model of the discharge. Similarly, the analysis of the buoyant (rising) plume within and beyond the "trap" level would require additional analysis methods. In the analysis presented here the spreading of the effluent on the seafloor, or within and beyond the trapping level and the subsequent additional dilution that would ensue, has not been analyzed. Flow Science recommends that the computed dilution at the seafloor, or at the trapping level, (i.e., at the end of the ZID), be used as the basis for any NPDES permitting activities and to analyze impacts.

4. Plume Analysis Methods

Two analysis methods have been used to evaluate the discharge of desalination brines (negatively buoyant plumes) from the MRWPCA diffuser: a semi-empirical method based on the work of Roberts et al. (1997) and Kikkert et al. (2007) and EPA's Visual Plumes method. The Visual Plumes method was also used to model scenarios where the effluent density is less than seawater (positively buoyant, or rising, plumes). Both the semi-empirical method and Visual Plumes were used to characterize negatively buoyant plumes in order to understand the range of dilution that might be expected for discharge from the MRWPCA diffuser system. The semi-empirical method also provides some level of redundancy and confirmation of results because Visual Plumes, although widely used in diffuser discharge analysis, has only very recently been validated against limited experimental data for the case of a negatively buoyant plume. The main advantage of the semi-empirical analysis method is that it is well-grounded in empirical observations, and thus is well-tested and has been verified by comparison to a relatively large dataset for this specific discharge condition. The main disadvantage is that the semi-empirical method requires longer to complete an analysis for a given discharge scenario. The analysis techniques for these two methods are described below.

4.1 Semi-Empirical Analysis Method

Laboratory studies of negatively buoyant jets and plumes have been conducted by many researchers (e.g., Kikkert et al., 2007; Roberts et al., 1997). Most of these have been conducted for inclined jets (i.e., jets that discharge upward at an angle), which increases the initial mixing of the plume. Fewer studies are available to characterize the mixing of negatively buoyant plumes from horizontally-oriented discharge ports. In the following sections, the general equations for a negatively buoyant jet from an angled port are presented first. The equations for a horizontal discharge are then derived from the general equations.

Discharge of a negatively buoyant jet from an angled port

Plume trajectory

The trajectory of a negatively buoyant discharge under a stagnant flow condition (i.e., no ambient current) can be computed from the following equations (Kikkert, et al., 2007) (see Figure 4 for nomenclature).

$$\frac{dn_*}{ds_*} = \frac{M_{B*}\cos\theta_0}{1 - M_{B*}\sin\theta_0} \qquad (1)$$

where:

$s_* = s/d$
$n_* = n/d$

s and *n* are the distances in directions along and perpendicular to the discharge port centerline, respectively; *d* is the effective diameter of the port (see **Figure 4**); and M_{B*} is the dimensionless buoyancy-generated momentum flux, which can be calculated from Eq. (2).

$$M_{B*} = 0.154\frac{s_*^2}{F_0^2} \qquad (2)$$

where F_0 is the initial densimetric Froude number:

$$F_0 = \frac{U_0}{\sqrt{gd(\rho_0 - \rho_a)/\rho_a}}$$

where

U_0 = initial jet velocity
g = gravitational acceleration
ρ_0 = initial density of the jet
ρ_a = ambient water density

Substituting Eq. (2) into Eq. (1) and integrating gives an equation for the discharge trajectory:

$$n_* = \frac{2.6F_0}{\tan\theta_0 \sin^{1/2}\theta_0}\left[-\frac{s_* \sin^{1/2}\theta_0}{2.6F_0} + \frac{1}{2}\ln\left(\frac{2.6F_0 + s_* \sin^{1/2}\theta_0}{2.6F_0 - s_* \sin^{1/2}\theta_0}\right)\right] \qquad (3)$$

Results from Eq. (3) agreed well with experimental data (Kikkert, et al., 2007).

Discharge of a negatively buoyant jet from a horizontal port

Plume trajectory

The plume trajectory of a horizontal discharge can be estimated using the equations for an angled jet. Specifically, for a horizontal discharge (i.e., $\theta_0 = 0$), Eq. (3) simplifies to the following relationship:

$$n_* = 0.051\frac{s_*^3}{F_0^2} \qquad (4)$$

Plume dilution for a horizontal discharge

For the horizontally discharged effluent, the empirical equations from Fischer et al., 1979 (Table 9.2, pp. 328) were used to compute the width and dilution of the effluent. i.e.,

*Plume width=2*0.13*distance along plume* (5)

The plume width calculated from Eq. (5) defines the edge of the plume as the location where the concentration is 37% (= e^{-1}, which is often used to characterize plume width) of the centerline concentration.

The volume flux and dilution are specified by:

Volume flux $\mu = 0.25M^{1/2}$ **distance along plume* (6)

Dilution = μ /(discharge flow rate) (7)

where $M=QU_0$ is the initial momentum flux of the effluent (Q and U_0 are the flow rate and initial velocity of the effluent, respectively).

Note that the semi-empirical analysis uses Kikkert for the trajectory and Fischer for dilution for 0º discharges.

4.2 Visual Plumes Analysis Method

Methodology

The UM3 model—part of the EPA Visual Plumes diffuser modeling package—was used to simulate the discharge of desalination brine and wastewater from the existing MRWPCA ocean diffuser. Visual Plumes is a mixing zone computer model developed from a joint effort led by US EPA. Visual Plumes can simulate both single and merging submerged plumes, and stratified ambient flow can be specified by the user. Visual Plumes can be used to compute the plume dilution, trajectory, diameter, and other plume variables (US EPA, 2003).

The UM3 model is based on the projected area entrainment hypothesis, which assumes ambient fluid is entrained into the plume through areas projected in directions along the plume centerline and perpendicular to the centerline (US EPA, 1994). In addition, shear entrainment is included. The plume envelope is assumed to be in steady state, and as a plume element moves through the envelope, the element radius changes in response to velocity convergence or divergence, and entrainment of ambient fluid. Conservation equations of mass, momentum and energy are used to calculate plume mass and concentrations.

The actual depth of the diffuser ports varies between 95 and 109 feet below mean sea level (MSL) since the diffuser is quite long and is situated on a sloping portion of the ocean floor. However, since Visual Plumes cannot model a sloping diffuser, an average depth of 104 feet below MSL was used (the deepest 120 ports on the diffuser are assumed to discharge in this case, thereby increasing the average port depth). Modeled ocean conditions are summarized in **Table 5**.

As with the semi-empirical method, Visual Plumes assumes circular discharge ports, so the actual elliptical discharge area was calculated for each port (**Appendix A**) and then converted to an effective circular discharge diameter for use in Visual Plumes.

A study by Palomar et al. (2012a, 2012b) showed that the UM3 model of the Visual Plumes can be applied to simulate negatively buoyant discharges. However, the study also showed that the UM3 model underpredicted centerline dilution ratios at the impact point by more than 50% for a negatively buoyant effluent discharged into a stagnant environment; for a number of scenarios with negatively buoyant effluent discharged into an ambient current, centerline dilution ratios at the impact point calculated by the UM3 model ranged from 40% lower to 7% higher than experimental data. The UM3 model of the Visual Plumes was used in this analysis to model negatively buoyant effluent discharged into a stagnant environment. As noted, the study of Palomar et al. (2012a, 2012b) has shown that the centerline dilution ratios computed using the UM3 model were more than 50% lower than data from experiments with similar discharge conditions. For this reason, the average dilution ratios calculated using UM3, which are nearly double the centerline dilution ratios, were used to estimate dilution of negatively buoyant plumes in this analysis. Since Visual Plumes has been more thoroughly validated for positively buoyant plumes, it alone was used for scenarios with rising plumes.

Table 5 – Visual Plumes modeled seasonal ocean conditions.

Depth (m)	Upwelling (July)		Davidson (January)		Oceanic (September)	
	Temp. (°C)	Salinity (ppt)	Temp. (°C)	Salinity (ppt)	Temp. (°C)	Salinity (ppt)
0	12.98	33.78	12.65	33.20	15.75	33.46
2	12.87	33.77	12.65	33.22	15.75	33.46
4	12.64	33.74	12.65	33.22	15.75	33.46
6	11.97	33.71	12.65	33.23	15.53	33.46
8	11.61	33.70	12.74	33.24	14.46	33.46
10	11.34	33.70	12.57	33.26	13.81	33.46
12	11.10	33.73	12.50	33.28	13.17	33.46
14	10.84	33.75	12.42	33.30	12.27	33.46
16	10.51	33.78	12.33	33.30	11.83	33.46
18	10.38	33.79	12.24	33.30	11.52	33.46
20	10.38	33.80	12.22	33.28	11.19	33.46
22	10.38	33.80	12.07	33.30	11.06	33.46
24	10.38	33.82	12.05	33.30	11.22	33.49
26	10.38	33.82	11.90	33.30	11.39	33.50
28	10.38	33.84	11.81	33.32	11.39	33.50
30	10.38	33.84	11.71	33.34	11.31	33.50
32	10.37	33.84	11.71	33.37	11.23	33.50
34	10.31	33.84	11.63	33.39	11.22	33.50
36	10.30	33.84	11.63	33.42	11.05	33.50
38	10.30	33.84	11.54	33.43	10.97	33.50

Source: Interpolated from ESA | Water (2013) ocean profile data, Appendix B.

5. Dilution Results

Several key results for the effluent plumes are reported at the edge of the ZID. As noted above, the ZID is defined as the zone immediately adjacent to a discharge where momentum and buoyancy-driven mixing produces rapid dilution of the discharge. Results for positively buoyant plumes presented in this Technical Memorandum were taken at the point where the plumes just reached the trap level, which is the depth level where the density of the diluted plume becomes the same as ambient seawater. Horizontal spreading of plumes at their trap levels was not included in this analysis. Results from each scenario generally include the following quantities:

- the horizontal distance from the diffuser port to the point at which the plume impacts the seafloor or reaches the trap level
- the dilution of the plume at the point at which the plume impacts the seafloor or reaches the trap level; for the semi-empirical method and the Visual Plumes analyses of rising plumes, centerline dilution is provided, while for the Visual Plumes analyses of negatively buoyant discharges, the average dilution within the plume is provided, in recognition of the conservative nature of Visual Plumes results for negatively buoyant plumes (see, e.g., Palomar et al., 2012a and 2012b)
- an estimate of the size of the plume (diameter) at the point of impact or just below the trap level (i.e., at the edge of the ZID)
- the maximum salinity at the seafloor (edge of ZID for negatively buoyant plumes)
- the percentage by which the maximum plume salinity at the seafloor (edge of ZID for negatively buoyant plumes) exceeds the ambient salinity.

Figure 5 shows a sample schematic graphic of the trajectory of a negatively buoyant plume from a horizontal discharge drawn approximately to scale. As the effluent travels away from the discharge port, it entrains ambient seawater, which increases the diameter of the plume and decreases the plume concentration.

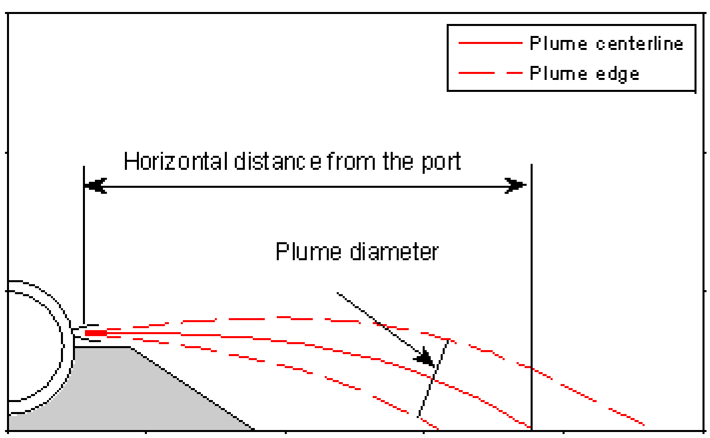

Figure 5. Sample graphic showing plume trajectory for the horizontal discharge configuration.

Table 6 presents analysis results for the four modeled scenarios. The plume in analysis 3.1 was positively buoyant (i.e., had discharge densities less than ambient seawater). This is because the plume in this analysis was a mixture of desalination brine and relatively significant amounts of comparatively non-saline (i.e., "fresh") wastewater effluent. For all other analyses the plumes were negatively buoyant (i.e., water denser than ambient seawater is discharged) since they consisted only of desalination brine, which is more dense than regular seawater. Results in **Table 6** show that the trajectory, diameter and dilution of the negatively buoyant plumes were nearly the same across all three modeled seasons, because the trajectories of these negatively buoyant plumes were short and close to the seafloor, where the differences in salinity and temperature (hence the difference in density) between the effluent and ambient sea water changed only slightly over the modeled seasons. Therefore for brine only cases, characteristics of the resulting plumes were nearly the same for the three modeled scenarios.

Dilution values predicted by the semi-empirical method were lower than the dilution values predicted by the Visual Plumes method. The predicted maximum plume salinity at the seafloor was 1.5 ppt above ambient ocean salinity.

Figures 6 and **7** illustrate the trajectory and shape of the negatively buoyant plume computed from Visual Plumes for Analysis 1.1 (as listed in **Table 3** and **Table 6**). **Figure 8** is an illustration of positively buoyant plumes just reaching the trap level, as computed from Visual Plumes for Analysis 3.1. Spreading of the plume within and beyond the trap level is not shown. Plumes computed for other scenarios have similar trajectories and shape as shown in these figures.

Table 6– Analysis results.

Analysis number	Effluent discharge flow rate (mgd)	Discharge Velocity (feet/ second)	Seasonal Condition	Diffuser port angle (θ_o)	Effluent salinity (ppt)	Ocean bkgrd. salinity at diffuser depth (ppt)	Semi-empirical method						VP method					
							Plume diam. (d) (inch)	Center-line Dilution	Horiz. Distance from port (ft)	Max. height above port (z_{me}) (ft)	Plume salinity at calc. dilution (ppt)	Salinity increase above ambient (ppt)	Plume diam. (inch)	Average Dilution	Horiz. Distance from port (ft)	Max. height above port (z_{me}) (ft)	Plume salinity at calc. dilution (ppt)	Salinity increase above ambient (ppt)
1.1	13.98	9.5	Upwelling (July)	0^o	58.23	33.84	36	16	12	--	35.36	1.5	42	25	8.6	--	34.82	1.0
2.1	13.98	9.5	Davidson (Jan.)	0^o	57.40	33.36	37	16	12	--	34.83	1.5	42	25	8.7	--	34.30	0.9
3.1	33.76	15.2	Davidson (Jan.)	0^o	24.23	33.36	--	--	--	--	--	--	230	68 [a]	47	32 [b]	--	--
4.1	13.98	9.5	Oceanic (Sept.)	0^o	57.64	33.50	35	16	12	--	35.01	1.5	42	25	8.7	--	34.47	1.0

Source: Flow Science Analysis, 2014.

[a] For Analysis 3.1, the dilution value is centerline dilution because the Visual Plumes model has been validated for positively buoyant plumes and no significant underprediction of dilution has been reported.

[b] These values are trap levels above the diffuser.

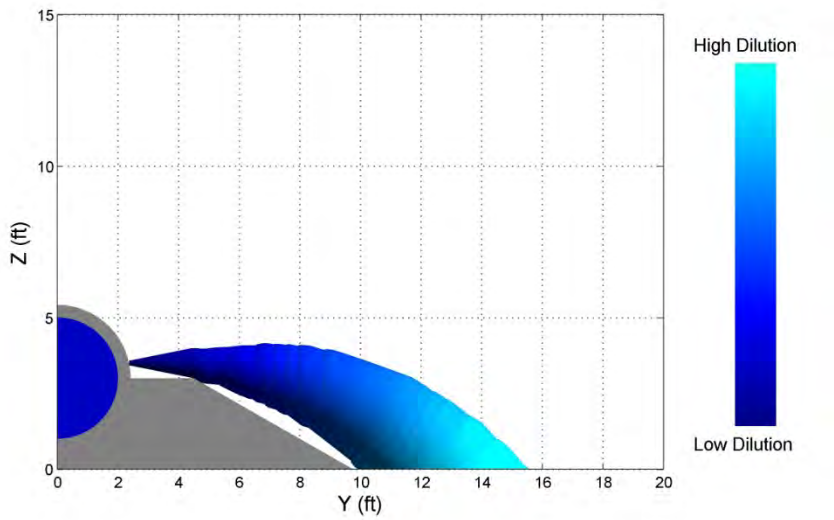

Figure 6. Analysis 1.1 (13.98 mgd, 58.23 ppt), plume computed from VP. Minimum dilution at seafloor is 25 (maximum salinity of 34.82 ppt).

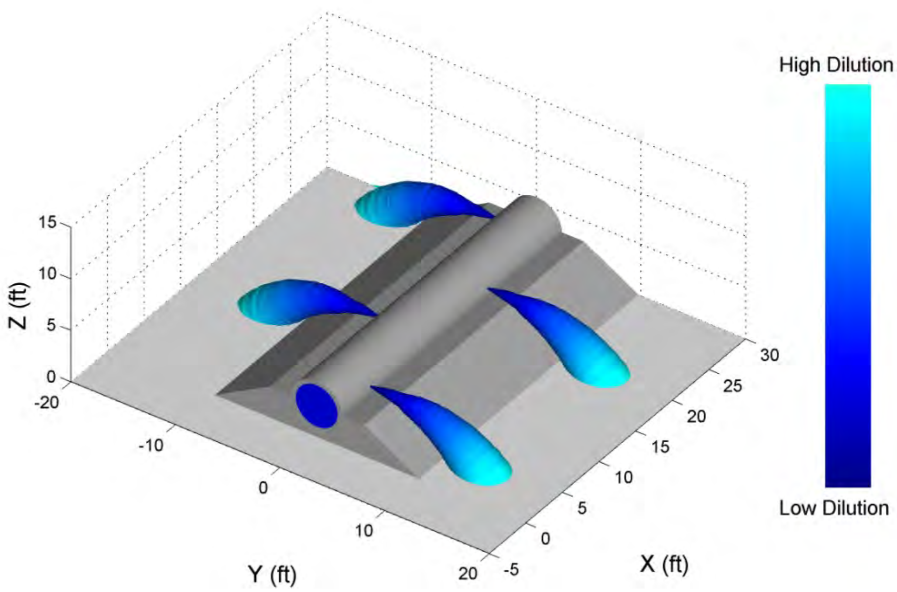

Figure 7. Analysis 1.1 (13.98 mgd, 58.23 ppt), plume computed from VP (3D view, only 4 ports are shown). Minimum dilution at seafloor is 25 (maximum salinity of 34.82 ppt).

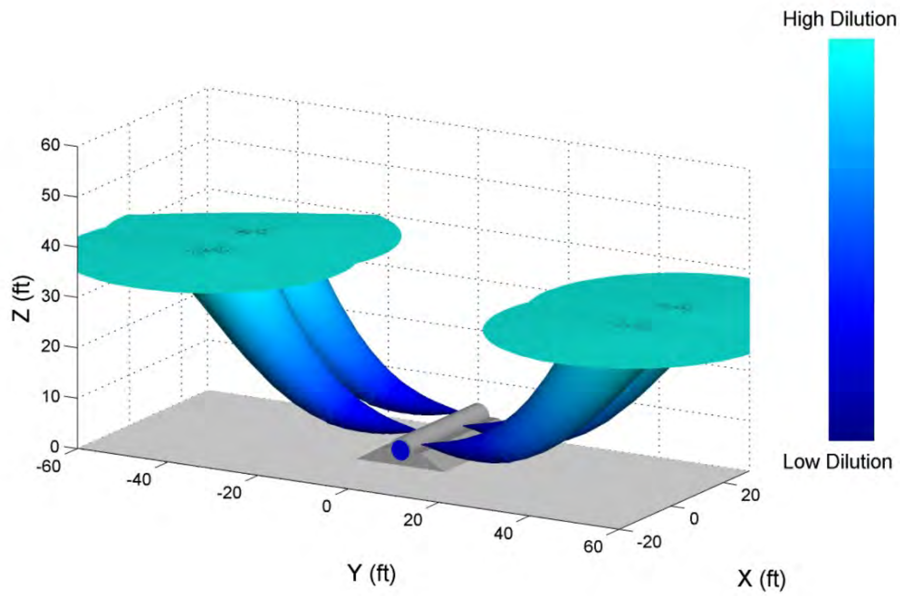

Figure 8. An illustration of the positively buoyant effluent plumes of Analysis 3.1. Note that only four diffuser ports are illustrated.

5. References

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APPENDIX A – DUCKBILL VALVE, EFFECTIVE OPEN AREA

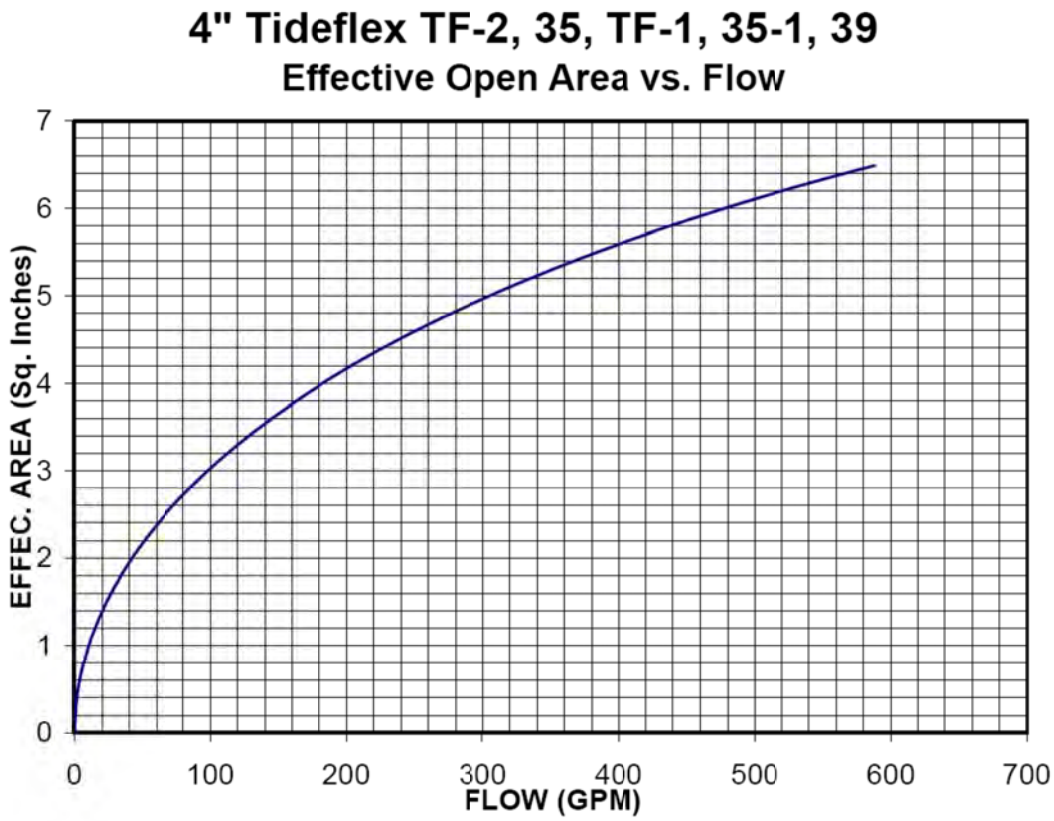

Chart provided by Tideflex Technologies.

APPENDIX B – AMBIENT OCEAN PROFILE DATA

Table B1- Ambient ocean profile data, MBARI station C1
(Source: ESA)

Upwelling (July)				Transition-Oceanic (Sept)				Davidson (Jan)			
2011 Profile		2011 Profile		2004.2 Profile		2004.1 Profile		2011 Profile		2004 Profile	
S (ppt)	Z (m)	T (^{o}C)	Z (m)	S (ppt)	Z (m)	T (^{o}C)	Z (m)	S (ppt)	Z (m)	T (^{o}C)	Z (m)
33.78	-0.93	12.98	-0.59	33.46	-3.30	15.83	-4.22	33.20	-0.41	12.65	-2.35
33.76	-1.97	12.91	-1.63	33.46	-4.29	15.66	-4.22	33.22	-0.40	12.65	-2.35
33.78	-1.98	12.84	-2.68	33.46	-5.28	15.66	-5.22	33.22	-1.44	12.65	-3.34
33.78	-3.03	12.77	-2.68	33.46	-6.28	15.75	-6.21	33.22	-2.47	12.65	-4.33
33.76	-4.06	12.77	-3.73	33.46	-7.27	15.83	-6.21	33.22	-3.51	12.65	-5.32
33.74	-4.05	12.70	-3.73	33.46	-8.27	15.75	-6.21	33.22	-4.54	12.65	-6.31
33.72	-4.04	12.63	-4.78	33.46	-9.26	15.66	-6.21	33.22	-5.57	12.65	-7.30
33.74	-5.10	12.56	-4.78	33.46	-10.25	15.23	-6.21	33.22	-6.61	12.74	-7.30
33.72	-5.09	12.35	-4.80	33.46	-11.25	15.15	-6.21	33.24	-6.60	12.74	-8.29
33.70	-6.13	12.28	-4.80	33.46	-12.24	15.06	-6.21	33.24	-7.63	12.65	-8.29
33.70	-7.17	12.21	-4.80	33.46	-13.23	14.98	-7.21	33.26	-8.65	12.57	-9.29
33.70	-8.22	12.14	-4.81	33.46	-14.23	14.89	-7.21	33.26	-9.69	12.57	-10.28
33.70	-9.27	12.07	-5.85	33.46	-15.22	14.81	-7.21	33.28	-10.71	12.57	-11.27
33.70	-10.32	12.00	-5.86	33.46	-16.22	14.72	-7.21	33.28	-11.74	12.48	-12.27
33.72	-11.37	11.93	-5.86	33.46	-17.21	14.64	-7.21	33.30	-12.77	12.48	-13.26
33.74	-12.43	11.86	-6.91	33.46	-18.20	14.55	-7.21	33.30	-13.80	12.39	-14.26
33.74	-13.48	11.79	-6.91	33.46	-19.20	14.47	-8.20	33.30	-14.83	12.39	-15.25
33.74	-14.52	11.72	-6.92	33.46	-20.19	14.38	-8.20	33.30	-15.87	12.31	-16.24
33.76	-14.53	11.65	-7.97	33.46	-21.18	14.30	-8.20	33.30	-16.90	12.31	-17.23
33.78	-15.59	11.58	-7.97	33.46	-22.18	14.21	-9.19	33.30	-17.93	12.22	-18.23
33.78	-16.64	11.51	-9.02	33.46	-23.17	14.12	-9.19	33.30	-18.97	12.22	-19.22
33.78	-17.69	11.44	-9.02	33.50	-24.16	14.04	-9.19	33.28	-20.01	12.22	-20.21
33.80	-18.74	11.36	-10.07	33.50	-25.16	13.95	-9.19	33.28	-21.05	12.14	-21.21
33.80	-19.79	11.29	-10.07	33.50	-26.15	13.87	-10.19	33.30	-22.07	12.05	-22.20
33.80	-20.84	11.29	-11.11	33.50	-27.14	13.78	-10.19	33.30	-23.10	12.05	-23.19
33.80	-21.89	11.22	-11.12	33.50	-28.14	13.70	-10.19	33.30	-24.14	12.05	-24.19
33.80	-22.93	11.15	-11.12	33.50	-29.13	13.61	-10.19	33.30	-25.17	11.97	-25.18
33.82	-23.99	11.08	-11.13	33.50	-30.12	13.53	-11.18	33.30	-26.20	11.88	-26.18
33.82	-25.04	11.08	-12.17	33.50	-31.12	13.44	-11.18	33.32	-27.23	11.88	-27.17
33.82	-26.08	11.01	-13.22	33.50	-32.11	13.36	-12.17	33.32	-28.26	11.80	-28.16
33.82	-27.13	10.94	-13.22	33.50	-33.11	13.27	-12.17	33.34	-29.28	11.80	-29.16
33.84	-28.19	10.87	-13.22	33.50	-34.10	13.19	-12.17	33.34	-30.32	11.71	-29.16
33.84	-29.24	10.80	-14.27	33.50	-35.09	13.10	-12.17	33.36	-31.34	11.71	-30.15
33.84	-30.28	10.73	-15.32	33.50	-36.09	13.02	-12.17	33.38	-32.36	11.71	-31.14
33.84	-31.33	10.66	-15.32	33.50	-37.08	12.93	-12.17	33.38	-33.40	11.71	-32.13
33.84	-32.38	10.59	-15.33	33.50	-38.07	12.85	-12.17	33.40	-34.42	11.63	-33.13
33.84	-33.42	10.52	-15.33	33.50	-39.07	12.76	-13.17	33.42	-35.44	11.63	-34.12
33.84	-34.47	10.45	-16.38	33.50	-40.06	12.67	-13.17	33.42	-36.48	11.63	-35.11
33.84	-35.52	10.38	-17.42	33.50	-41.06	12.59	-13.17	33.42	-37.51	11.63	-36.10
33.84	-36.57	10.38	-18.46	33.50	-42.05	12.50	-13.17	33.44	-38.53	11.54	-37.10
33.84	-37.61	10.38	-19.51	33.50	-43.04	12.42	-13.17	33.44	-39.57	11.54	-38.09
33.84	-38.66	10.38	-20.55	33.54	-44.03	12.33	-14.16	33.44	-40.60	11.46	-39.09
33.84	-39.71	10.38	-21.59	33.54	-45.03	12.25	-14.16	33.44	-41.64	11.37	-40.08
33.84	-40.75	10.38	-22.63	33.54	-46.02	12.16	-14.16	33.46	-42.66	11.29	-41.08
33.84	-41.80	10.38	-23.67	33.54	-47.01	12.08	-14.16	33.46	-43.69	11.20	-42.07
33.84	-42.85	10.38	-24.71	33.54	-48.01	11.99	-15.16	33.46	-44.73	11.20	-43.06
33.84	-43.90	10.38	-25.76	33.57	-49.00	11.91	-15.16	33.46	-45.76	11.20	-44.05
33.84	-44.94	10.38	-26.80	33.57	-49.99	11.82	-15.16	33.46	-46.79	11.12	-45.05

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Table B1 (continued)

Upwelling (July)				Transition-Oceanic (Sept)				Davidson (Jan)			
2011 Profile		2011 Profile		2004.2 Profile		2004.1 Profile		2011 Profile		2004 Profile	
S (ppt)	Z (m)	T (°C)	Z (m)	S (ppt)	Z (m)	T (°C)	Z (m)	S (ppt)	Z (m)	T (°C)	Z (m)
33.84	-45.99	10.38	-27.84			11.82	-16.15	33.48	-47.82	11.03	-46.05
33.86	-47.05	10.38	-28.88			11.74	-17.14	33.50	-48.84	11.03	-47.04
33.86	-48.09	10.38	-29.92			11.65	-18.14	33.50	-49.87	10.95	-48.03
33.86	-49.14	10.38	-30.97			11.57	-18.14	33.51	-50.90	10.86	-49.03
33.86	-50.19	10.37	-32.01			11.48	-18.14	33.51	-51.93	10.86	-50.02
33.86	-51.23	10.37	-33.05			11.39	-18.14	33.53	-52.95	10.77	-51.01
33.86	-52.28	10.30	-34.09			11.31	-18.14	33.53	-53.99	10.77	-52.01
		10.30	-35.14			11.22	-19.13			10.77	-53.00
		10.30	-36.18			11.22	-20.12			10.69	-53.99
		10.30	-37.22			11.14	-20.12			10.69	-54.98
		10.30	-38.26			11.14	-21.12				
		10.30	-39.30			11.05	-21.12				
		10.30	-40.34			11.05	-22.11				
		10.30	-41.39			11.14	-23.11				
		10.30	-42.43			11.22	-24.10				
		10.23	-43.47			11.31	-25.09				
		10.23	-44.52			11.39	-26.09				
		10.16	-45.56			11.39	-27.08				
		10.16	-46.60			11.39	-28.07				
		10.16	-47.65			11.39	-29.07				
		10.09	-48.69			11.31	-30.06				
		10.09	-49.73			11.31	-31.06				
		10.09	-50.78			11.22	-32.05				
		10.02	-51.82			11.22	-33.04				
						11.22	-34.04				
						11.14	-35.03				
						11.05	-36.02				
						11.05	-37.02				
						10.97	-38.01				
						10.88	-39.01				
						10.88	-40.00				
						10.88	-40.99				
						10.88	-41.99				
						10.80	-42.98				
						10.79	-43.98				
						10.79	-44.97				
						10.71	-45.96				
						10.71	-46.96				
						10.62	-47.95				
						10.62	-48.94				
						10.62	-49.94				
						10.62	-50.93				
						10.62	-51.93				
						10.62	-52.92				
						10.62	-53.91				

APPENDIX C – ANALYSES FOR ADDITIONAL SCENARIOS

TECHNICAL MEMORANDUM

DATE: August 25, 2014

TO: Environmental Science Associates (ESA)

FROM: Gang Zhao, Ph.D., P.E., Aaron Mead, P.E., E. John List, Ph.D., P.E.

SUBJECT: **MRWPCA Brine Discharge Diffuser Analysis – Additional Scenarios FSI 134032**

1. Introduction

In August 2014, Flow Science performed additional modeling analyses to evaluate the dilution of the desalination brines that may be generated in the future from two primary sources (the proposed Monterey desalination facility and the Groundwater Replenishment Project (GWR Project)). A mixture of brines from these two sources was also evaluated. Specifically, Flow Science modeled thirteen (13) additional discharge scenarios; calculated the desalination brine discharge rate that would be required to achieve a mixed salinity that would be at most 2 ppt above ambient salinity at the seafloor; and calculated the amount of seawater or treated wastewater that would be required to pre-dilute the desalination brine such that the mixed effluent would cause an increase of no more than 2 ppt above ambient salinity at the seafloor. Dilution analyses were conducted using both a semi-empirical method and USEPA's Visual Plumes suite of models, and dilution was evaluated for three seasonal conditions [Davidson current (January), Upwelling conditions (July), and Oceanic conditions (September)]. These analyses are part of the EIR preparation process for the planned Monterey Peninsula Water Supply Project, and the discharge scenarios presented in this Technical Memorandum supplement the discharge scenarios analyzed by Flow Science and presented in a previous Technical Memorandum (Flow Science 2014).

This Technical Memorandum (TM) describes the input data and the analysis methodology used by Flow Science to evaluate the dilution of desalination brines and summarizes the results of the dilution analyses.

2. Analysis Input Data

Discharge Scenarios

In August 2014, Flow Science performed additional analyses for the Monterey Peninsula Water Supply Project. The three tasks that made up these additional modeling analyses are summarized below.

Task 1. Model 13 additional discharge scenarios as specified in ESA's e-mail of October 10, 2013 and presented in **Table C1** below.

Task 2. Calculate the desalination brine discharge rate required to achieve a mixed salinity that is less than 2 ppt above ambient salinity at the impact point for the three seasonal conditions summarized in **Table C3**. No pre-dilution of the desalination brine was assumed for this task. A series of discharge rates were analyzed to determine the discharge rate required to keep the effluent salinity less than 2 ppt above ambient salinity.

Task 3. Calculate the amount of pre-dilution required for the desalination brine to achieve the less than 2 ppt salinity exceedance at the impact point for the mixed effluent. For this task, it was assumed that ambient seawater or treated wastewater would be used to pre-dilute the desalination brine before discharging to the outfall. A flow rate of 13.98 mgd was used for the desalination brine. Properties of the seawater and wastewater used to pre-dilute the brine are summarized in **Table C3**.

Table C1 – Discharge scenarios

Discharge Condition	Ambient Condition & Effluent Component[a,b]	Scenario Number	Discharge (mgd)[c]	Discharge Salinity (ppt)[d]	Discharge Temperature (^{o}C)
Existing	Davidson (Jan) WW	0.0	19.78	0.8	20.0
Desal Project Only	Upwelling (July) BR	5.1	8.99	58.23	9.9
	Davidson (Jan) BR	6.1	8.99	57.40	11.6
	Davidson (Jan) BR+WW	7.1	28.77	18.48	17.4
	Oceanic (Sept) BR	8.1	8.99	57.64	11.1
Desal Project	Upwelling (July) BR+GWR	9.1	9.72	54.16	11.0

Discharge Condition	Ambient Condition & Effluent Component[a,b]	Scenario Number	Discharge (mgd)[c]	Discharge Salinity (ppt)[d]	Discharge Temperature (^oC)
with GWR	Davidson (Jan) BR+GWR	10.1	9.72	53.39	12.2
	Davidson (Jan) + BR+GWR+WW	11.1	25.64	20.73	17.1
	Oceanic (Sept) BR+GWR	12.1	9.72	53.61	12.1
GWR Only	Upwelling (July) GWR	13.1	0.73	4	24.4
	Davidson (Jan) GWR	14.1	0.73	4	20.2
	Davidson (Jan) GWR+WW	15.1	16.65	0.93	20.0
	Oceanic (Sept) GWR	16.1	0.73	4	24.4

[a] BR: desalination brine. WW: wastewater. GWR: Monterey Peninsula Groundwater Replenishment Project.

[b] Salinity and temperature of the combined discharges were calculated as flow-weighted averages of BR, WW and GWR salinity and temperature data provided by ESA.

[c] mgd: million gallons per day.

[d] ppt: part per thousand.

Diffuser Configuration

The existing MRWPCA diffuser has 172 ports. Half of the ports discharge horizontally from one side of the diffuser and half discharge horizontally from the other side of the diffuser, in an alternating pattern. The ports are approximately 6 inches above the rock bedding of the diffuser pipeline, and drawings[2] (see **Figure C1**) indicate that they are located a minimum of approximately 3.5 feet above the seafloor. The gravel bedding dimensions are nominal, as shown in **Figure C1**, and therefore, the port height above the seafloor cannot be determined with high accuracy. Momentum of the effluent is a key factor in determining the dilution within the ZID. Toward the end of the ZID, the plume slows down and mixing is not as strong as at the beginning of the ZID. Therefore, the dilution results are not likely to change by much if the port height is off slightly. Considering the overall uncertainty in the analysis, it is not critical to determine the diffuser port height with high accuracy. According to MRWPCA, the fifty-two (52) ports nearest to the shore (i.e., the shallowest ports) are currently closed. In this analysis, Flow

[2] Section F, Drawing P-0.03, Contract Documents Volume 1 of 1: Ocean Outfall Contract No. 2.1, January 1982 by Engineering Science for MRWPCA

Science calculated plume concentrations for effluent discharged horizontally through the 120 open ports. A typical section of the current diffuser is shown in **Figure C1**, although the actual cross-sectional profile of the pipe type 3 rock may have changed over time. In this analysis, it was assumed that effluent plumes do not interact with the ballast. Details of the current diffuser configuration are summarized in **Table C2**.

Table C2 – Current diffuser configuration.

Parameter	Value
Diffuser length	1368 feet (417 m*)
Depth of diffuser ports	95 to 109 feet below MSL
Number of open ports	120
Port spacing	8 feet (2.44 m*)
Port diameter	2 inches (0.051 m*)
Port exit condition	Tideflex Series 35 4-inch duckbill valves
Port vertical angle	0° (horizontal)
Port elevation above sea floor	3.5 feet (1.07 m*)

*m = meters

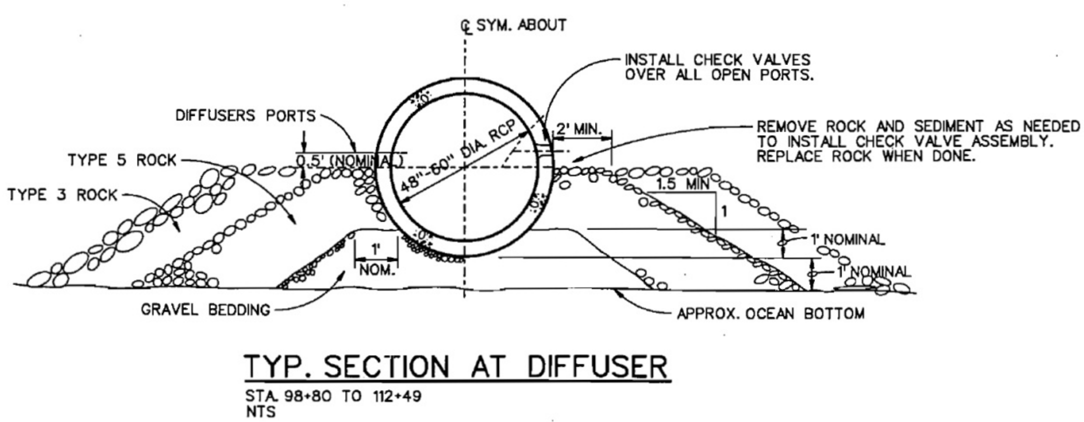

Figure C1. Typical diffuser section (currently in place).

The 120 ports that are currently open are fitted with Tideflex "duckbill" check valves, as shown in **Figure C2**. The shape of the duckbill valve opening is elliptic, and the area of the opening depends on the discharge flow rate. The valve opening area in this analysis was determined from an effective open area curve provided by Tideflex Technologies (included as **Appendix A**). Although the ports were modeled as round openings with the same opening area as the "duckbill" valves, the actual dilution will be higher than the dilution computed assuming circular ports because of the oblateness of the actual port opening.

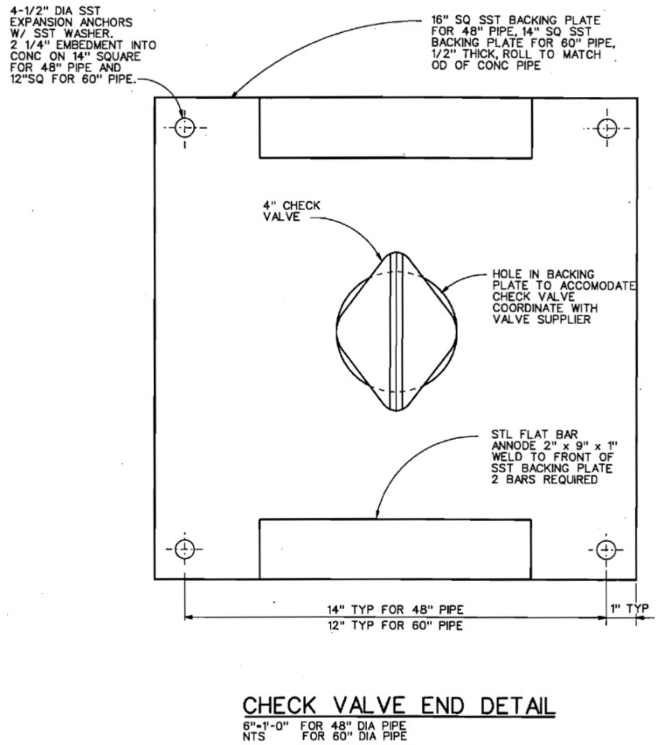

Figure C2. Typical "duckbill" valve detail (shown closed, i.e., with no flow).

Discharge Characteristics

Salinity (or total dissolved solids [TDS]) and temperature data for the brine, GWR concentrate, ambient seawater and the MRWPCA wastewater were provided by ESA. TDS is a measure of water salinity, and salinity and temperature are used to calculate the density of the effluent and ambient ocean water, which are important parameters in dilution analyses.

As summarized in **Table C3** below, ESA selected three seasonal ocean conditions for analysis: Upwelling (July), Davidson (January), and Oceanic (September). Therefore, discharge rate, temperature, and salinity/TDS data for these months were used in the analysis. For each discharge scenario, the desalination brine(s) and water from other sources were assumed to be fully mixed prior to discharge from the diffuser. Thus, the temperature and salinity of the combined flow were calculated as the flow-weighted average temperature and salinity of the brine and wastewater.

Table C3 – Three seasonal conditions of the desalination brine

Effluent Discharge Season	Brine		Pre-dilution Seawater		Wastewater	
	Salinity (ppt)	Temp. (C^o)	Salinity (ppt)	Temp. (C^o)	Salinity (ppt)	Temp. (C^o)
July (Upwelling)	58.23	9.9	33.8	9.9	0.8	24
January (Davidson)	57.40	11.6	33.4	11.6	0.8	20
September (Oceanic)	57.64	11.1	33.5	11.1	0.9	24

Source: average values provided by ESA.

Receiving Water Profiles

ESA provided Flow Science with representative ocean receiving water profile data (temperature and salinity) for the three months corresponding to the selected discharge scenarios (July, January, and September). Receiving water profile data were collected by the Monterey Bay Aquarium Research Institute (MBARI) at Station C1 at the head of Monterey Canyon, approximately five miles northwest of the MRWPCA wastewater ocean outfall (see **Figure C3**). This location has been occupied since 1988 by MBARI. Monthly conductivity, temperature, and depth (CTD) profiles have been collected since 2002. The proximity of the location to the MRWPCA ocean outfall and the extended data record make this the most appropriate and useful data set to characterize the ambient conditions for the brine discharge analysis. Vertical profiles of temperature and salinity were analyzed for the upper 50 meters of the water column for the years 2002-2012, and a single representative profile was selected for each of the three ocean seasons. For the July model runs, temperature and salinity profiles from 2011 were selected. For the September model runs, profiles from 2004 were selected. For the January model runs, a temperature profile from 2004 and a salinity profile from 2011 were selected. Profile data are shown in tabular form in **Appendix B**. Maximum and minimum values for each profile are shown in **Table C4**, and profile values used in this analysis for the three seasonal conditions are shown in **Table C5**.

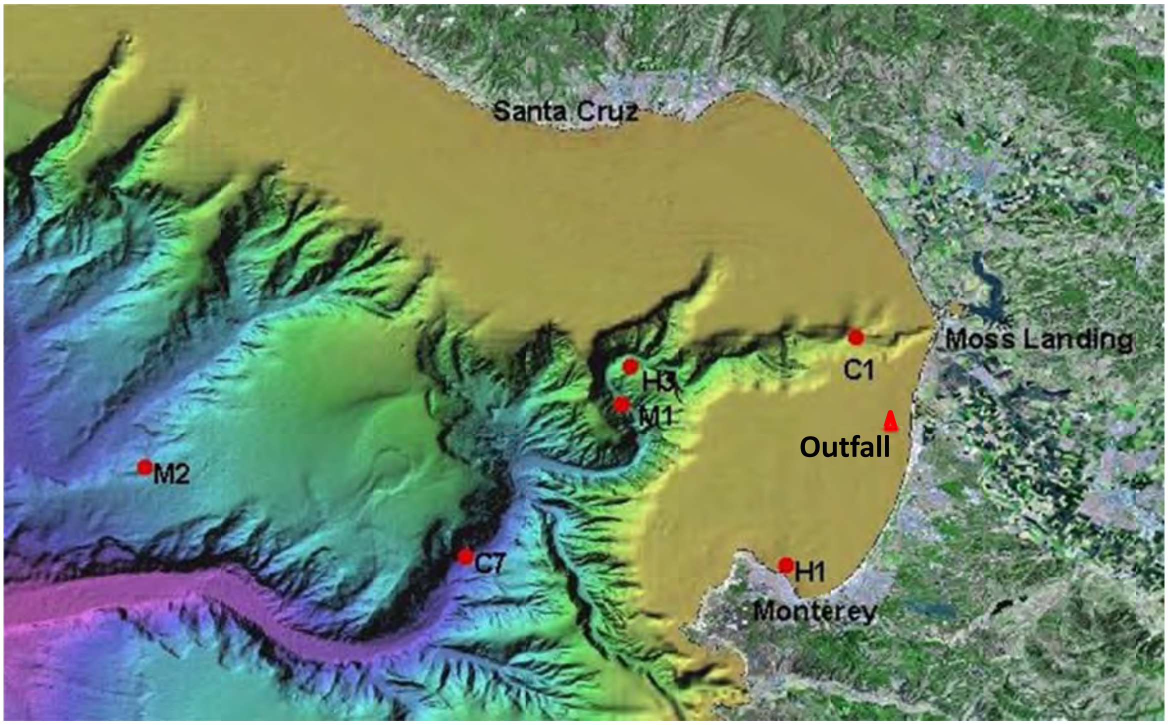

Figure C3. Location map, MBARI ocean monitoring stations and MRWPCA outfall.

Table C4 – Maximum and minimum ocean profile data.

Parameter	Season	Minimum	Maximum
Salinity (ppt)	Upwelling (July)	33.7	33.9
	Davidson (January)	33.2	33.5
	Oceanic (September)	33.5	33.6
Temperature (C^o)	Upwelling (July)	10.0	13.0
	Davidson (January)	10.7	12.7
	Oceanic (September)	10.6	15.8

Source: ESA (2013); Appendix B.

Table C5 – Modeled seasonal ocean conditions.

Depth (m)	Upwelling (July)		Davidson (January)		Oceanic (September)	
	Temp. (^{o}C)	Salinity (ppt)	Temp. (^{o}C)	Salinity (ppt)	Temp. (^{o}C)	Salinity (ppt)
0	12.98	33.78	12.65	33.20	15.75	33.46
2	12.87	33.77	12.65	33.22	15.75	33.46

Depth (m)	Upwelling (July)		Davidson (January)		Oceanic (September)	
	Temp. (°C)	Salinity (ppt)	Temp. (°C)	Salinity (ppt)	Temp. (°C)	Salinity (ppt)
4	12.64	33.74	12.65	33.22	15.75	33.46
6	11.97	33.71	12.65	33.23	15.53	33.46
8	11.61	33.70	12.74	33.24	14.46	33.46
10	11.34	33.70	12.57	33.26	13.81	33.46
12	11.10	33.73	12.50	33.28	13.17	33.46
14	10.84	33.75	12.42	33.30	12.27	33.46
16	10.51	33.78	12.33	33.30	11.83	33.46
18	10.38	33.79	12.24	33.30	11.52	33.46
20	10.38	33.80	12.22	33.28	11.19	33.46
22	10.38	33.80	12.07	33.30	11.06	33.46
24	10.38	33.82	12.05	33.30	11.22	33.49
26	10.38	33.82	11.90	33.30	11.39	33.50
28	10.38	33.84	11.81	33.32	11.39	33.50
30	10.38	33.84	11.71	33.34	11.31	33.50
32	10.37	33.84	11.71	33.37	11.23	33.50
34	10.31	33.84	11.63	33.39	11.22	33.50
36	10.30	33.84	11.63	33.42	11.05	33.50
38	10.30	33.84	11.54	33.43	10.97	33.50

Source: Interpolated from ESA | Water (2013) ocean profile data, Appendix B.

Receiving water flow conditions

As detailed in **Figure C1**, the existing diffuser ports are located just above the mid-point of the outfall pipe (i.e., below the crown of the outfall pipe), about 6 inches above the top of the ballast used to anchor the diffuser to the seafloor. Because the outfall rises above the seafloor, it will influence the patterns of currents (receiving water flow velocity) at the ports, and the current velocity at each individual port will be a complex function of the local geometry. Ocean currents increase the amount of dilution that occurs because they increase the flow of ambient water past the diffuser (i.e., increase the amount of ambient water available for mixing with the discharge). However, due to the complex outfall geometry, local field data collection would be required to characterize the actual current conditions and ambient turbulence levels at the diffuser ports, which was beyond the scope and budget of this analysis. To simplify the analysis, effluent dilution was analyzed for a uniform 0.0 fps current, which amounts to a “worst case,” stagnant (no current) receiving water condition. Stagnant conditions are typically used as the basis for developing NPDES permits, and the California Ocean Plan (SWRCB, 2009) requires the no-current condition be used in initial dilution calculations.

3. Trajectory and ZID of a Negatively Buoyant Plume

The effluent and ocean profiles data presented in **Tables C1 and C5** indicate the effluent is negatively buoyant for some scenarios. A schematic sketch of the trajectory of a negatively buoyant jet is shown in **Figure C4**, where θ_0 is the port angle, d is the port diameter, s is distance in the direction of the port centerline, n is distance in the direction perpendicular to the port centerline, z_{me} is the maximum rise of the plume, M_0 is the initial momentum flux at the point of discharge, and M_b is the buoyancy-generated momentum flux. x_{0R} is the horizontal distance between the port and the point where the plume centerline returns to the port height level. In this analysis, the diffuser ports are about 3.5 ft above seafloor, and the impact point is the location where the plume centerline reaches seafloor.

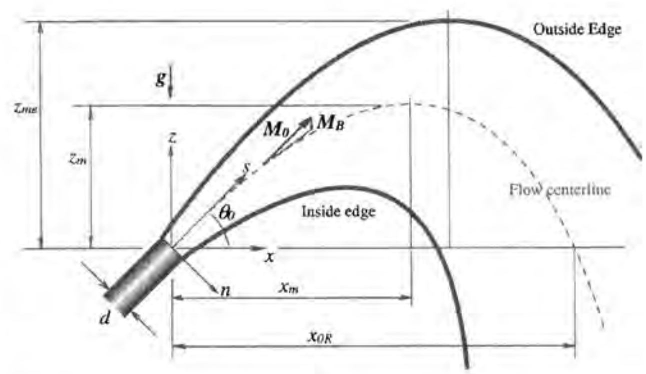

Fig. 1. Schematic diagram of the generic discharge configuration

Figure C4. Definition schematic for negatively buoyant jet (Kikkert, et al., 2007).

The methods described in **Section 4** were used to calculate the size of the plume and dilution of the discharged effluent within the “Zone of Initial Dilution,” or ZID. The ZID is defined as the zone immediately adjacent to a discharge where momentum and buoyancy-driven mixing produces rapid dilution of the discharge. In this analysis, the ZID ends at the point where the discharge plume impacts the seafloor for a dense (sinking) plume; for a positively buoyant (rising) effluent, the ZID ends at the point where the effluent plume reaches the water surface or attains a depth level where the density of the diluted effluent plume becomes the same as the density of ambient water (i.e., the “trap” level). Typically, within the ZID, which is limited in size, constituent concentrations are permitted to exceed water quality standards. A discharge is generally required to meet the relevant water quality standards at the edge of the ZID.

Beyond the point where the plumes reach the seafloor, some additional mixing will occur, and the discharged brine (now diluted) will travel along the seafloor as a density current. Based on the bathymetry near the diffuser, which steadily slopes out to sea, there is no “bowl” in which effluent could accumulate indefinitely. Rather, diluted effluent would flow downslope and gradually disperse. In the analysis presented here, the spreading of the effluent on the seafloor (or within and beyond the trapping level) and the subsequent additional dilution that would ensue, have not been analyzed. Flow Science recommends that the computed dilution at the seafloor, or at the trapping level (i.e., at the end of the ZID) be used as the basis for any NPDES permitting activities and to analyze impacts.

4. Plume Analysis Methods

Two analysis methods have been used to evaluate the discharge of desalination brines (negatively buoyant plumes) from the MRWPCA diffuser: a semi-empirical method based on the work of Roberts et al. (1997) and Kikkert et al. (2007), and EPA's Visual Plumes method. The Visual Plumes method was also used to model scenarios where the effluent density is less than seawater (positively buoyant, or rising, plumes). Both the semi-empirical method and Visual Plumes were used to characterize negatively buoyant plumes in order to understand the range of dilution that might be expected for discharge from the MRWPCA diffuser system. The semi-empirical method also provides some level of redundancy and confirmation of results because Visual Plumes, although widely used in diffuser discharge analysis, has only very recently been validated against limited experimental data for the case of a negatively buoyant plume. The main advantage of the semi-empirical analysis method is that it is well-grounded in empirical observations, and thus is well-tested and has been verified by comparison to a relatively large dataset for this specific discharge condition. The main disadvantage is that the semi-empirical method requires longer to complete an analysis for a given discharge scenario. The analysis techniques for these two methods are described below.

Semi-Empirical Analysis Method

Laboratory studies of negatively buoyant jets and plumes have been conducted by many researchers (e.g., Kikkert et al., 2007; Roberts et al., 1997). Most of these have been conducted for inclined jets (i.e., jets that discharge upward at an angle), which increase the initial mixing of the plume. Fewer studies are available to characterize the mixing of negatively buoyant plumes from horizontally-oriented discharge ports. In the following sections, the general equations for a negatively buoyant jet from an angled port are presented first. The equations for a horizontal discharge are then derived from the general equations.

Discharge of a negatively buoyant jet from an angled port

Plume trajectory

The trajectory of a negatively buoyant discharge under a stagnant flow condition (i.e., no ambient current) can be computed from the following equations (Kikkert, et al., 2007) (see **Figure C4** for nomenclature).

$$\frac{dn_*}{ds_*} = \frac{M_{B*}\cos\theta_0}{1 - M_{B*}\sin\theta_0} \qquad (1)$$

where:

$s_* = s/d$

$n_* = n/d$

s and *n* are the distances in directions along and perpendicular to the discharge port centerline, respectively; *d* is the effective diameter of the port (see **Figure C4**); and M_{B*} is the dimensionless buoyancy-generated momentum flux, which can be calculated from Eq. (2).

$$M_{B*} = 0.154\frac{s_*^2}{F_0^2} \qquad (2)$$

where F_0 is the initial densimetric Froude number:

$$F_0 = \frac{U_0}{\sqrt{gd(\rho_0 - \rho_a)/\rho_a}}$$

where

U_0 = initial jet velocity
g = gravitational acceleration
ρ_0 = initial density of the jet
ρ_a = ambient water density

Substituting Eq. (2) into Eq. (1) and integrating gives an equation for the discharge trajectory:

$$n_* = \frac{2.6F_0}{\tan\theta_0 \sin^{1/2}\theta_0}\left[-\frac{s_*\sin^{1/2}\theta_0}{2.6F_0} + \frac{1}{2}\ln\left(\frac{2.6F_0 + s_*\sin^{1/2}\theta_0}{2.6F_0 - s_*\sin^{1/2}\theta_0}\right)\right] \qquad (3)$$

Results from Eq. (3) agreed well with experimental data (Kikkert, et al., 2007).

Discharge of a negatively buoyant jet from a horizontal port

Plume trajectory

The plume trajectory of a horizontal discharge can be estimated using the equations for an angled jet. Specifically, for a horizontal discharge (i.e., $\theta_0 = 0$), Eq. (3) simplifies to the following relationship:

$$n_* = 0.051 \frac{s_*^3}{F_0^2} \qquad (4)$$

Plume dilution for a horizontal discharge

For the horizontally discharged effluent, the empirical equations from Fischer et al., 1979 (Table 9.2, pp. 328) were used to compute the width and dilution of the effluent. i.e.,

*Plume width=2*0.13*distance along plume* (5)

The plume width calculated from Eq. (5) defines the edge of the plume as the location where the concentration is 37% (= e^{-1}, which is often used to characterize plume width) of the centerline concentration.

The volume flux and dilution are specified by:

Volume flux $\mu = 0.25 M^{1/2}$ **distance along plume* (6)

Dilution = μ /(discharge flow rate) (7)

where $M=QU_0$ is the initial momentum flux of the effluent (Q and U_0 are the flow rate and initial velocity of the effluent, respectively).

Note that the semi-empirical analysis for 0º discharges uses Kikkert et al. (2007) for the trajectory and Fischer et al. (1979) for dilution.

