FINAL ENVIRONMENTAL IMPACT REPORT

AND RESPONSES TO PUBLIC COMMENTS

STATE CLEARINGHOUSE NO. 2016031038

Doheny Ocean Desalination Project

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1.0 INTRODUCTION

1.1 CEQA Requirements for a Final EIR

The South Coast Water District (District), in compliance with the California Environmental Quality Act (CEQA), has prepared this Final Environmental Impact Report (Final EIR) for the Doheny Ocean Desalination Project (Project). The District is required, after completion of a draft EIR, to consult with and obtain comments from public agencies having jurisdiction by law with respect to the proposed Project, and to provide the general public with an opportunity to comment on the draft EIR. The District, as the lead agency, is also required to respond to significant environmental issues raised in the review and consultation process. This Final EIR has been prepared to respond to public agency and general public comments received on the Draft EIR for the Project, which was circulated for public review from June 6, 2018 through August 6, 2018.

State CEQA Guidelines §15088 requires that lead agencies evaluate all comments on environmental issues received on the Draft EIR and prepare a written response. The written response must address the significant environmental issues raised. In addition, there must be a good faith and reasoned analysis in the written response. However, lead agencies need only respond to significant environmental issues associated with the project and do not need to provide all the information requested by commenters, as long as a good faith effort at full disclosure is made in the EIR (State CEQA Guidelines §15204).

State CEQA Guidelines §15204 recommends that commenters provide comments which focus on the sufficiency of the Draft EIR in identifying and analyzing the possible impacts on the environment and ways in which the significant effects of the project might be avoided or mitigated. State CEQA Guidelines §15204 also notes that commenters should provide an explanation and evidence supporting their comments. Pursuant to State CEQA Guidelines §15064, an effect shall not be considered significant in the absence of substantial evidence supporting such a conclusion.

State CEQA Guidelines §15204 is instructive and provides insight into both the obligation of commenting parties and how the Lead Agency should review and respond to comments. Section 15204 states in part:

> "(a) In reviewing draft EIRs, persons and public agencies should focus on the sufficiency of the document in identifying and analyzing the possible impacts on the environment and ways in which the significant effects of the project might be avoided or mitigated. Comments are most helpful when they suggest additional specific alternatives or mitigation measures that would provide better ways to avoid or mitigate the significant environmental effects. At the same time, reviewers should be aware that the adequacy of an EIR is determined in terms of what is reasonably feasible, in light of factors such as the magnitude of the project at issue, the severity of its likely environmental impacts, and the geographic scope of the project. ***CEQA does not require a lead agency to conduct every test or perform all research, study, and experimentation recommended or demanded by commentors. When responding to comments, lead agencies need only respond to significant environmental***

issues and do not need to provide all information requested by reviewers, as long as a good faith effort at full disclosure is made in the EIR." [emphasis added]

State CEQA Guidelines §15088 recommends that where a response to comment makes important changes in the information contain in the text of the Draft EIR, that the Lead Agency either revise the text of the Draft EIR or include marginal notes showing that information. The Final EIR for the Project has been prepared in accordance with CEQA. CEQA Guidelines §15132 indicates that the contents of a Final EIR shall consist of:

- "The draft EIR or a revision of the draft;
- Comments and recommendations received on the draft EIR either verbatim or in summary;
- A list of persons, organizations, and public agencies commenting on the draft EIR;
- The responses of the Lead Agency to significant environmental points raised in the review and consultation process; and
- Any other information added by the Lead Agency."

Pursuant to CEQA Guidelines §15088(b), the District has provided written responses to comments to any public agency that commented on the Draft EIR, at least ten (10) days prior to the District Board consideration of certifying the EIR as adequate under CEQA. In addition, the Final EIR will be made available to the general public at the District's offices in Laguna Beach, and on the District's website.

The Final EIR, along with other relevant information and public testimony at the Board of Directors' hearing, will be considered by the District's Board of Directors in determining whether or not to certify the EIR and approve the Project.

1.2 Organization of the Final EIR

This Final EIR document is organized as follows:

Section 1 **Introduction** - provides a brief introduction to this document.

Section 2 **Draft EIR Comments and Responses** – includes all comments received on the Draft EIR and the District's responses to those comments, in accordance with CEQA.

Section 3 **Draft EIR Errata** - presents clarifications, amplifications and insignificant modifications to the EIR, identifying revisions to the text of the document.

Section 4 **Final EIR Appendices** - provides information regarding the distribution of the Draft EIR as well as technical memos prepared in response to comments and for the Final EIR.

1.3 CEQA Process History

The District has complied with relevant CEQA Guidelines regarding the preparation and processing of the Project EIR. A brief summary of the Project's CEQA process is as follows:

- An initial Notice of Preparation (NOP) informing interested parties and agencies of the project was distributed on March 14, 2016.
- Written and verbal testimonies were given at a public scoping meeting held for the Project on March 31, 2016.
- An amended NOP containing refinements to the Project was distributed on November 17, 2017.
- Written and verbal testimonies were given at a further public scoping meeting held for the Project on December 7, 2017.
- The Draft EIR was initially distributed for public review on May 23, 2018, followed by an Amended Notice of Availability and redistribution of the Draft EIR for review beginning on June 6, 2018. The public review period closed on August 6, 2018.
- A Draft EIR public meeting was held on June 26, 2018, to receive public comments on the Draft EIR.
- Following release of the Draft EIR for public review, the District continued to engage with stakeholders, and initiated several technical analyses to further clarify and amplify the Draft EIR (refer to Section 2, Master Response 3 for further discussion).

1.4 Project Design and Funding Status

The "Project" under consideration for approval is the Local Project which could provide up to 5 million gallons per day of potable water. Along with considering certification of the Final EIR as adequate under CEQA, the District's Board of Directors will also consider whether or not to approve the Project. At present, the District has received a $10 million grant from the State of California under Proposition 1, and is pursuing additional funding and loan programs. These include a State Revolving Fund (SRF) loan through the State Water Resources Control Board (for low interest loans), a potential federal grant through the Bureau of Reclamation (pending), and a request to Metropolitan Water District to include the Project in its Local Resources Program financial assistance. Refer to Section 2, Master Responses 1 and 2 for additional discussion regarding the Local Project and the potential future Regional Project.

1.5 Summary of Technical Analyses in Final EIR

Through the review of Draft EIR comments and in preparation for the Final EIR, the District has clarified and amplified certain technical analyses and therefore has prepared certain technical memos for the Final EIR. These technical memos can be found in Section 4 of this document as attached appendices, and include the following:

- Coastal Hazard Analysis (Appendix 4.2.1)
- Brine discharge analysis based on Plumes 18b (Appendix 4.2.2)
- Hydrogeologic Analysis to evaluate Project impacts to the San Juan Creek surface water levels and potential upstream bedrock barrier (Appendix 4.2.3.1)

- San Juan Creek Lagoon Technical Memo (Appendix 4.2.3.2)
- Local Hazard Conditions and Drainage Study (Appendix 4.2.4 contains the clarified and amplified figures, while text modifications are shown in Section 3, *Draft EIR Errata*)
- Technical memos regarding marine biological resource effects, in light of above hydrogeology and brine discharge technical memos (Appendices 4.2.5.1 and 4.2.5.2)

As discussed further in Section 2, Master Response 3, these technical memos provide clarification and amplification of Draft EIR analyses, and do not disclose new or substantially more severe environmental impacts or other significant new information.

1.6 Clarifications, Amplifications and Modifications to the Draft EIR

Section 3.0, *Draft EIR Errata,* details the changes to the Draft EIR. CEQA Guidelines §15088.5 describes when an EIR requires recirculation prior to certification, stating in part:

> "(a) A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under Section 15087 but before certification. As used in this section, the term "information" can include changes in the project or environmental setting as well as additional data or other information. New information added to an EIR is not "significant" unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect (including a feasible project alternative) that the project's proponents have declined to implement. …
>
> (b) Recirculation is not required where the new information added to the EIR merely clarifies or amplifies or makes insignificant modifications in an adequate EIR."

In response to public comments, specific clarifications have been made to the Project Description to reiterate the scope and phasing of the proposed Project. Text changes have also been made to other sections to clarify and amplify the analysis or mitigation measures, and to make insignificant modifications to the Draft EIR. This information does not rise to the level of significant new information as the resulting impact analysis and alternatives considered remain essentially unchanged, and no new or more severe impacts have been identified. These changes do not warrant Draft EIR recirculation pursuant to CEQA Guidelines §15088.5. As set forth further below and elaborated upon in the respective Response to Comments, none of the Errata below reflect a new significant environmental impact, a "substantial increase" in the severity of an environmental impact for which mitigation is not proposed, or a new feasible alternative or mitigation measure that would clearly lessen significant environmental impacts but is not adopted, nor do the Errata reflect a "fundamentally flawed" or "conclusory" Draft EIR. Therefore, this Final EIR is not subject to recirculation prior to certification. (Refer to Section 2, Master Response 3 for additional discussion).

2.0 DRAFT EIR COMMENTS AND RESPONSES

In accordance with CEQA Guidelines §15132, the following is a list of persons, organizations, and public agencies that submitted comments on the Draft EIR during the public review period. This section includes all comments received by the District on the Draft EIR, including written comments, comments submitted online through the District's Project website, and oral comments received at the Draft EIR public meeting held on June 26, 2018. Although CEQA only requires a 45-day review period for the Draft EIR, the District provided a full 60 days for public review, which review period ran from June 6, 2018 through August 6, 2018.[1]

2.1 LIST OF DRAFT EIR COMMENTS

Comments have been numbered as shown below, with responses to each comment following the respective comment letter.

Reference	Commenter	Date
Federal		
F1	FEMA Region IX – U.S. Department of Homeland Security Gregor Blackburn, CFM Branch Chief	June 12, 2018
F2	National Oceanic and Atmospheric Administration Anthony Spina, Chief	August 2, 2018
State		
S1	California Coastal Commission Tom Luster - Energy, Ocean Resources, and Federal Consistency Division	August 3, 2018
S2	California Department of Toxic Substances Control Johnson P. Abraham, Project Manager	July 9, 2018
S3	California Department of Transportation (Caltrans) Scott Shelley, Branch Chief	August 2, 2018
S4	California State Lands Commission Cy R. Oggins, Chief	August 6, 2018
S5	Native American Heritage Commission Gayle Totton, B.S., M.A., Ph.D., Associate Governmental Project Analyst	June 22, 2018
S6	Office of Planning and Research, State Clearinghouse Scott Morgan, Director	August 7, 2018
S7	San Diego Regional Water Quality Control Board David Gibson, Executive Officer	August 6, 2018

1 The District initially released the Draft EIR on May 18, 2018, but subsequently realized it was missing certain pages in some copies. Therefore, on June 4, 2018, the District posted an Amended Notice of Availability and released the complete Draft EIR to begin the 60-day public review period.

Reference	Commenter	Date
Local		
L1	City of Dana Point Matt Schneider, Acting Director of Community Development	August 6, 2018
L2	Metropolitan Water District of Southern California Deirdre Brand, Environmental Planning Section	August 6, 2018
L3	Moulton Niguel Water District Todd Dmytryshyn, Principal Engineer	August 1, 2018
L4	Municipal Water District of Orange County Robert J. Hunter	August 6, 2018
L5	County of Orange Public Works Richard Vuong, Manager, Planning Division	August 3, 2018
L6	San Juan Basin Authority Norris Brandt, PE Administrator	August 5, 2018
L7	Santa Margarita Water District Don Bunts, Deputy General Manager	August 6, 2018
L8	South Coast Air Quality Management District Lijin Sun, J.D., Program Supervisor	June 5, 2018
L9	South Orange County Wastewater Authority Betty Burnett, General Manager	NA
L10	Southern California Regional Rail Authority, MetroLink Ron Mathieu, Planning Manager II	August 6, 2018
Organizations		
O1	CURE Tanya Gulesserian	August 6, 2018
O2	Nature Commission Kevin Nelson, Founder	July 27, 2018
O3	Orange County Coastkeeper Ray Heimstra, Associate Director	August 6, 2018
O4	Sierra Club Dr. Tom Williams, Water Committee	August 6, 2018
O5	South Laguna Civic Association Greg O’Loughlin, President	July 25, 2018
O6	Surfrider Foundation Katie Day, Staff Scientist	August 6, 2018
O7	CURE (late letter) Kyle Jones	April 4, 2019
June 26 DEIR Public Meeting		
M1	Richard Banister	June 26, 2018

Reference	Commenter	Date
M2	Richard Gardner	June 26, 2018
M3	Markus Lenger	June 26, 2018
M4	Richard Kanter	June 26, 2018
M5	Toni Nelson	June 26, 2018
M6	Ray Hiemstra	June 26, 2018
Web Comments (Public)		
W1	Robert & Toni Bancroft	June 6, 2018
W2	Joy Berry	July 24, 2018
W3	Steven Carpenter	May 29, 2018
W4	Kim Day	June 26, 2018
W5	Dan and Penny Elia	August 6, 2018
W6	David Goldberg	June 27, 2018
W7	Gordon Grannis	June 19, 2018
W8	Kathy Hartl	August 6, 2018
W9	Carolyn Keatinge	August 3, 2018
W10	Brian / Kathleen Knott	August 2, 2018
W11	Rebecca Mansfield	June 18, 2018
W12	Elizabeth Meehan	June 26, 2018
W13	Christopher Moore	July 23, 2018
W14	Stan Morgan	June 27, 2018
W15	Bennie F. Petty	June 5, 2018
W16	Hal & Mary Schaffer	June 24, 2018
W17	Dave Schroeder	June 23, 2018
W18	Michael Scott	June 20, 2018
W19	Aaron Simmons	June 5, 2018
W20	Bob & Betsey Unger	June 28, 2018
W21	David L. Whitaker	July 1, 2018
W22	Bendush William	June 25, 2018
W23	Bobby Young	August 3, 2018
W24	Chris Zamoscianyk	June 3, 2018
Web Comments (Organizations)		
W25	California Cultural Resources Preservation Alliance, Inc. Patricia Martz	August 16, 2018
W26	Citizens Coalitions for a Safe Community Dr. Tom Williams	August 6, 2018

Reference	Commenter	Date
W27	Citizens Coalitions for a Safe Community and Sierra Club Dr. Tom Williams	August 6, 2018
W28	Doheny Village Merchants Association James Schad	August 4, 2018
W29	Orange County Coastkeeper Ray Hiemstra	August 6, 2018
W30	R&R Technologies, Inc./Biosphere Carbon Group LLC Tim O'Connor	June 25, 2018
W31	San Juan Basin Authority Norris Brandt	August 6, 2018
W32	Surfrider Foundation Katie Day	August 6, 2018
Public		
P1	Rowena Anderson	NA
P2	Harold Breen	August 6, 2018
P3	Dan & Penny Elia	August 6, 2018
P4	Kathy Hartl	August 6, 2018
P5	Gillian Martin	June 28, 2018
P6	Ann Mintie	June 21, 2018
P7	Nick Skoularikis	June 27, 2018
P8	David Whiting	June 25, 2018
P9	Dr. Tom Williams	August 6, 2018
P10	Betty Youndt	June 25, 2018

2.2 MASTER RESPONSES

Certain comments received on the Draft EIR raised similar or closely related environmental issues. In some cases, the reader is referred or directed to other responses to comments that address the particular comment or issue. To address these related comments, the following Master Responses have been prepared to provide a broader response to issues that have been raised by more than one commenter. These Master Responses, together with the individual responses (in Section 2 of this Responses to Comments document) and Draft EIR Errata (in Section 3 of this Responses to Comments document), constitute the District's responses to comments on the Draft EIR pursuant to CEQA Guidelines §15088.

Master Response 1: Project Description Details

Some comments on the Draft EIR, particularly Comments S4 (State Lands Commission), L1 (City of Dana Point) and O4 (Sierra Club), requested further clarification of the Project Description. This Master Response 1 focuses on clarifications regarding the Phase I or "Local" Project.[1] In addition to the narrative discussion below, the Project Description has been further clarified as shown in Section 3, *Draft EIR Errata*.

Project Capacity

The Draft EIR states that the District only intends to pursue approvals for the Local Project of "up to" 5 million gallons per day (MGD) at this time (see, e.g., DEIR, p. 1.0-1) (refer to Master Response 2, for discussion of Local Project vs. Regional Project). Although the Preliminary Design Report (PDR) discusses an intermediate capacity of 10 MGD, the District is not pursuing that at this time. Like for the Regional Project, any capacity beyond 5 MGD would require additional CEQA review, regional project partnerships and funding agreements, and new or amended regulatory agency approvals.

The Draft EIR evaluates the Local Project capacity as being "up to" 5 MGD, recognizing that the District may proceed with a smaller scale Project. A potential future Regional Project would require partnership with other water agencies (see Master Response 2) to share financial responsibility and to create a regional product water conveyance system. These regional components have not been identified and would be beyond the capabilities and project goals of the District itself. Even with the Local Project, should the District proceed with the full 5 MGD of potable water capacity, the District could make some of this water available to other local water agencies, as noted in the Draft EIR (and discussed further in Responses O2-1 and O2-2), following further CEQA review. However, as no partners, commitments, or funding agreements are in place for use beyond the District, the amount of water, its destination, or how it would be used by other water agencies is speculative.

The Draft EIR also notes that certain Local Project facilities may be constructed to accommodate the potential future Regional Project, for the purposes of avoiding unnecessary removal of Local Project facilities ("throw-away facilities") should a Regional Project be pursued in the future. This is discussed in greater detail in Master Response 2, including additional graphics showing which facilities could be oversized in the Local Project.

[1] Differences between the Local Project and Regional Project are addressed in Master Response 2.

Project Lifespan

The Project has no specific "lifespan," as it is envisioned to be part of the District's water supply portfolio for the foreseeable future. Periodically, certain Project components would require maintenance or replacement, the impacts of which would be expected to be temporary, infrequent, and no more significant than impacts discussed in the EIR. Also refer to Response F2-3 regarding project lifespan and Responses S4-8 and O1-5 regarding potential for decommissioning or replacement of slant wells and pumps.

Project Footprint and Siting

As noted throughout the Draft EIR (pages 3.0-1, 3.0-14, Exhibits 3-4 through 3-9, for example), the Project footprint includes "study areas" for the slant wells, conveyance lines and the desalination plant site itself. While the desalination facility site is relatively well defined on the District's San Juan Creek Property, the Draft EIR notes that the slant wells and raw water conveyance pipelines could occur anywhere within the identified study areas. Preferred locations for the raw water conveyance lines are evaluated in the Draft EIR, as are generally anticipated locations for slant wells at Doheny State Beach (DSB) and Capistrano Beach Park. The Draft EIR evaluates a broader "study area" for raw water conveyance pipelines and slant wells to provide the District with flexibility during the EIR process, recognizing that, for complex major public works such as the Project, it is common for facilities to undergo various refinements as they move through the CEQA process, regulatory permitting, final design and field conditions during construction. This is particularly true given the phased nature of the Local Project, which is proposed for construction in phases, with slant well siting and design modified as each individual slant well is drilled, developed and begins production. Accordingly, the raw water conveyance system could vary slightly within the raw water conveyance study area, depending on the actual final locations for the slant wells that will convey water to the raw water conveyance pipelines. To allow for this flexibility, the EIR anticipates reasonably foreseeable impacts of facility construction within the study areas.

The Draft EIR has been clarified to identify specific siting criteria for slant well location and construction (see Section 3.0, *Draft EIR Errata*, "Project Facility Siting Criteria").

Slant wells could be located anywhere in the slant well study area, except those areas identified for avoidance (see Section 3, *Draft EIR Errata*). "Proposed locations for the slant wells are shown in Exhibit 3-3, Project Facility Locations, and Exhibit 3-4, Southeast Intake Well Study Area based on recent hydrological modeling done by Geoscience…." (Draft EIR, page 3.0-17). "Slant wellhead cluster locations are shown in Exhibit 3-3, Project Facility Locations, but may be revised based on further design work. Individual slant well dimensions are shown in Table 3-5, Slant Well Dimensions, which may be modified during final design, regulatory permitting, and/or field construction adjustments to reflect conditions in the field at the time of construction." (Draft EIR, pages 3.0-19 and 20). The Draft EIR is clarified to indicate avoidance areas, including the beach at DSB, San Juan Creek, San Juan Creek Lagoon, and the DSB North Creek drainage channel (see Section 3, *Draft EIR Errata*).

Regarding slant well construction on the beach, some comments requested further clarification, which has been added to the Project Description, indicating that there will be no beach construction at DSB, and only ***temporary*** beach construction at Capistrano Beach Park should slant wells be sited at that location (see *Section 3.0, Draft EIR Errata*).

Slant Well Number

The actual number of slant wells required for the Local Project will depend in part on slant well productivity, which will be monitored as each slant well is drilled, developed and operated. The number of wells may also depend on the final capacity design, as the proposal is for a plant that is "up to 5 MGD". As each well is installed, the District will refine the groundwater modeling and well siting. Based on available information including extensive groundwater modeling, field investigations, and operating a test well at DSB, the District anticipates for DSB that a total of three to four slant wells would be required from two separate well pods (three for production of the necessary 10 MGD of raw ocean water to produce 5 MGD of drinking water) and one slant well for redundancy (in the event one slant well requires maintenance, a fourth "redundant" well would allow the District to maintain production capacity, which is a standard practice with water supply projects).

Project Construction and Operation Assumptions

At the request of several commenters, detailed construction and operation assumptions developed for the GHG and air quality analyses have been incorporated into the Project Description, as shown in Section 3, *Draft EIR Errata*. Those assumptions include anticipated construction phasing, equipment needs, and operational hours for equipment type. Another edit to Draft EIR page 3.0-38 further clarifies both the construction schedule and anticipated consecutive drilling of intake wells. Text has been amplified to identify likely construction phasing and a preliminary schedule for each phase, consistent with information contained within the Draft EIR Appendices.

Slant Well Pod F and Capistrano Beach Park Slant Wells

Following release of the Draft EIR, an area of Capistrano Beach Park being considered for siting of slant wells (the "southeast intake wells" [see, e.g., DEIR, p. 3.0-19]) suffered storm damage, and the District determined it would be more challenging to construct those wells than originally anticipated due to high surf conditions, narrow parking lot area available for slant well construction, and uncertainty regarding Capistrano Beach Park's future conditions in light of coastal hazards associated with high surf storm damage. The District has not eliminated the southeast intake well area but recognizes that in order to pursue slant wells at this location, Orange County Parks or others would need to develop enhanced coastal protection of the parking lot area, as the District does not intend to incorporate any long-term coastal hazard protection for its slant wells as part of this Project.

As noted in the Draft EIR, the only southeast intake well that has been eliminated from consideration is Pod F. The slant well pod numbering system is not proposed for renumbering, as this would create unnecessary confusion due to Pods G and H being referenced in multiple technical studies, exhibits and Draft EIR sections. Elimination of Pod F is addressed in the Draft EIR, including on pages 3.0-19 and 3.0-20 which state:

> "**As discussed further in Section 4.0, the District has eliminated Pod F from consideration** at this time due to the narrow beach section, likely beach construction required, vulnerability to coastal

> hazards, temporary closure required for the Class I Beach Trail bike path, and temporary closure required for the Capistrano Bay Community Service District's maintenance facility access road. In addition, **Pod G has been shifted south, to the south of the basketball courts, to minimize disruption to the Capistrano Beach Park parking lot."** (emphasis added)

Construction Staging

Language explaining the nature of the preferred staging areas and their developed nature is provided in the Project Description (including Draft EIR page 3.0-38). Section 3, *Draft EIR Errata*, clarifies the location and "footprint" of planned staging areas for slant well construction, and identifies a seasonal construction schedule, screening methods and consecutive drilling concept.

Master Response 2: Local Project vs Regional Project Clarifications

Some commenters (e.g., Letters L1, O1 and O4) sought clarification regarding the "Local" or "Phase I" Project and the "Regional Project."

Only the Local Project (up to 5 MGD) is Being Pursued at this Time

The Draft EIR notes (e.g., pages 3.0-7, 3.0-14, 3.0-15, 3.0-36), that the District only intends to pursue permits and approvals for the "Local" Project, which is defined as being up to 5 million gallons per day (MGD) of desalinated water produced. The Draft EIR is therefore prepared at a project-level of review for construction of the Local Project, with the intent that the EIR can be used by the District and other responsible agencies for all necessary permits and approvals needed for final design, construction, operation and maintenance of the Local Project. The Regional Project is reviewed at a programmatic level, which would require additional CEQA documentation and regulatory agency approvals before it could be implemented.

Throughout the Project Description, the Draft EIR is clear that the District is only seeking approvals and permits to construct and operate the Local Project. For example (***with emphasis added***):

Draft EIR Page 3.0-14:

> "The Doheny Ocean Desalination Project would consist of the following main components: a subsurface water intake system, a raw (ocean) water conveyance pipeline, a desalination facility, a concentrate (brine) disposal system, a product water storage tank and distribution system, appurtenant facilities, and Offsite Electrical Transmission Facilities. **The Doheny Ocean Desalination Project is anticipated to be developed in two or more phases. Phase I would have a capacity of up to five (5) MGD of potable water, and the Regional Project would have a capacity of up to 15 MGD. At this time, the District is only pursuing approvals for the Phase I project, as there are currently no regional partners identified for the Regional Project. Accordingly, this EIR evaluates the Phase I Project at a "project-level" for final CEQA review for use by Responsible and Trustee agencies in the project's future permit and approval process. The Regional Project (up to 15 MGD) is evaluated at a "programmatic" level pursuant to CEQA, although construction approvals are not being sought at this time and the District will complete additional CEQA review and associated regulatory approvals for any capacity above 5 MGD.** The

Regional Project is discussed further in Section 3.5 below. A detailed description of proposed facilities is provided in Appendix 10.1, Preliminary Design Report."

Draft EIR Page 3.0-16

"The Preliminary Design Report (Appendix 10.1) evaluates three desalination capacity increments, of 5 MGD, 10 MGD, and 15 MGD. **However, the EIR focuses on the 5 MGD[2] Local Project for a project-level construction analysis, and 15 MGD as the upper range of a potential future Regional Project.** The associated technical studies (particularly groundwater modeling and brine discharge) evaluated intermediate capacities to verify that there would not be new or more significant impacts at some intermediate capacity such as 7.5 MGD or 10 MGD…."

Draft EIR Page 3.0-36

"***Note: At this time, the District is only intending to approve the Phase I Project. In addition, the Regional Project would require one or more Regional Partners and a Regional Project product water conveyance system, which has not been identified. Therefore, the Regional Project is addressed in this EIR at the "program" level, and as such would require additional CEQA documentation and regulatory agency approvals before it could be implemented."***

Certain Local Components Are Designed to Accommodate a Potential Future Regional Project

The Draft EIR also notes that, as part of the Local Project, certain facilities may be oversized to accommodate a potential future Regional Proejct. For example, the Draft EIR pages 3.0-16 to 3.0-17 explains:

"Certain pieces of common infrastructure for the Phase I project could be initially sized for the Regional Project, although utilization of this additional capacity could only occur following further CEQA review and appropriate regulatory approvals. This limited "flexible-sizing" decision would minimize future construction costs and downtime requirements should a larger capacity be pursued in the future (up to 15 MGD, subject to further CEQA review and regulatory approvals). As noted above, the Regional Project is discussed further below in Section 3.5, and the District only intends to pursue approvals for the Phase I project at this time. The following components could be sized for the Regional Project:

- Raw water conveyance pipeline (**only key segments, not including the additional facilities noted in Section 3.5**)
- Reverse Osmosis (RO) Building, Electrical Building, Administration Building (excluding additional RO membrane systems)
- Chemical Storage Structure
- Product Water Storage Tank
- Brine Disposal Tank and Discharge Piping

[2] *Note that actual production capacity may be smaller than five MGD depending on phasing, financing, and optimization during final design.*

> **If the District elected to size any or all of the above-outlined facilities for possible future expansion, no production above 5 MGD could occur without an additional public review process and associated supplemental CEQA document and regulatory approvals necessary for Regional Project facilities noted in Section 3.5."** (emph. added)

The sizing of certain components (identified above) to accommodate potential future expansion represents a prudent and cost-effective approach to site planning and engineering to limit the extent of future impacts should the facility be expanded in the future. This also avoids or minimizes environmental impacts and added ratepayer impact associated with demolishing undersized Local Project "throwaway" facilities and replacing them with larger Regional Project facilities in the event a future Regional Project is approved. This is particularly important for technically challenging crossings where it is environmentally and economically prudent to minimize unnecessary future construction, such as the raw water conveyance pipelines under San Juan Creek Lagoon, San Juan Creek, Pacific Coast Highway (PCH), the Southern California Regional Rail Authority (SCRRA) railroad, and major intersections such as Dana Point Harbor Drive and PCH (DEIR page 3.0-21). Certain facilities within the desalination plant itself may be constructed to accommodate a potential future Regional Project, including the main RO building and brine storage tank. An exhibit has been added to the EIR to clarify which segments of the raw water conveyance pipeline and brine discharge facility would be oversized, in addition to clarification on which desalination facility site components could be oversized as part of the Local Project (refer to Section 3, *Draft EIR Errata*).

Provision of these oversized Local Project components does not prejudice the District toward Regional Project approval for the reasons stated above, nor does it require Regional Project approval. They also do not have any effect on the desalination plant design capacity and do not allow the District to produce more than 5 MGD at the desalination plant without first constructing additional facilities needed for the Regional Project (after further review and approvals). The EIR is clear in that any desalination facility capacity beyond 5 MGD would require separate CEQA review, in addition to separate regulatory agency review and approval for new or modified permits and approvals. The District is only seeking funding for the Local Project at this time, and there are no Regional Project partners in place at this time. Therefore, allowance for certain Local Project facilities to be oversized is not "piecemealing" under CEQA, as the scope and details of a potential future Regional Project are uncertain without partner(s), and the Regional Project could not be approved, permitted or constructed without separate CEQA review and regulatory approvals.

Regional Project Addressed at a Programmatic Level

As shown in the above examples, the District distinguishes that the level of CEQA review conducted for the Local Project is for a Project EIR (CEQA Guidelines § 15161), while the potential future Regional Project is analyzed at a programmatic level (CEQA Guidelines § 15168). The EIR explains that the programmatic evaluation for future expansion is appropriate since approvals are not being sought, no regional partners are in place at this time, and key regional facilities (such as a regional product water conveyance system) have not been identified. The Draft EIR, in each analysis section and under a clearly labeled header, evaluates the potential impacts of the "Regional Project" to the extent they are reasonably foreseeable, based on all information known at this time and without engaging in speculation.

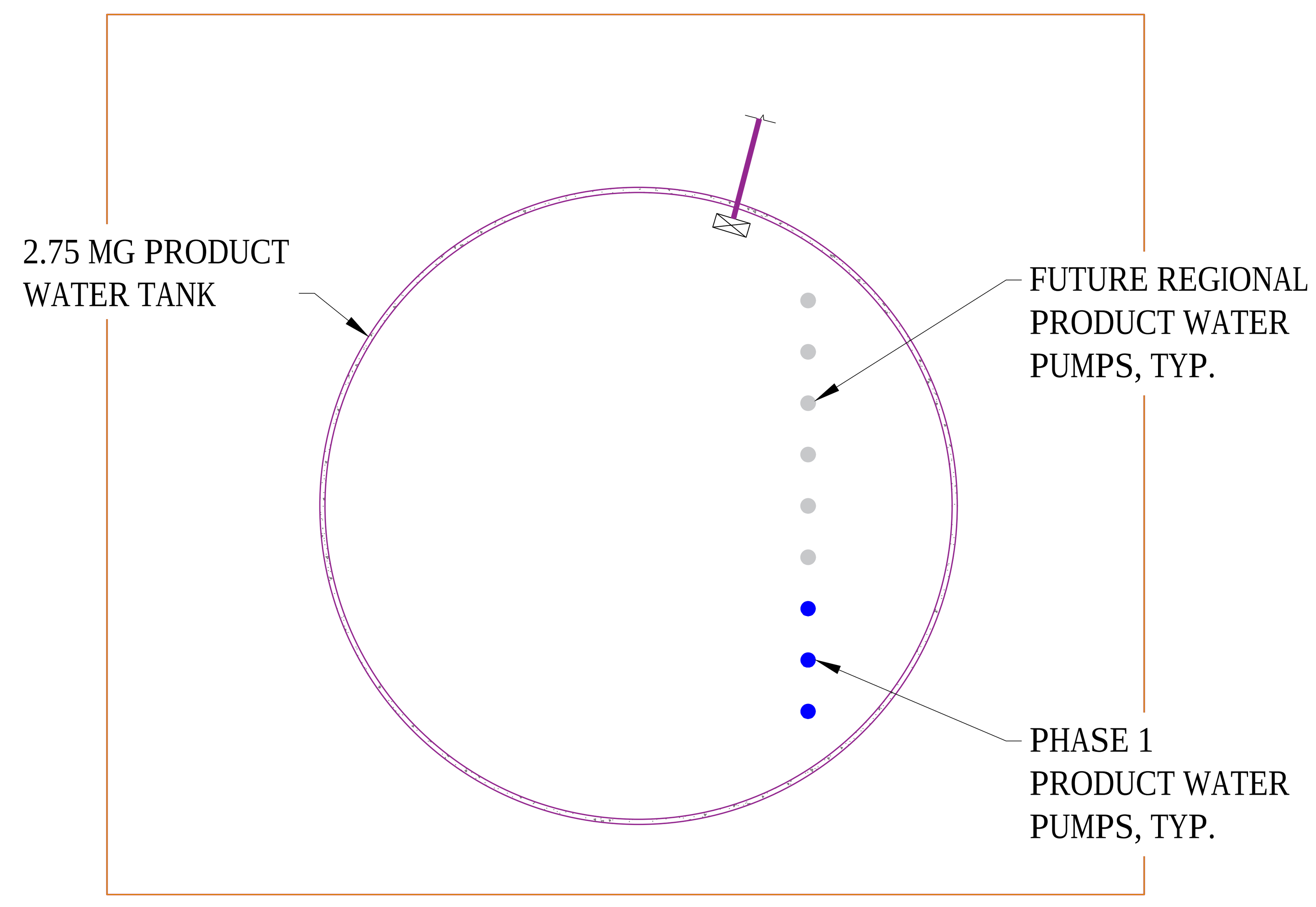
Rationale for Quantitative Analysis of Certain Regional Project Impacts

Given that the Draft EIR addresses the Regional Project at a “program level” of CEQA review, some commenters (Letter L1, Comments O1-4) questioned the EIR’s analysis of certain Regional Project impacts at the “project” level of detail. The District has endeavored to provide as much information as is reasonably available without engaging in speculation regarding the Regional Project. In that light, the EIR evaluates the Regional Project using quantitative analyses including air quality, greenhouse gas (GHG), brine discharge and groundwater modeling, which are all based on the relatively well understood potential impacts associated with a raw water intake and RO process producing up to 15 MGD of potable water. Since the District envisions constructing the RO process building for the Local Project in a way that could accommodate potential future Regional Project equipment, even the desalination site aesthetics and grading impacts are fairly well understood for the Regional Project. However, as noted in the Draft EIR, what is not well understood and led the District to evaluate the Regional Project at a program level, are the potential future end users, project partners, and offsite product water conveyance, storage and pumping facilities that could be required for a Regional Project. The Draft EIR (page 4.0-4) notes that it would be speculative to estimate impacts or draw conclusions for Regional Project facilities that have yet to be identified, and similarly the potential growth-inducing and cumulative impacts of a Regional Project are speculative without having regional project partners or end users identified. Therefore, the Draft EIR appropriately evaluates the Regional Project at a program level. Draft EIR notes (pages 4.2-33; 4.6-26) that the quantitative analyses associated with offsite product water conveyance are not included in the air quality and GHG analyses, and that the Regional Project could also have environmental impacts in other resource areas (biological, cultural, recreation, noise, etc.) depending on the location and nature of potential future offsite Regional Project facilities.

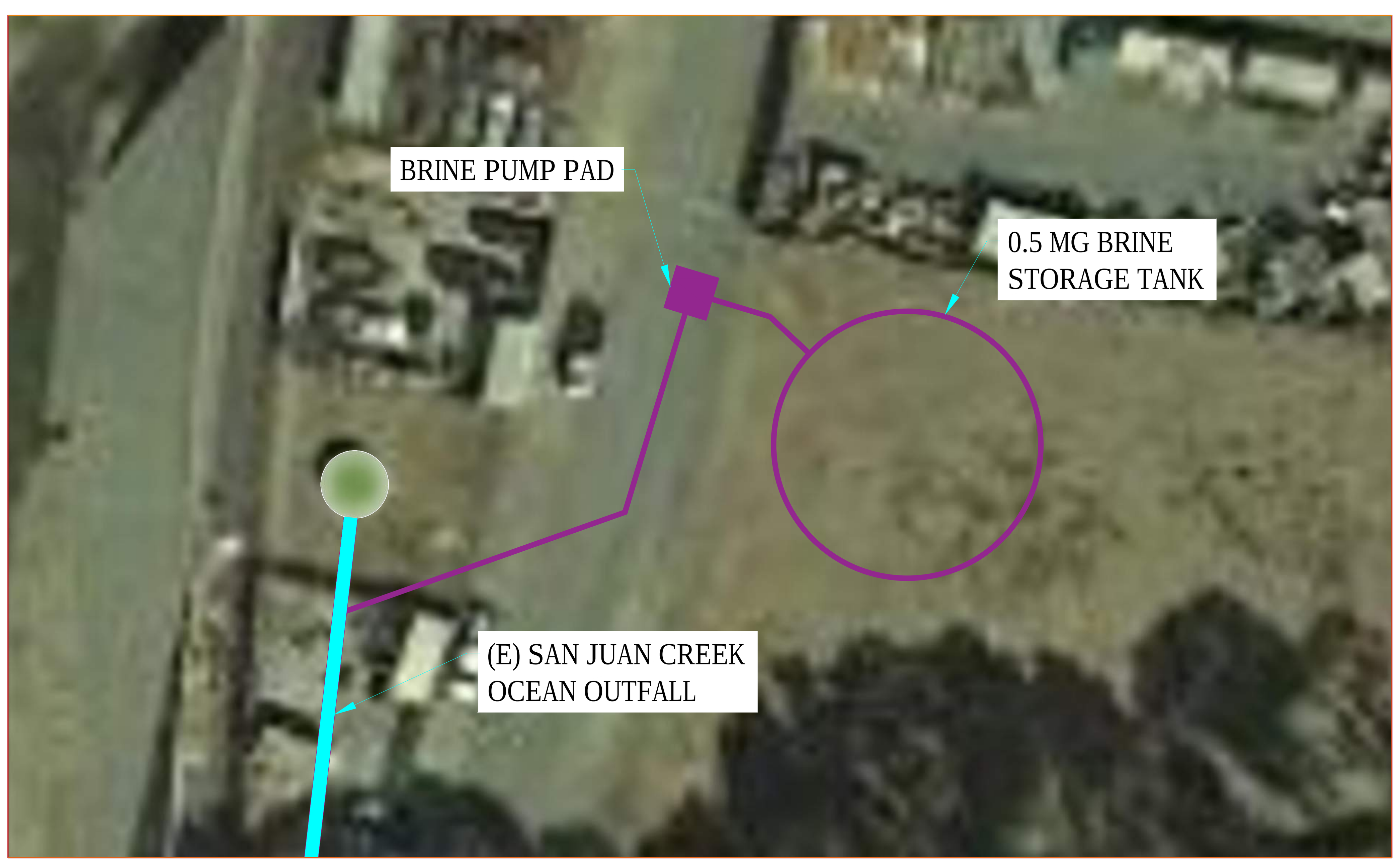
LEGEND

- SIZED FOR REGIONAL PROJECT
- SIZED FOR LOCAL PROJECT (UP TO 5 MGD)
- WELLHEADS (INDICATIVE)

NOTES:
1. NUMBER OF WELLHEADS / SLANTWELL CLUSTERS ARE SUBJECT TO CHANGE.
2. BRINE PUMP PAD WILL BE SIZED TO ACCOMMODATE ADDITIONAL PUMPS IN REGIONAL PHASE



1 PRODUCT WATER STORAGE TANK AND PUMPS
1" = 25'



2 BRINE STORAGE TANK - CONNECTION TO SAN JUAN CREEK OCEAN OUTFALL
1" = 25'

3 RAW WATER CONVEYANCE LAYOUT - PREFERRED ALIGNMENT
1" = 270'

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

N

GHD Inc.
320 Goddard Way, Suite 200
Irvine California USA 92618
T 1 949 250 0501 F 1 949 250 0541
E irvmail@ghd.com W www.ghd.com

Drawn	Designer
Drafting Check	Design Check
Approved (Project Director)	
Date	
Scale AS SHOWN	This Drawing shall not be used for Construction unless Signed and Sealed For Construction

Client **SOUTH COAST WATER DISTRICT**
Project **DOHENY DESALINATION PROJECT EIR**
Title **PROJECT DESIGN FEATURES**
REGIONAL VS LOCAL SIZING
Contract No.
Original Size Ansi D Drawing No: **1**
Sht - of -
Rev:

Master Response 3: Draft EIR Errata and Technical Memos

As part of the normal CEQA process, certain clarifications, amplifications, and insignificant modifications to the Draft EIR have been made, in response to Draft EIR comments, and also based on additional input provided by stakeholders through ongoing consultation and coordination since release of the Draft EIR for public review. In some cases, the District initiated technical corrections or clarifications to the Draft EIR. These clarifications, amplifications and modifications are reflected in the responses to comments and, where appropriate, resulted in specific text or graphic revisions to the Draft EIR, which are noted in Section 3, *Draft EIR Errata*.

For certain topics, the District elected to prepare technical memos to provide further clarifications and amplified evidence to support or validate the findings of the EIR (the technical memos are provided as appendices to this Final EIR, contained in Section 4.2, Final EIR Technical Analyses). A summary of each technical memo is included here:

- Appendix 4.2.1 Coastal Hazards Analysis for Final EIR
    - This 2019 study, prepared in response to comments for the Final EIR, provides further analysis to build on the Coastal Hazards Analysis prepared in 2017 for the Draft EIR of the Doheny Desalination Project. That earlier work is being amplified in response to a revision of the *California Coastal Commission Sea Level Rise Policy Guidance* document that was originally released in August 2015, but was updated in July 2018 with new sea level rise projections. In addition, there have been minor adjustments in the locations of some of the slant well heads and associated pumps being proposed for the Doheny Desalination Project. This study accounts for these intervening changes in policy guidance and minor modifications to the project description.

      This analysis further supports the Draft EIR's conclusion that no improvements are needed within San Juan Creek, and that Project construction and design will not create significant drainage or water quality impacts to San Juan Creek or areas across from the site. This does not add significant new information to the EIR.
- Appendix 4.2.2 Brine Discharge Analysis for Final EIR
    - The California State Water Resources Control Board released newly defined protocols that require the use of a specific hydrodynamic mixing model (referred to as Plumes 18b) to assess marine life impacts. This study implements these protocols using the Plumes 18b model to assess potential injury or mortality to small marine organisms entrained by discharges from the diffuser of the San Juan Creek Ocean Outfall that is being proposed as the discharge structure for brine by-product from the Doheny Desalination Project.

      In general, Plumes 18b predicted higher Minimum Initial Dilution, and smaller Zones of Initial Dilution (ZID) at deeper depths than was reported previously by Doheny Desalination Project dilution studies using the Visual Plumes (UM3) model. Using the Plumes 18b model for buoyant discharges, the Phase I "Local" Project is modeled to reduce marine life impacts ("turbulence mortality") associated with diffuser jets compared to "no project" conditions (the incremental turbulence mortality impact of the Project is beneficial, reducing the turbulence mortality and associated ZID). This modeling shows that under all reasonably foreseeable brine discharge scenarios, the Project will meet applicable Ocean Plan discharge requirements. No diffuser modification or other mitigation is required to meet Ocean Plan requirements. This does not add significant new information to the EIR.

- Appendix 4.2.3.1 Groundwater Modeling for Final EIR
    - GEOSCIENCE Support Services, Inc. (GEOSCIENCE) reviewed the DEIR comments related to project impacts to groundwater and surface water, including those provided by the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA-NMFS), San Juan Basin Authority, and Santa Margarita Water District. In response to these comments, GEOSCIENCE has conducted additional analysis regarding the influence of slant well pumping on San Juan Creek lagoon, surface and groundwater levels in the shallow aquifer, and potential changes due to a suspected bedrock barrier. This technical memorandum summarizes the results of that analysis.

      This analysis did not result in significant changes to the conclusions made in the Draft EIR and the associated Project design assumptions. The analysis concluded that both the creek outflow and the shallow aquifer near the lagoon are affected primarily by hydrologic conditions (i.e., precipitation patterns), and that the elevated bedrock does not affect the cumulative groundwater level responses from both the San Juan Watershed Project and Doheny Desalination Project. This does not add significant new information to the EIR.

- Appendix 4.2.3.2 Groundwater Modeling for Final EIR
    - GEOSCIENCE Support Services, Inc. (GEOSCIENCE) reviewed the DEIR comments related to project impacts to groundwater and surface water, including those provided by the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA-NMFS). In response to these comments, GEOSCIENCE conducted additional analysis regarding the influence of slant well pumping on San Juan Creek lagoon levels. This technical memorandum summarizes the results of that analysis.

      In summary, the analysis concluded that both the creek outflow and the shallow aquifer near the lagoon are highly affected by hydrologic conditions (i.e., precipitation patterns), where:

        - During periods of low precipitation (dry hydrologic conditions), water levels in the shallow aquifer generally fall below the average estimated lagoon bottom elevation – both during pumping conditions and in the absence of slant well pumping.

- Even during dry conditions when groundwater levels in the shallow aquifer fall below the lagoon bottom during No Project (no pumping) and Project (pumping) conditions, water is still present in the lagoon.
- When groundwater levels in the shallow aquifer fall below the lagoon/river bottom, surface water level in the lagoon is controlled by the hydraulic conductivity of the underlying sediments and is independent of groundwater levels.
- During periods of high precipitation (wet hydrologic conditions) groundwater levels in the shallow aquifer generally rise above the lagoon bottom.
- Additional seepage from the lagoon and streambed upgradient of the lagoon occurs under Project pumping conditions. However, decreases in San Juan Creek streamflow from Project pumping correspond to approximately 0.6 to 0.8 percent of the baseline outflow under Project pumping of 10 MGD from three slant wells at Doheny State Beach.
- This analysis does not change the original conclusions stated in the Draft EIR. This does not add significant new information to the EIR.

- Appendix 4.2.4 Local Hazard and Drainage Calculations for Final EIR
  - This 2019 study, prepared in response to comments for the Final EIR, provides further analysis to add to the Local Hazard Conditions and Drainage Study prepared in 2017 for the Draft EIR of the Doheny Desalination Project. That earlier work is being amplified herein in response to a revision of the *California Coastal Commission Sea Level Rise Policy Guidance* document that was originally released in August 2015, but was updated in July 2018 with new sea level rise projections. Additionally, this study includes a sensitivity analysis for a 500-year storm event, per comments on the Draft EIR.

    The study concluded that the recommended plant site improvement alternative proposed in the Draft EIR is still sufficient given the updated sea level rise projections to protect against floodwater inundation, and that areas surrounding the plant site will not experience an increase in inundation provided the proposed improvements to the site are implemented. It was further found that the sensitivity analysis maximum 500-year flood elevation would likely result in minimal inundation of the project site, provided these proposed improvements. This does not add significant new information to the EIR.
- Appendix 4.2.5.1 Diffuser Entrainment Memo for Final EIR
  - This memo was prepared to review diffuser entrainment mortality related to the discharge scenarios presented in additional brine modeling using Plumes 18b (Appendix 4.2.2) prepared for the South Coast Water District Doheny Desalination Project in response to comments for the Final EIR. This memo amplifies the work that was done in

Appendix 10.4.1 of the Draft EIR. This memo does not change the original conclusions stated in the Draft EIR and does not add significant new information to the EIR.

- Appendix 4.2.5.2 Brine Discharge Memo for Final EIR
  - This memo was prepared to review a range of impacts related to the dense (negatively buoyant) discharge scenarios presented in the brine modeling using Plumes 18b (Appendix 4.2.2) prepared for the South Coast Water District Doheny Desalination Plant in response to comments for the Final EIR. This memo amplifies the work that was done in Appendix 10.4.1 of the Draft EIR. This memo does not change the original conclusions stated in the Draft EIR and does not add significant new information to the EIR.

The Draft EIR Errata provides supporting detail and context regarding components of the Project Description, additional detail regarding construction phasing, scheduling and equipment, supporting details regarding slant well construction and staging, and amplification and strengthening of mitigation measures consistent with CEQA Guidelines § 15088.5(b).

None of these technical memos, parallel analyses, or clarifications result in new or substantially more severe environmental impacts that the District has not committed to mitigate.

CEQA Guidelines §15088.5 describes when an EIR requires recirculation prior to certification, stating in part:

> "(a) A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the draft EIR for public review under Section 15087 but before certification. As used in this section, the term "information" can include changes in the project or environmental setting as well as additional data or other information. New information added to an EIR is not "significant" unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect (including a feasible project alternative) that the project's proponents have declined to implement. "Significant new information" requiring recirculation include, for example, a disclosure showing that:
>
> (1) A new significant environmental impact would result from the project or from a new mitigation measure proposed to be implemented.
>
> (2) A substantial increase in the severity of an environmental impact would result unless mitigation measures are adopted that reduce the impact to a level of insignificance.
>
> (3) A feasible project alternative or mitigation measure considerably different from others previously analyzed would clearly lessen the environmental impacts of the project, but the project's proponents decline to apply it.
>
> (4) The draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded (*Mountain Lion Coalition v. Fish and Game Com.* (1989) 214 Cal.App.3d 1043)

(b) Recirculation is not required where the new information added to the EIR merely clarifies or amplifies or makes insignificant modifications in an adequate EIR."

The critical issue is whether any new information added is "significant," in which case recirculation is required. If it is not significant, recirculation is not required. (Pub. Res. Code § 21092.1; CEQA Guidelines § 15088.5). In all cases, as discussed in individual responses to comments, master responses, associated technical memos, and Draft EIR Errata, these minor clarifications and modifications do not identify new or substantially more severe environmental impacts that the District has not committed to mitigate. Here, the public has not been deprived of a meaningful opportunity to comment upon a substantial adverse environmental effect of the Project or an unadopted feasible project alternative or mitigation measure. Instead, the information added supports the existing analysis and conclusions, and responds to inquiries made from commenters. Therefore, the Draft EIR does not require recirculation.

Master Response 4: Slant Well Technology

With respect to the slant well technology, the Doheny Ocean Desalination Project has been studied for over 15 years with extensive prior feasibility studies, technical studies and a successfully installed and operated test slant well at Doheny State Beach (Doheny TSW) that operated for 18 months and produced approximately 3 MGD of raw intake water. The Municipal Water District of Orange County (MWDOC) prepared a design and feasibility study as early as 2003 to evaluate the use of this technology for a desalination project (Draft EIR, p. 3.0-9).

Slant wells are differentiated from typical water production wells in that slant wells are installed at an angle from the vertical. Similar to typical production wells, slant wells are typically installed using rotary drilling techniques, and completed with a straight rigid casing. Dual rotary drilling is differentiated from directional drilling in that the borehole remains straight, and the method is generally used for larger diameters (greater than 8 inches) than typical directionally drilled holes.

In a 2008 Phase 2 investigation study,[3] Geoscience compared several subsurface intake technologies and determined that slant wells were most advantageous due to the thin nature of the aquifer and comparatively better production than other methods. The 2008 Phase 2 study also included a detailed evaluation of dual rotary drilling and horizontal directional drilling methods for the development of the slant well intake system. The investigation concluded that the dual rotary angle drilling method was the most suitable for the Project site.

The dual rotary drilling method provides a large-diameter cased borehole inside which the well is constructed and gravel packed before the outer casing is then extracted. With the dual rotary method, the outer drill casing ensures a stable borehole, even in unconsolidated aquifer materials. Horizontal directional drilling, however, uses drilling fluids to stabilize the borehole, which may plug the surrounding aquifer and be difficult to remove during the well development process. Dual rotary drilling is also a relatively fast method of construction, compared to other drilling methods including horizontal directional drilling. The method is able to successfully drill through cobbles and boulders with the help of a carbide

[3] Geoscience Support Services, Inc. 2008. Horizontal Well Technology Application in Alluvial Marine Aquifers for Ocean Feedwater Supply and Pretreatment. Municipal Water District of Orange County. Fountain Valley, CA.

studded casing guide. Additionally, dual rotary drilling has a relatively small footprint compared to other drilling methods, which is ideal for both the Doheny State Beach and Capistrano Beach Park settings.

Slant well technology has been applied to several industries, including potable and agricultural water supply, and subterranean tunnel dewatering with some wells in operation for over a decade. Slant well technology has also been tested successfully for ocean desalination use at the Monterey Peninsula Water Supply Project Test Slant Well (Monterey TSW) in Marina, California.

The Monterey TSW was drilled using the dual rotary drilling method, to a length of 720 feet along an angle of 19 degrees below horizontal. This is substantially similar to the current well design for this Project, which considers wells up to 1,000 feet in length at an angle of approximately 10 degrees. (See, Draft EIR, p. 3.0-17). The Monterey TSW was pumped successfully for approximately 3 years from April 2015 to February 2018, per agreement with project stakeholders, at an average daily production capacity of 3 MGD. The well remains operational and is intended to be used for full-scale production to supply a planned seawater desalination plant as part of the Monterey Peninsula Water Supply Project.[4]

Currently, there are several slant wells operating successfully within the United States. A survey of completed slant well installations, done in 2015 by consultants MWH for California American Water, found eight (8) applications that meet the following criteria, in-line with the anticipated design for the proposed Project:

- Diameter greater than or equal to 12”
- Potable water supply well installed at an angle from the horizontal
- Straight and rigid design (not horizontal directional drilling)

The identified slant wells are detailed below in Table 1. The Monterey TSW has been added to this list, as it was just starting up at the time this survey was completed. This survey was based on available information gathered using internet searches and correspondence with industry professionals. This survey provides insight into the characteristics and operational history of the slant well technology up to the time this survey was completed. “Years of Operation” indicates the period of successful operation beginning with the earliest installed project well up to the completion of this survey in 2015. At the time of this survey all of the listed wells were still in operation, with the exception of the Doheny TSW which completed testing in 2012, and the Monterey TSW, which completed testing in 2018. Note for comparison, as detailed in Preliminary Design Report (EIR Appendix 10.1), the slant wells for the Project have a proposed design intake capacity of 3,000 gpm.

Table 1 Identified Slant Wells and Site Locations

Site Name	Location	No. of Wells	Capacity of Each Well (gpm)	Years of Operation
Lewis & Clark Regional Water System Slant Wells	Vermillion, SD	4	2,100 – 2,600	3

[4] Data and reports for the Monterey TSW are available online at https://www.watersupplyproject.org/test-well, last viewed April 26, 2019.

South Central Regional Water District Slant Wells	Bismarck, ND	9	300 – 400	10
Town of Bethlehem Water Distribution System Slant Wells	Selkirk, NY	5	347	10
City of Burnsville Water Treatment System Slant Wells	Burnsville, MN	2	2,500	7
Metropolitan Water District of Orange County (MWDOC) Doheny Ocean Desalination Project Test Slant Well	Dana Point, CA	1	1,660	2
Poweshiek Water Association Slant Wells	Brooklyn, IA	2	200 – 230	7
Cartwright Slant Wells Private Agricultural Slant Wells	Cartwright, ND	4	1,500	1
Minnesota Department of Transportation I-35 Dewatering Slant Well	Interstate 35, MN	1	600	1
Monterey Peninsula Water Supply Project (MPWSP) Test Slant Well	Marina, CA	1	2,056	3

Source: MWH. 2015. Slant Well Survey – Final Report. California American Water. Sacramento, CA.

With any well drilling project, whether it be a traditional vertical well or a slant well, there are inherent risks associated with construction and performance. Taking into consideration the success of the test slant wells at Doheny State Beach and Monterey Peninsula, and the breadth of other slant well applications outlined above, the use of slant wells for seawater intake presents an acceptable level of risk to the District. Furthermore, the Local Project is planned for construction in phases, with each slant well drilled and developed individually, allowing the Project's groundwater modeling and slant well siting, design and operational measures to be refined as data is developed from each well that comes online. Slant wells operate successfully, while also protecting California's coast and sea life. This is recognized in the California Ocean Plan, where subsurface intakes are indicated as the preferred method for withdrawing seawater from the ocean, as reflected in the following excerpt:

Per Section M.2.d.(1).(a):

> "Subject to chapter M.2.a.(2), the regional water board in consultation with State Water Board staff **shall require subsurface intakes*** unless it determines that subsurface intakes* are not feasible* based upon a comparative analysis of the factors listed below [Section M.2.d.(1).(a).i and ii] for surface and subsurface intakes.* A design capacity in excess of the need for desalinated* water as identified in chapter III.M.2.b.(2) shall not be used by itself to declare subsurface intakes* as not feasible.* … * See Appendix I for definition of terms." (emphasis added).

Federal Agency Comment Letters

F1 FEMA Region IX – U.S. Department of Homeland Security

F2 National Oceanic and Atmospheric Administration

U.S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA. 94607-4052

FEMA

June 12, 2018

Rick Shintaku, P.E.
Acting General Manager, District Engineer
31592 West Street
Laguna Beach, California 92651

Dear Mr. Shintaku:

This is in response to your request for comments regarding Amended Notice of Availability for Doheny Ocean Desalination Project Draft Environmental Impact Report – SCH 2016031038.

Please review the current effective countywide Flood Insurance Rate Maps (FIRMs) for the County of Orange (Community Number 060212) and City of Dana Point (Community Number 060736), Maps revised December 3. 2009. Please note that the City of Dana Point, Orange County, California is a participant in the National Flood Insurance Program (NFIP). The minimum, basic NFIP floodplain management building requirements are described in Vol. 44 Code of Federal Regulations (44 CFR), Sections 59 through 65. 1

A summary of these NFIP floodplain management building requirements are as follows:

- All buildings constructed within a riverine floodplain, (i.e., Flood Zones A, AO, AH, AE, and A1 through A30 as delineated on the FIRM), must be elevated so that the lowest floor is at or above the Base Flood Elevation level in accordance with the effective Flood Insurance Rate Map. 2

- If the area of construction is located within a Regulatory Floodway as delineated on the FIRM, any ***development*** must not increase base flood elevation levels. **The term *development* means any man-made change to improved or unimproved real estate, including but not limited to buildings, other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, and storage of equipment or materials.** A hydrologic and hydraulic analysis must be performed *prior* to the start of development, and must demonstrate that the development would not cause any rise in base flood levels. No rise is permitted within regulatory floodways. 3

- All buildings constructed within a coastal high hazard area, (any of the "V" Flood Zones
as delineated on the FIRM), must be elevated on pilings and columns, so that the lowest
horizontal structural member, (excluding the pilings and columns), is elevated to or above
the base flood elevation level. In addition, the posts and pilings foundation and the 4
structure attached thereto, is anchored to resist flotation, collapse and lateral movement
due to the effects of wind and water loads acting simultaneously on all building
components.

- Upon completion of any development that changes existing Special Flood Hazard Areas,
the NFIP directs all participating communities to submit the appropriate hydrologic and
hydraulic data to FEMA for a FIRM revision. In accordance with 44 CFR, Section 65.3,
as soon as practicable, but not later than six months after such data becomes available, a 5
community shall notify FEMA of the changes by submitting technical data for a flood
map revision. To obtain copies of FEMA's Flood Map Revision Application Packages,
please refer to the FEMA website at http://www.fema.gov/business/nfip/forms.shtm.

Please Note:

Many NFIP participating communities have adopted floodplain management building
requirements which are more restrictive than the minimum federal standards described in 44
CFR. Please contact the local community's floodplain manager for more information on local
floodplain management building requirements. The Dana Point floodplain manager can be 6
reached by calling Kyle Butterwick, Director, Community Development Department, at (949)
248-3563. The Orange County floodplain manager can be reached by calling Penny Lew, Senior
Civil Engineer, at (714) 647-3990.

If you have any questions or concerns, please do not hesitate to call Mark Delorey of the Mitigation staff at (510) 627-7015.

Sincerely,

for

Gregor Blackburn, CFM, Branch Chief
Floodplain Management and Insurance Branch

cc:

Kyle Butterwick, Director, Community Development Department, City of Dana Point
Penny Lew, Senior Civil Engineer, Orange County Public Works Department
Garret Tam Sing/Salomon Miranda, State of California, Department of Water Resources,
Southern Region Office
Mark Delorey, NFIP Planner, DHS/FEMA Region IX
Alessandro Amaglio, Environmental Officer, DHS/FEMA Region IX

Letter F1 Federal Emergency Management Agency Region IX

Gregor Blackburn, CFM, Branch Chief, Floodplain Insurance Management Branch
June 12, 2018

In addition to responses to these general comments provided by FEMA, the District has provided more detailed responses to other flood hazards comments, including those made by the California Coastal Commission (Response Nos. S1-14 through S1-17). Also refer to Appendix 4.2.4, which provides further clarification to the *Doheny Desalination Project Local Hazard Conditions and Drainage Study.*

Response F1-1

Comments requesting review of current effective countywide Flood Insurance Rate Maps (FIRMs) for the area are noted. The District has consulted current maps. Please see additional related responses below.

Response F1-2

Comment cites National Flood Insurance Program (NFIP) floodplain management building requirements, which are noted for the record. The recommended project site improvement in the Local Hazard Conditions and Drainage Study is to raise the project site above the Base Flood Elevation (BFE). As discussed in Draft EIR *Section 4.8 Hydrology*, the Project site and the buildings will be above the BFE as shown in FEMA FIRM 06059C0508J. Also refer to Response Nos. S1-3 and S1-15 for additional discussion related to site flood hazards, including analysis conducted for a 100-year storm event, as well as consideration of a 500-year storm event.

Response F1-3

Comment cites NFIP floodplain management building requirements, which are noted for the record. As shown in FEMA FIRM 06059C0508J, the section of San Juan Creek adjacent to the Project site is not a Regulatory Floodway.

Response F1-4

Comment cites NFIP floodplain management building requirements, which are noted for the record. As shown in FEMA FIRM 06059C0508J, the Project site is in Zone AO (Depth 1'), not in any of the "V" Flood Zones.

Response F1-5

Comment cites NFIP floodplain management building requirements, which are noted for the record. The South Coast Water District will submit the map revision application and related data to FEMA for the Project in accordance with these requirements.

Response F1-6

Contact information for the local community's floodplain manager with respect to local requirements is noted and appreciated.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

August 2, 2018

Rick Shintaku, PE
Acting General Manager
South Coast Water District
31592 West Street, Laguna Beach, CA 92651

Dear Mr. Shintaku:

Enclosed with this letter are the National Marine Fisheries Service's (NMFS) comments on the Draft Environmental Impact Report (DEIR) for the Doheny Ocean Desalination Project (Project) in Dana Point near Doheny State Beach. In accordance with California Environmental Quality Act regulations (14 CCR § 15151), the enclosed comments highlight where the DEIR is inadequate for disclosing the Project effects on endangered steelhead (*Oncorhynchus mykiss*) and habitat for this species in lower San Juan Creek including its seasonal lagoon[1]. 1

NMFS appreciates the opportunity to review and comment on the DEIR. Please contact Brittany Struck at (562) 432-3905 or via email at Brittany.Struck@noaa.gov if you have a question concerning this letter or enclosed comments.

Sincerely,

Anthony P. Spina
Chief, Southern California Branch
California Coastal Office

Enclosure

cc: Jonathan Snyder, U.S. Fish and Wildlife Service, Carlsbad
Mary Larson, California Department of Fish and Wildlife, Los Alamitos
Daniel Swenson, U.S. Army Corps of Engineers, Los Angeles District
Administrative File: 10019WCR2018CC00152

[1] An estuary that becomes separated from the ocean by a sandbar barrier for part of the year.

NOAA's National Marine Fisheries Service (NMFS) Comments on the South Coast Water District's (District) Draft Environmental Impact Report (DEIR) for the Doheny Ocean Desalination Project (Project)

August 2, 2018

As explained more fully in the comments that follow, the content of the DEIR does not allow NMFS to develop a clear understanding of the manner in which the Project may affect endangered steelhead and available habitat for this species, the amount, extent and duration of adverse impacts, and the implications of these impacts for survival and recovery of steelhead in the San Juan Creek watershed. The DEIR does not meet the California Environmental Quality Act (CEQA) criterion for adequacy and full disclosure in the context of significant, environmental issues. To this end, comments below are organized into the following categories: (1) impacts analysis, (2) climate analysis, (3) construction, operation, and long-term planning, (4) cumulative effects, and (5) technical clarifications. 2

Impacts Analysis

- The description of impacts to surface water (e.g., magnitude, extent, duration of impacted lagoon levels at the Project site) is inadequate to develop a clear understanding of the effects. The DEIR should be revised to include a discussion regarding the effects of reduced lagoon levels owing to the proposed Project. The revised EIR should incorporate tables, figures, and additional content that not only describes impacts but also explains physical, biological, and ecological effects to endangered steelhead and available habitat. For example, the revised EIR should translate the Project impact listed below into effects on lagoon habitat over the duration of the Project's expected lifespan (50-75 years).
    - Under wet hydrology, Scenario 1 lagoon levels average 10.91 feet NAVD88. This represents a change from the baseline scenario of -1.35 feet. 3
- Disclosure in the DEIR is often confined to discussion of the impacts, with no consideration of the related consequences due to the impacts. This renders the DEIR inadequate because the impacts are not an end in and of themselves; rather, the impacts are likely to generate additional effects and related consequences to endangered steelhead and habitat for this species, which are not disclosed. Therefore, the revised EIR should include a discussion of the effects and ultimate consequences due to each impact. For example, the revised EIR should translate Project impacts listed below into effects on riparian vegetation over the duration of the Project's expected lifespan (50-75 years).
    - Groundwater is expected to decline between approximately 5 feet for model layer 2 and 30 feet for model layers 5, 6, and 7.
    - Scenario 1 water levels in the shallow aquifer for Sites A, B, C and D near the lagoon are lower than the baseline water levels by an average of 5.54 ft., 5.28 ft., 4.79 ft., and 4.49 ft., respectively, over the entire model period. 4

- In Appendix 10.10.1, Section 4.1.2 (page 10), the DEIR discusses one model that is limited in its ability to predict lagoon levels because of the lack of measured data with which to calibrate the model against. In addition, the model was unable to simulate effects of high-flow events in the San Juan Creek and resulting beach erosion or changes in the lagoon-bank elevation. There seems to be a second model, the SJB Focused Groundwater Model, which was constructed to accurately model local effects of slant-well pumping, including 5
percolation from the lagoon at the mouth of San Juan Creek. However, because the manner in which both models have been applied is unclear, the revised EIR should clearly describe the methods and the full extent of effects to the surfacewater lagoon level and the characterization of the actual drawdown including the expected range of effects from the drawdown itself on instream habitat or features of instream habitat that support endangered steelhead.
- The “Likelihood of Occurrence” analysis (see Appendix 10.4.1, Table 8) should be revised to reflect an evaluation of steelhead occurrence for the next 75 years based on the Project lifespan. Steelhead-occurrence predictions should be based on long-term, systematic surveys, ecological literature, and frequency of past and future hydrologic triggers (i.e., rain events). The revised EIR should describe the biological basis or abundance criterion that establishes the following scale used in the DEIR to characterize steelhead occurrence: *Abundant>Common>Uncommon>Rare>Unlikely*. Likelihood of steelhead presence in San Juan Creek watershed, in part, is based on the amount, timing, and duration of future rainfall events as well as the availability and persistence of spawning and rearing habitat including the likelihood of restored access to historical steelhead habitat in the next 75 years. Overall, 6
current environmental conditions do not serve as an appropriate proxy for likelihood of steelhead presence over the next 75 years in lower San Juan Creek and its seasonal lagoon.
- Because there is a potential of endangered steelhead at the Project site, the District should add the Endangered Species Act (ESA) to the list of regulations that determines the thresholds of significance (Appendix 10.4.1, page 28). Thresholds should be based upon, at a minimum, the ESA criterion of avoiding or minimizing adverse effects to the species and their habitat. The District concludes there are no substantial adverse effects on designated critical habitat (Section 4.3 Biological Resources, page 4.3-39), however, the District may be missing, underestimating, or mischaracterizing the full suite of adverse effects to the species or its habitat when only describing or predicting substantial adverse effects. Further, using the threshold of “substantial adverse effects” is inadequate for disclosing the Project effects in its entirety including both ecological and biological impacts to steelhead based on the species ecology, life history, and habitat requirements.
- The vegetation analysis (or baseline study) was conducted to help determine if a drawdown of water in the creek would have a potential effect on vegetation due to the proposed Project activities, but within the District’s analysis, it remains unclear if there will be effects to riparian vegetation (page 89 of Appendix 10.4.2). The effects to riparian vegetation owing to 7
the Project should be disclosed in the revised EIR. Additionally, the revised EIR should clarify if current vegetation is subject to flood-control management such as trimming or removal to meet current flood-conveyance objectives.

Climate Analysis

- The revised EIR should include the ecological and biological consequences of changing the lagoon level regardless if it is a change within the range of natural variability for lagoon levels at this site (see Section 4.1.2, Table 4-3: Impact on Lagoon Level). The District should revise the DEIR to elaborate on consequences of changing the lagoon levels for a 8
duration of 50-75 years. In this regard, the revised EIR should include responses to the following questions: Does the magnitude of this impact change over time? Do the biological or ecological consequences change over time given the best, available climate change predictions for southern California?
- Seasonal ("current drought") conditions should not be used as an ecological rationale for explaining the status of suitable steelhead habitat over the next 50-75 years (see Appendix 9
10.4.1, page 8). The DEIR should be revised to include an analysis of expected suitable steelhead habitat over this 75-year time period.

Construction, Operation, and Long-term Planning

- Based on the Project description, the District should revise the DEIR to disclose how proposed elevation of the site (i.e., importing 64,600 cubic yards of fill) will result in direct 10
or indirect impacts to the riparian corridor, instream habitat, and the adjacent floodplain.
- The disclosure of ongoing effects to steelhead habitat from the proposed Project is currently lacking. The DEIR should be revised to include an Adaptive Management Plan with the capacity to monitor, detect, and respond to biological and ecological changes that may not have been anticipated during the design and planning phase. In this regard, the revised EIR should include the following elements: (1) a framework and process for evaluating and meaningfully describing how operations are expected to influence the magnitude, extent, and 11
quality of available surfacewater and other habitat elements throughout the duration of the Project, (2) a monitoring schedule for parameters such as water depths and lagoon levels, (3) water-quality criteria protective of endangered steelhead, and (4) a response plan when actual (future) habitat conditions do not align with expected conditions as characterized by the final EIR (i.e., deviations from predicted or anticipated habitat quality or quantity conditions).

Cumulative Effects

- The DEIR does not, but should, describe how the effects from San Juan Watershed Project were incorporated into or considered with the effects of the surfacewater lagoon level 12
drawdown (0.14 to 0.26 feet reduction) from the proposed Project (see Cumulative Projects, Table 4-1, page 4.0-7).
- The existing description of cumulative effects[2] in regard to endangered steelhead and habitat is inadequate because the description does not provide a sufficiently clear understanding of 13

[2] Under CEQA regulations, this analysis may rely on considerations of past, present, or probable future projects producing related or cumulative effects, including projects outside the agency's control, or may rely on projections of future effects contained in specified plans (Id. at § 15130, subd. (b)(1)(A)).

the amount, extent, location, duration and type of cumulative effects that are expected. The revised EIR should include Project impacts to the lagoon itself such as area, shape, vegetation, and depth based on an evaluation of cumulative effects to the lagoon given the proposed San Juan Watershed Project may result in impacts to lagoon water-surface elevation. 13

Technical Clarifications

The revised EIR should clarify the following:

- The difference between the scenario pumping amounts (Table 4-1) versus the "Potable Water Nominal Production Capacity" described in the Preliminary Design Report (Appendix 10.1); 14
- Whether the listed wells currently pump water. If so, then the models need to ensure results describe conditions that prevail when no pumping occurs to reflect an accurate "unimpaired" scenario (see Appendix 10.10.1 – Table 1). To understand the entirety of the effects from the proposed Project, the District should identify any current pumping that is being carried forward under the proposed Project in addition to any increased pumping from the intake pumping (see Appendix 10.10.2, Section 1.1.1, Baseline Scenario - No Project Pumping); 15
- Units of acre feet per year for discharge to the ocean under Scenario 1 do not help to characterize possible direct or indirect biological and ecological consequences for ocean habitat. The DEIR should be revise to incorporate units such as cubic feet per second or similar units that correspond to a daily, weekly, and monthly timescale (see Section 1.1.2, Scenario 1 – intake pumping of 4.3 MGD); 16
- The DEIR should be revised to clearly explain the connection between slant-well pumping approaching equilibrium after four years and impacts to lagoon habitat, steelhead, or upstream spawning patterns (see page 4.3-30, Section "Lagoon Water Levels" in Biological Resources). As written, the District's conclusion on level of impact appears speculative; 17
- Whether drainage improvements (see Appendix 10.9, page 21) are part of the Project within the next 75 years. If so, then the revised EIR should clarify the scope of the Project including additional planned activities during and after Phase 1 that are reasonably certain to occur; 18
- Whether the lagoon level drawdown has a range that would be indicative of the beach/sandbar during high and low rainfall conditions (see Figure 2-7 in Appendix 10.4.2); and, 19
- The geomorphology of the lower San Juan Creek lagoon was characterized from collecting data during three survey periods rather than over a range of different water-year types, thus erosion and accretion results only report how the system behaves under a severe drought (see Figures 2-9, 2-10, 2-11, in Appendix 10.4.2). Similarly, lagoon water levels were monitored for only one year. The revised EIR should explain describe variations in lagoon water levels after rainfall events of different magnitude and duration prior to a breach (e.g., Station 1). Ultimately, the revised EIR should disclose the limitations of abbreviated data-collection time periods for corresponding analyses. 20

Letter F2 National Oceanic and Atmospheric Administration

Anthony P. Spina, Chief, Southern California Branch
August 2, 2018

Response F2-1

Introductory comments are noted.

Response F2-2

Introductory comments regarding the Draft EIR's analysis are noted and responded to individually below.

Response F2-3

The Project's groundwater and hydrology modeling were clarified and amplified at the request of various comments. That groundwater modeling included extensive coordination with the San Juan Basin Authority (see Appendix 4.2.3). Project hydrology was also clarified and amplified in response to various comments, including 100-year and 500-year storm predictions based on updated sea level rise guidance (see Appendix 4.2.4).

The values cited in this comment are from the previous version of the modeling report (Foundational Actions Funding Program Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling for the Doheny Ocean Desalination Project Task 4 - Modeling of Slant Well Feed Water Supply Impacts and Mitigation Approaches, dated March 21, 2016). This report is included as Appendix 10.10.2. The model was updated with the results of additional field studies, and updated project scenarios were simulated. An updated model report entitled "Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data" was prepared and submitted March 1, 2018 and is presented as Appendix 10.10.1 in the DEIR. The results presented in Appendix 10.10.1 show under Scenario 1 pumping (10 MGD from Doheny beach) shallow groundwater levels could be expected to decrease between 10.46 ft. and 13.96 ft. and lagoon levels from 0.14 ft. to 0.26 ft. The lagoon level changes are for dry and wet hydrologic periods, respectively. Additional analysis completed to further quantify streamflow in response to comments (DEIR Doheny Desalination Project - Hydrogeologic Analysis Related to Responses to Comments - Evaluation of Project Impacts on San Juan Creek Surface Water Levels and Assessment of Project Impacts from Potential Upstream Bedrock "Barrier") shows that under Scenario 1, surface flows decrease by 0.1 cubic feet per second (cfs) under dry hydrologic conditions and 0.45 cfs under wet hydrologic conditions. Under Scenario 3 pumping (20 MGD from Doheny Beach and 10 MGD from Capistrano Beach), surface flows decrease by 0.13 cfs and 0.63 cfs under dry and wet hydrologic conditions, respectively. Under Scenario 4, surface flows decrease 0.15 to 0.74 cfs for dry and wet hydrologic conditions, respectively.

Refer to Response F2-6 below for additional discussion regarding changes in lagoon levels.

The Project does not have a defined lifespan, and based on the modeling cited above, hydrologic changes to the lagoon levels from the Project are projected to be less than significant. The modeling uses historic data from wet and dry years to forecast hydrologic changes resulting from the Project. Regardless of the ultimate lifespan of the Project, any prediction of local environmental conditions within the San Juan Creek watershed 50 to 75 years into the future – occurring from a wide range of influencing factors - would require a level of speculation that CEQA seeks to avoid. Refer to specific responses below to specific comments regarding existing environmental baseline conditions and Project impacts (such as Response F2-6 regarding the commenter's request to evaluate impacts to steelhead over the Project's lifespan).

Response F2-4

The values cited in this comment are from the previous version of the modeling report (Foundational Actions Funding Program Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling for the Doheny Ocean Desalination Project Task 4 - Modeling of Slant Well Feed Water Supply Impacts and Mitigation Approaches, dated March 21, 2016). The model was updated with the results of additional field studies and updated project scenarios were simulated. An updated model report entitled "Model Update and Refinement Using the results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data" was prepared and submitted March 1, 2018. Once shallow groundwater levels fall below the bottom of the creek bed as they do during natural seasonal cycles, infiltration rates remain the same. Under Scenario 1 pumping (10 MGD from Doheny Beach), lagoon levels are expected to decrease from 0.14 ft. to 0.26 ft for dry and wet hydrologic periods, respectively. Under Scenario 3, lagoon levels will decrease 0.16 ft and 0.63 ft for dry and wet hydrologic periods, respectively. Additional analysis completed in response to comments (DEIR Doheny Desalination Project - Hydrogeologic Analysis Related to Responses to Comments: - Evaluate Project Impacts on San Juan Creek Surface Water Levels and Assessment of Project Impacts from Potential Upstream Bedrock "Barrier" [Appendix 4.2.3A]) shows that a decrease in the surface level of the lagoon corresponds to a maximum change in surface outflow of 0.63 cfs or approximately 1.1% of the total average outflow at the ocean for Scenario 3 under wet hydrologic conditions, and 0.74 cfs or 1.3 % under Scenario 4.

Please see response to comment F2-3 above regarding the lifespan of the Project and the limitations to forecasting impacts of the Project 50 to 75 years into the future.

Response F2-5

The March 2016 modeling report was included as Appendix 10.10.1 in the DEIR and is entitled "Doheny Ocean Desalination Project – Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data." This study has been clarified and amplified (see Appendix 4.2.) to incorporate further model refinements based on consultation with the San Juan Basin Authority. That modeling also incorporated additional available environmental baseline data including the 2016 lagoon habitat assessment prepared by Chambers Group (see Response F2-6 below). As discussed in Section 3.4 of Appendix 10.10.1, the groundwater modeling was validated against geotechnical investigation data and borehole results. Further model validation was completed with the groundwater modeling contained in Appendix 4.2.3. The groundwater model would be further refined as the Project commences well development and operation, with actual slant well pumping results and associated lagoon monitoring being used to refine the model. Lagoon levels will be monitored as described in the Draft EIR Mitigation Measure BIO-4 and in response to comment F2-11 below.

The March 2016 report uses the San Juan Basin Regional Model refined and updated from the 2013 version to better understand feedwater quality produced overtime from the slant well system, drawdown effects along coastal reaches, and seawater flow and intrusion control. The refined model is designated as the San Juan Basin Focused model and covers the lower and middle San Juan Basin area. The focused model was used to assess groundwater and surface water responses near the slant wellfield and lagoon. With the recent geophysical surveys, another paleochannel system was indicated to be present offshore of Capistrano Beach. The nature and extent of this potential paleochannel needs to be validated with field investigations. Because this area is outside the area of the focused model, the 2016 regional model was used to evaluate changes in groundwater levels in this area. The changes in groundwater levels and surface flow are discussed in the comment above (F2-3).

Response F2-6

San Juan Creek is designated Critical Habitat for the Southern California Steelhead Evolutionarily Significant Unit (NOAA 2005). Steelhead is an anadromous, or ocean run, form of rainbow trout that migrates to the ocean as juvenile smolt and returns as an adult to freshwater streams to spawn. Source populations of rainbow trout are documented in the upper San Juan Creek watershed, and fish from the watershed were historically known to migrate downstream to the ocean and return to spawn as adult steelhead. As part of the downstream migration, smolts feed and transition to saltwater in estuaries before entering the ocean. Seasonal lagoons, such as the one at the mouth of San Juan Creek, provide summer rearing habitat for smolts, which may enhance survival when they enter the ocean.

Currently, physical barriers upstream of the lagoon prevent the migration necessary for southern steelhead (NOAA 2005). Several organizations and agencies are currently working toward improving these upstream barriers to fish migration, particularly Orange County Public Works, NOAA NMFS, California Department of Fish and Wildlife (CDFW), California Trout and Trout Unlimited. The I-5 Bridge Array Fish Passage Project on Trabuco Creek (a tributary of San Juan Creek) is a major fish passage improvement project designed to reduce impediments. Initial design and testing has been funded by a $522,762 grant from the California Wildlife Conservation Board to California Trout (Caltrout.org, 2017[1]). This proposed improvement, shown schematically below, is currently in concept design, but is pending additional funding, and pending approvals from regulatory agencies and stakeholders including Caltrans, Orange County Public Works, NOAA NMFS, CDFW, the San Diego Regional Water Quality Control Board, U.S. Army Corps of Engineers and others.

[1] http://caltrout.org/2017/12/caltrout-awarded-1-8m-pursue-restoration-fish-passage-projects/

I-5 Fish Passage – Alternative 2 (East Bank)

Perspective view of 3D model with aerial background, flow from top to bottom.

3D rendering by Michael Love & Assoc (Travis James, Mike Love) and NHC (Ed Wallace)
I-5 Trabuco fish passage project design team.

Source: 2018 Steelhead Summit Morning Sessions[2]

An additional barrier to steelhead migration is the Metrolink barrier, shown below, located just downstream of the proposed I-5 Fish Passage project. This man-made barrier was created as a result of construction of the rail bridge and has been identified in the San Juan and Trabuco Creeks Steelhead Recovery Watershed Management Plan (Trout Unlimited[3]) as a candidate for modification or removal. Plans for barrier modification or removal have yet to be designed, and its funding and implementation status is uncertain.

[2] https://www.calsalmon.org/sites/default/files/2018_SRF_SteelheadSummit_Morning_Session.pdf (accessed May 2, 2019).
[3] https://www.calfish.org/ProgramsData/ConservationandManagement/CaliforniaCoastalMonitoring/MonitoredRivers/SouthCoast/SanJuanCreek.aspx

Metrolink barrier on Arroyo Trabuco Creek, tributary to San Juan Creek – 2009 Courtesy of Valerie Taylor, CDFW[4]

Information concerning the recent presence of steelhead in lower San Juan Creek and lagoon is scarce. Observations of large numbers of steelhead smolts within the lagoon were last reported in the late 1930s (Swift et al. 1993),[5] but presence of smolts in the lagoon since then has not been recorded in the literature. Observations of adult steelhead in San Juan Creek have only been occasional. In the last 12 years, observations of three adult steelhead—one in 2007 (in the lower San Juan Creek) and two in 2008 (one in the estuary and one in the lower creek which was relocated to the estuary)—were documented (Becker and Reining 2008)[6] and one adult each was videoed in the San Juan Creek system in 2014 and 2018 (YouTube).[7]

In addition to the physical barriers to migration in the San Juan Creek watershed and lack of adequate hydrology to sustain migration patterns, current conditions in the lagoon, including high water

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4 https://www.calfish.org/ProgramsData/ConservationandManagement/CaliforniaCoastalMonitoring/MonitoredRivers/SouthCoast/SanJuanCreek.aspx (accessed May 2, 2019).

5 Swift, C.C., T.R. Haglund, M. Ruiz, and R.N. Fisher. 1993. The Status and Distribution of the Freshwater Fishes of Southern California, Bulletin of the Southern California Academy of Sciences: Vol. 92: Iss. 3.

6 Becker, G.S. and I.J. Reining. 2008. Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) Resources South of the Golden Gate, California. Prepared for: California State Coastal Conservancy and The Resources Legacy Fund Foundation.

7 You Tube. Video logs of adult steelhead reported from San Juan Creek: 2014: https://www.youtube.com/watch?v=I9rfUQguqwA; 2018: https://www.youtube.com/watch?v=MjD0oxuKS-o

temperature, variable dissolved oxygen levels with occasional anoxia, presence of avian and non-native fish predators, and lack of cover to provide refuge for the smolts from predators, result in a lack of suitable habitat for smolt in the lagoon. The Lower San Juan Creek and Seasonal Coastal Lagoon Habitat Assessment (Chambers Group 2016) concluded: "The seasonal coastal lagoon presently is poor habitat for steelhead smolts because of the large number of avian predators and the lack of cover."[8] In addition, the Doheny General Plan (CSP 2003) considered steelhead: "Not expected to occur within Doheny State Beach due to lack of suitable habitat."[9]

While adult steelhead are observed in the creek system on occasion, their occurrence is consistently associated with increased waterflow in the creek in winter or spring and a breached berm at the river mouth. While the adult fish pass through the estuary, a seasonal lagoon is not as critical for the adult fish as it would be for smolt. The ability to migrate upstream is essential for continued southern steelhead reproductive success in the system.

In evaluating water levels in the San Juan Creek seasonal lagoon, Geoscience (2019)[10] found that even during dry conditions when groundwater levels in the shallow aquifer fall below the lagoon, water is still present in the lagoon. In other words, when groundwater levels are below the bottom of the lagoon, as they are seasonal, the lagoon water levels become independent of groundwater levels (i.e., "free fall" conditions). Further evaluation of results of test well data indicated that initial pumping from the aquifer could initially draw down lagoon water levels, but that when groundwater level falls below the bottom of the lagoon, the aquifer and the seasonal lagoon become independent, and that further drawdown of the aquifer does not further reduce water level in the lagoon. Geoscience (2019)[11] determined changes to lagoon water levels as a result of Project pumping, which were modeled to range from -0.14 to -0.26 feet (ft) for the Phase I (up to 5 MGD) Project and -0.16 to -0.63 ft for the Regional Project for dry and wet hydrologic conditions, respectively. As discussed in the DEIR, this is within the range of normal variability of water level in the seasonal lagoon. For comparison, Chambers (2016)[12] reported water elevation swings of 0.3 to 1.6 feet behind the sand berm near the mouth of San Juan Creek resulting from the muted influence of ocean tides translating to the waters of the closed seasonal lagoon, and greater differences in water level in the lower San Juan Creek were reported as a result of rainfall and berm-breach events. Collectively, this information demonstrates that lagoon levels are influenced by surface and tidal flows more so than changes in groundwater elevations.

The potential impact to future migration of steelhead is addressed by Geoscience (2019),[13] based in part on the San Juan Creek Fish Passage Assessment (ESA 2017).[14] The groundwater model was used to assess the surface flow in Reach 1 and Reach 2 under baseline conditions, San Juan Watershed Project (SJWP)

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8 Chambers Group, Inc. (Chambers). 2016. Lower San Juan Creek and seasonal coastal lagoon habitat assessment Orange County, California. Prepared for the South Coast Water District and the Municipal Water District of Orange County. 94 p plus appendices.
9 California State Parks (CSP). 2003. Doheny State Beach. Preliminary General Plan and Draft Environmental Impact Report. SCH No. 2003021146. 130 p plus appendices.
10 Responses to Comments, Appendix 4.2.3.2.
11 Responses to Comments, Appendix 4.2.3.1.
12 Chambers Group, Inc. (Chambers). 2016. Lower San Juan Creek and seasonal coastal lagoon habitat assessment Orange County, California. Prepared for the South Coast Water District and the Municipal Water District of Orange County. 94 p plus appendices.
13 Ibid.
14 ESA. 2017. San Juan Creek Fish Passage Assessment: Hydrologic Modeling Report (Three Dam Alternative). Prepared for Santa Margarita Water District. May 11, 2017. 22 p.

Phase I conditions only, and under SJWP Phase I conditions along with Phase 1 (scenario 1) of the Doheny Desalination Project (up to 5 MGD Project) and various other Regional Project and cumulative scenarios (Geoscience 2019). The surface outflow from the groundwater model was analyzed to determine the days that surface flow was equal to or exceeded 60 cubic feet per second (cfs) in Reach 1 and 70 cfs in Reach 2 for all of the scenarios, which are the thresholds for fish passage established by the SJWP fish passage study for those reaches. Under maximum pumping conditions the operation of the Doheny Desalination Plant will reduce the potential fish passage days from 10.97 days per year to 10.76 days for the Phase I Project, and to 10.63 days (for the Regional Project), a reduction of less than 2% and 3% of potential migration time, respectively. For the Phase I Project, this equates to a reduction of approximately 5 hours per year for fish passage, and 7.7 hours per year for the Regional Project. The Phase I Project plus the proposed SJW Project would equate to a reduction of approximately 1.2 days for migration per year.

Due to existing habitat and hydrology limitations, it is speculative to predict future steelhead presence in the seasonal lagoon, which is already severely constrained as southern steelhead habitat. Even if steelhead were to occupy the lagoon, the modeling summarized above has shown that the Project's effects are nominal (within normal lagoon surface elevation changes, and only a total fish passage change of a few hours which would have to coincide with a migration attempt by a steelhead adult or smolt to adversely affect the steelhead migration, which is highly unlikely). Furthermore, for the Project's effects, if any, to affect steelhead migration, upper watershed hydrology and physical barrier limitations would need to be adequate to sustain migration, which based on available information cannot be reasonably determined with any certainty. Considerable changes in San Juan Creek hydrology and physical barriers that are outside of SCWD's authority to implement would need to occur in order for southern steelhead recovery to occur in San Juan Creek. Based on the information reviewed above, the determination of no significant adverse effects on critical habitat associated with San Juan Creek as a result of slant well operations presented in the DEIR is considered appropriate.

Recognizing that there is interest among stakeholders in restoring southern steelhead habitat in San Juan Creek, the Project incorporates various avoidance and minimization measures (as described in the DEIR) to reduce potential impacts from water level changes near the mouth of San Juan Creek, including the following:

- Phasing the installation of slant wells over time, to allow the groundwater modeling to be refined as slant well pump data is obtained;
- Utilizing existing and proposed new groundwater and lagoon water level monitoring; and
- Utilizing slant wells, rather than vertical wells, which substantially reduces the percentage of inland groundwater withdrawn to approximately 6% of the total raw water demand.

This groundwater monitoring and well phasing will enable the District and regulatory agencies to monitor well siting and phasing to ensure that lagoon water levels are not significantly impacted relative to southern steelhead as described in the DEIR by Mitigation Measure BIO-4. Note that NOAA NMFS is included within the agencies to be provided with the ongoing lagoon monitoring reports.

As part of the regulatory permitting process, the District will require one or more federal permits or approvals, including a Section 10 permit from the Army Corps of Engineers (Corps) under the Rivers and Harbors Appropriation Act. As part of this permitting, the Corps will consult with NOAA NMFS regarding Endangered Species Act (ESA) compliance under Section 7 of the ESA. NOAA NMFS will make a determination as to whether or not the Project has an "effect" on steelhead. Based on available information, the District believes that a "No Effect" or "Not Likely to Adversely Affect" determination is appropriate, although this determination is within the purview of NOAA NMFS.[15] Through this Section 7 consultation process, NOAA NMFS may request additional data, and may require further avoidance and minimization measures. Should ongoing lagoon monitoring reports, with which NOAA NMFS will receive copies, indicate new information that would change this ESA determination, NOAA NMFS may require further avoidance or minimization measures pursuant to the ESA.

Response F2-7

The Lower San Juan Creek and Seasonal Coastal Lagoon Habitat Assessment (Chambers Group, 2016) (Draft EIR appendix 10.4.2) was conducted to document baseline conditions at the proposed Project site. The study concluded: "Vegetation on the banks of the seasonal coastal lagoon includes obligate wetland plants, which would be sensitive to water drawdowns, native riparian species that are less likely to be affected by water fluctuations, and undesirable non-native species. The obligate wetland species include cattails and bulrushes as well as fleshy jaumea. Developing willow and mule fat plants also could be affected by a reduction in water, but mature plants that already were established would be less vulnerable." Because of the limited effect on lagoon surface water levels, the Project is not anticipated to have any significant impact on riparian vegetation bordering the lagoon.

Potential impacts associated with riparian habitat and hydrology are addressed in Sections 4.3 and 4.8 of the Draft EIR, respectively. The section of San Juan Creek adjacent to the Project site is a flood control channel maintained by Orange County. This section of the channel is bounded by levees and floodwalls along both banks and does not support characteristics of a riparian corridor. The seasonal lagoon and portions of San Juan Creek within Doheny State Beach are maintained by State Parks. The extent of vegetation maintenance activities in this area is not known but does not factor into the Project' s impact analysis because of the limited hydrologic changes documented above. The Project does not propose any riparian vegetation maintenance. Riparian vegetation is primarily limited to the banks of the seasonal lagoon (Figure 1-2 of DEIR Appendix 10.4.2), as vegetation within the lagoon is periodically scoured during major storm events. See also response to comment S1-5.

Response F2-8

Under Scenario 1 pumping (10 MGD from Doheny beach), lagoon levels are expected to decrease from 0.14 ft.to 0.26 ft for dry and wet hydrologic periods, respectively. Under Scenario 3 (Regional Project), lagoon levels will decrease 0.16 ft and 0.63 ft for dry and wet hydrologic periods, respectively. Additional analysis completed in response to comments (DEIR Doheny Desalination Project - Hydrogeologic Analysis Related to Responses to Comments - Evaluation of Project Impacts on San Juan Creek Surface Water Levels

[15] https://www.fws.gov/midwest/endangered/section7/ba_guide.html (accessed May 3, 2019).

and Assessment of Project Impacts from Potential Upstream Bedrock "Barrier"[16]) shows that under Scenario 4 pumping conditions the surface flow will decrease from 0.015 cfs for dry conditions to 0.74 cfs under wet conditions. The maximum decrease in the surface level of the lagoon corresponds to a maximum change (under 30 MGD pumping) in surface outflow of 0.74 cfs or approximately 1.3% of the total average outflow at the ocean under wet hydrologic conditions. The dry hydrologic conditions simulated was for the period 1947-1976. The wet hydrologic conditions was for the period 1978-1983. Since both dry and wet hydrologic conditions are anticipated to occur over the life of the Project, the impacts to lagoon levels and surface flow will remain within this range. Please see response to comment F2-3 above regarding the lifespan of the Project and the limitations to forecasting impacts of the Project 50 to 75 years into the future.

Response F2-9

Please refer to responses to comments F2-6 and F2-8. These responses explain the independence between dry and wet year groundwater levels lagoon water levels, and the less than significant effect the project will have on hydrologic conditions given lack of suitable steelhead habitat. Please see response to comment F2-3 above regarding the lifespan of the Project and the limitations to forecasting impacts of the Project 50 to 75 years into the future.

Response F2-10

Potential impacts associated with riparian habitat and hydrology are addressed in Sections 4.3 and 4.8 of the Draft EIR, respectively. The section of San Juan Creek adjacent to the Project site is a flood control channel maintained by Orange County. This section of the channel is bounded by levees and floodwalls along both banks and does not support characteristics of a riparian corridor (there is no "instream habitat"). The Local Hazard Conditions and Drainage Study showed that the proposed fill has negligible impact to the adjacent floodplain inundation depth and San Juan Creek water surface elevations. As this information is part of the Draft EIR and appendices, no revisions to the Draft EIR are necessary.

Response F2-11

Please see response to comments F2-5 and F2-6 regarding potential effects to steelhead habitat and findings of the groundwater modeling conducted for the Project that demonstrate that impacts are not significant.

Response F2-12

The cumulative impacts from the Project and San Juan Watershed projects were evaluated using the WEI model ("Bedrock Barrier Investigation") and model files developed for the SJWP.[17] The SJWP scenario is based on three rubber dams (Phase I of the SJWP). Geoscience added the Doheny Ocean Desalination Project (5 MGD, 10 MGD and 15 MGD) to the WEI model to ensure that the cumulative impacts from both

[16] Responses to Comments Appendix 4.2.3.1.
[17] "San Juan Creek Fish Passage Assessment – Hydrologic Modeling Report (Three dam alternative)", ESA, May 11, 2017.

projects was simulated. Refer to response to comment F2-6 and Appendix 4.2.3.1 to this Responses to Comments document for additional discussion.

Response F2-13

Cumulative impacts are addressed in Response No. F2-6 and in Appendix 4.2.3.1 . No new or substantially more severe environmental impacts have been identified.

Given the regional significance of the Project, the geographic scope of the cumulative impact analysis and related "list of projects" is very broad, including both specific projects and long-term policies and programs (Table 4-1, Draft EIR page 4.0-7). This approach correspondingly results in more generalized forecasting of potential cumulative effects, rather than a quantitative assessment of specific effects.

Cumulative effects, and how the Project may interact with these projects and programs, are identified in each section. Biological impacts (including endangered steelhead and water levels of San Juan Creek Lagoon) are included in Section 4.3. The Draft EIR acknowledges (page 4.3-48) that the Project may have an "effect" on the San Juan Creek seasonal lagoon, due to potential nominal reduction in lagoon water levels during periods when the lagoon is closed, although the Project effects are within the normal range of lagoon water level variation. The lagoon nonetheless is at the crossroads of potential influence by upstream activities (relative to reduction in base flow or changes in water quality or system hydrology) and local actions (relative to adjacent activities that may directly nor indirectly affect lagoon water quality or hydrology). Although the Project's impacts are neither individually or cumulatively significant, to the extent feasible, the District will participate in programs related to enhancing the long-term biological function of the San Juan Creek Lagoon (refer to Response F2-6 for further discussion).

Response F2-14

The comment refers to a Table 4-1, but there does not appear to be a reference to "scenario pumping amounts" in Table 4-1 of Section 4.0. Scenario pumping amounts refers to the volume of raw ocean water required to be pumped in order to produce the desired volume of drinking water (production capacity). The recovery of Seawater Desalination is approximately 50%, so pumping amounts for a facility producing 5 MGD of finished water would be roughly twice that (i.e., need to pump about 10 MGD of ocean water to produce 5 MGD of potable water, and pump 30 MGD ocean water to produce 15 MGD potable water). Table 3-2 in Section 3.0 refers to three scenarios. Scenario 1 and 2 indicate pumping at 10 MGD, which would be required to produce 5 MGD of potable water through the plant, and Scenario 3 indicates pumping at 30 MGD, necessary to produce 15 MGD of potable water.

Response F2-15

Current pumping occurring in the groundwater basin is "baseline," since it reflects conditions that exist apart from the Project. The proposed slant wells currently have no pumping as they do not exist at present. Baseline conditions reflect current modeled groundwater conditions based upon available data as described in the DEIR and Appendix 10.10.2 (Section 3.2.2 and Figure 4).

Response F2-16

The comment appears to be in reference to Appendix 10.10.2. This is a technical appendix, which has been summarized in the DEIR text, which generally uses MGD to refer to slant well pumping of ocean water and product water production. MGD and AFY are both typical terms for referring to desalination source water and product water. At the commenter's request, Appendix 4.2.3.1 addresses Project effects on San Juan Creek in terms of CFS, which is summarized in Response No. F2-6.

Response F2-17

Impacts to lagoon levels have been discussed in previous responses above (F2-5 and F2-6) and represent about 1.4 % decrease from historical flows under the maximum pumping scenario (30 MGD). When the slant well field is turned on the cone of depression will expand outward from the slant well screens. The water levels will reach equilibrium far sooner than the salinity of the water pumped. During interim slant well pumping prior to reaching salinity equilibrium, the slant well effects (water level changes) would be the same to that described under equilibrium conditions and only influenced by hydrology (i.e., wet, dry, and average climatic conditions). In addition, flow conditions in both depth and velocity during the period when the San Juan Creek is open to outflow at the ocean occurs on average 10.97 days during the year. The Project pumping will reduce the potential days for fish passage by less than 0.2 days on average.

Response F2-18

San Juan Creek improvements are outside of this Project scope and are being planned to be implemented by Orange County (refer to Response S1-16 for additional discussion). The "Project" evaluated within this EIR is based upon implementing flood hazard design "Alternative 1" as described in Section 3.5 of Appendix 4.2.4, and as stated on pages 3.0-35 and pages 4.8-35 to 4.8-36 of the DEIR. Other than importing fill to elevate the site (which is addressed throughout the DEIR), the Alternative 1 flood hazard solution requires relatively minor drainage system improvements within the Project site (not within San Juan Creek), as described on DEIR page 4.8-36.

Response F2-19

The elevation of groundwater in the aquifer when equilibrium is reached will be the lowest that the levels will reach. When the groundwater levels are below the bottom of the lagoon as they are now seasonally, then the lagoon levels become independent of the surface flow or standing water in the lagoon. Appendix 4.2.3.1 provides results of clarified and amplified groundwater modeling, wherein Table 2-1 (of Appendix 4.2.3.1) shows that the lagoon surface water elevations are still predicted to have nominal changes of 0.14 to 0.26 feet under dry and wet hydrologic conditions, respectively. As noted in the DEIR, this is not anticipated to represent a significant impact to seasonal lagoon habitat or species, as this is within normal lagoon water level variations.

Response F2-20

The EIR uses best available information to evaluate potential effects on the seasonal San Juan Creek lagoon. The EIR has concluded that the Project does not result in any significant unavoidable environmental impacts. The District acknowledges that the lagoon data is limited, but it is considered sufficient for the purposes of the EIR analyses, especially given the Project's nominal effects on lagoon surface levels and storm event flows. Refer to Response F2-3 regarding the commenter's request to consider longer hydrologic cycle periods. A technical assessment prepared for the FEIR, *DEIR Doheny Desalination Project - Hydrogeologic Analysis Related to Responses to Comments - Evaluation of Project Impacts on San Juan Creek Surface Water Levels and Assessment of Project Impacts from Potential Upstream Bedrock "Barrier,"* provides an analysis of lagoon levels under various Project and cumulative scenarios (Appendix 4.2.3.1). The analysis was conducted using available historical hydrology which includes both wet, dry, and average periods. In addition, the analysis of potential fish passage days also includes historical hydrologic conditions which considers wet, dry, and average hydrologic conditions and the number of potential days that San Juan Creek is open to the ocean and at a great enough depth for fish to move. The results have already been discussed in previous responses (F2-5 and F2-6), confirming DEIR conclusions that the Project is not anticipated to result in any significant unavoidable impacts to the lagoon. Mitigation Measure BIO-4 will provide for further assurance of groundwater modeling accuracy and appropriate monitoring (see Response F2-6).

State Agency Comment Letters

S1 California Coastal Commission

S2 California Department of Toxic Substances Control

S3 California Department of Transportation (Caltrans)

S4 California State Lands Commission

S5 Native American Heritage Commission

S6 Office of Planning and Research, State Clearinghouse

S7 San Diego Regional Water Quality Control Board

STATE OF CALIFORNIA—NATURAL RESOURCES AGENCY

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August 3, 2018

South Coast Water District
Attn: Mr. Rick Shintaku, P.E. – Acting General Manager, District Engineer
31592 West Street
Laguna Beach, CA 92651-6907

RE: Comments on Draft Environmental Impact Report ("DEIR") for proposed Doheny Ocean Desalination Project (State Clearinghouse No. 2016031038)

Dear Mr. Shintaku:

Thank you for the opportunity to comment on the above-referenced DEIR. The document evaluates a potential seawater desalination facility that the South Coast Water District ("District") proposes to build at a site along San Juan Creek, in Dana Point. The facility would include slant wells installed along Doheny State Beach and Capistrano Beach in Dana Point, a concentrate disposal system that would route facility effluent to the San Juan Creek Ocean Outfall, and various pipelines, storage tanks, and other components. The DEIR is meant to evaluate two potential projects – it provides "project-level" analyses of a local, "Phase 1" project that would provide about five million gallons per day ("MGD") of potable water and "programmatic-level" analyses of a potential future 15 MGD regional project that, if built, would share the site with the Phase 1 project. 1

The proposed project's components would be located within the coastal zone, some within the City of Dana Point Local Coastal Program ("LCP") jurisdiction and some within the Coastal Commission's retained permit jurisdiction, and our comments below are focused on review requirements of the Coastal Act and the LCP.

DEIR Comments

Section 4.1 – Aesthetics, Lights, and Glare: The Dana Point LCP designates the trail between the project site and the San Juan Creek a scenic corridor. As such, the project must conform to relevant scenic and visual protection policies of the LCP and Coastal Act. We recommend the document be revised to include analyses of the project's conformity to those policies. 2

Section 4.3 – Biological Resources (with Appendix 10.4.1 – Biological Resources Assessment and Appendix 10.4.2 – San Juan Creek Habitat Assessment): The desalination facility would be built on a site adjacent to San Juan Creek and the slant wells would be installed on nearby Doheny and Capistrano Beaches. These areas provide riparian, wetland, and shoreline habitat for sensitive species. Development affecting these areas would be subject to conformity to several LCP and Coastal Act provisions.[1] 3

[1] See, for example, Coastal Act Sections 30233, 30236, and 30244.

This section of the document (as well as Section 4.8 – Hydrology and Water Quality) describes a number of biological and hydrological attributes of San Juan Creek and its lagoon. The document also describes several components of the proposed project and their potential adverse effects on these coastal resources, but it does not adequately evaluate some potentially significant indirect impacts. For example, structural measures proposed or that may be needed to protect the 3
desalination facility site from flooding could redirect creek flows in a way that scours or otherwise damages riparian vegetation and sensitive habitats along the Creek, and proposed changes to the project site's stormwater collection and drainage systems could introduce additional contaminants into the Creek and adversely affect sensitive species. We recommend the document be revised to assess these potential impacts, particularly as they would affect sensitive habitats or listed species.

The document also describes nearby wetland areas as they are defined for purposes of the federal Clean Water Act, but it does not describe or evaluate any wetlands as defined for purposes of Coastal Act and LCP conformity. A key difference is that wetlands regulated under the Clean Water Act are delineated based on the presence of three wetland parameters – hydric soils, 4
hydrophytic vegetation, and presence of adequate hydrology – whereas the Coastal Act definition requires the presence of just one of those parameters. From the descriptions provided in the document, it appears there may be several areas of Coastal Act wetlands that could be affected by the proposed project. We recommend the document be revised so that its evaluations of the proposed project's effects include expected or potential effects on these wetlands.

Additionally, we note that Section 4.3.4 (at page 4.3-47) states that this reach of San Juan Creek lacks any sensitive vegetation or habitat and that the desalination facility will therefore result in less than significant impacts. However, this does not appear to be consistent with the 5
descriptions (at page 4.3-4, for example) of established riparian vegetation just downstream of the proposed facility that could be adversely affected, for example, as described in the comments above. We recommend the revised document evaluate these potential impacts.

Finally, although the document states that there would be no impact to environmentally sensitive habitat areas ("ESHA"), it does not consider possible impacts to two areas that would be affected by the project and that may constitute ESHA. In some cases, areas of sandy beach can rise to the level of ESHA and the grove of eucalyptus trees near the proposed facility are mature trees that 6
could be considered ESHA due to their potential to provide nesting and roosting habitat for birds. We recommend the revised document include additional information, such as results of any available nesting surveys, to help determine whether these areas might constitute ESHA.

Section 4.4 – Cultural Resources and Section 4.14 – Tribal Cultural Resources: Coastal Act Section 30244 requires protection of archaeological and cultural resources. Given that the proposed project's location is at near the mouth of a coastal stream and that several known archaeological sites are nearby, there is a high likelihood of finding additional cultural resources during project excavation and grading. The document describes results of a surface survey done 7
within the project site, but does not indicate whether any subsurface investigations were done. Additional onsite investigations by a professional archeologist may be needed prior to grading, as well as monitoring during ground disturbance activities, and any necessary test pits may require a permit from the City or Coastal Commission.

The document also indicates that recovery of materials and donation to a museum is the preferred protection measure; however, it does not adequately distinguish between treatment of archaeological/paleontological resources and tribal cultural resources. Please note that data recovery may not be the most protective method and that other alternative methods, such as capping and avoidance, or reburial may be preferred alternatives by the Native American monitors and may be more protective of the resource, regardless of their current condition. We recommend the document be revised after further consultation with appropriate tribal representatives to more fully evaluate its proposed mitigation measures. 8

Section 4.5 – Geology and Soils: The document at *Section 4.5.2 – Regulatory Framework* cites several state-level requirements, but does not include relevant requirements of the Coastal Act's Sections 30253(a) and (b), which require, in part, that new development minimize risks to life and property in areas of high geologic hazard, that it assure stability and structural integrity, and that it not create nor contribute significantly to erosion or geologic instability.[2] We recommend the EIR reference these requirements and evaluate the proposed project for conformity to these requirements. 9

In several places, the document notes that proposed project components would be located within areas subject to various seismic hazards and briefly mentions potential structural or design measures that could reduce the effects of these potential hazards on the project. Because these measures could have substantially different effects, we recommend the document more fully describe the measures being considered and identify their different impacts. For example, the document (at page 4.5-16) notes that project components would be within liquefaction zones and lists several measures – e.g., soil remediation, an adequately supportive foundation system, etc. – that can be used to reduce potential liquefaction effects. Soil remediation could require increased imports of fill material as compared to constructing a foundation system, and we recommend the document more fully describe and compare the effects of these and other measures being considered to address seismic hazards. 10

The document also describes the project's reliance on existing structures and possible changes to be conducted by others – for example, it refers (on page 4.5-16) to an existing concrete wall between the proposed facility and the San Juan Creek Channel and (on page 4.5-12) to the Orange County Flood Control District's needed improvements to the San Juan Creek Channel. We recommend the document include in its geologic and seismic evaluations a description of these structures and likely improvements and whether they will provide the necessary structural stability for the project. Because several of these structures would also be subject to coastal hazards related to climate change and sea level rise, we recommend they also be evaluated for how they may be affected by those hazards. 11

Section 4.6 – Greenhouse Gas Emissions (and Appendix 10.3 – Air Quality and Greenhouse Gas Calculations): The DEIR states that the District is committing to operate its facility as "carbon neutral," which it describes as having no net increase in GHG emissions compared to 12

[2] Section 30253 states, in relevant part: "New development shall do all of the following:
(a) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.
(b) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs."

that produced from its current baseline of water imported from the Colorado River Aqueduct and the State Water Project. However, as described in the document, the proposed facility would still result in an overall increase in GHG emissions and would not meet a "carbon neutral" standard.

The District's proposed approach would "credit" the District with reduced GHG emissions from not using the amount of imported water that would be replaced by an equal amount of desalinated water. As shown in Appendix 10.3 (Table 19), facility emissions (not including construction-related emissions – see comment below) are expected to total about 7,662 tonnes per year, while the proposed "credit" for displacing imported water would be 2,252 tonnes per year. However, because the imported water would continue to be imported to Southern California and continue to result in those emissions, using this proposed approach to calculate the facility's GHG contributions would still represent an increase of 2,252 tonnes of emissions in the overall regional water portfolio. 12

To ensure that the project operates as a "carbon neutral" facility, the currently accepted approach would be for the District to mitigate for all the GHG emissions that result from the facility's electricity use that aren't mitigated by the energy provider. For example, if the District's electricity provider generates 500 pounds of emissions for each megawatt produced, meeting a "carbon neutral" standard would require the District to offset those emissions or obtain acceptable credits based on the number of megawatts its project used each year. As the electricity provider continues to reduce its emissions per megawatt – e.g., by selecting renewable energy sources or those with lower GHG emissions – the District would be responsible for acquiring fewer offsets or credits each year. For this project, and with offsets or credits costing about $10 per tonne, dividing the costs for this additional 2,252 tonnes among the project's expected production of approximately 5600 acre-feet per year would represent a cost increase of less than about $4 per acre-foot, or less than 1% of the currently expected production costs. Even doubling the cost per tonne of offsets or credits would represent less than 1% of the expected water cost. It therefore appears to be economically feasible for the District to become fully "carbon neutral" by entirely offsetting its emissions rather than partially offsetting them, and we recommend the District take this approach for its proposed project.

Additionally, regarding construction-related emissions, the DEIR's Table 4.6-4 shows expected construction-related GHG emissions for the Phase 1 project to total about 12,989 tonnes. The District proposes to amortize the offsets or credits needed to account for those emissions over a 30-year period, with annualized emissions totaling about 415 tonnes. Amortizing these 13
emissions instead of providing offsets and credits concurrently with construction also prevents the project from being fully carbon neutral. To meet a "net zero" standard, we recommend the District obtain all the necessary offsets and credits for construction-related emissions concurrent with the project's construction phase.

Section 4.8 – Hydrology and Water Quality (and Appendix 10.9 – Local Hazard Conditions and Drainage Study): This section of the document evaluates potential effects of floods, tsunami, sea level rise, and coastal erosion, based in part on the analyses provided in Appendix 10.9. That Appendix states that the analyses were conducted pursuant to the Coastal 14
Commission's 2015 Sea Level Rise Policy Guidance. Please note that the 2015 Guidance has been replaced by more recent documents, specifically the 2017 Rising Seas in California (available at: http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf) and the 2018 State of California Sea-Level Rise Guidance

(available at: http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf). The new guidance includes several substantive changes to the analyses expected for critical infrastructure projects such as the proposed desalination 14
facility. We recommend the EIR's analyses be revised to incorporate the most recent guidance, and we are happy to provide additional information to the District about Coastal Commission implementation of the current guidance.

Additionally, and regarding the DEIR's flood analyses, the document notes that the desalination facility site is currently within the 100-year flood zone (Zone AO) and would experience an average three-foot inundation during that event, whereas the proposed project would import enough fill to elevate the site so that no structures would be placed within the 100-year flood 15
elevation. Because the project would be considered "critical infrastructure," we recommend that, along with evaluating the effects of a 100-year event, the EIR evaluate the effects of a 500-year event at both the existing site and at the site as it is proposed to be modified – for example, just as the document identifies how much fill would be needed to elevate the facility above the 100-year flood event, it should identify the fill amount needed to elevate above a 500-year event.

It also appears that the proposed facility would rely in part on changes being contemplated to the local storm drain system and those that may be proposed through the upcoming San Juan Creek 16
Flood Risk Management Feasibility Study. We recommend the EIR be modified to more fully describe those changes and how they would affect the facility site.

We also recommend the EIR include analyses of the effects of the project on displacing and redirecting flood flows from the desalination site onto nearby development and coastal resources. 17
For example, Impacts 4.8-3 and 4.8-4 both ask whether the project would substantially alter drainage patterns of the site or area, but the discussions of those impacts do not address that issue.

Section 4.12 – Recreation: The Coastal Act requires maximum public access and encourages recreation near the coast. The construction would temporarily interfere with access to portions of the state park and the beach. A public access route should be installed to avoid impacting public access to the beach, and or mitigation for impacts to public access should be provided. At a minimum, construction should avoid impacting access during peak use time between Memorial 18
Day and Labor Day.

Closing

Again, thank you for the opportunity to comment. We are happy to provide additional information or answer any questions you may have.

Sincerely,

Tom Luster
Energy, Ocean Resources, and Federal Consistency Division

Cc: Kevin Thomas, Kimley Horn
Amber Dobson, Coastal Commission

Letter S1 California Coastal Commission

Tom Luster, Energy, Ocean Resources, and Federal Consistency Division
August 3, 2018

Response S1-1

Introductory comments are noted for the record.

Response S1-2

Draft EIR pages 4.1-4 through 4.1-7 provide the regulatory framework relative to aesthetics, which identifies the California Coastal Act (Coastal Act) and the City of Dana Point General Plan (and Local Coastal Program [LCP] by incorporation) and Municipal Code as guiding policy and regulatory documents. Section 4.9, Land Use, provides a more comprehensive consistency analysis of Coastal Act and LCP policies. Please see Tables 4.9-1 and 4.9-4 of the Draft EIR for this consistency analysis. The Draft EIR concludes that the Project would result in less than significant visual impacts to the existing environment (including the area along San Juan Creek) because: a) the Project features are either subsurface or are to be located in an urbanized area zoned for industrial uses; b) Project construction will avoid sensitive areas such as the Doheny State Beach (DSB) beach and San Juan Creek seasonal lagoon; c) Project construction at DSB has minimized staging and laydown areas in DSB, and limits construction within DSB to avoid construction during the peak recreational season; and d) the EIR includes feasible mitigation to address temporary construction-related visual impacts and to enhance the design features of the desalination facility.

Response S1-3

The summary of Project features and requirements for LCP and Coastal Act compliance are noted. However, as discussed in Response No. L1-3, the City's LCP provides for automatic consolidated permit review, in which case the City's LCP is considered for guidance, and the Project is primarily reviewed for Coastal Act consistency. The comment raises issues without specific reference to any inadequacy in the Draft EIR. In response to comments, the District did further coastal hazard modeling to incorporate the latest projections from the updated State of California Sea-Level Rise Guidance document into the Draft EIR hydrology analysis, as well as to analyze 500-year flood hazards. That modeling further supports the Draft EIR's conclusion that no improvements are needed within San Juan Creek, and that Project construction and design will not create significant drainage or water quality impacts to San Juan Creek or areas across from the site. Refer to Responses L1-8, L1-9, and L5-14 through L5-19 for additional discussion, as well as Appendix 4.2.4.

Response S1-4

Coastal Act environmentally sensitive habitat areas (ESHA) policy compliance will be addressed as part of the Coastal Development Permitting process, with the City's LCP serving as a guidance document. Master Response 1 provides further clarification of the Project footprint during construction and operation. The Project's facilities at DSB will avoid all sensitive resources, by avoiding facilities on the beach, siting facilities within landscaped and developed portions of DSB, and using trenchless construction under San

Juan Creek, San Juan Lagoon and existing County storm drainage facilities (L01S02 system) (DEIR page 4.8-32). Nesting bird mitigation is also provided in BIO-1.

Response S1-5

Draft EIR page 4.3-47 and the associated analysis in the EIR addresses the Project's potential for conflict with any local policies or ordinances protecting biological resources. The impact conclusion on page 4.3-47 regarding riparian habitat notes that in the immediate area of the desalination facility adjacent to San Juan Creek, the creek is channelized and therefore is lacking sensitive vegetation or habitat. For that reason, the Project will not be in conflict with any such plans or policies. The habitat characterizations on page 4.3-4 describe the totality of the area studied for the EIR. That setting information identifies that riparian habitat exists downstream of the Project site, south of the PCH bridge. As Section 4.3 (Biological Resources) and Section 4.8 (Hydrology and Water Quality) conclude that the Project will not result in significant biological or hydrologic changes in the post-project environment with mitigation, the Project's impact to this downstream area of riparian vegetation will also be less than significant.

Response S1-6

The conservation of ESHA is required by the City of Dana Point General Plan and these requirements are noted in the Regulatory Framework Section 4.3.2 of the DEIR (page 4.3-24). The District understands that final determinations regarding ESHA rest with the Coastal Commission. The Draft EIR has provided available information regarding existing site conditions and the affected environment, including the proximity of mature trees and potential for nesting birds (DEIR, pages 4.3-42 and 4.3-43). Note that slant well construction at DSB was revised through consultation with State Parks to avoid construction on the beach (DEIR page 4.3-45). In addition, the DEIR includes mitigation (BIO-2) that would reduce impacts to nesting birds during construction to less than significant levels.

Response S1-7

Section 4.4 of the Draft EIR documents all research and field survey methods used and identifies that the Project site includes or is near several recorded cultural resource sites. However, no nearby recorded sites exhibit the size, complexity, importance or location relative to Project components to warrant pre-construction subsurface testing. Mitigation Measures CUL-2 and CUL-3 require construction monitoring due to this sensitivity and represent acceptable mitigation to address the potential for, and treatment of, subsurface resources.

Response S1-8

Mitigation for archaeological and tribal resources are addressed in Mitigation Measure CUL-2, while paleontological mitigation is addressed in Mitigation Measure CUL-3. Archaeological monitoring will be conducted during grading (Mitigation Measure CUL-2), and consultation with the appropriate tribal representatives will be conducted in the event any sensitive cultural resources are uncovered to determine the best method for protecting the resource consistent with the Public Resources Code (DEIR, page 4.4-33). As specified in CUL-2, the District shall offer local Native American tribes the opportunity to be present during initial deep excavations.

Response S1-9

In addition to provisions of the Coastal Act cited in the comment, the Draft EIR pages 4.5-11 and 4.5-12 present relevant General Plan goals and policies adopted to minimize risks to life and property, similar to the Coastal Act. Consistency with Coastal Act Section 30253 (a) and (b) are included in Table 4.9-1 of the Draft EIR, pages 4.9-25 and 4.9-26. This table provides a comprehensive policy consistency analysis for the Project. Mitigation Measure GEO-1 provides feasible mitigation to be implemented during the Project final design stage to address specific site conditions.

Response S1-10

Mitigation Measure GEO-1 requires that the final design stage of the Project respond to on-site conditions as identified in a site-specific soils engineering report, as required by California Building Standards Code 1803. The final geotechnical design recommendations are not and cannot be known at this time. Based on the preliminary geotechnical investigation, the Project proposes to address flood hazard and geotechnical design solutions through site clearing followed by importing sufficient clean fill to elevate the site above the 100-year flood zone. Even though there may be available clean fill within the District's San Juan Creek Property, the Draft EIR conservatively assumed that all of the fill would be imported. Therefore, the Draft EIR provides an impact analysis of reasonably foreseeable construction impacts associated with geotechnical remedial measures.

Response S1-11

The text on page 4.5-16 has been modified to clarify that the existing San Juan Creek channel wall is primarily for flood control purposes (refer to Section 3, *Draft EIR Errata*).

The geotechnical evaluation required by Mitigation Measure GEO-1 would require an evaluation of potential hazards for the entire site and all Project components. The Project is not relying on San Juan Creek flood control channel improvements by others, and no improvements to San Juan Creek channel are proposed as part of the Project. Complete structural design and evaluation of the proposed Plant facilities will be performed as part of final design.

Response S1-12

As noted in the Draft EIR (Mitigation Measure GHG-1), the District is proposing "net carbon neutrality" through mitigating the incremental increase in GHG emissions in comparison to baseline conditions, subjecting itself to independent third-party verification. This mitigation is considered fully compliant with CEQA and all current regulatory agency regulations at the local and State level.

As recognized by the 2017 Scoping Plan, the right to "safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes" as outlined in AB 685 (Eng., Chapter 524, Statutes of 2012) (California Legislative Information Website 2017), also known as the "human right to water" bill,[1] should take precedence over achieving GHG emission reductions from water sector activities where a potential conflict exists.[2] The 2017 Scoping Plan Update does not specify GHG reductions needed from the water sector to meet the goals of AB 32 and SB 32, as it recognizes that the energy intensity of water varies greatly depending on the geography, water source, and end use, and that "(a)s the energy sector is decarbonized through measures such as increased renewable energy and improved efficiency, energy intensities will also be reduced."

Furthermore, the 2017 Scoping Plan suggests the following project-level GHG reduction actions and thresholds for individual development projects:

> Beyond plan-level goals and actions, local governments can also support climate action when considering discretionary approvals and entitlements of individual projects through CEQA. Absent conformity with an adequate geographically-specific GHG reduction plan as described in the preceding section above, CARB recommends that projects incorporate design features and GHG reduction measures, to the degree feasible, to minimize GHG emissions. Achieving no net additional increase in GHG emissions, resulting in no contribution to GHG impacts, is an appropriate overall objective for new development.[3] (emph. added)

The State Air Resources Board has also indicated that using the net carbon neutral standard for an ocean desalination project (Poseidon Project) is appropriate where the project would replace water that would otherwise be imported.[4] Electricity-providers are separately required to achieve State-imposed GHG reduction measures through SB 350, SB 32 and related regulations, and the Department of Water Resources has separately committed to consistency with the State's GHG reduction policies through its Climate Action Plan.[5]

The District acknowledges that the Coastal Commission and some parties favor 100% carbon neutrality, and as such, in keeping with the District's well-established commitment to environmental stewardship, the District Board of Directors is currently considering committing to 100% carbon neutrality. While this commitment is beyond what is required by CEQA, the District recognizes that permitting agencies, such as the Coastal Commission, may seek additional mitigation beyond what is required by CEQA. In any event, the District can meet 100% carbon neutrality by implementing the GHG Reduction Plan required by Mitigation Measure GHG-1, using the same GHG offset options identified. Please see Mitigation Measure GHG-1 in Section 3, Draft EIR Errata.

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1 See also Executive Order N-10-19 (signed by Governor Gavin Newsom on April 29, 2019) which confirms that "water is a human right, and is central to California's strength and vitality . . ." and requires the California Natural Resources Agency, the California Environmental Protection Agency and the California Department of Food and Agriculture to prepare a water resilience portfolio.

2 California's 2017 Climate Change Scoping Plan at 93, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf (accessed March 24, 2019).

3 *Id.* at 101.

4 February 8, 2010 letter from CARB to the Coastal Commission.

5 California Dept. of Water Resources, Climate Action Plan, available at https://water.ca.gov/Programs/All-Programs/Climate-Change-Program/Climate-Action-Plan (accessed March 24, 2019).

Response S1-13

Mitigation Measure GHG-1 has been modified to include GHG offsets for construction emissions at the onset of construction, with emissions estimated and offset prior to construction, and then validated following construction, as set forth in Response S4-13 (see Section 3, *Draft EIR Errata*).

Response S1-14

The District added to the Local Hazard Conditions and Drainage Study (Appendix 10.9) based on the California Coastal Commission Sea Level Rise Policy Guidance, Draft Science Update - October 2018. The coastal hazard analysis itself (Appendix 10.7.1) now reflects the recently updated guidance document from the Coastal Commission, which includes current sea level projections for year 2100. Refer to Appendix 4.2.1 and Appendix 4.2.4 which demonstrate minor changes to analysis results based on projected sea levels. Neither study results in any substantive changes in Draft EIR conclusions.

Response S1-15

With respect to the flood analyses, the District added a section to the Local Hazard and Drainage Study (Appendix 4.2.3) to discuss a sensitivity analysis under a 500-year flood event. As discussed in Appendix 4.2.3 (pages 29-31) and Section 3, *Draft EIR Errata*, and in Response S1-3, the Project will be designed to the 100-year storm event. Should a 500-year storm event occur, the site design already incorporates added levels of freeboard, elevation of building foundations, and secondary containment around chemical storage areas. Appendix 4.2.3 states that "under the post-project condition, the recommended alternative will raise the project site to 28.2', to protect the project site from a 100-year flood plus 1' of freeboard. As the post-project ground elevation at the project site is 28.2', the maximum 500-year flood elevation of 28.3' would likely result in minimal flooding at the project site." Therefore, since the Project provides for 1' of "freeboard" with an elevation of 28.2' (the 1' freeboard is additional elevation above the 100-year flood protections), and the 500-year flood is predicted to be 28.3', even with a 500-year event the site would have nominal flooding of approximately 0.1 foot. The 500-year event is highly unlikely, and discussions with City staff confirm that it is not reasonable or practical to design to such an event when considering cost and likelihood of occurrence. Even with nominal flooding under a 500-year event, the event would be temporary, and certain site critical facilities would be further protected through elevated containment, such as that around chemical storage locations.

Response S1-16

The Doheny Desalination Project Local Hazard Conditions and Drainage Study (Draft EIR Appendix 10.9) included analysis on the proposed improvements at the Project site to the overall impacts to the floodplain. The Preliminary Design Report (Draft EIR Appendix 10.1) and the drainage study in Appendix 4.2.4 identify several potential alternatives to providing adequate flood protection for the desalination facility site, some of which would have relied upon improvements to San Juan Creek. However, as noted in the Draft EIR Sections 3 and 4.8, the Project proposes Alternative 1 (consisting of elevating the site above the flood zone) and does not propose or depend on potential future improvements to San Juan Creek by others.

Response S1-17

The Local Hazard Conditions and Drainage Study (Appendix 10.9 and Appendix 4.2.4) included analysis on the proposed improvements at the Project site to the overall impacts to the floodplain, including coastal areas, concluding that the Project would not result in significant unavoidable impacts to any offsite areas. The floodplain analysis shows that drainage improvements incorporated into Project design, as recommended, reduces flooding in adjacent areas by blocking overtopping from San Juan Creek.

Response S1-18

Please see Section 4.9, Land Use, and specifically Tables 4.9-1 through 4.9-4 for the relevant Coastal Act and LCP policy consistency analyses. Draft EIR Section 4.12, Recreation provides a detailed discussion of potential recreation facility impacts. As concluded in Section 4.12, Recreation, the Draft EIR acknowledges and discloses that Project construction would temporarily interfere with public access to a portion of Doheny State Beach and Capistrano Beach Park. Project construction for slant well construction, up to approximately 7 months, would be temporary and will be restored upon Project completion. Construction near the beach would be limited to areas identified in Exhibits 3-4 and 3-5 in Appendix B (to Appendix 10.1) and would not impact public access in these locations. Near-beach construction would also be temporary, occurring only during the off-season months between October 1 – May 1. This impact is considered less than significant because: a) disruption impacts are a temporary, not permanent, consequence of the proposal; and b) feasible mitigation measures have been identified (Mitigation Measures REC-1 and REC-2) to minimize this disruption through design changes and alternative access plans.

Department of Toxic Substances Control

Matthew Rodriquez
Secretary for
Environmental Protection

Barbara A. Lee, Director
5796 Corporate Avenue
Cypress, California 90630

Edmund G. Brown Jr.
Governor

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BY: ....

July 9, 2018

Mr. Rick Shintaku, PE
Acting General Manager, District Engineer
South Coast Water District
31592 West Street
Laguna Beach, California 92651
RShintaku@scwd.org

ENVIRONMENTAL IMPACT REPORT (EIR) FOR DOHENY OCEAN DESALINATION PROJECT, LOCATED AT THE NORTHEAST END OF CAPISTRANO BEACH, DANA POINT, ORANGE COUNTY (SCH# 2016031038)

Dear Mr. Shintaku:

The Department of Toxic Substances Control (DTSC) has reviewed the subject EIR. The following project description is stated in the EIR: "The desalination facility would produce up to 15 million gallons per day (MGD) of potable drinking water. The District intends to construct a facility with an initial capacity of up to 5 MGD,1 with potential for future expansions up to 15 MGD. Both the initial up to 5 MGD and ultimate up to 15 MGD capacities would be available for the District and local water agencies to provide a high quality, locally-controlled, drought-proof water supply. The desalination facility would also provide emergency backup water supplies, should an earthquake, system shutdown, or other event disrupt the delivery of imported water to the area. The Project would consist of a subsurface slant well2 intake system, raw (sea) water conveyance to the desalination facility site, a seawater desalination facility, brine disposal through an existing wastewater ocean outfall, solids handling facilities, and potable water delivery to adjacent distribution infrastructure." 1

Based on the review of the submitted document, DTSC has the following comments:

1. The EIR should identify and determine whether current or historic uses at the project site may have resulted in any release of hazardous wastes/substances. If there are any recognized environmental conditions in the project area, then proper investigation, sampling and remedial actions overseen by the appropriate regulatory agencies should be conducted prior to the new development or any construction. 2

2. The EIR further states, "As concluded in Impact 4.7-2 above, implementation of
Mitigation Measures HAZ-1 through HAZ-9 would ensure that Project
construction and operations would not create a significant hazard to the public or
the environment. Therefore, with mitigation, the Project would not result in a
significant hazard to the public or environment concerning a Government Code §
65962.5-listed site.' The EIR further states the potential for onsite and off-site
contaminants may require further evaluation and remediation. DTSC is unable to 3
evaluate whether vapor sampling and/or potential vapor intrusion risk was
adequately addressed due to lack of relevant detailed information in the EIR.
DTSC recommends soil gas sampling and vapor intrusion risk evaluation on sites
with releases of volatile organic compounds (VOCs) or total petroleum
hydrocarbons (TPH). DTSC recommends soil gas sampling to confirm no
residual VOC/TPH contamination remain onsite and/or risk is acceptable based
on applicable and relevant state guidelines.

3. If the project development involves soil export/import, proper evaluation is
required. If soil contamination is suspected or observed in the project area, then
excavated soil should be sampled prior to export/disposal. If the soil is
contaminated, it should be disposed of properly in accordance with all applicable 4
and relevant laws and regulations. In addition, if imported soil was used as
backfill onsite and/or backfill soil will be imported, DTSC recommends proper
evaluation/sampling as necessary to ensure the backfill material is free of
contamination.

4. If during construction/demolition of the project, soil and/or groundwater
contamination is suspected, construction/demolition in the area should cease and
appropriate health and safety procedures should be implemented. If it is
determined that contaminated soil and/or groundwater exist, the EIR should 5
identify how any required investigation and/or remediation will be conducted and
the appropriate government agency to provide regulatory oversight.

If you have any questions regarding this letter, please contact me at (714) 484-5380 or by email at Johnson.Abraham@dtsc.ca.gov.

Sincerely,

Johnson P. Abraham
Project Manager
Brownfields Restoration and School Evaluation Branch
Site Mitigation and Restoration Program – Cypress

kl/sh/ja

cc: See next page.

cc: Governor's Office of Planning and Research (via e-mail)
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P.O. Box 3044
Sacramento, California 95812-3044
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Mr. Dave Kereazis (via e-mail)
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Mr. Shahir Haddad, Chief (via e-mail)
Schools Evaluation and Brownfields Cleanup
Brownfields and Environmental Restoration Program - Cypress
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CEQA# 2016031038

Letter S2 California Department of Toxic Substances Control

Johnson P. Abraham, Project Manager
July 9, 2018

Response S2-1

The project description summary is noted for the record.

Response S2-2

Current and historic uses of the site, including full summaries of past site investigations, are included in Section 4.7 of the Draft EIR and Appendices 10.8.2 and 10.8.3 (Phase I and Phase II Environmental Site Assessments). These documents contain and disclose the record of past uses and releases of hazardous wastes and substances.

At the request of the County of Orange, the District reviewed additional potential sites of concern. The Environmental Data Resources (EDR) Radius Map Report with GeoCheck (EDR, July 24, 2017) was used to determine if there were any known incidents of hazardous materials releases on the Project site or in its vicinity that could affect Project construction or operation (Appendix 10.8.1). The documents on record did not show any active, acute or ongoing conditions that warrant remediation prior to construction. In addition, a Phase I Environmental Site Assessment (Phase I ESA, Ninyo & Moore, 1999) and a Phase II Environmental Site Assessment (Phase II ESA, Nino & Moore, 2001) was conducted at the Project site. That study included a review of regulatory files regarding potential off-site concerns, subsurface exploration and soils and groundwater testing at the project site. Mitigation Measures HAZ-1 through HAZ-9 provide safeguards and required actions to address hazardous materials issues during construction and operation.

Response S2-3

As detailed on pages 4.7-4 and 4.7-5 of the Draft EIR and in Response S2-2, the Phase I ESA was prepared in 1999 and identified two Recognized Environmental Conditions (RECs), defined as the likely presence of any hazardous substances or petroleum products that indicate an existing or past release, or threat of release. Both RECs pertained to Leaking Underground Storage Tank (LUST) sites outside of the Desalination Facility Study Area. The first REC identified was the Serra Lumber Company LUST case at 25802 Victoria Boulevard, approximately 100 feet east of the project site. The Phase I ESA Report identified that Serra Lumber Company reported a release of gasoline that affected soil only. A review of the California State Water Resources Control Board GeoTracker database in 2019 showed that the Orange County Health Care Agency (OCHCA) closed the environmental case and issued a "No Further Action" letter dated February 28, 1991.

The second REC identified was the Cannan Bart facility LUST case, approximately 100 feet east of the project site. The Phase I ESA identified that remediation at the Cannan Bart facility was being conducted by the removal of free product from groundwater. A review of the California State Water Resources Control Board GeoTracker database in 2019 showed that the Orange County Health Care Agency (OCHCA) closed the environmental case and issued a "No Further Action" letter dated May 9, 2005.

The Phase I ESA report did not identify any other RECs for the property. A Phase II ESA was conducted in 2000 to further evaluate the two identified RECs as well as other hazardous material use on and near the property. The Phase II ESA consisted of a series of soil borings, test pits, soil samples and groundwater samples. The Phase II ESA included 20 test pits with soil samples, one soil boring, and six borings with groundwater samples. The Phase II ESA identified low concentrations of diesel fuel in soil from one test pit. The detection was delineated vertically by a sample at seven feet below ground that did not have any petroleum hydrocarbon detections. The lateral extent of the contamination could not be defined. One sample, near an asphalt road contained low concentrations of heavy petroleum hydrocarbons, but Ninyo & Moore concluded it was not an environmental concern and likely was due to asphalt from the road. Ninyo & Moore did not conclude that soil vapor sampling was warranted at that time based on their findings. One groundwater sample contained methyl tertiary butyl ether (MTBE) below the State of California primary maximum contaminant limit (MCL), but above the secondary MCL. Ninyo & Moore concluded in the Phase II ESA that the MTBE did not pose a health risk.

To support anticipated future Project funding requirements, the District will conduct an updated Phase I ESA of the Desalination Facility Study Area prior to beginning construction. If any RECs are identified, the District will also conduct a Phase II ESA of the RECs, including soil vapor sampling if appropriate, prior to beginning construction. Mitigation measures HAZ-1 through HAZ-9 are in place to address any contamination identified during the Phase II ESA.

Response S2-4

DTSC's comments regarding import or export of soil are noted for the record. Mitigation Measures HAZ-4 has been clarified in Section 3, *Draft EIR Errata*, to specifically address required actions if soil contamination is encountered or suspected during construction and to prevent the import of contaminated soil.

Response S2-5

The Draft EIR addresses this issue, at page 4.7-25. Mitigation Measure HAZ-3 through HAZ-9 include provisions for evaluation and mitigation of soil and groundwater contamination, as referenced in the preceding responses.

STATE OF CALIFORNIA—CALIFORNIA STATE TRANSPORTATION AGENCY EDMUND G. BROWN Jr., Governor

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Making Conservation a California Way of Life.

August 2, 2018

Mr. Rick Shintaku
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

File: IGR/CEQA
SCH#: 2016031038
IGR LOG # 2017-00899
SR1
PM 1.077

Dear Mr. Shintaku,

Thank you for continuing to include the California Department of Transportation (Caltrans) in the review of the Amended Notice of Preparation (NOP) for a Draft Environmental Impact Report dated June 4, 2018 for the Doheny Ocean Desalination Project. The South Coast Water District proposes to develop an ocean water desalination facility at Doheny State Beach, in Dana Point. The proposed desalination facility would produce up to 15 MGD of potable water, with an initial demonstration phase of 4 to 5 MGD. The major components of the project includes subsurface slant well intake system, desalination facility, product water distribution, ocean water concentrate disposal, and electrical energy service. The desalination facility would be sited on existing South Coast Water District (SCWD) property and the subsurface intake wells would be located at Doheny State Beach. Both the initial 4 to 5 MGD and ultimate 15 MGD capacities would be available to the District and local water agencies to provide high quality, locally-controlled, drought-proof potable drinking water supply. The nearest state transportation facility to the project site is SR1. 1

Caltrans is a responsible agency on this project and has the following comments:

1. Applicant is to submit the Construction Traffic Control Plan (TCP) and Transportation Management Planning (TMP) for further review during an Encroachment Permit Process.

2. As stated in the review of the NOP, the proposed project improvements should be designed to avoid impact to dry weather runoff monitoring conducted by the City of Dana Point, San Juan Capistrano, State Parks, and Caltrans and any dry weather diversion structures proposed in the vicinity of the desalination plant.

3. Our previous comments in our April 12, 2016 letter are still valid. Attached is a copy of the letter for your reference.

"Provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability"

Please continue to coordinate with Caltrans for any future developments that could potentially impact State transportation facilities. If you have any questions, please do not hesitate to contact Maryam Molavi, at (657) 328-6280 or Maryam.Molavi@dot.ca.gov. 1

Sincerely,

Scott Shelley,
Branch Chief, Regional-IGR-Transit Planning
District 12

DEPARTMENT OF TRANSPORTATION
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Flex your power!
Be energy efficient!

April 12, 2016

Mr. Andrew Brunhart
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

File: IGR/CEQA
SCH#: 2016031038
Log #: 4658
SR-1

Dear Mr. Brunhard:

Thank you for the opportunity to review and comment on the **Notice of Preparation (NOP) for a draft Environmental Impact Report (EIR) for the Doheny Ocean Desalination Project.** The South Coast Water District proposes to develop an ocean water desalination facility in Dana Point, at Doheny State Beach. The proposed desalination facility would produce up to 15 MGD of potable water, with an initial demonstration phase of 4 to 5 MGD. The major components of the project includes subsurface slant well intake system, desalination facility, product water distribution, ocean water concentrate disposal, and electrical energy service. The desalination facility would be sited on existing South Coast Water District property and the subsurface intake wells would be located at Doheny State Beach. Both the initial 4 to 5 MGD and ultimate 15 MGD capacities would be available to the District and local water agencies to provide high quality, locally-controlled, drought-proof potable drinking water supply. The nearest state transportation facilities to the project site is SR-1. 2

Caltrans District 12 is a responsible and commenting agency on this project and has the following comments:

1. Caltrans D-12 NPDES Unit is currently in a coordination effort with the City of Dana Point, City of San Juan Capistrano, South Coast Water District, and State Parks to conduct dry weather runoff monitoring in the vicinity of the proposed Desalination Plant. Please insure that this information on this monitoring effort in included in the Final EIR.

2. The South Coast Water District must obtain a fee exempt Encroachment Permit prior to commencement of work within the State Right of Way. SCWD's contractor will also have to apply for the Double Permit to perform the work. If SCWD's contractor has not been exempt from permit fees in the Cooperative Agreement, a deposit of $3280 will be needed at the time of Double Permit Application submittal.

If the cost of work within the State R/W is below one Million Dollars the Encroachment Permit process will be handled by Caltrans Permits Branch, otherwise the permit should be authorized through Caltrans Project Development. Allow 2 to 4 weeks for a complete submittal to be reviewed and for a permit to be issued. When applying for Encroachment Permit, please incorporate Environmental Documentation, SWPPP, WQMP, Hydrology Report and Calculations, Traffic Control Plans (If lane closure required), Geotechnical Analysis, Materials specifications, and all relevant design details including design exception approvals.

2

For specific details on Caltrans Encroachment Permits procedure, please refer to Caltrans Encroachment Permits Manual. The latest edition of the Manual is available on the web site: http://www.dot.ca.gov/hq/traffops/developserv/permits/

Please continue to keep us informed of this project and any future developments that could potentially impact State transportation facilities. If you have any questions or need to contact us, please do not hesitate to call Maryam Molavi at 949-724-2267.

Sincerely,

Maureen El Harake

MAUREEN EL HARAKE, Branch Chief
Regional-Community-Transit Planning
District 12

Letter S3 California Department of Transportation

Scott Shelley, Branch Chief, Regional-IGR-Transit Planning, District 12
August 2, 2018

Responses S3-1 and S3-2

The comments and suggestions provided by District 12 regarding transportation management and controls, dry weather runoff monitoring, and encroachment permits are noted for the record. The Project does not require a Traffic Management Plan (TMP) for operational traffic due to the nominal traffic volumes. Only a construction traffic control plan is required. The Traffic Control Plan (TCP) is identified in Section 4.13 and required by Mitigation Measure TRF-2, which specifies that the plan will be submitted to Caltrans for review and approval. In addition, Mitigation Measure HWQ-1 has been modified as shown in Section 3.0 *Draft EIR Errata*.

STATE OF CALIFORNIA EDMUND G. BROWN JR., *Governor*

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Established in 1938

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August 6, 2018

File Ref: SCH # 2016031038

South Coast Water District
Attn: Mr. Rick Shintaku, PE
31592 West Street
Laguna Beach, CA 92651

VIA REGULAR & ELECTRONIC MAIL (rshintaku@scwd.org)

Subject: Draft Environmental Impact Report (EIR) for the Doheny Ocean Desalination Project, Orange County

Dear Mr. Shintaku:

The California State Lands Commission (Commission) staff has reviewed the subject Draft EIR for the Doheny Ocean Desalination Project (Project), which is being prepared by the South Coast Water District (District). The District, as the public agency proposing to carry out the Project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.). The Commission is a trustee agency for projects that could directly or indirectly affect sovereign lands and their accompanying Public Trust resources or uses. Additionally, because the Project involves work on sovereign land, the Commission will act as a responsible agency.

<u>Commission Jurisdiction and Public Trust Lands</u> 1

The Commission has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The Commission also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6009, subd. (c); 6009.1; 6301; 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the common law Public Trust Doctrine.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On navigable non-tidal waterways, including lakes, the state holds fee ownership of the bed of the waterway landward to the ordinary low-water mark and a Public Trust easement landward to the ordinary high-water mark, except where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

Based on review of our in-house records and maps, the proposed Project would be 1
located at Doheny State Beach (DSB) adjacent to the Pacific Ocean, and tide and submerged lands at this site are ungranted sovereign lands. Therefore, portions of the proposed intake and both temporary and permanent discharge infrastructure located waterward of the mean high tide line would require a lease from the Commission. The Commission's leasing application can be found on our website at www.slc.ca.gov.

Project Description

The District proposes to construct a new ocean water desalination facility to produce up to 5 million gallons per day (MGD) of potable drinking water (Phase I) with a potential future expansion to produce up to 15 MGD (Regional Project) to diversify the District's water source portfolio and increase water reliability and security. The following components have potential to affect State sovereign land.

- Feedwater Supply – Feedwater supply to the desalination facility would be produced from a proposed subsurface slant well intake system. The slant wells would be located south of the desalination facility site, with wellheads on 2
developed picnic and campground areas and the pipelines fully buried within DSB and approximately 800 feet seaward under the ocean floor.
- Ocean Water Concentrate Disposal –The reverse osmosis ocean water concentrate would be disposed to the San Juan Creek Ocean Outfall (SJCOO) for co-mingling with secondary treated wastewater from South Orange County Water Association's J.B. Latham Wastewater Treatment Plant.

The Draft EIR identifies Environmentally Superior Alternative as the "Seawater Intrusion Minimization (DSB Only)" alternative for Phase I. This alternative would construct slant wells at Pods C and D, reducing seawater intrusion, minimizing construction impacts, and avoiding impacts to Capistrano State Beach.

Environmental Review

Commission staff requests that the District consider the following comments on the Project's Draft EIR to ensure that impacts to State sovereign land are adequately analyzed for the Commission's use of the Final EIR to support the Commission's future consideration of a lease for the Project elements encroaching on State sovereign land.
Unless specified, all comments apply to Phase I only. 3

General Comments

1. Subsurface Well Location and Quantity: The Draft EIR states, throughout the document, that the subsurface slant wells for both Phase I and the Regional Project could be located anywhere within the study area. However, it also notes that certain portions of the study area will not be pursued for slant well construction, based on

discussions with regulatory agencies and to minimize certain impacts. For example,
page 4.3-46 notes that Pod F (a wellhead cluster) is no longer being considered but
pages 3.0-7 and 4.8-22 still include Pod F in the list of possible locations for
Capistrano Beach Park. The Final EIR should update the Project Description,
exhibits, and relevant portions of Sections 4.1 through 4.15 to remove areas no
longer under consideration as well as revise the proposed Pods to reflect District 3
decisions.

Once the appropriate areas are identified, Commission staff recommends that the
Final EIR revise the Project Description and Sections 4.1 through 4.15 to clearly
identify and analyze the worst-case scenario for subsurface intake wells. The Final
EIR should also clearly state if a specific impact would be the same regardless of
well placement.

The Draft EIR and supporting appendices also contain conflicting information
regarding the total number of slant wells. While Section 3.0 (Project Description)
notes that Phase I would require two to three pods (each projected to have at least
two wellheads) and page 4.3-44 (Biological Resources) indicates that "at least two to
three wells will be required", Appendix 10.3 (Air Quality and Greenhouse Gas
Calculations) provides the California Emissions Estimator Model (CalEEMod) air 4
emissions calculations for four wells for Phase I and six additional wells for the
Regional Project. In contrast, Appendix 10.1 (Preliminary Design Report), page 12
notes that more than four may be needed for Phase I if any slant well experiences
poor performance. Commission staff requests that the Final EIR both clarify the
number of wells for the proposed Project and explain what would trigger the need for
additional slant wells, including the likelihood of this occurrence and any associated
impacts.

2. <u>Construction – Schedule and Slant Wells</u>: The Draft EIR notes on page 3.0-38 that
there is no finalized construction schedule and instead provides that construction will
occur between October 2019 and December 2021. However, page 39 of Appendix
10.3 provides a construction schedule to determine air quality and greenhouse gas
impacts, thus identifying which construction activities would occur concurrently.
Commission staff recommends that this schedule be summarized in the Project
Description and in Section 4.2 (Air Quality), as relevant, to clearly identify the 5
construction scenario being evaluated.

In addition, the activities associated with slant well construction are only briefly
mentioned in the Project Description; it is not until page 4.2-31 where the slant well
construction activities are fully described. The Project Description should include the
information found on page 4.2-31 to ensure an accurate and consistent Project
Description required by State CEQA Guidelines, section 15124, subdivision (c).

3. <u>Construction – Pilings</u>: If subsurface slant wells are chosen at Capistrano State
Beach (Pods G or H), the skid-mounted drill rig could require high surf construction 6
mitigation measures, including "keying" the four pilings into underlying materials and

grouting them 20-30 feet deep.[1] The Final EIR should clarify how the pilings would 6
be installed, identify if any impact or vibratory pile driving would be required, and provide an associated impact analysis.

4. <u>Operation – Brine discharge</u>: The Draft EIR notes, throughout the document, that the brine discharge and other treated process waste streams would have a negligible impact by "in part" blending with wastewater from the J.B. Latham wastewater treatment plant as well as other plants. However, it does not appear that there are alternative or complementary methods for brine dilution. The Final EIR should either
remove the phrase "in part" or note that other Project design features or mitigation 7
measures, as relevant, would also reduce the impacts.

   Commission staff also requests that the Final EIR clarify whether the diluted brine discharge, with the resultant salinity increase, would require increased or different maintenance for the outfall pipeline. If so, the document must identify and analyze any associated impacts.

5. <u>Operation – Subsurface Intake Pumps</u>: The Project would use subsurface pumps within the slant well to extract the feedwater for desalination. Page 20 of Appendix
10.1 notes that these pumps have an operational life of 15 years, and Commission 8
staff understands that a new drill rig would be used to replace the pump at that time.[2] Please ensure the Final EIR includes this anticipated activity and evaluates any associated impacts.

<u>Air Quality</u>

6. <u>Air Quality Modeling Assumptions</u>: The Draft EIR states several times that all assumptions related to overlapping construction and conservative parameters are found within Appendix 10.3. Commission staff notes, however, that page 10 of Appendix 10.3 assumes "simultaneous construction of multiple components" but
does not clearly identify which components. In addition, the supporting appendix 9
does not state which assumptions are being used and does not show the parameters that affected the CalEEMod calculations. Section 4.2 of the Final EIR should include a summary that identifies the assumptions and conservative limits for both construction and operational emissions.

7. <u>Mitigation Measures</u>: The Draft EIR concludes that, for Impact 4.2-1, the Project would have a less-than-significant impact with mitigation incorporated. The analysis discusses mitigation measures AQ-1 through AQ-3, but then notes on page 4.2-22
that "no mitigation measures are required." The Final EIR should clarify whether this 10
impact would require mitigation and ensure that the correct determination is also reflected in the Mitigation Monitoring and Reporting Program.

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[1] Section 3.0 (Project Description), page 3.0-39 and Section 4.8 (Hydrology and Water Quality), page 4.8-28.

[2] K. Thomas and M. Donovan, pers. comm., July 25, 2018.

Biological Resources

8. Endangered Species – Black Abalone: If slant wells in Pods G or H (Capistrano State Beach) are chosen for Phase I or the Regional Project, then the existing riprap would be disturbed to place a new diffuser pipeline. Page 4.3-29 explains that black abalone could be found in this riprap but notes that the likelihood would be rare. Regardless, Commission staff recommends that the Final EIR require a pre-construction survey for black abalone, if slant wells are approved on Capistrano State Beach, and coordination with the appropriate state and federal agencies if the species is found. 11

Cultural Resources

9. Unanticipated Underwater Cultural Resource Discovery: The Draft EIR does not discuss underwater cultural resource discovery. However, pages 3 and 32 of Appendix 10.5.1 (Cultural Resources Report) note that construction of the slant wells may result in unanticipated underwater cultural resource discovery and set forth the required procedures. If the District has determined that the construction could result in this impact then it should be included in the Final EIR and analyzed accordingly.

   The Final EIR should also mention that the title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the state and under the jurisdiction of the Commission (Pub. Resources Code, § 6313). Commission staff requests that the District consult with Staff Attorney Jamie Garrett (see contact information at the end of this letter) should any cultural resources on state lands be discovered during construction of the proposed Project. In addition, Commission staff requests that the following statement be included in the EIR's Mitigation Monitoring and Reporting Plan: "The final disposition of archaeological, historical, and paleontological resources recovered on state lands under the jurisdiction of the California State Lands Commission must be approved by the Commission." 12

Greenhouse Gases

10. Greenhouse Gas (GHG) Mitigation Plan: Mitigation measure GHG-1 sets forth an Energy Minimization and GHG Reduction Plan. The Plan includes various mitigation options from a) to d), and notes that the District may include any or all options. Items a) through c) consist of onsite mitigation, while d) would require the District to purchase "carbon offsets." Commission staff recommends that the Plan include a preferred order for implementation, with the District committed to working through options a), b), and c) before proceeding with d) or any other offsite mitigation strategies. 13

    Mitigation measure GHG-2 requires the District to also submit annual reports identifying the actual GHG emissions and mitigation applied for that year, and notes that the results shall be used to adjust the offsets. Additional offsets, if required, would be in place by the end of the following year. Commission staff recommends that the mitigation measure clarify that any makeup mitigation would be verified and validated in the following year's report, to ensure that all impacts have been mitigated to a less-than-significant level. 13

Hazards and Hazardous Materials

11. Drilling Management and Monitoring Program (DMMP): Mitigation measure HAZ-1 describes the Drilling Management and Monitoring Program required to minimize hazardous releases into the marine environment. Page 4.7-28 notes that "in case of a spill, the DMMP shall clearly define measures that would be used to contain spills 14 and minimize other hazards." The Final EIR should include examples of similar measures that have been used for oil and gas drilling, if available, or that were identified for the construction of the 2006 Doheny slant well or the 2014 Monterey Peninsula slant well.[3]

Thank you for the opportunity to comment on the Draft EIR for the Project. As a responsible and trustee agency, the Commission will need to rely on the Final EIR for the issuance of any new lease as specified above and, therefore, Commission staff requests that you consider our comments prior to certification of the EIR.

Please send copies of future Project-related documents, including electronic copies of the Final EIR, Mitigation Monitoring and Reporting Program, Notice of Determination, CEQA Findings and, if applicable, Statement of Overriding Considerations when they 15 become available. Please refer questions concerning environmental review to Alexandra Borack, Environmental Scientist, at (916) 574-2399 or via email at Alexandra.Borack@slc.ca.gov. For questions concerning archaeological or historic resources under Commission jurisdiction, please contact Staff Attorney Jamie Garrett, at (916) 574-0398 or via email at Jamie.Garrett@slc.ca.gov. For questions concerning Commission leasing jurisdiction, please contact Cheryl Hudson, Public Lands Management Specialist, at (916) 574-0732 or via email at Cheryl.Hudson@slc.ca.gov.

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
A. Borack, Commission
C. Hudson, Commission
B. Johnson, Commission
J. Garrett, Commission

[3] Section 3.0 (Project Description), page 3.0-39 notes that dual rotary drilling, the technology chosen for the proposed Project's slant well construction, "has been effectively used for decades in oil and gas." The narrative continues to explain that the same drilling method was used for both the 2006 and 2014 test slant wells.

Letter S4 California State Lands Commission

Cy R. Oggins, Chief, Division of Environmental Planning and Management
August 6, 2018

Response S4-1

Comments regarding the Commission's role as a responsible and trustee agency and jurisdiction over ungranted sovereign (tide and submerged) lands are noted for the record. The District will comply with leasing procedures as established or required.

Response S4-2

The Summary of the Project Description is noted for the record.

Response S4-3

Refer to Master Response 1 for Project Description clarifications with respect to slant well siting and avoidance of sensitive resource locations. Pod F has been eliminated from further consideration, as reflected in mitigation measure REC-1. As stated in Section 4.12 and elsewhere in the Draft EIR, the slant well pod locations are conceptual and may be adjusted during final engineering, construction, and as groundwater modeling is updated as slant well construction is phased, in order to minimize environmental impacts while providing sufficient feedwater.

Response S4-4

Please see Response S4-3 above as well as Master Response 1 regarding clarifications to the Project description with respect to the anticipated number of slant wells. As discussed in the Draft EIR and Master Response 1, there is no inconsistency here. The technical modeling for air quality and GHG assumed four separate slant wells being drilled for Phase I, which is consistent with the Project Description noting "two to three pods" and the biological resources section noting "two to three wells," which was referring to wellhead vaults (or pods). It is most likely that the District will drill four slant wells from two wellhead pods with two wells each, at DSB, which matches all three of the above assumptions. As explained in Master Response 1, three wells should prove sufficient to draw the necessary 10 MGD of raw water to feed a 5 MGD capacity facility, while the fourth well would provide redundancy. The final number and location of slant wells will be determined during final design, and may be modified following successful drilling, development and initial production from the first slant well.

Response S4-5

Refer to Master Response 1 for Project Description clarifications with respect to slant well construction phasing. The construction information utilized for purposes of quantifying air quality and greenhouse gas emissions is required to populate the necessary inputs of the CalEEmod emissions calculation model. The air quality and greenhouse gas modeling is designed to estimate construction and operational emissions, but is not intended to dictate the construction schedule. The schedule as stated in the Draft EIR is dependent upon project approval and attainment of all necessary permits required for construction. Although the actual construction schedule will be later than shown in the Draft EIR, the Draft EIR conclusions are not affected. Please see Section 3, *Draft EIR Errata*, which provides additional information regarding the construction schedule and equipment needs.

Response S4-6

The drill rig necessary for constructing the slant wells, described on DEIR page 3.0-39, requires anchoring for normal operations independent of high surf conditions. The anchors are constructed by drilling a 10-inch borehole using a truck-mounted hollow-stem auger rig and cementing in a metal bar with eyelet in place. The anchors are needed to stabilize the rig when drilling and when pulling the drill casings. The augering for the installation would not require pile driving and therefore would not result in noise or vibration impacts associated with that process. As discussed further in Master Response 1, due to recent heavy surf and storm damage at Capistrano Beach Park, this area would only be considered for slant wells should the Capistrano Beach Park parking area be protected from future high surf and related coastal hazards.

Response S4-7

The term "in part" refers to the total Project design and operational conditions that result in less than significant brine impacts, which includes post-treatment brine conditioning, and utilizing the existing SOCWA outfall and its existing diffuser system.

Regarding brine effects on SOCWA outfall maintenance, the District has been coordinating with SOCWA on this topic and does not anticipate any additional outfall maintenance issues due to brine addition. SOCWA outfall terms and conditions will be set forth in a connection agreement between the District and SOCWA.

Response S4-8

The comment is correct that Draft EIR Appendix 10.1 discloses and estimates that subsurface intake pumps used in the slant wells could require replacement in the future after approximately 15 years. The process to replace pumps is anticipated to result in temporary mobilization of drill rig equipment to perform the task. Impacts would be no greater than those identified in the Draft EIR for construction impacts, since the work would take place within the existing well shafts, originating from the existing well pod locations. No new land disturbance or construction will be required to perform this task.

Response S4-9

Refer to Master Response 1 for clarifications regarding Project construction and operational assumptions. Appendix 10.3 contains the necessary information requested by the commenter regarding the assumptions being used and the parameters that affected the CalEEMod calculations. Specifically, please refer to Appendix 10.3 Section 2 (Modeling Parameters and Assumptions) for the following modeling assumptions for construction: CalEEMod land use entry; phase schedule and durations; equipment type, number, hours per day, horsepower and load factor; soils and material movement; offsite trips; and, assumptions for fugitive dust control consistent with SCAQMD Rule 403 requirements. In particular, please see Appendix 10.3 Table 8 and Table 9 for the construction schedule and duration, and equipment activity assumptions, respectively. Additionally, the CalEEMod output Section 3.0 Construction Detail contains the construction schedule and duration, equipment activity (type, number, hours per day, etc.), and offsite trips used in the model run. Operational assumptions and parameters are provided in Appendix 10.3 section 2.3 (Operation), including (but not exclusive to) water energy consumption parameters, transport energy, and carbon intensity factors applied in the analysis. Please also see Section 3, *Draft EIR Errata*, for additional information and clarifications regarding project schedule and equipment needs.

Response S4-10

Draft EIR page 4.2-22 will be modified to recognize that specific mitigation measures will be applied to mitigate Impact 4.2-1. Please see Section 3, *Draft EIR Errata*.

Response S4-11

Please see Section 3, *Draft EIR Errata*. Mitigation Measure MM BIO-5 has been included in the Final EIR to require preconstruction surveys and, if necessary, a black abalone protection plan.

Response S4-12

Draft EIR page 4.4-24, under Impact 4.4-1, identifies historical resources (including marine resources), and notes the nearest known shipwreck location. In addition, page 4.4-26 notes that the subsurface intake wells and the entirety of the area of potential effect (APE) is in an area considered sensitive for archaeological resources and that ground disturbing activities always have the potential to reveal previously undisclosed resources, including underwater resources. Mitigation Measures CUL-1 and CUL-2 apply to underwater resources as well as above ground resources.

Comments stating that the title and jurisdiction of cultural resources on or in the tide and submerged lands are vested in the state and under jurisdiction of the Commission are noted for the record. The last paragraph of CUL-2 has been clarified in Section 3, *Draft EIR Errata*, and will also be reflected in the Mitigation Monitoring and Reporting Program.

Response S4-13

In response to the commenter's concerns regarding preferred order for implementation of measures within Mitigation Measure GHG-1, the Draft EIR text on page 4.6-21 is modified as shown in Section 3, *Draft EIR Errata*.

In response to the commenter's concerns regarding verification of additional offsets (if required) Mitigation Measure GHG-2, in the Draft EIR on page 4.6-24 is modified as shown in Section 3, *Draft EIR Errata*.

Response S4-14

The drilling operations will be conducted in accordance with a Drilling Monitoring and Management Plan and spill prevention plan (Mitigation Measure HAZ-1) which is standard practice for drilling operations. The spill prevention plan and other standard construction and operational plans and Best Management Practices (BMPs) will be developed in consultation with applicable regulatory agencies through the Project's permitting process, should the Project be approved by the District's Board of Directors.

Response S4-15

The Commission's comments are appreciated and have been considered within this Final EIR. The District will provide the Commission with documents related to the CEQA review process as requested.

STATE OF CALIFORNIA Edmund G. Brown Jr., Governor

NATIVE AMERICAN HERITAGE COMMISSION
Environmental and Cultural Department
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691
Phone (916) 373-3710
Fax (916) 373-5471

June 22, 2018

Rick Shintaku, General Manager
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

Also sent via e-mail: rshintaku@scwd.org

Re: SCH# 2016031038, Doheny Ocean Desalination Project, City of Dana Point; Orange County, California

Dear Mr. Shintaku:

The Native American Heritage Commission (NAHC) has reviewed the Draft Environmental Impact Report (DEIR) prepared for the project referenced above. The review included the Executive Summary; the Introduction and Project Description; the Environmental Impact Analysis, section 4.4 Cultural Resources, and section 4.14 Tribal Cultural Resources; Appendix 10.5.1 Cultural Resources Report; and Appendix 10.5.2 AB52 Correspondence, prepared by Kimley Horn and Rincon Consultants for the South Coast Water District. We have the following concerns:

1. There is no documentation of **government-to-government consultation by the lead agency** under AB-52 with Native American tribes traditionally and culturally affiliated to the project area as required by statute, or that mitigation measures were developed in consultation with the tribes. Discussions under AB-52 may include the type of document prepared; avoidance, minimization of damage to resources; and proposed mitigation. **All documented correspondence for this project was initiated by consultants and does not comply with requirements for government-to-government consultation.** 1

The NAHC recommends lead agencies consult with all California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources.

A brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments is also attached.

Please contact me at gayle.totton@nahc.ca.gov or call (916) 373-3714 if you have any questions.

Sincerely,

Gayle Totton

Gayle Totton, B.S., M.A., Ph.D
Associate Governmental Project Analyst

Attachment

cc: State Clearinghouse

ADDITIONAL INFORMATION:

The California Environmental Quality Act (CEQA)[1], specifically Public Resources Code section 21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource is a project that may have a significant effect on the environment.[2] If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an environmental impact report (EIR) shall be prepared.[3] In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources with the area of project effect (APE).

CEQA was amended in 2014 by Assembly Bill 52. (AB 52).[4] **AB 52 applies to any project for which a notice of preparation or a notice of negative declaration or mitigated negative declaration is filed on or after July 1, 2015.** AB 52 created a separate category for "tribal cultural resources"[5], that now includes "a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment.[6] Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource.[7] Your project may also be subject to **Senate Bill 18 (SB 18)** (Burton, Chapter 905, Statutes of 2004), Government Code 65352.3, if it also involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space. **Both SB 18 and AB 52 have tribal consultation requirements**. Additionally, if your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966[8] may also apply.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

Agencies should be aware that AB 52 does not preclude agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52. For that reason, we urge you to continue to request Native American Tribal Consultation Lists and Sacred Lands File searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/. Additional information regarding AB 52 can be found online at http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf, entitled "Tribal Consultation Under AB 52: Requirements and Best Practices". 2

Pertinent Statutory Information:

Under AB 52:

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a **lead agency** shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice.

A **lead agency** shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project.[9] and **prior to the release of a negative declaration, mitigated negative declaration or environmental impact report**. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code § 65352.4 (SB 18).[10]

The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:

a. Alternatives to the project.
b. Recommended mitigation measures.
c. Significant effects.[11]

1. The following topics are discretionary topics of consultation:

a. Type of environmental review necessary.
b. Significance of the tribal cultural resources.
c. Significance of the project's impacts on tribal cultural resources.

If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. [12]

With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process **shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code sections 6254 (r) and 6254.10.** Any information submitted by a California Native

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[1] Pub. Resources Code § 21000 et seq.
[2] Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, § 15064.5 (b); CEQA Guidelines Section 15064.5 (b)
[3] Pub. Resources Code § 21080 (d); Cal. Code Regs., tit. 14, § 15064 subd.(a)(1); CEQA Guidelines § 15064 (a)(1)
[4] Government Code 65352.3
[5] Pub. Resources Code § 21074
[6] Pub. Resources Code § 21084.2
[7] Pub. Resources Code § 21084.3 (a)
[8] 154 U.S.C. 300101, 36 C.F.R. § 800 et seq.
[9] Pub. Resources Code § 21080.3.1, subds. (d) and (e)
[10] Pub. Resources Code § 21080.3.1 (b)
[11] Pub. Resources Code § 21080.3.2 (a)
[12] Pub. Resources Code § 21080.3.2 (a)

American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public.[13]

If a project may have a significant impact on a tribal cultural resource, **the lead agency's environmental document shall discuss** both of the following:

a. Whether the proposed project has a significant impact on an identified tribal cultural resource.
b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code section 21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource.[14]

Consultation with a tribe shall be considered concluded when either of the following occurs:

a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached.[15]

Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code section 21080.3.2 **shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program**, if determined to avoid or lessen the impact pursuant to Public Resources Code section 21082.3, subdivision (b), paragraph 2, and shall be fully enforceable.[16]

If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, **the lead agency shall consider feasible mitigation** pursuant to Public Resources Code section 21084.3 (b).[17]

An environmental impact report **may not be certified**, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:

a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code sections 21080.3.1 and 21080.3.2 and concluded pursuant to Public Resources Code section 21080.3.2.
b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process. 2
c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code section 21080.3.1 (d) and the tribe failed to request consultation within 30 days.[18]

This process should be documented in the Tribal Cultural Resources section of your environmental document.

Under SB 18:
Government Code § 65352.3 (a) (1) requires consultation with Native Americans on general plan proposals for the purposes of "preserving or mitigating impacts to places, features, and objects described § 5097.9 and § 5091.993 of the Public Resources Code that are located within the city or county's jurisdiction. Government Code § 65560 (a), (b), and (c) provides for consultation with Native American tribes on the open-space element of a county or city general plan for the purposes of protecting places, features, and objects described in Sections 5097.9 and 5097.993 of the Public Resources Code.

- SB 18 applies to **local governments** and requires them to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf
- Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe**.[19]
- There is no Statutory Time Limit on Tribal Consultation under the law.
- Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research,[20] the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code sections 5097.9 and 5097.993 that are within the city's or county's jurisdiction.[21]
- Conclusion Tribal Consultation: Consultation should be concluded at the point in which:
  - The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or

[13] Pub. Resources Code § 21082.3 (c)(1)
[14] Pub. Resources Code § 21082.3 (b)
[15] Pub. Resources Code § 21080.3.2 (b)
[16] Pub. Resources Code § 21082.3 (a)
[17] Pub. Resources Code § 21082.3 (e)
[18] Pub. Resources Code § 21082.3 (d)
[19] (Gov. Code § 65352.3 (a)(2)).
[20] pursuant to Gov. Code section 65040.2,
[21] (Gov. Code § 65352.3 (b)).

- Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation.[22]

NAHC Recommendations for Cultural Resources Assessments:

- Contact the NAHC for:
  - A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.
  - A Native American Tribal Contact List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.
    - The request form can be found at http://nahc.ca.gov/resources/forms/.
- Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
  - If part or the entire APE has been previously surveyed for cultural resources.
  - If any known cultural resources have been already been recorded on or adjacent to the APE.
  - If the probability is low, moderate, or high that cultural resources are located in the APE.
  - If a survey is required to determine whether previously unrecorded cultural resources are present.
- If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
  - The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
  - The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center. 2

Examples of Mitigation Measures That May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:

- Avoidance and preservation of the resources in place, including, but not limited to:
  - Planning and construction to avoid the resources and protect the cultural and natural context.
  - Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
- Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
  - Protecting the cultural character and integrity of the resource.
  - Protecting the traditional use of the resource.
  - Protecting the confidentiality of the resource.
- Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.
- Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed.[23]
- Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated.[24]

The lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.

- Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources.[25] In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.
- Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.
- Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code section 7050.5, Public Resources Code section 5097.98, and Cal. Code Regs., tit. 14, section 15064.5, subdivisions (d) and (e) (CEQA Guidelines section 15064.5, subds. (d) and (e)) address the processes to be

[22] (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).
[23] (Civ. Code § 815.3 (c)).
[24] (Pub. Resources Code § 5097.991).
[25] per Cal. Code Regs., tit. 14, section 15064.5(f) (CEQA Guidelines section 15064.5(f)).

followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery. 2

Letter S5 Native American Heritage Commission

Gayle Totton, B.S., M.A., Ph.D., Associate Governmental Project Analyst
June 22, 2018

Response S5-1

The District appreciates the Native American Heritage Commission's (NAHC) comments and additional information regarding AB 52. As noted on page 4.14-3 of the Draft EIR, the NAHC was contacted in February 2016 to request a review of the Sacred Lands File (SLF) as part of the Notice of Preparation (NOP). The NAHC responded on March 3, 2016 that the search of the SLF was completed for the Area of Potential Effect (APE) "with negative results," meaning that no sacred lands or resources were identified. The NAHC also provided a contact list for tribal groups or individuals who may have knowledge of cultural resources within the APE. Letters were mailed to each of these contacts requesting any information they may have on Native American cultural resources within the APE. As of June 2019, one response has been received, which simply requested standard archaeological monitoring during grading (see Appendix 10.5.2, AB52 Correspondence).

Pursuant to AB52, the District notes that as of June 2019, the District is not in receipt of communication from any native American tribes requesting to be included in AB52 consultation. The District initiated AB52 consultation upon release of the NOP as a standard practice.

The District is both the lead agency and project proponent of the Project. During the application and environmental review process, it is common for consultants, acting as an agent of and at the request of the Lead Agency, to send communications and consultation letters to tribal representatives on behalf of the Lead Agency. All AB52 correspondence was independently reviewed and analyzed by District staff.

The Draft EIR, including the Cultural Resources Assessment (Appendix 10.5.1), was also reviewed and analyzed by and reflects the independent judgment of District staff. The Draft EIR discusses additional research of potential sensitive resources conducted by the District's consulting team. In response to the research discussed in Appendix 10.5.1 as part of preparing the Draft EIR, the District modified Project pipeline alignments to avoid potentially sensitive resources.

Response S5-2

Letter attachments including CEQA requirements and pertinent statutory information are received and noted for the record.

STATE OF CALIFORNIA

GOVERNOR'S OFFICE of PLANNING AND RESEARCH

EDMUND G. BROWN JR.
GOVERNOR

KEN ALEX
DIRECTOR

RECEIVED
AUG 13 2018
BY:

August 7, 2018

Rick Shintaku
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

Subject: Doheny Ocean Desalination Project
SCH#: 2016031038

Dear Rick Shintaku:

The State Clearinghouse submitted the above named Draft EIR to selected state agencies for review. On the enclosed Document Details Report please note that the Clearinghouse has listed the state agencies that reviewed your document. The review period closed on August 6, 2018, and the comments from the responding agency (ies) is (are) enclosed. If this comment package is not in order, please notify the State Clearinghouse immediately. Please refer to the project's ten-digit State Clearinghouse number in future correspondence so that we may respond promptly.

Please note that Section 21104(c) of the California Public Resources Code states that:

> "A responsible or other public agency shall only make substantive comments regarding those activities involved in a project which are within an area of expertise of the agency or which are required to be carried out or approved by the agency. Those comments shall be supported by specific documentation." 1

These comments are forwarded for use in preparing your final environmental document. Should you need more information or clarification of the enclosed comments, we recommend that you contact the commenting agency directly.

This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act. Please contact the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Enclosures
cc: Resources Agency

Document Details Report
State Clearinghouse Data Base

SCH#	**2016031038**
Project Title	Doheny Ocean Desalination Project
Lead Agency	South Coast Water District

Type **EIR** Draft EIR

Description Note: Refer to NOC submitted on 6/5/2018.

The South Coast Water District proposes to develop an ocean water desalination facility in Dana Point, CA, at Doheny State Beach.The desalination facility would produce up to 15 million gallons per day (MGD) of potable drinking water. The District intends to construct a facility with an initial capacity of up to 5 MGD, with potential for future expansions up to 15 MGD. Both the initial up to 5 MGD and ultitmate up to 15 MGD capacities would be available for the District and local water agencies to provide a high quality, locally-controlled, drought-proof water supply.

Lead Agency Contact

Name	Rick Shintaku		
Agency	South Coast Water District		
Phone	949-499-4555	***Fax***	
email			
Address	31592 West Street		
City	Laguna Beach	***State*** CA	***Zip*** 92651

Project Location

County	Orange						
City	Dana Point						
Region							
Lat / Long	33° 27' 56.5" N / 117° 40' 53.1" W						
Cross Streets	Pacific Coast HWY and Park Lantern						
Parcel No.	668-404-05, 412-20, 415-18						
Township	T8S	***Range***	R8W	***Section***	S23	***Base***	

Proximity to:

Highways	SR-1, I-5
Airports	
Railways	Amtrak Pacific Surfliner
Waterways	San Juan Creek, Dana Point Harbor
Schools	St. Edwards, Del Obispo
Land Use	Recreation and Industrial/Business Zoning; Recreation/Open Space and Industrial Business Park GP designations

Project Issues Biological Resources; Coastal Zone; Flood Plain/Flooding; Geologic/Seismic; Noise; Population/Housing Balance; Public Services; Recreation/Parks; Schools/Universities; Sewer Capacity; Soil Erosion/Compaction/Grading; Toxic/Hazardous; Solid Waste; Traffic/Circulation; Vegetation; Water Quality; Water Supply; Wetland/Riparian; Growth Inducing; Landuse; Cumulative Effects; Aesthetic/Visual; Air Quality

Reviewing Agencies Resources Agency; Department of Boating and Waterways; California Coastal Commission; Department of Fish and Wildlife, Region 5; Office of Historic Preservation; Department of Parks and Recreation; Caltrans, District 12; Office of Emergency Services, California; State Water Resources Control Board, Division of Drinking Water; State Water Resources Control Board, Division of Water Quality; Regional Water Quality Control Board, Region 9; Native American Heritage Commission; Public Utilities Commission; State Lands Commission; Department of Toxic Substances Control

Date Received 06/05/2018 ***Start of Review*** 06/05/2018 ***End of Review*** 08/06/2018

Note: Blanks in data fields result from insufficient information provided by lead agency.

Letter S6 Office of Planning and Research, State Clearinghouse

Scott Morgan, Director

August 7, 2018

Response S6-1

State Clearinghouse receipt of the Draft EIR and acknowledgment of District compliance with requirements for draft environmental documents is noted for the record. This comment letter included copies of state agency comment letters that the District had also received separately, consisting of comment letters S2 (Department of Toxic Substances Control), S4 (State Lands Commission), S5 (Native American Heritage Commission), and S7 (Regional Water Quality Control Board). Responses to letters received from State agencies are addressed individually within this Final EIR document.

California Water Boards

San Diego Regional Water Quality Control Board

August 6, 2018

Sent Via Email Only

South Coast Water District
Attn: Mr. Rick Shintaku, PE
31592 West Street
Laguna Beach, CA 92651
rshintaku@scwd.org

In reply refer to / attn:
823689:bneill

Subject: Comments on the Doheny Ocean Desalination Project Draft Environmental Impact Report, South Coast Water District, California State Clearing House No. 2016031038

Mr. Shintaku:

The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) and the State Water Resources Control Board (State Water Board) (collectively Water Boards) have reviewed the Draft Environmental Impact Report (Draft EIR) dated May 2018. The Draft EIR evaluates potential environmental impacts due to the construction and operation of the Doheny Ocean Desalination Project (Project) owned by the South Coast Water District (Discharger). The Project includes a subsurface water intake system, a raw (ocean) water conveyance pipeline, a desalination facility providing 5 million gallons per day (MGD) of potable drinking water (with potential for a future expansion providing up to 15 MGD of drinking water), a concentrated brine disposal system, a product water storage tank with distribution system, appurtenant facilities, and electric transmission facilities. 1

The San Diego Water Board is the agency responsible for issuing the National Pollutant Discharge Elimination System (NPDES) permit for the discharge of brine and other wastes from the Project to the Pacific Ocean and for making a determination regarding the factors set forth in California Water Code (CWC) section 13142.5, subdivision (b) (CWC section 13142.5(b))[1]. The NPDES permit will implement the provisions of the Water Quality Control Plan for Ocean Waters of California (Ocean Plan), including the Amendment to the Ocean Plan Addressing Desalination Facility Intakes, Brine Discharges, and the Incorporation of Other Non-substantive Changes (Desalination Amendment).

In developing the CWC section 13142.5(b) determination and the NPDES permit for the Project, the San Diego Water Board, in consultation with the State Water Board and other pertinent regulatory agencies, will rely on the Final EIR for the Project, along with information in a forthcoming Report of Waste Discharge (ROWD) and other available information as part of the Discharger's future request for a CWC section 13142.5(b) determination for the Project. The San Diego Water Board may request that the Discharger submit additional information that is necessary for the CWC section 13142.5(b) determination or for the NPDES permit issuance.

[1] CWC section 13142.5(b) requires each new or expanded coastal powerplant or other industrial installation using seawater for cooling, heating, or industrial processing, to use the best available site, design, technology, and mitigation measures feasible to minimize the intake and mortality of all forms of marine life.

Although issuance of an NPDES permit is exempt from California Environmental Quality Act (CEQA) compliance pursuant to CWC section 13389, a CWC section 13142.5(b) determination is a discretionary approval subject to CEQA compliance. The San Diego Water Board is a responsible agency for purposes of complying with CEQA for a CWC section 13142.5(b) determination. 1

The Water Boards offer the following comments on sections 1, 2, 3, 4.3, 4.8, 5, 6, 7, and 8 and Appendices 10.4.1 and 10.11 of the Draft EIR. The remaining sections and appendices were not reviewed. The potential future expansion of the Project to increase drinking water production up to 15 MGD was not reviewed. A separate environmental analysis and a new CWC 13142.5(b) determination will be required prior to any future expansion increasing the production capacity of the Project beyond 5 MGD.

1. The Water Boards appreciate the early consultation opportunities that the Discharger has provided prior to issuance of the Draft EIR. The early consultation helped clarify aspects of the Project and permitting process.

2. The Project proposes a subsurface water intake system consisting of subsurface slant wells that draw ocean water from below the ocean floor. Subsurface intakes are the preferred intake technology in the Ocean Plan. In contrast to surface intakes, subsurface intakes avoid marine life impacts due to entrainment, impingement, and entrapment, thereby minimizing the Project's operational and construction impacts to all forms of marine life and eliminating the need to mitigate for intake-related operational mortality. 2

3. The Project proposes a brine disposal system through the existing San Juan Creek Ocean Outfall (SJCOO), commingled with the existing wastewater discharge from the J.B. Latham Wastewater Treatment Plant and other regional treatment plants. Disposal of brine by commingling with wastewater is the preferred brine discharge technology in the Ocean Plan. This discharge technology dilutes the high salinity concentration of the brine discharge to levels that are not toxic to marine life prior to discharge. By utilizing existing infrastructure, this discharge technology precludes new impacts from construction of a new outfall. Commingling the brine discharge with wastewater also prevents dense, negatively buoyant discharge plumes that can cause anoxic or hypoxic zones on the seafloor that would adversely impact marine life.

4. The Project will require enrollment in the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ. The Draft EIR should discuss that the Project will require enrollment in that Order. Information pertaining to the Construction General Permit is available on the State Water Board website at https://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.html. 3

5. If the Project will extract and discharge groundwater (e.g., for subsurface construction or trenching) during construction, the Project will require enrollment in General Waste Discharge Requirements for Groundwater Extraction Discharges to Surface Waters Within the San Diego Region, Order R9-2015-0013. The Draft EIR should discuss that the Project will require enrollment in that Order. Information pertaining to the Groundwater Extraction General Permit is available on the San Water Board website at https://www.waterboards.ca.gov/sandiego/board_decisions/adopted_orders/2015/R9-2015-0013.pdf.

6. Following Project construction, further evaluation will be needed to determine if the Discharger will need to be enrolled in the General Permit for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems, Order No. 2013-0001-DWQ. This Order regulates storm water runoff from small municipalities and other facilities. The Draft EIR should discuss that the Project may require enrollment in that Order. Information pertaining to the Small Municipal Separate Storm Sewer (MS4) General Permit is available on the State Water Board website at https://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.html. 3

7. The discharge of drinking water and off-spec water from the Project through the SJCOO will be regulated through an individual NPDES permit. The discharge of well development water and drinking water from the Project to surface waters other than through the SJCOO is subject to the Statewide NPDES Permit for Drinking Water System Discharges to Waters of the United States, Order WQ 2014-0194-DWQ. The Draft EIR should reference and discuss the Discharger's existing enrollment in Order WQ-2014-0194-DWQ and measures to comply with that Order. Information pertaining to the General Permit for Discharges from Drinking Water Systems is available on the State Water Board website at https://www.waterboards.ca.gov/water_issues/programs/npdes/drinkingwatersystems.shtml.

8. The San Diego Water Board supports restoration mitigation projects that conform with Resolution No. R9-2015-0041, Resolution to Support Restoration of Aquatic Ecosystems in the San Diego Region. The Resolution identifies implementation of the San Juan and Trabuco Creek Steelhead Recovery Watershed Management Plan projects as important steps in the recovery of steelhead and their critical habitat in the San Juan Creek watershed. Further evaluation will be needed to determine the amount of mitigation required for the Project, if any, and the appropriateness of out-of-kind mitigation for marine life impacts caused by the Project. Chapter III.M.2.e.(3)(b)v. of the Ocean Plan gives the San Diego Water Board the option to permit out-of-kind mitigation for open water or soft-bottom species. Chapter III.M.2.e.(3)(b)vi. of the Ocean Plan gives the San Diego Water Board discretion to apply a mitigation ratio to out-of-kind mitigation. The San Diego Water Board may apply a mitigation ratio based on the relative biological productivity of the impacted open water or soft-bottom habitat and the mitigation habitat, and the mitigation ratio shall not be less than one acre of mitigation habitat for every ten acres of impacted open water or soft-bottom habitat. Additionally, chapter III.M.2.e.(3)(b)viii. of the Ocean Plan allows the San Diego Water Board to increase the required mitigation ratio for any species and impacted natural habitat calculated in the Marine Life Mortality Report, when appropriate, to account for imprecisions associated with mitigation, including but not limited to, the likelihood of success, temporal delays in productivity, and the difficulty of restoring or establishing the desired productivity functions. The San Diego Water Board will evaluate compliance with the Ocean Plan's mitigation requirements when the Discharger submits a request for a CWC section 13142.5(b) determination. The Ocean Plan still requires mitigation even if a project proposes to use the preferred intake and discharge technologies in the Ocean Plan. However, use of the preferred technologies significantly reduces the amount of mitigation required. Chapter III.M.2.e.(1)(a) of the Ocean Plan does not require mitigation for intake-related operational mortality. For discharge-related operational mortality, an applicant proposing a project with a commingled discharge will need to evaluate the incremental increase in mortality resulting from the commingled discharge. If the brine is adequately diluted by the wastewater, there may be no salinity-related mortality, but there may be an incremental increase in shearing-related mortality through multiport diffusers. 4

9. On page 2.0-3, the Draft EIR states, "If a listed species may be adversely affected by a
project, [State Water Board] staff will confer with the [U.S. Fish and Wildlife Service], and/or
[National Marine Fisheries Service] to inform these agencies of project impacts to any
federally listed species or critical habitat." While the Water Boards consult with other
agencies when conducting the CWC section 13142.5(b) analyses, the Water Boards are not
responsible for making a determination as to whether threatened or endangered species are 5
being adversely affected by a proposed project or for raising this concern to the attention of
U.S. Fish and Wildlife Service and National Marine Fisheries Service. The Discharger is
responsible for consulting with U.S. Fish and Wildlife Service and National Marine Fisheries
Service on whether the Project may adversely affect threatened or endangered species.

10. The production capacities for a couple of the other seawater desalination projects listed on
page 4.0-8 need to be corrected. Currently, San Diego County Water Authority is seeking
agency approvals to build a pilot facility at Camp Pendleton with an open ocean intake flow 6
of 20 gallons per minute (gpm) and a subsurface intake flow of 20 gpm to test water quality
and different intake technologies. Pebbly Beach Desalination Plant's maximum production
capacity is currently 0.202 MGD.

11. It is unclear what the listed sources are referring to in Table 4.3-2 on page 4.3-17. 7

12. On page 4.3-26, the Water Boards suggest changing "The subsurface intakes are the
preferred ocean water intake method by the SWRCB's Ocean Plan Amendment, as they 8
avoid marine life impingement impacts" to "The subsurface intakes are the preferred ocean
water intake method by the SWRCB's Ocean Plan Amendment, as they eliminate marine life
impingement and entrainment impacts."

13. The note at the bottom of Table 4.3-3 says that the value presented in red was used in the
Area of Production Foregone evaluation. However, there are no values presented in red in 9
the table. Additionally, section 4.3 would benefit from an explanation of Table 4.3-3. It is
unclear what the reader is supposed to take away from this table.

Additionally, the Water Boards offer the following comments on the appendices to the Draft EIR:

<u>Appendix 10.4.1</u>

14. Page 5 discusses Acoustic Doppler Current Profilers deployed at Camp Pendleton. It is 10
unclear to the Water Boards how this oceanographic data is being used with respect to the
Project (e.g., were they used in the Empirical Transport Method/APF [ETM/APF] analyses?).
Therefore, the Water Boards recommend revising the appendix to include a description of
why these data are provided, as they are ~25 miles from the Project area and may not be
representative of conditions at the Project site.

15. Pages 39 and 42 discuss the LC-10 value in the context of shearing-related mortality. The
Water Boards recommend removing the discussion of the LC-10 shear stress level from the
Draft EIR. Sufficient data do not exist to determine shearing-related mortality on a species- 11
specific basis or to support this methodology. (See Roberts 2018
[https://www.waterboards.ca.gov/santaana/water_issues/programs/Wastewater/Poseidon/2018/4-18-18_Diffuser_Analysis_Method.pdf].)

16. Page 44 refers to "accepted APF evaluation methodologies." It is unclear to the Water 12
Boards how the ETM/APF analyses were performed for the Project and what, if any,

biological dataset is underlying these analyses. The ETM/APF analyses should follow the guidance provided in Appendix E to the Final Staff Report to the Desalination Amendment. 12
It is recommended that the Discharger meet with the Water Boards to review the methodology used in the ETM/APF analyses for the Project.

17. It is unclear to the Water Boards what information the reader is supposed to take away from Tables 11 and 12. Table 12 appears to confuse acute toxicity with APF estimates generally 13
derived from entrainment sampling. Additionally, there is no supporting information for the larval duration values in the table, such as justification for the number of days used or how these durations vary by taxon. The appendix should be revised to provide clear explanations of these tables and their associated analyses.

18. Page 43 and surrounding sections of this appendix appear to incorrectly indicate that only negatively buoyant discharge scenarios would impact marine life and that positively buoyant 14
discharge scenarios would not. The Water Boards suggest revising the appendix to indicate that any discharge will have an effect on marine life.

19. Appendix C within Appendix 10.4.1 includes information on different discharge scenarios. Please note that Appendix C may need to be revised to address comments below on 15
Appendix 10.11.

20. Appendix D within Appendix 10.4.1 mentions that discharge mortality is "23% of entrainment-related losses." Please note that this 23% estimate is based on a particular case of a single jet discharging dense effluent oriented at an upwards angle of 60 degrees. The Water Boards suggest that the Discharger follow the guidance provided in Roberts 16
2018 (https://www.waterboards.ca.gov/santaana/water_issues/programs/Wastewater/Poseidon/2018/4-18-18_Diffuser_Analysis_Method.pdf) to evaluate shearing-related mortality. Please also see comments 15 and 16.

Appendix 10.11

21. As described in the Draft EIR, the Discharger has stipulated that at least 0.35 MGD of wastewater will be available for blending of the Project's brine in the SJCOO. The Water Boards recommend removal of this appendix's analyses of scenarios where no wastewater (0 MGD) is discharged. Similarly, because the Discharger is not currently pursuing the 15 17
MGD regional project, the Water Boards recommend either removal of the analyses of scenarios where more than 5 MGD of brine is discharged, to simplify and clarify the report, or addition of explicitly worded text to make clear the purpose of including the analysis for the larger scale project.

22. Page 4 states, "The dilution study invokes the EPA certified Visual Plumes (UM3) mixing zone model initialized with the same effluent properties and environmental parameters assumed by the recently updated dilution study in Appendix-H of the current NPDES permit, RWQCB, (2014a)." Given that the discharge will no longer be wastewater, it is likely that 18
these initial conditions in the modeling are incorrect. The Water Boards suggest revising the initial conditions used in the model to represent the commingled effluent. Additionally, please include the modeling output files with the forthcoming ROWD and request for a CWC section 13142.5(b) determination for the Project. Please also see comment 20.

23. The appendix assumes that the discharge must meet the 101:1 dilution credit in the current NPDES permit (No. R9-2014-0105) for the SJCOO. Because the effluent characteristics are 19

changing from purely wastewater (existing effluent) to wastewater mixed with higher-salinity brine (proposed effluent), the San Diego Water Board will consider addressing this issue by amending or reissuing the current NPDES permit for the SJCOO or through issuance of a new individual NPDES permit for the Project's discharge. Therefore, the report should not assume that the commingled discharge will need to meet the 101:1 dilution credit in the current NPDES permit for the SJCOO. The report should be revised to include a proposed dilution credit for salinity at the point where the discharge meets the 2 parts per thousand (ppt) receiving water limit in the Ocean Plan, and this distance may not exceed 100 meters in any direction from the diffuser. The revised report should also include an additional analysis of the proposed size of the Zone of Initial Dilution (ZID) and an associated proposed dilution credit for the Ocean Plan Table 1 pollutants. 19

24. The Water Boards recommend revising the report to analyze the possibility of closing off some of the diffuser ports to manage the low discharge velocities that occur during low-flow events. This could allow for higher-velocity discharges that would lead to more rapid mixing during low-flow periods. 20

25. Page 8 incorrectly asserts that there is a "potential inconsistency" between the Ocean Plan and the current NPDES permit for the SJCOO. This text should be removed. The new or revised NPDES permit for the proposed discharge through the SJOO may include two distinct mixing zones: 1) the Brine Mixing Zone, which is not to exceed 100 m, and 2) the ZID for the Ocean Plan Table 1 pollutants. The new or revised permit for the proposed discharge through the SJOO will provide for appropriate receiving water limits and distinct mixing zones, so there will not be any "potential inconsistency" with the Ocean Plan. 21

26. As noted above in comment 15, the Water Boards suggest removing the discussion of the LC-10 shear stress level from the appendix. Please also see comment 27. 22

27. To evaluate shearing-related morality, the report uses the COSMOS/FlowWorks CFD modeling software, which is an unverified model that has not been approved by the Water Boards. Ocean Plan chapter III.M.2.e.(1)(b) states, in part, "The [Marine Life Mortality] report shall use any acceptable approach approved by the San Diego 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 Water Boards suggests that the Discharger follow the guidance provided in Roberts 2018 (https://www.waterboards.ca.gov/santaana/water_issues/programs/Wastewater/Poseidon/2018/4-18-18_Diffuser_Analysis_Method.pdf) to evaluate shearing-related mortality. The Water Boards also suggest analyzing the existing discharge (wastewater only) as well as the commingled discharge scenarios to provide an estimate of any incremental increase in mortality resulting from a commingled discharge. See also Ocean Plan chapter III.M.2.e.(1)(b). 23

28. The report concludes (page 9 and 89) that "no incremental turbulent shear impacts occur for dense brine-only discharges up to and including the maximum brine production output." This conclusion is premature as the analyses provided in this report are incomplete. Please also see comments 26 and 27. 24

29. Page 17 states, "Under wet weather conditions, Table -1 indicates the combined DDP brine/SOCWA wastewater effluent will remain buoyant and subject to the same permit requirements as the present SJCOO operating conditions." As described in comment 23, new permit conditions will be developed for the commingled effluent. 25

30. Page 56 appears to incorrectly indicate that the Ocean Plan receiving water limitation for salinity applies only to "dry" conditions. The report should be revised to include modeling results for all discharge scenarios, including both wet and dry weather scenarios. 26

31. Page 63 indicates that a "brine-only" discharge scenario will not comply with the Ocean Plan receiving water limitation for salinity of 2 ppt above natural background. Please note that if the revised analysis indicates that the brine-only discharge (combined with 0.35MGD wastewater) is not compliant with the Ocean Plan receiving water limitation, the Discharger will need to evaluate additional means to achieve compliance. Some examples may include modifying the diffuser port angles, closing off a subset of ports to increase discharge velocity, etc. 27

32. Page 66 refers to flow augmentation, which is prohibited by Ocean Plan chapter III.M.2.d.(2)(d). If the appendix is referring to commingling of wastewater and effluent, then the language should be revised to clarify this. 28

For questions or concerns, please contact Ben Neill with the San Diego Water Board at (619) 521-3376, Ben.Neill@waterboards.ca.gov. In the subject line of any response, please include the reference "823689: bneill".

Respectfully,

David Gibson
Executive Officer

DWG:jgs:dtb:bno:bin

cc by email:

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Letter S7 San Diego Regional Water Quality Control Board

David Gibson, Executive Officer
August 6, 2018

Response S7-1

Introductory comments regarding the Water Boards' roles and responsibilities in the environmental review process, permitting authority, and procedural information are noted for the record.

Response S7-2

General comments acknowledging the District's early consultation with the Water Boards, and describing Project components, including intake system and brine disposal system, are noted for the record.

Response S7-3

The referenced regulatory permitting programs are substantially consistent with those noted in the Draft EIR, including the regulatory framework discussion and as referenced in mitigation measures in Section 4.8, Hydrology and Water Quality (Draft EIR pages 4.8-9 through 4.8-11). The District is currently in permitting discussions with the Water Boards, which will determine the specific applicable permitting programs and processes required for the Project.

Response S7-4

The District appreciates information regarding mitigation strategies of the Regional Water Board and mitigation requirements that may be established through the permit process. In response to Regional Board comments, the District prepared brine discharge modeling (Appendix 4.2.2), which was used to update the estimated marine life impacts (Appendix 4.2.5). These studies support the Draft EIR conclusions, showing no marine life impacts due to ocean water intake (with use of subsurface intakes), and negligible impacts to ocean floor benthic environment (total ocean floor area affected by salinity greater than 2 ppt over average ambient is estimated at less than 0.33 acres). Using the Regional Board's recommended brine discharge modeling (see Response S7-18), for buoyant discharges, the Phase I Project is modeled to reduce marine life impacts ("turbulence mortality") associated with diffuser jets compared to "no project" conditions (the incremental turbulence mortality impact of the Project is beneficial, reducing the turbulence mortality and associated ZID). For dense discharges, the incremental effect of the Project is modeled to result in additional turbulence mortality, equating to approximately 5.57 acres in Area of Production Foregone. As discussed in the Draft EIR (page 4.3-33), this is not considered a significant impact under CEQA. The District recognizes that the Regional Board may determine that, as part of Ocean Plan compliance, the Project requires mitigation for turbulence mortality impacts. Note that turbulence mortality impacts would only occur with dense brine discharge scenarios. Should marine life mitigation be required under the Ocean Plan, the District has discussed with Regional Board staff pursuing mitigation at San Juan Creek seasonal lagoon such as that noted in the comment.

Response S7-5

The District appreciates the clarification and understands that the discharger is responsible for consultation with USFWS and/or NMFS if a project may adversely affect threatened or endangered species. Context for the Water Boards' role in the consultation process is noted for the record. Refer to Response F2 for responses to comments from NOAA NMFS. Note that the District has consulted with the USFWS and the U.S. Army Corps of Engineers through the Project's CEQA scoping process, although neither agency submitted comment letters on the Draft EIR.

Response S7-6

The referenced ocean desalination facilities will be modified in the Final EIR (see Section 3, *Draft EIR Errata*). These minor changes to cumulative project specifics do not change the Draft EIR conclusions.

Response S7-7

The sources listed in the footnote to Table 4.3-2 are from references in Appendix 10.4.4. This reference will be modified in the Final EIR, as noted in Section 3, *Draft EIR Errata*.

Response S7-8

Page 4.3-26 is edited as requested, as noted in Section 3, *Draft EIR Errata*.

Response S7-9

Draft EIR Appendix 10.11 (and as a result Table 4.3-3) was clarified pursuant to Comment S7-18, and is included in Appendix 4.2.2, and will also be incorporated into the Final EIR, as noted in Section 3, *Draft EIR Errata*. The clarified analyses (and resulting update to Table 4.3-3) do not change any Draft EIR conclusions (refer to Response S7-4 for additional discussion).

Response S7-10

These data were used because they were long-term (one-year), relatively recent, and provided data and scale for characterizing a similar near-shore current environment to the Project site. Origin of the data is described in the marine environment characterization section of Draft EIR Appendix 10.4.1 (page 15).

These data were utilized to estimate current transport for the Area of Production Foregone (APF) analysis to determine how far the larvae could be transported in one day, and from there calculate source water areas using a variety of larval durations (e.g., ranges from other entrainment studies). The current information is derived from Jenkins and Wasyl (2012), as referenced in Appendix 10.4.1. It is recognized that there is a distance of about 25 miles between the data acquisition site and the Project site, but the data was utilized along with other current data for the purpose of determining a reasonable approximation of source water volume. Use of this data is explained in Appendix D to Appendix 10.4.1.

Response S7-11

The brine discharge modeling was clarified as requested (refer to Appendix 4.2.2).

Response S7-12

Comment noted. Methodologies were addressed in the Conceptual APF appendix (Appendix D within Appendix 10.4.1). The District met with the Regional Board on several occasions to discuss Ocean Plan compliance modeling, including estimated marine life mortality. The Final EIR includes updated ETM/APF calculations (Appendix 4.2.5) based on the brine discharge modeling in Appendix 4.2.2. In particular, Appendix 4.2.5.2 includes additional ETM/APF clarifications, as discussed further in Response S7-13 below.

Response S7-13

Tables 11 and 12 were utilized to present exposure of organisms to lethal conditions and APF for modeled mixing scenarios regardless of final buoyancy condition for each mixing scenario for comparison of impacts. The justification for the larval durations was described in the Conceptual APF appendix (Appendix D within Appendix 10.4.1). The Draft EIR distinguishes between impacts based on buoyant or non-buoyant characteristics (pages 4.3-31 through 4.3-34). APF methodologies, including support for larval durations used for the analysis, are described in the Conceptual APF appendix (Appendix D to Appendix 10.4.1). APF estimates have been modified based upon clarified brine discharge modeling as requested by the commenter in Response S7-18. Those APF calculations are provided in Appendix 4.2.5.2.

As discussed in Response S7-4, the modeling shows that the Project has no marine life impact due to intake impingement or entrainment, has a beneficial impact for buoyant discharges, and a negligible (less than significant) benthic impact for dense discharges (less than 0.33 acres). Turbulence mortality impacts are also very small, with unscaled APF estimated at less than 6 acres.

Response S7-14

Refer to Response S7-4 and S7-13. The brine discharge modeling in Appendix 4.2.2 shows that the Project has a beneficial effect with buoyant discharges. Refer also to Appendix 4.2.5.2, which contains revised APF calculations based upon the revised brine modeling study in Appendix 4.2.2.

Response S7-15

Refer to Appendix 4.2.5.2, which contains revised APF calculations based upon the revised brine modeling study in Appendix 4.2.2. The appendices confirm that the discharge will not result in significant unavoidable impacts.

Response S7-16

Refer to Response S7-18. As requested, the brine discharge modeling was conducted using the Roberts 2018 methodology (refer to Appendix 4.2.2).

Response S7-17

Draft EIR Appendix 10.11 has been clarified. As shown in Table 4 of the brine discharge modeling study (Appendix 4.2.2), neither the Phase I nor the Regional Project require SOCWA wastewater for brine dilution in order to meet Ocean Plan requirements. Therefore, mitigation measure HWQ-3 has been deleted as shown in Section 3, *Draft EIR Errata*.

Response S7-18

In response to this comment, this study was conducted using the Plumes 18b model based on newly defined protocols by the California State Water Resources Control Board. Initialization details are provided in clarified Appendix 10.11, which includes the modeling output files (Appendix 4.2.2). That modeling also results in an update to Table 4.3-3 (see Section 3, *Draft EIR Errata* and Response No. S7-9). In addition, the District has submitted a draft NPDES/WDR permit application package including a Report of Waste Discharge. The District will request a formal California Water Code §13142.5(b) determination in the near future, as discussed with Regional Board staff.

Response S7-19

The District understands that the Regional Board will evaluate appropriate dilution credits as part of the Project's permitting process. The dilution credit on salinity can be obtained from the Plumes 18b dilution results contained in the brine dilution report, "Plumes 18b Modeling Assessment of Deleterious Diffuser Entrainment for the Doheny Desalination Project," dated 15 January 2019 (Appendix 4.2.2). That report shows that the Project (both Phase I and Regional Project) can meet Ocean Plan salinity requirements. The dilution credits for Table-1 pollutants can be addressed as part of the NPDES/WDR application, which is currently in review by the Regional Board.

Response S7-20

Draft EIR Appendix 10.11 has been clarified and is included as Appendix 4.2.2. The report in Appendix 4.2.2 shows that no diffuser modifications are required, as the Project can meet Ocean Plan requirements without diffuser modifications.

Response S7-21

The brine discharge report (Appendix 10.4.1) has been superseded by the clarified brine discharge modeling study, prepared in response to the commenter's requests (Appendix 4.2.2). There is no potential inconsistency between the Ocean Plan and the SJCOO NPDES permit.

Response S7-22

The brine discharge report (Appendix 10.4.1) has been superseded by the clarified brine discharge modeling study, prepared in response to the commenter's requests (Appendix 4.2.2). Reference to the LC-10 shear stress level has been removed.

Response S7-23

The brine discharge report (Appendix 10.4.1) has been superseded by the clarified brine discharge modeling study, prepared in response to the commenter's requests (Appendix 4.2.2). Also refer to Response S7-4 regarding marine life mortality analyses prepared in response to the revised brine discharge modeling study. Appendix 4.2.2 considers the guidance provided in Roberts 2018.

Response S7-24

The brine discharge report (Appendix 10.4.1) has been superseded by the clarified brine discharge modeling study, prepared in response to the commenter's requests (Appendix 4.2.2). Conclusions regarding turbulent shear impacts have been clarified.

Response S7-25

The brine discharge report (Appendix 10.4.1) has been superseded by the clarified brine discharge modeling study, prepared in response to the commenter's requests regarding permit requirements (Appendix 4.2.2). Refer also to Response S7-19.

Response S7-26

The brine discharge report (Appendix 10.4.1) has been superseded by the clarified brine discharge modeling study, prepared in response to the commenter's requests (Appendix 4.2.). As the numbers of scenarios were expanded in the revised dilution report, the terminology was modified. Also refer to Response S7-4. All clarifications and amplifications to the Draft EIR appendices have been completed to respond to public and responsible/trustee agency questions, and to incorporate best practices and modeling methods to communicate the potential impacts of the Project. As explained throughout these responses to comments, the clarified information and results do not result in any new significant impacts, nor do they require new mitigation or otherwise change the results of the Draft EIR. Refer to Master Response 3 for additional discussion regarding technical study clarifications and updates.

Response S7-27

Plumes 18b has predicted higher effective dilution and shorter distances to the 2 ppt over natural background compliance threshold than was reported previously in brine dilution studies using the Visual Plumes (UM3), and thus shows less impact than previously thought. Based on long term averages of ambient salinity records, natural background salinity at the SJCOO is 33.52 ppt, which therefore establishes the compliance threshold at 35.52 ppt under provisions of the California Ocean Plan (SWRCB, 2015). Plumes 18b results indicate this compliance threshold is met in less than 2.5 ft. from the point of discharge by all dense discharge operating conditions, including no wastewater flow scenario; whereas the Ocean Plan requires this compliance threshold is reached within 100 m from the discharge point. The modeled discharge is therefore compliant with the Ocean Plan.

Response S7-28

Flow augmentation was explored as a potential option should the Project not be able to meet Ocean Plan requirements under zero wastewater flow conditions. However, as shown in the revised discharge study (Appendix 4.2.2), the Project meets Ocean Plan requirements under all discharge requirements. Therefore, flow augmentation is no longer under consideration.

Local Agency Comment Letters

L1 City of Dana Point

L2 Metropolitan Water District of Southern California

L3 Moulton Niguel Water District

L4 Municipal Water District of Orange County

L5 County of Orange Public Works

L6 San Juan Basin Authority

L7 Santa Margarita Water District

L8 South Coast Air Quality Management District

L9 South Orange County Wastewater Authority

L10 Southern California Regional Rail Authority, MetroLink

CITY OF DANA POINT

COMMUNITY DEVELOPMENT DEPARTMENT

August 6, 2018

South Coast Water District
Rick Shintaku, Acting General Manager
31592 West Street
Laguna Beach, CA 92651-6907

SUBJECT: RESPONSE TO DRAFT ENVIRONMENTAL IMPACT REPORT FOR THE PROPOSED DOHENY OCEAN DESALINATION PROJECT

Dear Mr. Shintaku:

Thank you for meeting with City of Dana Point staff on July 12, 2018, to discuss the subject Draft Environmental Impact Report (EIR) for the Doheny Ocean Desalination Project. Based on our discussions and a review of the Draft EIR, the City of Dana Point has developed the attached comments and suggested mitigation measures for your consideration.

The City of Dana Point appreciates the opportunity to comment on this project. Should you have any questions regarding the information presented herein, please feel free to contact Belinda Deines, Senior Planner, at (949) 248-3570. 1

Sincerely,

Matt Schneider
Acting Director of Community Development

Attachment

Cc: Matt Sinacori, Director of Public Works
Matt Kunk, Principal Engineer
Lisa Zawaski, Senior Water Quality Engineer
Belinda Deines, Senior Planner

COMMENTS ON THE DOHENY OCEAN DESALINATION PROJECT
DRAFT ENVIRONMENTAL IMPACT REPORT

Local vs. Regional Project:

The Draft EIR and Preliminary Design Report (PDR), dated May 2018, characterize the local and regional projects inconsistently, and those inconsistencies are notable throughout the Draft EIR. The Draft EIR repeatedly emphasizes the fact that the regional project is addressed only at a programmatic level, and that if, and when the regional project were to be approved, additional environmental review would be required.

However, the PDR refers to a single "Project" with a range of production capacities from 5-15 1
MGD, proposed in three phases. Section 1.4.1 of the PDR states that "while original studies by MWDOC envisioned the Project as a Regional Ocean Desalination Facility capable of producing up to 15 MGD of potable water, SCWD may ultimately decide to build a smaller desalination facility sized for their own needs." It further states that "Certain pieces of common infrastructure between all Phases could be sized for Phase 3 ultimate capacity to minimize future construction costs, permitting and downtime requirements when the expansions take place." These references make it difficult to discern if the District's intent is to build only what is needed for local demand, to be expanded in the future, as portrayed in the Draft EIR, or if it intends to build a full-scale regional facility, with certain features scaled down for the first phase. The Draft EIR adds to this confusion and should be consistent throughout the chapters.

Below are some examples of how the Regional Project is inconsistent in the Draft EIR chapters:

- Based on the Project Description in the Draft EIR, all of the proposed subsurface intake wells, as well as the associated conveyance lines, capable of producing sufficient raw water for production of 15 MGD of product water are included in the project description. The Draft EIR explains that all of the well locations and pipeline alignments are being considered to preserve siting options. However, the PDR identifies these well and pipeline facilities as part of the 15 MGD Regional Project. The Draft EIR evaluates all of the wells at a project level of detail in each of the Draft EIR chapters.
- The Draft EIR also describes "flexible sizing", and notes that the following facilities
"could" be sized for the Regional Project: 2

    - Raw water conveyance pipeline – noting that "only key segments" would be upsized, and that this would not include the additional facilities described in Section 3.5. However, Section 3.5 is silent on raw water conveyance. It is therefore not possible to know which segments would be upsized, and how much additional construction would be involved in implementing the Regional Facility.

    - Desalination Plant site:
        - Reverse Osmosis (RO) Building, Electrical Building, Administration Building (excluding additional RO membrane systems)
        - Chemical Storage Structure
        - Product Water Storage Tank
        - Brine Disposal Tank and Discharge Piping

All of the aforementioned desalination plant site facilities are sited above ground, and according to the analysis in the Aesthetic section, the primary operational aesthetic impacts would be those associated with above-ground facilities. However, the discussion in the "Regional Project" section of the Aesthetics chapter states that analysis of aesthetic impacts from the Regional Project would be speculative, due to the lack of specific Regional Project facilities identified at this time. Relative to operational aesthetic impacts, there is virtually no difference between the Local Project 2
and the Regional Project, particularly on the desalination plant site itself.

- The Air Quality and GHG chapters include detailed assumptions and modeling of emissions for the Regional Project. While it is understood that these are merely assumptions, it is unclear how such assumptions can be made at a fairly specific level for these topics, while assumptions related to other environmental issues cannot. Presumably if there is considerable variability in the Regional Project design and operation, the fine-grained analysis in the air quality and GHG analyses are likely to yield results with a wide margin of error, which is not disclosed adequately in the analysis.

Project Description:
In addition to the need for clarity on the Local vs. Regional Project features, the following are additional issues of note in the Project Description.

- Regarding the selection of raw water conveyance lines, the Draft EIR notes the repaving moratorium on Del Obispo Street, which extends until 2021, and presumably would not be compatible with the project schedule. Based on this moratorium, the City's preference would be the South Alignment for the Raw Water Conveyance.
- Section 3.6 discusses project construction activities, but it is not clear what facilities and activities are associated with each phase.
- In discussing the Raw Water Conveyance Alignment (pages 3.0-40 and 41), the Project
Description states that the alignment beneath the Caltrans PCH bridge assumes that the 3
bents have been seismically retrofitted to allow for a transverse crossing within 10 feet of the pilings. This is an important assumption given that if this alignment is determined to be infeasible, the only other option would be within Del Obispo Street. Also, if reinforcement is needed/proposed, it would have significant cost and schedule implications, and would require an analysis of environmental effects.
- The permits and approvals matrix identifies CDP issuance by the City of Dana Point, and states that the permit "may be administered by the California Coastal Commission with the City's consent for consolidated permit review." The City's certified Local Coastal Plan ("LCP") incorporates the provision automatically providing for a consolidated CDP; therefore, a Coastal Development Permit will be processed directly by the California Coastal Commission for the entire project. As such, the development will be evaluated for consistency with the Coastal Act, and the policies of the City's LCP will be used as guidance.

Aesthetics, Light and Glare:
In general, the Draft EIR makes a number of statements and draws conclusions that appear to lack
supporting evidence, including the following: 4

- Temporary construction effects of the slant wells is determined to be less than significant with mitigation. A photograph of the Doheny test well, with varying screening, is provided as evidence to support this conclusion. It is also noted that sound curtains approximately

24-feet in height could be used for further screening. The mitigation that is offered for these effects is preparation of a Construction Lighting and Screening Plan should be expanded. It essentially defers the effectiveness of the mitigation to that "determined appropriate by the applicable jurisdiction(s)" without stating what standards would be applied, and who would determine the mitigation to be appropriate. The well locations that are within the City's LCP permit jurisdiction are those described as "Pods" F, G, and H (Capistrano Beach). Given that the well locations for the Phase 1 Local Project have not yet been selected, the City may wish to coordinate with the Coastal Commission to develop a standard mitigation that would apply to all of the potential well locations. 4

- Little analysis and support is provided to demonstrate that overall, construction of the facilities on the desalination plant site would not result in significant visual impacts. Moreover, there is virtually no analysis of cumulative impacts – the chapter merely states that all projects must meet applicable requirements of the City and Coastal Commission, then references the General Plan Final EIR and states that all Project impacts are mitigated to less than significant levels.

- Site architecture, landscape, and lighting design consideration should also be given to the site's visibility from areas east of San Juan Creek in Capistrano Beach, Doheny Village, and passenger rail traffic.

Air Quality:
The City recommends that the following mitigation measures be incorporated to ensure that the proposed project is in compliance with the City's best management practices.

- The applicant shall apply and obtain a haul route permit from the City of Dana Point for all truck activity for the proposed construction activities. The haul route for all activities shall be outlined in the permit application. 5

- During the construction phase, all construction materials, waste, grading or demolition debris, and stockpiles of soil, aggregates, soil amendments, etc. shall be properly covered, stored, managed, secured and disposed to prevent transport into the streets, gutters, storm drains, creeks and/or coastal waters by wind, rain, tracking, tidal erosion or dispersion.

Geology and Soils:

- Please provide a discussion addressing the potential impact of the proposed groundwater withdrawal (slant well pumping) from the unconsolidated alluvial sediments (paleochannel) on the support for the adjacent harbor facility and associated structures (jetty, etc.), and discuss the possibility of any subsidence as a result of the withdrawal.

- Please provide a discussion and clarify the potential impact on existing development resulting from reducing the water level of the shallow San Juan Basin (SJB) aquifer by up to an estimated 10.46' and 13.96' under Scenario 1, and 21.84' to 26.64' under Scenario 3, as reported in Appendix 10.10.1 ("Doheny Ocean Desalination Project, Model Update and Refinement…" by Geoscience, dated March 1, 2018). Please evaluate and address as necessary potential subsidence within the SJB with respect to the proposed groundwater withdrawal (slant well pumping) and associated potential impacts on existing structures, roadways, utilities, and other improvements. 6

- Should Comments 1 and 2 above be discussed or addressed elsewhere in the EIR, please provide a summary of the section and technical document addressing these comments. If the comments do not appear to be addressed elsewhere in the EIR, the City of Dana Point suggests the comments be added as additional mitigation measures prior to construction of slant wells. 6

- Please consider incorporating the following suggested mitigation measures to minimize potential temporary construction impacts:
  1. Please add the additional points to GEO-1:
     a. The applicant shall provide a complete site-specific geotechnical engineering report for review by the City of Dana Point City Engineer.

     b. A statement shall also be provided in the geotechnical report that on-site observation and testing shall be provided to allow the Engineer of Record to certify all work completed.

     c. Geotechnical recommendations shall be provided for constructing retaining walls and/or associated temporary slopes as applicable.

  2. Prior to construction of slant wells, address all environmental concerns as necessary with respect to the proposed groundwater withdrawal. Please perform additional sampling and evaluation of groundwater to assess groundwater quality and any impacts associated with off-site groundwater contamination and LUST facilities, and discuss potential impacts of any off-site groundwater contamination on the proposed groundwater withdrawal. A copy of the final hydrogeology or other studies for slant well construction shall be distributed to all stakeholders including the City of Dana Point. 7

  3. Prior to operations, a complete final Geotechnical Report shall be prepared by the project geotechnical consultant, in accordance with City of Dana Point standards. A copy of the final geotechnical report shall be distributed to all stakeholders including the City of Dana Point.

  4. Prior to operations, an As-Built Grading Plan shall be prepared by the Civil Engineer of Record. A copy of the as-built grading plans shall be distributed to all stakeholders including the City of Dana Point.

Hydrology and Water Quality:

- The analysis notes that under certain flow conditions for wastewater effluent through the SJCOO, salinity levels may exceed standards set forth in the Ocean Plan. The mitigation identified to reduce the impact is for the District to "ensure" that a specified minimum flow of wastewater effluent is achieved. However, it is unclear how the District can make such assurances. The PDR describes a brine storage tank that would presumably address this issue, but the EIR Project Description does not appear to mention that project feature. 8

- Page 4.8-19, please note that the SOC WMA Executive Committee recently approved the 2018 IRWM Final Plan on May 3, 2018. Please update as such.

- Page 4.8-19 please Update Orange County Drainage Area Management Plan to South Orange County Water Quality Improvement Plan (WQIP), recently approved by San Diego Regional Water Quality Control Board on June 20, 2018. Information and fact sheet available here: 8

http://www.ocwatersheds.com/documents/south_oc_water_quality_improvement_plan_(wqip)

- Please consider adding the following mitigation measure to HWQ-1:

  During the construction phase, all construction materials, waste, grading or demolition debris, and stockpiles of soil, aggregates, soil amendments, etc. shall be properly covered, stored, managed, secured and disposed to prevent transport into the streets, gutters, storm drains, creeks and/or coastal waters by wind, rain, tracking, tidal erosion or dispersion.

- The City requests that Mitigation Measure HWQ-4 be re-written to provide more clarity, detail, and specifications for the proposed Water Quality Management Plan (WQMP), and specifically requests that the following language be included in the mitigation measure:

  Early in the design/planning, the District (or its designee) shall prepare a Preliminary Water Quality Management Plan (WQMP) for review and approval by the City of Dana Point in conformance with *Model Water Quality Management Plan (Model WQMP) for South Orange County* (2017) and associated *Technical Guidance Document* (2017) identifying applicable site design BMPs, which address low impact development and designing the site in sustainable ways, source control BMPs, which are operation, management, LID/Treatment Control BMPs (Harvest & Reuse, On-site retention and/or biofiltration), and Hydromodification Management BMPs, as applicable. Prior to final approval and operations, a Final WQMP and Operations and Maintenance (O&M) Plan pursuant to the City's Water Quality Development Standards shall be prepared and submitted to the City for review and approval, including: housekeeping activities which control pollutants at the source, include staff and contractor training, street sweeping, storm drain system maintenance, efficient irrigation practices, litter management, etc.; and treatment BMPS, which remove pollutants from runoff prior to discharge. All these BMPs will be implemented for comprehensive pollutant management program and management and treatment of the runoff generated from the project. 9

  Final certification for all improvements associated with water quality and the project WQMP for review shall be submitted to the City Engineer by separate submittal by the project's Civil Engineer and indicate that the improvements as being substantially completed and in conformance with the approved WQMP. The City's WQMP Construction Certification letter template, including photos, shall be completed by the project's Civil Engineer, certifying that all structural best management practices (BMPs) described in the Project's WQMP have been constructed and installed in conformance with approved plans and specifications after a field inspection has been conducted.

- The applicant shall design and provide a Landscape Plan as a part of the permanent WQMP requirements. The Landscape Plan shall be in accordance with the City's Municipal Separate Storm Sewer Systems (MS4s) Permit requirements, and City of Dana Point Municipal Code Chapter 9.55 on Water Efficient Landscape Standards and Requirements. 9

- Please add a statement to HWQ-6 stating: A copy of the final hydrology study shall be distributed to all stakeholders including the City of Dana Point.

Noise:

- The City requests that the following additional mitigation measures be incorporated and applied to all phases/components of project construction:
  1. The project contractor shall, to the extent feasible, schedule construction activities to avoid the simultaneous operation of construction equipment so as to minimize noise levels resulting from operating several pieces of high noise level emitting equipment.
  2. Construction noise reduction methods such as shutting off idling equipment, 10 construction of a temporary noise barrier, maximizing the distance between construction equipment staging areas and adjacent residences, and use of electric air compressors and similar power tools, rather than diesel equipment, shall be used where feasible.
  3. Construction hours, allowable workdays, and the phone number of the job superintendent shall be clearly posted at all construction entrances to allow surrounding property owners to contact the job superintendent if necessary. In the event the City receives a complaint, appropriate corrective actions shall be implemented and a report of the action provided to the reporting party.

Recreation:

- This chapter notes that intake well pod F has been eliminated from further consideration due to conflicts with the bike path and construction too close to the beach. This should be 11 noted in the Project Description and throughout other chapters in the EIR.

Transportation and Traffic:

- Page 4.13-13, Third Paragraph – Remove Del Prado from list of allowable truck routes.

- Page 4.13-15, Paragraph 1 – Replace "railroad right of way" with "Coast Highway"; City's project, if ever constructed (currently no funding), would be done in the City's right of way. 12

- Page 4.13-15, Paragraph 4 – Replace "PCH" with "Coast Highway".

- Page 4.13-16, Paragraph 4 and 5; It is noted that the North Alignment is not preferred. The reasons are more than just the pavement moratorium. Reasons should also be noted regarding the avoidance and necessary mitigation for traffic impacts resultant from that work on PCH, Del Obispo and Dana Point Harbor Drive, all with heavy traffic loads, as well as impacts to City of Dana Point facilities and parks. TRF-2 is suggested.

- In addition to the mitigation measure, discussion should be added in this section describing the expected impacts by the trenching work and that SCWD is required to mitigate all impacts. 12

- Please consider the following suggested mitigation measures to minimize temporary construction impacts associated with the proposed project:
  1. Add TRF-3 as follows (or some version thereof): "Prior to construction, SCWD (or its designee) shall submit an encroachment permit application to the City of Dana Point for review. SCWD shall work with the City of Dana Point to address all impacts expected with the work per the City's Municipal Code, Encroachment Permit Standard Conditions and Details, and any other applicable regulation, and secure an encroachment permit prior to commencement of any work activities. The encroachment permit shall address at a minimum the required traffic control (also included in TRF-1), required asphalt and concrete repairs to City streets, storage of equipment and materials, water quality regulations, dust control, street sweeping, construction hours, and all other impacts/requirements."

  2. Prior to construction, the applicant shall prepare a Fire Master Plan and submit said plan to the Orange County Fire Authority (OCFA) and the City of Dana Point Public Works for review and approval. Hydrant locations shall be designated as part of the Plan. A Fire Mater Plan shall be required for the proposed facility and slant well location as deemed necessary by OCFA. 13

  3. During construction activities, the applicant shall coordinate all traffic, site ingress and egress and construction parking along Shoreline Drive with the City of Dana Point. The coordination shall address and minimize any potential impacts to PCH.

  4. Please consider adding the following modifications to TRF-1 - Prior to commencing Project construction, SCWD (or its designee) shall develop and implement a Parking and Staging Plan for all phases of construction to require that all Project-related parking occurs on-site or in pre-designated off-site parking areas. The Staging Area shall maintain through park access for motor vehicles, bicycles and pedestrians. To accommodate peak parking demand for Special Events during the off-season, SCWD (or its designee) shall coordinate with State Parks to reschedule Special Events to alternate venues or to outside the off-season construction period, and if not possible, shall arrange for sufficient off-site parking and shuttles such that the displaced parking stalls are offset. The contractor shall utilize shuttles to transport workers to and from any off-site staging/parking areas (if utilized) and Project construction areas. If off-site staging/parking areas are utilized, and are outside of SCWD property, such as in the City of Dana Point, SCWD (or its designee) shall notify and coordinate with the City, or other affected jurisdiction(s), on the location and duration of use of the off-site staging/parking area(s). At least 60 days prior to start of site mobilization, SCWD (or its designee) shall submit the Plan to each affected jurisdiction for review and approval.

5. Please consider the following recommendations to TRF-2 or as an additional mitigation measure:

   For all construction-related activities of all project components:
   - The extent and duration of open trench construction activities, including the timing of construction work shifts, nighttime construction activities (if any), and whether roadway plates will be used when construction is ceased for the day (and re-opened during construction), or used during the weekday AM and PM peak commute hours.

   For the preferred South Alignment of Raw Water Conveyance: 13
   - SCWD shall confirm with Caltrans and the City of Dana Point that the bents (columns/piles) of the PCH bridge over Doheny Park Road are seismically stable to allow for the transverse crossing of the raw water pipeline within 10 feet of the footings. If the bents are not seismically stable for the transverse crossing, SCWD shall develop an alternate plan to meet the seismic requirements of crossing under the bridge, or, consider use of the North Alignment, via Del Obispo Street.

   For the alternate North Alignment of Raw Water Conveyance:
   - SCWD shall reimburse the City of Dana Point for loss of the City's Pavement Grant Funds if the North Alignment is selected and construction activities occur before fall 2021. The City completed a major paving project on Del Obispo Street in 2016. The paving was grant funded with a 5-year moratorium on construction. The North Alignment will only be considered should the South Alignment be determined infeasible, or if SCWD elects to offset the City's loss of grant funds (which the City would forfeit if repaving occurs prior to fall 2021).

Utilities and Service Systems:

- There is no discussion in this section about the planned waterlines on City, State, railroad or County property. A section should be added addressing those pipelines and the impacts therewith. The City should reserve the right to review potential impacts prior to adoption of the EIR. In order to evaluate these impacts, please consider the following suggested mitigation measure for temporary construction impacts:

  1. Prior to any utility or underground improvements, the applicant shall submit an improvement plan (or improvement plans as needed), in compliance with City of Dana Point standards, for review and approval by the City Engineer. The applicant shall include: 14

     a. Submittal of plans and documents as required by the current Public Works Department's plan check policies, City of Dana Point Municipal Code and the City of Dana Point Grading Manual and City's Municipal Separate Storm Sewer Systems (MS4s) Permit requirements.

b. All work in the right-of-way shall be completed in conformance with the Encroachment Permit conditions to the satisfaction of the City Engineer.

c. The applicant shall be responsible for coordination with SDG&E, AT&T California and Cox Communication Services for the provision of electric, telephone and cable television services. All utility services shall be shown on the construction plans. All utility work, by other agencies, in the right of way will require separate permits from the Public Works Department.

d. Any City owned street or property damaged by the applicant's work shall be repaired per City Standards and as directed by the City Engineer. 14

e. The applicant shall provide design documents for all traffic control for the construction of all proposed street improvements, unless otherwise approved by the City Engineer. The traffic control plans shall be prepared by a licensed California Traffic Engineer and submitted for review and approval by the City Engineer.

f. The applicant shall relocate all impacted public and private utilities to allow for the construction of the proposed improvements.

g. The applicant shall coordinate with the Public Works Department should construction impact the seasonal City Trolley. The coordination and City Trolley route stop may result in additional temporary improvements constructed by the applicant.

Alternatives:

- The Alternatives discussion addresses recycling only as an expansion of the District's existing Title 22 irrigation water system. It makes reference to the regulatory restrictions associated with blending Title 22 water with potable water supplies, but it does not address the potential for potable reuse – applying advance treatment technologies, similar to those used for desalination - to recycle wastewater for potable use. 15

The City requests the following documents, as they become available, for informational purposes only. While the City does not have direct permit authority over this project, these items will help City staff ensure compliance with all applicable mitigation.

- The District (or its designee) shall provide grading plans to the City of Dana Point that clearly show the amount of earthwork and export or import required. The earthwork required and associated construction equipment, including truck trips should be in compliance with City standards, for work hours and noise ordinances. 16
- A copy of the final hydrogeology or other studies for slant well construction shall be distributed to all stakeholders including the City of Dana Point.
- A copy of the final geotechnical report shall be distributed to all stakeholders including the City of Dana Point.

Letter L1 City of Dana Point

Matt Schneider, Acting Director of Community Development

August 6, 2018

Response L1-1

This comment includes introductory remarks that do not require a response. Please see Master Response 2 regarding the description of the Local Project versus Regional Project. Specific comments regarding Local Project vs. Regional Project clarification are addressed below.

Response L1-2

Please see Master Response 1 regarding the Project description. Consistent with principles of CEQA, the EIR provides an analysis of the Local (Phase I) Project and the potential future Regional Project using available information and reasonably foreseeable circumstances. Recognizing that final slant well siting would be refined through the regulatory permitting and final design and construction process, the Draft EIR evaluates potential slant well impacts across a broad study area (as shown in DEIR Exhibit 3-1, Regional Vicinity and Exhibit 3-3, Project Facility Locations). Master Response 1, Master Response 2 and Responses S4-3 through S4-8 provide additional discussion and clarification regarding Project Description assumptions for the Local and Regional Project. Even though the District is only considering approval of the Local Project at this time, and the Local Project could function entirely independent of the Regional Project, the EIR evaluates potential future impacts of the Regional Project should it be pursued in the future. Where possible, Regional Project impacts were quantified.

With respect to slant wells, although the slant wells could be located anywhere within the slant well study area (shown on Exhibit 3-3, Project Facility Locations), only sufficient wells and related raw water conveyance pipelines to produce up to 5 MGD of potable water would be constructed during Phase I.

With respect to raw water conveyance lines, Section 3.5 (starting at DEIR, p. 30-36) begins with the note that the Regional Project would require increased capacity "at all of the above-stated components…." Raw water conveyance lines for the additional slant wells would be required to convey raw water from the slant wells to a raw water conveyance system leading to the desalination facility. Therefore, potential future Regional Project facilities would include additional slant wells and related facilities, additional raw water conveyance lines connecting the new slant wells to a larger raw water conveyance line, likely constructed in Phase I, that would carry raw water from Doheny State Beach (DSB) under PCH and the railroad to the desalination facility site.

With respect to the desalination facility site, Exhibit 3-6, Desalination Facility-Conceptual Site Plan (and corresponding graphics in Appendix 10.1, Preliminary Design Report) uses color coding to show which desalination facility components would be constructed during Phase I. The renderings contained in Appendix 10.1 and shown in DEIR Section 4.1, Aesthetics, show the ultimate desalination facility site concept for the Regional Project, as foreseen at this time. There would be only minor differences in operational aesthetic effects of the Phase I Project compared to the Regional Project, as the Phase I Project would only require Phase I facilities shown as Phase I facilities in Exhibit 3-6. For example, above-ground and visible infrastructure such as the RO membrane building, product water tank and the chemical storage area would be present for all phases, but other visible infrastructure, such as the alternative power supply pad, flocculators, sedimentation basin and additional catalytic media filters, would add to the project's visible profile within the site plan footprint once constructed for the Regional Project. Slant well impacts and associated raw water conveyance line construction impacts for the Regional Project would be similar to that described for the Local Project. The Draft EIR conservatively concludes that aesthetic effects of the Regional Project would be speculative at this time simply because the precise mix, design, and location of the components necessary for expansion can only be estimated for planning purposes at this juncture.

With respect to the Air Quality and GHG chapters and as stated in the Draft EIR, Phase 1 (Local Phase) is analyzed at a project-level, and Phase 2 (Regional Phase) at a program-level (Draft EIR Section 2.1, Purpose of the EIR, page 2.0-1). Therefore, the Draft EIR appropriately discloses the level of analysis and review for the Regional Project. Although design and operational variability may exist for the Regional Phase, exact design is not required to provide a reasonable and foreseeable conservative estimate of air and greenhouse gas emissions from Regional Phase construction and operation. For example, the Regional Project phase would include drilling and development of 5 slant wells, expansion of the Project site, and installation of additional equipment. The construction equipment activity required for slant well drilling and development would remain largely unchanged between the Local and Regional phases of Project construction regardless of where future slant wells are sited. Therefore, the construction equipment type, size (horsepower), assumed for slant well drilling and development for the Local phase (per well) is also used for the Regional Phase.

Response L1-3

Please see Master Responses 1 and 2 regarding the Project Description and clarifications associated with the Local versus Regional Project.

Regarding the raw water conveyance alignment options, given the moratorium on construction within Del Obispo Street until 2021, the City of Dana Point has indicated its preference for the South Alignment, indicated in the Preliminary Design Report (Appendix 10.1) as Alignment 6. This is also noted in the DEIR (page 1.0-58, page 3.0-20 and elsewhere), and the City's restatement of this preference is noted for the record.

The DEIR includes estimates of construction phasing and related construction assumptions based on Appendix 10.1, Preliminary Design Report and best available information, noting that actual construction details may be modified as part of regulatory permitting, final design or the construction process. In some cases, the Air Quality and GHG analyses required more detailed assumptions for construction and operational emission modeling. These assumptions have been pulled forward and included in the Project Description. Refer to Master Responses 1 and 2.

A closer inspection of the as-built drawings for the Caltrans PCH bridge indicates that this bridge has not undergone a recent seismic retrofit; however, the preferred South Alignment within Doheny Park Drive would not cross within 10 feet of the piles for the bridge abutments on either side of the road with any likely arrangement. Further, Chapter 17, page 29 of the Caltrans Project Development Procedures Manual stipulates Caltrans will allow utility installation as long as such installation is at least 24 inches horizontally from the outside of piles. Therefore, there is no conflict, reinforcement is not needed, there would be no "significant cost and schedule implications" and no additional environmental impacts with this alignment option.

The District acknowledges that a Coastal Development Permit will be processed directly by the California Coastal Commission for the entire Project. The statement on page 3.0-45 is clarified to that effect as noted in Section 3, *Draft EIR Errata*.

Response L1-4

With respect to temporary visual effects due to construction, please note that Draft EIR page 4.1-8 lists Project design features, including seasonal construction, siting of slant well vaults further inland from the beach, and reliance on the District's corporate yard for construction staging, to minimize these temporary impacts. Mitigation Measure AES-1 provides additional treatment to further reduce these impacts, and the simulations provide realistic conditions to disclose conditions and effectiveness of the mitigation during construction. Involvement of local jurisdictions, including the cities of Dana Point and San Juan Capistrano, is encouraged by the measure to allow input based on local preferences or sensitivities. The CEQA standard for effectiveness, however – to mitigate for the substantial degradation of the existing visual character or quality of the area – remains unchanged. Decisions regarding exact materials or screening heights may be part of the Screening Plan, but effectiveness is not deferred as demonstrated in the examples and simulations on pages 4.1-9, 4.1-10, and in Exhibits 4.1-9 through 4.1-13 at the conclusion of Section 4.1 of the Draft EIR. Coordination with the Coastal Commission on a standard treatment for well screening would be appropriate and consistent with the measure.

The analysis supporting conclusions regarding the effect of construction impacts is provided on pages 4.1-8 through 4.1-11. The analysis describes the various components of the facility, their relative impact given their footprint, scale and physical location relative to the area's existing aesthetic resources and views. The EIR's less than significant conclusions for construction impacts recognize and consider the existing degraded aesthetic conditions of the site, which is currently used for vehicle storage and industrial uses.

Regarding the effectiveness of site architecture, landscaping and lighting design from multiple viewpoints, treatment of visual impacts of the Project as a whole, through design, should serve as an effective strategy to minimize impacts from multiple locations. The Draft EIR page 4.1-16 explains that the individual site-specific aesthetic treatment and mitigation of cumulative projects in the vicinity also addresses the cumulative effect and should serve to improve the visual environment of the community over time. Exhibit 4.1-10 simulates the Project's appearance from the PCH bridge (compared to the existing condition), and Exhibit 4.13 simulates views from the passenger rail lines. These representative viewpoints support the EIR's conclusion that the Project would not impact scenic vistas as viewed from these and other locations and is based on the degraded nature of the existing visual environment at the site. Comparing the post-project appearance of the facility to the existing visually degraded state of the project site is the core of the analysis and conclusions. Finally, note that the temporary slant test well was successfully constructed at DSB and approved with nominal screening, without any known complaint.

Response L1-5

Measures to minimize fugitive dust and dispersal are addressed in Mitigation Measure AQ-3 and are consistent with SCAQMD's Fugitive Dust Mitigation Measures. Note that the first recommended mitigation measure is substantially similar to Mitigation Measure TRF-2, and the second recommended mitigation measure is substantially similar in intent and scope to Mitigation Measure AQ-3. For major public works projects such as this, it is common for multiple regulatory agencies having similar overlapping jurisdiction or resource area interests to have variations in the specific language desired for permit conditions.

To be as responsive as possible to the City's best management practices, additional bullet points will be added to Mitigation Measure AQ-3, as noted in Section 3, *Draft EIR Errata*.

Response L1-6

Subsidence from groundwater pumping occurs when sediments that are susceptible to hydrocompaction are dewatered. The evacuation of water from within the sediment structure results in a collapse of the soil grains, essentially reducing the thickness of the unit which results in subsidence. However, when groundwater is pumped from the aquifers beneath the ocean, the ocean acts as a constant recharge source and therefore the aquifer materials cannot be dewatered. To our knowledge, the Dana Point Harbor is constructed on pile foundation which are end bearing and keyed into bedrock beneath the unconsolidated material of which the aquifer is composed. Therefore, any potential movement of the aquifer itself would not result in subsidence impacts to the adjacent harbor facility and associated structures.

With regards to potential subsidence impacts to structures overlying the subterranean channel underlying San Juan Creek, the amount of potential subsidence is dependent on the thickness of the material that is susceptible to compaction after dewatering. Several thin fine-grained lithologic units are present near the mouth of San Juan Creek in the depth interval between 25 feet and 36.5 feet. The presence of these units was reported in "Horizontal Well Technology Application in Alluvial Marine Aquifers for Ocean Feedwater Supply and Pretreatment: Section 1: Hydrogeology Investigation, dated September 30, 2008." The combined thickness of the units is less than eight feet and therefore will not pose a risk for subsidence. In addition, the units discontinue inland in the subsurface before Pacific Coast Highway. Drawdown for the Phase I Project will not dewater the material and therefore, there is no potential subsidence risk to structures in the area from wellfield pumping. Under a potential future Regional Project scenario where all slant well pumping occurs at DSB (referred to as Scenario 4 in Appendix 4.2.3.1), drawdown will be greater and will range from -33.47 to -42.79 ft in the shallow aquifer as reported in the recent work included with these responses. Drawdown from the Regional Project will result in water levels decreasing so as to be lowered to elevations below the units noted above. But as noted above, since the fine-grained units are thin, discontinuous, and localized, there would be less than significant potential impacts from subsidence.

Response L1-7

The requested clarifications and modifications to Mitigation Measure GEO-1 will be incorporated into the Final EIR, with minor edits, as noted in Section 3, *Draft EIR Errata*. Recommended measures 1, 3 and 4 will be added as modifications to Mitigation Measure GEO-1, and further language in response to recommended measure 2 will be added as a modification of Mitigation Measure HAZ-3, as noted in Section 3, *Draft EIR Errata*.

Response L1-8

The brine modeling in Appendix 4.2.2 shows that a minimum dilution from SOCWA outfall wastewater is no longer required to achieve Ocean Plan consistency (refer to Response S7-17 and Appendix 4.2.2).

Additional comments regarding the recent approvals of the 2018 IRWM Final Plan (May 3, 2018) and Orange County Drainage Area Management Plan (June 20, 2018) are noted for the record.

Response L1-9

The requested modifications to Mitigation Measures HWQ-1 and HWQ-4 will be incorporated into the Final EIR as requested, as noted in Section 3, *Draft EIR Errata*.

With respect to the requested landscape plan, please see Mitigation Measure AES-2. This measure is amplified as noted in Section 3, *Draft EIR Errata*.

Mitigation Measure HWQ-6 is also expanded as noted Section 3, *Draft EIR Errata*.

Response L-1 10

The requested modifications, with minor edits, will be added as bullet items to the end of Mitigation Measures NOI-1 as noted in Section 3, *Draft EIR Errata*.

Response L1-11

Comment that Pod F has been eliminated from further consideration reflects the language of Mitigation Measure REC-1. As stated elsewhere in this section and the Draft EIR, the slant well pod locations are conceptual and envisioned to shift in order to avoid impacts. This is already noted in Section 1.6. Specifically, DEIR page 3.0-19 states that "As discussed further in Section 4.0, the District has eliminated Pod F from consideration at this time due to the narrow beach section, likely beach construction required, vulnerability to coastal hazards, temporary closure required for the Class I Beach Trail bike path, and temporary closure required for the Capistrano Bay Community Service District's maintenance facility access road."

Response L1-12

Text clarification and minor edits will be incorporated into the Final EIR as noted in Section 3, *Draft EIR Errata*. Please note that the Draft EIR and proposed Mitigation Measures TRF-1 and TRF-2 address both the north and south alignments and all aspects of construction, including trenching work.

The requested clarification to Page 4.13-16 will be incorporated into the Final EIR as noted in Section 3, *Draft EIR Errata*.

Response L1-13

With respect to first three bullet list items, suggested specific mitigation language, with minor edits, will be incorporated into the Final EIR as noted in Section 3, *Draft EIR Errata*.

With respect to the fourth bullet list item, this wording appears substantially consistent with current Mitigation Measure TRF-1 and is therefore not proposed for further editing.

With respect to the fifth bullet list item, measure TRF-2 has been modified as requested, as noted in Section 3, *Draft EIR Errata*.

Refer to Response L1-3 regarding the PCH bridge bents. This is no longer considered an issue, and no new or modified mitigation measures are required.

With respect to the sixth and final bullet list item in this comment, the requested measure has been added to existing Mitigation Measure TRF-2, as noted in Section 3, *Draft EIR Errata*.

Response L1-14

The comment is not clear as to which "planned water lines" are being referred to. The Draft EIR discusses and shows in exhibits the proposed slant wells, raw water conveyance lines, brine connection line to the SOCWA outfall, and connection to the onsite and nearby product water conveyance lines (see Exhibits 3-3 and 3-9). Impacts and mitigation for construction of these water lines is discussed throughout the Draft EIR. The requested measure is noted for the record, and is substantially reflected in existing standard practices, the City's existing encroachment permit process, and Mitigation Measure TRF-3 (refer to Section 3, *Draft EIR Errata*).

Response L1-15

Comment regarding the Alternatives analysis is noted for the record. The analysis provides a range of reasonable and feasible alternatives to the proposed Project intended to reduce or eliminate one or more environmental impacts. As noted in the Draft EIR, the District considered a wide range of alternatives as part of the Project scoping process. This included formation of a Water Reliability Working Group consisting of local stakeholders supported by a nationally recognized water reliability consultant.[1] The Working Group considered a wide range of water supply projects that could meet the District's fundamental water reliability needs. This range of projects included the San Juan Watershed Project (SJWP) (Section 3.3 of the Working Group's final report), for which Phase 2 includes an indirect potable reuse component. The SJWP was found to be less favorable than the proposed Project, although it is still under consideration by the San Juan Basin Authority, with the District being a partner in that project. The proposed Doheny Ocean Desalination Project does not preclude pursuit of the SJWP and, in fact, the District has engaged in extensive coordination and consultation with the San Juan Basin Authority with

[1] https://www.scwd.org/civicax/filebank/blobdload.aspx?blobid=8044 (accessed March 19, 2019).

respect to their project. Regarding direct potable reuse, this water supply option is currently not feasible from a regulatory perspective in California since it is currently not allowable. Should it become available, the District could consider adding this supply option to its water supply portfolio, although this would require separate CEQA review and extensive regulatory agency approvals.

Response L1-16

The District will provide the requested information as it becomes available for public distribution. The District appreciates the City's assistance and constructive comments through the Project's CEQA process and will continue to closely coordinate with City staff as the Project moves through the CEQA process. Should the Project be approved by the District, District staff would then initiate project design and local review coordination with City staff through the encroachment permit process and as required in EIR mitigation measures or as required in existing City review processes.

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

Office of the General Manager

August 6, 2018

Mr. Rick Shintaku, PE
South Coast Water District
Acting General Manager, Chief Engineer
31592 West Street,
Laguna Beach, CA 92651-6907

Dear Mr. Shintaku:

RE: Support for the Doheny Ocean Desalination Project Draft Environmental Impact Report

The Metropolitan Water District of Southern California (Metropolitan) would like to express support for the South Coast Water District's proposed Doheny Ocean Desalination Project (Proposed Project) and associated CEQA documents. The South Coast Water District (District) is proposing to develop an ocean water desalination facility in Dana Point, California, at Doheny State Beach and vicinity. The desalination facility would produce up to 15 million gallons per day (MGD) of potable drinking water. The District intends to construct a facility with an initial capacity of up to 5 MGD, with potential for future expansions up to 15 MGD. Both the initial up to 5 MGD and ultimate up to 15 MGD capacities would be available for the District and local water agencies to provide high quality, locally-controlled, drought-proof water supply. The desalination facility would also provide emergency backup water supplies should an earthquake, system shutdown, or other event disrupt the delivery of imported water to the area. The Proposed Project would consist of a subsurface slant well intake system, raw seawater conveyance to the desalination facility site, a seawater desalination facility, brine disposal through an existing wastewater ocean outfall, solids handling facilities, and potable water delivery to adjacent distribution infrastructure. 1

Metropolitan is a public agency and regional water wholesaler. Metropolitan is comprised of 26 member public agencies, serving approximately 19 million people in portions of six counties in Southern California, including Orange County. Metropolitan's mission is to provide its 5,200 square mile service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way.

The severity of the State's recent drought, the extended dry period on the Colorado River, and the projected long-term impacts of climate change underscore the need for continued diversification of Southern California's water resource portfolio. Metropolitan's long-term Integrated Water Resources Plan (IRP) achieves diversification with an "all-of-the-above" approach. This includes maintaining Colorado River Aqueduct supplies and restoring the reliability of the State Water Project, while also developing local climate-resilient resources such as seawater desalination. Metropolitan's IRP established a regional production goal of 2.4 million acre-feet per year from local supplies by 2040. Over the same horizon, local planning agencies project Metropolitan's service area to grow by more the three million people. New local projects, such as the District's Doheny

Mr. Rick Shintaku, PE
Page 2
August 6, 2018

Ocean Desalination Project, help increase local supplies and reduce Southern California's reliance on imported water supplies to meet expected future demands.

Metropolitan may act as a responsible agency under CEQA for future actions on the Proposed Project. Metropolitan has reviewed the DEIR and has determined that Metropolitan facilities will not be impacted by the project,that the DEIR and its associated documents provide a more than adequate 1
basis for the South Coast Water District's Board to determine that proposed project would meet its objectives, that the District has mitigated all of the potentially significant impacts identified to a less than significant level through implementation of feasible mitigation measures, and that the DEIR and associated documents meet all the requirement of the California Envionrmal Quality Act. Metropolitan, therefore, recommends that the South Coast Water District Board certify a final EIR and approve the Proposed Project. Please contact Warren Teitz at (213) 217-7418 or via e-mail at wteitz@mwdh2o.com, or contact Thomas Napoli of my staff at (213) 217-6720 or via e-mail at tnapoli@mwdh2o.com, if you have any questions.

Sincerely,

Vikki Dee Bradshaw

for
Deirdre Brand
Environmental Planning Section

WAT:vh

cc: Robert Hunter
General Manager
The Municipal Water District of Orange County
18700 Ward Street
Fountain Valley CA 92708

Bcc: Brad Coffey
Bob Harding
Warren Teitz
Tom Napoli
James Bodnar

Letter L2 Metropolitan Water District of Southern California

Deirdre Brand, Environmental Planning Section
August 6, 2018

Response L2-1

Comments in support of the Project and Metropolitan's role as a responsible agency under CEQA and its affirmation as to the adequacy of the Draft EIR are noted for the record.

moulton niguel water district

RECEIVED
AUG 06 2018
BY: ....

Comment Letter L3

August 1, 2018

South Coast Water District
Attn: Mr. Rick Shintaku, PE
Acting General Manager, District Engineer
31592 West Street
Laguna Beach, CA 92651

Subject: **Response from Moulton Niguel Water District to Notice of Availability of a Draft Environmental Impact Report for Proposed Doheny Ocean Desalination Project**

Dear Mr. Shintaku:

The Moulton Niguel Water District (MNWD) appreciates the opportunity to provide comments on the Draft Environmental Impact Report (EIR) for the proposed Doheny Ocean Desalination Project (Project). The following comment addresses areas that may yield potential environmental impacts to MNWD and communities it serves from the proposed Project that should be addressed in the EIR. This comment was provided previously by MNWD in response to the Notice of Preparation of the EIR but appears to have not been addressed in the Draft EIR.

1. **Impacts to the Regional Distribution System**

   The proposed Project will increase the local water supplies to the immediate areas, thereby reducing the amount of water necessary to be imported via the East Orange County Feeder #2 and the Joint Transmission Main. MNWD requests that the EIR analyze the expected volume of imported water to be reduced in the Joint Transmission Main, particularly during the winter months (December through February), and the potential impact the reduced flow would have on disinfection degradation within the Joint Transmission Main and on meeting the contractual obligations for minimum metered flow from the Metropolitan Water District of Southern California at the CM-10 takeout. 1

The MNWD appreciates your consideration of this comment in preparation of the Final EIR. Please feel free to discuss this comment further with Matt Collings, Assistant General Manager, at (949) 448-4032, Rod Woods, Director of Engineering, at (949) 425-3547 or myself at (949) 425-3549.

Regards,

MOULTON NIGUEL WATER DISTRICT

Todd Dmytryshyn
Principal Engineer

27500 La Paz Rd | Laguna Niguel, CA 92677 | 949. 831. 2500 | mnwd.com

Letter L3 Moulton Niguel Water District

Todd Dmytryshyn, Principal Engineer
August 1, 2018

Response L3-1

South Coast Water District (SCWD) is the Designated Operator (Operator)[1] of the Joint Regional Water Supply System (JRWSS), of which the Joint Transmission Main (JTM) is a component. There are nine (9) member agencies of the JRWSS, including SCWD and Moulton Niguel Water District (MNWD). Metropolitan Water District (MWD) regulates the Coastal Meter 10 Takeout (CM-10) to the JTM and the associated meter that controls flow to the JTM. That meter reliably reads down to a flow of 12.5 cubic-feet-per-second (cfs), which is ten percent (10%) of its maximum design flow. MWD imposes a charge when water flow through the JTM falls below 12.5 cfs (10% Below Charge).[2] Even when the 10% Below Charge has been imposed, all water quality regulatory requirements have been met within the JTM while SCWD has been Operator. Imposition of the 10% Below Charge is not itself an environmental impact within the purview of CEQA.

Low flow conditions in a pipeline can potentially impact water quality due to disinfectant degradation. Currently, and for the approximately 19 years during which it has been Operator, SCWD has managed water flow through the JTM to ensure full regulatory water quality compliance at all times. SCWD manages water flow through the JTM for day-to-day and long-term operations by regular monitoring and maintenance, which ensures the JTM meets all flow, water quality, and pressure requirements. SCWD's management of the JTM has included temporarily closing the CM-10 Takeout when experiencing low flow demands to avoid the 10% Below Charge until flow requirements are restored. SCWD regularly monitors water quality in the JTM to ensure compliance levels do not fall below regulatory requirements during normal operations, as well as daily monitoring during shutdown periods of the CM-10 Takeout. While SCWD has been Operator, at no point has water quality in the JTM fallen below required compliance levels, including during temporary shut-downs of the CM-10 Takeout.

Each JRWSS member agency owns a percentage of the capacity of the JTM.[3] SCWD's capacity is 6.34 cfs,[4] which is a fraction of the total capacity, and is significantly less than the 12.5 cfs needed to avoid the 10% Below Charge. Even if SCWD took water to its full 6.34 cfs capacity, this flow alone would not necessarily be sufficient to avoid the 10% Below Charge. Conversely, even if the Project resulted in SCWD taking no water through the JTM (thus eliminating up to 6.34 cfs flow through the JTM), this reduction in flow alone would be insufficient to trigger that charge.

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[1] See, Amended and Restated Joint Exercise of Powers Agreement to Operate and Maintain the Joint Transmission Main Facilities (2000) ("JTM Agreement").

[2] See, JTM Allocation Requirements Flow from CM-10 (SCWD, undated) (1 page), which discusses the 12.5 cfs meter and provides Table 1 allocations and minimum flow percentages; see also, JTM Allocation Requirements Flow from CM-10 (SCWD, undated) (2 pages), which discusses Options 1-6 for addressing low flow.

[3] See, Joint Regional Water Supply System (JRWSS) Capacity Allocation And Funding (Effective Date April 1, 2000) ("JRWSS Capacity and Funding Map").

[4] SCWD's capacity may increase slightly if the San Diego County Water Authority no longer receives potable water service through the JTM (30% of 2.28 cfs), but would still be significantly less than 12.5 cfs. (See JRWSS Capacity and Funding Map; JTM Agreement, pp. 7-8; see also, Wholesale Water Service Agreement and Lease of the San Onofre Feeder (2000)).

Further, regardless of the Project, the other JRWSS member agencies may change the amount of flow they receive through the JTM, which SCWD cannot predict or control. Alternatively, if SCWD stopped taking imported water through the JTM after the Project begins producing desalinated water, other member agencies may take some or all of that water through the JTM, which SCWD cannot predict or control. In addition, the extent to which this would affect the flow through the JTM depends in part on which agency took that imported water from which area of the JTM (i.e., a takeout at the top [e.g., CM-10 Takeout] of the pipeline impacts flow through more of the JTM than a takeout near the end of the pipeline), also which SCWD cannot predict or control. Therefore, SCWD cannot predict how much flow would go through the JTM even if SCWD stopped taking any water through the JTM as a result of the Project. With that uncertainty, it would be speculative for SCWD to attempt to calculate how changes to flow caused by the Project might impact water quality.

Further, even if SCWD took water through the JTM to its full 6.34 cfs capacity, this flow alone may be insufficient to necessarily prevent water quality issues due to low flow. Alternatively, if SCWD stopped taking any imported water through the JTM, a reduction of 6.34 cfs of flow would not necessarily cause any issue with water quality depending on how much flow other agencies take. Even when there have been instances of low flow (as when the 10% Below Charge has been applied), there have been no water quality violations, making it speculative to assume that the Project would have a negative impact on water quality in the JTM.

Regardless of the Project, in its role as Operator, SCWD would continue to manage flow within the JTM by modulating and adjusting flows as needed to meet water demand scenarios and assure flow and pressure requirements are achieved. SCWD would also continue to monitor water quality within the JTM to meet all regulatory requirements as in the past, which SCWD would do even during the winter months (December through February) when water demand is reduced. Further, if deemed necessary, one or more chlorine booster stations could be installed to continue to help prevent potential water quality issues in the JTM. Also, installation of a low flow meter, which could detect flows below the current detection level of 12.5 cfs, would lower the minimum flow necessary through the CM-10 Takeout to help avoid the 10% Below Charge. The cost of these measures would be shared between the member agencies according to their activities and the relevant agreements, with SCWD solely paying any costs attributable to the Project. The issue of low flow through the JTM is an operational issue that can be addressed through effective system management, monitoring, testing, and adjusting flows. Through its role as Operator, SCWD would continue to meet contractual obligations with MWD at the CM-10 Takeout.

MUNICIPAL WATER DISTRICT
OF ORANGE COUNTY

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August 6, 2018

Rick Shintaku, P.E.
Acting General Manager/Chief Engineer
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

Re: Letter of Support for South Coast Water District's Completion of the Final Environmental Impact Report: Doheny Ocean Desalination Project

Dear Mr. Shintaku:

The Municipal Water District of Orange County supports the 5 Million Gallon per Day Doheny Ocean Desalination Project and recommends that South Coast Water District proceed to complete the Final Environmental Impact Report. Development of the Doheny Ocean Desalination Project is a part of a long-term goal of water supply reliability by developing and supplementing SCWD's water supplies through the treatment of ocean water, and diversification of SCWD's water supply portfolio. The Municipal Water District of Orange County has been providing reliable, safe drinking water to its customers since 1951 and its service area includes SCWD. The need for the Doheny Ocean Desalination Project was identified in the Orange County Water Reliability Study as one of several projects that could be developed to meet South Orange County water reliability needs. The Municipal Water District of Orange County fully supports the project and SCWD's efforts to enhance water use efficiency and local water supply reliability. 1

If you have any questions or need additional information regarding our support of this project, please do not hesitate to contact me by email at rhunter@mwdoc.com or via telephone at (714) 593-5026.

Sincerely,

Robert J. Hunter
General Manager

Letter L4 Municipal Water District of Orange County

Robert Hunter, General Manager

August 6, 2018

Response L4-1

Comments in support of the project are noted for the record.

OC Public Works
Integrity, Accountability, Service, Trust
Shane L. Silsby, Director

August 3, 2018 NCL-18-022c

Rick Shintaku, PE - Acting General Manager, District Engineer
South Coast Water District
31592 West Street
Laguna Beach, CA, 92651

Subject: Notice of Availability of Draft Environmental Impact Report – Doheny Ocean Desalination Project

Dear Mr. Shintaku:

Thank you for the opportunity to comment on the Draft Environmental Impact Report (EIR) for the Doheny Ocean Desalination Project. The County of Orange offers the following comments for your consideration.

OC Environmental Health

1. In Section 4.7 (Hazards and Hazardous Materials) subsection 4.7.1 (Affected Environment) of the Draft EIR, seven leaking underground storage tank (LUST) sites are identified within ½-mile of the Project site. These sites are also depicted on Exhibit 4.7-1. The Orange County Health Care Agency (OCHCA) - Local Oversight Program (OCLOP) has identified four additional addresses within ½-mile of the Desalination Facility Study Site (DFSS), where one or more LUST sites have been located. The addresses for these sites, all located within the City of Dana Point and are as follows: 1
    - 34152 Del Obispo Street
    - 25802 Victoria Boulevard
    - 34242 Doheny Park Road
    - 26126 Victoria Boulevard

   Conditions at these sites, as they relate to the proposed project, should be reviewed.

2. The Draft EIR also references that LUST sites were reviewed with respect to the groundwater gradient and with the direction of assumed flow reported to the south. Please note, the reported flow directions at LUST sites near this project are variable with the nearest (open status) site to the DFSS, located at 34295 Doheny Park Road, reporting flow to the north, south, northeast and southwest during monitoring events conducted in 2017 and 2018. Further, Geoscience's March 21, 2016 Modeling of Slant Well Feed Water Supply, Impacts and Mitigation Approaches report indicates that plume maps used for model inputs were developed based on data available in GeoTracker. However, for example, former OCHCA cleanup case number 86UT047, located at 25802 Victoria Boulevard reported residual benzene concentrations in groundwater up to 610 µg/L at the time of closure in 2004 and was not included in the plume modeling. 2

3. Records associated with the LUST sites should be thoroughly reviewed to determine groundwater flow direction and to evaluate residual levels of contamination associated with the active and closed LUST sites as they pertain to potential impacts to the proposed project. Limited records pertaining to LUST sites may be obtained on the State Water Resources Control Board's GeoTracker database: http://geotracker.waterboards.ca.gov/. In addition, records for LUST sites maintained by OCHCA-Environmental Health (EH) may be obtained by contacting the OCHCA Custodian of Records at (714) 834-3536. Additional records can be obtained by contacting the San Diego Regional Water Quality Control Board. 2

4. Subsection 4.7.1 of the Draft EIR indicates that one solid waste landfill site (SWLS) is located within ½-mile of the Project site. The location or identification of the site is not provided on figures or tables in the Draft EIR; however, is identified as Del Obispo #3 in the May 27, 1999 Phase I Environmental Site Assessment (Phase I) provided in Appendix 10.8.2 of the report. The Del Obispo landfill site is a former burn dump located beneath Del Obispo Park. The Phase I also identifies other SWLS sites as "unmapped sites" within the environmental database report (EDR) which included sites known to be over 3 miles from the DSFF. The OCHCA – Local Enforcement Agency (LEA) noted that the EDR did not include the closed SWLS identified as Forster Canyon Landfill (aka County Refuse Disposal Station #17) which is located approximately 1.6 miles northeast of the DSFF. Information pertaining to SWLS can be obtained by contacting the OCHCA Custodian of Records at (714) 834-3536. Public records regarding landfills and other non-disposal sites are available on the CalRecycle database, SWIS (Solid Waste Information System). All solid waste sites are given a SWIS number for identification and are used by the LEAs and other agencies. The SWIS numbers for Del Obispo and Forster Canyon are 30-CR-0102 and 30-AB-0366, respectively. 3

5. The OCHCA noted that the study areas depicted on Exhibit 4.7-1 do not align with those depicted on Figure 4.7-2. For the purpose of this review the OCHCA evaluated the boundaries presented on Exhibit 4.7-1. If the boundaries presented on Exhibit 4.7-1 are in error, please notify the County of Orange. 4

<u>OC Parks</u>

1. Provide a thorough description of all infrastructure proposed for the project including intake wells, well head placement, and conveyance lines. 5

2. Provide a thorough discussion of direct, indirect and cumulative impacts expected to biological resources, with specific measures to offset such impacts, including California grunion and western snowy plover. 6

3. OC Parks is concerned about impacts to recreation both during construction and for long term operation and maintenance of the system including parking and beach access. 7

4. Natural sediment delivery has diminished over time and the beach face at Capistrano Beach becomes extremely narrow making the park susceptible to major damage during intense wave conditions. The shoreline has benefitted from large introductions of material but that has diminished in recent decades. Please include an analysis of sand supply in the system and how it relates to the requirements for the intake wells, as well as hazards due to erosion, storm surge and wave runup. 8

5. Capistrano Beach has been identified as a receiver site for beach nourishment and has
benefitted from dredging operations in Dana Point Harbor. Impacts related to dredging 9
operations or sand placement should be addressed in the EIR.

6. Sea levels are projected to rise in coming decades. Please include an analysis on the 10
impacts associated with climate change using the latest guidance.

7. The EIR should discuss feasible measures that could minimize significant impacts. 11

8. How will loss of parking revenue to OC Parks / County of Orange be mitigated? 12

9. The project proponent should not rely on OC Parks for shore protection for their wells. 13
The document should address how such protection will be accomplished.