Visual Plumes Analysis Method

Methodology

The UM3 model—part of the EPA Visual Plumes diffuser modeling package—was used to simulate the discharge of desalination brine and wastewater from the existing MRWPCA ocean diffuser. Visual Plumes is a mixing zone computer model developed from a joint effort led by USEPA. Visual Plumes can simulate both single and merging submerged plumes, and density-stratified ambient flow can be specified by the user. Visual Plumes can be used to compute the plume dilution, trajectory, diameter, and other plume variables (USEPA, 2003).

The UM3 model is based on the projected area entrainment hypothesis, which assumes ambient fluid is entrained into the plume through areas projected in directions along the plume centerline and perpendicular to the centerline (USEPA, 1994). In addition, velocity shear entrainment is also included. The plume envelope is assumed to be in steady state, and as a plume element moves through the envelope, the element radius changes in response to velocity convergence or divergence, and entrainment of ambient fluid. Conservation equations of mass, momentum and energy are used to calculate plume mass and concentrations.

The actual depth of the diffuser ports varies between 95 and 109 feet below mean sea level (MSL) since the diffuser is quite long and is situated on a sloping portion of the ocean floor. However, since Visual Plumes cannot model a sloping diffuser, an average depth of 104 feet below MSL was used (the deepest 120 ports on the diffuser discharge in this case, thereby increasing the average port depth). Modeled ocean conditions are summarized in **Table C5**.

As with the semi-empirical method, Visual Plumes assumes circular discharge ports, so the actual elliptical discharge area of the Tideflex valves was calculated for each port (**Appendix A**) and then converted to an effective circular discharge diameter for use in Visual Plumes.

A study by Palomar et al. (2012a, 2012b) showed that the UM3 model of the Visual Plumes can be applied to simulate negatively buoyant discharges. However, the study also found that the UM3 model underpredicted centerline dilution ratios at the impact point by more than 50% for a negatively buoyant effluent discharged into a stagnant environment; for a number of scenarios with negatively buoyant effluent discharged into an ambient current, centerline dilution ratios at the impact point calculated by the UM3 model ranged from 40% lower to 7% higher than experimental data.

The UM3 model of the Visual Plumes was used in this analysis to model negatively buoyant effluent discharged into a stagnant environment. Because the study of Palomar et al. (2012a, 2012b) has shown that the centerline dilution ratios computed using the UM3 model were more than 50% lower than data from experiments with similar discharge conditions, the average dilution ratios calculated using UM3, which are nearly double the centerline dilution ratios, were used to estimate dilution of negatively buoyant plumes in this analysis. Since Visual Plumes has been more thoroughly validated for positively buoyant plumes, it alone was used for scenarios with rising plumes.

5. Dilution Results

Results for thirteen new scenarios ("Task 1" Scenarios)

For the scenarios presented in **Table C1**, several key results for the effluent plumes are reported at the edge of the ZID. As noted above, the ZID is defined as the zone immediately adjacent to a discharge where momentum and buoyancy-driven mixing produces rapid dilution of the discharge. Results for positively buoyant plumes presented in this Technical Memorandum were taken at the point where the plumes just reach the trap level, which is the depth level where the density of the diluted plume becomes the same as ambient seawater. Horizontal spreading of plumes at their trap levels was not included in this analysis because it is beyond the ZID. Results from each scenario generally include the following quantities:

- the horizontal distance from the diffuser port to the point at which the plume impacts the seafloor or reaches the trap level.
- the dilution of the plume at the point at which the plume impacts the seafloor or reaches the trap level. For the semi-empirical method of analyzing negatively buoyant plumes and for the Visual Plumes analyses of rising plumes, centerline dilution is provided. For the Visual Plumes analyses of negatively buoyant discharges, the average dilution within the plume is provided, in recognition of the conservative nature of Visual Plumes results for negatively buoyant plumes (see, e.g., Palomar et al., 2012a and 2012b).
- an estimate of the size of the plume (diameter) at the point of impact or just below the trap level (i.e., at the edge of the ZID).
- the maximum salinity at the seafloor (edge of ZID for negatively buoyant plumes).
- the percentage by which the maximum plume salinity at the seafloor (edge of ZID for negatively buoyant plumes) exceeds the ambient salinity.

Figure C5 shows a sample schematic graphic of the trajectory of a negatively buoyant plume from a horizontal discharge drawn approximately to scale. As the effluent travels away from the discharge port, it entrains ambient seawater, which increases the diameter of the plume and decreases the plume concentration.

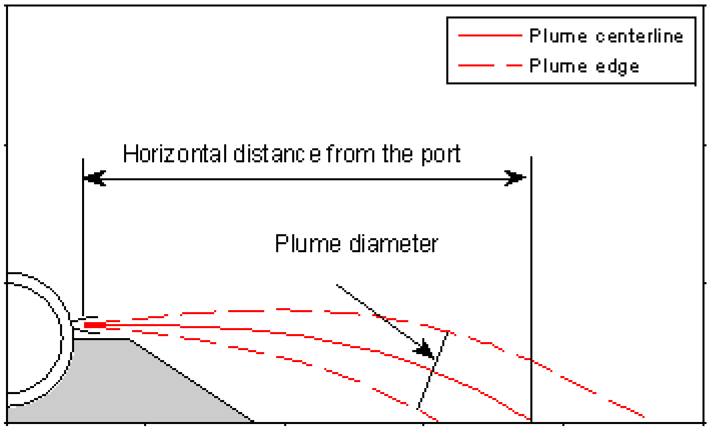

Figure C5. Sample graphic showing plume trajectory for the horizontal discharge configuration.

Table C6 presents analysis results for the 13 modeled scenarios of Task 1. The plumes were positively buoyant (i.e., had densities less than ambient seawater) for scenarios where the desalination brine was mixed with treated wastewater and for GWR Project scenarios. This is mainly because the salinity of the plumes in these scenarios was much lower than ambient seawater. The plumes were negatively buoyant (i.e., were denser than ambient seawater) for desalination brine only and for desalination brine mixed with GWR Project brine. Results in **Table C6** show that the trajectory, diameter and dilution of the negatively buoyant plumes were nearly the same across all three modeled seasons, because the trajectories of these negatively buoyant plumes were short and close to the seafloor, where the differences in salinity and temperature (hence the difference in density) between the effluent and ambient sea water changed only slightly over the modeled seasons. Therefore, for analyses of scenarios involving negatively buoyant, i.e., sinking, plumes, characteristics of the resulting plumes were similar for all seasons.

Dilution values predicted by the semi-empirical method were lower than the dilution values predicted by the Visual Plumes method. The predicted maximum plume salinity at the seafloor was 1.6 ppt above ambient ocean salinity.

Table C6 – Analysis results.

Analysis number	Effluent discharge flow rate (mgd) & component	Discharge Velocity (feet/ second)	Seasonal Condition	Effluent salinity (ppt)	Ocean bkgrd. salinity at diffuser depth (ppt)	Semi-empirical method						VP method					
						Plume diam. (d) (inch)	Center-line Dilution	Horiz. Distance from port (ft)	Max. height above port (z_{me}) (ft)	Plume salinity at calc. dilution (ppt)	Salinity increase above ambient (ppt)	Plume diam. (inch)	Average Dilution	Horiz. Distance from port (ft)	Max. height above port (z_{me}) (ft)	Plume salinity at calc. dilution (ppt)	Salinity increase above ambient (ppt)
0.0	19.78 WW	11.5	Davidson (Jan.)	0.8	33.36	--	--	--	--	--	--	246	167 [a]	27	69 [b]	--	--
5.1	8.99 BR	7.5	Upwelling (July)	58.23	33.84	31	15	10	--	35.47	1.6	36	25	8	--	34.82	1.0
6.1	8.99 BR	7.5	Davidson (Jan.)	57.40	33.36	31	15	10	--	34.98	1.6	36	26	8	--	34.30	0.9
7.1	28.77 BR+WW	13.9	Davidson (Jan.)	18.48	33.36	--	--	--	--	--	--	207	84 [a]	38	41 [b]	--	--
8.1	8.99 BR	7.5	Oceanic (Sept.)	57.64	33.50	31	15	10	--	35.11	1.6	36	25	8	--	34.47	1.0
9.1	9.72 BR+GWR	8	Upwelling (July)	54.16	33.84	34	17	11	--	35.04	1.2	39	27	8	--	34.59	0.8
10.1	9.72 BR+GWR	8	Davidson (Jan.)	53.39	33.36	34	17	11	--	34.55	1.2	40	27	8	--	34.12	0.8
11.1	25.64 BR+WW +GWR	13.1	Davidson (Jan.)	20.73	33.36	--	--	--	--	--	--	204	82 [a]	38	38 [b]	--	--
12.1	9.72 BR+GWR	8	Oceanic (Sept.)	53.61	33.50	34	17	11	--	34.68	1.2	39	27	8	--	34.24	0.7

Source: Flow Science Analysis, 2014.
BR: desalination brine. WW: wastewater. GWR: groundwater recharge.
[a] Dilution values are centerline dilution because the Visual Plumes model has been validated for positively buoyant plumes and no significant underprediction of dilution has been reported.
[b] These values are trap levels above the diffuser.

Table C6 – Analysis results (continued).

Analysis number	Effluent discharge flow rate (mgd) & component	Discharge Velocity (feet/ second)	Seasonal Condition	Effluent salinity (ppt)	Ocean bkgrd. salinity at diffuser depth (ppt)	Semi-empirical method						VP method					
						Plume diam. (d) (inch)	Center-line Dilution	Horiz. Distance from port (ft)	Max. height above port (z_{me}) (ft)	Plume salinity at calc. dilution (ppt)	Salinity increase above ambient (ppt)	Plume diam. (inch)	Average Dilution	Horiz. Distance from port (ft)	Max. height above port (z_{me}) (ft)	Plume salinity at calc. dilution (ppt)	Salinity increase above ambient (ppt)
13.1	0.73 GWR	3.4	Upwelling (July)	4	33.84	--	--	--	--	--	--	159	777 [a]	6	48 [b]	--	--
14.1	0.73 GWR	3.4	Davidson (Jan.)	4	33.36	--	--	--	--	--	--	86	270 [a]	5	24 [b]	--	--
15.1	16.65 WW+GWR	11	Davidson (Jan.)	0.9	33.36	--	--	--	--	--	--	243	180 [a]	24	68 [b]	--	--
16.1	0.73 GWR	3.4	Oceanic (Sept.)	4	33.50	--	--	--	--	--	--	121	678 [a]	5	41 [b]	--	--

Source: Flow Science Analysis, 2014.
BR: desalination brine. WW: wastewater. GWR: groundwater recharge.
[a] Dilution values are centerline dilution because the Visual Plumes model has been validated for positively buoyant plumes and no significant underprediction of dilution has been reported.
[b] These values are trap levels above the diffuser.

Impact of Discharge Rate on Effluent Dilution and Salinity

To explore the impact of the brine discharge rate on effluent dilution ratio and to determine the desalination brine discharge rate that results in salinity at the seafloor that exceeds ambient salinity levels by no more than 2 ppt , a series of brine discharge rates were analyzed using both the Visual Plumes model and the semi-empirical method. For this analysis, the desalination brine was assumed to be the only effluent discharged from the diffuser. The dilution and salinity levels for these scenarios are summarized in **Table C7**. **Figure C6** and **Figure C7** graphically present the effluent salinity (in ppt above ambient salinity) calculated using the semi-empirical method and the Visual Plumes method, respectively, at the impact point as a function of desalination brine discharge flow rates.

Results of the semi-empirical method showed that salinity values within the plume at the impact point were predicted to increase (i.e., dilution decreased) for desalination brine discharge rates up to 8 mgd in January and September and 10 mgd in July; salinity values then decreased (dilution increased) for higher discharge rates. The highest effluent salinity at the impact point was 1.6 ppt above ambient salinity.

The highest effluent salinity calculated by the Visual Plumes method was 1.0 ppt above ambient salinity. Results of the Visual Plumes method also showed that salinity at the impact point was predicted to increase (i.e., simulated dilution decreased) for desalination brine discharge rates up to 10 mgd for January and 8 mgd for July and September. Dilution and impact point salinity values remained nearly constant for higher discharge rates. It should be noted that although effluent dilution ratio remained almost unchanged, more ambient seawater was entrained into the plume for scenarios with higher discharge rates. The increase in entrained seawater was approximately proportional to the increase in discharge rate, so the dilution ratio remained almost unchanged. The 65 mgd discharge rate, the highest discharge rate analyzed, translates to a single port flow of about 0.84 cfs. Assuming it takes 10 seconds for the effluent to reach the impact point, the volume of the brine is about 8.4 ft^3. Port spacing on one side of the diffuser is 16 ft (ports are 8 ft apart on alternating sides of the diffuser), ports are about 3.5 ft above seafloor, and the impact point is about 10 ft away from the ports. This gives a seawater volume of about 560 ft^3 around one port, which is about 67 times the brine volume. Therefore even for the highest analyzed discharge rate, there is enough seawater to dilute the brine. It should be pointed out that despite remaining nearly unchanged for discharge rates in the range of 10 to 65 mgd, the dilution ratio may change for discharge rates higher than 65 mgd. For brine discharge rates much higher than 65 mgd, effluent plumes from neighboring ports may merge and there might not be enough seawater to dilute the effluent, and as a result, the effluent dilution ratio will be lower and salinity values will be higher.

Table C7 – Analysis results for various desalination brine-only discharge rates.

Flow	Semi-empirical method						VP method					
mgd	Jan.		July		Sept.		Jan.		July		Sept.	
	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)
0.5	19	1.3	19	1.3	19	1.3	48	0.5	49	0.5	48	0.5
1	17	1.4	17	1.5	17	1.4	39	0.6	39	0.6	39	0.6
2	16	1.5	16	1.6	16	1.5	33	0.7	33	0.7	33	0.7
3	15	1.6	15	1.6	15	1.6	30	0.8	30	0.8	30	0.8
4	15	1.6	15	1.6	15	1.6	28	0.8	28	0.9	28	0.9
6	15	1.6	15	1.6	15	1.6	26	0.9	26	0.9	26	0.9
8	15	1.6	15	1.6	15	1.6	26	0.9	25	1.0	25	0.9
10	16	1.5	15	1.6	16	1.6	25	0.9	25	1.0	25	1.0
12	16	1.5	16	1.5	16	1.5	25	0.9	25	1.0	25	1.0
14	16	1.5	16	1.5	16	1.5	25	0.9	25	1.0	25	1.0
16	17	1.4	16	1.5	17	1.5	25	1.0	25	1.0	25	1.0
18	17	1.4	17	1.4	17	1.4	25	0.9	25	1.0	25	1.0
20	17	1.4	17	1.4	17	1.4	25	1.0	25	1.0	25	1.0
22	18	1.4	17	1.4	17	1.4	25	1.0	25	1.0	25	1.0
24	18	1.3	18	1.4	18	1.4	25	0.9	25	1.0	25	1.0
26	18	1.3	18	1.4	18	1.3	25	1.0	25	1.0	25	1.0
28	18	1.3	18	1.3	18	1.3	25	0.9	25	1.0	25	1.0
30	18	1.3	18	1.3	18	1.3	25	1.0	25	1.0	25	1.0
32	19	1.3	19	1.3	19	1.3	25	0.9	25	1.0	25	1.0
34	19	1.3	19	1.3	19	1.3	25	1.0	25	1.0	25	1.0
36	19	1.2	19	1.3	19	1.3	25	1.0	25	1.0	25	1.0
38	19	1.2	19	1.3	19	1.3	25	1.0	25	1.0	25	1.0
40	20	1.2	19	1.3	19	1.2	25	1.0	25	1.0	25	1.0
45	20	1.2	20	1.2	20	1.2	25	0.9	25	1.0	25	1.0
50	20	1.2	20	1.2	20	1.2	25	0.9	25	1.0	25	1.0
55	21	1.1	21	1.2	21	1.2	25	0.9	25	1.0	25	1.0
60	21	1.1	21	1.2	21	1.1	25	0.9	25	1.0	25	1.0
65	22	1.1	22	1.1	22	1.1	25	0.9	25	1.0	25	1.0

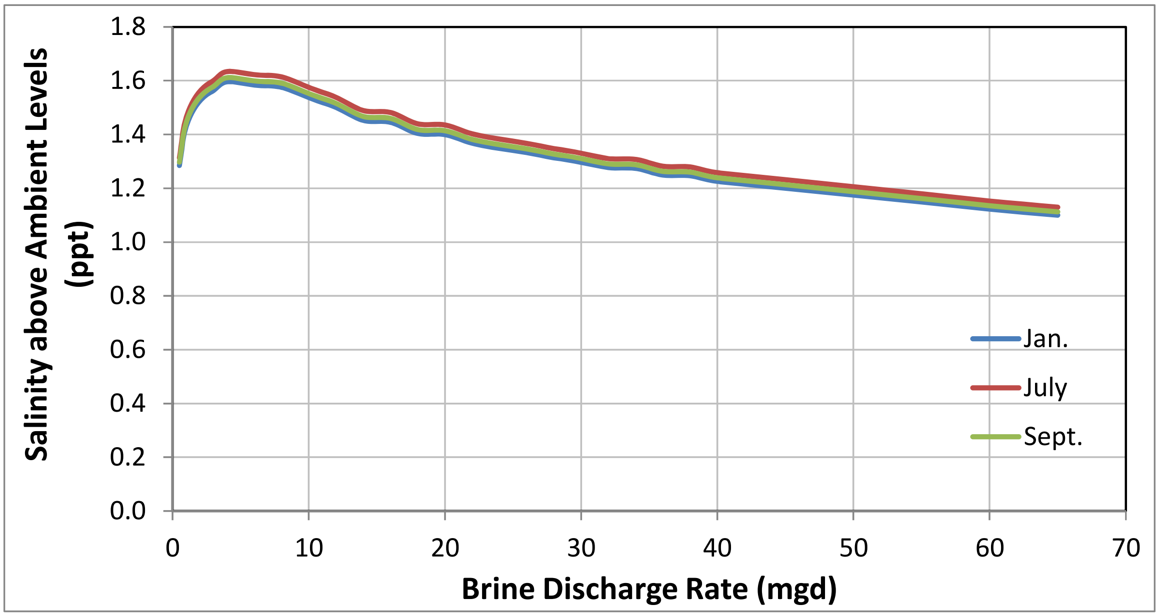

Figure C6. Simulated seafloor salinity (ppt above ambient salinity) for desalination brine calculated using the semi-empirical method.

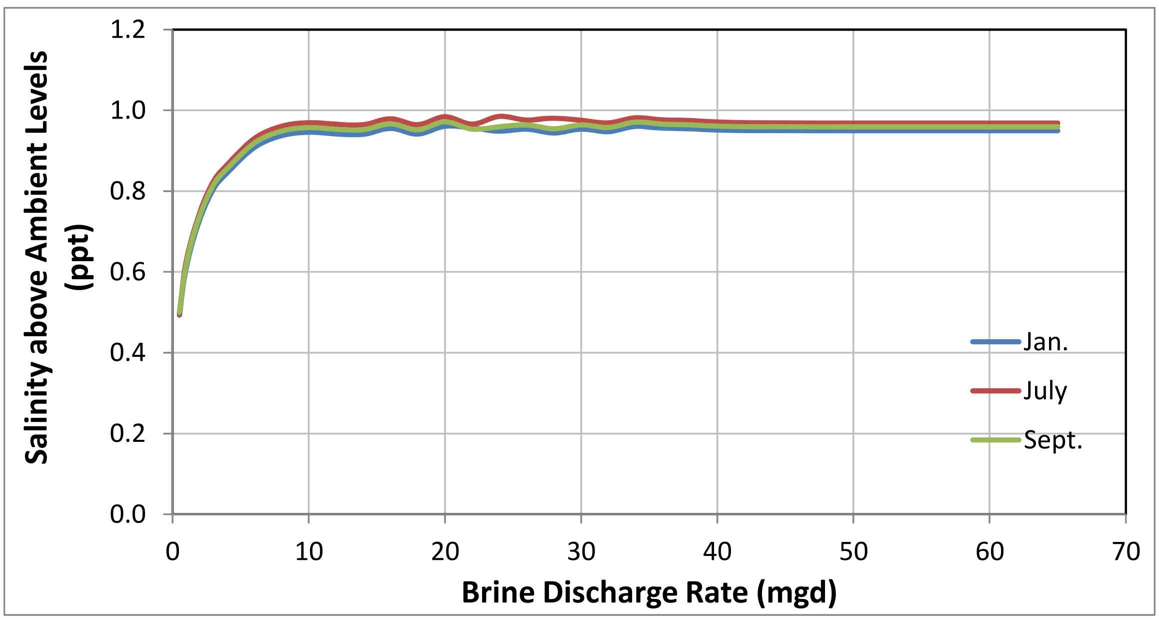

Figure C7. Simulated seafloor salinity (ppt above ambient salinity) for desalination brine calculated using the Visual Plumes method.

Impact of Seawater Pre-dilution on Effluent Dilution and Salinity

To reduce effluent salinity, seawater could be used to pre-dilute the desalination brine before discharging to the outfall pipeline. The impact of seawater pre-dilution on effluent dilution and salinity was evaluated for a series of discharge scenarios using both the Visual Plumes method and the semi-empirical method. In these scenarios, the flow rate of pre-dilution seawater was varied; the discharge rate of desalination brine was fixed at 13.98 mgd. The temperature and salinity of the desalination brine and seawater are summarized in **Table C3**, and temperature and salinity of the pre-diluted discharge was calculated as flow-weighted averages of the desalination brine and seawater. The effluent dilution and seafloor salinity for the pre-dilution scenarios are presented in **Table C8**. **Figure C8** and **Figure C9** show the salinity exceedence for the pre-dilution scenarios calculated using the semi-empirical method and the Visual Plumes method, respectively.

Results from both methods showed that the maximum seafloor salinity was simulated to decrease as the amount of seawater used to pre-dilute the desalination brine increased. Results of the semi-empirical method indicated that the highest effluent salinity at seafloor was 1.4 ppt above ambient salinity. Results from the Visual Plumes method showed that effluent salinity at seafloor was less than 0.9 ppt above ambient salinity.

Table C8 – Analysis results for seawater pre-dilution.

Flow		Semi-empirical method						VP method					
Mgd		Jan.		July		Sept.		Jan.		July		Sept.	
Sea-water	Sea-water + brine	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)
0.5	14.48	17	1.4	17	1.4	17	1.4	25	0.9	26	0.9	25	0.9
1	14.98	17	1.3	17	1.4	17	1.3	26	0.9	26	0.9	26	0.9
2	15.98	17	1.2	17	1.2	17	1.2	26	0.8	26	0.8	26	0.8
3	16.98	18	1.1	18	1.1	18	1.1	26	0.8	26	0.8	26	0.8
4	17.98	18	1.0	18	1.0	18	1.0	26	0.7	26	0.7	26	0.7
5	18.98	19	0.9	19	1.0	19	0.9	27	0.7	27	0.7	27	0.7
6	19.98	19	0.9	19	0.9	19	0.9	27	0.6	26	0.6	26	0.6
8	21.98	20	0.8	20	0.8	20	0.8	27	0.6	27	0.6	27	0.6
10	23.98	21	0.7	21	0.7	21	0.7	27	0.5	27	0.5	27	0.5
12	25.98	22	0.6	22	0.6	22	0.6	28	0.5	28	0.5	28	0.5
14	27.98	23	0.5	23	0.5	23	0.5	28	0.4	28	0.4	28	0.4
16	29.98	24	0.5	23	0.5	23	0.5	28	0.4	28	0.4	28	0.4
18	31.98	24	0.4	24	0.4	24	0.4	29	0.4	29	0.4	29	0.4

Flow		Semi-empirical method						VP method					
Mgd		Jan.		July		Sept.		Jan.		July		Sept.	
Sea-water	Sea-water + brine	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)
20	33.98	25	0.4	25	0.4	25	0.4	29	0.3	29	0.4	29	0.3
22	35.98	26	0.4	26	0.4	26	0.4	29	0.3	29	0.3	29	0.3
24	37.98	26	0.3	26	0.3	26	0.3	29	0.3	29	0.3	29	0.3
26	39.98	27	0.3	27	0.3	27	0.3	29	0.3	29	0.3	29	0.3
28	41.98	28	0.3	28	0.3	28	0.3	29	0.3	29	0.3	29	0.3
30	43.98	29	0.3	28	0.3	29	0.3	29	0.3	29	0.3	29	0.3
35	48.98	30	0.2	30	0.2	30	0.2	30	0.2	30	0.2	30	0.2
40	53.98	32	0.2	32	0.2	32	0.2	30	0.2	30	0.2	30	0.2

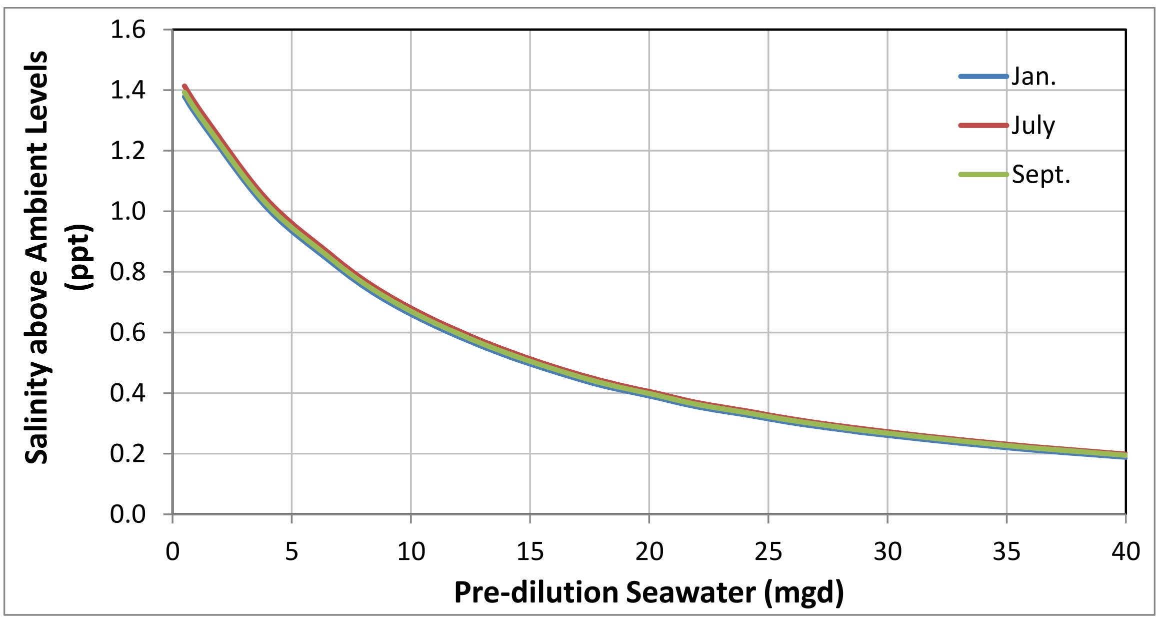

Figure C8. Simulated seafloor salinity (ppt above ambient salinity) for desalination brine (13.98 mgd) as a function of the flow rate of pre-dilution seawater; results calculated using the semi-empirical method.

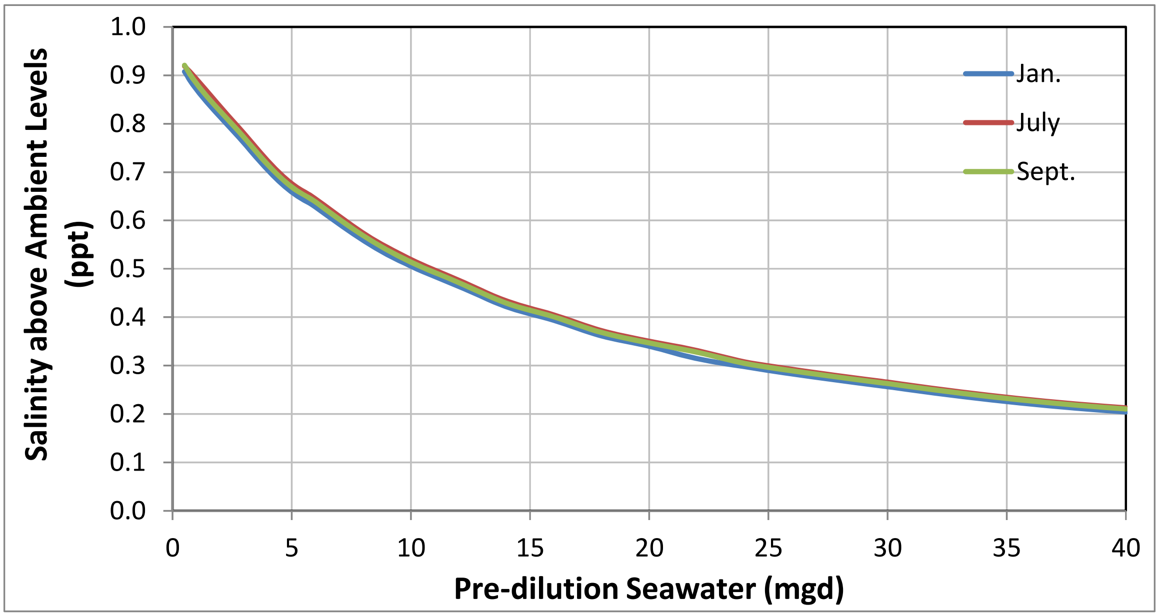

Figure C9. Simulated seafloor salinity (ppt above ambient salinity) for desalination brine (13.84 mgd) as a function of the flow rate of pre-dilution seawater; results calculated using the Visual Plumes method.

Impact of Treated Wastewater Pre-dilution on Effluent Dilution and Salinity

Instead of seawater, treated wastewater could also be used to pre-dilute the desalination brine before discharging to the outfall pipeline. The impact of treated wastewater pre-dilution on effluent dilution and salinity was evaluated for a number of discharge scenarios using both the Visual Plumes method and the semi-empirical method. In these scenarios, the flow rate of pre-dilution wastewater was varied; the discharge rate of desalination brine was fixed at 13.98 mgd. The temperature and salinity of the desalination brine and wastewater are summarized in **Table C3**, and temperature and salinity of the pre-diluted discharge was calculated as flow-weighted averages of the desalination brine and wastewater. The effluent dilution and seafloor salinity for the pre-dilution scenarios are presented in **Table C9**.

Results from both methods showed that the maximum seafloor salinity was simulated to decrease as the amount of treated wastewater used to pre-dilute the desalination brine increased. Results of both the semi-empirical method and the Visual Plumes method indicated that effluent salinity at seafloor was less than 2 ppt above ambient salinity for all three seasonal conditions.

Table C9 – Analysis results for treated wastewater pre-dilution.

Flow		Semi-empirical method						VP method					
mgd		Jan.		July		Sept.		Jan.		July		Sept.	
Waste water	Waste water + brine	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilutio n	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)	Dilution	Salinity increase above ambient (ppt)
0.25	14.23	17	1.4	17	1.4	17	1.4	26	0.9	26	0.9	26	0.9
0.5	14.48	17	1.3	17	1.3	17	1.3	26	0.9	26	0.9	26	0.9
1	14.98	18	1.2	17	1.2	18	1.2	26	0.8	26	0.8	26	0.8
2	15.98	19	0.9	19	0.9	19	0.9	27	0.6	27	0.6	27	0.6

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APPENDIX D3
Ocean Plan Compliance Assessment

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Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

Technical Memorandum

September 2017

Prepared for:

MRWPCA

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Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

Technical Memorandum

Pure Water Monterey
A Groundwater Replenishment Project

September 2017

Prepared By:

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Table of Contents

1 Executive Summary

In response to State Water Resources Control Board (SWRCB) Water Rights Orders WR 95-10, WR 2009-0060, and WR 2016-0016, two proposed projects are in development on the Monterey Peninsula to provide potable water to offset pending reductions of Carmel River water diversions: (1) a seawater desalination project known as the **Monterey Peninsula Water Supply Project** (MPWSP), and (2) a groundwater replenishment project known as the **Pure Water Monterey Groundwater Replenishment Project** (GWR Project). The capacity of the MPWSP is dependent on the construction of the GWR Project.

If the GWR Project is not constructed, the MPWSP would entail California American Water ("CalAm") building a seawater desalination facility capable of producing 9.6 million gallons per day (mgd) of drinking water. In the variation of the MPWSP where the GWR Project is constructed, known as the **Monterey Peninsula Water Supply Project Variant** ("Variant"), CalAm would build a smaller desalination facility capable of producing 6.4 mgd of drinking water, and a partnership between the Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) would build an advanced water treatment facility ("AWPF") as part of the GWR Project. This AWPF would be able to produce up to 4,300 acre-feet per year (AFY) (annual average of 3.8 mgd)[1] of highly purified recycled water to enable CalAm to extract 3,500 AFY (annual average of 3.1 mgd) from the Seaside Groundwater Basin for delivery to its customers.

Both the proposed desalination facility and the AWPF would employ reverse osmosis (RO) membranes to purify the waters, and as a result, both projects would produce RO concentrate waste streams that would be disposed through MRWPCA's existing ocean outfall: the brine concentrate from the desalination facility ("Desal Brine"), and the RO concentrate from the AWPF ("GWR Concentrate"). The goal of this technical memorandum (TM) is to analyze whether the discharges from the proposed projects through the existing ocean outfall would comply with the water quality objectives in the SWRCB 2015 Ocean Plan ("Ocean Plan") (SWRCB, 2015a).

The Ocean Plan sets forth numeric and narrative water quality objectives for the ocean with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting. The Regional Water Quality Control Boards utilize these objectives to develop water quality-based effluent limitations for ocean dischargers that have a reasonable potential to exceed the water quality objectives.

When municipal wastewater flows are released from an outfall (typically using specially designed diffusers), the wastewater and ocean water undergo rapid mixing due to the momentum

[1] The AWPF would be capable of producing up to 5 mgd of highly purified recycled water on a daily basis, but production would fluctuate throughout the year, such that the average annual production would be 3.8 mgd (4,300 AFY) in a non-drought year, when adding to the drought reserve.

and buoyancy of the discharge.[2] The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). For rising plumes, the Ocean Plan defines the initial dilution as complete when "the diluting wastewater ceases to rise in the water column and first begins to spread horizontally," (*i.e.*, when the momentum from the discharge has dissipated). For more saline discharges, a sinking plume forms when the discharge is denser than the ambient water (also known as a negatively buoyant plume). In the case of negatively buoyant plumes, the Ocean Plan defines the initial dilution as complete when "the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution."

The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge. The initial dilution occurs in an area known as the zone of initial dilution (ZID). The extent of dilution in the ZID is quantified and referred to as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive effluent limitations in the National Pollutant Discharge Elimination System (NPDES) permit that are applied to a wastewater discharge prior to ocean dilution.

The purpose of this analysis was to assess the ability of the MPWSP and Variant to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the secondary effluent, GWR Concentrate, Desal Brine and hauled waste for these projects. Dr. Philip Roberts, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, conducted modeling of the ocean discharge and estimated D_m values for scenarios involving different flow rates of the proposed projects and different ambient ocean conditions. These ocean modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan.

The estimates of minimum probable dilution (D_m) developed by Dr. Roberts for the MPWSP range from 14.4 to 98, and from 14.4 to 114 for the Variant. These D_m values are substantially lower than what is currently specified in the MRWPCA NPDES permit (145) and those estimated for the GWR Project, which range from 174 to 498 (see Appendix B). As a result of the reduced dilution, some contaminants, which have not traditionally been of concern for discharge through MRWPCA's ocean outfall, are estimated to potentially exceed the Ocean Plan objectives at the edge of the ZID. A summary of the constituents that show potential to exceed the Ocean Plan objectives is provided in Table ES-1 for the MPWSP, and Table ES-2 for the Variant. These constituents can be divided into three categories:

- **Category I -** Insufficient analytical sensitivity to determine compliance: The constituent was not detected above the method reporting limit (MRL) in any of the source waters, but the MRL is not sensitive enough to demonstrate compliance with the Ocean Plan objective.

[2] Municipal wastewater effluent, being low in salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water. GWR Concentrate, whether by itself or mixed with municipal wastewater effluent, is less dense than seawater and also rises (due to buoyancy) while it mixes with ocean water. Desal Brine, depending on the ratio of dilution with GWR Concentrate and municipal wastewater effluent, may be more or less dense than seawater.

- **Category II -** Estimated to be close to exceeding the Ocean Plan objective: The constituent is estimated to be at a concentration between 80% and 100% of the Ocean Plan objective at the edge of the ZID.
- **Category III -** Estimated to exceed the Ocean Plan objective: The constituent is estimated to be at a concentration higher than the Ocean Plan objective at the edge of the ZID.

Table ES-1: Summary of Compliance Conclusions for the MPWSP

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario[f]	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	4	140%
Ammonia			✓	5	102%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]	✓			--	--
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
TCDD Equivalents [e]	✓			--	--
2,4,6-Trichlorophenol	✓			--	--

Notes:
a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.
b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios
c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID
d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification
e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective
f: Flow scenarios are defined in Table 2 and Table 3

Table ES-2: Summary of Compliance Conclusions for the Variant

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario[f]	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	31	189%
Ammonia			✓	30	266%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]		✓		30	94%
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
Bis(2-ethyl-hexyl)phthalate		✓		30	84%
Chlordane			✓	30	199%
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
PCBs			✓	30	169%
TCDD Equivalents [e]			✓	30	131%
Toxaphene			✓	30	126%
2,4,6-Trichlorophenol	✓			--	--

Notes:
a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.
b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios
c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID
d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification
e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective
f: Flow scenarios are defined in Table 2 and Table 3

Based on the data, assumptions, modeling, and analytical methodology presented in this TM, the MPWSP and Variant show a potential to exceed certain Ocean Plan objectives under specific discharge scenarios (see Tables ES-1 and ES-2). In particular, potential issues were identified for the MPWSP and Variant discharge scenarios involving low to moderate secondary effluent flows with Desal Brine: discharges are estimated to exceed or come close to exceeding multiple Ocean Plan objectives, specifically those for cyanide and ammonia for the MPWSP, and cyanide, ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene for the Variant. Ammonia clearly exceeds the Ocean Plan objective and must be resolved for the MPWSP and Variant. When considering a best-case analysis for the Variant, acrylonitrile is estimated to come close to exceeding the Ocean Plan objective, and TCDD equivalents show a potential to exceed the objective. Additional analytical investigation regarding cyanide analysis is recommended to determine if the potential exceedances are representative of actual water quality conditions. Chlordane, PCBs and toxaphene, which were estimated to exceed the objectives for the Variant flow scenarios, were detected at concentrations that are orders of magnitude below detection limits of methods currently used for discharge compliance.

2 Introduction

In response to State Water Resources Control Board (SWRCB) Water Rights Orders WR 95-10, WR 2009-0060, and WR 2016-0016, two proposed projects are in development on the Monterey Peninsula to provide potable water to offset pending reductions of Carmel River water diversions: (1) a seawater desalination project known as the **Monterey Peninsula Water Supply Project** (MPWSP), and (2) a groundwater replenishment project known as the **Pure Water Monterey Groundwater Replenishment Project** (GWR Project). The capacity of the MPWSP is dependent on the construction of the GWR Project.[3]

If the GWR Project is constructed, the MPWSP would entail California American Water ("CalAm") building a seawater desalination facility capable of producing 9.6 million gallons per day (mgd) of drinking water. In the variation of the MPWSP where the GWR Project is constructed, known as the **Monterey Peninsula Water Supply Project Variant** ("Variant"), CalAm would build a smaller desalination facility capable of producing 6.4 mgd of drinking water, and a partnership between the Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) would build an advanced water treatment facility ("AWPF") as part of the GWR Project. This AWPF would be able to produce up to 4,300 acre-feet per year (AFY) (annual average of 3.8 mgd)[4] of highly purified recycled water to enable CalAm to extract 3,500 AFY (annual average of 3.1 mgd) from the Seaside Groundwater Basin for delivery to its customers.

The GWR Project involves treating secondary-treated wastewater (*i.e.*, secondary effluent) from MRWPCA's Regional Treatment Plant (RTP) through the proposed Advanced Water Purification Facility (AWPF) and then injecting up to 3,700 AFY of this highly purified recycled water into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply, and providing up to 600 AFY to Marina Coast Water District for urban landscape irrigation. The GWR Project will also provide additional tertiary recycled water for agricultural irrigation in the northern Salinas Valley as part of the Castroville Seawater Intrusion Project (CSIP). Both the proposed desalination facility and the AWPF would employ reverse osmosis (RO) membranes to purify the waters, and as a result, both projects would produce RO concentrate waste streams that would be disposed through MRWPCA's existing ocean outfall:

[3] Construction of the GWR Project is expected to begin in September 2018.

[4] The AWPF would be capable of producing up to 5 mgd of highly purified recycled water on a daily basis, but production would fluctuate throughout the year, such that the average annual production would be 3.8 mgd (4,300 AFY) in a non-drought year, when adding to the drought reserve.

the brine concentrate from the desalination facility ("Desal Brine"), and the RO concentrate from the AWPF ("GWR Concentrate").

The goal of this TM is to analyze whether the discharges from the proposed projects through the existing ocean outfall would comply with the numeric water quality objectives in the SWRCB 2015 Ocean Plan ("Ocean Plan") (SWRCB, 2015). A similar assessment of the GWR Project on its own was previously performed (Trussell Tech, 2017, see Appendix B), and so this document provides complementary information focused on the MPWSP and Variant projects.

The original version of this document (Trussell Tech, 2015a) and an addendum report to that document (Trussell Tech, 2015b) were included in both the GWR Project Consolidated Final Environmental Impact Report (CFEIR) and the MPWSP draft Environmental Impact Report (EIR). A second version of this document was updated to include new water quality data and flow scenarios for the MPWSP and Variant to address data gaps noted in the original analyses, and was included in the 2017 MPWSP draft EIR (Trussell Tech, 2016, see Appendix C). The following TM incorporates updates to the 2016 version, including additional water quality data and flow scenarios, and these revisions are discussed in more detail in the following sections.

2.1 Treatment through the Proposed CalAm Desalination Facility

This section describes the proposed treatment train for the MPWSP and Variant desalination facility. Seawater from the Monterey Bay would be extracted through subsurface slant wells beneath the ocean floor and piped to a new CalAm-owned desalination facility. This facility would consist of granular media pressure filters, cartridge filters, a two-pass RO membrane system, RO product-water stabilization (for corrosion control), and disinfection – (Figure 1). The RO process is expected to recover 42 percent of the influent seawater flow as product water, while the remainder of the concentrated influent water becomes the Desal Brine. The MPWSP and Variant product water (desalinated water) would be used for municipal drinking water, while the Desal Brine would be blended with (1) available RTP secondary effluent, (2) brine that is trucked and stored at the RTP, and (3) GWR Concentrate (for the Variant only), and discharged to the ocean through the existing MRWPCA ocean outfall. The volume of Desal Brine is dependent on the project size: 13.98 and 8.99 mgd for the MPWSP and Variant, respectively.

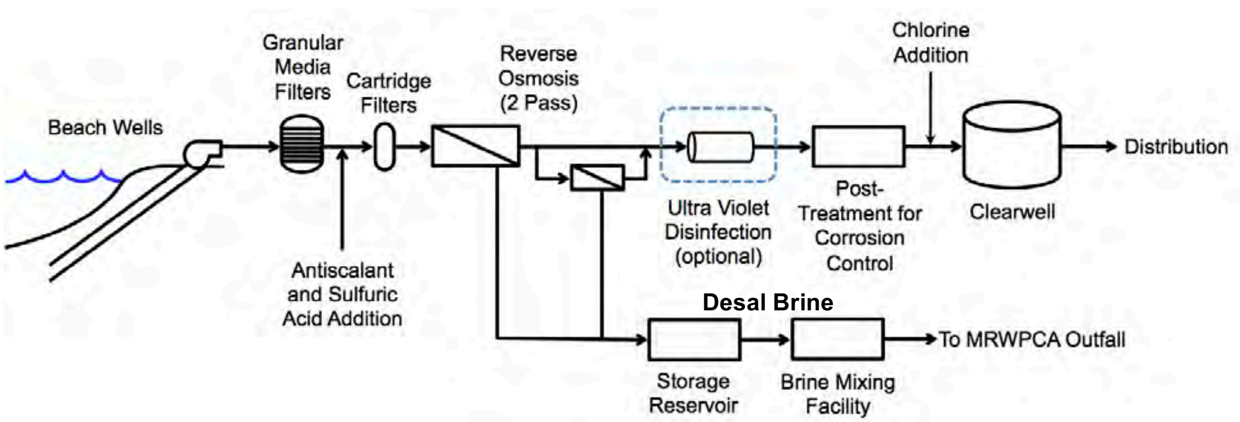

Figure 1 – Schematic of CalAm desalination facilities

2.2 Treatment through the RTP and Proposed AWT Facilities

The existing MRWPCA RTP treatment process includes screening, primary sedimentation, secondary biological treatment through trickling filters, followed by a solids contactor (*i.e.*, bio-flocculation), and clarification (Figure 2). Much of the secondary effluent undergoes tertiary treatment (coagulation, flocculation, granular media filtration, and disinfection) to produce recycled water used for agricultural irrigation. The unused secondary effluent is discharged to the Monterey Bay through the MRWPCA outfall. MRWPCA also accepts trucked brine waste for ocean disposal ("hauled waste"), which is stored in a pond and mixed with secondary effluent prior to being discharged.

The AWPF will include several advanced treatment technologies for purifying the secondary effluent: ozone (O_3), membrane filtration (MF), reverse osmosis (RO), an advanced oxidation process (AOP) using ultraviolet light (UV) and hydrogen peroxide, and finished water stabilization. The Project Partners conducted a pilot-scale study of the planned AWPF ozone, MF, and RO processes from December 2013 through July 2014, successfully demonstrating the ability of the various treatment processes to produce highly-purified recycled water that complies with the California Water Recycling Criteria for Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application (Groundwater Replenishment Regulations) (SWRCB, 2015b) and Central Coast Water Quality Control Plan (Basin Plan) standards, objectives and guidelines for groundwater (CCRWQCB, 2011). After the pilot-scale study, an advanced water purification demonstration facility was built to gain additional experience operating ozone, MF, and RO processes. The new facility also included a UV/hydrogen peroxide AOP and stabilization treatment. The demonstration facility is operated and maintained by MRWPCA.

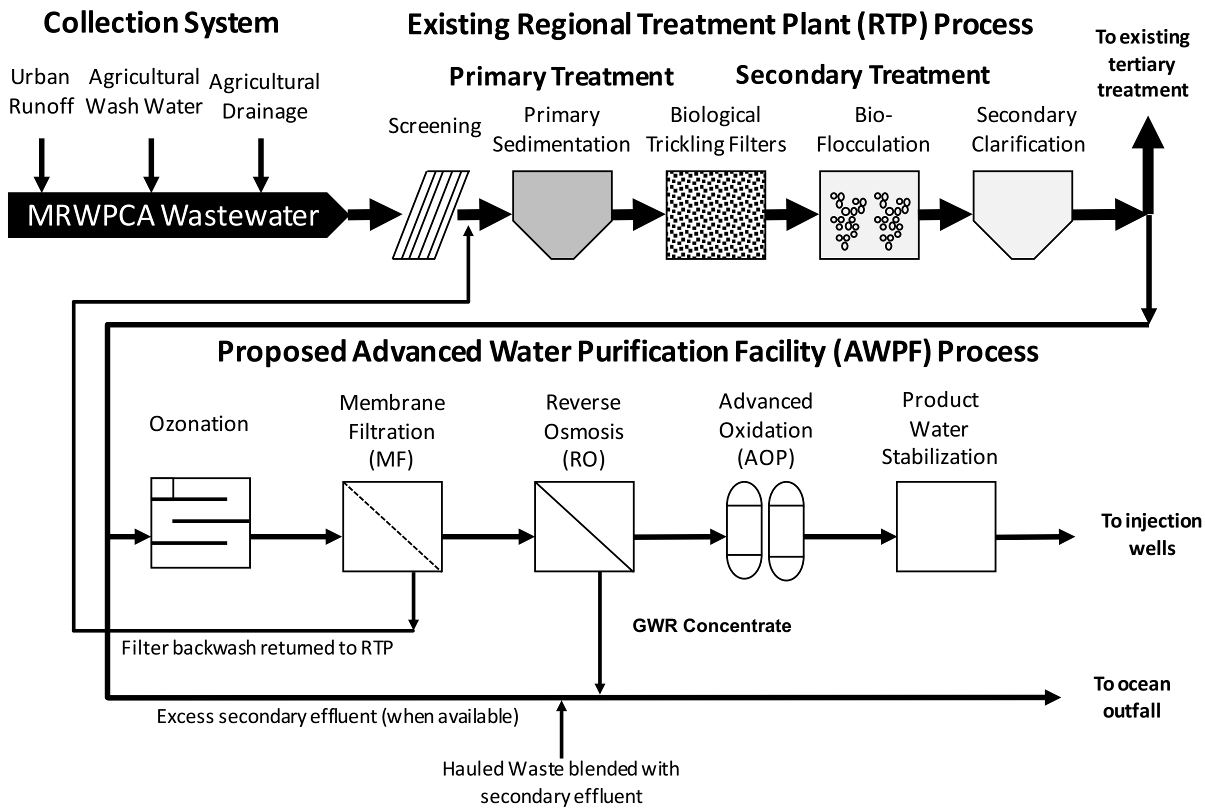

Figure 2 – Schematic of existing MRWPCA RTP and proposed AWPF treatment

2.3 California Ocean Plan

The Ocean Plan sets forth numeric and narrative water quality objectives for the ocean waters with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting (SWRCB, 2015a). The Regional Water Quality Control Boards utilize these objectives to develop water quality-based effluent limitations for ocean dischargers that have a reasonable potential to exceed the water quality objectives.

When municipal wastewater flows are released from an outfall (typically using specially designed diffusers), the wastewater and ocean water undergo rapid mixing due to the momentum and buoyancy of the discharge.[5] The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). For rising plumes, the Ocean Plan defines the initial dilution as complete when "the diluting wastewater ceases to rise in the water column and first begins to spread horizontally," (*i.e.*, when the momentum from the discharge has dissipated). For more saline discharges, a sinking plume forms when the discharge is denser than the ambient water (also known as a negatively buoyant

[5] Municipal wastewater effluent, being low in salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water. GWR Concentrate, whether by itself or mixed with municipal wastewater effluent, is less dense than seawater and also rises (due to buoyancy) while it mixes with ocean water. Desal Brine, depending on the ratio of dilution with GWR Concentrate and municipal wastewater effluent, may be more or less dense than seawater.

plume). In the case of negatively buoyant plumes, the Ocean Plan defines the initial dilution as complete when "the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution."

The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge. The initial dilution occurs in an area known as the zone of initial dilution (ZID). The extent of dilution in the ZID is quantified and referred to as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive National Pollutant Discharge Elimination System (NPDES) permit limits that are applied to a wastewater discharge prior to ocean dilution.

The current MRWPCA wastewater discharge is governed by NPDES Permit No. CA0048551 (currently implemented as Order No. R3-2014-0013) issued by the Central Coast Regional Water Quality Control Board ("RWQCB") (CCRWQCB, 2014). Because the existing NPDES permit for the MRWPCA ocean outfall must be amended to discharge Desal Brine, comparing future discharge concentrations to the current NPDES permit limits (that will likely change when the permit is amended) would not be an appropriate metric or threshold for determining whether the proposed projects would have a significant impact on marine water quality. Instead, compliance with the Ocean Plan objectives was selected as an appropriate threshold for determining whether the proposed projects would result in a significant impact requiring mitigation.

Dr. Philip Roberts, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, conducted dilution modeling of the ocean discharge and estimated D_m values for scenarios involving different flow rates of the proposed projects and different ambient ocean conditions. These ocean modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan. Dr. Roberts' report is included as Appendix D.

2.4 Future Ocean Discharges

A summary schematic of the MPWSP and Variant is presented in Figure 3. For the MPWSP, 23.58 mgd of ocean water (design capacity) would be treated in the desalination facility; an RO recovery of 42% would lead to an MPWSP Desal Brine flow of 13.98 mgd that would be discharged through the outfall. Following periods of plant shutdown, the facility may produce 16.31 mgd of Desal Brine to temporarily boost plant production. Secondary effluent from the RTP would also be discharged through the outfall, although the flow would be variable depending on both the raw wastewater flow and the proportion being processed through the tertiary treatment system at the Salinas Valley Reclamation Plant (SVRP) to produce recycled water for agricultural irrigation. The third and final discharge component is hauled waste that is trucked to the RTP and blended with secondary effluent prior to discharge. The maximum anticipated flow of the hauled waste is 0.03 mgd, and is blended with secondary effluent for a total flow of 0.1 mgd. These three discharge components (Desal Brine, secondary effluent, and hauled waste) would be mixed at the proposed Brine Mixing Facility prior to ocean discharge.

For the Variant, 15.93 mgd of ocean water (design capacity) would be pumped to the desalination facility, and an RO recovery of 42% would result in a Variant Desal Brine flow of

8.99 mgd. Similar to the larger desalination facility, the plant may produce 11.24 mgd of Desal Brine for a short period of time to boost plant production. The Variant would include the GWR Project, which involves the addition of new source waters to the RTP that would alter the water quality of the secondary effluent produced by the RTP. The secondary effluent in the Variant is referred to as "Variant secondary effluent," and would be different in quality from the MPWSP secondary effluent. Under the GWR Project, a portion of the secondary effluent would be fed to the AWPF, and the resultant GWR Concentrate (maximum 1.17 mgd) would be discharged through the outfall. The hauled waste received at the RTP would continue to be mixed with secondary effluent prior to discharge, and so the quality of the blended brine and secondary effluent will change as a result of the change in secondary effluent quality. The hauled waste for the Variant is referred to as "Variant hauled waste." The discharge components for the MPWSP and Variant are summarized in Table 1.

Table 1 – Discharge waters Included in each analysis

Project	Desal Brine	Secondary Effluent	Variant Secondary Effluent	Hauled Waste	Variant Hauled Waste [a]	GWR Concentrate
MPWSP	✓ (13.98 mgd, 16.31 mgd periodically)	✓ (flow varies)		✓ (0.1 mgd)		
Variant	✓ (8.99 mgd, 11.24 mgd periodically)		✓ (flow varies)		✓ (0.1 mgd)	✓ (1.17 mgd)

[a] This is placed in a separate category because it contains Variant secondary effluent.

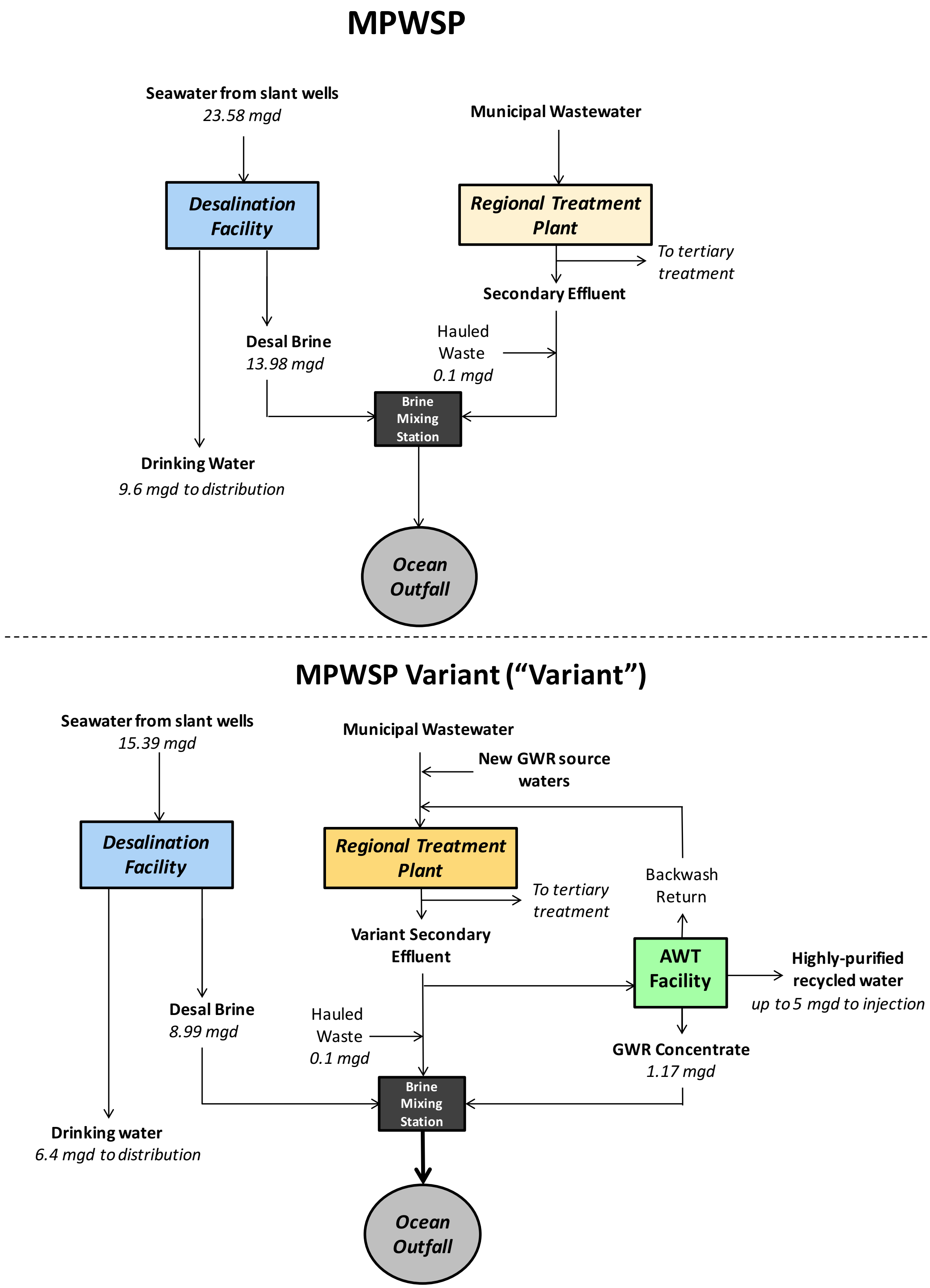

Figure 3 – Flow schematics for the MPWSP and Variant projects (specified flow rates are at design capacity)

2.5 Objective of Technical Memorandum

Trussell Technologies, Inc. ("Trussell Tech") estimated worst-case in-pipe water quality for the various ocean discharge scenarios (*i.e.*, prior to dilution through ocean mixing) for the proposed projects. Dr. Roberts' ocean discharge modeling and the results of the water quality analysis were then used to provide an assessment of whether the proposed projects would consistently meet Ocean Plan water quality objectives. The objective of this TM is to summarize the assumptions, methodology, results and conclusions of the Ocean Plan compliance assessment for the MPWSP and Variant.