<u>OC Infrastructure Programs /Flood Programs/Hydrology</u>

1. Since the City of Dana Point (City) is responsible for land use planning and
development within City limits, the City should review and approve all local hydrology
and hydraulic analyses including the needed 100-year flood protection for proposed 14
developments within the project area as required by the mitigation measure HWQ-6.
Proposed flood protection measures should not worsen existing conditions or move
flooding problems downstream or upstream of the project.

2. Hydrologic and hydraulic analyses should evaluate and compare quantitatively the
runoff volumes, peak flow rate increases, and adequacy and capacity of existing
drainage facilities. All appropriate studies (if necessary) must conform to the current 15
guidelines and criteria as specified in the Orange County Hydrology Manual (OCHM),
Addendum No. 1 to the OCHM, and the OCFCD Design Manual and should be included
in the EIR.

3. An agreement between the South Coast Water District and OCFCD is necessary to
address right-of-way, design details, operation and maintenance, construction 16
inspection, etc. of the proposed alignment of pipelines that encroach into OCFCD's
right-of way. A license agreement may be required.

4. SCWD will need to coordinate efforts for a CLOMR-F/LOMR-F with the City of Dana 17
Point, the flood administrator of the area.

5. Several phases of OCFCD levee protection projects are in place. Please coordinate with 18
OC Public Works staff for location/alignment and depth of the steel sheet piles.

6. All work (if any) within or adjacent to any OCFCD right-of-way for regional flood
control facilities should be conducted so as not to negatively impact channel's structural
integrity, hydraulic flow conditions, access and maintainability. Furthermore, all work
within OCFCD's rights-of-way should be conducted only after an encroachment permit
for the proposed work has been obtained from the County and a license agreement is 19
secured with adequate compensation for any on-going use of OCFCD's right-of-way.
For information regarding the permit application process and other details please refer
to the OC Development Services' website http://www.ocgov.com/gov/pw/ds/.
Technical reviews and approvals for the proposed work will be accomplished within the
permit process.

<u>OC Environmental Resources</u>

1. Section 4.8.2: The proposed project aligns with and is included in the Integrated Regional Water Management (IRWM) Plan for the South Orange County Watershed Management Area (SOCWMA). The Draft EIR was written prior to the May 2018 adoption of the 2018 update to the IRWM Plan by the SOCWMA Executive Committee, and cites the 2013 IRWM Plan; however, the proposed project aligns with and is included in both the 2013 and 2018 IRWM Plans.

2. Section 4.8.2: the proposed project described in the Draft EIR aligns with IRWM goals for
the South Orange County Watershed Management Area (SOCWMA). Specifically, the 20
project helps meet the objectives and strategies in the South OC IRWM Plan by creating local potable water supply and reducing reliance on imported water, which comprises approximately 97 percent of the watershed management area's potable water supply. The proposed project is described in the 2018 IRWM Plan as a source of new supply for South Orange County, and noted as a potential new source of potable supply in the OC Reliability Study. As also noted in the Executive Summary of the Draft EIR, both the initial Phase I of the project and future Regional Project will provide a drought-proof local supply that improves system reliability in the event of imported water delivery disruptions (Section 1.1).

3. Section 4.8.2: The South Orange County MS4 Co-Permittees have developed the South OC Water Quality Improvement Plan (WQIP) for the San Juan Hydrologic Unit in accordance with Provision B of the San Diego Regional MS4 Permit (2015 MS4 Permit). On June 20, 2018, the San Diego Regional Water Quality Control Board accepted the WQIP. The WQIP
details strategies to address the identified highest priority water quality conditions (Pathogen 21
Health Risk (indicator bacteria), Channel Erosion and Associated Geomorphic Impacts, and Unnatural Water Balance/Flow Regime). The conversion from pervious to impervious area can contribute to a condition of unnatural water balance. Therefore, the EIR should address the proposed project's creation of impervious area and mitigate accordingly.

4. Section 4.8.2: The draft EIR should note that Priority Projects, in accordance with the 2017 Model Water Quality Management Plan (Model WQMP) and Technical Guidance Document (TGD) for South Orange County, would require the development of a Water Quality Management Plan (WQMP). Mitigation of long-term stormwater runoff impacts in accordance with the 2017 Model WQMP and 2017 Technical Guidance Document (TGD) will be required (http://www.ocpublicworks.com/ds/water).

5. Section 4.8.2: Projects that, as part of a common plan of development, disturb one or more 22
acres are required to obtain coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Order 2009-0009-DWQ (As amended by 2010-0014-DWQ and 2012-0006-DWQ), adopted on September 2, 2009.

If you have any questions regarding these comments, please contact Geniece Higgins at (714) 433-6260 in Environmental Health Division, Eric Hull at (949) 585-6446 in OC Parks, Penny Lew at (714) 647-3990 or Anna Brzezicki at (714) 647-3989 in OC Flood Programs/Hydrology & Floodplain Management, Cindy Rivers at (714) 955-0674 or Jenna Voss at (714) 955-0652 in Environmental Resources, or Cindy Salazar at (714) 667-8870 in OC Development Services.

Sincerely,

Richard Vuong, Manager, Planning Division
OC Public Works Service Area/OC Development Services
300 North Flower Street
Santa Ana, California 92702-4048
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cc: Colby Cataldi, Deputy Director, OC Public Works
Nardy Khan, Deputy Director, OC Public Works
Joanna Chang, OC Public Works
Geniece Higgins, Environmental Health Division
Eric Hull, OC Parks
Scott Thomas, OC Parks
Susan Brodeur, OC Parks
Penny Lew, OC Flood Programs/Hydrology & Floodplain Management
Anna Brzezicki, OC Flood Programs/Hydrology & Floodplain Management
Cindy Rivers, Environmental Resources
Jenna Voss, Environmental Resources

Letter L5 Orange County Public Works

Richard Vuong, Manager, Planning Division
August 3, 2018

Response L5-1

Comment regarding additional LUST sites is noted. The site on Del Obispo Street is noted in Table 4.7-1. The sites with maps showing plumes delineated as a part of compliance work were considered in the project modeling work (page 4.7-25 of Draft EIR). The addresses supplied by the OC Health were investigated to determine the site status and potential impact from Project pumping.

34152 Del Obispo Street

Status: Closed – May 1990

Contaminants: Oils in groundwater

No reports/analytical records available for review – unable to determine if residual contaminants are below current screening levels (SLs). Property is cross-gradient based on assumed groundwater (GW) flow. Based on assumed GW depth from nearby site (4-16’) and presence of San Juan Creek in between the properties, impacts from potential residual contaminants are not expected.

25802 Victoria Boulevard

Status: Two closed cases – October 1990, February 1991

Contaminants: Diesel/Gasoline in soil

No reports/analytical records available for review – unable to determine if residual contaminants are below current SLs. Excavation was noted for 1965. Property is adjacent to Project site, which means GW flow could be cross-gradient or slightly down-gradient. Impacts from potential residual contaminants are possible, but not expected due to age of release and the fact that it is gasoline only impacted soil, and thus, is not likely to migrate.

34242 Doheny Park Road

Status: Closed – June 1992

Contaminants: Gasoline in groundwater

No reports/analytical records are available for review- unable to determine if residual contaminants are below current SLs. A pump & treat groundwater system was noted for 1987. Property is cross-gradient based on the assumed groundwater flow direction and located 800’ to the east/southeast of the Project site. Impacts from potential residual contaminants are not expected because the site residuals are anticipated to be in low concentrations for the overseeing agency to justify case closure, the low concentrations will continue to degrade, and movement of any potential low concentrations of residuals would also further dilute with downgradient flow.

26126 Victoria Boulevard

Status: Closed – July 2000

Contaminants: Gasoline in groundwater

No reports/analytical records available for review – unable to determine if residual contaminants are below current SLs. Excavation was noted for 1965. Property is cross-gradient based on assumed groundwater flow direction and located 1,500' to the southeast of the Project site. Impacts to the Project from potential residual contaminants are not expected because the site residuals are anticipated to be in low concentrations for the overseeing agency to justify case closure, the low concentrations will continue to degrade with time, and any movement initiated by slant well pumping of low concentration of residuals would further dilute with surrounding groundwater with downgradient flow.

Response L5-2

The State Board Geotracker website was reviewed. Previous modeling efforts have assessed worst case environmental conditions from the known contaminant plumes in the vicinity of the wellfield.

Per Geotracker, OCHCA clean-up case 86UT047 is located at 25742 Victoria Boulevard. The case was opened in 1986 and closed May 9, 2005. The case closure summary report dated 12/21/2005 reports that Benzene was measured at 85,200 microgram per liter (ug/l) before the corrective action was initiated and was measured at 610ug/L in water after corrective action. The case closure report states that the corrective action protects both existing and beneficial uses set forth by the Regional Board Basin Plan. This site is located approximately 2,200 feet from the wellfield. Previous modeling work included modeling of the plume at the Exxon Station 74816 located closer to the proposed wellfield at a distance of 1,500 feet. Initial concentrations at the Exxon Station were 1,000 ug/L. Modeling showed a complete dissipation of the plume at the higher extraction rates (21 and 30 MGD) with the plume expanding little and never getting close to the wellfield. At the lower extraction rates (4.3 and 8.6 MGD), the plume decreased in concentration to less than 10ug/L and was not approaching the wellfield (see Appendix 10.10.2). Therefore, impacts to the project from Benzene will not occur since groundwater from this site does not reach the wellfield.

Response L5-3

Comments and clarifications regarding the status and location of solid waste landfill sites (SWLS) are noted for the record. As noted above in Response No. L5-2, Geotracker was reviewed.

Response L5-4

The boundaries on Exhibit 4.7-1 are correct. Exhibit 4.7-2 will be modified to reflect the correct boundary for the Intake Study Area and Conveyance Study Area which apparently shifted during the printing process. Refer to Section 3, *Draft EIR Errata*.

Response L5-5

A summary and detailed description of all aspects of the Project, including proposed infrastructure, are in Draft EIR Section 3.0, Project Description.

Response L5-6

Biological resource impacts, including potential impacts to specific species, are detailed in Draft EIR Section 4. 3, Biological Resources. This section specifically addresses the following protected species: southern steelhead, western snowy plover, least Bell's vireo (Vireo bellii pusillus), and California least tern (Draft EIR, page 4.3-12 to 4.3-13). The California grunion is not a special status species under the Federal Endangered Species Act or California Endangered Species Act. Further, it is not identified as a sensitive animal species with known or potential occurrence within or near Doheny State Beach by the Doheny State Beach General Plan or General Plan EIR.

Response L5-7

Please see Draft EIR Sections 4.12 Recreation, and 4.13 Transportation and Traffic, which address impacts to recreation, parking and access. See also Section 4.9, Land Use and Planning, for a detailed policy consistency evaluation. OC Parks' concerns are noted for the record.

Response L5-8

Natural seasonal sand movement at Capistrano Beach does not have an impact on the intake wells, since the wells would be installed below the depth susceptible to diminishment. Draft EIR Section 4.8, Hydrology and Water Quality, includes a coastal hazard assessment for the Capistrano Beach intake area (Draft EIR Appendix 10.7.2, see also Appendix 4.2.1). Slant wells and associated vaults and piping would be buried below the scour depth for predicted potential future coastal erosion. The slant wells are therefore not anticipated to be affected by or to affect sediment transport. Slant well spoils, or the soil, dirt and/or rubble that results from an excavation, and spoils from trenching at Doheny State Beach (DSB) or Capistrano Beach Park could be made available to State Parks or OC Parks, to be determined through the encroachment permit process.

Response L5-9

Impacts related to harbor dredging or sand replenishment for other projects or purposes are related to those projects. Since the slant wells are not proposed for construction on the beach, even if sand replenishment should be implemented at DSB or Capistrano Beach Park, this is not anticipated to affect slant well construction or operation (it would be outside the construction footprint). At Capistrano Beach Park, any sand replenishment would be anticipated to further stabilize this narrow section of beach, and therefore would likely reduce the level of coastal hazards assumed in the EIR. Also refer to Response L5-8.

Response L5-10

Comments are noted for the record. Sea level rise related to the Project is addressed in Section 4.8, Hydrology and Water Quality, and in the coastal hazard assessment included as part of this Final EIR (refer to Response S1-14 and Appendix 4.2.1). Even with assuming the "high" range of future sea level rise, facilities will be adequately protected (page 4.8-36 of Draft EIR).

Response L5-11

Mitigation Measures are provided throughout the Draft EIR. No specific additional mitigation measures are noted in this comment.

Response L5-12

Compensation will be provided for loss of parking revenue due to construction activities. Appropriate compensation will be discussed further with OC Parks. However, changes to parking revenue are not an environmental impact subject to review within the Draft EIR. Should the District pursue slant wells at Capistrano Beach Park, compensation for lost revenue would be addressed through the encroachment permit and related approvals required from the County of Orange. At this time, slant wells at DSB are the preferred location.

Response L5-13

This comment is noted for the record. Refer to Master Response 1 regarding the status of slant well pods contemplated for Capistrano Beach Park. The District has met several times with OC Parks and County of Orange Public Works (OCPW) to discuss potential slant well locations at Capistrano Beach Park. Based on those discussions, the District understands that current shoreline protection at Capistrano Beach Park is not adequate to protect the parking lot and associated slant well construction areas from high surf hazards and coastal erosion. The District does not intend to initiate such protection independent of OC Parks, and therefore has identified Capistrano Beach Park slant well sites as secondary to DSB. Should shoreline protection at Capistrano Beach Park be constructed, any slant wells at Capistrano Beach Park would be protected.

Response L5-14

Comments regarding City review of flood control measures are noted for the record. Please see Response L1-9 to Letter L1. The Local Hazard Conditions and Drainage Study demonstrates that the proposed fill has negligible impact to the adjacent floodplain inundation depth and San Juan Creek surface elevations. The further coastal hazard modeling in this Final EIR expands discussion of 100-year flood hazards and potential future 500-year flood hazards (see Appendix 4.2.4). The Project proposes elevating the desalination facility site approximately three to five feet, to be above the 100-year flood hazard level. This design solution will not so much alter a drainage pattern, as it will protect the desalination facility site from existing drainage facility impacts, as these facilities are predicted to overtop or back up into the site during the 100-year storm. The hydrology study also recommends relocating an existing drainage inlet since the current inlet location is impacted by 100-year flood conditions where San Juan Creek backs up and overtops into the site. This is a favorable improvement to the existing condition.

Response L5-15

The District consulted with OCPW regarding appropriate design assumptions, which have been reflected in the Project hydrology studies, including the hydrology study contained in Appendix 4.2.4.[1] Comments

[1] Personal communication with OCPW by GHD on December 11, 2018.

regarding scope of hydrology analysis are noted. The Local Hazard Conditions and Drainage Study included data on pre- and post-project flow rates and volume in the storm drainage facilities at the project site.

Response L5-16

Comments regarding required license and right of way agreements are noted for the record. At this time, the District does not anticipate encroaching into County rights-of-way. The District will coordinate with OC Public Works regarding trenchless construction underneath San Juan Creek, to ensure the trenchless construction is deep enough to avoid the planned San Juan Creek bank improvements and associated sheetpiling.

Response L5-17

The comment regarding coordination with the City of Dana Point regarding a CLOMR-F/LOMR-F is noted. SCWD will coordinate with the City of Dana Point on FEMA map revision processes as needed (as noted in the Draft EIR on page 4.8-34 and in Mitigation Measure HWQ-5).

Response L5-18

Request to coordinate with OC Public Works regarding levee protection is noted. SCWD will coordinate with the Orange County Flood Control Department (OCFCD) on the levee protection projects that may affect the section of San Juan Creek adjacent to the Project site. Refer to Response L5-16.

Response L5-19

Comments regarding procedures for permitting and/or conducting work within OCFCD right of way are noted for the record. Refer to Response L5-16. At this time, the District does not anticipate encroachment into County rights-of-way.

Response L5-20

Comments regarding Project consistency with the recently updated (May 2018) IRWM Plan and OC Reliability Study are noted for the record.

Response L5-21

Comments regarding the South OC Water Quality Improvement Plan (WQIP) are noted. As stated in Draft EIR Section 4.8, construction and operation of the subsurface intake wells, southeast intake wells, raw water conveyance alignment, and brine disposal system would not significantly increase the impervious surface or otherwise affect the drainage patterns, since all facilities would be buried underground.

With regards to the Desalination Plant site on SCWD property adjacent to the San Juan Creek, Appendix 10.9 Hydrology Study outlines proposed impacts and mitigation of new impervious area on the site, indicating that implementation of construction and post-construction Best Management Practices (BMPs), including the preparation of a Water Quality Management Plan (WQMP) or equivalent document, a Notice of Intent, and a Stormwater Pollution Prevention Plan (SWPPP), would reduce water quality impacts to required levels. As part of the efforts to decrease impervious area, future design could include discussion on permeable surfaces that can be installed in lieu of Asphalt Concrete (AC) or concrete along walkways, driveways, aprons, and access roads.

Appendix 10.9 also evaluates flood protection improvement alternatives for the desalination plant site. The recommended improvement alternative recommends raising the Project site, along with relocation of a drainage inlet and installation of a detention basin which would provide runoff attenuate benefits Mitigation Measure HWQ-4 requires preparation of a Water Quality Management Plan, as modified through responses to comments.

Response L5-22

Comments regarding a WQMP and NPDES requirements are noted for the record. See also Response L5-21 and responses to Letter S7.

SAN JUAN BASIN AUTHORITY

26111 Antonio Parkway • Rancho Santa Margarita, CA 92688 (949) 459-6400 FAX (949) 459-6463

August 5, 2018

Mr. Rick Shintaku, PE
Acting General Manager
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

Subject: Doheny Ocean Desalination Project
CEQA Draft Environmental Impact Report (DEIR)

Dear Mr. Shintaku:

Thank you for the opportunity to review South Coast Water District's (SCWD's) Draft Environmental Impact Report (DEIR) for the Doheny Ocean Desalination Project (Doheny Desalter), dated May 17, 2018.

San Juan Basin Authority (SJBA) is a consortium of four local South Orange County water agencies, including SCWD, operating collaboratively under a Joint Exercise of Powers Agreement since 1971. SJBA manages the groundwater basin that extends along San Juan Creek and its tributaries, from the Santa Ana Mountains to the Pacific Ocean. 1

The San Juan Basin Authority (SJBA) commends SCWD for its leadership in pursuing additional water resources to serve South Orange County.

Section 2.0 of the DEIR correctly states, a DEIR "is an informational document which will inform public agency decision-makers and the public of the significant environmental effects of a proposed project." In the spirit of that statement, SJBA offers our comments on the DEIR to hopefully aid SCWD in optimizing the Doheny Desalter project.

SJBA reviewed the DEIR and has the following suggestions/comments relative to groundwater resources in the San Juan Basin.

1. **San Juan Bedrock Barrier** – As SJBA has evolved and improved its management of the groundwater basin over the last nearly five decades, it has become more apparent that behavior of groundwater flow in the Lower San Juan Basin is not simple. Rather, it appears to be complicated by underground geological features. In particular, geologic investigative borings point to a "bedrock high" in the general area of Stonehill Drive in Dana Point. This natural underground barrier is restricting the flow of fresh groundwater from upstream to downstream and vice versa. 2

   In recent months, SJBA has engaged Wildermuth Environmental, Inc. (WEI), an experienced local hydrogeologic consultant, to investigate the bedrock barrier even further. WEI has hired a sonic drilling contractor to drill targeted borings where the barrier appears to be most prominent and map its location for further study. Further, SJBA has also engaged WEI to construct two monitoring wells to enable SJBA to study the hydraulic behavior of the groundwater in this area. WEI's findings have been presented to the SJBA Board and Technical Advisory Group (TAG), which includes technical representatives from SCWD.

2

SJBA believes it would be prudent for SCWD to include a discussion of SJBA's barrier investigation in the DEIR. While a portion of the investigation is still underway, ultimately, it may prove there is a barrier that isolates fresh groundwater resources upstream of the barrier from seawater intrusion, allowing greater volumes of mixed sea water and groundwater to be pumped with little to no restriction. It may also allow greater volumes of raw water to be drawn through more conventional vertical wells, reducing impacts and costs.

2. **More Conventional Vertical Wells** – While slant wells have been selected by SCWD for multiple reasons to provide raw seawater to the Doheny Desalter, SCWD should not preclude the use of more conventional vertical wells, especially in light of a potential bedrock barrier that protects upstream fresh groundwater. The barrier may allow extraction of vast amounts of lower-salt groundwater just upstream of the ocean using large diameter vertical casings, instead of the more expensive, difficult to construct slant wells.

   3

   As a minimum, more discussion of the bedrock barrier could facilitate the vertical wells as an alternative construction method should SCWD determine at a later date that vertical wells are desirable. The construction of vertical wells uses gravity to aid in drilling, while slant well construction is forced to counter gravity to be successful. SCWD makes a good case that slant wells are not an entirely new technology, but there is still a much larger body of knowledge available on the construction and operation of vertical wells. Please include whatever discussion is needed so as not to preclude the use of vertical wells as an alternative construction/operational method.

3. **Outfall Discharge Quality** – The DEIR explains there is adequate outfall capacity remaining to serve other outfall capacity owners during operation of the Doheny Desalter project, even when the Regional scale facility is operational. However, more information is needed regarding the quality of the outfall discharge as more sewage is treated and used as recycled water, thus reducing the quantity of more dilute secondary 4 effluent for comingling/blending with desalter effluent. More discussion is needed regarding how much secondary effluent is available in the future for blending with Doheny Desalter effluent and contingency plans for maintaining outfall quality should more secondary effluent be diverted for other uses in the future.

4. **Elimination of Seawater Intrusion by Slant Wells** – Table 3-2 infers the slant wells will reduce or eliminate seawater intrusion into the groundwater basin. Further, there is a discussion on page 4.8-44 regarding production of an intrusion-inhibiting "trough." 5 However, there is no discussion of the bedrock barrier described above, which would likely add even more substance to the statement. The DEIR should describe the barrier and provide clarification of how the "trough" would reduce seawater intrusion. Also, we recommends a description of how the so-called "Stonehill Management Zone"

would likely provide a forebay for pumping high volumes of lower-salt seawater as the raw water source for the Doheny Desalter. 5

5. **Seawater Sink Created by Prior Slant Well Tests** – SJBA has been collecting a significant amount of groundwater level and quality data over the last ten years. In light of the existence of a bedrock barrier in the area of Stonehill Drive, SJBA's data indicates that the prior tests of slant well pumping may have significantly contributed 6
to the reversal of the groundwater hydraulic gradient between monitoring wells just inland from the ocean and the ocean. That reversal may well have contributed to the increase of chloride levels at the monitoring wells. SJBA recommends the DEIR discuss the possibility of such a hydraulic gradient reversal. If the slant well pumping was not likely contributing to the hydraulic gradient reversal, it should be discussed in the DEIR.

6. **Additional Monitoring Wells Needed** – Additional strategically located monitoring wells are needed to track potential short-term and long-term seawater intrusion brought 7
on by the slant wells. Such wells should be included in the project's Mitigation and Monitoring Plan. SJBA should be consulted regarding coordination of operation and maintenance of the monitoring wells, along with data and analysis sharing.

7. **Mixing of Water Qualities in the Distribution System** – It is not clear as to what happens to water quality if and when water is introduced from the Doheny Desalter into the distribution pipeline network. While the regional system is expected to be constructed in later phases of the Doheny Desalter, the DEIR contemplates surplus 8
treated water to be available to parties other than SCWD. The DEIR should describe potential water quality issues that may arise when product water is mixed with other water supplies in SCWD's and others' water distributions systems. It should also discuss how it will be monitored and remedied.

8. **Paleo Channel As A Source of Fresh Water** -- The paleo channel at the southeast intake wells, as described by the DEIR, is similar to the historic deep San Juan Creek channel substantiated by SJBA's barrier investigation. It is posited by the DEIR that there is likely limited flow of fresh water from this channel. SJBA recommends that 9
the freshwater contribution from the presumed paleo channel should not be overstated, because if the bedrock barrier described above exists as described by SJBA's investigation, little to no fresh water is passing the barrier and flowing toward the project's southeast slant wells.

9. **Water Rights Discussion** – In Table 3-10, there is no mention of State Water Resources Control Board water rights consultation. The following are some questions that may be appropriately addressed by the DEIR regarding regulatory constraints:
    a. If the Stonehill pumping area is deemed to be below the bedrock barrier and thus marine influenced, is there a need for a water rights permit to allow SCWD 10
    to pump from the area? If not, can SCWD use the water rights elsewhere? Or, should the permit be removed?
    b. If the slant wells partially extract fresh water, should that fresh water be accounted under SCWD's water rights permit?

10. **Water Infrastructure Usage Authority** – Does the use of "regional" pipelines require MWD/MWDOC or other local agency approvals? If so, are they appropriately listed 11
as Responsible Agencies that would be taking discretionary action?

11. **Sea Level Rise Consideration** – How is seawater rise being addressed, especially
related to the slant well wellheads? 12

12. **SGMA Basin Priority Designation** — The DEIR states the San Juan Basin is currently designated by the California State Groundwater Elevation Monitoring (CASGEM) program as "low." In recent weeks the State of California has released a new proposed 13
prioritization list, as provided under the Sustainable Groundwater Management Act (SGMA) of 2014. The new list proposes the San Juan Basin be designated as "very low" priority.

13. **Project Site Tide Gates** – According to DEIR Pages 4.15-6 and 4.15-14, the site has tide gates to drain surface drainage to the creek. What happens if the creek is full and 14
the site is flooded? Is there a stormwater pump station provided to drain the project?

14. **Effects on Upstream Groundwater Users** – More clarification is needed on if and
how pumping with the slant wells affects upstream groundwater pumping and users 15

15. **SJBA As A Forum for Collaboration** – SJBA recommends more discussion in the DEIR on how SJBA can be used successfully as a forum for coordinating 16
groundwater/barrier management, ocean desalination, vertical wellfields, etc.

16. **Additional Questions To Answer –** Some questions that you may want to answer through the CEQA technical analysis are:

    a. Does the existence of a barrier allow for the operation of the slant wells without concern for upstream pumping rights or habitat health? 17
    b. Is there a difference in how the slant wells would be operated depending on whether or not the barrier exists (or at least can be documented)?
    c. Can the Doheny Desalter be provided feed water from more conventional wells rather than slant wells, making the project potentially less expensive?

Again, SJBA commends SCWD on its pursuit of the Doheny Ocean Desalination Project. Please let me know if there is any information you need from SJBA to finalize your CEQA Environmental Impact Report (EIR). 18

Sincerely,

Norris Brandt, PE
Administrator

cc: SJBA Board of Directors
SJBA Technical Advisory Group

Letter L6 San Juan Basin Authority

Norris Brandt, PE, Administrator
August 5, 2018

Response L6-1

Introductory comments and the San Juan Basin Authority's (SJBA) role and authority are noted for the record.

Response L6-2

The District understands that SJBA has engaged with consultants to conduct additional bedrock barrier investigation. Recent subsurface exploratory work by SJBA using numerous borings has confirmed the existence of a portion of the bedrock surface near Stonehill Drive that is approximately 20 feet higher in elevation than previously understood. The results of the investigation were provided to SCWD and its consultants over the course of several meetings in an effort to understand and respond to SJBA comments. Although the specific elevation of bedrock was recently detected in the SJBA investigations, the location of elevated bedrock has been indicated historically by the fact that rising water has been documented at this location in San Juan Creek by surface water flow gaging and in historical aerial photography. Rising water occurs during wet seasons when the alluvial basin is full of water. As flow moves across the elevated section of bedrock, to accommodate the upstream volume, it rises to the surface. The elevated bedrock is flanked on either side by paleochannels which extend to elevations between -40 and -50 feet below mean sea level. The thickness of the alluvial aquifer in these paleochannels is 78 feet and 94 feet in the eastern and western paleochannels respectively (see Figure 3-2 of Final EIR Appendix 4.2.3.1). The thickness of alluvial aquifer above the elevated bedrock is 41 feet; therefore, a continuous aquifer is present and the constriction formed is not a barrier to groundwater flow (Appendix 4.2.3.1). Figures 14, 15, and 16 of Final EIR Appendix 4.2.3.1 show that project pumping will result in groundwater levels well above the elevated bedrock. Since the aquifer extends continuously over the elevated bedrock and project groundwater levels remain in the alluvial aquifer, the elevated bedrock does not isolate or separate the groundwater basin and does not represent a barrier to groundwater flow.

Response L6-3

Use of slant wells provides the best opportunity to eliminate or reduce groundwater impacts upstream from the Project wellfield. Although vertical wells may be feasible, use of vertical wells may have a greater impact on the upstream groundwater levels due to the potential for a significant percentage of inland groundwater being drawn into the vertical wells. See DEIR, p. 5.0-8. The use of slant wells ensures that the vast majority of the water supply will be sourced from the ocean. As stated in the previous response, exploratory drilling conducted by SJBA has confirmed the presence of elevated bedrock that does not act as a groundwater barrier to subsurface flow or isolate or separate the aquifer. Vertical wells are more likely to be susceptible to the elevated bedrock because the well screens in the vertical wells would be placed below the land surface (rather than below the sea floor as with slant wells) and therefore closer to the elevated bedrock. Pumping in the vertical wells area may result in groundwater levels that are lower in the aquifer over the elevated bedrock. A vertical well field was modeled as a part of the San Juan Basin Regional Groundwater Model Update and Seawater Extraction Barrier Impact Report, which was provided in Appendix E of the San Juan Basin Authority Groundwater and Desalination Optimization Program Foundational Actions Funding Program Final Report (prepared by SJBA, dated March 24, 2016).[1] Figure 38 shows a vertical well field near Highway 1 pumping 6,000 acre-ft/yr. Pumping from the vertical well field at this rate, which is approximately half the volume of Project Scenario 1, results in groundwater levels that are at about -20 feet below mean sea level in the area of the elevated bedrock as compared to slant well pumping water levels for Scenario 1, which are about +15 feet above mean (see Figure 14 in Final EIR Appendix 4.2.3.1). See also Master Response 4 regarding slant well operation and viability.

Response L6-4

Brine modeling in EIR Appendix 10.11 has been clarified using the California State Water Resources Control Board's required Plumes 18b hydrodynamic mixing model. In general, those modeling results were more favorable than the modeling presented in the Draft EIR, which used the Visual Plumes (UM3) protocol (that modeling is provided in Appendix 4.2.2). The modeling indicates that the Ocean Plan salinity compliance threshold is met within 1 foot from the point of discharge by all Phase I "Local" Project dense discharge operating conditions analyzed, and within 2.5 feet for all Regional Project scenarios, whereas the Ocean Plan requires this compliance threshold is reached within 100 meters from the discharge point. Thus, the Project would be fully compliant with Ocean Plan brine discharge limits by a wide margin of safety, according to Plumes 18b dilution simulations (see Table 4, Appendix 4.2.2), including under the unlikely scenario of zero wastewater discharge. These findings indicate the availability of wastewater in the discharge is not required to maintain Project brine discharge compliance with Ocean Plan water quality requirements. See, Section 3, *Draft EIR Errata* (deletion of Mitigation Measure HWQ-3).

Response L6-5

Refer to Responses L6-2, L6-4 and L6-6. The District has reviewed additional information provided by SJBA and it appears that a "bedrock barrier" does not exist, rather there is partial section of elevated bedrock that does not impede the flow of groundwater since 41 to 94 feet (see Figure 3-2 of Final EIR Appendix 4.2.3.1) of the alluvial aquifer lies above the bedrock in which groundwater flows. Since the base of the paleochannels at the elevated bedrock is deeper than -40 feet below sea level (see discussion in L6-2 above), if pumping upstream lowered the groundwater level below sea level, then seawater intrusion could be induced. Slant well pumping at the coast will serve to maintain a seaward gradient and thus aid in mitigating potential impacts of over-pumping upstream. In fact, at desalinated water production of 4.3 MGD or greater, the Project would create a seawater intrusion barrier that eliminates the continued inland advance of seawater intrusion, and even at lower production capacities would partially reduce seawater intrusion.[2]

Response L6-6

[1] https://sjbauthority.com/programs/san-juan-basin-optimization.html (accessed June 6, 2019).

[2] Draft EIR Appendix 10.10.2, pages 4 and 7.

The Project's wellfield will create a groundwater trough or "capture zone" at the coast when the wells are pumping. As an example, Figure 80 Appendix 10.10.2 shows that the greatest change in drawdown under a 21 MGD for the Phase I Project would occur offshore over the well screens. Therefore, the reversal in gradient would occur at or very near the shoreline. The gradient of the groundwater surface will be towards the slant well screens which will be located offshore. As the cone of depression is formed around the well screens, groundwater will flow from a portion of the onshore aquifer to offshore, and then to the well screens. A reversal in gradient will only occur immediately at the coast, thus not causing an increase in total dissolved solids (TDS) in wells upstream. The increase in TDS would be confined to the capture zone of the well and therefore would not have impacted SJBA monitoring wells which are located much farther upstream. Beyond the capture zone, the groundwater gradient inland would continue to be towards the coast, providing some potential mitigation of seawater intrusion from inland pumping. Refer to Response L6-5 for additional discussion regarding salinity gradient.

Response L6-7

Noted. Seawater intrusion brought on by the slant wells will be tracked with existing and, as necessary, additional new strategically located monitoring wells. Wells will be equipped with continuously recording water level and electrical conductivity transducers which will track any changes that occur in groundwater salinity with time. Any newly installed monitoring wells will be included, along with existing wells, in the Project's Mitigation Monitoring and Reporting Program, as required by Mitigation Measure BIO-4. BIO-4 is hereby modified to specifically include SJBA as an agency to be consulted regarding operations and maintenance of the wells and included in sharing groundwater monitoring reports (refer to Section 3*, Draft EIR Errata*).

Response L6-8

In general, there are several issues that utilities have encountered when introducing a new source of water into existing water supply. These are generally well understood and manageable. For seawater reverse osmosis (SWRO) finished water introduced into a traditional drinking water system, the principle issues include the following, which will be monitored as part of the Doheny Ocean Desalination Project, in close coordination with regulatory authorities such as MWDOC and the Division of Drinking Water (DDW). Where necessary, simple operational adjustments will be made to manage fluctuations in baseline water quality assumptions.

Seasonal variation in water temperature – SWRO plants with open ocean intake typically exhibit seasonal variation in the temperature of the finished water, in-line with fluctuating ocean temperatures. This can in turn affect other water quality parameters, such as reduced RO membrane rejection of salinity and chloride during warmer temperatures, which can present challenges for SWRO plant operations. While these challenges are generally manageable, the proposed Project, which will use subsurface intake wells, will experience less pronounced seasonal variation in temperature than for an open ocean intake, as evidenced by the slant well pilot study. This simplifies plant operability and does not pose a concern for this Project.

Disinfectant Residual – Currently MWD provides chloramine residual for disinfection through the distribution system. The Project will provide chloramine residual to the SWRO finished water at a level matching that provided by MWD imported water. SWRO finished water is found to have higher concentration of bromide than MWD delivered water. The chlorination of water containing bromide can contribute to chloramine decay and can form bromine containing disinfection by-products (DBP) when reacted with naturally occurring organic matter (NOM). Desalinated seawater contains very little NOM. Brominated DBPs are considered more of a health threat than chlorine containing DBP (e.g., bromoform vs. chloroform). The following measures have been found to be effective in mitigating bromide-induced chloramine decay and brominated DBP formation in SWRO finished drinking water (this will be regulated by DDW through the drinking water permit program, and regularly monitored by the District to ensure high-quality drinking water that meets all applicable drinking water regulations):

- Maintain SWRO finished water bromide concentrations at ~0.3 mg/L or lower.
- Maintain a blended drinking water pH level above 8.
- Chloramine boosting, both in SWRO finished water before blending, and in blended water at key points in the distribution system, if necessary.

Corrosion – Distribution systems can be made of a variety of materials, typically contingent on when the systems were installed. Older systems tend to be made of more problematic materials, including lead, Unlined Cast-Iron (ULCI), Galvanized Iron (GI), and copper with lead solder. Corrosivity of pipe materials is complex and is affected by pH, temperature, alkalinity, hardness, total dissolved solids (TDS), chloride and sulfate content. Two indices are commonly used to determine general corrosivity, the Langelier's Index and Calcium Carbonate Precipitation Potential (CCPP). Re-mineralized desalinated seawater generally compares to imported surface water as follows:

- Similar pH
- Similar temperature
- Lower hardness and alkalinity
- Lower dissolved organic carbon
- Lower total dissolved solids
- Higher chloride concentration
- Lower sulfate concentration

This suggests that corrosivity of the newly introduced SWRO finished water may be different than MWD imported surface water. The District will coordinate with DDW on a joint monitoring program related to lead and copper corrosion.

A recent study[3] investigating the integration of Carlsbad Desalinated seawater into the San Diego area conveyance and distribution network found that proactive disinfection measures, similar to those outlined above, precluded bromide-induced bromine decay in the system, and impacts on DBP concentration or speciation in the most sensitive reaches of the system were minimal. Additionally, there was no conclusive indication of an impact to lead or copper corrosion (the two materials of interest in the study, regulated by California's Lead and Copper Rule for Drinking Water) from the introduction of SWRO finished water into the system.

Response L6-9

The paleochannel which was discovered offshore of Capistrano Beach was likely created as a result of the confluence of several minor drainages when sea level was lower. Limited drilling and geophysical work at Capistrano Beach indicates that the paleochannel does not extend on land (see Draft EIR Appendix 10.10.1). Therefore, the paleochannel would have no source of fresh water other than water from fractures in the bedrock of the Capistrano Formation which would represent minor recharge from precipitation or landscape irrigation.

Response L6-10

Refer to Response L6-2 regarding the lack of a complete bedrock barrier.

As explained in the Draft EIR and further clarified in the groundwater modeling in Appendix 4.2.3.1, the Project is estimated to withdraw approximately 6.6%[4] of inland groundwater through the slant wells. The actual percentage may vary and will be monitored as part of ongoing Project groundwater monitoring.

However, though frequently referred to as such, the "San Juan Basin" is not a groundwater basin. It is part of the subterranean channel underlying San Juan Creek (refer to Response L7-10) and the water rights in the subterranean channel are surface water rights.[5] The question of whether the Project requires consultation with the State Water Resources Control Board (State Board), or whether SCWD needs a new or modified permit from the State Board for the Project is a question of law[6] which does not raise a significant environmental issue requiring response under CEQA.

Nevertheless, consistent with the water rights discussion in the Draft EIR (page 4.8-30 as clarified in Section 3, *Draft EIR Errata*), the District would note that: 1) the ultimate determination of the need for new or modified water rights, if any, would be made by the State Board, and this agency has not indicated

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[3] Arcadis. 2018. Carlsbad Desalinated Seawater Integration Study. The Water Research Foundation. Alexandria, VA.

[4] Draft EIR, page 4.8-30.

[5] The "San Juan Basin" is not a groundwater basin, but instead is part of the subterranean channel underlying San Juan Creek, as noted in SJBA's website, available at https://www.sjbauthority.com/program.html (accessed June 6, 2019); see also, Permit for Diversion and Use of Water, Permit 21138, Application 30337 of South Coast Water District (filed March 24, 1995); see also, Amended Permit for Diversion and Use of Water, Permit 21074, Application 30123 of San Juan Basin Authority (filed March 4, 1992).

[6] See, Water Code §§1200, 1201. There is no statutory or case law authority which extends the State Board's water rights regulatory authority past the point where the water flows from the subterranean channel into the ocean.

any need for such rights; and 2) off-shore flow is not in a subterranean channel subject to State Board regulatory jurisdiction. (Refer to responses L7-7 and L7-8).

The water in the subterranean stream moves down-gradient through the sand and gravel alluvium in the creek bed, generally in the same direction as the surface stream, pulled by gravity and pushed by hydrostatic pressure from upstream. An upstream pumping depression might reverse the subterranean flow, pulling some of the water back upstream, again by gravity and hydrostatic pressure. This cannot occur from off-shore subterranean pumping. Off-shore subterranean pumping might incrementally increase the velocity of subterranean flow in a seaward direction. The estimated capture of inland groundwater (from onshore sources) in the slant wells is estimated at approximately 6.6%. This flow, as it discharges into the ocean is not in a known and defined channel subject to State Board jurisdiction.

SJBA and the District both hold water rights permits to divert water from the subterranean stream underlying the bed of San Juan Creek.[7] (Refer to Response L7-10). Even if the Project requires new or modified groundwater rights, the volume of inland groundwater to be potentially withdrawn by the Project is less than the District's current water rights (0.6 MGD compared to an existing right of 1.15 MGD).

Response L6-11

Yes. As noted in the Draft EIR (page 3.0-45), the Project is seeking MWD approval of Local Resource Program funding. (See also, Response L3-1).

Response L6-12

Sea level rise related to the Project is addressed in *Section 4.8, Hydrology and Water Quality*.

The potential for flooded wellheads and overtopping rates for low and high range sea level rise projections is summarized in Table 7.1 and Table 7.2 of the Appendix 10.7.1 Coastal Hazards Analysis. The analysis was clarified in response to the 2018 revision of the California Coastal Commission Sea Level Rise Policy Guidance document. The flood extent is based on extremal total water levels (TWL's), or the sum of extreme waves coupled with extreme ocean water levels. Extremal TWL's were determined for the low and high range sea level rise projections for 2100. This is a worst-case approach since it includes wave runup. Wave runup is a short-term process and therefore may not result in flooding to the full extent of the runup elevation. While the projections indicate temporary overtopping of Doheny Beach and portions of Doheny State Park, the wellhead vaults will be fully buried and will be designed to allow for short-term overtopping without flooding or issue to the intake or the wider system, and any potential water infiltration can be removed with a manual sump pump. As noted in Response S1-14, the sea level rise analysis was clarified and amplified using recently adopted guidance from the California Coastal Commission. This modeling did not affect Draft EIR conclusions or mitigation requirements.

[7] As noted by SJBA, "The San Juan Basin is categorized as a subterranean flowing stream, thus water extraction from the basin falls under water rights regulation of the State Water Resources Control Board" (https://www.sjbauthority.com/programs.html, accessed June 6, 2019).

Response L6-13

Comments regarding the recently updated designation of the subterranean stream underlying San Juan Creek as “very low” priority in the California Statewide Groundwater Elevation Monitoring (CASGEM) program are noted for the record and will be reflected in Section 3, *Draft EIR Errata.* The “very low” priority indicates that the DWR does not consider the groundwater conditions in the stream to be of concern, suggesting that current groundwater management strategies are successful. The current management strategies are fully considered in the project hydrogeologic assessments and therefore this change of designation will have no impact on the Project.

Response L6-14

Please see Section 4.8 of the Draft EIR regarding potential flooding impacts and pre- and post-project conditions. This analysis has been clarified and amplified with respect to its coastal hazard analysis and updated 100-year flood analysis (Appendices 4.2.1 and 4.2.4). The analysis shows that, with the proposed site elevation raised above the 100-year flood plain, the site would be adequately protected in the 100-year storm event, and therefore a storm water pump station is not required. The analysis further indicates that site drainage improvements would not result in an increase in flooding during a storm event at any point around the plant site. Modeling for the analysis includes consideration of the upper watershed and existing site stormwater drainage features. The analysis in the FEIR Appendices is consistent with and further supports the conclusions of the Draft EIR.

Response L6-15

The reports provided in Appendix 10.10.1 and 10.10.2 provide an assessment of the effects on upstream pumpers. It is not clear what further clarification is desired. No significant impacts have been found to upstream groundwater pumpers or users.

Response L6-16

The District is a member of the San Juan Basin Authority and as such actively collaborates on matters affecting the SJBA. The District intends to continue in its role as an SJBA member agency to address issues related to groundwater, ocean desalination and related matters. Refer to Responses L6-3 and L6-17 regarding vertical wells.

Response L6-17

The results of the bedrock “barrier” investigation has been discussed in previous responses (see Response L6-2 and L6-5). The District coordinated extensively with SJBA on the groundwater barrier question and other matters, producing a technical response contained in Appendix 4.2.3. The technical response is entitled “Doheny Ocean Desalination Project - Hydrogeologic Analysis Related to Responses to Comments - Evaluate Project Impacts on San Juan Creek Surface Water Levels and Assessment of Project Impacts from Potential Upstream Bedrock “Barrier.” This technical response shows that drawdown from the slant well pumping is not impacted by the elevated bedrock. In fact, the elevated bedrock may result in a greater impact from the use of vertical wells, since the well screens would be closer to the elevated bedrock area (see Response L6-3).

Response L6-18

SJBA comments commending the Project are noted for the record.

Santa Margarita Water District

August 6, 2018

Kevin Thomas
Kimley-Horn
3880 Lemon Street, Suite 420
Riverside, CA 92501

Subject: Draft Environmental Impact Report for the Proposed Doheny Ocean Desalination Project (State Clearinghouse No. 2106031038)

Dear Mr. Thomas:

The Santa Margarita Water District (District) appreciates the opportunity to provide the South Coast Water District (SCWD) with comments on the Draft Environmental Impact Report (DEIR) for the Doheny Ocean Desalination Project (Project). The Project offers the potential to enhance local water reliability by providing a high quality, locally produced and controlled, drought proof water supply.

The District has reviewed the DEIR for the proposed Doheny Ocean Desalination Project in southern Orange County, California and has the following comments for SCWD's consideration:

1

Section 3.0, Project Description

Page 3.0-4. Figure 3-2 presents *MWDOC and SCWD Current Water Supply Portfolios* for 2015 and 2017 as pie charts. The pie charts represent that SCWD receives 85 and 77 percent of its supply from MWDOC for 2015 and 2017 respectively. The pie charts that represents that MWDOC receives 41 and 46 percent of its supply as imported water for 2015 and 2017 respectively is misleading in that all of the MWDOC water that is received by SCWD is imported water. The information in the MWDOC pie chart is not relevant to SCWD as MWDOC is not legally allowed to provide anything but imported water to SCWD. These charts do not support the statement that precedes the figure that states, *"the District is currently relying on imported water for approximately 85-100 percent of its water supply needs."*

Page 3.0-6. The first bullet under Figure 3-3 is a planning assumption used by CDM Smith in the December 2017 water supply reliability study, and not a finding of that study, as represented here.

2

Page 3.0-15. The fourth line of the paragraph just above Section 3.4.1 that states *"the project's facilities in the Coastal Zone are also appealable to the CCC"* is not accurate as written; it is the decision under the LCP, not the facilities, that is appealable.

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Page 3.0-16. The Phase 1 Local Project at 5 mgd is represented in the first bullet in the middle of the page as equating "*to up to approximately 3,192 AFY at 95% utilization.*" Yet Table 3-1 represents 5 mgd at 95% utilization as 5,320 AFY. Please be consistent.

Page 3.0-19. The last paragraph makes it unclear if Exhibits 3-3 and 3-4 identify the proposed project correctly or if they need to be modified to provide a true depiction of what is proposed.

2

Page 3.0-24. In the middle of the third paragraph, the text explains that, "*At steady state, groundwater modeling supports that the Project will be drawing in approximately 6.6% of brackish groundwater . . .*" This statement is true only at Doheny State Beach, if the next paragraph is also true.

Page 3.0-29. Table 3-7 should also include the quantities of chemicals anticipated to be stored on site.

Section 4.04, Cumulative Impacts Analysis

Page 4.0-9 table under San Juan Watershed Project. There will be additional brine generated from the City of San Juan Capistrano's Groundwater Recovery Plant than is currently being released if and when this project moves forward. Phases 2 and 3 of the San Juan Watershed Project or upstream Direct Potable Reuse projects will also generate additional brine that should be accounted for as a possible cumulative impact.

3

Page 4.0-9 table under San Juan Watershed Project. Footnote (3) doesn't seem to apply to this project.

Page 4.0-9 table under Dana Point Offshore Cumulative Effects. The SJCOO combines flows from the J.B. Latham Wastewater Plant, the Chiquita Water Reclamation Plant, the City of San Clemente Water Reclamation Plant and the 3A Water Reclamation Plant. The combination of the effluents individually and the various combinations from each of these plants should be considered in the analysis of the impacts of the brine from the proposed Project.

Section 4.3, Biological Resources

Page 4.3-5 Lagoon Habitat. Discussion on the possible cumulative effects of the Project's impact on the lagoon when taken in combination with the proposed San Juan Watershed Project is required. Identification of the results of simultaneous modeling of both proposed projects should be included.

4

The analysis in the DEIR that addresses shear stress mortality from the discharge of brine at the diffuser and compliance with the Ocean Plan Amendment, is included in Section 4.3, Biological Resources, on pages 4.3-33 through 4.3-34, and relies on the analysis presented in Appendix 10.4.1 and Appendix 10.11. Shear stress mortality is defined in those appendices by the value of LC10, being the critical threshold above which sub-lethal or greater injury may occur to marine organisms. Although the Ocean Plan Chapter III.M.2.e.(1)(b) notes that the applicant of a desalination facility

shall use any approach approved by the regional water board for evaluating shear stress mortality resulting from the facility's discharge, including any incremental increase in mortality resulting from a comingled discharge, the SWRCB and LARWQCB have recently published guidance for an 4
approach that differs from the approach taken in this DEIR. See the document at:

> https://www.waterboards.ca.gov/santaana/water_issues/programs/Wastewater/Poseidon/2018/4-18- 18_Diffuser_Analysis_Method.pdf

Section 4.8, Hydrology and Water Quality

The DEIR Section 4.8, Hydrology and Water Quality, relied on Appendix 10.11, Brine Dilution Assessment, to determine if the proposed project would violate any water quality standards or waste discharge requirements (Impact 4.8-1). As written, the one page of text and one page of tables addressing the impacts of the brine discharge system discussed within Impact 4.8-1, do not provide adequate analysis to support the determination that *"[t]he brine discharge from the Project will meet applicable water quality requirements as established in either a new or modified NPDES permit from the RWQCB for use of the existing SOCWA SJCOO discharge*." (page 4.8-26). A reviewer must read Appendix 10.11 to understand the methodology and the results.

With a working assumption that only the 5 mgd project is being analyzed in the EIR at a project- 5
level, the statement that "*all but one of the dense discharge cases in Table ES-3 manages to satisfy discharge limits*" set forth under the Ocean Plan Amendment is misleading, since only one realistic dense discharge was actually modeled (5 mgd of brine with 0.35 mgd of wastewater) and the modeling concluded that the Dm at the ZID would be 14:1, which would not meet the NPDES thresholds without some modification to the diffusers. The DEIR does not recognize this impact to ocean water quality. The impacts discussion in Section 4.8 did not disclose that the proposed project will not meet applicable water quality standards and would in fact, violate waste discharge requirements under low wastewater flow conditions. The DEIR did not: 1) explore a broader range of combined flow scenarios (testing a range of wastewater flows between 0.35 mgd and 8 mgd) to better understand at what point the dense plume becomes positively buoyant and lifts off the seafloor; 2) consider or explore mitigation to improve dilution of the dense plumes, such as increasing the port angle, or closing off some ports to increase velocity and therefore, dilution; 3) evaluate the potential secondary impacts from mitigation to increase dilution, or; 4) include a monitoring and reporting program as required by Ocean Plan Amendment Chapter III.M.4, which includes monitoring of effluent and receiving water characteristics, consistent with Chapter III.M.3, and impacts to all forms of marine life.

Section 4.8, Groundwater Analysis

In general, the DEIR does not provide sufficient hydrogeological setting information to describe the
local and regional groundwater conditions and to support the impact analysis; rather, it simply refers 6
the reader to the lengthy, highly technical appendices (10.10.1 Groundwater Model Update and 10.10.2 Modeling of Slant Well Feedwater Supply). While the information may be contained in the supporting appendices, it is the function and onus of the EIR to interpret and present the supporting

studies in such a way as to provide the reader with a comprehensive understanding of the baseline
environmental conditions and the project's effect on those conditions. Refer to CEQA Guideline 6
Section 15147.

The Affected Environment (Section 4.8) does not adequately describe the baseline hydrogeologic conditions. For instance, there is no detailed narrative or graphics describing the "paleo-channel" and hydrologic connection between the offshore groundwater and San Juan Basin, nor is there an adequate description or comparison of the hydrogeologic conditions underlying the Doheny State Beach area and Capistrano Beach Park. This deficiency leads to confusion in the analysis of Impact 4.8-2 that states, "*no such groundwater impact would occur for slant wells at Capistrano Beach Park since the area is not hydrologically connected to the onshore portion of the San Juan Basin.*" The results of the pilot testing of the slant wells suggested some intake of groundwater from the San Juan Basin and the groundwater modeling also showed the same. This is not discussed and would indicate the DEIR does not describe the inland hydrostratigraphy, which is necessary to determine impacts of the project on the deeper, inland aquifers and the relationship to the shallow nearshore
aquifer. Additionally, the groundwater setting does not characterize current seawater intrusion 7
except to address it by the statement *"[t]he San Juan Basin has historically experienced over-pumping, resulting in the District having to periodically shut down its GRF . . . to inhibit seawater intrusion."* Seasonal fluctuation in groundwater levels, locations of near-vicinity wells, and groundwater flow gradients are also not provided in the DEIR, which leads to difficulty in determining whether project effects lead to significant impacts at neighboring wells or on upstream groundwater levels. Existing groundwater quality is also not described to a degree that would support the impact conclusion that the groundwater is not useable due to high salinity levels. The document states *"limited groundwater quality data and hydrogeologic modeling indicates that these offshore areas would not draw from onshore groundwater resources as is the case at DSB near the mouth of San Juan Creek".* It appears that further data and modeling is required to confirm there is no impacts on upstream groundwater. This could possibly be accomplished through the use of monitoring wells to check on depth to groundwater and also the salinity to confirm seawater intrusion is not occurring in the existing basin. It also appears that further data and modeling is required in conjunction with the possible operating scenarios associated with the San Juan Watershed Project be performed to identify if there are any cumulative impacts that could be created by the construction and operation of both projects.

Without an adequate description of the baseline conditions, the analyses for construction impacts appear incomplete and unsupported. For example, the text on Page 4.8-29 states, "*For extended slant well pumping to remove iron and manganese, the net effect on the local groundwater supplies would be higher than the steady state conditions achieved after 18 months or so of pumping.*" This claim
is not clearly explained nor is the statement referenced but the impact conclusion, which is also not 8
substantiated, is that it is not considered significant because the condition is temporary, the affected groundwater is not useable, and the Project would ultimately provide a new source for potable supply. As shown with both the District's GRF and the City of San Juan Capistrano's GWRP the groundwater is usable with treatment and should not be discounted. Additionally, both facilities abilities to pump groundwater for treatment are predicated on no sea water intrusion being observed or the accompanying possible degradation to the ground water basin. Discussion must be made on

how to operate the Project without impacting the upstream groundwater users' ability to also operate. The actual effects on the local hydrology such as groundwater levels, initiation of temporary sea 8
water intrusion, or effects on neighboring wells are not addressed or described.

Operational groundwater impacts of the project focus on the volume of inland groundwater that would be withdrawn, the change in groundwater yield in the San Juan Basin, and sea water intrusion. The analysis also briefly mentions the changes in local groundwater levels. The text on page 4.8-30 states, "*[s]lant wells have the potential to reduce annual San Juan Basin groundwater yield by up to 392 AFY.*" The analysis continues by claiming that 392 AFY is not a significant impact because the Doheny State Beach wells "*will actually create a pumping "trough" which will reduce further seawater intrusion into the San Juan Basin.*" There is no data, graphic description, or supporting 9
information presented in the DEIR that substantiates the claim that a trough would reduce seawater intrusion. However, a footnote at the end of the sentence directs the reader to Appendix 10.10.1, page 53. Appendix 10.10.1 does not have a page 53 and page 53 in Appendix 10.10.2 discusses the effects of intake pumping under Scenario 1 but does not mention seawater intrusion or creation of a "trough." A maximum nearshore shallow aquifer water level decline of 13.96 feet is presented but the location, well type, and proximity to the slant wells is not described. This decline in groundwater level may have significant negative impacts on upstream groundwater wells. The text in this paragraph conflicts with other statements in the document that state the raw water will be 6.6% groundwater whereas this section limits this impact to approximately 5%.

The DEIR does not require monitoring to demonstrate the impact is limited to 392 AFY, nor does the DEIR require compensation for the lost volume of water that may occur upstream. The DEIR doesn't identify how the amount of groundwater will be taken into the Project will be measured. The 10
groundwater rights are mischaracterized in that the groundwater rights are reduced when less groundwater is available in accordance with the SJBA Adaptive Management Plan.

Section 5.0, Alternatives to the Proposed Project

The recent findings of the existence of an upstream hydrogeological barrier between the near shore and upstream ground water basin seemingly conflict with the comments made on Page 5.0-8 relative to the Vertical Well Technology Alternative. This approach appears to have been discounted with 11
little to no analysis even though the DEIR states "*Possible advantages of vertical wells include typically lower cost to install, less complex construction methods, and ability to locate the vertical wells away from the beach where coastal hazard and beach recreation conflicts may occur*".

Again, the Santa Margarita Water District appreciates this opportunity to comment on the DEIR for this very important water supply project for South Coast Water District and South Orange County. Please let me know if you have any questions as you complete this document. I can be reached at (949) 459-6602 or donb@smwd.com. 12

Sincerely,

Don Bunts
Deputy General Manager
Santa Margarita Water District

Letter L7 Santa Margarita Water District

Don Bunts, Deputy General Manager
August 6, 2018

Response L7-1

Regarding current water supply portfolios, MWDOC water supplies are relevant to provide context for the region's reliance on imported water, and to emphasize the differences between broader MWDOC reliance on 100% imported water and the District's unique situation in south Orange County, where SCWD's reliance on imported water depends at times on recycled water being used for irrigation and the Groundwater Recovery Facility (GRF) being operable and providing potable water. The Project Description was clarified to state that the water supplied to SCWD by MWDOC is 100% imported water and that the District is currently relying on imported water for approximately 77% of its water supply needs. See Section 3, *Draft EIR Errata*.

Response L7-2

Minor modifications and clarifications identified on pages 3.0-6, 3.0-15, 3.0-16, and 3.0-24 in the Project Description are noted and will be made as shown in Section 3, *Draft EIR Errata.*

See also, Master Response 1 regarding the Project Description and wellheads.

With regard to page 3.0-19, Exhibits 3-3 and 3-4 correctly depict the Project in its current state. The Project may be refined during final design stages, as appropriate. See Master Response 1 regarding the Project Description.

With regard to page 3.0-29, regarding the request for further information in Table 3-7, see Master Response 1 regarding the Project Description and on-site chemical storage.

Response L7-3

Refer to responses to Letter S7 regarding clarifications to the Project's brine discharge modeling, which show that even under zero wastewater flow conditions the Project can meet Ocean Plan brine discharge requirements. The Project would be compliant with a NPDES permit, which will establish waste discharge requirements for the South Orange County Wastewater Authority (SOCWA) discharge to the Pacific Ocean through the San Juan Creek Ocean Outfall. Compliance with the NPDES permit will ensure no cumulative impacts associated with additional brine occur as a result of the Project. See, Section 3, *Draft EIR Errata* (deletion of Mitigation Measure HWQ-3).

Regarding footnote (3) of Table 4-1, the footnote is applicable because the San Juan Creek and Western San Mateo Creek Watersheds SAMP falls within the cumulative setting for the Project.

Response L7-4

Refer to responses to Letter F2 regarding clarifications and amplified technical responses to address potential cumulative groundwater impacts of the San Juan Watershed Project (SJWP) operating concurrently with the proposed Project. The technical memo is provided as Appendix 4.2.5.2.

In response to comments from the San Diego Regional Water Quality Control Board, the Project brine discharge modeling was amplified (see Appendix 4.2.5.1) and no longer uses the LC10 methodology (refer to Response S7-11). Rather, the analysis uses methodology based on the approved approach requested by the SWRCB and LARWQCB as noted in Response S7-20 through S7-27.

Response L7-5

Refer to comprehensive responses on the subject of brine discharge modeling and Ocean Plan compliance in responses to Comment S7 from the San Diego Regional Water Quality Control Board. As discussed in Response S7-4, the Project would comply with the Ocean Plan and may require mitigation if determined necessary by the Regional Board. Discharge scenarios were clarified in the brine discharge modeling included as Appendix 4.2.5.1. Using the Regional Board's recommended brine discharge modeling (see Response S7-18), for buoyant discharges, the Local Project is modeled to reduce marine life impacts ("turbulence mortality") associated with diffuser jets compared to "no project" conditions (the incremental turbulence mortality impact of the Project is beneficial, reducing the turbulence mortality and associated zone of initial dilution [ZID]). For dense discharges, the incremental effect of the Project is modeled to result in additional turbulence mortality, equating to approximately 5.57 acres in Area of Production Foregone. As discussed in the Draft EIR (page 4.3-33), this is not considered a significant impact under CEQA. This modeling shows that under all reasonably foreseeable brine discharge scenarios, the Project will meet applicable Ocean Plan discharge requirements. No diffuser modification or other mitigation is required to meet Ocean Plan requirements.

As part of the Regional Board's permitting process, the District will be submitting appropriate documents to support the Regional Board's Water Code Section 13142.5 determination (as discussed on Draft EIR page 1.0-3, Table 3-10 and elsewhere), including any additional modeling required by the Regional Board and appropriate monitoring and reporting plans. Note that this is an Ocean Plan compliance issue, and not a CEQA compliance issue.

Response L7-6

Existing hydrogeological and groundwater conditions are explained on pages 4.8-4 and 4.8-5 of the Draft EIR, which is summarized from the Appendices. This comment appears to be a general introduction to more specific comments that follow and are addressed below.

Response L7-7

Baseline Hydrogeologic Conditions

Existing hydrogeological and groundwater conditions are explained on pages 4.8-4 and 4.8-5 of the Draft EIR, which is summarized from the Appendices. Reports from Appendix 10.10.1 and Appendix 10.10.2 provided a cumulative description of the baseline hydrogeologic conditions. Section 3 of Appendix 10.10.1 and Section 7 of Appendix 10.10.2 provide the references to the previous documents upon which modeling updates were made and which contain descriptions of the alluvium associated with San Juan Creek (paleochannel) as assessed in the seminal work for the slant well investigations. The extent of the offshore portion of the San Juan Creek paleochannel is shown graphically in Appendix 10.10.1. Appendix

10.10.1 provides the current limited information available for the hydrogeologic conditions of the Capistrano Beach offshore paleochannel. Figure 1 of Appendix 10.10.1 shows the location of the paleochannels in dark green and light green. Figure 1 indicates that the paleochannel is separate and not hydraulically connected to the San Juan Creek paleochannel at or near the shore. Therefore, where pumping at Doheny Beach may result in extraction of approximately 6.6% of inland groundwater (see Response L7-9), pumping at Capistrano Beach would not result in extraction of groundwater from the subterranean stream underlying San Juan Creek.

Groundwater Modeling and Associated Hydrostratigraphy

The groundwater model takes into consideration the extensive data available from construction of inland monitoring wells in addition to an extensive library of drillers logs from both the Wildermuth Environmental, Inc. (WEI) and Geoscience Support Services, Inc. (GSSI) databases. Therefore, the hydrostratigraphy simulated in the model considers the entire aquifer within the model domain, representing both the shallow and deeper zones and the interaction between the two aquifers. Through collaborative workshops and extensive coordination with the San Juan Basin Authority (SJBA), Santa Margarita Water District and their technical team, the groundwater modeling and associated stratigraphy was further validated and refined. The results of the collaboration have been incorporated into the technical memo provided as Final EIR Appendix 4.2.3.

Draft EIR Appendix 10.10.1, Groundwater Model, discusses the potential for seawater intrusion and concludes that there would be no seawater intrusion impact. The degree of ocean water intrusion into the subterranean channel as a result of scenario groundwater pumping was determined by TDS concentration over time. Detailed methodology is included in Draft EIR Appendix 10.10.2. Figures 9 and 10 of Draft EIR Appendix 10.10.1 and Figures 117 through 121 of Draft EIR Appendix 10.10.2 show TDS with time for the various project scenarios.

Effects on Groundwater Levels

The purpose of the previous Project modeling efforts to date has been to ascertain under various scenarios, the impacts on groundwater levels as it may affect upstream users and surface flow in San Juan Creek. Since the slant well screens will be located offshore, when the wells are turned on water will flow to the well screens located below the ocean floor resulting in a seaward gradient. Figures 31, 48, 64, 80, and 96 in Draft EIR Appendix 10.10.2 show the changes in groundwater elevations from the various project scenarios, and in all cases, pumping results in a seaward gradient towards the coast. Therefore, the Project wellfield will act in effect to mitigate upstream pumping during future dry seasons by maintaining a seaward gradient to the slant well screens.

Upstream Groundwater Effects

The impacts to upstream well users with respect to well capacities are discussed in both Draft EIR Appendices 10.10.1 and 10.10.2. Appendix 10.10.1 reports the potential reduction in local well yield from slant well pumping. (Draft EIR Appendix 10.10.1, Tables 1, 4-2).

A "San Juan Basin Focused Groundwater Model" computer simulation of the effects on the subterranean hydrology resulting from operation of the DSB slant wells was created for the Project. The model was originally developed in 2012 and was refined in 2015, 2016, and 2018 with data collected from 18 months of test operation of the Doheny prototype slant well, as well as with geophysical information which defined the distribution of the offshore portion of the aquifer. This data, together with data collected from operating water wells and groundwater monitoring wells established within the subterranean stream of lower San Juan Creek provides a geohydrologic representation of the subterranean stream (see Draft EIR Appendix 10.10.1 and 10.10.2 for discussion of model development). The model shows that operation of the DSB slant wells will create a pumping depression (trough) within the groundwater beneath the seafloor centered around the screened intakes to the slant wells.

The depression will induce a small amount of fresh water within the subterranean stream of lower San Juan Creek to move into the sub-oceanic aquifer beneath the seabed. However, a portion of this freshwater would under natural conditions flow towards the ocean, mix with seawater, and be lost to beneficial use. The model predicts that, when, and only when combined, with certain other hydrologic factors, this outflow causes minor reductions in water production capability in some wells within the subterranean stream of lower San Juan Creek (Draft EIR Appendix 10.10.1, Table 1). One of the factors necessary to create a reduction in water production capacity is the full legally permitted production of all wells within the subterranean stream of lower San Juan Creek. The other is a sustained, substantial drought within the San Juan Creek drainage watershed. The worst case would be during dry hydrologic conditions with all groundwater wells in the subterranean stream (including the City of San Juan Capistrano (CSJC) and SCWD's wells) pumping at permitted capacity when well yields could be reduced 392 AFY from scenario 1 pumping (Local Project). The theoretical potential reduction to the CSJC wellfield production is 175 AFY under scenario 1 pumping, while SCWD's groundwater wells would be the most potentially impacted (approximately 217 of the 392 AFY reduction would impact SCWD's own wells). However, pumping at the coast will maintain a seaward flow of water (gradient) during both wet and dry seasons. (Draft EIR Appendix 10.10.1, Table 1). The maintenance of a seaward gradient from the Project slant wells will act to inhibit seawater intrusion and prevent degradation to inland groundwater quality (Appendix 10.10.2, Figures 31, 48, 64, 80 and 96).

The model shows that the seaward flow of water (gradient) which induces outflow of fresh water has the salutary effect of inhibiting further seawater intrusion into aquifers within the subterranean stream of lower San Juan Creek, which in turn prevents degradation to inland groundwater quality. The beneficial effect of inhibiting further intrusion into the subterranean stream of lower San Juan Creek exists independently from the other factors that contribute to reduction in the water yield of the groundwater system. Protecting the subterranean stream of lower San Juan Creek from seawater intrusion may increase the sustainable yield (that amount of water that may be perennially produced without an adverse physical effect) from the groundwater system. (Draft EIR Appendix 10.10.2, Figures 31, 48, 64, 80 and 96). See Section 3.0, *Draft EIR Errata*, regarding clarification of second to last paragraph of DEIR, p. 4.8-29, and last paragraph of DEIR, pp. 4.8-30.

The reduced water production capacity of the subterranean stream of lower San Juan Creek is not caused by the outflow of fresh water induced by the slant wells alone, and only exists when combined with other factors. As well, the induced flow of fresh water inhibits seawater intrusion and potentially enhances the safe yield of the subterranean stream of lower San Juan Creek. Because of this, the reduced yield of the subterranean stream of lower San Juan Creek caused, in part, by the outflow of fresh water resulting from the slant wells is not a significant adverse environmental effect. In sum, the underlying technical studies found no significant impact to groundwater quality and quantity in the subterranean channel as discussed in the Draft EIR (on pages 4.8-30 and 4.8-44, with clarifications shown in Final EIR Section 3, *Draft EIR Errata*).

Further, both drought and groundwater pumping by diversion permit holders (SCWD and SJBA) contribute to the reduction in groundwater yield in the subterranean channel under San Juan Creek. The DEIR states that the Project's slant well pumping also contributes to this reduction in that it would reduce groundwater yield by 392 AFY. (DEIR, p. 4.8-30). However, even without the Project, those two other conditions alone (without Project-induced out flow) will result in a reduction of 115 AFY from average to dry hydrologic conditions and 800 AFY from wet to dry hydrologic conditions (Table 1, 2, and 3 Appendix 10.10.1).

What is known to date about the hydrogeologic conditions at Capistrano Beach is provided in Appendix 10.10.1. The District agrees that, prior to proceeding with slant wells at Capistrano Beach Park, additional investigation at Capistrano Beach and subsea areas should be conducted, which is consistent with recommendations in the Project's groundwater modeling studies and in the Draft EIR (such as Mitigation Measure BIO-3) which include offshore drilling, soil sampling, and water quality sampling. The additional investigations would serve to characterize the offshore paleochannel near Capistrano Beach and to allow comparison with hydrogeologic conditions at Doheny Beach.

Operating Scenarios of Cumulative Conditions

Modeling scenarios simulating the cumulative effects of the SJWP and the Doheny Ocean Desalination Project have been discussed in Response L7-3 above, as well as Responses F2-8, -12, -15, 17, and -19. The information provided demonstrates that the Doheny Desalination Project results in very little additional impacts on groundwater levels, lagoon levels, and surface water flow. In combination with SJWP, future Project monitoring will become a part of Project operations as required through EIR Mitigation Measure BIO-4 and regulatory agency permitting conditions, including preparation of a Mitigation Monitoring and Reporting Plan (MMRP) to assess the impacts of construction and operation of the feedwater system.

Response L7-8

Refer to above response (L7-7) regarding existing baseline discussion. See also Master Response 4 regarding slant viability and technology.

Regarding the comment about the text on page 4.8-29 relating to the potential for interim pumping conditions, the referenced statement will be clarified in the Final EIR. See Section 3.0, *Draft EIR Errata*.

Slant well pumping will be conducted in phases as each well is completed and tested. The data collected from water level responses from pumping as each well comes on line will be used to refine the focused groundwater model after each well installation. However, monitoring of groundwater level and quality will be conducted while pumping of the wellfield to remove iron and manganese is in operation to ensure that water level and water quality changes do not cause harm to upstream users. Current analysis included in Appendix 4.2.3.1 indicates that under historical worst-case drought conditions (2014) in the period of record (1947-2014), groundwater levels under Scenario 1 will result in an additional 3.8 feet of additional drawdown from baseline conditions at SCWD GRF well and 0.8 feet at the Kinoshita well (see Figures 11 through 22 of the technical response memo, provided as Final EIR Appendix 4.2.3.1). With the San Juan Watershed Project Phase 1C project, groundwater levels under Scenario 1 will result in an additional 3.4 feet of additional drawdown from baseline conditions at the SCWD GRF well and 0.5 feet at the Kinoshita well.

Refer to Response L6-5 for additional discussion and citations supporting the fact that the Project will reduce or eliminate seawater intrusion. With respect to usability of the groundwater, see Section 3, *Draft EIR Errata*.

Response L7-9

Refer to Response L6-5 for additional discussion regarding salinity gradient. The decrease in well capacity of 392 acre-feet-per-year (AFY) on average as stated on Draft EIR page 4.8-30 is due to a slight decrease in groundwater elevations, decreasing the saturated thickness and therefore well capacities. The small inland contribution of groundwater to the slant well screens will be brackish initially as shown by the typical groundwater quality at the SCWD GRF well. Pumping at the coast using the slant well field will ensure a continuous seaward gradient since the cone of depression will be deepest offshore over the slant well screens (refer to Response L6-5 for additional discussion regarding the salinity gradient and seawater intrusion benefits of the Project). Therefore, in time, the inland groundwater contribution may freshen up. The seaward gradient will result in inhibiting seawater intrusion, especially during drought periods, when groundwater elevations are lowest inland from the lack of recharge, as well as lowered levels from dry season supply pumping. The technical modeling (see Appendix 10.10.1) confirms the Project's potential draw on inland groundwater at approximately 6.6% under Scenario 1 conditions. Previous estimates of an inland draw of groundwater ranged from 4.2% to 6.3% depending on the scenario (see page 5 of Draft EIR Appendix 10.10.2), which has been clarified based on recent refinements to the model (Draft EIR Appendix 10.10.1) as well as differences in the specific proposed extraction scenarios. Therefore, the Draft EIR's use of "5%" is appropriate as a generalization to the average of prior inland groundwater percentages, which does not conflict with more specific estimates based on current groundwater modeling. Refer to Response L7-10 regarding groundwater modeling once the Project becomes operational. With respect to the Draft EIR footnote 22 on page 4.8-30, this citation has been corrected (see *Section 3, Draft EIR Errata*).

Response L7-10

Monitoring of groundwater levels and water quality will be conducted as part of the on-going operations to refine the groundwater model and validate the aquifer responses and impact predictions (see Mitigation Measure BIO-4). The purpose of on-going data collection and model refinement is to confirm or refine any potential decrease in upstream well capacities and any changes in water quality. The percentage of inland water contributing to the slant well production will be determined by a mass balance calculation, taking into account volumes and Total Dissolved Solids levels of inland groundwater, ocean water, and slant well production water. The calculation is shown in Section 4.1.3 of Appendix 10.10.1. In addition to EIR mitigation measures and regulatory agency permit conditions, the District is a member agency in the SJBA and as such is committed to address any groundwater basin management issues that should arise related to the Project or other operational activities, consistent with District and SJBA policies and programs such as the San Juan Basin Authority Adaptive Pumping Management Plan.

The District will work with SJBA to address any water rights allocation issues that may arise in the future with respect to the SJBA Adaptive Management Plan, and as discussed in Response L6-10, to the extent water rights becomes an issue, the District is prepared to work with the State Board to either modify its existing water rights permit or seek additional water rights.

Further, though frequently referred to as such, the "San Juan Basin" is not a groundwater basin. It is part of the subterranean channel underlying San Juan Creek (refer to Response L6-10 for additional discussion regarding San Juan "Basin" in fact being a subterranean channel). [1] The water rights in that subterranean channel are surface water rights. Refer to Response L6-10 and L7-7 regarding Project effects upon upstream groundwater wells. As a member of SJBA, the District is committed to monitoring water elevations and water quality in the subterranean channel and to doing its part to manage the water resources in the subterranean stream.

Response L7-11

The existence and impacts of the partial bedrock constriction as determined from recent investigations have been discussed in previous responses (see responses to San Juan Basin Authority L6-2, -3, -4, -5, -6 and -17). A vertical well field was modeled as a part of the San Juan Basin Regional Groundwater Model Update and Seawater Extraction Barrier Impact presented as Appendix E of the San Juan Basin Authority Groundwater and Desalination Optimization Program Foundational Actions Funding Program Final Report. Figure 38 shows a vertical well field near Highway 1 pumping 6,000 acre-ft/yr. Pumping from the vertical well field at this rate which is approximately half the volume of Project Scenario 1 results in groundwater levels that are at about -20 feet below mean sea level in the area of the elevated bedrock as compared to slant well pumping water levels for Scenario 1 which are about +15 feet above mean (See Figure 14 GSSI March 2019 report). Although it is true that construction costs for slant wells are higher than for the vertical wells, the methods to construct are similar to vertical wells and have been proven over a range of projects (MWH, 2015). [2]

The current locations of the slant wellfield wellheads consider long-term coastal erosion within the available coastal erosion models. See, Master Response 4 regarding slant well technology.

Response L7-12

This is a closing remark that does not itself raise any environmental issues and requires no further response.

[1] See https://www.sjbauthority.com/programs.html (accessed June 6, 2019); see also, Permit for Diversion and Use of Water, Permit 21138, Application 30337 of South Coast Water District (filed March 24, 1995); see also, Permit for Diversion and Use of Water, Permit 21074 of San Juan Basin Authority (filed May 4, 1992).

[2] California American Water Slant Well Study Survey, prepared by MWH, dated October 2015.

South Coast
Air Quality Management District
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South Coast AQMD (909) 396-2000 • www.aqmd.gov

SENT VIA E-MAIL AND USPS: June 5, 2018
rshintaku@scwd.org
Rich Shintaku, PE
Acting General Manager, Chief Engineer
South Coast Water District
31592 West Street
Laguna Beach, CA 92561

Draft Environmental Impact Report (Draft EIR) for the Proposed Doheny Ocean Desalination Project (SCH No.: 2016031038)

The South Coast Air Quality Management District (SCAQMD) staff appreciates the opportunity to comment on the above-mentioned document. The following comments are meant as guidance for the Lead Agency and should be incorporated into the Final EIR.

SCAQMD Staff's Summary of Project Description

The Lead Agency proposes to construct an ocean water desalination facility of up to 15 million gallons per day (MGD) of potable drinking water (Proposed Project). The Proposed Project would also include construction of a subsurface water intake system, an ocean water conveyance pipeline, a concentrate (brine) disposal system, a product water storage tank and distribution system, and offsite electrical transmission facilities. Construction of the Proposed Project is expected to take approximately 38 months.

General Conformity Review and Determination

In the Air Quality Analysis, the Lead Agency included a General Conformity review and analysis. The conformity determination process is intended to demonstrate that a proposed Federal action will not: (1) cause or contribute to new violations of a national ambient air quality standard (NAAQS); (2) interfere with provisions in the applicable SIP for maintenance of any NAAQS; (3) increase the frequency or severity of existing violations of any standard; or (4) delay the timely attainment of any standard. 1

The South Coast Air Basin (Basin) is designated as extreme non-attainment for ozone and serious non-attainment for PM2.5. To streamline the review process and to facilitate conformity determinations for projects in the Basin, two separate VOC and NOx general conformity budgets were established in the Final 2012 AQMP: 1 tons per day (tpd) of NOx and 0.2 tpd of VOC were set aside for this purpose every year, starting in 2013 until 2030. SCAQMD has set up a tracking system for projects requiring conformity determinations on a first come first serve basis, whereby the project emissions are debited from the applicable set aside accounts until they are depleted.

Should the Lead Agency have any questions related to the SCAQMD General Conformity review process and determination, the questions can be directed to Ms. Sang-Mi Lee, Program Supervisor, at slee@aqmd.gov.

SCAQMD Permits

Statewide Portable Equipment Registration is required for certain portable equipment used onsite for less than one year, and SCAQMD permit is required if onsite portable equipment is used for one year or more (California Health and Safety Code Section 41755). In the event that implementation of the Proposed Project requires a permit from SCAQMD, SCAQMD should be identified as a Responsible Agency for the Proposed Project in the Final EIR. Any assumptions used in the air quality analysis in the Final EIR will be the basis for permit conditions and limits. For more information on permits, please visit SCAQMD webpage at: http://www.aqmd.gov/home/permits. Questions on permits can be directed to SCAQMD's Engineering and Permitting staff at (909) 396-3385.

Conclusion

Pursuant to California Public Resources Code Section 21092.5(a) and CEQA Guidelines Section 15088(b), SCAQMD staff requests that the Lead Agency provide SCAQMD staff with written responses to all comments contained herein prior to the certification of the Final EIR. In addition, issues raised in the comments should be addressed in detail giving reasons why specific comments and suggestions are not accepted. There should be good faith, reasoned analysis in response. Conclusory statements unsupported by factual information will not suffice (CEQA Guidelines Section 15088(c)). Conclusory statements do not facilitate the purpose and goal of CEQA on public disclosure and are not meaningful or useful to decision makers and to the public who are interested in the Proposed Project. 1

SCAQMD staff is available to work with the Lead Agency to address these issues and any other questions that may arise. Please contact me at lsun@aqmd.gov if you have any questions regarding the enclosed comments.

Sincerely,

Lijin Sun

Lijin Sun, J.D.
Program Supervisor, CEQA IGR
Planning, Rule Development & Area Sources

LS
ORC180523-02
Control Number

Letter L8 South Coast Air Quality Management District

Lijin Sun, J.D., Program Supervisor
June 5, 2018

Response L8-1

This comment letter provides general guidance from SCAQMD regarding CEQA compliance, and does not raise specific substantive issues regarding the adequacy of Draft EIR analyses. Comments regarding the General Conformity Review and Determination Process and SCAQMD permit process are noted for the record. Per Draft EIR Impact 4.2-2, the Project's estimated construction and operational emissions would not exceed the applicable de minimis level for Orange County after implementation of Mitigation Measures AQ-1 through AQ-3. Therefore, additional general conformity analysis is not required, and a general conformity determination is not required. If it is determined through design advancement that the Project will require onsite portable equipment, as specified under California Health and Safety Code Section 41755, then the Project will comply with applicable permit requirements.

SOCWA

South Orange County Wastewater Authority

Andrew Brunhart
General Manager
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

SUBJECT: Draft Environmental Impact Report Comments

Dear Mr. Brunhart,

Thank you for the opportunity to comment on the Draft Environmental Impact Report (EIR) for the Doheny Desalination (Doheny Desal) Project. SOCWA is a ten-member joint powers authority providing wastewater treatment, operation support and maintenance of two ocean outfalls. South Coast Water District is one of the ten members of SOCWA.

The mission of the SOCWA is to collect, treat, beneficially reuse, and dispose of wastewater in an effective and economical manner that respects the environment, maintains the public's health and meets or exceeds all local, state and federal regulations. On of SOCWA's ocean outfalls, the San Juan Creek Ocean Outfall (SJCOO) would need to be utilized for disposal of brine from the Doheny Desal facility. SOCWA would like to highlight that the Doheny Desal Project is in alignment with the mission of SOCWA to respect the environment by proposing subsurface intake and comingled discharge that is the preferred technology of the State Water Resources Control Board in compliance with the California Ocean Plan. 1

SOCWA recognizes constrained local supplies that limit the ability of the South Coast Water District (SCWD) to deliver drinking water supplies in times of emergency. SOCWA supports the ability of SCWD to endeavor to complete the Doheny Desal facility to increase reliability in the South Orange County service area. In addition, the Doheny Desal facility meets the Regional Water Quality Control Board's (Region 9) Practical Vision by employing a strategy for achieving a sustainable local water supply. SOCWA is supportive of the SCWD, through the Doheny Desal Project, to provide water resources in times of emergency and as a long-term water reliability strategy.

34156 Del Obispo Street · Dana Point, CA 92629 · Phone: (949) 234-5400 · Fax: (949) 489-0130 · Website: www.socwa.com

In conclusion, SOCWA would like to commend the efforts by SCWD consulting staff who worked with staff from SOCWA for cooperation and consultation of NPDES permit related items. As stated earlier, SOCWA is a joint powers authority and has four other member agencies who discharge effluent to the SJCOO. It was important for SOCWA to discuss the implications of brine discharge to the SJCOO with SCWD consultants to ensure the protection of capacity rights and that water quality objectives are met through technical review of the proposed discharges in compliance with the California Ocean Plan. SOCWA appreciates the forthright responses and professionalism of the consultants in review of the Doheny Desal Project. 1

Thank you again for the opportunity to comment.

Sincerely,

B. Burnett

Betty Burnett
General Manager, SOCWA

Letter L9 South Orange County Wastewater Authority

Betty Burnett, General Manager
(undated)

Response L9-1

Comments in support of the Project are noted for the record. The District appreciates the cooperation and collaboration with SOCWA, and continues to coordinate with SOCWA staff relative to the Project, SOCWA outfall, and associated permitting processes.

METROLINK.
SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
900 Wilshire Blvd. Suite 1500 Los Angeles, CA 90017
metrolinktrains.com

August 6, 2018

South Coast Water District
Attn: Mr. Rick Shintaku, PE – General Manager, District Engineer
31592 West Street
Laguna Beach, CA 92651

RE: Doheny Ocean Desalination Project – Draft Environmental Impact Report (DEIR)

Dear Mr. Shintaku:

The Southern California Regional Rail Authority (SCRRA) has received the DEIR on the Doheny Ocean Desalination Project. Thank you for the opportunity to comment on key issues relative to SCRRA and operations of the railroad adjacent to the project site. As background information, SCRRA is a five-county Joint Powers Authority (JPA) that operates the regional commuter rail system known as Metrolink. Additionally, SCRRA provides rail engineering, construction, operations and maintenance services to its five JPA member agencies. The JPA consists of the Los Angeles County Metropolitan Transportation Authority (Metro), San Bernardino Associated Governments (SANBAG), Orange County Transportation Authority (OCTA), Riverside County Transportation Commission (RCTC) and Ventura County Transportation Commission (VCTC). 1

The railroad right of way (ROW) adjacent to the proposed project is operated and maintained by SCRRA and owned by OCTA. There are currently 13 Metrolink trains, 28 Amtrak and 5 BNSF freight trains that operate daily through this corridor Monday through Friday and reduced number of trains on the weekends.

Below are the SCRRA initial general comments and on the DEIR by Section:

Section 3.0 Project Description

- Page 4.13-16 and Exhibit 3-3: Can the south alignment pipes be routed along San Juan Creek to avoid the two crossings of the existing rail line? This would be similar to alignment Alternative 1 and 5 in the PDR [Appendix 10.6.1] 2

Section 4.8 Hydrology and Water Quality

- Exhibit 4.8-2 and 4.8-3: Exhibits shown difference in maximum flooding depth with and without project. Based on the exhibits, the project will increase the 100-yr maximum flooding depth along the railroad ROW, which is not acceptable. The project should maintain the existing maximum flooding depth over the railroad ROW at the minimum or, preferably, reduce it. The area where there is an increase flooding depth from the project is where SCRRA has a control point where single track becomes double track and is a 3 critical point along the railroad system. The increase flooding depth will most likely cause issues at this location and should be mitigated as part of this project. 3

Section 4.13 Transportation

- SCRRA should also be included review of TCP for construction through and adjacent to railroad ROW.
- Considerations should be made for improved access from Stonehill Drive down an access road to the site and also additional improvements from an access drive off of Pacific Coast Highway. Due to expected truck traffic this could involve adding a traffic signal at the intersection of Stonehill Drive and the access road paralleling San Juan 4
Creek. The improved access road should also be designed and constructed to allow adjacent property owners (like the Cassidy Bros. Nursery) to utilize the same roadway, which would could potentially eliminate the need for an at-grade crossing of the tracks.
- Consistent with Policy 5.6 on Page 4.13-10 in Section 4.13 of Transportation and Traffic, SCRRA recommends that the project include adequate fencing, walls and protections to preclude any trespassing into the very active rail corridor.

Section 4.15 Utilities & Service Systems

- Page 4.15-14, Impact 4.15-3: Has the project considered impacts to the adjacent railroad ROW if the existing stormwater drainage facilities are not upgraded? 5

Section 9.0 References

- SCRRA should be included as a referenced agency to provide Engineering Standards for pipelines under tracks; Right of Way encroachment approval procedures and Right of 6
Entry Forms. These can be found on the Metrolink website at www.metrolinktrains.com/about/agency/engineering--construction/

Appendix 10.1 Preliminary Design Report (PDR)

- Why was Alternative 1 and 5 not the preferred alternative as it appears to have the least impact to the general public and does not require crossing the railroad tracks twice? 7

Thanks again for providing us with a copy of this NOP for a DEIR for review. If you have any questions, please me at (213) 452-0456 or via e-mail at mathieur@scrra.net.

Sincerely,

Ron Mathieu
Planning Manager II

Cc: Roderick Diaz, SCRRA
Liz Lun, SCRRA
Dinah Minteer, OCTA
Jason Lee, OCTA

Letter L10 Southern California Regional Rail Authority, Metrolink

Ron Mathieu, Planning Manager II
August 6, 2018

Response L10-1

Introductory comments regarding the SCRRA and nearby rights of way and operations are noted.

Response L10-2

The proposed South Alignment for the conveyance pipeline would utilize trenchless construction to cross below the rail lines and highway to minimize impacts. Although the Draft EIR analyzes both the North and South alignments, the South Alignment is preferred and would be refined during the final feasibility analysis and design process. Earlier conveyance pipeline alignment studies (described in the Preliminary Design Report [PDR]) included consideration of following San Juan Creek, as suggested in this comment. However, this alignment was rejected as infeasible for several reasons: 1) major regulatory agency permit approvals would be required to trench along San Juan Creek with associated disruption of jurisdictional waters and sensitive habitat; 2) the bridge columns create severely constrained spaces to align the pipeline route; 3) using San Juan Creek could also conflict with planned San Juan Creek levee improvements and associated sheet piling which run at depth below ground; 4) using San Juan Creek would require additional agency approvals for right-of-way and easements, including from Orange County Public Works; and 5) other alignments were available that avoided these serious design and environmental issues.

Response L10-3

Exhibits 4.8-2 and 4.8-3 illustrate maximum flooding depths based on future conditions with flood control improvements in place. The analysis compares existing conditions (Exhibit 4.8-1) to the post-project condition, which are nearly identical. With virtually no change of existing conditions, the impact is less than significant.

The District notes that Exhibit 4.8-2 is mistitled. The title should read "Change in Flood Inundation, Existing Condition vs. Alternative 1," per Appendix 10.9 - Hydrology Study, as noted in Section 3, *Draft EIR Errata*. That means the flooding depths indicated in Exhibit 4.8-2 is the difference from Alternative 1 and the existing condition, so the depths over the site would be shallower with Alternative 1, given a 100-year flood. Based on this, the Project would result in decreased flood depth in the railroad ROW.

Response L10-4

Comments regarding the Construction Traffic Control Plan (TCP) are noted. Mitigation Measure TRF-2 notes that the TCP would be submitted for review and approval to each affected jurisdiction, which would include SCRRA. Issues and priorities identified by SCRRA will inform the TCP. Regarding project operations and long-term access to the site, page 3.0-36 identifies that site access will occur via the existing District access road. Section 4.13 (Transportation and Traffic, page 4.13-19) concludes that due to the small number of employees at the site (4-6 full-time personnel) and low traffic generation from employees and deliveries, no operational improvements to roadways or intersections are warranted and no CEQA significance thresholds are triggered.

With respect to fencing and safety, page 3.0-41 identifies that the perimeter of the site will be fenced. Compared to existing conditions at the desalination facility site, which contains vehicle storage and other uses that can attract an uncontrolled flow of visitors, the fenced project site will be a more controlled environment that would not attract or induce trespassing into the rail corridor.

Response L10-5

The District has considered potential impacts to the adjacent railroad right of way and other facilities. Please see Section 4.8 Hydrology and Water Quality and Response L10-3 above. The recommended site improvement in the Local Hazard Conditions and Drainage Study does not depend on improvements to the existing stormwater drainage facilities as these are being implemented by other agencies and are not included as a part of the project design. Even if the existing stormwater facilities are not upgraded, the Project will not significantly impact the adjacent railroad right of way.

Response L10-6

Section 9.0, References, lists all reference documents used or consulted in the preparation of the Draft EIR. It is noted that SCRRA would be an appropriate source for information and engineering standards and encroachment procedures associated with elements of project design and permitting.

Response L10-7

The PDR considered a series of design alternatives (Appendix 10.1) that informed the Draft EIR Project Description. Refer to Response L10-2 above regarding the use of trenchless construction to avoid impacts. Alternative 1, No Project, would achieve none of the project objectives and therefore is not a viable alternative to the project. Pages 5.0-16 and 5.0-17 of the DEIR identify Alternative 5 (Seawater Intrusion Minimization [DSB Only]) as the environmentally superior alternative as it could avoid or reduce impacts of the Project. The Project as proposed provides a wider range of slant well locations and flexibility for the final design; however, the DEIR discloses that Alternative 5 could be considered by the District, pending further consultation with State Parks and other regulatory agencies and stakeholders.

Organization Comment Letters

O1 CURE

O2 Nature Commission

O3 Orange County Coastkeeper

O4 Sierra Club

O5 South Laguna Civic Association

O6 Surfrider Foundation

O7 CURE - Late Receipt

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August 6, 2018

VIA OVERNIGHT MAIL

Rick Shintaku, PE
Acting General Manager, Chief Engineer
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

VIA EMAIL ONLY

Sonia Morgan
Public Information Officer
smorgan@scwd.org

Re: Comments on the Doheny Ocean Desalination Project Draft Environmental Impact Report (SCH No. 2016031038)

Dear Mr. Shintaku:

On behalf of California Unions for Reliable Energy ("CURE"), Doug Mangione, Jeff Gatlin, Thomas Duncan and Josh Vergason (collectively "Commenters"), we submit these comments on the Draft Environmental Impact Report ("DEIR") prepared by the South Coast Water District ("District"), pursuant to the California Environmental Quality Act, and its regulations ("CEQA"),[1] for the Doheny Ocean Desalination Project (SCH #2016031038) ("Project"). 1

The District is proposing to construct and operate an ocean water desalination facility and associated desalination subsurface intake system. The Project has an initial phase of up to 5 million gallons per day ("MGD") (also referred to as "Phase I") with a possible expansion to 15 MGD (also referred to as "Regional

[1] California Public Resources Code, §§ 21000 et seq.

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Project").[2] At this time, the District is only pursuing permits and approvals for the initial 5 MGD-phase of the Project.[3] The Regional Project would require separate CEQA review, and will be subject to additional regulatory agency permits and approvals.[4] The proposed facilities are located in the City of Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately one-half mile inland, adjacent to San Juan Creek.[5]

Based on our review of the DEIR, we conclude that the District fails to comply with CEQA and the DEIR must be withdrawn. The District lacks substantial evidence to support the DEIR's conclusions with respect to public health, odor, air quality, greenhouse gas, and biological resources impacts. The DEIR contains inadequate mitigation measures to reduce impacts to less than significant and has a flawed alternatives analysis.

These comments were prepared with the assistance of Phyllis Fox, Ph.D., 1
PE,[6] Shawn Smallwood, Ph.D.[7] and Radoslaw Sobczynski, Ph.D.[8] Dr. Fox, Dr. Smallwood, and Dr. Sobczynski each provide substantial evidence of potentially significant impacts that have not been adequately disclosed, analyzed, or mitigated. Their technical comments are attached hereto and are submitted to the District, in

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[2] Doheny Ocean Desalination Project Draft Environmental Impact Report (SCH No. 2016031038) ("DEIR"), § 1.0. pp. 1-2.

[3] DEIR, § 1.0. pp. 1-2.

[4] DEIR, § 1.0. p. 3.

[5] DEIR, § 1.0. pp. 1-2.

[6] Letter from P. Fox to L. Sobczynski (July 30, 2018) Comments on the Draft Environmental Impact Report for the Doheny Ocean Desalination Project (hereinafter, "Fox Comments"), **Exhibit A** (Dr. Fox's letter and CV are provided in hard copy and her references are enclosed on a USB).

[7] Letter from S. Smallwood (Aug. 3, 2018) Re: Doheny Ocean Desalination Project (hereinafter, "Smallwood Comments"), **Exhibit B** (Dr. Smallwood's letter and CV are provided in hard copy and his references are enclosed on a USB).

[8] Letter from R. Sobczynski to L. Sobczynski (Aug. 2, 2018) Comments on the Draft Environmental Impact Report for the Doheny Ocean Desalination Project (hereinafter, "Sobczynski Comments"), **Exhibit C** (Dr. Sobczynski's letter and CV are provided in hard copy and his references are enclosed on a USB).

addition to the comments in this letter. Accordingly the District must address and respond to Dr. Fox's, Dr. Smallwood's, and Dr. Sobczynski's comments separately.[9]

Pursuant to CEQA Guidelines, section 15088.5, the District must revise the
DEIR consistent with these comments. The revisions will result in significant new 1
information regarding previously undisclosed impacts and required mitigation
measures. Therefore, the EIR must be recirculated to allow the public a meaningful
opportunity to comment upon a substantial adverse environmental effect of the
project or a feasible way to mitigate or avoid such an effect.[10]

I. STATEMENT OF INTEREST

CURE is a coalition of labor organizations whose members encourage sustainable development of California's energy and natural resources. CURE's members help solve the State's energy problems by building, maintaining, and operating industrial facilities throughout California. Since its founding in 1997, CURE has been committed to building a strong economy and a healthier environment. CURE has helped cut smog-forming pollutants in half, reduced toxic emissions, increased the use of recycled water for cooling systems, and pushed for groundbreaking pollution control equipment as the standard for all new power plants, all while helping to ensure that new industrial facilities are built with highly trained, professional workers who live and raise families in nearby
communities. 2

CURE has an interest in enforcing environmental laws that encourage sustainable development and ensure a safe working environment for the members that they represent. Environmental degradation destroys cultural and wildlife areas, consumes limited fresh surface and ground water resources, causes water pollution, and imposes other stresses on the environmental carrying capacity of the state. This in turn jeopardizes future development by causing construction moratoriums and otherwise reducing future employment opportunities for the members of CURE's organizations. Additionally, the members of CURE's organizations live, recreate and work in the City of Dana Point, Capistrano Beach,

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[9] The Commenters reserve the right to supplement these comments at later hearings and proceedings related to this Project. Gov. Code § 65009(b); PRC § 21177(a); *Bakersfield Citizens for Local Control v. Bakersfield* (2004) 124 Cal. App. 4th 1184, 1199-1203; *see Galante Vineyards v. Monterey Water Dist.* (1997) 60 Cal. App. 4th 1109, 1121.

[10] 14 Cal. Code Regs., § 15088.5 ("CEQA Guidelines").

San Juan Capistrano and other areas of Orange County that suffer the impacts of projects that are detrimental to human health and the environment. CURE therefore has a direct interest in enforcing environmental laws to minimize the adverse impacts of projects that would otherwise degrade the environment. Finally, CURE members are concerned about projects that risk serious environmental harm without providing countervailing economic benefits. For these reasons, CURE's mission includes improving California's economy and the environment by ensuring that new conventional and renewable power plants and their related transmission 2
facilities use the best practices to protect our clean air, land and water and to minimize their environmental impacts and footprint.

Commenters Doug Mangione, Jeff Gatlin, Thomas Duncan and Josh Vergason live, work, and recreate in the vicinity of the Project. Mr. Mangione, Mr. Gatlin, Mr. Duncan and Mr. Vergason, are residents of Capistrano Beach, the City of Dana Point and San Juan Capistrano, California. These individuals will be directly impacted by the Project's unmitigated environmental impacts, and therefore have a direct interest in enforcing environmental laws to minimize the adverse impacts that the Project would otherwise have on the environment.

II. THE DEIR FAILS TO INCLUDE A COMPLETE PROJECT DESCRIPTION.

The DEIR does not meet CEQA's requirements because it fails to include a complete project description, rendering the entire analysis inadequate. Without a complete project description, the environmental analysis under CEQA will be impermissibly narrow, thus minimizing the Project's impacts and undercutting public review.[11]

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CEQA places the burden of environmental investigation on the government rather than the public. Accordingly, a lead agency may not hide behind its failure to obtain a complete and accurate project description.[12] CEQA requires that the project description contained in a CEQA document that is circulated for public review contain sufficiently detailed information to permit a meaningful evaluation and review of the potential environmental impacts of a proposed project.[13]

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[11] *See, e.g., Laurel Heights Improvement Assn. v. Regents of the Univ. of Cal.* (1988) 47 Cal.3d 376.

[12] *Sundstrom v. County of Mendocino* (1988) 202 Cal.App.3d 296, 311.

[13] 14 Cal. Code Regs. § 15124 (hereafter "CEQA Guidelines").

California courts have repeatedly held that "an accurate, stable and finite project description is the sine qua non of an informative and legally sufficient [CEQA document]."[14] In contrast, an inaccurate or incomplete project description renders the analysis of environmental impacts inherently unreliable. Without a complete project description, the environmental analysis under CEQA will be impermissibly narrow, thus minimizing the project's impacts and undercutting public review.[15] 3

A. The District Must Analyze the Environmental Effects of the Expanded, 15 MGD Project.

Public agencies must conduct CEQA analysis for "discretionary projects proposed to be carried out or approved by public agencies" at the earliest possible time.[16] Here, the District states that it is only analyzing the 5 MGD Project, and will decide if it would expand the Project to 15 MGD at a later date. This approach is inconsistent with CEQA.

CEQA prohibits an agency from committing itself to a definite course of action on a project before evaluating its environmental effects.[17] The duty to perform CEQA review applies at the first instance that a public agency proposes to "approve" a project.[18] Approval is deemed to occur "upon the earliest commitment to issue or the issuance by the public agency of a discretionary contract."[19] The California Supreme Court has stated that "postponing environmental analysis can permit 'bureaucratic and financial momentum' to build irresistibly behind a proposed project, 'thus providing a strong incentive to ignore environmental concerns.'"[20] CEQA requires early environmental review for precisely this reason. 4

[14] County of Inyo v. City of Los Angeles (3d Dist. 1977) 71 Cal.App.3d 185, 193.

[15] *See, e.g., Laurel Heights Improvement Association v. Regents of the University of California* (1988) 47 Cal.3d 376.

[16] Pub. Resources Code, § 21080(a); *Save Tara v. City of West Hollywood* (2008) 45 Cal.4th 116, 139.

[17] *Save Tara v. City of West Hollywood* (2008) 45 Cal.4th 116, 139.

[18] Pub. Resources Code, § 21080(a); 14 Cal. Code Regs., § 15352(a); *Save Tara v. City of West Hollywood* (2008) 45 Cal.4th 116; *Riverwatch v. Olivenhain Mun. Water Dist.* (2009) 170 Cal.App.4th 1186.

[19] CEQA Guidelines, § 15352(b).

[20] *Save Tara, supra*, 45 Cal. 4th at 134-135, *citing Laurel Heights Improvement Assn. v. Regents of University of California* ("*Laurel Heights I*") (1988) 47 Cal.3d 376, 395.

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Here, the District will construct components for the 5 MGD Project. However, the DEIR admits that it will construct certain components with the 15 MGD plant in mind:

> the following desalination facility components are anticipated to be sized initially to accommodate an eventual expansion up to 15 MGD of desalination capacity: the chemical storage area, [research and development] pad, [reverse osmosis ("RO")] membrane building, electrical building, administration/ operations/ lab building, RO suck-back tank product water tank, discharge holding tank, and several key components of the seawater intake pipeline.[21]

Other components will not be initially sized to accommodate an expansion, but could be expanded upon if the 15 MGD Project moves forward. These include the catalytic media filters, RO membrane system, calcite contactors, electrical switchgear and transformers, product water pump station, and solids handling 4
system.[22] At that time the "bureaucratic and financial momentum to build" the expanded 15 MGD Project may be too difficult to overcome because some work has already been completed.[23] The Supreme Court has expressly warned against this approach.

Similarly, because a project is defined as the "whole of an action," a public agency may not segment or "piecemeal" a project into several pieces if the effect is to avoid full disclosure of environmental impact.[24] Even where individual projects are undertaken in phases or multiple parts, where the total undertaking comprises a project with significant environmental effect, the lead agency must fully analyze each project in a single environmental document.[25]

The District is attempting to segment the Project into an initial phase and then into an expanded phase. All phases of the Project — "whole of an action" —

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[21] DEIR, § 3.0, p. 37.

[22] DEIR, § 3.0, p. 37.

[23] *City of Redlands v. San Bernardino County* (2002) 96 Cal.App.4th 398, 410.

[24] See *Tuolumne County Citizens for Responsible Growth, Inc. v. City of Sonora* (2007) 155 Cal. App. 4th 1214, 1231 (discussing that because opening of home improvement center was conditioned on completion of road realignment, two acts were part of single project for purposes of CEQA).

[25] CEQA Guidelines, § 15165.

must be evaluated in a single EIR. Accordingly, the District must revise the EIR to include a Project-level analysis of the 15 MGD Project. 4

B. The DEIR Fails to Describe the Decommissioning Phase of the Project.

CEQA requires a complete description of the Project, including its decommissioning phase. The complete project description must include the "later phases of the project, and any secondary, support, or off-site features necessary for its implementation."[26] The requirements of CEQA cannot be avoided by chopping a large project into many small parts or by excluding reasonably foreseeable future activities that may become part of the project.[27]

Here, the DEIR fails to describe the full scope of the Project, and thus fails to disclose the full range and severity of the Project's environmental impacts. The DEIR does not provide an operating life span for the Project. The District only assumes, for the purpose of conducting air quality modeling, that the Project will have a 30-year operational life.[28] Nor is there any discussion of the Project's 5
decommissioning phase. A complete project description must include the full scope of the Project.

1. Slant Wells' Decommissioning Is Not Adequately Described.

The DEIR fails to provide an explanation of the decommissioning phase for the Project's slant wells. Thus, the DEIR fails to analyze and mitigate significant impacts from decommissioning the wells.

During Project decommissioning, well materials would have to be removed or destroyed in accordance with state well destruction standards. For example, California Well Standards Bulletin 74-81 and 74-90 requires removal or destruction of wells that are no longer useful or are abandoned.[29] The California Well Standards

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[26] *Bozung v. Local Agency Formation Com.* (1975), 13 Cal.3d 263, 283-84.

[27] Pub. Resources Code § 21159.27 (prohibiting piecemealing); *see also Rio Vista Farm Bureau Center v. County of Solano* (1992) 5 Cal.App.4th 351, 370.

[28] DEIR, § 4.6, p. 17.

[29] California Well Standards, Section 23 (Requirements for Destroying Wells) http://wdl.water.ca.gov/groundwater/wells/california_well_standards/wws/wws_combined_sec23.htm, **Exhibit D**.

describe an intensive process for destroying wells, including cleaning, excavation, removing materials, filling, sealing and other activities.[30]

Unique to this Project are the Project's subsurface slant wells. Clogged, or otherwise ineffective, slant wells would need to be decommissioned, abandoned, and replaced. Indeed clogging and other maintenance problems have already been an issue for this Project. Between 2006 and 2012, the test slant well lost its efficiency from an original value of 95% to 52%.[31] Additionally, an operational report for the Doheny wells stated that future wells must be carefully constructed so that the wells do not become immediately clogged.[32] Therefore, it is reasonably foreseeable that decommissioning wells is part of the Project. The DEIR must describe decommissioning and evaluate the impact of replacing slant wells in the reasonably foreseeable event that clogging or other problems occur during the construction and operational lifetime of the Project.

The DEIR fails to mention the common sense impact on the environment
from decommissioning, abandoning, and replacing slant wells. By failing to disclose, 5
analyze and mitigate this impact, the DEIR fails to adequately describe the Project.

2. *Other Desalination Facilities' Decommissioning Is Not Adequately Described.*

The DEIR must consider *all* potentially significant impacts from decommissioning the *entire* Project. Decommissioning the desalination plant and related facilities (including, in part, abandoning the subsurface slant wells) would result in environmental impacts, including impacts to air quality, biological resources, water, and solid waste capacity. As a result, the DEIR fails to identify the Project's potentially significant impacts from Project decommissioning and fails to

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[30] California Well Standards, Sections 20-22 (Purpose of Destruction, Definition of 'Abandoned' Well, General Requirement) http://wdl.water.ca.gov/groundwater/wells/california_well_standards/wws/wws_combined_sec20-22.html, **Exhibit E.**

[31] Williams, D.E. (2015) Yield and Sustainability of Large Scale Slant Well Feedwater Supplies for Ocean Water Desalination Plants, p. 3, **Exhibit F.**

[32]Final Summary Report for the Doheny Ocean Desalination Project Phase 3 Investigation: Extended Pumping and Pilot Plat Test Regional Watershed and Groundwater Modeling Full Scale Project Conceptual Assessment, January 2014. Municipal Water District of Orange County ("MWDOC"), at p.57, *available at* https://www.scwd.org/civica/filebank/blobdload.asp?BlobID=5592 ("MWDOC – Final Summary, 2014"), **Exhibit G.**

incorporate mitigation measures to reduce those impacts to a less than significant level.

An accurate and complete project description is necessary to perform an adequate evaluation of the potential environmental effects of the proposed Project, 5
which includes reasonably foreseeable decommissioning. The District must prepare a revised DEIR that fully describes decommissioning for all Project components, including the plant, the slant wells, pipelines, and other associated facilities. Only by doing so will the District be able to properly analyze and mitigate impacts from decommissioning the whole Project, as required by State law.

III. THE DEIR FAILS TO ADEQUATELY DISCLOSE, ANALYZE, AND MITIGATE SIGNIFICANT PUBLIC HEALTH, ODOR, AIR QUALITY, GREENHOUSE GASES AND BIOLOGICAL RESOURCES IMPACTS.

The District fails to adequately disclose, analyze, and mitigate impacts to several resources, including public health, odor, air quality, greenhouse gases ("GHG"), and biological resources. CEQA requires that an agency analyze the potential environmental impacts of its proposed actions in an EIR (except in certain limited circumstances).[33] The EIR is the very heart of CEQA.[34] "The foremost principle in interpreting CEQA is that the Legislature intended the act to be read so as to afford the fullest possible protection to the environment within the reasonable
scope of the statutory language."[35] 6

CEQA has two primary purposes. First, CEQA is designed to inform decision makers and the public about the potential, significant environmental effects of a project.[36] "Its purpose is to inform the public and its responsible officials of the environmental consequences of their decisions before they are made. Thus, the EIR 'protects not only the environment but also informed self-government.'"[37] The EIR has been described as "an environmental 'alarm bell' whose purpose it is to alert the

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[33] See, e.g., Pub. Resources Code, § 21100.

[34] *Dunn-Edwards v. BAAQMD* (1992) 9 Cal.App.4th 644, 652.

[35] *Communities for a Better Environment v. Cal. Res. Agency* (2002) 103 Cal. App.4th 98, 109.

[36] CEQA Guidelines, § 15002(a)(1).

[37] *Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal. 3d 553, 564.

public and its responsible officials to environmental changes before they have reached ecological points of no return."[38]

Second, CEQA requires public agencies to avoid or reduce environmental damage when "feasible" by requiring "environmentally superior" alternatives and all feasible mitigation measures.[39] The EIR serves to provide agencies and the public with information about the environmental impacts of a proposed project and to "identify ways that environmental damage can be avoided or significantly reduced."[40] If the project will have a significant effect on the environment, the agency may approve the project only if it finds that it has "eliminated or substantially lessened all significant effects on the environment where feasible" and that any unavoidable significant effects on the environment are "acceptable due to overriding concerns."[41]

While the courts review an EIR using an "abuse of discretion" standard, "the reviewing court is not to 'uncritically rely on every study or analysis presented by a project proponent in support of its position. *A clearly inadequate or unsupported study is entitled to no judicial deference.*"[42] As the courts have explained, a prejudicial abuse of discretion occurs "if the failure to include relevant information precludes informed decision-making and informed public participation, thereby thwarting the statutory goals of the EIR process."[43] 6

[38] *Berkeley Keep Jets Over the Bay v. Bd. of Port Comm'rs.* (2001) 91 Cal. App. 4th 1344, 1354; *County of Inyo v. Yorty* (1973) 32 Cal.App.3d 795, 810.

[39] CEQA Guidelines, § 15002(a)(2) and (3); *see also Berkeley Jets*, 91 Cal.App.4th at 1354; *Citizens of Goleta Valley*, 52 Cal.3d at 564.

[40] CEQA Guidelines, §15002(a)(2).

[41] Pub. Resources Code, § 21081; CEQA Guidelines, § 15092(b)(2)(A) & (B).

[42] *Berkeley Jets*, 91 Cal. App. 4th 1344, 1355 (emphasis added), *quoting, Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 391 409, fn. 12.

[43] *Berkeley Jets*, 91 Cal.App.4th at 1355; *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713, 722; *Galante Vineyards v. Monterey Peninsula Water Management Dist.* (1997) 60 Cal.App.4th 1109, 1117; *County of Amador v. El Dorado County Water Agency* (1999) 76 Cal.App.4th 931, 946.

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A. The DEIR Fails to Adequately Disclose, Analyze and Mitigate the Project's Health Risks.

The DEIR fails as an information disclosure document under CEQA by failing to adequately disclose, analyze, and mitigate the Project's public health impacts. In particular, the District concludes that "the toxics impact related to construction would be less than significant."[44] The District lacks substantial evidence to support this conclusion. Instead, Dr. Fox provides substantial evidence that the public health risk may be significant.[45]

CEQA requires lead agencies to prepare risk assessments to evaluate the nature and extent of the health hazards posed by exposure to toxic materials released by a project. CEQA Guidelines section 15126.2(a) expressly requires a CEQA document to discuss the "health and safety problems caused by the physical changes that a project will precipitate."[46] Numerous cases have held that CEQA must analyze human health impacts. For example, in *Communities for a Better Environment v. South Coast Air Quality Management District*,[47] the Supreme Court held that a Mitigated Negative Declaration for a refinery was inadequate for failure to analyze nitrogen oxide emissions, pollutants known to have significant effects on human health.[48] 7

The Courts of Appeal have repeatedly held that a CEQA document must analyze impacts of projects on human health. In *Communities for a Better Environment v. City of Richmond*, the court held that a CEQA document is inadequate where it "does not address the public health or other environmental consequences of processing heavier crude [thereby emitting Toxic Air Contaminants ("TAC")], let alone analyze, quantify, or propose measures to mitigate those impacts."[49] In *Bakersfield Citizens for Local Control v. City of Bakersfield,*[50] the

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[44] DEIR, § 4.2, p. 31.

[45] Fox Comments, p. 2.

[46] CEQA Guidelines, § 15126.2(a).

[47] *Communities for a Better Environment v. South Coast Air Quality Management District*, (2010) 48 Cal. 4th 310, 317.

[48] 48 Cal.4th at 317.

[49] *Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 82. *See also Californians for Alternatives to Toxics v. Cal. Dep't of Food & Agric.* (2006) 136 Cal.App.4th 1, 16, (EIR on statewide application of pesticide was inadequate when it failed to independently evaluate risks of toxic exposure.)

court held that an EIR for a commercial shopping center was inadequate because it failed to correlate adverse air quality impacts to resulting adverse health impacts on surrounding communities. The court explained:

> [The] City's failure to...correlate the adverse air quality impacts to resulting adverse health consequences, cannot be dismissed as harmless or insignificant defects. As a result of these omissions, meaningful assessment of the true scope of numerous potentially serious adverse environmental effects was thwarted. No discrete or severable aspects of the projects are unaffected by the omitted analyses; the defects relate to the shopping centers in their entirety, not just to one specific retailer. These deficiencies precluded informed public participation and decision making.[51]

In *Berkeley Keep Jets Over the Bay Com. v. Bd. of Port Comrs.*,[52] the court held that an EIR must include a "human health risk assessment."[53] In *Berkeley Jets*, the Port of Oakland approved a development plan for the Oakland International Airport. The EIR admitted that the Project would result in an increase in the release of TACs, which were known to cause both carcinogenic and adverse noncarcinogenic health effects.[54] The EIR adopted mitigation measures to reduce TAC emissions, but failed to perform a health risk assessment to quantify the Project's impacts on human health. The court held that the mitigation measures alone were insufficient, and that the Port had a duty to analyze the health risks associated with exposure to TACs:

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> The Port has not cited us to any reasonably conscientious effort it took either to collect additional data or to make further inquiries of environmental or regulatory agencies having expertise in the matter. These failures flout the requirement that the lead agency consult "with all responsible agencies and with any other public agency which has jurisdiction by law over natural resources affected by the project . . . ." (§ 21080.3, subd. (a).) At the very least, the documents submitted by the public raised substantial questions about the

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[50] (2004) 124 Cal.App.4th 1184, 1219-20 ("on remand, the health impacts resulting from the adverse air quality impacts must be identified and analyzed in the new EIR's.").

[51] *Id.*, at 1220-21.

[52] *Berkeley Keep Jets Over the Bay Com. v. Bd. of Port Comrs.* ("*Berkeley Jets*") (2001) 91 Cal.App.4th 1344.

[53] *Id.*, at 1369.

[54] *Id.*, at 1364.

> project's effects on the environment and the unknown health risks to the area's residents...the Port has not offered any justification why more definitive information could not have been provided....The EIR's approach of simply labeling the effect "significant" without accompanying analysis of the project's impact on the health of the Airport's employees and nearby residents is inadequate to meet the environmental assessment requirements of CEQA.[55]

Here, the District is required to conduct an assessment of the Project's potentially significant public health impacts. As in *Berkeley Jets*, there is no dispute that the Project will use off-road diesel construction equipment and on-road heavy-duty diesel trucks that generate Diesel Particulate Matter ("DPM") emissions.[56] The DEIR identifies DPM as the main TAC of concern.[57] Construction would occur near sensitive receptors[58] over a period of approximately 20 months for Phase I and an additional 18 months if the Project is expanded to 15 MGD.[59] There is also no dispute that the District did not prepare an assessment of the health risks associated with that exposure. This violates CEQA's requirement that the lead agency correlate the adverse air quality impacts generated by a project to their resulting adverse health consequences.[60] 7

Even though the DEIR did not prepare a health risk assessment, the District still concludes —without any substantial evidence to support its conclusion — that "the toxics impact related to construction would be less than significant."[61] On the contrary, Dr. Fox provides substantial evidence based on expert opinion that "cancer health impacts from DPM may be significant" based on the extensive construction of several Project components that will last longer than 2 months near sensitive receptors.[62] Slant well drilling, for example, is expected to occur 24 hours a

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[55] *Id.* at 1370-71.

[56] Fox Comments, p. 2 (referring to DEIR, § 4.2, pp. 30-31).

[57] Fox Comments, p. 2.

[58] Fox Comments, p. 2 (some sensitive receptors are less than 25 meters from excavation work).

[59] DEIR, § 4.2, p. 31.

[60] *Berkeley Jets*, 91 Cal.App.4th at 1370-71; DEIR, § 4.2, pp. 23-24 (identifying significant unmitigated construction emissions)

[61] DEIR, § 4.2, p. 31.

[62] Fox Comments, pp. 4-5.

day, 7 days per week for about 6 months out of the year and within 90 feet from a residence along Beach Road.[63]

Dr. Fox identifies numerous mitigation measures that would protect the public from the health risk associated with this Project, as well as measures to reduce the cumulative health risk associated with constructing projects concurrently with this Project elsewhere in the South Coast Air Basin.[64] Dr. Fox proposes, among other measures, limiting engine idling to two minutes for delivery trucks and dump trucks, and suspending construction activities during Stage II smog alerts.[65] 7

The courts may not look for "perfection" in a CEQA document, but do expect "adequacy, completeness, and a good faith effort at full disclosure [in an EIR]."[66] The District has failed to meet these requirements. Dr. Fox explains that health risk assessments are routinely performed for construction projects and due to the proximity to sensitive receptors and duration of construction.[67] The failure to prepare a health risk assessment is a glaring omission. The District must prepare a health risk assessment to adequately disclose, analyze, and mitigate the Project's public health risks and disclose those significant risks in a revised and recirculated EIR.

B. The DEIR Fails to Adequately Disclose, Analyze and Mitigate the Project's Odor Impacts.

Rather than conduct an adequate analysis of odor impacts from construction, the DEIR merely concludes that odor impacts would be less than significant. The District explains:

> The primary source of odor anticipated from the construction of the proposed 8
> Project would be exhaust emissions from the diesel equipment and haul (soil import/export) trucks. However, as noted in the Impact 4.2-4 discussion above, emissions from diesel construction equipment and vehicles would be

[63] Fox Comments, p. 4.

[64] Fox Comments, p. 5.

[65] Fox Comments, p. 5.

[66] CEQA Guidelines, § 15151.

[67] Fox Comments, p. 5.

> temporary and would not be expected to cause any odor issues that would affect a substantial number of people. Therefore, the odors impact related to construction would be less than significant.[68]

The District's conclusion is flawed for several reasons.

First, an EIR must identify all potentially significant environmental effects. Significant effects may be "both short-term and long-term."[69] Thus, even temporary Project impacts may have significant effects on the environment that require mitigation.[70] CEQA does not permit the District to dismiss odor impacts on the basis that they are "temporary."

Second, the District lacks substantial evidence to support its less-than-significant impact conclusion. Project construction will result in diesel exhaust.[71] As Dr. Fox explains, the odors associated with diesel exhaust "are characterized by offensive odors."[72] Yet, the DEIR does not contain any analysis at all to support its conclusion that odor impacts would not be significant.[73] The only way to conclude that odor impacts are insignificant is to use air dispersion modeling to estimate ambient concentrations of DPM at nearby sensitive receptors and compare the resulting concentrations to DPM odor thresholds.[74] In any case, the District conducted no analysis whatsoever. Thus, the DEIR fails as an informational document under CEQA and the District lacks substantial evidence to support its conclusion. 8

Whereas the DEIR lacks substantial evidence to support its conclusion, Dr. Fox provides substantial evidence based on her expert opinion that odor impacts will be significant.[75] The District admits that the "primary source of odor anticipated from the construction of the proposed Project would be exhaust

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[68] DEIR, § 4.2, p. 31.

[69] CEQA Guidelines, § 15126.2(a).

[70] CEQA Guidelines, § 15126.2(a).

[71] Fox Comments, p. 5.

[72] Fox Comments, p. 6.

[73] Fox Comments, p. 6.

[74] Fox Comments, p. 7.

[75] CEQA Guidelines, § 15384.

emissions from the diesel equipment and haul (soil import/export) trucks."[76] Dr.
Fox comments, "[b]ased on my personal experience at construction sites, residential
areas are close enough to Project construction sites for residents to smell noxious
diesel and other exhaust fumes."[77] Furthermore, mitigation is available and should
be required to reduce the significant odor impact from all construction within at
least 1,000 feet of sensitive receptors.[78] For example, the construction equipment 8
can be equipped with diesel oxidation catalysts, which eliminate odors.[79]

The DEIR fails as an information disclosure document by failing to adequately analyze and disclose the Project's odor impacts. Consequently, the District must revise and recirculate the EIR to adequately disclose, analyze and mitigate the Project's significant odor impact.

C. The DEIR Fails to Adequately Disclose, Analyze, and Mitigate the Project's Air Quality Impacts.

The DEIR contains numerous flaws in its air quality analysis, rendering the analysis unreliable and the impacts underestimated. The District must revise the air quality analysis to account for all sources of construction emissions and operational emissions in a recirculated EIR.

1. The DEIR Underestimates Construction Emissions.

The DEIR omits highly relevant information from its air quality analysis. As
a result, the DEIR underestimates construction emissions. Dr. Fox explains that the 9
construction emissions were estimated using default and other assumptions in the
CalEEMod 2016.3.2 model. However, CalEEMod fails to account for all sources of
PM10 and PM2.5 construction emissions.

First, CalEEMod omits windblown dust from graded areas and storage piles and fugitive dust from off-road travel.[80] As Dr. Fox explains, these emissions must

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[76] DEIR, § 4.2, p. 31.

[77] Fox Comments, p. 6; *see also* Fox Comments, p. 2 (some sensitive receptors are less than 25 meters from excavation work).

[78] Fox Comments, p. 8.

[79] Fox Comments, p. 8.

[80] Fox Comments, p. 8.

be separately calculated using a different tool, the U.S. EPA Compilation of Air Pollution Emissions Factors AP-42.[81] Once separately calculated those emissions must be added to the CalEEMod total.[82] Dr. Fox provides substantial evidence that windblown dust from graded areas and storage piles and fugitive dust from off-road travel can be the major sources of PM10 and PM2.5 emissions from construction projects.[83]

Dr. Fox adds that windblown dust from disturbed soils is a particular concern for this Project due to Santa Ana Winds that occur in the area. Santa Ana winds are capable of reaching 30 to 50 mph.[84] When a high wind event occurs during grading, cut and fill, or soil movement, or from bare graded soil surfaces, significant amounts of PM10, PM2.5, and associated Valley Fever spores and silica dust, would be released. Dr. Fox provides substantial evidence that "[t]hese emissions could result in public health impacts from the silica and Valley Fever spores and/or violations of PM10 and P2.5 [California Ambient Air Quality Standards] and [National Ambient Air Quality Standards]."[85] A violation of these standards is a significant air quality impact pursuant to the District's thresholds of significance.[86] Also, construction 9
causing the spread of silica and Valley Fever spores is a significant public health impact. Dr. Fox states that the District must calculate wind erosion emissions and account for the added risk of high wind events.[87]

Second, the District fails to adjust CalEEMod's default emission factors for certain portions of the site. CalEEMod provides recommended default values based on site-specific information, such as land use type, meteorological data, total lot acreage, project type and typical equipment associated with a project type. If more specific project information is known, the user can change the default values and input project-specific values, but CEQA requires that such changes be justified by substantial evidence.[88] Once all of the values are inputted into the model, the project's construction and operational emissions are calculated, and "output files"

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[81] Fox Comments, p. 9.

[82] Fox Comments, p. 9.

[83] Fox Comments, p. 9.

[84] Fox Comments, p. 9.

[85] Fox Comments, p. 9.

[86] DEIR, § 4.2, p. 19.

[87] Fox Comments, p. 10

[88] CalEEMod User Guide, p. 2, 9, *available at:* http://www.caleemod.com/, **Exhibit H.**

are generated. These output files disclose to the reader what parameters were used in calculating the emissions, including which values were changed.

Dr. Fox determined that some of the on-site soil conditions will require more aggressive use of construction equipment than assumed in the District's CalEEMod.[89] Dr. Fox provides substantial evidence that when the CalEEMod's default emissions factors are adjusted to reflect this more aggressive use of construction equipment, then there will be increased emissions from those portions of the site. The District's emissions analysis is therefore underestimated.[90]

Third, the District proposes certain mitigation measures to reduce significant
NOx emissions below CEQA significance thresholds.[91] However, as Dr. Fox
comments, these measures assume that the equipment is operating under optimal
conditions and average site conditions.[92] Thus, the true emissions may be higher
than the level assumed in the emissions calculations.[93] Moreover, the mitigation
measures do not include any method to validate that the construction equipment is
emitting at the levels assumed in the DEIR.[94] Dr. Fox proposes that the District 9
require the use of Portable Emission Measurement Systems to verify tailpipe
emissions from construction equipment.[95]

In sum, the District underestimated the Project's construction emissions. Moreover, Dr. Fox provides substantial evidence that the construction emissions may exceed significant thresholds. The District must recirculate a revised EIR that fully discloses, analyzes, and mitigates the Project's construction emissions.

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89 Fox Comments, pp. 9-10.

90 Fox Comments, p. 10.

91 Fox Comments, p. 10.

92 Fox Comments, p. 10.

93 Fox Comments, p. 10.

94 Fox Comments, p. 10.

95 Fox Comments, p. 10.

2. *The DEIR Impermissibly Excludes Significant Operational Emissions from Electricity Generation.*

Dr. Fox reviewed the Project's emissions and determined that the criteria pollutant emissions from electricity generation are not included in the emission summaries.[96] The District's excuse for failing to include these emissions is that

> criteria pollutant emissions associated with electricity demand cannot be ascribed to a specific air basin or air district and it cannot be determined whether the air pollutant emissions associated with electricity generation would degrade air quality in a specific air basin or air district.[97]

The District may not omit this analysis.[98] CEQA requires that the District disclose all potential direct, indirect, and cumulative significant environmental impacts of a project.[99] Even though electricity may be generated outside the South Coast Air Basin, it is also likely that power plants within the Air Basin could supply the Project's power.[100] Thus, similar to the District acknowledging that the Project will generate TACs but failing to analyze health risks, here, the District calculates the Project's electrical energy use but fails to take the next step in analyzing the Project's impacts from criteria pollutant emissions from energy generation.[101] As a result, the District lacks substantial evidence to support the conclusions in its air quality analysis.[102] 10

In response to the lack of substantial evidence, Dr. Fox estimated indirect electricity generation emissions to assess the Project's impacts.[103] Her calculations provide substantial evidence that NOx and SOx emissions from electricity generation may exceed the CEQA significance thresholds of 100 pounds/day and 150 pounds/day respectively.[104] Her calculations show that the initial phase of the

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[96] Fox Comments, p. 11.

[97] DEIR, § 4.2, p. 27.

[98] Fox Comments, p. 12.

[99] Pub. Resources Code, § 21100(b)(1); CEQA Guidelines, § 15126.2(a).

[100] Fox Comments, p. 12.

[101] *Berkeley Keep Jets Over the Bay Com. v. Bd. of Port Comrs.* (2001) 91 Cal.App.4th 1344, 1370-71.

[102] Fox Comments, p. 12.

[103] Fox Comments, p. 12.

[104] Fox Comments, p. 12.

Project's emissions would be 152 pounds/day of NOx and 532 pounds/day of SOx.[105] If the Project is expanded to 15 MGD, then emissions would be 464 pounds/day of NOx and 1,624 pounds/day of SOx.[106] Thus, operational emissions from electricity generation are significant, requiring mitigation.[107] Dr. Fox proposes feasible mitigation, including a requirement to use only electricity from renewable sources.[108] 10

The District fails to account for significant operational criteria pollutant emissions from the generation of electricity to support the reverse osmosis system, slant wells, and support facilities. The District must revise the EIR to disclose the additional emissions that will necessarily occur and their potentially significant air quality impact. Then, the District must propose feasible mitigation, such as mandating the use of electricity from renewable resources, to reduce the impacts to less than significant.

D. The DEIR Fails to Adequately Disclose, Analyze and Mitigate Significant Impacts to Biological Resources.

The DEIR contains numerous flaws with respect to its assessment of the Project's potentially significant impacts on biological resources. The DEIR does not contain a legally adequate description of the environmental setting, does not propose feasible or enforceable mitigation measures and lacks substantial evidence to support its conclusion that impacts to biological resources would be less than significant with mitigation.

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The District identifies an impact to biological resources as significant if, among others, it will result in a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service.[109] A significant impact may also occur if the Project will interfere substantially with the movement of any native resident or migratory fish or wildlife species or with

[105] Fox Comments, p. 12.

[106] Fox Comments, p. 12.

[107] Fox Comments, p. 12.

[108] Fox Comments, p. 12.

[109] DEIR, § 4.3, p. 26

established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.[110] The District concludes that the Project will have a less than significant impact on biological resources after implementation of mitigation measures. 11

Whereas the District lacks substantial evidence to support its less than significant with mitigation impact conclusion, Dr. Smallwood and Dr. Sobczynski provide substantial evidence that the Project may have significant impacts, even with mitigation, from Project construction and slant well operation, respectively. The District must revise and recirculate the EIR to adequately disclose, analyze and mitigate significant impacts to biological resources.

1. *Impacts on Biological Resources from Project Construction and Operation are Potentially Significant.*

The DEIR's biological resources analysis is plagued with a multi-step problem that starts with a lack of necessary information on the existing environmental setting, which is critical to ensuring an adequate assessment of the Project's potentially significant impacts. Without an adequate baseline and accurate impacts analysis, the District is then unable to identify feasible and effective mitigation measures. As a result, the DEIR's conclusion that the proposed mitigation measures would reduce significant impacts to less than significant is unsupported. 12

Describing the environmental setting accurately and completely for each environmental condition in the vicinity of the Project is critical to an accurate, meaningful evaluation of environmental impacts. The courts have clearly stated that, "[b]efore the impacts of a project can be assessed and mitigation measures considered, an [environmental review document] must describe the existing environment. It is only against this baseline that any significant environmental effects can be determined."[111] For example, in *Sierra Club v. State Bd. of Forestry* (1994), the lead agency failed to comply with CEQA when it failed to collect information regarding the presence of old-growth-dependent species on the site of a proposed timber harvest.[112] Without that information, the lead agency could not

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[110] DEIR, § 4.3, p. 41.

[111] *County of Amador v. El Dorado County Water Agency* (1999) 76 Cal.App.4th 931, 952.

[112] *Sierra Club v. State Bd. of Forestry* (1994) 7 Cal.4th 1215, 1236–1237.

identify the environmental impacts of the project.[113] Also, the agency could not comply with its CEQA duty to prevent environmental damage by refusing to approve projects if feasible mitigation measures are available which will avoid or substantially lessen significant environmental effects.[114] The *Sierra Club* court concluded that when the agency failed to gather information regarding the presence of the four old-growth-dependent species on the site, the agency made any meaningful assessment of the potentially significant environment impacts of timber harvesting and the development of site-specific mitigation measures impossible.[115] The court determined that the agency failed to comply with the law.[116]

Like the EIR in *Sierra Club v. State Bd. of Forestry*, this DEIR fails to comply with CEQA's requirement to adequately evaluate, analyze and mitigate significant environmental impacts. First, the District fails to adequately evaluate the environmental setting. Specifically, the District failed to gather the necessary information on the Project's landscape and special-status species to meaningfully assess the Project's potentially significant environmental impacts.

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The Project is located at the "juncture of two linear landscape features commonly used by wildlife for long-range movement." [117] One is a long creek, San Juan Creek, and the other is the Pacific Ocean coastline.[118] San Juan Creek connects Doheny State Beach "with several of the canyons within the upper San Juan Creek watershed, providing for movement between a highly disturbed urban region and areas of natural habitat, including areas within the Cleveland National Forest north and east of Interstate 5." [119] In addition,

> The beach and associated riparian areas along the Pacific Ocean provide important stopover sites for migratory birds, while the ocean itself supports fish and marine mammals that migrate along the

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[113] *Id.*

[114] *Id.*

[115] *Id.*

[116] *Id.*

[117] Smallwood Comments, p. 2.

[118] California Department of Parks and Recreation, Doheny State Beach, General Plan and Draft Environmental Impact Report (2003), p. 2-23, available at https://www.parks.ca.gov/pages/21299/files/dohenygeneralplan.pdf.

[119] *Id.*

> Southern California Bight. In addition to these wildlife corridors, a strip of native and exotic vegetation runs along the southwestern edge of Coast Highway. Although highly disturbed, it acts as a corridor for resident and migratory birds and other wildlife and links Doheny SB with higher-quality habitat fragments along the coastal bluffs to the northwest.[120]

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However, the District inadequately evaluated the Project's biologically rich environmental setting. In so doing, the District deprived the public and decisionmakers from understanding the impact this Project would have if it were constructed at this landscape juncture. The DEIR must be revised to examine if the Project would interfere with wildlife movement at or near this juncture.[121] Moreover, without an adequate environmental setting, the District lacks support for its conclusion that, with mitigation, construction and operation would not substantially interfere with the movement of wildlife species or with established wildlife corridors. As discussed in further detail below, the proposed mitigation measure is inadequate to demonstrate impacts on wildlife movement and established corridors would actually be reduced.

Equally alarming is the DEIR's incomplete analysis of special-status species. The DEIR determines only 5 special-status species of terrestrial wildlife as common at the Project site, 2 as uncommon, 4 as rare, and 1 as unlikely.[122] Dr. Smallwood states that the District's identification is not supported by substantial evidence. As an initial matter, the District failed to conduct any detection surveys to identify special-status species at the Project site. Dr. Smallwood comments "[n]o effort was made in the field to detect species of wildlife potentially affected by the project."[123] To fill this gap in information, Dr. Smallwood investigated how many special-status species may be at or near the Project site. The research revealed that there may be as many as 75 special-status species of terrestrial wildlife at or near the Project site.[124] By way of example, of those 75 species, thirty are birds.[125] The DEIR,

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[120] *Id.*

[121] Smallwood Comments, p. 10.

[122] Smallwood Comments, p. 2.

[123] Smallwood Comments, p. 2.

[124] Smallwood Comments, pp. 2-5; *see also id.*, at Table 1.

[125] Smallwood Comments, p. 6.

however, only lists twelve special-status bird species in Table 4.3-1 of the DEIR.[126] Dr. Smallwood comments that the analysis for these twelve birds is "extremely cursory."[127] As for the eighteen other bird species that were not included on the list, the analysis is obviously nonexistent.[128] The District must support its conclusions with substantial evidence.[129] By omitting species altogether from the existing environmental setting, the District's impact conclusion and proposed mitigation measures are unsupported. 13

To fully evaluate and then analyze the Project's potentially significant impacts on as many as 75 special-status species, Dr. Smallwood states that detection surveys need to be completed during the CEQA review process and recirculated in a revised EIR for public review and comment.[130] Dr. Smallwod states that "[t]he detection surveys must be done in compliance with guidelines and protocols that wildlife ecologists have uniquely developed for use with each special-status species."[131] The detection surveys are critical for an accurate assessment of impacts and formulation of mitigation measures.[132]

Second, the District fails to adequately analyze the impacts from noise, truck trips, and habitat fragmentation on wildlife movement. With respect to noise, the DEIR fails to consider the impact that construction and operational noise will have on terrestrial species of wildlife.[133] Indeed, the DEIR fails altogether to assess the operational noise associated with the brine disposal system.[134] Dr. Smallwood provides substantial evidence that noise impacts can contribute to habitat fragmentation and adversely impact as many as 75 species identified as candidate, sensitive, or special-status species in regulations enforced by the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service.[135] The noise 14

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[126] DEIR, § 4.3, p. 14.

[127] Smallwood Comments, p. 6.

[128] Smallwood Comments, p. 6.

[129] *San Francisco Baykeeper, Inc. v. California State Lands Commission* (2015) 242 Cal.App.4th 202, 228.

[130] Smallwood Comments, pp. 11-12.

[131] Smallwood Comments, pp. 11-12.

[132] Smallwood Comments, pp. 11-12.

[133] Smallwood Comments, p. 7.

[134] Smallwood Comments, p. 7.

[135] Smallwood Comments, p. 8.

can interfere with auditory signals related to mate-attraction, territorial defense, foraging, and others.[136] The species may also undergo physiological stress associated with startling responses to noise and increased effort to overcome noise interference.[137] For example, Dr. Smallwood, comments that "increasing residential noise from 42 dB to 63 dB forced one bird species to increase its call frequency by 9%, which was significant."[138] 14

Here, construction noise will range from 76 to 101 dBA within 50 feet from the source.[139] Therefore, the Project's noise will have a significant impact on birds.[140] In failing to evaluate or analyze the impacts from noise, the District has not proposed any mitigation measures to address significant noise impacts on species.[141] Dr. Smallwood recommends that the District revise the EIR to include surveys to estimate the significant noise impacts and propose mitigation measures.[142]

With respect to traffic impacts, the DEIR fails to assess traffic-caused mortality of wildlife caused by the Project's construction and operation.[143] Dr. Smallwood describes a number of studies showing that project-generated traffic can have devastating tolls on wildlife.[144] One such study documented that an increase in traffic from 5 cars per hour to 20 cars per hour tripled the number of amphibians found dead on the road.[145] Dr. Smallwood provides substantial evidence that due to increased mortality caused by project-generated traffic, the Project would likely have substantial adverse effects on special-status species.[146] Dr. Smallwood recommends that the District revise the EIR to include surveys to estimate significant traffic impacts.[147] Once fully evaluated and analyzed, the District can 15

[136] Smallwood Comments, p. 8.

[137] Smallwood Comments, p. 8.

[138] Smallwood Comments, p. 8.

[139] Smallwood Comments, p. 7.

[140] Smallwood Comments, pp. 8-9.

[141] Smallwood Comments, p. 9.

[142] Smallwood Comments, p. 12.

[143] Smallwood Comments, p. 9.

[144] Smallwood Comments, p. 9.

[145] Smallwood Comments, p. 9.

[146] Smallwood Comments, p. 9.

[147] Smallwood Comments, p. 12; *id.*, p. 11 (Figure 6).

then formulate mitigation measures to address significant traffic impacts on species. 15

Regarding wildlife movement, and as discussed above, the DEIR does not adequately evaluate the Project's landscape or the landscape's importance in species migration.[148] Specifically, the DEIR does not analyze the Project site to determine if it is used as stop-over habitat or staging habitat by volant wildlife on migration, or as crossover habitat used by nonvolant wildlife during dispersal, migration or home range patrol.[149] Nor does the DEIR consider the significance of the landscape as a landscape bottleneck.[150] As a result, the District failed to adequately analyze how the Project may fragment the existing habitat or even block the landscape bottleneck. Habitat fragmentation and blocking the bottleneck have the significant impact of reducing habitat to smaller or more isolated patches of habitat.

Dr. Smallwood analyzed the likely movement routes of wildlife and provides substantial evidence that the Project's construction and operation will likely result 16
in habitat fragmentation. Due to habitat fragmentation, "the project would likely have substantial adverse effects on 75 species identified as candidate, sensitive, or special-status species in regulations enforced by the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service."[151] Dr. Smallwood also opines that the facility may block the wildlife movement bottleneck and, as a result, the Project's "interference with wildlife movement in the region can be severe."[152]

Despite a wholly inadequate analysis of wildlife movement and established wildlife corridors, the District does not propose mitigation measures that address impacts on wildlife movement in the region.[153] The District does propose Mitigation Measure BIO-2 in an attempt to reduce impacts to sensitive habitat.[154] The measure would require review and approval from State Parks and applicable regulatory agencies to demonstrate that the facility will avoid sensitive habitat. However, Dr. Smallwood comments that there is no way to determine if this

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148 Smallwood Comments, p. 10.

149 Smallwood Comments, p. 10.

150 Smallwood Comments, p. 10.

151 Smallwood Comments, p. 6; DEIR, § 4.3, pp. 25-26 (describing significance thresholds).

152 Smallwood Comments, p. 10.

153 Smallwood Comments, p. 11; DEIR, § 4.3, pp. 34-37.

154 DEIR, § 4.3, p. 36.

measure would actually reduce impacts because the District failed to identify sensitive and important habitat in the first place.[155] Dr. Smallwood recommends that the District conduct surveys to determine the significance of the landscape.[156] Then, once the impacts are disclosed and analyzed, Dr. Smallwood suggests that the District could provide compensatory mitigation as a feasible mitigation measure.[157]

In sum, the DEIR lacks the necessary information to evaluate, analyze, and 16
mitigate impacts to 75 special status species, wildlife movement, and established corridors in this biologically rich landscape. Dr. Smallwood provides substantial evidence that impacts to biological resources will be significant and that the proposed mitigation measures do not reduce the impact to less than significant.[158] Dr. Smallwood suggests mitigation measures, but warns that his suggestions should not be considered to reduce impacts to less than significant until the environmental setting and impacts have been adequately analyzed.[159] The District must revise the EIR to cure the deficiencies in the Project's biological resources analysis and to propose feasible mitigation measures to reduce significant impacts.

2. *Slant Well Operation Will Result in Significant Impacts on Biological Resources and Is Inconsistent With the City of Dana Point's General Plan.*

The District fails to provide an adequate analysis of the impact that slant well operations will have on the aquatic environment.[160] As discussed above, the District defines an impact as significant if it would result in a substantial adverse effect, either directly or through habitat modifications, on any special status species. Additionally, an impact is significant if it will conflict with any local policies or ordinances protecting biological resources.[161] One such policy is from the City of
Dana Point's General Plan.[162] The General Plan provides a framework for 17
development and includes goals and policies pertaining to the preservation of

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[155] Smallwood Comments, p. 12.

[156] Smallwood Comments, p. 12.

[157] Smallwood Comments, p. 13.

[158] Smallwood Comments, p. 13.

[159] Smallwood Comments, p. 13.

[160] Sobczynski Comments, p. 12.

[161] DEIR, § 4.3, p. 25.

[162] DEIR, § 4.3, pp. 24-25.

biological and natural resources. Relevant here is Policy 4.4 that states that the City shall "[p]reserve, maintain and, where feasible, enhance and restore marine resource areas and coastal water. Special protection shall be given to areas and species of special biological or economic significance."[163]

The District relies heavily on the assumption that slant wells will not conflict with any policies[164] and will have a less than significant impact because

> [subsurface slant well technology] is the preferred method for ocean water intake by regulatory agencies and the environmental community, and is consistent with the [State Water Resource Control Board's Ocean Plan Amendment], avoiding marine life impingement and entrainment associated with screened ocean intakes. The feedwater would infiltrate to the seawater intake systems through the overlying material without any disturbance to the substrate habitats. Therefore, operation of the seawater intake system would not result in impacts to candidate, sensitive, or special-status species[.][165]

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First, compliance with laws and regulations is not a substitute for analyzing impacts and proposing mitigation measures. Nor is compliance with a regulation or law an indication of the sufficiency of mitigation measures where there is substantial evidence that the project may result in significant impacts.[166] CEQA requires a lead agency to fully assess the significance of a Project's impacts in light of substantial evidence "notwithstanding compliance with the adopted regulations or requirements."[167] Furthermore, the DEIR may not simply assert "a bare conclusion . . . not supported by facts or analysis."[168]

In *Communities for a Better Env't v. California Res. Agency*, the court struck down a CEQA Guideline because it "impermissibly allow[ed] an agency to find a cumulative effect insignificant based on a project's compliance with some

[163] DEIR, § 4.3, pp. 24-25.

[164] DEIR, § 4.3, pp. 45-47.

[165] DEIR, § 4.3, p. 30.

[166] *Keep our Mountains Quiet v. County of Santa Clara* (2015) 236 Cal.App.4th 714, 733; *Communities for a Better Env't v. California Res. Agency* (2002) 126 Cal.Rptr.2d 441.

[167] CEQA Guidelines § 15064.4.

[168] *Association of Irritated Residents v. County of Madera* (2003) 107 Cal.App.4th 1383, 1390-1391.

generalized plan rather than on the project's actual environmental impacts."[169] The court concluded that "[i]f there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding that the project complies with the specified plan or mitigation program addressing the cumulative problem, an EIR must be prepared for the project."[170] Thus, the ruling supports the notion that compliance with an applicable standard outside of the CEQA process does not automatically obviate a lead agency's obligation to consider substantial evidence and analyze and mitigate potentially significant impacts.

In *Keep Our Mountains Quiet v. County of Santa Clara*, neighbors of a wedding venue sued over the County's failure to prepare an EIR due to significant noise impacts.[171] The court concluded that "a fair argument [exists] that the Project may have a significant environmental noise impact" and reasoned that although the noise levels would likely comply with local noise standards, "compliance with the ordinance does not foreclose the possibility of significant noise impacts."[172] The court ordered the County to prepare an EIR. Thus, the District has a separate duty pursuant to CEQA to conduct a full analysis and mitigation of potentially significant impacts from slant well operation. 17

Second, the District's decision to utilize subsurface slant well technology on the basis that it avoids impingement and entrainment is separate and distinct from the risks the technology poses from *infiltration* of small organic matter into the subsurface.[173] Here, Dr. Sobczynski explains that, due to infiltration, slant well operation will detrimentally alter the subsurface and have a substantial adverse effect on biological resources.

Dr. Sobczynski explains that some organic matter is so small that it is dissolved in seawater.[174] Thus, when the ocean water is drawn through the subsurface because of slant well operations, the dissolved organic matter will

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[169] *Communities for a Better Env't v. California Res. Agency* (2002) 126 Cal.Rptr.2d 441, 453.

[170] *Id.*

[171] *Keep our Mountains Quiet*, *supra*, 236 Cal.App.4th, at p. 733.

[172] *Id.*

[173] The dictionary defines infiltrate as "to cause (something, such as a liquid) to permeate something by penetrating its pores or interstices" or "to pass into or through (a substance) by filtering or permeating." https://www.merriam-webster.com/dictionary/infiltrate.

[174] Sobczynski Comments, p. 7.

infiltrate with the flux of source water.[175] Small amounts of organic matter will naturally infiltrate into the subsurface; however, Dr. Sobczynski conducted modeling to demonstrate that the slant wells will draw excessive organic matter into the subsurface. Dr. Sobczynski's results provide substantial evidence that slant well operations are 100 times stronger in drawing organic matter into the subsurface than natural aquatic conditions.[176] In other words, slant well operations will pull organic matter through the subsurface at a much faster rate than existing natural conditions.[177] During this forced and excessive infiltration of small organic matter, the organic matter can attach itself to inorganic matter, such as sand, *and stay there.*[178]

Over time, Dr. Sobczynski comments, slant well operations will cause a significant amount of biomatter to accumulate in the subsurface.[179] Dr. Sobczynski calculates that 20 to 60 kg/per day of small organic matter will be deposited in the subsurface.[180] If the Project is expanded to the 15 MGD plant, then 60 to 180 kg/per day will be deposited, thus, resulting in an even more severe significant impact to biological resources.[181] Additionally, the constant flux of ocean water will push the 17
organic matter deeper and deeper in the subsurface increasing the zone of accumulated organic matter.[182]

Once in the subsurface, anaerobic (meaning low oxygen) conditions in the subsurface can cause sulfate reducing bacteria to proliferate and consume the infiltrated organic matter.[183] The sulfate reducing bacteria release hydrogen sulfide as a byproduct of their digestion.[184] Dr. Sobczynski provides substantial evidence that at high enough concentrations hydrogen sulfide is toxic to aerobic marine life, including many species that the DEIR designates as special status. Indeed, hydrogen sulfide is responsible for "fishkill" events around the world, including in

[175] Sobczynski Comments, p. 7.

[176] Sobczynski Comments, p. 11 (Figure 4).

[177] Sobczynski Comments, p. 11 (Figure 4).

[178] Sobczynski Comments, § p. 7.

[179] Sobczynski Comments, pp. 8-9.

[180] Sobczynski Comments, p. 9.

[181] Sobczynski Comments, p. 9.

[182] Sobczynski Comments, pp. 7, 11.

[183] Sobczynski Comments, pp. 9-10.

[184] Sobczynski Comments, pp. 9, 12-13

California.[185] Thus, Dr. Sobczynski concludes that due to slant well operations, the Project will have a substantial adverse effect on many special status marine species that occur in or near the Project vicinity.[186]

In failing to acknowledge the accumulation of organic matter in the subsurface and the likely event that toxic hydrogen sulfide gas will be released into the aquatic habitat, the District lacks substantial evidence to support its conclusion that there are less than significant impacts from the Project's slant well operation. Additionally, the Project violates the City of Dana Point's General Plan Policy 4.4 to preserve marine resources areas and coastal waters.[187] Even the environmentally superior alternative, which calls for fewer slant wells, but uses slant wells nonetheless, will have a significant impact on biological resources.[188] Moreover, the District did not evaluate or analyze this potential impact and therefore does not propose specific mitigation measures to reduce the impact from slant well operations to less than significant.[189] 17

In failing to disclose this significant impact, the DEIR fails as an information disclosure document and its less than significant impact conclusion cannot be relied upon. The EIR must be revised and recirculated to disclose and analyze this significant impact on biological resources. Then, the District must formulate mitigation measures to address the significant impacts.

IV. MITIGATION MEASURES PROPOSED IN THE DEIR ARE DEFERRED, UNENFORCEABLE OR OTHERWISE INADEQUATE

The DEIR proposes mitigation measures that are infeasible, unenforceable, or otherwise inadequate. Under CEQA, an EIR is inadequate unless it includes "a detailed statement setting forth . . . mitigation measures proposed to minimize [the project's] significant effects on the environment."[190] An EIR may conclude an impact 18

[185] Sobczynski Comments, pp. 13-14.

[186] Sobczynski Comments, p. 14.

[187] DEIR, § 4.3, pp. 24-25.

[188] DEIR, § 1.0, p. 56 (the "Seawater Intrusion Minimization (DSB Only)" Alternative is the environmentally superior alternative.); DEIR, § 5.0, p. 16 (rather than an assumed three to four wells with the Project, this Alternative may only require two to three slant wells due to higher production capacity).

[189] *See* Sobczynski Comments, p. 14.

[190] Pub. Resources Code, § 21100(b)(3); CEQA Guidelines, § 15126(e).

is significant and unavoidable only if all available and feasible mitigation measures have been proposed, but are inadequate to reduce the impact to a less than significant level.[191] Mitigation measures must be fully enforceable through permit conditions, agreements or other legally binding instruments.[192] A CEQA lead agency may not rely on mitigation measures of uncertain efficacy or feasibility.[193] This approach helps "insure the integrity of the process of decision by precluding stubborn problems or serious criticism from being swept under the rug."[194]

A. The DEIR Impermissibly Defers Mitigating the Project's Greenhouse Gas Impacts.

The DEIR contains impermissibly deferred mitigation measures to reduce the impact from greenhouse gas emissions. An agency may defer mitigation only when three narrow, specific prerequisites are met: (1) an EIR contains criteria or performance standards to govern future actions implementing the mitigation; (2) practical considerations preclude development of the measures at the time of initial project approval; and (3) the agency has assurances that the future mitigation will be *both* "feasible and efficacious."[195] An agency may not satisfy its mitigation requirements by merely ordering a project proponent to "obtain a . . . report and then comply with any recommendations that may be made in the report."[196] 18

In *Communities for a Better Environment v. City of Richmond*,[197] an EIR for a Chevron refinery project was deemed legally inadequate in part because the mitigation measures for GHG emissions were impermissibly deferred. The EIR in that case was "legally required to describe, evaluate and ultimately adopt feasible mitigation measures which would 'mitigate or avoid' [GHG] impacts."[198]

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[191] Pub. Resources Code, § 21081; CEQA Guidelines, § 15092 (b)(2)(A) & (B).

[192] CEQA Guidelines, § 15126.4(a)(2).

[193] *Kings County Farm Bur. v. County of Hanford* (1990) 221 Cal.App.3d 692, 727-28 (a groundwater purchase agreement found to be inadequate mitigation because there was no record evidence that replacement water was available).

[194] *Concerned Citizens of Costa Mesa, Inc. v. 32nd Dist. Agricultural Assn.* (1986) 42 Cal.3d 929, 935.

[195] *Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 94-95; *San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal.App.4th 645, 669-71; CEQA Guidelines § 15126.4(a)(1)(B).

[196] *Defend the Bay v. City of Irvine* (2004) 119 Cal.App.4th 1261, 1275.

[197] *Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 95.

[198] *Id.*, at 91.

The mitigation measure at issue in the Chevron project EIR stated that "[n]o later than one (1) year after approval of this Conditional Use Permit, Chevron shall submit to the City, for approval by the City Council, a plan for achieving complete reduction of GHG emissions. . ."[199] As the court explained, the mitigation measure "required Chevron, within one year of Project approval, to hire and fully fund 'a qualified independent expert' to complete an inventory of greenhouse gas emissions and to identify potential emissions reduction opportunities."[200] Furthermore, the measure stated that Chevron "shall consider implementation of measures that achieve GHG reductions including, but not limited to, the following measures . . ."[201] The measure then listed several potential mitigation measures. The respondents in the case argued that the EIR failed to adequately formulate a plan to mitigate GHG emissions, but instead offered "a menu of potential mitigation measures, with the specific measures to be selected by Chevron and approved by the City Council a year after Project approval."[202]

The court found that the measure was deferred mitigation, which is impermissible under CEQA. The court stated, in part, that the measure amounted to "a generalized goal of no net increase in greenhouse gas emissions and . . . a handful of cursorily described mitigation measures for future."[203] Furthermore, the court found that "[n]o effort [was] made to calculate what, if any, reductions in the Project's anticipated greenhouse gas emissions would result from each of these vaguely described future mitigation measures" and that the list of potential mitigation measures was "nonexclusive, undefined, untested and of unknown efficacy."[204] 18

Here, the District impermissibly defers identification of mitigation for significant GHG impacts by requiring an Energy Minimization and GHG Reduction Plan ("Plan").[205] Not only does the District defer preparation of this Plan outside the public review process mandated by CEQA, but Dr. Fox identifies a number of other

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199 *Id.*

200 *Id.*, at 92.

201 *Id.*

202 *Id.*

203 *Id.*, at 93.

204 *Id.*

205 DEIR, § 4.6, p. 21; Fox Comments, p. 10.

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deficiencies in the deferred mitigation.[206] These include, among others, that the Plan permits the use of offsets.[207] However, the offsets are not identified and there is no evidence that they are available.[208]

In addition, the DEIR does not require the offsets to be local, which would carry co-benefits of reducing NOx and other pollutants in the vicinity of the Project site.[209] As discussed above, Dr. Fox provides substantial evidence that the Project has significant operational air quality impacts, requiring all feasible mitigation, such as local offsets.[210] Moreover, it is uncertain if the offsets would apply for the entire life of the facility or if they would be a one-time reduction.[211] 18

As proposed, the mitigation measure to reduce greenhouse gas emissions is so uncertain in how it will be implemented that it provides no assurance or accountability to an apprehensive citizenry that impacts will actually be reduced to less than significant.[212] In other words, the measure is illusory. The District must address these deficiencies in a revised EIR.

B. The DEIR's Mitigation Measures for Biological Resources are Ineffective.

The DEIR proposes mitigation measures to reduce impacts on biological resources.[213] However, Mitigation Measure BIO-1 would be ineffective at reducing the Project's significant impacts.[214] BIO-1 calls for preconstruction nesting bird surveys. Dr. Smallwood comments that preconstruction nesting bird surveys rely upon an adequate assessment of the existing environmental setting.[215] As discussed 19

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[206] DEIR, § 4.6, p. 21 (Plan shall be prepared prior to the start of the Project construction activities); Fox Comments, p. 10.

[207] Fox Comments, p. 10.

[208] DEIR, § 4.6, p. 21.

[209] Fox Comments, p. 10.

[210] Fox Comments, pp. 10-11, 12; DEIR, § 4.6, p. 23 (offsets must be in California "[t]o the extent practicable".

[211] Fox Comments, p. 11.

[212] CEQA Guidelines, § 15003(d).

[213] DEIR, § 4.3, pp. 34-37.

[214] Smallwood Comments, p. 11.

[215] Smallwood Comments, p. 12.

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above, the District failed to conduct any detection surveys for this Project. Consequently, Dr. Smallwood comments that the biologists conducting the preconstruction nesting surveys lack the necessary information on where special-status species may exist.[216] Thus, Dr. Smallwood states that the measure is unlikely to be effective and that it does nothing more than provide a onetime effort to rescue special status species from crushing deaths under heavy construction machinery.[217] The mitigation measure does not provide any assurance that impacts to special-status species will actually be avoided.[218] 19

As discussed above, Mitigation Measure BIO-2 would also be ineffective. The EIR must be revised to include an adequate environmental baseline and an assessment of impacts before it can propose mitigation measures.[219]

C. The DEIR's Mitigation Measure for Noise Are Impermissibly Deferred.

Mitigation Measure NOI-1 impermissibly defers mitigation by containing vague criteria and performance standards. The measure states: "When feasible, construction haul routes shall avoid noise sensitive uses."[220] However, "when feasible" is not defined and is vague. As previously discussed, this measure is deeply relevant to significant impacts on biological resources, not just sensitive receptors. The District must revise this mitigation measure to ensure that the measure contains criteria or performance standards to assure the public that the impact will actually be reduced to less than significant.[221]

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[216] Smallwood Comments, p. 12.

[217] Smallwood Comments, p. 12.

[218] Smallwood Comments, p. 12.

[219] Smallwood Comments, p. 12.

[220] DEIR, § 1.0, p. 37.

[221] *Communities for a Better Environment v. City of Richmond* (2010) 184 Cal.App.4th 70, 94-95; *San Joaquin Raptor Rescue Center v. County of Merced* (2007) 149 Cal.App.4th 645, 669-71; CEQA Guidelines § 15126.4(a)(1)(B).

V. THE DEIR'S SELECTION OF ALTERNATIVES AND CHOICE OF THE ENVIRONMENTALLY SUPERIOR ALTERNATIVE IS FLAWED

In failing to disclose and analyze the Project's significant impacts, the District sets forth an inadequate alternatives analysis. As described above, the Project may result in significant impacts to biological resources due to slant well operations. The District selected an environmentally superior alternative that proposes to use two to three slant wells rather than three to four slant wells.[222] However, even if the slant well operation is reduced, there will still be substantial bioaccumulation and a significant risk that the aquatic habitat will be exposed to toxic hydrogen sulfide.

"The purpose of an [EIR] is to provide public agencies and the public in general with detailed information about the effect which a proposed project is likely to have on the environment; to list ways in which the significant effects of such a project might be minimized; and to indicate alternatives to such a project."[223] An inadequate alternatives analysis can invalidate an EIR.[224] 21

In *Washoe Meadows Community v. Department of Parks and Recreation*, the court stated:

> Only through an accurate view of the project may affected outsiders and public decision-makers balance the proposal's benefit against its environmental cost, consider mitigation measures, assess the advantage of terminating the proposal, i.e. the 'no project' alternative . . ., and weigh other alternatives in the balance.[225]

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[222] DEIR, § 1.0, p. 56 (the "Seawater Intrusion Minimization (DSB Only)" Alternative is the environmentally superior alternative.); DEIR, § 5.0, p. 16 (rather than an assumed three to four wells with the Project, this Alternative may only require two to three slant wells due to higher production capacity).

[223] Pub. Resources Code, § 21061.

[224] *See Banning Ranch Conservancy v. City of Newport Beach* (2017) 2 Cal.5th 918, 937 ("the EIR did not meaningfully address feasible alternatives or mitigation measures ... [and] the decision to forego discussion of these topics cannot be considered reasonable."); *id.*, at p. 942 (finding the lead agency abused its discretion when it certified an inadequate EIR.)

[225] *Washoe Meadows Community v. Department of Parks and Recreation* (2017) 17 Cal.App.5th 277, 287, *review denied (Jan. 24, 2018).*

Here, the District's failure to disclose and adequately analyze the impacts from infiltration from slant well operations results in a legally inadequate alternatives analysis. Specifically, the environmentally superior alternative is not a true alternative because it relies on the same technology that will result in an unanalyzed and undisclosed significant impact on the environment.[226] The District must re-evaluate feasible alternatives that would reduce the Project's significant impacts to biological resources and other resources from construction, operation and decommissioning of the slant wells. Based on that revised analysis, the lead agencies are required to propose an environmentally superior alternative.[227] 21

VI. CONCLUSION

The DEIR contains legal errors and lacks substantial evidence to support its conclusions. Instead, substantial evidence shows that the Project will result in significant, unmitigated public health, odor, air quality, greenhouse gas, and biological resources impacts. Therefore, the District must prepare a revised EIR. The District must then recirculate the revised EIR to ensure that the public is not deprived of a meaningful opportunity to comment on the significant impacts and feasible ways to mitigate or avoid those impacts. 22

Sincerely,

Tanya Gulesserian

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Exhibits

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[226] DEIR, § 1.0, p. 56; DEIR, § 5.0, p. 16.

[227] CEQA Guidelines, § 15126.6(e).

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CURE Exhibits

EXHIBIT A

Comments

on the

Draft Environmental Impact Report

for the

Doheny Ocean Desalination Project

Issued by the
South Coast Water District
May 2018

July 30, 2018

Phyllis Fox, PhD, PE
745 White Pine Avenue
Rockledge, FL 32955

1. INTRODUCTION AND SUMMARY

The South Coast Water District (SCWD or the District or the Applicant) proposes to develop an ocean water desalination facility in Dana Point, California, at Doheny State Beach and vicinity. The facility would produce up to 15 million gallons per day (MGD) of potable drinking water by replacing currently imported water with desalinated sea water. The Draft Environmental Impact (DEIR)[1] for this Project evaluated two options—an initial facility capable of producing 5 MGD (Phase 1) and a future facility capable of producing 15 MGD (Regional Project). The District is only pursuing the Phase 1 Project at this time. Capacity beyond 5 MGD would be subject to additional CEQA review.[2]

The Project consists of subsurface slant wells located on Doheny Beach, raw seawater conveyance to the desalination facility; a seawater desalination facility; chemical, product water, and brine disposal tanks; brine disposal through an existing wastewater ocean outfall; solids handling facilities; and potable water delivery to adjacent distribution infrastructure.[3] I reviewed the Project description, air quality, and greenhouse gas emission sections of this DEIR.

In sum, based on the available information, in my opinion the DEIR is substantially deficient and does not fulfill its mandate as an informational document under CEQA to inform the public of potential impacts. It has omitted sources of emissions and underestimated others, including:

- GHG, criteria pollutants, and TAC emissions from construction equipment were either underestimated or not estimated.
- PM10 and PM2.5 fugitive dust emissions from off-road construction activities were omitted.
- PM10 and PM2.5 fugitive dust emissions from wind erosion were omitted.
- The impact of Santa Ana winds on PM10 and PM2.5 emissions, and associated Valley Fever spores, were omitted.
- The DEIR failed to evaluate health impacts of Project construction, which will occur within 82 feet of sensitive receptors.

My resume is included in Exhibit 1 to these Comments. I have over 40 years of experience in the field of environmental engineering, including air emissions and air pollution control; greenhouse gas (GHG) emission inventory and control; water quality and water supply investigations; hazardous waste investigations; hazard investigations; risk of upset modeling; environmental permitting; nuisance investigations (odor, noise); environmental impact reports (EIRs), including CEQA/NEPA documentation; risk assessments; and litigation support. I have

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[1] Kimley-Horn & Associates, Inc., Draft Environmental Impact Report, Doheny Ocean Desalination Project, Prepared for South Coast Water District, May 17, 2018 (DEIR); available at: http://scwd.org/depts/engineering/projects/water_supply_projects/oceandesal3/environmental_documents/draft_environmental_impact_report/sections.htm.

[2] DEIR, p. 3.0-36.

[3] DEIR, pp. 3.0-16/17.

M.S. and Ph.D. degrees in environmental engineering from the University of California at Berkeley. I am a licensed professional engineer in California.

I have prepared comments, responses to comments and sections of CEQA and NEPA documents on air quality, greenhouse gas emissions, water supply, water quality, hazardous waste, public health, risk assessment, worker health and safety, odor, risk of upset, noise, land use, and other areas for well over 500 CEQA and NEPA documents. This work includes EIRs, EISs, Negative Declarations (NDs), and Mitigated Negative Declarations (MNDs). My work has been specifically cited in two published CEQA opinions: *Berkeley Keep Jets Over the Bay Committee, City of San Leandro, and City of Alameda et al. v. Board of Port Commissioners* (2001) 111 Cal. Rptr. 2d 598, and *Communities for a Better Environment v. South Coast Air Quality Management Dist.* (2010) 48 Cal. 4th 310; and has supported the record in many other CEQA and NEPA cases.

2. THE DEIR FAILED TO EVALUATE PUBLIC HEALTH RISKS

The DEIR establishes CEQA significance thresholds, including "[e]xpose sensitive receptors to substantial pollutant concentrations..."[4] The air quality section of the DEIR discusses toxic air contaminants (TACs) generally, identifying diesel particulate matter (DPM) as the main TAC of concern. However, many additional TACs are released by construction equipment, including benzene and aldehydes.

The DEIR also identifies off-road diesel construction equipment and construction material deliveries using on-road heavy-duty diesel trucks as the main source of DPM.[5] Further, the DEIR identifies sensitive receptors very close to construction work sites, ranging from less than 25 meters (82 feet) to 90 meters (295 feet).[6] Residential units are located at less than 25 meters from excavation work throughout the pipeline route.[7] Elsewhere, the DEIR states "There are a number of existing residences close to the Project."[8]

However, in spite of this information, the DEIR concludes that "the toxics impact related to construction would be less than significant"[9] without conducting any analysis whatsoever. Instead, the DEIR incorrectly cites the Office of Environmental Health Hazard Assessment's (OEHHA's) risk assessment guidelines (2015) as only requiring a health risk assessment (HRA) based on a 24 hour a day, 7 days per week, 365 days per year, 30-year exposure period."[10] The DEIR argues that as the construction of Phase I and the Regional Project is expected to last about 20 months and 18 months, respectively, and would occur during working hours (8 to 10

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[4] DEIR, p. 4.2-19.

[5] DEIR, pp. 4.2-30/31.

[6] DEIR, Table 4.2-13.

[7] DEIR, Table 4.2-13.

[8] DEIR, Appendix 10.4, pdf 4.

[9] DEIR, p. 4.2-31.

[10] DEIR, p. 4.2-31.

hours per day), except for the slant well construction, sensitive receptors would have "limited exposure to TAC emissions during construction that is well below the conditions needed for possible adverse long-term impacts associated with DPM. Therefore, the toxics impact related to construction would be less than significant."[11]

This is inconsistent with the OEHHA risk assessment document on which the DEIR relies. The OEHHA risk assessment guidance manual cited in the DEIR specifically states:

> Due to the uncertainty in assessing cancer risk from very short-term exposures, we do not recommend assessing cancer risk for projects lasting less than two months at the MEIR. We recommend that exposure from projects longer than 2 months but less than 6 months be assumed to last 6 months (e.g., a 2-month project would be evaluated as if it lasted 6 months). Exposure from projects lasting more than 6 months should be evaluated for the duration of the project. In all cases, for assessing risk to residential receptors, the exposure should be assumed to start in the third trimester to allow for the use of the ASFs (OEHHA, 2009). Thus, for example, if the District is evaluating a proposed 5-year mitigation project at a hazardous waste site, the cancer risks for the residents would be calculated based on exposures starting in the third trimester through the first five years of life.
>
> For the MEIW, we recommend using the same minimum exposure requirements used for the residential receptor (i.e., no evaluation for projects less than 2 months; projects longer than 2 months but less than 6 months are assumed to last 6 months; projects longer than 6 months would be evaluated for the duration of the project). Although the off-site worker scenario assumes that the workers are 16 years of age or older with an Age-Sensitivity Factor of 1, another risk management consideration for short-term project cancer assessment is whether there are women of child bearing age at the worksite and whether the MEIW receptor has a daycare center. In this case, the Districts may wish to treat the off-site MEIW in the same way as the residential scenario to account for the higher susceptibility during the third trimester of pregnancy, and for higher susceptibility of infants and children.
>
> Finally, the risk manager may want to consider a lower cancer risk threshold for risk management for very short-term projects. Typical District guidelines for evaluating risk management of Hot Spots facilities range around a cancer risk of 1 per 100,000 exposed persons as a trigger for risk management. Permitting thresholds also vary for each District. There is valid scientific concern that the rate of exposure may influence the risk – in other words, a higher exposure to a carcinogen over a short period of time may be a greater risk than the same total exposure spread over a much longer time period. In addition, it is inappropriate from a public health perspective to allow a lifetime acceptable risk to accrue in a short period of time (e.g., a very high exposure to a carcinogen over a short period of time resulting in a 1×10^{-5} cancer risk). Thus, consideration should be given for very short term projects to using a lower cancer risk trigger for permitting decisions.

Thus, the very risk assessment guidelines that the DEIR relies on to conclude that no health risk assessment is required for short-term construction projects specifically requires a

[11] DEIR, p. 4.2-31.

health risk assessment for construction projects lasting longer than 2 months, and further recommends using a lower cancer risk significance threshold[12] than cited in the DEIR.[13]

The conceptual construction schedule indicates that the construction of several Project components will last longer than 2 months, including drilling of slant wells 1-2 (180 days), project-wide pipework excavations (427 days), drilling and development of slant wells 3-4 (240 days), drilling and development of slant wells 5-10 (690 days), and reverse osmosis (RO) building foundation (100 days), among many others.[14] The slant well drilling would occur 24 hours a day, 7 days per week for about 6 months out of the year.[15]

The DEIR does not contain the type of information normally relied upon to determine if the OEHHA risk assessment guidance is complied with; including a detailed construction schedule, and maps that locate each project construction site and identify all nearby sensitive receptors, including their distance from construction work and duration of exposure. Instead, one must rely on the noise analysis to identify sensitive receptors. The noise analysis, which does identify sensitive receptors, fails to disclose the duration of exposure or to include maps showing the location of all sensitive receptors, as would be required for an HRA.

The noise analysis identifies many nearby sensitive receptors,[16] including those near intake well construction: a residence along Beach Road at 90 feet, Capistrano Beach Park at 200 feet, and residences on the Bluff (estimated as 34832 Doheny Place) at 325 feet.[17] These receptors are adjacent to well drilling sites, where construction will occur 24 hours per day, 7 days per week.

Other sensitive receptors for the Northern Alignment include new apartments and Del Obispo Community Park at 50 feet, homes on Village Road at 90 feet, apartments on Quail Run at 153 feet, residences on Bluff at 300 feet, and apartments on Dana Bluff at 300 feet.[18] Sensitive receptors for the Southern Alignment include residences on Doheny Place and apartments on Dana Bluff at 300 feet and apartments on Domingo Avenue at 350 feet.[19] Similarly, sensitive

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[12] Office of Environmental Health Hazard Assessment (OEHHA), Risk Assessment Guidelines: Guidance Manual for Preparation of Health Risk Assessments, February 2015 (OEHHA 2015), Section 8.2.10: Cancer Risk Evaluation of Short Term Projects, pp. 8-17/18; available at: https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0.

[13] Appendix 100.3, pdf 7 (10 in one million).

[14] DEIR, Appendix 10.3, Table 8.

[15] DEIR, p. 4.2-31.

[16] DEIR, Tables 4.10-5, 4.10-7, 4.10-8, 4.10-9.

[17] DEIR, Table 4.10-7.

[18] DEIR, Table 4.10-8.

[19] DEIR, Table 4.10-9.

receptors are close to the desalination facility construction site, including Del Obispo Community Park at 600 feet and apartments on Quail Run at 720 feet.[20]

The DEIR fails to disclose any information about TAC sensitive receptors at any of these locations (e.g., workers, residents, young children). For example, Del Obispo Park, which is adjacent to many Project components, is open from 6:00 AM to 10:00 PM and includes a playground area.[21]

Health risk assessments are routinely performed for construction projects. The proximity of identified sensitive receptors and the duration of construction indicate that a health risk assessment should have been prepared for this Project. Based on my experience, I expect that cancer health impacts from DPM may be significant. Further, the DEIR fails to recognize that Project construction emissions would occur concurrently with and subsequent to countless other construction projects elsewhere in the air basin. The DEIR also failed to evaluate cumulative health impacts of construction, which are also likely significant.[22] These impacts could be mitigated by requiring catalyzed diesel particulate traps and diesel oxidation catalysts on construction equipment. These emissions could be further reduced by

- Using alternative fueled equipment (e.g., propane), where available;
- Limiting engine idling to two minutes for delivery trucks and dump trucks;
- Suspending construction activities during Stage II smog alerts;
- Purchasing local GHG offsets that provide PM2.5 benefits (See Comment 5); and
- Employing a construction site manager to verify that engines are properly maintained and to maintain a log.

As the DEIR did not include a health risk assessment for Project construction, did not identify or quantify TAC emissions, and does not include any analysis to verify that none is required, the DEIR fails as an informational document under CEQA.

3. THE DEIR FAILED TO EVALUATE ODOR IMPACTS

The DEIR establishes a CEQA significance threshold for odor of "creat[ing] objectionable odors affecting a substantial number of people."[23] The DEIR evaluates odor in Impact 4.2-5, and concludes that the "primary source of odor anticipated from the construction of the proposed Project would be exhaust emissions from the diesel equipment and haul (...) trucks." However, the DEIR then concludes, with no analysis whatsoever, that "emissions from diesel construction

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[20] DEIR, Table 4.10-10.

[21] Parks & Recreation, Dana Point, CA, Del Obispo Park; available at: http://www.danapoint.org/department/community-services-and-parks/parks/parks-trails/del-obispo-park.

[22] Don Anair, Union of Concerned Scientists, Digging Up Trouble. The Health Risks of Construction in California, 2006; available at: http://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_vehicles/digging-up-trouble.pdf.

[23] DEIR, p. 4.2-19.

equipment and vehicles would be temporary and would not be expected to cause any odor issues that would affect a substantial number of people. Therefore, the odor impact related to construction would be less than significant."[24]

This "analysis" is entirely inadequate, and the DEIR's conclusion regarding the significance of odor impacts is completely unsupported, as well as incorrect. Noise impacts are similar to odor impacts, in that noise would also be "temporary" and would affect the same receptors. Both noise and odor would impact a substantial number of people, due to construction of Project components near numerous residential developments. The DEIR included a detailed noise analysis[25] but did not include any odor analysis at all. Based on my personal experience at construction sites, residential areas are close enough to Project construction sites for residents to smell noxious diesel and other exhaust fumes.

The odors—smoky, burnt, oily, kerosene—and accompanying eye and nose irritation associated with diesel exhaust have been documented for decades.[26] A 1970 EPA report noted that "[e]xhaust gases emitted by diesel engines are characterized by offensive odors, which can be rated by human judges." Elsewhere, the EPA noted that "[o]dor is undoubtedly the prime sensory attribute of diesel exhaust under the typical circumstances of human exposure."[27]

The DEIR's dismissal of potential odor impacts of diesel exhaust emissions due to their "temporary" nature and the incorrect assertion that they would not be expected to cause any odor issues that would affect a "substantial number of people" is not acceptable, particularly

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[24] DEIR, p. 4.2-32.

[25] DEIR, Section 4.10: Noise, and Appendix 10.12: Noise Data.

[26] Arthur D. Little, Inc., Chemical Identification of the Odor Components in Diesel Engine Exhaust, June 1971; available at: https://nepis.epa.gov/Exe/ZyNET.exe/9101G0ZG.TXT?ZyActionD=ZyDocument&Client=EPA&Index=Prior+to+1976&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C70thru75%5CTxt%5C00000021%5C9101G0ZG.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL; R. H. Linnell and W. E. Scott, Diesel Exhaust Composition and Odor Studies, *Journal of the Air Pollution Control Association*, v. 12, 2012, no. 11, pp. 510-545; available at: www.tandfonline.com/doi/pdf/10.1080/00022470.1962.10468121.

[27] Amos Turk and others, Sensory Evaluation of Diesel Exhaust Odors, U.S. Department of Health, Education, and Welfare Report, February 1970; available at: https://nepis.epa.gov/Exe/ZyNET.exe/9100HJM4.TXT?ZyActionD=ZyDocument&Client=EPA&Index=Prior+to+1976&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C70thru75%5CTxt%5C00000012%5C9100HJM4.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL#.

when undocumented. The DEIR made no attempt to quantify the number of people who would be affected by odor. Further, these assertions are contrary to the facts in the DEIR and specifically the noise analysis, which found significant impacts.

The odor of diesel exhaust is considered by most people to be objectionable. The EPA found that, at high intensities, diesel exhaust may also produce sufficient physiological and psychological effects to warrant concern for public health.[28] The proposed Project would be constructed as close as 50 feet from apartments and the Del Obispo Community Park, and 90 feet from homes. See Comment 1. The injection well sites are near residential buildings and drilling would occur 24 hours per day, 7 days per week, thus including sensitive nighttime hours when significant odor impacts could occur. Further, clouds of chemicals from diesel-powered equipment when working and idling at the Project site can travel downwind for miles and drift into heavily populated areas.[29]

The DEIR should have evaluated odor impacts. The analysis of odor is no different than that of air quality impacts. One identifies the odiferous compounds that would be present—in this case diesel exhaust, represented by PM2.5, another surrogate or a collection of odiferous compounds[30]—estimates their emission rates, and uses AERMOD or other dispersion models to estimate ambient concentrations at the location of sensitive receptors. The modeled ambient concentrations are then compared to published odor thresholds.[31] The DEIR does not contain any analysis at all. Design criteria, for example, have been developed for diesel-fueled equipment based on the 1:2000 odor dilution threshold, including for a 400-hp diesel truck, a 250-kW diesel generator, and a 2,000-kW diesel generator. The resulting design criteria are 5,293 $ug/m^3/g/s$; 492 $ug/m^3/g/s$; and 66 $ug/m^3/g/s$, respectively, for this equipment.[32]

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[28] EPA, Health Assessment Document for Diesel Engine Exhaust, EPA/600/8-90/057F, May 2002; https://nepis.epa.gov/Exe/ZyNET.exe/300055PV.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1986+Thru+1990&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C86thru90%5CTxt%5C00000006%5C300055PV.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL.

[29] Union of Concerned Scientists, *op. cit.*

[30] M. M. Roy and N. N. Mustafi, Investigation of Odorous Components in the Exhaust of DI Diesel Engines, International Conference on Mechanical Engineering, December 26-28, 2001, pp. II 31-36; available at: https://me.buet.ac.bd/icme/icme2001/cdfiles/Papers/Environment/6_Final_en01(31-36).pdf.

[31] See, for example, J. E. Alpert and N. T. Wu, Odor Modeling as a Tool in Site Planning, *BioCycle Magazine*, 2012; available at: http://www.compostingcouncil.org/wp/wp-content/uploads/2014/02/9-OdorModeling.pdf.

[32] U.S. EPA, Modeling Exhaust Dispersion for Specifying Acceptable Exhaust/Intake Designs, Table 1; available at: http://labs21.lbl.gov/DPM/Assets/bp_modeling_508.pdf.

Finally, mitigation is available for odor impacts from construction equipment and should be required for all construction within at least 1,000 feet of sensitive receptors. Construction equipment that operates near sensitive receptors, for example, can be equipped with a diesel oxidation catalyst, which eliminates odors,[33] or other methods identified in Comment 2 may be used.

The FEIR for the Phillips 66 Santa Maria Rail Terminal in San Louis Obispo County, for example, provided a quantitative odor analysis estimating that fugitive crude oil vapor emissions from equipment leaks could produce H_2S levels at the property line of up to 1.7 parts per billion ("ppb") and less than 1 ppb at residences. Based on an H_2S odor limit of 2 ppb with a significant impact being assigned to levels that could exceed the 50 percent odor threshold at 1 ppb, the Santa Maria Rail Terminal FEIR found that fugitive emissions could cause odor impacts offsite and odor emissions would be potentially significant.[34]

It is well known that DPM has an unpleasant odor.[35] As discussed in Comment 2, there are many nearby sensitive receptors that could experience odor impacts. The only way to conclude that odor impacts are insignificant is to use air dispersion modeling to estimate ambient concentrations of DPM (and other odoriferous compounds) at nearby sensitive receptors and compare the resulting concentrations odor thresholds. The DEIR does not contain any analysis at all to support its conclusion that odor impacts would not be significant. Thus, it fails as an informational document under CEQA.

4. CONSTRUCTION EMISSIONS ARE UNDERESTIMATED

Construction emissions were estimated using default and other assumptions in the CalEEMod 2016.3.2 model. There are several problems with the way this model was used to estimate construction emissions.

First, the DEIR exclusively used the CalEEMod model to estimate construction emissions. However, this model does not include all sources of PM10 and PM2.5 construction emissions. It omits windblown dust from graded areas and storage piles and fugitive dust from off-road travel:[36]

> Fugitive dust associated with grading, demolition, truck loading, and on-road vehicles traveling along paved and unpaved roads. (Fugitive dust from wind blown sources such as storage piles and inactive disturbed areas, as well as fugitive dust from off-road vehicle travel, are not quantified in CalEEMod, which is consistent with approaches taken in other comprehensive models.)

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[33] W. Addy Majewski, Diesel Oxidation Catalyst, 2012; available at: https://www.dieselnet.com/tech/cat_doc.php.

[34] Marine Research Specialists, Final Environmental Impact Report and Vertical Coastal Access Project Assessment, Phillips 66 Company Rail Spur Extension and Crude Unloading Project, December 2015.Draft EIR for Santa Maria Rail Terminal Phillips, pp. 4.3-78/79. Exhibit 2.

[35] Linnell and Scott, Diesel Exhaust Composition and Odor Studies.

[36] CAPCOA 2016, pdf 8. This same language appears in CAPCOA 2017, pdf 7.

These emissions must be separately calculated using methods in AP-42[37] and added to the CalEEMod total. The DEIR did not calculate these emissions. Based on calculations I have made in other cases, windblown dust from graded areas and storage piles and fugitive dust from off-road travel are the major sources of PM10 and PM2.5 emissions from construction projects. These emissions taken alone frequently exceed the PM10 and PM2.5 significance thresholds. Thus, the DEIR fails as an informational document.

Windblown dust from disturbed soils is a particular concern at this site due to the Santa Ana winds that occur in the area. These winds are strong, extremely dry, down-slope winds that originate inland and affect coastal Southern California. As these winds are particularly strong, reaching 30 to 50 mph, they can raise significant amounts of dust, even when conventional tracking and other such controls are used, often prompting alerts from air pollution control districts.[38] If Santa Ana winds occurred during grading, cut and fill, or soil movement, or from bare graded soil surfaces (even if periodically wetted), significant amounts of PM10, PM2.5, and associated Valley Fever spores and silica dust would be released. These emissions could result in public health impacts from the silica and Valley Fever spores and/or violations of PM10 and PM2.5 CAAQS and NAAQS. These potential impacts were not evaluated.

Wind erosion emissions are typically calculated using methods in AP-42,[39] which require detailed information on site topography, wind profiles, and dispersion modeling. This information is not cited or included in the DEIR. Generally, wind erosion impacts are estimated using AERMOD. The DEIR does not include any calculations of wind erosion emissions but rather tacitly assumes that compliance with conventional construction mitigation measures and regulations will result in adequate wind erosion control,[40] without any analysis at all and without acknowledging the added risk of Santa Ana winds.

Second, construction emissions depend upon the conditions at the site. The CalEEMod uses default emission factors.[41] However, the geotechnical report indicates that some of the on-site soil conditions will require more aggressive use of construction equipment than assumed in

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37 U.S. EPA, Compilation of Air Pollutant Emission Factors, Report AP-42; available at https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors#Proposed.

38 SCAQMD Issues Dust and Ash Advisory Due to Strong Winds in the Southland; available at https://lasentinel.net/scaqmd-issues-dust-and-ash-advisory-due-to-strong-winds-in-the-southland.html.

39 U.S. EPA, AP-42, Section 13.2.5 Industrial Wind Erosion; available at https://www3.epa.gov/ttnchie1/ap42/ch13/final/c13s0205.pdf.

40 DEIR, p. 2.6-18, 3.2-14, 3.2-20.

41 H. Fan, A Critical Review and Analysis of Construction Equipment Emission Factors, *Procedia Engineering*, v. 196, 2017, pp. 351–358, Sec. 3.4; available at: https://www.sciencedirect.com/science/article/pii/S1877705817330801.

the CalEEMod calculations.[42] The default emission factors should have been adjusted to increase emissions for these portions of the site.

Third, the DEIR relies on certain mitigation measures to reduce significant NOx emissions below CEQA significance thresholds. However, these measures assume all equipment is operating under optimal conditions and average site conditions. However, many factors affect the emissions from construction equipment, many of which could result in emissions far above the levels assumed in the mitigated construction emissions. These include routine and major maintenance, running repair, tire/track condition, operator skills, jobsite conditions, etc. The mitigation measures do not include any method to true up or validate that the construction equipment is emitting at the levels assumed in the DEIR.[43] This is easily done using Portable Emission Measurement Systems (PEMS).[44] The DEIR should be modified to require the use of PEMS to verify tailpipe emissions from construction equipment.

5. THE PROPOSED GHG MITIGATION IS INADEQUATE

The DEIR did not determine whether greenhouse gas (GHG) emissions would be significant using conventional CEQA significance thresholds, such as the SCAQMD's 10,000 MT/yr threshold. Rather, the DEIR states that the SCWD "supports the objective of AB 32 ... [and] has voluntarily committed to ensure the Project is net carbon neutral."[45] The DEIR must establish enforceable mitigation to assure that the Project is net carbon neutral. The proposed mitigation does not achieve this goal.

First, the GHG mitigation program (GHG-1) will be developed outside of the EIR, preventing review under CEQA.

Second, the GHG emissions that must be mitigated can be "trued up" – that is, revised at the discretion of the applicant and lead agency.[46] This would occur outside of CEQA review, preventing public comment.

Third, the GHG emissions can be mitigated using third-party-verifiable GHG offsets that "to the extent practicable, must be located within California..."[47] Allowing offsets anywhere within California, outside of the Project area, or beyond, forgoes the benefits of local offsets, which include reductions in NOx and other pollutants, which are significant and unmitigated when indirect electricity emissions are included.

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[42] DEIR, Appendix 10.6.1, Preliminary Geotechnical Study–2015, pp. 3-4.

[43] Fan, 2017.

[44] C. Fulper, Portable Emissions Measurement Strategy, U.S. Environmental Protection Agency, 2002; available at: https://www.epa.gov/sites/production/files/2015-03/documents/02132002mstrs_fulper.pdf.

[45] DEIR, p. 4.6-16.

[46] DEIR, p. 4.6-23/24, GHG-2.

[47] DEIR, p. 4.6-23, GHG-2(d).

In general, all feasible on-site mitigation should be required before off-site offsets are used. On-site GHG mitigation is important because it contributes to the mitigation of other significant and unavoidable Project impacts, including significant operational NOx impacts. Thus, all feasible on-site GHG mitigation must be implemented as mitigation for other significant impacts.[48]

Fourth, the DEIR fails to require that the offsets offer an equivalent GHG reduction benefit annually, as opposed to a one-time reduction.

Fifth, the DEIR fails to disclose whether the GHG mitigation would apply annually for the entire life of the facility.

Sixth, the offset program does not require any direct investment in local infrastructure, allowing all off-site reductions to be offset purchases. Offset purchases would not mitigate other significant impacts that would be mitigated by on-site GHG mitigation.

Seventh, the offset program fails to identify nearby GHG mitigation options that have many local co-benefits. The offset program, for example, could require the funding of off-site, solar-powered EV charging stations and energy efficiency improvements at existing facilities located in the surrounding communities that will be adversely impacted by the Project, including building retrofits and solar panel installations.

6. THE DEIR EXCLUDES SIGNIFICANT ELECTRICITY GENERATION EMISSIONS

The DEIR concluded that operational criteria pollutant emissions were not significant.[49] The major source of operational criteria pollutant emissions from the Project is the generation of electricity to support the RO system, slant wells, and support facilities. The DEIR excluded criteria pollutant emissions from electricity generation in its emission summaries. The DEIR argues that including electricity emissions is not appropriate because "emissions associated with energy consumption occur where the energy is generated. Since power plants are located throughout (and outside) the state, criteria pollutant emissions associated with electricity demand cannot be ascribed to a specific air basin or air district and it cannot be determined whether the air pollutant emissions associated with electricity generation would degrade air quality in a specific air basin or air district."[50] However, as the DEIR elsewhere acknowledges, CEQA Guidelines Appendix F requires a "discussion of the potential energy impacts of the proposed project, with particular emphasis on avoiding or reducing inefficient, wasteful and unnecessary consumption of energy…"[51]

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[48] Office of Planning and Research, Chapter 8, Climate Change, p. 230; available at: [http://www.opr.ca.gov/docs/OPR_C8_final.pdf.](http://www.opr.ca.gov/docs/OPR_C8_final.pdf)

[49] DEIR, Tables 4.2-10, 4.2-11.

[50] DEIR, p. 4.2-27.

[51] DEIR, p. 6.0-9.

The DEIR does not contain any analysis of potential energy impacts of the Project. Even though the electricity may be generated outside of the South Coast Air Basin (SCAB), it is equally likely that power plants within the SCAB will supply the Project's power.[52] Unless the DEIR is modified to prohibit the use of electricity produced within the SCAB or to require 100% renewable energy, the EIR must include emissions from electricity generation, add them to criteria pollutant emissions from other Project components, and compare them to CEQA significance thresholds. In fact, the SCAQMD's CEQA significance thresholds, which the DEIR relied on, specifically apply to both "direct and indirect emissions."[53] Electricity generation is an indirect emission source.

I estimated indirect electricity generation emissions from the amount of electricity required to support the Project and emissions factors for delivered electricity.[54] The resulting calculations are summarized in Table 1. This table shows that NOx and SOx emissions from electricity generation alone may exceed the CEQA significance thresholds (shown in red in Table 1). Thus, operational emissions from electricity generation are significant, requiring mitigation. Mitigation could include a requirement to use only electricity from renewable sources. This could be specified as a condition in the applicant's contract with San Diego Gas and Electric (SDG&E)[55] or any other electricity provider.

Table 1. Criteria Pollutant Emissions from Electricity Generation

	Emission Factor (1) (lb/kWh)	Phase I Emissions (2) (lb/day)	Phase II Emissions (3) (lb/day)	Significance Threshold (lb/day)
NOx	0.00195	152	464	100
SOx	0.00682	532	1624	150
CO	0.000546	43	130	550
VOC	0.0000645	5	15	75
PM10	0.0000699	5	17	150

(1) Deru and Torcellini, June 2007, Table 4.

(2) Emission Factor lb/kWh x 28,484,064 kwh/yr/365 day/yr (DEIR, Appx 10.3 pdf 26).

(3) Emission Factor lb/kWh x 86,935,877 kwh/yr/365 day/yr (DEIR Appx. 10.3, pdf 26).

52 See California Operational Power Plants, May 16, 2018; available at: http://www.energy.ca.gov/maps/powerplants/power_plant_statewide.html.

53 SCAQMD, CEQA Air Quality Handbook, April 1993, p. 6-2.

54 M. Deru and P. Torcellini, Source Energy and Emission Factors for Energy Use in Buildings, NREL Technical Report NREL/TP-550-38617, June 2007, Table 3, pdf 15; available at: https://www.nrel.gov/docs/fy07osti/38617.pdf.

55 DEIR, p. 6.0-9.

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Dr. Fox has over 40 years of experience in the field of environmental engineering, including air pollution control (BACT, BART, MACT, LAER, RACT), greenhouse gas emissions and control, cost effectiveness analyses, water quality and water supply investigations, hydrology, hazardous waste investigations, environmental permitting, nuisance investigations (odor, noise), environmental impact reports, CEQA/NEPA documentation, risk assessments, and litigation support.

EDUCATION

Ph.D. Environmental/Civil Engineering, University of California, Berkeley, 1980.
M.S. Environmental/Civil Engineering, University of California, Berkeley, 1975.
B.S. Physics (with high honors), University of Florida, Gainesville, 1971.

REGISTRATION

Registered Professional Engineer: Arizona (2001-2014: #36701; retired), California (2002-present; CH 6058), Florida (2001-2016; #57886; retired), Georgia (2002-2014; #PE027643; retired), Washington (2002-2014; #38692; retired), Wisconsin (2005-2014; #37595-006; retired)
Board Certified Environmental Engineer, American Academy of Environmental Engineers, Certified in Air Pollution Control (DEE #01-20014), 2002-2014; retired)
Qualified Environmental Professional (QEP), Institute of Professional Environmental Practice (QEP #02-010007, 2001-2015: retired).

PROFESSIONAL HISTORY

Environmental Management, Principal, 1981-present
Lawrence Berkeley National Laboratory, Principal Investigator, 1977-1981
University of California, Berkeley, Program Manager, 1976-1977
Bechtel, Inc., Engineer, 1971-1976, 1964-1966

PROFESSIONAL AFFILIATIONS

American Chemical Society (1981-2010)
Phi Beta Kappa (1970-present)
Sigma Pi Sigma (1970-present)

Who's Who Environmental Registry, PH Publishing, Fort Collins, CO, 1992.
Who's Who in the World, Marquis Who's Who, Inc., Chicago, IL, 11th Ed., p. 371, 1993-present.
Who's Who of American Women, Marquis Who's Who, Inc., Chicago, IL, 13th Ed., p. 264, 1984-present.
Who's Who in Science and Engineering, Marquis Who's Who, Inc., New Providence, NJ, 5th Ed., p. 414, 1999-present.
Who's Who in America, Marquis Who's Who, Inc., 59th Ed., 2005.
Guide to Specialists on Toxic Substances, World Environment Center, New York, NY, p. 80, 1980.
National Research Council Committee on Irrigation-Induced Water Quality Problems (Selenium), Subcommittee on Quality Control/Quality Assurance (1985-1990).
National Research Council Committee on Surface Mining and Reclamation, Subcommittee on Oil Shale (1978-80)

REPRESENTATIVE EXPERIENCE

Performed environmental and engineering investigations, as outlined below, for a wide range of industrial and commercial facilities including: petroleum refineries and upgrades thereto; reformulated fuels projects; refinery upgrades to process heavy sour crudes, including tar sands and light sweet crudes from the Eagle Ford and Bakken Formations; petroleum, gasoline and ethanol distribution terminals; coal, coke, and ore/mineral export terminals; LNG export, import, and storage terminals; crude-by-rail projects; shale oil plants; crude oil/condensate marine and rail terminals; coal gasification and liquefaction plants; oil and gas production, including conventional, thermally enhanced, hydraulic fracking, and acid stimulation techniques; underground storage tanks; pipelines; compressor stations; gasoline stations; landfills; railyards; hazardous waste treatment facilities; nuclear, hydroelectric, geothermal, wood, biomass, waste, tire-derived fuel, gas, oil, coke and coal-fired power plants; transmission lines; airports; hydrogen plants; petroleum coke calcining plants; coke plants; activated carbon manufacturing facilities; asphalt plants; cement plants; incinerators; flares; manufacturing facilities (e.g., semiconductors, electronic assembly, aerospace components, printed circuit boards, amusement park rides); lanthanide processing plants; ammonia plants; nitric acid plants; urea plants; food processing plants; wineries; almond hulling facilities; composting facilities; grain processing facilities; grain elevators; ethanol production facilities; soy bean oil extraction plants; biodiesel plants; paint formulation plants; wastewater treatment plants; marine terminals and ports; gas processing plants; steel mills; iron nugget production facilities; pig iron plant, based on blast furnace technology; direct reduced iron plant; acid regeneration facilities; railcar refinishing facility; battery manufacturing plants; pesticide manufacturing and repackaging facilities; pulp and paper mills; olefin plants; methanol plants;

ethylene crackers; alumina plants, desalination plants; battery storage facilities; selective catalytic reduction (SCR) systems; selective noncatalytic reduction (SNCR) systems; halogen acid furnaces; contaminated property redevelopment projects (e.g., Mission Bay, Southern Pacific Railyards, Moscone Center expansion, San Diego Padres Ballpark); residential developments; commercial office parks, campuses, and shopping centers; server farms; transportation plans; and a wide range of mines including sand and gravel, hard rock, limestone, nacholite, coal, molybdenum, gold, zinc, and oil shale.

EXPERT WITNESS/LITIGATION SUPPORT

- For the California Attorney General, assist in determining compliance with probation terms in the matter of People v. Chevron USA.
- For plaintiffs, assist in developing Petitioners' proof brief for National Parks Conservation Association et al v. U.S. EPA, Petition for Review of Final Administrative Action of the U.S. EPA, In the U.S. Court of Appeals for the Third Circuit, Docket No. 14-3147.
- For plaintiffs, expert witness in civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1997-2000) at the Cemex cement plant in Lyons, Colorado. Reviewed produced documents, prepared expert and rebuttal reports on PSD applicability based on NOx emission calculations for a collection of changes considered both individually and collectively. Deposed August 2011. *United States v. Cemex, Inc.*, In U.S. District Court for the District of Colorado (Civil Action No. 09-cv-00019-MSK-MEH). Case settled June 13, 2013.
- For plaintiffs, in civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1988 – 2000) at James De Young Units 3, 4, and 5. Reviewed produced documents, analyzed CEMS and EIA data, and prepared netting and BACT analyses for NOx, SO2, and PM10 (PSD case). Expert report February 24, 2010 and affidavit February 20, 2010. *Sierra Club v. City of Holland, et al.*, U.S. District Court, Western District of Michigan (Civil Action 1:08-cv-1183). Case settled. Consent Decree 1/19/14.
- For plaintiffs, in civil action alleging failure to obtain MACT permit, expert on potential to emit hydrogen chloride (HCl) from a new coal-fired boiler. Reviewed record, estimated HCl emissions, wrote expert report June 2010 and March 2013 (Cost to Install a Scrubber at the Lamar Repowering Project Pursuant to Case-by-Case MACT), deposed August 2010 and March 2013. *Wildearth Guardian et al. v. Lamar Utilities Board,* Civil Action No. 09-cv-02974, U.S. District Court, District of Colorado. Case settled August 2013.
- For plaintiffs, expert witness on permitting, emission calculations, and wastewater treatment for coal-to-gasoline plant. Reviewed produced documents. Assisted in

preparation of comments on draft minor source permit. Wrote two affidavits on key issues in case. Presented direct and rebuttal testimony 10/27 - 10/28/10 on permit enforceability and failure to properly calculate potential to emit, including underestimate of flaring emissions and omission of VOC and CO emissions from wastewater treatment, cooling tower, tank roof landings, and malfunctions. *Sierra Club, Ohio Valley Environmental Coalition, Coal River Mountain Watch, West Virginia Highlands Conservancy v. John Benedict, Director, Division of Air Quality, West Virginia Department of Environmental Protection and TransGas Development System, LLC*, Appeal No. 10-01-AQB. Virginia Air Quality Board remanded the permit on March 28, 2011 ordering reconsideration of potential to emit calculations, including: (1) support for assumed flare efficiency; (2) inclusion of startup, shutdown and malfunction emissions; and (3) inclusion of wastewater treatment emissions in potential to emit calculations.

- For plaintiffs, expert on BACT emission limits for gas-fired combined cycle power plant. Prepared declaration in support of CBE's Opposition to the United States' Motion for Entry of Proposed Amended Consent Decree. Assisted in settlement discussions. *U.S. EPA, Plaintiff, Communities for a Better Environment, Intervenor Plaintiff, v. Pacific Gas & Electric Company, et al.*, U.S. District Court, Northern District of California, San Francisco Division, Case No. C-09-4503 SI.

- Technical expert in confidential settlement discussions with large coal-fired utility on BACT control technology and emission limits for NOx, SO2, PM, PM2.5, and CO for new natural gas fired combined cycle and simple cycle turbines with oil backup. (July 2010). Case settled.

- For plaintiffs, expert witness in remedy phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1998-99) at Gallagher Units 1 and 3. Reviewed produced documents, prepared expert and rebuttal reports on historic and current-day BACT for SO2, control costs, and excess emissions of SO2. Deposed 11/18/09. *United States et al. v. Cinergy, et al.*, In U.S. District Court for the Southern District of Indiana, Indianapolis Division, Civil Action No. IP99-1693 C-M/S. Settled 12/22/09.

- For plaintiffs, expert witness on MACT, BACT for NOx, and enforceability in an administrative appeal of draft state air permit issued for four 300-MW pet-coke-fired CFBs. Reviewed produced documents and prepared prefiled testimony. Deposed 10/8/09 and 11/9/09. Testified 11/10/09. *Application of Las Brisas Energy Center, LLC for State Air Quality Permit*; before the State Office of Administrative Hearings, Texas. Permit remanded 3/29/10 as LBEC failed to meet burden of proof on a number of issues including MACT. Texas Court of Appeals dismissed an appeal to reinstate the permit. The Texas Commission on Environmental Quality and Las Brisas Energy Center, LLC sought to overturn the Court of Appeals decision but moved to have their appeal dismissed in August 2013.

- For defense, expert witness in unlawful detainer case involving a gasoline station, minimart, and residential property with contamination from leaking underground storage tanks. Reviewed agency files and inspected site. Presented expert testimony on July 6, 2009, on causes of, nature and extent of subsurface contamination. *A. Singh v. S. Assaedi*, in Contra Costa County Superior Court, CA. Settled August 2009.

- For plaintiffs, expert witness on netting and enforceability for refinery being upgraded to process tar sands crude. Reviewed produced documents. Prepared expert and rebuttal reports addressing use of emission factors for baseline, omitted sources including coker, flares, tank landings and cleaning, and enforceability. Deposed. *In the Matter of Objection to the Issuance of Significant Source Modification Permit No. 089-25484-00453 to BP Products North America Inc., Whiting Business Unit, Save the Dunes Council, Inc., Sierra Club., Inc., Hoosier Environmental Council et al., Petitioners, B. P. Products North American, Respondents/Permittee,* before the Indiana Office of Environmental Adjudication. Case settled.

- For plaintiffs, expert witness on BACT, MACT, and enforceability in appeal of Title V permit issued to 600 MW coal-fired power plant burning Powder River Basin coal. Prepared technical comments on draft air permit. Reviewed record on appeal, drafted BACT, MACT, and enforceability pre-filed testimony. Drafted MACT and enforceability pre-filed rebuttal testimony. Deposed March 24, 2009. Testified June 10, 2009. *In Re: Southwestern Electric Power Company*, Arkansas Pollution Control and Ecology Commission, Consolidated Docket No. 08-006-P. Recommended Decision issued December 9, 2009 upholding issued permit. Commission adopted Recommended Decision January 22, 2010.

- For plaintiffs, expert witness in remedy phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications (1989-1992) at Wabash Units 2, 3 and 5. Reviewed produced documents, prepared expert and rebuttal report on historic and current-day BACT for NOx and SO2, control costs, and excess emissions of NOx, SO2, and mercury. Deposed 10/21/08. *United States et al. v. Cinergy, et al.*, In U.S. District Court for the Southern District of Indiana, Indianapolis Division, Civil Action No. IP99-1693 C-M/S. Testified 2/3/09. Memorandum Opinion & Order 5-29-09 requiring shutdown of Wabash River Units 2, 3, 5 by September 30, 2009, run at baseline until shutdown, and permanently surrender SO2 emission allowances.

- For plaintiffs, expert witness in liability phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for three historic modifications (1997-2001) at two portland cement plants involving three cement kilns. Reviewed produced documents, analyzed CEMS data covering subject period, prepared netting analysis for NOx, SO_2 and CO, and prepared expert and rebuttal reports. *United States v. Cemex California Cement,* In U.S. District Court for the Central District of California, Eastern Division, Case No. ED CV 07-00223-GW (JCRx). Settled 1/15/09.

- For intervenors Clean Wisconsin and Citizens Utility Board, prepared data requests, reviewed discovery and expert report. Prepared prefiled direct, rebuttal and surrebuttal testimony on cost to extend life of existing Oak Creek Units 5-8 and cost to address future regulatory requirements to determine whether to control or shutdown one or more of the units. Oral testimony 2/5/08. Application for a Certificate of Authority to Install Wet Flue Gas Desulfurization and Selective Catalytic Reduction Facilities and Associated Equipment for Control of Sulfur Dioxide and Nitrogen Oxide Emissions at Oak Creek Power Plant Units 5, 6, 7 and 8, WPSC Docket No. 6630-CE-299.
- For plaintiffs, expert witness on alternatives analysis and BACT for NOx, SO2, total PM10, and sulfuric acid mist in appeal of PSD permit issued to 1200 MW coal fired power plant burning Powder River Basin and/or Central Appalachian coal (Longleaf). Assisted in drafting technical comments on NOx on draft permit. Prepared expert disclosure. Presented 8+ days of direct and rebuttal expert testimony. Attended all 21 days of evidentiary hearing from 9/5/07 – 10/30/07 assisting in all aspects of hearing. *Friends of the Chatahooche and Sierra Club v. Dr. Carol Couch, Director, Environmental Protection Division of Natural Resources Department, Respondent, and Longleaf Energy Associates, Intervener.* ALJ Final Decision 1/11/08 denying petition. ALJ Order vacated & remanded for further proceedings, Fulton County Superior Court, 6/30/08. Court of Appeals of GA remanded the case with directions that the ALJ's final decision be vacated to consider the evidence under the correct standard of review, July 9, 2009. The ALJ issued an opinion April 2, 2010 in favor of the applicant. Final permit issued April 2010.
- For plaintiffs, expert witness on diesel exhaust in inverse condemnation case in which Port expanded maritime operations into residential neighborhoods, subjecting plaintiffs to noise, light, and diesel fumes. Measured real-time diesel particulate concentrations from marine vessels and tug boats on plaintiffs' property. Reviewed documents, depositions, DVDs, and photographs provided by counsel. Deposed. Testified October 24, 2006. *Ann Chargin, Richard Hackett, Carolyn Hackett, et al. v. Stockton Port District*, Superior Court of California, County of San Joaquin, Stockton Branch, No. CV021015. Judge ruled for plaintiffs.
- For plaintiffs, expert witness on NOx emissions and BACT in case alleging failure to obtain necessary permits and install controls on gas-fired combined-cycle turbines. Prepared and reviewed (applicant analyses) of NOx emissions, BACT analyses (water injection, SCR, ultra low NOx burners), and cost-effectiveness analyses based on site visit, plant operating records, stack tests, CEMS data, and turbine and catalyst vendor design information. Participated in negotiations to scope out consent order. *United States v.*

Nevada Power. Case settled June 2007, resulting in installation of dry low NOx burners (5 ppm NOx averaged over 1 hr) on four units and a separate solar array at a local business.

- For plaintiffs, expert witness in appeal of PSD permit issued to 850 MW coal fired boiler burning Powder River Basin coal (Iatan Unit 2) on BACT for particulate matter, sulfuric acid mist and opacity and emission calculations for alleged historic violations of PSD. Assisted in drafting technical comments, petition for review, discovery requests, and responses to discovery requests. Reviewed produced documents. Prepared expert report on BACT for particulate matter. Assisted with expert depositions. Deposed February 7, 8, 27, and 28, 2007. *In Re PSD Construction Permit Issued to Great Plains Energy, Kansas City Power & Light – Iatan Generating Station, Sierra Club v. Missouri Department of Natural Resources, Great Plains Energy, and Kansas City Power & Light*. Case settled March 27, 2007, providing offsets for over 6 million ton/yr of CO2 and lower NOx and SO_2 emission limits.
- For plaintiffs, expert witness in remedy phase of civil action relating to alleged violations of the Clean Air Act, Prevention of Significant Deterioration, for historic modifications of coal-fired boilers and associated equipment. Reviewed produced documents, prepared expert report on cost to retrofit 24 coal-fired power plants with scrubbers designed to remove 99% of the sulfur dioxide from flue gases. Prepared supplemental and expert report on cost estimates and BACT for SO2 for these 24 complaint units. Deposed 1/30/07 and 3/14/07. *United States and State of New York et al. v. American Electric Power*, In U.S. District Court for the Southern District of Ohio, Eastern Division, Consolidated Civil Action Nos. C2-99-1182 and C2-99-1250. Settlement announced 10/9/07.
- For plaintiffs, expert witness on BACT, enforceability, and alternatives analysis in appeal of PSD permit issued for a 270-MW pulverized coal fired boiler burning Powder River Basin coal (City Utilities Springfield Unit 2). Reviewed permitting file and assisted counsel draft petition and prepare and respond to interrogatories and document requests. Reviewed interrogatory responses and produced documents. Assisted with expert depositions. Deposed August 2005. Evidentiary hearings October 2005. *In the Matter of Linda Chipperfield and Sierra Club v. Missouri Department of Natural Resources*. Missouri Supreme Court denied review of adverse lower court rulings August 2007.
- For plaintiffs, expert witness in civil action relating to plume touchdowns at AEP's Gavin coal-fired power plant. Assisted counsel draft interrogatories and document requests. Reviewed responses to interrogatories and produced documents. Prepared expert report "Releases of Sulfuric Acid Mist from the Gavin Power Station." The report evaluates sulfuric acid mist releases to determine if AEP complied with the requirements of CERCLA Section 103(a) and EPCRA Section 304. This report also discusses the formation, chemistry, release characteristics, and abatement of sulfuric acid mist in support of the claim that these releases present an imminent and substantial endangerment to public

health under Section 7002(a)(1)(B) of the Resource Conservation and Recovery Act ("RCRA"). *Citizens Against Pollution v. Ohio Power Company*, In the U.S. District Court for the Southern District of Ohio, Eastern Division, Civil Action No. 2-04-cv-371. Case settled 12-8-06.

- For petitioners, expert witness in contested case hearing on BACT, enforceability, and emission estimates for an air permit issued to a 500-MW supercritical Power River Basin coal-fired boiler (Weston Unit 4). Assisted counsel prepare comments on draft air permit and respond to and draft discovery. Reviewed produced file, deposed (7/05), and prepared expert report on BACT and enforceability. Evidentiary hearings September 2005. *In the Matter of an Air Pollution Control Construction Permit Issued to Wisconsin Public Service Corporation for the Construction and Operation of a 500 MW Pulverized Coal-fired Power Plant Known as Weston Unit 4 in Marathon County, Wisconsin*, Case No. IH-04-21. The Final Order, issued 2/10/06, lowered the NOx BACT limit from 0.07 lb/MMBtu to 0.06 lb/MMBtu based on a 30-day average, added a BACT SO2 control efficiency, and required a 0.0005% high efficiency drift eliminator as BACT for the cooling tower. The modified permit, including these provisions, was issued 3/28/07. Additional appeals in progress.
- For plaintiffs, adviser on technical issues related to Citizen Suit against U.S. EPA regarding failure to update New Source Performance Standards for petroleum refineries, 40 CFR 60, Subparts J, VV, and GGG. *Our Children's Earth Foundation and Sierra Club v. U.S. EPA et al.* Case settled July 2005. CD No. C 05-00094 CW, U.S. District Court, Northern District of California – Oakland Division. Proposed revisions to standards of performance for petroleum refineries published 72 FR 27178 (5/14/07).
- For interveners, reviewed proposed Consent Decree settling Clean Air Act violations due to historic modifications of boilers and associated equipment at two coal-fired power plants. In response to stay order, reviewed the record, selected one representative activity at each of seven generating units, and analyzed to identify CAA violations. Identified NSPS and NSR violations for NOx, SO_2, PM/PM10, and sulfuric acid mist. Summarized results in an expert report. *United States of America, and Michael A. Cox, Attorney General of the State of Michigan, ex rel. Michigan Department of Environmental Quality, Plaintiffs, and Clean Wisconsin, Sierra Club, and Citizens' Utility Board, Intervenors, v. Wisconsin Electric Power Company, Defendant*, U.S. District Court for the Eastern District of Wisconsin, Civil Action No. 2:03-CV-00371-CNC. Order issued 10-1-07 denying petition.
- For a coalition of Nevada labor organizations (ACE), reviewed preliminary determination to issue a Class I Air Quality Operating Permit to Construct and supporting files for a 250-MW pulverized coal-fired boiler (Newmont). Prepared about 100 pages of technical analyses and comments on BACT, MACT, emission calculations, and enforceability. Assisted counsel draft petition and reply brief appealing PSD permit to U.S. EPA Environmental Appeals Board (EAB). Order denying review issued 12/21/05. *In re*

Newmont Nevada Energy Investment, LLC, TS Power Plant, PSD Appeal No. 05-04 (EAB 2005).

- For petitioners and plaintiffs, reviewed and prepared comments on air quality and hazardous waste based on negative declaration for refinery ultra low sulfur diesel project located in SCAQMD. Reviewed responses to comments and prepared responses. Prepared declaration and presented oral testimony before SCAQMD Hearing Board on exempt sources (cooling towers) and calculation of potential to emit under NSR. Petition for writ of mandate filed March 2005. Case remanded by Court of Appeals to trial court to direct SCAQMD to re-evaluate the potential environmental significance of NOx emissions resulting from the project in accordance with court's opinion. California Court of Appeals, Second Appellate Division, on December 18, 2007, affirmed in part (as to baseline) and denied in part. *Communities for a Better Environment v. South Coast Air Quality Management District and ConocoPhillips and Carlos Valdez et al v. South Coast Air Quality Management District and ConocoPhillips.* Certified for partial publication 1/16/08. Appellate Court opinion upheld by CA Supreme Court 3/15/10. *(2010) 48 Cal.4th 310.*
- For amici seeking to amend a proposed Consent Decree to settle alleged NSR violations at Chevron refineries, reviewed proposed settlement, related files, subject modifications, and emission calculations. Prepared declaration on emission reductions, identification of NSR and NSPS violations, and BACT/LAER for FCCUs, heaters and boilers, flares, and sulfur recovery plants. *U.S. et al. v. Chevron U.S.A.*, Northern District of California, Case No. C 03-04650. Memorandum and Order Entering Consent Decree issued June 2005. Case No. C 03-4650 CRB.
- For petitioners, prepared declaration on enforceability of periodic monitoring requirements, in response to EPA's revised interpretation of 40 CFR 70.6(c)(1). This revision limited additional monitoring required in Title V permits. 69 FR 3203 (Jan. 22, 2004). *Environmental Integrity Project et al. v. EPA* (U.S. Court of Appeals for the District of Columbia). Court ruled the Act requires all Title V permits to contain monitoring requirements to assure compliance. *Sierra Club v. EPA*, 536 F.3d 673 (D.C. Cir. 2008).
- For interveners in application for authority to construct a 500 MW supercritical coal-fired generating unit before the Wisconsin Public Service Commission, prepared pre-filed written direct and rebuttal testimony with oral cross examination and rebuttal on BACT and MACT (Weston 4). Prepared written comments on BACT, MACT, and enforceability on draft air permit for same facility.
- For property owners in Nevada, evaluated the environmental impacts of a 1,450-MW coal-fired power plant proposed in a rural area adjacent to the Black Rock Desert and Granite Range, including emission calculations, air quality modeling, comments on proposed use permit to collect preconstruction monitoring data, and coordination with agencies and other interested parties. Project cancelled.

- For environmental organizations, reviewed draft PSD permit for a 600-MW coal-fired power plant in West Virginia (Longview). Prepared comments on permit enforceability; coal washing; BACT for SO_2 and PM10; Hg MACT; and MACT for HCl, HF, non-Hg metallic HAPs, and enforceability. Assist plaintiffs draft petition appealing air permit. Retained as expert to develop testimony on MACT, BACT, offsets, enforceability. Participate in settlement discussions. Case settled July 2004.
- For petitioners, reviewed record produced in discovery and prepared affidavit on emissions of carbon monoxide and volatile organic compounds during startup of GE 7FA combustion turbines to successfully establish plaintiff standing. *Sierra Club et al. v. Georgia Power Company* (Northern District of Georgia).
- For building trades, reviewed air quality permitting action for 1500-MW coal-fired power plant before the Kentucky Department for Environmental Protection (Thoroughbred).
- For petitioners, expert witness in administrative appeal of the PSD/Title V permit issued to a 1500-MW coal-fired power plant. Reviewed over 60,000 pages of produced documents, prepared discovery index, identified and assembled plaintiff exhibits. Deposed. Assisted counsel in drafting discovery requests, with over 30 depositions, witness cross examination, and brief drafting. Presented over 20 days of direct testimony, rebuttal and sur-rebuttal, with cross examination on BACT for NOx, SO_2, and PM/PM10; MACT for Hg and non-Hg metallic HAPs; emission estimates for purposes of Class I and II air modeling; risk assessment; and enforceability of permit limits. Evidentiary hearings from November 2003 to June 2004. *Sierra Club et al. v. Natural Resources & Environmental Protection Cabinet, Division of Air Quality and Thoroughbred Generating Company et al.* Hearing Officer Decision issued August 9, 2005 finding in favor of plaintiffs on counts as to risk, BACT (IGCC/CFB, NOx, SO_2, Hg, Be), single source, enforceability, and errors and omissions. Assist counsel draft exceptions. Cabinet Secretary issued Order April 11, 2006 denying Hearing Offer's report, except as to NOx BACT, Hg, 99% SO2 control and certain errors and omissions.
- For citizens group in Massachusetts, reviewed, commented on, and participated in permitting of pollution control retrofits of coal-fired power plant (Salem Harbor).
- Assisted citizens group and labor union challenge issuance of conditional use permit for a 317,000 ft^2 discount store in Honolulu without any environmental review. In support of a motion for preliminary injunction, prepared 7-page declaration addressing public health impacts of diesel exhaust from vehicles serving the Project. In preparation for trial, prepared 20-page preliminary expert report summarizing results of diesel exhaust and noise measurements at two big box retail stores in Honolulu, estimated diesel PM10 concentrations for Project using ISCST, prepared a cancer health risk assessment based on these analyses, and evaluated noise impacts.

- Assisted environmental organizations to challenge the DOE Finding of No Significant Impact (FONSI) for the Baja California Power and Sempra Energy Resources Cross-Border Transmissions Lines in the U.S. and four associated power plants located in Mexico (DOE EA-1391). Prepared 20-page declaration in support of motion for summary judgment addressing emissions, including CO_2 and NH_3, offsets, BACT, cumulative air quality impacts, alternative cooling systems, and water use and water quality impacts. Plaintiff's motion for summary judgment granted in part. U.S. District Court, Southern District decision concluded that the Environmental Assessment and FONSI violated NEPA and the APA due to their inadequate analysis of the potential controversy surrounding the project, water impacts, impacts from NH_3 and CO_2, alternatives, and cumulative impacts. *Border Power Plant Working Group v. Department of Energy and Bureau of Land Management*, Case No. 02-CV-513-IEG (POR) (May 2, 2003).

- For Sacramento school, reviewed draft air permit issued for diesel generator located across from playfield. Prepared comments on emission estimates, enforceability, BACT, and health impacts of diesel exhaust. Case settled. BUG trap installed on the diesel generator.

- Assisted unions in appeal of Title V permit issued by BAAQMD to carbon plant that manufactured coke. Reviewed District files, identified historic modifications that should have triggered PSD review, and prepared technical comments on Title V permit. Reviewed responses to comments and assisted counsel draft appeal to BAAQMD hearing board, opening brief, motion to strike, and rebuttal brief. Case settled.

- Assisted California Central Coast city obtain controls on a proposed new city that would straddle the Ventura-Los Angeles County boundary. Reviewed several environmental impact reports, prepared an air quality analysis, a diesel exhaust health risk assessment, and detailed review comments. Governor intervened and State dedicated the land for conservation purposes April 2004.

- Assisted Central California city to obtain controls on large alluvial sand quarry and asphalt plant proposing a modernization. Prepared comments on Negative Declaration on air quality, public health, noise, and traffic. Evaluated process flow diagrams and engineering reports to determine whether proposed changes increased plant capacity or substantially modified plant operations. Prepared comments on application for categorical exemption from CEQA. Presented testimony to County Board of Supervisors. Developed controls to mitigate impacts. Assisted counsel draft Petition for Writ. Case settled June 2002. Substantial improvements in plant operations were obtained including cap on throughput, dust control measures, asphalt plant loadout enclosure, and restrictions on truck routes.

- Assisted oil companies on the California Central Coast in defending class action citizen's lawsuit alleging health effects due to emissions from gas processing plant and leaking underground storage tanks. Reviewed regulatory and other files and advised counsel on merits of case. Case settled November 2001.

- Assisted oil company on the California Central Coast in defending property damage claims arising out of a historic oil spill. Reviewed site investigation reports, pump tests, leachability studies, and health risk assessments, participated in design of additional site characterization studies to assess health impacts, and advised counsel on merits of case. Prepare health risk assessment.
- Assisted unions in appeal of Initial Study/Negative Declaration ("IS/ND") for an MTBE phaseout project at a Bay Area refinery. Reviewed IS/ND and supporting agency permitting files and prepared technical comments on air quality, groundwater, and public health impacts. Reviewed responses to comments and final IS/ND and ATC permits and assisted counsel to draft petitions and briefs appealing decision to Air District Hearing Board. Presented sworn direct and rebuttal testimony with cross examination on groundwater impacts of ethanol spills on hydrocarbon contamination at refinery. Hearing Board ruled 5 to 0 in favor of appellants, remanding ATC to district to prepare an EIR.
- Assisted Florida cities in challenging the use of diesel and proposed BACT determinations in prevention of significant deterioration (PSD) permits issued to two 510-MW simple cycle peaking electric generating facilities and one 1,080-MW simple cycle/combined cycle facility. Reviewed permit applications, draft permits, and FDEP engineering evaluations, assisted counsel in drafting petitions and responding to discovery. Participated in settlement discussions. Cases settled or applications withdrawn.
- Assisted large California city in federal lawsuit alleging peaker power plant was violating its federal permit. Reviewed permit file and applicant's engineering and cost feasibility study to reduce emissions through retrofit controls. Advised counsel on feasible and cost-effective NOx, SOx, and PM10 controls for several 1960s diesel-fired Pratt and Whitney peaker turbines. Case settled.
- Assisted coalition of Georgia environmental groups in evaluating BACT determinations and permit conditions in PSD permits issued to several large natural gas-fired simple cycle and combined-cycle power plants. Prepared technical comments on draft PSD permits on BACT, enforceability of limits, and toxic emissions. Reviewed responses to comments, advised counsel on merits of cases, participated in settlement discussions, presented oral and written testimony in adjudicatory hearings, and provided technical assistance as required. Cases settled or won at trial.
- Assisted construction unions in review of air quality permitting actions before the Indiana Department of Environmental Management ("IDEM") for several natural gas-fired simple cycle peaker and combined cycle power plants.
- Assisted coalition of towns and environmental groups in challenging air permits issued to 523 MW dual fuel (natural gas and distillate) combined-cycle power plant in Connecticut. Prepared technical comments on draft permits and 60 pages of written testimony addressing

emission estimates, startup/shutdown issues, BACT/LAER analyses, and toxic air emissions. Presented testimony in adjudicatory administrative hearings before the Connecticut Department of Environmental Protection in June 2001 and December 2001.

- Assisted various coalitions of unions, citizens groups, cities, public agencies, and developers in licensing and permitting of over 110 coal, gas, oil, biomass, and pet coke-fired power plants generating over 75,000 MW of electricity. These included base-load, combined cycle, simple cycle, and peaker power plants in Alaska, Arizona, Arkansas, California, Colorado, Georgia, Florida, Illinois, Indiana, Kentucky, Michigan, Missouri, Ohio, Oklahoma, Oregon, Texas, West Virginia, Wisconsin, and elsewhere. Prepared analyses of and comments on applications for certification, preliminary and final staff assessments, and various air, water, wastewater, and solid waste permits issued by local agencies. Presented written and oral testimony before various administrative bodies on hazards of ammonia use and transportation, health effects of air emissions, contaminated property issues, BACT/LAER issues related to SCR and SCONOx, criteria and toxic pollutant emission estimates, MACT analyses, air quality modeling, water supply and water quality issues, and methods to reduce water use, including dry cooling, parallel dry-wet cooling, hybrid cooling, and zero liquid discharge systems.
- Assisted unions, cities, and neighborhood associations in challenging an EIR issued for the proposed expansion of the Oakland Airport. Reviewed two draft EIRs and prepared a health risk assessment and extensive technical comments on air quality and public health impacts. The California Court of Appeals, First Appellate District, ruled in favor of appellants and plaintiffs, concluding that the EIR "2) erred in using outdated information in assessing the emission of toxic air contaminants (TACs) from jet aircraft; 3) failed to support its decision not to evaluate the health risks associated with the emission of TACs with meaningful analysis," thus accepting my technical arguments and requiring the Port to prepare a new EIR. See *Berkeley Keep Jets Over the Bay Committee, City of San Leandro, and City of Alameda et al. v. Board of Port Commissioners* (August 30, 2001) 111 Cal.Rptr.2d 598.
- Assisted lessor of former gas station with leaking underground storage tanks and TCE contamination from adjacent property. Lessor held option to purchase, which was forfeited based on misrepresentation by remediation contractor as to nature and extent of contamination. Remediation contractor purchased property. Reviewed regulatory agency files and advised counsel on merits of case. Case not filed.
- Advised counsel on merits of several pending actions, including a Proposition 65 case involving groundwater contamination at an explosives manufacturing firm and two former gas stations with leaking underground storage tanks.
- Assisted defendant foundry in Oakland in a lawsuit brought by neighbors alleging property contamination, nuisance, trespass, smoke, and health effects from foundry operation.

Inspected and sampled plaintiff's property. Advised counsel on merits of case. Case settled.

- Assisted business owner facing eminent domain eviction. Prepared technical comments on a negative declaration for soil contamination and public health risks from air emissions from a proposed redevelopment project in San Francisco in support of a CEQA lawsuit. Case settled.
- Assisted neighborhood association representing residents living downwind of a Berkeley asphalt plant in separate nuisance and CEQA lawsuits. Prepared technical comments on air quality, odor, and noise impacts, presented testimony at commission and council meetings, participated in community workshops, and participated in settlement discussions. Cases settled. Asphalt plant was upgraded to include air emission and noise controls, including vapor collection system at truck loading station, enclosures for noisy equipment, and improved housekeeping.
- Assisted a Fortune 500 residential home builder in claims alleging health effects from faulty installation of gas appliances. Conducted indoor air quality study, advised counsel on merits of case, and participated in discussions with plaintiffs. Case settled.
- Assisted property owners in Silicon Valley in lawsuit to recover remediation costs from insurer for large TCE plume originating from a manufacturing facility. Conducted investigations to demonstrate sudden and accidental release of TCE, including groundwater modeling, development of method to date spill, preparation of chemical inventory, investigation of historical waste disposal practices and standards, and on-site sewer and storm drainage inspections and sampling. Prepared declaration in opposition to motion for summary judgment. Case settled.
- Assisted residents in east Oakland downwind of a former battery plant in class action lawsuit alleging property contamination from lead emissions. Conducted historical research and dry deposition modeling that substantiated claim. Participated in mediation at JAMS. Case settled.
- Assisted property owners in West Oakland who purchased a former gas station that had leaking underground storage tanks and groundwater contamination. Reviewed agency files and advised counsel on merits of case. Prepared declaration in opposition to summary judgment. Prepared cost estimate to remediate site. Participated in settlement discussions. Case settled.
- Consultant to counsel representing plaintiffs in two Clean Water Act lawsuits involving selenium discharges into San Francisco Bay from refineries. Reviewed files and advised counsel on merits of case. Prepared interrogatory and discovery questions, assisted in deposing opposing experts, and reviewed and interpreted treatability and other technical studies. Judge ruled in favor of plaintiffs.

- Assisted oil company in a complaint filed by a resident of a small California beach community alleging that discharges of tank farm rinse water into the sanitary sewer system caused hydrogen sulfide gas to infiltrate residence, sending occupants to hospital. Inspected accident site, interviewed parties to the event, and reviewed extensive agency files related to incident. Used chemical analysis, field simulations, mass balance calculations, sewer hydraulic simulations with SWMM44, atmospheric dispersion modeling with SCREEN3, odor analyses, and risk assessment calculations to demonstrate that the incident was caused by a faulty drain trap and inadequate slope of sewer lateral on resident's property. Prepared a detailed technical report summarizing these studies. Case settled.
- Assisted large West Coast city in suit alleging that leaking underground storage tanks on city property had damaged the waterproofing on downgradient building, causing leaks in an underground parking structure. Reviewed subsurface hydrogeologic investigations and evaluated studies conducted by others documenting leakage from underground diesel and gasoline tanks. Inspected, tested, and evaluated waterproofing on subsurface parking structure. Waterproofing was substandard. Case settled.
- Assisted residents downwind of gravel mine and asphalt plant in Siskiyou County, California, in suit to obtain CEQA review of air permitting action. Prepared two declarations analyzing air quality and public health impacts. Judge ruled in favor of plaintiffs, closing mine and asphalt plant.
- Assisted defendant oil company on the California Central Coast in class action lawsuit alleging property damage and health effects from subsurface petroleum contamination. Reviewed documents, prepared risk calculations, and advised counsel on merits of case. Participated in settlement discussions. Case settled.
- Assisted defendant oil company in class action lawsuit alleging health impacts from remediation of petroleum contaminated site on California Central Coast. Reviewed documents, designed and conducted monitoring program, and participated in settlement discussions. Case settled.
- Consultant to attorneys representing irrigation districts and municipal water districts to evaluate a potential challenge of USFWS actions under CVPIA section 3406(b)(2). Reviewed agency files and collected and analyzed hydrology, water quality, and fishery data. Advised counsel on merits of case. Case not filed.
- Assisted residents downwind of a Carson refinery in class action lawsuit involving soil and groundwater contamination, nuisance, property damage, and health effects from air emissions. Reviewed files and provided advice on contaminated soil and groundwater, toxic emissions, and health risks. Prepared declaration on refinery fugitive emissions. Prepared

deposition questions and reviewed deposition transcripts on air quality, soil contamination, odors, and health impacts. Case settled.

- Assisted residents downwind of a Contra Costa refinery who were affected by an accidental release of naphtha. Characterized spilled naphtha, estimated emissions, and modeled ambient concentrations of hydrocarbons and sulfur compounds. Deposed. Presented testimony in binding arbitration at JAMS. Judge found in favor of plaintiffs.
- Assisted residents downwind of Contra Costa County refinery in class action lawsuit alleging property damage, nuisance, and health effects from several large accidents as well as routine operations. Reviewed files and prepared analyses of environmental impacts. Prepared declarations, deposed, and presented testimony before jury in one trial and judge in second. Case settled.
- Assisted business owner claiming damages from dust, noise, and vibration during a sewer construction project in San Francisco. Reviewed agency files and PM10 monitoring data and advised counsel on merits of case. Case settled.
- Assisted residents downwind of Contra Costa County refinery in class action lawsuit alleging property damage, nuisance, and health effects. Prepared declaration in opposition to summary judgment, deposed, and presented expert testimony on accidental releases, odor, and nuisance before jury. Case thrown out by judge, but reversed on appeal and not retried.
- Presented testimony in small claims court on behalf of residents claiming health effects from hydrogen sulfide from flaring emissions triggered by a power outage at a Contra Costa County refinery. Analyzed meteorological and air quality data and evaluated potential health risks of exposure to low concentrations of hydrogen sulfide. Judge awarded damages to plaintiffs.
- Assisted construction unions in challenging PSD permit for an Indiana steel mill. Prepared technical comments on draft PSD permit, drafted 70-page appeal of agency permit action to the Environmental Appeals Board challenging permit based on faulty BACT analysis for electric arc furnace and reheat furnace and faulty permit conditions, among others, and drafted briefs responding to four parties. EPA Region V and the EPA General Counsel intervened as amici, supporting petitioners. EAB ruled in favor of petitioners, remanding permit to IDEM on three key issues, including BACT for the reheat furnace and lead emissions from the EAF. Drafted motion to reconsider three issues. Prepared 69 pages of technical comments on revised draft PSD permit. Drafted second EAB appeal addressing lead emissions from the EAF and BACT for reheat furnace based on European experience with SCR/SNCR. Case settled. Permit was substantially improved. See *In re: Steel Dynamics, Inc.*, PSD Appeal Nos. 99-4 & 99-5 (EAB June 22, 2000).

- Assisted defendant urea manufacturer in Alaska in negotiations with USEPA to seek relief from penalties for alleged violations of the Clean Air Act. Reviewed and evaluated regulatory files and monitoring data, prepared technical analysis demonstrating that permit limits were not violated, and participated in negotiations with EPA to dismiss action. Fines were substantially reduced and case closed.
- Assisted construction unions in challenging PSD permitting action for an Indiana grain mill. Prepared technical comments on draft PSD permit and assisted counsel draft appeal of agency permit action to the Environmental Appeals Board challenging permit based on faulty BACT analyses for heaters and boilers and faulty permit conditions, among others. Case settled.
- As part of a consent decree settling a CEQA lawsuit, assisted neighbors of a large west coast port in negotiations with port authority to secure mitigation for air quality impacts. Prepared technical comments on mobile source air quality impacts and mitigation and negotiated a $9 million CEQA mitigation package. Represented neighbors on technical advisory committee established by port to implement the air quality mitigation program. Program successfully implemented.
- Assisted construction unions in challenging permitting action for a California hazardous waste incinerator. Prepared technical comments on draft permit, assisted counsel prepare appeal of EPA permit to the Environmental Appeals Board. Participated in settlement discussions on technical issues with applicant and EPA Region 9. Case settled.
- Assisted environmental group in challenging DTSC Negative Declaration on a hazardous waste treatment facility. Prepared technical comments on risk of upset, water, and health risks. Writ of mandamus issued.
- Assisted several neighborhood associations and cities impacted by quarries, asphalt plants, and cement plants in Alameda, Shasta, Sonoma, and Mendocino counties in obtaining mitigations for dust, air quality, public health, traffic, and noise impacts from facility operations and proposed expansions.
- For over 100 industrial facilities, commercial/campus, and redevelopment projects, developed the record in preparation for CEQA and NEPA lawsuits. Prepared technical comments on hazardous materials, solid wastes, public utilities, noise, worker safety, air quality, public health, water resources, water quality, traffic, and risk of upset sections of EIRs, EISs, FONSIs, initial studies, and negative declarations. Assisted counsel in drafting petitions and briefs and prepared declarations.
- For several large commercial development projects and airports, assisted applicant and counsel prepare defensible CEQA documents, respond to comments, and identify and evaluate "all feasible" mitigation to avoid CEQA challenges. This work included developing mitigation programs to reduce traffic-related air quality impacts based on

energy conservation programs, solar, low-emission vehicles, alternative fuels, exhaust treatments, and transportation management associations.

SITE INVESTIGATION/REMEDIATION/CLOSURE

- Technical manager and principal engineer for characterization, remediation, and closure of waste management units at former Colorado oil shale plant. Constituents of concern included BTEX, As, 1,1,1-TCA, and TPH. Completed groundwater monitoring programs, site assessments, work plans, and closure plans for seven process water holding ponds, a refinery sewer system, and processed shale disposal area. Managed design and construction of groundwater treatment system and removal actions and obtained clean closure.
- Principal engineer for characterization, remediation, and closure of process water ponds at a former lanthanide processing plant in Colorado. Designed and implemented groundwater monitoring program and site assessments and prepared closure plan.
- Advised the city of Sacramento on redevelopment of two former railyards. Reviewed work plans, site investigations, risk assessment, RAPS, RI/FSs, and CEQA documents. Participated in the development of mitigation strategies to protect construction and utility workers and the public during remediation, redevelopment, and use of the site, including buffer zones, subslab venting, rail berm containment structure, and an environmental oversight plan.
- Provided technical support for the investigation of a former sanitary landfill that was redeveloped as single family homes. Reviewed and/or prepared portions of numerous documents, including health risk assessments, preliminary endangerment assessments, site investigation reports, work plans, and RI/FSs. Historical research to identify historic waste disposal practices to prepare a preliminary endangerment assessment. Acquired, reviewed, and analyzed the files of 18 federal, state, and local agencies, three sets of construction field notes, analyzed 21 aerial photographs and interviewed 14 individuals associated with operation of former landfill. Assisted counsel in defending lawsuit brought by residents alleging health impacts and diminution of property value due to residual contamination. Prepared summary reports.
- Technical oversight of characterization and remediation of a nitrate plume at an explosives manufacturing facility in Lincoln, CA. Provided interface between owners and consultants. Reviewed site assessments, work plans, closure plans, and RI/FSs.
- Consultant to owner of large western molybdenum mine proposed for NPL listing. Participated in negotiations to scope out consent order and develop scope of work. Participated in studies to determine premining groundwater background to evaluate

applicability of water quality standards. Served on technical committees to develop alternatives to mitigate impacts and close the facility, including resloping and grading, various thickness and types of covers, and reclamation. This work included developing and evaluating methods to control surface runoff and erosion, mitigate impacts of acid rock drainage on surface and ground waters, and stabilize nine waste rock piles containing 328 million tons of pyrite-rich, mixed volcanic waste rock (andesites, rhyolite, tuff) Evaluated stability of waste rock piles. Represented client in hearings and meetings with state and federal oversight agencies.

REGULATORY (PARTIAL LIST)

- In April 2018, prepared 26 pages of comments on greenhouse gas emissions and mitigation as proposed in the San Diego County Climate Action Plan.
- In March/April 2018, prepared 37 pages of comments on the IS/MND for the 2305 Mission College Boulevard Data Center, Santa Clara, California.
- In March 2018, prepared 40 pages of comments on the IS/MND for the Diablo Energy Storage Facility in Pittsburg, California.
- In March 2018, prepared 19 pages of comments on Infill Checklist/Mitigated Negative Declaration for the Legacy@Livermore Project on CalEEMod emission calculations, including NOx and PM10 and construction health risk assessment.
- In January 2018, prepared 28 pages of comments on draft Permit to Construct for the Davis Refinery Project, North Dakota, as a minor source of criteria pollutants and HAPs.
- In December 2017, prepared 19 pages of comments on DEIR for the Rialto Bioenergy Facility, Rialto, California.
- In November and December 2017, prepared 6 pages of comments on the Ventura County Air Pollution Control District's Preliminary Determination if Compliance (PDOC) for Mission Rock Energy Center.
- In November 2017, prepared 11 pages of comments on control technology evaluation for the National Emission Standards for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry Residual Risk and Technology Review.
- In September and November 2017, prepared comments on revised Negative Declaration for Delicato Winery in San Joaquin County, California.
- In October and November 2017, prepared comments on North City Project Pure Water San Diego Program DEIR/DEIS to reclaim wastewater for municipal use.

- In August 2017, reviewed DEIR on a new residential community in eastern San Diego County and research and wrote 60 pages of comments on air quality, greenhouse gas emissions, and health impacts.
- In August 2017, reviewed responses to comments on Part 70 operating permit for IGP Methanol's Gulf Coast Methanol Complex, near Myrtle Grove, Louisiana, and researched and wrote comments on metallic HAP issues.
- In July 2017, reviewed the FEIS for an expansion of the Port of Gulfport and researched and wrote 10 pages of comments on air quality and public health.
- In June 2017, reviewed and prepared technical report on an Application for a synthetic minor source construction permit for a new Refinery in North Dakota.
- In June 2017, reviewed responses to NPCA and other comments on the BP Cherry Point Refinery modifications and assisted counsel in evaluating issues to appeal, including GHG BACT, coker heater SCR cost effectiveness analysis, and SO_2 BACT.
- In June 2017, reviewed Part 70 Operating Permit Renewal/Modification for the Noranda Alumina LC/Gramercy Holdings I, LLC alumina processing plant, St. James, Louisiana, and prepared comments on HAP emissions from bauxite feedstock.
- In May and June 2017, reviewed FEIR on Tesoro Integration Project and prepared responses to comments on the DEIR.
- In May 2017, prepared comments on tank VOC and HAP emissions from Tesoro Integration Project, based on real time monitoring at the Tesoro and other refineries in the SCAQMD.
- In April 2017, prepared comments on Negative Declaration for Delicato Winery in San Joaquin County, California.
- In March 2017, reviewed Negative Declaration for Ellmore geothermal facility in Imperial County, California and prepared summary of issues.
- In March 2017, prepared response to Phillips 66 Company's Appeal of the San Luis Obispo County Planning Commission's Decision Denying the Rail Spur Extension Project Proposed for the Santa Maria Refinery.
- In February 2017, prepared comments on Kalama draft Title V permit for 10,000 MT/day methanol production and marine export facility in Kalama, Washington.
- In January 2017, researched and wrote 51 pages of comments on proposed Title V and PSD permits for the St. James Methanol Plant, St. James Louisiana, on BACT and enforceability of permit conditions.

- In December 2016, prepared comments on draft Title V Permit for Yuhuang Chemical Inc. Methanol Plant, St. James, Louisiana, responding to EPA Order addressing enforceability issues.
- In November 2016, prepared comments on Initial Study/Mitigated Negative Declaration for the AES Battery Energy Storage Facility, Long Beach, CA.
- In November 2016, prepared comments on Campo Verde Battery Energy Storage System Draft Environmental Impact Report.
- In October 2016, prepared comments on Title V Permit for NuStar Terminal Operations Partnership L.P, Stockton, CA.
- In October 2016, prepared expert report, Technical Assessment of Achieving the 40 CFR Part 423 Zero Discharge Standard for Bottom Ash Transport Water at the Belle River Power Plant, East China, Michigan. Reported resulted in a 2 year reduction in compliance date for elimination of bottom ash transport water. 1/30/17 DEQ Letter.
- In September 2016, prepared comments on Proposed Title V Permit and Environmental Assessment Statement, Yuhuang Chemical Inc. Methanol Plant, St. James, Louisiana.
- In September 2016, prepared response to "Further Rebuttal in Support of Appeal of Planning Commission Resolution No. 16-1, Denying Use Permit Application 12PLN-00063 and Declining to Certify Final Environmental Impact Report for the Valero Benicia Crude-by-Rail Project.
- In August 2016, reviewed and prepared comments on manuscript: Hutton et al., Freshwater Flows to the San Francisco Bay-Delta Estuary over Nine Decades: Trends Evaluation.
- In August/September 2016, prepared comments on Mitigated Negative Declaration for the Chevron Long Wharf Maintenance and Efficiency Project.
- In July 2016, prepared comments on the Ventura County APCD Preliminary Determination of Compliance and the California Energy Commission Revised Preliminary Staff Assessment for the Puente Power Project.
- In June 2016, prepared comments on an Ordinance (1) Amending the Oakland Municipal Code to Prohibit the Storage and Handling of Coal and Coke at Bulk Material Facilities or Terminals Throughout the City of Oakland and (2) Adopting CEQA Exemption Findings and supporting technical reports. Council approved Ordinance on an 8 to 0 vote on June 27, 2016.
- In May 2016, prepared comments on Draft Title V Permit and Draft Environmental Impact Report for the Tesoro Los Angeles Refinery Integration and Compliance Project.

- In March 2016, prepared comments on Valero's Appeal of Planning Commission's Denial of Valero Crude-by-Rail Project.
- In February 2016, prepared comments on Final Environmental Impact Report, Santa Maria Rail Spur Project.
- In February 2016, prepared comments on Final Environmental Impact Report, Valero Benicia Crude by Rail Project.
- In January 2016, prepared comments on Draft Programmatic Environmental Impact Report for the Southern California Association of Government's (SCAG) 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy.
- In November 2015, prepared comments on Final Environmental Impact Report for Revisions to the Kern County Zoning Ordinance – 2015(C) (Focused on Oil and Gas Local Permitting), November 2015.
- In October 2015, prepared comments on Revised Draft Environmental Report, Valero Benicia Crude by Rail Project.
- In September 2015, prepared report, "Environmental, Health and Safety Impacts of the Proposed Oakland Bulk and Oversized Terminal, and presented oral testimony on September 21, 2015 before Oakland City Council on behalf of the Sierra Club.
- In September 2015, prepared comments on revisions to two chapters of EPA's Air Pollution Control Cost Manual: Docket ID No. EPA-HQ-OAR-2015-0341.
- In June 2015, prepared comments on DEIR for the CalAm Monterey Peninsula Water Supply Project.
- In April 2015, prepared comments on proposed Title V Operating Permit Revision and Prevention of Significant Deterioration Permit for Arizona Public Service's Ocotillo Power Plant Modernization Project (5 GE LMS100 105-MW simple cycle turbines operated as peakers), in Tempe, Arizona; Final permit appealed to EAB.
- In March 2015, prepared "Comments on Proposed Title V Air Permit, Yuhuang Chemical Inc. Methanol Plant, St. James, Louisiana". Client filed petition objecting to the permit. EPA granted majority of issues. In the Matter of Yuhuang Chemical Inc. Methanol Plant, St. James Parish, Louisiana, Permit No. 2560-00295-V0, Issued by the Louisiana Department of Environmental Quality, Petition No. VI-2015-03, Order Responding to the Petitioners' Request for Objection to the Issuance of a Title V Operating Permit, September 1, 2016.
- In February 2015, prepared compilation of BACT cost effectiveness values in support of comments on draft PSD Permit for Bonanza Power Project.

- In January 2015, prepared cost effectiveness analysis for SCR for a 500-MW coal fire power plant, to address unpermitted upgrades in 2000.
- In January 2015, prepared comments on Revised Final Environmental Impact Report for the Phillips 66 Propane Recovery Project. *Communities for a Better Environment et al. v. Contra Costa County et al. Contra Costa County (Superior Court, Contra Costa County, Case No. MSN15-0301, December 1, 2016).*
- In December 2014, prepared "Report on Bakersfield Crude Terminal Permits to Operate." In response, the U.S. EPA cited the Terminal for 10 violations of the Clean Air Act. The Fifth Appellate District Court upheld the finding in this report in CBE et al v. San Joaquin Valley Unified Air Pollution Control District and Bakersfield Crude Terminal LLC et al, Super. Ct. No. 284013, June 23, 2017.
- In December 2014, prepared comments on Revised Draft Environmental Impact Report for the Phillips 66 Propane Recovery Project.
- In November 2014, prepared comments on Revised Draft Environmental Impact Report for Phillips 66 Rail Spur Extension Project and Crude Unloading Project, Santa Maria, CA to allow the import of tar sands crudes.
- In November 2014, prepared comments on Draft Environmental Impact Report for Phillips 66 Ultra Low Sulfur Diesel Project, responding to the California Supreme Court Decision, *Communities for a Better Environment v. South Coast Air Quality Management Dist. (2010) 48 Cal.4th 310.*
- In November 2014, prepared comments on Draft Environmental Impact Report for the Tesoro Avon Marine Oil Terminal Lease Consideration.
- In October 2014, prepared: "Report on Hydrogen Cyanide Emissions from Fluid Catalytic Cracking Units", pursuant to the Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards, 79 FR 36880.
- In October 2014, prepared technical comments on Final Environmental Impact Reports for Alon Bakersfield Crude Flexibility Project to build a rail terminal to allow the import/export of tar sands and Bakken crude oils and to upgrade an existing refinery to allow it to process a wide range of crudes.
- In October 2014, prepared technical comments on the Title V Permit Renewal and three De Minimus Significant Revisions for the Tesoro Logistics Marine Terminal in the SCAQMD.
- In September 2014, prepared technical comments on the Draft Environmental Impact Report for the Valero Crude by Rail Project.

- In August 2014, for EPA Region 6, prepared technical report on costing methods for upgrades to existing scrubbers at coal-fired power plants.
- In July 2014, prepared technical comments on Draft Final Environmental Impact Reports for Alon Bakersfield Crude Flexibility Project to build a rail terminal to allow the import/export of tar sands and Bakken crude oils and to upgrade an existing refinery to allow it to process a wide range of crudes.
- In June 2014, prepared technical report on Initial Study and Draft Negative Declaration for the Tesoro Logistics Storage Tank Replacement and Modification Project.
- In May 2014, prepared technical comments on Intent to Approve a new refinery and petroleum transloading operation in Utah.
- In March and April 2014, prepared declarations on air permits issued for two crude-by-rail terminals in California, modified to switch from importing ethanol to importing Bakken crude oils by rail and transferring to tanker cars. Permits were issued without undergoing CEQA review. One permit was upheld by the San Francisco Superior Court as statute of limitations had run. The Sacramento Air Quality Management District withdrew the second one due to failure to require BACT and conduct CEQA review.
- In March 2014, prepared technical report on Negative Declaration for a proposed modification of the air permit for a bulk petroleum and storage terminal to the allow the import of tar sands and Bakken crude oil by rail and its export by barge, under the New York State Environmental Quality Review Act (SEQRA).
- In February 2014, prepared technical report on proposed modification of air permit for midwest refinery upgrade/expansion to process tar sands crudes.
- In January 2014, prepared cost estimates to capture, transport, and use $CO2$ in enhanced oil recovery, from the Freeport LNG project based on both Selexol and Amine systems.
- In January 2014, prepared technical report on Draft Environmental Impact Report for Phillips 66 Rail Spur Extension Project, Santa Maria, CA. Comments addressed project description (piecemealing, crude slate), risk of upset analyses, mitigation measures, alternative analyses and cumulative impacts.
- In November 2013, prepared technical report on the Phillips 66 Propane Recovery Project, Rodeo, CA. Comments addressed project description (piecemealing, crude slate) and air quality impacts.
- In September 2013, prepared technical report on the Draft Authority to Construct Permit for the Casa Diablo IV Geothermal Development Project Environmental Impact Report and Declaration in Support of Appeal and Petition for Stay, U.S. Department of the Interior, Board of Land Appeals, Appeal of Decision Record for the Casa Diablo IV Geothermal Development Project.

- In September 2013, prepared technical report on Effluent Limitation Guidelines for Best Available Technology Economically Available (BAT) for Bottom Ash Transport Waters from Coal-Fired Power Plants in the Steam Electric Power Generating Point Source Category.
- In July 2013, prepared technical report on Initial Study/Mitigated Negative Declaration for the Valero Crude by Rail Project, Benicia, California, Use Permit Application 12PLN-00063.
- In July 2013, prepared technical report on fugitive particulate matter emissions from coal train staging at the proposed Coyote Island Terminal, Oregon, for draft Permit No. 25-0015-ST-01.
- In July 2013, prepared technical comments on air quality impacts of the Finger Lakes LPG Storage Facility as reported in various Environmental Impact Statements.
- In July 2013, prepared technical comments on proposed Greenhouse Gas PSD Permit for the Celanese Clear Lake Plant, including cost analysis of CO2 capture, transport, and sequestration.
- In June/July 2013, prepared technical comments on proposed Draft PSD Preconstruction Permit for Greenhouse Gas Emission for the ExxonMobil Chemical Company Baytown Olefins Plant, including cost analysis of CO2 capture, transport, and sequestration.
- In June 2013, prepared technical report on a Mitigated Negative Declaration for a new rail terminal at the Valero Benicia Refinery to import increased amounts of "North American" crudes. Comments addressed air quality impacts of refining increased amounts of tar sands crudes.
- In June 2013, prepared technical report on Draft Environmental Impact Report for the California Ethanol and Power Imperial Valley 1 Project.
- In May 2013, prepared comments on draft PSD permit for major expansion of midwest refinery to process 100% tar sands crudes, including a complex netting analysis involving debottlenecking, piecemealing, and BACT analyses.
- In April 2013, prepared technical report on the Draft Supplemental Environmental Impact Statement (DSEIS) for the Keystone XL Pipeline on air quality impacts from refining increased amount of tar sands crudes at Refineries in PADD 3.
- In October 2012, prepared technical report on the Environmental Review for the Coyote Island Terminal Dock at the Port of Morrow on fugitive particulate matter emissions.
- In October 2012-October 2014, review and evaluate Flint Hills West Application for an expansion/modification for increased (Texas, Eagle Ford Shale) crude processing and

related modification, including netting and BACT analysis. Assist in settlement discussions.

- In February 2012, prepared comments on BART analysis in PA Regional Haze SIP, 77 FR 3984 (Jan. 26, 2012). On Sept. 29, 2015, a federal appeals court overturned the U.S. EPA's approval of this plan, based in part on my comments, concluding "..we will vacate the 2014 Final Rule to the extent it approved Pennsylvania's source-specific BART analysis and remand to the EPA for further proceedings consistent with this Opinion." Nat'l Parks Conservation Assoc. v. EPA, 3d Cir., No. 14-3147, 9/19/15.
- Prepared cost analyses and comments on New York's proposed BART determinations for NOx, SO2, and PM and EPA's proposed approval of BART determinations for Danskammer Generating Station under New York Regional Haze State Implementation Plan and Federal Implementation Plan, 77 FR 51915 (August 28, 2012).
- Prepared cost analyses and comments on NOx BART determinations for Regional Haze State Implementation Plan for State of Nevada, 77 FR 23191 (April 18, 2012) and 77 FR 25660 (May 1, 2012).
- Prepared analyses of and comments on New Source Performance Standards for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units, 77 FR 22392 (April 13, 2012).
- Prepared comments on CASPR-BART emission equivalency and NOx and PM BART determinations in EPA proposed approval of State Implementation Plan for Pennsylvania Regional Haze Implementation Plan, 77 FR 3984 (January 26, 2012).
- Prepared comments and statistical analyses on hazardous air pollutants (HAPs) emission controls, monitoring, compliance methods, and the use of surrogates for acid gases, organic HAPs, and metallic HAPs for proposed National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units, 76 FR 24976 (May 3, 2011).
- Prepared cost analyses and comments on NOx BART determinations and emission reductions for proposed Federal Implementation Plan for Four Corners Power Plant, 75 FR 64221 (October 19, 2010).
- Prepared cost analyses and comments on NOx BART determinations for Colstrip Units 1- 4 for Montana State Implementation Plan and Regional Haze Federal Implementation Plan, 77 FR 23988 (April 20, 2010).
- For EPA Region 8, prepared report: Revised BART Cost Effectiveness Analysis for Tail-End Selective Catalytic Reduction at the Basin Electric Power Cooperative Leland Olds Station Unit 2 Final Report, March 2011, in support of 76 FR 58570 (Sept. 21, 2011).

- For EPA Region 6, prepared report: Revised BART Cost-Effectiveness Analysis for Selective Catalytic Reduction at the Public Service Company of New Mexico San Juan Generating Station, November 2010, in support of 76 FR 52388 (Aug. 22, 2011).
- For EPA Region 6, prepared report: Revised BART Cost-Effectiveness Analysis for Flue Gas Desulfurization at Coal-Fired Electric Generating Units in Oklahoma: Sooner Units 1 & 2, Muskogee Units 4 & 5, Northeastern Units 3 &4, October 2010, in support of 76 FR 16168 (March 26, 2011). My work was upheld in: *State of Oklahoma v. EPA*, App. Case 12-9526 (10th Cri. July 19, 2013).
- Identified errors in N_2O emission factors in the Mandatory Greenhouse Gas Reporting Rule, 40 CFR 98, and prepared technical analysis to support Petition for Rulemaking to Correct Emissions Factors in the Mandatory Greenhouse Gas Reporting Rule, filed with EPA on 10/28/10.
- Assisted interested parties develop input for and prepare comments on the Information Collection Request for Petroleum Refinery Sector NSPS and NESHAP Residual Risk and Technology Review, 75 FR 60107 (9/29/10).
- Technical reviewer of EPA's "Emission Estimation Protocol for Petroleum Refineries," posted for public comments on CHIEF on 12/23/09, prepared in response to the City of Houston's petition under the Data Quality Act (March 2010).
- Prepared comments on SCR cost effectiveness for EPA's Advanced Notice of Proposed Rulemaking, Assessment of Anticipated Visibility Improvements at Surrounding Class I Areas and Cost Effectiveness of Best Available Retrofit Technology for Four Corners Power Plant and Navajo Generating Station, 74 FR 44313 (August 28, 2009).
- Prepared comments on Proposed Rule for Standards of Performance for Coal Preparation and Processing Plants, 74 FR 25304 (May 27, 2009).
- Prepared comments on draft PSD permit for major expansion of midwest refinery to process up to 100% tar sands crudes. Participated in development of monitoring and controls to mitigate impacts and in negotiating a Consent Decree to settle claims in 2008.
- Reviewed and assisted interested parties prepare comments on proposed Kentucky air toxic regulations at 401 KAR 64:005, 64:010, 64:020, and 64:030 (June 2007).
- Prepared comments on proposed Standards of Performance for Electric Utility Steam Generating Units and Small Industrial-Commercial-Industrial Steam Generating Units, 70 FR 9706 (February 28, 2005).
- Prepared comments on Louisville Air Pollution Control District proposed Strategic Toxic Air Reduction regulations.

- Prepared comments and analysis of BAAQMD Regulation, Rule 11, Flare Monitoring at Petroleum Refineries.
- Prepared comments on Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electricity Utility Steam Generating Units (MACT standards for coal-fired power plants).
- Prepared Authority to Construct Permit for remediation of a large petroleum-contaminated site on the California Central Coast. Negotiated conditions with agencies and secured permits.
- Prepared Authority to Construct Permit for remediation of a former oil field on the California Central Coast. Participated in negotiations with agencies and secured permits.
- Prepared and/or reviewed hundreds of environmental permits, including NPDES, UIC, Stormwater, Authority to Construct, Prevention of Significant Deterioration, Nonattainment New Source Review, Title V, and RCRA, among others.
- Participated in the development of the CARB document, *Guidance for Power Plant Siting and Best Available Control Technology*, including attending public workshops and filing technical comments.
- Performed data analyses in support of adoption of emergency power restoration standards by the California Public Utilities Commission for "major" power outages, where major is an outage that simultaneously affects 10% of the customer base.
- Drafted portions of the Good Neighbor Ordinance to grant Contra Costa County greater authority over safety of local industry, particularly chemical plants and refineries.
- Participated in drafting BAAQMD Regulation 8, Rule 28, Pressure Relief Devices, including participation in public workshops, review of staff reports, draft rules and other technical materials, preparation of technical comments on staff proposals, research on availability and costs of methods to control PRV releases, and negotiations with staff.
- Participated in amending BAAQMD Regulation 8, Rule 18, Valves and Connectors, including participation in public workshops, review of staff reports, proposed rules and other supporting technical material, preparation of technical comments on staff proposals, research on availability and cost of low-leak technology, and negotiations with staff.
- Participated in amending BAAQMD Regulation 8, Rule 25, Pumps and Compressors, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of low-leak and seal-less technology, and negotiations with staff.

- Participated in amending BAAQMD Regulation 8, Rule 5, Storage of Organic Liquids, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of controlling tank emissions, and presentation of testimony before the Board.
- Participated in amending BAAQMD Regulation 8, Rule 18, Valves and Connectors at Petroleum Refinery Complexes, including participation in public workshops, review of staff reports, proposed rules and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of low-leak technology, and presentation of testimony before the Board.
- Participated in amending BAAQMD Regulation 8, Rule 22, Valves and Flanges at Chemical Plants, etc, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability and costs of low-leak technology, and presentation of testimony before the Board.
- Participated in amending BAAQMD Regulation 8, Rule 25, Pump and Compressor Seals, including participation in public workshops, review of staff reports, proposed rules, and other supporting technical material, preparation of technical comments on staff proposals, research on availability of low-leak technology, and presentation of testimony before the Board.
- Participated in the development of the BAAQMD Regulation 2, Rule 5, Toxics, including participation in public workshops, review of staff proposals, and preparation of technical comments.
- Participated in the development of SCAQMD Rule 1402, Control of Toxic Air Contaminants from Existing Sources, and proposed amendments to Rule 1401, New Source Review of Toxic Air Contaminants, in 1993, including review of staff proposals and preparation of technical comments on same.
- Participated in the development of the Sunnyvale Ordinance to Regulate the Storage, Use and Handling of Toxic Gas, which was designed to provide engineering controls for gases that are not otherwise regulated by the Uniform Fire Code.
- Participated in the drafting of the Statewide Water Quality Control Plans for Inland Surface Waters and Enclosed Bays and Estuaries, including participation in workshops, review of draft plans, preparation of technical comments on draft plans, and presentation of testimony before the SWRCB.
- Participated in developing Se permit effluent limitations for the five Bay Area refineries, including review of staff proposals, statistical analyses of Se effluent data, review of

literature on aquatic toxicity of Se, preparation of technical comments on several staff proposals, and presentation of testimony before the Bay Area RWQCB.

- Represented the California Department of Water Resources in the 1991 Bay-Delta Hearings before the State Water Resources Control Board, presenting sworn expert testimony with cross examination and rebuttal on a striped bass model developed by the California Department of Fish and Game.
- Represented the State Water Contractors in the 1987 Bay-Delta Hearings before the State Water Resources Control Board, presenting sworn expert testimony with cross examination and rebuttal on natural flows, historical salinity trends in San Francisco Bay, Delta outflow, and hydrodynamics of the South Bay.
- Represented interveners in the licensing of over 20 natural-gas-fired power plants and one coal gasification plant at the California Energy Commission and elsewhere. Reviewed and prepared technical comments on applications for certification, preliminary staff assessments, final staff assessments, preliminary determinations of compliance, final determinations of compliance, and prevention of significant deterioration permits in the areas of air quality, water supply, water quality, biology, public health, worker safety, transportation, site contamination, cooling systems, and hazardous materials. Presented written and oral testimony in evidentiary hearings with cross examination and rebuttal. Participated in technical workshops.
- Represented several parties in the proposed merger of San Diego Gas & Electric and Southern California Edison. Prepared independent technical analyses on health risks, air quality, and water quality. Presented written and oral testimony before the Public Utilities Commission administrative law judge with cross examination and rebuttal.
- Represented a PRP in negotiations with local health and other agencies to establish impact of subsurface contamination on overlying residential properties. Reviewed health studies prepared by agency consultants and worked with agencies and their consultants to evaluate health risks.