3 Methodology for Ocean Plan Compliance Assessment

Water quality data from various sources for the different treatment process influent and waste streams were compiled. Trussell Tech combined these data for different flow scenarios and used ocean modeling results (*i.e.*, D_m values) to assess compliance of different discharge scenarios with the Ocean Plan objectives. This section documents the data sources and provides further detail on the methodology used to perform this analysis. A summary of the methodology is presented in Figure 4.

3.1 Methodology for Determination of Discharge Water Quality

The amounts and combinations of various wastewaters that would be disposed through the MRWPCA outfall will vary depending on the capacity, seasonal and daily flow characteristics, and extent and timing of implementation of the proposed projects.

Detailed discussions about the methods used to determine the discharge water qualities related to the GWR Project were previously discussed and can be found in Appendix B. This previous analysis included water quality estimates of the secondary effluent, Variant secondary effluent, hauled waste, Variant hauled waste, and the GWR Concentrate (*i.e.*, all of the discharges except for the Desal Brine). In the previous analysis, Trussell Tech assumed that the highest observed values for the various Ocean Plan constituents within each type of water flowing to and treated at the RTP, including the AWPF as applicable, to be the worst-case water quality.[6] These same data and assumptions were used in the analysis described in this memorandum. Use of these worst-case water quality concentrations ensures that the analysis in this memorandum is conservative related to the Ocean Plan compliance assessment (and thus, the impact analysis for the MPWSP environmental review processes).

To determine the impact of the MPWSP and Variant, the worst-case water quality of the Desal Brine was estimated using available data from CalAm's temporary test subsurface slant well on the CEMEX mine property in Marina, California. Long-term pumping and water quality sampling from this well began in April 2015.[7] As in the previous Ocean Plan compliance

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[6] Except for copper, where instead the median was calculated from the data for each new source water because the maximum values detected seemed to be outliers, and the Ocean Plan objective for copper considered in this assessment is the 6-month median concentration.

[7] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

assessments, the highest observed concentrations in the slant well were used for this Ocean Plan compliance assessment.[8]

The methodology for determining the water quality of the Desal Brine and secondary effluent is further described in this section (the methodology for all other discharge waters can be found in Appendix B). A summary of which discharge waters are considered for both the MPWSP and Variant, and which data sources were used in the determination of the water quality for each discharge stream is shown in Figure 4.

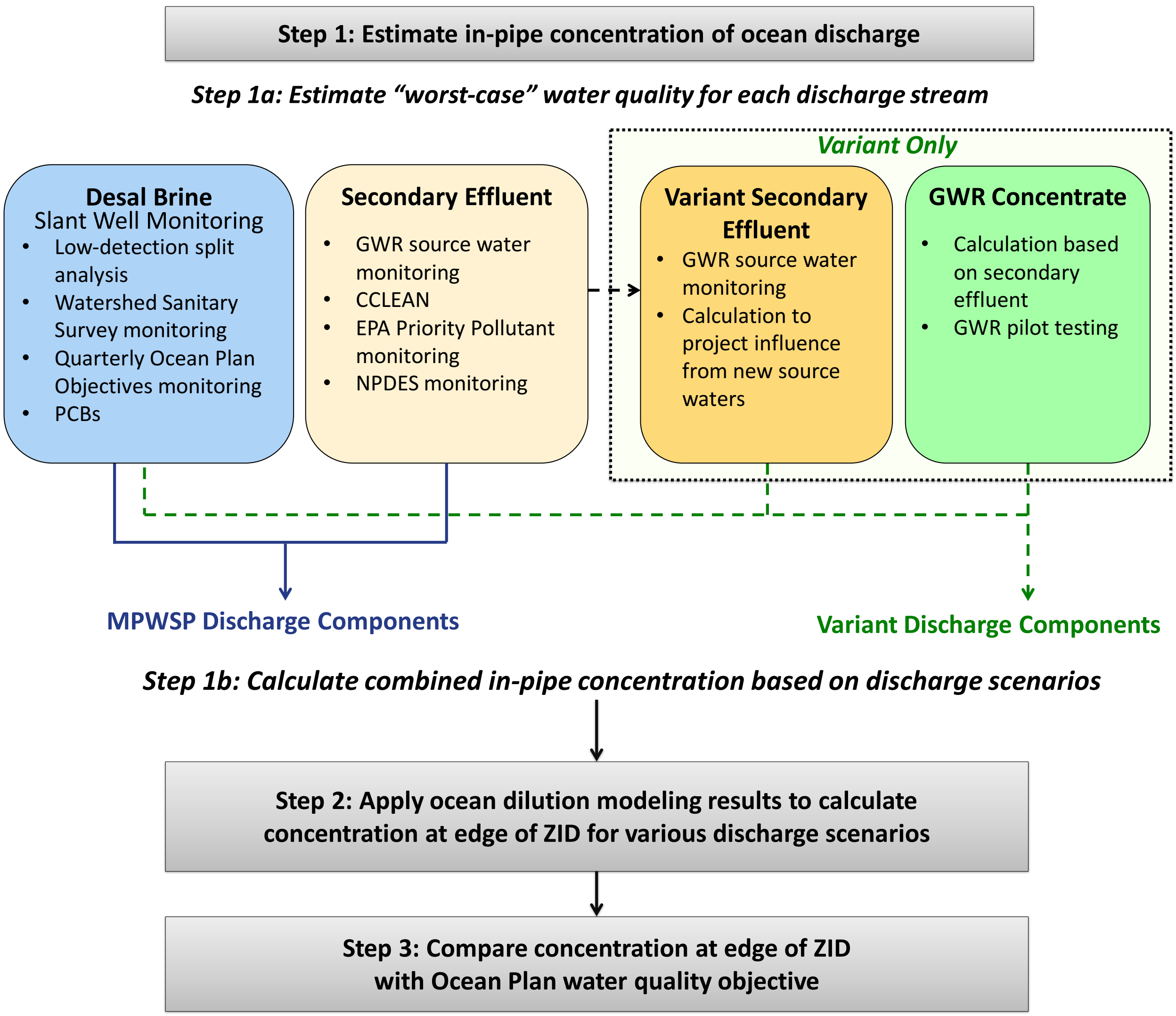

Figure 4 – Logic flow chart for determination of MPWSP and Variant compliance with Ocean Plan objectives.

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[8] Except for copper, where instead the median was calculated from data from the test slant well because the maximum values detected seemed to be outliers, and the Ocean Plan objective for copper considered in this assessment is the 6-month median concentration.

3.1.1 Secondary Effluent

For the MPWSP, the discharged secondary effluent would not be impacted by additional source waters that would be brought in for the Variant; therefore, the historical secondary effluent quality was used in the analysis. The following sources of data were considered for selecting a secondary effluent concentration for each constituent in the analysis:

- Secondary effluent water quality monitoring conducted for the GWR Project from July 2013 through June 2014.
- MRWPCA RTP historical NPDES compliance water quality data collected semi-annually by MRWPCA (2005- Spring 2017).
- Historical NPDES RTP Priority Pollutant data collected annually by MRWPCA (2004-2016).
- Water quality data collected semi-annually by the Central Coast Long-Term Environmental Assessment Network (CCLEAN) (2008-2016) (CCLEAN, 2014).

The secondary effluent concentration for each constituent selected for the analysis was the maximum reported value from the above sources. In some cases, constituents were not detected (ND); in these cases, the values are reported as ND (<MRL). In cases where the analysis of a constituent was detected but not quantified, the result is also reported as less than the Method Reporting Limit ND (<MRL).[9] Because the actual concentration could be any value equal to or less than the MRL, the conservative approach is to use the value of the MRL for the compliance analysis. For some ND constituents, the MRL exceeds the Ocean Plan objective, and thus no compliance determination can be made.[10] A detailed discussion of the cases where a constituent was reported as less than the MRL is included in the GWR Project TM in Appendix B (Trussell Technologies, 2017).

Cyanide has been detected in the RTP effluent at relatively high levels compared to the discharge requirements. The maximum detected value in the RTP effluent was 81 μg/L.

Several investigations have been conducted into the accuracy of sampling, preservation, and analytical methods for cyanide. These have shown that sample holding time and preservation have a significant impact on measured cyanide concentrations. Pandit et al. (2006) demonstrated that when sodium hydroxide was added to adjust the pH higher than 12, as specified in accepted methods for cyanide measurement in order to preserve the sample, the measured cyanide concentrations were consistently higher than those for samples preserved at pH 10 to 11. They also showed that cyanide levels increased within the recommended holding times of the approved cyanide methods (at pH 12).

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[9] The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (*i.e.*, the lower limit of quantitation). Therefore, acceptable quality control and quality assurance procedures are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the Method Detection Limit (or greater). The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. (40 Code of Federal Regulations Section136 Appendix B).

[10] This phenomenon is common in the implementation of the Ocean Plan where for some constituents, suitable analytical methods are not capable of measuring low enough to quantify the minimum toxicologically relevant concentrations. For these constituents, a discharge is considered compliant if the monitoring results are less than the MRL.

In addition, the 2015 California Ocean Plan specifies the following:

If a discharger can demonstrate to the satisfaction of the Regional Water Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by the approved method in 40 CFR PART 136, as revised May 14, 1999.

Based on the above information, it is recommended that additional cyanide sampling be conducted using different methods (*e.g.*, analysis within 15 minutes with no preservation) to determine if the laboratory method leads to inaccurately high cyanide values. It is also recommended to determine if a method can be performed that distinguishes between weakly and strongly complexed cyanide. Until this is completed, all cyanide concentrations presently available are used in this Ocean Plan compliance assessment.

3.1.2 Desalination Brine

Trussell Tech used the following four sources of data for the Desal Brine water quality assessment:

- A one-time 7-day composite sample from the test slant well with separate analysis of particulate and dissolved phase fractions of constituents using low-detection CCLEAN analysis techniques (February 18-25, 2016). The maximum total concentration was used in this analysis (*i.e.* the sum of the concentration in the particulate and dissolved phase fractions).[11] Of the constituents analyzed with this split phase method,[12] all were detected 100% in the dissolved phase, except PCBs, which were detected 99% in the dissolved phase.
- CalAm Watershed Sanitary Survey monitoring program monthly test slant well sampling water quality results (May 2015 – April 2017).[13]
- Quarterly sampling of the test slant well for constituents specified in the Ocean Plan (November 2015, February, June, and September 2016).
- Test slant well sampling by Geoscience Support Services, Inc. ("Geoscience") every other month for polychlorinated biphenyls (PCBs) (May 2015 – February 2016).[11]

The maximum value observed in any of the data sources was assumed to be the "worst-case" water quality for the raw seawater feeding the desalination facility. If a constituent was ND in all samples, and multiple analysis methods were used with varying MRL values, the highest MRL

[11] Only method detection limits were provided for these results. When a constituent was ND in this dataset, the method detection limit was used for analysis.
[12] Hexachlorobutadiene, hexachlorobenzene, HCH, heptachlor, aldrin, chlordane, DDT, heptachlor epoxide, dieldrin, Endrin, endosulfans, toxaphene, PCBs
[13] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

was assumed for compliance analysis; the exception to this statement is when data were available from the low detection limit 7-day composite sample. For these constituents,[14] the detected value from the low detection analysis was used, even if it was lower than the MRL provided by the standard analysis methods. If the sample results of a constituent reported the concentration as less than the MRL, the MRL was assumed for compliance analysis and the concentration is reported as ND (<MRL) in this TM. Equation 1 was used to calculate a conservative estimate of the Desal Brine concentration (C_{Brine}) for each constituent by using a concentration factor of 1.73, which was calculated assuming complete rejection of the constituent in the feed water (C_{Feed}) and a 42% recovery ($\%_R$) through the seawater RO membranes.

$$C_{Brine} = \frac{C_{Feed}}{1-\%_R} \qquad (1)$$

3.1.3 Combined Ocean Discharge Concentrations

Having estimated the worst-case concentrations for each of the discharge components, the combined concentration prior to discharge was determined as a flow-weighted average of the contributions of each of the discharge components appropriate for the MPWSP and Variant.

3.2 Ocean Modeling Methodology

In order to determine Ocean Plan compliance, Trussell Tech used the following information: (1) the in-pipe (*i.e.*, pre-ocean dilution) concentration of a constituent ($C_{in\text{-}pipe}$) that was developed as discussed in the previous section, (2) the minimum probable dilution for the ocean mixing (D_m) for the discharge flow scenarios that were modeled by Dr. Roberts[15] (Roberts, P. J. W, 2017), and (3) the background concentration of the constituent in the ocean ($C_{Background}$) that is specified in Table 3 of the Ocean Plan (SWRCB, 2015b). With this information, the concentration at the edge of the zone of initial dilution (C_{ZID}) was calculated using the following equation:

$$C_{ZID} = \frac{C_{In-pipe} + D_m * C_{Background}}{1 + D_m} \qquad (2)$$

The C_{ZID} was then compared to the Ocean Plan water quality objectives[16] in Table 1 of the Ocean Plan (SWRCB, 2015). In this table, there are three categories of objectives: (1)

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[14] Endrin, hexachlorocyclohexane, chlordane, DDT, dieldrin, heptachlor, heptachlor epoxide, hexachlorobutadiene, PCBs, toxaphene.

[15] The Ocean Plan defines dilution differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S - 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Ocean Plan Equation 1.

[16] Note that the Ocean Plan also defines effluent limitations for oil and grease, suspended solids, settleable solids, turbidity, and pH (see Ocean Plan Table 2). These parameters were not evaluated in this assessment. It is assumed that, if necessary, the pH of the water would be adjusted to be within acceptable limits prior to discharge. Oil and grease, suspended solids, settable solids, and turbidity in the GWR Concentrate and Desal Brine would be significantly lower than the secondary effluent. Prior to the AWPF RO treatment process, the process flow would be treated by MF, which will reduce these parameters, and the waste stream from the MF will be returned to RTP

Objectives for Protection of Marine Aquatic Life, (2) Objectives for Protection of Human Health – Non-Carcinogens, and (3) Objectives for Protection of Human Health – Carcinogens. There are also three objectives for each constituent included in the first category (for marine aquatic life): six-month median, daily maximum and instantaneous maximum concentration. For the other two categories, there is one objective: 30-day average concentration. When a constituent had three objectives, the lowest objective, the six-month median, was used to estimate compliance. This approach was taken because the discharge scenarios, discussed in further detail below, could be experienced for six months, and therefore the 6-month median objective would need to be met. For the ammonia objectives (specifically, the total ammonia concentration calculated as the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4), expressed in μg/L as N) the daily maximum and 6-month median objectives were evaluated.

For each discharge scenario, if the C_{ZID} was below the Ocean Plan objective, then it was assumed that the discharge would comply with the Ocean Plan. However, if the C_{ZID} exceeds the Ocean Plan objective, then it was concluded that the discharge scenario could violate the Ocean Plan objective. Note that this approach could not be applied for some constituents, *viz.*, acute toxicity, chronic toxicity, and radioactivity. Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the secondary effluent and GWR Concentrate, and these individual concentrations would comply with the Ocean Plan objectives. Toxicity testing on the seawater was not included in the analysis for this TM; it will be evaluated by another method not discussed in this TM.

Dr. Roberts performed modeling of various discharge scenarios for the MPWSP and Variant that include combinations of Desal Brine, secondary effluent, GWR Concentrate, and hauled waste (Roberts, P. J. W, 2017). Forty-seven scenarios resulting in the worst-case dilution conditions will be presented in this TM. These scenarios assume the maximum flow rates for the GWR Concentrate, Desal Brine and hauled waste, which is a conservative assumption in terms of constituent loading and minimum dilution. Additional flow scenarios were modeled by Dr. Roberts, and can be found in his report (Appendix D).

3.2.1 Ocean Modeling Scenarios

The modeled scenarios are summarized in Tables 2 and 3 for the MPWSP and the Variant, respectively. The Variant discharge scenarios that have no Desal Brine (*i.e.*, Scenarios 21 through 29) have already been analyzed and found to comply with the Ocean Plan (Trussell Tech 2017, see Appendix B); these scenarios are shown in Table 3 for completeness, but for simplicity, the analysis of these scenarios is not repeated in Section 4.

The MPWSP flow scenarios included in this analysis cover the range of potential future discharge compositions, with various secondary effluent flows and Desal Brine flows included. The amount of secondary effluent being discharged is dependent on the demand for recycled water (highest demand, and lowest secondary effluent discharge is experienced during the

headworks. Prior to the Desalination Facility RO treatment process, the process flow would be treated by granular media filters and cartridge filters, which reduce these parameters. The waste stream from the granular media filter would be further treated in gravity thickening basins prior to any discharge of the decant through the ocean outfall. The cartridge filters will be disposed off-site and the solids will not be returned to the process.

summer months), and whether the SVRP is operational. Modeling the minimum secondary effluent flows (*i.e.*, no secondary effluent discharged) provides conditions where the influence of Desal Brine on the ocean discharge water quality is maximized and the discharge plumes are negatively buoyant. The moderate secondary effluent flow scenarios create conditions where the Desal Brine and the secondary effluent have similar levels of influence on the water quality of the ocean discharge, as well as neutrally buoyant discharge plumes. The high secondary effluent flow scenarios provide analysis of the highest expected flows that may be discharged, where the discharge is buoyant.

Table 2 - Modeled flow scenarios for the MPWSP

Flow Scenario No.	Discharge Flows (mgd)		
	Secondary Effluent [a]	Desal Brine	Hauled Waste
MPWSP with Normal Desal Brine Flow			
1	0	13.98	0.1
2	2	13.98	0.1
3	4	13.98	0.1
4	6	13.98	0.1
5	9	13.98	0.1
6	10	13.98	0.1
7	19.78	13.98	0.1
MPWSP with High Desal Brine Flow			
8	0	16.31	0.1
9	2	16.31	0.1
10	7	16.31	0.1
11	8	16.31	0.1
12	10	16.31	0.1
13	12	16.31	0.1
14	16	16.31	0.1

[a] Note that RTP wastewater flows have been declining in recent years as a result of water conservation; while 19.78 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

Similar to the flow scenarios for the MPWSP, Variant flow scenarios were selected to cover the complete range of potential future discharge compositions. These scenarios encompass periods when the AWPF is offline, and/or the desalination plant is offline. They also cover short-term operations with higher Desal Brine discharges when the desalination plant is catching up on production after periods of being offline. All these potential operating conditions were considered with varying amounts of secondary effluent flow, as it is possible that any of these conditions may be experienced during future operations.

Table 3 – Modeled flow scenarios for the Variant

Flow Scenario No.	Discharge Flows (mgd)			
	Secondary Effluent [a]	Desal Brine	GWR Concentrate	Hauled Waste [b]
Variant with AWPF Offline				
15	0	8.99	0	0
16	2	8.99	0	0
17	4	8.99	0	0
18	5.8	8.99	0	0
19	14	8.99	0	0
20	19.78	8.99	0	0
Variant with Desalination Plant Offline				
21	0	0	1.17	0
22	0.4	0	1.17	0
23	0.8	0	1.17	0
24	3	0	1.17	0
25	5	0	1.17	0
26	7	0	1.17	0
27	9	0	1.17	0
28	21	0	1.17	0
29	23.4	0	1.17	0
Variant with Normal Flows				
30	0	8.99	1.17	0
31	2	8.99	1.17	0
32	4	8.99	1.17	0
33	6	8.99	1.17	0
34	11	8.99	1.17	0
35	15.92	8.99	1.17	0
Variant with High Desal Brine Flows and AWPF Offline				
36	0	11.24	0	0
37	3	11.24	0	0
38	5	11.24	0	0
39	9	11.24	0	0
40	12	11.24	0	0
41	16	11.24	0	0
Variant with High Desal Brine Flows				
42	0	11.24	1.17	0
43	1	11.24	1.17	0
44	4	11.24	1.17	0
45	9	11.24	1.17	0
46	12	11.24	1.17	0
47	16	11.24	1.17	0

[a] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 24.7 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.
[b] A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded from the D_m calculation.

3.2.2 Ocean Modeling Assumptions

Dr. Roberts documented the modeling assumptions and results in a TM (Roberts, P. J. W., 2017, Appendix D). Changes incorporated into this modeling work compared to the work produced in 2016 included (a) modification to the outfall end gate to include one 6-inch Tideflex valve instead of an open end, (b) analysis of all worst-case ocean conditions, and (c) additional flow scenarios incorporating higher brine discharge flows. The modeling assumptions were specific to ambient ocean conditions: Davidson (November to March), Upwelling (April to August), and Oceanic (September to October).[17] In order to conservatively demonstrate Ocean Plan compliance, the lowest D_m from the applicable ocean conditions was used for each flow scenario. For all scenarios, the ocean modeling was performed assuming all 129 operational diffuser ports were open.

Three methods were used when modeling the ocean mixing: (1) the Cederwall formula (for neutral and negatively buoyant plumes only), (2) the mathematical model UM_3 in the United States Environmental Protection Agency's (EPA's) Visual Plume suite, and (3) the NRFIELD model (for positively buoyant plumes only), also from the EPA's Visual Plume suite (Roberts, P. J. W., 2017). When results were provided from both Cederwall and UM_3, the minimum estimated D_m value was used in this analysis; when results were provided from both UM_3 and NRFIELD, the D_m value estimated with the UM_3 model was selected for consistency, such that all dilution results for buoyant discharges used for this analysis were determined using the same model.

4 Ocean Plan Compliance Results

4.1 Water Quality of Combined Discharge

As described above, the first step in the Ocean Plan compliance analysis was to estimate the worst-case water quality for the future wastewater discharge components (*viz.*, Desal Brine, secondary effluent, hauled waste and GWR Concentrate). The estimated water quality for each type of discharge is provided in Table 4. Specific assumptions and data sources for each constituent are documented in the Table 4 footnotes.

Table 4 – Estimated worst-case water quality for the various discharge waters

Constituent	Units	Desal Brine	Secondary Effluent		Hauled Waste		GWR Concentrate	Footnotes
			MPWSP	*Variant*	*MPWSP*	*Variant*		
Ocean Plan water quality objectives for protection of marine aquatic life								
Arsenic	μg/L	17.2	45	45	45	45	12	2,6,16,21
Cadmium	μg/L	5.0	1	1.2	1	1.2	6.5	1,7,15,21
Chromium (Hexavalent)	μg/L	ND(<0.03)	ND(<2)	2.5	130	130	13	3,7,15,21

[17] Note that these ranges assign the transitional months to the ocean condition that is typically more restrictive at relevant discharge flows.

Constituent	Units	Desal Brine	Secondary Effluent		Hauled Waste		GWR Concentrate	Footnotes
			MPWSP	*Variant*	*MPWSP*	*Variant*		
Copper	µg/L	0.5	11	11	39	39	58	1,7,15,21,28
Lead	µg/L	ND(<0.5)	0.11	2.69	0.76	2.69	14.2	1,7,15,21
Mercury	µg/L	0.414	0.019	0.085	0.044	0.085	0.510	1,10,16,21
Nickel	µg/L	11.0	5.2	12.2	5.2	12.2	64	1,7,15,21
Selenium	µg/L	8.4	4	6.4	75	75	34	1,7,15,21
Silver	µg/L	0.50	0.14	0.77	0.14	0.77	4.05	1,10,15,21
Zinc	µg/L	9.5	20	57.5	170	170	303	1,7,15,21
Cyanide	µg/L	ND(<8.6)	81	89.7	81	89.7	143	1,7,16,17,21
Total Chlorine Residual	µg/L	--	ND(<200)	ND(<200)	ND(<200)	ND(<200)	ND(<200)	5
Ammonia (as N) 6-mo median	µg/L	143.1	42,900	42,900	42,900	42,900	225,789	1,6,15,21,27
Ammonia (as N) daily max	µg/L	143.1	49,000	49,000	49,000	49,000	257,895	1,6,15,21,27
Acute Toxicity	TUa	--	2.3	2.3	2.3	2.3	0.77	1,12,16,17,24
Chronic Toxicity	TUc	--	40	40	80	40	100	1,12,16,17,24
Phenolic Compounds (non-chlorinated)	µg/L	ND(<86.2)	69	69	69	69	363	1,6,14,15,23,2526
Chlorinated Phenolics	µg/L	ND(<34.5)	ND(<20)	ND(<20)	ND(<20)	ND(<20)	ND(<20)	3,9,18,23,25,26
Endosulfan	µg/L	ND(<3.4E-6)	0.015	0.046	0.015	0.046	0.24	1,10,14,15,22,25
Endrin	µg/L	ND(<1.6E-6)	0.000112	0.000112	0.000112	0.000112	0.00059	4,8,15,22
HCH (Hexachlorocyclohexane)	µg/L	0.000043	0.036	0.059	0.036	0.059	0.312	1,10,14,15,22, 25
Radioactivity (Gross Beta)	pCi/L	ND(<5.17)	32	32	307	307	34.8	1,6,12,16,17,23
Radioactivity (Gross Alpha)	pCi/L	22.4	18	18	457	457	14.4	1,6,12,16,17,23
Objectives for protection of human health - noncarcinogens								
Acrolein	µg/L	ND(<3.4)	ND(<5)	8.3	ND(<5)	8.3	44	3,7,15,23
Antimony	µg/L	0.21	0.65	0.78	0.65	0.78	4.1	1,7,15,21
Bis (2-chloroethoxy) methane	µg/L	ND(<16.7)	ND(<0.5)	ND(<4.0)	ND(<0.5)	ND(<4.0)	ND(<1)	3,9,18,23
Bis (2-chloroisopropyl) ether	µg/L	ND(<16.7)	ND(<0.5)	ND(<4.0)	ND(<0.5)	ND(<4.0)	ND(<1)	3,9,18,23
Chlorobenzene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Chromium (III)	µg/L	17	3.0	6.9	87	87	36	2,7,15,21
Di-n-butyl phthalate	µg/L	ND(<16.7)	ND(<5)	ND(<7)	ND(<5)	ND(<7)	ND(<1)	3,9,18,23
Dichlorobenzenes	µg/L	ND(<0.9)	1.6	1.6	1.6	1.6	8.4	1,10,15,21
Diethyl phthalate	µg/L	ND(<0.9)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<1)	3,9,18,23
Dimethyl phthalate	µg/L	ND(<0.9)	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.5)	3,9,18,23
4,6-dinitro-2-methylphenol	µg/L	ND(<84.5)	ND(<0.5)	ND(<19)	ND(<0.5)	ND(<19)	ND(<5)	3,9,18,23
2,4-dinitrophenol	µg/L	ND(<86.2)	ND(<0.5)	ND(<9)	ND(<0.5)	ND(<9)	ND(<5)	3,9,18,23
Ethylbenzene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Fluoranthene	µg/L	ND(<0.2)	0.00684	0.00684	0.00684	0.00684	0.0360	4,8,15,23
Hexachlorocyclopentadiene	µg/L	ND(<0.09)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.05)	3,9,18,23
Nitrobenzene	µg/L	ND(<41.4)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<1)	3,9,18,23
Thallium	µg/L	ND(<0.1)	ND(<0.5)	0.68	ND(<0.5)	0.68	3.6	3,7,15,21
Toluene	µg/L	ND(<0.9)	0.47	0.48	0.47	0.48	2.5	1,10,15,21
Tributyltin	µg/L	ND(<0.08)	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.02)	3,13,18,23
1,1,1-trichloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Objectives for protection of human health - carcinogens								
Acrylonitrile	µg/L	ND(<3.4)	ND(<2)	2.5	ND(<2)	2.5	13	3,7,15,23
Aldrin	µg/L	ND(<6.7E-5)	ND(<0.005)	ND(<0.007)	ND(<0.005)	ND(<0.007)	ND(<0.01)	3,9,18,23
Benzene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Benzidine	µg/L	ND(<86.2)	ND(<0.5)	ND(<18.6)	ND(<0.5)	ND(<18.6)	ND(<0.05)	3,9,18,23
Beryllium	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.68)	0.0052	0.0052	ND(<0.5)	3,9,17,18,21
Bis(2-chloroethyl)ether	µg/L	ND(<41.4)	ND(<0.5)	ND(<4.0)	ND(<0.5)	ND(<4.0)	ND(<1)	3,9,18,23
Bis(2-ethyl-hexyl)phthalate	µg/L	ND(<1.0)	78	78	78	78	411	2,6,15,23
Carbon tetrachloride	µg/L	ND(<0.9)	ND(<0.5)	0.50	ND(<0.5)	0.50	2.66	3,7,15,21
Chlordane	µg/L	1.45E-5	0.00122	0.00122	0.00122	0.00122	0.0064	4,8,14,15,22,25
Chlorodibromomethane	µg/L	ND(<0.9)	ND(<0.5)	2.2	ND(<0.5)	2.2	12	3,7,15,21
Chloroform	µg/L	ND(<0.9)	2	34	2	34	180	2,7,15,21
DDT	µg/L	1.7E-6	0.001	0.001	0.001	0.001	0.0003	4,7,14,19,22,25
1,4-dichlorobenzene	µg/L	ND(<0.9)	1.6	1.6	1.6	1.6	8.4	1,6,15,21
3,3-dichlorobenzidine	µg/L	ND(<86)	ND(<0.03)	ND(<18)	ND(<0.03)	ND(<18)	ND(<2)	3,9,18,23
1,2-dichloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1-dichloroethylene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	0.5	0.5	ND(<0.5)	3,9,18,21
Dichlorobromomethane	µg/L	ND(<0.9)	ND(<0.5)	2.4	ND(<0.5)	2.4	12	3,7,15,21
Dichloromethane	µg/L	ND(<0.9)	0.88	0.88	0.88	0.88	4.6	1,7,15,21
1,3-dichloropropene	µg/L	ND(<0.9)	ND(<0.5)	0.56	ND(<0.5)	0.56	3.0	3,7,15,21

Constituent	Units	Desal Brine	Secondary Effluent MPWSP	Secondary Effluent Variant	Hauled Waste MPWSP	Hauled Waste Variant	GWR Concentrate	Footnotes
Dieldrin	µg/L	4.7E-5	0.0007	0.0015	0.0007	0.0015	0.0001	4,7,19,22
2,4-dinitrotoluene	µg/L	ND(<0.2)	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.1)	3,9,18,23
1,2-diphenylhydrazine	µg/L	ND(<16.7)	ND(<0.5)	ND(<4)	ND(<0.5)	ND(<4)	ND(<1)	3,9,18,23
Halomethanes	µg/L	ND(<0.9)	0.54	1.3	0.73	1.3	6.9	2,7,14,15,21
Heptachlor	µg/L	ND(<6.9E-7)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	2,9,18,22
Heptachlor epoxide	µg/L	ND(<1.6E-6)	0.000088	0.000088	0.000088	0.000088	0.000463	4,8,15,22
Hexachlorobenzene	µg/L	ND (<6.5E-5)	0.000078	0.000078	0.000078	0.000078	0.000411	4,8,15,22
Hexachlorobutadiene	µg/L	ND(<3.4E-7)	0.000009	0.000009	0.000009	0.000009	0.000047	4,8,15,22
Hexachloroethane	µg/L	ND(<16.7)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<0.5)	3,9,18,23
Isophorone	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,23
N-Nitrosodimethylamine	µg/L	ND(<0.003)	0.017	0.086	0.017	0.086	0.150	2,7,16,17,23
N-Nitrosodi-N-Propylamine	µg/L	ND(<0.003)	0.076	0.076	0.076	0.076	0.019	2,6,16,17,23
N-Nitrosodiphenylamine	µg/L	ND(<16.7)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<1)	3,9,18,23
PAHs	µg/L	2.2E-3	0.04	0.04	0.04	0.04	0.21	4,7,14,15,22,25
PCBs	µg/L	0.00013	0.00068	0.00068	0.00068	0.00068	0.00357	4,8,14,15,22,25
TCDD Equivalents	µg/L	ND (<2.5E-5)	1.37E-7	1.39E-7	1.37E-7	1.39E-7	7.29E-7	4,7,13,14,15,23, 25
1,1,2,2-tetrachloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Tetrachloroethylene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Toxaphene	µg/L	3.97E-5	0.0071	0.0071	0.0071	0.0071	0.0373	4,8,15,22
Trichloroethylene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1,2-trichloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
2,4,6-trichlorophenol	µg/L	ND(<16.7)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<1)	3,9,18,23
Vinyl chloride	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21

Table 4 Footnotes:

MPWSP Secondary Effluent and Hauled Waste

[1] The value reported is based on MRWPCA historical data.

[2] The value reported is based on secondary effluent data collected during the GWR Project source water monitoring programs (not impacted by the proposed new source waters), and are representative of future water quality under the MPWSP scenario.

[3] The MRL provided represents the Maximum Reported Value in Table F-3 of MRWPCA's current NPDES permit. There are two exceptions to this statement: (1) the maximum reported value for hexavalent chromium was disregarded as it was the concentration measured in the hauled waste, not the secondary effluent (2) chlorinated phenolics was not included in Table F-3, and so the MRL provided is the reported value from MRWPCA's priority pollutant monitoring.

Total Chlorine Residual

[5] For all waters, it is assumed that dechlorination will be provided such that the total chlorine residual will be below detection.

Variant Secondary Effluent and Hauled Waste

[6] Existing RTP effluent exceeds concentrations observed in other proposed source waters; the value reported is the existing secondary effluent value.

[7] The proposed new source waters may increase the secondary effluent concentration; the value reported is based on estimated source water blends.

[8] RTP effluent value is based on CCLEAN data; no other source waters were considered due to MRL differences.

[9] MRL provided represents the maximum flow-weighted MRL based on the blend of source waters.

[10] The only water with a detected concentration was the RTP effluent, however the flow-weighted concentration increases due to higher MRLs for the proposed new source waters.

[11] Additional source water data are not available; the reported value is for RTP effluent.

[12] Calculation of the flow-weighted concentration was not feasible due to constituent. The maximum observed value is reported.

[13] Agricultural Wash Water data are based on an aerated sample, instead of a raw water sample.

[14] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.

GWR Concentrate Data

[15] The value presented represents a calculated value assuming no removal prior to RO, complete rejection through RO membrane, and an 81% RO recovery.
[16] The value represents the maximum value observed during the pilot testing study.
[17] The calculated value for the AWPF data (described in note 15) was not used in the analysis because it was not considered representative. It is expected that the value would increase as a result of treatment through the AWPF (*e.g.* formation of N-Nitrosodimethylamine as a disinfection by-product), or that it will not concentrate linearly through the RO (*e.g.* toxicity and radioactivity).
[18] The MRL provided represents the limit from the source water and pilot testing monitoring programs.
[19] The value presented represents a calculated value assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, 36% and 44% removal through ozone for DDT and dieldrin, respectively, 92% and 97% removal through MF for DDT and dieldrin, respectively, recycling of the MF backwash to the RTP, complete rejection through the RO membrane, and an 81% RO recovery. The assumed removals are based on results from ozone bench-scale testing of Blanco Drain water blended with secondary effluent and low detection sampling through the RTP.
[20] Footnote not used

Desal Brine Data

[21] The value reported is based on test slant well data collected through the Watershed Sanitary Survey.
[22] The value reported is based on data from the one-time 7-day composite sample from the test slant well. If ND, the method detection limit was used for the analysis instead of the MRL. MRLs were not available for this data set.
[23] The value reported is based on data from the test slant well collected through the quarterly Ocean Plan constituents monitoring.
[24] Acute and chronic toxicity have not been measured or estimated
[25] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.
[26] Chlorinated phenolic compounds is the sum of the following: 4-chloro-3-methylphenol, 2-chlorophenol, pentachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol. Non-chlorinated phenolic compounds is the sum of the following: 2,4-dimethylphenol, 4,6-Dinitro-2-methylphenol, 2,4-dinitrophenol, 2-methylphenol, 4-methylphenol, 2-nitrophenol, 4-nitrophenol, and phenol.

General

[27] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[28] The value reported for the Variant secondary effluent was calculated using the median of the data collected for the new source waters and is an estimate of the potential increase in concentration of the secondary effluent based on estimated source water blends. The value reported for the Desal Brine was calculated with the median of the data collected from the test slant well and assuming a 42% recovery through the RO. The median values were used because the maximum values detected in both sources appear to be outliers, and because the Ocean Plan objective is a 6-month median concentration, it is reasonable to use the median value detected from these source waters.

4.2 Ocean Modeling Results

The resulting estimates of minimum probable dilution (D_m) for each discharge scenario are presented in Tables 5 and 6 (Roberts, P. J. W., 2017). For discharge scenarios that were modeled with more than one modeling method, the lowest D_m (*i.e.*, most conservative) is reported in the tables below. For the MPWSP, the flow scenarios in which little or no secondary effluent was discharged (Scenarios 1, 2, 8, and 9) resulted in the lowest D_m values as a result of the discharge plume being negatively buoyant. At higher secondary effluent flows, the discharge plume would be positively buoyant, resulting in an increased D_m, as evidenced in Scenarios 7 and 14. The same trend was observed for Variant scenarios.

The estimates of minimum probable dilution (D_m) for the MPWSP range from 14.4 to 98, and 14.4 to 114 for the Variant. These D_m values are substantially lower than what is currently specified in the MRWPCA NPDES permit (145) and those estimated for the GWR Project, which range from 174 to 498 (see Appendix B). As a result of the reduced dilution, some contaminants, which have not traditionally been of concern for discharge through MRWPCA's ocean outfall, are estimated to potentially exceed the Ocean Plan objectives at the edge of the ZID.

Table 5 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for MPWSP

Flow Scenario No.	Ocean Condition	Discharge flows (mgd)			D_m [b]
		Secondary Effluent [a]	Desal Brine	Hauled Waste	
MPWSP with Normal Desal Brine Flow					
1	Davidson	0	13.98	0.1	14.4
2	Davidson	2	13.98	0.1	15.8
3	Davidson	4	13.98	0.1	17.8
4	Davidson	6	13.98	0.1	20.9
5	Davidson	9	13.98	0.1	26.7
6	Upwelling	10	13.98	0.1	38.2
7	Upwelling	19.78	13.98	0.1	98
MPWSP with High Desal Brine Flow					
8	Davidson	0	16.31	0.1	14.5
9	Davidson	2	16.31	0.1	15.7
10	Davidson	7	16.31	0.1	21.8
11	Davidson	8	16.31	0.1	23.5
12	Davidson	10	16.31	0.1	29.2
13	Davidson	12	16.31	0.1	43.9
14	Oceanic	16	16.31	0.1	87

[a] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

[b] Several models were used to estimate the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. The Ocean Plan defines dilution differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S - 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

Table 6 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for Variant

Flow Scenario No.	Ocean Condition	Discharge flows (mgd)				D_m [c]
		Secondary Effluent [a]	Desal Brine	GWR Concentrate	Hauled Waste [b]	
Variant with AWPF Offline						
15	Davidson	0	8.99	0	0	15.7
16	Davidson	2	8.99	0	0	16.4
17	Davidson	4	8.99	0	0	19.9
18	Davidson	5.8	8.99	0	0	28.4
19	Upwelling	14	8.99	0	0	109.0
20	Upwelling	19.78	8.99	0	0	117.0
Variant with Normal Flows						
30	Davidson	0	8.99	1.17	0	15.5
31	Davidson	2	8.99	1.17	0	17.7
32	Davidson	4	8.99	1.17	0	23.8
33	Davidson	6	8.99	1.17	0	67.5
34	Upwelling	11	8.99	1.17	0	106.0
35	Upwelling	15.92	8.99	1.17	0	114.0
Variant with High Desal Brine Flows and AWPF Offline						
36	Davidson	0	11.24	0	0	14.4
37	Davidson	3	11.24	0	0	17.1
38	Davidson	5	11.24	0	0	20.5
39	Upwelling	9	11.24	0	0	90.0
40	Oceanic	12	11.24	0	0	94.0
41	Upwelling	16	11.24	0	0	102.0
Variant with High Desal Brine Flows						
42	Davidson	0	11.24	1.17	0	15.2
43	Davidson	1	11.24	1.17	0	16.0
44	Davidson	4	11.24	1.17	0	20.8
45	Upwelling	9	11.24	1.17	0	90.0
46	Upwelling	12	11.24	1.17	0	97.0
47	Upwelling	16	11.24	1.17	0	104

[a] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

[b] Hauled waste was not included in the modeling of MPWSP flow scenarios; however, the change in both flow and TDS from the addition of hauled waste is less than 1% and thus is expected to have a negligible impact on the modeled D_m.

[c] Several models were used to estimate the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. The Ocean Plan defines dilution differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S - 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

4.3 Ocean Plan Compliance Results

The flow-weighted in-pipe concentration for each constituent was calculated for each modeled discharge scenario using the water quality presented in Table 4 and the discharge flows presented in Tables 2 and 3. The in-pipe concentration was then used to calculate the concentration at the edge of the ZID using the D_m values presented in Tables 5 and 6. The resulting concentrations for each constituent in each scenario were compared to the Ocean Plan objectives to assess compliance. The estimated concentrations for the 47 flow scenarios (14 for the MPWSP and 33 for the Variant) for all constituents are presented as concentrations at the edge of the ZID (Appendix A, Table A1 and A3) and as a percentage of the Ocean Plan objective (Appendix A, Table A2 and A4).

Some constituents were estimated to potentially exceed or come close to exceeding the Ocean Plan water quality objectives for the MPWSP and Variant; however, some of these constituents were never detected above the MRL in any of the source waters, but the MRLs are higher than the Ocean Plan objective. Due to this insufficient analytical sensitivity, no compliance conclusion can be drawn for these constituents. This is a common occurrence for ocean discharges since the MRL of the approved compliance analysis method is higher than the Ocean Plan objective for certain constituents.

Of the constituents detected in the source waters, two (cyanide and ammonia) were identified as having potential to exceed the Ocean Plan objective in the MPWSP, and eight (cyanide, ammonia, acrylonitrile, beryllium, chlordane, PCBs, TCDD equivalents, and toxaphene) were identified as having potential to exceed the Ocean Plan objective in the Variant. Within this Variant subset of eight constituents, acrylonitrile, beryllium and TCDD equivalents were detected in some of the source waters, but not in the others. For these analyses, the MRLs themselves were above the Ocean Plan objective. To assess the blended concentrations for these constituents, a value of zero was assumed for any sources when the concentration was below the MRL.[18] This approach is a "best-case" scenario because it assumes the lowest possible concentration—namely, a value of zero—for any constituent below the reporting limit. This approach is still useful, however, to bracket the analysis and assess the potential for Ocean Plan compliance issues under best-case conditions. Through this method, TCDD equivalents continues to show potential to exceed the Ocean Plan objective for the Variant. The estimated concentration of acrylonitrile[19] and beryllium at the edge of the ZID is less than the Ocean Plan objective and therefore did not show exceedances through this "best-case" analysis. However, because this is only a partial analysis (a special case), it is not possible to draw conclusions on whether acrylonitrile and beryllium will comply with the Ocean Plan during actual conditions.

The constituents that may exceed the Ocean Plan objective, or come close to exceeding the objective, are shown at their estimated concentration at the edge of the ZID in Table 7 for the MPWSP and Table 8 for the Variant, and as the concentration at the edge of the ZID as a

[18] Additionally, the Ocean Plan states that for constituents that are made up of an aggregate of constituents, a concentration of 0 can be assumed for the individual constituents that are not detected above the MRL, such as TCDD equivalents.

[19] Acrylonitrile was only detected in one potential source water for the Variant. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant.

percentage of the Ocean Plan objective in Table 9 and 10 for the MPWSP and Variant, respectively. The “best-case” scenario compliance assessment results for acrylonitrile and TCDD equivalents are also included in these tables.

Table 7 – Estimated concentrations at the edge of the ZID for Ocean Plan constituents of concern in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Cyanide	µg/L	1	0.6	1.1	1.3	1.4	1.3	1.0	0.5	0.6	1.0	1.3	1.3	1.2	0.9	0.5
Ammonia (as N) – 6-mo median [b]	µg/L	600	29	341	523	600	614	461	255	26	301	575	585	546	409	243
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																
Acrylonitrile [c d]	µg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	4	0.1	0.7	1.0	1.1	1.1	0.8	0.5	0.1	0.6	1.1	1.1	1.0	0.8	0.4
Chlordane	µg/L	2.3E-05	1.5E-06	1.0E-05	1.5E-05	1.7E-05	1.8E-05	1.3E-05	7.3E-06	1.4E-06	9.1E-06	1.7E-05	1.7E-05	1.6E-05	1.2E-05	6.9E-06
PCBs	µg/L	1.9E-05	8.9E-06	1.2E-05	1.4E-05	1.4E-05	1.3E-05	9.2E-06	4.6E-06	8.8E-06	1.2E-05	1.3E-05	1.3E-05	1.1E-05	8.1E-06	4.6E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6.3E-11	1.1E-09	1.7E-09	1.9E-09	1.9E-09	1.5E-09	8.1E-10	5.4E-11	9.4E-10	1.8E-09	1.9E-09	1.7E-09	1.3E-09	7.7E-10
Toxaphene [e]	µg/L	2.1E-04	5.8E-06	5.7E-05	8.7E-05	1.0E-04	1.0E-04	7.6E-05	4.2E-05	5.3E-06	5.1E-05	9.6E-05	9.7E-05	9.1E-05	6.8E-05	4.0E-05

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 8 – Estimated concentrations at the edge of the ZID for Ocean Plan constituents of concern in the Variant [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Cyanide	µg/L	1	0.6	1.4	1.6	1.4	0.5	0.5	1.5	1.9	1.7	0.7	0.5	0.6	0.6	1.4	1.6	0.5	0.5	0.5	1.3	1.6	1.8	0.6	0.6	0.6
Ammonia (as N) – 6-mo median [b]	µg/L	600	39	474	648	581	239	251	1593	1551	1248	473	326	316	34	519	627	212	235	246	1333	1363	1227	335	327	320
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c d]	µg/L	0.1	0.002	0.03	0.04	0.03	0.01	0.01	0.1	0.1	0.1	0.03	0.02	0.02	0.001	0.03	0.04	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
Bis(2-ethyl-hexyl)phthalate	µg/L	4	0.1	0.9	1.2	1.1	0.4	0.5	2.9	2.9	2.3	0.9	0.6	0.6	0.1	1.0	1.2	0.4	0.4	0.5	2.5	2.5	2.3	0.6	0.6	0.6
Chlordane	µg/L	2.3E-05	2E-06	1E-05	2E-05	2E-05	7E-06	7E-06	5E-05	4E-05	4E-05	1E-05	9E-06	9E-06	2E-06	2E-05	2E-05	6E-06	7E-06	7E-06	4E-05	4E-05	4E-05	1E-05	9E-06	9E-06
PCBs	µg/L	1.9E-05	9E-06	1E-05	1E-05	1E-05	4E-06	4E-06	3E-05	3E-05	2E-05	9E-06	6E-06	5E-06	9E-06	1E-05	1E-05	4E-06	4E-06	4E-06	3E-05	3E-05	2E-05	6E-06	6E-06	6E-06
TCDD Equivalents [d]	µg/L	3.9E-09	1E-10	2E-09	2E-09	2E-09	8E-10	8E-10	5E-09	5E-09	4E-09	2E-09	1E-09	1E-09	8E-11	2E-09	2E-09	7E-10	8E-10	8E-10	4E-09	4E-09	4E-09	1E-09	1E-09	1E-09
Toxaphene [e]	µg/L	2.1E-04	7E-06	8E-05	1E-04	1E-04	4E-05	4E-05	3E-04	3E-04	2E-04	8E-05	5E-05	5E-05	7E-06	9E-05	1E-04	4E-05	4E-05	4E-05	2E-04	2E-04	2E-04	6E-05	5E-05	5E-05

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 9 – Estimated concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Cyanide	µg/L	1	59%	108%	133%	140%	134%	99%	52%	58%	101%	134%	133%	120%	88%	51%
Ammonia (as N) – 6-mo median [b]	µg/L	600	5%	57%	87%	100%	102%	77%	43%	4%	50%	96%	97%	91%	68%	40%
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																
Acrylonitrile [c d]	µg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	4	3%	19%	28%	32%	32%	24%	13%	3%	17%	31%	31%	29%	22%	13%
Chlordane	µg/L	2.3E-05	6%	44%	66%	75%	77%	57%	32%	6%	39%	72%	73%	68%	51%	30%
PCBs	µg/L	1.9E-05	47%	64%	72%	72%	66%	49%	24%	46%	61%	69%	67%	60%	43%	24%
TCDD Equivalents [d]	µg/L	3.9E-09	2%	27%	42%	49%	50%	38%	21%	1%	24%	47%	48%	44%	33%	20%
Toxaphene [e]	µg/L	2.1E-04	3%	27%	42%	47%	48%	36%	20%	3%	24%	45%	46%	43%	32%	19%

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 10 – Estimated concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the Variant [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Cyanide	µg/L	1	61%	138%	163%	139%	53%	55%	150%	189%	173%	71%	55%	56%	61%	144%	158%	49%	53%	55%	135%	158%	176%	55%	56%	57%
Ammonia (as N) – 6-mo median [b]	µg/L	600	7%	79%	108%	97%	40%	42%	266%	258%	208%	79%	54%	53%	6%	86%	105%	35%	39%	41%	222%	227%	205%	56%	54%	53%
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c d]	µg/L	0.1	2%	28%	38%	34%	14%	14%	94%	92%	74%	28%	19%	19%	1%	30%	37%	13%	14%	15%	79%	81%	73%	20%	19%	19%
Bis(2-ethyl-hexyl)phthalate	µg/L	4	3%	26%	34%	31%	12%	13%	84%	81%	65%	25%	17%	17%	3%	28%	33%	11%	12%	13%	70%	72%	64%	18%	17%	17%
Chlordane	µg/L	2.3E-05	8%	60%	81%	72%	30%	31%	199%	193%	155%	59%	40%	39%	7%	66%	79%	26%	29%	30%	167%	170%	153%	42%	40%	40%
PCBs	µg/L	1.9E-05	47%	71%	77%	63%	22%	23%	169%	156%	121%	45%	30%	28%	47%	73%	74%	22%	23%	23%	149%	147%	124%	32%	30%	29%
TCDD Equivalents [d]	µg/L	3.9E-09	2%	39%	53%	48%	20%	21%	131%	128%	103%	39%	27%	26%	2%	42%	52%	17%	19%	20%	110%	112%	101%	28%	27%	26%
Toxaphene [e]	µg/L	2.1E-04	4%	38%	51%	46%	19%	20%	126%	122%	98%	37%	26%	25%	3%	41%	50%	17%	19%	19%	105%	108%	97%	26%	26%	25%

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Potential issues for cyanide and ammonia compliance were identified to occur when there is no, or relatively low secondary effluent flow mixed with hauled waste and Desal Brine, as in MPWSP Scenarios 2-6 and 9-13. Potential issues were also identified to occur when there is little or no secondary effluent flow discharged for the Variant Project, as in Variant Scenarios 16-18, 30-32, 37, 38, and 42-44. The constituents of interest related to these scenarios are cyanide, ammonia, acrylonitrile, bis(2-ethyl-hexyl)phthalate, chlordane, PCBs, TCDD equivalents, and toxaphene. Ammonia is expected to be the constituent with the highest exceedance, being 2.66 times the Ocean Plan objective in flow scenario 30 (0 mgd secondary effluent with hauled waste, 1.17 mgd GWR Concentrate and 8.99 mgd Desal Brine). This scenario is problematic because constituents that have relatively high loadings in the secondary effluent are concentrated in the GWR Concentrate. This scenario assumes the GWR Concentrate flow is much smaller than the Desal Brine flow, such that the resulting discharge plume is negatively buoyant and achieves poor ocean dilution.

Chlordane, PCBs, and toxaphene were only detected when analyzed with low-detection methods, which have far greater sensitivity than standard methods. These results were used to investigate potential to exceed Ocean Plan objectives because these objectives are orders of magnitude below detection limits of methods currently used for discharge compliance.

5 Conclusions

The purpose of this analysis was to assess the ability of the MPWSP and Variant to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the secondary effluent, GWR Concentrate, Desal Brine and hauled waste for these projects. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and scenario. A summary of the constituents that show potential to exceed the Ocean Plan objectives is provided in Table 11 for the MPWSP and Table 12 for the Variant. These constituents can be divided into three categories:

- **Category I -** Insufficient analytical sensitivity to determine compliance: The constituent was not detected above the MRL in any of the source waters, but the MRL is not sensitive enough to demonstrate compliance with the Ocean Plan objective.
- **Category II -** Estimated to be close to exceeding the Ocean Plan objective: The constituent is estimated to be at a concentration between 80% and 100% of the Ocean Plan objective at the edge of the ZID.
- **Category III -** Estimated to exceed the Ocean Plan objective: The constituent is estimated to be at a concentration higher than the Ocean Plan objective at the edge of the ZID.

Table 11: Summary of Compliance Conclusions for the MPWSP

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	4	140%
Ammonia			✓	5	102%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]	✓			--	--
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
TCDD Equivalents [e]	✓			--	--
2,4,6-Trichlorophenol	✓			--	--

Notes:

a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.

b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios

c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID

d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification

e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective

Table 12: Summary of Compliance Conclusions for the Variant

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	31	189%
Ammonia			✓	30	266%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]		✓		30	94%
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
Bis(2-ethyl-hexyl)phthalate		✓		30	84%
Chlordane			✓	30	199%
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
PCBs			✓	30	169%
TCDD Equivalents [e]			✓	30	131%
Toxaphene			✓	30	126%
2,4,6-Trichlorophenol	✓			--	--

Notes:
a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.
b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios
c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID
d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification
e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective

Based on the data, assumptions, modeling, and analytical methodology presented in this TM, the MPWSP and Variant show a potential to exceed certain Ocean Plan objectives under specific discharge scenarios (see Tables 11 and 12). In particular, potential issues were identified for the MPWSP and Variant flow scenarios involving low to moderate secondary effluent flows with Desal Brine. Under these conditions, discharges are estimated to exceed or come close to exceeding multiple Ocean Plan objectives, specifically those for cyanide and ammonia for the MPWSP, and cyanide, ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene for the

Variant. Ammonia clearly exceeds the Ocean Plan objective and must be resolved for the MPWSP and Variant. When considering a best-case analysis for the Variant, acrylonitrile comes close to exceeding the Ocean Plan objective, and TCDD equivalents show a potential to exceed the objective. Additional analytical investigation regarding cyanide analysis is recommended to determine if the potential exceedances are representative of actual water quality conditions. Chlordane, PCBs and toxaphene, which were estimated to exceed the objectives for Variant flow scenarios, were detected at concentrations that are orders of magnitude below detection limits of methods currently used for discharge compliance.