WATER QUALITY/RESOURCES

- Directed and participated in research on environmental impacts of energy development in the Colorado River Basin, including contamination of surface and subsurface waters and modeling of flow and chemical transport through fractured aquifers.
- Played a major role in Northern California water resource planning studies since the early 1970s. Prepared portions of the Basin Plans for the Sacramento, San Joaquin, and Delta basins including sections on water supply, water quality, beneficial uses, waste load allocation, and agricultural drainage. Developed water quality models for the Sacramento and San Joaquin Rivers.

- Conducted hundreds of studies over the past 40 years on Delta water supplies and the impacts of exports from the Delta on water quality and biological resources of the Central Valley, Sacramento-San Joaquin Delta, and San Francisco Bay. Typical examples include:

    1. Evaluate historical trends in salinity, temperature, and flow in San Francisco Bay and upstream rivers to determine impacts of water exports on the estuary;
    2. Evaluate the role of exports and natural factors on the food web by exploring the relationship between salinity and primary productivity in San Francisco Bay, upstream rivers, and ocean;
    3. Evaluate the effects of exports, other in-Delta, and upstream factors on the abundance of salmon and striped bass;
    4. Review and critique agency fishery models that link water exports with the abundance of striped bass and salmon;
    5. Develop a model based on GLMs to estimate the relative impact of exports, water facility operating variables, tidal phase, salinity, temperature, and other variables on the survival of salmon smolts as they migrate through the Delta;
    6. Reconstruct the natural hydrology of the Central Valley using water balances, vegetation mapping, reservoir operation models to simulate flood basins, precipitation records, tree ring research, and historical research;
    7. Evaluate the relationship between biological indicators of estuary health and down-estuary position of a salinity surrogate (X2);
    8. Use real-time fisheries monitoring data to quantify impact of exports on fish migration;
    9. Refine/develop statistical theory of autocorrelation and use to assess strength of relationships between biological and flow variables;
    10. Collect, compile, and analyze water quality and toxicity data for surface waters in the Central Valley to assess the role of water quality in fishery declines;
    11. Assess mitigation measures, including habitat restoration and changes in water project operation, to minimize fishery impacts;
    12. Evaluate the impact of unscreened agricultural water diversions on abundance of larval fish;
    13. Prepare and present testimony on the impacts of water resources development on Bay hydrodynamics, salinity, and temperature in water rights hearings;
    14. Evaluate the impact of boat wakes on shallow water habitat, including interpretation of historical aerial photographs;

15. Evaluate the hydrodynamic and water quality impacts of converting Delta islands into reservoirs;
16. Use a hydrodynamic model to simulate the distribution of larval fish in a tidally influenced estuary;
17. Identify and evaluate non-export factors that may have contributed to fishery declines, including predation, shifts in oceanic conditions, aquatic toxicity from pesticides and mining wastes, salinity intrusion from channel dredging, loss of riparian and marsh habitat, sedimentation from upstream land alternations, and changes in dissolved oxygen, flow, and temperature below dams.

- Developed, directed, and participated in a broad-based research program on environmental issues and control technology for energy industries including petroleum, oil shale, coal mining, and coal slurry transport. Research included evaluation of air and water pollution, development of novel, low-cost technology to treat and dispose of wastes, and development and application of geohydrologic models to evaluate subsurface contamination from in-situ retorting. The program consisted of government and industry contracts and employed 45 technical and administrative personnel.
- Coordinated an industry task force established to investigate the occurrence, causes, and solutions for corrosion/erosion and mechanical/engineering failures in the waterside systems (e.g., condensers, steam generation equipment) of power plants. Corrosion/erosion failures caused by water and steam contamination that were investigated included waterside corrosion caused by poor microbiological treatment of cooling water, steam-side corrosion caused by ammonia-oxygen attack of copper alloys, stress-corrosion cracking of copper alloys in the air cooling sections of condensers, tube sheet leaks, oxygen in-leakage through condensers, volatilization of silica in boilers and carry over and deposition on turbine blades, and iron corrosion on boiler tube walls. Mechanical/engineering failures investigated included: steam impingement attack on the steam side of condenser tubes, tube-to-tube-sheet joint leakage, flow-induced vibration, structural design problems, and mechanical failures due to stresses induced by shutdown, startup and cycling duty, among others. Worked with electric utility plant owners/operators, condenser and boiler vendors, and architect/engineers to collect data to document the occurrence of and causes for these problems, prepared reports summarizing the investigations, and presented the results and participated on a committee of industry experts tasked with identifying solutions to prevent condenser failures.
- Evaluated the cost effectiveness and technical feasibility of using dry cooling and parallel dry-wet cooling to reduce water demands of several large natural-gas fired power plants in California and Arizona.

- Designed and prepared cost estimates for several dry cooling systems (e.g., fin fan heat exchangers) used in chemical plants and refineries.
- Designed, evaluated, and costed several zero liquid discharge systems for power plants.
- Evaluated the impact of agricultural and mining practices on surface water quality of Central Valley steams. Represented municipal water agencies on several federal and state advisory committees tasked with gathering and assessing relevant technical information, developing work plans, and providing oversight of technical work to investigate toxicity issues in the watershed.

AIR QUALITY/PUBLIC HEALTH

- Prepared or reviewed the air quality and public health sections of hundreds of EIRs and EISs on a wide range of industrial, commercial and residential projects.
- Prepared or reviewed hundreds of NSR and PSD permits for a wide range of industrial facilities.
- Designed, implemented, and directed a 2-year-long community air quality monitoring program to assure that residents downwind of a petroleum-contaminated site were not impacted during remediation of petroleum-contaminated soils. The program included real-time monitoring of particulates, diesel exhaust, and BTEX and time integrated monitoring for over 100 chemicals.
- Designed, implemented, and directed a 5-year long source, industrial hygiene, and ambient monitoring program to characterize air emissions, employee exposure, and downwind environmental impacts of a first-generation shale oil plant. The program included stack monitoring of heaters, boilers, incinerators, sulfur recovery units, rock crushers, API separator vents, and wastewater pond fugitives for arsenic, cadmium, chlorine, chromium, mercury, 15 organic indicators (e.g., quinoline, pyrrole, benzo(a)pyrene, thiophene, benzene), sulfur gases, hydrogen cyanide, and ammonia. In many cases, new methods had to be developed or existing methods modified to accommodate the complex matrices of shale plant gases.
- Conducted investigations on the impact of diesel exhaust from truck traffic from a wide range of facilities including mines, large retail centers, light industrial uses, and sports facilities. Conducted traffic surveys, continuously monitored diesel exhaust using an aethalometer, and prepared health risk assessments using resulting data.
- Conducted indoor air quality investigations to assess exposure to natural gas leaks, pesticides, molds and fungi, soil gas from subsurface contamination, and outgasing of carpets, drapes, furniture and construction materials. Prepared health risk assessments using collected data.

- Prepared health risk assessments, emission inventories, air quality analyses, and assisted in the permitting of over 70 1 to 2 MW emergency diesel generators.
- Prepare over 100 health risk assessments, endangerment assessments, and other health-based studies for a wide range of industrial facilities.
- Developed methods to monitor trace elements in gas streams, including a continuous real-time monitor based on the Zeeman atomic absorption spectrometer, to continuously measure mercury and other elements.
- Performed nuisance investigations (odor, noise, dust, smoke, indoor air quality, soil contamination) for businesses, industrial facilities, and residences located proximate to and downwind of pollution sources.

PUBLICATIONS AND PRESENTATIONS (Partial List - Representative Publications)

J.P. Fox, P.H. Hutton, D.J. Howes, A.J. Draper, and L. Sears, Reconstructing the Natural Hydrology of the San Francisco Bay-Delta Watershed, Hydrology and Earth System Sciences, Special Issue: Predictions under Change: Water, Earth, and Biota in the Anthropocene, v. 19, pp. 4257-4274, 2015. http://www.hydrol-earth-syst-sci.net/19/4257/2015/hess-19-4257-2015.pdf. See also: Estimates of Natural and Unimpaired Flows for the Central Valley of California: Water Years 1922-2014 at: https://msb.water.ca.gov/documents/86728/a702a57f-ae7a-41a3-8bff-722e144059d6.

D. Howes, P. Fox, and P. Hutton, Evapotranspiration from Natural Vegetation in the Central Valley of California: Monthly Grass Reference Based Vegetation Coefficients and the Dual Crop Coefficient Approach, *Journal of Hydrologic Engineering*, v.20, no. 10, October 2015.

Phyllis Fox and Lindsey Sears, *Natural Vegetation in the Central Valley of California*, June 2014, Prepared for State Water Contractors and San Luis & Delta-Mendota Water Authority, 311 pg.

J.P. Fox, T.P. Rose, and T.L. Sawyer, Isotope Hydrology of a Spring-fed Waterfall in Fractured Volcanic Rock, 2007.

C.E. Lambert, E.D. Winegar, and Phyllis Fox, Ambient and Human Sources of Hydrogen Sulfide: An Explosive Topic, Air & Waste Management Association, June 2000, Salt Lake City, UT.

San Luis Obispo County Air Pollution Control District and San Luis Obispo County Public Health Department, *Community Monitoring Program,* February 8, 1999.

The Bay Institute, *From the Sierra to the Sea. The Ecological History of the San Francisco Bay-Delta Watershed*, 1998.

J. Phyllis Fox, *Well Interference Effects of HDPP's Proposed Wellfield in the Victor Valley Water District*, Prepared for the California Unions for Reliable Energy (CURE), October 12, 1998.

J. Phyllis Fox, *Air Quality Impacts of Using CPVC Pipe in Indoor Residential Potable Water Systems*, Report Prepared for California Pipe Trades Council, California Firefighters Association, and other trade associations, August 29, 1998.

J. Phyllis Fox and others, *Authority to Construct Avila Beach Remediation Project*, Prepared for Unocal Corporation and submitted to San Luis Obispo Air Pollution Control District, June 1998.

J. Phyllis Fox and others, *Authority to Construct Former Guadalupe Oil Field Remediation Project*, Prepared for Unocal Corporation and submitted to San Luis Obispo Air Pollution Control District, May 1998.

J. Phyllis Fox and Robert Sears, *Health Risk Assessment for the Metropolitan Oakland International Airport Proposed Airport Development Program*, Prepared for Plumbers & Steamfitters U.A. Local 342, December 15, 1997.

Levine-Fricke-Recon (Phyllis Fox and others), *Preliminary Endangerment Assessment Work Plan for the Study Area Operable Unit, Former Solano County Sanitary Landfill, Benicia, California*, Prepared for Granite Management Co. for submittal to DTSC, September 26, 1997.

Phyllis Fox and Jeff Miller, "Fathead Minnow Mortality in the Sacramento River," *IEP Newsletter*, v. 9, n. 3, 1996.

Jud Monroe, Phyllis Fox, Karen Levy, Robert Nuzum, Randy Bailey, Rod Fujita, and Charles Hanson, *Habitat Restoration in Aquatic Ecosystems. A Review of the Scientific Literature Related to the Principles of Habitat Restoration*, Part Two, Metropolitan Water District of Southern California (MWD) Report, 1996.

Phyllis Fox and Elaine Archibald, *Aquatic Toxicity and Pesticides in Surface Waters of the Central Valley*, California Urban Water Agencies (CUWA) Report, September 1997.

Phyllis Fox and Alison Britton, *Evaluation of the Relationship Between Biological Indicators and the Position of X2*, CUWA Report, 1994.

Phyllis Fox and Alison Britton, *Predictive Ability of the Striped Bass Model*, WRINT DWR-206, 1992.

J. Phyllis Fox, *An Historical Overview of Environmental Conditions at the North Canyon Area of the Former Solano County Sanitary Landfill*, Report Prepared for Solano County Department of Environmental Management, 1991.

J. Phyllis Fox, *An Historical Overview of Environmental Conditions at the East Canyon Area of the Former Solano County Sanitary Landfill*, Report Prepared for Solano County Department of Environmental Management, 1991.

Phyllis Fox, *Trip 2 Report, Environmental Monitoring Plan, Parachute Creek Shale Oil Program*, Unocal Report, 1991.

J. P. Fox and others, "Long-Term Annual and Seasonal Trends in Surface Salinity of San Francisco Bay," *Journal of Hydrology*, v. 122, p. 93-117, 1991.

J. P. Fox and others, "Reply to Discussion by D.R. Helsel and E.D. Andrews on Trends in Freshwater Inflow to San Francisco Bay from the Sacramento-San Joaquin Delta," *Water Resources Bulletin*, v. 27, no. 2, 1991.

J. P. Fox and others, "Reply to Discussion by Philip B. Williams on Trends in Freshwater Inflow to San Francisco Bay from the Sacramento-San Joaquin Delta," *Water Resources Bulletin*, v. 27, no. 2, 1991.

J. P. Fox and others, "Trends in Freshwater Inflow to San Francisco Bay from the Sacramento-San Joaquin Delta," *Water Resources Bulletin*, v. 26, no. 1, 1990.

J. P. Fox, "Water Development Increases Freshwater Flow to San Francisco Bay," *SCWC Update*, v. 4, no. 2, 1988.

J. P. Fox, *Freshwater Inflow to San Francisco Bay Under Natural Conditions*, State Water Contracts, Exhibit 262, 58 pp., 1987.

J. P. Fox, "The Distribution of Mercury During Simulated In-Situ Oil Shale Retorting," *Environmental Science and Technology*, v. 19, no. 4, pp. 316-322, 1985.

J. P. Fox, "El Mercurio en el Medio Ambiente: Aspectos Referentes al Peru," (Mercury in the Environment: Factors Relevant to Peru) Proceedings of Simposio Los Pesticidas y el Medio Ambiente," ONERN-CONCYTEC, Lima, Peru, April 25-27, 1984. (Also presented at Instituto Tecnologico Pesquero and Instituto del Mar del Peru.)

J. P. Fox, "Mercury, Fish, and the Peruvian Diet," *Boletin de Investigacion*, Instituto Tecnologico Pesquero, Lima, Peru, v. 2, no. 1, pp. 97-116, 1984.

J. P. Fox, P. Persoff, A. Newton, and R. N. Heistand, "The Mobility of Organic Compounds in a Codisposal System," *Proceedings of the Seventeenth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1984.

P. Persoff and J. P. Fox, "Evaluation of Control Technology for Modified In-Situ Oil Shale Retorts," *Proceedings of the Sixteenth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1983.

J. P. Fox, *Leaching of Oil Shale Solid Wastes: A Critical Review*, University of Colorado Report, 245 pp., July 1983.

J. P. Fox, *Source Monitoring for Unregulated Pollutants from the White River Oil Shale Project*, VTN Consolidated Report, June 1983.

A. S. Newton, J. P. Fox, H. Villarreal, R. Raval, and W. Walker II, *Organic Compounds in Coal Slurry Pipeline Waters*, Lawrence Berkeley Laboratory Report LBL-15121, 46 pp., Sept. 1982.

M. Goldstein et al., *High Level Nuclear Waste Standards Analysis, Regulatory Framework Comparison*, Battelle Memorial Institute Report No. BPMD/82/E515-06600/3, Sept. 1982.

J. P. Fox et al., *Literature and Data Search of Water Resource Information of the Colorado, Utah, and Wyoming Oil Shale Basins*, Vols. 1-12, Bureau of Land Management, 1982.

A. T. Hodgson, M. J. Pollard, G. J. Harris, D. C. Girvin, J. P. Fox, and N. J. Brown, *Mercury Mass Distribution During Laboratory and Simulated In-Situ Retorting*, Lawrence Berkeley Laboratory Report LBL-12908, 39 pp., Feb. 1982.

E. J. Peterson, A. V. Henicksman, J. P. Fox, J. A. O'Rourke, and P. Wagner, *Assessment and Control of Water Contamination Associated with Shale Oil Extraction and Processing*, Los Alamos National Laboratory Report LA-9084-PR, 54 pp., April 1982.

P. Persoff and J. P. Fox, *Control Technology for In-Situ Oil Shale Retorts*, Lawrence Berkeley Laboratory Report LBL-14468, 118 pp., Dec. 1982.

J. P. Fox, *Codisposal Evaluation: Environmental Significance of Organic Compounds*, Development Engineering Report, 104 pp., April 1982.

J. P. Fox, *A Proposed Strategy for Developing an Environmental Water Monitoring Plan for the Paraho-Ute Project*, VTN Consolidated Report, Sept. 1982.

J. P. Fox, D. C. Girvin, and A. T. Hodgson, "Trace Elements in Oil Shale Materials," *Energy and Environmental Chemistry, Fossil Fuels*, v.1, pp. 69-101, 1982.

M. Mehran, T. N. Narasimhan, and J. P. Fox, "Hydrogeologic Consequences of Modified In-situ Retorting Process, Piceance Creek Basin, Colorado," *Proceedings of the Fourteenth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1981 (LBL-12063).

U. S. DOE (J. P. Fox and others), *Western Oil Shale Development: A Technology Assessment*, v. 1-9, Pacific Northwest Laboratory Report PNL-3830, 1981.

J. P. Fox (ed), "Oil Shale Research," Chapter from the *Energy and Environment Division Annual Report 1980*, Lawrence Berkeley Laboratory Report LBL-11989, 82 pp., 1981 (author or co-author of four articles in report).

D.C. Girvin and J.P. Fox, On-Line Zeeman Atomic Absorption Spectroscopy for Mercury Analysis in Oil Shale Gases, U.S. EPA Report EPA-600/7-80-130, June 1980.

J. P. Fox, *The Partitioning of Major, Minor, and Trace Elements during In-Situ Oil Shale Retorting*, Ph.D. Dissertation, U. of Ca., Berkeley, also Report LBL-9062, 441 pp., 1980 (*Diss. Abst. Internat.*, v. 41, no. 7, 1981).

J.P. Fox, "Elemental Composition of Simulated *In Situ* Oil Shale Retort Water," *Analysis of Waters Associated with Alternative Fuel Production, ASTM STP 720*, L.P. Jackson and C.C. Wright, Eds., American Society for Testing and Materials, pp. 101-128, 1981.

J. P. Fox, P. Persoff, P. Wagner, and E. J. Peterson, "Retort Abandonment -- Issues and Research Needs," in *Oil Shale: the Environmental Challenges*, K. K. Petersen (ed.), p. 133, 1980 (Lawrence Berkeley Laboratory Report LBL-11197).

J. P. Fox and T. E. Phillips, "Wastewater Treatment in the Oil Shale Industry," in *Oil Shale: the Environmental Challenges*, K. K. Petersen (ed.), p. 253, 1980 (Lawrence Berkeley Laboratory Report LBL-11214).

R. D. Giauque, J. P. Fox, J. W. Smith, and W. A. Robb, "Geochemical Studies of Two Cores from the Green River Oil Shale Formation," *Transactions*, American Geophysical Union, v. 61, no. 17, 1980.

J. P. Fox, "The Elemental Composition of Shale Oils," Abstracts of Papers, 179th National Meeting, ISBN 0-8412-0542-6, Abstract No. FUEL 17, 1980.

J. P. Fox and P. Persoff, "Spent Shale Grouting of Abandoned In-Situ Oil Shale Retorts," *Proceedings of Second U.S. DOE Environmental Control Symposium*, CONF-800334/1, 1980 (Lawrence Berkeley Laboratory Report LBL-10744).

P. K. Mehta, P. Persoff, and J. P. Fox, "Hydraulic Cement Preparation from Lurgi Spent Shale," *Proceedings of the Thirteenth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1980 (Lawrence Berkeley Laboratory Report LBL-11071).

F. E. Brinckman, K. L. Jewett, R. H. Fish, and J. P. Fox, "Speciation of Inorganic and Organoarsenic Compounds in Oil Shale Process Waters by HPLC Coupled with Graphite Furnace Atomic Absorption (GFAA) Detectors," Abstracts of Papers, Div. of Geochemistry, Paper No. 20, Second Chemical Congress of the North American Continent, August 25-28, 1980, Las Vegas (1980).

J. P. Fox, D. E. Jackson, and R. H. Sakaji, "Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters," *Proceedings of the Thirteenth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1980 (Lawrence Berkeley Laboratory Report LBL-11072).

J. P. Fox, *The Elemental Composition of Shale Oils*, Lawrence Berkeley Laboratory Report LBL-10745, 1980.

R. H. Fish, J. P. Fox, F. E. Brinckman, and K. L. Jewett, *Fingerprinting Inorganic and Organoarsenic Compounds in Oil Shale Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Detector*, Lawrence Berkeley Laboratory Report LBL-11476, 1980.

National Academy of Sciences (J. P. Fox and others), *Surface Mining of Non-Coal Minerals, Appendix II: Mining and Processing of Oil Shale and Tar Sands*, 222 pp., 1980.

J. P. Fox, "Elemental Composition of Simulated In-Situ Oil Shale Retort Water," in *Analysis of Waters Associated with Alternative Fuel Production*, ASTM STP 720, L. P. Jackson and C. C. Wright (eds.), American Society for Testing and Materials, pp. 101-128, 1980.

R. D. Giauque, J. P. Fox, and J. W. Smith, *Characterization of Two Core Holes from the Naval Oil Shale Reserve Number 1*, Lawrence Berkeley Laboratory Report LBL-10809, 176 pp., December 1980.

B. M. Jones, R. H. Sakaji, J. P. Fox, and C. G. Daughton, "Removal of Contaminative Constituents from Retort Water: Difficulties with Biotreatment and Potential Applicability of Raw and Processed Shales," *EPA/DOE Oil Shale Wastewater Treatability Workshop*, December 1980 (Lawrence Berkeley Laboratory Report LBL-12124).

J. P. Fox, *Water-Related Impacts of In-Situ Oil Shale Processing*, Lawrence Berkeley Laboratory Report LBL-6300, 327 p., December 1980.

M. Mehran, T. N. Narasimhan, and J. P. Fox, *An Investigation of Dewatering for the Modified In-Situ Retorting Process, Piceance Creek Basin, Colorado*, Lawrence Berkeley Laboratory Report LBL-11819, 105 p., October 1980.

J. P. Fox (ed.) "Oil Shale Research," Chapter from the *Energy and Environment Division Annual Report 1979*, Lawrence Berkeley Laboratory Report LBL-10486, 1980 (author or coauthor of eight articles).

E. Ossio and J. P. Fox, *Anaerobic Biological Treatment of In-Situ Oil Shale Retort Water*, Lawrence Berkeley Laboratory Report LBL-10481, March 1980.

J. P. Fox, F. H. Pearson, M. J. Kland, and P. Persoff, *Hydrologic and Water Quality Effects and Controls for Surface and Underground Coal Mining -- State of Knowledge, Issues, and Research Needs*, Lawrence Berkeley Laboratory Report LBL-11775, 1980.

D. C. Girvin, T. Hadeishi, and J. P. Fox, "Use of Zeeman Atomic Absorption Spectroscopy for the Measurement of Mercury in Oil Shale Offgas," *Proceedings of the Oil Shale Symposium: Sampling, Analysis and Quality Assurance*, U.S. EPA Report EPA-600/9-80-022, March 1979 (Lawrence Berkeley Laboratory Report LBL-8888).

D. S. Farrier, J. P. Fox, and R. E. Poulson, "Interlaboratory, Multimethod Study of an In-Situ Produced Oil Shale Process Water," *Proceedings of the Oil Shale Symposium: Sampling, Analysis and Quality Assurance*, U.S. EPA Report EPA-600/9-80-022, March 1979 (Lawrence Berkeley Laboratory Report LBL-9002).

J. P. Fox, J. C. Evans, J. S. Fruchter, and T. R. Wildeman, "Interlaboratory Study of Elemental Abundances in Raw and Spent Oil Shales," *Proceedings of the Oil Shale Symposium: Sampling, Analysis and Quality Assurance*, U.S. EPA Report EPA-600/9-80-022, March 1979 (Lawrence Berkeley Laboratory Report LBL-8901).

J. P. Fox, "Retort Water Particulates," *Proceedings of the Oil Shale Symposium: Sampling, Analysis and Quality Assurance*, U.S. EPA Report EPA-600/9-80-022, March 1979 (Lawrence Berkeley Laboratory Report LBL-8829).

P. Persoff and J. P. Fox, "Control Strategies for In-Situ Oil Shale Retorts," *Proceedings of the Twelfth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1979 (Lawrence Berkeley Laboratory Report LBL-9040).

J. P. Fox and D. L. Jackson, "Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters," *Proceedings of the DOE Wastewater Workshop*, Washington, D. C., June 14-15, 1979 (Lawrence Berkeley Laboratory Report LBL-9716).

J. P. Fox, K. K. Mason, and J. J. Duvall, "Partitioning of Major, Minor, and Trace Elements during Simulated In-Situ Oil Shale Retorting," *Proceedings of the Twelfth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1979 (Lawrence Berkeley Laboratory Report LBL-9030).

P. Persoff and J. P. Fox, *Control Strategies for Abandoned In-Situ Oil Shale Retorts*, Lawrence Berkeley Laboratory Report LBL-8780, 106 pp., October 1979.

D. C. Girvin and J. P. Fox, *On-Line Zeeman Atomic Absorption Spectroscopy for Mercury Analysis in Oil Shale Gases*, Environmental Protection Agency Report EPA-600/7-80-130, 95 p., August 1979 (Lawrence Berkeley Laboratory Report LBL-9702).

J. P. Fox, *Water Quality Effects of Leachates from an In-Situ Oil Shale Industry*, Lawrence Berkeley Laboratory Report LBL-8997, 37 pp., April 1979.

J. P. Fox (ed.), "Oil Shale Research," Chapter from the *Energy and Environment Division Annual Report 1978*, Lawrence Berkeley Laboratory Report LBL-9857 August 1979 (author or coauthor of seven articles).

J. P. Fox, P. Persoff, M. M. Moody, and C. J. Sisemore, "A Strategy for the Abandonment of Modified In-Situ Oil Shale Retorts," *Proceedings of the First U.S. DOE Environmental Control Symposium*, CONF-781109, 1978 (Lawrence Berkeley Laboratory Report LBL-6855).

E. Ossio, J. P. Fox, J. F. Thomas, and R. E. Poulson, "Anaerobic Fermentation of Simulated In-Situ Oil Shale Retort Water," *Division of Fuel Chemistry Preprints*, v. 23, no. 2, p. 202-213, 1978 (Lawrence Berkeley Laboratory Report LBL-6855).

J. P. Fox, J. J. Duvall, R. D. McLaughlin, and R. E. Poulson, "Mercury Emissions from a Simulated In-Situ Oil Shale Retort," *Proceedings of the Eleventh Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1978 (Lawrence Berkeley Laboratory Report LBL-7823).

J. P. Fox, R. D. McLaughlin, J. F. Thomas, and R. E. Poulson, "The Partitioning of As, Cd, Cu, Hg, Pb, and Zn during Simulated In-Situ Oil Shale Retorting," *Proceedings of the Tenth Oil Shale Symposium*, Colorado School of Mines Press, Golden, CO, 1977.

Bechtel, Inc., *Treatment and Disposal of Toxic Wastes*, Report Prepared for Santa Ana Watershed Planning Agency, 1975.

Bay Valley Consultants, *Water Quality Control Plan for Sacramento, Sacramento-San Joaquin and San Joaquin Basins*, Parts I and II and Appendices A-E, 750 pp., 1974.

POST GRADUATE COURSES
(Partial)

S-Plus Data Analysis, MathSoft, 6/94.
Air Pollutant Emission Calculations, UC Berkeley Extension, 6-7/94
Assessment, Control and Remediation of LNAPL Contaminated Sites, API and USEPA, 9/94
Pesticides in the TIE Process, SETAC, 6/96
Sulfate Minerals: Geochemistry, Crystallography, and Environmental Significance, Mineralogical Society of America/Geochemical Society, 11/00.
Design of Gas Turbine Combined Cycle and Cogeneration Systems, Thermoflow, 12/00
Air-Cooled Steam Condensers and Dry- and Hybrid-Cooling Towers, Power-Gen, 12/01
Combustion Turbine Power Augmentation with Inlet Cooling and Wet Compression, Power-Gen, 12/01
CEQA Update, UC Berkeley Extension, 3/02
The Health Effects of Chemicals, Drugs, and Pollutants, UC Berkeley Extension, 4-5/02
Noise Exposure Assessment: Sampling Strategy and Data Acquisition, AIHA PDC 205, 6/02
Noise Exposure Measurement Instruments and Techniques, AIHA PDC 302, 6/02
Noise Control Engineering, AIHA PDC 432, 6/02
Optimizing Generation and Air Emissions, Power-Gen, 12/02
Utility Industry Issues, Power-Gen, 12/02
Multipollutant Emission Control, Coal-Gen, 8/03
Community Noise, AIHA PDC 104, 5/04
Cutting-Edge Topics in Noise and Hearing Conservation, AIHA 5/04
Selective Catalytic Reduction: From Planning to Operation, Power-Gen, 12/05
Improving the FGD Decision Process, Power-Gen, 12/05
E-Discovery, CEB, 6/06
McIlvaine Hot Topic Hour, FGD Project Delay Factors, 8/10/06
McIlvaine Hot Topic Hour, What Mercury Technologies Are Available, 9/14/06
McIlvaine Hot Topic Hour, SCR Catalyst Choices, 10/12/06
McIlvaine Hot Topic Hour, Particulate Choices for Low Sulfur Coal, 10/19/06
McIlvaine Hot Topic Hour, Impact of PM2.5 on Power Plant Choices, 11/2/06
McIlvaine Hot Topic Hour, Dry Scrubbers, 11/9/06
Cost Estimating and Tricks of the Trade – A Practical Approach, PDH P159, 11/19/06
Process Equipment Cost Estimating by Ratio & Proportion, PDH G127 11/19/06
Power Plant Air Quality Decisions, Power-Gen 11/06
McIlvaine Hot Topic Hour, WE Energies Hg Control Update, 1/12/07
Negotiating Permit Conditions, EEUC, 1/21/07
BACT for Utilities, EEUC, 1/21/07
McIlvaine Hot Topic Hour, Chinese FGD/SCR Program & Impact on World, 2/1/07
McIlvaine Hot Topic Hour, Mercury Control Cost & Performance, 2/15/07

McIlvaine Hot Topic Hour, Mercury CEMS, 4/12/07
Coal-to-Liquids – A Timely Revival, 9th Electric Power, 4/30/07
Advances in Multi-Pollutant and CO_2 Control Technologies, 9th Electric Power, 4/30/07
McIlvaine Hot Topic Hour, Measurement & Control of PM2.5, 5/17/07
McIlvaine Hot Topic Hour, Co-firing and Gasifying Biomass, 5/31/07
McIlvaine Hot Topic Hour, Mercury Cost and Performance, 6/14/07
Ethanol 101: Points to Consider When Building an Ethanol Plant, BBI International, 6/26/07
Low Cost Optimization of Flue Gas Desulfurization Equipment, Fluent, Inc., 7/6/07.
McIlvaine Hot Topic Hour, CEMS for Measurement of NH3, SO3, Low NOx, 7/12/07
McIlvaine Hot Topic Hour, Mercury Removal Status & Cost, 8/9/07
McIlvaine Hot Topic Hour, Filter Media Selection for Coal-Fired Boilers, 9/13/07
McIlvaine Hot Topic Hour, Catalyst Performance on NOx, SO3, Mercury, 10/11/07
PRB Coal Users Group, PRB 101, 12/4/07
McIlvaine Hot Topic Hour, Mercury Control Update, 10/25/07
Circulating Fluidized Bed Boilers, Their Operation, Control and Optimization, Power-Gen, 12/8/07
Renewable Energy Credits & Greenhouse Gas Offsets, Power-Gen, 12/9/07
Petroleum Engineering & Petroleum Downstream Marketing, PDH K117, 1/5/08
Estimating Greenhouse Gas Emissions from Manufacturing, PDH C191, 1/6/08
McIlvaine Hot Topic Hour, NOx Reagents, 1/17/08
McIlvaine Hot Topic Hour, Mercury Control, 1/31/08
McIlvaine Hot Topic Hour, Mercury Monitoring, 3/6/08
McIlvaine Hot Topic Hour, SCR Catalysts, 3/13/08
Argus 2008 Climate Policy Outlook, 3/26/08
Argus Pet Coke Supply and Demand 2008, 3/27/08
McIlvaine Hot Topic Hour, SO3 Issues and Answers, 3/27/08
McIlvaine Hot Topic Hour, Mercury Control, 4/24/08
McIlvaine Hot Topic Hour, Co-Firing Biomass, 5/1/08
McIlvaine Hot Topic Hour, Coal Gasification, 6/5/08
McIlvaine Hot Topic Hour, Spray Driers vs. CFBs, 7/3/08
McIlvaine Hot Topic Hour, Air Pollution Control Cost Escalation, 9/25/08
McIlvaine Hot Topic Hour, Greenhouse Gas Strategies for Coal Fired Power Plant Operators, 10/2/08
McIlvaine Hot Topic Hour, Mercury and Toxics Monitoring, 2/5/09
McIlvaine Hot Topic Hour, Dry Precipitator Efficiency Improvements, 2/12/09
McIlvaine Hot Topic Hour, Coal Selection & Impact on Emissions, 2/26/09
McIlvaine Hot Topic Hour, 98% Limestone Scrubber Efficiency, 7/9/09
McIlvaine Hot Topic Hour, Carbon Management Strategies and Technologies, 6/24/10
McIlvaine Hot Topic Hour, Gas Turbine O&M, 7/22/10

McIlvaine Hot Topic Hour, Industrial Boiler MACT – Impact and Control Options, March 10, 2011
McIlvaine Hot Topic Hour, Fuel Impacts on SCR Catalysts, June 30, 2011.
Interest Rates, PDH P204, 3/9/12
Mechanics Liens, PDHOnline, 2/24/13.
Understanding Concerns with Dry Sorbent Injection as a Coal Plant Pollution Control, Webinar #874-567-839 by Cleanenergy.Org, March 4, 2013
Webinar: Coal-to-Gas Switching: What You Need to Know to Make the Investment, sponsored by PennWell Power Engineering Magazine, March 14, 2013. Available at: https://event.webcasts.com/viewer/event.jsp?ei=1013472.

EXHIBIT B

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South Coast Water District
Mr. Rick Shintaku, PE – Acting General Manager/Chief Engineer
31592 West St
Laguna Beach, CA 92651

3 August 2018

RE: Doheny Ocean Desalination Project

Dear Mr. Rick Shintaku,

I write to comment on the South Coast Water District's (SCWD 2018) draft EIR and supporting documents on biological resources (Chambers Group 2016, MBC Aquatic Sciences 2018) prepared for the proposed Doheny Ocean Desalination Project, which I understand would cover 28.7 acres located where San Juan Creek reaches the Pacific Ocean near Doheny State Beach and 3 miles SW of San Juan Capistrano. Specifically, I write to comment on the potential biological resource impacts associated with the project, which I understand would pump-intake 10 to 30 million gallons per day from coastal waters.

My qualifications for preparing expert comments are the following. I hold a Ph.D. degree in Ecology from University of California at Davis, where I also worked for four years as a post-graduate researcher in the Department of Agronomy and Range Sciences. My research is on animal density and distribution, habitat selection, habitat restoration, interactions between wildlife and human infrastructure and activities, conservation of rare and endangered species, and on the ecology of invading species. I have authored papers on special-status species issues, including "Using the best scientific data for endangered species conservation" (Smallwood et al. 1999) and "Suggested standards for science applied to conservation issues" (Smallwood et al. 2001). I served as Chair of the Conservation Affairs Committee for The Wildlife Society – Western Section. I am a member of The Wildlife Society and the Raptor Research Foundation, and I've been a part-time lecturer at California State University, Sacramento. I served as Associate Editor of Biological Conservation and of wildlife biology's premier scientific journal, The Journal of Wildlife Management, and I served on the Editorial Board of Environmental Management.

I have performed wildlife surveys in California for thirty-three years. I studied the impacts of human activities and human infrastructure on wildlife, including on golden eagle, Swainson's hawk, burrowing owl, San Joaquin kangaroo rat, mountain lion, California tiger salamander, California red-legged frog, and other species. I have performed research on wildlife mortality caused by wind turbines, electric distribution lines, agricultural practices, and road traffic, and I've performed wildlife surveys at many proposed project sites. I collaborate with colleagues worldwide on the underlying science and policy issues related to anthropogenic impacts on wildlife.

My CV is attached.

BIOLOGICAL IMPACTS ASSESSMENT

The draft EIR and supporting documents provided no evidence that targeted wildlife surveys were performed at the proposed project site or its surroundings. No effort was made in the field to detect species of wildlife potentially affected by the project. Therefore, the DEIR is inadequate for informing the public about baseline conditions related to wildlife use of the site.

Although appropriate field surveys would be more informative of the baseline conditions, wildlife impacts analysis relying on literature review and speculation can suffice so long as determinations of presence or absence of species err on the side of caution, consistent with the Precautionary Principle in risk assessment. The DEIR does not err on the side of caution, however. Attributed to human disturbance and high human visitation rates, Chambers Group (2016) characterized wildlife on the proposed project site as urban-adapted. This characterization diminishes potential wildlife impacts by implying that few special-status species use the site. In fact, the DEIR determines only 5 special-status species of terrestrial wildlife as common at the project site, 2 as uncommon, 4 as rare, and 1 as unlikely. The DEIR neglects to consider the impacts of 63 additional special-status species of terrestrial wildlife reportedly detected on or very near the site (https://eBird.org) or having possible or probable occurrence potential based on geographic range overlap and habitat availability.

The impacts analysis neglects the landscape context of the site as the juncture of two linear landscape features commonly used by wildlife for long-range movement – a long creek and the coastline. It also neglects the effects of habitat fragmentation, leaving increasingly smaller patches of habitat in which wildlife can persist. Further, the DEIR regards avian use of habitat to be of no significant impact unless the avian use consists of nesting. The fallacy of this assumption is that birds cannot successfully nest without the capacity to forage and find refuge during the non-breeding seasons. All habitat use is important to special-status species, not just 'nesting habitat.'

Chambers Group (2016) reported 11 western snowy plovers having been seen on site, as well as 175 California least terns. However, Chambers Group (2016) assessed California least terns' occurrence potential as High, whereas the DEIR assessed it as Uncommon. Similarly, Chambers Group (2016) assessed least Bell's vireo occurrence potential as Low, but the DEIR merely mentioned that the species could pass through on migration. These inconsistencies should be addressed in a revised draft of the EIR. Furthermore, in my review of eBird postings, geographic range maps and habitat characterizations, I tallied 75 special-status species of terrestrial wildlife documented at the proposed project site or likely to occur at the site (Table 1). The proposed project site is one of the richest in special-status species occurrences I have seen in my nearly 30 years of reviewing environmental documentation of potential project impacts.

Table 1. *Occurrence likelihoods of special-status species at or near the proposed project site, according to SCWD (2018) (DEIR) and my own review of eBird (https://eBird.org) and other information.*

Common name	Species name	Status[1]	Occurrence likelihood	
			DEIR	Smallwood
Redhead	Aythya americana	SSC3	No mention	eBird on site
Common loon	*Gavia immer*	SSC	Rare	eBird on site
Brant	*Branta bernicla*	SSC2	No mention	eBird on site
American white pelican	*Pelecanus erythrorhyynchos*	SSC	No mention	eBird on site
Brown pelican	*Pelecanus occidentalis*	CFP	Common	eBird on site
Double-crested cormorant	*Phalacrocorax auritus*	TWL	Common	eBird on site
Least bittern	*Ixobrychus exilis*	SSC2	No mention	eBird nearby
Turkey vulture	*Cathartes aura*	CDFW 3503.5	No mention	eBird on site
Osprey	*Pandion haliaetus*	TWL, CDFW 3503.5	No mention	eBird on site
White-tailed kite	*Elanus luecurus*	CFP, TWL, CDFW 3503.5	No mention	eBird on site
Sharp-shinned hawk	*Accipiter striatus*	TWL, CDFW 3503.5	No mention	eBird on site
Cooper's hawk	*Accipiter cooperii*	TWL, CDFW 3503.5	No mention	eBird on site
Northern harrier	*Circus cyaneus*	SSC3, CDFW 3503.5	No mention	eBird on site
Zone-tailed hawk	*Buteo albonotatus*	CDFW 3503.5	No mention	eBird on site
Red-shouldered hawk	*Buteo lineatus*	CDFW 3503.5	No mention	eBird on site
Red-tailed hawk	*Buteo jamaicensis*	CDFW 3503.5	No mention	eBird on site
American kestrel	*Falco sparverius*	CDFW 3503.5	No mention	eBird on site
Merlin	*Falco columbarius*	TWL, CDFW 3503.5	No mention	eBird on site
Peregrine falcon	*Falco peregrinus*	CE, CFP, CDFW 3503.5, BCC	No mention	eBird on site
Western snowy plover	*Charadrius alexandrines nivosus*	FT	Common	eBird on site
Whimbrel	*Numenius phaeopus*	BCC	No mention	eBird on site
Long-billed curlew	*Numenius americanus*	BCC, TWL	Rare	eBird on site
Marbled godwit	*Limosa fedoa*	BCC	No mention	eBird on site
Red knot	*Calidris canutus*	BCC	No mention	eBird on site
Short-billed dowitcher	*Limnodromus griseus*	BCC	No mention	eBird on site
California gull	*Larus californicus*	TWL	Common	eBird on site
California least tern	*Sternula antillarum*	FE, CE	Uncommon	eBird on site

Common name	Species name	Status[1]	Occurrence likelihood	
			DEIR	Smallwood
Elegant tern	*Thalasseus elegans*	TWL	Common	eBird on site
Caspian tern	*Hydroprogne caspia*	BCC	Uncommon	eBird on site
Black skimmer	*Rynchops niger*	BCC, SSC3	Rare	eBird on site
Xantus's murrelet	*Synthliboramphus hypoleucus*	CT, BCC	No mention	eBird nearby
Rhinoceros auklet	*Cerorhinca monocerata*	TWL	No mention	eBird on site
Barn owl	*Tyto alba*	CDFW 3503.5	No mention	eBird on site
Great-horned owl	*Bubo virginianus*	CDFW 3503.5	No mention	eBird nearby
Western screech-owl	*Megascops kennicottii*	BCC, CDFW 3503.5	No mention	eBird nearby
Vaux's swift	*Chaetura vauxi*	SSC2	No mention	eBird on site
Costa's hummingbird	*Calypte costae*	BCC	No mention	eBird on site
Allen's hummingbird	*Selasphorus sasin*	BCC	No mention	eBird on site
Lewis's woodpecker	*Melanerpes lewis*	BCC	No mention	eBird on site
Nuttall's woodpecker	*Picoides nuttallii*	BCC	No mention	eBird on site
Southwestern willow flycatcher	*Empidonax trailii extimus*	FE, CE	No mention	eBird on site
Loggerhead shrike	*Lanius ludovicianus*	BCC, SSC2	No mention	eBird on site
Least Bell's vireo	*Vireo bellii pusillus*	FE, CE	No mention	eBird very close
Purple martin	*Progne subis*	SSC2	No mention	eBird on site
Oak titmouse	*Baeolophus inornatus*	BCC	No mention	eBird nearby
San Diego cactus wren	*Campylorhynchs brunneicapillus sandiegensis*	BCC, SSC1	No mention	eBird on site
Clark's marsh wren	*Cistothorus palustris clarkae*	SSC2	No mention	eBird on site
California gnatcatcher	*Polioptila c. californica*	CT, SSC	Low	eBird on site
Yellow warbler	*Dendroica petechia*	BCC, SSC2	No mention	eBird on site
Common yellowthroat	*Geothlypis trichas*	BCC, SSC3	No mention	eBird on site; nesting
Yellow-breasted chat	*Icteria virens*	SSC3	No mention	eBird on site
Summer tanager	*Piranga rubra*	SSC1	No mention	eBird nearby
Oregon vesper sparrow	*Pooecetes gramineus affinis*	SSC2	No mention	eBird nearby
Belding's savannah sparrow	*Passerculus sandwichensis beldingi*	CE	No mention	eBird on site
Grasshopper sparrow	*Ammodramus savannarum*	SSC2	No mention	eBird nearby

Common name	Species name	Status[1]	Occurrence likelihood	
			DEIR	Smallwood
Lawrence's goldfinch	*Spinus lawrencei*	BCC	No mention	eBird very close
Coast patch-nosed snake	*Salvadora hexalepis virgultea*	SSC	No mention	Possible
Two-striped gartersnake	*Thamnophis hammondii*	SSC	No mention	Possible
Southern California legless lizard	*Anniella stebbinsi*	SSC	No mention	Probable
Blainville's horned lizard	*Phrynosoma blainvillii*	SSC	No mention	Probable
San Diegan tiger whiptail	*Aspidoscelis tigris stejnegeri*	SSC	No mention	Probable
Southwestern pond turtle	*Actinemys pallida*	SSC	No mention	Probable
Arroyo toad	*Anaxyrus californicus*	FE, SSC	No mention	Certain
California red-legged frog	*Rana draytonii*	FT, SSC	No mention	Possible
Western spadefoot	*Spea hammondii*	SSC	No mention	Possible
Western yellow bat	*Lasiurus xanthinus*	SSC	No mention	Possible
Pallid bat	*Antrozous pallidus*	SSC	No mention	Possible
Small-footed myotis	*Myotis cililabrum*	WBWG	No mention	Possible
Spotted bat	*Euderma maculatum*	SSC	No mention	Possible
Townsend's big-eared bat	*Plecotus t. townsendii*	SSC	No mention	Possible
Western mastiff bat	*Eumops perotis*	SSC	No mention	Possible
Western red bat	*Lasiurus blossevillii*	SSC	No mention	Possible
Pacific pocket mouse	*Perognathus longimembris pacificus*	FE, SSC	Low	Certain
Southern grasshopper mouse	*Onychomys torridus ramona*	SSC	No mention	Possible
American badger	*Taxidea taxus*	SSC	No mention	Possible

[1] Listed as FE = federal endangered, BCC = U.S. Fish and Wildlife Service Bird of Conservation Concern, CE = California endangered, CT = California threatened, CFP = California Fully Protected (CDFG Code 4700), SSC = California species of special concern (not threatened with extinction, but rare, very restricted in range, declining throughout range, peripheral portion of species' range, associated with habitat that is declining in extent), SSC1, SSC2 and SSC3 = California Bird Species of Special Concern priorities 1, 2 and 3, respectively (Shuford and Gardali 2008), TWL = Taxa to Watch List (Shuford and Gardali 2008), CDFW 3503.5 = California Department of Fish and Wildlife Code 3503.5 (Birds of prey), and WBWG = Western Bat Working Group listing as moderate or high priority.

SCWD (2018:4.3-6) mentions arroyo toad larvae having been seen on the project site, as well as Pacific pocket mouse and 30 special-status species of birds. However, arroyo toad, which is listed as Endangered under the federal Endangered Species Act, fails to show up in Table 4.3-1 of the DEIR and is not mentioned again. Pacific pocket mouse is also listed as Endangered under the federal Endangered Species Act, but fails to show up in Table 4.3-1 of the DEIR and is not mentioned again. Twelve of the 30 special-status species of bird are listed in Table 4.3-1 of the DEIR, but impact assessments are extremely cursory for these species and non-existent for the other 18 special-status species of birds composing the tally on page 4.3-6. The DEIR is deficient in its impacts analysis of special-status species of terrestrial wildlife.

In my review, I found many more cases of special-status species occurrences or likely occurrences that warrant impacts analysis in a revised EIR. Occurrences of many of these species can be readily confirmed by examining photos of the species' detections that are posted on eBird. I provide examples of these photo records in Figures 1 through 5. In total, eBird postings included 46 special-status species of birds on the project site, and another 10 species nearby. The DEIR underestimates the special-status species richness of the site, and therefore underestimates the project's potential impacts.

Eleven of the species in Table 1 are listed as threatened or endangered by either or both the federal and California Endangered Species Acts. A revised EIR should address potential impacts of the project on all 75 of the species appearing in my Table 1. It should also provide mitigation measures for these 75 species, including minimization and compensatory measures.

In summary, due to habitat fragmentation, the project would likely have substantial adverse effects on 75 species identified as candidate, sensitive, or special-status species in regulations enforced by the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service. As I will discuss below, the proposed mitigation will not reduce these impacts to less than significant.

Figure 1. *Black skimmer records (blue symbols) in proposed project area, eBird.*

Figure 2. *Brant records (blue symbols) in proposed project area, eBird.*

Figure 3. *Western snowy plover records (blue symbols) in proposed project area, eBird.*

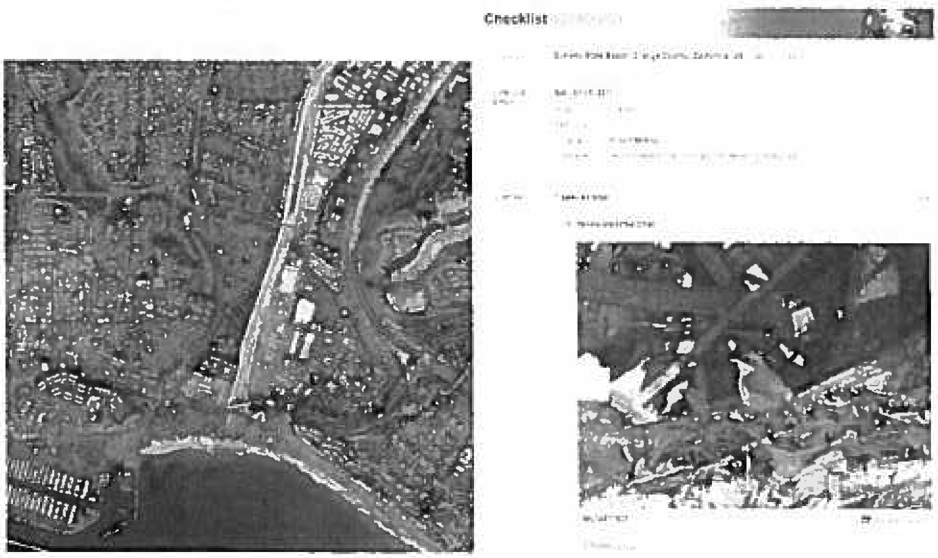

Figure 4. *Yellow-breasted chat record (blue symbol) in proposed project area, eBird.*

Figure 5. *Northern harrier, redhead, and Belding's savannah sparrow records (blue symbols) in proposed project area, eBird.*

Noise Impacts on Wildlife

According to SCWD (2018:4.10-15), construction noise will range 76 to 101 dBA within 50 feet of source. However, no prediction is provided of the noise associated with the brine disposal system, which SCWD (2018:4.10-23) reports will be located >1,000 feet from sensitive receptors (residences). This operational noise is not assessed for potential impacts on terrestrial species of wildlife, and neither is the projected construction noise.

Noise impacts can contribute to habitat fragmentation, which is defined as the reduced numerical capacity of a species caused by the pattern of habitat loss or degradation (Smallwood 2015). Habitat-penetration of noise that interferes with auditory signals related to mate-attraction, territorial defense, foraging, and predator alarm-calling can degrade habitat, thereby reducing the effective population size (Anthony and Blumstein 2000). Another impact of noise is physiological stress associated with startling responses to noise and increased effort to overcome noise interference (Francis and Barber 2013). For example, increasing residential noise from 42 dB to 63 dB forced one bird species to increase its call frequency by 9%, which was significant (Slabbekoorn and Peet 2003). Noise impacts can reduce habitat patch sizes and habitat connectivity, which reduces the numerical capacity of a species and therefore contributes to habitat fragmentation (Smallwood 2015). Worse, habitat-penetration of noise can transform habitat patches into ecological sinks for species attracted to the habitat for its structure connoting the availability of cover, forage and breeding opportunities, but where noise will interfere with the species' ability to capitalize on these opportunities. Ecological sinks remove individuals of a species from habitat patches where those individuals could have functioned as members of a population.

Noise affects animal behaviors, so numerical abundance around noise sources is not always the most useful metric for assessing a species' response to noise (Pater et al. 2009, Francis and Barber 2013). Noise can change activity patterns by time of day or by spatial exposure to noise, and it can be perceived and reacted upon as false threats or false cues. Also, dBA and equivalent continuous sound levels (L_{eq}) are not necessarily the best ways to characterize noise that might adversely affect wildlife (Francis and Barber 2013). Sudden or episodic noises can be more disruptive to some species than continuous or regular noises, so it is helpful to characterize the spectra of noise sources. Noise impacts should be assessed within the auditory frequency range perceived by the species (Pater et al. 2009), as well, so audiograms of each species should be compared to the acoustical spectra of sound sources (Pater et al. 2009).

As an example of what can be learned from comparing avian audiograms to acoustical spectra of sound sources, Warrington et al. (2018) detected most effects of extractive energy noise "resulted from noise frequencies with the greatest overlap with song features." Warrington et al. (2018) found particular infrastructure generated noise that affected particular aspects of a bird's call, and these effects were measured at distances of 43 to 451 m from sources. Noise impacts on wildlife can be highly significant, but they are also complex. Whereas thorough analysis of noise impacts on each species of wildlife is likely infeasible, gross analysis is feasible and warranted. The EIR should be revised to include analysis of potential noise impacts on wildlife, along with mitigation measures.

In summary, through habitat modification and direct impacts of project-generated noise on behavior and survival, the project would likely have substantial adverse effects on as many as 75 species identified as candidate, sensitive, or special-status species in regulations enforced by the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service. The proposed mitigation will not reduce these impacts to less than significant because none of the proposed mitigation addresses noise impacts.

Traffic Impacts on Wildlife

The DEIR provides no estimate of passenger car equivalent daily trips generated by the project, nor does it analyze traffic impacts on wildlife. There is no prediction of the number of truck trips or passenger car trips, nor is there any characterization of the distances driven per day or the roads traveled to and from the project site. The traffic information missing from the DEIR is important because it relates to traffic-caused mortality of wildlife that would result from the project. Vehicle collisions have accounted for the deaths of many thousands of reptile, amphibian, mammal, bird, and arthropod fauna, and the impacts have often been found to be significant at the population level (Forman et al. 2003).

Traffic impacts have taken devastating tolls on wildlife across North America. In Canada, 3,562 birds were estimated killed per 100 km of road per year (Bishop and Brogan 2013), and the US estimate of avian mortality on roads is 2,200 to 8,405 deaths per 100 km per year, or 89 million to 340 million total per year (Loss et al. 2014). Local impacts can be more intense than nationally. Mendelsohn et al. (2009) found 1,275 carcasses of 49 species of mammals, birds, amphibians and reptiles over 15 months of searches for traffic-caused wildlife fatalities along a 2.5 mile stretch of Vasco Road in Contra Costa County, California. Adjusting this number for the proportion of fatalities that were not found due to scavenger removal and searcher error, and the estimated fatality rate is 243,740 animals killed per 100 km of road per year, or 29 times that of Loss et al.'s (2014) upper bound estimate and 68 times the Canadian estimate. Furthermore, of the 49 species found as fatalities on Vasco Road, 8 (16%) were special-status species. Some of the annual tolls, adjusted for the proportions not found, were estimated at 760 California red-legged frogs, 899 California tiger salamanders, 4 burrowing owls and 5 American badgers along a 2.5 mile stretch of road. These are not trivial numbers, but it can also be said that no single project contributes entirely to these death tolls. These tolls are the products of cumulative impacts from projects such as the proposed project. Project-generated traffic impacts on wildlife need to be addressed.

Many thousands of roadkill wildlife incidents also have been reported to the UC Davis Road Ecology Center (Shilling et al. 2017). The costs to drivers is also high (Shilling et al. 22017), and should be analyzed as a potential impact in a revised EIR.

Increased use of existing roads will increase wildlife fatalities (Kobylarz 2001). According to Kobylarz (2001: Figure 7), an increase in traffic from 5 cars per hour to 20 cars per hour tripled the number of amphibians found dead along 4 reaches of road searched by foot. Patterns like this one can be used to predict road mortality increases that are generated by traffic servicing the project. The EIR needs to inform readers of daily trips on existing roads around the project site, as well as the predicted increase in daily trips on these same roads due to the project. From this increase in daily trips, the project's impact on wildlife caused by traffic can be predicted.

In summary, due to increased mortality caused by project-generated traffic, the project would likely have substantial adverse effects on as many as 75 species identified as candidate, sensitive, or special-status species in regulations enforced by the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service. The proposed mitigation will not reduce these impacts to less than significant because none of the proposed mitigation addresses road mortality caused by the project.

Wildlife Movement

Given the 75 special-status species of wildlife known to occur or likely to occur at the project site, it is obvious that the site serves as an important hub for wildlife movement in the region. Adding to this conclusion are the out-of-range species reportedly seen on the site, such as zone-tailed hawk. The site is located at the outlet of San Juan Creek and the Pacific Ocean, and the shape of the coastline forms a natural catchment of volant birds and bats traveling along the coast in search of a north-south landscape corridor (Figure 6). The site needs to be analyzed for its potential use as stop-over habitat (Taylor et al. 2011) or staging habitat (Warnock 2010) by volant wildlife on migration, and as crossover habitat used by nonvolant wildlife during dispersal, migration or home range patrol. The site also needs to be analyzed for whether it is located within a natural wildlife movement bottleneck (Runge et al. 2014). If it is located within a natural landscape bottleneck, then the project's interference with wildlife movement in the region can be severe.

California State Parks (2003:2-23) similarly concluded, "*Doheny SB has two viable wildlife corridors, San Juan Creek and the interface with the Pacific Ocean. San Juan Creek connects Doheny SB with several of the canyons within the upper San Juan Creek watershed, providing for movement between a highly disturbed urban region and areas of natural habitat, including areas within the Cleveland National Forest north and east of Interstate 5.*" California State Parks' conclusion is consistent with my graphic shown in Figure 6. Further reinforcing my conclusions, California State Parks (2003:2-23) added "*The beach and associated riparian areas along the Pacific Ocean provide important stopover sites for migratory birds, while the ocean itself supports fish and marine mammals that migrate along the Southern California Bight. In addition to these wildlife corridors, a strip of native and exotic vegetation runs along the southwestern edge of Coast Highway. Although highly disturbed, it acts as a corridor for resident and migratory birds and other wildlife and links Doheny SB with higher-quality habitat fragments along the coastal bluffs to the northwest.*"

Figure 6. *Likely movement routes of volant wildlife in the region of the proposed project, along coastline and into and out of riparian forests. Dana Point forms a natural catchment of birds and bats flying up the coast, and San Juan Creek looks like a convenient route for birds and bats encountering Dana Point while heading north.*

Due to the project's location in what looks like a landscape bottleneck for migrating and dispersing wildlife along what could be an established native resident or migratory wildlife movement corridor, the project would likely interfere substantially with the movement of native resident wildlife species. Not only would the open space within this bottleneck be replaced by industrial structures, but the project's noise could degrade the stop-over value of neighboring patches of vegetation by increasing stress where stop-over habitat needs to provide rest and recovery. The project could block what is already a movement bottleneck resulting from both the landscape and intense habitat fragmentation in the region. The proposed mitigation would not reduce these impacts to less than significant levels because none of the proposed mitigation addresses impacts on wildlife movement in the region.

MITIGATION

BIO-1 Preconstruction Nesting Bird Survey

Whereas preconstruction bird surveys ought to be performed, these types of surveys are not designed or intended to *reduce* project impacts, let alone to reduce impacts to less than significant levels. Preconstruction surveys are only intended as last-minute minimization measures, whereby readily detectable members of special-status species are rescued from crushing deaths under heavy construction machinery. This one time effort, which might or might not actually result in animal rescues, is considered nothing more than a minimization measure. It cannot possibly *reduce* project impacts, because by definition reduction measure can only be implemented after construction.

Detection surveys need to be completed prior to the circulation of a revised EIR. Detection surveys are needed to inform preconstruction take-avoidance surveys by mapping out where biologists performing preconstruction surveys are most likely to find animals before the tractor blade finds them. Detection surveys are also needed to assess impacts, because preconstruction surveys are not designed for assessing impacts. Detection surveys are also needed to inform the formulation of appropriate mitigation measures, because preconstruction surveys are not intended for this role either. What is missing from the EIR, and what is in greater need than preconstruction surveys, is detection surveys consistent with guidelines and protocols that wildlife ecologists have uniquely developed for use with each special-status species.

BIO-2 DSB Facility Siting. Any facilities sited within DSB shall be reviewed and approved by State Parks and applicable regulatory agencies prior to construction, demonstrating avoidance of sensitive habitat...

This measure makes sense, but an analysis is needed of whether a desalination facility located at this site would significantly reduce use of the site by 75 special-status species, including 11 threatened and endangered species. The project needs to be analyzed for its potential to fragment habitat in a landscape setting that could prove to be a wildlife movement bottleneck.

RECOMMENDED MEASURES

Surveys to Estimate Noise Impacts

If the project goes forward, I suggest implementation of an experimental design, such as a before-after, control-impact (BACI) design or an impact-gradient design, to measure the effects of project-generated noise on local wildlife. A research fund should be allocated to qualified biologists early enough prior to construction so that 'before' phase metrics of acoustic spectra and bird and frog audiograms and behavior patterns can be sampled for comparison to 'after' phase metrics. If the project is to go forward, then a responsible measure in the face of high uncertainty involving precious biological resources would be to learn about the project's impacts so that future similar projects can be more carefully planned.

Surveys to Estimate Traffic Impacts

Similar to the experiment on noise impacts, if the project goes forward, then an experiment should be funded to measure the project's contribution to road mortality of wildlife in the area.

Habitat Enhancements & Restoration to Improve Wildlife Movement through the Region

Where habitat has already been degraded along San Juan Creek, mitigation could consist of enhancements or restoration to provide cover and vertical structure for birds moving through the area. Barriers to movement of nonvolant species of wildlife could also be removed or modified to facilitate passage along San Juan Creek.

Fund Wildlife Rehabilitation Facilities

Compensatory mitigation should be added as a mitigation measure in a revised EIR. Compensatory mitigation ought to also include funding contributions to wildlife rehabilitation facilities to cover the costs of injured animals that will be delivered to these facilities for care. Most of the injuries will likely be caused by the increased trip generation of cars and trucks, as well as line collisions and electrocutions caused by the small power plant needed to energize the pumps and other facilities.

However, as discussed above the draft EIR lacks the necessary information to evaluate, analyze, and mitigate the impacts on all of the special-status species. Both the existing and proposed mitigation measures can only be determined to reduce impacts to less than significant once the impacts have been adequately evaluated and analyzed in a revised Environmental Impact Report.

Thank you for your attention,

Shawn Smallwood

Shawn Smallwood, Ph.D.

REFERENCES CITED

Anthony, L.L., and D.T. Blumstein. 2000. Integrating behavior into wildlife conservation: the multiple ways that behavior can reduce N_e. Biological Conservation 95:303-315.

Bishop, C. A. and J. M. Brogan. 2013. Estimates of Avian Mortality Attributed to Vehicle Collisions in Canada. Avian Conservation and Ecology 8:2. http://dx.doi.org/10.5751/ACE-00604-080202.

California State Parks. 2003. Doheny State Beach Preliminary General Plan and Draft Environmental Impact Report, SCH No. 2003021146. Department of Parks and Recreation, Sacramento, California.

Chambers Group, Inc. 2016. Lower San Juan Creek and seasonal coastal lagoon habitat assessment Orange County, California. Report to South Coast Water District, Laguna Beach, California.

Francis, C. D. and J. R. Barber. 2013. A framework for understanding noise impacts on wildlife: an urgent conservation priority. Frontiers in Ecology and Environment 11:305–313. doi:10.1890/120183

SCWD 2018. Doheny Ocean Desalination Project Draft Environmental Impact Report. State Clearinghouse No. 2016031038. Prepared by Kimley-Horn & Associates, Inc. for South Coast Water District, Laguna Beach, California.

Loss, S. R., T. Will, and P. P. Marra. 2014. Estimation of Bird-Vehicle Collision Mortality on U.S. Roads. Journal of Wildlife Management 78:763-771.

Mendelsohn, M., W. Dexter, E. Olson, and S. Weber. 2009. Vasco Road wildlife movement study report. Report to Contra Costa County Public Works Department, Martinez, California.

MBC Aquatic Sciences. 2018. Impact Assessment: South Coast Water District Doheny Desalination Project. Report to GHD Inc., Irvine, California.

Pater, L. L., T. G. Grubb, and D. D. Delaney. 2009. Recommendations for improved assessment of noise impacts on wildlife. Journal of Wildlife Management 73(5):788–795.

Runge, C. A., T. G. Martin, H. P. Possingham, S. G. Willis, and R. A. Fuller. 2014. Conserving mobile species. Frontiers in Ecology and Environment 12(7): 395–402, doi:10.1890/130237.

Shuford, W. D., and T. Gardali, [eds.]. 2008. California bird species of special concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California.

Smallwood, K. S. 2015. Habitat fragmentation and corridors. Pages 84-101 in M. L. Morrison and H. A. Mathewson, Eds., Wildlife habitat conservation: concepts, challenges, and solutions. John Hopkins University Press, Baltimore, Maryland, USA.

Smallwood, K.S., J. Beyea and M. Morrison. 1999. Using the best scientific data for endangered species conservation. Environmental Management 24:421-435.

Smallwood, K.S., A. Gonzales, T. Smith, E. West, C. Hawkins, E. Stitt, C. Keckler, C. Bailey, and K. Brown. 2001. Suggested standards for science applied to conservation issues. Transactions of the Western Section of the Wildlife Society 36:40-49.

Slabbekoorn, H. and M. Peet. 2003. Birds sing at a higher pitch in urban noise. Nature 424:267.

Taylor, P. D., S. A. Mackenzie, B. G. Thurber, A. M. Calvert, A. M. Mills, L. P. McGuire, and C. G. Guglielmo. 2011. Landscape movements of migratory birds and bats reveal an expanded scale of stopover. PlosOne 6(11): e27054. doi:10.1371/journal.pone.0027054.

Warnock, N. 2010. Stopping vs. staging: the difference between a hop and a jump. Journal of Avian Biology 41:621-626.

Warrington, M. H., C. M. Curry, B. Antze, and N. Koper. 2018. Noise from four types of extractive energy infrastructure affects song features of Savannah Sparrows. The Condor 120(1):1-15.

Kenneth Shawn Smallwood
Curriculum Vitae

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Born May 3, 1963 in
Sacramento, California.
Married, father of two.

Ecologist

Expertise

- Finding solutions to controversial problems related to wildlife interactions with human industry, infrastructure, and activities;
- Wildlife monitoring and field study using GPS, thermal imaging, behavior surveys;
- Using systems analysis and experimental design principles to identify meaningful ecological patterns that inform management decisions.

Education

Ph.D. Ecology, University of California, Davis. September 1990.
M.S. Ecology, University of California, Davis. June 1987.
B.S. Anthropology, University of California, Davis. June 1985.
Corcoran High School, Corcoran, California. June 1981.

Experience

- 478 professional publications, including:
- 82 peer reviewed publications
- 24 in non-reviewed proceedings
- 370 reports, declarations, posters and book reviews
- 8 in mass media outlets
- 87 public presentations of research results at meetings

Editing for scientific journals: Guest Editor, *Wildlife Society Bulletin*, 2012-2013, of invited papers representing international views on the impacts of wind energy on wildlife and how to mitigate the impacts. Associate Editor, *Journal of Wildlife Management*, March 2004 to 30 June 2007. Editorial Board Member, *Environmental Management*, 10/1999 to 8/2004. Associate Editor, *Biological Conservation*, 9/1994 to 9/1995.

Member, Alameda County Scientific Review Committee (SRC), August 2006 to April 2011. The five-member committee investigated causes of bird and bat collisions in the Altamont Pass Wind Resource Area, and recommended mitigation and monitoring measures. The SRC reviewed the science underlying the Alameda County Avian Protection Program, and advised the County on how to reduce wildlife fatalities.

Consulting Ecologist, 2004-2007, California Energy Commission (CEC). Provided consulting services as needed to the CEC on renewable energy impacts, monitoring and research, and produced several reports. Also collaborated with Lawrence-Livermore National Lab on research to understand and reduce wind turbine impacts on wildlife.

Consulting Ecologist, 1999-2013, U.S. Navy. Performed endangered species surveys, hazardous waste site monitoring, and habitat restoration for the endangered San Joaquin kangaroo rat, California tiger salamander, California red-legged frog, California clapper rail, western burrowing owl, salt marsh harvest mouse, and other species at Naval Air Station Lemoore; Naval Weapons Station, Seal Beach, Detachment Concord; Naval Security Group Activity, Skaggs Island; National Radio Transmitter Facility, Dixon; and, Naval Outlying Landing Field Imperial Beach.

Part-time Lecturer, 1998-2005, California State University, Sacramento. Instructed Mammalogy, Behavioral Ecology, and Ornithology Lab, Contemporary Environmental Issues, Natural Resources Conservation.

Senior Ecologist, 1999-2005, BioResource Consultants. Designed and implemented research and monitoring studies related to avian fatalities at wind turbines, avian electrocutions on electric distribution poles across California, and avian fatalities at transmission lines.

Chairman, Conservation Affairs Committee, The Wildlife Society--Western Section, 1999-2001. Prepared position statements and led efforts directed toward conservation issues, including travel to Washington, D.C. to lobby Congress for more wildlife conservation funding.

Systems Ecologist, 1995-2000, Institute for Sustainable Development. Headed ISD's program on integrated resources management. Developed indicators of ecological integrity for large areas, using remotely sensed data, local community involvement and GIS.

Associate, 1997-1998, Department of Agronomy and Range Science, University of California, Davis. Worked with Shu Geng and Mingua Zhang on several studies related to wildlife interactions with agriculture and patterns of fertilizer and pesticide residues in groundwater across a large landscape.

Lead Scientist, 1996-1999, National Endangered Species Network. Informed academic scientists and environmental activists about emerging issues regarding the Endangered Species Act and other environmental laws. Testified at public hearings on endangered species issues.

Ecologist, 1997-1998, Western Foundation of Vertebrate Zoology. Conducted field research to determine the impact of past mercury mining on the status of California red-legged frogs in Santa Clara County, California.

Senior Systems Ecologist, 1994-1995, EIP Associates, Sacramento, California. Provided consulting services in environmental planning, and quantitative assessment of land units for their conservation and restoration opportunities basedon ecological resource requirements of 29 special-status species. Developed ecological indicators for prioritizing areas within Yolo County to receive mitigation funds for habitat easements and restoration.

Post-Graduate Researcher, 1990-1994, Department of Agronomy and Range Science, *U.C. Davis*. Under Dr. Shu Geng's mentorship, studied landscape and management effects on temporal and spatial patterns of abundance among pocket gophers and species of Falconiformes and Carnivora in the Sacramento Valley. Managed and analyzed a data base of energy use in California agriculture. Assisted with landscape (GIS) study of groundwater contamination across Tulare County, California.

Work experience in graduate school: Co-taught Conservation Biology with Dr. Christine Schonewald, 1991 & 1993, UC Davis Graduate Group in Ecology; Reader for Dr. Richard Coss's course on Psychobiology in 1990, UC Davis Department of Psychology; Research Assistant to Dr. Walter E. Howard, 1988-1990, UC Davis Department of Wildlife and Fisheries Biology, testing durable baits for pocket gopher management in forest clearcuts; Research Assistant to Dr. Terrell P. Salmon, 1987-1988, UC Wildlife Extension, Department of Wildlife and Fisheries Biology, developing empirical models of mammal and bird invasions in North America, and a rating system for priority research and control of exotic species based on economic, environmental and human health hazards in California. Student Assistant to Dr. E. Lee Fitzhugh, 1985-1987, UC Cooperative Extension, Department of Wildlife and Fisheries Biology, developing and implementing statewide mountain lion track count for long-term monitoring.

Fulbright Research Fellow, Indonesia, 1988. Tested use of new sampling methods for numerical monitoring of Sumatran tiger and six other species of endemic felids, and evaluated methods used by other researchers.

Projects

Repowering wind energy projects through careful siting of new wind turbines using map-based collision hazard models to minimize impacts to volant wildlife. Funded by wind companies (principally NextEra Renewable Energy, Inc.), California Energy Commission and East Bay Regional Park District, I have collaborated with a GIS analyst and managed a crew of five field biologists performing golden eagle behavior surveys and nocturnal surveys on bats and owls. The goal is to quantify flight patterns for development of predictive models to more carefully site new wind turbines in repowering projects. Focused behavior surveys began May 2012 and continue. Collision hazard models have been prepared for seven wind projects, three of which were built. Planning for additional repowering projects is underway.

Test avian safety of new mixer-ejector wind turbine (MEWT). Designed and implemented a before-after, control-impact experimental design to test the avian safety of a new, shrouded wind turbine developed by Ogin Inc. (formerly known as FloDesign Wind Turbine Corporation). Supported by a $718,000 grant from the California Energy Commission's Public Interest Energy Research program and a 20% match share contribution from Ogin, I managed a crew of seven field biologists who performed periodic fatality searches and behavior surveys, carcass detection trials, nocturnal behavior surveys using a thermal camera, and spatial analyses with the collaboration of a GIS analyst. Field work began 1 April 2012 and ended 30 March 2015 without Ogin installing its MEWTs, but we still achieved multiple important scientific advances.

Reduce avian mortality due to wind turbines at Altamont Pass. Studied wildlife impacts caused by 5,400 wind turbines at the world's most notorious wind resource area. Studied how impacts are perceived by monitoring and how they are affected by terrain, wind patterns, food resources, range management practices, wind turbine operations, seasonal patterns, population cycles, infrastructure management such as electric distribution, animal behavior and social interactions.

Reduce avian mortality on electric distribution poles. Directed research toward reducing bird electrocutions on electric distribution poles, 2000-2007. Oversaw 5 founds of fatality searches at 10,000 poles from Orange County to Glenn County, California, and produced two large reports.

Cook *et al.* v. Rockwell International *et al.*, No. 90-K-181 (D. Colorado). Provided expert testimony on the role of burrowing animals in affecting the fate of buried and surface-deposited radioactive and hazardous chemical wastes at the Rocky Flats Plant, Colorado. Provided expert reports based on four site visits and an extensive document review of burrowing animals. Conducted transect surveys for evidence of burrowing animals and other wildlife on and around waste facilities. Discovered substantial intrusion of waste structures by burrowing animals. I testified in federal court in November 2005, and my clients were subsequently awarded a $553,000,000 judgment by a jury. After appeals the award was increased to two billion dollars.

Hanford Nuclear Reservation Litigation. Provided expert testimony on the role of burrowing animals in affecting the fate of buried radioactive wastes at the Hanford Nuclear Reservation, Washington. Provided three expert reports based on three site visits and extensive document review. Predicted and verified a certain population density of pocket gophers on buried waste structures, as well as incidence of radionuclide contamination in body tissue. Conducted transect surveys for evidence of burrowing animals and other wildlife on and around waste facilities. Discovered substantial intrusion of waste structures by burrowing animals.

Expert testimony and declarations on proposed residential and commercial developments, gas-fired power plants, wind, solar and geothermal projects, water transfers and water transfer delivery systems, endangered species recovery plans, Habitat Conservation Plans and Natural Communities Conservation Programs. Testified before multiple government agencies, Tribunals, Boards of Supervisors and City Councils, and participated with press conferences and depositions. Prepared expert witness reports and court declarations, which are summarized under Reports (below).

Protocol-level surveys for special-status species. Used California Department of Fish and Wildlife and US Fish and Wildlife Service protocols to search for California red-legged frog, California tiger salamander, arroyo southwestern toad, blunt-nosed leopard lizard, western pond turtle, giant kangaroo rat, San Joaquin kangaroo rat, San Joaquin kit fox, western burrowing owl, Swainson's hawk, Valley elderberry longhorn beetle and other special-status species.

Conservation of San Joaquin kangaroo rat. Performed research to identify factors responsible for the decline of this endangered species at Lemoore Naval Air Station, 2000-2013, and implemented habitat enhancements designed to reverse the trend and expand the population.

Impact of West Nile Virus on yellow-billed magpies. Funded by Sacramento-Yolo Mosquito and Vector Control District, 2005-2008, compared survey results pre- and post-West Nile Virus epidemic for multiple bird species in the Sacramento Valley, particularly on yellow-billed magpie and American crow due to susceptibility to WNV.

Workshops on HCPs. Assisted Dr. Michael Morrison with organizing and conducting a 2-day workshop on Habitat Conservation Plans, sponsored by Southern California Edison, and another 1-day workshop sponsored by PG&E. These Workshops were attended by academics, attorneys, and consultants with HCP experience. We guest-edited a Proceedings published in Environmental Management.

Mapping of biological resources along Highways 101, 46 and 41. Used GPS and GIS to delineate vegetation complexes and locations of special-status species along 26 miles of highway in San Luis Obispo County, 14 miles of highway and roadway in Monterey County, and in a large area north of Fresno, including within reclaimed gravel mining pits.

GPS mapping and monitoring at restoration sites and at Caltrans mitigation sites. Monitored the success of elderberry shrubs at one location, the success of willows at another location, and the response of wildlife to the succession of vegetation at both sites. Also used GPS to monitor the response of fossorial animals to yellow star-thistle eradication and natural grassland restoration efforts at Bear Valley in Colusa County and at the decommissioned Mather Air Force Base in Sacramento County.

Mercury effects on Red-legged Frog. Assisted Dr. Michael Morrison and US Fish and Wildlife Service in assessing the possible impacts of historical mercury mining on the federally listed California red-legged frog in Santa Clara County. Also measured habitat variables in streams.

Opposition to proposed No Surprises rule. Wrote a white paper and summary letter explaining scientific grounds for opposing the incidental take permit (ITP) rules providing ITP applicants and holders with general assurances they will be free of compliance with the Endangered Species Act once they adhere to the terms of a "properly functioning HCP." Submitted 188 signatures of scientists and environmental professionals concerned about No Surprises rule US Fish and Wildlife Service, National Marine Fisheries Service, all US Senators.

Natomas Basin Habitat Conservation Plan alternative. Designed narrow channel marsh to increase the likelihood of survival and recovery in the wild of giant garter snake, Swainson's hawk and Valley Elderberry Longhorn Beetle. The design included replication and interspersion of treatments for experimental testing of critical habitat elements. I provided a report to Northern Territories, Inc.

Assessments of agricultural production system and environmental technology transfer to China. Twice visited China and interviewed scientists, industrialists, agriculturalists, and the Directors of the Chinese Environmental Protection Agency and the Department of Agriculture to assess the need and possible pathways for environmental clean-up technologies and trade opportunities between the US and China.

Yolo County Habitat Conservation Plan. Conducted landscape ecology study of Yolo County to spatially prioritize allocation of mitigation efforts to improve ecosystem functionality within the

County from the perspective of 29 special-status species of wildlife and plants. Used a hierarchically structured indicators approach to apply principles of landscape and ecosystem ecology, conservation biology, and local values in rating land units. Derived GIS maps to help guide the conservation area design, and then developed implementation strategies.

Mountain lion track count. Developed and conducted a carnivore monitoring program throughout California since 1985. Species counted include mountain lion, bobcat, black bear, coyote, red and gray fox, raccoon, striped skunk, badger, and black-tailed deer. Vegetation and land use are also monitored. Track survey transect was established on dusty, dirt roads within randomly selected quadrats.

Sumatran tiger and other felids. Upon award of Fulbright Research Fellowship, I designed and initiated track counts for seven species of wild cats in Sumatra, including Sumatran tiger, fishing cat, and golden cat. Spent four months on Sumatra and Java in 1988, and learned Bahasa Indonesia, the official Indonesian language.

Wildlife in agriculture. Beginning as post-graduate research, I studied pocket gophers and other wildlife in 40 alfalfa fields throughout the Sacramento Valley, and I surveyed for wildlife along a 200 mile road transect since 1989 with a hiatus of 1996-2004. The data are analyzed using GIS and methods from landscape ecology, and the results published and presented orally to farming groups in California and elsewhere. I also conducted the first study of wildlife in cover crops used on vineyards and orchards.

Agricultural energy use and Tulare County groundwater study. Developed and analyzed a data base of energy use in California agriculture, and collaborated on a landscape (GIS) study of groundwater contamination across Tulare County, California.

Pocket gopher damage in forest clear-cuts. Developed gopher sampling methods and tested various poison baits and baiting regimes in the largest-ever field study of pocket gopher management in forest plantations, involving 68 research plots in 55 clear-cuts among 6 National Forests in northern California.

Risk assessment of exotic species in North America. Developed empirical models of mammal and bird species invasions in North America, as well as a rating system for assigning priority research and control to exotic species in California, based on economic, environmental, and human health hazards.

Peer Reviewed Publications

Smallwood, K. S., D. A. Bell, E. L. Walther, E. Leyvas, S. Standish, J. Mount, B. Karas. 2018. Estimating wind turbine fatalities using integrated detection trials. Journal of Wildlife Management: 1169-1184.

Smallwood, K. S. 2017. Long search intervals under-estimate bird and bat fatalities caused by wind turbines. Wildlife Society Bulletin 41:224-230.

Smallwood, K. S. 2017. The challenges of addressing wildlife impacts when repowering wind energy projects. Pages 175-187 in Köppel, J., Editor, Wind Energy and Wildlife Impacts: Proceedings from the CWW2015 Conference. Springer. Cham, Switzerland.

May, R., Gill, A. B., Köppel, J. Langston, R. H.W., Reichenbach, M., Scheidat, M., Smallwood, S., Voigt, C. C., Hüppop, O., and Portman, M. 2017. Future research directions to reconcile wind turbine–wildlife interactions. Pages 255-276 in Köppel, J., Editor, Wind Energy and Wildlife Impacts: Proceedings from the CWW2015 Conference. Springer. Cham, Switzerland.

Smallwood, K. S. 2017. Monitoring birds. M. Perrow, Ed., Wildlife and Wind Farms - Conflicts and Solutions, Volume 2. Pelagic Publishing, Exeter, United Kingdom. www.bit.ly/2v3cR9Q

Smallwood, K. S., L. Neher, and D. A. Bell. 2017. Siting to Minimize Raptor Collisions: an example from the Repowering Altamont Pass Wind Resource Area. M. Perrow, Ed., Wildlife and Wind Farms - Conflicts and Solutions, Volume 2. Pelagic Publishing, Exeter, United Kingdom. www.bit.ly/2v3cR9Q

Johnson, D. H., S. R. Loss, K. S. Smallwood, W. P. Erickson. 2016. Avian fatalities at wind energy facilities in North America: A comparison of recent approaches. Human–Wildlife Interactions 10(1):7-18.

Sadar, M. J., D. S.-M. Guzman, A. Mete, J. Foley, N. Stephenson, K. H. Rogers, C. Grosset, K. S. Smallwood, J. Shipman, A. Wells, S. D. White, D. A. Bell, and M. G. Hawkins. 2015. Mange Caused by a novel Micnemidocoptes mite in a Golden Eagle (*Aquila chrysaetos*). Journal of Avian Medicine and Surgery 29(3):231-237.

Smallwood, K. S. 2015. Habitat fragmentation and corridors. Pages 84-101 in M. L. Morrison and H. A. Mathewson, Eds., Wildlife habitat conservation: concepts, challenges, and solutions. John Hopkins University Press, Baltimore, Maryland, USA.

Mete, A., N. Stephenson, K. Rogers, M. G. Hawkins, M. Sadar, D. Guzman, D. A. Bell, J. Shipman, A. Wells, K. S. Smallwood, and J. Foley. 2014. Emergence of Knemidocoptic mange in wild Golden Eagles (Aquila chrysaetos) in California. Emerging Infectious Diseases 20(10):1716-1718.

Smallwood, K. S. 2013. Introduction: Wind-energy development and wildlife conservation. Wildlife Society Bulletin 37: 3-4.

Smallwood, K. S. 2013. Comparing bird and bat fatality-rate estimates among North American wind-energy projects. Wildlife Society Bulletin 37:19-33. + Online Supplemental Material.

Smallwood, K. S., L. Neher, J. Mount, and R. C. E. Culver. 2013. Nesting Burrowing Owl Abundance in the Altamont Pass Wind Resource Area, California. Wildlife Society Bulletin: 37:787-795.

Smallwood, K. S., D. A. Bell, B. Karas, and S. A. Snyder. 2013. Response to Huso and Erickson Comments on Novel Scavenger Removal Trials. Journal of Wildlife Management 77: 216-225.

Bell, D. A., and K. S. Smallwood. 2010. Birds of prey remain at risk. Science 330:913.

Smallwood, K. S., D. A. Bell, S. A. Snyder, and J. E. DiDonato. 2010. Novel scavenger removal trials increase estimates of wind turbine-caused avian fatality rates. Journal of Wildlife Management 74: 1089-1097 + Online Supplemental Material.

Smallwood, K. S., L. Neher, and D. A. Bell. 2009. Map-based repowering and reorganization of a wind resource area to minimize burrowing owl and other bird fatalities. Energies 2009(2):915-943. http://www.mdpi.com/1996-1073/2/4/915

Smallwood, K. S. and B. Nakamoto. 2009. Impacts of West Nile Virus Epizootic on Yellow-Billed Magpie, American Crow, and other Birds in the Sacramento Valley, California. The Condor 111:247-254.

Smallwood, K. S., L. Rugge, and M. L. Morrison. 2009. Influence of Behavior on Bird Mortality in Wind Energy Developments: The Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 73:1082-1098.

Smallwood, K. S. and B. Karas. 2009. Avian and Bat Fatality Rates at Old-Generation and Repowered Wind Turbines in California. Journal of Wildlife Management 73:1062-1071.

Smallwood, K. S. 2008. Wind power company compliance with mitigation plans in the Altamont Pass Wind Resource Area. Environmental & Energy Law Policy Journal 2(2):229-285.

Smallwood, K. S., C. G. Thelander. 2008. Bird Mortality in the Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 72:215-223.

Smallwood, K. S. 2007. Estimating wind turbine-caused bird mortality. Journal of Wildlife Management 71:2781-2791.

Smallwood, K. S., C. G. Thelander, M. L. Morrison, and L. M. Rugge. 2007. Burrowing owl mortality in the Altamont Pass Wind Resource Area. Journal of Wildlife Management 71:1513-1524.

Cain, J. W. III, K. S. Smallwood, M. L. Morrison, and H. L. Loffland. 2005. Influence of mammal activity on nesting success of Passerines. J. Wildlife Management 70:522-531.

Smallwood, K.S. 2002. Habitat models based on numerical comparisons. Pages 83-95 *in* Predicting species occurrences: Issues of scale and accuracy, J. M. Scott, P. J. Heglund, M. Morrison, M. Raphael, J. Haufler, and B. Wall, editors. Island Press, Covello, California.

Morrison, M. L., K. S. Smallwood, and L. S. Hall. 2002. Creating habitat through plant relocation: Lessons from Valley elderberry longhorn beetle mitigation. Ecological Restoration 21: 95-100.

Zhang, M., K. S. Smallwood, and E. Anderson. 2002. Relating indicators of ecological health and integrity to assess risks to sustainable agriculture and native biota. Pages 757-768 *in* D.J. Rapport, W.L. Lasley, D.E. Rolston, N.O. Nielsen, C.O. Qualset, and A.B. Damania (eds.), Managing for Healthy Ecosystems, Lewis Publishers, Boca Raton, Florida USA.

Wilcox, B. A., K. S. Smallwood, and J. A. Kahn. 2002. Toward a forest Capital Index. Pages 285-298 *in* D.J. Rapport, W.L. Lasley, D.E. Rolston, N.O. Nielsen, C.O. Qualset, and A.B. Damania (eds.), Managing for Healthy Ecosystems, Lewis Publishers, Boca Raton, Florida USA.

Smallwood, K.S. 2001. The allometry of density within the space used by populations of Mammalian Carnivores. Canadian Journal of Zoology 79:1634-1640.

Smallwood, K.S., and T.R. Smith. 2001. Study design and interpretation of Sorex density estimates. Annales Zoologi Fennici 38:141-161.

Smallwood, K.S., A. Gonzales, T. Smith, E. West, C. Hawkins, E. Stitt, C. Keckler, C. Bailey, and K. Brown. 2001. Suggested standards for science applied to conservation issues. Transactions of the Western Section of the Wildlife Society 36:40-49.

Geng, S., Yixing Zhou, Minghua Zhang, and K. Shawn Smallwood. 2001. A Sustainable Agro-ecological Solution to Water Shortage in North China Plain (Huabei Plain). Environmental Planning and Management 44:345-355.

Smallwood, K. Shawn, Lourdes Rugge, Stacia Hoover, Michael L. Morrison, Carl Thelander. 2001. Intra- and inter-turbine string comparison of fatalities to animal burrow densities at Altamont Pass. Pages 23-37 in S. S. Schwartz, ed., Proceedings of the National Avian-Wind Power Planning Meeting IV. RESOLVE, Inc., Washington, D.C.

Smallwood, K.S., S. Geng, and M. Zhang. 2001. Comparing pocket gopher (*Thomomys bottae*) density in alfalfa stands to assess management and conservation goals in northern California. Agriculture, Ecosystems & Environment 87: 93-109.

Smallwood, K. S. 2001. Linking habitat restoration to meaningful units of animal demography. Restoration Ecology 9:253-261.

Smallwood, K. S. 2000. A crosswalk from the Endangered Species Act to the HCP Handbook and real HCPs. Environmental Management 26, Supplement 1:23-35.

Smallwood, K. S., J. Beyea and M. Morrison. 1999. Using the best scientific data for endangered species conservation. Environmental Management 24:421-435.

Smallwood, K. S. 1999. Scale domains of abundance among species of Mammalian Carnivora. Environmental Conservation 26:102-111.

Smallwood, K.S. 1999. Suggested study attributes for making useful population density estimates. Transactions of the Western Section of the Wildlife Society 35: 76-82.

Smallwood, K. S. and M. L. Morrison. 1999. Estimating burrow volume and excavation rate of pocket gophers (Geomyidae). Southwestern Naturalist 44:173-183.

Smallwood, K. S. and M. L. Morrison. 1999. Spatial scaling of pocket gopher (*Geomyidae*) density. Southwestern Naturalist 44:73-82.

Smallwood, K. S. 1999. Abating pocket gophers (*Thomomys* spp.) to regenerate forests in clearcuts. Environmental Conservation 26:59-65.

Smallwood, K. S. 1998. Patterns of black bear abundance. Transactions of the Western Section of the Wildlife Society 34:32-38.

Smallwood, K. S. 1998. On the evidence needed for listing northern goshawks (*Accipter gentilis*) under the Endangered Species Act: a reply to Kennedy. J. Raptor Research 32:323-329.

Smallwood, K. S., B. Wilcox, R. Leidy, and K. Yarris. 1998. Indicators assessment for Habitat Conservation Plan of Yolo County, California, USA. Environmental Management 22: 947-958.

Smallwood, K. S., M. L. Morrison, and J. Beyea. 1998. Animal burrowing attributes affecting hazardous waste management. Environmental Management 22: 831-847.

Smallwood, K. S, and C. M. Schonewald. 1998. Study design and interpretation for mammalian carnivore density estimates. Oecologia 113:474-491.

Zhang, M., S. Geng, and K. S. Smallwood. 1998. Nitrate contamination in groundwater of Tulare County, California. Ambio 27(3):170-174.

Smallwood, K. S. and M. L. Morrison. 1997. Animal burrowing in the waste management zone of Hanford Nuclear Reservation. Proceedings of the Western Section of the Wildlife Society Meeting 33:88-97.

Morrison, M. L., K. S. Smallwood, and J. Beyea. 1997. Monitoring the dispersal of contaminants by wildlife at nuclear weapons production and waste storage facilities. The Environmentalist 17:289-295.

Smallwood, K. S. 1997. Interpreting puma (*Puma concolor*) density estimates for theory and management. Environmental Conservation 24(3):283-289.

Smallwood, K. S. 1997. Managing vertebrates in cover crops: a first study. American Journal of Alternative Agriculture 11:155-160.

Smallwood, K. S. and S. Geng. 1997. Multi-scale influences of gophers on alfalfa yield and quality. Field Crops Research 49:159-168.

Smallwood, K. S. and C. Schonewald. 1996. Scaling population density and spatial pattern for terrestrial, mammalian carnivores. Oecologia 105:329-335.

Smallwood, K. S., G. Jones, and C. Schonewald. 1996. Spatial scaling of allometry for terrestrial, mammalian carnivores. Oecologia 107:588-594.

Van Vuren, D. and K. S. Smallwood. 1996. Ecological management of vertebrate pests in agricultural systems. Biological Agriculture and Horticulture 13:41-64.

Smallwood, K. S., B. J. Nakamoto, and S. Geng. 1996. Association analysis of raptors on an agricultural landscape. Pages 177-190 in D.M. Bird, D.E. Varland, and J.J. Negro, eds., Raptors in human landscapes. Academic Press, London.

Erichsen, A. L., K. S. Smallwood, A. M. Commandatore, D. M. Fry, and B. Wilson. 1996. White-tailed Kite movement and nesting patterns in an agricultural landscape. Pages 166-176 in D. M. Bird, D. E. Varland, and J. J. Negro, eds., Raptors in human landscapes. Academic Press, London.

Smallwood, K. S. 1995. Scaling Swainson's hawk population density for assessing habitat-use across an agricultural landscape. J. Raptor Research 29:172-178.

Smallwood, K. S. and W. A. Erickson. 1995. Estimating gopher populations and their abatement in forest plantations. Forest Science 41:284-296.

Smallwood, K. S. and E. L. Fitzhugh. 1995. A track count for estimating mountain lion *Felis concolor californica* population trend. Biological Conservation 71:251-259

Smallwood, K. S. 1994. Site invasibility by exotic birds and mammals. Biological Conservation 69:251-259.

Smallwood, K. S. 1994. Trends in California mountain lion populations. Southwestern Naturalist 39:67-72.

Smallwood, K. S. 1993. Understanding ecological pattern and process by association and order. Acta Oecologica 14(3):443-462.

Smallwood, K. S. and E. L. Fitzhugh. 1993. A rigorous technique for identifying individual mountain lions *Felis concolor* by their tracks. Biological Conservation 65:51-59.

Smallwood, K. S. 1993. Mountain lion vocalizations and hunting behavior. The Southwestern Naturalist 38:65-67.

Smallwood, K. S. and T. P. Salmon. 1992. A rating system for potential exotic vertebrate pests.

Biological Conservation 62:149-159.

Smallwood, K. S. 1990. Turbulence and the ecology of invading species. Ph.D. Thesis, University of California, Davis.

Peer-reviewed Reports

Smallwood, K. S., and L. Neher. 2017. Comparing bird and bat use data for siting new wind power generation. Report CEC-500-2017-019, California Energy Commission Public Interest Energy Research program, Sacramento, California. http://www.energy.ca.gov/2017publications/CEC-500-2017-019/CEC-500-2017-019.pdf and http://www.energy.ca.gov/2017publications/CEC-500-2017-019/CEC-500-2017-019-APA-F.pdf

Smallwood, K. S. 2016. Bird and bat impacts and behaviors at old wind turbines at Forebay, Altamont Pass Wind Resource Area. Report CEC-500-2016-066, California Energy Commission Public Interest Energy Research program, Sacramento, California. http://www.energy.ca.gov/2016publications/CEC-500-2016-066/CEC-500-2016-066.pdf

Sinclair, K. and E. DeGeorge. 2016. Framework for Testing the Effectiveness of Bat and Eagle Impact-Reduction Strategies at Wind Energy Projects. S. Smallwood, M. Schirmacher, and M. Morrison, eds., Technical Report NREL/TP-5000-65624, National Renewable Energy Laboratory, Golden, Colorado.

Brown, K., K. S. Smallwood, J. Szewczak, and B. Karas. 2016. Final 2012-2015 Report Avian and Bat Monitoring Project Vasco Winds, LLC. Prepared for NextEra Energy Resources, Livermore, California.

Brown, K., K. S. Smallwood, J. Szewczak, and B. Karas. 2014. Final 2013-2014 Annual Report Avian and Bat Monitoring Project Vasco Winds, LLC. Prepared for NextEra Energy Resources, Livermore, California.

Brown, K., K. S. Smallwood, and B. Karas. 2013. Final 2012-2013 Annual Report Avian and Bat Monitoring Project Vasco Winds, LLC. Prepared for NextEra Energy Resources, Livermore, California. http://www.altamontsrc.org/alt_doc/p274_ventus_vasco_winds_2012_13_avian_bat_monitoring_report_year_1.pdf

Smallwood, K. S., L. Neher, D. Bell, J. DiDonato, B. Karas, S. Snyder, and S. Lopez. 2009. Range Management Practices to Reduce Wind Turbine Impacts on Burrowing Owls and Other Raptors in the Altamont Pass Wind Resource Area, California. Final Report to the California Energy Commission, Public Interest Energy Research – Environmental Area, Contract No. CEC-500-2008-080. Sacramento, California. 183 pp. http://www.energy.ca.gov/2008publications/CEC-500-2008-080/CEC-500-2008-080.PDF

Smallwood, K. S., and L. Neher. 2009. Map-Based Repowering of the Altamont Pass Wind Resource Area Based on Burrowing Owl Burrows, Raptor Flights, and Collisions with Wind Turbines. Final Report to the California Energy Commission, Public Interest Energy Research – Environmental Area, Contract No. CEC-500-2009-065. Sacramento, California. 63 pp.

http://www.energy.ca.gov/2009publications/CEC-500-2009-065/CEC-500-2009-065.PDF

Smallwood, K. S., K. Hunting, L. Neher, L. Spiegel and M. Yee. 2007. Indicating Threats to Birds Posed by New Wind Power Projects in California. Final Report to the California Energy Commission, Public Interest Energy Research – Environmental Area, Contract No. Pending. Sacramento, California.

Smallwood, K. S. and C. Thelander. 2005. Bird mortality in the Altamont Pass Wind Resource Area, March 1998 – September 2001 Final Report. National Renewable Energy Laboratory, NREL/SR-500-36973. Golden, Colorado. 410 pp.

Smallwood, K. S. and C. Thelander. 2004. Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area. Final Report to the California Energy Commission, Public Interest Energy Research – Environmental Area, Contract No. 500-01-019. Sacramento, California. 531 pp. http://www.energy.ca.gov/reports/500-04-052/2004-08-09_500-04-052.PDF

Thelander, C.G. S. Smallwood, and L. Rugge. 2003. Bird risk behaviors and fatalities at the Altamont Pass Wind Resource Area. Period of Performance: March 1998—December 2000. National Renewable Energy Laboratory, NREL/SR-500-33829. U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia. 86 pp.

Thelander, C.G., S. Smallwood, and L. Rugge. 2001. Bird risk behaviors and fatalities at the Altamont Wind Resource Area – a progress report. Proceedings of the American Wind Energy Association, Washington D.C. 16 pp.

Non-Peer Reviewed Publications

Smallwood, K. S., D. Bell, and S. Standish. 2018. Skilled dog detections of bat and small bird carcasses in wind turbine fatality monitoring. Report to East Bay Regional Park District, Oakland, California.

Smallwood, K. S. 2009. Methods manual for assessing wind farm impacts to birds. Bird Conservation Series 26, Wild Bird Society of Japan, Tokyo. T. Ura, ed., in English with Japanese translation by T. Kurosawa. 90 pp.

Smallwood, K. S. 2009. Mitigation in U.S. Wind Farms. Pages 68-76 in H. Hötker (Ed.), Birds of Prey and Wind Farms: Analysis of problems and possible solutions. Documentation of an International Workshop in Berlin, 21st and 22nd October 2008. Michael-Otto-Instiut im NABU, Goosstroot 1, 24861 Bergenhusen, Germany. http://bergenhusen.nabu.de/forschung/greifvoegel/

Smallwood, K. S. 2007. Notes and recommendations on wildlife impacts caused by Japan's wind power development. Pages 242-245 in Yukihiro Kominami, Tatsuya Ura, Koshitawa, and Tsuchiya, Editors, Wildlife and Wind Turbine Report 5. Wild Bird Society of Japan, Tokyo.

Thelander, C.G. and S. Smallwood. 2007. The Altamont Pass Wind Resource Area's Effects on Birds: A Case History. Pages 25-46 in Manuela de Lucas, Guyonne F.E. Janss, Miguel Ferrer Editors, Birds and Wind Farms: risk assessment and mitigation. Madrid: Quercus.

Neher, L. and S. Smallwood. 2005. Forecasting and minimizing avian mortality in siting wind turbines. Energy Currents. Fall Issue. ESRI, Inc., Redlands, California.

Jennifer Davidson and Shawn Smallwood. 2004. Laying plans for a hydrogen highway. Comstock's Business, August 2004:18-20, 22, 24-26.

Jennifer Davidson and Shawn Smallwood. 2004. Refined conundrum: California consumers demand more oil while opposing refinery development. Comstock's Business, November 2004:26-27, 29-30.

Smallwood, K.S. 2002. Review of "The Atlas of Endangered Species." By Richard Mackay. Environmental Conservation 30:210-211.

Smallwood, K.S. 2002. Review of "The Endangered Species Act. History, Conservation, and Public Policy." By Brian Czech and Paul B. Krausman. Environmental Conservation 29: 269-270.

Smallwood, K.S. 1997. Spatial scaling of pocket gopher (Geomyidae) burrow volume. Abstract in Proceedings of 44th Annual Meeting, Southwestern Association of Naturalists. Department of Biological Sciences, University of Arkansas, Fayetteville.

Smallwood, K.S. 1997. Estimating prairie dog and pocket gopher burrow volume. Abstract in Proceedings of 44th Annual Meeting, Southwestern Association of Naturalists. Department of Biological Sciences, University of Arkansas, Fayetteville.

Smallwood, K.S. 1997. Animal burrowing parameters influencing toxic waste management. Abstract in Proceedings of Meeting, Western Section of the Wildlife Society.

Smallwood, K.S, and Bruce Wilcox. 1996. Study and interpretive design effects on mountain lion density estimates. Abstract, page 93 in D.W. Padley, ed., *Proceedings 5th Mountain Lion Workshop*, Southern California Chapter, The Wildlife Society. 135 pp.

Smallwood, K.S, and Bruce Wilcox. 1996. Ten years of mountain lion track survey. Page 94 in D.W. Padley, ed. Abstract, page 94 in D.W. Padley, ed., *Proceedings 5th Mountain Lion Workshop*, Southern California Chapter, The Wildlife Society. 135 pp.

Smallwood, K.S, and M. Grigione. 1997. Photographic recording of mountain lion tracks. Pages 75-75 in D.W. Padley, ed., *Proceedings 5th Mountain Lion Workshop*, Southern California Chapter, The Wildlife Society. 135 pp.

Smallwood, K.S., B. Wilcox, and J. Karr. 1995. An approach to scaling fragmentation effects. Brief 8, Ecosystem Indicators Working Group, 17 March, 1995. Institute for Sustainable Development, Thoreau Center for Sustainability – The Presidio, PO Box 29075, San Francisco, CA 94129-0075.

Wilcox, B., and K.S. Smallwood. 1995. Ecosystem indicators model overview. Brief 2, Ecosystem Indicators Working Group, 17 March, 1995. Institute for Sustainable Development, Thoreau Center for Sustainability – The Presidio, PO Box 29075, San Francisco, CA 94129-0075.

EIP Associates. 1996. Yolo County Habitat Conservation Plan. Yolo County Planning and Development Department, Woodland, California.

Geng, S., K.S. Smallwood, and M. Zhang. 1995. Sustainable agriculture and agricultural sustainability. Proc. 7th International Congress SABRAO, 2nd Industrial Symp. WSAA. Taipei, Taiwan.

Smallwood, K.S. and S. Geng. 1994. Landscape strategies for biological control and IPM. Pages 454-464 in W. Dehai, ed., Proc. International Conference on Integrated Resource Management for Sustainable Agriculture. Beijing Agricultural University, Beijing, China.

Smallwood, K.S. and S. Geng. 1993. Alfalfa as wildlife habitat. California Alfalfa Symposium 23:105-8.

Smallwood, K.S. and S. Geng. 1993. Management of pocket gophers in Sacramento Valley alfalfa. California Alfalfa Symposium 23:86-89.

Smallwood, K.S. and E.L. Fitzhugh. 1992. The use of track counts for mountain lion population census. Pages 59-67 in C. Braun, ed. Mountain lion-Human Interaction Symposium and Workshop. Colorado Division of Wildlife, Fort Collins.

Smallwood, K.S. and E.L. Fitzhugh. 1989. Differentiating mountain lion and dog tracks. Pages 58-63 in Smith, R.H., ed. Proc. Third Mountain Lion Workshop. Arizona Game and Fish Department, Phoenix.

Fitzhugh, E.L. and K.S. Smallwood. 1989. Techniques for monitoring mountain lion population levels. Pages 69-71 in Smith, R.H., ed. Proc. Third Mountain Lion Workshop. Arizona Game and Fish Department, Phoenix.

Reports to or by Alameda County Scientific Review Committee (Note: all documents linked to SRC website have since been removed by Alameda County)

Smallwood, K. S. 2014. Data Needed in Support of Repowering in the Altamont Pass WRA. http://www.altamontsrc.org/alt_doc/p284_smallwood_data_needed_in_support_of_repowering_in_the_altamont_pass_wra.pdf

Smallwood, K. S. 2013. Long-Term Trends in Fatality Rates of Birds and Bats in the Altamont Pass Wind Resource Area, California. http://www.altamontsrc.org/alt_doc/r68_smallwood_altamont_fatality_rates_longterm.pdf

Smallwood, K. S. 2013. Inter-annual Fatality rates of Target Raptor Species from 1999 through 2012 in the Altamont Pass Wind Resources Area. http://www.altamontsrc.org/alt_doc/p268_smallwood_inter_annual_comparison_of_fatality_rates_1999_2012.pdf

Smallwood, K. S. 2012. General Protocol for Performing Detection Trials in the FloDesign Study of the Safety of a Closed-bladed Wind Turbine. http://www.altamontsrc.org/alt_doc/p246_smallwood_flodesign_detection_trial_protocol.pdf

Smallwood, K. S., l. Neher, and J. Mount. 2012. Burrowing owl distribution and abundance study through two breeding seasons and intervening non-breeding period in the Altamont Pass Wind Resource Area, California. http://www.altamontsrc.org/alt_doc/p245_smallwood_et_al_burrowing_owl_density_2012.pdf

Smallwood, K. S 2012. Draft study design for testing collision risk of Flodesign wind turbine in former AES Seawest wind projects in the Altamont Pass Wind Resource Area (APWRA). http://www.altamontsrc.org/alt_doc/p238_smallwood_floeesign_draft_study_design_april_2012.pdf

Smallwood, L. Neher, and J. Mount. 2012. Winter 2012 update on burrowing owl distribution and abundance study in the Altamont Pass Wind Resource Area, California. http://www.altamontsrc.org/alt_doc/p232_smallwood_et_al_winter_owl_survey_update.pdf

Smallwood, S. 2012. Status of avian utilization data collected in the Altamont Pass Wind Resource Area, 2005-2011. http://www.altamontsrc.org/alt_doc/p231_smallwood_apwra_use_data_2005_2011.pdf

Smallwood, K. S., L. Neher, and J. Mount. 2011. Monitoring Burrow Use of Wintering Burrowing Owls. http://www.altamontsrc.org/alt_doc/p229_smallwood_et_al_progress_monitoring_burrowing_owl_burrow_use.pdf

Smallwood, K. S., L. Neher, and J. Mount. 2011. Nesting Burrowing Owl Distribution and Abundance in the Altamont Pass Wind Resource Area, California. http://www.altamontsrc.org/alt_doc/p228_smallwood_et_al_for_nextera_burrowing_owl_distribution_and_abundance_study.pdf

Smallwood, K. S. 2011. Draft Study Design for Testing Collision Risk of Flodesign Wind Turbine in Patterson Pass Wind Farm in the Altamont Pass Wind Resource Area (APWRA). http://www.altamontsrc.org/alt_doc/p100_src_document_list_with_reference_numbers.pdf

Smallwood, K. S. 2011. Sampling Burrowing Owls Across the Altamont Pass Wind Resource Area. http://www.altamontsrc.org/alt_doc/p205_smallwood_neher_progress_on_sampling_burrowing_owls_across_apwra.pdf

Smallwood, K. S. 2011. Proposal to Sample Burrowing Owls Across the Altamont Pass Wind Resource Area. http://www.altamontsrc.org/alt_doc/p198_smallwood_proposal_to_sample_burrowing_owls_across_apwra.pdf

Smallwood, K. S. 2010. Comments on APWRA Monitoring Program Update. http://www.altamontsrc.org/alt_doc/p191_smallwood_comments_on_apwra_monitoring_program_update.pdf

Smallwood, K. S. 2010. Inter-turbine Comparisons of Fatality Rates in the Altamont Pass Wind Resource Area. http://www.altamontsrc.org/alt_doc/p189_smallwood_report_of_apwra_fatality_rate_patterns.pdf

Smallwood, K. S. 2010. Review of the December 2010 Draft of M-21: Altamont Pass Wind Resource Area Bird Collision Study. http://www.altamontsrc.org/alt_doc/p190_smallwood_review_of_december_2010_monitoring_report.pdf

Alameda County SRC (Shawn Smallwood, Jim Estep, Sue Orloff, Joanna Burger, and Julie Yee). Comments on the Notice of Preparation for a Programmatic Environmental Impact Report on Revised CUPs for Wind Turbines in the Alameda County portion of the Altamont Pass. http://www.altamontsrc.org/alt_doc/p183_src_integrated_comments_on_nop.pdf

Smallwood, K. S. 2010. Review of Monitoring Implementation Plan. http://www.altamontsrc.org/alt_doc/p180_src_comments_on_dip.pdf

Burger, J., J. Estep, S. Orloff, S. Smallwood, and J. Yee. 2010. SRC Comments on CalWEA Research Plan. http://www.altamontsrc.org/alt_doc/p174_smallwood_review_of_calwea_removal_study_plan.pdf

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, J. Burger, and J. Yee). SRC Comments on Monitoring Team's Draft Study Plan for Future Monitoring. http://www.altamontsrc.org/alt_doc/p168_src_comments_on_m53_mt_draft_study_plan_for_future_monitoring.pdf

Smallwood, K. S. 2010. Second Review of American Kestrel-Burrowing owl (KB) Scavenger Removal Adjustments Reported in Alameda County Avian Monitoring Team's M21 for the Altamont Pass Wind Resource Area. http://www.altamontsrc.org/alt_doc/p171_smallwood_kb_removal_rates_follow_up.pdf

Smallwood, K. S. 2010. Assessment of Three Proposed Adaptive Management Plans for Reducing Raptor Fatalities in the Altamont Pass Wind Resource Area. http://www.altamontsrc.org/alt_doc/p161_smallwood_assessment_of_amps.pdf

Smallwood, K. S. and J. Estep. 2010. Report of additional wind turbine hazard ratings in the Altamont Pass Wind Resource Area by Two Members of the Alameda County Scientific Review Committee. http://www.altamontsrc.org/alt_doc/p153_smallwood_estep_additional_hazard_ratings.pdf

Smallwood, K. S. 2010. Alternatives to Improve the Efficiency of the Monitoring Program. http://www.altamontsrc.org/alt_doc/p158_smallwood_response_to_memo_on_monitoring_costs.pdf

Smallwood, S. 2010. Summary of Alameda County SRC Recommendations and Concerns and Subsequent Actions. http://www.altamontsrc.org/alt_doc/p147_smallwood_summary_of_src_recommendations_and_concerns_1_11_10.pdf

Smallwood, S. 2010. Progress of Avian Wildlife Protection Program & Schedule. http://www.altamontsrc.org/alt_doc/p148_smallwood_progress_of_avian_wildlife_protection_program_1_11_10.pdf

Smallwood, S. 2010. Old-generation wind turbines rated for raptor collision hazard by Alameda County Scientific Review Committee in 2010, an Update on those Rated in 2007, and an Update on Tier Rankings. http://www.altamontsrc.org/alt_doc/p155_smallwood_src_turbine_ratings_and_status.pdf

Smallwood, K. S. 2010. Review of American Kestrel-Burrowing owl (KB) Scavenger Removal Adjustments Reported in Alameda County Avian Monitoring Team's M21 for the Altamont Pass Wind Resource Area. http://www.altamontsrc.org/alt_doc/p154_smallwood_kb_removal_rates_041610.pdf

Smallwood, K. S. 2010. Fatality Rates in the Altamont Pass Wind Resource Area 1998-2009. Alameda County SRC document P-145.

Smallwood, K. S. 2010. Comments on Revised M-21: Report on Fatality Monitoring in the Altamont Pass Wind Resource Area. P144 SRC Comments on 2009 Draft Monitoring Report M21.

Smallwood, K. S. 2009. http://www.altamontsrc.org/alt_doc/p129_smallwood_search_interval_summaries_supplemental_to_m39.pdf

Smallwood, K. S. 2009. Smallwood's review of M32. Alameda County SRC document P-111. 6 pp. http://www.altamontsrc.org/alt_doc/p111_smallwoods_review_of_m32.pdf

Smallwood, K. S. 2009. 3rd Year Review of 16 Conditional Use Permits for Windworks, Inc. and Altamont Infrastructure Company, LLC. Comment letter to East County Board of Zoning Adjustments. 10 pp + 2 attachments.

Smallwood, K. S. 2008. Weighing Remaining Workload of Alameda County SRC against Proposed Budget Cap. Alameda County SRC document not assigned. 3 pp.

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, J. Burger, and J. Yee). 2008. SRC comments on August 2008 Fatality Monitoring Report, M21. Alameda County SRC document P-107. 21 pp. http://www.altamontsrc.org/alt_doc/p107_smallwood_review_of_july_2008_monitoring_report_m21.pdf

Smallwood, K. S. 2008. Burrowing owl carcass distribution around wind turbines. Alameda County SRC document 106. 8 pp. http://www.altamontsrc.org/alt_doc/p106_smallwood_burrowing_owl_carcass_distribution_around_wind_turbines.pdf

Smallwood, K. S. 2008. Assessment of relocation/removal of Altamont Pass wind turbines rated as hazardous by the Alameda County SRC. Alameda County SRC document P-103. 10 pp. http://www.altamontsrc.org/alt_doc/p103_assessment_of_src_recommendations_to_ relocate_rated_turbines.pdf

Smallwood, K. S. and L. Neher. 2008. Summary of wind turbine-free ridgelines within and around the APWRA. Alameda County SRC document P-102. 4 pp.

Smallwood, K. S. and B. Karas. 2008. Comparison of mortality estimates in the Altamont Pass Wind Resource Area when restricted to recent fatalities. Alameda County SRC document P-101.

Smallwood, K. S. 2008. On the misapplication of mortality adjustment terms to fatalities missed during one search and found later. Alameda County SRC document P-97. 3 pp.

Smallwood, K. S. 2008. Relative abundance of raptors outside the APWRA. Alameda County SRC document P-88. 6 pp.

Smallwood, K. S. 2008. Comparison of mortality estimates in the Altamont Pass Wind Resource Area. Alameda County SRC document P-76. 19 pp

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, J. Burger, and J. Yee). 2010. Guidelines for siting wind turbines recommended for relocation to minimize potential collision-related mortality of four focal raptor species in the Altamont Pass Wind Resource Area. Alameda County SRC document P-70.

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, J. Burger, and J. Yee). December 11, 2007. SRC selection of dangerous wind turbines. Alameda County SRC document P-67. 8 pp.

Smallwood, S. October 6, 2007. Smallwood's answers to Audubon's queries about the SRC's recommended four month winter shutdown of wind turbines in the Altamont Pass. Alameda County SRC document P-23.

Smallwood, K. S. October 1, 2007. Dissenting opinion on recommendation to approve of the AWI Blade Painting Study. Alameda County SRC document P-60.

Smallwood, K. S. July 26, 2007. Effects of monitoring duration and inter-annual variability on precision of wind-turbine caused mortality estimates in the Altamont Pass Wind Resource Area, California. SRC Document P44.

Smallwood, K. S. July 26, 2007. Memo: Opinion of some SRC members that the period over which post-management mortality will be estimated remains undefined. SRC Document P43.

Smallwood, K. S. July 19, 2007. Smallwood's response to P24G. SRC Document P41, 4 pp.

Smallwood, K. S. April 23, 2007. New Information Regarding Alameda County SRC Decision of 11 April 2007 to Grant FPLE Credits for Removing and Relocating Wind Turbines in 2004. SRC Document P26.

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, and J. Burger [J. Yee abstained]).

April 17, 2007. SRC Statement in Support of the Monitoring Program Scope and Budget.

Smallwood, K. S. April 15, 2007. Verification of Tier 1 & 2 Wind Turbine Shutdowns and Relocations. SRC Document P22.

Smallwood, S. April 15, 2007. Progress of Avian Wildlife Protection Program & Schedule.

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, J. Burger, and J. Yee). April 3, 2007. Alameda County Scientific Review Committee replies to the parties' responses to its queries and to comments from the California Office of the Attorney General. SRC Document S20.

Smallwood, S. March 19, 2007. Estimated Effects of Full Winter Shutdown and Removal of Tier I & II Turbines. SRC Document S19.

Smallwood, S. March 8, 2007. Smallwood's Replies to the Parties' Responses to Queries from the SRC and Comments from the California Office of the Attorney General. SRC Document S16.

Smallwood, S. March 8, 2007. Estimated Effects of Proposed Measures to be Applied to 2,500 Wind Turbines in the APWRA Fatality Monitoring Plan. SRC Document S15.

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, J. Burger, and J. Yee). February 7, 2007. Analysis of Monitoring Program in Context of 1/1//2007 Settlement Agreement.

Smallwood, S. January 8, 2007. Smallwood's Concerns over the Agreement to Settle the CEQA Challenges. SRC Document S5.

Alameda County SRC (Smallwood, K. S., S. Orloff, J. Estep, J. Burger, and J. Yee). December 19, 2006. Altamont Scientific Review Committee (SRC) Recommendations to the County on the Avian Monitoring Team Consultants' Budget and Organization.

Reports to Clients

Smallwood, K. S., and L. Neher. 2018. Siting wind turbines to minimize raptor collisions at Rooney Ranch and Sand Hill Repowering Project, Altamont Pass Wind Resource Area. Report to S-Power, Salt Lake City, Utah.

Smallwood, K. S. 2017. Summary of a burrowing owl conservation workshop. Report to Santa Clara Valley Habitat Agency, Morgan Hill, California.

Smallwood, K. S., and L. Neher. 2017. Comparison of wind turbine collision hazard model performance prepared for repowering projects in the Altamont Pass Wind Resources Area. Report to NextEra Energy Resources, Inc., Office of the California Attorney General, Audubon Society, East Bay Regional Park District.

Smallwood, K. S., and L. Neher. 2016. Siting wind turbines to minimize raptor collisions at Summit Winds Repowering Project, Altamont Pass Wind Resource Area. Report to Salka, Inc., Washington, D.C.

Smallwood, K. S., L. Neher, and D. A. Bell. 2017. Mitigating golden eagle impacts from repowering Altamont Pass Wind Resource Area and expanding Los Vaqueros Reservoir. Report to East Contra Costa County Habitat Conservation Plan Conservancy and Contra Costa Water District.

Smallwood, K. S. 2016. Report of Altamont Pass research as Vasco Winds mitigation. Report to NextEra Energy Resources, Inc., Office of the California Attorney General, Audubon Society, East Bay Regional Park District.

Smallwood, K. S., and L. Neher. 2016. Siting Wind Turbines to Minimize Raptor collisions at Sand Hill Repowering Project, Altamont Pass Wind Resource Area. Report to Ogin, Inc., Waltham, Massachusetts.

Smallwood, K. S., and L. Neher. 2015a. Siting wind turbines to minimize raptor collisions at Golden Hills Repowering Project, Altamont Pass Wind Resource Area. Report to NextEra Energy Resources, Livermore, California.

Smallwood, K. S., and L. Neher. 2015b. Siting wind turbines to minimize raptor collisions at Golden Hills North Repowering Project, Altamont Pass Wind Resource Area. Report to NextEra Energy Resources, Livermore, California.

Smallwood, K. S., and L. Neher. 2015c. Siting wind turbines to minimize raptor collisions at the Patterson Pass Repowering Project, Altamont Pass Wind Resource Area. Report to EDF Renewable Energy, Oakland, California.

Smallwood, K. S., and L. Neher. 2014. Early assessment of wind turbine layout in Summit Wind Project. Report to Altamont Winds LLC, Tracy, California.

Smallwood, K. S. 2015. Review of avian use survey report for the Longboat Solar Project. Report to EDF Renewable Energy, Oakland, California.

Smallwood, K. S. 2014. Information needed for solar project impacts assessment and mitigation planning. Report to Panorama Environmental, Inc., San Francisco, California.

Smallwood, K. S. 2014. Monitoring fossorial mammals in Vasco Caves Regional Preserve, California: Report of Progress for the period 2006-2014. Report to East Bay Regional Park District, Oakland, California.

Smallwood, K. S. 2013. First-year estimates of bird and bat fatality rates at old wind turbines, Forebay areas of Altamont Pass Wind Resource Area. Report to FloDesign in support of EIR.

Smallwood, K. S. and W. Pearson. 2013. Neotropical bird monitoring of burrowing owls (*Athene cunicularia*), Naval Air Station Lemoore, California. Tierra Data, Inc. report to Naval Air Station Lemoore.

Smallwood, K. S. 2013. Winter surveys for San Joaquin kangaroo rat (*Dipodomys nitratoides*) and burrowing owls (*Athene cunicularia*) within Air Operations at Naval Air Station, Lemoore. Report to Tierra Data, Inc. and Naval Air Station Lemoore.

Smallwood, K. S. and M. L. Morrison. 2013. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) conservation research in Resource Management Area 5, Lemoore Naval Air Station: 2012 Progress Report (Inclusive of work during 2000-2012). Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California.

Smallwood, K. S. 2012. Fatality rate estimates at the Vantage Wind Energy Project, year one. Report to Ventus Environmental, Portland, Oregon.

Smallwood, K. S. and L. Neher. 2012. Siting wind turbines to minimize raptor collisions at North Sky River. Report to NextEra Energy Resources, LLC.

Smallwood, K. S. 2011. Monitoring Fossorial Mammals in Vasco Caves Regional Preserve, California: Report of Progress for the Period 2006-2011. Report to East Bay Regional Park District.

Smallwood, K. S. and M. L. Morrison. 2011. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) Conservation Research in Resource Management Area 5, Lemoore Naval Air Station: 2011 Progress Report (Inclusive of work during 2000-2011). Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California.

Smallwood, K. S. 2011. Draft study design for testing collision risk of FloDesign Wind Turbine in Patterson Pass, Santa Clara, and Former AES Seawest Wind Projects in the Altamont Pass Wind Resource Area (APWRA). Report to FloDesign, Inc.

Smallwood, K. S. 2011. Comments on Marbled Murrelet collision model for the Radar Ridge Wind Resource Area. Report to EcoStat, Inc., and ultimately to US Fish and Wildlife Service.

Smallwood, K. S. 2011. Avian fatality rates at Buena Vista Wind Energy Project, 2008-2011. Report to Pattern Energy.

Smallwood, K. S. and L. Neher. 2011. Siting repowered wind turbines to minimize raptor collisions at Tres Vaqueros, Contra Costa County, California. Report to Pattern Energy.

Smallwood, K. S. and M. L. Morrison. 2011. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) Conservation Research in Resource Management Area 5, Lemoore Naval Air Station: 2010 Progress Report (Inclusive of work during 2000-2010). Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California.

Smallwood, K. S. 2010. Wind Energy Development and avian issues in the Altamont Pass, California. Report to Black & Veatch.

Smallwood, K. S. and L. Neher. 2010. Siting repowered wind turbines to minimize raptor collisions at the Tres Vaqueros Wind Project, Contra Costa County, California. Report to the East Bay Regional Park District, Oakland, California.

Smallwood, K. S. and L. Neher. 2010. Siting repowered wind turbines to minimize raptor collisions at Vasco Winds. Report to NextEra Energy Resources, LLC, Livermore, California.

Smallwood, K. S. 2010. Baseline avian and bat fatality rates at the Tres Vaqueros Wind Project, Contra Costa County, California. Report to the East Bay Regional Park District, Oakland, California.

Smallwood, K. S. and M. L. Morrison. 2010. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) Conservation Research in Resource Management Area 5, Lemoore Naval Air Station: 2009 Progress Report (Inclusive of work during 2000-2009). Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California. 86 pp.

Smallwood, K. S. 2009. Mammal surveys at naval outlying landing field Imperial Beach, California, August 2009. Report to Tierra Data, Inc. 5 pp

Smallwood, K. S. 2009. Mammals and other Wildlife Observed at Proposed Site of Amargosa Solar Power Project, Spring 2009. Report to Tierra Data, Inc. 13 pp

Smallwood, K. S. 2009. Avian Fatality Rates at Buena Vista Wind Energy Project, 2008-2009. Report to members of the Contra Costa County Technical Advisory Committee on the Buena Vista Wind Energy Project. 8 pp.

Smallwood, K. S. 2009. Repowering the Altamont Pass Wind Resource Area more than Doubles Energy Generation While Substantially Reducing Bird Fatalities. Report prepared on behalf of Californians for Renewable Energy. 2 pp.

Smallwood, K. S. and M. L. Morrison. 2009. Surveys to Detect Salt Marsh Harvest Mouse and California Black Rail at Installation Restoration Site 30, Military Ocean Terminal Concord, California: March-April 2009. Report to Insight Environmental, Engineering, and Construction, Inc., Sacramento, California. 6 pp.

Smallwood, K. S. 2008. Avian and Bat Mortality at the Big Horn Wind Energy Project, Klickitat County, Washington. Unpublished report to Friends of Skamania County. 7 pp.

Smallwood, K. S. 2009. Monitoring Fossorial Mammals in Vasco Caves Regional Preserve, California: report of progress for the period 2006-2008. Unpublished report to East Bay Regional Park District. 5 pp.

Smallwood, K. S. and M. L. Morrison. 2008. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) Conservation Research in Resource Management Area 5, Lemoore Naval Air Station: 2008 Progress Report (Inclusive of work during 2000-2008). Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California. 84 pp.

Smallwood, K. S. and M. L. Morrison. 2008. Habitat Assessment for California Red-Legged Frog at Naval Weapons Station, Seal Beach, Detachment Concord, California. Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California. 48

pp.

Smallwood, K. S. and B. Nakamoto 2008. Impact of 2005 and 2006 West Nile Virus on Yellow-billed Magpie and American Crow in the Sacramento Valley, California. 22 pp.

Smallwood, K. S. and M. L. Morrison. 2008. Former Naval Security Group Activity (NSGA), Skaggs Island, Waste and Contaminated Soil Removal Project (IR Site #2), San Pablo Bay, Sonoma County, California: Re-Vegetation Monitoring. Report to U.S. Navy, Letter Agreement – N68711-04LT-A0045. Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California. 10 pp.

Smallwood, K. S. and M. L. Morrison. 2008. Burrowing owls at Dixon Naval Radio Transmitter Facility. Report to U.S. Navy. Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California. 28 pp.

Smallwood, K. S. and M. L. Morrison. 2008. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) Conservation Research in Resource Management Area 5, Lemoore Naval Air Station: 2007 Progress Report (Inclusive of work during 2001-2007). Naval Facilities Engineering Command, Southwest, Desert Integrated Products Team, San Diego, California. 69 pp.

Smallwood, K. S. and M. L. Morrison. 2007. A Monitoring Effort to Detect the Presence of the Federally Listed Species California Clapper Rail and Salt Marsh Harvest Mouse, and Wetland Habitat Assessment at the Naval Weapons Station, Seal Beach, Detachment Concord, California. Installation Restoration (IR) Site 30, Final Report to U.S. Navy, Letter Agreement – N68711-05LT-A0001. U.S. Navy Integrated Product Team (IPT), West, Naval Facilities Engineering Command, San Diego, California. 8 pp.

Smallwood, K. S. and M. L. Morrison. 2007. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) Conservation Research in Resource Management Area 5, Lemoore Naval Air Station: 2006 Progress Report (Inclusive of work during 2001-2006). U.S. Navy Integrated Product Team (IPT), West, Naval Facilities Engineering Command, Southwest, Daly City, California. 165 pp.

Smallwood, K. S. and C. Thelander. 2006. Response to third review of Smallwood and Thelander (2004). Report to California Institute for Energy and Environment, University of California, Oakland, CA. 139 pp.

Smallwood, K. S. 2006. Biological effects of repowering a portion of the Altamont Pass Wind Resource Area, California: The Diablo Winds Energy Project. Report to Altamont Working Group. Available from Shawn Smallwood, puma@yolo.com . 34 pp.

Smallwood, K. S. 2006. Impact of 2005 West Nile Virus on Yellow-billed Magpie and American Crow in the Sacramento Valley, California. Report to Sacramento-Yolo Mosquito and Vector Control District, Elk Grove, CA. 38 pp.

Smallwood, K. S. and M. L. Morrison. 2006. San Joaquin kangaroo rat (*Dipodomys n. nitratoides*) Conservation Research in Resource Management Area 5, Lemoore Naval Air Station: 2005 Progress Report (Inclusive of work during 2001-2005). U.S. Navy Integrated Product Team

(IPT), West, Naval Facilities Engineering Command, South West, Daly City, California. 160 pp.

Smallwood, K. S. and M. L. Morrison. 2006. A monitoring effort to detect the presence of the federally listed species California tiger salamander and California red-legged frog at the Naval Weapons Station, Seal Beach, Detachment Concord, California. Letter agreements N68711-04LT-A0042 and N68711-04LT-A0044, U.S. Navy Integrated Product Team (IPT), West, Naval Facilities Engineering Command, South West, Daly City, California. 60 pp.

Smallwood, K. S. and M. L. Morrison. 2006. A monitoring effort to detect the presence of the federally listed species California Clapper Rail and Salt Marsh Harvest Mouse, and wetland habitat assessment at the Naval Weapons Station, Seal Beach, Detachment Concord, California. Sampling for rails, Spring 2006, Installation Restoration (IR) Site 1. Letter Agreement – N68711-05lt-A0001, U.S. Navy Integrated Product Team (IPT), West, Naval Facilities Engineering Command, South West, Daly City, California. 9 pp.

Morrison, M. L. and K. S. Smallwood. 2006. Final Report: Station-wide Wildlife Survey, Naval Air Station, Lemoore. Department of the Navy Integrated Product Team (IPT) West, Naval Facilities Engineering Command Southwest, 2001 Junipero Serra Blvd., Suite 600, Daly City, CA 94014-1976. 20 pp.

Smallwood, K. S. and M. L. Morrison. 2006. Former Naval Security Group Activity (NSGA), Skaggs Island, Waste and Contaminated Soil Removal Project, San Pablo Bay, Sonoma County, California: Re-vegetation Monitoring. Department of the Navy Integrated Product Team (IPT) West, Naval Facilities Engineering Command Southwest, 2001 Junipero Serra Blvd., Suite 600, Daly City, CA 94014-1976. 8 pp.

Dorin, Melinda, Linda Spiegel and K. Shawn Smallwood. 2005. Response to public comments on the staff report entitled *Assessment of Avian Mortality from Collisions and Electrocutions* (CEC-700-2005-015) (Avian White Paper) written in support of the 2005 Environmental Performance Report and the 2005 Integrated Energy Policy Report. California Energy Commission, Sacramento. 205 pp.

Smallwood, K. S. 2005. Estimating combined effects of selective turbine removal and winter-time shutdown of half the wind turbines. Unpublished CEC staff report, June 23. 1 p.

Erickson, W. and S. Smallwood. 2005. Avian and Bat Monitoring Plan for the Buena Vista Wind Energy Project Contra Costa County, California. Unpubl. report to Contra Costa County, Antioch, California. 22 pp.

Lamphier-Gregory, West Inc., Shawn Smallwood, Jones & Stokes Associates, Illingworth & Rodkin Inc. and Environmental Vision. 2005. Environmental Impact Report for the Buena Vista Wind Energy Project, LP# 022005. County of Contra Costa Community Development Department, Martinez, California.