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Appendix A

Table A1 – Complete list of estimated concentrations of Ocean Plan constituents at the edge of the ZID for the MPWSP

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Arsenic	µg/L	8	3.9	4.1	4.1	4.0	3.9	3.7	3.3	3.9	4.0	4.0	4.0	3.8	3.6	3.3
Cadmium	µg/L	1	0.3	0.3	0.2	0.2	0.1	0.1	0.03	0.3	0.3	0.2	0.1	0.1	0.1	0.03
Chromium (Hexavalent)	µg/L	2	0.06	0.06	0.06	0.06	0.05	0.04	0.02	0.05	0.06	0.05	0.05	0.04	0.03	0.02
Copper	µg/L	3	1.9	2.0	2.1	2.1	2.1	2.1	2.0	1.9	2.0	2.1	2.1	2.1	2.1	2.0
Lead	µg/L	2	0.03	0.03	0.02	0.02	0.01	0.01	0.003	0.03	0.03	0.02	0.02	0.01	0.01	0.004
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.002	0.03	0.02	0.01	0.01	0.01	0.01	0.003
Nickel	µg/L	5	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.7	0.6	0.4	0.4	0.3	0.2	0.1
Selenium	µg/L	15	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0.6	0.5	0.3	0.3	0.2	0.2	0.1
Silver	µg/L	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Zinc	µg/L	20	8.2	8.2	8.2	8.2	8.2	8.2	8.1	8.2	8.2	8.2	8.2	8.2	8.1	8.1
Cyanide	µg/L	1	0.6	1.1	1.3	1.4	1.3	1.0	0.5	0.6	1.0	1.3	1.3	1.2	0.9	0.5
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	29	341	523	600	614	461	255	26	301	575	585	546	409	243
Ammonia (as N) - Daily Max	µg/L	2,400	32	388	597	684	701	526	291	28	342	656	668	623	467	277
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	5.6	5.0	4.4	3.7	2.9	2.0	0.8	5.6	5.0	3.6	3.3	2.6	1.8	0.9
Chlorinated Phenolics [b]	µg/L	1	<2.2	<1.9	<1.7	<1.4	<1.0	<0.7	<0.3	<2.2	<2.0	<1.3	<1.2	<1.0	<0.6	<0.3
Endosulfan	µg/L	0.009	7E-06	1E-04	2E-04	2E-04	2E-04	2E-04	9E-05	6E-06	1E-04	2E-04	2E-04	2E-04	1E-04	8E-05
Endrin	µg/L	0.002	2E-07	1E-06	1E-06	2E-06	2E-06	1E-06	7E-07	1E-07	8E-07	2E-06	2E-06	1E-06	1E-06	6E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	2E-05	3E-04	4E-04	5E-04	5E-04	4E-04	2E-04	2E-05	2E-04	5E-04	5E-04	5E-04	3E-04	2E-04
Radioactivity (Gross Beta) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Objectives for protection of human health – non carcinogens – 30-day average limit																
Acrolein	µg/L	220	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.04	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.05
Antimony	µg/L	1200	0.01	0.02	0.02	0.02	0.01	0.01	0.005	0.01	0.02	0.01	0.01	0.01	0.01	0.005
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Chlorobenzene	µg/L	570	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Chromium (III)	µg/L	190000	1.2	0.9	0.8	0.6	0.4	0.3	0.1	1.1	1.0	0.6	0.5	0.4	0.3	0.1
Di-n-butyl phthalate	µg/L	3500	<1.1	<0.9	<0.7	<0.6	<0.4	<0.3	<0.1	<1.1	<0.9	<0.6	<0.5	<0.4	<0.3	<0.1
Dichlorobenzenes	µg/L	5100	0.1	0.1	0.1	0.05	0.04	0.03	0.01	0.1	0.1	0.05	0.05	0.04	0.03	0.01
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.03	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.03
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.1	<0.05	<0.03	<0.02	<0.1	<0.1	<0.1	<0.1	<0.04	<0.03	<0.02
4,6-dinitro-2-methylphenol	µg/L	220	<5.4	<4.4	<3.5	<2.7	<1.9	<1.3	<0.4	<5.4	<4.5	<2.6	<2.3	<1.7	<1.1	<0.5

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
2,4-Dinitrophenol [b]	µg/L	4.0	<5.6	<4.5	<3.6	<2.7	<1.9	<1.3	<0.4	<5.5	<4.6	<2.6	<2.4	<1.8	<1.1	<0.5
Ethylbenzene	µg/L	4100	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Fluoranthene	µg/L	15	0.01	0.01	0.01	0.01	0.004	0.003	0.001	0.01	0.01	0.01	0.005	0.004	0.002	0.001
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003
Nitrobenzene	µg/L	4.9	<2.7	<2.1	<1.7	<1.3	<0.9	<0.6	<0.2	<2.7	<2.2	<1.3	<1.1	<0.9	<0.5	<0.2
Thallium	µg/L	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003
Toluene	µg/L	85000	0.06	0.05	0.04	0.03	0.03	0.02	0.01	0.06	0.05	0.03	0.03	0.02	0.02	0.01
Tributyltin [b]	µg/L	0.0014	<0.005	<0.005	<0.004	<0.003	<0.003	<0.002	<0.001	<0.005	<0.005	<0.003	<0.003	<0.002	<0.002	<0.001
1,1,1-Trichloroethane	µg/L	540000	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Objectives for protection of human health - carcinogens - 30-day average limit [c,d]																
Acrylonitrile [c,d]	µg/L	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aldrin [b]	µg/L	0.000022	<7E-06	<4E-05	<6E-05	<7E-05	<7E-05	<5E-05	<3E-05	<6E-06	<4E-05	<7E-05	<7E-05	<6E-05	<5E-05	<3E-05
Benzene	µg/L	5.9	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Benzidine [b]	µg/L	0.000069	<5.6	<4.5	<3.6	<2.7	<1.9	<1.3	<0.4	<5.5	<4.6	<2.6	<2.4	<1.8	<1.1	<0.5
Beryllium [d]	µg/L	0.033	2E-06	2E-06	2E-06	1E-06	8E-07	6E-07	2E-07	2E-06	2E-06	1E-06	9E-07	7E-07	4E-07	2E-07
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.7	<2.1	<1.7	<1.3	<0.9	<0.6	<0.2	<2.7	<2.2	<1.3	<1.1	<0.9	<0.5	<0.2
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.7	1.0	1.1	1.1	0.8	0.5	0.1	0.6	1.1	1.1	1.0	0.8	0.4
Carbon tetrachloride	µg/L	0.90	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Chlordane	µg/L	0.000023	1E-06	1E-05	2E-05	2E-05	2E-05	1E-05	7E-06	1E-06	9E-06	2E-05	2E-05	2E-05	1E-05	7E-06
Chlorodibromomethane	µg/L	8.6	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Chloroform	µg/L	130	0.1	0.1	0.1	0.1	0.05	0.03	0.02	0.1	0.1	0.1	0.1	0.04	0.03	0.02
DDT	µg/L	0.00017	6E-07	8E-06	1E-05	1E-05	1E-05	1E-05	6E-06	5E-07	7E-06	1E-05	1E-05	1E-05	1E-05	6E-06
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.05	0.04	0.03	0.01	0.1	0.1	0.05	0.05	0.04	0.03	0.01
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.6	<4.5	<3.5	<2.7	<1.9	<1.3	<0.4	<5.5	<4.6	<2.6	<2.4	<1.8	<1.1	<0.5
1,2-Dichloroethane	µg/L	28	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
1,1-Dichloroethylene	µg/L	0.9	0.06	0.05	0.04	0.03	0.03	0.02	0.01	0.06	0.05	0.03	0.03	0.02	0.02	0.01
Dichlorobromomethane	µg/L	6.2	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Dichloromethane	µg/L	450	0.06	0.05	0.05	0.04	0.03	0.02	0.01	0.06	0.05	0.04	0.04	0.03	0.02	0.01
1,3-dichloropropene	µg/L	8.9	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Dieldrin	µg/L	0.00004	3E-06	8E-06	1E-05	1E-05	1E-05	8E-06	4E-06	3E-06	7E-06	1E-05	1E-05	9E-06	7E-06	4E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.02	<0.03	<0.03	<0.03	<0.02	<0.01	<0.01	<0.02	<0.03	<0.03	<0.03	<0.02	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Halomethanes	µg/L	130	0.1	0.05	0.04	0.03	0.03	0.02	0.01	0.1	0.05	0.03	0.03	0.02	0.02	0.01
Heptachlor [b]	µg/L	0.00005	<5E-06	<8E-05	<1E-04	<1E-04	<1E-04	<1E-04	<6E-05	<4E-06	<7E-05	<1E-04	<1E-04	<1E-04	<9E-05	<6E-05
Heptachlor Epoxide	µg/L	0.00002	1E-07	8E-07	1E-06	1E-06	1E-06	1E-06	5E-07	1E-07	7E-07	1E-06	1E-06	1E-06	9E-07	5E-07
Hexachlorobenzene	µg/L	0.00021	4E-06	4E-06	4E-06	3E-06	3E-06	2E-06	7E-07	4E-06	4E-06	3E-06	3E-06	2E-06	2E-06	8E-07
Hexachlorobutadiene	µg/L	14	3E-08	9E-08	1E-07	1E-07	1E-07	1E-07	5E-08	3E-08	8E-08	1E-07	1E-07	1E-07	9E-08	5E-08
Hexachloroethane	µg/L	2.5	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Isophorone	µg/L	730	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
N-Nitrosodimethylamine	µg/L	7.3	0.0002	0.0003	0.0003	0.0003	0.0003	0.0002	0.0001	0.0002	0.0003	0.0003	0.0003	0.0003	0.0002	0.0001
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.001	0.001	0.0005	0.0003	0.001	0.001	0.001	0.001	0.001	0.0004

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
N-Nitrosodiphenylamine	µg/L	2.5	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
PAHs	µg/L	0.0088	0.0002	0.0004	0.0005	0.0006	0.0005	0.0004	0.0002	0.0002	0.0004	0.0005	0.0005	0.0005	0.0004	0.0002
PCBs	µg/L	0.000019	9E-06	1E-05	1E-05	1E-05	1E-05	9E-06	5E-06	9E-06	1E-05	1E-05	1E-05	1E-05	8E-06	5E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6E-11	1E-09	2E-09	2E-09	2E-09	1E-09	8E-10	5E-11	9E-10	2E-09	2E-09	2E-09	1E-09	8E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Tetrachloroethylene	µg/L	2.0	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Toxaphene [e]	µg/L	2.1E-04	6E-06	6E-05	9E-05	1E-04	1E-04	8E-05	4E-05	5E-06	5E-05	1E-04	1E-04	9E-05	7E-05	4E-05
Trichloroethylene	µg/L	27	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.03	<0.02	<0.02	<0.01	<0.01	<0.03	<0.03	<0.02	<0.02	<0.02	<0.01	<0.01

a: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent.
b: All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A2 – Complete list of estimated concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Arsenic	µg/L	8	49%	51%	51%	50%	49%	46%	41%	49%	51%	50%	49%	48%	45%	41%
Cadmium	µg/L	1	32%	27%	22%	17%	12%	8%	3%	32%	27%	17%	15%	11%	7%	3%
Chromium (Hexavalent)	µg/L	2	3%	3%	3%	3%	2%	2%	1%	3%	3%	3%	2%	2%	1%	1%
Copper	µg/L	3	64%	67%	69%	69%	70%	69%	68%	64%	66%	69%	70%	70%	69%	68%
Lead	µg/L	2	2%	1%	1%	1%	1%	0.4%	0.1%	2%	1%	1%	1%	1%	0.4%	0.2%
Mercury	µg/L	0.04	68%	55%	44%	35%	25%	17%	6%	68%	56%	33%	30%	23%	15%	7%
Nickel	µg/L	5	14%	12%	10%	8%	6%	4%	2%	14%	12%	8%	7%	6%	4%	2%
Selenium	µg/L	15	4%	3%	3%	2%	2%	1%	0.4%	4%	3%	2%	2%	2%	1%	0.5%
Silver	µg/L	0.7	26%	25%	25%	24%	24%	24%	23%	26%	25%	24%	24%	24%	23%	23%
Zinc	µg/L	20	41%	41%	41%	41%	41%	41%	40%	41%	41%	41%	41%	41%	41%	40%
Cyanide	µg/L	1	59%	108%	133%	140%	134%	99%	52%	58%	101%	134%	133%	120%	88%	51%
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	5%	57%	87%	100%	102%	77%	43%	4%	50%	96%	97%	91%	68%	40%
Ammonia (as N) - Daily Max	µg/L	2,400	1%	16%	25%	29%	29%	22%	12%	1%	14%	27%	28%	26%	19%	12%
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	19%	17%	15%	12%	10%	7%	3%	19%	17%	12%	11%	9%	6%	3%
Chlorinated Phenolics [b]	µg/L	1	--	--	--	--	--	<72%	<26%	--	--	--	--	--	<63%	<31%
Endosulfan	µg/L	0.009	0.1%	1%	2%	2%	2%	2%	1%	0.1%	1%	2%	2%	2%	2%	1%
Endrin	µg/L	0.002	0.01%	0.05%	0.1%	0.1%	0.1%	0.1%	0.03%	0.01%	0.04%	0.08%	0.08%	0.07%	0.05%	0.03%
HCH (Hexachlorocyclohexane)	µg/L	0.004	0.5%	7%	11%	13%	13%	10%	5%	0.4%	6%	12%	12%	11%	9%	5%
Radioactivity (Gross Beta) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Objectives for protection of human health – non carcinogens – 30-day average limit																
Acrolein	µg/L	220	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.05%	<0.02%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.04%	<0.02%
Antimony	µg/L	1200	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Bis (2-chloroethoxy) methane	µg/L	4.4	<25%	<20%	<16%	<12%	<8%	<6%	<2%	<24%	<20%	<12%	<11%	<8%	<5%	<2%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.1%	<0.1%	<0.1%	<0.04%	<0.03%	<0.02%	<0.01%	<0.1%	<0.1%	<0.04%	<0.04%	<0.03%	<0.02%	<0.01%
Chlorobenzene	µg/L	570	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.03%	<0.03%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<2%	<1%	<1%	<1%	<0.2%	<2%	<2%	<1%	<1%	<1%	<0.5%	<0.2%
2,4-Dinitrophenol [b]	µg/L	4.0	--	--	--	<69%	<47%	<32%	<9%	--	--	<66%	<59%	<44%	<28%	<12%
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.05%	0.04%	0.03%	0.02%	0.01%	0.1%	0.1%	0.04%	0.03%	0.02%	0.02%	0.01%

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario: MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.02%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<54%	<44%	<35%	<27%	<19%	<13%	<4%	<54%	<45%	<26%	<23%	<17%	<11%	<5%
Thallium	µg/L	2	<0.3%	<0.4%	<0.5%	<0.5%	<0.5%	<0.3%	<0.2%	<0.3%	<0.4%	<0.5%	<0.5%	<0.4%	<0.3%	<0.2%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [b]	µg/L	0.0014	--	--	--	--	--	--	<46%	--	--	--	--	--	--	<54%
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																
Acrylonitrile [c d]	µg/L	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aldrin [b]	µg/L	0.000022	<30%	--	--	--	--	--	--	<28%	--	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<1%	<0.4%	<0.3%	<0.1%	<1%	<1%	<1%	<1%	<0.4%	<0.3%	<0.1%
Benzidine [b]	µg/L	0.000069	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium [d]	µg/L	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-chloroethyl)ether [b]	µg/L	0.045	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	19%	28%	32%	32%	24%	13%	3%	17%	31%	31%	29%	22%	13%
Carbon tetrachloride	µg/L	0.90	<6%	<5%	<5%	<4%	<3%	<2%	<1%	<6%	<5%	<4%	<3%	<3%	<2%	<1%
Chlordane	µg/L	0.000023	6%	44%	66%	75%	77%	57%	32%	6%	39%	72%	73%	68%	51%	30%
Chlorodibromomethane	µg/L	8.6	<1%	<1%	<0.5%	<0.4%	<0.3%	<0.2%	<0.1%	<1%	<1%	<0.4%	<0.4%	<0.3%	<0.2%	<0.1%
Chloroform	µg/L	130	0.04%	0.05%	0.05%	0.04%	0.04%	0.03%	0.01%	0.04%	0.05%	0.04%	0.04%	0.03%	0.02%	0.01%
DDT	µg/L	0.00017	0.3%	5%	7%	8%	8%	6%	3%	0.3%	4%	8%	8%	7%	6%	3%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.3%	0.3%	0.3%	0.3%	0.2%	0.1%	0.1%
3,3-Dichlorobenzidine [b]	µg/L	0.0081	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.1%	<0.03%
1,1-Dichloroethylene	µg/L	0.9	6%	5%	5%	4%	3%	2%	1%	6%	5%	4%	3%	3%	2%	1%
Dichlorobromomethane	µg/L	6.2	<1%	<1%	<1%	<1%	<0.4%	<0.3%	<0.1%	<1%	<1%	<1%	<0.5%	<0.4%	<0.3%	<0.1%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%
1,3-dichloropropene	µg/L	8.9	<1%	<1%	<0.5%	<0.4%	<0.3%	<0.2%	<0.1%	<1%	<1%	<0.4%	<0.3%	<0.3%	<0.2%	<0.1%
Dieldrin	µg/L	0.00004	8%	19%	25%	27%	27%	20%	10%	8%	18%	26%	26%	24%	17%	10%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<1%	<1%	<0.5%	<0.5%	<1%	<1%	<1%	<1%	<1%	<0.5%
1,2-Diphenylhydrazine [b]	µg/L	0.16	--	--	--	--	--	--	<45%	--	--	--	--	--	--	<62%
Halomethanes	µg/L	130	0.04%	0.04%	0.03%	0.03%	0.02%	0.01%	0.01%	0.04%	0.04%	0.03%	0.02%	0.02%	0.01%	0.01%
Heptachlor [b]	µg/L	0.00005	<9%	--	--	--	--	--	--	<8%	--	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	4%	6%	6%	6%	5%	3%	1%	3%	6%	6%	6%	4%	3%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	2%	1%	1%	0.3%	2%	2%	1%	1%	1%	1%	0.4%
Hexachlorobutadiene	µg/L	14	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Hexachloroethane	µg/L	2.5	<43%	<35%	<28%	<22%	<15%	<10%	<3%	<43%	<36%	<21%	<19%	<14%	<9%	<4%
Isophorone	µg/L	730	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodimethylamine	µg/L	7.3	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.2%	0.3%	0.3%	0.3%	0.2%	0.1%	0.1%	0.2%	0.3%	0.3%	0.3%	0.2%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<43%	<35%	<28%	<22%	<15%	<10%	<3%	<43%	<36%	<21%	<19%	<14%	<9%	<4%
PAHs	µg/L	0.0088	2%	4%	6%	6%	6%	5%	2%	2%	4%	6%	6%	6%	4%	2%
PCBs	µg/L	0.000019	47%	64%	72%	72%	66%	49%	24%	46%	61%	69%	67%	60%	43%	24%

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
TCDD Equivalents [d]	µg/L	3.9E-09	2%	27%	42%	49%	50%	38%	21%	1%	24%	47%	48%	44%	33%	20%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<1%	<1%	<0.3%	<2%	<2%	<1%	<1%	<1%	<1%	<0.3%
Tetrachloroethylene	µg/L	2.0	<3%	<2%	<2%	<2%	<1%	<1%	<0.3%	<3%	<2%	<2%	<2%	<1%	<1%	<0.4%
Toxaphene [e]	µg/L	2.1E-04	3%	27%	42%	47%	48%	36%	20%	3%	24%	45%	46%	43%	32%	19%
Trichloroethylene	µg/L	27	<0.2%	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.1%	<0.03%
1,1,2-Trichloroethane	µg/L	9.4	<1%	<1%	<0.4%	<0.4%	<0.3%	<0.2%	<0.1%	<1%	<1%	<0.4%	<0.3%	<0.3%	<0.2%	<0.1%
2,4,6-Trichlorophenol [b]	µg/L	0.29	--	--	--	--	--	--	<25%	--	--	--	--	--	<75%	<34%
Vinyl chloride	µg/L	36	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.04%	<0.01%	<0.1%	<0.1%	<0.1%	<0.1%	<0.05%	<0.03%	<0.02%

a: Note that if the percentage was determined to be less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the constituent was estimated to be 0.000001% of the objective, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

b: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.

c: All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.

e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A3 – Complete list of estimated concentrations of Ocean Plan constituents at the edge of the ZID for the Variant

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Arsenic	µg/L	8	3.9	4.1	4.1	3.9	3.3	3.3	3.8	4.0	3.9	3.4	3.3	3.3	3.9	4.1	4.1	3.3	3.3	3.3	3.9	3.9	4.0	3.3	3.3	3.3
Cadmium	µg/L	1	0.3	0.2	0.2	0.1	0.02	0.02	0.3	0.2	0.2	0.1	0.03	0.02	0.3	0.2	0.2	0.04	0.03	0.03	0.3	0.3	0.2	0.04	0.03	0.03
Chromium (Hexavalent)	µg/L	2	0.09	0.09	0.09	0.06	0.02	0.02	0.17	0.15	0.11	0.04	0.02	0.02	0.08	0.08	0.07	0.02	0.02	0.02	0.14	0.14	0.11	0.03	0.02	0.02
Copper	µg/L	3	1.9	2.0	2.1	2.1	2.0	2.0	2.3	2.3	2.3	2.1	2.1	2.1	1.9	2.1	2.1	2.0	2.0	2.0	2.3	2.3	2.2	2.1	2.1	2.1
Lead	µg/L	2	0.03	0.05	0.06	0.05	0.02	0.02	0.13	0.12	0.09	0.03	0.02	0.02	0.03	0.05	0.06	0.02	0.02	0.02	0.11	0.11	0.09	0.02	0.02	0.02
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.002	0.002	0.03	0.02	0.01	0.005	0.003	0.002	0.03	0.02	0.01	0.003	0.003	0.003	0.03	0.02	0.02	0.004	0.003	0.003
Nickel	µg/L	5	0.7	0.6	0.5	0.4	0.1	0.1	1.0	0.9	0.6	0.2	0.1	0.1	0.7	0.6	0.5	0.1	0.1	0.1	1.0	0.9	0.7	0.2	0.1	0.1
Selenium	µg/L	15	0.6	0.5	0.4	0.3	0.1	0.1	0.7	0.6	0.4	0.1	0.1	0.1	0.6	0.5	0.4	0.1	0.1	0.1	0.7	0.6	0.5	0.1	0.1	0.1
Silver	µg/L	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Zinc	µg/L	20	8.2	8.7	8.8	8.7	8.3	8.3	10.2	10.1	9.6	8.6	8.4	8.4	8.2	8.7	8.8	8.3	8.3	8.3	9.9	9.9	9.6	8.4	8.4	8.4
Cyanide	µg/L	1	0.6	1.4	1.6	1.4	0.5	0.5	1.5	1.9	1.7	0.7	0.5	0.6	0.6	1.4	1.6	0.5	0.5	0.5	1.3	1.6	1.8	0.6	0.6	0.6
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	39	474	648	581	239	251	1593	1551	1248	473	326	316	34	519	627	212	235	246	1333	1363	1227	335	327	320
Ammonia (as N) - Daily Max	µg/L	2,400	43	540	739	663	273	286	1819	1771	1425	540	372	361	37	591	716	242	268	281	1521	1555	1401	383	373	365
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	5.5	4.8	3.9	2.7	0.7	0.6	7.1	5.9	4.2	1.5	0.9	0.8	5.6	4.6	3.8	0.9	0.8	0.7	6.9	6.4	4.7	1.0	0.9	0.8
Chlorinated Phenolics [b]	µg/L	1	<2.2	<1.8	<1.4	<1.0	<0.2	<0.2	<2.0	<1.6	<1.2	<0.4	<0.2	<0.2	<2.2	<1.7	<1.4	<0.3	<0.3	<0.3	<2.0	<1.9	<1.4	<0.3	<0.3	<0.2
Endosulfan	µg/L	0.009	3E-05	5E-04	7E-04	6E-04	3E-04	3E-04	2E-03	2E-03	1E-03	5E-04	3E-04	3E-04	3E-05	5E-04	7E-04	2E-04	3E-04	3E-04	1E-03	1E-03	1E-03	4E-04	3E-04	3E-04
Endrin	µg/L	0.002	2E-07	1E-06	2E-06	2E-06	6E-07	7E-07	4E-06	4E-06	3E-06	1E-06	9E-07	8E-07	2E-07	1E-06	2E-06	6E-07	6E-07	6E-07	4E-06	4E-06	3E-06	9E-07	9E-07	8E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	4E-05	6E-04	9E-04	8E-04	3E-04	3E-04	2E-03	2E-03	2E-03	7E-04	5E-04	4E-04	4E-05	7E-04	9E-04	3E-04	3E-04	3E-04	2E-03	2E-03	2E-03	5E-04	5E-04	4E-04
Radioactivity (Gross Beta) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of human health – non carcinogens – 30-day average limit																										
Acrolein	µg/L	220	0.2	0.3	0.2	0.2	0.1	0.1	0.5	0.4	0.3	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.4	0.4	0.3	0.1	0.1	0.1
Antimony	µg/L	1200	0.01	0.02	0.02	0.01	0.01	0.01	0.04	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.04	0.03	0.03	0.01	0.01	0.01
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.6	<0.1	<0.1	<0.1
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.6	<0.1	<0.1	<0.1
Chlorobenzene	µg/L	570	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Chromium (III)	µg/L	190000	1.1	0.9	0.7	0.5	0.1	0.1	1.2	1.0	0.7	0.2	0.1	0.1	1.2	0.9	0.7	0.1	0.1	0.1	1.2	1.1	0.8	0.2	0.1	0.1
Di-n-butyl phthalate	µg/L	3500	<1.1	<0.9	<0.7	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.9	<0.6	<0.1	<0.1	<0.1
Dichlorobenzenes	µg/L	5100	0.1	0.1	0.1	0.04	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.01	0.1	0.1	0.1	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.03	<0.03	<0.1	<0.1	<0.1	<0.04	<0.03	<0.03	<0.1	<0.1	<0.1	<0.03	<0.03	<0.03	<0.1	<0.1	<0.1	<0.03	<0.03	<0.03
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.04	<0.01	<0.01	<0.1	<0.1	<0.05	<0.02	<0.01	<0.01	<0.1	<0.1	<0.1	<0.02	<0.02	<0.01	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01
4,6-dinitro-2-methylphenol	µg/L	220	<5.3	<4.1	<3.1	<2.0	<0.4	<0.3	<4.5	<3.5	<2.4	<0.8	<0.4	<0.4	<5.4	<3.9	<3.0	<0.6	<0.5	<0.4	<4.7	<4.2	<2.9	<0.6	<0.5	<0.4
2,4-Dinitrophenol [b]	µg/L	4.0	<5.4	<4.1	<3.0	<1.9	<0.4	<0.3	<4.6	<3.5	<2.3	<0.8	<0.4	<0.3	<5.6	<3.8	<2.9	<0.6	<0.5	<0.4	<4.8	<4.3	<2.8	<0.5	<0.5	<0.4
Ethylbenzene	µg/L	4100	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Fluoranthene	µg/L	15	0.01	0.01	0.01	0.004	0.001	0.001	0.01	0.01	0.005	0.001	0.001	0.001	0.01	0.01	0.01	0.001	0.001	0.001	0.01	0.01	0.01	0.001	0.001	0.001
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.003	<0.003	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003
Nitrobenzene	µg/L	4.9	<2.6	<2.0	<1.4	<0.9	<0.2	<0.1	<2.2	<1.6	<1.1	<0.3	<0.2	<0.1	<2.7	<1.8	<1.4	<0.3	<0.2	<0.2	<2.3	<2.0	<1.3	<0.2	<0.2	<0.2
Thallium	µg/L	2	0.01	0.01	0.01	0.01	0.004	0.004	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.004	0.004	0.004	0.03	0.03	0.02	0.01	0.01	0.01
Toluene	µg/L	85000	0.05	0.05	0.04	0.02	0.01	0.01	0.06	0.05	0.04	0.01	0.01	0.01	0.06	0.04	0.03	0.01	0.01	0.01	0.06	0.06	0.04	0.01	0.01	0.01
Tributyltin [b]	µg/L	0.0014	<0.005	<0.004	<0.003	<0.002	<0.001	<0.001	<0.005	<0.004	<0.003	<0.001	<0.001	<0.001	<0.005	<0.004	<0.003	<0.001	<0.001	<0.001	<0.005	<0.004	<0.003	<0.001	<0.001	<0.001
1,1,1-Trichloroethane	µg/L	540000	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c]	µg/L	0.10	0.002	0.03	0.04	0.03	0.01	0.01	0.1	0.1	0.1	0.03	0.02	0.02	0.001	0.03	0.04	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
Aldrin [b]	µg/L	0.000022	<9E-06	<8E-05	<1E-04	<1E-04	<4E-05	<4E-05	<8E-05	<1E-04	<1E-04	<5E-05	<4E-05	<4E-05	<8E-06	<9E-05	<1E-04	<3E-05	<4E-05	<4E-05	<6E-05	<9E-05	<1E-04	<4E-05	<4E-05	<4E-05
Benzene	µg/L	5.9	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Benzidine [b]	µg/L	0.000069	<5.4	<4.2	<3.1	<2.0	<0.4	<0.3	<4.6	<3.6	<2.4	<0.8	<0.4	<0.4	<5.6	<4.0	<3.0	<0.6	<0.5	<0.5	<4.8	<4.3	<2.9	<0.6	<0.5	<0.4
Beryllium [c]	µg/L	0.033	4E-06	3E-06	2E-06	1E-06	2E-07	4E-07	3E-06	2E-06	1E-06	5E-07	2E-07	2E-07	3E-06	2E-06	1E-06	3E-07	2E-07	2E-07	3E-06	2E-06	1E-06	3E-07	2E-07	2E-07
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.6	<2.0	<1.4	<0.9	<0.2	<0.1	<2.2	<1.7	<1.1	<0.4	<0.2	<0.1	<2.7	<1.8	<1.4	<0.3	<0.2	<0.2	<2.3	<2.0	<1.3	<0.3	<0.2	<0.2
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.9	1.2	1.1	0.4	0.5	2.9	2.9	2.3	0.9	0.6	0.6	0.1	1.0	1.2	0.4	0.4	0.5	2.5	2.5	2.3	0.6	0.6	0.6
Carbon tetrachloride	µg/L	0.90	0.05	0.05	0.04	0.02	0.01	0.01	0.06	0.05	0.04	0.01	0.01	0.01	0.06	0.04	0.03	0.01	0.01	0.01	0.06	0.06	0.04	0.01	0.01	0.01
Chlordane	µg/L	0.000023	2E-06	1E-05	2E-05	2E-05	7E-06	7E-06	5E-05	4E-05	4E-05	1E-05	9E-06	9E-06	2E-06	2E-05	2E-05	6E-06	7E-06	7E-06	4E-05	4E-05	4E-05	1E-05	9E-06	9E-06
Chlorodibromo-methane	µg/L	8.6	0.1	0.1	0.1	0.05	0.02	0.02	0.1	0.1	0.1	0.03	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02
Chloroform	µg/L	130	0.1	0.4	0.5	0.5	0.2	0.2	1.3	1.3	1.0	0.4	0.3	0.3	0.1	0.4	0.5	0.2	0.2	0.2	1.1	1.1	1.0	0.3	0.3	0.3

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																										
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
DDT	µg/L	0.00017	8E-07	1E-05	1E-05	1E-05	5E-06	6E-06	2E-06	1E-05	1E-05	6E-06	5E-06	5E-06	7E-07	1E-05	1E-05	5E-06	5E-06	6E-06	2E-06	6E-06	1E-05	5E-06	5E-06	5E-06
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.04	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.01	0.1	0.1	0.1	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.4	<4.2	<3.1	<2.0	<0.4	<0.3	<4.6	<3.6	<2.4	<0.8	<0.4	<0.4	<5.6	<4.0	<3.0	<0.6	<0.5	<0.4	<4.8	<4.3	<2.9	<0.6	<0.5	<0.4
1,2-Dichloroethane	µg/L	28	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
1,1-Dichloroethylene	µg/L	0.9	0.05	0.05	0.04	0.02	0.01	0.01	0.05	0.04	0.03	0.01	0.01	0.01	0.06	0.04	0.03	0.01	0.01	0.01	0.05	0.05	0.03	0.01	0.01	0.01
Dichlorobromo-methane	µg/L	6.2	0.1	0.1	0.1	0.05	0.02	0.02	0.1	0.1	0.1	0.03	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02
Dichloromethane	µg/L	450	0.05	0.05	0.04	0.03	0.01	0.01	0.08	0.07	0.05	0.02	0.01	0.01	0.06	0.05	0.04	0.01	0.01	0.01	0.07	0.07	0.05	0.01	0.01	0.01
1,3-dichloropropene	µg/L	8.9	0.05	0.05	0.04	0.03	0.01	0.01	0.07	0.05	0.04	0.01	0.01	0.01	0.06	0.04	0.04	0.01	0.01	0.01	0.07	0.06	0.04	0.01	0.01	0.01
Dieldrin	µg/L	0.00004	4E-06	2E-05	2E-05	2E-05	9E-06	9E-06	4E-06	2E-05	2E-05	9E-06	8E-06	8E-06	4E-06	2E-05	2E-05	8E-06	9E-06	9E-06	4E-06	1E-05	2E-05	7E-06	8E-06	8E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.03	<0.04	<0.03	<0.01	<0.01	<0.01	<0.03	<0.03	<0.01	<0.01	<0.01	<0.01	<0.03	<0.03	<0.01	<0.01	<0.01	<0.01	<0.02	<0.03	<0.01	<0.01	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.6	<0.1	<0.1	<0.1
Halomethanes	µg/L	130	0.1	0.1	0.05	0.04	0.01	0.01	0.1	0.1	0.1	0.02	0.01	0.01	0.1	0.1	0.05	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.01	0.01
Heptachlor [b]	µg/L	0.00005	<7E-06	<1E-04	<1E-04	<1E-04	<6E-05	<6E-05	<8E-05	<1E-04	<1E-04	<7E-05	<5E-05	<6E-05	<6E-06	<1E-04	<1E-04	<5E-05	<5E-05	<6E-05	<6E-05	<1E-04	<1E-04	<5E-05	<6E-05	<6E-05
Heptachlor Epoxide	µg/L	0.00002	2E-07	1E-06	1E-06	1E-06	5E-07	5E-07	3E-06	3E-06	3E-06	1E-06	7E-07	7E-07	2E-07	1E-06	1E-06	4E-07	5E-07	5E-07	3E-06	3E-06	3E-06	7E-07	7E-07	7E-07
Hexachlorobenzene	µg/L	0.00021	4E-06	4E-06	3E-06	2E-06	7E-07	6E-07	6E-06	5E-06	4E-06	1E-06	8E-07	8E-07	4E-06	4E-06	3E-06	8E-07	8E-07	7E-07	6E-06	6E-06	4E-06	1E-06	9E-07	8E-07
Hexachlorobutadiene	µg/L	14	3E-08	1E-07	1E-07	1E-07	5E-08	5E-08	4E-07	3E-07	3E-07	1E-07	7E-08	7E-08	3E-08	1E-07	1E-07	5E-08	5E-08	5E-08	3E-07	3E-07	3E-07	7E-08	7E-08	7E-08
Hexachloroethane	µg/L	2.5	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.1	<0.1	<0.1	<1.1	<0.7	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.5	<0.1	<0.1	<0.1
Isophorone	µg/L	730	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
N-Nitrosodimethylamine	µg/L	7.3	0.0003	0.001	0.001	0.001	0.0005	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.0003	0.001	0.001	0.0004	0.0005	0.001	0.001	0.001	0.002	0.001	0.001	0.001
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.0004	0.001	0.0004	0.001	0.001	0.0005	0.0004	0.0004	0.0003	0.001	0.001	0.0004	0.0004	0.0004	0.0003	0.001	0.001	0.0004	0.0004	0.0004
N-Nitrosodiphenylamine	µg/L	2.5	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.1	<0.1	<0.1	<1.1	<0.7	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.5	<0.1	<0.1	<0.1
PAHs	µg/L	0.0088	0.0002	0.0005	0.0007	0.0006	0.0002	0.0002	0.0016	0.0015	0.0012	0.0005	0.0003	0.0003	0.0002	0.0006	0.0007	0.0002	0.0002	0.0002	0.0014	0.0014	0.0012	0.0003	0.0003	0.0003
PCBs	µg/L	0.000019	9E-06	1E-05	1E-05	1E-05	4E-06	4E-06	3E-05	3E-05	2E-05	9E-06	6E-06	5E-06	9E-06	1E-05	1E-05	4E-06	4E-06	4E-06	3E-05	3E-05	2E-05	6E-06	6E-06	6E-06
TCDD Equivalents [c]	µg/L	3.9E-09	1E-10	2E-09	2E-09	2E-09	8E-10	8E-10	5E-09	5E-09	4E-09	2E-09	1E-09	1E-09	8E-11	2E-09	2E-09	7E-10	8E-10	8E-10	4E-09	4E-09	4E-09	1E-09	1E-09	1E-09
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Tetrachloroethylene	µg/L	2.0	<0.1	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.05	<0.03	<0.01	<0.01	<0.01
Toxaphene [e]	µg/L	2.1E-04	7E-06	8E-05	1E-04	1E-04	4E-05	4E-05	3E-04	3E-04	2E-04	8E-05	5E-05	5E-05	7E-06	9E-05	1E-04	4E-05	4E-05	4E-05	2E-04	2E-04	2E-04	6E-05	5E-05	5E-05
Trichloroethylene	µg/L	27	<0.1	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.05	<0.03	<0.01	<0.01	<0.01
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.05	<0.03	<0.01	<0.01	<0.01
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.1	<0.1	<0.1	<1.1	<0.7	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.5	<0.1	<0.1	<0.1
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.02	<0.02	<0.005	<0.01	<0.03	<0.03	<0.02	<0.01	<0.005	<0.004	<0.03	<0.03	<0.02	<0.01	<0.01	<0.005	<0.03	<0.03	<0.02	<0.01	<0.01	<0.005

a: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent.
b: All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A4 – Complete list of estimated concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Arsenic	µg/L	8	49%	52%	51%	48%	41%	41%	48%	50%	48%	42%	41%	41%	49%	51%	51%	41%	41%	41%	48%	49%	49%	41%	41%	41%
Cadmium	µg/L	1	32%	25%	18%	12%	2%	2%	31%	24%	16%	5%	3%	2%	32%	23%	18%	4%	3%	3%	32%	28%	19%	4%	3%	3%
Chromium (Hexavalent)	µg/L	2	5%	5%	4%	3%	1%	1%	8%	7%	5%	2%	1%	1%	4%	4%	4%	1%	1%	1%	7%	7%	5%	1%	1%	1%
Copper	µg/L	3	64%	68%	70%	70%	68%	68%	78%	77%	75%	70%	69%	69%	64%	68%	70%	68%	68%	68%	75%	76%	75%	69%	69%	69%
Lead	µg/L	2	2%	3%	3%	2%	1%	1%	6%	6%	5%	2%	1%	1%	2%	3%	3%	1%	1%	1%	6%	6%	5%	1%	1%	1%
Mercury	µg/L	0.04	66%	52%	38%	25%	6%	5%	65%	50%	34%	12%	7%	6%	68%	49%	37%	9%	8%	7%	66%	59%	40%	9%	8%	7%
Nickel	µg/L	5	14%	13%	11%	8%	2%	2%	21%	17%	13%	4%	3%	2%	14%	12%	11%	3%	2%	2%	20%	18%	14%	3%	3%	3%
Selenium	µg/L	15	4%	3%	3%	2%	0.5%	0.4%	5%	4%	3%	1%	1%	0%	4%	3%	3%	1%	1%	0.5%	5%	4%	3%	1%	1%	1%
Silver	µg/L	0.7	26%	26%	26%	25%	24%	23%	29%	28%	27%	24%	24%	24%	26%	26%	26%	24%	24%	24%	29%	28%	27%	24%	24%	24%
Zinc	µg/L	20	41%	43%	44%	44%	41%	41%	51%	50%	48%	43%	42%	42%	41%	43%	44%	41%	41%	41%	49%	49%	48%	42%	42%	42%
Cyanide	µg/L	1	61%	138%	163%	139%	53%	55%	150%	189%	173%	71%	55%	56%	61%	144%	158%	49%	53%	55%	135%	158%	176%	55%	56%	57%
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	7%	79%	108%	97%	40%	42%	266%	258%	208%	79%	54%	53%	6%	86%	105%	35%	39%	41%	222%	227%	205%	56%	54%	53%
Ammonia (as N) - Daily Max	µg/L	2,400	2%	22%	31%	28%	11%	12%	76%	74%	59%	23%	16%	15%	2%	25%	30%	10%	11%	12%	63%	65%	58%	16%	16%	15%
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	18%	16%	13%	9%	2%	2%	24%	20%	14%	5%	3%	3%	19%	15%	13%	3%	3%	2%	23%	21%	16%	3%	3%	3%
Chlorinated Phenolics [b]	µg/L	1	--	--	--	--	<23%	<21%	--	--	--	<41%	<24%	<22%	--	--	--	<31%	<28%	<25%	--	--	--	<30%	<27%	<24%
Endosulfan	µg/L	0.009	0.4%	6%	8%	7%	3%	3%	19%	18%	15%	6%	4%	4%	0%	6%	7%	3%	3%	3%	16%	16%	15%	4%	4%	4%
Endrin	µg/L	0.002	0.01%	0.1%	0.1%	0.1%	0.03%	0.03%	0.2%	0.2%	0.2%	0.1%	0.04%	0.04%	0.01%	0.1%	0.1%	0.03%	0.03%	0.03%	0.2%	0.2%	0.2%	0.04%	0.04%	0.04%
HCH (Hexachlorocyclohexane)	µg/L	0.004	1%	16%	22%	20%	8%	9%	55%	53%	43%	16%	11%	11%	1%	18%	22%	7%	8%	8%	46%	47%	42%	12%	11%	11%
Radioactivity (Gross Beta) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of human health – non carcinogens – 30-day average limit																										
Acrolein	µg/L	220	0.1%	0.1%	0.1%	0.1%	0.03%	0.03%	0.2%	0.2%	0.1%	0.1%	0.03%	0.03%	0.1%	0.1%	0.1%	0.03%	0.03%	0.03%	0.2%	0.2%	0.2%	0.04%	0.04%	0.03%
Antimony	µg/L	1200	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Bis (2-chloroethoxy) methane	µg/L	4.4	<24%	<19%	<14%	<9%	<2%	<2%	<20%	<16%	<11%	<4%	<2%	<2%	<25%	<18%	<13%	<3%	<2%	<2%	<21%	<19%	<13%	<3%	<2%	<2%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.1%	<0.1%	<0.1%	<0.03%	<0.01%	<0.01%	<0.1%	<0.1%	<0.04%	<0.01%	<0.01%	<0.01%	<0.1%	<0.1%	<0.05%	<0.01%	<0.01%	<0.01%	<0.1%	<0.1%	<0.05%	<0.01%	<0.01%	<0.01%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.03%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<1%	<1%	<0.2%	<0.2%	<2%	<2%	<1%	<0.4%	<0.2%	<0.2%	<2%	<2%	<1%	<0.3%	<0.2%	<0.2%	<2%	<2%	<1%	<0.3%	<0.2%	<0.2%
2,4-Dinitrophenol [b]	µg/L	4.0	--	--	<74%	<47%	<9%	<7%	--	--	<58%	<19%	<10%	<8%	--	--	<72%	<14%	<12%	<10%	--	--	<70%	<14%	<11%	<9%
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.04%	0.02%	<0.01%	<0.01%	0.1%	0.05%	0.03%	0.01%	<0.01%	<0.01%	0.1%	0.1%	0.04%	0.01%	0.01%	<0.01%	0.1%	0.1%	0.04%	0.01%	0.01%	<0.01%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<53%	<40%	<28%	<18%	<3%	<2%	<45%	<34%	<22%	<7%	<4%	<3%	<54%	<37%	<28%	<5%	<5%	<4%	<47%	<42%	<27%	<5%	<4%	<3%
Thallium	µg/L	2	0.3%	1%	1%	1%	0.2%	0.2%	1%	1%	1%	0.4%	0.3%	0.3%	0.3%	1%	1%	0.2%	0.2%	0.2%	1%	1%	1%	0.3%	0.3%	0.3%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [b]	µg/L	0.0014	--	--	--	--	<41%	<36%	--	--	--	<69%	<42%	<37%	--	--	--	<53%	<49%	<44%	--	--	--	<51%	<46%	<42%
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c]	µg/L	0.10	2%	28%	38%	34%	14%	14%	94%	92%	74%	28%	19%	19%	1%	30%	37%	13%	14%	15%	79%	81%	73%	20%	19%	19%
Aldrin [b]	µg/L	0.000022	<41%	--	--	--	--	--	--	--	--	--	--	--	<38%	--	--	--	--	--	--	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<0.4%	<0.1%	<0.1%	<1%	<1%	<0.5%	<0.2%	<0.1%	<0.1%	<1%	<1%	<1%	<0.1%	<0.1%	<0.1%	<1%	<1%	<1%	<0.1%	<0.1%	<0.1%
Benzidine [b]	µg/L	0.000069	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium [c]	µg/L	0.033	0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	0.01 %	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Bis(2-chloroethyl)ether [b]	µg/L	0.045	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	26%	34%	31%	12%	13%	84%	81%	65%	25%	17%	17%	3%	28%	33%	11%	12%	13%	70%	72%	64%	18%	17%	17%
Carbon tetrachloride	µg/L	0.90	6%	5%	4%	3%	1%	1%	7%	6%	4%	1%	1%	1%	6%	5%	4%	1%	1%	1%	7%	6%	5%	1%	1%	1%
Chlordane	µg/L	0.000023	8%	60%	81%	72%	30%	31%	199%	193%	155%	59%	40%	39%	7%	66%	79%	26%	29%	30%	167%	170%	153%	42%	40%	40%
Chlorodibromo-methane	µg/L	8.6	1%	1%	1%	1%	0.2%	0.2%	1%	1%	1%	0.4%	0.2%	0.2%	1%	1%	1%	0.2%	0.2%	0.2%	1%	1%	1%	0.3%	0.2%	0.2%
Chloroform	µg/L	130	0.1%	0.3%	0.4%	0.4%	0.1%	0.2%	1%	1%	1%	0.3%	0.2%	0.2%	0.1%	0.3%	0.4%	0.1%	0.1%	0.2%	1%	1%	1%	0.2%	0.2%	0.2%

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
DDT	µg/L	0.00017	0.5%	6%	9%	8%	3%	3%	1%	6%	7%	3%	3%	3%	0.4%	7%	8%	3%	3%	3%	1%	4%	7%	3%	3%	3%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.2%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%	0.3%	0.3%	0.3%	0.1%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%
3,3-Dichlorobenzidine [b]	µg/L	0.0081	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.1%	<0.1%	<0.02%	<0.02%	<0.2%	<0.1%	<0.1%	<0.04%	<0.02%	<0.02%	<0.2%	<0.2%	<0.1%	<0.03%	<0.03%	<0.02%	<0.2%	<0.2%	<0.1%	<0.03%	<0.02%	<0.02%
1,1-Dichloroethylene	µg/L	0.9	6%	5%	4%	3%	1%	1%	6%	5%	3%	1%	1%	1%	6%	5%	4%	1%	1%	1%	6%	5%	4%	1%	1%	1%
Dichlorobromo-methane	µg/L	6.2	1%	1%	1%	1%	0.3%	0.3%	2%	2%	1%	1%	0.3%	0.3%	1%	1%	1%	0.3%	0.3%	0.3%	2%	2%	2%	0.4%	0.4%	0.3%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	0.02%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	0.02%	0.02%	0.01%	<0.01%	<0.01%	<0.01%
1,3-dichloropropene	µg/L	8.9	1%	1%	0.4%	0.3%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%	1%	0.5%	0.4%	0.1%	0.1%	0.1%	1%	1%	0.5%	0.1%	0.1%	0.1%
Dieldrin	µg/L	0.00004	10%	47%	61%	53%	21%	22%	11%	41%	48%	22%	19%	21%	10%	50%	59%	19%	21%	22%	10%	26%	48%	18%	20%	21%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<0.5%	<1%	<0.4%	<1%	<1%	<0.5%	<0.4%	<0.4%	<0.5%	<1%	<1%	<0.4%	<0.5%	<0.5%	<0.4%	<1%	<1%	<0.4%	<0.4%	<0.4%
1,2-Diphenylhydrazine [b]	µg/L	0.16	--	--	--	--	<51%	<42%	--	--	--	--	<54%	<45%	--	--	--	<76%	<67%	<56%	--	--	--	<72%	<62%	<53%
Halomethanes	µg/L	130	0.04%	0.04%	0.04%	0.03%	0.01%	0.01%	0.1%	0.1%	0.05%	0.02%	0.01%	0.01%	0.04%	0.04%	0.04%	0.01%	0.01%	0.01%	0.1%	0.1%	0.05%	0.01%	0.01%	0.01%
Heptachlor [b]	µg/L	0.00005	<14%	--	--	--	--	--	--	--	--	--	--	--	<12%	--	--	--	--	--	--	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	5%	7%	6%	2%	3%	17%	16%	13%	5%	3%	3%	1%	6%	7%	2%	2%	3%	14%	14%	13%	3%	3%	3%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	1%	0.3%	0.3%	3%	3%	2%	1%	0.4%	0.4%	2%	2%	2%	0.4%	0.4%	0.3%	3%	3%	2%	0.5%	0.4%	0.4%
Hexachlorobutadiene	µg/L	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	µg/L	2.5	<42%	<32%	<23%	<15%	<3%	<2%	<36%	<27%	<18%	<6%	<3%	<2%	<43%	<30%	<23%	<4%	<4%	<3%	<37%	<33%	<22%	<4%	<4%	<3%
Isophorone	µg/L	730	<0.01%	<0.01%	--	--	--	--	<0.01%	<0.01%	--	--	--	--	<0.01%	<0.01%	--	--	--	--	<0.01%	<0.01%	--	--	--	--
N-Nitrosodimethylamine	µg/L	7.3	--	0.01%	0.02%	0.02%	0.01%	0.01%	0.02%	0.02%	0.02%	0.01%	0.01%	0.01%	--	0.02%	0.02%	0.01%	0.01%	0.01%	0.02%	0.02%	0.02%	0.01%	0.01%	0.01%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.3%	0.3%	0.3%	0.1%	0.1%	0.1%	0.2%	0.3%	0.1%	0.1%	0.1%	0.1%	0.3%	0.3%	0.1%	0.1%	0.1%	0.1%	0.2%	0.3%	0.1%	0.1%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<42%	<32%	<23%	<15%	<3%	<2%	<36%	<27%	<18%	<6%	<3%	<2%	<43%	<30%	<23%	<4%	<4%	<3%	<37%	<33%	<22%	<4%	<4%	<3%
PAHs	µg/L	0.0088	2%	6%	8%	7%	3%	3%	18%	18%	14%	5%	4%	3%	2%	7%	7%	2%	3%	3%	16%	16%	14%	4%	4%	4%
PCBs	µg/L	0.000019	47%	71%	77%	63%	22%	23%	169%	156%	121%	45%	30%	28%	47%	73%	74%	22%	23%	23%	149%	147%	124%	32%	30%	29%
TCDD Equivalents [c]	µg/L	3.9E-09	2%	39%	53%	48%	20%	21%	131%	128%	103%	39%	27%	26%	2%	42%	52%	17%	19%	20%	110%	112%	101%	28%	27%	26%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<0.3%	<0.2%	<2%	<2%	<1%	<0.4%	<0.3%	<0.2%	<2%	<2%	<2%	<0.3%	<0.3%	<0.3%	<2%	<2%	<1%	<0.3%	<0.3%	<0.3%
Tetrachloroethylene	µg/L	2.0	3%	2%	2%	1%	0.3%	0.3%	2%	2%	1%	1%	0.3%	0.3%	3%	2%	2%	0.4%	0.4%	0.3%	3%	2%	2%	0.4%	0.3%	0.3%
Toxaphene [e]	µg/L	2.1E-04	4%	38%	51%	46%	19%	20%	126%	122%	98%	37%	26%	25%	3%	41%	50%	17%	19%	19%	105%	108%	97%	26%	26%	25%
Trichloroethylene	µg/L	27	0.2%	0.2%	0.1%	0.1%	0.02%	0.02%	0.2%	0.2%	0.1%	0.04%	0.02%	0.02%	0.2%	0.2%	0.1%	0.03%	0.03%	0.02%	0.2%	0.2%	0.1%	0.03%	0.03%	0.02%
1,1,2-Trichloroethane	µg/L	9.4	1%	0.5%	0.4%	0.3%	0.1%	0.1%	1%	0.4%	0.3%	0.1%	0.1%	0.1%	1%	0.5%	0.4%	0.1%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%
2,4,6-Trichlorophenol [b]	µg/L	0.29	--	--	--	--	25%	20%	--	--	--	51%	27%	21%	--	--	--	39%	33%	27%	--	--	--	37%	31%	26%
Vinyl chloride	µg/L	36	0.1%	0.1%	0.1%	0.05%	0.01%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%	0.01%

a: Note that if the percentage was determined to be less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the constituent was estimated to be 0.000001% of the objective, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.
c: All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Appendix B

Trussell Technologies, Inc (Trussell Tech), 2017. “Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project.” *Technical Memorandum prepared for MRWPCA and MPWMD*. September.

Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project

Technical Memorandum
September 2017

Prepared for:

Partners for Pure Water Solutions

MRWPCA

Monterey Peninsula Water Management District

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Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project

Technical Memorandum

Pure Water Monterey
A Groundwater Replenishment Project

September 2017

Prepared By:

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Table of Contents

1 Executive Summary

Monterey Regional Water Pollution Control Agency (MRWPCA) and the Monterey Peninsula Water Management District ("Project Partners") are implementing the Pure Water Monterey Groundwater Replenishment Project ("Project"). The Project involves treating secondary effluent from MRWPCA's Regional Treatment Plant (RTP) through the proposed Advanced Water Purification Facility (AWPF) and then injecting this highly purified recycled water into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply. The Project will also provide additional tertiary recycled water for agricultural irrigation in the northern Salinas Valley as part of the Castroville Seawater Intrusion Project (CSIP). A waste stream, the reverse osmosis concentrate ("RO concentrate"), will be generated by the AWPF and discharged through the existing MRWPCA ocean outfall, which currently discharges secondary effluent from the RTP. The goal of this technical memorandum is to analyze whether discharge of the Project's RO concentrate to the Pacific Ocean (Monterey Bay) through the existing outfall would comply with numeric water quality objectives in the California Ocean Plan to protect marine aquatic life and human health.

The California Ocean Plan sets forth numeric and narrative water quality objectives for ocean waters with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting (SWRCB, 2015). For typical wastewater discharges, when released from an outfall, the wastewater and ocean water undergo rapid mixing due to the momentum and buoyancy of the discharge. The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge into the ocean. The initial dilution occurs in an area known as the zone of initial dilution (ZID), and the Ocean Plan objectives are to be met at the edge of the ZID. The extent of dilution in the ZID is quantified as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive NPDES permit limits that are applied to a wastewater discharge prior to ocean dilution.

Trussell Technologies, Inc. (Trussell Tech) estimated worst-case in-pipe discharge water quality (*i.e.*, prior to being discharged through the outfall and diluted in the ocean) for the Project and used the dilution modeling results determined by Dr. Philip Roberts to provide an assessment of whether the Project would consistently meet Ocean Plan water quality objectives. The resulting concentrations for each constituent in each scenario were compared to its minimum Ocean Plan objective to assess compliance. The estimated concentrations for eight different flow scenarios are presented in the following technical memorandum (TM) (Tables 3 and 4). None of the constituents are expected to exceed their Ocean Plan objective[1]. Ammonia is estimated to reach a concentration closest to its minimum objective, with the highest estimated concentration at the edge of the ZID at 71% of the objective.

[1] Aldrin, benzidine, 3,3-dichlorobenzidine and heptachlor were not detected in any source waters, however their MRLs are greater than the Ocean Plan objective. Therefore, no percentages are presented Table 4 as no compliance conclusions can be drawn for these constituents. This is a common occurrence for ocean discharges since the MRL is higher than the Ocean Plan objective for some constituents.

The purpose of the analysis documented in this TM was to assess the ability of the Project to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the RTP secondary effluent, RO concentrate, and hauled waste (blended with secondary effluent) for the Project. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and discharge scenario. Compliance assessments could not be made for selected constituents due to analytical limitations, but this is a common occurrence for these Ocean Plan constituents. Based on the data, assumptions, modeling, and analytical methodology presented in this technical memorandum, the Project will comply with all numeric Ocean Plan objectives.

2 Introduction

Monterey Regional Water Pollution Control Agency (MRWPCA) and the Monterey Peninsula Water Management District ("Project Partners") are in the process of implementing the Pure Water Monterey Groundwater Replenishment Project ("Project"). The Project involves treating secondary effluent from MRWPCA's Regional Treatment Plant (RTP) through the proposed Advanced Water Purification Facility (AWPF) and then injecting this highly purified recycled water into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply. The Project will also provide additional tertiary recycled water for agricultural irrigation in the northern Salinas Valley as part of the Castroville Seawater Intrusion Project (CSIP). A waste stream, the reverse osmosis concentrate ("RO concentrate"), will be generated by the AWPF and discharged through the existing MRWPCA ocean outfall, which currently discharges secondary effluent from the RTP. The goal of this technical memorandum is to analyze whether discharge of the Project's RO concentrate to the Pacific Ocean (Monterey Bay) through the existing outfall would comply with numeric water quality objectives in the California Ocean Plan to protect marine aquatic life and human health.

The original version of this document (Trussell Technologies, 2015b) and an addendum report to that document (Trussell Technologies, 2015c) was included in the Project's Consolidated Final Environmental Impact Report (CFEIR). This version has been updated to reflect an increase in capacity of the AWPF to produce more product water and thus more RO concentrate. In addition, new water quality data have been included since the original analysis (including years 2012 – 2017), and the ocean dilution modeling has correspondingly been revised. Further details regarding these updates are included in the following sections.

2.1 Treatment through the RTP and AWPF

The existing RTP treatment process includes screening, primary sedimentation, secondary biological treatment through trickling filters (TFs), followed by a solids contactor (*i.e.*, bio-flocculation), and then clarification (Figure 1). Much of the secondary effluent undergoes tertiary treatment (coagulation, flocculation, granular media filtration and disinfection) to produce recycled water used for agricultural irrigation. The unused secondary effluent is discharged to the Monterey Bay through an existing ocean outfall. The RTP also accepts trucked brine waste ("hauled waste") for ocean disposal, which is stored in a pond and mixed with secondary effluent prior to being discharged.

The AWPF will include several advanced treatment technologies for purifying the secondary effluent water: ozone (O_3), membrane filtration (MF), reverse osmosis (RO), an advanced oxidation process (AOP) using ultraviolet light (UV) and hydrogen peroxide, and finished water stabilization. The Project Partners conducted a pilot-scale study of the ozone, MF, and RO processes of the AWPF from December 2013 through July 2014, successfully demonstrating the ability of the various treatment processes to produce highly-purified recycled water that complies with the California Water Recycling Criteria for Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application (Groundwater Replenishment Regulations) (SWRCB, 2014) and Central Coast Water Quality Control Plan (Basin Plan) standards, objectives and guidelines for groundwater (CCWQCB, 2011). After the pilot-scale study, an advanced water purification demonstration facility was built to gain additional experience operating ozone, MF, and RO processes; the new facility also includes a UV/hydrogen peroxide AOP and stabilization treatment. The demonstration facility is operated and maintained by MRWPCA.

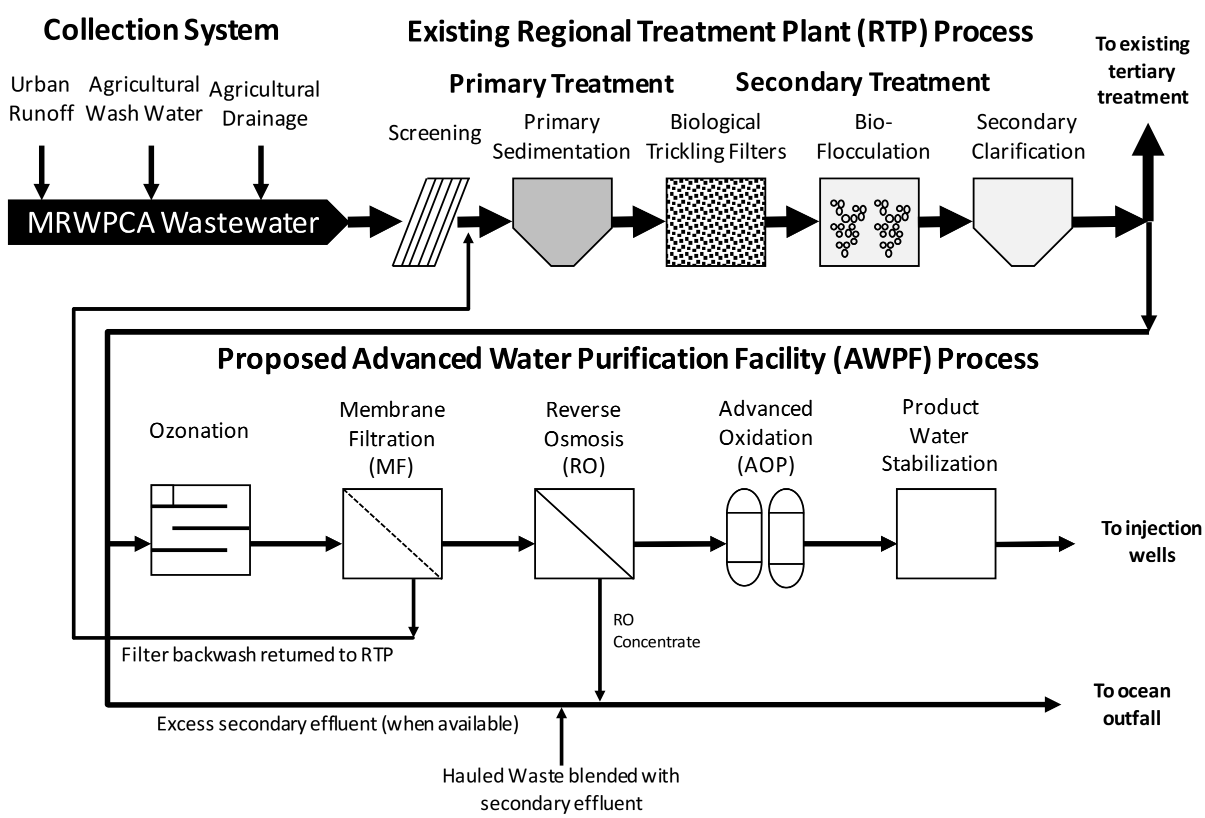

Figure 1 – Simplified diagram of existing MRWPCA RTP and Future AWPF treatment processes

Reverse osmosis is an excellent removal process, separating out most dissolved constituents from the recycled water. The dissolved constituents removed through RO are concentrated into a waste stream known as the RO concentrate. Unlike the waste from the MF, the RO concentrate cannot be recycled back to the RTP headworks and would be discharged through the existing ocean outfall. Discharges through the outfall are subject to National Pollution Discharge Elimination System (NPDES) permitting based on requirements specified in the California State Water Resources Control Board 2015 Ocean Plan ("Ocean Plan") (SWRCB, 2015). Monitoring of the RO concentrate was conducted during the Project's pilot-scale study.