Morrison, M. L. and K. S. Smallwood. 2005. A monitoring effort to detect the presence of the federally listed species California clapper rail and salt marsh harvest mouse, and wetland habitat assessment at the Naval Weapons Station, Seal Beach, Detachment Concord, California.

Targeted Sampling for Salt Marsh Harvest Mouse, Fall 2005 Installation Restoration (IR) Site 30. Letter Agreement – N68711-05lt-A0001, U.S. Department of the Navy, Naval Facilities Engineering Command Southwest, Daly City, California. 6 pp.

Morrison, M. L. and K. S. Smallwood. 2005. A monitoring effort to detect the presence of the federally listed species California clapper rail and salt marsh harvest mouse, and wetland habitat assessment at the Naval Weapons Station, Seal Beach, Detachment Concord, California. Letter Agreement – N68711-05lt-A0001, U.S. Department of the Navy, Naval Facilities Engineering Command Southwest, Daly City, California. 5 pp.

Morrison, M. L. and K. S. Smallwood. 2005. Skaggs Island waste and contaminated soil removal projects, San Pablo Bay, Sonoma County, California. Report to the U.S. Department of the Navy, Naval Facilities Engineering Command Southwest, Daly City, California. 6 pp.

Smallwood, K. S. and M. L. Morrison. 2004. 2004 Progress Report: San Joaquin kangaroo rat (*Dipodomys nitratoides*) Conservation Research in Resources Management Area 5, Lemoore Naval Air Station. Progress report to U.S. Department of the Navy, Lemoore, California. 134 pp.

Smallwood, K. S. and L. Spiegel. 2005a. Assessment To Support An Adaptive Management Plan For The APWRA. Unpublished CEC staff report, January 19. 19 pp.

Smallwood, K. S. and L. Spiegel. 2005b. Partial Re-assessment of An Adaptive Management Plan For The APWRA. Unpublished CEC staff report, March 25. 48 pp.

Smallwood, K. S. and L. Spiegel. 2005c. Combining biology-based and policy-based tiers of priority for determining wind turbine relocation/shutdown to reduce bird fatalities in the APWRA. Unpublished CEC staff report, June 1. 9 pp.

Smallwood, K. S. 2004. Alternative plan to implement mitigation measures in APWRA. Unpublished CEC staff report, January 19. 8 pp.

Smallwood, K. S., and L. Neher. 2005. Repowering the APWRA: Forecasting and minimizing avian mortality without significant loss of power generation. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2005-005. 21 pp. [Reprinted (in Japanese) in Yukihiro Kominami, Tatsuya Ura, Koshitawa, and Tsuchiya, Editors, Wildlife and Wind Turbine Report 5. Wild Bird Society of Japan, Tokyo.]

Morrison, M. L., and K. S. Smallwood. 2004. Kangaroo rat survey at RMA4, NAS Lemoore. Report to U.S. Navy. 4 pp.

Morrison, M. L., and K. S. Smallwood. 2004. A monitoring effort to detect the presence of the federally listed species California clapper rails and wetland habitat assessment at Pier 4 of the Naval Weapons Station, Seal Beach, Detachment Concord, California. Letter Agreement N68711-04LT-A0002. 8 pp. + 2 pp. of photo plates.

Smallwood, K. S. and M. L. Morrison. 2003. 2003 Progress Report: San Joaquin kangaroo rat

(*Dipodomys nitratoides*) Conservation Research at Resources Management Area 5, Lemoore Naval Air Station. Progress report to U.S. Department of the Navy, Lemoore, California. 56 pp. + 58 figures.

Smallwood, K. S. 2003. Comparison of Biological Impacts of the No Project and Partial Underground Alternatives presented in the Final Environmental Impact Report for the Jefferson-Martin 230 kV Transmission Line. Report to California Public Utilities Commission. 20 pp.

Morrison, M. L., and K. S. Smallwood. 2003. Kangaroo rat survey at RMA4, NAS Lemoore. Report to U.S. Navy. 6 pp. + 7 photos + 1 map.

Smallwood, K. S. 2003. Assessment of the Environmental Review Documents Prepared for the Tesla Power Project. Report to the California Energy Commission on behalf of Californians for Renewable Energy. 32 pp.

Smallwood, K. S., and M. L. Morrison. 2003. 2002 Progress Report: San Joaquin kangaroo rat (*Dipodomys nitratoides*) Conservation Research at Resources Management Area 5, Lemoore Naval Air Station. Progress report to U.S. Department of the Navy, Lemoore, California. 45 pp. + 36 figures.

Smallwood, K. S., Michael L. Morrison and Carl G. Thelander 2002. Study plan to test the effectiveness of aerial markers at reducing avian mortality due to collisions with transmission lines: A report to Pacific Gas & Electric Company. 10 pp.

Smallwood, K. S. 2002. Assessment of the Environmental Review Documents Prepared for the East Altamont Energy Center. Report to the California Energy Commission on behalf of Californians for Renewable Energy. 26 pp.

Thelander, Carl G., K. Shawn Smallwood, and Christopher Costello. 2002 Rating Distribution Poles for Threat of Raptor Electrocution and Priority Retrofit: Developing a Predictive Model. Report to Southern California Edison Company. 30 pp.

Smallwood, K. S., M. Robison, and C. Thelander. 2002. Draft Natural Environment Study, Prunedale Highway 101 Project. California Department of Transportation, San Luis Obispo, California. 120 pp.

Smallwood, K.S. 2001. Assessment of ecological integrity and restoration potential of Beeman/Pelican Farm. Draft Report to Howard Beeman, Woodland, California. 14 pp.

Smallwood, K. S., and M. L. Morrison. 2002. Fresno kangaroo rat (*Dipodomys nitratoides*) Conservation Research at Resources Management Area 5, Lemoore Naval Air Station. Progress report to U.S. Department of the Navy, Lemoore, California. 29 pp. + 19 figures.

Smallwood, K.S. 2001. Rocky Flats visit, April 4th through 6th, 2001. Report to Berger & Montaque, P.C. 16 pp. with 61 color plates.

Smallwood, K.S. 2001. Affidavit of K. Shawn Smallwood, Ph.D. in the matter of the U.S. Fish and

Wildlife Service's rejection of Seatuck Environmental Association's proposal to operate an education center on Seatuck National Wildlife Refuge. Submitted to Seatuck Environmental Association in two parts, totaling 7 pp.

Magney, D., and K.S. Smallwood. 2001. Maranatha High School CEQA critique. Comment letter submitted to Tamara & Efren Compeán, 16 pp.

Smallwood, K.S. 2001. Preliminary Comments on the Proposed Blythe Energy Project. Submitted to California Energy Commission on March 15 on behalf of Californians for Renewable Energy (CaRE). 14 pp.

Smallwood, K. S. and D. Mangey. 2001. Comments on the Newhall Ranch November 2000 Administrative Draft EIR. Prepared for Ventura County Counsel regarding the Newhall Ranch Specific Plan EIR. 68 pp.

Magney, D. and K. S. Smallwood. 2000. Newhall Ranch Notice of Preparation Submittal. Prepared for Ventura County Counsel regarding our recommended scope of work for the Newhall Ranch Specific Plan EIR. 17 pp.

Smallwood, K. S. 2000. Comments on the Preliminary Staff Assessment of the Contra Costa Power Plant Unit 8 Project. Submitted to California Energy Commission on November 30 on behalf of Californians for Renewable Energy (CaRE). 4 pp.

Smallwood, K. S. 2000. Comments on the California Energy Commission's Final Staff Assessment of the MEC. Submitted to California Energy Commission on October 29 on behalf of Californians for Renewable Energy (CaRE). 8 pp.

Smallwood, K. S. 2000. Comments on the Biological Resources Mitigation Implementation and Monitoring Plan (BRMIMP). Submitted to California Energy Commission on October 29 on behalf of Californians for Renewable Energy (CaRE). 9 pp.

Smallwood, K. S. 2000. Comments on the Preliminary Staff Assessment of the Metcalf Energy Center. Submitted to California Energy Commission on behalf of Californians for Renewable Energy (CaRE). 11 pp.

Smallwood, K. S. 2000. Preliminary report of reconnaissance surveys near the TRW plant south of Phoenix, Arizona, March 27-29. Report prepared for Hagens, Berman & Mitchell, Attorneys at Law, Phoenix, AZ. 6 pp.

Morrison, M.L., K.S. .Smallwood, and M. Robison. 2001. Draft Natural Environment Study for Highway 46 compliance with CEQA/NEPA. Report to the California Department of Transportation. 75 pp.

Morrison, M.L., and K.S. Smallwood. 1999. NTI plan evaluation and comments. Exhibit C in W.D. Carrier, M.L. Morrison, K.S. Smallwood, and Vail Engineering. Recommendations for NBHCP land acquisition and enhancement strategies. Northern Territories, Inc., Sacramento.

Smallwood, K. S. 1999. Estimation of impacts due to dredging of a shipping channel through Humboldt Bay, California. Court Declaration prepared on behalf of EPIC.

Smallwood, K. S. 1998. 1998 California Mountain Lion Track Count. Report to the Defenders of Wildlife, Washington, D.C. 5 pages.

Smallwood, K.S. 1998. Draft report of a visit to a paint sludge dump site near Ridgewood, New Jersey, February 26th, 1998. Unpublished report to Consulting in the Public Interest.

Smallwood, K.S. 1997. Science missing in the "no surprises" policy. Commissioned by National Endangered Species Network and Spirit of the Sage Council, Pasadena, California.

Smallwood, K.S. and M.L. Morrison. 1997. Alternate mitigation strategy for incidental take of giant garter snake and Swainson's hawk as part of the Natomas Basin Habitat Conservation Plan. Pages 6-9 and *iii* illustrations in W.D. Carrier, K.S. Smallwood and M.L. Morrison, Natomas Basin Habitat Conservation Plan: Narrow channel marsh alternative wetland mitigation. Northern Territories, Inc., Sacramento.

Smallwood, K.S. 1996. Assessment of the BIOPORT model's parameter values for pocket gopher burrowing characteristics. Report to Berger & Montague, P.C. and Roy S. Haber, P.C., Philadelphia. (peer reviewed).

Smallwood, K.S. 1997. Assessment of plutonium releases from Hanford buried waste sites. Report Number 9, Consulting in the Public Interest, 53 Clinton Street, Lambertville, New Jersey, 08530.

Smallwood, K.S. 1996. Soil Bioturbation and Wind Affect Fate of Hazardous Materials that were Released at the Rocky Flats Plant, Colorado. Report to Berger & Montague, P.C., Philadelphia.

Smallwood, K.S. 1996. Second assessment of the BIOPORT model's parameter values for pocket gopher burrowing characteristics and other relevant wildlife observations. Report to Berger & Montague, P.C. and Roy S. Haber, P.C., Philadelphia.

Smallwood, K.S., and R. Leidy. 1996. Wildlife and Their Management Under the Martell SYP. Report to Georgia Pacific, Corporation, Martel, CA. 30 pp.

EIP Associates. 1995. Yolo County Habitat Conservation Plan Biological Resources Report. Yolo County Planning and Development Department, Woodland, California.

Smallwood, K.S. and S. Geng. 1995. Analysis of the 1987 California Farm Cost Survey and recommendations for future survey. Program on Workable Energy Regulation, University-wide Energy Research Group, University of California.

Smallwood, K.S., S. Geng, and W. Idzerda. 1992. Final report to PG&E: Analysis of the 1987 California Farm Cost Survey and recommendations for future survey. Pacific Gas & Electric Company, San Ramon, California. 24 pp.

Fitzhugh, E.L. and K.S. Smallwood. 1987. Methods Manual – A statewide mountain lion population index technique. California Department of Fish and Game, Sacramento.

Salmon, T.P. and K.S. Smallwood. 1989. Final Report – Evaluating exotic vertebrates as pests to California agriculture. California Department of Food and Agriculture, Sacramento.

Smallwood, K.S. and W. A. Erickson (written under supervision of W.E. Howard, R.E. Marsh, and R.J. Laacke). 1990. Environmental exposure and fate of multi-kill strychnine gopher baits. Final Report to USDA Forest Service –NAPIAP, Cooperative Agreement PSW-89-0010CA.

Fitzhugh, E.L., K.S. Smallwood, and R. Gross. 1985. Mountain lion track count, Marin County, 1985. Report on file at Wildlife Extension, University of California, Davis.

Comments on Environmental Documents

I was retained or commissioned to comment on environmental planning and review documents, including:

- The Villages of Lakeview EIR (2017; 28 pp);
- Notes on Proposed Study Options for Trail Impacts on Northern Spotted Owl (2017; 4 pp);
- San Gorgonio Crossings EIR (2017; 22 pp);
- Replies to responses on Jupiter Project IS and MND (2017; 12 pp);
- MacArthur Transit Village Project Modified 2016 CEQA Analysis (2017; 12 pp);
- Central SoMa Plan DEIR (2017; 14 pp);
- Colony Commerce Center Specific Plan DEIR (2016; 16 pp);
- Fairway Trails Improvements MND (2016; 13 pp);
- Review of Avian-Solar Science Plan (2016; 28 pp);
- Replies to responses on Initial Study for Pyramid Asphalt (2016; 5 pp);
- Initial Study for Pyramid Asphalt (2016; 4 pp);
- Agua Mansa Distribution Warehouse Project Initial Study (2016; 14 pp);
- Santa Anita Warehouse IS and MND (2016; 12 pp);
- CapRock Distribution Center III DEIR (2016: 12 pp);
- Orange Show Logistics Center Initial Study and MND (2016; 9 pp);
- City of Palmdale Oasis Medical Village Project IS and MND (2016; 7 pp);
- Comments on proposed rule for incidental eagle take (2016, 49 pp);
- Grapevine Specific and Community Plan FEIR (2016; 25 pp);
- Grapevine Specific and Community Plan DEIR (2016; 15 pp);
- Clinton County Zoning Ordinance for Wind Turbine siting (2016);
- Hallmark at Shenandoah Warehouse Project Initial Study (2016; 6 pp);
- Tri-City Industrial Complex Initial Study (2016; 5 pp);
- Hidden Canyon Industrial Park Plot Plan 16-PP-02 (2016; 12 pp);
- Kimball Business Park DEIR (2016; 10 pp);
- Jupiter Project IS and MND (2016; 9 pp);
- Revised Draft Giant Garter Snake Recovery Plan of 2015 (2016, 18 pp);
- Palo Verde Mesa Solar Project Draft Environmental Impact Report (2016; 27 pp);

- Reply Witness Statement on Fairview Wind Project, Ontario, Canada (2016; 14 pp);
- Fairview Wind Project, Ontario, Canada (2016; 41 pp);
- Supplementary Reply Witness Statement Amherst Island Wind Farm, Ontario (2015, 38 pp);
- Witness Statement on Amherst Island Wind Farm, Ontario (2015, 31 pp);
- Second Reply Witness Statement on White Pines Wind Farm, Ontario (2015, 6 pp);
- Reply Witness Statement on White Pines Wind Farm, Ontario (2015, 10 pp);
- Witness Statement on White Pines Wind Farm, Ontario (2015, 9 pp);
- Proposed Section 24 Specific Plan Agua Caliente Band of Cahuilla Indians DEIS (2015, 9 pp);
- Replies to comments 24 Specific Plan Agua Caliente Band of Cahuilla Indians FEIS (2015, 6 pp);
- Willow Springs Solar Photovoltaic Project DEIR (2015; 28 pp);
- Sierra Lakes Commerce Center Project DEIR (2015, 9 pp);
- Columbia Business Center MND (2015; 8 pp);
- West Valley Logistics Center Specific Plan DEIR (2015, 10 pp);
- World Logistic Center Specific Plan FEIR (2015, 12 pp);
- Bay Delta Conservation Plan EIR/EIS (2014, 21 pp);
- Addison Wind Energy Project DEIR (2014, 32 pp);
- Response to Comments on the Addison Wind Energy Project DEIR (2014, 15 pp);
- Addison and Rising Tree Wind Energy Project FEIR (2014, 12 pp);
- Alta East Wind Energy Project FEIS (2013, 23 pp);
- Blythe Solar Power Project Staff Assessment, California Energy Commission (2013, 16 pp);
- Clearwater and Yakima Solar Projects DEIR (2013, 9 pp);
- Cuyama Solar Project DEIR (2014, 19 pp);
- Draft Desert Renewable Energy Conservation Plan (DRECP) EIR/EIS (2015, 49 pp);
- Kingbird Solar Photovoltaic Project EIR (2013, 19 pp);
- Lucerne Valley Solar Project Initial Study & Mitigated Negative Declaration (2013, 12 pp);
- Palen Solar Electric Generating System Final Staff Assessment of California Energy Commission, (2014, 20 pp);
- Rebuttal testimony on Palen Solar Energy Generating System (2014, 9 pp);
- Rising Tree Wind Energy Project DEIR (2014, 32 pp);
- Response to Comments on the Rising Tree Wind Energy Project DEIR (2014, 15 pp);
- Soitec Solar Development Project Draft PEIR (2014, 18 pp);
- Comment on the Biological Opinion (08ESMF-00-2012-F-0387) of Oakland Zoo expansion on Alameda whipsnake and California red-legged frog (2014; 3 pp);
- West Antelope Solar Energy Project Initial Study and Negative Declaration (2013, 18 pp);
- Willow Springs Solar Photovoltaic Project DEIR (2015, 28 pp);
- Alameda Creek Bridge Replacement Project DEIR (2015, 10 pp);
- Declaration on Tule Wind project FEIR/FEIS (2013; 24 pp);
- Sunlight Partners LANDPRO Solar Project Mitigated Negative Declaration (2013; 11 pp);
- Declaration in opposition to BLM fracking (2013; 5 pp);
- Rosamond Solar Project Addendum EIR (2013; 13 pp);
- Pioneer Green Solar Project EIR (2013; 13 pp);
- Reply to Staff Responses to Comments on Soccer Center Solar Project Mitigated Negative

Declaration (2013; 6 pp);
- Soccer Center Solar Project Mitigated Negative Declaration (2013; 10 pp);
- Plainview Solar Works Mitigated Negative Declaration (2013; 10 pp);
- Reply to the County Staff's Responses on comments to Imperial Valley Solar Company 2 Project (2013; 10 pp);
- Imperial Valley Solar Company 2 Project (2013; 13 pp);
- FRV Orion Solar Project DEIR (PP12232) (2013; 9 pp);
- Casa Diablo IV Geothermal Development Project (3013; 6 pp);
- Reply to Staff Responses to Comments on Casa Diablo IV Geothermal Development Project (2013; 8 pp);
- FEIS prepared for Alta East Wind Project (2013; 23 pp);
- Metropolitan Air Park DEIR, City of San Diego (2013;);
- Davidon Homes Tentative Subdivision Map and Rezoning Project DEIR (2013; 9 pp);
- Analysis of Biological Assessment of Oakland Zoo Expansion Impacts on Alameda Whipsnake (2013; 10 pp);
- Declaration on Campo Verde Solar project FEIR (2013; 11pp);
- Neg Dec comments on Davis Sewer Trunk Rehabilitation (2013; 8 pp);
- Declaration on North Steens Transmission Line FEIS (2012; 62 pp);
- City of Lancaster Revised Initial Study for Conditional Use Permits 12-08 and 12-09, Summer Solar and Springtime Solar Projects (2012; 8 pp);
- J&J Ranch, 24 Adobe Lane Environmental Review (2012; 14 pp);
- Reply to the County Staff's Responses on comments to Hudson Ranch Power II Geothermal Project and the Simbol Calipatria Plant II (2012; 8 pp);
- Hudson Ranch Power II Geothermal Project and the Simbol Calipatria Plant II (2012; 9 pp);
- Desert Harvest Solar Project EIS (2012; 15 pp);
- Solar Gen 2 Array Project DEIR (2012; 16 pp);
- Ocotillo Sol Project EIS (2012; 4 pp);
- Beacon Photovoltaic Project DEIR (2012; 5 pp);
- Declaration on Initial Study and Proposed Negative Declaration for the Butte Water District 2012 Water Transfer Program (2012; 11 pp);
- Mount Signal and Calexico Solar Farm Projects DEIR (2011; 16 pp);
- City of Elk Grove Sphere of Influence EIR (2011; 28 pp);
- Comment on Sutter Landing Park Solar Photovoltaic Project MND (2011; 9 pp);
- Statement of Shawn Smallwood, Ph.D. Regarding Proposed Rabik/Gudath Project, 22611 Coleman Valley Road, Bodega Bay (CPN 10-0002) (2011; 4 pp);
- Declaration of K. Shawn Smallwood on Biological Impacts of the Ivanpah Solar Electric Generating System (ISEGS) (2011; 9 pp);
- Comments on Draft Eagle Conservation Plan Guidance (2011; 13 pp);
- Comments on Draft EIR/EA for Niles Canyon Safety Improvement Project (2011; 16 pp);
- Declaration of K. Shawn Smallwood, Ph.D., on Biological Impacts of the Route 84 Safety Improvement Project (2011; 7 pp);
- Rebuttal Testimony of Witness #22, K. Shawn Smallwood, Ph.D, on Behalf of Intervenors Friends of The Columbia Gorge & Save Our Scenic Area (2010; 6 pp);
- Prefiled Direct Testimony of Witness #22, K. Shawn Smallwood, Ph.D, on Behalf of

Intervenors Friends of the Columbia Gorge & Save Our Scenic Area. Comments on Whistling Ridge Wind Energy Power Project DEIS, Skamania County, Washington (2010; 41 pp);

- Evaluation of Klickitat County's Decisions on the Windy Flats West Wind Energy Project (2010; 17 pp);
- St. John's Church Project Draft Environmental Impact Report (2010; 14 pp.);
- Initial Study/Mitigated Negative Declaration for Results Radio Zone File #2009-001 (2010; 20 pp);
- Rio del Oro Specific Plan Project Final Environmental Impact Report (2010;12 pp);
- Answers to Questions on 33% RPS Implementation Analysis Preliminary Results Report (2009: 9 pp);
- SEPA Determination of Non-significance regarding zoning adjustments for Skamania County, Washington. Second Declaration to Friends of the Columbia Gorge, Inc. and Save Our Scenic Area (Dec 2008; 17 pp);
- Comments on Draft 1A Summary Report to CAISO (2008; 10 pp);
- County of Placer's Categorical Exemption of Hilton Manor Project (2009; 9 pp);
- Protest of CARE to Amendment to the Power Purchase and Sale Agreement for Procurement of Eligible Renewable Energy Resources Between Hatchet Ridge Wind LLC and PG&E (2009; 3 pp);
- Tehachapi Renewable Transmission Project EIR/EIS (2009; 142 pp);
- Delta Shores Project EIR, south Sacramento (2009; 11 pp + addendum 2 pp);
- Declaration of Shawn Smallwood in Support of Care's Petition to Modify D.07-09-040 (2008; 3 pp);
- The Public Utility Commission's Implementation Analysis December 16 Workshop for the Governor's Executive Order S-14-08 to implement a 33% Renewable Portfolio Standard by 2020 (2008; 9 pp);
- The Public Utility Commission's Implementation Analysis Draft Work Plan for the Governor's Executive Order S-14-08 to implement a 33% Renewable Portfolio Standard by 2020 (2008; 11 pp);
- Draft 1A Summary Report to California Independent System Operator for Planning Reserve Margins (PRM) Study (2008; 7 pp.);
- SEPA Determination of Non-significance regarding zoning adjustments for Skamania County, Washington. Declaration to Friends of the Columbia Gorge, Inc. and Save Our Scenic Area (Sep 2008; 16 pp);
- California Energy Commission's Preliminary Staff Assessment of the Colusa Generating Station (2007; 24 pp);
- Rio del Oro Specific Plan Project Recirculated Draft Environmental Impact Report (2008: 66 pp);
- Replies to Response to Comments Re: Regional University Specific Plan Environmental Impact Report (2008; 20 pp);
- Regional University Specific Plan Environmental Impact Report (2008: 33 pp.);
- Clark Precast, LLC's "Sugarland" project, Negative Declaration (2008: 15 pp.);
- Cape Wind Project Draft Environmental Impact Statement (2008; 157 pp.);
- Yuba Highlands Specific Plan (or Area Plan) Environmental Impact Report (2006; 37 pp.);
- Replies to responses to comments on Mitigated Negative Declaration of the proposed

Mining Permit (MIN 04-01) and Modification of Use Permit 96-02 at North Table Mountain (2006; 5 pp);

- Mitigated Negative Declaration of the proposed Mining Permit (MIN 04-01) and Modification of Use Permit 96-02 at North Table Mountain (2006; 15 pp);
- Windy Point Wind Farm Environmental Review and EIS (2006; 14 pp and 36 Powerpoint slides in reply to responses to comments);
- Shiloh I Wind Power Project EIR (2005; 18 pp);
- Buena Vista Wind Energy Project Notice of Preparation of EIR (2004; 15 pp);
- Negative Declaration of the proposed Callahan Estates Subdivision (2004; 11 pp);
- Negative Declaration of the proposed Winters Highlands Subdivision (2004; 9 pp);
- Negative Declaration of the proposed Winters Highlands Subdivision (2004; 13 pp);
- Negative Declaration of the proposed Creekside Highlands Project, Tract 7270 (2004; 21 pp);
- On the petition California Fish and Game Commission to list the Burrowing Owl as threatened or endangered (2003; 10 pp);
- Conditional Use Permit renewals from Alameda County for wind turbine operations in the Altamont Pass Wind Resource Area (2003; 41 pp);
- UC Davis Long Range Development Plan of 2003, particularly with regard to the Neighborhood Master Plan (2003; 23 pp);
- Anderson Marketplace Draft Environmental Impact Report (2003: 18 pp + 3 plates of photos);
- Negative Declaration of the proposed expansion of Temple B'nai Tikyah (2003: 6 pp);
- Antonio Mountain Ranch Specific Plan Public Draft EIR (2002: 23 pp);
- Response to testimony of experts at the East Altamont Energy Center evidentiary hearing on biological resources (2002: 9 pp);
- Revised Draft Environmental Impact Report, The Promenade (2002: 7 pp);
- Recirculated Initial Study for Calpine's proposed Pajaro Valley Energy Center (2002: 3 pp);
- UC Merced -- Declaration of Dr. Shawn Smallwood in support of petitioner's application for temporary restraining order and preliminary injunction (2002: 5 pp);
- Replies to response to comments in Final Environmental Impact Report, Atwood Ranch Unit III Subdivision (2003: 22 pp);
- Draft Environmental Impact Report, Atwood Ranch Unit III Subdivision (2002: 19 pp + 8 photos on 4 plates);
- California Energy Commission Staff Report on GWF Tracy Peaker Project (2002: 17 pp + 3 photos; follow-up report of 3 pp);
- Initial Study and Negative Declaration, Silver Bend Apartments, Placer County (2002: 13 pp);
- UC Merced Long-range Development Plan DEIR and UC Merced Community Plan DEIR (2001: 26 pp);
- Initial Study, Colusa County Power Plant (2001: 6 pp);
- Comments on Proposed Dog Park at Catlin Park, Folsom, California (2001: 5 pp + 4 photos);
- Pacific Lumber Co. (Headwaters) Habitat Conservation Plan and Environmental Impact Report (1998: 28 pp);
- Final Environmental Impact Report/Statement for Issuance of Take authorization for listed

species within the MSCP planning area in San Diego County, California (Fed. Reg. 62 (60): 14938, San Diego Multi-Species Conservation Program) (1997: 10 pp);

- Permit (PRT-823773) Amendment for the Natomas Basin Habitat Conservation Plan, Sacramento, CA (Fed. Reg. 63 (101): 29020-29021) (1998);
- Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). (Fed. Reg. 64(176): 49497-49498) (1999: 8 pp);
- Review of the Draft Recovery Plan for the Arroyo Southwestern Toad (*Bufo microscaphus californicus*) (1998);
- Ballona West Bluffs Project Environmental Impact Report (1999: oral presentation);
- California Board of Forestry's proposed amended Forest Practices Rules (1999);
- Negative Declaration for the Sunset Skyranch Airport Use Permit (1999);
- Calpine and Bechtel Corporations' Biological Resources Implementation and Monitoring Program (BRMIMP) for the Metcalf Energy Center (2000: 10 pp);
- California Energy Commission's Final Staff Assessment of the proposed Metcalf Energy Center (2000);
- US Fish and Wildlife Service Section 7 consultation with the California Energy Commission regarding Calpine and Bechtel Corporations' Metcalf Energy Center (2000: 4 pp);
- California Energy Commission's Preliminary Staff Assessment of the proposed Metcalf Energy Center (2000: 11 pp);
- Site-specific management plans for the Natomas Basin Conservancy's mitigation lands, prepared by Wildlands, Inc. (2000: 7 pp);
- Affidavit of K. Shawn Smallwood in Spirit of the Sage Council, et al. (Plaintiffs) vs. Bruce Babbitt, Secretary, U.S. Department of the Interior, et al. (Defendants), Injuries caused by the No Surprises policy and final rule which codifies that policy (1999: 9 pp).

Comments on other Environmental Review Documents:

- Proposed Regulation for California Fish and Game Code Section 3503.5 (2015: 12 pp);
- Statement of Overriding Considerations related to extending Altamont Winds, Inc.'s Conditional Use Permit PLN2014-00028 (2015; 8 pp);
- Draft Program Level EIR for Covell Village (2005; 19 pp);
- Bureau of Land Management Wind Energy Programmatic EIS Scoping document (2003: 7 pp.);
- NEPA Environmental Analysis for Biosafety Level 4 National Biocontainment Laboratory (NBL) at UC Davis (2003: 7 pp);
- Notice of Preparation of UC Merced Community and Area Plan EIR, on behalf of The Wildlife Society—Western Section (2001: 8 pp.);
- Preliminary Draft Yolo County Habitat Conservation Plan (2001; 2 letters totaling 35 pp.);
- Merced County General Plan Revision, notice of Negative Declaration (2001: 2 pp.);
- Notice of Preparation of Campus Parkway EIR/EIS (2001: 7 pp.);
- Draft Recovery Plan for the bighorn sheep in the Peninsular Range (*Ovis candensis*) (2000);
- Draft Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*), on behalf of The Wildlife Society—Western Section (2000: 10 pp.);
- Sierra Nevada Forest Plan Amendment Draft Environmental Impact Statement, on behalf of The Wildlife Society—Western Section (2000: 7 pp.);

- State Water Project Supplemental Water Purchase Program, Draft Program EIR (1997);
- Davis General Plan Update EIR (2000);
- Turn of the Century EIR (1999: 10 pp);
- Proposed termination of Critical Habitat Designation under the Endangered Species Act (Fed. Reg. 64(113): 31871-31874) (1999);
- NOA Draft Addendum to the Final Handbook for Habitat Conservation Planning and Incidental Take Permitting Process, termed the HCP 5-Point Policy Plan (Fed. Reg. 64(45): 11485 - 11490) (1999; 2 pp + attachments);
- Covell Center Project EIR and EIR Supplement (1997).

Position Statements I prepared the following position statements for the Western Section of The Wildlife Society, and one for nearly 200 scientists:

- Recommended that the California Department of Fish and Game prioritize the extermination of the introduced southern water snake in northern California. The Wildlife Society--Western Section (2001);
- Recommended that The Wildlife Society—Western Section appoint or recommend members of the independent scientific review panel for the UC Merced environmental review process (2001);
- Opposed the siting of the University of California's 10th campus on a sensitive vernal pool/grassland complex east of Merced. The Wildlife Society--Western Section (2000);
- Opposed the legalization of ferret ownership in California. The Wildlife Society--Western Section (2000);
- Opposed the Proposed "No Surprises," "Safe Harbor," and "Candidate Conservation Agreement" rules, including permit-shield protection provisions (Fed. Reg. Vol. 62, No. 103, pp. 29091-29098 and No. 113, pp. 32189-32194). This statement was signed by 188 scientists and went to the responsible federal agencies, as well as to the U.S. Senate and House of Representatives.

Posters at Professional Meetings

Leyvas, E. and K. S. Smallwood. 2015. Rehabilitating injured animals to offset and rectify wind project impacts. Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 9-12 March 2015.

Smallwood, K. S., J. Mount, S. Standish, E. Leyvas, D. Bell, E. Walther, B. Karas. 2015. Integrated detection trials to improve the accuracy of fatality rate estimates at wind projects. Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 9-12 March 2015.

Smallwood, K. S. and C. G. Thelander. 2005. Lessons learned from five years of avian mortality research in the Altamont Pass WRA. AWEA conference, Denver, May 2005.

Neher, L., L. Wilder, J. Woo, L. Spiegel, D. Yen-Nakafugi, and K.S. Smallwood. 2005. Bird's eye view on California wind. AWEA conference, Denver, May 2005.

Smallwood, K. S., C. G. Thelander and L. Spiegel. 2003. Toward a predictive model of avian fatalities in the Altamont Pass Wind Resource Area. Windpower 2003 Conference and Convention, Austin, Texas.

Smallwood, K.S. and Eva Butler. 2002. Pocket Gopher Response to Yellow Star-thistle Eradication as part of Grassland Restoration at Decommissioned Mather Air Force Base, Sacramento County, California. White Mountain Research Station Open House, Barcroft Station.

Smallwood, K.S. and Michael L. Morrison. 2002. Fresno kangaroo rat (*Dipodomys nitratoides*) Conservation Research at Resources Management Area 5, Lemoore Naval Air Station. White Mountain Research Station Open House, Barcroft Station.

Smallwood, K.S. and E.L. Fitzhugh. 1989. Differentiating mountain lion and dog tracks. Third Mountain Lion Workshop, Prescott, AZ.

Smith, T. R. and K. S. Smallwood. 2000. Effects of study area size, location, season, and allometry on reported *Sorex* shrew densities. Annual Meeting of the Western Section of The Wildlife Society.

Presentations at Professional Meetings and Seminars

Repowering the Altamont Pass. Altamont Symposium, The Wildlife Society – Western Section, 5 February 2017.

Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area, 1999-2007. Altamont Symposium, The Wildlife Society – Western Section, 5 February 2017.

Conservation and recovery of burrowing owls in Santa Clara Valley. Santa Clara Valley Habitat Agency, Newark, California, 3 February 2017.

Mitigation of Raptor Fatalities in the Altamont Pass Wind Resource Area. Raptor Research Foundation Meeting, Sacramento, California, 6 November 2015.

From burrows to behavior: Research and management for burrowing owls in a diverse landscape. California Burrowing Owl Consortium meeting, 24 October 2015, San Jose, California.

The Challenges of repowering. Keynote presentation at Conference on Wind Energy and Wildlife Impacts, Berlin, Germany, 10 March 2015.

Research Highlights Altamont Pass 2011-2015. Scientific Review Committee, Oakland, California, 8 July 2015.

Siting wind turbines to minimize raptor collisions: Altamont Pass Wind Resource Area. US Fish and Wildlife Service Golden Eagle Working Group, Sacramento, California, 8 January 2015.

Evaluation of nest boxes as a burrowing owl conservation strategy. Sacramento Chapter of the Western Section, The Wildlife Society. Sacramento, California, 26 August 2013.

Predicting collision hazard zones to guide repowering of the Altamont Pass. Conference on wind power and environmental impacts. Stockholm, Sweden, 5-7 February 2013.

Impacts of Wind Turbines on Wildlife. California Council for Wildlife Rehabilitators, Yosemite, California, 12 November 2012.

Impacts of Wind Turbines on Birds and Bats. Madrone Audubon Society, Santa Rosa, California, 20 February 2012.

Comparing Wind Turbine Impacts across North America. California Energy Commission Staff Workshop: Reducing the Impacts of Energy Infrastructure on Wildlife, 20 July 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. California Energy Commission Staff Workshop: Reducing the Impacts of Energy Infrastructure on Wildlife, 20 July 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. Alameda County Scientific Review Committee meeting, 17 February 2011

Comparing Wind Turbine Impacts across North America. Conference on Wind energy and Wildlife impacts, Trondheim, Norway, 3 May 2011.

Update on Wildlife Impacts in the Altamont Pass Wind Resource Area. Raptor Symposium, The Wildlife Society—Western Section, Riverside, California, February 2011.

Siting Repowered Wind Turbines to Minimize Raptor Collisions. Raptor Symposium, The Wildlife Society - Western Section, Riverside, California, February 2011.

Wildlife mortality caused by wind turbine collisions. Ecological Society of America, Pittsburgh, Pennsylvania, 6 August 2010.

Map-based repowering and reorganization of a wind farm to minimize burrowing owl fatalities. California burrowing Owl Consortium Meeting, Livermore, California, 6 February 2010.

Environmental barriers to wind power. Getting Real About Renewables: Economic and Environmental Barriers to Biofuels and Wind Energy. A symposium sponsored by the Environmental & Energy Law & Policy Journal, University of Houston Law Center, Houston, 23 February 2007.

Lessons learned about bird collisions with wind turbines in the Altamont Pass and other US wind farms. Meeting with Japan Ministry of the Environment and Japan Ministry of the Economy, Wild Bird Society of Japan, and other NGOs Tokyo, Japan, 9 November 2006.

Lessons learned about bird collisions with wind turbines in the Altamont Pass and other US wind farms. Symposium on bird collisions with wind turbines. Wild Bird Society of Japan, Tokyo, Japan, 4 November 2006.

Responses of Fresno kangaroo rats to habitat improvements in an adaptive management framework. California Society for Ecological Restoration (SERCAL) 13th Annual Conference, UC Santa

Barbara, 27 October 2006.

Fatality associations as the basis for predictive models of fatalities in the Altamont Pass Wind Resource Area. EEI/APLIC/PIER Workshop, 2006 Biologist Task Force and Avian Interaction with Electric Facilities Meeting, Pleasanton, California, 28 April 2006.

Burrowing owl burrows and wind turbine collisions in the Altamont Pass Wind Resource Area. The Wildlife Society - Western Section Annual Meeting, Sacramento, California, February 8, 2006.

Mitigation at wind farms. Workshop: Understanding and resolving bird and bat impacts. American Wind Energy Association and Audubon Society. Los Angeles, CA. January 10 and 11, 2006.

Incorporating data from the California Wildlife Habitat Relationships (CWHR) system into an impact assessment tool for birds near wind farms. Shawn Smallwood, Kevin Hunting, Marcus Yee, Linda Spiegel, Monica Parisi. Workshop: Understanding and resolving bird and bat impacts. American Wind Energy Association and Audubon Society. Los Angeles, CA. January 10 and 11, 2006.

Toward indicating threats to birds by California's new wind farms. California Energy Commission, Sacramento, May 26, 2005.

Avian collisions in the Altamont Pass. California Energy Commission, Sacramento, May 26, 2005.

Ecological solutions for avian collisions with wind turbines in the Altamont Pass Wind Resource Area. EPRI Environmental Sector Council, Monterey, California, February 17, 2005.

Ecological solutions for avian collisions with wind turbines in the Altamont Pass Wind Resource Area. The Wildlife Society—Western Section Annual Meeting, Sacramento, California, January 19, 2005.

Associations between avian fatalities and attributes of electric distribution poles in California. The Wildlife Society - Western Section Annual Meeting, Sacramento, California, January 19, 2005.

Minimizing avian mortality in the Altamont Pass Wind Resources Area. UC Davis Wind Energy Collaborative Forum, Palm Springs, California, December 14, 2004.

Selecting electric distribution poles for priority retrofitting to reduce raptor mortality. Raptor Research Foundation Meeting, Bakersfield, California, November 10, 2004.

Responses of Fresno kangaroo rats to habitat improvements in an adaptive management framework. Annual Meeting of the Society for Ecological Restoration, South Lake Tahoe, California, October 16, 2004.

Lessons learned from five years of avian mortality research at the Altamont Pass Wind Resources Area in California. The Wildlife Society Annual Meeting, Calgary, Canada, September 2004.

The ecology and impacts of power generation at Altamont Pass. Sacramento Petroleum Association, Sacramento, California, August 18, 2004.

Burrowing owl mortality in the Altamont Pass Wind Resource Area. California Burrowing Owl Consortium meeting, Hayward, California, February 7, 2004.

Burrowing owl mortality in the Altamont Pass Wind Resource Area. California Burrowing Owl Symposium, Sacramento, November 2, 2003.

Raptor Mortality at the Altamont Pass Wind Resource Area. National Wind Coordinating Committee, Washington, D.C., November 17, 2003.

Raptor Behavior at the Altamont Pass Wind Resource Area. Annual Meeting of the Raptor Research Foundation, Anchorage, Alaska, September, 2003.

Raptor Mortality at the Altamont Pass Wind Resource Area. Annual Meeting of the Raptor Research Foundation, Anchorage, Alaska, September, 2003.

California mountain lions. Ecological & Environmental Issues Seminar, Department of Biology, California State University, Sacramento, November, 2000.

Intra- and inter-turbine string comparison of fatalities to animal burrow densities at Altamont Pass. National Wind Coordinating Committee, Carmel, California, May, 2000.

Using a Geographic Positioning System (GPS) to map wildlife and habitat. Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

Suggested standards for science applied to conservation issues. Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

The indicators framework applied to ecological restoration in Yolo County, California. Society for Ecological Restoration, September 25, 1999.

Ecological restoration in the context of animal social units and their habitat areas. Society for Ecological Restoration, September 24, 1999.

Relating Indicators of Ecological Health and Integrity to Assess Risks to Sustainable Agriculture and Native Biota. International Conference on Ecosystem Health, August 16, 1999.

A crosswalk from the Endangered Species Act to the HCP Handbook and real HCPs. Southern California Edison, Co. and California Energy Commission, March 4-5, 1999.

Mountain lion track counts in California: Implications for Management. Ecological & Environmental Issues Seminar, Department of Biological Sciences, California State University, Sacramento, November 4, 1998.

"No Surprises" -- Lack of science in the HCP process. California Native Plant Society Annual Conservation Conference, The Presidio, San Francisco, September 7, 1997.

In Your Interest. A half hour weekly show aired on Channel 10 Television, Sacramento. In this episode, I served on a panel of experts discussing problems with the implementation of the Endangered Species Act. Aired August 31, 1997.

Spatial scaling of pocket gopher (*Geomyidae*) density. Southwestern Association of Naturalists 44th Meeting, Fayetteville, Arkansas, April 10, 1997.

Estimating prairie dog and pocket gopher burrow volume. Southwestern Association of Naturalists 44th Meeting, Fayetteville, Arkansas, April 10, 1997.

Ten years of mountain lion track survey. Fifth Mountain Lion Workshop, San Diego, February 27, 1996.

Study and interpretive design effects on mountain lion density estimates. Fifth Mountain Lion Workshop, San Diego, February 27, 1996.

Small animal control. Session moderator and speaker at the California Farm Conference, Sacramento, California, Feb. 28, 1995.

Small animal control. Ecological Farming Conference, Asylomar, California, Jan. 28, 1995.

Habitat associations of the Swainson's Hawk in the Sacramento Valley's agricultural landscape. 1994 Raptor Research Foundation Meeting, Flagstaff, Arizona.

Alfalfa as wildlife habitat. Seed Industry Conference, Woodland, California, May 4, 1994.

Habitats and vertebrate pests: impacts and management. Managing Farmland to Bring Back Game Birds and Wildlife to the Central Valley. Yolo County Resource Conservation District, U.C. Davis, February 19, 1994.

Management of gophers and alfalfa as wildlife habitat. Orland Alfalfa Production Meeting and Sacramento Valley Alfalfa Production Meeting, February 1 and 2, 1994.

Patterns of wildlife movement in a farming landscape. Wildlife and Fisheries Biology Seminar Series: Recent Advances in Wildlife, Fish, and Conservation Biology, U.C. Davis, Dec. 6, 1993.

Alfalfa as wildlife habitat. California Alfalfa Symposium, Fresno, California, Dec. 9, 1993.

Management of pocket gophers in Sacramento Valley alfalfa. California Alfalfa Symposium, Fresno, California, Dec. 8, 1993.

Association analysis of raptors in a farming landscape. Plenary speaker at Raptor Research Foundation Meeting, Charlotte, North Carolina, Nov. 6, 1993.

Landscape strategies for biological control and IPM. Plenary speaker, International Conference on Integrated Resource Management and Sustainable Agriculture, Beijing, China, Sept. 11, 1993.

Landscape Ecology Study of Pocket Gophers in Alfalfa. Alfalfa Field Day, U.C. Davis, July 1993.

Patterns of wildlife movement in a farming landscape. Spatial Data Analysis Colloquium, U.C. Davis, August 6, 1993.

Sound stewardship of wildlife. Veterinary Medicine Seminar: Ethics of Animal Use, U.C. Davis. May 1993.

Landscape ecology study of pocket gophers in alfalfa. Five County Grower's Meeting, Tracy, California. February 1993.

Turbulence and the community organizers: The role of invading species in ordering a turbulent system, and the factors for invasion success. Ecology Graduate Student Association Colloquium, U.C. Davis. May 1990.

Evaluation of exotic vertebrate pests. Fourteenth Vertebrate Pest Conference, Sacramento, California. March 1990.

Analytical methods for predicting success of mammal introductions to North America. The Western Section of the Wildlife Society, Hilo, Hawaii. February 1988.

A state-wide mountain lion track survey. Sacramento County Dept Parks and Recreation. April 1986.

The mountain lion in California. Davis Chapter of the Audubon Society. October 1985.

Ecology Graduate Student Seminars, U.C. Davis, 1985-1990: Social behavior of the mountain lion; Mountain lion control; Political status of the mountain lion in California.

Other forms of Participation at Professional Meetings

- Scientific Committee, Conference on Wind energy and Wildlife impacts, Berlin, Germany, March 2015.
- Scientific Committee, Conference on Wind energy and Wildlife impacts, Stockholm, Sweden, February 2013.
- Workshop co-presenter at Birds & Wind Energy Specialist Group (BAWESG) Information sharing week, Bird specialist studies for proposed wind energy facilities in South Africa, Endangered Wildlife Trust, Darling, South Africa, 3-7 October 2011.
- Scientific Committee, Conference on Wind energy and Wildlife impacts, Trondheim, Norway, 2-5 May 2011.
- Chair of Animal Damage Management Session, The Wildlife Society, Annual Meeting, Reno, Nevada, September 26, 2001.

- Chair of Technical Session: Human communities and ecosystem health: Comparing perspectives and making connection. Managing for Ecosystem Health, International Congress on Ecosystem Health, Sacramento, CA August 15-20, 1999.

- Student Awards Committee, Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

- Student Mentor, Annual Meeting of the Western Section of The Wildlife Society, Riverside, CA, January, 2000.

Printed Mass Media

Smallwood, K.S., D. Mooney, and M. McGuinness. 2003. We must stop the UCD biolab now. Op-Ed to the Davis Enterprise.

Smallwood, K.S. 2002. Spring Lake threatens Davis. Op-Ed to the Davis Enterprise.

Smallwood, K.S. Summer, 2001. Mitigation of habitation. The Flatlander, Davis, California.

Entrikan, R.K. and K.S. Smallwood. 2000. Measure O: Flawed law would lock in new taxes. Op-Ed to the Davis Enterprise.

Smallwood, K.S. 2000. Davis delegation lobbies Congress for Wildlife conservation. Op-Ed to the Davis Enterprise.

Smallwood, K.S. 1998. Davis Visions. The Flatlander, Davis, California.

Smallwood, K.S. 1997. Last grab for Yolo's land and water. The Flatlander, Davis, California.

Smallwood, K.S. 1997. The Yolo County HCP. Op-Ed to the Davis Enterprise.

Radio/Television

PBS News Hour,

FOX News, Energy in America: Dead Birds Unintended Consequence of Wind Power Development, August 2011.

KXJZ Capital Public Radio -- Insight (Host Jeffrey Callison). Mountain lion attacks (with guest Professor Richard Coss). 23 April 2009;

KXJZ Capital Public Radio -- Insight (Host Jeffrey Callison). Wind farm Rio Vista Renewable Power. 4 September 2008;

KQED QUEST Episode #111. Bird collisions with wind turbines. 2007;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. December 27, 2001;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. May 3, 2001;

KDVS Speaking in Tongues (host Ron Glick), Yolo County HCP: 1 hour. February 8, 2001;

KDVS Speaking in Tongues (host Ron Glick & Shawn Smallwood), California Energy Crisis: 1 hour. Jan. 25, 2001;

KDVS Speaking in Tongues (host Ron Glick), Headwaters Forest HCP: 1 hour. 1998;

Davis Cable Channel (host Gerald Heffernon), Burrowing owls in Davis: half hour. June, 2000;

Davis Cable Channel (hosted by Davis League of Women Voters), Measure O debate: 1 hour. October, 2000;

KXTV 10, In Your Interest, The Endangered Species Act: half hour. 1997.

Reviews of Journal Papers (Scientific journals for whom I've provided peer review)

Journal	Journal
American Naturalist	Journal of Animal Ecology
Journal of Wildlife Management	Western North American Naturalist
Auk	Journal of Raptor Research
Biological Conservation	National Renewable Energy Lab reports
Canadian Journal of Zoology	Oikos
Ecosystem Health	The Prairie Naturalist
Environmental Conservation	Restoration Ecology
Environmental Management	Southwestern Naturalist
Functional Ecology	The Wildlife Society--Western Section Trans.
Journal of Zoology (London)	Proc. Int. Congress on Managing for Ecosystem Health
Journal of Applied Ecology	Transactions in GIS
Ecology	Tropical Ecology
Biological Control	The Condor

Committees

- Scientific Review Committee, Alameda County, Altamont Pass Wind Resource Area
- Ph.D. Thesis Committee, Steve Anderson, University of California, Davis
- MS Thesis Committee, Marcus Yee, California State University, Sacramento

Other Professional Activities or Products

Testified in Federal Court in Denver during 2005 over the fate of radio-nuclides in the soil at Rocky Flats Plant after exposure to burrowing animals. My clients won a judgment of $553,000,000. I have also testified in many other cases of litigation under CEQA, NEPA, the Warren-Alquist Act, and other environmental laws. My clients won most of the cases for which I testified.

Testified before Environmental Review Tribunals in Ontario, Canada regarding proposed White Pines and Amherst Island Wind Energy projects.

Testified in Skamania County Hearing in 2009 on the potential impacts of zoning the County for development of wind farms and hazardous waste facilities.

Testified in deposition in 2007 in the case of O'Dell et al. vs. FPL Energy in Houston, Texas.

Testified in Klickitat County Hearing in 2006 on the potential impacts of the Windy Point Wind Farm.

Memberships in Professional Societies

The Wildlife Society
Raptor Research Foundation

Honors and Awards

Fulbright Research Fellowship to Indonesia, 1987
J.G. Boswell Full Academic Scholarship, 1981 college of choice
Certificate of Appreciation, The Wildlife Society—Western Section, 2000, 2001
Northern California Athletic Association Most Valuable Cross Country Runner, 1984
American Legion Award, Corcoran High School, 1981, and John Muir Junior High, 1977
CIF Section Champion, Cross Country in 1978
CIF Section Champion, Track & Field 2 mile run in 1981
National Junior Record, 20 kilometer run, 1982
National Age Group Record, 1500 meter run, 1978

Community Activities

District 64 Little League Umpire, 2003-2007
Dixon Little League Umpire, 2006-07
Davis Little League Chief Umpire and Board member, 2004-2005
Davis Little League Safety Officer, 2004-2005
Davis Little League Certified Umpire, 2002-2004
Davis Little League Scorekeeper, 2002
Davis Visioning Group member
Petitioner for Writ of Mandate under the California Environmental Quality Act against City of Woodland decision to approve the Spring Lake Specific Plan, 2002
Served on campaign committees for City Council candidates

Representative Clients/Funders

Law Offices of Stephan C. Volker
Blum Collins, LLP
Eric K. Gillespie Professional Corporation
Law Offices of Berger & Montague
Lozeau | Drury LLP
Law Offices of Roy Haber
Law Offices of Edward MacDonald
Law Office of John Gabrielli
Law Office of Bill Kopper
Law Office of Donald B. Mooney
Law Office of Veneruso & Moncharsh
Law Office of Steven Thompson
Law Office of Brian Gaffney
California Wildlife Federation
Defenders of Wildlife
Sierra Club
National Endangered Species Network
Spirit of the Sage Council
The Humane Society
Hagens Berman LLP
Environmental Protection Information Center
Goldberg, Kamin & Garvin, Attorneys at Law
Californians for Renewable Energy (CARE)
Seatuck Environmental Association
Friends of the Columbia Gorge, Inc.
Save Our Scenic Area
Alliance to Protect Nantucket Sound
Friends of the Swainson's Hawk
Alameda Creek Alliance
Center for Biological Diversity
California Native Plant Society
Endangered Wildlife Trust
and BirdLife South Africa
AquAlliance
Oregon Natural Desert Association
Save Our Sound
G3 Energy and Pattern Energy
Emerald Farms
Pacific Gas & Electric Co.
Southern California Edison Co.
Georgia-Pacific Timber Co.
Northern Territories Inc.
David Magney Environmental Consulting
Wildlife History Foundation
NextEra Energy Resources, LLC
Ogin, Inc.
EDF Renewables
National Renewable Energy Lab
Altamont Winds LLC
Salka Energy
Comstocks Business (magazine)
BioResource Consultants
Tierra Data
Black and Veatch
Terry Preston, Wildlife Ecology Research Center
EcoStat, Inc.
US Navy
US Department of Agriculture
US Forest Service
US Fish & Wildlife Service
US Department of Justice
California Energy Commission
California Office of the Attorney General
California Department of Fish & Wildlife
California Department of Transportation
California Department of Forestry
California Department of Food & Agriculture
Ventura County Counsel
County of Yolo
Tahoe Regional Planning Agency
Sustainable Agriculture Research & Education Program
Sacramento-Yolo Mosquito and Vector Control District
East Bay Regional Park District
County of Alameda
Don & LaNelle Silverstien
Seventh Day Adventist Church
Escuela de la Raza Unida
Susan Pelican and Howard Beeman
Residents Against Inconsistent Development, Inc.
Bob Sarvey
Mike Boyd
Hillcroft Neighborhood Fund
Joint Labor Management Committee, Retail Food Industry
Lisa Rocca
Kevin Jackson
Dawn Stover and Jay Letto
Nancy Havassy
Catherine Portman (for Brenda Cedarblade)
Ventus Environmental Solutions, Inc.
Panorama Environmental, Inc.
Adams Broadwell Professional Corporation

Representative special-status species experience

Common name	Species name	Description
Field experience		
California red-legged frog	*Rana aurora draytonii*	Protocol searches; Many detections
Foothill yellow-legged frog	*Rana boylii*	Presence surveys; Many detections
Western spadefoot	*Spea hammondii*	Presence surveys; Few detections
California tiger salamander	*Ambystoma californiense*	Protocol searches; Many detections
Coast range newt	*Taricha torosa torosa*	Searches and multiple detections
Blunt-nosed leopard lizard	*Gambelia sila*	Detected in San Luis Obispo County
California horned lizard	*Phrynosoma coronatum frontale*	Searches; Many detections
Western pond turtle	*Clemmys marmorata*	Searches; Many detections
San Joaquin kit fox	*Vulpes macrotis mutica*	Protocol searches; detections
Sumatran tiger	*Panthera tigris*	Track surveys in Sumatra
Mountain lion	*Puma concolor californicus*	Research and publications
Point Arena mountain beaver	*Aplodontia rufa nigra*	Remote camera operation
Giant kangaroo rat	*Dipodomys ingens*	Detected in Cholame Valley
San Joaquin kangaroo rat	*Dipodomys nitratoides*	Monitoring & habitat restoration
Monterey dusky-footed woodrat	*Neotoma fuscipes luciana*	Non-target captures and mapping of dens
Salt marsh harvest mouse	*Reithrodontomys raviventris*	Habitat assessment, monitoring
Salinas harvest mouse	*Reithrodontomys megalotus distichlus*	Captures; habitat assessment
Bats		Thermal imaging surveys
California clapper rail	*Rallus longirostris*	Surveys and detections
Golden eagle	*Aquila chrysaetos*	Numerical & behavioral surveys
Swainson's hawk	*Buteo swainsoni*	Numerical & behavioral surveys
Northern harrier	*Circus cyaeneus*	Numerical & behavioral surveys
White-tailed kite	*Elanus leucurus*	Numerical & behavioral surveys
Loggerhead shrike	*Lanius ludovicianus*	Large area surveys
Least Bell's vireo	*Vireo bellii pusillus*	Detected in Monterey County
Willow flycatcher	*Empidonax traillii extimus*	Research at Sierra Nevada breeding sites
Burrowing owl	*Athene cunicularia hypugia*	Numerical & behavioral surveys
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	Monitored success of relocation and habitat restoration
Analytical		
Arroyo southwestern toad	*Bufo microscaphus californicus*	Research and report.
Giant garter snake	*Thamnophis gigas*	Research and publication
Northern goshawk	*Accipiter gentilis*	Research and publication
Northern spotted owl	*Strix occidentalis*	Research and reports
Alameda whipsnake	*Masticophis lateralis euryxanthus*	Expert testimony

EXHIBIT C

Comments
on
Draft Environmental Impact Report
for the
Doheny Ocean Desalination Project
Prepared for Adams Broadwell Joseph & Cardozo

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I have reviewed the Draft Environmental Impact Report (DEIR) for the Doheny Ocean Desalination Project (Project). The DEIR fails to adequately analyze impacts to biological resources relating to slant well operation. Specifically, the DEIR does not discuss the accumulation of organic matter in the filter sand and sediment near the slant wells. This accumulation will aid in developing hydrogen sulfide pockets. The slant well operation will fundamentally and adversely alter the marine habitat. As such, this Project and even the environmentally superior alternative[1] (the alternative also uses slant well technology) will have a significant impact on the environment, which the DEIR does not adequately disclose, analyze, or mitigate.[2] I submit the following comments for consideration to the South Coast Water District (SCWD).

I. SCWD EVALUATION AND ANALYSIS OF BIOLOGICAL RESOURCES

The California Environmental Quality Act (CEQA) allows each agency to define what is a significant impact when analyzing projects that require the agency's discretionary approval.[3] Relevant to my analysis, the SCWD defines a biological resources impact as "significant" if it would, among others:

> Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service[.][4]

Moreover, the SCWD indicates that "[t]he Project's potential impacts concerning biological resources would be avoided or reduced" because "[t]he subsurface intakes are the preferred ocean water intake method by the SWRCB's Ocean Plan Amendment, as they avoid marine life impingement impacts."[5] Though the slant wells may avoid direct impingement and entrainment of large marine life, they, instead, cause infiltration of dissolved, suspended, and particulate organic matter ("DOM," "SOM," and "POM," respectively). As discussed in further detail below, this infiltration will have a substantial adverse effect on the marine habitat and on the plethora of threatened, endangered and sensitive marine species.[6] Thus, contrary to the SCWD's conclusion that "operation of the seawater intake system would not result in impacts to candidate, sensitive, or special-status species," it is in my expert opinion that the Project will have a significant impact.[7]

II. Introduction

SCWD is proposing to construct and operate an ocean water desalination plant in Dana Point. This Project will utilize subsurface slant wells to intake water to produce up to 15

[1] Draft Environmental Impact Report for Doheny Ocean Desalination Project ("DEIR"), 2018, pg 1.0-56 ("Seawater Intrusion Minimization (DSB Only)" alternative).
[2] DEIR, pg 1.0-56.
[3] Pub. Resources Code, section 21092.2; CEQA Guidelines, section 15064.
[4] DEIR, pg 4.3-25.
[5] DEIR, pg 4.3-26.
[6] DEIR, pg 4.3-14.
[7] DEIR, pg 4.3-30.

million gallons per day ("MGD") of potable drinking water, with an initial phase of up to 5 MGD.[8] At this time, the SCWD intends to only pursue permitting and construction of the initial 5 MGD phased Project.[9] The estimated amount of seawater intake is 10 to 30 MGD.[10] The subsurface intake wells will be located at Doheny State Beach and Capistrano Beach.

I am qualified to evaluate the technical merits of the subsurface slant well, the potential physical and chemical impacts resulting from the slant well intake, and identify where the DEIR should disclose additional information. I have over thirty-five years of experience in the field of physical and natural sciences. I earned a doctorate degree in plasma chemistry diagnostics and laser spectroscopy, and a master's degree in spectroscopy and physical chemistry. I hold three US patents and one International and two more are pending. I have subject matter expertise in evaluating prior art patents and public domain proposals in spectroscopy and physical chemistry, and in utilizing high performance computational methods for imaging and analytical chemistry applications. My curriculum vitae is attached to this letter.

III. Background: Slant Well Technology

Unlike open-ocean intakes, which draw water from above the seafloor, subsurface slant wells draw water from aquifers and through the seabed. The intake is made possible by a high power submersible pump contained within the slant well. Each slant well is capable of drawing in 3-4 million gallons of water per day of untreated ocean water, which equates to six Olympic swimming pools or a cube that is 74 feet long, 74 feet wide, and 74 feet high. In its initial phase the Project calls for 10MGD which will produce 5MGD of potable water.[11] The Project assumes constructing three to four wells. Additional slant wells would be constructed if the Project is expanded to the 15 MGD plant.[12]

Overtime, the slant well technology should draw primarily from "young" ocean water.

> *Geochemical tracers used to quantify water sources to the Doheny test slant well during an almost two year pumping test (2010-2012) were used to estimate slant well connectivity to the ocean and relevant amounts of water sources.*
>
> *Test results support the increased capture of shallow, young marine ground water. Natural isotope data showed after one year of pumping, recharge to the slant well consisted of a mixture of brackish ground water (which showed a decreasing trend), ocean water (which showed an increasing trend), and old marine ground water which initially increased and then slightly decreased as it was being removed from the aquifer. This reflected the fresh/salt interface being induced to migrate toward the well. The geochemical data combined with a three-*

[8] DEIR, pg 1.0-3.
[9] DEIR, pg 1.0-3.
[10] DEIR, pg 1.0-1.
[11] DEIR, pg 1.0-1.
[12] DEIR, pg 1.0-55.

dimensional variable density flow and solute transport model predicted that the old marine ground water would be fully removed from the subsea aquifer within approximately one year at the full scale production rate of 30 mgd. Furthermore, upon reaching steady state conditions, (approximately one year), and after removal of the old marine ground water, the source of water to the feed water supply wells was predicted to consist of 95% "younger" ocean water (with very low levels of dissolved iron/manganese, ~ 2 µg/L), and 5% brackish ground water (~2 mg/L of dissolved iron/manganese), resulting in a blended concentration of approximately 0.10 mg/L.[13]

The anticipated hydrogeologic transition is illustrated in the Figure 1 below, which is from the Final Summary Report for the Doheny Ocean Desalination Project Phase 3 Investigation, prepared by the Municipal Water District of Orange County (MWDOC) in 2014.[14] This figure is reproduced, in part, on p. 3.0-24 in the DEIR.[15]

[13] Williams, D.E. 2015. Yield and Sustainability of Large Scale Slant Well Feedwater Supplies for Ocean Water Desalination Plants, pg. 5, 15 ("Slant wells completed in subsea aquifers typically produce over 95% of their supply from ocean water sources (vertical leakage through the sea floor) and lateral flow from subsea aquifers.") ("Williams, 2015")
[14] Municipal Water District of Orange County (MWDOC), January 2014. Final Summary Report for the Doheny Ocean Desalination Project Phase 3 Investigation: Extended Pumping and Pilot Plat Test Regional Watershed and Groundwater Modeling Full Scale Project Conceptual Assessment, *available at* https://www.scwd.org/civica/filebank/blobdload.asp?BlobID=5592 ("MWDOC – Final Summary, 2014"); *see also* Williams, 2015, at pg. 3 (evaluating the Doheny wells at Dana Point and the Monterey test slant well).
[15] DEIR, pg. 3.0-24/25.

- Illustration of Slant Well Source Water Production vs. Time

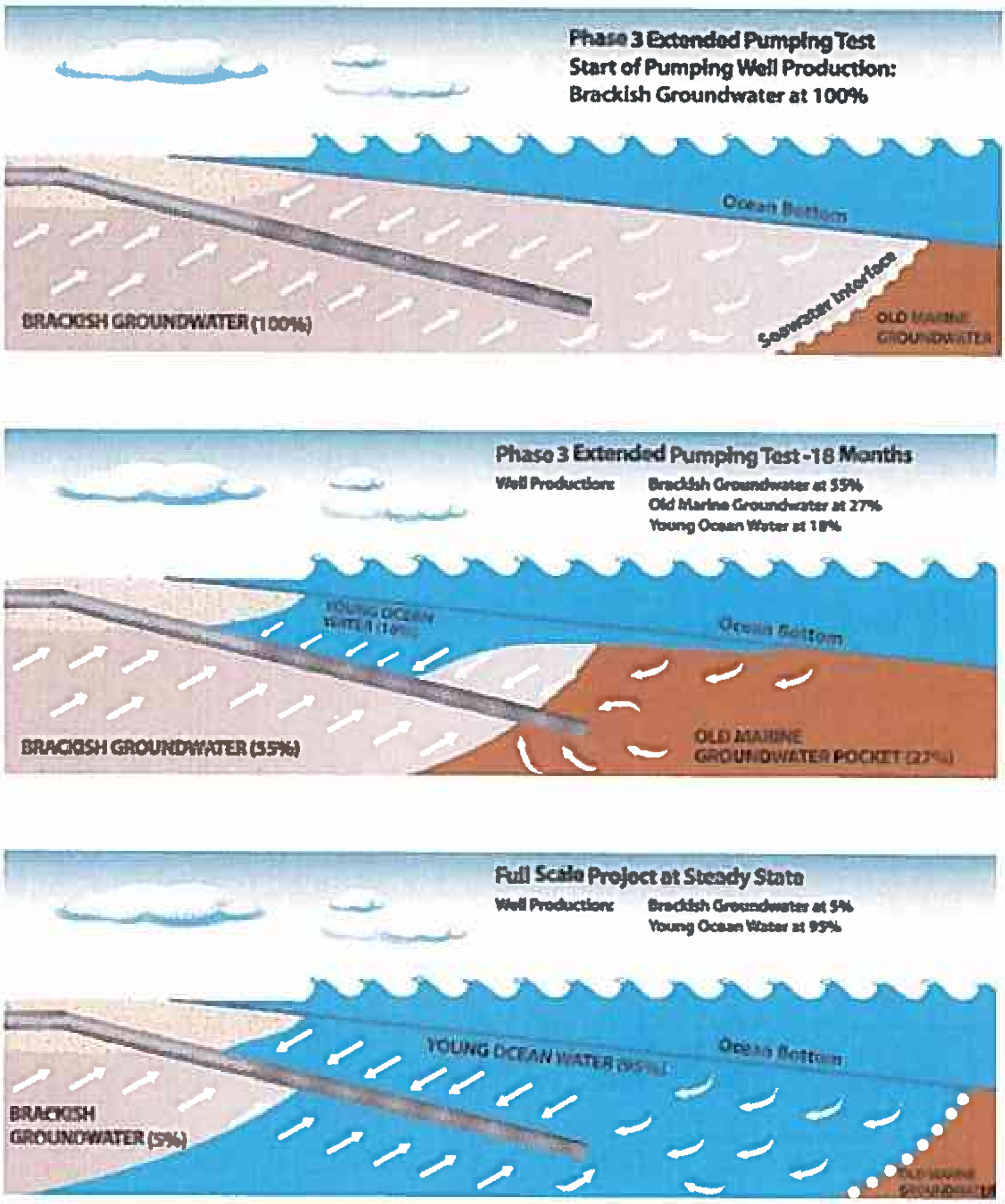

Figure 1. Final Summary Report Doheny Wells[16]

[16] MWDOC – Final Summary, 2014, at pg. 19.

The DEIR indicates in Table 3-3 that the wells would draw 93.4% young ocean water once the Project reaches steady state operations.[17]

Table 3-3: Summary of Predictive Scenario Feedwater Quality

Model Run	Doheny Beach		Capistrano Beach Park	
	Percentage of Ocean Water	Time for TDS for Stabilize	Percentage of Ocean Water	Time for TDS for Stabilize
Scenario 1 (Project Pumping of 10 MGD from Doheny Beach Park)	93.4%	10 months[9]	-	-
Scenario 2 (Project Pumping of 10 MGD from Capistrano Beach Park)	-	-	100%	days
Scenario 3 (Project Pumping of 30 MGD – 20 from Doheny Beach, 10 from Capistrano Beach Park)	93.4%	12 months	100%	days

Source: Geoscience, Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data, December 2017

Table 1. DEIR, p. 3.0-14

IV. Analysis

The SCWD's has no discussion whatsoever about the infiltration of small organic matter into the subsurface. The impact conclusion needs to be revised to address my comments and analyze the impacts of these small organic particles on the sea environment.

a. *Biomass will accumulate*

In order to understand the significance of small organic matter as it relates to slant well operations, it is necessary to understand the forces at work in this situation. The ocean feedwater contains small and large organic and inorganic particles. The basic premise of the slant well technology is that it uses the sand and sediment on the ocean floor as the filter medium for water pretreatment in the desalination process.

Water in the ocean behaves differently when it comes into contact with the seafloor than when it is just in the larger ocean. As noted by Dr. I. N. McCave, wave velocity scales down logarithmically to the sea floor.[18] This means that a wave traveling quickly on the sea surface will travel quite slowly near the sea floor. In fact, there is little variation of the wave speed along the seafloor due to this logarithmic scaling. On average, we can conclude from McCave's work, that the layer of water, with width of 1mm, adjacent to

[17] DEIR, pg 3.0-24.

[18] McCave, 2008. Size Sorting During Transport and Deposition Of Fine Sediments: Sortable Silt and Flow Speed *in* Developments in Sedimentology, Volume 60, pg 121-144, ISSN 0070-4571, DOI: 10.1016/ S0070-4571(08)00208-2 pg 130. In a turbulent flow, the speed decreases logarithmically towards the bed because of the drag, so very close to the bed the flow is slow and becomes laminar, or at least dominated by viscosity.

the seafloor, is traveling at the speed of 1cm/s.[19]

This boundary layer[20] serves as a cushion that can push larger particles away from the seafloor.[21] However, this is not the case for dissolved organic matter (DOM) and suspended organic matter (SOM). DOM and SOM are on the scale of microns, meaning one-millionth of a meter. DOM and SOM are so small that they will not get swept away by the wave action near the seafloor. Instead these particles will become trapped in a vortex and/or slow moving boundary layer that exist on the seafloor. Additionally, shear forces above the boundary layer will disaggregate larger particulate organic matter (POM) resulting in smaller material that can also get trapped in the boundary layer.[22]

Once in the boundary layer, DOM and SOM are small enough to be subject to the sucking force of the slant well and will get infiltered into the sand or any other permeable sediment on the sea floor. The DOM and SOM will be carried with the source water through the capillaries into the subsurface[23]. During their transport DOM and SOM will bind to variously sized inorganic particles, such as silica grains, clays, and other minerals, thus forming humus, gels, and other aggregates in the subsurface.

Due to physico-chemical adsorption, the organic mass will not be washed away at the water-sediment interface. Adsorption of organic compounds onto marine sediments is known and the subject of several studies and references therein.[24] Moreover, the biomass will be continually pushed down further into the seabed thus expanding the range of bioaccumulation.

More POM is in the Subsurface than is Free Floating

Dr. Lech Kotwicki's research[25], which I include as Exhibit A to these comments, directly supports my assertion that organic matter will infiltrate and accumulate in the subsurface.

In Kotwicki's paper[26], *Fine organic particles in a sandy beach system (Puck Bay, Baltic Sea)*, he examined 100 grams of sterile sand samples and recorded how much POM was bound to sand grains, how much POM was free floating, and how much POM was lost in the first wash and how much was lost in the tenth wash. Kotwicki observed that 40 to 60% of POM adheres to the surface of sand grains, see Figure 2 of Exhibit A.[27] Kotwicki confirmed that, even in the rinsed sample, POM, in the form of diatom cells and bacterial colonies, binds to the microcavities of individual sand grains. In other words,

[19] McCave, pg 130
[20] Note also that McCave's assessment about speeds at the seafloor is consistent with my own simulations that small organic particles will be immobilized by vortices on the seafloor.
[21] Personal communications Huettel and Kotwicki 4/18/2018
[22] McCave, pg 132
[23] Jaradat, Aiman Q., Grimberg, Stefan J., and Holsen, Thomas M., 2009. Colloid Transport through Natural Filter Media, *in* Journal of Environmental Engineering © ASCE.
[24] Sansone, Francis J., Andrews, Christine C., and Okamoto, Mauri Y., 1997. Adsorption of short-chain organic acids onto nearshore marine sediments, *in* Geochimica el Cosmochimica Acta Vol. 51. pp. 1889-1896 (Exhibit F).
[25] Kotwicki, L, Weslawski, J.M., Szaltynis, A., Stasiak, A., Kupiec, A., 2005. Fine organic particles in a sandy beach system (Puck Bay, Baltic Sea) *in* OCEANOLOGIA, 47, pp. 165–180. Publication 2005, by Institute of Oceanology PAS. (Exhibit A)
[26] Ibid.
[27] Ibid.

what Kotwicki's research shows is that POM will bind to sand grains even in high velocity washes.

Indeed, Kotwicki's research has serious implications for this Project because he found that there is more POM in the subsurface water than there is free floating POM above the seafloor. The logical extension to this is that considerable quantities of POM will be binding to sand grains in the filter medium.

Kotwicki's experimental and quantitative observations confirm that organic matter will enter the subsurface and will accumulate there. In my opinion the same will be true as a result of this Project: the concentration of POM in the subsurface will be larger than it is in free floating water.

Biomass Accumulation will be Substantial

Next, not only will organic matter accumulate, but also there is agreement among scientists that the accumulation will be substantial. I refer you to research by O.K. Borodovskiy, 1965, at pages 33-82.[28] References contained within that study conclude that one cubic meter of surface seawater contains 0.5-1.5 grams of SOM.

Additionally, Drs. Precht's, and Huettel's research, included as Exhibits B[29] and C[30], supports Borodovskiy's research. Precht and Huettel provide an infiltration rate of $0.01 cm/s^{-1}$ for sandy sediments by rapid wave driven advective transport.

Assuming the filtration rates determined by Precht and Huettel, Exhibit D,[31] the daily input of Particulate Organic Carbon (POC) into coastal sands is approximately 1.4–2 grams m^{-2} day^{-1} (for POC concentration in swash water ranging from 10 to 25 mg dm^{-3}). Thus, active forcing of fine particles by circular waves into the sand may exceed sedimentation rates. These conditions are analogous to the ones we will see for this Project.

Furthermore, Drs. Sansone, Andrews, and Okamota's research, Exhibit E,[32] shows that deposits of DOM, SOM, POM in the subsurface will be adsorbed, and the degree of adsorption is not correlated with the surface area of grain, slit, or clay.[33]

Studies of different sea water pre-treatment technologies, by S. Rodríguez[34] show that substantial fractions of DOM and SOM reach Reverse Osmosis (RO) filter membranes:

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[28] Borodovskiy, O. K., 1965. Marine Geology 3 at 33-82 – Elsevier Publishing Company

[29] Precht, E., Franke, U., Polorecky, L., Huettel, M., 2004. Oxygen Dynamics in Permeable Sediments with Wave-Driven Pore Water Exchange *in* Limnology and Oceanography, Vol. 49, No. 3, pp. 693-705 (Exhibit B).

[30] Precht, E., Huettel, M., 2004. Rapid wave-driven advective pore water exchange in a permeable coastal sediment Journal of Sea Research 51, 93– 107 (Exhibit C).

[31] Precht, E. and Huettel, M., 2003. Advective pore-water exchange driven by surface gravity waves and its ecological implications, in *Limnol. Oceanogr.*, 48(4), 1674–1684 (Exhibit D)

[32] Sansone, F.J., Andrews, C.C., Okamoto, M.Y., 1987. Adsorption of short-chain organic acids onto nearshore marine sediments, *in Geochimica el Cosmochimica Acta* Vol. 51. pp. 1889-1896, (Exhibit E)

[33] Ibid., pg 1893

[34] Rodriguez, S.S.G., 2011. Particulate and Organic Matter Fouling of Seawater Reverse Osmosis Systems: Characterization, Modelling and Applications ISBN 978-0-415-62092-5 (Taylor & Francis Group) pg 6

"Beach wells and the infiltration gallery [subsurface intake method] removed almost twice the DOM and SOM in form of biopolymers (~70 %) compared to other raw seawater pre-treatment methods."[35]

The above statement means that the environment is taxed from the very beginning of the desalination process. The research also suggests that the 5MGD plant, which needs approximately 10 MGD of raw water, will deposit 20 to 60 kg/per day of total organic matter (consisting of DOM and SOM) in the sediment. If the Project is expanded to the 15 MGD plant, then 60-180 kg/day of DOM and SOM will be deposited, thus resulting in a more significant impact on the aquatic habitat.

Additionally, runoffs from storms or Harmful Algal Blooms event may amplify DOM and SOM concentrations, by supplying nutrients washed from the land.[36] Storm water runoff also contains colloidal material, particles that range in size from 0.01 to 1.0 μm.

One can envision a coffee maker with a paper filter and a mixer placed above. By analogy the waves are the mixer, and the sandy beach is the filter. The spinning propeller induces a circular motion of soaked coffee grounds and will improve the speed of filtration, and the filter will prevent the ground coffee from getting into the brew. However, the filter itself will permanently absorb microparticles. Rinsing a clogged filter does not solve the problem of permanently absorbed microparticles. A filter can be discarded; unfortunately the same does not apply to the sandy beaches used for the purpose of induced filtration. Clogging of the capture zone in the Project is only a matter of time.

b. *Anoxic Subsurface will Lead to Toxic Conditions in the Aquatic Habitat*

In anaerobic conditions, the accumulated biomass in the filter medium will support growth of sulfate reducing bacteria (SRB) that are capable of releasing hydrogen sulfide (H_2S).

As described in further detail below, the flow of water due to slant well operations is not enough to oxygenate the subsurface and remove undigested organic matter. This brings us back to the problem of organic matter that will be left undigested and that will become food for sulfate reducing bacteria (SRB). The "food" will also be a source of pollution due to potential release of H_2S.

Anoxic conditions occur in the subsurface.

First, not even considering slant well operations, beginning at shallow depths much of the subsurface waters is already anaerobic even in wave dynamic environments.

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[35] Ibid. pg. 61
[36] Jaradat, A. Q., Grimberg, S. J., and Holsen, T. M., 2009. Colloid Transport through Natural Filter Media, *in* Journal of Environmental Engineering © ASCE.

Precht's and Heuttel's research[37] shows that **<u>only</u>** at most the first few centimeters of sediment will be oxygenated.[38] In their research, Precht and Huettel reproduced oscillatory wave conditions that are present in the swash and surf zones (*i.e.*, high turbulent conditions). The oscillatory wave conditions did oxygenate the first few millimeters to few centimeters of sediments, but beyond that zone, substantial depletion of dissolved oxygen occurs.

Second, slant well technology will not oxygenate the entire depth of the filter strata. Slant well technology is a slow infiltration method.

Geoscience found that the vertical infiltration rate of ocean water migrating downward through the seafloor during slant wellfield operation is quite low, at approximately 0.000051 feet per second (fps) in the immediate vicinity overlying the wellfield and 0.00000078 fps at the outer limits of the ocean water source area. This slow rate of infiltration would be imperceptible to benthic organisms. At this Project site benthic organisms routinely experience much greater currents and wave surge in the active wave climate offshore Doheny Beach.[39]

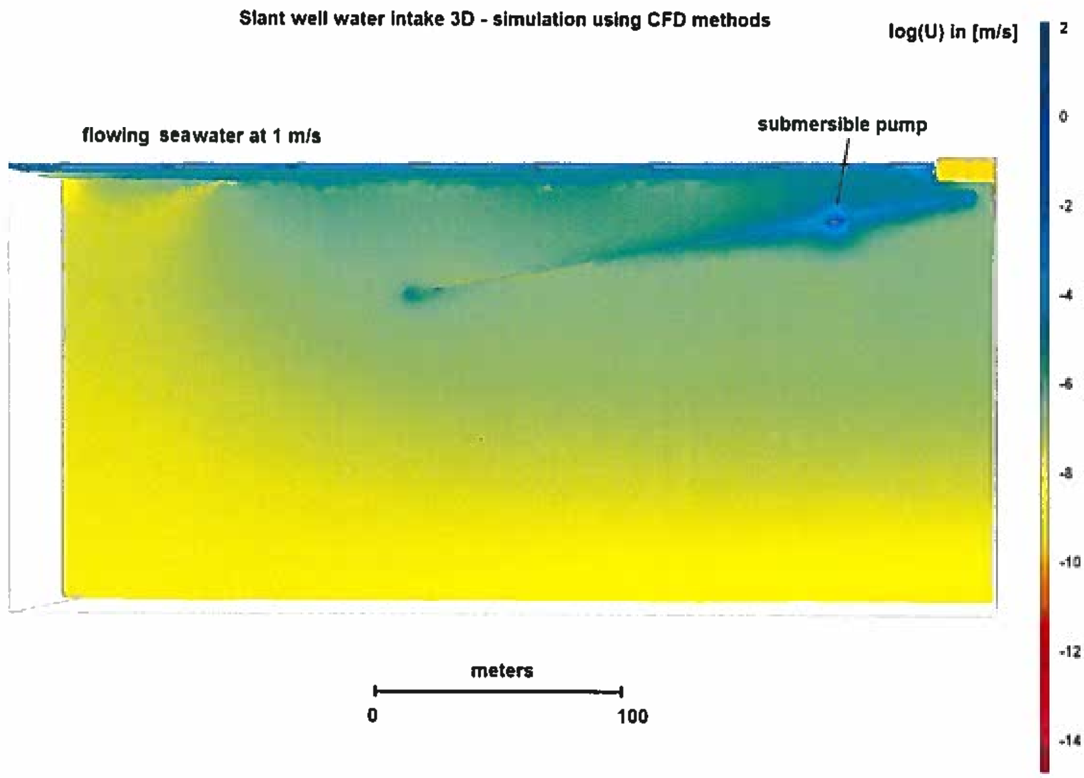

Figure 2. Cross-section of slant well water intake zone. Computational Fluid Dynamics (CFD) was used to represent the water flow velocities field. The suction force of the submersible pump force DOM and SOM deeper into sediment.

[37] Precht, E., Franke, U., Polorecky, L., Huettel, M., 2004. Oxygen Dynamics in Permeable Sediments with Wave-Driven Pore Water Exchange *in* Limnology and Oceanography, Vol. 49, No. 3, pp. 693-705 (Exhibit B).
[38] Ibid. Fig 4 pg 6; Precht, E. and Huettel, M., 2003. Advective pore-water exchange driven by surface gravity waves and its ecological implications, in *Limnol. Oceanogr.*, 48(4), 1674–1684 (Exhibit D).
[39] DEIR, p. 3.0-11.

Figure 3. Zoomed-in suction zone above the slant well from Figure 2. The flux of DOM, SOM, POM matter will follow the infiltration path of water and will eventually be adsorbed and immobilized. That organic matter becomes a nutrient for anaerobic bacteria producing hydrogen sulfide. The infiltration zone depends on the submersible pump capacity, however my preliminary modeling shows that one can expect DOM and SOM concentrations at least two orders of magnitude higher than in natural fluxes caused by advective waves actions. As can be seen by the color scale, colloids will deposit in the entire filter strata and there is more DOM and SOM above and in the direct vicinity of the slant well.

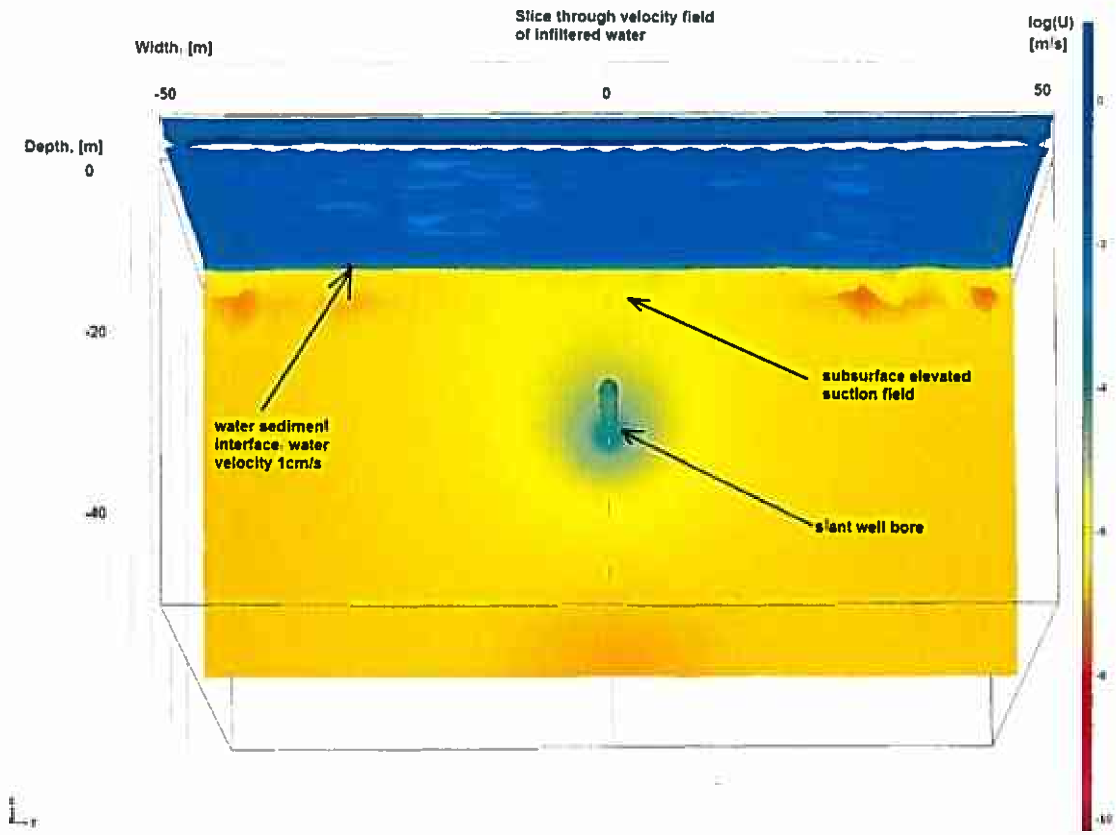

Figure 4. Illustration of flux gradient in subsurface sediment. The conclusion from the flux velocity numerical analysis in the 3-D model of flow shows that infiltration of DOM and SOM due to pumping action through the porous media is at least 100 times higher than natural transport caused by wave action alone. A cylindrical halo having a radius of 30 meters will contain elevated nutrients for anaerobic bacteria.

However the above explanation does not address the biochemical processes below the surface. At such a low infiltration rate, the dissolved oxygen (DO) will be completely consumed by biochemical processes in a filtration distance of 0.9m.[40] Induced infiltration may somewhat extend the depth of oxygenation, but not enough to oxygenate the entire subsurface that will have accumulated biomatter. Moreover, events like a power outage in the pump station may, within hours, lead to excessive production of deadly hydrogen sulfide. This is because dissolved oxygen will be rapidly depleted in the sediment top portion of the seafloor and if H_2S reaches concentrations of 2 ppb, it will threaten wildlife and the ocean habitat. The ongoing accompanying effect is the acidification of the subsurface water.

c. *Environmental impact due to organic waste stimulating production of H_2S*

The production of toxic H_2S will deteriorate, adversely disturb, physico-chemically and bio-chemically modify the aquatic habitat and harm marine species, thus resulting in a significant impact based on the SCWD's own significance thresholds.[41]

Even though the production of toxic H_2S can be naturally mitigated in well-oxygenated and dynamic waters exposed to daylight, there is neither daylight nor oxygen in the anoxic subsurface to reduce the production of toxic H_2S. Additionally, the slant well operations will extend the anoxic environment because of forced nutrient loading into sediments. The eventual mixing of H_2S by storms with surface water must be considered. All in all, the environmental impact from the Project on the aquatic habitat due to production of toxic H_2S is significant as opposed to less than significant as the DEIR states.[42]

As a summary of the discussion above, first, the rise of organics in the porous media due to presence of infiltration fluxes of DOM and SOM will be substantial and surely above normal diffusion rates in the natural habitat. Consequently the buildup of a food reservoir for anaerobic bacteria and sulfate reducing bacteria (SRB) will follow and there will be an accompanying effect of greater acidification.

The seawater — while traveling through the filtering sediments — will rapidly undergo acidification due to interaction with anaerobic bio-digestion of DOM and SOM. This can already be seen from the test slant well that is being operated for the Monterey Peninsula Water Supply Project. Based on data from the Monterey Peninsula Water Supply Project that has constructed and operated a test slant well (the same technology that is proposed here) the pH at the slant well output will be in the range from 7.1 to 6.8.[43] At pH 7.0, fifty percent of the amount of total H_2S concentration will exist in its unionized, gaseous and toxic form. And, H_2S in its unionized form is extremely toxic,

[40] Bartak, R., Grischek, T., Ghodeif, K., and Ray, C., 2012. Beach Sand Filtration as Pre-Treatment for RO Desalination, International Journal of Water Sciences, Vol. 1, 2:2012 DOI: 10.5772/53034
[41] DEIR, p. 4.3-25
[42] DEIR, p. 4.3-26.
[43] Monterey Peninsula Water Supply Project, Test Slant Well Long Term Pumping, Monitoring Report No. 120 – Geoscience (2017).

see T.U. Bagarino's research in Exhibit F.[44] A concentration of 2ppb is considered the upper limit for tolerance. In seawater, H_2S exists in ionized (non toxic) and unionized (toxic) form. At highly basic sea water, at pH 9, 99% of hydrogen sulfide exists in non-toxic form and 1% in toxic. Small variations are expected due to salinity and temperature. However observed pH levels in Doheny State Beach in Dana Point was 8.2, which yields an estimated 10-15% of unionized (toxic) form of H_2S. The more acidic the water the more unionized (toxic) form of H_2S exists.

Based on the Monterey Peninsula Water Supply Project's test slant well results, sulfate reducing processes appear to already be actively ongoing in the filter medium causing acidification of the source water as it is pulled into the test slant well. If not for anaerobic bio-digestion of DOM and SOM, which acidifies water, the water would not be more acidic at the output than it is prior to entering the subsurface. The same can be expected to be true for this Project.

The Preliminary Design Report in the DEIR's Appendix 10.1 shows pH data derived from the pumping model with pH changes over 36 months period.[45] The model is driven by the requirement of boosting pH to remove elevated Fe/Mn concentration of iron and manganese from the feedwater.[46]

As expected, the pH level at the beginning of pumping of the Dana Point test slant well is consistent with data obtained in the test slant well at the Monterey Peninsula Water Supply Project.[47] Since there is no mention in the description of the model that acidification mechanisms in anoxic sediment were taken into account, in my expert opinion, the expected pH 8.0 after 36 month period of pumping is unrealistic. The Computation Fluid Dynamic models used in preliminary design report are deficient in providing realistic flow dynamics. If the models included bio-reactive processes and colloidal particle deposition,[48] they would give a better estimate of natural filter usability and help estimate the amount of cumulated organic matter.[49]

Studies confirm that there can be substantial releases of H_2S and $S(CH_3)_2$ from anaerobic sediments into the atmosphere from shallow marine sediments.[50] Additionally, increased production of H_2S gas in the sediment, as a result of slant well operations, can evolve into non-permeable anoxic pockets in the sediment, and stay there. Development of these pockets increases the risk of hazardous environmental events. For example, during a storm, pockets containing toxic gas and/or derivatives, such as $S(CH_3)_2$, can burst releasing the toxins into the aquatic habitat causing a fish-kill .[51] A

[44] Bagarino, T.U. Sulfide as a Toxicant in Aquatic Habitats, (Exhibit F).
[45] DEIR, Appx. 10.1, p. 8, Table 1 (Report for South Coast Water District - Doheny Ocean Desalination Project, 111/10709.)
[46] DEIR, Appx. 10.1, p. 7 (Report for South Coast Water District - Doheny Ocean Desalination Project, 111/10709.)
[47] Monterey Peninsula Water Supply Project, Test Slant Well Long Term Pumping, Monitoring Report No. 120 - Geoscience
[48] Li, Y., Sarishvili, O., Omari, A., Ahmadi, A., PU, H., 2017. Colloidal Particle Deposition in Porous Media Under Flow: A Numerical Approach *in* International Journal of Modeling and Optimization - Vol. 7, no.1, pg 43-47.
[49] Bradford, S.A., Simunek, J., Bettahar, M., Tadassa, Y. F., van Genuchten, M. T., and Yates, S.R., 2005. Straining of Colloids at Textural Interfaces *in* Water Resources Research, Vol. 41, W10404, DOI:10.1029/2004WR00367.
[50] Hansen, M.H., Ingyosen, K., Jorgensen, B.B., 1978. Mechanisms of Hydrogen Sulfide Release from Coastal Marine Sediments to the Atmosphere, *in* Limunology and Oceanography, V.23(1), pg 68 -76.
[51] Sloan, R. Ecological Investigations of a Fish Kill in Pescadero Lagoon, CA, 2006. Available at https://www.scribd.com/document/341232545/2006-Fish-Kill-in-Pescadero-Lagoon

fish-kill can be caused from sediments having 200ppb of H_2S content. See R. Sloan's Ecological Investigations of a Fish Kill in Pescadero Lagoon, California.[52]

Moreover, Table 3 in Appendix 10.1 shows in the Pilot Test Biological Sampling Results that there is detected bacterial content, which constitutes organic matter, in the beach filter medium.[53] This raises additional concerns of further introducing and expanding the bio-hazardous agents into the sand of a public beach through forced infiltration.

The potential for a hazardous event is a significant (and currently undisclosed to the public) impact on the aquatic habitat as a result of the Project operations.

d. Mitigation Measures Are Required For A Significant Impact

When an impact is significant, feasible mitigation measures are required.[54] As mentioned above, the mere operation of the slant well will result in the production of deadly hydrogen sulfide as a result of anaerobic respiration of cumulated slimes, and colloids under the subsurface. The production of toxic hydrogen sulfide will have a substantial adverse effect, either directly or through habitat modifications, on protected marine species. Therefore there is an undisclosed, unanalyzed, and unmitigated significant impact. Accordingly, the slant well operation results in a significant impact on the ocean environment.

Agencies must disclose that the impact is significant and conduct studies to assess the problem. Consider the increased severity of the impact if the facility is decommissioned and the slant wells are abandoned at the end of its operating life.[55] Since this impact is not disclosed to the public and decisionmakers as a significant impact,[56] the SCWD must revise the EIR to correct this deficiency. In the revision, SCWD must disclose this significant impact.[57]

V. CONCLUSION

The impact to biological resources is not less than significant as the DEIR purports.[58] It is significant.

In reviewing the DEIR there is no indication that the SCWD considered that the slant wells would pose a significant impact on the marine environment. And the operation of the slant wells *will* have a significant impact on the marine environment. The buildup of organic material in the subsurface combined with low oxygen conditions can produce significant quantities of toxic H_2S, particularly during full scale operation. The impact will be even greater if the Project is expanded to produce 15 MGD of potable drinking water a day. Accordingly, the operation of slant wells will have a substantial adverse impact

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[52] Ibid.
[53] DEIR, Appx. 10.1, p. 9 (Report for South Coast Water District - Doheny Ocean Desalination Project, 111/10709/.)
[54] Public Resources Code, section 21002.
[55] *See* DEIR, p. 4.9-2 (discussing abandoned test slant well at Doheny State Beach).
[56] FEIR/S, 4.5-52 (Impact 4.5-4 is "less than significant").
[57] CEQA Guidelines, section 15088.5.
[58] DEIR, p. 4.3-30.

on the aquatic habitat and the protected species that live in it. As such, the impact is significant.[59]

As discussed above, I already suspect that the aquatic habitat is changing based on the test slant well data at the very similar Monterey Peninsula Water Supply Project. Experimental evidence at the Monterey Peninsula Water Supply Project test slant well suggest that the source water is acidifying in its transport through the subsurface causing an adverse environmental effect. In other words, biochemical processes carried by anaerobic bacteria during digestion of DOM and SOM seem to already be taking place in the subsurface and acidifying the water that then enters the test slant well. I can expect the same here.

Finally, in my expert opinion, this Project's impacts will be significant. The DEIR fails as an information disclosure document to address these impacts. The public and decision makers must be told about this significant impact in a revised EIR.

EXHIBITS:

A. Kotwicki, Fine organic particles in a sandy beach system -2005
B. Precht Huettel, Oxygen Dynamics in Permeable Sediments -2004
C. Precht Huettel, Rapid wave-driven advective pore water exchange - 2003
D. Precht Huettel, Advective pore-water exchange - 2003
E. F.Sansone, Adsorption of short-chain organic acids onto nearshore marine sediments - 1987
F. T.U.Bagarinao, Sulfide as toxicant in Aquatic Habitat-1993

[59] DEIR, p. 4.3-30.

RADEK SOBCZYNSKI, Ph.D.

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Interdisciplinary Scientist • Principal Investigator • Chemical Physicist • Inventor

Spectroscopic Analytical Chemistry • Spectroscopic Laser Technologies • Exploratory Research and Development for Physical and Natural Sciences • Photonics Hardware and Software Systems Design

Professional Experience:

2007-Present, Chemled Technologies, LLC – CTO, Principal Investigator.

Invented and developed atomic resonant laser class for multitude applications in analytical chemistry, photonics -patented. Secured funding from US-Government Department of Defense-Missile Defense Agency (DoD), National Oceanic and Atmospheric Administration (NOAA), and Connecticut Innovation. Work resulted in two utility patents – *"Self-Locking Atomic Emission Laser With An Intracavity, Atomic Plasma As Resonance Line Seeder,"* – issued and *"Laser With Intracavity Narrowband Magneto-Optic Atomic Filter."* – pending. Developed laser sensor for precise determination of calcium and strontium in seawater under contract with NOAA. Submitted research and development proposals for (1) LIDAR ceilometer for cloud height and aerosol detection in atmosphere, (DoD) and (2) mobile coastal analyzer for multipurpose analytical observations (NOAA). Performed electrocatalytic bio-remediation studies with robotic Energy Generating Autonomous Sailing Craft (EGASC) system to prevent Harmful Algal Blooms (HAB). Boosted 300% analytical performance and sensitivity for sulfur, nitrogen, oxygen and carbon for elemental analyzer by improving deep UV spectrometer optics. Examined and evaluated the technical feasibility of prior art patents. Developed commercial software and hardware for scientific instrument companies – (Andor, Newport, JAS GmbH).

2005-2007, Princeton Instruments, Acton Research Corporation, companies owned by Roper Corporation, Senior Scientist.

Invented VSMS™ advanced multi-grating imaging spectrograph for ICP, LIBS, and single event spectral energy imprints. VSMS principles have been applied in Mars Rover mission and military stand-off systems.

1996-2005, Spectra Physics – Newport – Oriel – companies owned by Thermo Fisher Scientific, www.oriel.com , www.newport.com , www.thermofisher.com. Member of company management team, Production automation and calibration manager, Technology manager, FTIR product line manager.

Direct involvement in technical contract negotiations. Development of systems for photonics, biology, chemistry. QC laboratory organization. Manufacturing personnel training.

1995- 1998, Hadaspectrum, Start-up. Co-founder.

Development and commercialization of III-V NIR LED's spectral range 1000 – 2600nm for chemical sensing. Design and fabrication of hybrid arrays for chemical and bio-sensing for absorption bands, water, hydrocarbons. Characterization of III-V materials for industrial client (Telcom Devices).

1990-1995, DOM Associates, R&D-Manager.

R&D and technology management. Invented, developed, and patented Hadamard Transform spectrometers and signal processing, which received more than eighty citations as prior art in the US. Patent Office database.

1987-1990, Kansas State University, Post Doctoral Researcher.

Dr. D.W. Setser's laboratory – Post-Doc. Performed energy transfer studies in excimer molecules used in excimer lasers. Automated scientific apparatus for studies in chemical kinetics.

1980-1987, Warsaw University, Plasma Diagnostic Laboratory, Research Scientist.

Ph.D. earned through contributions to the plasma diagnostics field.

Subject Matter Expertise:

- High Energy Lasers DPAL and IPSSL; Spectral Systems Design for LIBS, VUV, DUV, VIS, NIR, FTIR, Atomic, Laser Spectroscopy, Fluorescence, Raman, FTIR and Hyper-spectral Microscopy.
- Applied spectroscopy and physical chemistry.
- Laser and spectral systems for chemical, material science, or biological applications.
- Technical evaluation of prior art patents and public domain proposals in spectroscopy and physical chemistry.
- Algorithms for imaging and analytical chemistry applications.
- Designs of ergonomically friendly GUI designs with live data fusion and hardware interfacing.
- Hardware accelerated algorithms VHDL-FPGA, CUDA, Matlab, Simulink, COMSOL
- Implementations with Xilinx VHDL IP-cores®, Altera VHDL using Vivado® and Quartus® frameworks.
- Development of ergonomic commercial software for spectroscopic instruments using Matlab language and expert toolboxes such as chemometrics, neural networks, signal processing.
- Web enabled (Internet of Things) wireless chemical sensors.
- Implementation of EM-CCD, iCCD Cameras, Single Point Detectors, FTIR spectrometers, Dispersive Spectrometers for 1-D or 2-D imaging general spectroscopy, sensors for physical chemistry or life sciences.

Major accomplishments:

Inventions:

- Invented IPPSL laser class, 2013-2017. Patent US 9,653,873 granted May 2017– (Chemled Technologies).
- Invented VSMS™ technology for optical spectrometers 2005 – (Princeton Instruments).
- Invented spectrograph with segmented dispersion device, US patent office publication 20070030484 – (Acton Research Corporation).
- Invented Hadamard spectrometer for blood glucose monitoring, issued US Patents 5,257,086, 5,488,474 – (DOM Associates).

Developments:

- System development for field deployable low power LIDAR-Ceilometer (based on invented novel FADOF technology for precise atomic wavelength locking) – (Chemled Technologies).
- Laser Optical pumping development for several kilowatt alkali vapor and periodic group VIII lasers (patent pending) – (Chemled Technologies).
- System development for remote LIBS – (Princeton Instruments).
- System architecture and product line management of VIS-NIR BlueFTS® 400nm – 2300nm and MIR8025 0.7- 25µm Fourier Transform Spectrometer – (Oriel Instruments).
- Major redesign and migration of QC and manufacturing software (Win98) to XP platform for radiometric laboratory – (Oriel Instruments).
- Developed hardware accelerated computational engines for optical instruments (VHDL, NET-OS), Wi-Fi WEB enabled controller for Solar Simulators – (client Abet-Technologies).
- Automated radiometric laboratory – (Oriel Instruments).

Grants and Research and Development Contracts from US government:

- DoD-Missile Defense Agency – Project title: *Intracavity Plasma Solid State Laser for DPAL-Rb Rb Optical Pumping.* – (Chemled Technologies).
- NOAA, Project title: *Laser Sensor for Unattended, Selective, and Precise Determination of Calcium and Strontium in Seawater Programs* – (Chemled Technologies).

Operational Improvements for Companies:

- Analyzed revenues sales activities by product line for 4000 Oriel catalog products, using Neural Network Classification algorithms. Novel graphical representation allowing rapid identification of growth – (Oriel Instruments).
- Originated Optical Network Performance Monitoring for Thermo Fisher Scientific Growth Strategy.
- Planned initiative in telecom sector 20-50M$ revenues proposal – (Thermo Fisher Scientific).
- Designed and introduced to the market ModuSense: modular sensors for chemicals detection with PCMCIA and TOSLINK, Plug and Play connectivity – (Telcom Devices).
- Provided web crawler tool for retrieval of names of prospective customers in area of laser physics – (Oriel Instruments).
- Streamlined spectrographs production through automated QC – procedure which resulted in 1000 man-hour per year savings of highly qualified technicians' time – (Oriel Instruments).
- Developed and commercialized Chemleds™, InGaAsP Solid State Light Emitters for NIR spectral region, Opto-electronics Arrays, ModuSense®, Lasers – (Hadaspectrum, Ltd.).

Selected Publications:

1. R. Sobczynski, H. Lange, S. Kurowski, *Dynamics of the formation of excited hydrogen, H(n=2,3,4), during a pulse discharge in methane,* PLASMA CHEMISTRY AND PLASMA PROCESSING, Vol. 8, No.1, pp. 101-110 (March 1988).
2. A. Rys, T. Piotrowski, R. Sobczynski, *Light emitting diode arrays for consumer and medical applications.* MATERIALS SCIENCE & ENGINEERING: B, SOLID-STATE MATERIALS FOR ADVANCED TECHNOLOGY, ISSN 0921-5107 (February 1998).

3. R. Sobczynski, R. Beaman, D. W. Setser, and N. Sadeghi, CHEM. PHYS. LETT. 154, 349 (1989). This paper reported preliminary studies of Kr(5s'[1/2]0*)* reactions using the optical pumping technique.
4. R. Sobczynski, D.W. Setser, and A.R. Slagle, *Vibrational energy and bimolecular reactions: Enhancement of the electron transfer derived product channels for quenching of* $Xe(^3P_2)$ *and* $Kr(^3P_2)$ *atoms by* CF_nCl_{4-n}, $C_2F_nCl_{6-n}$, *and* $CF_3CFClCF_2Cl$., J. CHEM. PHYS. 92, 1132 (1990).
5. R. Sobczynski, J.L. Porter, R. M. Hammaker, and W.G. Fateley, *Diode arrays may light up compact spectrometers,* LASER FOCUS WORLD 31(3), 75 (1995).
6. R.Sobczynski, *Energy Generating Autonomous Sailing Craft,* NASA TECHNICAL BRIEFS, SUSTAINABLE TECHNOLOGIES (Apr. 27, 2011).

Education:

1986: Ph.D. in plasma chemistry diagnostics and laser spectroscopy, Department of Chemistry, Warsaw University, Warsaw, Poland.
1980: M.Sc. in spectroscopy and physical chemistry, Institute of Physical Chemistry, Warsaw University, Warsaw, Poland.

Other Languages:

Polish (native), German, Russian

EXHIBIT A

Fine organic particles in a sandy beach system (Puck Bay, Baltic Sea)*

OCEANOLOGIA, 47 (2), 2005.
pp. 165–180.

KEYWORDS
Detritus
Sandy beach system
Energy flow
Filtration
Suspension
Coastal waters
C/N ratio

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Abstract

A total of over 550 samples of particulate organic matter (POM) were obtained from swash and groundwater samples taken on a monthly basis from seven localities on the sandy shores of Puck Bay in 2002 and 2003. Sandy sediment cores from the swash zone were collected to assess the amount of POM in the pore waters. The mean annual concentrations of POM varied between localities from 20 to 500 mg in groundwater and from 6 to 200 mg dm^{-3} in swash water. The carbon/nitrogen (C/N) ratio in suspended matter was always higher in groundwater (annual mean 12) than in swash water (annual mean 7). The C/N ratio indicates a local, algal origin of POM in the shallow coastal zone.

* This research was funded by the LITUS (International Biodiversity Observation Year project) and COSA projects (5th FP of the EU. and SPB COSA of Polish KBN).

The complete text of the paper is available at http://www.iopan.gda.pl/oceanologia/

1. Introduction

The great diversity of suspended, particulate organic matter (POM) (passing through a 0.5 mm mesh net and retained on a 0.0005 mm filter) makes up a large part of the detritus pool in the marine ecosystem (Verity et al. 2000). It is important as food for filter feeders, a substrate for microbial life, and finally, after sedimentation, as a food source for deposit feeders (Iglesias et al. 1996, Madon et al. 1998, Parent & Morin 1999, Gilek et al. 2001). In permeable sediments (sand and gravel), small particles can be efficiently transported into the sediment during both filtration and bioturbation, but in fine sediments the only efficient means of sediment mixing is bioturbation (Rush et al. 2000, Propp & Propp 2001, Reise 2002). Numerous papers have dealt with organic suspensions in offshore waters (e.g. Shushkina et al. 2000) and estuaries (e.g. Mazzola et al. 2001, Goñi et al. 2003), but in this respect very shallow waters of recreational importance (bathing) have received scant attention. The dynamics of the sea in the breaker zone and the transport of terrestrial POM organics out to sea make swash water very turbid and rich in suspensions (Puleo et al. 2000, Ullman et al. 2003). Furthermore, POM is known to be an important substrate/adsorbent for contaminants, e.g. heavy metals in coastal waters (Sokolowski et al. 2001).

Concern about the quality of bathing waters is associated with reduced water transparency, the threat of excess organic matter deposition and of toxic algal blooms (e.g. the EU bathing waters directive). Hence, an understanding of organic matter turnover in particular recreational areas is a matter of prime concern. In the European coastal zone, the processes of primary production are well known and subject to monitoring (Wasmund et al. 2001, Gazeau et al. 2004), but those of mineralisation and decomposition are still poorly understood (Kunnis 1998, Koelmans & Prevo 2003, Ehrenhauss & Huettel 2004).

The present paper aims to provide novel, fundamental data on the seasonality of fine organic suspensions (POM) in coastal waters. In particular, it focuses on the relationship between ground water, swash water and pore water in sand based on the example of the southern Baltic coast. A separate paper dealing with macrodetritus (litter, debris washout) is to follow (Kotwicki et al., in preparation).

In the present paper we have addressed the following research questions:

- How much POM is free-floating in the pore waters of the swash zone, as compared to POM adhering to sand grains?
- How large is the biomass of fine organic particles (POM) in the swash water and ground water of the beaches along the shore of Puck Bay, and how does it change seasonally?

- How fast does POM fill the sediment in the swash zone under natural conditions?
- What are the carbon and nitrogen contents of the POM examined in this study, and how do they vary seasonally?

2. Material and methods

Particulate matter in the surface water was collected from the swash water (0.5 m depth) a few metres from the water line. Three separate samples (a few metres apart) were taken with a 5 dm^3 plastic pail, then poured into marked 250 cm^3 plastic containers and transported to the laboratory in a cool box.

Particulate matter in the ground water was collected from three holes dug at the drift line (usually a few metres above the water line). From 10 to 50 cm in depth and 20 cm in diameter (depending on the slope of the beach), these holes became filled with ground water within seconds. Three 250 cm^3 samples of water were collected from each hole, and transported to the laboratory in a cool box.

The temperature and salinity of the swash water were measured electronically in situ, accurate to 0.1°C and 0.1 PSU respectively.

Particulate matter from submerged sands was obtained from sediment cores taken from the same site as the swash water with a cylindrical Morduchai-Boltovskij corer (ϕ = 15 cm). Each sand core was placed in a plastic pail and divided into two parts. One part was processed for organic matter content (dried at 65°C, weighed, combusted at 450°C, and reweighed) and granulometry (passed through a set of standard sieves). The other part was rinsed in tap water (multiple flotation and shaking) to remove all the suspended particles from the sand.

The particulate matter was passed through pre-weighed GFF filters, large particles having previously been removed with a 0.5 mm screen. The filters were dried at 65°C to constant weight, and combusted at 450°C to determine the loss on ignition. The sands at this locality are dominated by quartz, so there was no need to correct for calcified elements. The water content in the swash zone sand was assumed to make up 25% of the wet sand weight (cf. Urban-Malinga & Opaliński 2001, samples collected from the same site).

Sand cores retrieved from the swash zone were used for the experiment on the fine-particle infiltration rate. The sand was cleaned of all free-floating particles (see above), dried, placed into three 0.5 mm mesh bags (15 × 15 cm cylinders), and replaced at the same spot in the swash zone from where it had been collected. Samples of untreated original sand, and rinsed (experimental) sand were retained as controls. On each of the first, second and third days, 3×10 cm subsamples were taken from the centres of the three experimental cores. All samples (control and subsequent experimental) were dried, weighed, combusted and reweighed to calculate the loss on ignition.

The filters containing POM were analysed on the CHN analyser at the Chemistry Department of the University of Gdańsk.

All sampling and experiments were carried out on the Sopot municipal beach on a monthly basis between 2002 and 2003; measurements of particulate matter were also made at seven other localities along Puck Bay (Fig. 1). Altogether, 280 samples of swash water and 270 of ground water were analysed for organic matter content. A further 140 samples of POM were analysed for CHN content.

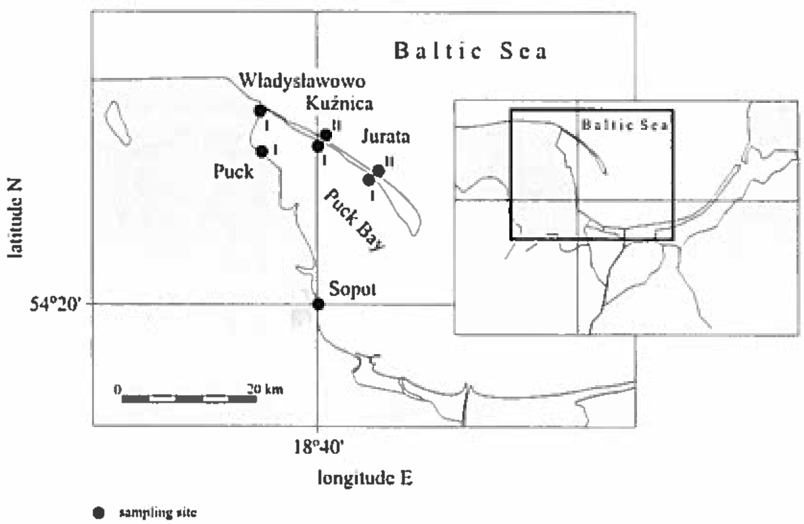

Fig. 1. Location of the sampling sites (sites marked I are on the shores of Puck Bay, sites marked II are on the open sea side)

3. Study area

The Gulf of Gdańsk is a semi-sheltered area of flat, sandy shores on the southern Baltic Sea. The sea is microtidal and the water brackish (5–8 PSU), with surface temperatures ranging from 0°C in winter to > 22°C in July and August. Medium and coarse quartz sands (grain diameter 0.15 to 0.3 mm) make up the coastal sediments. The study area is a eutrophic water basin with a high primary production (> 150 g C m^{-2} per annum, Gazeau et al. 2004). Beaches are intermediate, with sand bars and a breaker zone. Coastal waves do not normally exceed a height of 1 m during storms. Despite the presence of few large cities on its perimeter, and the resulting microbial contamination, much of the Gulf is given over to seaside recreation (Olańczuk-Neyman 2001). Apart from phytoplankton production, filamentous algae and sea-grass beds contribute to the detritus pool. A summary of the numerous studies of Puck Bay and its general characteristics is accessible at http://www.iopan.gda.pl/projects/puckbay.

4. Results

POM from the swash zone: free-floating POM versus POM adhering to sand grains

Sampled six times, the sediments of the Sopot beach swash zone were treated to remove all floating particles. This experiment showed 40 to 60% of POM to be adhering to the surface of sand grains. 60 to 90% of the pool of free-floating POM was removed after a single rinsing (Fig. 2). Microscopic examination confirmed the presence of diatom cells and bacterial colonies in the microcavities of individual sand grains from the rinsed sample.

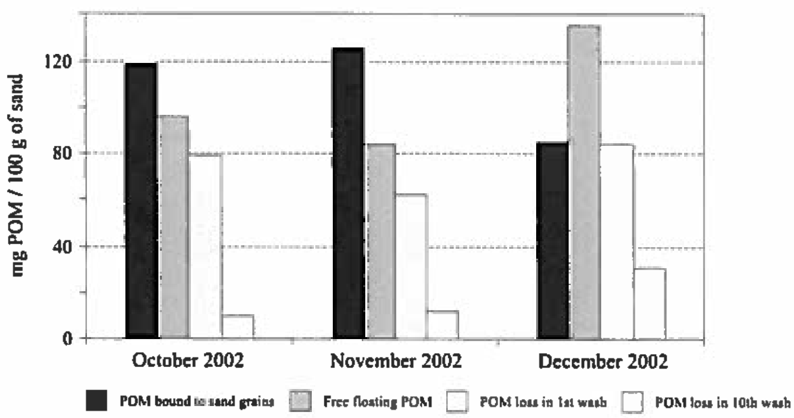

Fig. 2. Loss of free-floating particulate organic matter (POM) due to rinsing of the sand core samples; Sopot 2002

Seasonality and biomass of swash water and ground water POM in the Puck Bay beach system

The highest POM contents were measured in ground waters, the lowest ones in swash waters at all the sampling sites. The maximum (Puck, 6595 mg POM dm^{-3}) and highest mean values (1284 mg POM dm^{-3}) were noted in the ground waters of the inner part of Puck Bay. The minimum (3.4 mg POM) and lowest annual mean values (32.4 mg POM dm^{-3}) were recorded in the ground waters at Sopot (Fig. 3, Table 1). The POM concentration in swash waters was lowest in the relatively exposed sites of Sopot and Jurata (annual mean 10 to 13 mg dm^{-3}), and highest in the inner part of Puck Bay (Puck, annual mean 62 mg dm^{-3}). The concentration of swash water POM was very low (1 mg dm^{-3}) at many localities (Table 1). The average biomass of POM in swash waters in the area examined (a 120 km-long coastline and a 20 m-broad breaker zone 0.5 m deep) is estimated to be 64 tonnes of organic matter during the growing season (Table 3, page 175).

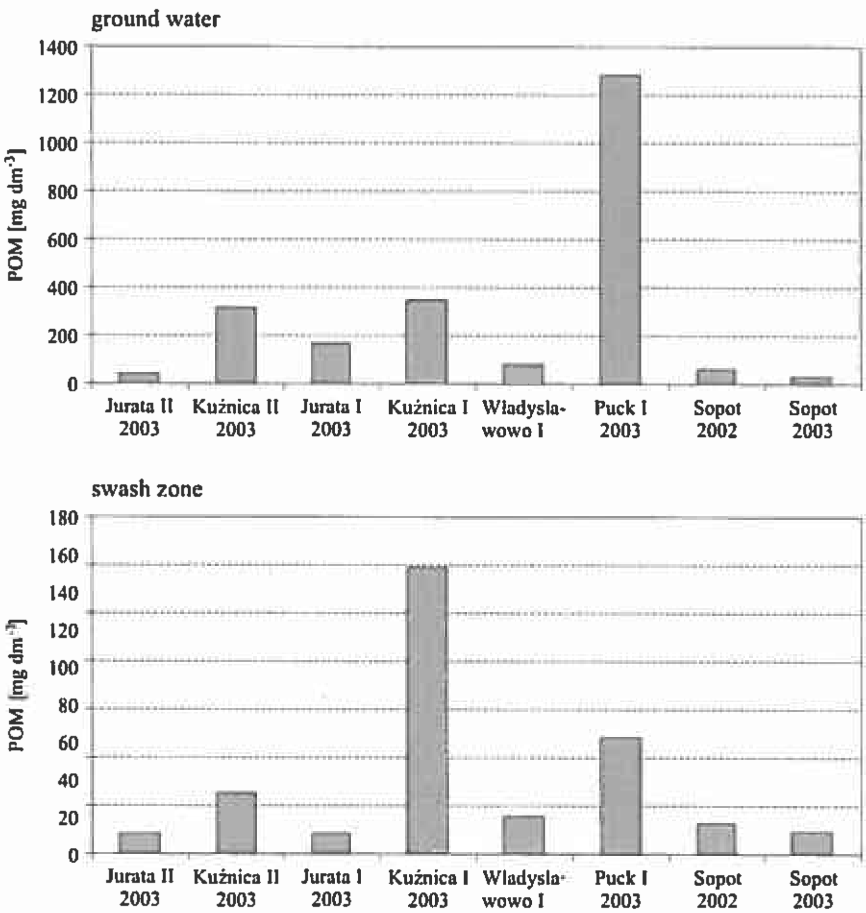

Fig. 3. Annual mean concentration of particulate organic matter (POM) in ground and swash waters from the sites examined in 2002 and 2003 (for site denotations, see caption to Fig. 1)

Table 1. Summary of particulate organic matter (POM) measurements from swash water (280 samples) and ground water (278 samples) collected in 2003

Month	Swash zone	Ground water	Swash zone	Ground water	Swash zone	Ground water
	POM [mg dm^{-3}] minimum–maximum		POM [mg dm^{-3}] mean ± SD		SD/mean	
January	1–40	4–1187	12.6 ± 12	182 ± 348	1.0	1.9
February	2.9–19	10–72	9.9 ± 7	31 ± 25	0.7	0.8
March	1–1023	3–644	74.8 ± 207	107 ± 164	2.8	1.5
April	3.9–348	7–3920	29.6 ± 68	421 ± 946	2.3	2.2
May	1–33	12–3123	11.4 ± 9	321 ± 639	0.8	2.0
June	5–79	26–1920	18.9 ± 15	268 ± 402	0.8	1.5
July	2.3–2540	13–1532	184.0 ± 595	141 ± 300	3.2	2.1
August	0.5–393	4–4600	43.5 ± 91	496 ± 1016	2.1	2.0
September	1–29	18–624	9.2 ± 6	97 ± 174	0.7	1.8
October	1–43	7–2922	15.9 ± 95	158 ± 555	0.6	3.5
November	2–101	4–6596	20.9 ± 25	421 ± 1382	1.2	3.3
December	1–14	7–50	6.1 ± 3	19 ± 13	0.6	0.6

SD – standard deviation.

In situ POM accumulation rate in the swash zone sediment

The experiment to expose cleaned sediment cores in the swash zone demonstrated the rate of POM flow into the sediment. Regardless of season, cleaned sediment exposed to swash water attained particulate matter concentrations similar to those in natural sand within two days (Table 2).

C/N ratio of POM and the seasonality of its chemical characteristics

The C/N ratio of the POM examined here ranged from 4 to 26, with distinct differences between swash waters (annual mean 7) and ground water (annual mean 12). This difference was maintained throughout the year, except in August and December, when the C/N ratios of swash and ground water POM attained the same values (Fig. 4). C/N ratios were generally higher in the winter months (12 and 18 for swash and ground water respectively) and lower in summer (6 and 8 respectively), the lowest value being recorded in swash water POM (3.2 in summer) and the highest in ground water (22.5 in winter). The greatest variability in C/N ratios occurred in swash water, while the SD of these values from ground water

Table 2. Cleaned sediment enrichment in particulate organic matter (POM) after exposure in the swash zone, Sopot 2003

Month	Natural sediment core (POM content) [mg POM (100 g sand)$^{-1}$]	Cleaned sediment core control POM content [mg POM (100 g sand)$^{-1}$]	Cleaned sediment core after 24 h exposure [mg POM (100 g sand)$^{-1}$]	Cleaned sediment core after 48 h exposure [mg POM (100 g sand)$^{-1}$]	Mean amount of POM in swash water [mg dm^{-3}]	Mean mass of POM [tonnes] in 120 km long swash zone (width 20 m, depth 0.5 m)
January	213.6	149.6	191.4	220.1	13	15
February	176.5	109.4			10	12
March	201.6	95.5	179.3	228.2	75	90
April	177.5	93.4	161.9	181.3	30	35
May	152.9	104.0	140.2	147.7	11	14
June	161.0	90.1	126.2	137.1	19	23
July	108.8	97.9	169.2	180.3	184	221
August	127.8	134.0	128.3	135.9	43	52
September	245.0	100.3	157.0	165.1	9	11
October	221.1	111.6	154.8	174.2	16	19
November	221.1	103.0	146.3	178.0	21	25
December	209.8	127.4	196.9	237.5	6	7

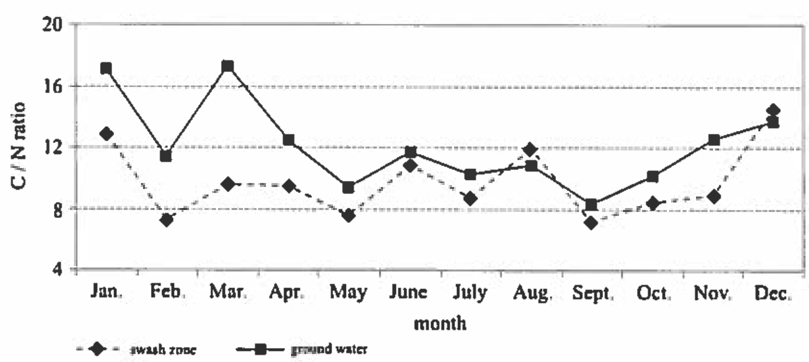

Fig. 4. Carbon/nitrogen ratio in fine suspensions from swash and ground waters; Sopot 2003

samples was more stable, except in March when extreme values were noted (C/N = 22.5) (Fig. 4).

The pattern of seasonal changes in POM concentrations in swash and ground waters and the C/N ratios is similar: two distinct peaks in swash water in March and July, followed by POM peaks in ground waters in May, August and November (Fig. 5).

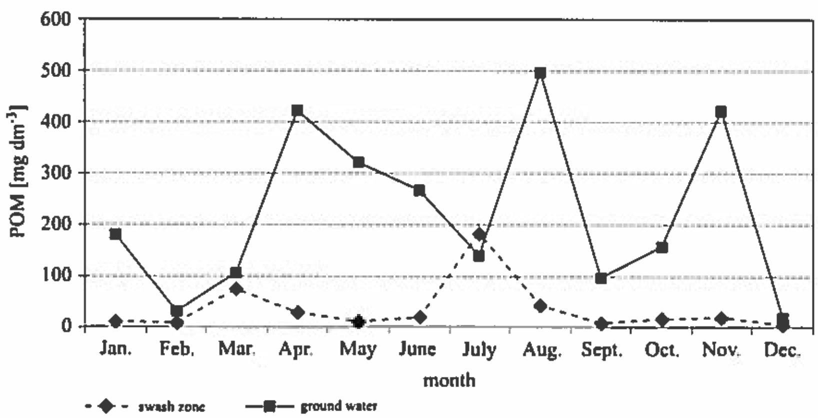

Fig. 5. Particulate organic matter (POM) in swash and ground waters; monthly means; Sopot 2003

5. Discussion

The problem of organic particles adhering to sediment grains is well known to sediment microbiologists, who use ultrasound (sonification techniques) to remove bacteria before counting cells (Crump et al. 1998, Olańczuk-Neyman & Jankowska 2001). Microphytobenthic diatoms are also commonly reported to adhere firmly to sand grains (Snoeijs et al. 1990, Brown & McLachlan 1990). Amorphous detritus not derived from organisms, especially adhesive macromolecules of peptides, polysaccharides (Transparent Extracellular Polymers), is likely to be of importance (Rusch et al. 2001). Schumann et al. (2001) report mucous colloids along the Baltic Sea coast as constituting over 60% of the detritus volume. Of the meiofauna, only some ciliates are known to adhere to sand grains, but these were not abundant in our sampling area (A. Świstulska personal communication). Among the free-moving meiofauna, Turbellaria and Nematoda are readily eluted from the sediment core, unlike pelagic and semi-pelagic animals (Rotatoria, nauplii of Copepoda), which are retained within the sediment (Kotwicki et al. 2002).

The particulate matter from the open Puck Bay is dominated by very small size-fractions, the 2–10 μm fraction makes up 80% of POM in coastal waters (Bradtke et al. 1997). In the Mediterranean, the nano- and pico-fractions of detrital particles in the detritus pool exceed that of larger particles by a factor of 10 (Mostajir et al. 1995). Closer to the shore in more turbid swash waters, large particles may dominate, with 77% of POM consisting of the 80–300 μm fraction (Kotwicki et al. 2002). POM can consist of mesozooplankton and microplankton, faecal pellets, bacteria, algal aggregates or terrigenous matter, depending on the season and location (Lundsgaard et al. 1999, Coban-Yildiz et al. 2000).

The amount of POM reported from the open Gulf of Gdańsk is significantly lower, and ranges from 3–9 mg dm^{-3} (Maksymowska et al. 1997) to 6–180 mg dm^{-3} in turbid swash waters (Table 3). The amount of POM in a turbid Atlantic estuary was similar to our swash water values (Maksymowska et al. 1997). The ground water pool of suspended matter at the beach face has not been reported in the literature, but there are indications that in a number of localities the beachfront acts as a sediment trap and its ground waters may contain elevated quantities of POM (Ullman et al. 2003).

According to Huettel et al. (1996), the question of fine-particle infiltration into sands has been addressed in the literature (e.g. Boudreau et al. 2001, Propp & Propp 2001). The rate of this infiltration has been measured, mainly under experimental conditions, for diatoms and bacteria (Ehrenhauss & Huettel 2004). In sandy sediments the rate of infiltration – advective transport – is relatively fast at 0.01 cm s^{-1} (Precht & Huettel 2004). The sinking rates of POC from detritus in near-shore waters were reported to range from 0.019 to 1.430 g C m^{-2} day^{-1} (Estrum-Yousef et al. 2000). Taking the filtration efficiency to be 140 dm^3 m^{-2} day^{-1}, Precht & Huettel (2004) estimated the daily input of POC into coastal sands at 1.4–2 g m^{-2} day^{-1} (for POC concentration in swash water ranging from 10 to 25 mg dm^{-3}). Thus, active forcing of fine particles into the sand may exceed sedimentation rates.

The C/N ratio of the swash-water POM examined in this study is typical of the phytoplankton-dominated fraction in spring and summer (from 7 to 9): such values were indeed recorded in the open part of the Gulf (Maksymowska et al. 1997, 2000). Elevated winter values (10 to 18) and those from the beach ground water may indicate that the POM here is of terrestrial origin (Maksymowska et al. 1997, 2000). Detritus deposited on the seabed in shallow waters was found to be mainly of pelagic algal origin in the North Sea and Skagerrak (Boon et al. 1999), in Asian waters (Kennedy et al. 2004), and in the Baltic Sea (Schumann et al. 2001, 2003). Other

Table 3. Characteristics of marine suspensions from various coastal regions

Locality	TSM	POM	Phytoplankton	Bacteria	Zooplankton	POC	Source
	[mg dm^{-3}]						
Winyah Bay, USA estuary, Atlantic	0.4–12					0.1–3	Goñi et al. 2003
Marennes-Oléron, estuary, Atlantic	40–180					1–11	Maksymowska et al. 1997
Sopot, Baltic Sea	4–125	7–125		1	0.6–112	8.8	Kotwicki et al. 2002, Jankowska 2001
Sopot, Baltic Sea		2–150				0.5–40	this paper
Gulf of Gdańsk, Baltic Sea	3 to 9					0.3–0.7	Maksymowska et al. 1997
Darss-Zingst Bodden, Baltic Sea						16	Schumann et al. 2003
Gulf of Gdańsk, Baltic Sea			10–500	10	100–1000	0.9–1.9	Witek 1995

TSM – total suspension matter, POM – particulate organic matter, POC – particulate organic carbon.

authors suggest the importance of macrodetritus for the export of organic matter from coastal waters (Boon et al. 1999, Bouchard & Lefeuvre 2000). Mazzola et al. (2001) found 75% of the detritus pool to be of heterotrophic, microplanktonic origin. The C/N ratio of detritus devoid of live algae or bacteria is quite high (35–50, according to Verity et al. (2000)).

The rate of microbial decomposition of detritus in the sea has been studied experimentally and seems to be very fast: from 8 to 11 days for the complete degradation of microalgal detritus (Kunnis 1998, Ploug & Grossart 2000). Taking 10 days to be the mean time required for algal POM decomposition and a growing season of 210 days' duration, we have estimated its production at 32 tonnes of POC (64 tonnes of POM) biomass $\times 21$ decomposition periods = 672 tonnes C, and correspondingly, 96 tonnes of N (from an averaged C/N ratio of 7). Decomposition of macrodetritus in coastal waters is much slower (40–100 days for algal debris, Jędrzejczak 2002). Apart from bacteria, the meiofauna seems to be an important component of detritus decomposition in permeable sands (Sundbäck et al. 1996). The macrofauna, specifically the seston feeders, are also important consumers of POM, since data from the Baltic Sea show that a 6000 tonnes biomass of zebra mussels daily filters 15 tonnes of POM from suspensions in the Neva estuary in the summer season (Orlova et al. 2004).