2.2 California Ocean Plan

The California Ocean Plan sets forth numeric and narrative water quality objectives for ocean waters with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting (SWRCB, 2015). For typical wastewater discharges, when released from an outfall, the wastewater and ocean water undergo rapid mixing due to the momentum and buoyancy of the discharge.[2] The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge into the ocean. The initial dilution occurs in an area known as the zone of initial dilution (ZID), and the Ocean Plan objectives are to be met at the edge of the ZID. The extent of dilution in the ZID is quantified as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive NPDES permit limits that are applied to a wastewater discharge prior to ocean dilution.

The current RTP wastewater discharge is governed by Order No. R3-2014-0013 (NPDES permit No. CA0048551) issued by the Central Coast Regional Water Quality Control Board (RWQCB). Because the current NPDES permit for the existing ocean outfall must be amended to include RO concentrate in the waste discharge, comparing future discharge concentrations to current NPDES permit limits would not be an appropriate metric or threshold for determining whether the Project would have a significant impact on marine water quality. Instead, compliance with the Ocean Plan objectives was selected as an appropriate threshold for determining whether the Project would result in a significant impact requiring mitigation. Dilution modeling of the Project's ocean discharge was conducted by Dr. Philip Roberts
, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, to determine D_m values for the various discharge scenarios at different ambient ocean conditions. The dilution modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan.

2.3 Objective of Technical Memorandum

Trussell Technologies, Inc. (Trussell Tech) estimated worst-case in-pipe discharge water quality (*i.e.*, prior to being discharged through the outfall and diluted in the ocean) for the Project and used the dilution modeling results determined by Dr. Roberts to provide an assessment of whether the Project would consistently meet Ocean Plan water quality objectives. The purpose of this technical memorandum (TM) is to summarize the assumptions, methodology, results and conclusions of the Ocean Plan compliance assessment.

3 Methodology for Ocean Plan Compliance Assessment

To analyze impacts due to ocean discharge of RO concentrate, the Project technical team (Trussell Tech with MRWPCA staff) conducted a thorough water quality and flow characterization of the current secondary effluent and the new sources of water to be diverted

[2] Municipal wastewater effluent, being low in salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water.

into the wastewater collection system. After primary and secondary treatment, this effluent will be used as influent to the AWPF. The team collected all available water quality data for secondary effluent and water quality monitoring results for the Project's new source waters through a one-year monitoring program conducted from July 2013 to June 2014. The new source waters included in the monitoring program were agricultural wash water, and waters from the Blanco Drain, Lake El Estero, and Tembladero Slough. Regular monthly and quarterly sampling was carried out for the RTP secondary effluent, agricultural wash water, and Blanco Drain drainage water. Limited sampling of stormwater from Lake El Estero was performed due to seasonal availability, and there was one sampling event for the Tembladero Slough drainage water. Additional data from routine monitoring of the Reclamation Ditch and Salinas Urban Stormwater Runoff was also incorporated into the analysis (for years 2012 to 2017).

Lake El Estero and the Tembladero Slough are no longer included as new source waters for the Project, and so the monitoring data for those source waters were not included in this analysis. For the Reclamation Ditch, water quality data related to the Ocean Plan were only available for ammonia, copper, zinc, arsenic, cadmium, lead, nickel, and total phenols. For the remaining constituents identified in the Ocean Plan, the concentrations in the Reclamation Ditch waters were conservatively assumed to be the higher of either the Blanco Drain or Tembladero Slough concentrations.

Using the full suite of data, the team estimated the future worst-case water quality of the combined ocean discharge. With the results of dilution modeling, concentrations at the edge of the ZID were estimated to determine the ability of the Project to comply with the Ocean Plan objectives. The purpose of this section is to outline the methodology used to make this determination. A summary of the methodology is presented in Figure 2.

3.1 Methodology for Determination of Discharge Water Quality

Water quality data for three types of discharge waters were used to estimate the future combined water quality in the ocean outfall discharge under Project conditions: (1) the RTP secondary effluent, (2) hauled waste (discussed in Section 3.1.3), and (3) the Project RO concentrate. First, Trussell Tech estimated the potential influence of the new source waters (*e.g.*, agricultural wash water, stormwater and agricultural drainage waters) on the worst-case water quality for each of the three types of discharge water. The volumetric contribution of each new source water will change under the different flow scenarios that can occur under the Project. MRWPCA staff worked with Schaaf and Wheeler consultants to estimate the available volume of source waters for each month of the different types of operational years for the Project (Andrew Sterbenz, Schaaf and Wheeler, June 05, 2017). The monthly flows for each source water were estimated for three types of operational years: (1) wet/normal years where a drought reserve is being built, (2) wet/normal years where the drought reserve has been met, and (3) a drought year. All the different flow scenarios were considered in developing the assumed worst-case concentrations for the Ocean Plan constituents in the secondary effluent. This conservative approach used the highest observed concentrations from all data sources for each source water in the analysis[3].

Cyanide has been detected in the RTP effluent and other new source waters (Agricultural Wash Water and the Blanco Drain) at relatively high levels compared to the discharge requirements. The maximum detected value in the RTP effluent was 81 µg/L; the maximum seen in the Agricultural Wash Water and the Blanco Drain was 89 µg/L and 127 µg/L, respectively.

Several investigations have been conducted into the accuracy of sampling, preservation, and analytical methods for cyanide. These have shown that sample holding time and preservation have a significant impact on measured cyanide concentrations. Pandit et al. (2006) demonstrated that when sodium hydroxide was added to adjust the pH higher than 12, as specified in accepted methods for cyanide measurement in order to preserve the sample, the measured cyanide concentrations were consistently higher than those for samples preserved at pH 10 to 11. Pandit et al. also showed that cyanide levels increased within the recommended holding times of the approved cyanide methods (at pH 12).

In addition, the 2015 California Ocean Plan specifies the following:

If a discharger can demonstrate to the satisfaction of the Regional Water Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by the approved method in 40 CFR PART 136, as revised May 14, 1999.

Based on the above information, it is recommended that additional cyanide sampling be conducted using different methods (*e.g.,* analysis within 15 minutes with no preservation) to determine if the current laboratory method leads to inaccurately high cyanide values. It is also recommended to determine if a method can be performed that distinguishes between weakly and strongly complexed cyanide. Until this evaluation is completed, all cyanide concentrations presently available are used in this Ocean Plan compliance assessment.

It was also assumed that no constituent removal occurred through the RTP when considering the new source waters, and so the concentration detected through the source water monitoring program was used to calculate the concentration in the RTP secondary effluent. The exceptions to this statement are dieldrin and DDT. RTP sampling and bench-scale testing were conducted for these constituents to determine removal through the RTP, ozone and MF processes. The minimum removal through the RTP and ozone process was observed to be 91% and 96% for dieldrin and DDT, respectively (Trussell Tech, 2016b). The MF process was observed to remove

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[3] The exception to this statement is copper. The median copper concentration was used to estimate the water quality impact of the additional source waters, as the maximum values detected appear to be outliers. Additionally, the minimum Ocean Plan objective for copper is a 6-month median value, and so it is reasonable to use the median value detected from the new source waters to estimate compliance.

a minimum of 97% and 92% for dieldrin and DDT, respectively (Trussell Tech, 2016b). However, the MF system only removes the constituents from the RO concentrate, as the MF backwash water is returned to the RTP headworks.

Once the estimated worst-case water quality was determined for the RTP secondary effluent, these values were used in estimating the worst-case water qualities for the hauled waste and the RO concentrate, as appropriate. The methodology for each type of water is further described in the following sections.

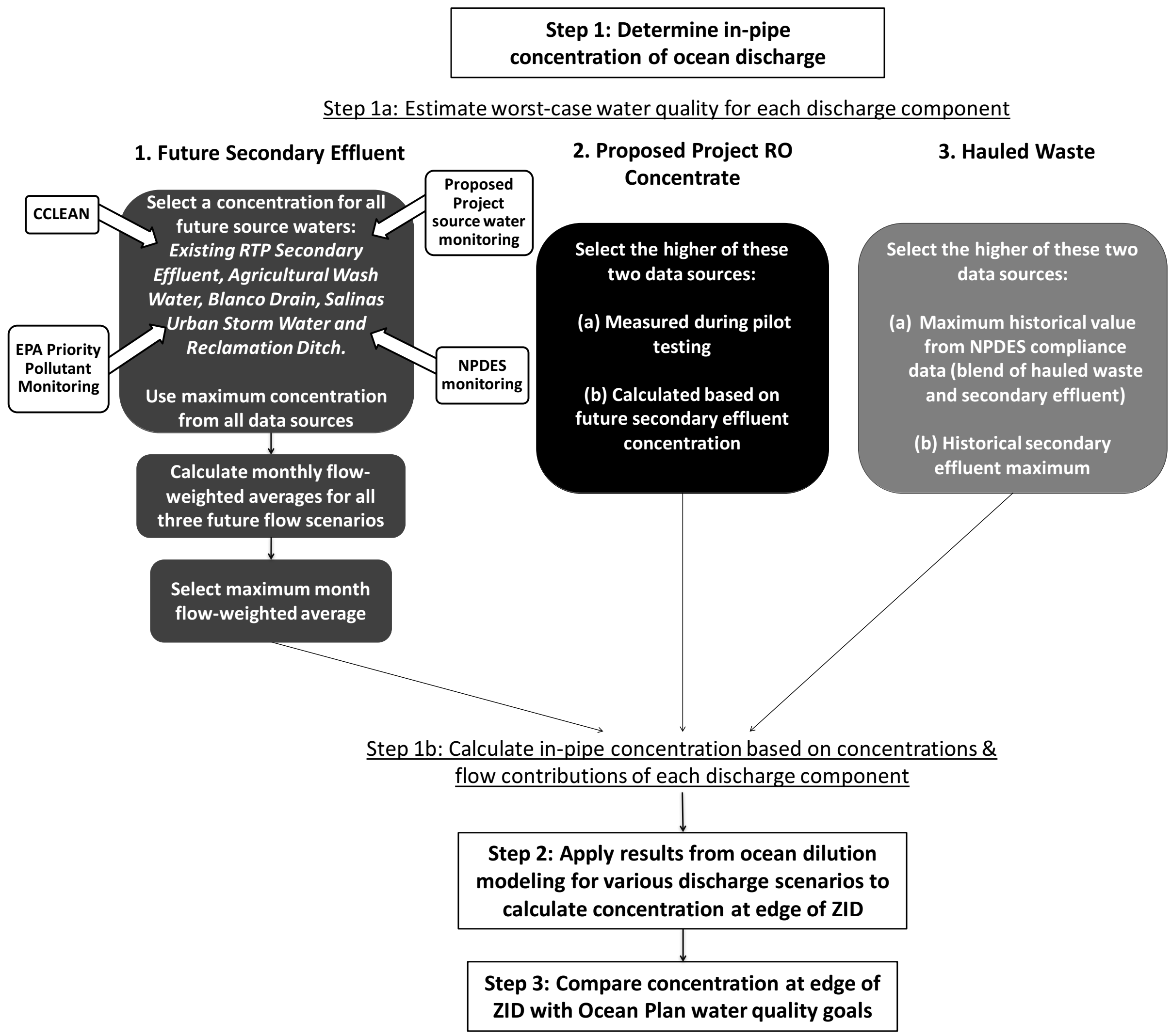

Figure 2 – Logic flow-chart for determination of project compliance with the Ocean Plan objectives

3.1.1 Future Secondary Effluent

The Project involves bringing new source waters into the RTP, and so the water quality of those source waters, as well as the existing secondary effluent, was taken into account to estimate the water quality of the future secondary effluent. Although the new source waters will be brought into the RTP influent, it was assumed that no removal of constituents occurred through the RTP when calculating the secondary effluent concentration (except dieldrin and DDT, as described in the previous section). The following sources of data were considered for selecting an existing secondary effluent concentration for each constituent in the analysis:

- Source water monitoring conducted for the Project from July 2013 through June 2014
- NPDES storm water discharge monitoring for the City of Salinas (2012 – 2017) and the Salinas Industrial Ponds (2017)
- RTP historical NPDES compliance data collected semi-annually by MRWPCA (2005-Spring 2017)
- Historical NPDES RTP Priority Pollutant data collected annually by MRWPCA (2004-2016)
- Data collected semi-annually by the Central Coast Long-Term Environmental Assessment Network (CCLEAN) (2008-2016)

The existing secondary effluent concentration for each constituent selected for the analysis was the maximum reported value from the above sources.

Limited data sources were available for several of the new source waters (*i.e.*, agricultural wash water, Blanco Drain, and the Reclamation Ditch). Agricultural wash water and Blanco Drain water quality data was collected during the source water monitoring conducted for the Project. NPDES storm water discharge monitoring for the City of Salinas (2012 – 2017) and Salinas Industrial Ponds monitoring (2017) provided additional data for the Reclamation Ditch and the agricultural wash water. For these new source waters, the maximum observed concentration was selected for Ocean Plan compliance analysis.[4]

Source water flows used for calculation of blended future secondary effluent concentrations were taken from the three projected operational conditions prepared by MRWPCA: (a) normal/wet year, building reserve, (b) normal/wet year, full reserve, and (c) drought year. For each constituent, a total of 36 future concentrations were calculated – 12 months of the year for the three projected future source water flow contributions. Of these concentrations, the maximum monthly flow-weighted concentration was selected for each constituent to be used for the Ocean Plan compliance analysis.

When a constituent could not be quantified or was not detected, it was reported as less than the Method Reporting Limit (<MRL).[5] Because the actual concentration could be any value equal to or less than the MRL, the conservative approach is to use the value of the MRL in the flow-

[4] Except for copper, where instead the median was calculated from the data for each new source water because the maximum values detected seemed to be outliers, and the Ocean Plan objective for copper considered in this assessment is the 6-month median concentration.

[5] The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (*i.e.*, the lower limit of quantitation). Therefore, acceptable quality control and quality assurance procedures are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the Method Detection Limit (or greater). The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. (40 Code of Federal Regulations Section136 Appendix B).

weighting calculations. In some cases, constituents were not detected above the MRL in any of the source waters, so the concentrations for these constituents were reported as ND (<MRL) in this TM. In cases where the analysis of a constituent was detected but was not quantifiable, the results were also reported in this TM as less than the Method Reporting Limit, ND (<MRL). For some non-detected constituents, the MRL exceeds the Ocean Plan objective, and thus no compliance determination could be made.[6]

The following approaches were used for addressing the cases where a constituent was reported as less than the MRL:

- **Aggregate constituents with multiple congeners or sub-components:** Some Ocean Plan constituents are a combination of multiple congeners or sub-components (*e.g.*, chlordane, PAHs, PCBs, and TCDD equivalents, among others). Per the Ocean Plan, if individual congeners or sub-components are below the MRL, they are assumed to be zero for the purposes of calculating the aggregate parameter.
- **Combining different types of waters:** The same approach was used for both combining different source waters (*i.e.*, estimating future secondary effluent concentrations based on a flow-weighted average of source water contributions) and for combining the different discharge components (*i.e.*, RTP secondary effluent, hauled waste, and RO concentrate). For each constituent:
  - ***When all waters had maximum values reported above the MRL*:** The flow-weighted average of the maximum detected concentrations was used when all waters had values reported above the MRL.
  - ***When some or all waters had maximum values reported as less than the MRL*:**
    - When the MRL was at least two orders of magnitude greater (*i.e.*, at least 100 times greater) than the highest detected value from the other waters, the waters with maximum concentrations below the MRL were ignored. This case is exclusive to times when CCLEAN data were reported as detections for the RTP secondary effluent, and all the other source waters were below the MRL[7] (*i.e.*, hexachlorobutadiene was detected at a concentration of 9.0×10^{-6} µg/L in the secondary effluent via CCLEAN, and the MRL of all other source waters was 0.5 µg/L). The analytical methods used for CCLEAN can detect concentrations many orders of magnitude below the detection limits for traditional methods, and thus to include the MRL value from the other methods would overshadow the CCLEAN data. Additionally, in cases where the traditional analytical method had an MRL greater than the Ocean Plan objective, performing the analysis using the high MRL from the non-CCLEAN methods would result in an inability to make a compliance determination for these constituents.

[6] This phenomenon is common in the implementation of the Ocean Plan where for some constituents, suitable analytical methods are not capable of measuring low enough to quantify the minimum toxicologically relevant concentrations. For these constituents, a discharge is considered compliant if the monitoring results are less than the MRL.

[7] Specifically, this case applies to endrin, fluoranthene, chlordane, heptachlor epoxide, hexachlorobenzene, hexachlorobutadiene, PCBs, and toxaphene.

- When the MRL was less than two orders of magnitude greater (*i.e.*, less than 100 times greater) than the highest detected value from the other waters, the constituents were reported as less than the MRL and were assumed to have a concentration equal to the MRL for the purposes of calculating a flow-weighted average (*i.e.*, mercury was detected in the secondary effluent at a concentration of 0.019 µg/L, but was not detected in any other source waters, where the MRL was 0.2 µg/L).

3.1.2 GWR RO Concentrate

Two potential worst-case estimates of constituent concentrations were available for assessing the Project's RO concentrate:

- Measured in the concentrate during pilot testing
- Calculated from the blended future secondary effluent concentration, using the following treatment assumptions[8]:
    - No removal prior to the RO process (*i.e.*, no removal through the RTP or AWPF ozone or MF), except for dieldrin and DDT
    - 81% RO recovery (*i.e.*, of the water feeding into the RO system, 81% is product water, also known as permeate, and 19% is the RO concentrate)
    - Complete rejection of each constituent by the RO membrane (i.e., 100% of the constituent is in the RO concentrate)

The higher of these two values was selected as the final concentration of the RO concentrate for all constituents, except as noted in the Table 1 footnotes.

3.1.3 Hauled Waste

Currently, small volumes of brine are trucked to the RTP and blended with secondary effluent in a brine pond. The blended waste from this pond ("hauled waste") is then discharged along with the secondary effluent bound for ocean discharge (when there is excess secondary effluent to discharge). For the Project, the hauled waste will be discharged with both secondary effluent and RO concentrate (see Figure 1). The point where the hauled waste is added to the ocean discharge water is downstream of the AWPF intake, and thus will not impact the quality of the Project product water or the RO concentrate. Currently, all sampling of the hauled waste takes place after dilution by secondary effluent in the brine pond, so the data represent a mix of secondary effluent and brine water. It is appropriate to use these data for the hauled waste quality since the practice of diluting with secondary effluent will continue in the future. Two potential values were available for the hauled waste constituent concentrations:

- Historical NPDES compliance data collected semi-annually by MRWPCA (2005-Spring 2017) of hauled waste water diluted with existing secondary effluent
- Calculated future secondary effluent constituent concentrations, as previously described.

The higher of these two values was selected for all constituents; because the hauled waste is diluted by secondary effluent prior to discharge, it is also appropriate to use future secondary effluent concentrations to represent the concentration within the hauled waste. Even if a

[8] Based on the treatment assumptions, the RO concentrate would equal 5.3 times the AWPF influent (*i.e.*, blended future secondary effluent) concentration.

constituent was not present in the hauled waste, if it was present in the secondary effluent it would be present in the combined discharge.

3.1.4 Combined Ocean Discharge Concentrations

Having calculated the worst-case future concentrations for each of the three discharge components (i.e., secondary effluent, RO concentrate, blended hauled waste), the combined concentration prior to discharge was determined as a flow-weighted average of the contributions of each of these three discharge components. Depending on drought conditions and water usage for agricultural irrigation, the amount of secondary effluent discharged to the ocean will vary. A range of potential discharge scenarios was considered to encompass the worst-case water quality conditions of the combined discharge, as described in Section 4.2.

3.2 Ocean Modeling and Ocean Plan Compliance Analysis Methodology

In order to determine Ocean Plan compliance, Trussell Tech used the following information: (1) the in-pipe concentration (*i.e.*, pre-ocean dilution) of a constituent ($C_{in\text{-}pipe}$) that was calculated as discussed in the previous section, (2) the minimum probable dilution for ocean mixing (D_m) for the relevant discharge flow scenarios that was modeled by Dr. Roberts[9] (Roberts, P. J. W, 2017), and (3) the background concentration of the constituent in the ocean ($C_{Background}$) that is specified in the Ocean Plan's "Table 3." With this information, the concentration at the edge of the zone of initial dilution (C_{ZID}) was calculated using the following equation:

$$C_{ZID} = \frac{C_{In-pipe} + D_m * C_{Background}}{1 + D_m} \qquad (1)$$

The C_{ZID} was then compared to the Ocean Plan objectives[10] in the Ocean Plan's "Table 1" (SWRCB, 2015). As described previously, the in-pipe concentration was estimated as a flow-weighted average of the future secondary effluent, Project RO concentrate, and hauled waste with the concentrations determined as discussed above. The D_m values for various flow scenarios were determined by modeling. Note that this approach could not be applied for some constituents (*e.g.*, acute toxicity, chronic toxicity, and radioactivity[11]).

[9] The Ocean Plan defines D_m differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S – 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

[10] Note that the Ocean Plan (see Ocean Plan Table 2) also defines effluent limitations for oil and grease, suspended solids, settable solids, turbidity, and pH. These parameters were not evaluated in this assessment. It is assumed that, if necessary, the pH of the water would be adjusted to be within acceptable limits prior to discharge; the current AWPF design does not include to ability to change the RO concentrate pH because pilot testing and RO performance modeling indicated it was not necessary. Oil and grease, suspended solids, settable solids, and turbidity in the RO concentrate would be significantly lower than the secondary effluent. Prior to the RO treatment, the process flow would be treated by MF, which will reduce these parameters, and the waste stream from the MF will be returned to RTP headworks.

[11] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives (Trussell

Two methods were used when modeling the ocean mixing: (1) the mathematical model UM_3 in the United States Environmental Protection Agency's (EPA's) Visual Plume suite, and (2) the NRFIELD model (for positively buoyant plumes only), also from the EPA's Visual Plume suite (Roberts, P. J. W., 2017). When results were provided from both methods, the D_m value estimated with the UM_3 model was selected for consistency, such that all dilution results used for this analysis were determined using the same model.

Dr. Roberts documented the dilution modeling assumptions and results in a technical memorandum (Roberts, P. J. W., 2017, Appendix A). Additional analysis assumptions were made as follows:

- **Flow**: A sensitivity analysis of the relationship between D_m and flow rate was performed for the various discharge types. The greatest D_m sensitivity to flow changes was determined to be from variations in the RTP secondary effluent flow. To simplify the analysis, the flow scenarios used in the compliance analysis only considered the maximum flows for the hauled waste and the RO concentrate because these flows result in the lowest D_m, thus making the analysis conservative. The flows considered for each discharge type are as follows:
  - ***Secondary effluent*:** a range of conditions was modeled that reflect realistic future discharge scenarios (minimum flow, moderate flow, and maximum flow).
  - ***Project RO concentrate*:** 1.17 million gallons per day (mgd), which would be the resulting RO concentrate flow when the AWPF is producing 5.0 mgd of highly-purified recycled water (corresponding AWPF influent is 6.86 mgd of RTP secondary effluent). Although the AWPF will not be operated at this influent flowrate year-round, this is the highest potential RO concentrate flow and therefore the most conservative assessment.
  - ***Hauled waste:*** A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded when determining the D_m value. However, the impact of hauled waste on assumed in-pipe water quality was still assessed. A hauled waste flow of 0.03 mgd blended with secondary effluent for a total flow of 0.1 mgd was used for calculating the in-pipe concentrations of each constituent.
- **Total Dissolved Solids (TDS)**: the greatest dilution is achieved when the salinity of the discharge water is lower and the most different from the ambient ocean salinity; therefore, the most conservative TDS will be the highest (*i.e.*, closest to ambient salinity) of:
  - ***Secondary effluent:*** 1,100 milligram per liter (mg/L), which is the maximum expected future TDS, taking into account the flow contribution of each source water and the maximum observed TDS value from each source water

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Technologies, 2015c and 2016a). Current discharges of the secondary effluent and hauled waste are monitored semiannually for acute toxicity, chronic toxicity, and radioactivity per the existing NPDES permit. See section 4.4.

  - ***Project RO concentrate*:** 5,800 mg/L, which is the maximum expected future TDS based on the maximum expected future secondary effluent TDS and the RO treatment assumptions listed in the section above (*i.e.* in a drought year).
- **Ocean salinity**: 33,340 mg/L – 33,890 mg/L, depending on the ocean condition
- **Temperature**:
  - ***Secondary effluent*:** 20˚C
  - ***Project RO concentrate***: 20˚C

An additional consideration of the ocean dilution modeling is the variation in ocean conditions throughout the year. Three conditions were modeled for all flow scenarios: Davidson (December to February), Upwelling (March to September), and Oceanic (October to November)[12]. To conservatively demonstrate Ocean Plan compliance, the lowest D_m from the applicable ocean conditions was used for each flow scenario.

Ocean dilution modeling covered the range of potential operating conditions, and the results showed that Ocean Plan compliance would be achieved when considering all potential secondary effluent flowrates. To simplify the calculation and presentation of these results, representative flowrate ranges were chosen. To select the representative flow scenarios for compliance assessment, the balance between in-pipe dilution and dilution through the outfall was considered. In general, higher secondary effluent flows discharged to the ocean would provide dilution of the Project RO concentrate; however, greater dilution due to ocean water mixing would be provided at lower wastewater discharge flows. The balance of these influences was considered in determining compliance under the eight representative discharge conditions that are described in Section 4.2 for the Project.

4 Ocean Plan Compliance Results

4.1 Water Quality of Combined Discharge

As described above, the first step in the Ocean Plan compliance analysis was to estimate the worst-case water quality for each of the three future discharge components: future RTP effluent, Project RO concentrate, and blended hauled waste. A summary of the estimated water qualities of these components is given in Table 1. Additional considerations and assumptions for each constituent are documented in the Table 1 notes section.

Table 1 – Summary of estimated worst-case water quality for the three waste streams that would be discharged through the ocean outfall

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Ocean Plan water quality objectives for protection of marine aquatic life					
Arsenic	µg/L	45	45	12	1,12
Cadmium	µg/L	1.2	1.2	6.5	2,11
Chromium (Hexavalent)	µg/L	2.5	130	13	2,11

[12] Note that these ranges assign the transitional months (March, September, and November) to the ocean condition that is typically more restrictive at relevant discharge flows.

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Copper	µg/L	11	39	58	2,11,17
Lead	µg/L	2.69	2.69	14.2	2,11
Mercury	µg/L	0.085	0.085	0.510	5,12
Nickel	µg/L	12.2	12.2	64	2,11
Selenium	µg/L	6.4	75	34	2,11
Silver	µg/L	0.77	0.77	4.05	5,11
Zinc	µg/L	57.5	170	303	2,11
Cyanide	µg/L	89.7	89.7	143	2,12,13
Total Chlorine Residual	µg/L	ND(<200)	ND(<200)	ND(<200)	10
Ammonia (as N), 6-month median	µg/L	42,900	42,900	225,789	1,11,18
Ammonia (as N), daily maximum	µg/L	49,000	49,000	257,895	1,11,18
Acute Toxicity	TUa	2.3	2.3	0.77	7,12,13
Chronic Toxicity	TUc	40	40	100	7,12,13
Phenolic Compounds (non-chlorinated)	µg/L	69	69	363	1,9,11
Chlorinated Phenolics	µg/L	ND(<20)	ND(<20)	ND(<20)	4,14
Endosulfan	µg/L	0.046	0.046	0.24	5,9,11
Endrin	µg/L	0.000112	0.000112	0.00059	3,11
HCH (Hexachlorocyclohexane)	µg/L	0.059	0.059	0.312	5,9,11
Radioactivity (Gross Beta)	pCi/L	32	307	34.8	1,7,12,13
Radioactivity (Gross Alpha)	pCi/L	18	457	14.4	1,7,12,13
Objectives for protection of human health - noncarcinogens					
Acrolein	µg/L	8.3	8.3	44	2,11
Antimony	µg/L	0.78	0.78	4.1	2 ,11
Bis (2-chloroethoxy) methane	µg/L	ND(<4.0)	ND(<4.0)	ND(<1)	4,14
Bis (2-chloroisopropyl) ether	µg/L	ND(<4.0)	ND(<4.0)	ND(<1)	4,14
Chlorobenzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Chromium (III)	µg/L	6.9	87	36	2,11
Di-n-butyl phthalate	µg/L	ND(<7)	ND(<7)	ND(<1)	4,14
Dichlorobenzenes	µg/L	1.6	1.6	8	5,11
Diethyl phthalate	µg/L	ND(<5)	ND(<5)	ND(<1)	4,14
Dimethyl phthalate	µg/L	ND(<2)	ND(<2)	ND(<0.5)	4,14
4,6-dinitro-2-methylphenol	µg/L	ND(<19)	ND(<19)	ND(<5)	4,14
2,4-dinitrophenol	µg/L	ND(<9)	ND(<9)	ND(<5)	4,14
Ethylbenzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Fluoranthene	µg/L	0.00684	0.00684	0.0360	3,11
Hexachlorocyclopentadiene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.05)	4,14
Nitrobenzene	µg/L	ND(<2.1)	ND(<2.1)	ND(<1)	4,14
Thallium	µg/L	0.68	0.68	3.6	2,11
Toluene	µg/L	0.48	0.48	2.5	5,11
Tributyltin	µg/L	ND(<0.05)	ND(<0.05)	ND(<0.02)	8,14
1,1,1-trichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Objectives for protection of human health - carcinogens					
Acrylonitrile	µg/L	2.5	2.5	13	2,11
Aldrin	µg/L	ND(<0.007)	ND(<0.007)	ND(<0.01)	4,14
Benzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Benzidine	µg/L	ND(<18.6)	ND(<18.6)	ND(<0.05)	4,14
Beryllium	µg/L	ND(<0.68)	0.0052	ND(<0.5)	4,14
Bis(2-chloroethyl)ether	µg/L	ND(<4.0)	ND(<4.0)	ND(<1)	4,14
Bis(2-ethyl-hexyl)phthalate	µg/L	78	78	411	1,11
Carbon tetrachloride	µg/L	0.50	0.50	2.66	2,11
Chlordane	µg/L	0.00122	0.00122	0.0064	3,9,11
Chlorodibromomethane	µg/L	2.2	2.2	12	2,11

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Chloroform	µg/L	34	34	180	2,11
DDT	µg/L	0.001	0.001	0.0003	2,9,11,15
1,4-dichlorobenzene	µg/L	1.6	1.6	8.4	1,11
3,3-dichlorobenzidine	µg/L	ND(<18)	ND(<18)	ND(<2)	4,14
1,2-dichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
1,1-dichloroethylene	µg/L	ND(<0.5)	0.5	ND(<0.5)	4,14
Dichlorobromomethane	µg/L	2.4	2.4	12	2,11
Dichloromethane (methylenechloride)	µg/L	0.88	0.88	4.6	2,11
1,3-dichloropropene	µg/L	0.56	0.56	3.0	2,11
Dieldrin	µg/L	0.0015	0.0015	0.0001	2,11,15
2,4-dinitrotoluene	µg/L	ND(<2)	ND(<2)	ND(<0.1)	4,14
1,2-diphenylhydrazine (azobenzene)	µg/L	ND(<4)	ND(<4)	ND(<1)	4,14
Halomethanes	µg/L	1.3	1.3	6.9	2,9,11
Heptachlor	µg/L	ND(<0.01)	ND(<0.01)	ND(<0.01)	4,14
Heptachlor epoxide	µg/L	0.000088	0.000088	0.000463	3,11
Hexachlorobenzene	µg/L	0.000078	0.000078	0.000411	3,11
Hexachlorobutadiene	µg/L	0.000009	0.000009	0.000047	3,11
Hexachloroethane	µg/L	ND(<2.1)	ND(<2.1)	ND(<0.5)	4,14
Isophorone	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
N-Nitrosodimethylamine	µg/L	0.086	0.086	0.150	2,12,13
N-Nitrosodi-N-Propylamine	µg/L	0.076	0.076	0.019	1,12,13
N-Nitrosodiphenylamine	µg/L	ND(<2.1)	ND(<2.1)	ND(<1)	4,14
PAHs	µg/L	0.04	0.04	0.21	2,9,11
PCBs	µg/L	0.00068	0.00068	0.00357	3,9,11
TCDD Equivalents	µg/L	1.39E-7	1.39E-7	7.29E-7	2,8,9,11
1,1,2,2-tetrachloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Tetrachloroethylene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Toxaphene	µg/L	0.0071	0.0071	0.0373	3,11
Trichloroethylene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
1,1,2-trichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
2,4,6-trichlorophenol	µg/L	ND(<2.1)	ND(<2.1)	ND(<1)	4,14
Vinyl chloride	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14

Table 1 Notes:

RTP Effluent and Hauled Waste Data

[1] Existing RTP effluent exceeds concentrations observed in other proposed source waters; the value reported is the existing secondary effluent value.

[2] The proposed new source waters may increase the secondary effluent concentration; the value reported is based on estimated source water blends.

[3] RTP effluent value is based on CCLEAN data; no other source waters were considered due to MRL differences.

[4] MRL provided represents the maximum flow-weighted MRL based on the blend of source waters.

[5] The only water with a detected concentration was the RTP effluent, however the flow-weighted concentration increases due to higher MRLs for the proposed new source waters.

[6] Additional source water data are not available; the reported value is for RTP effluent.

[7] Calculation of the flow-weighted concentration was not feasible due to the constituent, and so the maximum observed value is reported.

[8] Agricultural Wash Water data are based on an aerated sample, instead of a raw water sample.

[9] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.

[10] For all waters, dechlorination will be provided when needed such that the total chlorine residual will be below detection.

RO Concentrate Data
[11] The value presented represents a calculated value assuming no removal prior to RO, complete rejection through RO membrane, and an 81% RO recovery.
[12] The value represents the maximum value observed during the pilot testing study.
[13] The calculated value for the RO concentrate data (described in note 11) was not used in the analysis because it was not considered representative. It is expected that the value would increase as a result of treatment through the AWPF (*e.g.* formation of N-Nitrosodimethylamine as a disinfection by-product), or that it will not concentrate linearly through the RO (*e.g.* toxicity and radioactivity).
[14] The MRL provided represents the limit from the source water and pilot testing monitoring programs.
[15] The value presented represents a calculated value assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, 36% and 44% removal through ozone for DDT and dieldrin, respectively, 92% and 97% removal through MF for DDT and dieldrin, respectively, recycling of the MF backwash to the RTP, complete rejection through the RO membrane, and an 81% RO recovery. The assumed removals are based on results from ozone bench-scale testing of Blanco Drain water blended with secondary effluent and low detection sampling through the RTP.

General
[16] Footnote not used
[17] The value reported for the secondary effluent was calculated using the median of the data collected for the new source waters and is an estimate of the potential increase in concentration of the secondary effluent based on estimated source water blends. The median value was used because the maximum values detected in new source waters appear to be outliers, and because the Ocean Plan objective is a 6-month median concentration, it is reasonable to use the median value detected from these source waters.
[18] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).

4.2 Ocean Modeling Results

Dr. Roberts performed dilution modeling of various discharge scenarios that included combinations of RTP secondary effluent, hauled waste, and Project RO concentrate (Appendix A, Table C3). Year-round compliance with the Ocean Plan objectives was assessed through the evaluation of eight representative discharge scenarios covering the expected range of secondary effluent discharge flows. All scenarios assume the maximum flow rates for the RO concentrate and hauled waste, which is a conservative assumption in terms of constituent loading and minimum dilution.

To assess potential future discharge compositions, various secondary effluent flow rates were included in this analysis. These scenarios encompass the range of operating conditions that is expected to occur for the Project, as well as the best- and worse-case ocean dilution conditions. The eight scenarios used for the compliance assessment, in terms of secondary effluent flow rates to be discharged with the other waste streams, are shown in Table 2, and include:

- **Minimum Wastewater Flow (Upwelling) – Scenario 1:** the maximum influence of the Project RO concentrate on the ocean discharge (*i.e.*, no secondary effluent discharged). The Upwelling ocean condition was used since it represents the worst-case dilution for this flow scenario.
- **Low Wastewater Flow (Upwelling) – Scenarios 2-3:** significant influence of the Project RO concentrate on the ocean discharge (*i.e.*, minimal secondary effluent discharged). The

Upwelling ocean condition was used as it represents the worst-case dilution for this flow scenario.

- **Moderate Wastewater Flow (Upwelling) – Scenarios 4-7:** conditions with a moderate wastewater flow when the Project RO concentrate has a greater influence on the in-pipe water quality than in Scenario 8, but where the ocean dilution (D_m) is reduced due to the higher overall discharge flow (*i.e.*, compared to Scenarios 1-3). The Upwelling ocean condition was used as it represents the worst-case dilution for these scenarios.
- **High Wastewater Flow (Upwelling) – Scenario 8:** the highest expected flow that will be discharged. The Upwelling ocean condition was used as it represents the worst-case dilution for this flow scenario.

Table 2 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis

No.	Discharge Scenario (Ocean Condition)	Flows (mgd)			D_m
		Secondary Effluent	RO Concentrate	Blended Hauled Waste[1]	
1	Minimum wastewater flow (Upwelling)	0	1.17	0	498
2	Low wastewater flow (Upwelling)	0.4	1.17	0	460
3	Low Wastewater Flow (Upwelling)	0.6	1.17	0	442
4	Moderate wastewater flow (Upwelling)	2	1.17	0	358
5	Moderate wastewater flow (Upwelling)	4	1.17	0	299
6	Moderate wastewater flow (Upwelling)	4.5	1.17	0	289
7	Moderate wastewater flow (Upwelling)	5	1.17	0	281
8	High wastewater flow (Upwelling)	23.4	1.17	0	174

[1]A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded from the D_m calculation.

4.3 Ocean Plan Compliance Results

The flow-weighted in-pipe concentration for each constituent was calculated for each modeled discharge scenario using the water quality presented in Table 1 and the flows presented in Table 2. The in-pipe concentration was then used to calculate the concentration at the edge of the ZID using the D_m values presented in Table 2[13]. The resulting concentrations for each constituent in each scenario were compared to the Ocean Plan objective to assess compliance. The estimated concentrations for all eight flow scenarios are presented as concentrations at the edge of the ZID

[13] The Ocean Plan defines D_m differently than Dr. Roberts. Dr. Roberts provided dilution results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as D_m = S – 1. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

(Table 3) and as a percentage of the Ocean Plan objective (Table 4). As shown, none of the constituents are expected to exceed their Ocean Plan objective[14]. Ammonia is estimated to reach a concentration closest to its objective, where it is 71% of the objective in Scenario 1.

Table 3 – Estimated concentrations of Ocean Plan constituents at the edge of the ZID

Constituent	Units	Ocean Plan Objective	Estimated Concentrations at Edge of ZID by Discharge Scenario							
			1	2	3	4	5	6	7	8
Objectives for protection of marine aquatic life										
Arsenic	µg/L	8	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.2
Cadmium	µg/L	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chromium (Hexavalent)	µg/L	2	0.04	0.04	0.04	0.03	0.02	0.02	0.02	0.02
Copper	µg/L	3	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Lead	µg/L	2	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mercury	µg/L	0.04	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	µg/L	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Selenium	µg/L	15	0.1	0.1	0.1	0.05	0.05	0.05	0.04	0.05
Silver	µg/L	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Zinc	µg/L	20	8.6	8.5	8.5	8.4	8.4	8.3	8.3	8.4
Cyanide	µg/L	1	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	424	371	355	302	278	276	273	295
Ammonia (as N) - Daily Max	µg/L	2,400	484	424	406	345	318	315	312	337
Acute Toxicity[a]	TUa	0.3								
Chronic Toxicity[a]	TUc	1								
Phenolic Compounds (non-chlorinated)	µg/L	30	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.5
Chlorinated Phenolics	µg/L	1	0.04	0.04	0.05	0.1	0.1	0.1	0.1	0.1
Endosulfan	µg/L	0.009	4.5E-04	4.0E-04	3.8E-04	3.2E-04	3.0E-04	3.0E-04	2.9E-04	3.2E-04
Endrin	µg/L	0.002	1.1E-06	9.7E-07	9.3E-07	7.9E-07	7.3E-07	7.2E-07	7.1E-07	7.7E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	5.9E-04	5.1E-04	4.9E-04	4.2E-04	3.9E-04	3.8E-04	3.8E-04	4.1E-04
Radioactivity (Gross Beta)[a]	pci/L	–								
Radioactivity (Gross Alpha)[a]	pci/L	–								
Objectives for protection of human health - noncarcinogens										
Acrolein	µg/L	220	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Antimony	µg/L	1200	0.01	0.01	0.01	0.01	0.01	0.005	0.005	0.01
Bis (2-chloroethoxy) methane	µg/L	4.4	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Chlorobenzene	µg/L	570	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Chromium (III)	µg/L	190000	0.1	0.1	0.1	0.06	0.05	0.05	0.05	0.05
Di-n-butyl phthalate	µg/L	3500	<0.003	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.04
Dichlorobenzenes	µg/L	5100	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Diethyl phthalate	µg/L	33000	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02	<0.03

[14] Aldrin, benzidine, 3,3-dichlorobenzidine and heptachlor were not detected in any source waters, however their MRLs are greater than the Ocean Plan objective. Therefore, no percentages are presented Table 4 as no compliance conclusions can be drawn for these constituents. This is a common occurrence for ocean discharges since the MRL is higher than the ocean plan objective for some constituents.

Constituent	Units	Ocean Plan Objective	Estimated Concentrations at Edge of ZID by Discharge Scenario							
			1	2	3	4	5	6	7	8
Dimethyl phthalate	µg/L	820000	<0.001	<0.002	<0.002	<0.00	<0.01	<0.01	<0.01	<0.01
4,6-dinitro-2-methylphenol	µg/L	220	<0.01	<0.02	<0.02	<0.04	<0.1	<0.1	<0.1	<0.1
2,4-Dinitrophenol	µg/L	4.0	<0.01	<0.01	<0.01	<0.02	<0.03	<0.03	<0.03	<0.05
Ethylbenzene	µg/L	4100	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Fluoranthene	µg/L	15	6.8E-05	5.9E-05	5.7E-05	4.8E-05	4.4E-05	4.4E-05	4.4E-05	4.7E-05
Hexachlorocyclopentadiene	µg/L	58	<0.0002	<0.0004	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.003
Nitrobenzene	µg/L	4.9	<0.002	<0.003	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01
Thallium	µg/L	2	0.01	0.01	0.01	0.005	0.004	0.004	0.004	0.005
Toluene	µg/L	85000	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.003
Tributyltin	µg/L	0.0014	<4.5E-05	<6.3E-05	<7.0E-05	<1.1E-04	<1.4E-04	<1.5E-04	<1.6E-04	<2.8E-04
1,1,1-Trichloroethane	µg/L	540000	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Objectives for protection of human health - carcinogens										
Acrylonitrile	µg/L	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Aldrin[b]	µg/L	0.000022	<2.0E-05	<2.0E-05	<2.0E-05	<2.2E-05	<2.6E-05	<2.6E-05	<2.7E-05	<4.1E-05
Benzene	µg/L	5.9	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Benzidine[b]	µg/L	0.000069	<0.003	<0.01	<0.02	<0.03	<0.0	<0.1	<0.1	<0.1
Beryllium	µg/L	0.033	0.0009	0.0011	0.0012	0.0017	0.0021	0.0022	0.0023	0.0038
Bis(2-chloroethyl)ether	µg/L	0.045	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.8	0.7	0.6	0.5	0.5	0.5	0.5	0.5
Carbon tetrachloride	µg/L	0.90	0.00	0.004	0.004	0.004	0.003	0.003	0.003	0.003
Chlordane	µg/L	0.000023	1.2E-05	1.1E-05	1.0E-05	8.5E-06	7.9E-06	7.8E-06	7.7E-06	8.3E-06
Chlorodibromomethane	µg/L	8.6	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02
Chloroform	µg/L	130	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
DDT	µg/L	0.00017	6.3E-07	1.0E-06	1.2E-06	2.0E-06	2.7E-06	2.8E-06	3.0E-06	5.3E-06
1,4-Dichlorobenzene	µg/L	18	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
3,3-Dichlorobenzidine[b]	µg/L	0.0081	<0.01	<0.01	<0.02	<0.03	<0.05	<0.1	<0.1	<0.1
1,2-Dichloroethane	µg/L	28	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
1,1-Dichloroethylene	µg/L	0.9	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.003
Dichlorobromomethane	µg/L	6.2	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Dichloromethane (methylenechloride)	µg/L	450	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,3-dichloropropene	µg/L	8.9	0.01	0.005	0.005	0.004	0.004	0.004	0.004	0.004
Dieldrin	µg/L	0.00004	4.9E-07	1.2E-06	1.5E-06	2.8E-06	4.0E-06	4.3E-06	4.5E-06	8.3E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.001	<0.001	<0.002	<0.004	<0.01	<0.01	<0.01	<0.01
1,2-Diphenylhydrazine (azobenzene)	µg/L	0.16	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Halomethanes	µg/L	130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Heptachlor[b]	µg/L	0.00005	<2.0E-05	<2.2E-05	<2.3E-05	<2.8E-05	<3.3E-05	<3.4E-05	<3.5E-05	<5.7E-05
Heptachlor Epoxide	µg/L	0.00002	8.7E-07	7.6E-07	7.3E-07	6.2E-07	5.7E-07	5.7E-07	5.6E-07	6.0E-07
Hexachlorobenzene	µg/L	0.00021	7.7E-07	6.7E-07	6.5E-07	5.5E-07	5.1E-07	5.0E-07	5.0E-07	5.4E-07
Hexachlorobutadiene	µg/L	14	8.9E-08	7.8E-08	7.5E-08	6.3E-08	5.8E-08	5.8E-08	5.7E-08	6.2E-08
Hexachloroethane	µg/L	2.5	<0.001	<0.002	<0.003	<0.004	<0.01	<0.01	<0.01	<0.01
Isophorone	µg/L	730	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
N-Nitrosodimethylamine	µg/L	7.3	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0005
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.00005	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0004
N-Nitrosodiphenylamine	µg/L	2.5	<0.002	<0.003	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01
PAHs	µg/L	0.0088	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
PCBs	µg/L	0.000019	6.7E-06	5.9E-06	5.6E-06	4.8E-06	4.4E-06	4.4E-06	4.3E-06	4.7E-06
TCDD Equivalents	µg/L	3.9E-09	1.4E-09	1.2E-09	1.1E-09	9.7E-10	9.0E-10	8.9E-10	8.8E-10	9.5E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Tetrachloroethylene	µg/L	2.0	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Toxaphene	µg/L	2.1E-04	7.0E-05	6.1E-05	5.9E-05	5.0E-05	4.6E-05	4.6E-05	4.5E-05	4.9E-05
Trichloroethylene	µg/L	27	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
1,1,2-Trichloroethane	µg/L	9.4	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
2,4,6-Trichlorophenol	µg/L	0.29	<0.002	<0.003	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01
Vinyl chloride	µg/L	36	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituents. These constituents were measured individually for the secondary effluent and RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives.
[b] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

Table 4 – Estimated concentrations of all COP constituents, expressed as percent of Ocean Plan Objective

Constituent	Units	Ocean Plan Objective	Estimated Percentage of Ocean Plan Objective at Edge of ZID by Discharge Scenario[c]							
			1	2	3	4	5	6	7	8
Objectives for protection of marine aquatic life										
Arsenic	µg/L	8	38%	38%	38%	39%	39%	39%	39%	40%
Cadmium	µg/L	1	1%	1%	1%	1%	1%	1%	1%	1%
Chromium (Hexavalent)	µg/L	2	2%	2%	2%	1%	1%	1%	1%	1%
Copper	µg/L	3	70%	70%	70%	69%	69%	69%	69%	69%
Lead	µg/L	2	1%	1%	1%	1%	1%	1%	1%	1%
Mercury	µg/L	0.04	4%	3%	3%	3%	3%	3%	3%	3%
Nickel	µg/L	5	2%	2%	2%	2%	2%	2%	2%	2%
Selenium	µg/L	15	0.5%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%
Silver	µg/L	0.7	24%	24%	24%	24%	23%	23%	23%	23%
Zinc	µg/L	20	43%	42%	42%	42%	42%	42%	42%	42%
Cyanide	µg/L	1	28%	28%	28%	30%	34%	35%	35%	53%
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	71%	62%	59%	50%	46%	46%	46%	49%
Ammonia (as N) - Daily Max	µg/L	2,400	20%	18%	17%	14%	13%	13%	13%	14%
Acute Toxicity[a]	TUa	0.3								
Chronic Toxicity[a]	TUc	1								
Phenolic Compounds (non-chlorinated)	µg/L	30	2%	2%	2%	2%	1%	1%	1%	2%
Chlorinated Phenolics	µg/L	1	4%	4%	5%	6%	7%	7%	7%	11%
Endosulfan	µg/L	0.009	5%	4%	4%	4%	3%	3%	3%	4%
Endrin	µg/L	0.002	0.1%	0.05%	0.05%	0.04%	0.04%	0.04%	0.04%	0.04%
HCH (Hexachlorocyclohexane)	µg/L	0.004	15%	13%	12%	10%	10%	10%	9%	10%
Radioactivity (Gross Beta)[a]	pci/L	–								
Radioactivity (Gross Alpha)[a]	pci/L	–								
Objectives for protection of human health - noncarcinogens										
Acrolein	µg/L	220	0.04%	0.03%	0.03%	0.03%	0.02%	0.02%	0.02%	0.03%
Antimony	µg/L	1200	0.001%	0.001%	0.001%	0.0005%	0.0004%	0.0004%	0.000%	0.000%
Bis (2-chloroethoxy) methane	µg/L	4.4	<0.1%	<0.1%	<0.1%	<0.2%	<0.3%	<0.3%	<0.3%	<0.5%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Di-n-butyl phthalate	µg/L	3500	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.02%	<0.03%	<0.0%
2,4-Dinitrophenol	µg/L	4.0	<0.3%	<0.3%	<0.4%	<1%	<1%	<1%	<1%	<1%
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<0.04%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.2%
Thallium	µg/L	2	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin	µg/L	0.0014	<3%	<4%	<5%	<8%	<10%	<11%	<11%	<20%
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health - carcinogens										

Constituent	Units	Ocean Plan Objective	Estimated Percentage of Ocean Plan Objective at Edge of ZID by Discharge Scenario[c]							
			1	2	3	4	5	6	7	8
Acrylonitrile	µg/L	0.10	25%	21%	21%	17%	16%	16%	16%	17%
Aldrin[b]	µg/L	0.000022	--	--	--	--	--	--	--	--
Benzene	µg/L	5.9	<0.02%	<0.02%	<0.02%	<0.02%	<0.03%	<0.03%	<0.03%	<0.0%
Benzidine[b]	µg/L	0.000069	--	--	--	--	--	--	--	--
Beryllium	µg/L	0.033	3%	3%	4%	5%	6%	7%	7%	12%
Bis(2-chloroethyl)ether	µg/L	0.045	<5%	<9%	<11%	<18%	<24%	<26%	<27%	<49%
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	22%	19%	18%	16%	14%	14%	14%	15%
Carbon tetrachloride	µg/L	0.90	1%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%
Chlordane	µg/L	0.000023	52%	46%	44%	37%	34%	34%	34%	36%
Chlorodibromomethane	µg/L	8.6	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Chloroform	µg/L	130	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
DDT	µg/L	0.00017	0.4%	1%	1%	1%	2%	2%	2%	3%
1,4-Dichlorobenzene	µg/L	18	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
3,3-Dichlorobenzidine[b]	µg/L	0.0081	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	0.01%	0.01%
1,1-Dichloroethylene	µg/L	0.9	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.3%
Dichlorobromomethane	µg/L	6.2	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.3%
Dichloromethane (methylenechloride)	µg/L	450	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
1,3-dichloropropene	µg/L	8.9	0.1%	0.1%	0.1%	0.04%	0.04%	0.04%	0.04%	0.04%
Dieldrin	µg/L	0.00004	1%	3%	4%	7%	10%	11%	11%	21%
2,4-Dinitrotoluene	µg/L	2.6	<0.02%	<0.1%	<0.1%	<0.1%	<0.2%	<0.2%	<0.2%	<0.4%
1,2-Diphenylhydrazine (azobenzene)	µg/L	0.16	<2%	<3%	<3%	<5%	<7%	<7%	<8%	<14%
Halomethanes	µg/L	130	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Heptachlor[b]	µg/L	0.00005	<40%	<43%	<45%	<56%	<67%	<69%	<71%	--
Heptachlor Epoxide	µg/L	0.00002	4%	4%	4%	3%	3%	3%	3%	3%
Hexachlorobenzene	µg/L	0.00021	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.3%
Hexachlorobutadiene	µg/L	14	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Hexachloroethane	µg/L	2.5	<0.05%	<0.1%	<0.1%	<0.2%	<0.2%	<0.2%	<0.3%	<0.5%
Isophorone	µg/L	730	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodimethylamine	µg/L	7.3	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.01%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.01%	0.02%	0.02%	0.0%	0.1%	0.1%	0.1%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<0.1%	<0.1%	<0.1%	<0.2%	<0.3%	<0.3%	<0.3%	<0%
PAHs	µg/L	0.0088	5%	4%	4%	3%	3%	3%	3%	3%
PCBs	µg/L	0.000019	35%	31%	30%	25%	23%	23%	23%	25%
TCDD Equivalents	µg/L	3.9E-09	35%	31%	29%	25%	23%	23%	23%	24%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.04%	<0.05%	<0.05%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Tetrachloroethylene	µg/L	2.0	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Toxaphene	µg/L	2.1E-04	33%	29%	28%	24%	22%	22%	21%	23%
Trichloroethylene	µg/L	27	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
1,1,2-Trichloroethane	µg/L	9.4	<0.01%	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.02%	<0.03%
2,4,6-Trichlorophenol	µg/L	0.29	<1%	<1%	<1%	<2%	<2%	<2%	<2%	<4%
Vinyl chloride	µg/L	36	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituents. These constituents were measured individually for the secondary effluent and RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives (see Section 4.4).
[b] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
[c] Note that if the percentage was determined to be less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the constituent was estimated to be 0.000001% of the objective, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

4.4 Toxicity

The NPDES permit includes daily maximum effluent limitations for acute and chronic toxicity that are based on the current allowable D_m of 145. The acute toxicity effluent limitation is 4.7 TUa (acute toxicity units) and the chronic toxicity effluent limitation is 150 TUc (chronic toxicity units). The permit requires that toxicity testing be conducted twice per year, with one sample collected during the wet season when the discharge is primarily secondary effluent and once during the dry season when the discharge is primarily trucked brine waste. The MRWPCA ocean discharge has consistently complied with these toxicity limits (CCRWQCB, 2014).

Toxicity testing of RO concentrate generated by the pilot testing was conducted in support of the Project (Trussell Technologies, 2015). On April 9, 2014, a sample of RO concentrate was sent to Pacific EcoRisk for acute and chronic toxicity analysis. Based on these results (RO concentrate values presented in Table 1), the Project concentrate requires a minimum D_m of 16:1 and 99:1 for acute and chronic toxicity, respectively, to meet the Ocean Plan objectives. These D_m values were compared to estimated D_m values for the discharge of RO concentrate only from the Project's full-scale AWPF and the discharge of RO concentrate combined with secondary effluent from the RTP. The minimum dilution modeled for the various Project discharge scenarios was 174:1, which is when the secondary effluent discharge is at the highest expected flow for future discharges. Given that the lowest expected D_m value for the various Project ocean discharge scenarios is greater than the required dilution factor for compliance with the Ocean Plan toxicity objectives, this sample illustrates that the discharge scenarios would comply with Ocean Plan objectives.

5 Conclusions

The purpose of the analysis documented in this technical memorandum was to assess the ability of the Project to comply with the numeric Ocean Plan water quality objectives. Trussell Tech used a conservative approach to estimate the water qualities of the RTP secondary effluent, RO concentrate, and hauled waste (blended with secondary effluent) for the Project. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and scenario. Compliance assessments could not be made for select constituents, as noted, due to analytical limitations, but this is a common occurrence for these Ocean Plan constituents. Based on the data, assumptions, modeling, and analytical methodology presented in this technical memorandum, the Project would comply with all Ocean Plan objectives.

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Appendix C

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DRAFT Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

Technical Memorandum
July 2016

Prepared for:

MRWPCA

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DRAFT Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

Technical Memorandum

Pure Water Monterey
A Groundwater Replenishment Project

July 2016

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Table of Contents

1 Introduction

In response to State Water Resources Control Board (SWRCB) Water Rights Orders WR 95-10 and WR 2009-0060, two proposed projects are in development on the Monterey Peninsula to provide potable water to offset pending reductions of Carmel River water diversions: (1) a seawater desalination project known as the **Monterey Peninsula Water Supply Project** (MPWSP), and (2) a groundwater replenishment project known as the **Pure Water Monterey Groundwater Replenishment Project** (GWR Project). The capacity of the MPWSP is dependent on whether the GWR Project is constructed.

If the GWR Project is not constructed, the MPWSP would entail California American Water ("CalAm") building a seawater desalination facility capable of producing 9.6 million gallons per day (mgd) of drinking water. In a variation of that project where the GWR Project is constructed, known as the **Monterey Peninsula Water Supply Project Variant** ("Variant"), CalAm would build a smaller desalination facility capable of producing 6.4 mgd of drinking water, and a partnership between the Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) would build an advanced water treatment facility ("AWT Facility") capable of producing up to 3,700 acre-feet per year (AFY) (3.3 mgd)[1] of highly purified recycled water to enable CalAm to extract 3,500 AFY (3.1 mgd) from the Seaside Groundwater Basin for delivery to their customers (the AWT Facility is part of the GWR Project).

The AWT Facility would purify secondary-treated wastewater (*i.e.*, secondary effluent) from MRWPCA's Regional Treatment Plant (RTP), and this highly purified recycled water would be injected into the Seaside Groundwater Basin and later extracted for municipal water supplies. Both the proposed desalination facility and the proposed AWT Facility would employ reverse osmosis (RO) membranes to purify the waters, and as a result, both projects would produce RO concentrate waste streams that would be disposed through the existing MRWPCA ocean outfall: the brine concentrate from the desalination facility ("Desal Brine"), and the RO concentrate from the AWT Facility ("GWR Concentrate").

The goal of this technical memorandum is to analyze whether the discharges from the proposed projects through the existing ocean outfall would impact marine water quality, and thus, human health, marine biological resources, or beneficial uses of the receiving waters. A similar assessment of the GWR Project on its own was previously performed (Trussell Technologies, 2015, see Appendix B), and so this document provides complementary information focused on the MPWSP and the Variant projects.