6. Conclusions

Fine organic particles (POM) reach higher concentrations in the beach-front ground water than in the swash. The main source of POM is pelagic microplankton production. C/N ratios show consistently that POM is decomposed to a higher degree in ground water than in swash water.

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References

Boon A. R., Duineveld G. C. A., Kok A., 1999, *Benthic organic matter supply and metabolism at depositional and non-depositional areas in the North Sea*, Estuar. Coast. Shelf Sci., 49 (5), 747–761.

Bouchard V., Lefeuvre J. C., 2000, *Primary production and macro-detritus dynamics in a European salt marsh: carbon and niotrogen budgets*, Aquat. Bot., 67, 23–42.

Boudreau B. P., Huettel M., Forster S., Jahnke R. A., McLachlan A., Middelburg J. J., Nielson P., Sansone F., Taghon G., Van Raaphorst W., Webster I., Węsławski J. M., Wiberg P., Sundby B., 2001, *Permeable marine sediments: overturning an old paradigm*, EOS, Trans. Am. Geoph. Union, 82 (11), 133–136.

Bradtke K., Latała A., Czabański P., 1997, *Temporal and spatial variations in particle concentrations and size distributions in the Gulf of Gdańsk*, Oceanol. Stud., 26 (2)–(3), 39–59.

Brown A. C., McLachlan A., 1990, *Ecology of sandy shores*, Elsevier, Amsterdam, 328 pp.

Coban-Yildiz Y., Chiavari G., Fabbri D., Gaines A. F., Galletti G., Tugrul S., 2000, *The chemical composition of Black Sea suspended particulate organic matter: pyrolysis – GC/MS as a complementary tool to traditional oceanographic analyses*, Mar. Chem., 69 (1)–(2), 55–67.

Crump B. C., Barros J. A., Simenstad C. A., 1998, *Dominance of particle attached bacteria in Columbia River estuary, USA*, Aquat. Microb. Ecol., 14, 7–18.

Ehrenhauss S., Huettel M., 2004, *Advective transport and decomposition of chain-forming planktonic diatoms in permeable sediments*, J. Sea Res., 52 (3), 179–197.

Estrum-Yousef S. R., Feuerpfeil P., Schubert H., Schumann R., 2000, *Quality of particulate matter and its potential sinking rates in pelagic samples of inshore and Bodden waters of the southern Baltic Sea*, Int. Rev. Hydrobiol., 85, 341–357.

Gazeau F., Smith S. V., Gentili B., Frankignoulle M., Gattuso J. P., 2004, *The European coastal zone: characterization and first assessment of ecosystem metabolism*, Estuar. Coast. Shelf Sci., 60 (4), 673–694.

Gilek M., Littorin B., Saetre P., 2001, *Spatial patterns of abundance and growth of Mytilus edulis on boulders in the Northern Baltic Sea proper*, Hydrobiologia, 452 (1)–(3), 59–68.

Goñi M. A., Teixeira M. J., Perkey D. W., 2003, *Sources and distribution of organic matter in a river-dominated estuary (Winyah Bay, SC, USA)*, Estuar. Coast. Shelf Sci., 57 (5)–(6), 1023–1048.

Huettel M., Ziebis W., Forster S., 1996, *Flow induced uptake of particulate matter in permeable sediments*, Limnol. Oceanogr., 41 (2), 309–322.

Iglesias J. I. P., Urrutia M. B., Navarro E., Alvarez-Jorna P., Larretxea X., Bougrier S., Heral M., 1996, *Variability of feeding processes in the cockle Cerastoderma edule (L.) in response to changes in seston concentration and composition*, J. Exp. Mar. Biol. Ecol., 197 (1), 121–143.

Jankowska K., 2001, *Ecosystem of sandy beaches as a live environment of heterotrophic bacteria*, Ph.D. thesis, Politech. Gd., Gdańsk, 188 pp., (in Polish).

Jędrzejczak M.F., 2002, *Stranded Zostera marina L. vs wrack fauna community interactions on a Baltic sandy beach (Hel, Poland): a short-term pilot study. Part I. Driftline effects of fragmented detritivory, leaching and decay rates*, Oceanologia, 44 (2), 273–286.

Kennedy H., Gacia E., Kennedy D.P., Papadimitriou S., Duarte C.M., 2004, *Organic carbon sources to SE Asian coastal sediments*, Estuar. Coast. Shelf Sci., 60 (1), 59–68.

Koelmans A.A., Prevo L., 2003, *Production of dissolved organic carbon in aquatic sediment suspensions*, Water Res., 37, 2217–2222.

Kotwicki L., Danielewicz J., Turzyński M., Węsławski J.M., 2002, *Preliminary studies on the organic matter deposition and particle filtration processes in a sandy beach in Sopot – southern Baltic Sea*, Oceanol. Stud., 31 (3)–(4), 71–84.

Kunnis K., 1998, *Development of microbial community during Skeletonema costatum detritus degradation*, Hydrobiologia, 363, 253–260.

Lundsgaard C., Olesen M., Reigstad M., Olli K., 1999, *Sources of settling material: aggregation and zooplankton mediated fluxes in the Gulf of Riga*, J. Marine Syst., 23, 197–210.

Madon S.P., Schneider D.W., Stoeckel J.A., Sparks R.E., 1998, *Effects of inorganic sediment and food concentrations on energetic processes of the zebra mussel, Dreissena polymorpha: implications for growth in turbid rivers*, Can. J. Fish. Aquat. Sci., 55 (2), 401–413.

Maksymowska D., Feuillet-Girard M., Piekarek-Jankowska H., Heral M., 1997, *Temporal variation in the accumulation of organic carbon and nitrogen in the suspended matter and silty surface sediment of the western Gulf of Gdańsk (southern Baltic Sea) – comparison with the Atlantic Bay of Marennes-Oléron*, Oceanol. Stud., 2/3, 91–116.

Maksymowska D., Richard P., Piekarek-Jankowska H., Riera P., 2000, *Chemical and isotopic composition of the organic matter sources in the Gulf of Gdańsk (southern Baltic Sea)*, Estuar. Coast. Shelf Sci., 51 (5), 585–598.

Mazzola A., Fabiano M., Pusceddu A., Sara G., 2001, *Particulate organic matter composition in semi-enclosed marine system*, Chem. Ecol., 17, 315–334.

Mostajir B., Dolan J.R., Rassoulzadegan F., 1995, *Seasonal variations of pico- and nano-detrital particles (DAPI Yellow Particles, DYP) in the Ligurian Sea (NW Mediterranean)*, Aquat. Microb. Ecol., 9 (3), 267–277.

Olańczuk-Neyman K., Jankowska K., 2001, *Bacteriological quality of the sandy beach in Sopot (Gdańsk Bay, southern Baltic)*, Pol. J. Environ. Stud., 10 (6), 451–455.

Orlova M., Golubkov S., Kalinina L., Ignatieva N., 2004, *Dreissena polymorpha (Bivalvia: Dreissenidae) in the Neva Estuary (eastern Gulf of Finland, Baltic Sea): is it a biofilter or source for pollution?*, Mar. Pollut. Bull., 49 (3), 196–205.

Parent S., Morin A., 1999, *The role of copepod dominated meiofauna in the mineralisation of organic matter in a cold marine mesocosm*, Can. J. Fish. Aquat. Sci., 56 (10), 1938–1948.

Ploug H., Grossart H. P., 2000, *Bacterial growth and grazing on diatom aggregates: respiratory carbon turnover as a function of aggregate size and sinking velocity*, Limnol. Oceanogr., 45 (7), 1467–1475.

Precht E., Huettel M., 2004, *Rapid wave driven advective pore water exchange in a permeable coastal sediment*, J. Sea Res., 51 (2), 93–107.

Propp M. V., Propp L. N., 2001, *Pore waters and the transformation of nutrients in marine subtidal sands*, Russ. J. Mar. Biol., 27, 36–43.

Puleo J. A., Beach R. A., Holman R. A., Allen J. S., 2000, *Swash zone sediment suspension and transport and the importance of bore-generated turbulence*, J. Geophys. Res.–Oceans, 105, 17021–17044.

Reise K., 2002, *Sediment mediated species interactions in coastal waters*, J. Sea Res., 48 (2), 127–141.

Rusch A., Forster S., Huettel M., 2001, *Bacteria, diatoms and detritus in an intertidal sandflat subject to advective transport across the water-sediment interface*, Biogeochemistry, 55 (1), 1–27.

Rusch A., Huettel M., Forster S., 2000, *Particulate organic matter in permeable marine sands – dynamics in time and depth*, Estuar. Coast. Shelf Sci., 51 (4), 399–414.

Schumann R., Rentsch D., Görs S., Schiewer U., 2001, *Seston particles along a eutrophication gradient in coastal waters of the southern Baltic Sea: significance of detritus and transparent mucoid material*, Mar. Ecol. Progr. Ser., 218, 17–31.

Schumann R., Rieling T., Görs S., Hammer A., Selig U., Schiewer U., 2003, *Viability of bacteria from different aquatic habitats. I. Environmental conditions and productivity*, Aquat. Microb. Ecol., 32 (2), 121–135.

Shushkina E. A., Vinogradov M. E., Lebedeva L. P., 2000, *Processes of detritus production and fluxes of organic matter from epipelagic zones in different ocean regions*, Oceanolog, 40, 183–191.

Snoeijs P., Leskinen E., Sundbäck K., Kuylenstierna M., Witkowski A., Hällfors G., 1990, *Microphytobenthic cell density and species composition in the surface sediment in a shallow brackish-water bay (Gulf of Finland)*, Aqua Fenn., 20, 103–114.

Sokołowski A., Wolowicz M., Hummel H., 2001, *Distribution of dissolved and labile particulate trace metals in the overlying bottom water in the Vistula River plume (southern Baltic Sea)*, Mar. Pollut. Bull., 42 (10), 967–980.

Sundbäck K., Nilsson P., Jönsson B., 1996, *Balance between autotrophic and heterotrophic components and processes in microbenthic communities of sandy sediments. A field study*, Estuar. Coast. Shelf Sci., 43 (6), 689–706.

Ullman W. J., Chang B., Miller D. C., Madsen J. A., 2003, *Groundwater mixing, nutrient diagenesis and discharges across a sandy beach face, Cape Henlopen, Delaware, USA*, Estuar. Coast. Shelf Sci., 57 (3), 539–552.

Urban-Malinga B., Opaliński K. W., 2001, *Interstitial community oxygen consumption in a Baltic sandy beach: horizontal zonation*, Oceanologia, 43 (4), 455–468.

Verity P. G., Williams S. C., Hong Y., 2000, *Formation, degradation and mass: volume ratios of detritus derived from decaying phytoplankton*, Mar. Ecol. Progr. Ser., 207, 53–68.

Wasmund N., Andrushaitis A., Łysiak-Pastuszak E., Müller-Karulis B., Nausch G., Neumann T., Ojaveer H., Olenina I., Postel L., Witek Z., 2001, *Trophic status of the south-eastern Baltic Sea: a comparison of coastal and open areas*, Estuar. Coast. Shelf Sci., 53 (6), 849–864.

Witek Z., 1995, *Biological production and its consumption in the marine ecosystem of the western Gdańsk Basin*, Wyd. Mor. Inst. Ryb., Gdynia, 145 pp., (in Polish).

EXHIBIT B

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Oxygen dynamics in permeable sediments with wave-driven pore water exchange

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Abstract

The effects of advective pore water exchange driven by shallow water waves on the oxygen distribution in a permeable ($k = 3.3 \times 10^{-12}$ to 4.9×10^{-11} m^2) natural sediment were studied with a planar oxygen optode in a wave tank. Our experiments demonstrate that pore water flow driven by the interaction of sediment topography and oscillating boundary flow changes the spatial and temporal oxygen distribution in the upper sediment layer. Oxygenated water intruding in the ripple troughs and deep anoxic pore water drawn to the surface under the ripple crests create an undulating oxic–anoxic boundary within the upper sediment layer, mirroring the topographical features of the sediment bed. Anoxic upwelling zones under ripple crests can separate the oxic sediment areas of neighboring ripple troughs with steep horizontal oxygen concentration gradients. The optode showed that migrating wave ripples are trailed by their pore water flow field, alternately exposing sediment volumes to oxic and anoxic pore water, which can be a mechanism for remobilizing particulate oxidized metal precipitates and for promoting coupled nitrification–denitrification. More rapid ripple migration (experimental threshold ~20 cm h^{-1}) produces a continuous oxic surface layer that inhibits the release of reduced substances from the bed, which under slowly moving ripples is possible through the anoxic vertical upwelling zones. Swift, dramatic changes in oxygen concentration in the upper layers of permeable seabeds because of surface gravity waves require that sediment-dwelling organisms are tolerant to anoxia or highly mobile and enhance organic matter mineralization.

The dominant boundary layer flows in shallow marine environments are those generated by surface gravity waves. This dominance is reflected by the presence of wave ripples structuring large areas of shallow sandy seabeds that are abundant in coastal, estuarine, and shelf environments. Most of these sandy sediments are permeable ($k > 10^{-12}$ m^2) and thus allow interstitial water motion. Pressure differences at the sediment–water interface might drive interfacial solute transport through the surface layers of these beds. This advective transport can exceed transport by molecular diffusion by several orders of magnitude (Huettel and Webster 2001). In contrast, the major transport mechanisms in fine-grained muddy sediments are molecular diffusion and locally bioturbation (Berner 1980; Aller 1982).

Increased fluid exchange between sediment and overlying water affects the oxygen dynamics in permeable sediments and therefore also affects biogeochemical processes. Booij et al. (1991) showed in benthic chamber experiments that oxygen-rich water can be advected vertically into sandy sediment, which increased the oxygen penetration depth in the sediment as a function of the flow velocity of the overlying water. Advective oxygen distribution in permeable sand because of unidirectional boundary flow interacting with sediment topography was studied by Ziebis et al. (1996), who showed that oxygen is transported rapidly and effectively into deeper sediment layers and could thus enhance mineralization of organic matter (Forster et al. 1996). This organic matter could be transferred from the boundary layer into the top centimeters of the sediments as suspended particles or phytoplankton by advection (Huettel et al. 1996b; Huettel and Rusch 2000). As a consequence of these processes, advective pore water flow can generate a complex biogeochemical zonation in the sediment with areas of enhanced nitrification or iron precipitation and vertical channels through which ammonium and reduced metals are transported to the sediment surface (Huettel et al. 1998).

Surface gravity waves produce oscillating flows at the sediment–water interface by the wave orbital water motion (e.g., *see* p. 54 in Denny 1988) in areas with a water depth shallower than half the wavelength of the waves. The ability of such oscillating boundary flows to drive pore water flow was shown by Webb and Theodor (1968, 1972) by injecting dyed water into coarse, sandy, nearshore sediment and observing its reappearance at the sediment surface. Wave-driven in situ pore water velocities were measured by Precht and Huettel (2004). Shum (1992) calculated the pore water motion under a rippled bed over one wave period with a two-dimensional computational model, showing that the zone of advection extends several ripple heights below the ripple surface over a wide range of wave conditions and sediment characteristics. These transport studies suggest that waves, by enhancing advective fluid exchange between sediment and overlying water, also affect the biogeochemical process-

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es in permeable beds in the same way as unidirectional flows. Oxygen distributions underneath a rippled surface exposed to progressing waves modeled by Shum (1993) revealed that, in permeable beds, oxygen concentration gradients in the horizontal might be the same order of magnitude as those in the vertical. In a wave tank study quantifying the wave-induced advective interfacial exchange, Precht and Huettel (2003) showed that horizontal tracer concentration gradients migrate with sediment topography (ripple) propagation. These authors suggested that this could be of significance for sediment oxygen dynamics because sediments might alternately be exposed to changing oxygen concentrations.

The planar oxygen optode technique employed in this study to assess the oxygen dynamics in the sediment was introduced by Glud et al. (1996) and has been used successfully to measure oxygen production, consumption, and dynamics in marine systems (e.g., microbial mats, Glud et al. 1998, 1999). Glud et al. (2001) also developed an in situ instrument for planar O_2 optode measurements at benthic interfaces.

The aim of this study was to elucidate the effects of advection driven by wave-generated oscillating boundary flow interacting with mobile sediment topography on the oxygen dynamics of natural sediment. To achieve this goal, experiments were carried out in natural sandy sediment in a laboratory wave tank with a planar oxygen optode.

Materials and methods

Sediment and sediment preparation—The sediment used in this study was collected in an intertidal flat at Sylt Island in the German North Sea (55°2′N, 08°26′E) in February 2001 at a temperature of 4°C. Sediment was sampled in two layers: the top 2 cm, then down to 20 cm depth. These sediments were transported separately and were combined again in the laboratory wave tank within 24 h of sampling. The wave tank was filled with ~1,750 liters of artificial seawater (Instant Sea®) with a salinity of 31 and kept at a constant temperature of 17°C.

The sediment surface was leveled by the foraging activity of a small *Carcinus maenas* crab, which also eliminated the initially abundant *Hydrobia ulvae* mud snails. The sediment then was left under a constant recirculating unidirectional flow of ~5 cm s^{-1} (at 10 cm above the bed) for 12 months to regain a quasi-natural balance. Infauna consisted mostly of oligochaetes of the Tubificidae family living in the upper 2 cm of the sediment. No nourishment was added to the wave tank during the first months after the setup to prevent accumulation of nutrients. Starting 8 weeks before and during the experiments, powdered dried red algae (ground to a particle size between 125 and 250 μm) equivalent to an input of 1 g m^{-2} was added biweekly by suspending the material and evenly distributing it in the wave tank.

Sediment analyses—At the sediment sampling site, sediment cores (2.6 cm diameter, 12 cm long) were taken for measurement of in situ permeability and porosity. Three representative sediment samples were additionally taken for grain size analyses. Before and after the experiments, sediment cores (2.6 cm diameter) were taken in the wave tank for analyses of permeability (~12 cm long), porosity (10 cm long), and grain size distribution (10 cm). Additionally, grain sizes and permeability of the upper 2.5 cm of the sediment were assessed.

For porosity and pore water analysis, the sediment subcores taken in-situ and from the laboratory wave tank were sectioned into 1-cm-thick horizontal slices. Porosity averaged over depth, as calculated from wet and dry (after drying until constant weight at 60°C) weights of the sediment slices, was 37.1% (SD = 2.0, n = 10) in situ, 34.0% (SD = 2.3, n = 20) before the experiments, and 36.2% (SD = 3.8, n = 30) after the experiments. The sediment subcores used to assess the permeability were sealed after sampling and stored at 4°C until the measurements were carried out within a few days. Permeability was assessed by the constant head method (Klute and Dirksen 1986) directly on the retrieved sediment cores. Values for density and dynamic viscosity were calculated after Krögel (1997). In situ sediment permeability was 7.6×10^{-12} m^2 (SD = 1.4×10^{-12} m^2, n = 4) and wave tank permeability 3.3×10^{-12} m^2 (SD = 0.8×10^{-12} m^2, n = 2), with higher permeability of the surface sediment (upper 2.5 cm) of 4.9×10^{-11} m^2 (SD = 0.04×10^{-11} m^2, n = 3). In situ grain size distribution was determined by desalination, drying, and sieving with a set of eight calibrated sieves. The median grain size of the sediment was 180 μm.

Wave tank setup—The laboratory wave tank used in this study was made of clear acrylic and had an open channel length of 520 cm with a rectangular cross section (50 cm high, 47 cm wide). Two acrylic boxes were put into the open channel section (upstream box: 240 cm long, downstream box: 120 cm long, both 19 cm high and spanning the entire width of the channel) such that the gap between the two boxes had a width of 120 cm and could be filled with sediment (Fig. 1). Filled with a sediment layer of 22 cm depth, this setup amounted to a sediment volume of 124 dm^3. The two boxes in the open channel section were covered with 3 cm of sediment to create an overall even surface with uniform roughness throughout the open channel section. Initially, the sediment surface was level, and all subsequent ripple formation was the response of the bed to the applied wave action. Waves were generated at the upstream end of the wave tank with a paddle driven by an electric motor, controlling wave amplitude by the stroke of the eccentric and wave frequency via motor speed. This setup permitted reproducible generation of sinusoidal waves of selected amplitude and frequency. At the downstream end of the wave tank, the dissipation of the waves was achieved by an artificial beach made of an acrylic plate 1 m long covered by a 10-cm-thick mat of highly permeable plastic foam, causing the waves to run up and break.

Hydrodynamics—The hydrodynamic conditions in the wave tank were measured with a three-beam DANTEC® LDA (laser doppler anemometer) system in the backscatter mode. This LDA technique allows three-dimensional measurements of the flow velocity in a spheroidal measuring volume 600 μm long and 70 μm in diameter. During the

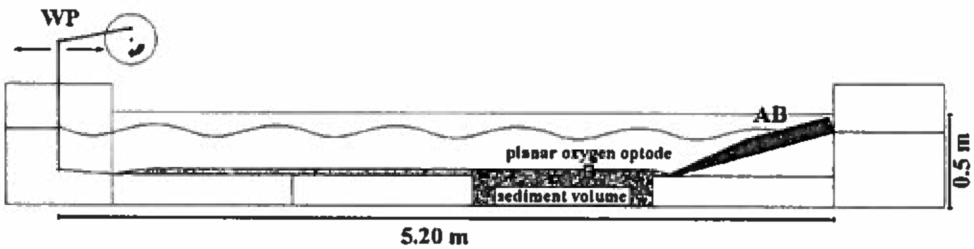

Fig. 1. Wave tank setup. WP, wave paddle; AB, artificial beach.

experiments, vertical velocity profiles (120–0.5 mm above the sediment) of the horizontal and vertical velocities were measured above unrippled sections of the experimental sediment surface. In the water layer closer than 6 mm to the sediment–water interface, the LDA setup only allowed the measurement of the horizontal velocity component. During the experiments in which ripples formed, the root mean square values of the horizontal velocity (U_{RMS}) 12 cm above the sediment surface ranged from 0.12 to 0.14 m s^{-1}. In the experiments with flow not sufficient to initiate sediment mobilization, U_{RMS} was ~0.06 m s^{-1}.

Oxygen measurements—The two-dimensional oxygen distribution was measured with a planar semitransparent oxygen optode (3.7 cm wide, 5.7 cm high) glued to the inside wall of the wave tank such that 2.7 cm of the optode was above and 3 cm was below the level sediment–water interface. The optical oxygen measurement is based on the dynamic or collisional quenching of the luminescence of an indicator by oxygen (Kautsky 1939). Commonly used oxygen indicators are platinum-porphyrins embedded in a polystyrene matrix (Papkovsky et al. 1992; Liebsch et al. 2000).

The planar sensing foils comprised two layers: a transparent polyester support foil (125 μm thick, Goodfellow) and the sensing layer, which was spread by knife. The luminescent oxygen indicator (59 mg) platinum(II) mesotetra (pentafluorophenyl) porphyrin (Pt-PFP, Porphyrin Products) was dissolved in 14.7 g chloroform (Merck, Darmstadt) and 1.63 g polystyrene (Sigma-Aldrich). To increase the amount of excitation light within the sensing layer, 1.63 g titanium dioxide particles (TiO_2 < 5 μm, Aldrich) were added. These particles do not interfere with the quenching but enhance the signal by scattering. Therefore, they increase the output luminescence signal at the expense of loosing a clear view of the structure behind the sensor (Klimant and Wolfbeis 1995). The concentration of the fluorophore in the cured sensing layer was 1.8% (w/w). The thickness of the semitransparent sensing layer was approximately 30 μm, resulting in an overall thickness of the planar optode of 155 μm.

The O_2 distribution measurements were conducted by the specially developed modular luminescence lifetime imaging system, MOLLI, as described by Holst et al. (1998) and Holst and Grunwald (2001). The planar optode was illuminated by blue (λ_{max} = 475 nm) excitation light of diodes (LEDs, HLMP-CB 15, Agilent), and the luminescence (λ_{max} = 647 nm) emitted by the optode was filtered with a red optical filter (80% transmission at ≥620 nm; Deep Golden Amber, LEE-Filters) to remove most of the reflected excitation light. The luminescence images of the planar optode were recorded by a charge-coupled device (CCD) camera (SensiCam, PCO) with a resolution of 640 × 480 pixels. The images covered an area of 25.6 × 19.2 mm. Taking the thickness of the sensing layer (30 μm) and the spatial resolution of the imaging system into account, the spatial resolution of the oxygen images was 40 × 40 μm $pixel^{-1}$. In order to determine the distribution of oxygen concentrations, the two-dimensional luminescence lifetime distributions were evaluated by the rapid lifetime determination (RLD) method (Woods et al. 1984; Ballew and Demas 1989; Liebsch et al. 2000). Further image processing was carried out with a custom-made computer program (Holst and Grunwald 2001). The planar optode was calibrated before and after the experiments by recording images corresponding to 0% and 100% air saturation. The measured luminescence lifetime distributions were converted into oxygen concentration values by a modified two-component model of the Stern–Volmer equation (Klimant et al. 1995; Holst and Grunwald 2001).

The accuracy of the oxygen measurements of the optode, as determined with 11 high-frequency measurements, was ±7% of air saturation at 70–90% air saturation and ±2.5% at 0–10% air saturation. The lower accuracy at higher oxygen concentrations occurs because higher oxygen content leads to a weaker luminescence signal. The stability of the optode was checked by calibrations before and after the experiments, and the calibration function of the sensor foil did not change significantly during 1.5 yr of experiments. The rate at which the optode could accurately follow changes is ~1 Hz, which is significantly lower than the measuring intervals employed (minutes).

Sediment topography—The sediment relief in front of the planar optode had to be assessed simultaneously with the oxygen measurements. This was achieved by a CCD camera positioned on the side of the wave tank opposite the planar optode. The camera's field of vision covered the area of the planar optode and was fixed slightly elevated relative to the optode in a 10° downward angle so that the sediment topography directly in front of the optode did not obstruct vision (Fig. 2). The camera was triggered simultaneously with the diodes that emitted the excitation light for the oxygen measurements. Thus, the obtained images showed the planar optode with the background light of the diodes and was partly darkened by the respective sediment relief. The sediment relief was assessed from these images with an edge-detecting algorithm that used the transition between dark and light

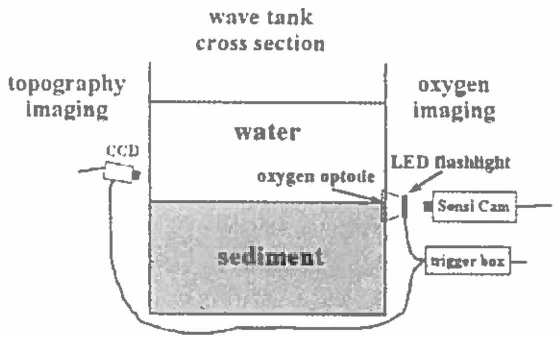

Fig. 2. Side view of the setup for the simultaneous oxygen and surface topography imaging in the wave tank.

regions of the image corresponding to the sediment surface relief. With three fluorescently marked reference points, the horizontally mirrored image of the sediment surface relief and oxygen distribution images could be aligned precisely. The sediment relief line was superimposed on the oxygen distribution images in a batch conversion routine. Time sequences of the resulting composite images were combined to produce animations of the oxygen dynamics in the sediment, simultaneously showing the changes of the sediment relief.

Experiments—To assess pore water velocities and pore water flow patterns under typical wave conditions, an experiment was carried out with waves equivalent to those in experiments 2, 5, 6, and 7 (Table 1). Prior to the experiment, the sediment surface was leveled. After the waves were switched on, ripples formed (wavelength = 2.5 cm, amplitude = 0.5 cm), and Rhodamine WT solution was injected into the sediment at various locations adjacent to the transparent wave tank wall next to the planar optode—ripple troughs and crests included. The development of the dye clouds in the sediment was recorded in high-resolution photographs taken at distinct time intervals (15 or 60 s). From the dye migration, the pore water velocities could be assessed.

Seven successful wave tank oxygen dynamics experiments were conducted between April and June 2002. All experiments were carried out with surface gravity waves of variable lengths and heights. The bed was smoothed before the experimental runs, and no artificial roughness elements were placed on the sediment surface. Exceptions were experiments 3 and 4, which were carried out with the remaining sediment topography of the previous experiment 2 to test the case of identical sediment topography and decreased flow velocities. During all experiments, oxygen images measured by the planar optode, together with the sediment relief images, were recorded. The experimental parameters relevant to the different experimental settings are listed in Table 1.

Results

Ripples—Orbital wave ripples formed in all experiments with smooth sediment surfaces in a matter of minutes (Table 1). However, the ripple evolution did not occur in a regular

Table 1. Experimental parameters.

Parameter	Experiment 1	2	3	4	5	6	7
Date	16 May 02	16 May 02	27 May 02	30 May 02	05 Jun 02	26 Jun 02	08 Jul 02
Duration (h)	4.5	15	1.5	3.5	26	5	36
Waves							
Wave height (cm)	8	8	7	3	8	8	8
Wave length (cm)	80	70	80	120	70	70	70
Period (s)	0.75	0.75	0.8	1	0.75	0.75	0.75
Flume							
Water depth (cm)	20	17	17	17	17	16.5	17
Sediment depth (cm)	20	20	20	20	20	20	20
Measurements							
LDA (laser doppler anemometer)	No	Yes	No	Yes	No	No	Yes
Ripples							
Sediment surface	Level and smooth	Level and smooth	Existing topography	Existing topography	Level and smooth	Existing topography	Level and smooth
First ripples (min)	15	15	0	0	15	0	15

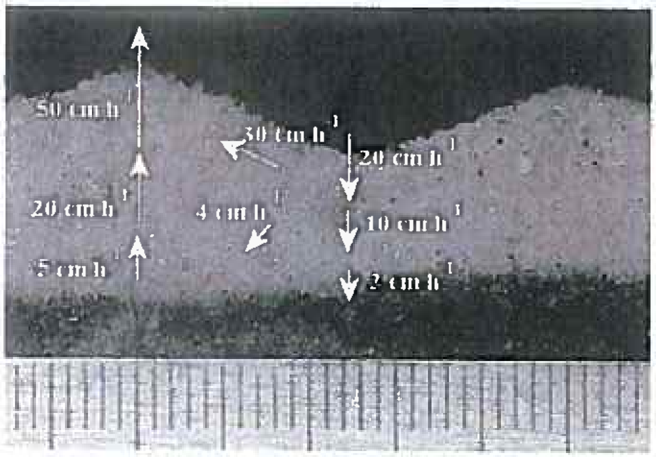

Fig. 3. Summary of pore water velocity measurements conducted with soluble tracer. The arrows indicate the observed pore water directions and are not to scale. The scale bar (mm) is shown at the bottom.

manner and uniformly in all experiments. Usually, ripples evolved in patches and spread over the rest of the sediment surface. Therefore, it could take some time until ripples formed in front of the planar optode. Ripple migration did not occur continuously and was characterized by variable velocities. Moreover, it could be observed that in the first experiment, ripple evolution was generally slower, which can most likely be attributed to EPS (extracellular polymeric substances) excreted by active organisms on the sediment surface. This effect was however not investigated further in the experiments.

Pore water velocity—A symmetrical advective flow pattern develops when the oscillating boundary flows interact with the wave ripples. Water enters the sediment at the ripple troughs and leaves it at the ripple crests. Figure 3 shows the directions of pore water movement with the corresponding velocities assessed from the measurements of the injected dye clouds. Pore water velocities are higher closer to the sediment and lie in the range of centimeters to decimeters per hour.

Oxygen measurements—The average oxygen penetration depth into the sediment under stagnant conditions without waves was ~3 mm. This oxygen distribution, governed predominantly by molecular diffusion, was only locally altered by oligochaete bioirrigation (Fig. 4a).

After the waves were switched on, but prior to the formation of sediment ripples in front of the planar optode, the oxygen penetration depth slowly increased to 5 mm within ~80 min (Fig. 4b). This effect can be attributed to advection associated with small-scale surface roughness or wave pumping (Riedl et al. 1972).

Figure 4a,b shows nonsaturation oxygen values in the water column. This is an effect that occurs when large anoxic areas are imaged by the oxygen optode. Because of reflections of the luminescent light within the acrylic wave tank wall, anoxic regions of the studied area affect the measurements in neighboring oxic regions. Although a reverse influence also takes place, the former is more pronounced because of the stronger luminescence intensity generated within anoxic regions. This effect lowers the spatial resolution of the oxygen images, but on a lower spatial scale than required to observe the principles of the processes studied here.

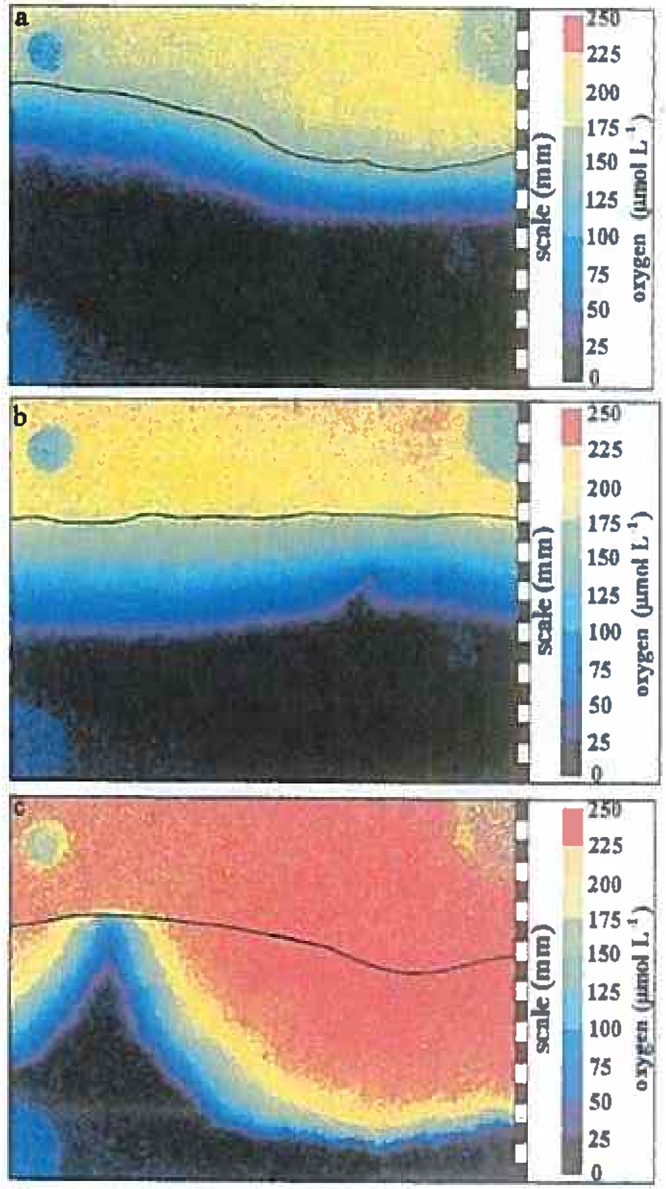

Fig. 4. (a) Oxygen image under stagnant conditions without waves (experiment 3). The black line indicates the sediment surface relief. (b) Oxygen image demonstrating an increased oxygen penetration depth under oscillating flow in the absence of sediment topography (experiment 6). The black line indicates the sediment surface relief. (c) Image of oxygen distribution linked to a stationary sediment ripple under oscillating flow (experiment 1). The black line indicates the sediment surface relief. Each black and white bar of the scale corresponds to 1 mm.

After ripples formed in front of the planar optode, the

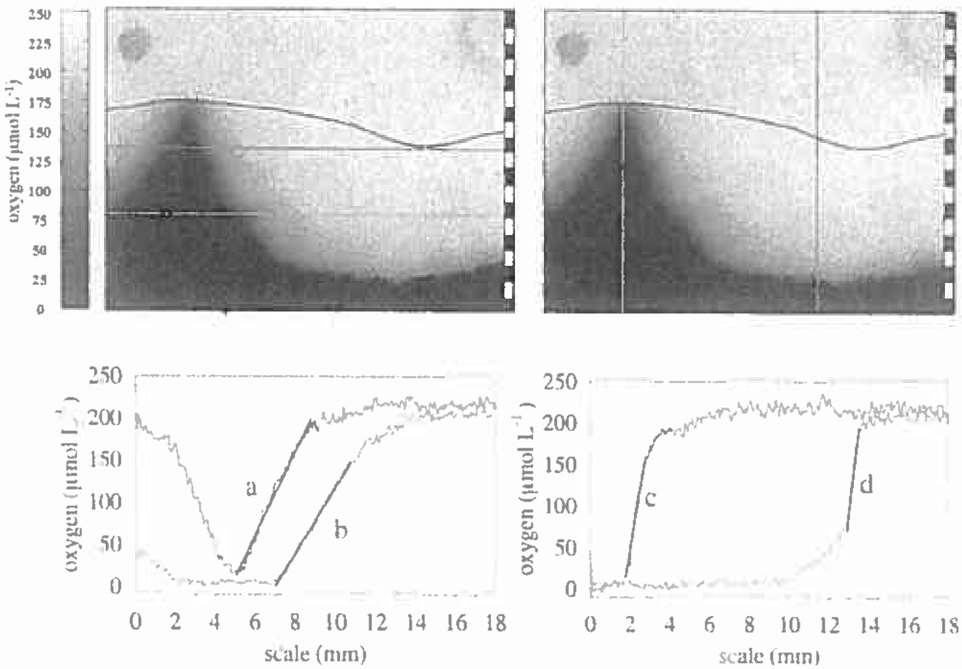

Fig. 5. Horizontal (left) and vertical (right) oxygen concentration profiles extracted from an optode image underneath a stationary ripple under oscillating flow (experiment 1). The black lines indicate the sediment surface relief; the grey lines show the extracted profiles. The depicted gradients of the oxygen concentration profiles correspond to (a) 49, (b) 39, (c) 150, and (d) 190 μmol L^{-1} mm^{-1}.

changes in the oxygen distribution in the sediment as a result of the ensuing advective pore water flows could be recorded with the optode. Upwelling of anoxic pore water from lower sediment layers led to an oxygen-depleted zone underneath the ripple crests. In the ripple troughs, oxygen-rich water from the water column was forced into the sediment, generating oxygenated zones in the sediment that reached a maximum depth of 1 cm (wave amplitude = 8 cm, wavelength = 80 cm; ripple amplitude = 0.4 cm, ripple wavelength = 2.9 cm). Thus, the pore water flows produced an oxygen distribution pattern reflecting the structure of the ripple topography, with alternating oxic and anoxic zones associated with ripple troughs and crests, respectively (Fig. 4c). This oxygen distribution led to steep horizontal oxygen concentration gradients underneath the ripple crests (Fig. 5).

In the experiments with existing sediment ripples at the optode and flow that was not strong enough to initiate further sediment movement, it could be observed that the final oxygen distributions in the sediment were similar regardless of the hydrodynamic forcing. With decreasing wave energy, the time needed to reach the final equilibrium was increased (from 46 min in experiment 3 to 216 min in experiment 4), showing that the pore water flow pattern is dependent on the sediment topography, whereas the pore water velocity is dependent on the magnitude of the hydrodynamic forcing. With even lower bottom flows, higher oxygen consumption, or both in the sediment, one can expect the equilibrium oxic–anoxic boundary to be shifted upward in the sediment because the reduced input of oxygen-rich water into the sediment cannot cover the demand of oxygen-consuming processes in the sediment.

In the case of sediment ripples migrating in front of the planar optode, the pore water flow field and the associated oxygen distribution migrated with the ripples, alternately exposing sediment to oxic and anoxic conditions. This is shown in Fig. 6a (upper panel) presenting a series of oxygen distribution patterns under slowly migrating ripples.

The effect of exposing sediment alternately to variable oxygen concentrations is depicted in Fig. 6b, showing oxygen profiles extracted from the same vertical row of pixels of the two-dimensional oxygen images as a function of time. This figure demonstrates how an initial equilibrium phase (75 min) was succeeded by a phase with ripple migration, causing pronounced oxygen changes in the sediment. The redox conditions at one single vertical profile in this case changed six times from anoxic to oxic within 90 min.

When ripples migrated faster, at rates of 10 to 20 cm h^{-1}, the oxygen-depleted zones started to lag behind the ripple crests and showed incompletely anoxic conditions (Fig. 6a, middle panel). When the ripple migration velocity in our experiments exceeded ~20 cm h^{-1}, the anoxic or oxygen-depleted zone underneath the ripple crest became completely detached from the ripple topography, leading to a thick, uninterrupted oxygenated sediment surface layer (Fig. 6a, lower panel). This is in accordance with Elliott and Brooks (1997*a,b*), who found that release and trapping of pore water exchanges more water between the sediment and overlying water than advective pore water flow when the ripple migration velocity exceeds the pore water flow velocity.

The dynamics of the oxygen distribution become clearer in the animations that can be found in Web Appendix 1 (http://www.aslo.org/lo/toc/vol_49/issue_3/0693a1.html). The oxygen distribution in the sediment beneath a stationary ripple after the waves were switched on (corresponding to Fig. 4a,c), as well as the oxygen dynamics in the sediment with slowly and fast-migrating ripples (corresponding to Fig. 6), are shown.

After the waves were switched off, the effects of the sediment's oxygen consumption could be observed with the optode. The oxic–anoxic boundary slowly moved upward until oxygen distributions reached the pre-experimental state with a homogeneous diffusive oxygen penetration depth of about 3 mm.

The oxygen consumption rates (OCRs) were calculated by fitting the changes in O_2 concentration over time (Fig. 7). In a pixel close to the sediment surface (circle), the O_2 concentration changed linearly with time, indicating that the effect of diffusion was negligible. The corresponding OCR, equivalent to the negative value of the slope of the O_2 decrease, was $0.32 \pm 0.01\ \mu mol\ L^{-1}\ min^{-1}$.

The situation is different in a pixel close to the oxic–anoxic boundary (square). The decrease of O_2 with time is initially faster ($\sim 1.53 \pm 0.07\ \mu mol\ L^{-1}\ min^{-1}$ during the interval between 0 and 50 min) and gradually slows down ($\sim 0.28 \pm 0.03\ \mu mol\ L^{-1}\ min^{-1}$ during the interval between 150 and 200 min) because of the combined effects of oxygen consumption by the sediment and molecular diffusion that causes depletion of O_2. The influence of diffusion was determined by examining the images of O_2 distribution at the time intervals 0–50 min and 150–200 min. It was found that the rate of the observed O_2 depletion was enhanced by molecular diffusion during the first time interval, whereas it was slowed down by diffusion during the second time interval. Subtracting the contribution of molecular diffusion from the observed O_2 depletion rate, we found that the true OCR here was about $0.67 \pm 0.07\ \mu mol\ L^{-1}\ min^{-1}$.

Because these two pixels are representatives of two extremes, we can conclude that the O_2 consumption rate varied across the oxic part of the sediment between 0.32 ± 0.01 and $0.67 \pm 0.07\ \mu mol\ L^{-1}\ min^{-1}$. It should be noted that these values are expressed in terms of the volume of the pore water. If one wants to obtain the values expressed per volume of sediment, one would have to multiply them by porosity, which in our case was ~36%.

Discussion

We showed in a previous study (Precht and Huettel 2003) that the interaction of wave-generated oscillating boundary flows and ripple topography produced zones of up- and downwelling pore water in permeable sands that propagated with ripple migration. These finding suggested that waves can produce a complex and dynamic oxygen distribution in sandy sea beds that would strongly influence benthic organisms and sediment biogeochemistry.

Here, we demonstrated that wave-driven advective pore water flow associated with sediment wave ripples creates a pattern of sediment zones where oxygen-rich water is forced into the bed alternating with zones where anoxic pore water is drawn to the surface. The spatial and temporal distribution of these zones is closely related to the ripple topography and its changes. Because the oxygen distribution under such a rippled surface changes mainly in two dimensions, the planar oxygen optode technique proved to be a powerful tool to investigate the two-dimensional distribution and dynamics of oxygen distribution at the spatial and temporal scales of the pore water flow field.

Sediment permeability, magnitude of boundary currents, and ripple height and spacing control the advective pore water velocities, flow directions, and penetration depths (Huettel and Webster 2001). The advective penetration of a reactant like oxygen additionally depends on the consumption rates in the flushed sediment layers. Thus, the oxygen distribution pattern we observed is a complex result of oxygen injection into specific areas, with ensuing directed oxygen transport along streamlines, and sedimentary oxygen consumption characterized by a vertical gradient, with higher rates in the deeper layers. The waves transformed the smooth sediment with a thin, continuous, oxygenated surface layer into a rippled bed with a thick oxygenated layer interrupted by oxygen-depleted zones of upwelling deep pore water. Consequently, steep horizontal oxygen concentration gradients developed in the sediment, as had been predicted by Shum (1993).

The advective oxygen transport in our sediments from the wave–topography interaction was more than one order of magnitude faster than transport by diffusion (with our settings, 0.13 cm in 1 h), explaining the relatively deep oxygen penetration into a sediment with oxygen consumption rates of $0.33–0.67\ \mu mol\ L^{-1}\ min^{-1}$. In permeable sediments with a homogeneous permeability, the vertical extension of the pore water flow field equals approximately the ripple wavelengths (Rutherford et al. 1995). The maximum oxygen penetration depth we could observe in the ripple troughs was 14 mm, which corresponds to 18 mm below the flat sediment surface. With ripple wavelengths between 25 and 30 mm, the oxygen penetration depth we observed was only slightly lower than the sediment depth theoretically affected by advection, demonstrating the dominance of oxygen injection over oxygen consumption, although our sediment had consumption rates common in shelf sediments. Because of this dominance, pore water flushing caused by the interaction of oscillating boundary flows and ripple topography increased the oxic sediment volume more than threefold in our experiments compared with the situation of a stagnant water column and diffusive transport alone.

Biogeochemical zonation—In our previous wave tank experiments (Precht and Huettel 2003), sharp boundaries of the dye patterns developed, which revealed that the pore water drawn to the surface under the ripple crest mixes very little with pore water of adjacent sediment zones. The fluid basically flows to the surface along streamlines that do not cross, except for the mixing caused by dispersion in the porous medium. Because the pore water ascends from different biogeochemical reaction zones, a pattern develops with up-

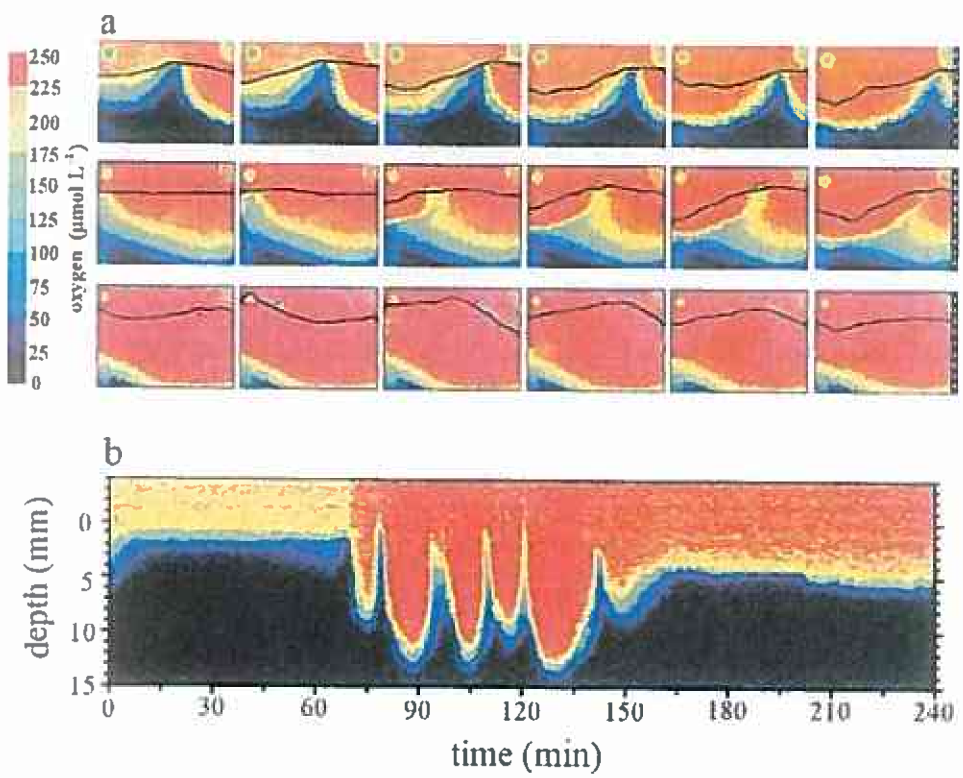

Fig. 6. (a) Time series of images of oxygen distributions under a slowly migrating ripple with a fully developed mobile upwelling zone (upper panel: image interval, 1 min; experiment 6), under a migrating ripple with an upwelling zone lagging behind the ripple crest (middle panel: image interval, 2 min; experiment 2), and under a fast-migrating ripple with no anoxic upwelling zone linked to ripple crests (lower panel: image interval, 2 min; experiment 2). (b) An example of a time series oxygen profile extracted from one selected vertical row of pixels of the planar optode images, revealing a temporal exposure of the sediment to redox oscillations (experiment 6).

welling flows that differ in their solute inventories. These pore water flows focus and narrow as they approach the ripple crest where fluid of different composition (and residence time in the sediment) emerges through narrow bands paralleling the crests (Fig. 8). With increasing distance from the center zone, these "emergence bands" release pore water from lesser and lesser depths and with shorter residence times in the sediment. As revealed by the oxygen concentration pattern under the stationary ripple (Fig. 4c), this produces bands of distinctly different geochemical characteristics at the sediment surface, which can be reflected, for example, by bands of different iron precipitates (Huettel et al. 1998). Microorganisms like sulfide oxidizers, denitrifiers, or iron oxidizers can profit from such patterns and the steep concentration gradients they produce (Fig. 5). Although the central upwelling zone might carry refractory dissolved organic matter (DOM), Fe^{2+}, and NH_4^+ to the surface, "outer" zones might release more labile DOM and NO_3^- resulting from enhanced organic matter decomposition and nitrification in the ripple slopes.

The situation in the ripple troughs is different. No solutes can be released from this area because molecular diffusion cannot counteract the water flow into the sediment. This implies that flux out of rippled permeable sediments averaged over larger areas only occurs through a fraction of the actual sediment surface area that is confined to the ripple crests. In our experiments, the total width of the upwelling zone at the ripple crest was between 6 and 8 mm, while the sediment band separating these zones was ~20–24 mm wide. This resulted in an uptake : release area ratio of about 3, whereas the volume flow through both areas is the same for reasons of mass balance (which explains why the upwelling pore water flow reaches higher velocities than the downwelling flows; Fig. 3). Because the width of the upwelling zone linked to each ripple should be proportional to the ripple wavelength, we conservatively estimate that, also in natural environments, the flux from a permeable sediment into the water column occurs only in <30% of the actual sediment surface areas in seabeds where advective exchange is effective. This demonstrates a major difference between sandy and cohesive sediment beds: in permeable seabeds, the fluxes are tightly linked to surface topography, and the fluxes out of the sediment occur in confined areas that are much smaller than the areas with fluxes into the sediment. In cohesive sediments, the mainly diffusive fluxes occur over the whole sediment surface in both directions, in and out of the sediment, with local hotspots, where directed bioturbative transport prevails.

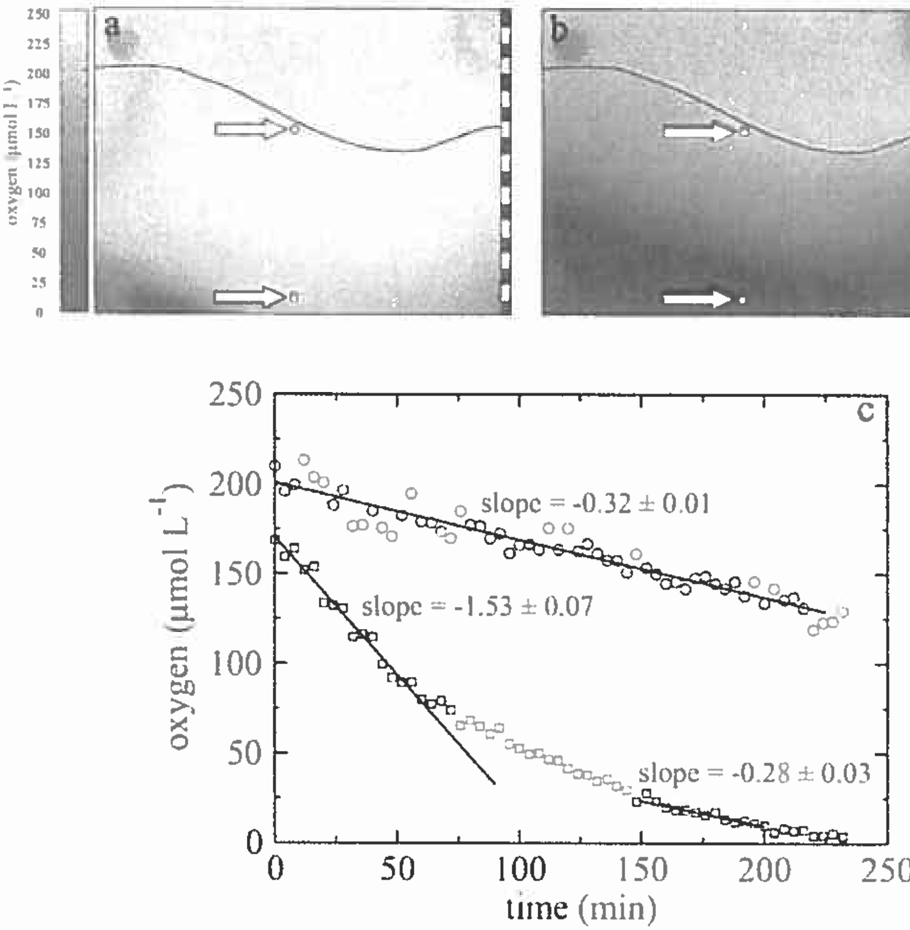

Fig. 7. Assessment of the oxygen consumption rates in the sediment. (a) Optode image of oxygen distribution directly after experiment 1. (b) Optode image of oxygen distribution 80 min after the experiment. The square and the circle (not to scale) indicate the areas of 3 × 3 pixels (~100 × 100 μm) over which the oxygen consumption rates were calculated. (c) Fitting the changes of the O_2 concentration over time: circles, O_2 concentration close to the sediment corresponding to an OCR of 0.32 ± 0.01 μmol L^{-1} min^{-1}; squares, O_2 concentration deeper in the sediment close to the initial oxic–anoxic boundary.

The advective pore water motion and the linked oxygen distribution also affect the microbiological system, which in turn affects the biochemical zonation. Prior to the experiments, the sediment in our study was kept under constant recirculating flow for 12 months; thus, the microbiological community had time to adjust to the new conditions. During the experiments, the oxic–anoxic boundary shifted, which implies that either the newly oxygenated zones became rapidly colonized by aerobes or that aerobic microorganisms were already present and became active. Because they are not the focus of this study, we have no information on these mechanisms. In later experiments, however, we can expect a microbial community that is tolerant against oxic and anoxic conditions and therefore adapted to the rapid changes in oxygen in the upper sediment layers.

Natural environments—The effect of wave action and bottom currents on interfacial pore water exchange was studied on an intertidal North Sea sandflat by Rutgers van der Loeff (1981). An increased apparent diffusivity in the upper 1.5 cm of the sandy sediments was measured. Measurements of pore water oxygen profiles in the North Sea by Lohse et al. (1996) revealed that the effective oxygen diffusion coefficients in the surface layers of sandy sediments could be >100 times higher than the molecular diffusion coefficients, which was attributed to turbulent diffusion driven by near-bottom currents. Moreover, Webb and Theodor (1968) and Precht and Huettel (2004) observed that wave-driven advective pore water flow is a natural process occurring in near-shore environments. Because the processes studied here are caused by the interaction of boundary flows and topography, it could be argued that in spite of small wavelength and shallow water depth, the laboratory results are applicable to natural permeable sediments affected by waves.

Sandy sediments are abundant in the global continental shelf environment (Emery 1968; de Haas et al. 2002), and sands like our experimental sediment with a median grain size of 180 μm are common on the shelf; for example, Cac-

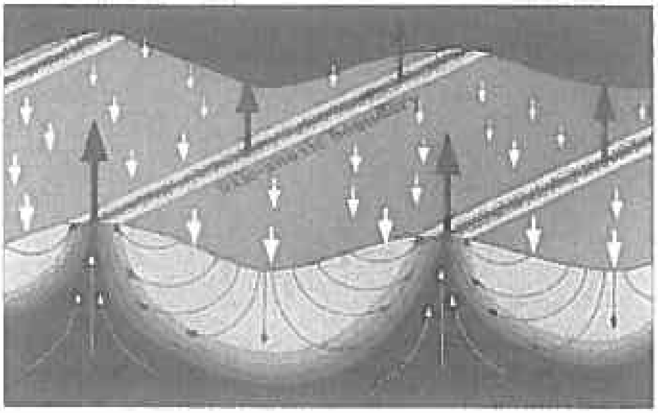

Fig. 8. Schematic drawing of the biogeochemical reaction zones underneath stationary ripples created by wave-induced advective pore water flow. In the center of the release areas, pore water from the deepest reaction zones emerges, whereas at the outer edges of these areas, pore water that resided for a shorter time in the sediment, and therefore has a different solute content, leaves the sediment. Black arrows indicate flow out of the sediment, white arrows flow into the sediment.

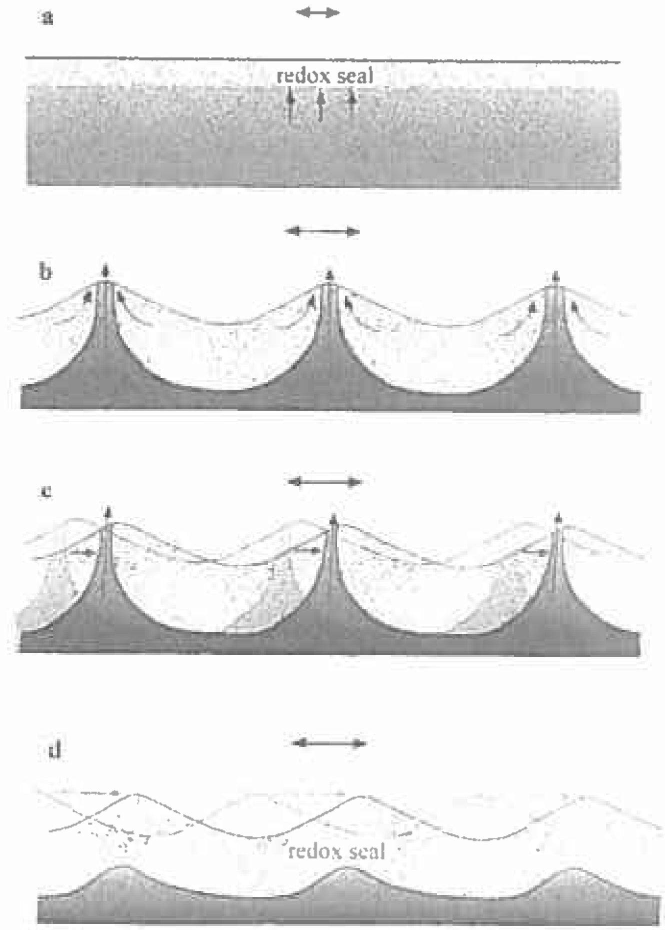

Fig. 9. Schematic diagram of (a) no sediment topography, oscillating flow; (b) stationary ripples; (c) ripples moving slower than pore water; (d) ripples moving faster than pore water. Grey indicates anoxic pore water. Arrows indicate water or pore water flow directions. See text for further details.

chione et al. (1999) and Ogston and Sternberg (1999) describe shelf sands with a grain size of 125–250 μm and ripples of 9 cm wavelength at 60 m water depth.

Previous studies have shown that wave-induced boundary flows might reach the sediment surface in large areas of the global continental shelf down to >100 m (Wiberg and Harris 1994; Harris and Wiberg 2001). The extent of the shelf areas affected by waves was numerically assessed by Harris and Coleman (1998): for example, in large areas of the southern North Sea, wave-induced flow exceeds the mobilization threshold for quartz sands of 100 μm diameter 10–50% of the time.

However, the wave ripples that formed during our experiments were of the orbital type (Wiberg and Harris 1994), with wavelengths between 2.5 and 3 cm. Under natural conditions, mainly anorbital ripples with comparable heights but longer wavelengths (~9 cm for a sediment of our grain size) are formed. This suggests that, in nature, wave-driven pore water advection affects greater sediment depths than in our experiments, given that the permeability of the sediment is sufficiently high. As the pore water flow velocities decrease with depth, the oxic water entering the sediment in the ripple troughs will be deoxygenated by oxygen consumption because of the longer residence time in the sediment. Therefore, it is unlikely that the sediment depth affected by advective transport equals the actual sediment depth that is exposed to oxygen through advective flushing. Nevertheless, larger ripple spacing means that the sediment depth from which material can be released is increased. Thus, a storm event that produces or enhances bed ripples might affect sediment water exchange and penetration depth of advective pore flows much longer than its actual duration because of the persistence of the topography. After a storm, this "memory effect" might increase sedimentary biological and biogeochemical activity by the higher particle filtration and oxygen penetration associated with the "new" topography.

Effect of sediment topography—This study revealed four scenarios of advective interfacial exchange caused by waves dependent on the existence and mobility of sediment topography (Fig. 9).

(1) Sediment without significant topography: This scenario involves the development of a continuous oxidized sediment surface layer with a slightly increased oxygen penetration depth from small-scale advection, shear-driven Brinkman flow (Basu and Khalili 1999), and possibly wave pumping (Riedl et al. 1972). Additional solute release is caused by molecular diffusion and bioirrigation. The sediment is redox sealed, meaning that reduced substances that precipitate or are adsorbed under oxic conditions (e.g., Fe^{2+}) cannot penetrate from deeper, anoxic sediment layers to the surface because they are trapped in the oxidized surface layer.

(2) Sediment surface with stationary ripples: This scenario has vertically alternating oxic and anoxic surface layers, with the oxygen penetration depth locally increased by

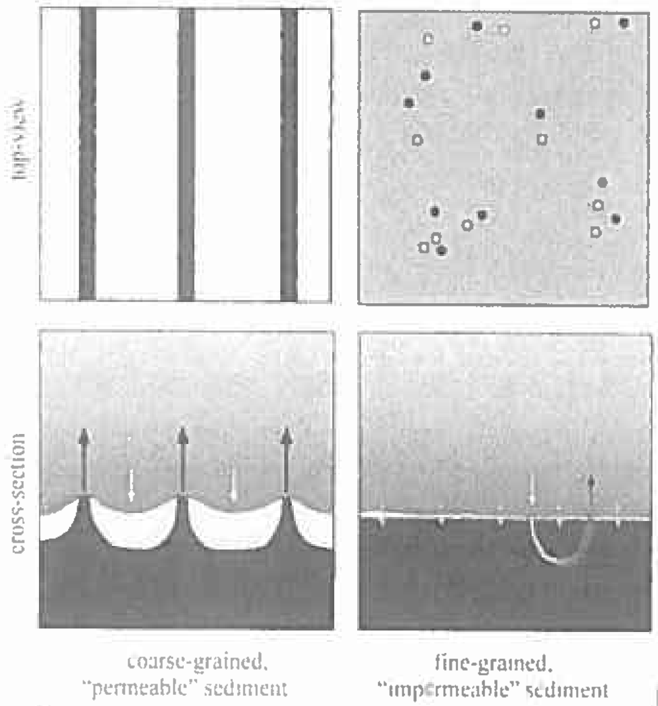

Fig. 10. Top views (upper panels) and cross-sections of a coarse-grained, rippled, permeable sediment (left) and a fine-grained, impermeable bed (right). Black indicates solute flux from the sediment, white indicates solute flux into the sediment, and grey is simultaneous flux into and out of the bed at the same location in the impermeable bed. The flux in and out of a rippled, permeable bed is limited to distinct zones of in- and outflow, whereas the diffusive transport that prevails in fine-grained sediments occurs over the whole sediment surface area (with bioturbation producing local hotspots of transport).

nearly one order of magnitude. The flushed sediment volume compared to stagnant conditions increases more than threefold. Upwelling of pore water from deeper sediment layers creates anoxic channels to the surface, through which reduced substances can be released to the water column. A horizontal geochemical zonation develops at the ripple crests with the deepest, and likely strongest, reduced pore water emerging in the center of the ripple crest. With increasing distance from this central upwelling, the pore water released from the ripple originates from less and less deeper zones, thus containing lesser amounts of reduced substances. The vertical anoxic upwelling zones under the ripple crests might confine oxygen-dependent meiofauna to the sediment volume underneath the ripple troughs.

(3) Sediment surface with ripples moving slower than pore water: The flushed sediment volume relative to stagnant conditions increases more than threefold and is comparable with scenario 2. Mobile pore water upwelling zones, alternately exposing sediment volumes to oxic and anoxic conditions, enhance organic matter degradation in the upper sediment layer through associated redox oscillations (Aller 1994).

Anoxic upwellings passing through oxic zones could remobilize precipitated oxidized iron or manganese compounds and leach reduced Mn or Fe from the sediment. The cycling of Fe and Mn is believed to be closely linked to bioturbation because it constitutes the mechanism that transports oxidized precipitates into deeper, anoxic sediment layers, where they are remobilized (Aller 1990; Canfield et al. 1993). The mechanism we describe here opens a secondary pathway for the remobilization and cycling of oxidized metal precipitates.

Mobile vertical anoxic zones might cause migration of oxygen-dependent infauna and select for a bacterial community that is tolerant to oxygen and anoxic conditions. Sulfide oxidizers that depend on oxygen or that can store nitrate, like *Beggiatoa* (Jørgensen and Des Marais 1990) or *Thioploca* (Fossing et al. 1995; Huettel et al. 1996a), might profit from alternating pore water down- and upwelling. Likewise, nitrifiers and denitrifiers could profit from this alternating exposure.

(4) Sediment with ripples moving faster than pore water: In this case, the upwelling of pore water is too slow to follow the ripple migration. A continuous oxic layer can develop that creates a redox-sealed sediment with an undulating oxic–anoxic interface. The sediment volume flushed by oxygen-rich water reaches a maximum under these circumstances (increased more than sixfold to stagnant conditions). Intensive mixing of upwelling and downwelling pore water within the sediment might cause layers with increased precipitation of redox-sensitive substances (e.g., the common ferric iron coatings on surface layer sands).

Between scenarios 3 and 4, there is a gradual transition. In our experiments, when the ripples propagated at velocities of <10 cm h^{-1}, the oxygen-depleted zones under the ripple crests were fully developed with fully anoxic conditions in the centers (scenario 3). With ripple propagation velocities of >20 cm h^{-1}, the upwelling zone became detached from the ripple crests (scenario 4). With pore water velocities between 10 and 20 cm h^{-1}, the oxygen-depleted zone trailed behind the ripple crest and showed only slight oxygen depletion. Therefore, ripple migration velocity defines not only how long a sediment volume is exposed to anoxic conditions but also the degree of anoxia and which spectrum of substances can be "leached" from the sediment because of the passage of an oxygen-depleted or oxic zone (applicable to Fe, Mn, NO_3, NH_4, PO_4, and possibly to heavy metals like Pb, Cd, or Hg).

Doucette et al. (2002) measured the migration rates of wave ripples 45 m offshore at shallow water depths with ripple wavelengths and sediment grain sizes comparable to those in our study. They observed averaged ripple migration rates of 55 cm h^{-1}, which would mean that, at least in the highly mobile nearshore environment, scenario 4 of a redox-sealed sediment with completely oxic surface layer occurs. Migration rates of larger wave ripples (ripple wavelengths typically 10–100 cm; sediment median grain size = 400 μm) were measured by Traykovski et al. (1999) at 11 m water depth, and it was found that these bedforms moved at velocities between 1 and 3 cm h^{-1}. These values show that all the scenarios we described for the flume sediment can occur in natural environments.

We conclude that surface gravity waves can control oxygen transport and distribution in shallow permeable sediments. Because this influence is affected by the formation of sediment wave ripples and associated advective pore water flows, the regularity of the ripple topography is reflected in the oxygen distribution pattern in the upper sediment layer, with alternating zones of oxic and anoxic sediment. This establishes a fundamental difference between fine-grained, impermeable sediments and sandy permeable beds. Although in the fine-grained beds the diffusive sediment–water solute exchange takes place everywhere at the surface and simultaneously in both directions (into and out of the sediment via diffusion and associated counterdiffusion), influx and efflux is spatially well separated in permeable sand beds, with solute penetration in the ripple troughs and solute release from the ripple crests (Fig. 10). Thus, the fluxes into the sediment take place through a larger surface area than the fluxes out of the sediment. The separation of influx and efflux can generate a regular pattern of extremely different biogeochemical zones at the surface. The tight link between topography and pore water flow fields makes this distribution pattern highly dynamic, as ripples migrate or change their shape. Through the persistence of ripples after a storm event, this memory effect of the sea bed might control sediment metabolism a long time after such an event, through advective exchange caused by the interaction of boundary flows (e.g., tidal flows) and relict topography.

References

ALLER, R. C. 1982. The effects of macrobenthos on chemical properties of marine sediment and overlying water, p. 53–102. *In* P. L. McCall and M. J. S. Tevesz [eds.], Animal–sediment relations. Plenum Press.

———. 1990. Bioturbation and manganese cycling in hemipelagic sediments. Phil. Trans. R. Soc. Lond. A **331:** 51–68.

———. 1994. Bioturbation and remineralization of sedimentary organic matter: Effects of redox oscillation. Chem. Geol. **114:** 331–345.

BALLEW, R. M., AND J. N. DEMAS. 1989. An error analysis of the rapid lifetime determination method for the evaluation of single exponential decays. Anal. Chem. **61:** 30–33.

BASU, A. J., AND A. KHALILI. 1999. Computation of flow through a fluid–sediment interface in a benthic chamber. Phys. Fluids **11:** 1395–1405.

BERNER, R. A. 1980. Early diagenesis—a theoretical approach. Princeton Univ. Press.

BOOIJ, K., W. HELDER, AND B. SUNDBY. 1991. Rapid redistribution of oxygen in a sandy sediment induced by changes in the flow velocity of the overlying water. Neth. J. Sea Res. **28:** 149–165.

CACCHIONE, D. A., P. L. WIBERG, J. LYNCH, J. IRISH, AND P. TRAYKOVSKI. 1999. Estimates of suspended-sediment flux and bedform activity on the inner portion of the Eel continental shelf. Mar. Geol. **154:** 83–97.

CANFIELD, D. E., B. THAMDRUP, AND J. W. HANSEN. 1993. The anaerobic degradation of organic-matter in Danish coastal sediments—iron reduction, manganese reduction, and sulfate reduction. Geochim. Cosmochim. Acta **57:** 3867–3883.

DE HAAS, H., T. C. E. VAN WEERING, AND H. DE STIGTER. 2002. Organic carbon in shelf seas: Sinks or sources, processes and products. Cont. Shelf Res. **22:** 691–717.

DENNY, M. W. 1988. Biology and the mechanics of the wave-swept environment. Princeton Univ. Press.

DOUCETTE, J. S., E. S. HARVEY, AND M. R. SHORTIS. 2002. Stereo-video observation of nearshore bedforms on a low energy beach. Mar. Geol. **189:** 289–305.

ELLIOTT, A. H., AND N. H. BROOKS. 1997*a*. Transfer of nonsorbing solutes to a streambed with bed forms: Theory. Water Resour. Res. **33:** 123–136.

———, AND ———. 1997*b*. Transfer of nonsorbing solutes to a streambed with bed forms: Laboratory experiments. Water Resour. Res. **33:** 137–151.

EMERY, K. O. 1968. Relict sediments on continental shelves of the world. Am. Assoc. Pet. Geol. Bull. **52:** 445–464.

FORSTER, S., M. HUETTEL, AND W. ZIEBIS. 1996. Impact of boundary layer flow velocity on oxygen utilisation in coastal sediments. Mar. Ecol. Prog. Ser. **143:** 173–185.

FOSSING, H., AND OTHERS. 1995. Concentration and transport of nitrate by the mat-forming sulfur bacterium *Thioploca*. Nature **374:** 713–715.

GLUD, R. N., N. B. RAMSING, J. K. GUNDERSEN, AND I. KLIMANT. 1996. Planar optrodes: A new tool for fine scale measurements of two-dimensional O-2 distribution in benthic communities. Mar. Ecol. Prog. Ser. **140:** 217–226.

———, C. M. SANTEGOEDS, D. DE BEER, O. KOHLS, AND N. B. RAMSING. 1998. Oxygen dynamics at the base of a biofilm studied with planar optodes. Aquat. Microb. Ecol. **14:** 223–233.

———, M. KUHL, O. KOHLS, AND N. B. RAMSING. 1999. Heterogeneity of oxygen production and consumption in a photosynthetic microbial mat as studied by planar optodes. J. Phycol. **35:** 270–279.

———, A. TENGBERG, M. KUHL, P. O. J. HALL, I. KLIMANT, AND G. HOLST. 2001. An in situ instrument for planar O-2 optode measurements at benthic interfaces. Limnol. Oceanogr. **46:** 2073–2080.

HARRIS, C. K., AND P. L. WIBERG. 2001. A two-dimensional, time-dependent model of suspended sediment transport and bed reworking for continental shelves. Comput. Geosci. **27:** 675–690.

HARRIS, P. T., AND R. COLEMAN. 1998. Estimating global shelf sediment mobility due to swell waves. Mar. Geol. **150:** 171–177.

HOLST, G., AND B. GRUNWALD. 2001. Luminescence lifetime imaging with transparent oxygen optodes. Sens. Actuator B Chem. **74:** 78–90.

———, O. KOHLS, I. KLIMANT, B. KONIG, M. KUHL, AND T. RICHTER. 1998. A modular luminescence lifetime imaging system for mapping oxygen distribution in biological samples. Sens. Actuator B Chem. **51:** 163–170.

HUETTEL, M., AND A. RUSCH. 2000. Transport and degradation of phytoplankton in permeable sediment. Limnol. Oceanogr. **45:** 534–549.

———, S. FORSTER, S. KLOSER, AND H. FOSSING. 1996*a*. Vertical migration in the sediment-dwelling sulfur bacteria *Thioploca* spp. in overcoming diffusion limitations. Appl. Environ. Microbiol. **62:** 1863–1872.

———, W. ZIEBIS, AND S. FORSTER. 1996*b*. Flow-induced uptake of particulate matter in permeable sediments. Limnol. Oceanogr. **41:** 309–322.

———, ———, ———, AND G. I. LUTHER. 1998. Advective transport affecting metal and nutrient distribution and interfacial fluxes in permeable sediments. Geochim. Cosmochim. Acta **62:** 613–631.

———, AND I. T. WEBSTER. 2001. Porewater flow in permeable sediments, p. 144–179. *In* B. P. Boudreau and B. B. Jørgensen [eds.], The benthic boundary layer. Oxford Univ. Press.

JØRGENSEN, B. B., AND D. J. DES MARAIS. 1990. The diffusive boundary layer of sediments: Oxygen microgradients over a microbial mat. Limnol. Oceanogr. **35:** 1343–1355.

KAUTSKY, H. 1939. Quenching of luminescence by oxygen. Trans. Faraday Soc. **35:** 216–219.

KLIMANT, I., AND O. S. WOLFBEIS. 1995. Oxygen-sensitive luminescent materials based on silicone-soluble ruthenium diimine complexes. Anal. Chem. **67:** 3160–3166.

———, V. MEYER, AND M. KÜHL. 1995. Fiber-optic oxygen microsensors, a new tool in aquatic biology. Limnol. Oceanogr. **40:** 1159–1165.

KLUTE, A., AND C. DIRKSEN. 1986. Hydraulic conductivity and diffusivity: Laboratory methods, p. 687–734. *In* A. Klute [ed.], Methods of soil analysis—part 1—physical and mineralogical methods. American Society of Agronomy.

KRÖGEL, F. 1997. Einfluß von Viskosität und Dichte des Seewassers auf Transport und Ablagerung von Wattsedimenten (Langeooger Rückseitenwatt, südliche Nordsee). Ber. Fachbereich Geowiss. Univ. Bremen **102:** 1–168.

LIEBSCH, G., I. KLIMANT, B. FRANK, G. HOLST, AND O. S. WOLFBEIS. 2000. Luminescence lifetime imaging of oxygen, pH, and carbon dioxide distribution using optical sensors. Appl. Spectrosc. **54:** 548–559.

LOHSE, L., E. H. G. EPPING, W. HELDER, AND W. VANRAAPHORST. 1996. Oxygen pore water profiles in continental shelf sediments of the North Sea—turbulent versus molecular diffusion. Mar. Ecol. Prog. Ser. **145:** 63–75.

OGSTON, A. S., AND R. W. STERNBERG. 1999. Sediment-transport events on the northern California continental shelf. Mar. Geol. **154:** 69–82.

PAPKOVSKY, D. B., J. OLAH, I. V. TROYANOVSKY, N. A. SADOVSKY, V. D. RUMYANTSEVA, A. F. MIRONOV, A. I. YAROPOLOV, AND A. P. SAVITSKY. 1992. Phosphorescent polymer films for optical oxygen sensors. Biosens. Bioelectron. **7:** 199–206.

PRECHT, E., AND M. HUETTEL. 2003. Advective pore water exchange driven by surface gravity waves and its ecological implications. Limnol. Oceanogr. **48:** 1674–1684.

———, AND ———. 2004. Rapid wave-driven advective pore water exchange in a permeable coastal sediment. J. Sea Res. **51:** 93–107.

RIEDL, R. J., N. HUANG, AND R. MACHAN. 1972. The subtidal pump: A mechanism of interstitial water exchange by wave action. Mar. Biol. **13:** 210–221.

RUTGERS VAN DER LOEFF, M. M. 1981. Wave effects on sediment water exchange in a submerged sand bed. Neth. J. Sea Res. **15:** 100–112.

RUTHERFORD, J. C., J. D. BOYLE, A. H. ELLIOTT, T. V. J. HATHERELL, AND T. W. CHIU. 1995. Modeling benthic oxygen-uptake by pumping. J. Environ. Eng. **121:** 84–95.

SHUM, K. T. 1992. Wave-induced advective transport below a rippled water–sediment interface. J. Geophys. Res. **97:** 789–808.

———. 1993. The effects of wave-induced pore water circulation on the transport of reactive solutes below a rippled sediment bed. J. Geophys. Res. **98:** 10,289–10,301.

TRAYKOVSKI, P., A. E. HAY, J. D. IRISH, AND J. F. LYNCH. 1999. Geometry, migration, and evolution of wave orbital ripples at LEO-15. J. Geophys. Res. **104:** 1505–1524.

WEBB, J. E., AND J. THEODOR. 1968. Irrigation of submerged marine sands through wave action. Nature **220:** 682–683.

———, AND ———. 1972. Wave-induced circulation in submerged sands. J. Mar. Biol. Assoc. U.K. **52:** 903–914.

WIBERG, P. L., AND C. K. HARRIS. 1994. Ripple geometry in wave-dominated environments. J. Geophys. Res. **99:** 775–789.

WOODS, R. J., S. SCYPINSKI, L. J. C. LOVE, AND H. A. ASHWORTH. 1984. Transient digitizer for the determination of microsecond luminescence lifetimes. Anal. Chem. **56:** 1395–1400.

ZIEBIS, W., M. HUETTEL, AND S. FORSTER. 1996. Impact of biogenic sediment topography on oxygen fluxes in permeable seabeds. Mar. Ecol. Prog. Ser. **140:** 227–237.

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Rapid wave-driven advective pore water exchange in a permeable coastal sediment

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Abstract

In this study we present in-situ measurements of pore water flow velocities in a coastal sandy sediment (permeability = 3.65×10^{-10} m^2). The advective pore water flows were driven by the interaction of oscillating boundary flows with sediment wave ripples, (amplitude = 7 cm, wavelength = 30 to 50 cm). The measurements were carried out in the Mediterranean Sea at 50 to 70 cm water depth during a phase of very low wave energy (max. wave amplitude = 10 cm). An optode technique is introduced that permits direct pore water flow measurements using a fluorescent tracer. Near the sediment surface (0.5 cm depth) pore water reached velocities exceeding 40 cm h^{-1}. Thus, advective transport exceeded transport by molecular diffusion by at least 3 orders of magnitude. Based on the pore water velocity measurements and ripple spacing, we calculate that 140 L m^{-2} d^{-1} are filtered through the sediment. Pore water visualisation experiments revealed a flow field with intrusion of water in the ripple troughs and pore water release at the ripple crests. The wave-driven water flow through the sediment, thus, was directly linked to the wave-generated sediment topography, and its spatial dimensions. These results show that surface waves cause water filtration through permeable sediments at water depths smaller than half the wavelength. We conclude that surface gravity waves constitute an important hydromechanical process that may convert large areas of the continental shelves into expansive filter systems. Surface gravity waves thereby could affect suspended particle concentration and cycling of matter in the shelf.

Keywords: Permeable sediment; Coastal sand; Advection; In-situ optode; Pore water flow velocity measurements; Surface gravity waves

1. Introduction

In permeable sandy sediments that are common in coastal and shelf environments (De Haas et al., 2002), interaction of boundary layer flow and sediment topography can drive interstitial pore water flows. Such advective transport may be an important link between sediment and water column processes and could affect coastal and shelf biogeochemical cycling as it can exceed transport by molecular diffusion by several orders of magnitude (Webb and Theodor, 1972; Rutgers van der Loeff, 1981; Lohse et al., 1996; Huettel and Webster, 2001).

Webb and Theodor (1968) observed that under moderate wave conditions dyed water injected into a coarse sandy nearshore sediment was drawn to the sediment surface in a matter of minutes. These authors concluded that surface gravity waves were the driving

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force behind this process, as density-driven and biological processes could be ruled out. Shum (1992) used a two-dimensional numerical approach to calculate the trajectories of pore water particles under a rippled bed over one wave period. The results indicated that the zone of advection extended to a few ripple heights below the ripple surface over a wide ange of wave conditions and sediment characteristics. Advective exchange driven by surface gravity waves was quantified in a series of laboratory wave tank experiments by Precht and Huettel (2003). These authors also showed that wave-induced pore water exchange increased sharply at the temporal transition from a smooth to a rough sediment surface when ripples were generated by the oscillating boundary flows.

The term 'subtidal pump' for the exchange between sediment and water column driven by wave-related hydrostatic pressure oscillations was introduced by Riedl et al. (1972). These authors used in-situ data to calculate the amount of water forced through the bed and concluded that the subtidal pump could filter the global ocean volume through the shelf sediments in ca. 14000 years. Rutgers van der Loeff (1981) described the effect of wave pumping in intertidal flats and concluded that observed increased solute flux was caused by pore water exchange driven by waves. In order to explain net transport of solutes by periodic interstitial motion, the concept of mechanical dispersion was added to the subtidal pump theory (Harrison et al., 1983). In a numerical and experimental approach, Webster and Taylor (1992) showed that dispersion driven by surface gravity waves was able to enhance the solute transfer between sediment bed and overlying water and introduced the term rotational dispersion. Precht and Huettel (2003) proposed that wave-driven exchange at water depths < wavelength/2 caused by oscillating flow-sediment topography interaction may exceed the effects of wave-pumping at least by a factor of 3.

These wave-induced transport processes may cause characteristic changes in the biogeochemical zonation of permeable sediments. Shum's (1993) model calculations indicate that the oxygen distribution in the pore water underneath a rippled surface under progressing waves can display horizontal concentration gradients that may be of the same order of magnitude as those in the vertical direction.

Advective exchange processes driven by unidirectional near-bottom flows have been studied in more detail than exchange driven by oscillating currents. Thibodeaux and Boyle (1987) and Savant et al. (1987) investigated the flow patterns in permeable sediment generated by obstructions on the sediment surface. Advective solute exchange was studied and quantified for a streambed with bedforms and nonsorbing solutes (Elliott and Brooks, 1997a,b); a rippled bed and adsorbing metals (Eylers et al., 1995); biogenic sediment structures and nonsorbing solutes (Huettel and Gust, 1992) and solid obstacle-boundary flow interactions (Hutchinson and Webster, 1998). The biogeochemical implications of advection were examined by Ziebis et al. (1996) for oxygen penetration depth, and by Huettel et al. (1998) for biogeochemical reaction zones in permeable sediments. With interfacial water exchange, suspended particles (Huettel et al., 1996) or phytoplankton (Huettel and Rusch, 2000) locally can be transferred from the boundary layer into the top centimetres of permeable sediments. Thus, the classical one-dimensional approach developed for describing the distribution of pore water constituents and for measuring the related fluxes across the sediment-water interface is inadequate for permeable shelf beds that permit pore water flows (Shum and Sundby, 1996).

The aim of the present study was to gather in-situ data on advective exchange driven by oscillating flow – ripple interaction, and to compare the results with the findings of laboratory studies and model calculations. A method to directly measure pore water velocities in a natural environment and its application to facilitate estimates of the magnitude of advection and its filtering effects is presented. Additionally, a method permitting the visualisation of the evolving pore water flow patterns was applied and is presented.

2. Methods

2.1. Study site

Pore water velocity measurements and pore water flow field visualisations were carried out in October 2001 in shallow-water sediments of Campese Bay at the western coast of the Island of Giglio. Giglio is part of the Tuscany Archipelago in the Mediterranean

Sea off the western coast of Italy, approximately 150 km north-west of Rome at 42°20′ N, 10° 52′ E (Fig. 1). The tidal regime is microtidal as in the whole Mediterranean Sea. The beach and sublittoral of Campese Bay consist of permeable medium sand with a high content of Pyrite grains as iron ore was mined on Giglio and washed and loaded in Campese Bay until ca. 1950. In the shallow (< 10 m) areas of the bay, surface gravity waves produce wave ripples parallel to the coast, while in the deeper regions mounds created by the burrowing activity of the mud shrimp *Calianassa truncata* are the main topographical features (Ziebis et al., 1996). Due to the calm weather conditions prior to the measurement campaign, the *Calianassa* activities had largely destroyed the regular wave ripple pattern in the areas deeper than 2 m. Salinity during the measurement period was 39, water temperature ca. 22 °C and weather conditions were calm with wind velocities of 2 to 5 m s^{-1}. The measurements were carried out in sediment at 50 to 70 cm water depth. This shallow depth was chosen as only small waves were present. Symmetric wave ripples dominated the sediment topography at the study site with amplitudes between 6 and 8 cm and wavelengths between 30 and 50 cm. Although rolling sand grains could be observed at the ripple crests, the ripples as such remained stationary during the measurements.

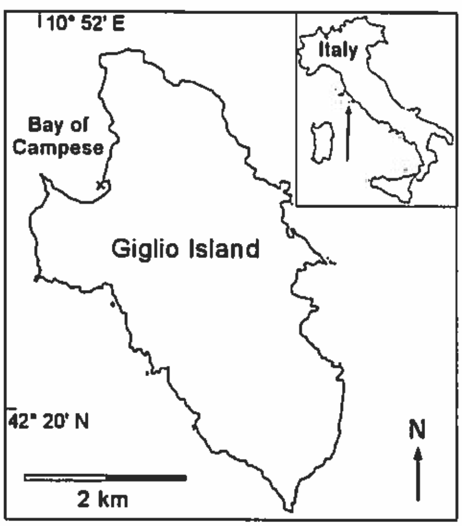

Fig. 1. Bay of Campese, x indicating study site.

The grain size distributions in the sediment surface layer (0–5 cm) were different at the ripple troughs and crests, with median values of 370 μm and 500 μm for the crests and troughs, respectively. The higher median value for the troughs was mainly due to a slight accumulation of gravel (max. diameter: ca. 1 cm) in the ripple troughs. This had no significant influence on permeability and porosity, which were 3.65×10^{-10} m^2 (sd = 1.64×10^{-10}, n = 4) and 36.9 % (sd = 1.35, n = 10), regardless of where the sediment cores for these measurements were taken.

2.2. Water column hydrodynamics

The wave heights were measured with a pole fitted with a scale that was anchored in the sediment at the study site. Water currents were measured using an Acoustic Doppler Velocimeter (Nortek). The ADV technique allows 3 component current measurements in a small measuring volume located ca. 10 cm below the sensor. Two time series of triplicate flow measurements were carried out; one set above a ripple crest, one above a trough. The downwards measuring ADV sensor was attached to a custom-built aluminium frame with a transverse system permitting us to move the measuring volume vertically to predefined specific depths (27, 15, 5 cm and 30, 19, 5 cm above the sediment surface at crest and trough, respectively). Flow velocities were recorded at each measuring point for 1000 s with a sampling frequency of 25 Hz.

2.3. Pore water flow measurements

The measurements of the pore water flow velocities were carried out by injecting 2 ml of fluorescent dye into the sediment and subsequently following the movement of the dye cloud through the sediment with optical sensors. The dye was a Fluorescein solution (100 mg L^{-1}) with a density attuned to the local seawater by addition of NaCl to neutral buoyancy.

The principle of detection of a fluorescent solution with optical fibres is similar to that of oxygen measurements with optodes as laid out by Klimant et al. (1995). De Beer and Schramm (1999) employed this technique of detection of a fluorescent dye with an optical fibre to measure convective transport in a biofilm. For Fluorescein concentration measurements, blue light (λ = 470 nm) is emitted through an optical fibre into the measuring medium where the light causes excitation of the Fluorescein. The resulting fluorescence signal is transferred back through the same optical fibre, and the intensity is measured after passage through a green interference filter ($\lambda = 519$ nm) with a photo-multiplier tube (PMT). The intensity of the signal is linearly proportional to the Fluorescein concentration within the range of the dye concentrations employed (F. Janssen, unpubl. data). A custom-built fibre optical switch with 7 channels allowed connecting 6 optical fibres for fluorescence measurements and one internal reference. The electronics were housed in a sealed titanium cylinder, and power was supplied by a submergible 24 V battery. The cylinder containing the electronics and the battery were placed onto the sediment 3 m away from the actual measuring site ensuring no interference with the measurements. Prior to the measurements, thermal equilibrium of the electronics with the surrounding water was allowed, as the PMT gain is temperature sensitive. A cable connection allowed the direct surveillance of the measured data with a laptop computer on the beach.

The optical fibres (Radiall; fibre diameter = 140 µm) were stripped of their outer elastic plastic coating but retained their inner plastic cladding for protection resulting in a sensor tip diameter of < 1 mm. The ends of the fibres were cut straight to achieve an optimal compromise between sturdiness and signal strength.

The fluorescence sensors were fixed in an array that was constructed from mesh wire (mesh width 1.25 cm). This set-up allowed aligning the sensors in a 'comb' with 1.25 cm vertical distance between the sensor tips (Fig. 2). A hypodermic needle was attached to the array 2.5 cm below and parallel with the lowest sensor tip. The end of the needle was vertically aligned with the sensor tips. The shaft of the needle was connected with tubing to a syringe that permitted release of a defined tracer volume through the buried open end of the needle. With this set-up, the optical sensors and the hypodermic needle could be placed at fixed and known positions in the sediment covering a distance of 8.75 cm. For the measurements, the array was positioned vertically in the centre of the ripple crests parallel to the ripple geometry. The uppermost fluorescence sensor was ca. 1 mm below the sediment surface at the ripple crests so that the dye was injected ca. 8.8 cm below the sediment surface. The sensor

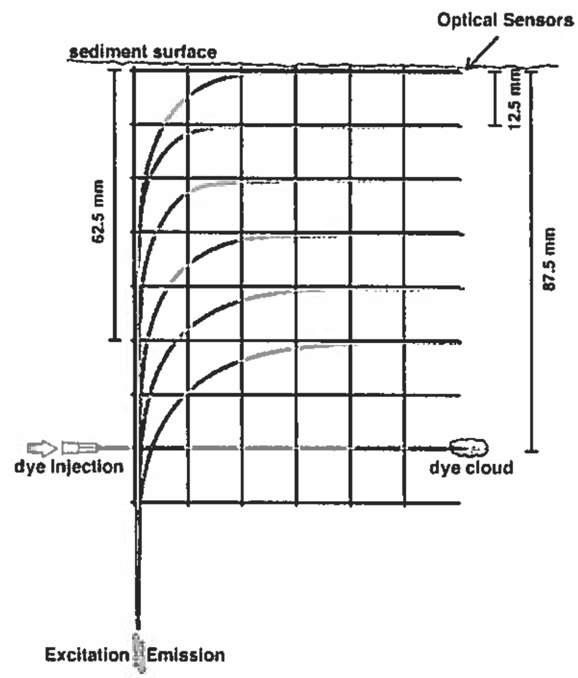

Fig. 2. Sketch of the set-up of the optical sensors: grey are the optical fibres, black the mesh wire framework.

array was inserted into the ripple manually by partially removing the ripple, pressing the array horizontally into an undisturbed part of the ripple and rebuilding the ripple where it had been disturbed. Thus all measurements were carried out in undisturbed parts of the ripples. After injection of Fluorescein, the passage of the dye cloud past the optical sensors could be recorded in the measurements. Four successful measurements of dye migration in the sediment were carried out, two of them with three successive dye injections. The bulk flow velocity of the pore water could then be inferred from the time between the passages of the Fluorescein concentration maxima at the individual optical sensors.

2.4. Pore water flow visualisation

The temporal distribution of a dye cloud in the sediment in order to assess the pore water flows could be visualised in-situ with a simple technique: a 20 cm wide and 30 cm long transparent polycarbonate plate (6 mm thick) was carefully pushed vertically into the sediment perpendicular to the ripples and thus aligned with the main boundary flow. By removing the sediment on one side of the plate, the cross-section of the ripple became visible. The plate had silicone-sealed holes (0.5 cm in diameter) drilled at regular intervals in a rectangular grid pattern. Through these holes, dye could be injected into the sediment with a hypodermic needle, and additionally these holes served as reference points. The dyes employed for these pore water flow visualisations were neutrally buoyant and thermally equilibrated Rhodamine or Fluorescein solutions. The movement and development of the dye cloud in the sediment could be observed visually through the transparent sheet and for quantitative analyses was recorded with an underwater digital camera. The camera was attached to a custom-built aluminium frame anchored in the sediment and photographs were taken at regular time intervals.

2.5. Sediment characteristics and pore water analyses

At the study site, 3 sediment samples were taken at ripple crests and 3 in the ripple troughs. Each sample consisted of surface sediment (top 5 cm of the sediment) and comprised about 500 g of dry material, which was used to assess grain size distributions using a column of 8 sieves.

To assess the porosity, 5 + 5 sediment cores (diameter: 2.6 cm, length: 3.3 to 9 cm) were taken at ripple troughs and crests. Supernatant water was carefully removed, and the cores were sealed and stored for transport. The porosities of the respective cores were calculated from the wet and dry (after drying at 50 °C to constant weight) weights and corrected for salinity.

For permeability measurements, 4 sediment cores (diameter: 2.6 cm, length between 8.5 and 13.7 cm) were taken at both ripple crests and ripple troughs. Measurements were done directly after sampling with a constant head permeameter (Klute and Dirksen, 1986).

For nutrient analyses, pore water was extracted using a steel pore water sampler with a perforated pointed tip filled with filter material. 3 × 3 samples were taken 10, 20 and 30 cm below both ripple troughs and crests (ca. 4 to 5 ml each). According to the measured porosities, pore water was extracted from a sediment volume of ca. 13.5 cm^3, which means a vertical resolution of ca. 3 cm assuming a spherical shape of the extracted water volume. These 18 pore water samples and 3 open water samples were preserved with 0.1 ml of $HgCl_{2\ sat.}$ solution directly after retrieval, sealed and stored for nutrient analysis. The samples were diluted by factor of 3 and analysed spectrophotometrically for NO_3^-, NO_2^-, NH_4^+, PO_4^{3-} and $Si(OH)_4$ with a Scalar 5-canal Continuous-Flow-Auto-Analyser. The chemistry of the underlying reactions is described in Grasshoff et al. (1999). Pore water salinity was measured in the same samples.

Sediment temperature measurements were carried out with temperature loggers (HOBO, resolution = 0.7 °C) at various sediment depths down to 20 cm.

3. Results

3.1. Flow measurements in the water column

Wave conditions during the entire measurement period were calm with wave amplitudes not exceeding 10 cm. A power spectrum analysis of the ADV data revealed a distinct peak at 0.18 Hz, implying a main wave period of 5.5 s. Wave amplitude was 6 cm during the ADV measurements, and this wave action was not strong enough to induce ripple migration. Only motion of very few sand grains at the ripple crests could be observed. An excerpt representative of the measurements and the conditions during the study period is shown in Fig. 3. The dominant water motion 27 cm above the ripple crest was the horizontal oscillation perpendicular to the crests with maximum velocities of 30 and −30 cm s^{-1}, whereas maximum vertical velocities reached 10 cm s^{-1} and −10 cm s^{-1}. The averaged orbital velocities were 9.8 cm s^{-1} and 9.2 cm s^{-1} at 27 cm and 15 cm above the ripple crests, respectively. The RMS values for the main horizontal velocity component at these depths were 9.7 and 8.5 cm s^{-1}, respectively.

3.2. Pore water flow field

The motion of the pore water tracer in the sediment could directly be observed through the transparent panes inserted into the sand bed. Tracer injection at different locations under the ripple

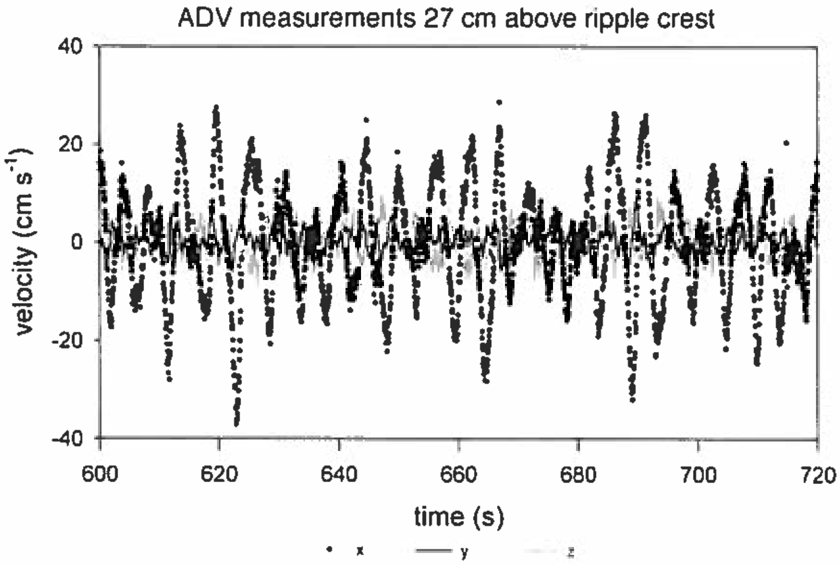

Fig. 3. Excerpt from one of the ADV measurements.

revealed the local pore water flow pattern, and the sum of all observations gave an image of the pore water flow field.

After injection of a dye cloud (2.5 cm diameter) directly underneath the ripple crest at 6 cm sediment depth, the dye migrated vertically upwards and finally emerged from the sediment at the ripple crest. The upwelling dye cloud became horizontally compressed and vertically elongated on its path to the ripple crest. (Fig. 4a).

Injection of dye to 1 cm sediment depth into the land- and seaward slopes of the ripples resulted in sideways dye movement along a curved path towards the ripple crest, where it finally emerged from the sediment (Fig. 4b).

Injection of dye into the centre of a ripple trough showed the dye cloud propagating downwards and simultaneously being stretched towards the ripple crests, with the first dye release at the ripple crest after 30 min (Fig. 4c).

The pore water flow field that could be reconstructed from these observations is schematically depicted in Fig. 5. Water enters the sediment in the ripple troughs and at the ripple flanks and

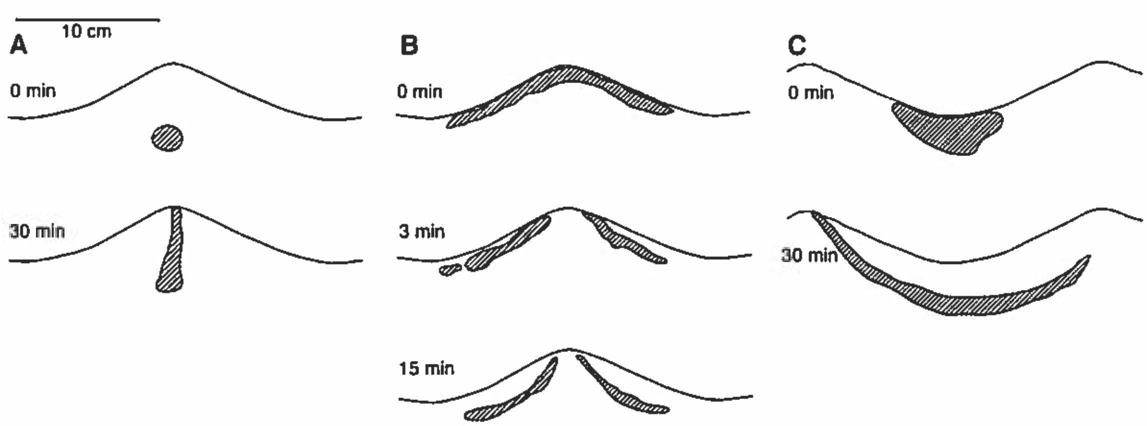

Fig. 4. a–c. Sketch summarising the results of the pore water flow field dye experiments.

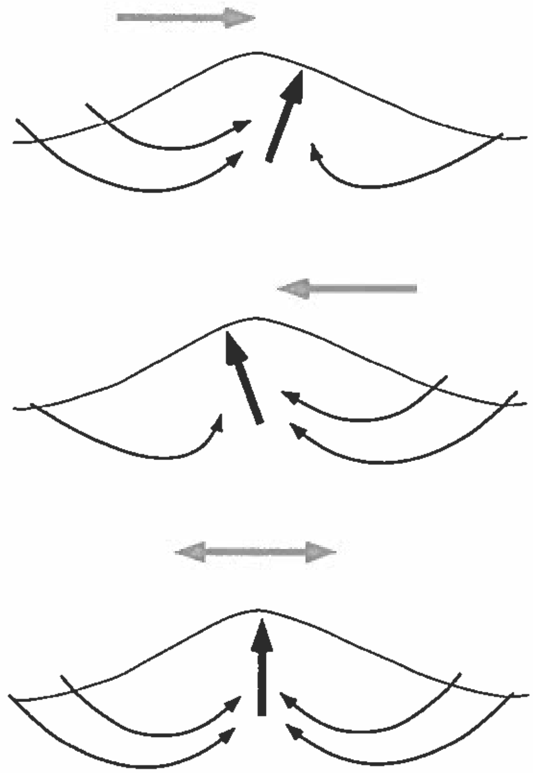

Fig. 5. Schematic overview of pore water flow field driven by oscillating flow interacting with a sediment ripple. Top and centre show the pore water flow field that would develop under steady unidirectional flow in opposing directions; the bottom drawing shows the averaged pore water flow field under oscillating flow as induced by surface gravity waves.

leaves the sediment centred at the ripple crests. This pattern evolves as the average of the two pore water flow fields that would evolve under unidirectional flows in opposing directions. The seawater penetrating into the sediment close to the ripple crest follows a short path to the ripple crest and passes the sediment relatively fast and close to the sediment surface. Water penetrating in the centre of the troughs reaches deeper zones of the sediment, but all filtered water leaves the sediment through the emergence zone, a band comprising the central area of the ripple crest. Using the pore water flow field images, the lengths of the pore water pathways could be estimated, which, in the upper 10 cm of the sediment, ranged from 10 to 31 cm (average: 17.5 cm).

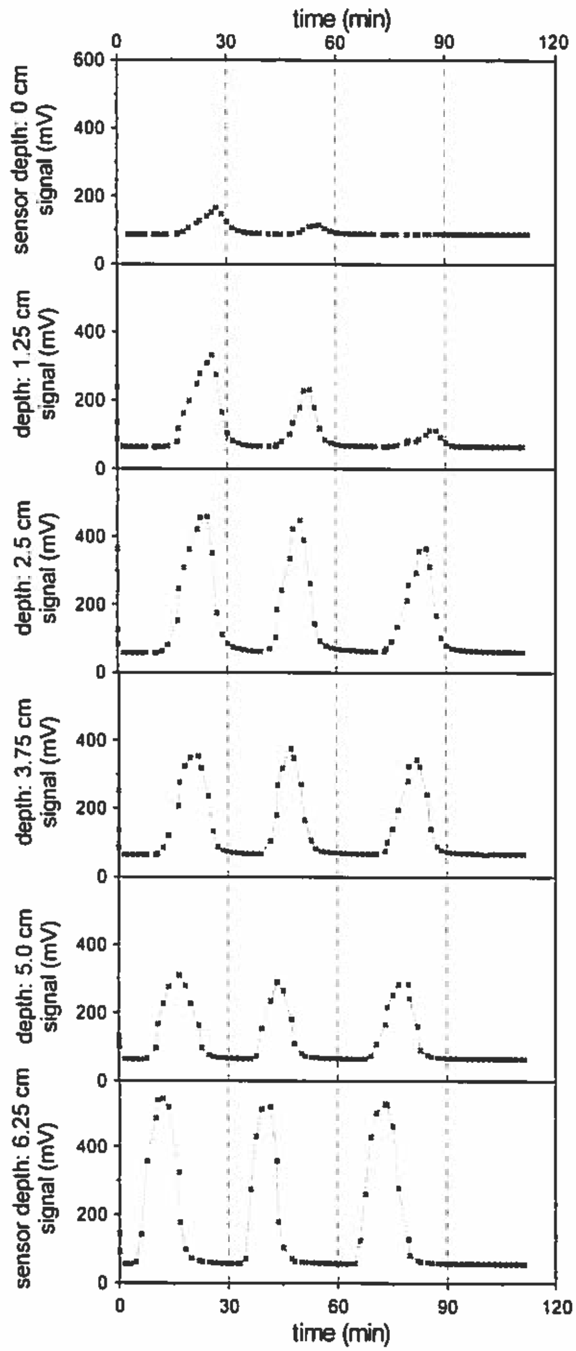

Fig. 6. Result of pore water velocity measurements: example with 3 successive dye injections passing the sensors on their path to the ripple crest.

3.3. Pore water velocity

The pore water velocity measurements were conducted in the upwelling zone along a vertical line directly underneath the ripple crests. In all measurements, the tracer cloud passed by the optical sensors and created distinct peaks in the sensor signal. This is presented in Fig. 6, which shows the results of an experiment with three sequential dye injections. The results of all other experiments looked similar. The matrix-averaged pore water velocity is the bulk velocity at which the tracer cloud moves through the sediment. It can be calculated from the distance of the signal peaks. The upward bulk velocity between 0 and 6.25 cm depth averaged over all valid measurements was 26 cm h^{-1} (sd = 16.2, n = 36). Fig. 7 shows a plot of the averaged vertical pore water velocities versus depth. It can be seen that the velocity decreased with depth with values ranging from >40 cm h^{-1} between the uppermost sensors to 21 cm h^{-1} between the lowest sensors.

3.4. Pore water characteristics

The nutrient concentrations did not change significantly in the pore water samples taken at 10, 20 and 30 cm depth and were not significantly different from the nutrient concentration in the overlying water except for silicate. No accumulation of NO_3^-, NO_2^-, NH_4^+ or PO_4^{3-} in these layers could be detected.

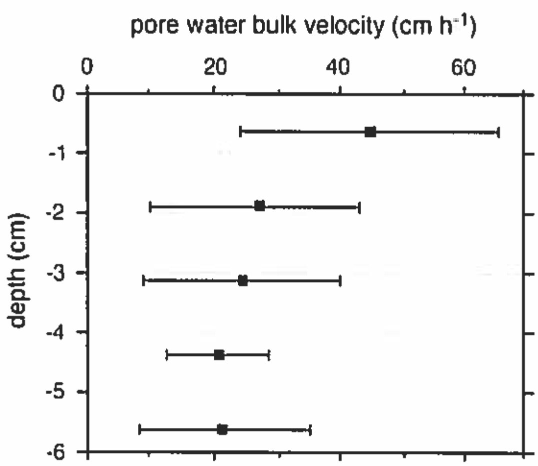

Fig. 7. Upward pore water velocity underneath ripple crest at various depths.

$Si(OH)_4$ was detectable with 11 μM (sd = 4, n = 18) in the pore water and 2.4 μM (sd = 0.12, n = 4) in the water column. The pore water solute concentrations were very low with measured concentrations of NO_3^-, NO_2^-, NH_4^+ and PO_4^{3-} around or below the detection limit of 0.3 μM in the pore water and water column samples.

Pore water salinity was ca. 39 and uniform over depth in the upper 30 cm of the sediments. Likewise, sediment temperature was 21.5 °C down to 20 cm and showed no significant variations at the resolution of the sensors.

4. Discussion

In this study, we present direct in-situ measurements of interstitial flow velocities in permeable coastal sediment. The measurements reveal that even weak wave action can produce rapid and effective pore water exchange in shallow permeable beds. In the sediments investigated, pore water velocities of almost 1 cm min^{-1} were reached near the sediment water interface.

The optode technique proved to be a useful method for measuring the pore water velocities in-situ without disturbing the sediment structure. The optodes were embedded in the sediments such that pore water flow velocities were measured only in undisturbed sections of the ripples, and the thin optodes did not create additional pathways for pore water. A possible local sediment compaction caused by the optode insertion would reduce sediment permeability and therefore lower pore water flow velocities. While pore water velocities could be determined from the passage of concentration peaks by the sensor tips, a quantitative analysis of the dye concentration in the pore space was not possible. The strength of the fluorescence signals was not only dependent on the dye concentrations but also on the pore space geometry in front of the optical sensor, possible mechanical damage to the sensor tip or fouling. Efforts to calibrate the sensors in-situ to obtain quantitative data on dye concentrations were unsuccessful, which did not affect pore water velocity measurements but excluded assessment of phenomena such as dispersion. Moreover, it can be inferred from Fig. 6 that the intensity of the fluorescence signals decreased at the upper measuring ports. This is probably due to the sensor array not being perfectly aligned with the pathway of the dye cloud. The dye cloud, which is narrowed on its path to the sediment surface, then passes the upper sensors not centrally causing a weaker signal. Other explanations may be dispersion or longitudinal advection caused by imperfectly aligned ripples and waves. The weak signal at the uppermost sensor may also be caused by minor grain migration on the ripple crests in the measurements with multiple injections, thereby exposing the sensor.

Injection of the dye into the sediment produces a pressure gradient that will drive pore water flow. This temporal artificial pressure gradient will not affect the measured pore water velocities, as these are measured well after the injection by inferring the velocity from the passage of the peak of dye concentrations at the single sensors.

The transparent acrylic plates inserted into the sediment for pore water visualisation were more likely to affect the results because sections of the plates sticking out of the sediment could obstruct the flow. This effect could be minimised by placing the plates perpendicular to the main direction of the oscillating flows. However, the technique only allows the visualisation of flow directly adjacent to the acrylic plate. Therefore wall effects that may reduce the pore water velocity near the plate could not be excluded. Additionally, the missing part of the ripple may have an influence on the pore water flow. Nevertheless, this technique produced reproducible results that were consistent with the optode measurements and the findings of previous studies suggesting that the artefacts linked to the wall effect were relatively small.

Pore water flows in permeable beds can be caused by a number of different processes, and in the following we discuss how these processes may have affected our observations. Interstitial water motion close to the swash zone can be linked to beach drainage after swash run up (Riedl and Machan, 1972). Waves running up the beach could theoretically cause pore water motion as far away from the beach as where our measurements were carried out. This beach groundwater ideally flows on curved pathways through the beach back into the sea (Longuet-Higgins, 1983; Li et al., 1999). On a larger time scale, also tidal dynamics may drive beach drainage (Nielsen, 1990). Neither process could explain the observed flow pattern within the ripple. Furthermore, the swash zone only spanned a few centimetres during the measurements and the study site is microtidal.

Density-driven convection due to salinity or temperature differences is another possible mechanism to drive interstitial flows (Webster et al., 1996; Rocha, 2000). As the salinity measurements in the upper 30 cm of the sediment and the temperature measurements in the upper 20 cm showed no variability, this mechanism can be ruled out as driving force for the pore water flow patterns observed in this study.

The recorded pattern of water entering the sediment in the ripple troughs and emerging from the sediment at the ripple crests is in very good agreement with the observations of Webb and Theodor (1972) after in-situ dye injection – reappearance experiments and the model calculations by Shum (1992). In contrast to unidirectional flows that cause upwelling of fluid under the downstream slope of sediment ripples (Huettel and Gust, 1992; Huettel et al., 1996), wave-induced oscillating flows can produce a symmetric pore water flow pattern relative to the sediment ripples as the strength of the flow is similar in both directions (Fig. 5). The water penetrating on both sides of the ripple and the acceleration of the pore water close to the sediment surface result in a narrowing and focusing of the centrally upwelling pore fluid. This flow field characteristically reduces mixing of the pore water moving from deeper sediment layers towards the surface.

With the measured averaged pore water velocity of 26 cm h^{-1} under the ripple crests (upper 6.2 cm), solutes in the pore water can effectively be transported over a distance of 1 cm in less than 3 min. The time it would take a solute to travel this distance by molecular diffusion can be approximated by $t = z^2 / 2D$ with t, z and D denoting time (s), distance (cm) and diffusion coefficient in water (cm^2 s^{-1}), respectively. The span of biogeochemically relevant D values for ions, gasses and molecules in water ranges from 0.4 to 2×10^{-5} cm^2 s^{-1} (Jorgensen, 2001). For oxygen in seawater with a salinity of 39 and a temperature of 22 °C, the diffusion coefficient is 2.07×10^{-5} cm^2 s^{-1} (Li and Gregory, 1974). In the sediment, the tortuosity of 2.99 (Boudreau, 1996) has to be taken into account to assess the sediment's effective diffusion coefficient, which is, calculated after Boudreau (1996), 2.55×10^{-6} cm^2 s^{-1}. Using these values in the above equation shows that diffusive transport of oxygen would need ca. 54 h to overcome the distance of 1 cm in our sediment. Advective oxygen transport in our sediments due to the wave-topography interaction thus is more than three orders of magnitude faster than transport by diffusion alone.

A tortuosity of ca. 3 implies that the actual velocity of water flowing through the sediment's pore space is three times faster than the bulk velocity of a several centimetre wide solute cloud moving through the sediment. Under the ripple crest, this matrix-averaged velocity ranged from >40 cm h^{-1} close to the surface to 20.5 cm h^{-1} between 6.2 and 5 cm depth. The typical directional swimming velocity of a bacterium lies in the order of 2 μm s^{-1} (Jørgensen, 2001), which equals ca. 1 cm h^{-1}. This value is 60 to 120 times lower than the interstitial velocities we measured corrected for tortuosity, which may explain why more than 90% of the bacterial cells in surface layers of permeable sea beds are attached to the mineral grains (Rusch et al., 2001).

The resulting rapid advective pore water exchange in the upper sediment layers is reflected in the uniform pore water nutrient profiles showing values around or below the detection limit. Only $Si(OH)_4$ displayed slightly elevated but uniform values in the sediment compared to the overlying water.

In combination with the uniform pore water salinity and sediment temperatures, these findings indicate that at least the upper 30 cm of the sediment were completely and constantly flushed, linking pore water concentrations tightly to the solute concentrations in the overlying water column. Constant flushing of the sediment causes at least the upper 20 to 30 cm of the sediment to be in thermal equilibrium with the overlying water.

The upward pore water velocity under the ripple crests can additionally be used to assess the filtering rates of water through the sediment because the only areas where pore water was released from the sediment were the ripple crests: with an average distance of 40 cm between neighbouring ripple crests, the total length of ripple crest per m^2 of sediment surface at our study site was approximately 250 cm. Multiplied by the averaged pore water upwelling velocity of 26 cm h^{-1} underneath the ripple crests, an average width of the release zone of 2.5 cm and the porosity of 36.9 %, this results in a filtering rate of ca. 140 L m^{-2} d^{-1}.

Advective filtering leads to enhanced transfer of suspended particles (Huettel et al., 1996) or phytoplankton (Huettel and Rusch, 2000) into the sediment. During the measurement campaign, the particulate organic carbon (POC) content in the water column of Campese Bay was approximately 0.4 mg C L^{-1} dry mass (C. Wild, unpubl. data). Assuming complete filtering of the particulate matter in the sediment, the filtering rate we assessed suggests that at the study site ca. 50 mg m^{-2} d^{-1} particulate organic carbon could be carried into the sediment by this wave-induced exchange process. This is in the same range as the findings of Durrieu De Madron et al. (2000), who found between 16 and 24 mg m^{-2} d^{-1} particulate organic carbon deposition on the shelf of the Gulf of Lions in the Mediterranean. Canfield and Teske (1996) calculated a median carbon oxidation rate of 164 mg m^{-2} d^{-1} for modern coastal sediments in water depths <200 m from the findings of 60 studies. As 87.5 to 97% of the carbon deposited at the seafloor is decomposed (Berger et al., 1989), our values are in the same order of magnitude but smaller, which can be attributed to the oligotrophic conditions in the Mediterranean.

4.1. Comparison with other studies

To our knowledge, very few studies have dealt with in-situ measurements of wave-induced transport processes. Webb and Theodor (1968, 1972) worked at 3 m water depth under waves producing stronger bottom boundary flow than in this study. The sediment at their study site was coarser (median ca. 1000 μm) and thus more permeable. Calculations of filtering rates based on their estimates for pore water velocity (average 130 cm h^{-1}) underneath the ripple crests result in an average filtering rate of ca. 300 L m^{-2} d^{-1} (assuming a conservative release area width of 2 cm and a porosity of 37%). This value is larger than our findings, due to the different wave and sediment characteristics, but lies well within the range of this study.

Compared to the findings of Riedl et al. (1972), who investigated wave pumping on the North Carolina Shelf, our results suggest a filtering rate that is 3 to 4 times larger and deeper penetration of the advective flows into the sea bed. The sediments

Riedl et al. (1972) examined were slightly finer (250 to 177 μm mean grain diameter) but this may have been partly compensated by the stronger wave action present during their field experiments. The magnitude of the filtration rates we calculated from the in-situ measurements is also supported by wave tank experiments of (Precht and Huettel, 2003), which were carried out with a finer, less permeable sediment and smaller ripples than in Campese Bay but resulted in a filtering rate larger or in the same range as in this study (60 to 590 L m^{-2} d^{-1}).

Interstitial flow induced by unidirectional currents was studied in the laboratory by Savant et al. (1987). These authors employed sand with a mean particle diameter of 370 μm, and a flow of 20 cm s^{-1} over ripples of 5 cm height and 50 cm wavelength. Thus, the physical parameters were comparable to those we found at our study site. These authors observed pore-water flow velocities between 3.2 cm h^{-1} and 26.3 cm h^{-1}. This demonstrates that advective porewater motion induced by oscillating and unidirectional flow lies in the same order of magnitude.

The filtering rates calculated from measurements can be compared to the rates derived from the analytical model of Elliott (1990) that gives the pressure perturbation p created by a sediment ripple interacting with unidirectional flow as:

$$p = 0.14\rho u^2(\delta/0.34H)^{3/8} \quad (1)$$

For $\delta/H \leq 0.34$ and with ρ, u, δ and H denoting density, mean current velocity, ripple height and water depth, respectively. From the pressure perturbation, the flow volume per area can be calculated:

$$w_0 = (2k/\rho\nu L_D)p \quad (2)$$

With k, ν, and L_D denoting permeability, kinematic viscosity and decay length (= the length scale of the ripple), respectively (Huettel and Webster, 2001). Using the measured values ($u_{RMS} = 0.09$ m s^{-1}; $\delta = 0.07$ m; $k = 3.65 \times 10^{-10}$ m^2; $L_D = 0.40$ m and $\nu = 1.024 \times 10^{-6}$ m^2 s^{-1} (calculated after Krögel, 1997), this results in a mean pressure perturbation of 1.05 Pa, which yields a theoretical flushing rate of 158 L m^{-2} d^{-1}. This is in very good agreement with our measured values.

The findings of previous studies on the magnitude of solute transport driven by different processes in the sediment are summarised in Fig. 8. Fig. 9 shows the ensuing filtering rates of water through permeable sediments and reveals that wave-driven advective pore water flow and filtering substantially exceed the magnitude of other wave-driven transport processes, with the exception of swash in- and exfiltration. The latter, however, has only a very limited spatial extent. The pore water velocities under unidirectional flow are similar to those we found in this study, so it is likely that filtering rates can reach higher values than those reported so far.

4.2. Applicability of data on a broader scale

In this study, we describe advective pore water exchange driven by the interaction of oscillating boundary flow with sediment topography rather than wave-related hydrostatic pressure oscillations. Webb and Theodor (1968) showed that these processes also occur in slightly deeper water. Wave-driven advection can take place in extended areas of the global shelves covered by permeable sediments with water depths < wavelength/2. Here, oscillating currents are generated at the seafloor, which then interact with the sediment topography. The magnitude of the advective pore water exchange depends on sediment permeability, bed topography and near-bottom flow velocities.

Many of the sediments of the global shelf seas consist of coarse-grained relict sediments (Emery, 1968) and a wealth of studies have described the abundance of sands and wave ripples on the continental shelves for a variety of study sites and water depths (e.g. Cacchione et al., 1999; Li and Amos, 1999). The study of Black and Oldman (1999) carried out on the Australian and New Zealand Shelf showed that the sediment parameters at our study site can also be found in deeper shelf areas. These authors describe a 20 km wide zone between 20 and 45 m water depth with grain sizes of 300 to 900 μm and ripple wavelengths ranging from 30 to 100 cm, which is close to or larger than the values we found in Campese Bay. The similar sediment characteristics indicate that the hydrodynamic forcing at the seabed may be comparable at both study sites, suggesting that the magnitude of probable advective processes would also be similar. Taking the 20 km wide zone between 20 and 45 m water depth into account and assuming a filtering rate of 140 L m^{-2} d^{-1}, each 1 km of shelf could filter slightly more than 1 km^3 a^{-1} of water

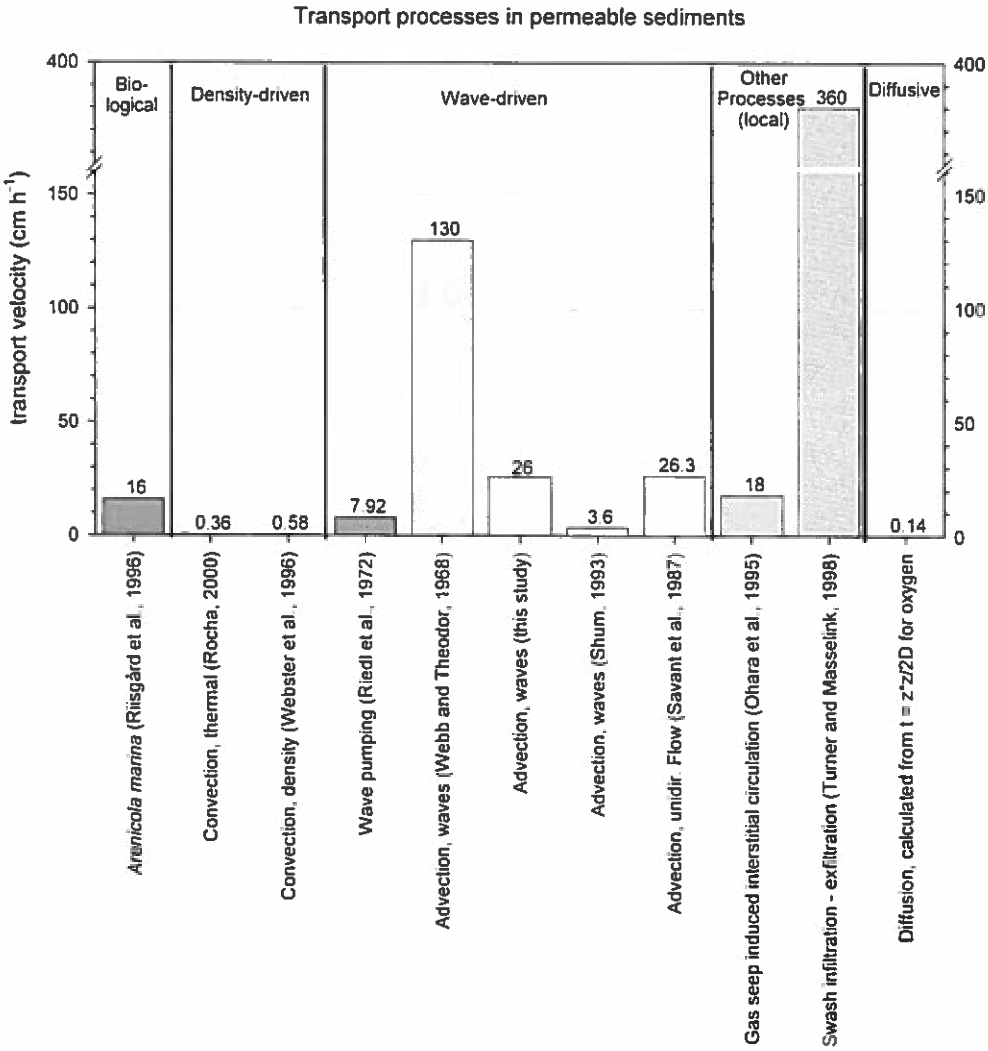

Fig. 8. Comparison of transport velocities in permeable sediments driven by different processes (Riisgård et al., 1996; Ohara et al., 1995; Turner and Masselink, 1998).

through its sediments in this zone alone. This value is considerably larger than the value of 0.419 km^3 a^{-1} of filtering by wave pumping that Riedl et al. (1972) assume for 1 km of an averaged global shelf transect from the beach to the 200 m isobath. This indicates that wave-driven advection is an important mechanism for the interfacial exchange of water, solutes and suspended particles in shallow shelf and coastal environments.

We conclude that for a given sandy coastal sediment with typical permeability, the bulk pore water velocities due to wave-driven advection we measured in-situ lie in the same order of magnitude (several cm h^{-1}) as those driven by advection due to unidirectional flows. The observed wave-driven advection was at least 3 orders of magnitude faster at our study site than solute transfer by diffusion would have been. In shallow coastal environments, the pore water velocities and filtering rates caused by wave induced oscillating boundary flows interacting with sediment topography substantially exceed other wave-driven transport processes. The ecological significance of

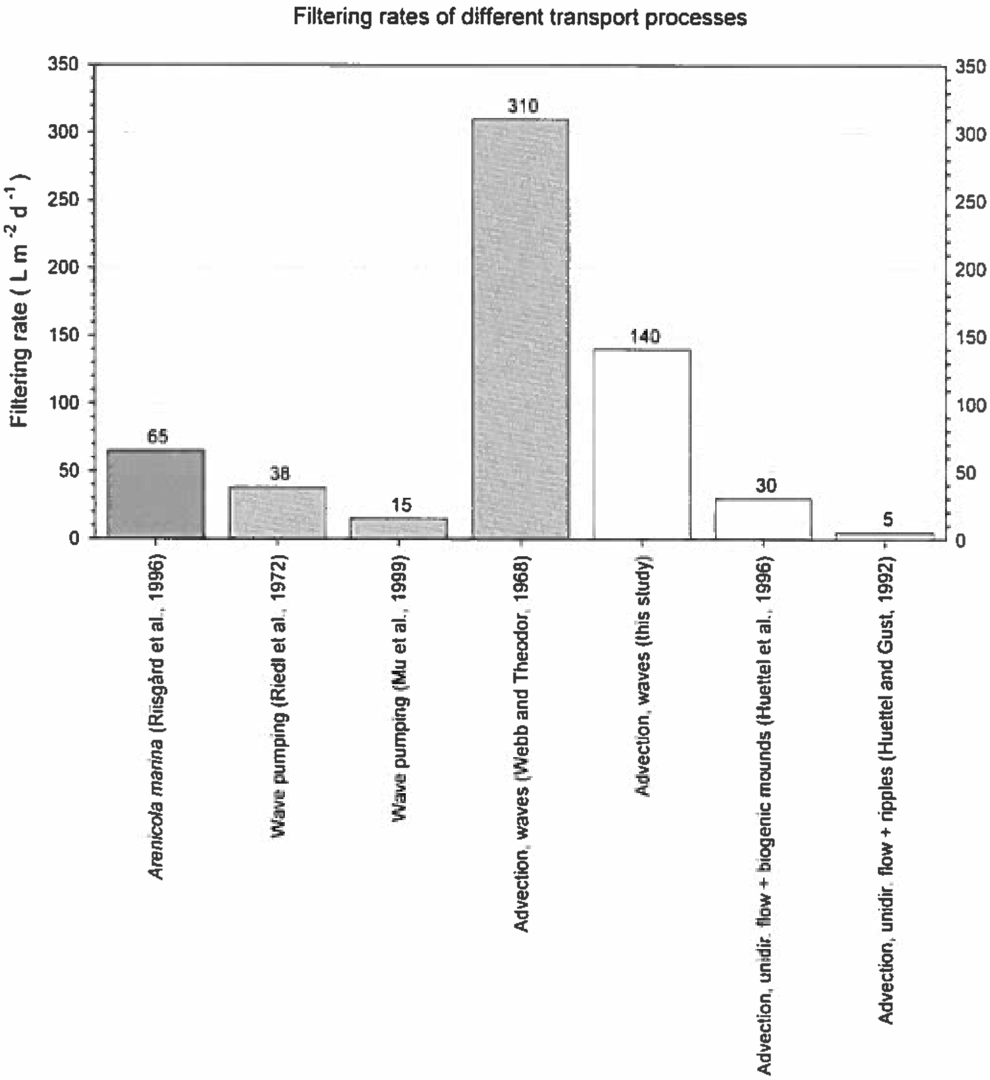

Fig. 9. Comparison of filtering rates through permeable sediments driven by different processes (Riisgård et al., 1996; Mu et al., 1999).

the filtration caused by wave - sediment topography - interaction is the efficient transport of organic substances and electron acceptors into the sands, thereby increasing the contribution of per-meable sediments in the coastal mineralisation of matter.

Future research should attempt to assess pore water velocities under variable wave conditions, water depths and sediment characteristics in order to quantify the contribution of wave-related sediment filtration to the coastal cycles of matter.

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References

Berger, W.H., Smetacek, V.S., Wefer, G., 1989. Ocean productivity and paleoproductivity — an overview. In: Berger, W.H., Smetacek, V.S., Wefer, G. (Eds.), Productivity of the Ocean: Present and Past. John Wiley & Sons, New York, pp. 1–34.

Black, K.P., Oldman, J.W., 1999. Wave mechanisms responsible for grain sorting and non-uniform ripple distribution across two moderate-energy, sandy continental shelves. Mar. Geol. 162, 121–132.

Boudreau, B.P., 1996. The diffusive tortuosity of fine-grained unlithified sediments. Geochim. Cosmochim. Acta 60, 3139–3142.

Cacchione, D.A., Wiberg, P.L., Lynch, J., Irish, J., Traykovski, P., 1999. Estimates of suspended-sediment flux and bedform activity on the inner portion of the Eel continental shelf. Mar. Geol. 154, 83–97.

Canfield, D.E., Teske, A., 1996. Late proterozoic rise in atmospheric oxygen concentration inferred from phylogenetic and sulphur-isotope studies. Nature 382, 127–132.

De Beer, D., Schramm, A., 1999. Micro-environments and mass transfer phenomena in biofilms studied with microsensors. Wat. Sci. Tech. 39, 173–178.