The original version of this document (Trussell Technologies, 2015b) and an addendum report to that document (Trussell Technologies, 2015c) were included in both the GWR Project Consolidated Final Environmental Impact Report (CFEIR) and the MPWSP draft Environmental Impact Report (EIR). This version has been updated to include new water quality data and flow

[1] One million gallons per day is equal to 1,121 acre-feet per year. The AWT Facility would be capable of producing up to 4 mgd of highly purified recycled water on a daily basis, but production would fluctuate throughout the year, such that the average annual production would be 3.3 mgd (3,700 AFY) in a non-drought year.

scenarios for the MPWSP and Variant to address data gaps noted in the original analyses (2015b and 2015c).

1.1 Treatment through the Proposed CalAm Desalination Facility

This section describes the proposed treatment train for the MPWSP and Variant desalination facility. Seawater from the Monterey Bay would be extracted through subsurface slant wells beneath the ocean floor and piped to a new CalAm-owned desalination facility. This facility would consist of granular media pressure filters, cartridge filters, a two-pass RO membrane system, RO product-water stabilization (for corrosion control), and disinfection (Figure 1). The RO process is expected to recover 42 percent of the influent seawater flow as product water, while the remainder of the concentrated influent water becomes the Desal Brine. The MPWSP and Variant product water (desalinated water) would be used for municipal drinking water, while the Desal Brine would be blended with (1) available RTP secondary effluent, (2) brine that is trucked and stored at the RTP, and (3) GWR Concentrate (for the Variant only), and discharged to the ocean through the existing MRWPCA ocean outfall. The volume of Desal Brine is dependent on the project size: 13.98 and 8.99 mgd for the MPWSP and Variant, respectively.

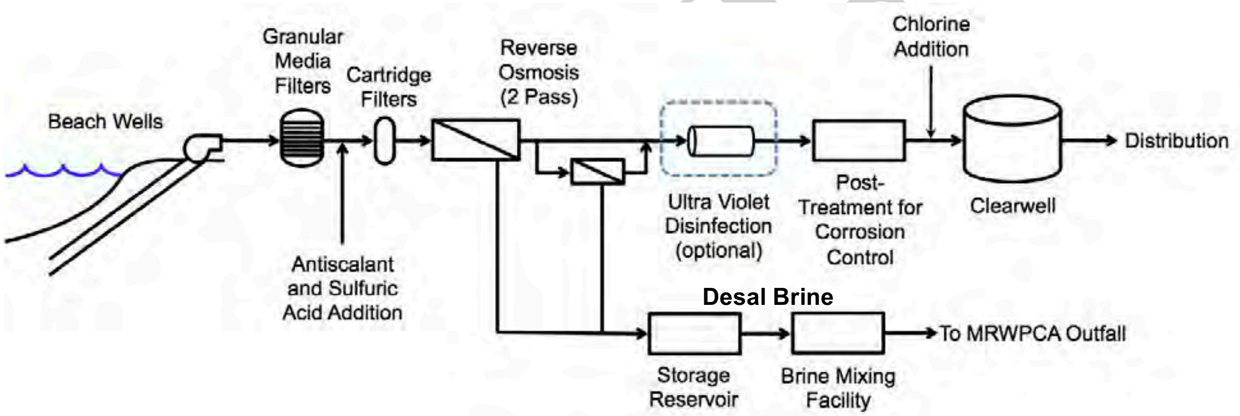

Figure 1 – Schematic of CalAm desalination facilities

1.2 Treatment through the RTP and Proposed AWT Facilities

The existing MRWPCA RTP treatment process includes screening, primary sedimentation, secondary biological treatment through trickling filters followed by a solids contactor (*i.e.*, bio-flocculation), and clarification (Figure 2). Much of the secondary effluent undergoes tertiary treatment (granular media filtration and disinfection) to produce recycled water used for agricultural irrigation. The unused secondary effluent is discharged to the Monterey Bay through the MRWPCA outfall. MRWPCA also accepts trucked brine waste for ocean disposal ("hauled brine"), which is stored in a pond and mixed with secondary effluent for disposal.

The proposed AWT Facility would include several advanced treatment technologies for purifying the secondary effluent: ozone (O_3), biologically active filtration (BAF) (this is an optional unit process), membrane filtration (MF), RO, and an advanced oxidation process (AOP) using ultraviolet light ("UV") and hydrogen peroxide. MRWPCA and the MPWMD conducted a pilot-scale study of the ozone, MF, and RO components of the AWT Facility from December 2013 through July 2014, successfully demonstrating the ability of the various treatment processes to produce highly purified recycled water that complies with the California

Groundwater Replenishment Water Recycling Criteria ("Groundwater Replenishment Regulations"),[2] the SWRCB's Anti-degradation and Recycled Water Policies,[3] and the Water Quality Control Plan for the Central Coastal Basin (Basin Plan)[4] standards, objectives and guidelines for groundwater. Water quality monitoring of the concentrate from the RO was also conducted during the pilot-scale study.

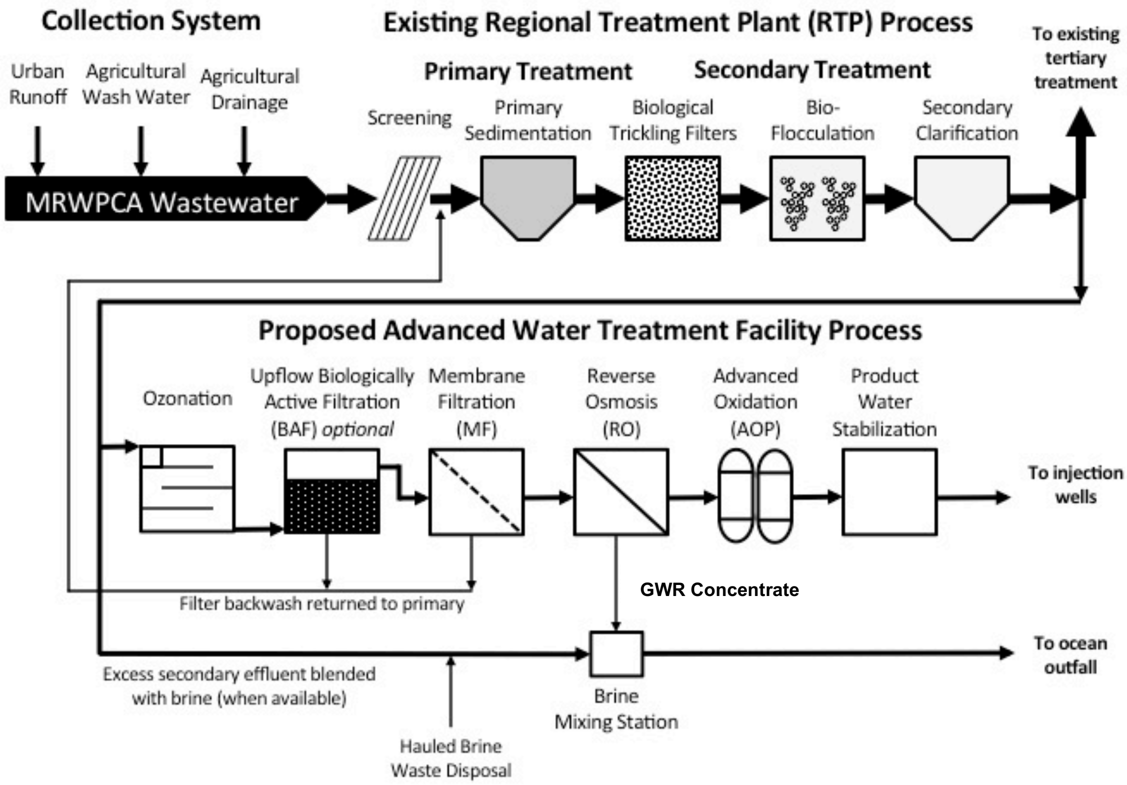

Figure 2 – Schematic of existing MRWPCA RTP and proposed AWT Facility treatment

1.3 California Ocean Plan

The SWRCB 2012 Ocean Plan ("Ocean Plan") sets forth water quality objectives for the ocean with the intent of preserving the quality of the ocean water for beneficial uses, including the protection of both human and aquatic ecosystem health (SWRCB, 2012). Regional Water Quality Control Boards utilize these objectives to develop water quality-based effluent limitations for ocean dischargers that have a reasonable potential to exceed the water quality objectives.

When municipal wastewater flows are released from an outfall, the wastewater and ocean water undergo rapid mixing due to the momentum (from specially designed diffusers) and buoyancy of

2 SWRCB (2014) Water Recycling Criteria. Title 22, Division 4, Chapter 3, California Code of Regulations.

3 See http://www.swrcb.ca.gov/plans_policies/

4 See http://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs/basin_plan_2011.pdf

the discharge.[5] The mixing occurring in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). For rising plumes, the Ocean Plan defines the initial dilution as complete when "the diluting wastewater ceases to rise in the water column and first begins to spread horizontally," (*i.e.*, when the momentum from the discharge has dissipated). For more saline discharges, a sinking plume can form when the discharge is denser than the ambient water (also known as a negatively buoyant plume). In the case of negatively buoyant plumes, the Ocean Plan defines the initial dilution as complete when "the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution."

The Ocean Plan objectives are to be met after the initial dilution of the discharge. The initial dilution occurs in an area known as the zone of initial dilution (ZID). The extent of dilution in the ZID is quantified and referred to as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive the National Pollutant Discharge Elimination System (NPDES) permit limits for a wastewater discharge prior to ocean dilution.

The current MRWPCA wastewater discharge is governed by NPDES permit R3-2014-0013 issued by the Central Coast Regional Water Quality Control Board ("RWQCB"). Because the existing NPDES permit for the MRWPCA ocean outfall must be amended to discharge Desal Brine, comparing future discharge concentrations to the current NPDES permit limits (that will likely change when the permit is amended) would not be an appropriate metric or threshold for determining whether the proposed projects would have a significant impact on marine water quality. Instead, compliance with the Ocean Plan objectives was selected as an appropriate threshold for determining whether or not the proposed projects would result in a significant impact requiring mitigation.

Dr. Philip Roberts, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, conducted modeling of the ocean discharge and estimated D_m values for scenarios involving different flows of the proposed projects and different ambient ocean conditions. These ocean modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan.

1.4 Future Ocean Discharges

A summary schematic of the MPWSP and Variant is presented in Figure 3. For the MPWSP, 23.58 mgd of ocean water (design capacity) would be treated in the desalination facility; an RO recovery of 42% would lead to an MPWSP Desal Brine flow of 13.98 mgd that would be discharged through the outfall. Secondary effluent from the RTP would also be discharged through the outfall, although the flow would be variable depending on both the raw wastewater flow and the proportion being processed through the tertiary treatment system at the Salinas Valley Reclamation Plant (SVRP) to produce recycled water for agricultural irrigation. The third

[5] Municipal wastewater effluent, being effectively fresh water in terms of salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water. GWR Concentrate, whether by itself or mixed with municipal wastewater effluent, is less dense than seawater and also rises (due to buoyancy) while it mixes with ocean water.

and final discharge component is hauled brine that is trucked to the RTP and blended with secondary effluent prior to discharge. The maximum anticipated flow of this stream is 0.1 mgd (blend of brine and secondary effluent). These three discharge components (Desal Brine, secondary effluent, and hauled brine) would be mixed at the proposed Brine Mixing Facility prior to ocean discharge.

For the Variant, 15.93 mgd of ocean water (design capacity) would be pumped to the desalination facility, and an RO recovery of 42% would result in a Variant Desal Brine flow of 8.99 mgd. The Variant would include the GWR Project, which involves the addition of new source waters to the RTP that would alter the water quality of the secondary effluent produced by the RTP. The secondary effluent in the Variant is referred to as "Variant secondary effluent," and would be different in quality from the MPWSP secondary effluent. Under the GWR Project, a portion of the secondary effluent would be fed to the AWT Facility, and the resultant GWR Concentrate (maximum 0.94 mgd) would be discharged through the outfall. The hauled brine received at the RTP would continue to be blended with secondary effluent prior to discharge, the quality of the blended brine and secondary effluent will change as a result of the change in secondary effluent quality; the hauled brine for the Variant is referred to as "Variant hauled brine." The discharge components for the MPWSP and Variant are summarized in Table 1.

Table 1 – Discharge waters Included in each analysis

Project	Desal Brine	Secondary Effluent	Variant Secondary Effluent	Hauled Brine	Variant Hauled Brine [a]	GWR Concentrate
MPWSP	✓ (13.98 mgd)	✓ (flow varies)		✓ (0.1 mgd)		
Variant	✓ (8.99 mgd)		✓ (flow varies)		✓ (0.1 mgd)	✓ (0.94 mgd)

[a] This is placed in a separate category because it contains Variant secondary effluent.

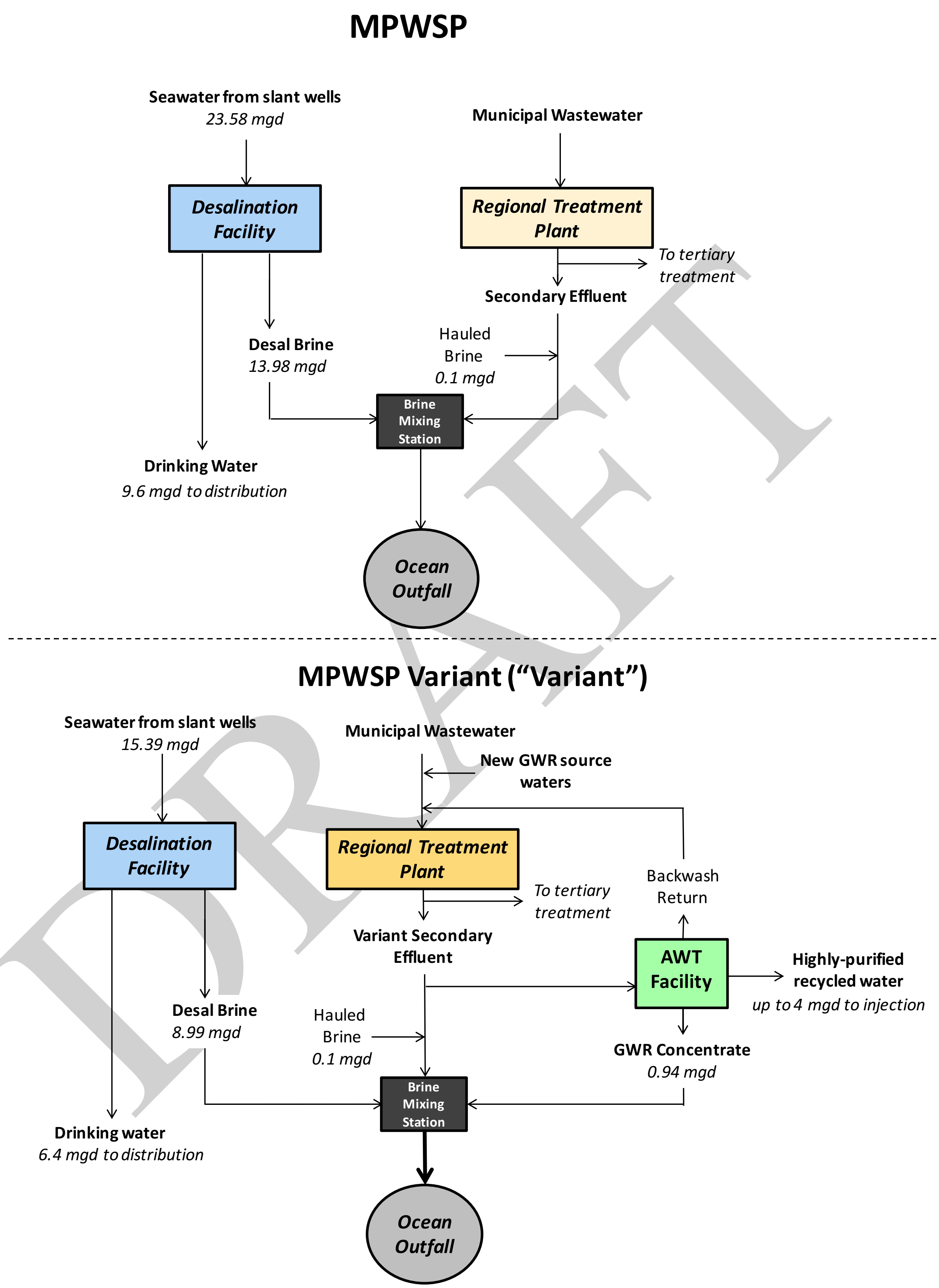

Figure 3 – Flow schematics for the MPWSP and Variant projects (specified flow rates are at design capacity)

1.5 Objective of Technical Memorandum

Trussell Technologies, Inc. ("Trussell Tech") estimated worst-case in-pipe water quality for the various ocean discharge scenarios (*i.e.*, prior to dilution through ocean mixing) for the proposed projects. Dr. Roberts' ocean discharge modeling and the results of the water quality analysis were then used to provide an assessment of whether the proposed projects would consistently meet Ocean Plan water quality objectives. The objective of this technical memorandum is to summarize the assumptions, methodology, results and conclusions of the Ocean Plan compliance assessment for the MPWSP and Variant.

2 Methodology for Ocean Plan Compliance Assessment

Water quality data from various sources for the different treatment process influent and waste streams were compiled. Trussell Tech combined these data for different flow scenarios and used ocean modeling results (*i.e.*, D_m values) to assess compliance of different discharge scenarios with the Ocean Plan objectives. This section documents the data sources and provides further detail on the methodology used to perform this analysis. A summary of the methodology is presented in Figure 4.

2.1 Methodology for Determination of Discharge Water Quality

The amounts and combinations of various wastewaters that would be disposed through the MRWPCA outfall will vary depending on the capacity, seasonal and daily flow characteristics, and extent and timing of implementation of the proposed projects.

Detailed discussions about the methods used to determine the discharge water qualities related to the GWR Project were previously discussed and can be found in Appendix B. This previous analysis included water quality estimates of the secondary effluent, Variant secondary effluent, hauled brine, Variant hauled brine, and the GWR Concentrate (*i.e.*, all of the discharges except for the Desal Brine). In the previous analysis, Trussell Tech assumed that the highest observed values for the various Ocean Plan constituents within each type of water flowing to and treated at the RTP, including the AWT Facility as applicable, to be the worst-case water quality.[6] These same data and assumptions were used in the analysis described in this memorandum. Use of these worst-case water quality concentrations ensures that the analysis in this memorandum is conservative related to the Ocean Plan compliance assessment (and thus, the impact analysis for the MPWSP environmental review processes).

To determine the impact of the MPWSP and Variant, the worst-case water quality of the Desal Brine was estimated using available data from CalAm's temporary test subsurface slant well on the CEMEX mine property in Marina, California. Long-term pumping and water quality

[6] The exception to this statement is cyanide. In mid-2011, Monterey Bay Analytical Service (MBAS) began performing the cyanide analysis on the RTP secondary effluent, at which time the reported values increased by an order of magnitude. Because no operational or source water composition changes took place at this time that would result in such an increase, it is reasonable to conclude the increase is an artifact of the change in analysis method and therefore the results were questionable. Therefore, although the cyanide concentrations reported by MBAS are presented, they are not used in the analysis for evaluating compliance with the Ocean Plan objectives.

sampling from this well began in April 2015.[7] As in the previous Ocean Plan compliance assessments, the highest observed concentrations in the slant well were used for this Ocean Plan compliance assessment.

The methodology for determining the water quality of the Desal Brine and secondary effluent is further described in this section (the methodology for all other discharge waters can be found in Appendix B). A summary of which discharge waters are considered for both the MPWSP and Variant, and which data sources were used in the determination of the water quality for each discharge stream is shown in Figure 4.

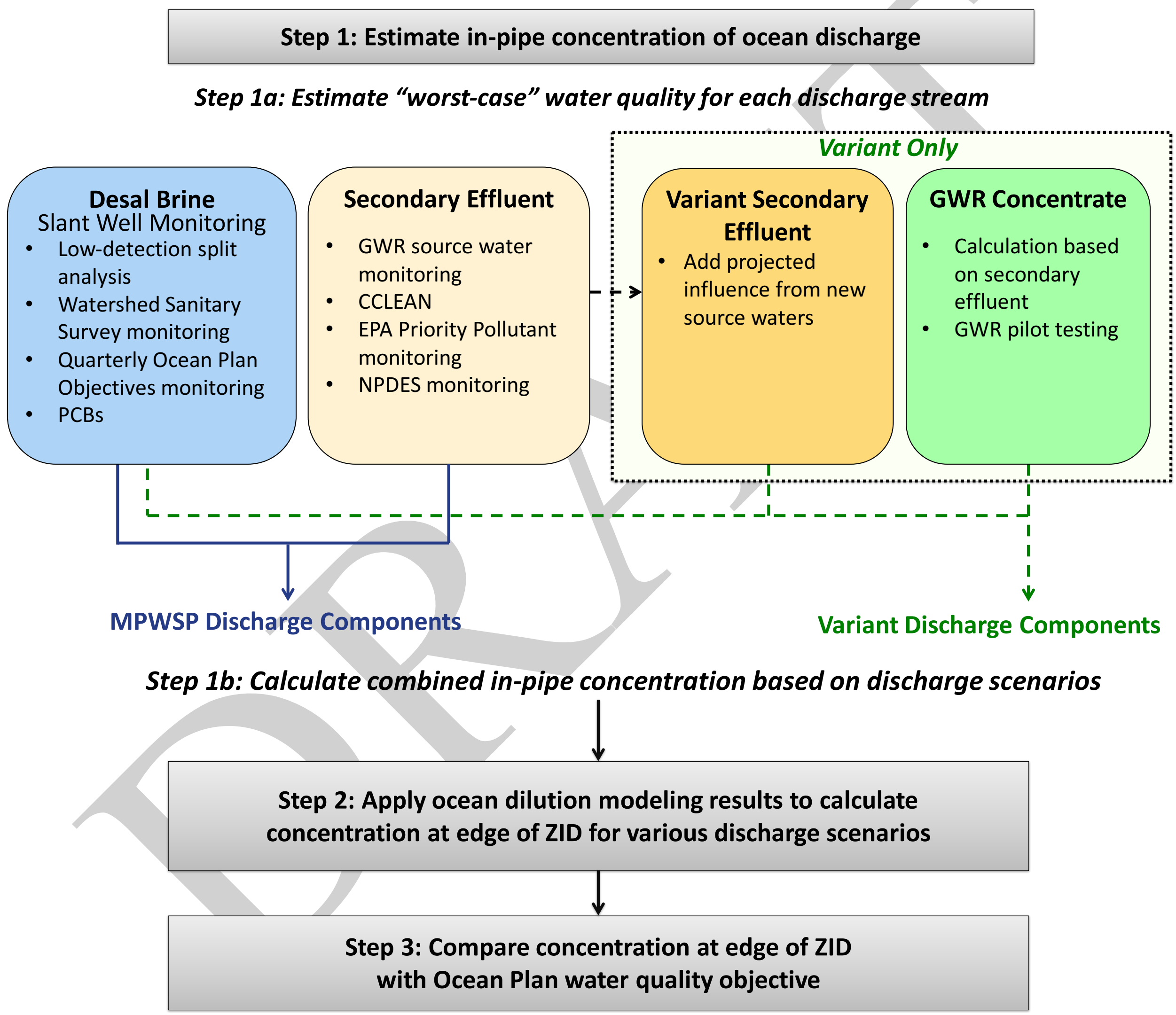

Figure 4 – Logic flow chart for determination of MPWSP and Variant compliance with Ocean Plan objectives.

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[7] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

2.1.1 Secondary Effluent

For the MPWSP, the discharged secondary effluent would not be impacted by additional source waters that would be brought in for the Variant; therefore, the historical secondary effluent quality was used in the analysis. The following sources of data were considered for selecting a secondary effluent concentration for each constituent in the analysis:

- Secondary effluent water quality monitoring conducted for the GWR Project from July 2013 through June 2014.
- Historical NPDES compliance water quality data collected semi-annually by MRWPCA (2005-2014).
- Historical Priority Pollutant data collected annually by MRWPCA (2004-2014).
- Water quality data collected by the Central Coast Long-Term Environmental Assessment Network (CCLEAN) (2008-2015).

The secondary effluent concentration for each constituent selected for the analysis was the maximum reported value from the above sources. In some cases, constituents were not detected (ND) in any of the source waters; in these cases, the values are reported as ND(<MRL). In cases where the analysis of a constituent that was detected but not quantified, the result is reported as less than the Method Reporting Limit ND(<MRL).[8] Because the actual concentration could be any value equal to or less than the MRL, the conservative approach is to use the value of the MRL. For some ND constituents, the MRL exceeds the Ocean Plan objective, and thus no compliance determination can be made.[9] A detailed discussion of the cases where a constituent was reported as less than the MRL is included in the GWR Project technical memorandum in Appendix B (Trussell Technologies, 2015a).

2.1.2 Desalination Brine

Trussell Tech used the following four sources of data for the Desal Brine water quality assessment:

- A one-time 7-day composite sample from the test slant well with separate analysis of particulate and dissolved phase fractions of constituents using low-detection CCLEAN analysis techniques (February 18-25, 2016). The maximum total concentration was used in this analysis (*i.e.* the sum of the concentration in the particulate and dissolved phase

[8] The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (*i.e.*, the lower limit of quantitation). Therefore, acceptable quality control and quality assurance procedures are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the Method Detection Limit (or greater). The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. (40 Code of Federal Regulations Section136 Appendix B).

[9] This phenomenon is common in the implementation of the Ocean Plan where for some constituents, suitable analytical methods are not capable of measuring low enough to quantify the minimum toxicologically relevant concentrations. For these constituents, a discharge is considered compliant if the monitoring results are less than the MRL.

fractions).[10] Of the constituents analyzed with this split phase method,[11] all were detected 100% in the dissolved phase, except PCBs, which were detected 99% in the dissolved phase.

- CalAm Watershed Sanitary Survey monitoring program monthly test slant well sampling water quality results (May 2015 – February 2016).[12]
- Quarterly sampling of the test slant well for constituents specified in the Ocean Plan (November 2015 and February 2016).
- Test slant well sampling by Geoscience Support Services, Inc. ("Geoscience") every other month for polychlorinated biphenyls (PCBs) (May 2015 – February 2016).[11]

The maximum value observed in any of the data sources was assumed to be the "worst-case" water quality for the raw seawater feeding the desalination facility. If a constituent was ND in all samples, and multiple analysis methods were used with varying MRL values, the highest MRL was assumed for compliance analysis; the exception to this statement is when data was available from the low detection limit 7-day composite sample. As for the secondary effluent water quality, if the sample results of a constituent reported the concentration as less than the MRL, the MRL was assumed for compliance analysis and the concentration is reported as ND(<MRL) in this TM. Equation 1 was used to calculate a conservative estimate of the Desal Brine concentration (C_{Brine}) for each constituent by using a concentration factor of 1.73, which was calculated assuming complete rejection of the constituent in the feed water (C_{Feed}) and a 42 percent recovery ($\%_R$) through the seawater RO membranes.

$$C_{Brine} = \frac{C_{Feed}}{1 - \%_R} \qquad (1)$$

The original Technical Memorandum (TM) (Trussell Technologies, 2015b) noted that no data were available for several Ocean Plan constituents. For constituents that lacked Desal Brine data, a concentration of zero was assumed for the previous analysis, such that the partial influence of the other discharge streams could still be assessed. Thus, a complete "worst-case" assessment for these constituents was not previously possible. The updated analysis discussed in this TM includes data for all of the constituents where no data were previously available, except for toxicity, which will be discussed in Section 2.2.

2.1.3 Combined Ocean Discharge Concentrations

Having estimated the worst-case concentrations for each of the discharge components, the combined concentration prior to discharge was determined as a flow-weighted average of the contributions of each of the discharge components appropriate for the MPWSP and Variant.

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[10] Only method detection limits were provided for these results. When a constituent was ND in this dataset, the method detection limit was used for analysis.

[11] Hexachlorobutadiene, hexachlorobenzene, HCH, heptachlor, Aldrin, chlordane, DDT, heptachlor epoxide, dieldrin, Endrin, endosulfans, toxaphene, PCBs

[12] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

2.2 Ocean Modeling Methodology

In order to determine Ocean Plan compliance, Trussell Tech used the following information: (1) the in-pipe (*i.e.*, pre-ocean dilution) concentration of a constituent ($C_{in-pipe}$) that was developed as discussed in the previous section, (2) the minimum probable dilution for the ocean mixing (D_m) for the discharge flow scenarios that were modeled by Dr. Roberts[13] (Roberts, P. J. W, 2016), and (3) the background concentration of the constituent in the ocean ($C_{Background}$) that is specified in Table 3 of the Ocean Plan (SWRCB, 2012). With this information, the concentration at the edge of the zone of initial dilution (C_{ZID}) was calculated using the following equation:

$$C_{ZID} = \frac{C_{In-pipe} + D_m * C_{Background}}{1 + D_m} \qquad (2)$$

The C_{ZID} was then compared to the Ocean Plan water quality objectives[14] in Table 1 of the Ocean Plan (SWRCB, 2012). In this table, there are three categories of objectives: (1) Objectives for Protection of Marine Aquatic Life, (2) Objectives for Protection of Human Health – Non-Carcinogens, and (3) Objectives for Protection of Human Health – Carcinogens. There are three objectives for each constituent included in the first category (for marine aquatic life): six-month median, daily maximum and instantaneous maximum concentration. For the other two categories, there is one objective: 30-day average concentration. When a constituent had three objectives, the lowest objective, the six-month median, was used to estimate compliance. This approach was taken because the discharge scenarios, discussed in further detail below, could be experienced for six months, and therefore the 6-month median objective would need to be met. For the ammonia objectives (specifically, the total ammonia concentration calculated as the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4), expressed in µg/L as N) the daily maximum and 6-month median objectives were evaluated.

For each discharge scenario, if the C_{ZID} was below the Ocean Plan objective, then it was assumed that the discharge would comply with the Ocean Plan. However, if the C_{ZID} exceeds the Ocean Plan objective, then it was concluded that the discharge scenario could violate the Ocean Plan objective. Note that this approach could not be applied for some constituents, *viz.*, acute toxicity, chronic toxicity, and radioactivity. Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the secondary effluent and GWR Concentrate, and these individual concentrations would comply with the Ocean Plan

[13] The Ocean Plan defines D_m differently than Dr. Roberts. A value of 1 must be subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

[14] Note that the Ocean Plan also defines effluent limitations for oil and grease, suspended solids, settleable solids, turbidity, and pH (see Ocean Plan Table 2). These parameters were not evaluated in this assessment. It is assumed that, if necessary, the pH of the water would be adjusted to be within acceptable limits prior to discharge. Oil and grease, suspended solids, settable solids, and turbidity in the GWR Concentrate and Desal Brine would be significantly lower than the secondary effluent. Prior to the AWT Facility RO treatment process, the process flow would be treated by MF, which will reduce these parameters, and the waste stream from the MF will be returned to RTP headworks. Prior to the Desalination Facility RO treatment process, the process flow would be treated by granular media filters and cartridge filters, which reduce these parameters. The waste stream from the granular media filter would be further treated in gravity thickening basins prior to any discharge of the decant through the ocean outfall. The cartridge filters will be disposed off-site and the solids will not be returned to the process.

objectives. Toxicity testing on the seawater was not included in the analysis for this TM; it will be evaluated by another method not discussed in this TM.

Dr. Roberts performed modeling of 16 discharge scenarios for the MPWSP and Variant that include combinations of Desal Brine, secondary effluent, GWR Concentrate, and hauled brine (Roberts, P. J. W, 2016). All scenarios assume the maximum flow rates for the GWR Concentrate, Desal Brine and hauled brine, which is a conservative assumption in terms of constituent loading and minimum dilution.

2.2.1 Ocean Modeling Scenarios

The modeled scenarios are summarized in Tables 2 and 3 for the MPWSP and the Variant, respectively. The baseline MPWSP discharge scenario in Table 2 that has no Desal Brine (*i.e.* Scenario 1) is shown for completeness, but will not be analyzed in this TM as this flow scenario would fall under MRWPCA's existing NPDES permit, for which a D_m value is already established. The Variant discharge scenarios that have no Desal Brine (*i.e.* Scenarios 11 through 15) have already been analyzed and found to comply with the Ocean Plan (Trussell Tech 2015, see Appendix B); these scenarios are shown in Table 3 for completeness, but for simplicity, the analysis of these scenarios is not repeated in Section 3.

Table 2 - Modeled flow scenarios for the MPWSP

No.	Discharge Scenario	Discharge Flows (mgd)		
		Secondary Effluent	Desal Brine	Hauled Brine [a]
1	Baseline - high secondary effluent [b]	19.78	0	0.1
2	Desal Brine with no secondary effluent	0	13.98	0.1
3	Desal Brine with low secondary effluent	1	13.98	0.1
4	Desal Brine with low secondary effluent	2	13.98	0.1
5	Desal Brine with moderate secondary effluent	9	13.98	0.1
6	Desal Brine with high secondary effluent [b]	19.78	13.98	0.1

[a] Hauled brine was not included in the modeling of MPWSP flow scenarios; however, the change in both flow and TDS from the addition of hauled brine is less then 1% and thus is expected to have a negligible impact on the modeled D_m.

[b] Note that RTP wastewater flows have been declining in recent years as a result of water conservation; while 19.78 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

MPWSP Flow Scenarios:

(1) **Baseline – high secondary effluent:** The baseline flow scenario with no Desal Brine. This scenario represents times when the desalination facility is offline, the demand for recycled water is lowest (*e.g.*, during winter months), and the SVRP is not operational.

(2) **Desal Brine with no secondary effluent:** The maximum influence of the Desal Brine on the overall discharge (*i.e.*, no secondary effluent discharged). This scenario would be representative of conditions when demand for recycled water is highest (*e.g.*,

during summer months), and all of the RTP secondary effluent is recycled through the SVRP for agricultural irrigation.

(3-4) **Desal Brine with low secondary effluent:** Desal Brine discharged with a relatively low amount of secondary effluent, resulting in a negatively buoyant plume. This scenario represents times when demand for recycled water is high, but there is excess secondary effluent that is discharged to the ocean.

(5) **Desal Brine with moderate secondary effluent:** Desal Brine discharged with a relatively moderate secondary effluent flow that results in a plume with slightly negative buoyancy. This scenario would be representative of conditions when demand for recycled water is low, and there is excess secondary effluent that is discharged to the ocean.

(6) **Desal Brine with high secondary effluent:** Desal Brine discharged with a relatively high amount of secondary effluent, resulting in a positively buoyant plume. This scenario would be representative of conditions when demand for recycled water is lowest (*e.g.*, during winter months), and the SVRP is not operational.

Table 3 – Modeled flow scenarios for the Variant

No.	Discharge Scenario	Discharge Flows (mgd)			
		Secondary Effluent	Desal Brine	GWR Concentrate	Hauled Brine [a]
1	Desal Brine only	0	8.99	0	0.1
2	Desal Brine with low secondary effluent	1	8.99	0	0.1
3	Desal Brine with low secondary effluent	2	8.99	0	0.1
4	Desal Brine with moderate secondary effluent	5.8	8.99	0	0.1
5	Desal Brine with high secondary effluent [b]	19.78	8.99	0	0.1
6	Desal Brine with GWR Concentrate and no secondary effluent	0	8.99	0.94	0.1
7	Desal Brine with GWR Concentrate and low secondary effluent	1	8.99	0.94	0.1
8	Desal Brine with GWR Concentrate and low secondary effluent	3	8.99	0.94	0.1
9	Desal Brine with GWR Concentrate and moderate secondary effluent	5.3	8.99	0.94	0.1
10	Desal Brine with GWR Concentrate and high secondary effluent	15.92	8.99	0.94	0.1
11	RTP design capacity with GWR Concentrate [c]	24.7	0	0.94	0.1
12	RTP capacity with GWR Concentrate with current port configuration [c]	23.7	0	0.94	0.1
13	Minimum secondary effluent flow with GWR Concentrate [c]	0	0	0.94	0.1
14	Minimum secondary effluent flow with GWR Concentrate during Davidson oceanic conditions [c]	0.4	0	0.94	0.1
15	Moderate secondary effluent flow with GWR concentrate [c]	3	0	0.94	0.1

[a] Hauled brine was not included in the modeling of Variant scenarios involving discharge of desalination brine. However, the change in both flow and TDS from the addition of hauled brine is less than 1% and thus is expected to have a negligible impact on the modeled D_m.

[b] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

[c] Scenarios 11 through 15 were analyzed as part of a previous analysis (see Appendix B), and based on the documented assumptions, the GWR Concentrate would comply with the Ocean Plan objectives; therefore, these scenarios are not discussed further in this memorandum.

Variant Flow Scenarios:

(1) **Desal Brine only:** Desal Brine discharged without secondary effluent or GWR Concentrate. This scenario would be representative of conditions when the smaller (6.4 mgd) desalination facility is in operation, but the AWT Facility is not operating

(*e.g.*, offline for maintenance), and all of the secondary effluent is recycled through the SVRP (*e.g.*, during high irrigation water demand summer months).

(2-3) **Desal Brine with low secondary effluent:** Desal Brine discharged with low secondary effluent flow, but no GWR Concentrate, which results in a negatively buoyant plume. This scenario would be representative of times when the smaller desalination facility is in operation, but the AWT Facility is not operating (*e.g.* offline for maintenance), and most of the secondary effluent is recycled through the SVRP (*e.g.*, during high irrigation water demand summer months).

(4) **Desal Brine with moderate secondary effluent:** Desal Brine discharged with a relatively moderate flow of secondary effluent, but no GWR concentrate, which results in a plume with slightly negative buoyancy. This scenario represents times when demand for recycled water is low (*e.g.*, during winter months), and the AWT Facility is not operating.

(5) **Desal Brine with high secondary effluent:** Desal Brine discharged with a relatively high flow of secondary effluent, but no GWR concentrate, resulting in a positively buoyant plume. This scenario would be representative of conditions when demand for recycled water is lowest (*e.g.*, during winter months), and neither the SVRP nor the AWT Facility are operational.

(6) **Desal Brine with GWR Concentrate and no secondary effluent:** Desal Brine discharged with GWR Concentrate and no secondary effluent. This scenario would be representative of the condition where both the desalination facility and the AWT Facility are in operation, and there is the highest demand for recycled water through the SVRP (*e.g.*, during summer months).

(7-8) **Desal Brine with GWR Concentrate and low secondary effluent:** Desal Brine discharged with low secondary effluent flow and GWR Concentrate, which results in a negatively buoyant plume. This scenario would be representative of times when both the desalination facility and the AWT Facility are in operation, and most of the secondary effluent is recycled through the SVRP (*e.g.*, during high irrigation water demand summer months).

(9) **Desal Brine with GWR Concentrate and moderate secondary effluent:** Desal Brine discharged with GWR Concentrate and a relatively moderate secondary effluent flow that results in a plume with slightly negative buoyancy. This scenario represents times when both the desalination facility and the AWT Facility are operating, but demand for recycled water is low and there is excess secondary effluent discharged to the ocean.

(10) **Desal Brine with GWR Concentrate and high secondary effluent:** Desal Brine discharged with GWR Concentrate and a relatively high flow of secondary effluent. The reduction of secondary effluent flow between Scenario 5 and this scenario is a result of the AWT Facility operation. This would be a typical discharge scenario when there is no demand for tertiary recycled water (*e.g.*, during winter months).

(11-15) **Variant conditions with no Desal Brine contribution**: These scenarios represent a range of conditions that would exist when the CalAm desalination facilities were offline for any reason. These conditions were previously evaluated (Trussell Tech, 2015) and thus are not discussed further in this technical memorandum.

2.2.2 Ocean Modeling Assumptions

Dr. Roberts documented the modeling assumptions and results in a technical memorandum (Roberts, P. J. W., 2016). The modeling assumptions were specific to ambient oceanic conditions: Davidson (November to March), Upwelling (April to August), and Oceanic (September to October).[15] In order to conservatively demonstrate Ocean Plan compliance, the lowest D_m from the applicable ocean conditions was used for each flow scenario. For all scenarios, the ocean modeling was performed assuming all 129 operational diffuser ports were open.

Three methods were used when modeling the ocean mixing: (1) the Cederwall formula (for neutral and negatively buoyant plumes only), (2) the mathematical model UM_3 in the United States Environmental Protection Agency's (EPA's) Visual Plume suite, and (3) the NRFIELD model (for positively buoyant plumes only), also from the EPA's Visual Plume suite (Roberts, P. J. W., 2016). When results were provided from multiple methods, the minimum predicted D_m value was used in this analysis as a conservative approach.

3 Ocean Plan Compliance Results

3.1 Water Quality of Combined Discharge

As described above, the first step in the Ocean Plan compliance analysis was to estimate the worst-case water quality for the future wastewater discharge components (*viz.*, Desal Brine, secondary effluent, hauled brine and GWR Concentrate). The estimated water quality for each type of discharge is provided in Table 4. The Desal Brine water quality previously assumed in Trussell Technologies, 2015b is also included in Table 4 for reference ("Previous Desal Brine"); only the updated Desal Brine water quality was used in this analysis ("Updated Desal Brine"). Specific assumptions and data sources for each constituent are documented in the Table 4 footnotes.

Table 4 – Estimated worst-case water quality for the various discharge waters

Constituent	Units	Updated Desal Brine	Previous Desal Brine	Secondary Effluent		Hauled Brine		GWR Concentrate	Footnotes
				MPWSP	*Variant*	*MPWSP*	*Variant*		
Objectives for protection of marine aquatic life – 6-month median limit									
Arsenic	µg/L	17.2	37.9	45	45	45	45	12	2,6,16,21
Cadmium	µg/L	5.0	7.9	1	1.2	1	1.2	6.4	1,7,15,21
Chromium (Hexavalent)	µg/L	ND(<0.03)	–	ND(<2)	2.7	130	130	14	3,7,15,21
Copper	µg/L	0.5	3.07	10	10.5	39	39	55	1,7,15,21,28
Lead	µg/L	ND(<0.5)	6.4	ND(<0.5)	0.82	0.76	0.82	4.3	1,3,7,15,21
Mercury	µg/L	0.414	ND(<0.3)	0.019	0.089	0.044	0.089	0.510	1,10,16,21
Nickel	µg/L	11.0	ND(<8.6)	5.2	13.1	5.2	13.1	69	1,7,15,21
Selenium	µg/L	ND(<0.09)	55.2	3	6.5	75	75	34	2,7,15,21
Silver	µg/L	0.50	0.064	ND(<0.19)	ND(<1.59)	ND(<0.19)	ND(<1.59)	ND(<0.19)	3,9,18,21
Zinc	µg/L	9.5	ND(<35)	20	48.4	20	48.4	255	1,7,15,21
Cyanide (MBAS data)	µg/L	--	--	81	89.5	81	89.5	143	1,7,16,20
Cyanide	µg/L	ND(<8.6)	ND(<8.6)	7.2	7.2	46	46	38	1,11,15,20,21
Total Chlorine Residual	µg/L	--	ND(<200)	ND(<200)	ND(<200)	ND(<200)	ND(<200)	ND(<200)	5
Ammonia (as N) 6-mo median	µg/L	143.1	ND(<86.2)	36,400	36,400	36,400	36,400	191,579	1,6,15,21,27

[15] Note that these ranges assign the transitional months to the ocean condition that is typically more restrictive at relevant discharge flows.

Constituent	Units	Updated Desal Brine	Previous Desal Brine	Secondary Effluent		Hauled Brine		GWR Concentrate	Footnotes
				MPWSP	*Variant*	*MPWSP*	*Variant*		
Ammonia (as N) daily max	µg/L	143.1	ND(<86.2)	49,000	49,000	49,000	49,000	257,895	1,6,15,21,27
Acute Toxicity	TUa	--	–	2.3	2.3	2.3	2.3	0.77	1,12,16,17,24
Chronic Toxicity	TUc	--	–	40	40	80	40	100	1,12,16,17,24
Phenolic Compounds (non-chlorinated)	µg/L	ND(<86.2)	–	69	69	69	69	363	1,6,14,15,23,25 26
Chlorinated Phenolics	µg/L	ND(<34.5)	–	ND(<20)	ND(<20)	ND(<20)	ND(<20)	ND(<20)	3,9,18,23,25,26
Endosulfan	µg/L	ND(<3.4E-6)	6.7E-05	0.015	0.048	0.015	0.048	0.25	1,10,14,15,22,25
Endrin	µg/L	ND(<1.6E-6)	2.8E-05	0.000079	0.000079	0.000079	0.000079	0.00042	4,8,15,22
HCH (Hexachlorocyclohexane)	µg/L	0.000043	0.00068	0.034	0.060	0.034	0.060	0.314	1,15,22,25
Radioactivity (Gross Beta)	pCi/L	ND(<5.17)	–	32	32	307	307	34.8	1,6,12,16,17,23
Radioactivity (Gross Alpha)	pCi/L	22.4	–	18	18	457	457	14.4	1,6,12,16,17,23
Objectives for protection of human health – non carcinogens – 30-day average limit									
Acrolein	µg/L	ND(<3.4)	–	ND(<5)	9.0	ND(<5)	9.0	47	3,7,15,23
Antimony	µg/L	0.19	16.6	0.65	0.79	0.65	0.79	4.1	1,6,15,21
Bis (2-chloroethoxy) methane	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Bis (2-chloroisopropyl) ether	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Chlorobenzene	µg/L	ND(<0.9)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Chromium (III)	µg/L	17	106.9	3.0	7.3	87	87	38	2,6,15,21
Di-n-butyl phthalate	µg/L	ND(<16.7)	–	ND(<5)	ND(<7)	ND(<5)	ND(<7)	ND(<1)	3,9,18,23
Dichlorobenzenes	µg/L	ND(<0.9)	–	1.6	1.6	1.6	1.6	8	1,6,15,21
Diethyl phthalate	µg/L	ND(<0.9)	–	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<1)	3,9,18,23
Dimethyl phthalate	µg/L	ND(<0.9)	–	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.5)	3,9,18,23
4,6-dinitro-2-methylphenol	µg/L	ND(<84.5)	–	ND(<0.5)	ND(<20)	ND(<0.5)	ND(<20)	ND(<5)	3,9,18,23
2,4-dinitrophenol	µg/L	ND(<86.2)	–	ND(<0.5)	ND(<13)	ND(<0.5)	ND(<13)	ND(<5)	3,9,18,23
Ethylbenzene	µg/L	ND(<0.9)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Fluoranthene	µg/L	ND(<0.2)	0.0019	0.00654	0.00654	0.00654	0.00654	0.03442	4,9,18,23
Hexachlorocyclopentadiene	µg/L	ND(<0.09)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.05)	3,9,18,23
Nitrobenzene	µg/L	ND(<41.4)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<1)	3,9,18,23
Thallium	µg/L	ND(<0.1)	ND(<1.7)	ND(<0.5)	0.69	ND(<0.5)	0.69	3.7	3,7,15,21
Toluene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Tributyltin	µg/L	ND(<0.08)	–	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.02)	3,13,18,23
1,1,1-trichloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Objectives for protection of human health – carcinogens – 30-day average limit									
Acrylonitrile	µg/L	ND(<3.4)	–	ND(<2)	2.5	ND(<2)	2.5	13	3,7,15,23
Aldrin	µg/L	ND(<6.7E-5)	–	ND(<0.005)	ND(<0.007)	ND(<0.005)	ND(<0.007)	ND(<0.01)	3,9,18,23
Benzene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Benzidine	µg/L	ND(<86.2)	–	ND(<0.5)	ND(<19.8)	ND(<0.5)	ND(<19.8)	ND(<0.05)	3,9,18,23
Beryllium	µg/L	ND(<0.9)	ND(<1.7)	ND(<0.5)	ND(<0.69)	0.0052	0.0052	ND(<0.5)	3,9,17,18,21
Bis(2-chloroethyl)ether	µg/L	ND(<41.4)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Bis(2-ethyl-hexyl)phthalate	µg/L	ND(<1.0)	ND(<1.0)	78	78	78	78	411	2,6,15,23
Carbon tetrachloride	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	0.50	ND(<0.5)	0.50	2.66	3,7,15,21
Chlordane	µg/L	1.45E-5	0.0002	0.00068	0.00068	0.00068	0.00068	0.0036	4,8,14,15,22,25
Chlorodibromomethane	µg/L	ND(<0.9)	–	ND(<0.5)	2.4	ND(<0.5)	2.4	13	3,7,15,21
Chloroform	µg/L	ND(<0.9)	–	2	39	2	39	204	2,7,15,21
DDT	µg/L	1.7E-6	0.00055	0.0001	0.0001	0.0012	0.0012	0.006	4,7,14,19,22,25
1,4-dichlorobenzene	µg/L	ND(<0.9)	ND(<0.9)	1.6	1.6	1.6	1.6	8.4	1,6,15,21
3,3-dichlorobenzidine	µg/L	ND(<86.2)	–	ND(<0.025)	ND(<19)	ND(<0.025)	ND(<19)	ND(<2)	3,9,18,23
1,2-dichloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1-dichloroethylene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	0.5	0.5	ND(<0.5)	3,9,18,21
Dichlorobromomethane	µg/L	ND(<0.9)	–	ND(<0.5)	2.6	ND(<0.5)	2.6	14	3,7,15,21
Dichloromethane	µg/L	ND(<0.9)	ND(<0.9)	0.55	0.64	0.55	0.64	3.4	1,7,15,21
1,3-dichloropropene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	0.56	ND(<0.5)	0.56	3.0	3,7,15,21
Dieldrin	µg/L	4.7E-5	8.8E-05	0.0001	0.0001	0.0006	0.0006	0.0033	4,7,19,22
2,4-dinitrotoluene	µg/L	ND(<0.2)	–	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.1)	3,9,18,23
1,2-diphenylhydrazine	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Halomethanes	µg/L	ND(<0.9)	–	0.54	1.4	0.73	1.4	7.5	2,7,14,15,21
Heptachlor	µg/L	ND(<6.9E-7)	8.6E-06	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	3,9,18,22
Heptachlor epoxide	µg/L	ND(<1.6E-6)	ND(<0.02)	0.000079	0.000079	0.000079	0.000079	0.000416	4,8,15,22
Hexachlorobenzene	µg/L	ND (<6.5E-5)	ND(<0.09)	0.000078	0.000078	0.000078	0.000078	0.000411	4,8,15,22,23
Hexachlorobutadiene	µg/L	ND(<3.4E-7)	–	0.000009	0.000009	0.000009	0.000009	0.000047	4,8,15,22
Hexachloroethane	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<0.5)	3,9,18,23
Isophorone	µg/L	ND(<0.9)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,23
N-Nitrosodimethylamine	µg/L	ND(<0.003)	ND(<0.003)	0.017	0.096	0.017	0.096	0.150	2,7,16,17,23

Constituent	Units	Updated Desal Brine	Previous Desal Brine	Secondary Effluent		Hauled Brine		GWR Concentrate	Footnotes
				MPWSP	Variant	MPWSP	Variant		
N-Nitrosodi-N-Propylamine	µg/L	ND(<0.003)	ND(<0.003)	0.076	0.076	0.076	0.076	0.019	2,6,16,17,23
N-Nitrosodiphenylamine	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<1)	3,9,18,23
PAHs	µg/L	2.2E-3	0.012	0.03	0.03	0.03	0.03	0.19	4,8,14,15,22,25
PCBs	µg/L	0.00013	0.002	0.00068	0.00068	0.00068	0.00068	0.00357	4,8,14,15,22,25
TCDD Equivalents	µg/L	ND (<2.5E-5)	–	1.37E-7	1.42E-7	1.37E-7	1.42E-7	7.46E-7	4,13,14,15,23,25
1,1,2,2-tetrachloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Tetrachloroethylene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Toxaphene	µg/L	3.97E-5	ND(<0.0013)	0.0071	0.0071	0.0071	0.0071	0.0373	4,8,15,22
Trichloroethylene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1,2-trichloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
2,4,6-trichlorophenol	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<1)	3,9,18,23
Vinyl chloride	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21

Table 4 Footnotes:

MPWSP Secondary Effluent and Hauled Brine

[1] The value reported is based on MRWPCA historical data.
[2] The value reported is based on secondary effluent data collected during the GWR Project source water monitoring programs (not impacted by the proposed new source waters), and are representative of future water quality under the MPWSP scenario.
[3] The MRL provided represents the limit from NPDES monitoring data for secondary effluent and hauled waste. In cases where constituents had varying MRLs, in general, the lowest MRL is reported.
[4] RTP effluent value presented based on CCLEAN data.

Total Chlorine Residual

[5] For all waters, it is assumed that dechlorination will be provided such that the total chlorine residual will be below detection.

Variant Secondary Effluent and Hauled Brine

[6] Existing RTP effluent exceeds concentrations observed in other proposed source waters; the value reported is the existing secondary effluent value.
[7] The proposed new source waters may increase the secondary effluent concentration; the value reported is based on predicted source water blends.
[8] RTP effluent value is based on CCLEAN data; no other source waters were considered due to MRL differences.
[9] MRL provided represents the maximum flow-weighted MRL based on the blend of source waters.
[10] The only water with a detected concentration was the RTP effluent, however the flow-weighted concentration increases due to higher MRLs for the proposed new source waters.
[11] Additional source water data are not available; the reported value is for RTP effluent.
[12] Calculation of the flow-weighted concentration was not feasible due to constituent. The maximum observed value is reported.
[13] Agricultural Wash Water data are based on an aerated sample, instead of a raw water sample.
[14] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.

GWR Concentrate Data

[15] The value presented represents a calculated value assuming no removal prior to RO, complete rejection through RO membrane, and an 81% RO recovery.
[16] The value represents the maximum value observed during the pilot testing study.
[17] The calculated value for the AWT Facility data (described in note 15) was not used in the analysis because it was not considered representative. It is expected that the value would increase as a result of treatment through the AWT Facility (*e.g.* formation of N-Nitrosodimethylamine as a disinfection by-product), or that it will not concentrate linearly through the RO (*e.g.* toxicity and radioactivity).
[18] The MRL provided represents the limit from the source water and pilot testing monitoring programs.

[19] The value presented represents a calculated value assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, and 36% and 44% removal through ozone for DDT and dieldrin, respectively, complete rejection through the RO membrane, and an 81% RO recovery. The assumed removals are based on results from ozone bench-scale testing of Blanco Drain water blended with secondary effluent and low detection sampling through the RTP.

Cyanide Data
[20] In mid-2011, MBAS began performing the cyanide analysis on the RTP effluent, at which time the reported values increased by an order of magnitude. Because no operational or source water composition changes took place at this time that would result in such an increase, it is reasonable to conclude the increase is an artifact of the change in analysis method and therefore questionable. Therefore, the cyanide values as measured by MBAS are listed separately from other cyanide values, and the MBAS data were not be used in the analysis for evaluating compliance with the Ocean Plan objectives.

Desal Brine Data
[21] The value reported is based on test slant well data collected through the Watershed Sanitary Survey.
[22] The value reported is based on data from the one-time 7-day composite sample from the test slant well. If ND, the method detection limit was used for the analysis instead of the MRL. MRLs were not available for this data set.
[23] The value reported is based on data from the test slant well collected through the quarterly Ocean Plan constituents monitoring.
[24] Acute and chronic toxicity have not been measured or estimated
[25] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.
[26] Chlorinated phenolic compounds is the sum of the following: 4-chloro-3-methylphenol, 2-chlorophenol, pentachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol. Non-chlorinated phenolic compounds is the sum of the following: 2,4-dimethylphenol, 4,6-Dinitro-2-methylphenol, 2,4-dinitrophenol, 2-methylphenol, 4-methylphenol, 2-nitrophenol, 4-nitrophenol, and phenol.

General
[27] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[28] The value reported for the Variant secondary effluent was calculated using the median of the data collected for the new source waters and is an estimate of the potential increase in concentration of the secondary effluent based on predicted source water blends. The value reported for the Desal Brine was calculated with the median of the data collected from the test slant well and assuming a 42% recovery through the RO. The median values were used because the maximum values detected in both sources appear to be outliers, and because the Ocean Plan objective is a 6-month median concentration, it is reasonable to use the median value detected from these source waters.

3.2 Ocean Modeling Results

The estimated minimum probable dilution (D_m) for each discharge scenario is presented in Tables 5 and 6 (Roberts, P. J. W., 2016). For discharge scenarios that were modeled with more than one modeling method, the lowest D_m (*i.e.*, most conservative) is reported in the tables below. For the MPWSP, the flow scenarios in which little or no secondary effluent was discharged (Scenarios 2, 3 and 4) resulted in the lowest D_m values as a result of the discharge plume being negatively buoyant. At higher secondary effluent flows, the discharge plume would be positively buoyant, resulting in an increased D_m, as evidenced in Scenario 6. The same trend was observed for Variant scenarios.

Table 5 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for MPWSP

No.	Discharge Scenario (Ocean Condition)	Discharge flows (mgd)			D_m [b]
		Secondary effluent	Desal Brine	Hauled brine [a]	
2	Desal Brine with no secondary effluent	0	13.98	0.1	14.6
3	Desal Brine with low secondary effluent	1	13.98	0.1	15.2
4	Desal Brine with low secondary effluent	2	13.98	0.1	16.0
5	Desal Brine with moderate secondary effluent	9	13.98	0.1	34.3
6	Desal Brine with high secondary effluent [c]	19.78	13.98	0.1	153

[a] Hauled brine was not included in the modeling of MPWSP flow scenarios; however, the change in both flow and TDS from the addition of hauled brine is less than 1% and thus is expected to have a negligible impact on the modeled D_m.

[b] Several models were used to predict the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. A value of 1 has also been subtracted from Dr. Roberts' values to take into account the different definition of dilution/D_m provided by Dr. Roberts versus the Ocean Plan.

[c] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

Table 6 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for Variant

No.	Discharge Scenario	Discharge Flows (mgd)				D_m [b]
		Secondary Effluent	Desal Brine	GWR Concentrate	Hauled Brine [a]	
1	Desal Brine only	0	8.99	0	0.1	14.9
2	Desal Brine with low secondary effluent	1	8.99	0	0.1	15.7
3	Desal Brine with low secondary effluent	2	8.99	0	0.1	16.7
4	Desal Brine with moderate secondary effluent	5.8	8.99	0	0.1	31.5
5	Desal Brine with high secondary effluent [b]	19.78	8.99	0	0.1	104
6	Desal Brine with GWR Concentrate and no secondary effluent	0	8.99	0.94	0.1	15.6
7	Desal Brine with GWR Concentrate and low secondary effluent	1	8.99	0.94	0.1	16.4
8	Desal Brine with GWR Concentrate and low secondary effluent	3	8.99	0.94	0.1	20.3
9	Desal Brine with GWR Concentrate and moderate secondary effluent	5.3	8.99	0.94	0.1	54.4
10	Desal Brine with GWR Concentrate and high secondary effluent	15.92	8.99	0.94	0.1	194

[a] Hauled brine was not included in the modeling of Variant scenarios involving discharge of desalination brine. However, the change in both flow and TDS from the addition of hauled brine is less than 1% and thus is expected to have a negligible impact on the modeled D_m.

[b] Several models were used to predict the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. A value of 1 has also been subtracted from Dr. Roberts' values to take into account the different definition of dilution/D_m provided by Dr. Roberts versus the Ocean Plan.

3.3 Ocean Plan Compliance Results

The flow-weighted in-pipe concentration for each constituent was calculated for each modeled discharge scenario using the water quality presented in Table 4 and the discharge flows presented in Tables 2 and 3. The in-pipe concentration was then used to calculate the concentration at the edge of the ZID using the D_m values presented in Tables 5 and 6. The resulting concentrations for each constituent in each scenario were compared to the Ocean Plan objectives to assess compliance. The estimated concentrations for the 15 flow scenarios (5 for the MPWSP and 10 for the Variant) for all constituents are presented as concentrations at the edge of the ZID (Appendix A, Table A1 and A3) and as a percentage of the Ocean Plan objective (Appendix A, Table A2 and A4).

It was identified that some constituents are estimated to exceed the Ocean Plan objective for some discharge scenarios. Seventeen[16] constituents were highlighted to potentially exceed the Ocean Plan water quality objectives; however, ten[17] of these constituents were never detected above the MRL in any of the source waters, and the MRLs are higher than the Ocean Plan objective.[18] Due to this insufficient analytical sensitivity, no compliance conclusion can be drawn for these constituents. This is a typical occurrence for ocean discharges since the MRL of the approved compliance analysis method is higher than the Ocean Plan objective for certain constituents.

Of the constituents detected in the source waters, seven were identified as having potential to exceed the Ocean Plan objective in the Variant. Within this subset, acrylonitrile, beryllium and TCDD equivalents were detected in some of the source waters, but not in the others. For these analyses, the MRLs themselves were above the Ocean Plan objective. To assess the blended concentrations for these constituents, a value of zero was assumed for any sources when the concentration was below the MRL.[19] This approach is a "best-case" scenario because it assumes the lowest possible concentration—namely, a value of zero—for any constituent below the reporting limit. This approach is still useful, however, to bracket the analysis and assess the potential for Ocean Plan compliance issues under best-case conditions. Through this method, TCDD equivalents shows potential to exceed the Ocean Plan objective for the Variant. The predicted concentration of acrylonitrile[20] and beryllium at the edge of the ZID is less than the Ocean Plan objective and therefore did not show exceedances through this "best-case" analysis.

A list of the constituents that may exceed the Ocean Plan are shown at their estimated concentration at the edge of the ZID in Table 7 for the MPWSP and Table 8 for the Variant, and as the concentration at the edge of the ZID as a percentage of the Ocean Plan objective in Table 9 and 10 for the MPWSP and Variant, respectively. The "best-case" scenario compliance assessment results for TCDD equivalents is also included in these tables.

[16] Ammonia, chlorinated phenolics, 2,4-dinitrophenol, tributyltin, acrylonitrile, aldrin, benzidine, beryllium, bis(2-chloroethyl)ether, chlordane, 3,3-dichlorobenzidine, 1,2-diphenylhydrazine, heptachlor, PCBs, TCDD equivalents, toxaphene, 2,4,6-trichlorophenol

[17] Chlorinated phenolics, 2,4-dinitrophenol, tributyltin, aldrin, benzidine, bis(2-chloroethyl)ether, 3,3-dichlorobenzidine, 1,2-diphenylhydrazine, heptachlor, 2,4,6-trichlorophenol

[18] The exceptions to this statement are: 2,4-dinitrophenol was ND in the MPWSP Secondary Effluent, and this MRL is lower than the Ocean Plan objective (*i.e.*, MRL = 0.5 ug/L versus 4 ug/L = objective); heptachlor was not detected above the MRL in the slant well, and this MRL is lower than the Ocean Plan objective (*i.e.*, MRL = 0.00000069 ug/L versus 0.00005 ug/L).

[19] Additionally, the Ocean Plan states that for constituents that are made up of an aggregate of constituents, a concentration of 0 can be assumed for the individual constituents that are not detected above the MRL, such as TCDD equivalents.

[20] Acrylonitrile was only detected in one potential source water for the Variant. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant.

Table 7 – Predicted concentrations at the edge of the ZID for Ocean Plan constituents of concern in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Ammonia (as N) – 6-mo median [b]	µg/L	600	25.7	172.1	287	409.0	139.2
Objectives for protection of human health - carcinogens - 30-day average limit [c d]							
Chlordane	µg/L	2.3E-05	1.23E-06	3.91E-06	6.00E-06	7.89E-06	2.65E-06
PCBs	µg/L	1.9E-05	8.76E-06	1.07E-05	1.20E-05	9.86E-06	2.94E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6.23E-11	6.17E-10	1.05E-09	1.53E-09	5.22E-10
Toxaphene [e]	µg/L	2.1E-04	5.75E-06	3.42E-05	5.65E-05	7.99E-05	2.71E-05

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[c] Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 8 – Predicted concentrations at the edge of the ZID for Ocean Plan constituents of concern in the Variant [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Ammonia (as N) – 6-mo median [b]	µg/L	600	34	245	396	446	239	1111	1154	1060	445	151
Objectives for protection of human health - carcinogens - 30-day average limit [c]												
Chlordane	µg/L	2.3E-05	1.37E-6	5.24E-6	7.98E-6	8.61E-6	4.53E-6	2.15E-5	2.22E-5	2.03E-5	8.49E-6	2.86E-6
PCBs	µg/L	1.9E-05	8.72E-6	1.15E-5	1.33E-5	1.07E-5	4.85E-6	2.77E-5	2.76E-5	2.40E-5	9.68E-6	3.05E-6
TCDD Equivalents [c]	µg/L	3.9E-09	9.81E-11	9.26E-10	1.52E-9	1.73E-9	9.30E-10	4.30E-9	4.47E-9	4.11E-9	1.73E-9	5.87E-10
Toxaphene [d]	µg/L	2.1E-04	7.37E-6	4.84E-5	7.77E-5	8.72E-5	4.66E-5	2.17E-4	2.25E-4	2.07E-4	8.68E-5	2.94E-5

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[c] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[d] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 9 – Predicted concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Ammonia (as N) – 6-mo median [b]	μg/L	600	4%	29%	48%	68%	23%
Objectives for protection of human health – carcinogens – 30-day average limit [c d]							
Chlordane	μg/L	2.3E-05	5%	17%	26%	34%	12%
PCBs	μg/L	1.9E-05	46%	56%	63%	52%	15%
TCDD Equivalents [d]	μg/L	3.9E-09	2%	16%	27%	39%	13%
Toxaphene [e]	μg/L	2.1E-04	3%	16%	27%	38%	13%

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).

[c] Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.

[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.

[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 10 – Predicted concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the Variant [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Scenario									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Ammonia (as N) – 6-mo median [b]	µg/L	600	5.7%	41%	66%	74%	40%	185%	192%	177%	74%	25%
Objectives for protection of human health - carcinogens - 30-day average limit [c]												
Chlordane	µg/L	2.3E-05	6%	23%	35%	37%	20%	94%	97%	88%	37%	12%
PCBs	µg/L	1.9E-05	46%	61%	70%	57%	26%	146%	145%	126%	51%	16%
TCDD Equivalents [c]	µg/L	3.9E-09	3%	24%	39%	44%	24%	110%	115%	105%	44%	15%
Toxaphene [d]	µg/L	2.1E-04	4%	23%	37%	42%	22%	103%	107%	99%	41%	14%

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[c] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[d] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Potential issues were identified to occur when there is no, or relatively low, secondary effluent flow mixed with hauled brine, GWR Concentrate and Desal Brine, as in Variant Scenarios 6, 7 and 8. The constituents of interest related to these scenarios are ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene. Ammonia is expected to be the constituent with the highest exceedance, being 1.92 times the Ocean Plan objective in Scenario 7 (1 mgd secondary effluent with hauled brine, GWR Concentrate and Desal Brine). This scenario is problematic because constituents that have relatively high loadings in the secondary effluent are concentrated in the GWR Concentrate. This scenario assumes the GWR Concentrate flow is much smaller than the Desal Brine flow, such that the resulting discharge plume is negatively buoyant and achieves poor ocean dilution. Based on this analysis, Scenarios 6, 7 and 8 have been identified as having constituents that may exceed the Ocean Plan objective.

Chlordane, PCBs, and toxaphene were only detected when analyzed with low-detection methods, which have far greater sensitivity than standard methods. These results were used to investigate potential to exceed Ocean Plan objectives because these objectives are orders of magnitude below detection limits of methods currently used for discharge compliance.

4 Conclusions

The purpose of this analysis was to assess the ability of the MPWSP and Variant to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the secondary effluent, GWR Concentrate, Desal Brine and hauled brine for these projects. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and scenario. Seventeen constituents showed potential to exceed the Ocean Plan objectives. These constituents can be divided into three categories:

- Detected concentrations exceed Ocean Plan objectives (Category I): four constituents were detected in all source waters and the blended concentration at the edge of the ZID exceeded the Ocean Plan objective
- Insufficient analytical sensitivity to determine compliance (Category II): ten constituents were not detected above the MRL in any of the source waters, but the MRL was not sensitive enough to demonstrate compliance with the Ocean Plan objective
- Combination of Categories I and II: discharge blends contain sources with exceedances of Ocean Plan objectives (Category I) and sources whose compliance is indeterminate (Category II).

Based on the data, assumptions, modeling, and analytical methodology presented in this technical memorandum, the Variant shows a potential to exceed certain Ocean Plan objectives under specific discharge scenarios. In particular, potential issues were identified for the Variant discharge scenarios involving low secondary effluent flows with Desal Brine and GWR Concentrate: discharges are predicted to exceed or come close to exceeding multiple Ocean Plan objectives, specifically those for ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene. Ammonia clearly exceeds the Ocean Plan objective and must be resolved for the Variant. TCDD equivalents shows a potential to exceed the Ocean Plan objective through a best-case analysis. Chlordane, PCBs and toxaphene, which were predicted to exceed the objectives, were detected at concentrations that are orders of magnitude below detection limits of methods currently used for discharge compliance.

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Appendix A

Table A1 – Complete list of predicted concentrations of Ocean Plan constituents at the edge of the ZID for the MPWSP

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Arsenic	µg/L	8	3.9	4.0	4.1	3.7	3.2
Cadmium	µg/L	1	0.3	0.3	0.3	0.1	0.02
Chromium (Hexavalent)	µg/L	2	0.1	0.1	0.1	0.04	0.01
Copper	µg/L	3	1.9	2.0	2.0	2.1	2.0
Lead	µg/L	2	0.03	0.03	0.03	0.01	0.003
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.002
Nickel	µg/L	5	0.7	0.7	0.6	0.2	0.05
Selenium	µg/L	15	0.04	0.05	0.05	0.04	0.01
Silver	µg/L	0.7	0.2	<0.2	<0.2	<0.2	<0.2
Zinc	µg/L	20	8.1	8.1	8.2	8.2	8.0
Cyanide	µg/L	1	0.6	0.5	0.5	0.2	0.1
Total Chlorine Residual	µg/L	2	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	25.7	172.1	287	409.0	139.2
Ammonia (as N) - Daily Max	µg/L	2,400	31.4	228.8	384	549.8	187.2
Acute Toxicity [a]	TUa	0.3					
Chronic Toxicity [a]	TUc	1					
Phenolic Compounds (non-chlorinated)	µg/L	30	5.5	5.2	4.9	2.2	0.5
Chlorinated Phenolics [b]	µg/L	1	<2.20	<2.06	<1.92	<0.82	<0.17
Endosulfan	µg/L	0.009	7.05E-06	6.77E-05	1.15E-04	1.68E-04	5.72E-05
Endrin	µg/L	0.002	1.35E-07	4.45E-07	6.86E-07	9.09E-07	3.05E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	1.82E-05	1.56E-04	2.63E-04	3.81E-04	1.30E-04
Radioactivity (Gross Beta) [a]	pCi/L	0.0					
Radioactivity (Gross Alpha) [a]	pCi/L	0.0					
Objectives for protection of human health – non carcinogens – 30-day average limit							
Acrolein	µg/L	220	<0.2	<0.2	<0.2	<0.1	<0.03
Antimony	µg/L	1200	0.01	0.01	0.01	0.01	0.003
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.1	<1.0	<0.9	<0.3	<0.05
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.1	<1.0	<0.9	<0.3	<0.05
Chlorobenzene	µg/L	570	<0.1	<0.1	<0.05	<0.02	<0.004
Chromium (III)	µg/L	190000	1.1	1.0	0.9	0.3	0.1
Di-n-butyl phthalate	µg/L	3500	<1.1	<1.0	<0.9	<0.3	<0.1
Dichlorobenzenes	µg/L	5100	<0.1	0.1	0.1	0.03	0.01
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.02
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.04	<0.01
4,6-dinitro-2-methylphenol	µg/L	220	<5.4	<4.8	<4.3	<1.5	<0.2
2,4-Dinitrophenol [b]	µg/L	4.0	<5.5	<4.9	<4.4	<1.5	<0.2
Ethylbenzene	µg/L	4100	<0.1	<0.1	<0.05	<0.02	<0.004
Fluoranthene	µg/L	15	<0.01	0.01	0.01	0.003	0.0005
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.002
Nitrobenzene	µg/L	4.9	<2.6	<2.4	<2.1	<0.7	<0.1
Thallium	µg/L	2	<0.01	<0.01	<0.01	<0.01	<0.002
Toluene	µg/L	85000	<0.06	<0.05	<0.05	<0.02	<0.004
Tributyltin [b]	µg/L	0.0014	<0.01	<0.005	<0.005	<0.002	<0.0004
1,1,1-Trichloroethane	µg/L	540000	<0.1	<0.1	<0.05	<0.02	<0.004
Objectives for protection of human health – carcinogens – 30-day average limit							
Acrylonitrile [c d]	µg/L	0.10	--	--	--	--	--
Aldrin [b]	µg/L	0.000022	<6.51E-06	<2.63E-05	<4.18E-05	<5.70E-05	<1.92E-05

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Benzene	µg/L	5.9	<0.1	<0.1	<0.05	<0.02	<0.004
Benzidine [b]	µg/L	0.000069	<5.5	<4.9	<4.4	<1.5	<0.2
Beryllium [d]	µg/L	0.033	2.38E-6	2.14E-6	1.91E-6	6.41E-7	1.00E-7
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.6	<2.4	<2.1	<0.7	<0.1
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.4	0.7	0.9	0.3
Carbon tetrachloride	µg/L	0.90	<0.1	<0.1	<0.05	<0.02	<0.004
Chlordane	µg/L	0.000023	1.23E-6	3.91E-6	6.00E-6	7.89E-6	2.65E-6
Chlorodibromomethane	µg/L	8.6	<0.1	<0.1	<0.05	<0.02	<0.004
Chloroform	µg/L	130	0.1	0.1	0.1	0.04	0.01
DDT	µg/L	0.00017	1.53E-7	5.28E-7	8.21E-7	1.09E-6	3.68E-7
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.03	0.01
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.5	<4.9	<4.4	<1.5	<0.2
1,2-Dichloroethane	µg/L	28	<0.1	<0.1	<0.05	<0.02	<0.004
1,1-Dichloroethylene	µg/L	0.9	0.1	0.1	0.05	0.02	0.004
Dichlorobromomethane	µg/L	6.2	<0.1	<0.1	<0.05	<0.02	<0.004
Dichloromethane	µg/L	450	<0.1	0.1	0.05	0.02	0.004
1,3-dichloropropene	µg/L	8.9	<0.1	<0.1	<0.05	<0.02	<0.004
Dieldrin	µg/L	0.00004	3.01E-6	3.15E-6	3.21E-6	2.01E-6	5.37E-7
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.02	<0.02	<0.03	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.1	<1.0	<0.9	<0.3	<0.05
Halomethanes	µg/L	130	0.1	0.1	0.05	0.02	0.004
Heptachlor [b]	µg/L	0.00005	<4.60E-06	<4.51E-05	<7.69E-05	<1.12E-04	<3.81E-05
Heptachlor Epoxide	µg/L	0.00002	1.35E-07	4.45E-07	6.86E-07	9.09E-07	3.05E-07
Hexachlorobenzene	µg/L	0.00021	4.18E-06	4.08E-06	3.93E-06	1.99E-06	4.72E-07
Hexachlorobutadiene	µg/L	14	2.60E-08	6.03E-08	8.68E-08	1.06E-07	3.52E-08
Hexachloroethane	µg/L	2.5	<1.1	<1.0	<0.9	<0.3	<0.05
Isophorone	µg/L	730	<0.1	<0.1	<0.05	<0.02	<0.004
N-Nitrosodimethylamine	µg/L	7.3	0.0002	0.0003	0.0003	0.0002	0.0001
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.0003
N-Nitrosodiphenylamine	µg/L	2.5	<1.1	<1.0	<0.9	<0.3	<0.05
PAHs	µg/L	0.0088	1.51E-04	2.48E-04	3.23E-04	3.45E-04	1.11E-04
PCBs	µg/L	0.000019	8.76E-06	1.07E-05	1.20E-05	9.86E-06	2.94E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6.23E-11	6.17E-10	1.05E-09	1.53E-09	5.22E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.1	<0.1	<0.05	<0.02	<0.004
Tetrachloroethylene	µg/L	2.0	<0.1	<0.1	<0.05	<0.02	<0.004
Toxaphene [e]	µg/L	2.1E-04	5.75E-06	3.42E-05	5.65E-05	7.99E-05	2.71E-05
Trichloroethylene	µg/L	27	<0.1	<0.1	<0.05	<0.02	<0.004
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.1	<0.05	<0.02	<0.004
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.1	<1.0	<0.9	<0.3	<0.05
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.03	<0.01	<0.003

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent.

[b] All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

[c] Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.

[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance

determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A2 – Complete list of predicted concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Arsenic	µg/L	8	49%	50%	51%	46%	40%
Cadmium	µg/L	1	32%	29%	26%	10%	2%
Chromium (Hexavalent)	µg/L	2	3%	3%	3%	2%	1%
Copper	µg/L	3	64%	65%	67%	69%	68%
Lead	µg/L	2	2%	2%	2%	1%	0.2%
Mercury	µg/L	0.04	67%	61%	54%	20%	4%
Nickel	µg/L	5	14%	13%	12%	5%	1%
Selenium	µg/L	15	0.3%	0.3%	0.4%	0.3%	0.1%
Silver	µg/L	0.7	26%	<26%	<25%	<24%	<23%
Zinc	µg/L	20	40%	41%	41%	41%	40%
Cyanide	µg/L	1	57%	54%	51%	23%	5%
Total Chlorine Residual	µg/L	2	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	4%	29%	48%	68%	23%
Ammonia (as N) - Daily Max	µg/L	2,400	1%	10%	16%	23%	8%
Acute Toxicity [b]	TUa	0.3					
Chronic Toxicity [b]	TUc	1					
Phenolic Compounds (non-chlorinated)	µg/L	30	18%	17%	16%	7%	2%
Chlorinated Phenolics [c]	µg/L	1	--	--	--	--	--
Endosulfan	µg/L	0.009	0.1%	1%	1%	2%	1%
Endrin	µg/L	0.002	0.01%	0.02%	0.03%	0.05%	0.02%
HCH (Hexachlorocyclohexane)	µg/L	0.004	0.5%	4%	7%	10%	3%
Radioactivity (Gross Beta) [b]	pci/L	0.0					
Radioactivity (Gross Alpha) [b]	pci/L	0.0					
Objectives for protection of human health – non carcinogens – 30-day average limit							
Acrolein	µg/L	220	<0.1%	<0.1%	<0.1%	<0.1%	<0.01%
Antimony	µg/L	1200	0.0010%	0.0011%	0.0012%	0.0009%	0.0002%
Bis (2-chloroethoxy) methane	µg/L	4.4	<24%	<22%	<20%	<7%	<1%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.09%	<0.08%	<0.07%	<0.02%	<0.01%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	0.0006%	0.0005%	0.0005%	0.0002%	0.00003%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.03%	<0.03%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	0.001%	0.001%	0.001%	0.001%	0.0002%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<2%	<1%	<0.1%
2,4-Dinitrophenol [c]	µg/L	4.0	--	--	--	--	--
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.1%	0.02%	0.003%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<54%	<48%	<43%	<15%	<2%
Thallium	µg/L	2	<0.3%	<0.4%	<0.4%	<0.4%	<0.1%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [c]	µg/L	0.0014	--	--	--	--	--
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]				
			MPWSP				
			2	3	4	5	6
Objectives for protection of human health – carcinogens – 30-day average limit							
Acrylonitrile [d e]	µg/L	0.10	--	--	--	--	--
Aldrin [c]	µg/L	0.000022	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<0.3%	<0.1%
Benzidine [c]	µg/L	0.000069	--	--	--	--	--
Beryllium [e]	µg/L	0.033	0%	0%	0%	0%	0%
Bis(2-chloroethyl)ether [c]	µg/L	0.045	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	12%	19%	25%	9%
Carbon tetrachloride	µg/L	0.90	<6%	<6%	<5%	<2%	<0.5%
Chlordane	µg/L	0.000023	5%	17%	26%	34%	12%
Chlorodibromomethane	µg/L	8.6	<1%	<1%	<1%	<0.2%	<0.05%
Chloroform	µg/L	130	0.04%	0.04%	0.05%	0.03%	0.01%
DDT	µg/L	0.00017	0.09%	0.31%	0.48%	0.64%	0.22%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.2%	0.05%
3,3-Dichlorobenzidine [c]	µg/L	0.0081	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%
1,1-Dichloroethylene	µg/L	0.9	6%	6%	5%	2%	0.5%
Dichlorobromomethane	µg/L	6.2	<1%	<1%	<1%	<0.3%	<0.1%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.005%	0.001%
1,3-dichloropropene	µg/L	8.9	<1%	<1%	<1%	<0.2%	<0.05%
Dieldrin	µg/L	0.00004	8%	8%	8%	5%	1%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<0.3%
1,2-Diphenylhydrazine [c]	µg/L	0.16	--	--	--	--	--
Halomethanes	µg/L	130	0.04%	0.04%	0.04%	0.02%	0.003%
Heptachlor [c]	µg/L	0.00005	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	2%	3%	5%	2%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	1%	0.2%
Hexachlorobutadiene	µg/L	14	1.86E-7%	4.30E-7%	6.20E-7%	7.60E-7%	2.52E-7%
Hexachloroethane	µg/L	2.5	<43%	<38%	<35%	<12%	<2%
Isophorone	µg/L	730	<0.008%	<0.007%	<0.007%	<0.003%	<0.001%
N-Nitrosodimethylamine	µg/L	7.3	0.003%	0.004%	0.004%	0.003%	0.001%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.1%	0.2%	0.2%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<43%	<38%	<34%	<12%	<2%
PAHs	µg/L	0.0088	2%	3%	4%	4%	1%
PCBs	µg/L	0.000019	46%	56%	63%	52%	15%
TCDD Equivalents [e]	µg/L	3.9E-09	2%	16%	27%	38%	13%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<0.2%
Tetrachloroethylene	µg/L	2.0	<3%	<3%	<2%	<1%	<0.2%
Toxaphene [e]	µg/L	2.1E-04	3%	16%	27%	38%	13%
Trichloroethylene	µg/L	27	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%
1,1,2-Trichloroethane	µg/L	9.4	<1%	<1%	<1%	<0.2%	<0.04%
2,4,6-Trichlorophenol [c]	µg/L	0.29	--	--	--	--	--
Vinyl chloride	µg/L	36	<0.1%	<0.1%	<0.1%	<0.04%	<0.01%

[a] Note that if the percentage as determined by using the MRL was less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the MRL indicated the value was <0.000001%, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

[b] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.

[c] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A3 – Complete list of predicted concentrations of Ocean Plan constituents at the edge of the ZID for the Variant

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario – Variant 1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Arsenic	µg/L	8	3.9	4.0	4.1	3.8	3.3	3.8	4.0	4.0	3.4	3.2
Cadmium	µg/L	1	0.3	0.3	0.2	0.1	0.02	0.3	0.3	0.2	0.1	0.01
Chromium (Hexavalent)	µg/L	2	0.09	0.09	0.09	0.06	0.02	0.16	0.2	0.1	0.05	0.01
Copper	µg/L	3	1.9	2.0	2.0	2.1	2.1	2.2	2.3	2.2	2.1	2.0
Lead	µg/L	2	0.03	0.03	0.03	0.02	0.01	0.1	0.05	0.04	0.02	0.004
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.002	0.03	0.02	0.02	0.01	0.002
Nickel	µg/L	5	0.7	0.7	0.6	0.4	0.1	1.0	0.9	0.7	0.3	0.1
Selenium	µg/L	15	0.1	0.1	0.1	0.1	0.05	0.2	0.2	0.2	0.1	0.03
Silver	µg/L	0.7	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Zinc	µg/L	20	8.1	8.3	8.5	8.5	8.3	9.5	9.5	9.3	8.5	8.2
Cyanide	µg/L	1	0.6	0.6	0.5	0.3	0.1	0.7	0.7	0.5	0.2	0.05
Total Chlorine Residual	µg/L	2	–	–	–	–	–	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	34	245	396	446	239	1111	1154	1060	445	151
Ammonia (as N) - Daily Max	µg/L	2,400	43	328	531	600	322	1493	1551	1425	598	203
Acute Toxicity [a]	TUa	0.3										
Chronic Toxicity [a]	TUc	1										
Phenolic Compounds (non-chlorinated)	µg/L	30	5.4	5.0	4.7	2.4	0.7	6.7	6.2	4.8	1.8	0.4
Chlorinated Phenolics [b]	µg/L	1	<2.2	<2.0	<1.8	<0.9	<0.2	<2.0	<1.8	<1.4	<0.5	<0.1
Endosulfan	µg/L	0.009	3.3E-05	3.1E-04	5.1E-04	5.9E-04	3.2E-04	1.5E-03	1.4E-03	1.4E-03	5.9E-04	2.0E-04
Endrin	µg/L	0.002	1.5E-07	6.0E-07	9.2E-07	9.9E-07	5.2E-07	2.5E-06	2.6E-06	2.3E-06	9.8E-07	3.3E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	4.4E-05	3.9E-04	6.4E-04	7.3E-04	3.9E-04	1.8E-03	1.9E-03	1.7E-03	7.3E-04	2.5E-04
Radioactivity (Gross Beta) [a]	pci/L	0.0										
Radioactivity (Gross Alpha) [a]	pci/L	0.0										
Objectives for protection of human health – non carcinogens – 30-day average limit												
Acrolein	µg/L	220	0.2	0.2	0.3	0.2	0.1	0.5	0.4	0.4	0.1	0.04
Antimony	µg/L	1200	0.01	0.02	0.02	0.01	0.01	0.03	0.03	0.03	0.01	0.004
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Chlorobenzene	µg/L	570	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Chromium (III)	µg/L	190000	1.1	1.0	0.9	0.4	0.1	1.2	1.1	0.8	0.3	0.1
Di-n-butyl phthalate	µg/L	3500	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.1
Dichlorobenzenes	µg/L	5100	0.1	0.1	0.1	0.04	0.01	0.1	0.1	0.1	0.03	0.01
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.04	<0.1	<0.1	<0.1	<0.04	<0.02
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.04	<0.02	<0.1	<0.1	<0.05	<0.02	<0.01

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario									
			Variant									
			1	2	3	4	5	6	7	8	9	10
4,6-dinitro-2-methylphenol	µg/L	220	<5.3	<4.6	<4.1	<1.8	<0.4	<4.6	<4.1	<3.0	<1.0	<0.2
2,4-Dinitrophenol [b]	µg/L	4.0	<5.4	<4.7	<4.1	<1.8	<0.3	<4.7	<4.1	<3.0	<1.0	<0.2
Ethylbenzene	µg/L	4100	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Fluoranthene	µg/L	15	0.01	0.01	0.01	0.003	0.001	0.01	0.01	0.01	0.002	0.0003
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.004	<0.01	<0.01	<0.01	<0.004	<0.002
Nitrobenzene	µg/L	4.9	<2.6	<2.2	<1.9	<0.8	<0.1	<2.2	<2.0	<1.4	<0.5	<0.1
Thallium	µg/L	2	0.01	0.01	0.01	0.01	0.005	0.03	0.03	0.02	0.01	0.003
Toluene	µg/L	85000	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Tributyltin [b]	µg/L	0.0014	<0.01	<0.005	<0.004	<0.002	<0.001	<0.005	<0.004	<0.003	<0.001	<0.0003
1,1,1-Trichloroethane	µg/L	540000	<0.05	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Objectives for protection of human health – carcinogens – 30-day average limit												
Acrylonitrile [c]	µg/L	0.10	0.001	0.007	0.011	0.012	0.007	0.034	0.035	0.031	0.013	0.004
Aldrin [b]	µg/L	0.000022	<9.0E-06	<4.9E-05	<7.8E-05	<8.7E-05	<4.6E-05	<6.4E-05	<9.2E-05	<1.1E-04	<5.6E-05	<2.4E-05
Benzene	µg/L	5.9	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Benzidine [b]	µg/L	0.000069	<5.4	<4.7	<4.2	<1.8	<0.4	<4.7	<4.2	<3.0	<1.0	<0.2
Beryllium [c]	µg/L	0.033	3.61E-6	3.10E-6	2.66E-6	1.08E-6	1.72E-7	3.14E-6	2.72E-6	1.88E-6	6.15E-7	1.03E-7
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.6	<2.2	<1.9	<0.8	<0.2	<2.2	<2.0	<1.4	<0.5	<0.1
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.6	0.9	1.0	0.5	2.4	2.5	2.3	1.0	0.3
Carbon tetrachloride	µg/L	0.90	0.1	0.05	0.04	0.02	0.01	0.1	0.1	0.04	0.02	0.004
Chlordane	µg/L	0.000023	1.4E-06	5.2E-06	8.0E-06	8.6E-06	4.5E-06	2.2E-05	2.2E-05	2.0E-05	8.5E-06	2.9E-06
Chlorodibromomethane	µg/L	8.6	0.1	0.1	0.1	0.05	0.02	0.1	0.1	0.1	0.04	0.01
Chloroform	µg/L	130	0.1	0.3	0.5	0.5	0.3	1.2	1.3	1.2	0.5	0.2
DDT	µg/L	0.00017	9.6E-07	8.1E-06	1.3E-05	1.5E-05	8.1E-06	3.7E-05	3.9E-05	3.6E-05	1.5E-05	5.1E-06
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.04	0.01	0.1	0.1	0.1	0.03	0.01
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.4	<4.7	<4.2	<1.8	<0.4	<4.7	<4.2	<3.0	<1.0	<0.2
1,2-Dichloroethane	µg/L	28	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
1,1-Dichloroethylene	µg/L	0.9	0.1	0.05	0.04	0.02	0.01	0.05	0.05	0.04	0.01	0.003
Dichlorobromomethane	µg/L	6.2	0.1	0.1	0.1	0.05	0.02	0.1	0.1	0.1	0.04	0.01
Dichloromethane	µg/L	450	0.1	0.05	0.05	0.02	0.01	0.1	0.1	0.05	0.02	0.004
1,3-dichloropropene	µg/L	8.9	0.1	0.05	0.05	0.02	0.01	0.1	0.1	0.04	0.02	0.004
Dieldrin	µg/L	0.00004	3.3E-06	6.6E-06	8.8E-06	8.5E-06	4.2E-06	2.1E-05	2.2E-05	2.0E-05	8.1E-06	2.7E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.02	<0.03	<0.03	<0.01	<0.01	<0.02	<0.03	<0.01	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Halomethanes	µg/L	130	0.1	0.1	0.1	0.03	0.01	0.1	0.1	0.1	0.03	0.01
Heptachlor [b]	µg/L	0.00005	<7.0E-6	<6.5E-5	<1.1E-4	<1.2E-4	<6.6E-05	<6.3E-05	<1.1E-04	<1.5E-04	<7.5E-05	<3.4E-05
Heptachlor Epoxide	µg/L	0.00002	1.5E-7	6.0E-7	9.2E-7	9.9E-7	5.2E-7	2.5E-6	2.6E-6	2.3E-6	9.8E-7	3.3E-7
Hexachlorobenzene	µg/L	0.00021	4.1E-6	4.0E-6	3.8E-6	2.2E-6	7.0E-7	5.9E-6	5.5E-6	4.4E-6	1.6E-6	4.4E-7
Hexachlorobutadiene	µg/L	14	2.8E-8	7.7E-8	1.1E-7	1.2E-7	6.0E-8	2.9E-7	3.0E-7	2.7E-7	1.1E-7	3.8E-8
Hexachloroethane	µg/L	2.5	<1.0	<0.9	<0.8	<0.3	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Isophorone	µg/L	730	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
N-Nitrosodimethylamine	µg/L	7.3	0.0003	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.0003
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.001	0.0003	0.001	0.001	0.001	0.0003
N-Nitrosodiphenylamine	µg/L	2.5	<1.0	<0.9	<0.8	<0.3	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
PAHs	µg/L	0.0088	0.0002	0.0003	0.0004	0.0004	0.0002	0.0012	0.0012	0.0010	0.0004	0.0001
PCBs	µg/L	0.000019	8.7E-6	1.2E-5	1.3E-5	1.1E-5	4.8E-6	2.8E-5	2.8E-5	2.4E-5	9.7E-6	3.0E-6
TCDD Equivalents [c]	µg/L	3.9E-09	9.8E-11	9.3E-10	1.5E-9	1.7E-9	9.3E-10	4.3E-9	4.5E-9	4.1E-9	1.7E-9	5.9E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Tetrachloroethylene	µg/L	2.0	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Toxaphene [e]	µg/L	2.1E-04	7.4E-06	4.8E-05	7.8E-05	8.7E-05	4.7E-05	2.2E-04	2.3E-04	2.1E-04	8.7E-05	2.9E-05
Trichloroethylene	µg/L	27	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.0	<0.9	<0.8	<0.3	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.03	<0.02	<0.005	<0.03	<0.03	<0.02	<0.01	<0.003

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.
[b] All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
[c] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A4 – Complete list of predicted concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Arsenic	µg/L	8	49%	50%	51%	47%	41%	48%	49%	50%	43%	39%
Cadmium	µg/L	1	31%	27%	24%	11%	2%	31%	27%	20%	7%	1%
Chromium (Hexavalent)	µg/L	2	5%	5%	5%	3%	1%	8%	8%	6%	2%	1%
Copper	µg/L	3	64%	66%	68%	69%	68%	75%	75%	75%	70%	68%
Lead	µg/L	2	2%	2%	2%	1%	0.3%	3%	2%	2%	1%	0.2%
Mercury	µg/L	0.04	66%	58%	51%	23%	6%	64%	57%	42%	15%	4%
Nickel	µg/L	5	14%	13%	13%	7%	2%	20%	19%	15%	6%	1%
Selenium	µg/L	15	0.4%	1%	1%	1%	0.3%	2%	2%	1%	1%	0.2%
Silver	µg/L	0.7	26%	<27%	<27%	<26%	<24%	<26%	<26%	<27%	<25%	<24%
Zinc	µg/L	20	41%	42%	43%	43%	41%	47%	48%	47%	43%	41%
Cyanide	µg/L	1	57%	53%	49%	26%	7%	71%	65%	50%	18%	5%
Total Chlorine Residual	µg/L	2	–	–	–	–	–	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	6%	41%	66%	74%	40%	185%	192%	177%	74%	25%
Ammonia (as N) - Daily Max	µg/L	2,400	2%	14%	22%	25%	13%	62%	65%	59%	25%	8%
Acute Toxicity [b]	TUa	0.3										
Chronic Toxicity [b]	TUc	1										
Phenolic Compounds (non-chlorinated)	µg/L	30	<18%	<17%	<16%	<8%	<2%	<22%	<21%	<16%	<6%	<1%
Chlorinated Phenolics [c]	µg/L	1	--	--	--	--	--	--	--	--	--	--
Endosulfan	µg/L	0.009	0.4%	3%	6%	7%	4%	16%	17%	15%	7%	2%
Endrin	µg/L	0.002	0.01%	0.03%	0.05%	0.05%	0.03%	0.1%	0.1%	0.1%	0.05%	0.02%
HCH (Hexachlorocyclohexane)	µg/L	0.004	1%	10%	16%	18%	10%	45%	47%	43%	18%	6%
Radioactivity (Gross Beta) [b]	pci/L	0.0										
Radioactivity (Gross Alpha) [b]	pci/L	0.0										
Objectives for protection of human health – non carcinogens – 30-day average limit												
Acrolein	µg/L	220	0.1%	0.1%	0.1%	0.1%	0.03%	0.2%	0.2%	0.2%	0.1%	0.02%
Antimony	µg/L	1200	0.001%	0.001%	0.001%	0.001%	0.0005%	0.003%	0.003%	0.002%	0.001%	0.0003%
Bis (2-chloroethoxy) methane	µg/L	4.4	<24%	<21%	<18%	<8%	<2%	<21%	<18%	<13%	<5%	<1%

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.1%	<0.1%	<0.1%	<0.03%	<0.01%	<0.1%	<0.1%	<0.05%	<0.02%	<0.004%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.004%	<0.001%	<0.01%	<0.01%	<0.01%	<0.002%	<0.001%
Chromium (III)	µg/L	190000	0.001%	0.001%	0.0005%	0.0002%	0.0001%	0.001%	0.001%	0.0004%	0.0001%	0.00003%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.03%	<0.02%	<0.01%	<0.003%	<0.03%	<0.02%	<0.02%	<0.01%	<0.001%
Dichlorobenzenes	µg/L	5100	0.001%	0.001%	0.001%	0.001%	0.0003%	0.002%	0.002%	0.001%	0.001%	0.0002%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<2%	<1%	<0.2%	<2%	<2%	<1%	<0.5%	<0.1%
2,4-Dinitrophenol [c]	µg/L	4.0	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.1%	0.02%	0.004%	0.1%	0.1%	0.04%	0.01%	0.002%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<53%	<45%	<39%	<16%	<3%	<46%	<40%	<28%	<9%	<2%
Thallium	µg/L	2	0.3%	0.5%	1%	0.5%	0.2%	1%	1%	1%	0.5%	0.2%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [c]	µg/L	0.0014	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health – carcinogens – 30-day average limit												
Acrylonitrile [d]	µg/L	0.10	1%	7%	11%	12%	7%	34%	35%	31%	13%	4%
Aldrin [c]	µg/L	0.000022	--	--	--	--	--	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<0.4%	<0.1%	<1%	<1%	<1%	<0.2%	<0.1%
Benzidine [c]	µg/L	0.000069	--	--	--	--	--	--	--	--	--	--
Beryllium [d]	µg/L	0.033	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bis(2-chloroethyl)ether [c]	µg/L	0.045	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	16%	25%	28%	15%	69%	72%	66%	27%	9%
Carbon tetrachloride	µg/L	0.90	6%	5%	5%	2%	1%	7%	6%	5%	2%	0.4%
Chlordane	µg/L	0.000023	6%	23%	35%	37%	20%	94%	97%	88%	37%	12%
Chlorodibromomethane	µg/L	8.6	1%	1%	1%	0.5%	0.2%	1%	1%	1%	0.4%	0.1%
Chloroform	µg/L	130	0.1%	0.2%	0.3%	0.4%	0.2%	1%	1%	1%	0.4%	0.1%
DDT	µg/L	0.00017	1%	5%	8%	9%	5%	22%	23%	21%	9%	3%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.2%	0.1%	1%	0.5%	0.4%	0.2%	0.05%
3,3-Dichlorobenzidine [c]	µg/L	0.0081	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.05%	<0.01%
1,1-Dichloroethylene	µg/L	0.9	6%	5%	5%	2%	1%	6%	5%	4%	1%	0.4%
Dichlorobromomethane	µg/L	6.2	1%	1%	1%	1%	0.3%	2%	2%	2%	1%	0.2%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.005%	0.002%	0.01%	0.01%	0.01%	0.004%	0.001%
1,3-dichloropropene	µg/L	8.9	1%	1%	1%	0.3%	0.1%	1%	1%	0.5%	0.2%	0.04%
Dieldrin	µg/L	0.00004	8%	16%	22%	21%	11%	54%	55%	49%	20%	7%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<1%	<0.4%	<1%	<1%	<1%	<0.3%
1,2-Diphenylhydrazine [c]	µg/L	0.16	--	--	--	--	--	--	--	--	--	--
Halomethanes	µg/L	130	0.04%	0.04%	0.04%	0.03%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%
Heptachlor [c]	µg/L	0.00005	--	--	--	--	--	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	3%	5%	5%	3%	12%	13%	12%	5%	2%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	1%	0.3%	3%	3%	2%	1%	0.2%
Hexachlorobutadiene	µg/L	14	2E-7%	6E-7%	8E-7%	8E-7%	4E-7%	2E-6%	2E-6%	2E-6%	8E-7%	3E-7%
Hexachloroethane	µg/L	2.5	<42%	<36%	<32%	<14%	<3%	<36%	<32%	<23%	<8%	<1%
Isophorone	µg/L	730	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodimethylamine	µg/L	7.3	0.004%	0.01%	0.02%	0.01%	0.01%	0.01%	0.02%	0.02%	0.01%	0.005%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.2%	0.3%	0.3%	0.1%	0.1%	0.2%	0.3%	0.1%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<42%	<36%	<32%	<14%	<3%	<36%	<32%	<23%	<8%	<1%

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]									
			Variant									
			1	2	3	4	5	6	7	8	9	10
PAHs	µg/L	0.0088	2%	3%	4%	4%	2%	14%	14%	12%	5%	1%
PCBs	µg/L	0.000019	46%	61%	70%	57%	26%	146%	145%	126%	51%	16%
TCDD Equivalents [d]	µg/L	3.9E-09	3%	24%	39%	44%	24%	110%	115%	105%	44%	15%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<0.3%	<2%	<2%	<2%	<1%	<0.1%
Tetrachloroethylene	µg/L	2.0	<3%	<2%	<2%	<1%	<0.3%	<2%	<2%	<2%	<1%	<0.2%
Toxaphene [e]	µg/L	2.1E-04	4%	23%	37%	42%	22%	103%	107%	99%	41%	14%
Trichloroethylene	µg/L	27	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.05%	<0.01%
1,1,2-Trichloroethane	µg/L	9.4	<1%	<1%	<0.5%	<0.2%	<0.1%	<1%	<0.5%	<0.4%	<0.1%	<0.03%
2,4,6-Trichlorophenol [c]	µg/L	0.29	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	µg/L	36	<0.1%	<0.1%	<0.1%	<0.04%	<0.01%	<0.1%	<0.1%	<0.1%	<0.03%	<0.01%

[a] Note that if the percentage as determined by using the MRL was less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the MRL indicated the value was <0.000001%, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

[b] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.

[c] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.

[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Appendix D

Roberts, P. J. W, 2017. "Modeling Brine Disposal into Monterey Bay – Supplement." *Technical Memorandum to Environmental Science Associates (ESA)*. 22 September.

Modeling Brine Disposal into Monterey Bay – Supplement

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Final Report

Prepared for
ESA | Environmental Science Associates
San Francisco, California

September 22, 2017

CONTENTS

Executive Summary

Additional dilution simulations are presented for the disposal of brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. The report is a supplement to Roberts (2016) and addresses new flow scenarios and other issues that have been raised.

It has been suggested to replace the opening in the end gate of the diffuser with a check valve. A 6-inch valve was proposed, and analyses of the internal hydraulics of the diffuser and outfall were conducted. The check valve had minimal effect on the flow distribution between the diffuser ports and minimal effect on head loss. The flow from the end gate was reduced slightly and the exit velocity considerably increased. The effect of the valve orientation on dilution of brine discharges was investigated. It was found that any upward angle greater than about 20° would result in dilutions that meet the BMZ salinity requirements. The optimum angle to maximize dilution is 60°.

Dilutions were computed for all new flow scenarios assuming the 6-inch check valve was installed in the end gate.

The effect of currents on the brine jets was addressed. Dilutions were predicted using the mathematical model UM3 for the pure brine discharges for various anticipated current speeds. Jets discharging into the currents were bent back and dilutions were increased by the current. Jets discharging with the current were swept downstream and impacted the seabed farther from the diffuser. All dilutions with currents were greater than those with zero current, and all impact points were well within the BMZ.

It has been suggested to orient the nozzles along the diffuser upwards (from their present horizontal angles) to increase the dilution of dense effluents. This would decrease the dilution of buoyant effluents, however. Dilutions were predicted for dense and buoyant effluents. For dense effluents, increasing the nozzle angle increased dilution considerably; for buoyant effluents, the dilutions reduced slightly.

LIST OF FIGURES

List of Tables

1. INTRODUCTION

It is proposed to dispose of the brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. Discharge will be through an existing outfall and diffuser usually used for domestic wastewater disposal. Because of varying flow scenarios, the effluent and its composition vary from pure secondary effluent to pure brine. Sixteen scenarios, with flows ranging from 9.0 to 33.8 mgd (million gallons per day) and densities from 998.8 to 1045.2 kg/m^3, were previously analyzed in Roberts (2016). The internal hydraulics of the outfall and diffuser were computed and dilutions predicted for flow scenarios resulting in buoyant and dense effluents. It was found that, for all dense discharge conditions, the salinity requirements in the new California Ocean Plan were met within the BMZ (Brine Mixing Zone).

Since that report was completed, new flow scenarios have been proposed that include higher volumes of brine and GWR effluent, the inclusion of hauled brine, and situations where the desalination plant is offline. It has been requested to analyze dilutions for many more flow combinations for typical and variant cases. And it is proposed to replace the opening in the diffuser's end gate, which allows some brine to be released at a low velocity and therefore low dilution, with a check valve that would increase the exit velocity and therefore increase dilution. The check valve would be angled upwards, further increasing dilution. Finally, it has been suggested to replace the horizontal 4-inch check valves along the diffuser with upwardly oriented valves that would increase the dilution of dense effluents.

The specific tasks addressed in this report are:

- Analyze internal hydraulics accounting for the effect of the new proposed end gate check valve;
- Compute dilutions for new scenarios with dense and buoyant flow effluents accounting for the effect of the valve;
- Assess the effects of currents on dense discharges;
- Compute the dilution of dense discharges from the end gate;
- Analyze the effect of varying the nozzle angle on the dilution of dense and buoyant effluents.

2. Modeling Scenarios

2.1 Introduction

To address the additional concerns and issues that have been raised, the revised dilution analyses will include the following:

- **End-Gate**: The outfall hydraulics will be revised assuming the end-gate has been replaced with one Tideflex valve. The assumed end-gate configuration may be modified depending on the California Ocean Plan (COP) compliance analysis results.
- **Effluent Water Quality:** The salinity and temperature of the secondary effluent and GWR effluent shall remain unchanged from prior analyses presented in the 2017 Draft EIR/EIS.
- **Ocean Conditions**: Dilution analyses shall incorporate conditions related to the ocean seasons consistent with previous analyses. Worst-case conditions shall be assessed and presented.
- **Mitigation:** Preliminary assessments of the impact of diffuser nozzle orientation on dilution of dense and buoyant effluents will be made.
- **Currents:** The effects of currents on the advection and dispersion of dense effluents will be assessed.

All revised discharge scenarios will incorporate consideration of a modified end-gate on outfall diffuser hydraulics and dilution.

Model analyses will be done for typical and high brine discharge scenarios with a range of secondary and GWR effluent flows. Modeling the highest RO concentrate flow expected follows the conservative approach previously used on COP compliance evaluations for this project. Also, scenarios involving high flows of secondary effluent will be assessed for typical operations of the Variant both with and without GWR effluent. In addition, it has been requested that discharge scenarios where brine is absent be included in dilution model analyses to cover times when the desalination plant is offline.

2.2 Environmental and Discharge Conditions

In the previous report, Roberts (2016), oceanographic measurements obtained near the diffuser were discussed. Traditionally, three oceanic seasons have been defined in Monterey Bay: Upwelling (March-September), Oceanic (September-November), and Davidson (November-March). Density profiles were averaged by season to obtain representative profiles for the dilution simulations. The profiles are shown in Figure 1 and are tabulated in Appendix A. The salinities and temperatures near the depth of the diffuser were averaged seasonally as summarized in Table 1.

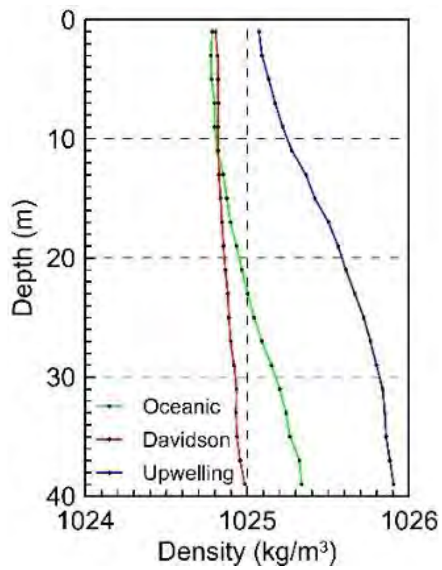


Figure 1. Seasonally averaged density profiles used for dilution simulations.

Table 1. Seasonally Averaged Properties at Diffuser Depth

Season	Temperature (°C)	Salinity (ppt)	Density (kg/m³)
Davidson	14.46	33.34	1024.8
Upwelling	11.48	33.89	1025.8
Oceanic	13.68	33.57	1025.1

The assumed constituent properties are summarized in Table 2.

Table 2. Assumed Properties of Effluent Constituents

Constituent	Temperature (°C)	Salinity (ppt)	Density (kg/m³)
Secondary effluent	20.0	0.80	998.8
Brine	9.9	58.23	1045.2
GWR	20.0	5.80	1002.6
Hauled brine	20.0	40.00	1028.6

2.3 Discharge Scenarios

Following publication of the 2017 MPWSP Draft EIR/EIS, the MRWPCA commented on several concerns related to the impact analysis regarding Ocean Plan and NPDES compliance. Specifically, discharge scenarios involving higher volumes of desalination brine (following a shut down for repair or routine maintenance) had not been assessed. Also, it was requested that higher resolution model analysis be conducted for scenarios involving low and moderate flows of secondary effluent for all project alternatives. Additionally, the MRWPCA requested that increased GWR effluent flows be assessed as part of planning for an increased capacity PWM project. Finally, it was requested that hauled brine be included in the dilution analysis for the Proposed Project.

It is proposed that revised model analysis be completed for typical and high brine discharge scenarios with secondary effluent flows ranging from 0 to 10 mgd and with the inclusion of hauled brine. Additionally, scenarios involving high flows of secondary effluent (15 and 19.78 mgd) will be assessed for typical operations. In addition, MPWPCA has requested that discharge scenarios where brine is absent be included in dilution model analyses to cover times when the desal plant is offline and to revise dilution model estimates based on the modified end-gate which may alter the outfall diffuser hydraulics.

Table 3 details the revised discharge scenarios for dilution model analysis of the Proposed Project (full size desalination facility and no implementation of GWR/PWM).

Table 4 details revised discharge scenarios for dilution model analysis of the Variant (MPWSP Alternative, reduced capacity desalination facility with PWM/GWR).

Table 3. Modeled Discharge Scenarios – Project (no GWR)

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
T1	SE Only	0.00	19.78	0	0.1	19.88	1.00	999.0
T2	Brine only	13.98	0.00	0	0.1	14.08	58.10	1045.1
T3	Brine + Low SE	13.98	1.00	0	0.1	15.08	54.30	1042.0
T4	Brine + Low SE	13.98	2.00	0	0.1	16.08	50.97	1039.4
T5	Brine + Low SE	13.98	3.00	0	0.1	17.08	48.04	1037.0
T6	Brine + Low SE	13.98	4.00	0	0.1	18.08	45.42	1034.9
T7	Brine + Moderate SE	13.98	5.00	0	0.1	19.08	43.08	1033.0
T8	Brine + Moderate SE	13.98	6.00	0	0.1	20.08	40.98	1031.3
T9	Brine + Moderate SE	13.98	7.00	0	0.1	21.08	39.07	1029.7
T10	Brine + Moderate SE	13.98	8.00	0	0.1	22.08	37.34	1028.3
T11	Brine + Moderate SE	13.98	9.00	0	0.1	23.08	35.76	1027.1
T12	Brine + High SE	13.98	10.00	0	0.1	24.08	34.30	1025.9
T13	Brine + High SE	13.98	15.00	0	0.1	29.08	28.54	1021.2
T14	Brine + High SE	13.98	19.78	0	0.1	33.86	24.63	1018.1
T15	High Brine only	16.31	0.00	0	0.1	16.41	58.12	1045.1
T16	High Brine + Low SE	16.31	1.00	0	0.1	17.41	54.83	1042.5
T17	High Brine + Low SE	16.31	2.00	0	0.1	18.41	51.89	1040.1
T18	High Brine + Low SE	16.31	3.00	0	0.1	19.41	49.26	1038.0
T19	High Brine + Low SE	16.31	4.00	0	0.1	20.41	46.89	1036.1
T20	High Brine + Moderate SE	16.31	5.00	0	0.1	21.41	44.73	1034.3

Table 4. Modeled Discharge Scenarios – Variant

Case ID	Scenario	Constituent Flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
V1	Brine only	8.99	0.00	0	0.0	8.99	58.23	1045.2
V2	Brine + Low SE	8.99	1.00	0	0.0	9.99	52.48	1040.6
V3	Brine + Low SE	8.99	2.00	0	0.0	10.99	47.78	1036.8
V4	Brine + Low SE	8.99	3.00	0	0.0	11.99	43.86	1033.6
V5	Brine + Low SE	8.99	4.00	0	0.0	12.99	40.55	1030.9
V6	Brine + Moderate SE	8.99	5.00	0	0.0	13.99	37.70	1028.6
V7	Brine + Moderate SE	8.99	5.80	0	0.0	14.79	35.71	1027.0
V8	Brine + Moderate SE	8.99	7.00	0	0.0	15.99	33.09	1024.9
V9	Brine + High SE	8.99	14.00	0	0.0	22.99	23.26	1017.0
V10	Brine + High SE	8.99	19.78	0	0.0	28.77	18.75	1013.3
V11	GWR Only	0.00	0.00	1.17	0.0	1.17	5.80	1002.6
V12	Low SE + GWR	0.00	0.40	1.17	0.0	1.57	4.53	1001.6
V13	Low SE + GWR	0.00	3.00	1.17	0.0	4.17	2.20	999.9
V14	High SE + GWR	0.00	23.70	1.17	0.0	24.87	1.04	999.0
V15	High SE + GWR	0.00	24.70	1.17	0.0	25.87	1.03	999.0
V16	Brine + High GWR only	8.99	0.00	1.17	0.0	10.16	52.19	1040.3
V17	Brine + High GWR + Low SE	8.99	1.00	1.17	0.0	11.16	47.59	1036.6
V18	Brine + High GWR + Low SE	8.99	2.00	1.17	0.0	12.16	43.74	1033.5
V19	Brine + High GWR + Low SE	8.99	3.00	1.17	0.0	13.16	40.48	1030.9
V20	Brine + High GWR + Low SE	8.99	4.00	1.17	0.0	14.16	37.67	1028.6
V21	Brine + High GWR + Moderate SE	8.99	5.00	1.17	0.0	15.16	35.24	1026.6
V22	Brine + High GWR + Moderate SE	8.99	5.30	1.17	0.0	15.46	34.57	1026.1
V23	Brine + High GWR + Moderate SE	8.99	6.00	1.17	0.0	16.16	33.11	1024.9
V24	Brine + High GWR + Moderate SE	8.99	7.00	1.17	0.0	17.16	31.23	1023.4
V25	Brine + High GWR + High SE	8.99	11.00	1.17	0.0	21.16	25.48	1018.7
V26	Brine + High GWR + High SE	8.99	15.92	1.17	0.0	26.08	20.82	1015.0
V27	Brine + Low GWR only	8.99	0.00	0.94	0.0	9.93	53.27	1041.2
V28	Brine + Low GWR + Low SE	8.99	1.00	0.94	0.0	10.93	48.47	1037.3
V29	Brine + Low GWR + Low SE	8.99	3.00	0.94	0.0	12.93	41.09	1031.4
V30	Brine + Low GWR + Moderate SE	8.99	5.30	0.94	0.0	15.23	35.01	1026.4
V31	Brine + Low GWR + High SE	8.99	15.92	0.94	0.0	25.85	20.95	1015.1
V32	High Brine only	11.24	0.00	0.00	0.0	11.24	58.23	1045.2
V33	High Brine + Low SE	11.24	0.50	0.00	0.0	11.74	55.78	1043.3
V34	High Brine + Low SE	11.24	1.00	0.00	0.0	12.24	53.54	1041.4
V35	High Brine + Low SE	11.24	2.00	0.00	0.0	13.24	49.55	1038.2
V36	High Brine + Low SE	11.24	3.00	0.00	0.0	14.24	46.13	1035.5
V37	High Brine + Low SE	11.24	4.00	0.00	0.0	15.24	43.16	1033.0
V38	High Brine + Moderate (5) SE	11.24	5.00	0.00	0.0	16.24	40.55	1030.9
V39	High Brine + GWR only	11.24	0.00	1.17	0.0	12.41	53.29	1041.2
V40	High Brine + GWR + Low SE	11.24	0.50	1.17	0.0	12.91	51.25	1039.6
V41	High Brine + GWR + Low SE	11.24	1.00	1.17	0.0	13.41	49.37	1038.0
V42	High Brine + GWR + Low SE	11.24	2.00	1.17	0.0	14.41	46.00	1035.3
V43	High Brine + GWR + Low SE	11.24	3.00	1.17	0.0	15.41	43.07	1033.0
V44	High Brine + GWR + Low SE	11.24	4.00	1.17	0.0	16.41	40.49	1030.9
V45	High Brine + GWR + Moderate SE	11.24	5.00	1.17	0.0	17.41	38.21	1029.0

3. Outfall Hydraulics

3.1 Introduction

The outfall and diffuser is described in Roberts (2016) (see Figure 1 in that report) as follows:

The Monterey Regional Water Pollution Control Agency (MRWPCA) outfall at Marina conveys the effluent to the Pacific Ocean to a depth of about 100 ft below Mean Sea Level (MSL). The ocean segment extends a distance of 9,892 ft from the Beach Junction Structure (BJS). Beyond this there is a diffuser section 1,406 ft long. The outfall pipe consists of a 60-inch internal diameter (ID) reinforced concrete pipe (RCP), and the diffuser consists of 480 ft of 60-inch RCP with a single taper to 840 ft of 48-inch ID. The diffuser has 171 ports of two-inch diameter: 65 in the 60-inch section and 106 in the 48-inch section. The ports discharge horizontally alternately from both sides of the diffuser at a spacing of 16 ft on each side except for one port in the taper section that discharges vertically for air release. The 42 ports closest to shore are presently closed, so there are 129 open ports distributed over a length of approximately 1024 ft. The 129 open ports are fitted with four inch Tideflex "duckbill" check valves (the four inch refers to the flange size not the valve opening). The valves open as the flow through them increases so the cross-sectional area is variable. The end gate has an opening at the bottom about two inches high. The hydraulic characteristics of the four-inch valves and the procedure to compute the flow distribution in the diffuser with the end gate opening was detailed in Roberts (2016) Appendix A.

It is proposed to replace the end gate opening with a Tideflex check valve. A suitable valve is a 6 inch Tideflex check valve, Hydraulic Code 355. The hydraulic characteristics of this valve are shown in Figure 2.

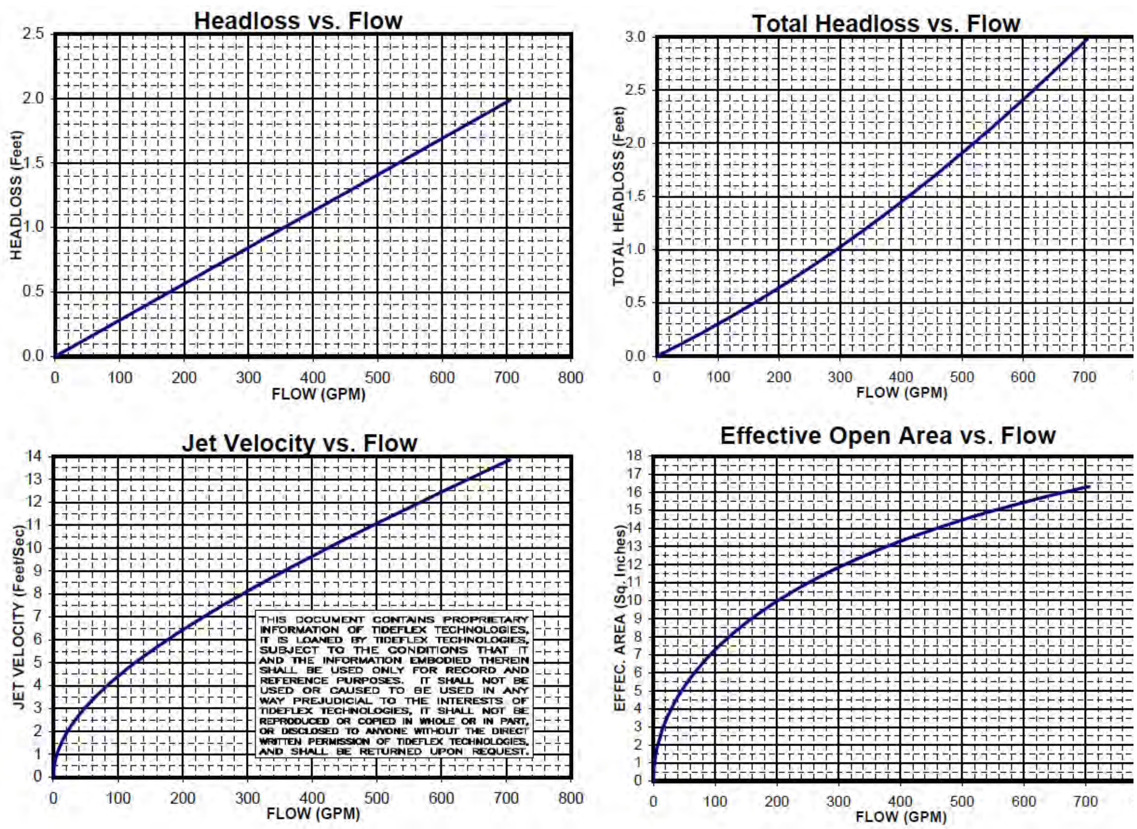


Figure 2. Characteristics of 6-inch TideFlex check valve Hydraulic Code 355.

The same methodology to compute the internal hydraulics as outlined in Roberts (2016) was used. For the purposes of the hydraulic computations, the relationship between the total head loss across the valve, E' and the flow Q of Figure 2 was approximated by:

$$Q = -28.24E'^2 + 319.8E' \tag{1}$$

The calculation procedure followed that in Roberts (2016) except that the open end gate relationship was replaced by Eq. 1.

Typical flow variations with and without the end gate valve are shown in Figure 3. This shows Case T1, mostly secondary effluent with a total flow of 19.88 mgd, density 999.0 kg/m^3, and case T2, almost pure brine with a flow of 14.08 mgd, density 1045.1 kg/m^3. The flow distributions with and without the Tideflex valve are virtually indistinguishable. The flow exiting from the end gate is reduced slightly from 4% to 3% of the total for T1 and from 5% to 4% for T2. The velocity from the end gate is increased significantly by the check valve, from 6.7 to 10.7 ft/s for T1 and from 6.1 to 9.7 ft/s for T2. The additional total head loss through the outfall due to the check valve is negligible, about 0.01 ft.

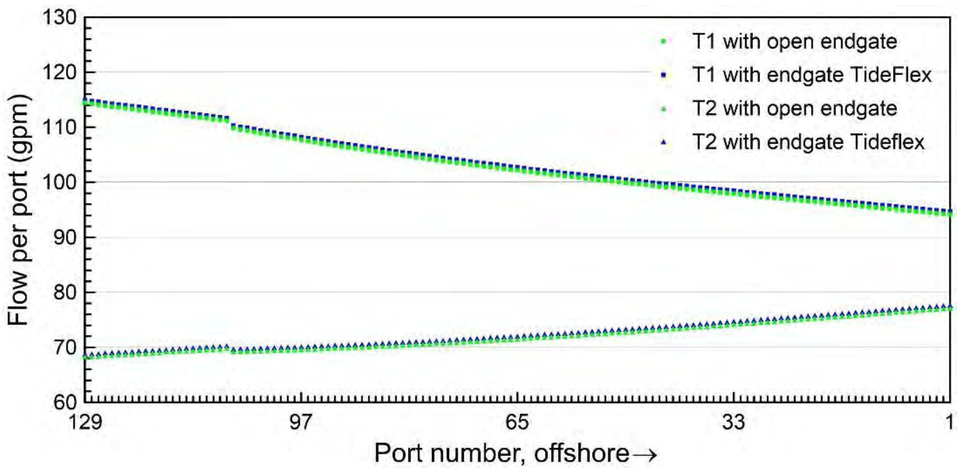


Figure 3. Typical port flow distributions with and without the endgate check valve for cases T1 and T2.

3.2 Effect of End Gate Valve on Dilution

The end gate check valve decreases the flow from the end gate and increases the flow from the two-inch ports. The dilution calculations later in this report assume the check valve is in place. To assess the effect of the valve on dilution from the main diffuser, dilutions were calculated for cases T1 and T2.

For T1, the total flow through the two-inch ports increased from 19.1 to 19.2 mgd (0.5%) and the port diameter increased from 2.00 to 2.01 inches. This had no effect on dilution (when rounded to a whole number).

For T2, the total flow through the two-inch ports increased from 13.4 to 13.5 mgd (0.8%) and the port diameter was unchanged at 1.84 inches. This had no effect on dilution (when rounded to a whole number).

4. Dense Discharge Dilution

4.1 Introduction

The calculation procedure was similar to that in Roberts (2016), where dilutions were predicted by two methods. First was the semi-empirical equation due to Cederwall (1968) (Eq. 3 in Roberts, 2016):

$$\frac{S_i}{F_j} = 0.54\left(0.66 + 0.38\frac{z}{dF_j}\right)^{5/3} \tag{2}$$

where S_i is the impact dilution, F_j the jet densimetric Froude number, and z the height of the nozzle above the seabed. Second, the dilution and trajectories of the jets were predicted by UM3, a Lagrangian entrainment model in the mathematical modeling suite Visual Plumes (Frick et al. 2003, Frick 2004, and Frick and Roberts 2016).

First, the internal hydraulics program was run to determine the flow variation along the diffuser. Dilutions were then computed for the flow and equivalent nozzle diameter for the innermost and outermost nozzles and the lowest dilution chosen. Worst-case oceanic conditions were assumed, which corresponds to the lowest oceanic density, the “Davidson” condition (Table 1), i.e. salinity = 33.34 ppt, density = 1024.8 kg/m^3.

4.2 Results

The results for the Project scenarios (Table 3) are summarized in Table 5, and for the Variant (Table 4) in Table 6. For large density differences, the Cederwall equation gives the lowest dilutions but as the effluent density approaches the ambient density, UM3 gives lower dilutions. To be conservative, the lowest of the two model predictions was chosen, as shown in last columns of Tables 5 and 6. The increase in dilution from the impact point to the edge of the BMZ was assumed to be 20% as discussed in Roberts (2016).

All dense discharges meet the Ocean Plan requirement of a 2 ppt increment in salinity at the edge of the BMZ.

Table 5. Summary of Dilution Simulations for Dense Effluent Scenarios – Project (no GWR)

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt
T2	14.08	58.10	1045.1	77.8	1.88	9.0	28.5	15.4	16.2	10.2	15.4	1.61	18.5	1.34
T3	15.08	54.30	1042.0	82.8	1.91	9.3	31.6	16.0	16.1	10.4	16.0	1.31	19.2	1.09
T4	16.08	50.97	1039.4	80.8	1.89	9.2	34.5	16.8	17.6	11.6	16.8	1.05	20.1	0.88
T5	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	17.7	18.5	12.7	17.7	0.83	21.2	0.69
T6	18.08	45.42	1034.9	91.6	1.95	9.8	43.4	18.8	19.5	13.8	18.8	0.64	22.5	0.54
T7	19.08	43.08	1033.0	97.1	1.98	10.1	49.2	20.1	20.9	15.3	20.1	0.48	24.2	0.40
T8	20.08	40.98	1031.3	103.1	2.01	10.4	56.5	21.9	22.2	16.8	21.9	0.35	26.3	0.29
T9	21.08	39.07	1029.7	108.7	2.02	10.9	67.4	24.8	24.9	19.2	24.8	0.23	29.7	0.19
T10	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	28.2	27.5	21.9	27.5	0.15	33.0	0.12
T11	23.08	35.76	1027.1	119.8	2.07	11.4	103.3	34.2	27.7	22.3	27.7	0.09	33.2	0.07
T12	24.08	34.30	1025.9	125.3	2.10	11.6	150.4	46.7	39.2	33.0	39.2	0.02	47.0	0.02
T15	16.41	58.12	1045.1	82.4	1.90	9.3	29.3	15.5	16.3	10.5	15.5	1.60	18.6	1.33
T16	17.41	54.83	1042.5	87.8	1.93	9.6	32.3	16.1	16.9	11.3	16.1	1.34	19.3	1.11
T17	18.41	51.89	1040.1	93.3	1.96	9.9	35.4	16.7	17.5	12.1	16.7	1.11	20.1	0.92
T18	19.41	49.26	1038.0	98.7	1.99	10.2	38.9	17.5	18.4	13.1	17.5	0.91	21.0	0.76
T19	20.41	46.89	1036.1	104.8	2.01	10.6	43.6	18.6	19.3	14.2	18.6	0.73	22.3	0.61
T20	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	19.6	20.4	15.4	19.6	0.58	23.6	0.48

Table 6. Summary of Dilution Simulations for Dense Effluent Scenarios – Variant

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
V1	9.0	58.23	1045.2	51.6	1.68	7.5	23.9	15.7	16.0	8.6	15.7	1.59	18.8	1.32
V2	10.0	52.48	1040.6	55.8	1.72	7.7	28.9	16.3	16.9	9.6	16.3	1.17	19.6	0.98
V3	11.0	47.78	1036.8	54.9	1.71	7.7	33.1	17.4	18.1	10.5	17.4	0.83	20.8	0.69
V4	12.0	43.86	1033.6	61.5	1.76	8.1	40.3	18.8	19.8	12.4	18.8	0.56	22.6	0.47
V5	13.0	40.55	1030.9	67.3	1.81	8.4	49.2	20.9	21.6	14.4	20.9	0.35	25.0	0.29
V6	14.0	37.70	1028.6	73.4	1.85	8.8	64.3	24.6	24.9	17.5	24.6	0.18	29.5	0.15
V7	14.8	35.71	1027.0	76.8	1.87	9.0	86.0	30.3	29.4	21.4	29.4	0.08	35.3	0.07
V8	16.0	33.09	1024.9	76.3	1.87	8.9	382.9	110.2	67.6	51.4	67.6	0.00	81.1	0.00
V16	10.2	52.19	1040.3	56.8	1.72	7.8	29.7	16.5	17.3	9.9	16.5	1.14	19.8	0.95
V17	11.2	47.59	1036.6	56.1	1.72	7.8	33.6	17.4	18.3	10.8	17.4	0.82	20.9	0.68
V18	12.2	43.74	1033.5	63.5	1.79	8.1	40.1	18.7	19.3	12.3	18.7	0.56	22.4	0.46
V19	13.2	40.48	1030.9	68.3	1.81	8.5	50.3	21.1	21.8	14.5	21.1	0.34	25.4	0.28
V20	14.2	37.67	1028.6	73.8	1.85	8.8	65.0	24.8	24.9	17.5	24.8	0.17	29.8	0.15
V21	15.2	35.24	1026.6	80.9	1.89	9.3	97.2	33.2	31.7	23.5	31.7	0.06	38.0	0.05
V22	15.5	34.57	1026.1	79.8	1.89	9.1	114.2	37.7	34.3	25.6	34.3	0.04	41.2	0.03
V23	16.2	33.11	1024.9	83.3	1.91	9.3	395.8	113.5	68.5	53.5	68.5	0.00	82.2	0.00
V27	9.9	53.27	1041.2	55.3	1.71	7.7	28.5	16.3	16.9	9.5	16.3	1.22	19.6	1.02

Table 6. Summary of Dilution Simulations for Dense Effluent Scenarios – Variant

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
V28	10.9	48.47	1037.3	59.3	1.75	7.9	33.1	17.1	17.8	10.7	17.1	0.88	20.6	0.74
V29	12.9	41.09	1031.4	67.0	1.80	8.5	48.1	20.6	21.1	13.9	20.6	0.38	24.7	0.31
V30	15.2	35.01	1026.4	78.3	1.88	9.1	100.6	34.1	32.6	24.1	32.6	0.05	39.1	0.04
V32	11.2	58.23	1045.2	63.3	1.78	8.2	26.5	15.4	16.1	9.3	15.4	1.61	18.5	1.34
V33	11.7	55.78	1043.3	57.1	1.73	7.8	27.0	15.8	16.5	9.2	15.8	1.42	19.0	1.18
V34	12.2	53.54	1041.4	67.3	1.81	8.4	29.9	16.1	16.8	10.3	16.1	1.26	19.3	1.05
V35	13.2	49.55	1038.2	66.4	1.80	8.4	33.3	16.9	17.8	11.0	16.9	0.96	20.3	0.80
V36	14.2	46.13	1035.5	72.7	1.84	8.8	38.8	18.1	19.0	12.4	18.1	0.71	21.7	0.59
V37	15.2	43.16	1033.0	78.9	1.88	9.1	45.3	19.6	20.3	13.9	19.6	0.50	23.5	0.42
V38	16.2	40.55	1030.9	85.0	1.92	9.4	53.7	21.5	22.0	15.8	21.5	0.33	25.9	0.28
V39	12.4	53.29	1041.2	61.5	1.76	8.1	29.5	16.2	17.0	10.0	16.2	1.23	19.5	1.02
V40	12.9	51.25	1039.6	64.5	1.79	8.2	31.3	16.5	17.3	10.5	16.5	1.09	19.8	0.91
V41	13.4	49.37	1038.0	67.6	1.81	8.4	33.7	17.0	17.8	11.1	17.0	0.95	20.4	0.79
V42	14.4	46.00	1035.3	73.9	1.85	8.8	39.1	18.1	18.8	12.4	18.1	0.70	21.7	0.58
V43	15.4	43.07	1033.0	80.0	1.89	9.2	45.6	19.6	20.2	14.0	19.6	0.50	23.5	0.41
V44	16.4	40.49	1030.9	85.8	1.92	9.5	54.4	21.7	22.3	16.0	21.8	0.33	26.1	0.27
V45	17.4	38.21	1029.0	90.3	1.95	9.7	66.0	24.7	24.7	18.4	24.7	0.20	29.6	0.16

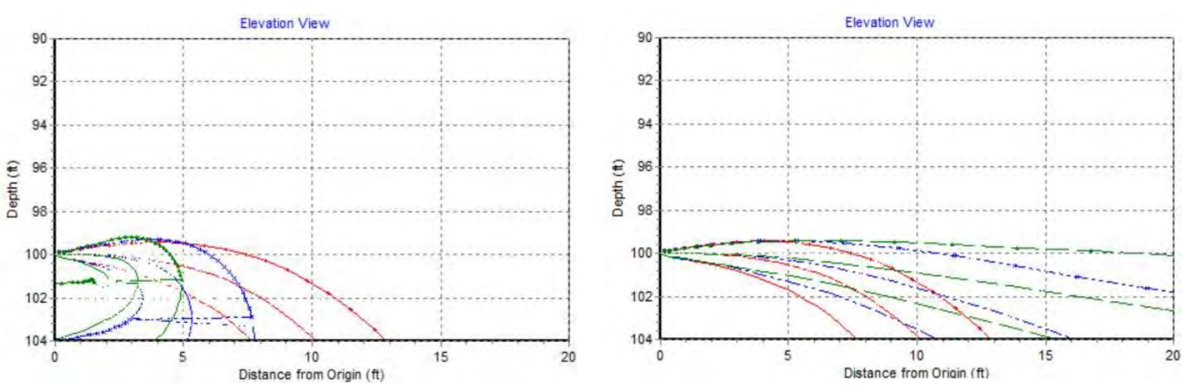
4.3 Effect of Currents

The effect of currents on the dynamics of dense jets has been questioned. All simulations have been done with zero current speed, as this is usually the worst case that results in lowest dilutions. According to the Research Activity Panel of the Monterey Bay National Marine Sanctuary, currents in the vicinity of the diffuser are commonly 5 to 10 cm/s and can reach 20 cm/s.

The effect of currents on dense jets is determined by the dimensionless parameter $u_r F_j$ (Gungor and Roberts 2009) where $u_r = u_a/u$ is the ratio of the ambient current speed, u_a, to the jet velocity, u. If $u_r F_j \ll 1$ the current does not significantly affect the jet; if $u_r F_j \gg 1$ the jet will be significantly deflected by the current and dilution increases significantly. Gungor and Roberts (2009) investigated the effects of currents on vertical dense jets; experiments on multiport diffusers with 60° nozzles were reported by Abessi and Roberts (2017).

There are no known experiments on horizontal dense jets in flowing currents so we investigated the phenomenon using the UM3 model in Visual Plumes. We simulated the pure brine case, T2 (Table 3) at current speeds of zero, 5, 10, and 20 cm/s. Because of the orientation of the MRWPCA diffuser (see Figure 1 of Roberts 2016) the predominant current direction is expected to be perpendicular to the diffuser axis. The nozzles are perpendicular to the diffuser, so the current direction relative to the individual jets is either counter-flow (jets directly opposing the current), or co-flow (jets in the same direction as the currents.

UM3 was run for all cases. Screen shots of the jet trajectories for counter- and co-flowing jets are shown in Figure 4.



a) Counter-flow **b) Co-flow**

Figure 4. Screen shots of UM3 simulations of dense jet trajectories (Case T2) in counter- and co-flowing currents. Red: zero current; Blue: 10 cm/s; Green: 20 cm/s.

In counter flowing currents, the jets are bent backwards and impact the seabed closer to the diffuser. In co-flowing currents, the jets are advected downstream and impact the seabed farther from the diffuser. The numerical results are summarized in Table 7.

Table 7. UM3 Simulations of Case T2 with Current

Current	Counter-flow		Co-flow	
Speed (cm/s)	Dilution	Impact distance (ft)	Dilution	Impact distance (ft)
0	16.2	10	16.2	10
5	17.3	8	22.6	13
10	18.9	5	38.4	16
20	32.6	0	78.0	27

It can be seen that the effect of the currents is to increase dilution compared to the zero current case. The maximum impact distance from the diffuser occurs with co-flowing currents and increases as the current speed increases. In this case, the maximum impact distance (for u_a = 20 cm/s) is 27 ft (8.2 m). Clearly, this is much less than the distance to the edge of the BMZ (100 m) so we conclude that neglecting the effect of currents is indeed conservative, and the Ocean Plan regulations will be met for all anticipated currents.

4.4 Dilution of End Gate Check Valve

As discussed in Section 3, it has been proposed to replace the opening in the end gate with a 6-inch Tideflex check valve. We simulated the dilution of this valve for various nozzle angles for the worst case of pure brine, T2 (Table 3). The flow distributions along the diffuser for this case were shown in Figure 3. The exit velocity from the end gate check valve is 9.7 ft/s and the equivalent round diameter is 4.1 inches, yielding a densimetric Froude number, F_j = 20.7.

The effect of nozzle angle on the dilution of dense jets is discussed in Section 6.2. Using Figure 6, the impact dilutions for various angles were calculated. The results are summarized in Table 8.

The corresponding dilution for the main diffuser nozzles is 15.4 (Table 5). It is therefore apparent that any nozzle angle greater than about 20° will result in dilutions greater than the main diffuser and will meet the BMZ requirements. Dilution is maximized for a 60° nozzle.

Table 8. Effect of Nozzle Angle on Impact Dilution for Flow from End Gate Check Valve for Case T2 (14.08 mgd, 1045.1 kg/m^3).

Nozzle angle (Degrees)	Impact dilution
0	8.9
10	12.3
20	18.9
30	25.6
40	31.6
50	35.7
60	36.9

5. Buoyant Discharge Dilution

5.1 Introduction

The same procedures and models discussed in Roberts (2016) were used except that all three seasonal profiles were used for each flow scenario to determine the worst-case condition. Inspection of Tables 3 and 4 show that there are 14 cases of buoyant discharges, i.e., the effluent density is less than the receiving water density. Three are for the Project and 11 for the Variant. Two models in the US EPA modeling suite Visual Plumes were used: NRFIELD and UM3. Zero current speed was assumed in all cases.

5.2 Results

The following procedure was used: The internal hydraulics program was first run for each scenario and the average diameter and flow for each nozzle was obtained. UM3 and NRFIELD were then run for each oceanic season.

As was observed in Roberts (2016), for very buoyant cases, the average dilution predicted by UM3 is close to the minimum (centerline) dilution predicted by NRFIELD. They diverge as the effluent becomes only slightly buoyant (i.e. the effluent density approaches the ambient density), with UM3 dilutions being considerably higher.

NRFIELD is based on experiments conducted for parameters typical of domestic wastewater discharges into coastal waters and estuaries. For this situation, dilution and mixing are mainly dependent on the source buoyancy flux with momentum flux playing a minor role. As the effluent density approaches the background density, buoyancy becomes less important and the mixing becomes dominated by momentum. In that situation, NRFIELD continues to give predictions but issues a warning that "The results are extrapolated" when the parameters are outside the range of the original experiments. Table 9 summarizes the results; NRFIELD predictions are only given when they fall within the experimental range on which it is based.

The plume behavior depends strongly on the shape of the density profile (Figure 1) but dilutions are generally very high. The Upwelling profile always gives deepest submergence and lowest dilutions. The plumes are always submerged with the Upwelling and Oceanic profiles but some plumes surface with the weak Davidson stratification. Dilutions are very high for surfacing plumes, up to 842 (Case V12) when the flow is very low.

Table 9. Summary of Dilution Simulations for Buoyant Effluent Scenarios – Project and Variant

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height (centerline) (ft)	Minimum dilution	Rise height (centerline) (ft)	Rise height (top) (ft)
T1	Upwelling	19.88	1.00	999.0	103.7	2.01	10.5	27.9	188	57	179	41	57
	Davidson								327	100	349	100	100
	Oceanic								239	80	238	50	72
T13	Upwelling	29.08	28.54	1021.2	151.6	2.18	13.0	80.6	93	28			
	Davidson								127	57			
	Oceanic								94	27			
T14	Upwelling	33.86	24.63	1018.1	176.4	2.25	14.2	66.7	99	36			
	Davidson								147	76			
	Oceanic								104	41			
V9	Upwelling	22.99	23.26	1017.0	119.6	2.10	11.1	50.3	110	37			
	Davidson								172	75			
	Oceanic								116	42			
V10	Upwelling	28.77	18.75	1013.3	149.9	2.18	12.9	48.3	118	44	100	39	41
	Davidson								202	96	215	97	100
	Oceanic								132	58	134	57	59
V11	Upwelling	1.17	5.80	1002.6	6.5	0.71	5.3	25.4	495	30			
	Davidson								974	48			
	Oceanic								549	35			
V12	Upwelling	1.57	4.53	1001.6	8.4	0.81	5.2	23.1	457	31	385	25	32
	Davidson								842	50	652	33	45
	Oceanic								520	37	460	28	36

Table 9. Summary of Dilution Simulations for Buoyant Effluent Scenarios – Project and Variant

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height (centerline) (ft)	Minimum dilution	Rise height (centerline) (ft)	Rise height (top) (ft)
V13	Upwelling	4.17	2.20	999.9	21.7	1.24	5.8	19.9	324	39	301	30	40
	Davidson								547	66	687	51	74
	Oceanic								376	47	378	35	47
V14	Upwelling	24.87	1.04	999.0	129.6	2.11	11.9	30.9	174	60	165	56	59
	Davidson								290	100	301	67	100
	Oceanic								223	86	235	55	81
V15	Upwelling	25.87	1.03	999.0	134.8	2.13	12.1	31.4	172	60	163	57	59
	Davidson								281	100	293	67	100
	Oceanic								221	87	232	56	82
V24	Upwelling	17.16	31.23	1023.4	89.3	1.94	9.7	87.3	91	20			
	Davidson								131	46			
	Oceanic								91	18			
V25	Upwelling	21.16	25.48	1018.7	109.8	2.03	10.9	56.2	107	33			
	Davidson								159	65			
	Oceanic								111	37			
V26	Upwelling	26.08	20.82	1015.0	135.6	2.13	12.2	49.7	115	41			
	Davidson								191	89			
	Oceanic								124	49			
V31	Upwelling	25.85	20.95	1015.1	134.4	2.13	12.1	49.5	115	41			
	Davidson								191	89			
	Oceanic								124	49			

6. Dilution Mitigation – Effect of Nozzle Angle

6.1 Introduction

Orienting the nozzles upwards from horizontal will increase the dilution of brine mixtures that are more dense than the receiving water. For buoyant effluents, it will decrease dilution slightly. In this section, we investigate the effect on dilution of varying nozzle orientations for dense and buoyant effluents.

6.2 Dense Effluents

The effect of nozzle angle on dense jets has been recently investigated by Abessi and Roberts (2015). Figure 5 shows central plane tracer concentrations (inverse of dilution) obtained by laser-induced fluorescence for dense jets with angles ranging from 15° to 85°. For very shallow angles, e.g. 15°, the jet impacts the bed quickly, reducing dilution. For steep angles, e.g. 85°, the trajectory is also truncated and the jet falls back on itself, which also reduces dilution.

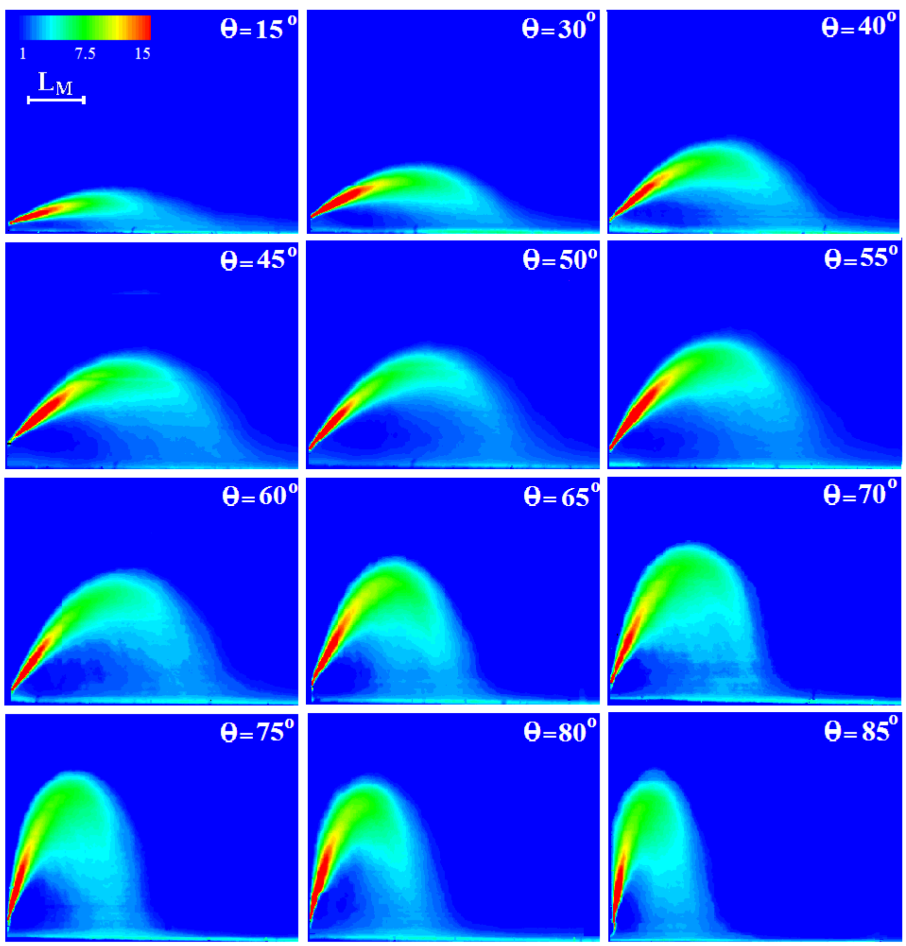


Figure 5. Central plane tracer concentrations for dense jets at various nozzle angles from 15° to 85°. After Abessi and Roberts (2015).

The optimum angle for dilution is 60°. This is illustrated by Figure 6, which shows the variation with nozzle angle on normalized impact dilution (S_i/F_j) and near field dilution (S_n/F_j) for single jets.

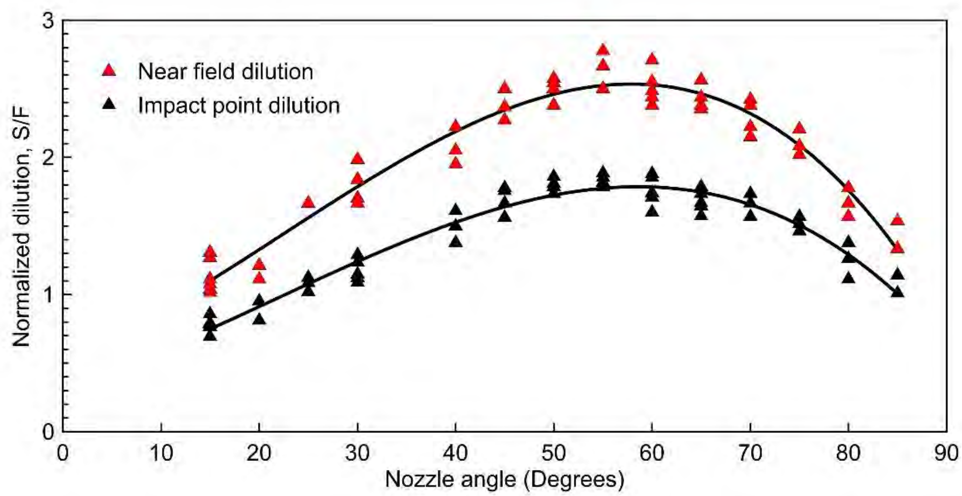


Figure 6. Effect of nozzle angle on normalized dilution of dense jets. After Abessi and Roberts (2015).

Impact dilutions were computed for the "worst-case" of brine only (T2, for conditions, see Table 3) using Figure 6. The results are tabulated in Table 10 and plotted in Figure 7. The effect of the height of the nozzle above the seabed, z, is determined by the dimensionless parameter z/dF_j, where d is the nozzle diameter. For Monterey, the nozzles are four feet above the seabed, so for case T2 we have $z/dF_j \approx 0.93$. The experiments of Abessi and Roberts were done with nozzles closer to the bed, with h/dF_j ranging from 0.12 to 0.39, so actual dilutions are expected to be higher than predicted in Table 10.

Dilution calculations with UM3 are also shown for completeness with other simulations. However, it is known that UM3 considerably underestimates dilutions for inclined jets (Palomar et al. 2012), therefore only the Abessi and Roberts results are used.

Table 10. Effect of Nozzle Angle on Dense Jets Case T2.
(for conditions, see Table 3)

Case ID	Nozzle angle	Dilution predictions				At impact		At BMZ	
		Cederwall	Abessi and Roberts (2015a)		UM3	Dilution	Salinity increment	Dilution	Salinity increment
	(deg)	Impact	Impact	Near field	Impact		(ppt)		(ppt)
T2	0	15.4	-	-	16.1	15.4	1.61	18.5	1.34
	10	-	16.9	25.2	18.7	16.9	1.47	20.3	1.22
	20	-	25.9	37.8	20.9	25.9	0.95	31.1	0.80
	30	-	35.3	50.8	22.8	35.3	0.70	42.3	0.59
	40	-	43.4	62.3	24.3	43.4	0.57	52.1	0.48
	50	-	49.0	70.0	24.5	49.0	0.50	58.9	0.42
	60	-	50.7	71.9	24.4	50.7	0.49	60.9	0.41

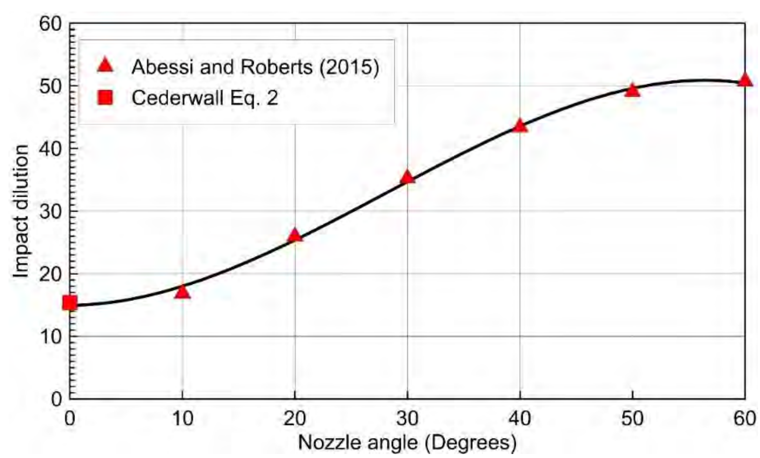


Figure 7. Effect of nozzle angle on dilution of dense jets, case T2.

Increasing the angle from horizontal (0°) to 60° increases dilution considerably, from 15 to 51. A 30° angle more than doubles the dilution compared to the horizontal jets.

The dilution at the BMZ is computed as 120% of the impact dilution. Note that in Table 10 the increase in dilution from the impact point to the end of the near field is more than 20%. This result, however, is for a single jet, and the increase for merged jets is less than this, and is conservatively assumed to be 20%, as explained in Roberts (2016).

6.3 Buoyant Effluents

Diffusers for buoyant effluents are usually designed with horizontal nozzles to maximize the length of the jet trajectory up to the terminal rise height, and therefore maximize dilution. Inclining the nozzles upwards will usually reduce dilution, although for very buoyant discharges in deep water the effect may be minimal. This is because the dynamics are then buoyancy dominated and the effect of momentum flux and therefore nozzle orientation is unimportant.

For very buoyant discharges, NRFIELD is the preferred model. NRFIELD, however, assumes the nozzles to be horizontal, so UM3 was used to assess the effect of nozzle orientation.

Simulations were run with UM3 for selected cases to bracket the expected results. The chosen cases were for the project scenarios (Table 3): T1 (mainly pure secondary effluent) and T13 (brine plus high secondary effluent). The latter case is only slightly buoyant and resulted in the lowest dilution of the buoyant cases. The simulations were run only for the oceanic conditions that gave the highest dilutions (Upwelling) and lowest dilutions (Davidson).

The results are summarized in Table 11 and plotted in Figure 8.

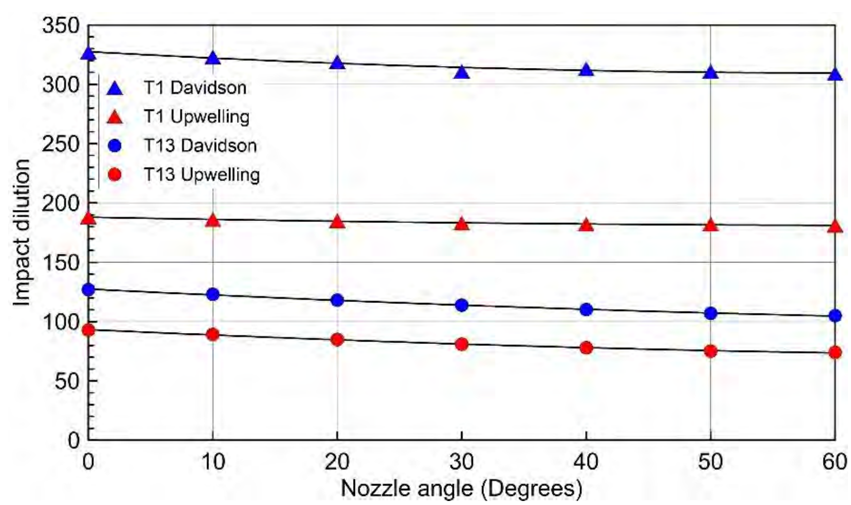


Figure 8. Effect of nozzle angle on dilution for selected buoyant discharge scenarios.

The results are insensitive to nozzle angle, especially for the very buoyant case of mainly pure secondary effluent (T1). Changing the nozzles from horizontal to 60° for the Davidson condition reduces dilution from 327 to 309, and for Upwelling condition from 188 to 181. For case T13 the corresponding reductions are from 127 to 105 and from 93 to 75. The percentage reductions for T13 are greater due to the increased effect of momentum flux, and therefore nozzle angle. More modest changes in orientation result in lesser effect; for a 30° nozzle the dilution reductions range from 3 to 13%.

Table 11. Effect of nozzle Angle on Dilution for Selected Buoyant Effluent Scenarios

Case ID	Oceanic Season	Effluent conditions			Nozzle angle	UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density	(deg)	Average dilution	Rise height (centerline) (ft)
T1	Upwelling	19.88	1.00	999.0	0	188	57
					10	186	58
					20	185	58
					30	183	59
					40	182	60
					50	182	61
					60	181	61
T1	Davidson	19.88	1.00	999.0	0	327	100
					10	323	100
					20	319	100
					30	311	100
					40	313	100
					50	311	100
					60	309	100
T13	Upwelling	29.08	28.54	1021.2	0	93	28
					10	89	29
					20	85	30
					30	81	31
					40	78	33
					50	75	35
					60	74	37
T13	Davidson	29.08	28.54	1021.2	0	127	57
					10	123	57
					20	118	57
					30	114	58
					40	110	60
					50	107	61
					60	105	63

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APPENDIX A. DENSITY PROFILES

The seasonally averaged density profiles assumed for modeling purposes are summarized below.

Depth (m)	Density (kg/m^3)		
	Upwelling	**Davidson**	**Oceanic**
1	1025.1	1024.8	1024.8
3	1025.1	1024.8	1024.8
5	1025.1	1024.8	1024.8
7	1025.2	1024.8	1024.8
9	1025.2	1024.8	1024.8
11	1025.3	1024.8	1024.8
13	1025.4	1024.8	1024.9
15	1025.4	1024.8	1024.9
17	1025.5	1024.8	1024.9
19	1025.6	1024.9	1024.9
21	1025.6	1024.9	1025.0
23	1025.7	1024.9	1025.0
25	1025.7	1024.9	1025.0
27	1025.8	1024.9	1025.1
29	1025.8	1024.9	1025.1
31	1025.8	1024.9	1025.2
33	1025.9	1024.9	1025.2
35	1025.9	1024.9	1025.3

Appendix B. Additional Scenarios

In a memorandum from Trussell Technologies, Inc. dated July 21, 2017, dilution simulations for some additional scenarios were requested. They were contained in table 9 of that memo, which is reproduced below.

Table 9 –Proposed Flow Scenarios for Additional Modeling

No.	RTP Secondary Effluent	Hauled Waste	GWR Concentrate	Desal Brine	Ocean Condition[1]
MPWSP with high Desal Brine flow					
1	6	0	--	16.31	All
2	7	0	--	16.31	All
3	8	0	--	16.31	All
4	9	0	--	16.31	All
5	10	0	--	16.31	All
6	12	0	--	16.31	All
7	14	0	--	16.31	All
8	16	0	--	16.31	All
Variant with Desal Off					
9	8	0	1.17	0	All
Variant with GWR Concentrate off and high Desal Brine flow					
10	6	0	--	11.24	All
11	7	0	--	11.24	All
12	8	0	--	11.24	All
13	9	0	--	11.24	All
14	10	0	--	11.24	All
15	12	0	--	11.24	All
16	14	0	--	11.24	All
17	16	0	--	11.24	All
Variant with high Desal Brine flow					
18	6	0	1.17	11.24	All
19	7	0	1.17	11.24	All
20	8	0	1.17	11.24	All
21	9	0	1.17	11.24	All
22	10	0	1.17	11.24	All
23	12	0	1.17	11.24	All
24	14	0	1.17	11.24	All
25	16	0	1.17	11.24	All

1: All ocean conditions should be modeled when using the UM3 and NRFIELD models. For dense plumes that are modeled with Cederwall and UM3, the worst-case ocean condition should be used.

The flow conditions for these additional scenarios are summarized in Table B1. Dilutions were simulated according to the same procedures as outlined in Sections 4 and 5. The results for dense discharges are summarized in Table B2 and for buoyant discharges in Table B3.

Table B1. Additional Modeled Discharge Scenarios

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
AT1	MPWSP with high desal brine flow	16.31	6.00	0.00	0.0	22.31	42.78	1032.7
AT2		16.31	7.00	0.00	0.0	23.31	40.98	1031.3
AT3		16.31	8.00	0.00	0.0	24.31	39.33	1030.0
AT4		16.31	9.00	0.00	0.0	25.31	37.81	1028.7
AT5		16.31	10.00	0.00	0.0	26.31	36.40	1027.6
AT6		16.31	12.00	0.00	0.0	28.31	33.89	1025.6
AT7		16.31	14.00	0.00	0.0	30.31	31.70	1023.8
AT8		16.31	16.00	0.00	0.0	32.31	29.79	1022.2
AV9	Variant with desal off	0.00	8.00	1.17	0.0	9.17	1.44	999.3
AV10	Variant with GWR concentrate off and high desal brine flow	11.24	6.00	0.00	0.0	17.24	38.24	1029.1
AV11		11.24	7.00	0.00	0.0	18.24	36.19	1027.4
AV12		11.24	8.00	0.00	0.0	19.24	34.35	1025.9
AV13		11.24	9.00	0.00	0.0	20.24	32.69	1024.6
AV14		11.24	10.00	0.00	0.0	21.24	31.19	1023.4
AV15		11.24	12.00	0.00	0.0	23.24	28.58	1021.3
AV16		11.24	14.00	0.00	0.0	25.24	26.38	1019.5
AV17		11.24	16.00	0.00	0.0	27.24	24.50	1018.0
AV18	Variant with high desal brine flow	11.24	6.00	1.17	0.0	18.41	36.18	1027.4
AV19		11.24	7.00	1.17	0.0	19.41	34.36	1025.9
AV20		11.24	8.00	1.17	0.0	20.41	32.71	1024.6
AV21		11.24	9.00	1.17	0.0	21.41	31.22	1023.4
AV22		11.24	10.00	1.17	0.0	22.41	29.87	1022.3
AV23		11.24	12.00	1.17	0.0	24.41	27.48	1020.4
AV24		11.24	14.00	1.17	0.0	26.41	25.46	1018.7
AV25		11.24	16.00	1.17	0.0	28.41	23.73	1017.3

Table B2. Summary of Dilution Simulations for Dense Additional Scenarios

Case ID	Effluent conditions			Port conditions				Predictions			At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Impact distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
AT1	22.3	42.78	1032.7	116.0	2.06	11.2	57.9	22.1	21.4	16.6	21.4	0.42	25.7	0.35
AT2	23.3	40.98	1031.3	120.7	2.08	11.4	60.7	22.8	22.8	18.1	22.8	0.34	27.4	0.28
AT3	24.3	39.33	1030.0	125.5	2.10	11.6	69.2	25.0	24.5	19.8	24.5	0.24	29.4	0.20
AT4	25.3	37.81	1028.7	130.3	2.11	12.0	81.4	28.2	27.2	22.3	27.2	0.16	32.6	0.14
AT5	26.3	36.40	1027.6	135.1	2.13	12.2	97.8	32.5	30.2	25.3	30.2	0.10	36.2	0.08
AT6	28.3	33.89	1025.6	144.7	2.16	12.7	195.3	58.6	44.9	39.0	44.9	0.01	53.9	0.01
AV10	17.2	38.24	1029.1	89.4	1.94	9.7	66.0	24.7	24.6	18.2	24.6	0.20	29.5	0.17
AV11	18.2	36.19	1027.4	93.6	1.96	10.0	86.1	30.0	28.8	22.0	28.8	0.10	34.6	0.08
AV12	19.2	34.35	1025.9	98.4	1.99	10.2	133.0	42.4	37.4	29.7	37.4	0.03	44.9	0.02
AV18	18.4	36.18	1027.4	94.7	1.97	10.0	86.4	30.0	28.7	22.0	28.7	0.10	34.4	0.08
AV19	19.4	34.36	1025.9	99.5	1.99	10.3	135.0	42.9	37.6	29.8	37.6	0.03	45.1	0.02

Table B3. Summary of Dilution Simulations for Buoyant Additional Scenarios

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height centerline (ft)	Minimum dilution	Rise height centerline (ft)	Rise height top (ft)
AT7	Upwelling	30.31	31.70	1023.8	157.8	2.20	13.3	123.3	88	19			
	Davidson								120	45			
	Oceanic								90	17			
AT8	Upwelling	32.31	29.79	1022.2	179.2	2.26	14.3	98.6	90	26			
	Davidson								118	53			
	Oceanic								88	23			
AV9	Upwelling	9.17	1.44	999.3	55.9	1.72	7.7	22.4	244	48	234	35	48
	Davidson								467	100	584	67	100
	Oceanic								309	66	315	42	60
AV13	Upwelling	20.24	32.69	1024.6	108.9	2.03	10.8	133.6	91	17			
	Davidson								100	15			
	Oceanic								138	41			
AV14	Upwelling	21.24	31.19	1023.4	114.9	2.06	11.1	96.5	88	20			
	Davidson								124	47			
	Oceanic								88	18			
AV15	Upwelling	23.24	28.58	1021.3	126.9	2.08	12.0	76.2	96	28			
	Davidson								133	55			
	Oceanic								95	26			
AV16	Upwelling	25.24	26.38	1019.5	138.7	2.11	12.7	68.1	100	32			
	Davidson								144	64			
	Oceanic								104	35			
AV17	Upwelling	27.24	24.50	1018.0	151.1	2.15	13.4	63.6	103	36			
	Davidson								155	73			
	Oceanic								109	41			

Table B3. Summary of Dilution Simulations for Buoyant Additional Scenarios

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height centerline (ft)	Minimum dilution	Rise height centerline (ft)	Rise height top (ft)
AV20	Upwelling	20.41	32.71	1024.6	110.1	2.02	11.0	136.9	92	17			
	Davidson								139	41			
	Oceanic								101	15			
AV21	Upwelling	21.41	31.22	1023.4	116.1	2.02	11.6	102.6	91	20			
	Davidson								126	64			
	Oceanic								91	18			
AV22	Upwelling	22.41	29.87	1022.3	116.4	2.06	11.2	81.3	93	24			
	Davidson								128	51			
	Oceanic								90	21			
AV23	Upwelling	24.41	27.48	1020.4	134.0	2.10	12.4	71.8	98	30			
	Davidson								138	59			
	Oceanic								101	31			
AV24	Upwelling	26.41	25.46	1018.7	145.8	2.14	13.0	65.4	101	34			
	Davidson								149	68			
	Oceanic								106	38			
AV25	Upwelling	28.4	23.73	1017.3	157.6	2.17	13.7	62.3	105	37			
	Davidson								161	78			
	Oceanic								110	43			

APPENDIX C. EFFECT OF NOZZLE ANGLE ON DILUTION

In order to further investigate the effect of nozzle angle on dilution for various scenarios, additional model runs were undertaken for horizontal and 60° nozzles. Most were previously analyzed cases, whose flow properties are given in Tables 3 and 4. Table C1 summarizes the properties of the new cases.

Dilutions were simulated according to the same procedures as outlined in Sections 4 and 5. Table C2 summarizes the results for dense discharges. For the buoyant cases, only Upwelling and Davidson conditions were run to bracket the expected results. Because NRFIELD only allows for horizontal nozzles, only results for UM3 are shown in Table C3.

Table C1. Further Modeled Discharge Scenarios

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
1	GWR only	0.00	0.00	1.17	0.0	1.17	5.80	1002.6
5		0.00	0.40	1.17	0.0	1.57	4.53	1001.6
7		0.00	0.60	1.17	0.0	1.77	4.11	1001.3
12		0.00	2.00	1.17	0.0	3.17	2.65	1000.2
16		0.00	4.00	1.17	0.0	5.17	1.93	999.7
17		0.00	4.50	1.17	0.0	5.67	1.83	999.6
18		0.00	5.00	1.17	0.0	6.17	1.75	999.5
32		0.00	23.40	1.17	0.0	24.57	1.04	999.0
New	Variant with normal flows and GWR offline	8.99	10.00	0.00	0.0	18.99	27.99	1020.8
New2		8.99	6.50	1.17	0.0	16.66	32.14	1024.1
New3		8.99	7.00	1.17	0.0	17.16	31.23	1023.4

Table C2. Summary of Dilution Simulations for Dense Scenarios

Case ID	Nozzle angle (deg)	Effluent conditions			Port conditions				Impact dilution predictions			At impact (ZID)		AT BMZ	
		Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Flow (gpm)	Diam. (in.)	Velocity (ft/s)	Froude no.	Cederwall	Abessi & Roberts 2015a	UM3	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
T5	0	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	17.7	-	18.5	17.7	0.83	21.2	0.69
	60	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	-	68.9	-	68.9	0.21	82.6	0.18
T10	0	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	28.2	-	27.5	27.5	0.15	33.0	0.12
	60	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	-	143.7	-	143.7	0.03	172.4	0.02
T20	0	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	19.6	-	20.4	19.6	0.58	23.6	0.48
	60	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	-	85.7	-	85.7	0.13	102.8	0.11
AT6	0	28.31	33.89	1025.6	144.7	2.16	12.7	194.0	58.3	-	44.9	44.9	0.01	53.9	0.01
	60	28.31	33.89	1025.6	144.7	2.16	12.7	194.0	-	345.6	-	345.6	0.00	414.8	0.00
V2	0	9.99	52.48	1040.6	55.8	1.72	7.7	28.9	16.3	-	16.9	16.3	1.17	19.6	0.98
	60	9.99	52.48	1040.6	55.8	1.72	7.7	28.9	-	51.5	-	51.5	0.37	61.9	0.31
V4	0	11.99	43.86	1033.6	61.5	1.76	8.1	40.3	18.8	-	19.8	18.8	0.56	22.6	0.47
	60	11.99	43.86	1033.6	61.5	1.76	8.1	40.3	-	71.8	-	71.8	0.15	86.1	0.12
V6	0	13.99	37.70	1028.6	73.4	1.85	8.8	64.3	24.6	-	24.9	24.6	0.18	29.5	0.15
	60	13.99	37.70	1028.6	73.4	1.85	8.8	64.3	-	114.6	-	114.6	0.04	137.5	0.03
V8	0	15.99	33.09	1024.9	76.3	1.87	8.9	382.9	110.2	-	67.6	67.6	0.00	81.1	0.00
	60	15.99	33.09	1024.9	76.3	1.87	8.9	382.9	-	682.3	-	682.3	0.00	818.8	0.00
V16	0	10.16	52.19	1040.3	56.8	1.72	7.8	29.7	16.5	-	17.3	16.5	1.14	19.8	0.95
	60	10.16	52.19	1040.3	56.8	1.72	7.8	29.7	-	52.9	-	52.9	0.36	63.5	0.30
V17	0	11.16	47.59	1036.6	56.1	1.72	7.8	33.6	17.4	-	18.3	17.4	0.82	20.9	0.68
	60	11.16	47.59	1036.6	56.1	1.72	7.8	33.6	-	59.9	-	59.9	0.24	71.9	0.20
V19	0	13.16	40.48	1030.9	68.3	1.81	8.5	50.3	21.1	-	21.8	21.1	0.34	25.4	0.28
	60	13.16	40.48	1030.9	68.3	1.81	8.5	50.3	-	89.6	-	89.6	0.08	107.6	0.07
V22	0	15.46	34.57	1026.1	79.8	1.89	9.1	114.2	37.7	-	34.3	34.3	0.04	41.2	0.03
	60	15.46	34.57	1026.1	79.8	1.89	9.1	114.2	-	203.5	-	203.5	0.01	244.2	0.01
V23	0	16.16	33.11	1024.9	83.3	1.91	9.3	395.8	113.5	-	68.5	68.5	0.00	82.2	0.00
	60	16.16	33.11	1024.9	83.3	1.91	9.3	395.8	-	705.4	-	705.4	0.00	846.5	0.00

Table C2. Summary of Dilution Simulations for Dense Scenarios

Case ID	Nozzle angle (deg)	Effluent conditions			Port conditions				Impact dilution predictions			At impact (ZID)		AT BMZ	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (in.)	Velocity (ft/s)	Froude no.	Cederwall	Abessi & Roberts 2015a	UM3	Dilution	Salinity incr-ement (ppt)	Dilution	Salinity incr-ement (ppt)
V32	0	11.24	58.23	1045.2	63.3	1.78	8.2	26.5	15.4	-	16.1	15.4	1.61	18.5	1.34
	60	11.24	58.23	1045.2	63.3	1.78	8.2	26.5	-	47.2	-	47.2	0.53	56.6	0.44
V36	0	14.24	46.13	1035.5	72.7	1.84	8.8	38.8	18.1	-	19.0	18.1	0.71	21.7	0.59
	60	14.24	46.13	1035.5	72.7	1.84	8.8	38.8	-	69.1	-	69.1	0.19	82.9	0.15
AV10	0	17.24	38.24	1029.1	89.4	1.94	9.7	65.9	24.7	-	27.5	24.7	0.20	29.6	0.17
	60	17.24	38.24	1029.1	89.4	1.94	9.7	65.9	-	117.4	-	117.4	0.04	140.9	0.03
AV12	0	19.24	34.35	1025.9	98.4	1.99	10.2	132.4	42.2	-	37.4	37.4	0.03	44.9	0.02
	60	19.24	34.35	1025.9	98.4	1.99	10.2	132.4	-	235.9	-	235.9	0.00	283.1	0.00
V39	0	12.41	53.29	1041.2	61.5	1.76	8.1	29.5	16.2	-	17.0	16.2	1.23	19.5	1.02
	60	12.41	53.29	1041.2	61.5	1.76	8.1	29.5	-	52.6	-	52.6	0.38	63.1	0.32
V43	0	15.41	43.07	1033.0	80.0	1.89	9.2	45.6	19.6	-	20.2	19.6	0.50	23.5	0.41
	60	15.41	43.07	1033.0	80.0	1.89	9.2	45.6	-	81.2	-	81.2	0.12	97.5	0.10
V45	0	17.41	38.21	1029.0	90.3	1.95	9.7	66.0	24.7	-	18.4	18.4	0.26	22.1	0.22
	60	17.41	38.21	1029.0	90.3	1.95	9.7	66.0	-	117.7	-	117.7	0.04	141.2	0.03
AV19	0	19.41	34.36	1025.9	99.5	1.99	10.3	134.4	42.8	-	37.6	37.6	0.03	45.1	0.02
	60	19.41	34.36	1025.9	99.5	1.99	10.3	134.4	-	239.4	-	239.4	0.00	287.3	0.00

Table C3. Summary of Dilution Simulations for Buoyant Further Scenarios

Case ID	Season	Effluent conditions			Port conditions					UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Nozzle angle (deg)	Flow (gpm)	Diam. (inch)	Velocity (ft/s	Froude no.	Average dilution	Rise height (centerline) (ft)
New	Upwelling	18.99	27.99	1020.8	0	98.5	1.99	10.2	62.8	101	28
					60					82	34
	Davidson				0					145	55
					60					123	58
V25	Upwelling	21.16	25.48	1018.7	0	109.8	2.03	10.9	56.2	107	33
					60					91	39
	Davidson				0					159	65
					60					141	70
AV14	Upwelling	21.24	31.19	1023.4	0	114.9	2.06	11.1	96.5	88	20
					60					66	28
	Davidson				0					124	47
					60					94	49
AV21	Upwelling	21.41	31.22	1023.4	0	116.1	2.02	11.6	102.6	91	20
					60					68	30
	Davidson				0					126	64
					60					96	49
1	Upwelling	1.17	5.80	1002.6	0	6.8	0.71	5.5	26.6	499	29
					60					488	30
	Davidson				0					987	S
					60					949	S
5	Upwelling	1.57	4.53	1001.6	0	8.1	0.79	5.3	23.7	461	31
					60					447	32
	Davidson				0					853	50
					60					817	50
7	Upwelling	1.77	4.11	1001.3	0	9.3	0.85	5.3	22.6	443	32
					60					428	33
	Davidson				0					800	S
					60					768	S

Table C3. Summary of Dilution Simulations for Buoyant Further Scenarios

Case ID	Season	Effluent conditions			Port conditions					UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Nozzle angle (deg)	Flow (gpm)	Diam. (inch)	Velocity (ft/s	Froude no.	Average dilution	Rise height (centerline) (ft)
12	Upwelling	3.17	2.65	1000.2	0	16.5	1.11	5.5	20.1	359	36
					60					347	37
	Davidson				0					609	59
					60					586	59
16	Upwelling	5.17	1.93	999.7	0	26.9	1.35	6.0	19.9	300	51
					60					291	41
	Davidson				0					517	S
					60					507	S
17	Upwelling	5.67	1.83	999.6	0	29.6	1.40	6.2	19.9	290	S
					60					282	S
	Davidson				0					509	S
					60					504	S
18	Upwelling	6.17	1.75	999.5	0	32.3	1.44	6.4	20.2	282	S
					60					274	S
	Davidson				0					506	S
					60					510	S
32	Upwelling	24.57	1.04	999.0	0	128.0	2.10	11.9	30.9	175	S
					60					168	S
	Davidson				0					291	S
					60					276	S
New2	Upwelling	16.66	32.14	1024.1	0	86.1	1.92	9.5	103.5	92	18
					60					65	26
	Davidson				0					131	43
					60					95	46
New3	Upwelling	17.16	31.23	1023.4	0	89.0	1.94	9.7	87.0	91	20
					60					69	29
	Davidson				0					131	46
					60					102	48