De Haas, H., Van Weering, T.C.E., De Stigter, H., 2002. Organic carbon in shelf seas: sinks or sources, processes and products. Cont. Shelf Res. 22, 691–717.

Durrieu De Madron, X., Abassi, A., Heussner, S., Monaco, A., Aloisi, J.C., Radakovitch, O., Giresse, P., Buscail, R., Kerherve, P., 2000. Particulate matter and organic carbon budgets for the Gulf of Lions (NW Mediterranean). Oceanol. Acta 23, 717–730.

Elliott, A.H., 1990. Transfer of solutes into and out of streambeds. Ph.D. Thesis, California Institute of Technology, Pasadena.

Elliott, A.H., Brooks, N.H., 1997a. Transfer of nonsorbing solutes to a streambed with bed forms: Theory. Water Resour. Res. 33, 123–136.

Elliott, A.H., Brooks, N.H., 1997b. Transfer of nonsorbing solutes to a streambed with bed forms: Laboratory experiments. Water Resour. Res. 33, 137–151.

Emery, K.O., 1968. Relict sediments on continental shelves of the world. Am. Assoc. Pet. Geol. Bull. 52, 445–464.

Eylers, H., Brooks, N.H., Morgan, J.J., 1995. Transport of adsorbing metals from stream water to a stationary sand-bed in a laboratory flume. Mar. Freshw. Res. 46, 209–214.

Grasshoff, K., Kremling, K., Ehrhardt, M., 1999. Methods of Seawater Analysis. Wiley-VCH Verlag, Weinheim.

Harrison, W.D., Musgrave, D., Reeburgh, W.S., 1983. A wave-induced transport process in marine sediments. J. Geophys. Res. 88, 7617–7622.

Huettel, M., Gust, G., 1992. Impact of bioroughness on interfacial solute exchange in permeable sediments. Mar. Ecol. Prog. Ser. 89, 253–267.

Huettel, M., Rusch, A., 2000. Transport and degradation of phytoplankton in permeable sediment. Limnol. Oceanogr. 45, 534–549.

Huettel, M., Webster, I.T., 2001. Porewater flow in permeable sediments. In: Boudreau, B.P., Jorgensen, B.B. (Eds.), The Benthic Boundary Layer. Oxford University Press, Oxford, pp. 144–179.

Huettel, M., Ziebis, W., Forster, S., 1996. Flow-induced uptake of particulate matter in permeable sediments. Limnol. Oceanogr. 41, 309–322.

Huettel, M., Ziebis, W., Forster, S., Luther, G.I., 1998. Advective transport affecting metal and nutrient distribution and interfacial fluxes in permeable sediments. Geochim. Cosmochim. Acta 62, 613–631.

Hutchinson, P.A., Webster, I.T., 1998. Solute uptake in aquatic sediments due to current-obstacle interactions. J. Environ. Eng.-ASCE 124, 419–426.

Jorgensen, B.B., 2001. Life in the diffusive boundary layer. In: Boudreau, B.P., Jorgensen, B.B. (Eds.), The Benthic Boundary Layer. Oxford University Press, Oxford, pp. 348–373.

Klimant, I., Meyer, V., Kühl, M., 1995. Fiber-optic oxygen microsensors, a new tool in aquatic biology. Limnol. Oceanogr. 40, 1159–1165.

Klute, A., Dirksen, C., 1986. Hydraulic conductivity and diffusivity: laboratory methods. In: Klute, A. (Ed.), Methods of Soil Analysis — Part 1 — Physical and Mineralogical Methods. Am. Soc. Agron, Madison, WI, pp. 687–734.

Krögel, F., 1997. Einfluß von Viskosität und Dichte des Seewassers auf Transport und Ablagerung von Wattsedimenten (Langeooger Rückseitenwatt, südliche Nordsee). Ber. aus d. FB Geow. d. Univ. Bremen 102, 168 pp.

Li, L., Barry, D.A., Stagnitti, F., Parlange, J.Y., 1999. Submarine groundwater discharge and associated chemical input to a coastal sea. Water Resour. Res. 35, 3253–3259.

Li, M.Z., Amos, C.L., 1999. Field observations of bedforms and sediment transport thresholds of fine sand under combined waves and currents. Mar. Geol. 158, 147–160.

Li, Y.H., Gregory, S., 1974. Diffusion of ions in sea water and in deep sea sediments. Geochim. Cosmochim. Acta 38, 703–714.

Lohse, L., Epping, E.H.G., Helder, W., Van Raaphorst, W., 1996. Oxygen pore water profiles in continental shelf sediments of the North Sea - turbulent versus molecular diffusion. Mar. Ecol. Prog. Ser. 145, 63–75.

Longuet-Higgins, M.S., 1983. Wave set-up, percolation and undertow in the surf zone. Proc. R. Soc. London Ser. A-Math. Phys. Eng. Sci. 390, 283–291.

Mu, Y.K., Cheng, A.H.D., Badiey, M., Bennett, R., 1999. Water wave driven seepage in sediment and parameter inversion based on pore pressure data. Int. J. Numer. Anal. Methods Geomech. 23, 1655–1674.

Nielsen, P., 1990. Tidal dynamics of the water-table in beaches. Water Resour. Res. 26, 2127–2134.

Ohara, S.C.M., Dando, P.R., Schuster, U., Bennis, A., Boyle, J.D., Chui, F.T.W., Hatherell, T.V.J., Niven, S.J., Taylor, L.J., 1995.

Gas seep induced interstitial water circulation — observations and environmental implications. Cont. Shelf Res. 15, 931–994.

Precht, E., Huettel, M., 2003. Advective pore water exchange driven by surface gravity waves and its ecological implications. Limnol. Oceanogr. 48, 1674–1684.

Riedl, R.J., Machan, E.A., 1972. Hydrodynamic patterns in lotic intertidal sands and their bioclimatological implications. Mar. Biol. 13, 179–209.

Riedl, R.J., Huang, N., Machan, R., 1972. The subtidal pump: a mechanism of interstitial water exchange by wave action. Mar. Biol. 13, 210–221.

Riisgård, H.U., Berntsen, I., Tarp, B., 1996. The lugworm (*Arenicola marina*) pump: characteristics, modelling and energy cost. Mar. Ecol. Prog. Ser. 138, 149–156.

Rocha, C., 2000. Density-driven convection during flooding of warm, permeable intertidal sediments: the ecological importance of the convective turnover pump. J. Sea Res. 43, 1–14.

Rusch, A., Forster, S., Huettel, M., 2001. Bacteria, diatoms and detritus in an intertidal sandflat subject to advective transport across the water-sediment interface. Biogeochemistry 55, 1–27.

Rutgers van der Loeff, M.M., 1981. Wave effects on sediment water exchange in a submerged sand bed. Neth. J. Sea Res. 15, 100–112.

Savant, S.A., Reible, D.D., Thibodeaux, L.J., 1987. Convective transport within stable river sediments. Water Resour. Res. 23, 1763–1768.

Shum, K.T., 1992. Wave-induced advective transport below a rippled water-sediment interface. J. Geophys. Res. 97, 789–808.

Shum, K.T., 1993. The effects of wave-induced pore water circulation on the transport of reactive solutes below a rippled sediment bed. J. Geophys. Res. 98, 10289–10301.

Shum, K.T., Sundby, B., 1996. Organic matter processing in continental shelf sediments — the subtidal pump revisited. Mar. Chem. 53, 81–87.

Thibodeaux, L.J., Boyle, J.D., 1987. Bedform-generated convective transport in bottom sediment. Nature 325, 341–343.

Turner, I.L., Masselink, G., 1998. Swash infiltration-exfiltration and sediment transport. J. Geophys. Res. Oceans 103, 30813–30824.

Webb, J.E., Theodor, J., 1968. Irrigation of submerged marine sands through wave action. Nature 220, 682–683.

Webb, J.E., Theodor, J.L., 1972. Wave-induced circulation in submerged sands. J. Mar. Biol. Assoc. UK 52, 903–914.

Webster, I.T., Norquay, S.J., Ross, F.C., Wooding, R.A., 1996. Solute exchange by convection within estuarine sediments. Estuar. Coast. Shelf Sci. 42, 171–183.

Webster, I.T., Taylor, J.H., 1992. Rotational dispersion in porous media due to fluctuating flows. Water Resour. Res. 28, 109–119.

Ziebis, W., Huettel, M., Forster, S., 1996. Impact of biogenic sediment topography on oxygen fluxes in permeable seabeds. Mar. Ecol. Prog. Ser. 140, 227–237.

EXHIBIT D

Limnol. Oceanogr., 48(4), 2003, 1674–1684

Advective pore-water exchange driven by surface gravity waves and its ecological implications

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Abstract

The effects of surface gravity waves on pore-water release from permeable sediment ($k = 1.3$–1.8×10^{-11} m^2) in shallow water were studied in a wave tank. Our tracer experiments demonstrated that shallow-water waves can increase fluid exchange between sandy sediment and overlying water 50-fold, relative to the exchange by molecular diffusion. The main driving force for this increased exchange are the pressure gradients generated by the interaction of oscillating boundary flows and sediment wave ripples. These gradients produce a pore-water flow field, with a regular pattern of intrusion and release zones, that migrates with ripple propagation. The ensuing topography-related filtering rates in the wave tank ranged from 60 to 590 L m^{-2} d^{-1} and exceeded the solute exchange rates caused by hydrostatic wave pumping (38 L m^{-2} d^{-1}) and initial molecular diffusion (corresponding to 10–12 L m^{-2} d^{-1}). Wave-induced filtration is ecologically relevant because permeable sandy sediments are very abundant on the continental margins and can be converted into effective filter systems, which suggests that these sediments are sites for rapid mineralization and recycling. We propose that the wave influenced continental shelf may be subdivided into two zones: a shallow zone (water depth < wavelength/2), where wave orbital motion at the sea floor creates ripples and causes topography related advective filtering; and a deeper zone (wavelength/2 < water depth < wavelength), where wave pumping enhances interfacial exchange by hydrostatic pressure oscillations.

Physical and biological transport link the biogeochemical processes in the water column and sediment. Whereas molecular diffusion and, locally, also bioturbation are the major transport mechanisms in the cohesive, fine-grained deep-sea deposits (Berner 1980; Aller 1982, 2001), solute transport caused by pore-water flows increases in importance in permeable sandy shelf sediments. Here, boundary layer flows, interacting with sea-bed topography, induce pressure differences at the sediment-water interface that lead to pore-water motion in permeable sediments. The ensuing advective transport can exceed transport by molecular diffusion by several orders of magnitude (Huettel and Webster 2001).

In areas where water depth (D) is smaller than half the wavelength (λ) of the surface gravity waves, oscillating flows are generated at the sediment-water interface by the wave orbital-water motion (e.g., Denny 1988). Webb and Theodor (1968, 1972) showed, by injecting dyed water into coarse sandy nearshore sediment and observing its reappearance at the sediment surface, that such oscillating boundary flows could drive sediment-water–interfacial fluxes. The trajectories of pore-water particles under a rippled bed over one wave period were calculated by Shum (1992). His results suggested that the zone of advection extends several ripple heights below the sediment surface over a wide range of wave conditions and sediment characteristics. Indications that surface gravity waves may be relevant for the cycling of matter in shallow environments were reported by Oldham and Lavery (1999), who measured an increased release of nutrient-rich pore water from estuarine sediment and attributed this enhancement to the effect of waves.

For pore-water exchange driven by wave-related hydrostatic pressure oscillations, Riedl et al. (1972) introduced the term "subtidal pump." On the basis of field observations, those authors presented model calculations that suggested that the subtidal pump could filter the complete ocean volume in only 14,000 yr. Rutgers van der Loeff (1981) described the same process as increased diffusivity in the upper 1–1.5 cm of intertidal sandy sediment under low to moderate wave action. To include the wave pumping in their in situ flux measurements, Malan and McLachlan (1991) deployed benthic chambers with flexible membrane tops that revealed that oxygen consumption and solute fluxes are positively correlated with wave action. However, it is not obvious how the circular motion of pore water within sediment can cause net solute transport, because the displacement through the wave cycle guides the fluid back to its origin. To explain net transport, Harrison et al. (1983) included mechanical dispersion in the subtidal pump theory. In contrast to shear dispersion, the rotational dispersion caused by waves does not rely on molecular diffusion to be effective but requires that the direction of the pressure gradient rotate with time (Webster et al. 1996). The results of rotational dispersion are similar to those of diffusive processes; however, it can be many times more effective than molecular diffusion or shear dispersion as a transport mechanism.

These transport studies suggest that waves, by enhancing fluid exchange between sediment and overlying water, also affect the biogeochemical processes in permeable beds. Modeled oxygen distributions underneath a rippled surface exposed to progressing waves have suggested that, in permeable beds, concentration gradients in the horizontal can be in the same order of magnitude as those in the vertical

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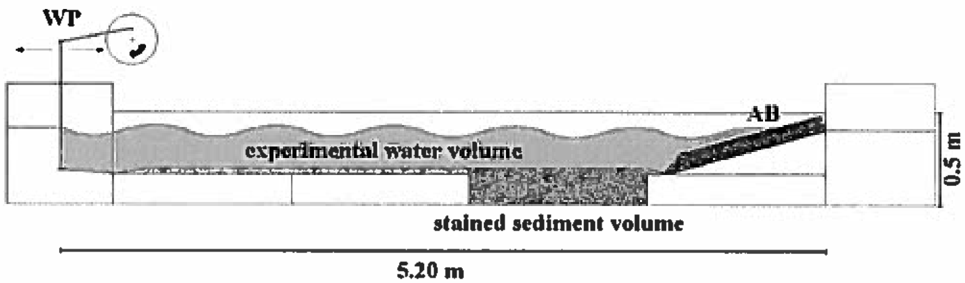

Fig. 1. The laboratory wave tank (light gray, sealed off water volume; dark gray, experimental water volume; WP, wave paddle; AB, artificial beach).

(Shum 1993). These findings demonstrate that the classical one-dimensional approach frequently used to describe the distribution of pore-water constituents and to assess the related fluxes across the sediment-water interface is inadequate for sandy, permeable sea beds (Shum and Sundby 1996).

The potential relevance of wave-induced advective pore-water exchange for metabolic processes in permeable shelf sands may be inferred from results obtained in flume studies that have addressed advective pore-water exchange driven by unidirectional flows. Those studies showed that advective interfacial fluid transport provides a rapid pathway for suspended organic particles and phytoplankton cells into permeable sediments (Huettel et al. 1996; Huettel and Rusch 2000). Simultaneously, oxygen can be transported advectively deep into the bed (Shum 1993; Ziebis et al. 1996), which enhances the mineralization of this material (Forster et al. 1996). The advectively induced pore-water flow field in sediment generates a complex biogeochemical zonation with areas of enhanced nitrification or iron precipitation and vertical channels through which ammonium and reduced metals are transported to the sediment surface (Huettel et al. 1998).

The aim of the present study was to characterize and quantify the effects of surface gravity waves on fluid exchange between a sandy bed and the overlying water column and to investigate the mechanisms leading to wave-induced interfacial exchanges. To achieve this, a set of laboratory wave-tank experiments was conducted with sandy sediment stained with the conservative soluble tracer Rhodamine WT. The use of Rhodamine WT allowed the synchronous quantification of the interfacial flux and visualization of the evolving pore-water flow pattern.

Materials and methods

Wave-tank setup—Four experiments (experiments [Exp] 1–4) were carried out in a laboratory wave tank. The wave tank was made of clear acrylic and had an open channel section of 520 cm length with rectangular cross-section (50 cm high × 47 cm wide). Two acrylic boxes ("upstream" box, 240 cm long and "downstream" box, 120 cm long; both 19 cm high and spanning the width of the channel) were placed into the open channel section, such that the opening between the two boxes enclosed a section of 120 cm length that could be filled with sediment (Fig. 1). Waves were generated at the upstream end of the wave tank with a paddle driven by an electric motor. The wave amplitude was controlled by the stroke of the eccentric, and the wave frequency could be adjusted via the motor speed. This setup permitted the reproducible generation of sinusoidal waves of selected amplitude and frequency. At the downstream end of the wave tank, the dissipation of the waves was achieved by an artificial beach made of an acrylic wedge of 1 m length that caused the waves to run up and break. In Exps 3 and 4, this wedge was additionally covered by a 10-cm-thick mat of highly permeable plastic foam, to maximize the dissipation of the wave energy. The open channel section was sealed from the other parts of the wave tank and from the two inset acrylic boxes, to prevent loss of the tracer into those sections.

All experiments were conducted with propagating waves. Amplitudes, wavelengths, and frequencies are listed in Table 1. The hydrodynamic conditions in Exps 3 and 4 were identical.

Sediment preparation and sampling—The experimental sediment was cleaned, and sieved, dry quartz sand originating from the Weser river estuary (in northern Germany) with a grain size distribution of 100–300 μm and was mixed with Rhodamine WT tracer solution, which gave it a pink appearance. The initial tracer concentrations for the respective experiments are listed in Table 1. The saturated pink sediment was inserted into the trough enclosed by the two acrylic boxes, to produce a sediment layer of 25 (Exp 1) or 22 (Exps 2–4) cm depth with 141 and 124 dm^3 volume, respectively. The two boxes in the open channel section were covered with 6 (Exp 1) or 3 (Exps 2–4) cm of unstained sand of identical grain size. The sediment was compacted by the application of low-frequency vibration, and the surface was carefully smoothed before each experiment, to create an overall even surface with uniform roughness in the open channel section. Ripple evolution occurred as a response of the bed to the applied wave action.

The use of Rhodamine WT as a tracer to stain the sediments had two functions. First, sequential water sampling during the experiments and subsequent analysis of the tracer content of the samples allowed the assessment of the flux of pore water from the sediment over time. Second, the red color of Rhodamine WT allowed direct observation of the evolving pore-water flow patterns in the sediment.

Directly before and after each wave-tank experiment, sediment subcores of 2.6 cm diameter and 10 cm length were

Table 1. Summary of experimental parameters. Permeabilities, porosities, and tracer concentrations are initial values. Variability in initial permeability and porosity values are due to different degrees of compaction of the sediment.

Experiment	Exp 1	Exp 2	Exp 3	Exp 4	Diff 1	Diff 2
Start	14 Sep 1999	16 Sep 1999	11 Jul 2000	14 Nov 2000	22 Jun 1999	11 Jul 2000
End	15 Sep 1999	17 Sep 1999	12 Jul 2000	15 Nov 2000	24 Jun 1999	12 Jul 2000
Duration (h)	14.75	19.4	24	24	72	24
Sediment*						
Permeability (m^2)	1.32×10^{-11}	1.32×10^{-11}	1.79×10^{-11}	1.82×10^{-11}	2.02×10^{-11}	1.75×10^{-11}
Porosity (vol%)	36.6	36.9	37.3	38.1	38.25	37.7
Sediment depth (cm)	22	21.5	22	22	22	20.5
Water	Fresh, 19°C					
Tracer	Rhodamine WT				Brilliant Blue	Rhodamine WT
Tracer concentration (μmol L^{-1})	40	39	21	5	47	19
Water depth (cm)	15	20	17	17	17	17
Wave	Propagating				None	
Amplitude (cm)	8	9	6	6	—	—
Length (cm)	60	80	60	60	—	—
Frequency (Hz)	1.56	1.2	1.3	1.3	—	—

* Quartz sand, 100–300 μm.

taken from the experimental sediment volume for porosity, permeability, and tracer distribution analyses. Additionally, several surface sediment samples (1 cm in diameter × 2.5 cm long) were taken after Exps 3 and 4 using cutoff syringes. After carefully replacing the retrieved sediment volumes with equally stained sediment, the wave tank was filled with ~1,750 liters of freshwater. The water level in the channel was raised very slowly, to minimize tracer release from the sediment. The water volume in the channel that could exchange with the sediment pore water amounted to 360 liters in Exps 1 and 2 and 410 liters in Exps 3 and 4. Table 1 gives an overview of the experimental parameters.

Diffusion experiments—Two sets of diffusion experiments (diffusion [Diff] 1 and 2) were set up in three acrylic cylindrical chambers (19 cm inner diameter × 40 cm high) with stained sediment, to assess the diffusive release of tracer from the sediment. The experimental parameters are presented in Table 1. After compaction, sediment subcores were taken from each chamber and prepared for analysis of tracer content, permeability, and porosity, as described above for the subcores from the wave tank. After the extracted sediment volumes had been replaced by stained sediment, the sediment surfaces were covered with a plastic film, and 4.25 liters of freshwater were added to each chamber without mixing with the stained pore water. Then the plastic films were removed, and the chambers were kept under stagnant conditions for the duration of the experiments. At regular time intervals, the water column of each chamber was gently mixed by five horizontal strokes with a spatula to homogenize tracer distribution, and water samples (3 × 2 cm^3) were taken and stored for later analysis of their Rhodamine WT content. After the experiments, the chambers were carefully drained, and a second set of sediment subcores was taken for analyses of tracer gradient over depth, permeability, and porosity.

Analyses—The sediment subcores taken from the laboratory wave tank, and the diffusion chambers were sectioned into 1-cm-thick horizontal slices for pore-water and porosity analysis. The porosity of the sediment samples of the respective cores was calculated from the wet and dry (after 48 h drying at 60°C) weights of the sediment slices.

Pore-water extraction was achieved by centrifugation at 2,900 × g for 10 min at 10°C. The extracted pore water was analyzed for its Rhodamine content by spectrophotometry (absorption, 556 nm) or fluorescence spectrophotometry (excitation, 570 nm and emission, 556 nm). The absolute tracer concentrations of the analyzed samples were calculated from the extinction coefficient for Rhodamine WT.

The sediment subcores used to assess the permeability were sealed after sampling and stored at 4°C until the measurements were carried out, usually within a few days. Permeability was assessed using a constant head permeameter (Klute and Dirksen 1986), and values for the dynamic viscosity (η) were calculated according to the method of Krögel (1997).

During all experiments, water samples were collected at preset time intervals, with the shortest intervals during the initial phase of the experiments. After starting the wave experiments, a tracer cloud developed over the stained sediment that then dispersed over the entire volume of the open channel section. Our flux calculations, therefore, are based on the integrated dye content of the entire channel. Samples (3 × 5 ml) were taken at six representative positions from the experimental water volume and also from the sealed off sections of the wave tank, to assess tracer loss due to possible leakages into the sealed sections. The water samples were stored at 10°C and subsequently analyzed for their tracer content, to determine the flux of tracer between sediment and water.

Hydrodynamics were measured using a three-beam DANTEC laser Doppler anemometer (LDA) system in the back-

Table 2. Summary of the experimental results.

Experiment	Exp 1	Exp 2	Exp 3	Exp 4	Diff 1	Diff 2
Ripple length (cm)	3	3	2.5	2.5	—	—
Ripple height (cm)	0.7	0.7	0.5	0.5	—	—
Ripple height/length ratio	0.23	0.23	0.2	0.2	—	—
First ripples evolved (min)	15	5	10	20	—	—
Initial ripple evolution	Complete	Complete	Half of the sediment surface	Patchy	—	—
Calculated washout depth (cm)/after (h)	2.6/14	3.0/17	3.1/24	3.2/24	0.8/24	0.7/24
Calculated washout depth after 2 h (cm)	2.6	2.2	0.9	1	0.2	0.3
Tracer exchange rate ($L\ m^{-2}\ d^{-1}$)	222	590	60	93	12 (1st h)	10 (1st h)

scatter mode during all experiments except Exp 4. This LDA technique allows three-dimensional measurements of the flow velocity in a spheroidal measuring volume as small as 70 μm in diameter. During Exp 3, two vertical profiles (100–2 mm above the sediment) of the horizontal (u) and vertical (v) velocities were measured 150 min after the start of the experiment above an unrippled section of the experimental sediment surface. In the water layer closer than 6 mm to the sediment-water interface, the LDA setup only allowed the measurement of the u velocity component.

Results

Pore-water flow pattern—The waves caused advective pore-water exchange in the wave tank that exceeded the maximum diffusive exchange (based on exchange rate in the first hour) in the stagnant control tank by factor 8–54. This flux enhancement was mainly caused by pore-water flows driven by oscillating boundary flows interacting with the wave-generated sediment ripples. The small flux enhancements prior to the development of the ripple topography revealed that the sinusoidal hydrostatic pressure oscillations due to the passage of the surface gravity waves ("wave pumping") had relatively little influence on the pore-water exchange. Table 2 summarizes the results of the wave-tank and diffusion experiments.

In the wave-tank experiments, four phases could be distinguished after the initiation of the waves:

1. The initial phase was characterized by a smooth sediment surface and moderate tracer release from the sediment. During this phase, diffusion, wave pumping (sensu Riedl et al. 1972), and some advective release linked to small-scale topography elements remaining on the smoothed sediment surface drove the interfacial solute flux.
2. The transitional phase started with the onset of ripple formation and ended when the entire sediment surface was covered with ripples. Within this period, the contribution of advective interfacial tracer exchange caused by ripple-flow interaction increased rapidly. At the end of this phase, solute release rates reached their maxima.
3. The flushing phase occurred when the tracer was advectively washed from the upper sediment layer mainly because of oscillating flow–ripple interaction. Because of rapid tracer removal, its release rates decreased during this phase.
4. The final equilibrium phase occurred when the tracer release was limited by the diffusion of tracer from deeper sediment layers into the flushed layer, with the concentration gradient not situated at the sediment-water interface but at the lower limit of the washout zones.

Figure 2a–c shows the initial (Fig. 2a) tracer distribution in the sediment and the distribution after 20 min (Fig. 2b) and 24 h (Fig. 2c) during Exp 3. Ripple formation started 10 min into the experiment.

During the initial phase, wave action removed the red dye from the upper 1–2 mm of the sediment, producing a thin, uniform washout layer. During ripple formation, light-colored washout zones free of tracer formed rapidly in the ripple troughs, where water was forced into the sediment. This fluid intrusion was balanced by the release of pore water from confined upwelling zones at the ripple crests (Fig. 2b,d,e). This pore-water flow pattern was firmly linked to the sediment ripples (Fig. 2d,f) and propagated with ripple migration. Later during the experiment, sediment bars (Rey et al. 1995) formed with wavelengths of ~30 cm and amplitudes of ~1 cm. Such bars are formed by resonance effects that exist in wave tanks because of partial wave reflection. Ripples were larger on the bar crests and smaller in the bar troughs. Intrusion and release zones linked to ripple and bar topographies combined to form larger irregular areas of down- and upwelling (Fig. 2c).

Figure 2f shows an area of sediment surface that displayed no ripples until 23 h after the start of Exp 3. This section permitted the direct comparison of tracer washout caused by hydrostatic wave pumping and topography-flow interaction. Whereas areas with ripples were characterized by washout zones and pore-water upwelling zones reaching the sediment surface, this smooth area displayed only a very thin uninterrupted surface layer depleted in tracer comparable to that observed during the initial phase of the experiment. This

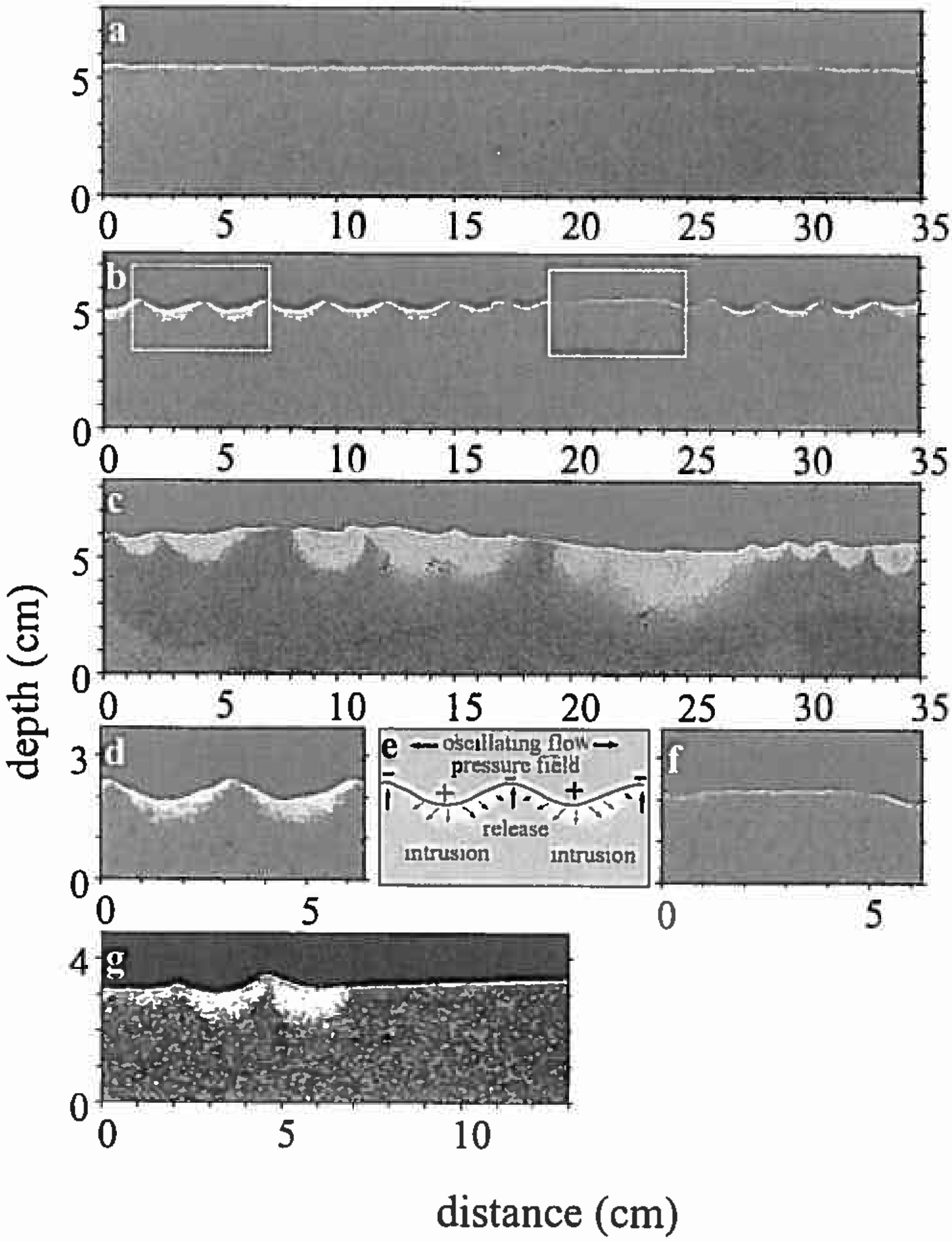

Fig. 2. Evolution of the washout pattern during Exp 3. Dark areas of the sediment indicate a high Rhodamine content; red and contrast were digitally enhanced before the figure was changed to grayscale. (a) Before the experiment, when there was a smooth sediment surface; (b) after 20 min (boxes indicate the sectors magnified in panels d and f); (c) after 24 h; (d) magnified from panel b, after 20 min; (e) sketch of the pore-water flow pattern and the current-induced pressure field; (f) magnified from panel b, after 20 min; (g) exceptional area, where ripples had not formed by 23 h.

contrast reveals the dominance of the topography-related pore-water release.

Because ripple formation did not take place in the same manner in all experiments, the release of tracer varied as well. In Exps 1 and 2, ripples covered the complete experimental sediment surface after 45 min. This resulted in a pronounced peak of tracer release. In Exp 2, tracer release increased sharply after 50 min and started to level out after 105 min (Fig. 3). The first derivative of tracer concentration over time yielded the filtration rate (Fig. 3), which in Exp 2 peaked at 590 L m^{-2} d^{-1}. During the other experiments, the filtration rates ranged from 222 (Exp 1) to 60 and 93 (Exps 3 and 4, respectively) L m^{-2} d^{-1}. In comparison, the tracer volume released by diffusion from the sediments under stag-

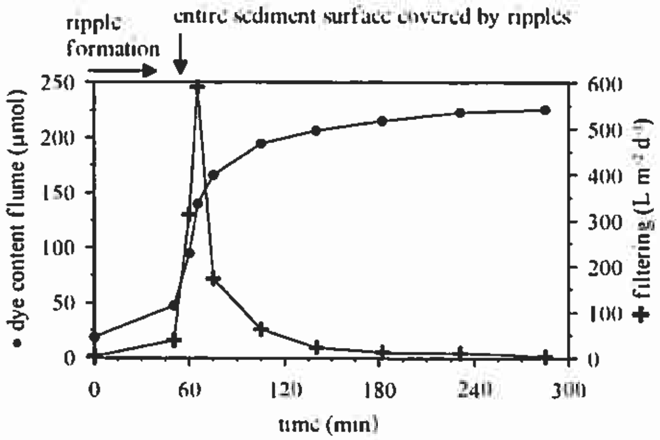

Fig. 3. Tracer release (solid circles) and derived filtering rates (crosses) during Exp 2.

nant water columns during the first hour of the experiments corresponded to a fluid exchange of ~12 and 10 L m^{-2} d^{-1} for Diffs 1 and 2. All experiments are summarized in Fig. 4, which gives a picture of the sediment depths that theoretically had to be completely flushed of tracer to explain its concentration increase in the water column over time during the different experiments. This normalized tracer release for water volume, sediment surface area, and porosity, such that all experiments became directly comparable. Figure 4 demonstrates that the four wave-tank experiments showed a much stronger initial tracer release pulse from the sediment than the diffusion experiments under stagnant conditions. In all experiments, the high initial fluxes leveled out after a few hours and approached values on the order of the diffusive release because most of the tracer was then flushed from the upper sediment layer. Consequently, total tracer release rates at the end of all flume runs were similar. After 24 h, the total release of tracer from the sediment under waves still

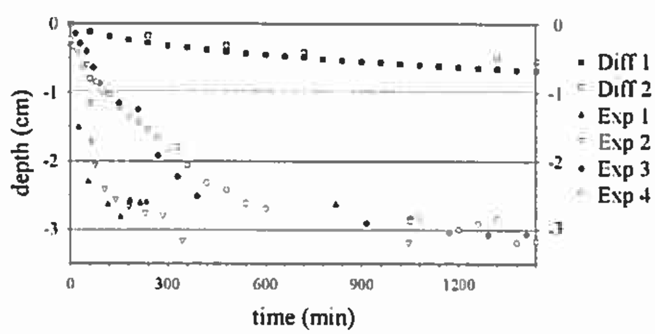

Fig. 4. Dye release during the wave experiments (Exps 1–4) and the control diffusion chambers (Diff 1, Brilliant Blue; Diff 2, Rhodamine WT) into the water, expressed as theoretical sediment depths completely flushed free of dye—this form of presentation is independent of initial tracer concentrations, sediment surface area, and experimental water volume. In reality, washout affected larger depths than this theoretical depth. The calculation assumed complete washout; however, observed horizontal dye concentration gradients in the sediment demonstrated that washout depths varied locally.

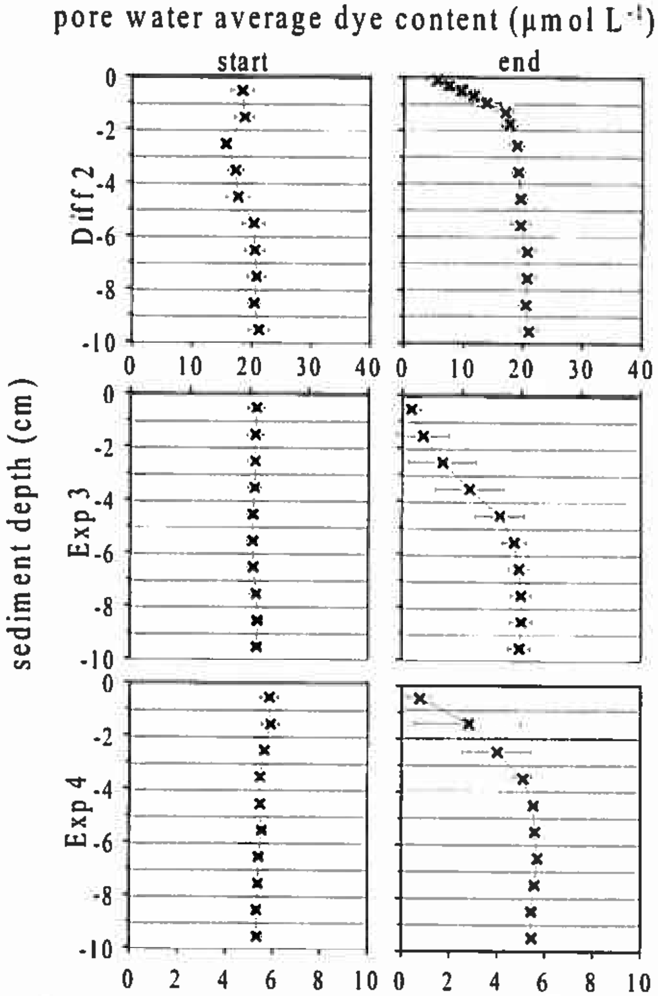

Fig. 5. Average sediment pore-water dye concentration distributions over depth before and after Exps 3 and 4 (same wave settings) and Diff 2: (left) before the experiment and (right) after the experiment. Error bars show the standard deviation.

was four to six times higher than that under stagnant conditions, and the final theoretical depth of complete flushing during all wave experiments was ~3 cm.

The analyses of the pore water from the sediment cores taken before and after the experiments quantified the vertical concentration gradients that had developed in the sediment. These gradients confirmed the theoretical washout depths inferred from the water samples, because both methods yielded the same results. The initial tracer distributions showed homogeneous concentrations over all depths with little scatter (Fig. 5). The cores taken after Exps 3 and 4 revealed that the averaged release of tracer affected the sediment down to ~4 cm depth. This was four times higher than in the diffusive cores, where reduced tracer concentrations were detectable only down to 1 cm. The error bars reflect the horizontal variations of tracer concentration that characterized the washout zone between 1 and 3 cm sediment depth.

Hydrodynamics—The wavelengths (λ) of the propagating waves ranged from 60 to 80 cm and the water depths (d)

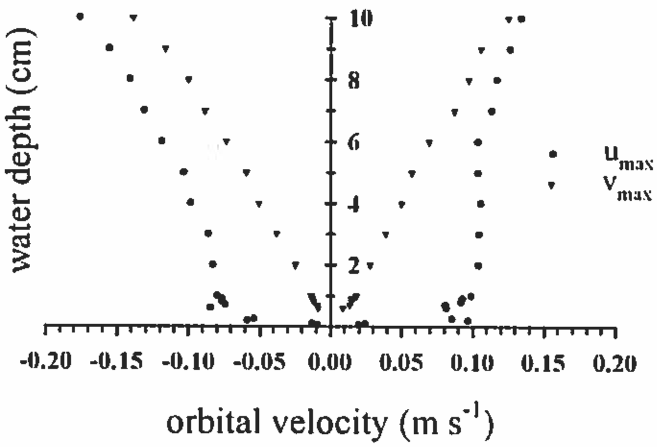

Fig. 6. Profiles of maximum orbital velocities measured with the LDA at the beginning of Exp 3 above unrippled experimental sediment surface; solid circles indicate maximum horizontal velocity (u) and solid triangles indicate maximum vertical velocities (v). Values of v decreased linearly and values of u decreased nonlinearly. Between 0 and 0.6 cm above the sediment surface, the LDA setup only allowed for the measurement of u.

from 15 to 20 cm. With $d < \lambda/2$, oscillating water motion was present at the sediment-water interface.

Figure 6 shows the mean maximal orbital velocities u_{max} and v_{max} for each depth, measured over the smooth sediment surface at the beginning of Exp 3. The maximum boundary shear stress can be calculated using the velocity gradient in the viscous sublayer:

$$\tau_{0m} = \rho\nu(\delta u/\delta z) \tag{1}$$

with density ρ, dynamic viscosity ν, velocity in x-direction u, and height over sediment z (Caldwell and Chriss 1979). With an averaged maximum value of 0.1 m s^{-1} for δu for a δz of 0.1 cm, directly over the sediment surface, this results in $\tau_{0m} = 0.107$ N m^{-2}. Inferred from

$$u_{*max} = (\tau_{0m}/\rho)^{1/2} \tag{2}$$

the maximum shear velocity $u_{*max} = 0.01$ m s^{-1}. Assessing u_{*max} from a log velocity profile yields a similar result, with $u_{*max} = 0.012$ m s^{-1}, which results in $\tau_{0m} = 0.148$ N m^{-2}.

Ripple formation—The shear velocity required to move a sediment particle of our sediment (calculated according to $u_* = 0.06\sqrt{(\rho_s - \rho_f)gD}$, where ρ_s is the density of the sand grains, ρ_f is the density of the fluid, g is gravitational acceleration, and D is the grain diameter; Hsü 1989) was smaller and ranged 0.0024–0.0042 m s^{-1}. Consequently, ripples started forming on parts of the sediment surface within the initial 20 min of all wave experiments (Table 2). Even though the sediment surface was carefully leveled and smoothed before the experiments started, a few small roughness elements of up to 1 mm height were still existent, and ripple formation started at these areas. From the zones of initial ripple formation, the ripples spread over the entire experimental sediment area, which took 60 and 15 min in Exps 1 and 2, respectively, and 8–10 h in Exps 3 and 4. The ripples migrated in the same direction as the waves propagated, and their initial migration speed ranged between 2 and 3 cm h^{-1}.

Discussion

Advection and wave pumping—Our experiments show that wave-induced oscillating flows interacting with sediment topography drive advective processes in a manner similar to that of unidirectional flow, as described by, for example, Savant et al. (1987), Thibodeaux and Boyle (1987), or Huettel and Gust (1992). Under oscillating flow, water is forced into the sediment at the ripple troughs and flanks, and pore water emerges centered at the ripple crest, as predicted by Shum's (1992) model calculations. According to Rutherford et al. (1995), the pressure perturbation along a sediment dune (ripple) surface is sinusoid, with a wavelength equal to the dune wavelength. This could be confirmed in our experiments for the flow fields that developed under oscillating flows, because washout was closely linked to ripple (and bar) wavelength. Likewise, applying mathematical models developed for the estimation of filtration rates caused by unidirectional flows to our settings produced exchange rates that were close to those we measured in the wave experiments. If we assumed that oscillating flows produce pressure gradients at protruding topography in a manner similar to unidirectional flows, the pressure perturbation at each ripple was estimated by

$$p = 0.14\rho u^2(\delta/0.34d)^{3/8} \tag{3}$$

for $\delta/H \leq 0.34$ with ripple height δ, water depth d, density ρ, and mean current velocity u (Elliott 1990; Huettel and Webster 2001). For u we used a root-mean square value of the oscillating horizontal velocity component that was 0.112 m s^{-1} at 10-cm water depth in Exp 3. From this pressure perturbation, the fluid exchange rate w_0 could be calculated according to

$$w_0 = (2k/\rho\nu L_D)p \tag{4}$$

with k, ν, and L_D denoting permeability, kinematic viscosity, and decay length (the length scale of the ripple), respectively (Huettel and Webster 2001). Using the parameters and ripple dimensions of Exp 3, this gives a mean pressure perturbation of 1.11 Pa, which yields a theoretical flushing rate of 116 L m^{-2} d^{-1}. The bars of 30-cm amplitude and 1-cm height would additionally contribute 12 L m^{-2} d^{-1} of filtration. The resulting total flushing rate of 128 L m^{-2} d^{-1} is in the same order of magnitude as the ones measured in our experiments.

It is clear that the wave-generated flow–topography interaction addressed in the present study only can cause filtration where the orbital motion reaches the sea bed (depth < wavelength/2). However, surface gravity waves cause filtration beyond that depth as well, because of the hydrostatic pressure oscillations they produce.

Riedl et al. (1972) estimated that, averaged over the global continental margin, wave pumping filters ~33 L m^{-2} d^{-1} through sandy shelf sediments. Mu et al. (1999) calculated a seepage of 15 L m^{-2} d^{-1} into and out of a flat sandy (*md* = 164 μm) seabed at 15 m water depth caused by wave-induced hydrostatic pressure oscillations (wave height = 1.5 m; length = 10 m, period = 6 s), which suggests a substantially smaller filtration rate than that proposed by Riedl et al. (1972).

Our experimental setup was not designed to quantify wave pumping. Nevertheless, the initial phase of Exp 2, when a rippled surface topography had not yet developed, may have indicated the magnitude of the effect of hydrostatic pressure oscillations on pore-water release (Fig. 2). During this phase, we recorded a filtration rate of 38 L m^{-2} d^{-1}. This rate must be treated as a maximum estimate, because, in our flume experiments, the ratio between sediment permeability and water depth was large relative to most areas in the shelf. However, because this rate is in the range of the findings of Mu et al. (1999) and Riedl et al. (1972), we used this value as an approximation for the effects of wave pumping. The comparison of this rate and the filtration rate caused by oscillating flow–topography interaction suggests that, where wave orbital motion reaches the seabed, oscillating flow–topography interaction is more effective for pore-water exchange than wave pumping.

In our wave tank, exchange rates caused by oscillating flow–topography interaction reached up to 590 L m^{-2} d^{-1}. Because our calculations were based on the maximum observable pulse of tracer release from the sediment, the resulting estimates of the water volume filtered through the sediment by wave action are minimum values. This is because the pulse maximum depends on how fast the ripples are formed, as shown by the delayed release of tracer during Exps 3 and 4, during which ripples initially formed on half the sediment surface (Exp 3) or were patchy over the duration of several hours (Exp 4). It is likely that, in these two experiments, the final filtration rates with fully developed sediment topography were higher, but by that time an assessment of the effective filtration was impossible because most of the tracer had already been washed from the upper sediment layers.

Oscillating flow–topography interaction caused a clear increase of the interfacial tracer flux relative to the controls with stagnant water, but how applicable are these results to natural environments? In shallow littoral regions, hydrodynamic settings almost identical to our flume settings may be found, and in such environments we can expect effects on pore-water exchange similar to those we observed in the laboratory. In situ measurements by Precht and Huettel (unpubl. data) in a littoral zone (70 cm water depth) with sands of comparable permeability revealed filtration rates very similar to those recorded in the wave tank. The visual observations of dye transport by Webb and Theodor (1968) confirm this transport process for a permeable rippled bed at 3 m depth. Similar observations could be made in a rippled carbonate sand bed at 18 m water depth off the East coast of Oahu (M.H. unpubl. data). Wave ripples on the seabed are frequently found in areas with water depths <100 m (e.g., Cacchione et al. 1999; Ogston and Sternberg 1999). These ripples disclose that surface gravity waves generated substantial oscillating flows at these depths that were capable of moving sediment. Where the sediment is permeable enough, such flows will generate advective pore-water exchange.

Natural environments—Large sections of the world's shelf areas display conditions that allow advective processes to occur: they are covered by permeable sandy sediments, display sediment topography in form of ripples, and are permanently or episodically reached by oscillating currents. Waves dominate sediment dynamics in large shelf areas, with the majority of sediment-transport occurring during times of energetic long period waves (e.g., Wiberg and Harris 1994; Harris and Wiberg 1997). The extension of the shelf areas affected by waves was numerically assessed by Harris and Coleman (1998) with the result that, for example, in the North Atlantic, wave climate was such that quartz sands of 100 μm diameter would be mobilized down to a

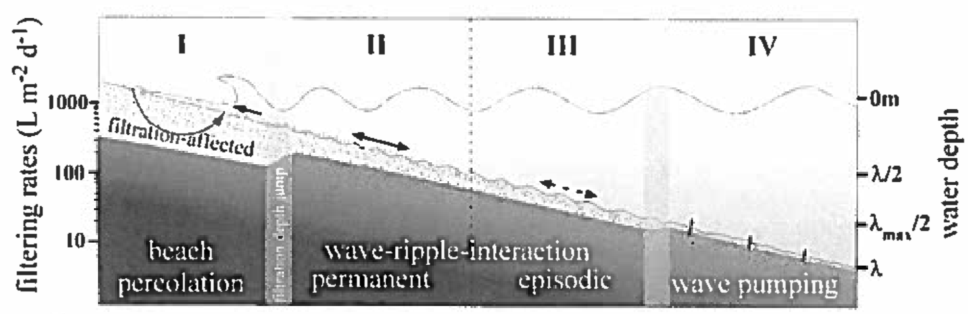

Fig. 7. Schematic overview of the different sediment-water interaction processes due to surface gravity waves in coastal and shelf environments (λ = wavelength). (I) In the beach zone, beach percolation can lead to very high filtering rates in a zone of limited lateral extension. In lower parts of the beach, resuspension and high sediment mobility can lead to pore-water release and particulate organic matter burial. (II) In the permanent advection zone (water depth < $\lambda/2$), surface gravity waves permanently induce oscillating boundary flow that, by interacting with sediment ripples, lead to constant advective solute exchange. This advective flushing of the upper sediment layers leads to a relatively thick oxygenated sediment layer and particle transport into the bed. (III) In the episodic advection zone (water depth < $\lambda_{max}/2$), episodic advection is due to oscillating flow-sediment topography interaction (*see Fig. 8*). (IV) In the wave pumping zone ($\lambda/2$ < water depth < λ), waves are only effective for the interfacial exchange due to pumping caused by hydrostatic pressure oscillations. In deeper areas, interfacial transport is governed by diffusion and bioirrigation.

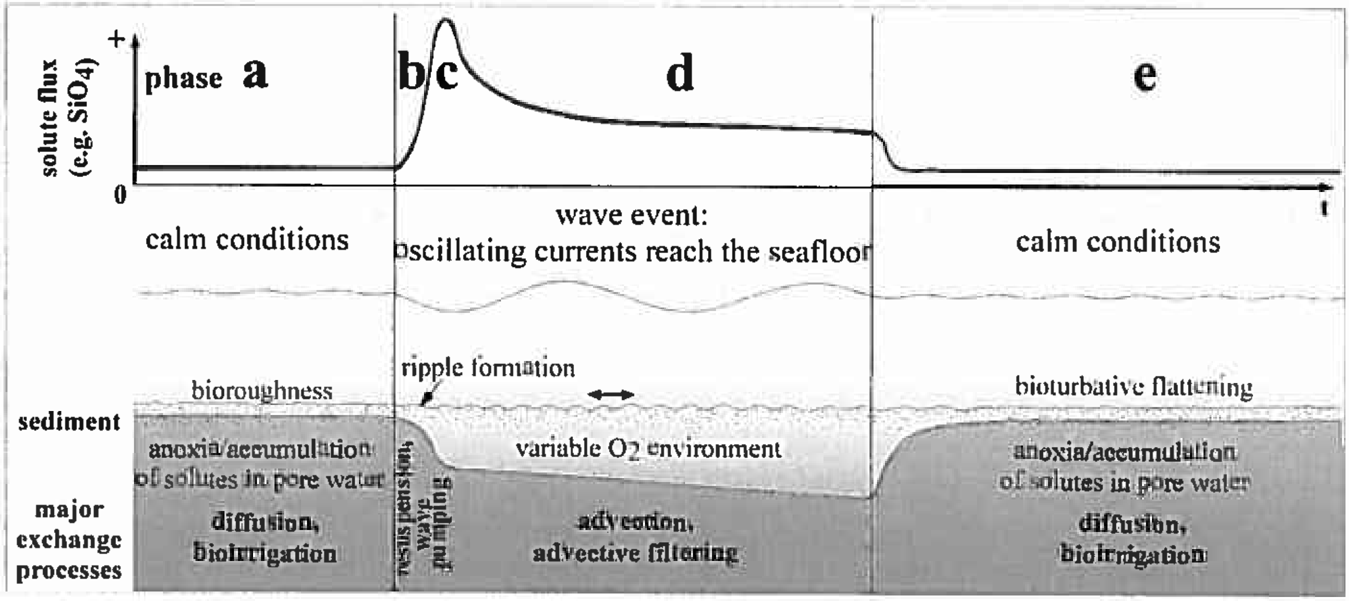

Fig. 8. Schematic overview of sediment water–interface processes in areas episodically affected by wave events. (a, calm phase) In the absence of effective interfacial transport mechanisms, permeable sandy sediments may accumulate solutes (e.g., silicate) and small particles in their pore space. (b, wave phase) At the beginning of a wave event, the exchange between the permeable sediment and the overlying water may be driven by advection linked to oscillating flow interacting with sediment topography (e.g., bioroughness; Huettel and Gust 1992; Oldham and Lavery 1999) or existing relict ripples. (c, wave phase) With continuing wave action, oscillating bottom currents generate sediment ripples. Boundary flow–ripple interaction causes advective filtering that exchanges the pore water of the upper sediment layer; therefore, a maximum advective solute release takes place. (d, wave phase) With continuing wave action and after the maximum solute flux, oxygen-rich water is being filtered through the sediment, and mobile horizontal oxygen concentration gradients may develop (Shum 1993). Ensuing alternating exposure to variable redox conditions may result in more complete and rapid decomposition of organic material trapped in the upper sediment layer (Aller 1994). An equilibrium solute flux develops, and constant intrusion of oxygen-rich water into the sediment may increase overall oxygen penetration depth into the sediment. (e, calm phase) After the wave event, the water exchange across the interface is reduced to its original low value, filtering is reduced, solute concentrations increase in the sediment, and the former oxygen penetration depth is reinstated.

depth of 234 m at least once over a 3-yr period. Wiberg and Harris (1994) showed the effects of water depth, wave height, wave period, and sediment grain size on ripple formation. They calculated that orbital ripples could form at a water depth of 100 m with a wave period of 12 s, 4 m wave height, and a sediment grain size of 250 μm.

On the basis of literature cited throughout the present article and our results, we suggest that the coastal and shelf seas can be divided into four depth zones that show different sediment-water interaction processes due to surface gravity waves (Fig. 7). The first and uppermost zone (not addressed in the present study) is the beach, where the run-up of waves may cause filtering rates of up to 85 m^3 m^{-1} d^{-1} (McLachlan 1989), which equals, dependent on the lateral extension of the filtering zone, ~1,000 L m^{-2} d^{-1}. The second zone is made up of those shallow areas where the sediment is nearly permanently exposed to oscillating currents that cause filtration when they interact with bed topography. In the third zone, wave orbital motion reaches the seafloor only episodically, and in the fourth zone it never does. In the latter zone, wave-induced hydrostatic pressure oscillations may enhance sediment-water fluid exchange. The lateral extension of these zones varies, depending on the shelf slope and wave regime. With filtering rates of ~1,000 L m^{-2} d^{-1} in beaches, 100 L m^{-2} d^{-1} caused by ripple-flow interaction, ~30 L m^{-2} d^{-1} by wave pumping (Riedl et al. 1972; Mu et al. 1999), and molecular diffusion equivalent to a fluid exchange rate of ~10 L m^{-2} d^{-1}, the ratio among the average rates caused by the four transport processes may be roughly 100 : 10 : 3 : 1.

The wave-induced filtering, thus, generally increases with decreasing water depth, and our study suggests that this increase is not steady but displays stepwise changes in its increase rates because of the dominance of different wave-driven exchange processes in the four depth zones (Fig. 7). This is most obvious at the interface of the sublittoral zone and the adjacent beach. However, the boundary between zones with and without wave ripples can be abrupt and sharp, and we can expect a jump in the filtration rate between those areas, as indicated by the sudden increase of flushing rate with evolving topography in our flume experiments. The changing magnitude of the filtration rate with depth may have ecological consequences that are linked to the associated changes in transport rates of metabolites into and out of the sediment.

In the second zone, where waves have the strongest impact on the submerged seafloor, ripples are permanent features of the sediment surface, and steady advection leads to a complete and permanent flushing of the upper sediment layers, which therefore may be relatively rich in oxygen. Permanent advective transport of fine particles into the sediment and steady flushing of decomposition products from the bed may convert these areas into efficient biocatalytic filters (Huettel et al. 1998).

In our experiments, we measured strong initial pulses of solute release from the sandy sediment when ripples were formed. Such a scenario may take place in the third zone, where surface gravity waves reach the seafloor only episodically. The nutrient pulses Oldham and Lavery (1999) measured in such an environment could be attributed to this effect. Figure 8 proposes a sequence describing the solute fluxes across the sediment-water interface during an episodical storm event in the shallow, sandy shelf environment.

Applicability of experiments—Our experimental sediment had a grain size distribution of 100–300 μm, which may be representative for the most common grain size on the continental shelves. Cacchione et al. (1999) and Ogston and Sternberg (1999), for example, described shelf sands with a grain size distribution of 125 and 250 μm and ripples with 9 cm wavelength at 60 m water depth. Additionally, large areas of the shelves are covered by coarser, more permeable sediments (e.g., Emery 1968; Marinelli et al. 1998; Black and Oldman 1999), where advective processes may be much stronger than those observed in our flume experiments. The advective flux we observed during our experiments was mainly caused by the interaction of sediment topography and boundary layer flow. All topography evolved as the response of the bed to the hydrodynamic conditions during the respective experiments. No artificial roughness elements were placed or built on the sediment surface. Thus, the bed roughness was in equilibrium with the surface gravity waves, and the observed solute flux was not exaggerated by, for example, oversized sediment topography.

However, under laboratory conditions, wave ripples may form that are different to those common in nature. Wiberg and Harris (1994) showed that most laboratory experiments produce orbital ripples, with ripple spacing proportional to the wave orbital diameter, and this was also the case in our experiments. In nature, nearly all wave ripples are of the anorbital or suborbital type, and their wavelengths are proportional to sediment grain size rather than to wave properties. For a natural environment, Wiberg and Harris (1994) predicted a ripple spacing of ~10 cm for sand with a median grain size of 200 μm, which results in about one third of the ripples per unit area as in our experiments. Even with only one third of ripples per unit surface area and on the basis of the maximum but conservative filtering rate of 590 L m^{-2} d^{-1} we recorded, this would result in a filtering rate of ~200 L m^{-2} d^{-1}.

We suggest that the numerical approaches developed to calculate advective filtering under unidirectional flow can be used to obtain conservative estimates of wave-induced advective exchange. We can estimate the magnitude and importance of these processes by applying these relationships to field data from previous studies. Cacchione et al. (1999) presented data from the Eel continental shelf, situated at ~50 m water depth. Using values of 40 cm s^{-1} for u (120 cm over sediment), 9 cm ripple amplitude, 1.1 cm ripple height (calculated with a ripple steepness of 0.12; Wiberg and Harris 1994), and 1.5 × 10^{-11} m^2 permeability (assumed to be similar to that in the present study because of the similar grain size), we obtained a filtering rate of 103 L m^{-2} d^{-1}. Li and Amos (1999) conducted a field study on the Nova Scotia shelf at 56 m water depth. With a maximal wave-induced u = 25 cm s^{-1} (50 cm over sediment), ripple amplitude L_D = 9 cm; (calculated) ripple height δ = 1.1 cm, and an assumed permeability of 1.5 × 10^{-11} m^2, we calculated 68 L m^{-2} d^{-1} of advective filtering during single events, whereas, during calmer periods with bottom currents below 10 cm s^{-1}, calculated filtering was reduced to 11 L m^{-2} d^{-1}. On the basis of these calculations and our experimental findings, we conclude that 50–100 L m^{-2} d^{-1} is a moderate value for advective filtering in permeable shelf sediments exposed to oscillating flow. Sediments only episodically reached by waves may display similar filtering rates but only during storm events. In these beds, however, wave pumping by hydrostatic pressure oscillations may constantly enhance solute release.

The ecological relevance of wave-induced filtration is linked to the high load of organic matter commonly present in nearshore waters. In contrast to continuous pore-water advection caused by constant unidirectional flow, wave-induced pore-water exchange is characterized by pulsing flow due to the constant acceleration and deceleration of the boundary current. These pulsing flows can transport particulate matter efficiently through the pore space, thereby enhancing the filtration capacity of the bed. Surface gravity waves convert the sand sediments ubiquitous in the shallow shelf into effective filter systems, which suggests that these beds are sites for rapid mineralization and recycling.

References

ALLER, R. C. 1982. The effects of macrobenthos on chemical properties of marine sediment and overlying water, p. 53–102. *In* P. L. McCall and M. J. S. Tevesz [eds.], Animal-sediment relations. Plenum.

———. 1994. Bioturbation and remineralization of sedimentary organic matter: effects of redox oscillation. Chem. Geol. **114:** 331–345.

———. 2001. Transport and reactions in the bioirrgated zone, p. 269–301. *In* B. P. Boudreau and B. B. Jorgensen [eds.], The benthic boundary layer. Oxford Univ. Press.

BERNER, R. A. 1980. Early diagenesis—a theoretical approach. Princeton Univ. Press.

BLACK, K. P., AND J. W. OLDMAN. 1999. Wave mechanisms responsible for grain sorting and non-uniform ripple distribution across two moderate-energy, sandy continental shelves. Mar. Geol. **162:** 121–132.

CACCHIONE, D. A., P. L. WIBERG, J. LYNCH, J. IRISH, AND P. TRAYKOVSKI. 1999. Estimates of suspended-sediment flux and bedform activity on the inner portion of the Eel continental shelf. Mar. Geol. **154:** 83–97.

CALDWELL, D. R., AND T. M. CHRISS. 1979. The viscous sublayer at the sea floor. Science **205:** 1131–1132.

DENNY, M. W. 1988. Biology and the mechanics of the wave-swept environment. Princeton Univ. Press.

ELLIOTT, A. H. 1990. Transfer of solutes into and out of streambeds. Ph.D. thesis, California Institute of Technology.

EMERY, K. O. 1968. Relict sediments on continental shelves of the world. Am. Assoc. Pet. Geol. Bull. **52:** 445–464.

FORSTER, S., M. HUETTEL, AND W. ZIEBIS. 1996. Impact of boundary layer flow velocity on oxygen utilisation in coastal sediments. Mar. Ecol. Prog. Ser. **143:** 173–185.

HARRIS, C. K., AND P. L. WIBERG. 1997. Approaches to quantifying long-term continental shelf sediment transport with an example from the Northern California STRESS mid-shelf site. Cont. Shelf Res. **17:** 1389–1418.

HARRIS, P. T., AND R. COLEMAN. 1998. Estimating global shelf sediment mobility due to swell waves. Mar. Geol. **150:** 171–177.

HARRISON, W. D., D. MUSGRAVE, AND W. S. REEBURGH. 1983. A wave-induced transport process in marine sediments. J. Geophys. Res. **88:** 7617–7622.

HSÜ, K. J. 1989. Physical principles of sedimentology. Springer Verlag.

HUETTEL, M., AND G. GUST. 1992. Impact of bioroughness on interfacial solute exchange in permeable sediments. Mar. Ecol. Prog. Ser. **89:** 253–267.

———, AND A. RUSCH. 2000. Transport and degradation of phytoplankton in permeable sediment. Limnol. Oceanogr. **45:** 534–549.

———, AND I. T. WEBSTER. 2001. Porewater flow in permeable sediments, p. 144–179. *In* B. P. Boudreau and B. B. Jorgensen [eds.], The benthic boundary layer. Oxford Univ. Press.

———, W. ZIEBIS, AND S. FORSTER. 1996. Flow-induced uptake of particulate matter in permeable sediments. Limnol. Oceanogr. **41:** 309–322.

———, ———, ———, AND G. I. LUTHER. 1998. Advective transport affecting metal and nutrient distribution and interfacial fluxes in permeable sediments. Geochim. Cosmochim. Acta **62:** 613–631.

KLUTE, A., AND C. DIRKSEN. 1986. Hydraulic conductivity and diffusivity: Laboratory methods, p. 687–734. *In* A. Klute [ed.], Methods of soil analysis. Part 1, Physical and mineralogical methods. American Society of Agronomy.

KRÖGEL, F. 1997. Einfluß von Viskosität und Dichte des Seewassers auf Transport und Ablagerung von Wattsedimenten (Langeooger Rückseitenwatt, südliche Nordsee). Berichte aus dem Fachbereich Geowissenschaften der Universität Bremen. 102.

LI, M. Z., AND C. L. AMOS. 1999. Field observations of bedforms and sediment transport thresholds of fine sand under combined waves and currents. Mar. Geol. **158:** 147–160.

MALAN, D. E., AND A. MCLACHLAN. 1991. In situ benthic oxygen fluxes in a nearshore coastal marine system: A new approach to quantify the effect of wave action. Mar. Ecol. Prog. Ser. **73:** 69–81.

MARINELLI, R. L., R. A. JAHNKE, D. B. CRAVEN, J. R. NELSON, AND J. E. ECKMAN. 1998. Sediment nutrient dynamics on the South Atlantic Bight continental shelf. Limnol. Oceanogr. **43:** 1305–1320.

MCLACHLAN, A. 1989. Water filtration by dissipative beaches. Limnol. Oceanogr. **34:** 774–780.

MU, Y. K., A. H. D. CHENG, M. BADIEY, AND R. BENNETT. 1999. Water wave driven seepage in sediment and parameter inversion based on pore pressure data. Int. J. Num. Anal. Methods Geomech. **23:** 1655–1674.

OGSTON, A. S., AND R. W. STERNBERG. 1999. Sediment-transport events on the northern California continental shelf. Mar. Geol. **154:** 69–82.

OLDHAM, C. E., AND P. S. LAVERY. 1999. Porewater nutrient fluxes in a shallow fetch-limited estuary. Mar. Ecol. Prog. Ser. **183:** 39–47.

REY, V., A. G. DAVIES, AND M. BELZONS. 1995. On the formation of bars by the action of waves on an erodible bed—a laboratory study. J. Coast. Res. **11:** 1180–1194.

RIEDL, R. J., N. HUANG, AND R. MACHAN. 1972. The subtidal pump: A mechanism of interstitial water exchange by wave action. Mar. Biol. **13:** 210–221.

RUTGERS VAN DER LOEFF, M. M. 1981. Wave effects on sediment water exchange in a submerged sand bed. Neth. J. Sea Res. **15:** 100–112.

RUTHERFORD, J. C., J. D. BOYLE, A. H. ELLIOTT, T. V. J. HATHERELL, AND T. W. CHIU. 1995. Modeling benthic oxygen-uptake by pumping. J. Environ. Eng. ASCE **121:** 84–95.

SAVANT, S. A., D. D. REIBLE, AND L. J. THIBODEAUX. 1987. Convective transport within stable river sediments. Water Resour. Res. **23:** 1763–1768.

SHUM, K. T. 1992. Wave-induced advective transport below a rippled water-sediment interface. J. Geophys. Res. **97:** 789–808.

———. 1993. The effects of wave-induced pore water circulation on the transport of reactive solutes below a rippled sediment bed. J. Geophys. Res. **98:** 10289–10301.

———, AND B. SUNDBY. 1996. Organic matter processing in continental shelf sediments—the subtidal pump revisited. Mar. Chem. **53:** 81–87.

THIBODEAUX, L. J., AND J. D. BOYLE. 1987. Bedform-generated convective transport in bottom sediment. Nature **325:** 341–343.

WEBB, J. E., AND J. L. THEODOR. 1968. Irrigation of submerged marine sands through wave action. Nature **220:** 682–683.

———, AND ———. 1972. Wave-induced circulation in submerged sands. J. Mar. Biol. Assoc. U.K. **52:** 903–914.

WEBSTER, I. T., S. J. NORQUAY, F. C. ROSS, AND R. A. WOODING. 1996. Solute exchange by convection within estuarine sediments. Estuar. Coast. Shelf Sci. **42:** 171–183.

WIBERG, P. L., AND C. K. HARRIS. 1994. Ripple geometry in wave-dominated environments. J. Geophys. Res. **99:** 775–789.

ZIEBIS, W., M. HUETTEL, AND S. FORSTER. 1996. Impact of biogenic sediment topography on oxygen fluxes in permeable seabeds. Mar. Ecol. Prog. Ser. **140:** 227–237.

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EXHIBIT E

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Adsorption of short-chain organic acids onto nearshore marine sediments

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Abstract—The adsorption of acetate, butyrate, lactate, and stearate was measured using a clastic mud from Cape Lookout Bight, N.C. (CLB), a lateritic muddy sand from Kahana Stream, Oahu, Hawaii (KS), and a fine carbonate sand from Waimanalo Beach, Oahu, (WB). Partition coefficients (K_d, moles adsorbed per g of solid phase/moles dissolved per ml of porewater) ranged from $10^{2.3}$ to $\leq 10^{-3.0}$, and displayed the following trends: CLB > KS > WB, and stearate $\gg$ acetate $\simeq$ butyrate > lactate. The percent adsorption of the sediment organic acid pools showed similar trends: stearate, 99%; acetate, 9–23%; butyrate, 5–23%; lactate, $\leq$0.2–7%. These results reflected the relatively nonpolar nature of the sand surfaces in WB and KS sediments, and the polarities of the organic acids. K_d was approximately constant for each organic acid-sediment combination over a dissolved organic acid concentration range of 10^7, using concentrations between 1M and 10^{-14} M. This constancy over a wide porewater concentration range suggested that adsorption was not limited by the availability of surface adsorption sites.

INTRODUCTION

ORGANIC MATTER decomposition in marine sediments is an important biogeochemical process which remains incompletely understood, and as a result there is much interest in increasing our understanding of the reaction pathways and rates. Techniques have therefore been developed to measure the very low concentrations of small organic acid (OA) intermediates involved in the terminal decomposition reactions of organic matter in sediments and their porewaters (*e.g.*, ANSBAEK and BLACKBURN, 1980; BARCELONA *et al.*, 1980; SANSONE and MARTENS, 1981b). However, these methods either (a) measure only the porewater concentrations, or (b) measure the whole-sediment concentration without discriminating between porewater pools and those associated with the sediment solid phase.

Methods have also been developed for the measurement of apparent turnover rates of these terminal degradation intermediates in sediments (*e.g.*, ANSBAEK and BLACKBURN, 1980; SANSONE and MARTENS, 1981b; LOVLEY and KLUG, 1982; SANSONE, 1986). However, these rates must be termed "apparent" (SANSONE and MARTENS, 1981a) because they are derived from substrate concentration measurements described above, which may not directly reflect the substrate bioavailability. Calculation of actual turnover rates would require a knowledge of the amount of the whole sediment substrate concentration which is available to the responsible microorganisms, data that are currently unknown. For example, studies by CHRISTENSEN and BLACKBURN (1982), SHAW *et al.* (1984), and PARKES *et al.* (1984) have indicated that a significant portion of the analytically measurable acetate in marine sediments may not be available to anaerobic bacteria for metabolism. The cause of this phenomena, however, remains unknown.

The bioavailability of organic compounds in sediments is closely related to the distribution of these compounds between porewater (in both free and complexed form) and the solid phase (BRINK *et al.*, 1980). It has been shown for several organics that solid phase interactions can diminish to varying degrees the availability of the compounds to microorganisms, presumably by raising the energy required to transport the compounds into the cells (*e.g.*, STOTZKY, 1980).

To our knowledge the question of the bioavailability of adsorbed organic substrates has not been addressed in the literature in any quantitative fashion, although some qualitative data are available. STOTZKY (1980) reported that proteins complexed directly onto clay particles were not available to microbes, but those adsorbed to other previously bound proteins on the clays were utilized. FLETCHER *et al.* (1980) concluded that organics located within clay layers would not be available to bacteria or higher organisms.

Previous adsorption studies

Early work on the adsorption of organic compounds on surfaces was conducted with standard surfaces such as silica gel, carbon black, graphite, and activated charcoal (see review by KIPLING, 1965). However, the applicability of these studies to systems with non-standard surfaces such as natural sediments with organic coatings (*e.g.*, SUESS, 1973) has been questioned (DAVIS, 1982).

THENG (1974) concluded that short-chain organic acids (SCOAs) would interact with the exchangeable calcium ions on the surface of clay minerals *via* the SCOA carboxyl groups. However, HOFFMANN and BRINDLEY (1960) observed that a chain length of at least five carbons was necessary for noncharged organics to adsorb appreciably onto montmorillonite from dilute solution. Also, HAMAKER and THOMPSON (1972) and BURNS (1980) have noted that the maximum adsorption of long-chain OAs is generally at a higher pH in soils than the pK_a of the individual acids; this was attributed to the fact that the "solution pH" of a soil may not adequately describe the conditions present at the solid/liquid interface, particularly when clay minerals are involved. It appears that empirical approaches offer the best hope at this point for understanding the adsorption of specific organic compounds on natural sediment surfaces.

Organic coatings have been shown to play a major role in soil and sediment adsorption of hydrophobic organic compounds (*e.g.*, SCHWARZENBACH and WESTALL, 1981; WU and GSCHWEND, 1986) and metals (*e.g.*, DAVIS and LECKIE, 1981), but there is little data for hydrophilic organic compounds. Organic coatings on solid surfaces may take the form of multiple layers due to the apparent preference of dissolved organic compounds to adsorb to bound organic matter rather than to clean mineral surfaces (STOTZKY, 1980). This phenomenon has been reported in studies of the adsorption of amino acids onto marine sediments (ROSENFELD, 1979) and natural dissolved organic matter onto metal oxides and clay minerals (DAVIS, 1982).

BENJAMIN and LECKIE (1981) have stressed the need of performing adsorption experiments over a wide range of concentrations in order to accurately predict behavior in natural systems; they found that a relatively few number of highly active, quickly saturated sites dominated metal adsorption on a pure oxide surface.

This study

There were four main objectives of this research. First, we wished to measure the distribution of several SCOAs between the porewater and the solid phase in three very different types of marine sediment: a clastic mud, a lateritic muddy sand, and a fine carbonate sand. It was hoped that this range of solutes and absorbents would provide information on the main factors controlling adsorption in natural sediments. Second, we wished to calculate adsorption coefficients for the SCOAs and sediments studied. Third, we hoped to use the coefficients to provide information on the mechanisms of adsorption. For example, coefficients that decrease with increasing SCOA concentration would indicate a saturation of adsorption sites. Fourth, we wished to estimate an upper limit on the degree to which adsorption lowers the bioavailability of SCOAs to microorganisms. This estimate would rely on the assumptions that maximum utilization of SCOAs occurs when they are in solution, and that all losses of SCOA bioavailability are due to adsorption.

SCOA adsorption was measured at room temperature (approximately 23°C) by treating sterile sediment with varying amounts of a non-labeled SCOA, along with a fixed trace amount of the corresponding ^{14}C-labelled SCOA. The samples were shaken, centrifuged, and sub-sampled for measurement of ^{14}C-activity in the supernatant and in the sediment. Partition coefficients were computed using a knowledge of the water content in the centrifuged sediment, and of the distribution of radioactivity between the supernatant and solid phase subsamples.

Only short-term (approximately 20 min) experiments were performed in this study because of the difficulties in keeping the sediments sterile over significantly longer periods. Loss of sterility would lead to rapid microbial consumption of the very labile SCOAs, and result in ambiguous data. Consequently we could not discriminate between the mechanisms of adsorption and absorption in these experiments, although for convenience we will only use the former expression in this paper.

MATERIALS AND METHODS

Sample collection and description

Three different marine sediments were used in these experiments; the bulk properties are listed in Table 1. The first sediment type was an anoxic clastic mud obtained during the midsummer months of 1983 and 1984 from station A-1 in Cape Lookout Bight, North Carolina (CLB; for a description of this site see MARTENS and KLUMP, 1980). Samples were collected from the top 10 cm of sediment by a scuba diver using a large bucket. After collection the forty-liter composite samples were manually homogenized, transferred to 500-ml glass bottles fitted with teflon-lined screw caps, and refrigerated at 4°C for the subsequent air shipment to our laboratory in Hawaii. Upon arrival, sediment samples were sterilized by gamma-ray irradiation of at least 2.5 MRad (*ca.* 14.5 h) using a 10,000 Curie Co-60 source (Hawaii Research Irradiator, University of Hawaii at Manoa). These bottles of anoxic, sterile CLB sediments were stored at 0–4°C until adsorption experiments were conducted; no visual evidence of sediment oxidation was noted.

The other two types of sediment were collected from nearshore locations on the island of Oahu, Hawaii. Fine carbonate beach sand was obtained by a diver from the surface sediments just outside the surf zone (approximately 1.5–3 m water depth) at Waimanalo Beach (WB). Samples of this aerobic sediment were wet sieved through a 350 μm mesh screen using seawater from the site, and then transported (about 45 min) to our Honolulu-based laboratory for irradiation as described above.

The Kahana Stream (KS) sediment was obtained from an estuarine embayment fed by a small mountain stream. Samples were taken from a depth of 0–20 cm into the lateritic muddy sand by driving a PVC core tube (8.5 cm o.d.) into the sediment. The cores were transported (about 45 min) to our laboratory, where large particulate debris was manually removed and the core samples homogenized after discarding

Table 1. Bulk sediment properties.

Site	Organic C (% dry weight, g/g)	Inorganic C (% dry weight, g/g)	% H_2O (g/g)	Surface Area (m^2/g)	Mineralogy	Grain Size
CLB	3.5	0.02	68	14	Aluminosilicates	Clay
KS	1.3	5.8	45	25	Ca(Mg)CO_3 (15-20 mole % Mg), aragonite, kaolinite-metahalloysite, amorphous Si and Fe-oxides	Fine sand + silty clay
WB	0.17	11	29	1.3	Ca(Mg)CO_3 (10-15 mole % Mg), aragonite	Fine - very fine sand

the brown oxidized surface layer (generally the top 2–3 cm); samples were then irradiated as described above. Porewater salinity from the KS site ranged between 16 and 20‰, with the near-surface porewater being generally less saline than that found deeper in the core.

The whole-sediment pH values were: CLB, 7.0; WB, 8.1; KS, 7.7. Irradiation of the sediments did not cause significant changes in the pH (data not shown).

Adsorption experiments

For each experiment, a sediment sample was added to each of 5 or 6 tared, 50 ml polypropylene screw-cap centrifuge tubes (Corning 25330) using a plastic syringe with the barrel end removed to form an open-ended cylinder. The tubes were then gamma-ray irradiated as described above. Transfers of CLB sediment were conducted under anaerobic conditions by use of a controlled atmosphere glove box (Kewaunee Scientific, Lockhart, Texas) filled with O_2-free argon. Sediment-filled centrifuge tubes were placed in one-liter glass screw-cap bottles before removal from the glove box so that the sediment would not oxidize during subsequent gamma irradiation. The irradiated samples were returned to the glove box for further processing. WB samples were handled under ambient atmosphere since they were not obtained from an anoxic environment. The KS sample tubes were purged of O_2 by use of a slow stream of argon gas before irradiation in order to maintain a relatively O_2-free environment during irradiation.

Two slightly different methodologies were used for the preparation of sediment slurries and the measurement of radioactivity in the sediment pellets. In the earlier stages of this research 30–40 cm^3 of sediment plus 10–20 ml of overlying seawater (sparged with Ar for CLB sediment) were added to each tube before sterilization (Method A). For later experiments no overlying water was added and only 15–20 cm^3 were dispensed per tube (Method B). The resulting water-sediment ratios ($ml_{water}/cm^3_{solid\ phase}$) were: CLB, 7.9–11; WB, 3.8–5.4; KS, 3.8. The resulting solid phase concentrations ($g_{solid\ phase}/l_{wet\ sediment}$) were: CLB, 140–190; WB, 150–180; KS, 900.

In both methods 3 ml of a sterile solution of SCOA (acetate, butyrate or lactate) were added to each sterile sediment sample (with the exception of WB with butyrate, to which only 1 ml of unlabelled butyrate was added), followed by the additions of 20 μl of ^{14}C-labelled SCOA (solution preparation and concentrations are detailed below). The samples were shaken for 20 min on a wrist-action shaker (Burrell, Pittsburgh, PA) and then centrifuged for 10 min at 4360 × g. Triplicate 1 ml aliquots of supernatant were assayed for radioactivity on a Packard Tri-Carb 4640 liquid scintillation counter using Aquasure (NEN, New England Nuclear) as the scintillant. The remaining supernatant was decanted and its density determined, after which the weight of the sediment pellet was recorded.

The sediment pellet was manually homogenized before further processing. In method A, the labelled SCOA from triplicate 1 g pellet subsamples was extracted from the sediment particles into Aquasure by repeated vortexing and sonication before liquid scintillation counting. Quench curves were prepared for each experiment to account for color quenching and efficiency corrections. In method B, three 0.5-g replicate pellet subsamples were dispensed into film tubes (Nalge 500-0100) which were then sealed and rolled to fit into size 00 gelatin capsules. ^{14}C-labelled organic compounds associated with the sediment phase were oxidized to $^{14}CO_2$ and subsequently trapped in a CO_2-absorbing scintillant (Oxyfluor, NEN) using an Intertechnique Oxymat (INUS Corp., Fairfield, New Jersey). Samples were corrected for the Oxymat recovery efficiency (88–96%).

Solution preparation and concentrations

Serial dilutions of a concentrated stock solution of each SCOA were made using UV-oxidized seawater collected from each particular site; stock solution pH was adjusted to 8.0 with 20% Na_2CO_3. For each experiment, 5 to 6 sediment tubes were prepared, each receiving a different concentration of SCOA solution. A tube which contained only UV-oxidized seawater served as a control. The concentrations of the solutions added ranged between 500 mM and 5 μM for acetate, 50 mM and 10 μM for butyrate, and 40 mM and 2 μM for lactate.

A total of 0.11 μCi of 1,2-^{14}C-sodium acetate (ICN Pharmaceuticals, Inc.; 55.5 mCi $mmol^{-1}$), 0.062 μCi of 1,2,3-^{14}C-sodium lactate (ICN, 90 mCi $mmol^{-1}$), or 0.06 to 0.07 μCi of 1-^{14}C-sodium butyrate (Amersham, 56 mCi $mmol^{-1}$) were added to each tube in method A. In method B, 0.05 μCi of ^{14}C-butyrate or 0.02 μCi ^{14}C-acetate were added per sediment tube. All solutions were filter-sterilized or gamma-irradiated before addition to sediment samples.

The effect of gamma-irradiation on the SCOA concentrations was determined as follows. Acetate (900 μM), butyrate (1.1 mM), and lactate (4.1 mM) solutions were prepared in UV-oxidized distilled water, brought to pH 10.0 with 5% Na_2CO_3, and filter-sterilized with 0.45 μm Millipore inline filters. Aliquots of each solution were dispensed into sterile, combusted 1-ml vials sealed with Teflon-lined septa, and then gamma-irradiated with exposures ranging from 0 to 5.8 MRad. Non-irradiated controls for each treatment were maintained at 16°C (the temperature within the gamma-irradiator) during the 0–30 h irradiation periods. All solutions were freeze-dried prior to analysis. Acetate and butyrate samples were derivitized overnight with methanolic-HCl (SANSONE and MARTENS, 1981b). The resulting SCOA methyl esters were determined using a Varian 3700 gas chromatograph interfaced with a Finnigan MAT model 700 Ion Trap Detector. Lactate concentrations were determined using a Dionex 4000i ion chromatograph. After 5.8 MRad exposure 5% of the original acetate remained; after 4.5 MRad exposure 28% of the original butyrate remained; after 4.6 MRad exposure 52% of the original lactate remained (data not shown). These data were used to estimate the resulting concentrations of acetate, butyrate, and lactate solutions that were gamma-irradiated before addition to sediment samples.

Gamma irradiation time-course experiments

In order to find the dosage necessary to sterilize our sediment samples, the rate of microbial oxidation of ^{14}C-labelled acetate in our sediments was measured (SANSONE and MARTENS, 1981b) after different gamma ray exposures. Briefly, 3 ml of fine-grain carbonate sediment collected from Kaneohe Bay, Oahu were placed into sterile, 15-ml Vacutainer culture tubes to which 1 ml of sterile, sulfate-free artificial seawater and 0.2 μCi of ^{14}C-acetate were added. Triplicate samples were gamma irradiated between 1 and 16.5 h (0.3 to 4.87 MRad, respectively), after which an acid-formalin solution was added to terminate the incubation. Microbially-produced $^{14}CO_2$ was trapped on filters wetted with Protosol (NEN), and the radioactivity counted to generate a time-course of acetate turnover *vs.* dose of gamma irradiation. Acid formalin-killed controls were used to correct for any chemically-produced $^{14}CO_2$.

Microbial activity was eliminated with 2.3 MRad of radiation (Fig. 1). Consequently, adsorption experiments were conducted with sediment samples that had been irradiated for at least 2.5 MRad.

Adsorption control experiments

Adsorption isotherms were also generated for stearate, a surface-active fatty acid known to adsorb readily to carbonate minerals (SUESS, 1970), as a verification of the experimental protocol. The adsorption of stearate onto KS and CLB sediments was monitored following the procedures of method B, with the exception that in the CLB experiment only 1 ml of unlabelled stearate solution was added to each tube. Sodium stearate solutions were prepared in methanol and subsequently diluted with UV-sterilized seawater to yield concentration

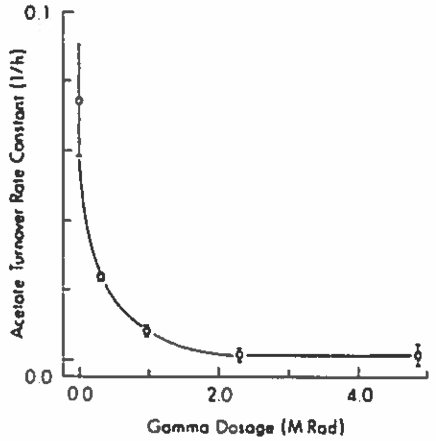

FIG. 1. Effects of gamma-ray irradiation on the microbial oxidation of ^{14}C-labelled acetate in South Kaneohe Bay, Oahu mud. Vertical bars indicate the standard deviation of triplicate samples.

ranges between 2.3 M and 23 fM for KS experiments, and between 0.23 μM and 0.23 nM for CLB sediments. KS sediments received a total of 0.01 μCi of 1-^{14}C-stearic acid (NEN; 56 mCi mmol^{-1}) per tube. CLB sediments received either 0.01 or 0.03 μCi of ^{14}C-stearate per tube. Method A was used for adsorption of stearate onto WB sediments, except that no unlabelled stearate solution was added. Instead, the ^{14}C-stearate solution was added in varying volumes to each tube to yield a range of stearate concentrations from 0.48 to 5.53 μM (0.272 to 2.72 μCi per tube).

In addition, because of the high adsorptivity of stearate, the centrifuge tube walls were monitored for adsorbed radiolabel by first removing the remaining sediment, and then washing the tube walls three consecutive times with 5% Na_2CO_3. After each wash the tubes were centrifuged and 1 ml of the supernatant was assayed for radioactivity; the pooled counts were subtracted from sediment radioactivity measurements. Mass balance calculations indicated that greater than 72% of the added label could be accounted for at the end of the experiments when using this procedure (data not shown).

Calculation of partition coefficients

Partition coefficients (K_d) were calculated from the ratio of the activity in the solid phase to the activity dissolved in the water phase of the system:

$$K_d = \frac{\text{dpm adsorbed per gram of dry sediment}}{\text{dpm dissolved per milliliter of water}}. \quad (1)$$

The total activity associated with the solid phase in each tube was calculated by correcting the sediment pellet activity for the estimated amount of activity in the porewater of the pellet according to the following equation:

$$S = (A \cdot B) - [D\{(Ef_w d^{-1}) - V\}] \quad (2)$$

where:

S = dpm in solid phase/tube
A = dpm adsorbed/mass of sediment pellet subsample (g)
B = sediment net weight post-centrifugation (g)/tube
D = dpm dissolved/volume of supernatant (ml)
E = pre-centrifugation sediment net weight (g)/tube
f_w = fraction of water in the sediment (g/g)
d = density of the liquid phase (porewater + added solutions) (g/ml)
V = volume of supernatant (ml)/tube = $(B - E)/d$.

The activity in the solid phase was then normalized to the mass of dry sediment:

$$\frac{\text{dpm adsorbed}}{\text{g dry sediment}} = \frac{S}{E - (Ed)}. \quad (3)$$

A mass balance of the added radiotracer was calculated at the end of each experiment. Data were only used from experiments in which we could recover 72–150% of the added label in the sum of the following pools: wet sediment, overlying water, and adsorbed to the centrifuge tube wall (stearate only).

Bulk sediment analyses

Organic carbon was determined by wet oxidation using cold 6% H_3PO_4/persulfate and infrared analysis of the resulting CO_2 (SMITH *et al.*, 1981). Inorganic carbon was calculated as the difference between total carbon and organic carbon. Sediment surface area was measured by BET analysis of freeze-dried unamended samples by Omicron Technology Corp. (Berkeley Hgts., N.J.). Mineralogy was determined by X-ray diffraction analysis (Philips Norelco) using Ni-filtered CuKα radiation. The presence of metahalloysite is likely responsible for the relatively high surface area of KS sediment despite its coarse grain size as compared to CLB sediment.

RESULTS AND DISCUSSION

Adsorption measurements

Previous adsorption studies with aquatic sediments have relied, for the most part, on non-sterile samples to which relatively large amounts of nonlabelled xenobiotics have been added. Two factors make this approach inappropriate for experiments involving readily degraded short-chain organic intermediates which are typically found only at trace levels in natural sediments. First, as mentioned above, these latter experiments need to be conducted under sterile conditions due to the fast turnover rates of these compounds. Second, these experiments require the use of radio-labelled adsorbates because of the much lower concentrations of SCOAs in natural sediments as compared with the levels commonly used in xenobiotic studies.

The requirement for sterile experiments presents a major methodological obstacle due to the many potential physical and chemical effects associated with conventional sterilization techniques. We have found gamma-ray irradiation to be the most desirable method of sediment sterilization for the following reasons: a) it is highly effective in eliminating microbial SCOA oxidation in sediment (Fig. 1); b) samples can be kept sealed in anaerobic glass jars during treatment; c) the radiation is not seriously affected by sample self-adsorption (MCLAREN, 1969); d) radioactivity is not induced in samples; and e) radiation-induced chemical changes are small compared to alternative methods (SALONIUS *et al.*, 1967; MCLAREN, 1969), although it is possible that irradiation may have resulted in changes in the organic composition of the sediment that could affect our results.

Adsorption kinetics

The kinetics of OA adsorption was investigated by performing time-course experiments (Fig. 2). Samples

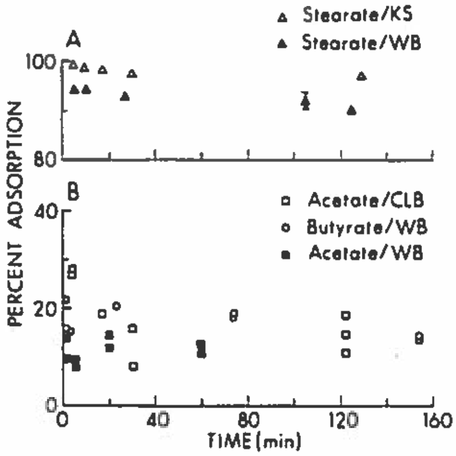

FIG. 2. Kinetics of the adsorption of acetate, butyrate, and stearate onto the solid phase of Cape Lookout Bight (CLB), Kahana Stream (KS), and Waimanalo Beach (WB) sediments. Stearate data points are means of triplicate samples (error bar indicates standard error; the standard errors of other stearate data points are smaller than the symbols).

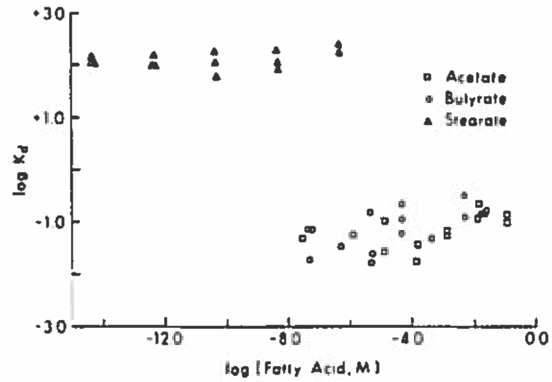

FIG. 4. Partition coefficients measured with Kahana Stream sediment. Lactate adsorption was not determined for this sediment.

were processed as described above, except that the first acetate and butyrate WB samples were not centrifuged, thereby allowing elapsed times of only 1 min.

Acetate adsorption onto CLB sediment did not significantly change after 20 min; other OA-sediment mixtures reached equilibrium in shorter time periods. These experiments showed that adsorption could be measured using short equilibration periods, thereby reducing the risks of errors due to accidental microbial contamination and the subsequent decomposition of the very labile SCOAs studied.

Partition coefficients

Figures 3–5 show the partition coefficients measured over large dissolved OA concentration ranges in the three sediments studied. In general, the coefficients displayed the following trends: stearate ⪢ acetate ≃ butyrate > lactate, and CLB > KS > WB. These results reflect 1) the polarities of the dissolved organic acids, and 2) the relatively nonpolar nature of the sand in the KS and WB sediments compared to the clays in the KS and CLB sediments. Dielectric constants provide a convenient means of estimating the polarity of molecules (*e.g.*, BELL and GROSS, 1929) when molecular dipole moment values are not available, as is the case for most organic acids. Table 2 compares our measured K_d values with published dielectric constant data.

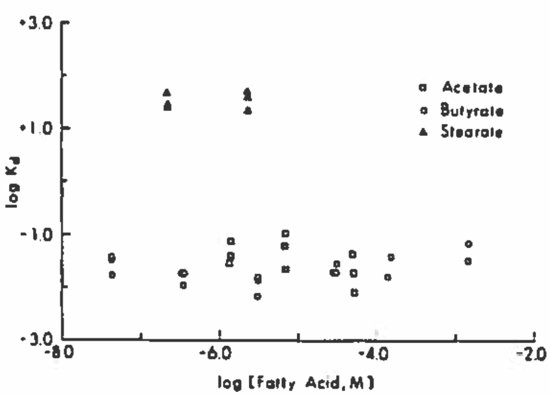

FIG. 3. Partition coefficients measured with Waimanalo Beach sediment. Lactate adsorption was not detected ($K_d \leq 10^{-6}$). Data points in Figs. 3–5 represent individual experiments.

Greater OA polarity results in greater solubility in porewater, and, hence, lower adsorption onto solid surfaces. The presence of polar functional groups on the surfaces of clays (*e.g.*, KUMMERT and STUMM, 1980), and the relative lack of such groups on the surfaces of the carbonate sands, are likely to be a major factor controlling the sediment polarity. The result of these differences is the larger adsorption of the OAs onto CLB and, to a lesser degree, KS sediments as compared to WB sediments. This relationship, however, is likely to be complicated by the effects of organic coatings (see "Effect of organic coatings", below).

The constancy of K_d as a function of dissolved OA concentration indicates that the adsorption isotherms (mass adsorbed *vs.* dissolved concentration) are linear over the ranges used, thus suggesting that OA adsorption is not limited by the availability of surface adsorption sites in these sediments (GILES *et al.*, 1974). The latter hypothesis can be tested by using the surface area data presented in Table 1 to estimate the concentration of SCOA that would be needed to produce monolayer films on the different sediments: WB, 75 mmol l_{pw}^{-1}; KS, 860 mmol l_{pw}^{-1}; CLB, 190 mmol l_{pw}^{-1}. These values are much larger than the concentrations used in the adsorption experiments, and are greater than 1000 times higher than the *in situ* CLB SCOA concentrations (SANSONE, 1986). The hypothesis is further supported by the fact that the degree of adsorption by the three sediments is not correlated with the differences in their surface areas.

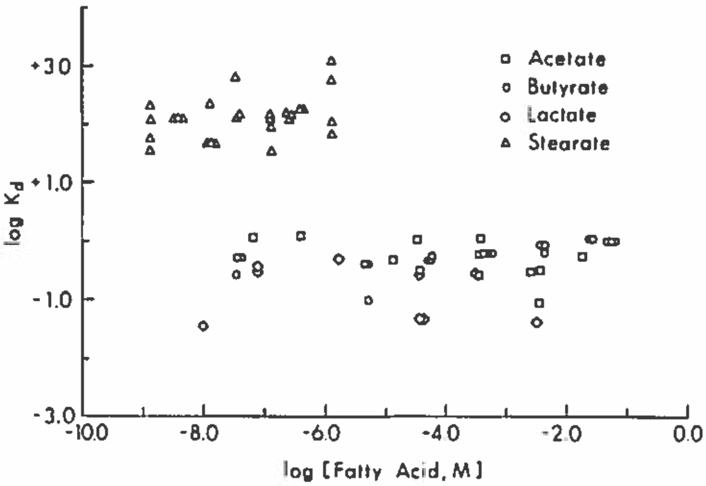

FIG. 5. Partition coefficients measured with Cape Lookout Bight sediments.

The partition coefficients measured for CLB and WB sediments may have been affected by the use of sediment slurries. Data of O'CONNOR and CONNOLLY (1980) and DI TORO *et al.* (1985) indicate that for a variety of sorbates there may be up to a 1:1 inverse relationship in sediment slurry experiments between the partition coefficient measured and the particle concentration. Thus, the partition coefficients we report for CLB and WB sediments may be up to 1.3–1.8 and 1.1–1.3 times too high, respectively, for *in situ* conditions since the sediments were diluted by these amounts.

Percent adsorption and SCOA bioavailability

The percentage of the total sediment OA pools that are adsorbed onto the solid phase of the sediments studied are listed in Table 3. These results were calculated using the following relationship:

$$P = \frac{R}{R+1} 100\% \qquad (4)$$

where:

P = percentage of total sediment OA adsorbed
$R = K_d \rho (1 - f_w) f_w^{-1}$
ρ = density of the porewater (g/ml).

Stearate is nearly completely adsorbed, as would be expected from its very low polarity. Lactate, which is the most polar of the OAs studied, is not significantly adsorbed onto WB sediment. The significantly higher adsorption of lactate onto CLB sediment suggests that the presence of polar functional groups on the clay surfaces (*e.g.*, KUMMERT and STUMM, 1980) may be important in controlling SCOA adsorption in this type of sediment.

Our results are consistent with those of SHAW *et al.* (1984); they reported that 10% to 40% of acetate added to Skan Bay sediments became associated with sediment particles. Since only a fraction of the acetate, butyrate, and lactate pools of the sediments studied are adsorbed onto the solid phase, it is likely that adsorption is at most a relatively minor control on the bioavailability of SCOAs. Nevertheless, other SCOA-sediment interactions such as clay-layer intercalation (FLETCHER *et al.*, 1980; STOTZKY, 1980) may be important.

Table 2. Dielectric constants for the organic acids studied (data from Weast, 1985), and the corresponding mean sediment partition coefficients. The dielectric constant of water is shown for comparison. ND = not determined.

	Dielectric constant	Partition coefficient (K_d)		
		CLB	KS	WB
Water	79	-	-	-
Lactate	22	0.20	<0.001	ND
Acetate	6.2	0.65	0.085	0.046
Butyrate	3.0	0.67	0.11	0.025
Stearate	2.3	210	140	36

Table 3. Percent of total organic acid pools adsorbed onto sediment solid phase. The range of values measured is shown in parentheses. ND = not determined.

Organic acid	Mean % adsorbed		
	CLB	KS	WB
Stearate	99 (98–100)	99 (99–100)	99 (98–99)
Acetate	24 (4–39)	10 (2–22)	9 (2–19)
Butyrate	24 (4–35)	12 (2–29)	5 (1–14)
Lactate	9 (0–18)	ND	≤0.2

The potential effects of sediment dilution during our experiments (see "Partition coefficients", above) could result in overestimates of the calculated percent SCOA adsorption (Table 3) by up to a factor of approximately 1.4 and 1.2, respectively, for CLB and WB sediments. Such an effect would further confirm our conclusion that only a limited amount of SCOA adsorption occurs in these sediments.

Effect of organic coatings

For each of the OAs studied there was an analogous approximately linear relationship between the sediment organic matter content and $\log(K_d)$ (Fig. 6). Our results are similar to those reported by O'CONNOR and CONNOLLY (1980) for kepone, and support the hypothesis that OA adsorption is largely due to interaction of the OAs with organic coatings on the sediment solid phases. This hypothesis is further supported by the results of ZULLIG and MORSE (1983), who found no adsorption of butyrate from synthetic seawater onto clean calcium carbonate mineral surfaces. Further studies with other sediments will be needed, however, to determine whether the measurement of bulk organic content can be a useful aid in estimating OA adsorption onto natural sediments.

CONCLUSIONS

The methods presented here provide a means of studying the adsorption of extremely bioactive compounds onto natural sediments. The use of gamma-ray irradiation allows the study of compounds with very fast rates of biological turnover (SCOA turnover rate constants can be larger than 10 h^{-1} in organic-rich sediments, *e.g.*, SANSONE, 1986). The use of natural sediments circumvents the uncertainties resulting from extrapolating results from experiments using clean mineral phases to the complicated surfaces of natural sediments.

The results of this study suggest that the adsorption of SCOAs onto marine sediments can be predicted by a knowledge of the polarity of these compounds and

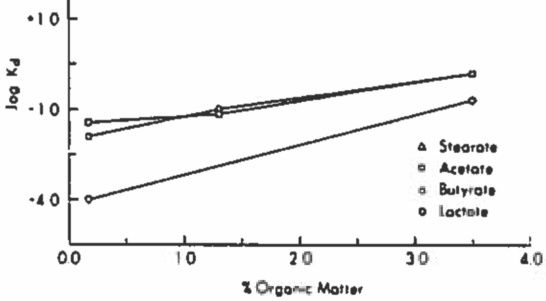

FIG. 6. Measured partition coefficients (arithmetic means of data presented in Figs. 3–5) *vs.* the organic matter content (% dry weight) of the sediments (data from Table 1).

the characteristics of the surfaces of the sediment solid phase. Even in fine carbonate sand the availability of surface area does not appear to limit adsorption. Since the types of sediment used in this study covered a broad range, it is likely that the data presented here will be useful in predicting the behavior of SCOAs in other marine sediments. Nevertheless, further research with natural sediments will be needed to determine the effect of *in situ* conditions (*e.g.*, temperature, redox state, and sediment organic content) on adsorption processes.

We conclude that only relatively small fractions of the total SCOA pools are bound to the sediment solid phase, and thus adsorption is at most a relatively minor control on the bioavailability of SCOAs. Thus the observations of highly restricted bioavailability of acetate in marine sediments (*e.g.*, CHRISTENSEN and BLACKBURN, 1982; SHAW *et al.*, 1984; PARKES *et al.*, 1984) may be largely due to other, currently unknown phenomena.

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REFERENCES

ANSBAEK M. and BLACKBURN T. J. (1980) A method for the analysis of acetate turnover in a coastal marine sediment. *Microb. Ecol.* **5**, 253–264.

BARCELONA M. J., LILJESTAND H. M. and MORGAN J. J. (1980) Determination of low molecular weight volatile fatty acids in aqueous samples. *Anal. Chem.* **52**, 321–325.

BELL J. M. and GROSS P. M. (1929) *Elements of Physical Chemistry*. Longmans, Green and Co. 466p.

BENJAMIN M. M. and LECKIE J. O. (1981) Multiple-site adsorption of Cd, Cu, Zn, and Pb on amorphous iron oxyhydroxide. *J. Colloid Interface Sci.* **79**, 209–221.

BRINK R. H., BRONSON D. and BLAN B. (1980) Synopsis of discussion session. In *Biotransformation and Fate of Chemicals in the Aquatic Environment* (eds. A. W. MAKI, K. L. DICKSON and J. CAIRNS, JR.), p. 63. Amer. Soc. Microbiology, Washington, D.C.

BURNS R. G. (1980) Microbial adhesion to soil surfaces: consequences for growth and enzyme activities. In *Microbial Adhesion to Surfaces* (eds. R. C. BERKELEY *et al.*), p. 252. Soc. Chem. Industry, London.

CHRISTENSEN D. and BLACKBURN T. H. (1982) Turnover of ^{14}C-labeled acetate in marine sediments. *Mar. Biol.* **71**, 113–119.

DAVIS J. A. (1982) Adsorption of natural dissolved organic matter at the oxide/water interface. *Geochim. Cosmochim. Acta* **46**, 2381–2393.

DAVIS J. A. and LECKIE J. O. (1981) Effect of adsorbed complexing ligands on trace metal uptake by hydrous oxides. *Environ. Sci. Technol.* **12**, 1309–1315.

DI TORO D. M., MAHONY J. D., KIRCHGRABER P., O'BYRNE A. L., PASQUALE L. R. and PICCIRILLI D. C. (1985) Effects of nonreversibility, particle concentration, and ionic strength on heavy metal sorption. *Environ. Sci. Technol.* **20**, 55–61.

FLETCHER M., LATHAM M. J., LYNCH J. M. and RUTTER P. R. (1980) The characteristics of interfaces and their role in microbial attachment. In: *Microbial Adhesion to Surfaces* (eds. R. C. BERKELEY *et al.*), pp. 68–74. Soc. Chem. Industry, London.

GILES C. H., SMITH D. and HUITSON A. (1974) A general treatment of the solute adsorption isotherm. I. Theoretical. *J. Colloid Interface Sci.* **47**, 755–765.

HAMAKER J. W. and THOMPSON J. M. (1972) Adsorption. In *Organic Chemicals in the Soil Environment, Vol. I* (eds. C. A. GORING and J. W. HAMAKER), pp. 49–143. Marcel-Dekker, New York.

HOFFMANN R. W. and BRINDLEY G. W. (1960) Adsorption of non-ionic aliphatic molecules from aqueous solutions on montmorillonite. *Geochim. Cosmochim. Acta* **20**, 15–29.

KIPLING J. J. (1965) *Adsorption from Solution of Non-Electrolytes.* Academic Press, New York.

KUMMERT R. and STUMM W. (1980) The surface complexation of organic acids on hydrous γ-Al_2O_3. *J. Colloid Interface Sci.* **75**, 373–385.

LOVLEY D. R. and KLUG M. J. (1982) Intermediary metabolism of organic matter in the sediments of a eutrophic lake. *Appl. Environ. Microbiol.* **43**, 552–560.

MARTENS C. S. and KLUMP J. V. (1980) Biogeochemical cycling in an organic-rich coastal marine basin—I. Methane sediment-water exchange processes. *Geochim. Cosmochim. Acta* **44**, 471–490.

MCLAREN A. D. (1969) Radiation as a technique in soil biology and biochemistry. *Soil Biol. Biochem.* **1**, 63–73.

O'CONNOR D. J. and CONNOLLY J. P. (1980) The effect of concentration of adsorbing solids on the partition coefficient. *Water Res.* **14**, 1517–1523.

PARKES R. J., TAYLOR J. and JORCK-RAMBERG D. (1984) Demonstration, using *Desulfobacter* sp., of two pools of acetate with different biological availabilities in marine pore water. *Marine Biol.* **83**, 271–276.

ROSENFELD J. K. (1979) Amino acid diagenesis and adsorption in nearshore anoxic sediments. *Limnol. Oceanogr.* **24**, 1014–1021.

SALONIUS P. O., ROBINSON J. B. and CHASE F. E. (1967) A comparison of autoclaved and gamma-irradiated soils as media for microbial colonization experiments. *Plant Soil* **2**, 239–248.

SANSONE F. J. (1986) Depth distribution of short-chain organic acid turnover in Cape Lookout Bight sediments. *Geochim. Cosmochim. Acta* **50**, 99–105.

SANSONE F. J. and MARTENS C. S. (1981a) Methane production from acetate and associated methane fluxes from anoxic coastal sediments. *Science* **211**, 707–709.

SANSONE F. J. and MARTENS C. S. (1981b) Determination of volatile fatty acid turnover rates in organic-rich marine sediments. *Marine Chem.* **10**, 233–247.

SCHWARZENBACH R. P. and WESTALL J. (1981) Transport of nonpolar organic compounds from surface water to groundwater. Laboratory sorption studies. *Environ. Sci. Technol.* **15**, 1360–1367.

SHAW D. G., ALPERIN M. J., REEBURGH W. S. and MAINTOSH D. J. (1984) Biogeochemistry of acetate in anoxic sediments of Skan Bay, Alaska. *Geochim. Cosmochim. Acta* **48**, 1819–1825.

SMITH S. V., KIMMERER W. J., LAWS E. A., BROCK R. E. and WALSH T. W. (1981) Kaneohe Bay sewage diversion experiment: perspectives on ecosystem responses to nutritional perturbation. *Pacific Sci.* **35**, 387–388.

STOTZKY G. (1980) Surface interactions between clay minerals and microbes, viruses, and soluble organics, and the probable importance of these interactions to the ecology of microbes in soil. In *Microbial Adhesion to Surfaces* (eds. R. C. BERKELEY *et al.*), pp. 233–247. Soc. Chem. Industry, London.

SUESS E. (1970) Interaction of organic compounds with calcium carbonate. I. Association phenomena and geochemical implications. *Geochim. Cosmochim. Acta* **34**, 157–168.

SUESS E. (1973) Interaction of organic compounds with calcium carbonate. II. Organo-carbonate association in Recent sediments. *Geochim. Cosmochim. Acta* **37**, 2435–2447.

THENG B. K. (1974) *The Chemistry of Clay-Organic Reactions*, pp. 20–23. John Wiley and Sons, New York.

WEAST R. C. (ed.) (1985) *CRC Handbook of Chemistry and Physics, 66th ed.*, pp. E50–E52. CRC Press.

WU S. and GSCHWEND P. M. (1986) Sorption kinetics of hydrophobic organic compounds to natural sediments and soils. *Environ. Sci. Technol.* **20**, 717–725.

ZULLIG J. J. and MORSE J. W. (1983) The adsorption of fatty acid homologs onto calcium carbonate mineral surfaces in dilute aqueous solutions and seawater. *Eos* **64**, 1034.

EXHIBIT F

Research Update

Sulfide as a Toxicant in Aquatic Habitats*

T.U. Bagarinao, Scientist, SEAFDEC/AQD

Hydrogen sulfide is more than just a disagreeable odor from a stagnant marsh: it is a serious menace to all aerobic organisms. Sulfide has a wide variety of adverse effects, the major one being the inhibition of cytochrome c oxidase, the terminal enzyme in aerobic respiration located in the inner membrane of mitochondria. As a toxicant that occurs widely in aquatic (particularly marine) habitats, sulfide may influence the health, survival, productivity, and distribution of various organisms. The effects of sulfide on mammals are well-known and are discussed in some detail here because at the biological level they are the same as in plants, invertebrates, and fishes.

Dose- and pH-dependent toxicity

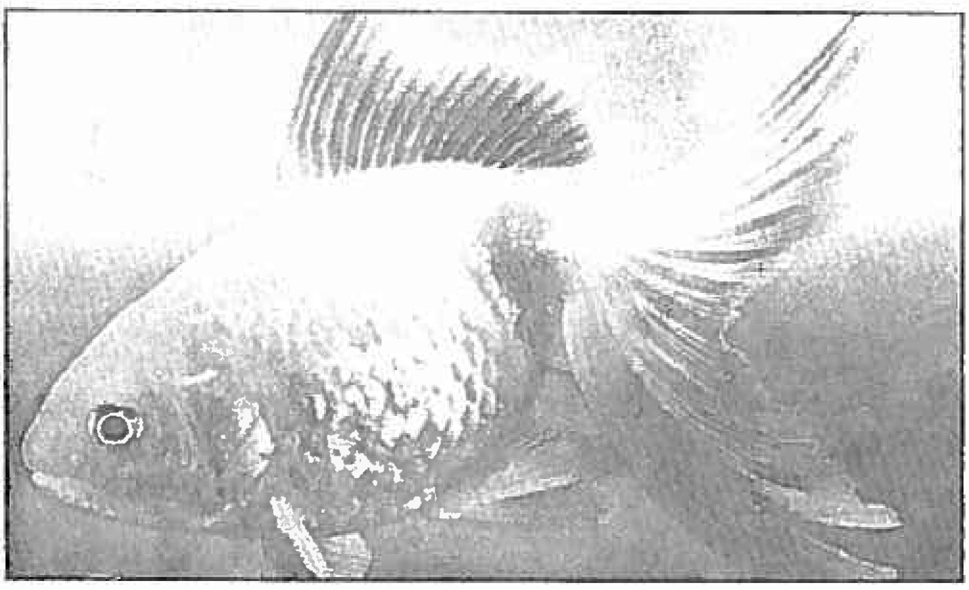
Sulfide toxicity is dose-dependent for any one species and varies with the particular biological system (e.g., whole organism, isolated mitochondria or enzyme preparation) under study. Nanomolar sulfide concentrations are sufficient to inhibit cytochrome c oxidase, while micromolar concentrations are toxic at the whole-animal level. Toxicity depends on the balance between the diffusion rate of sulfide towards the enzyme, and the rate at which sulfide is removed or detoxified by agents external to the enzyme. Some species are more tolerant to sulfide than others and utilize various means of coping with sulfide toxicity, sometimes several mechanisms in concert.

The concentration of sulfide that is toxic depends on pH. In seawater of typical pH 8.3, about 6% is H_2S; in sediments of typical pH 7.0, about 50% is H_2S. The rate of diffusion of sulfide into cells is directly proportional to the concentration of H_2S in the external solution. H_2S freely crosses membranes, while the HS^- anion may be electrically excluded. However, HS^- anions may also contribute to toxicity at high sulfide concentrations. In many organisms, sulfide toxicity is modulated by pH.

Toxicity to mammals

The toxic effects of sulfide are best understood in mammals and are generally similar in aquatic organisms. Sulfide is an industrial health hazard for people working in oil wells and refineries, kraft paper mills, tanneries, sewers, manure pits, fishing fleets, and hot-spring reservoirs. At the physiological level, sulfide has two major effects on mammals: (1) local inflammation and irritation of moist membranes including the eye and respiratory tract, and (2) cardiac arrest due to paralysis of the respiratory centers of the brain. Prolonged exposure to as low as 50 ppm H_2S in air causes inflammation, dryness,

*Source: *Aquatic Toxicology* 24:21-62, 1992.



Freshwater fishes such as the goldfish are less tolerant of sulfide than marine fishes such as the California killifish that lives in salt marshes. Sulfide toxicity increases with temperature, decreases with pH and oxygen concentration, and varies with fish.

hoarseness, cough, bronchitis, pneumonia, and at concentrations exceeding 250 ppm in air, also lung edema. Lung edema is the single most notable lesion in human cases of sulfide inhalation poisoning. Intravenous or intraperitoneal administration of sodium sulfide has similar effects on respiration, except lung edema.

Adverse effects of sulfide on the nervous system include headache, lightheadedness, sleep disturbances, drowsiness, fatigue, spasms, disturbed equilibrium, convulsions, agitation, and in severe cases, deep coma, nerve paralysis, unconsciousness, and death. Like cyanide, sulfide also initially causes rapid breathing, then cessation of breathing and death. About 700 ppm H_2S in air is rapidly fatal to humans; very low concentrations (0.02-0.13 ppm) can be smelled and give some warning, but 150 ppm in air paralyzes the olfactory nerve.

The effects of sulfide at the whole-organism level have their basis at the cellular and molecular level. The *in vivo* biochemical effects of sulfide in mammals include: (1) inhibition of cytochrome *c* oxidase and oxidative phosphorylation, resulting in tissue hypoxia and ATP depletion; (2) metabolic impairments due to changes in enzyme activities, metabolites and cofactors; (3) production of reactive radicals and alteration of membrane permeability, causing edema and organ-specific functional disorders; (4) neurotoxicity; and (5) changes in blood proteins.

About 20 other enzymes are inhibited by sulfide—including superoxide dismutase, catalase, and glutathione peroxidase that act against cellular injury caused by reactive oxygen species. Inhibition of these enzymes as well as the stimulation of xanthine oxidase by sulfide allow cellular injury to proceed unchecked.

Neurotoxiciy and particularly the arrest of central respiratory drive during sulfide poisoning in mammals may be due to the: (1) extremely rapid alterations in amino acid neurotransmitter levels in the brainstem, (2) inhibition of monoamine oxidase, and (3) disruption of action potentials and sodium channel function. Moreover, sulfide at high concentrations *in vitro* causes the formation of sulfhemoglobin and sulfmyoglobin, which can no longer transport oxygen. However, mammals and fishes poisoned by sulfide rarely contain sulfhemoglobin in the bloodstream, and impairment of oxygen transport is not involved in acute sulfide poisoning.

The role of sulfide in mass kills of fish, shrimps, and other animals in brackish-water earthen ponds, lakes, and sea cages should be determined.

Toxicity to plants

Sulfide is a causal factor in 12 of 27 physiological disorders of rice, and is the primary cause of straighthead disease and mild sulfide disease. Sulfide inhibits respiration, oxygen release, and nutrient uptake by rice roots. Disease-resistant cultivars show higher tolerance to sulfide. Likewise, sulfide inhibits the growth of the salt marsh plants *Puccinella maritima*, *Atriplex patula* and *Festuca rubra*, but not of *Salicornia europaea*, which is able to establish and grow in areas of the lower marsh from which the others are excluded by sulfide. *Spartina alterniflora*, the cordgrass that dominates the salt marshes of the US east coast, takes up sulfide without acute toxicity effects over a long growing season.

Sulfide has complex effects on photosynthesis, cell division, respiration, assimilation and fermentative ability in cyanobacteria and unicellular algae. Some species and strains of algae could multiply in the presence of 250-500 µM sulfide, whereas others are inhibited in 30-60 µM sulfide. Photosynthesis in some cyanobacteria decreases in the presence of sulfide, with 50% inhibition at 100 µM sulfide in non-heterocystous species.

Toxicity to macro-invertebrates

Aquatic invertebrates have been studied in terms of the tolerance levels and adaptations to sulfide. In tolerance studies, sulfide exposure was coupled with hypoxia or anoxia and the effects compared with those of hypoxia or anoxia alone. In all cases, sulfide was shown to worsen the effects of hypoxia and anoxia. Various marine worms including the lugworm *Arenicola marina* survive 2-5 days of exposure to 10 mM sulfide. The burrowing intertidal worm *Cirriformia tentaculata* survives 10 days under anoxia and 5 days under anoxia plus 200 µM sulfide. Similarly, the tube-dwelling worm *Nereis diversicolor*, found usually in silty sediments in the innermost parts of estuaries and fjords, is more tolerant to anoxia plus 180 µM sulfide than *N. virens*, which occurs in oxidized sand bottoms. The priapulid worm *Halicryptus spinulosus* is able to survive exposure to 200 µM sulfide for at least 40 days.

The infaunal sea star *Ctenodiscus crispatus* from muddy bottoms survives hypoxia plus 1.5 µM sulfide for 10 days, while *Asterias vulgaris* and *A. forbesi* from the rocky intertidal survive only 4-5 days under the same conditions. Survival of the coot clam *Mulinia lateralis* during anoxia plus sulfide is much lower than under anoxia alone, decreases with sulfide concentration (200 μM to 2.68 mM) and temperature (10°C and 20°C), and increases with the size of the clam. Of two mudflat clams, *Macoma nasuta* is more tolerant to sulfide than *M. secta*, and both show lower tolerance to anoxia in the presence of sulfide.

Compared with other benthic invertebrates, crustaceans have low tolerance to hypoxia and sulfide. The heart rate of the vent crab *Bythograea thermydron* is unaffected by >1 mM sulfide, while those of three shallow-water crab species are severely affected when sulfide concentrations reach 300 μM. *Pachygrapsus crassipes*, which burrows in sulfide-rich sediments in salt marshes, is less affected by sulfide than *Cancer antennarius*, which lives on sand and rocks, and *Portunus zantusii*, which is free-swimming. In continuous-flow bioassays of eight species of freshwater crustaceans and insects, the 96-hour LC_{50} H_2S (lethal concentration for 50% of the animals) range from 0.6 μM in *Baetis* to 31 μM in *Asellus*.

Toxicity to freshwater fishes

Ironically, the toxic effects of sulfide were first studied in freshwater habitats where less sulfide is produced than in comparable marine habitats. These studies were conducted initially in relation to pollution of lakes and streams by sewage and kraft mill effluents, and later in recognition of sulfide itself as a factor in fishery and aquaculture production. The documented effects of sulfide on freshwater fishes include: (1) enhanced survival and growth at low sulfide concentrations between 0.02 and 0.4 μM H_2S, attributed to the antibiotic effect of sulfide; (2) reduced survival and growth at sulfide concentrations greater than 0.45 μM H_2S; (3) lower swimming endurance; (4) tissue irritation and death; (5) lower food consumption and conversion; (6) inhibited spawning behavior and reduced egg production; and (7) lower survival of eggs and smaller size and higher incidence of deformities in newly hatched larvae. A 30-day exposure of sexually maturing common carp *Cyprinus carpio* to a sublethal concentration of 280 μM total sulfide (about 28 μM H_2S) causes a gradual decrease in gonad size due to liver malfunction.

Among the juveniles of eight species of freshwater fishes, the 96-hour LC_{50} H_2S concentrations vary from 0.1 μM at 25°C in goldfish *Carassius auratus* to 23 μM at 6.5°C in the fathead minnow *Pimephales promelas*. The fry stage is up to three times more sensitive to sulfide than the juveniles. Sulfide toxicity increases as temperature rises, as oxygen concentration falls, and as pH decreases.

Toxicity to marine fishes

Many species of marine fishes occur in areas with low to high levels of sulfide. In field tests in cages near pulp and paper mills in Port Angeles (Washington) harbor, the mortality of juvenile salmon occurred at H_2S concentrations of 4 μM and greater. The codlet *Bregmaceros nectabanus* spends 10-11 hours in the anoxic, sulfide-containing zone of the Cariaco Trench off Venezuela during vertical migration over a depth range of 800 meters. Many deep-sea fishes have been observed at the hydrothermal vents, and three endemic genera (*Thermarces, Bythites,* and *Thermobiotes*) seem to have some sort of obligate relationship with the vents in both Pacific and Atlantic Oceans. Several species of fish have also been obtained from trawls in the sulfide-rich hydrocarbon seep 600 meters deep off Louisiana. Groupers, cottonwicks and red snappers swim freely in and out of the sulfidic stream at the East Flower Garden brine seep 72 m deep in the Gulf of Mexico.

Sulfide tolerance differs among marine fishes from a salt marsh, an enclosed bay and the open coast, being high, intermediate and low, consistent with the relative sulfide levels that may be encountered in these habitats. The California killifish *Fundulus parvipinnis*, a salt marsh resident, is highly tolerant of sulfide, the 96-hour LC_{50} being 700 μM and the 8-hour LC_{50} being 5 mM total sulfide (or 42 and 300 μM H_2S). The speckled sanddab *Citharichthys stigmaeus* from the open coast is intolerant of sulfide, dying within 2 hours at a constant 200 μM total sulfide. The killifish tolerates sulfide levels 100 - 1000 x greater than those that inhibit cytochrome c oxidase. This is because killifish mitochondria can oxidize (10 - 20 μm) sulfide to thiosulfate and remove it before it reaches the enzyme.

The role of sulfide in mass kills of fish, shrimps and other animals in brackishwater earthen ponds, lakes and sea cages should be determined.

First African Fisheries Congress
1 - 5 August 1994
Nairobi, Kenya

The Fisheries Society of Africa (FISA), a member of the World Council of Fisheries Societies, is organizing the First African Fisheries Congress in Nairobi, Kenya, 1-5 August, 1994.

FISA and the Organizing Committee of the African Congress invite interested parties to a roundtable discussion on South-South Cooperation in Research and Development. For further information, write, call or fax: Fisheries Society of Africa, Department of Zoology, University of Nairobi, P.O. Box 30197, Nairobi, Kenya, Tel. 442316 or 442121 Ext. 536. Fax: 254-2-336885.

Exhibits D-H of the CURE comment letter (O1) are contained at the end of this Final EIR (Attachment A – Comment O1 Attachments D-H), as these are documents provided by the commenter, and therefore part of the environmental record, but they do not raise specific issues regarding EIR adequacy.

These attachments include:

- *Exhibit D – Water Well Standards*
- *Exhibit E – Water Well Standards*
- *Exhibit F – IDA Technical Paper (Dennis Williams, 2015)*
- *Exhibit G – Extended Pumping and Pilot Test (MWDOC, 2014)*
- *Exhibit H – CalEEMod User Manual (2017)*

Letter O1 CURE

Tanya Gulesserian
August 6, 2018

Response O1-1

Introductory comments, summary of the Project description and references to various Draft EIR reviewers are noted for the record. All attachments to the comment letter have been received. As the specific comments in the letter re-state the comments in the attachments, responses to the letter also fully respond to the attachments. The request for recirculation is discussed in Response O1-22.

Response O1-2

Commenter's statement of interest is noted for the record.

Response O1-3

Please see Master Response 1 regarding the Project Description. Commenter provides general information about CEQA requirements and lead agency responsibilities. The specific comments and responses related to the Project Description are discussed further below.

Response O1-4

Please see Master Response 1 regarding the nature and extent of the Project Description and Master Response 2 regarding the Local (or Phase 1) Project (up to 5 MGD) versus the Regional Project. The DEIR is clearly identified as a Program EIR pursuant to CEQA Guidelines §15168, with the Local Project addressed at a project-level environmental analysis and the Regional Project addressed programmatically. On pages 2.0-2 and 4.0-3 through 4.0-5, the DEIR explains why a Program EIR is appropriate. The comment does not provide any substantial evidence to refute these reasons.

The Local Project stands independent of and does not require nor ensure construction of the Regional Project. The District is only considering approval of the Local Project and any related permits or approvals will only be for the Local Project. The Regional Project is addressed to the extent potential future expansion is reasonably foreseeable, but at this time there are no specific regional project partners in place, no financing, and no known end users and related potential additional infrastructure. Although certain Local Project components may be constructed to accommodate potential future use with a Regional Project, this is to reduce or avoid environmental impacts. Should future expansion be approved, any future expansion beyond 5 MGD will require separate CEQA review, separate regulatory permitting, and could not occur without additional infrastructure such as additional slant wells.

Response O1-5

Regarding the Project's lifespan and future decommissioning of the slant wells, the Project's operational lifespan does not have a planned end date. The commenter's citation of DEIR page 4.6-16 and 4.6-17 regarding "an assumed 30-year operational life" of the Project is referring to the amortization of construction emissions over this time period for purposes of calculating greenhouse gas emissions pursuant to SCAQMD methodology, and the inputs required for the CalEEMod emissions model. The project lifespan is not defined or estimated by this modeling input. Please also see Master Response 1, and Responses F2-3, F2-8 and F2-9 regarding the issue of project lifespan.

The commenter correctly notes footnotes (Footnote 31 and 32) of the reports, which provide an evaluation of the loss of well efficiency and potential for clogging in the Doheny Test Slant Well. As reported, the Doheny Test Well was not completely developed. Development traditionally is accomplished by pumping a well 1.5 times the anticipated pumping rate using a well development pump to remove the fine sediments in the aquifer around the well screen. The Test Slant Well was not designed to include a pump chamber to accommodate a large enough pump. Incomplete development can lead to well clogging from fine material that are not removed from the well during development. The lessons learned from the Doheny Test well were applied to the test slant well for the Monterey Peninsula Water Supply Project (MPWSP) in 2014 by including the appropriately sized pump chamber to allow complete development of the test slant well. Continuous pumping between May 2016 and February 2018 showed a stable to slightly increasing specific capacity (well discharge volume divided by the water level drawdown in the well).

The fully developed test slant well at MPWSP showed no evidence of clogging as specific capacities remained stable to slightly increase over the long-term testing period. These design improvements will be included in the full-scale Doheny Slant Wells, including an appropriately sized pump chamber, and complete development of the well (DEIR, Section 3.4.2). However, as is standard practice with vertical wells used for water supply, periodic re-development (maintenance) of the slant wells is recommended to maintain the highest efficiency.

For additional information regarding slant well operations, testing, performance and applied technology, see Master Response 4.

The Draft EIR assumes that the Project facilities will require routine repair and maintenance over time, including routine replacement of certain components (such as RO membranes) and possibly emergency repair and maintenance, typical of major water treatment facilities. Project facilities will continue to be subject to the Mitigation Monitoring and Reporting Program, regulatory permit conditions and applicable local, state and federal laws and regulations. The District is not aware of nor has any evidence been presented that would suggest a new or more severe environmental impact from continued Project operation, other than what is addressed in the DEIR. If for any reason a well or wells require abandonment or replacement during the ongoing operation of the Project, such actions may require an amendment to previously issued permits (which may or may not trigger supplemental environmental review), and/or would be governed by existing laws and regulations currently in place to prevent environmental impacts, such as California Well Standards, Sections 20-23. The current concept includes a standby well, which would be available to put in operation if other wells are offline for maintenance or replacement. This flexibility ensures that if a well or wells are off-line the operational life of the project is not compromised.

Slant well decommissioning is not part of the proposed Project. However, if decommissioning were necessary for any reason, that process would include removing the submersible pump and down-hole instrumentation, and video recording the well to verify that it is clean. If needed, the well is airlifted clean, a standard industry practice that uses air for cleaning. The well casing is then cut and removed with a minimum 10-foot of cover. The well is tremie grouted full with neat cement grout as the casing is being pulled. The process is not prolonged or intensive. The Phase 3 Extended Pumping and Pilot Plant Testing test slant well at Doheny State Beach, which operated for 18 months between 2010 and 2012, was recently decommissioned. Decommissioning of the 350-foot test slant well took 10 days. It is anticipated that decommissioning of a full-scale (up to 1,000-foot) slant well would take 15 days. Decommissioning would require the use of a drill rig, backhoe, pipe trailer, and pick-up trucks, and would proceed during daylight hours only to avoid noise or other impacts to adjacent properties.

With respect to "decommissioning" other components of the project, please see above response. There is no planned end date to the functional life of the Project. CEQA does not typically require analysis of "decommissioning" other types of projects, such as residential and commercial development, as such an analysis would require a great deal of speculation regarding future environmental conditions and project lifespans that simply cannot be known.

Response O1-6

General comments regarding CEQA requirements are noted for the record. The comments do not provide any specific issue with the DEIR adequacy and therefore no specific response is required. The specific comments and responses related to analysis and mitigation of impacts are discussed further below.

Response O1-7

The commenter cites multiple court decisions as evidence that the proposed Project must complete a quantified Health Risk Assessment (HRA) with dispersion modeling. The decisions cited by the commenter involved large stationary source projects, and the commenter does not identify how the court decisions are relevant or applicable to the Project. As shown below, the court cases cited do not involve project types, pollution sources, or a magnitude of emissions that are representative of the proposed Project.

Communities for a Better Environment v. South Coast Air Quality Management District

The project was a diesel fuel manufacturing facility's request to produce ultra-low sulfur diesel. Central to the case was that the lead agency improperly relied on a baseline level of permitted emissions which did not reflect existing physical conditions, thereby underestimating the level of operational nitrogen dioxide emissions that would occur under the proposed project. As stated in the decision, "In all other respects, the SCAQMD properly exercised its discretion in concluding that the project would not have a significant adverse environmental impact."

Communities for a Better Environment v. City of Richmond

The project was a proposed upgrade of manufacturing facilities at an existing refinery to process a wider variety of crude oil from a wider variety of sources. Respondents expressed concern that heavier, lower-quality crude requires more intensive processing and is inherently more polluting, creating serious public health risks, including increased releases of selenium, mercury, sulfur flare gas, greenhouse gases, particulate matter, and the greater likelihood of upsets, which lead to emergencies and flaring. The court found that the EIR did not "address the public health or other environmental consequences of processing heavier crude, let alone analyze, quantify, or propose measures to mitigate those impacts."

Bakersfield Citizens for Local Control v. City of Bakersfield

The projects at issue were two proposed shopping centers within 3.6 miles of each other, each with a proposed 220,000-square-foot Walmart Supercenter. The EIR for each project identifies that the respective projects would have significant and unavoidable adverse impacts on air quality. At issue for air quality was a lack of cumulative impact analysis that accounted for both shopping centers. As stated in the decision, "…neither EIR acknowledges the health consequences that necessarily result from the identified adverse air quality impacts," and, "health impacts resulting from the adverse air quality impacts must be identified and analyzed in the new EIRs."

Berkeley Keep Jets Over the Bay Com. v. Bd. of Port Comrs

The project consisted of the Port of Oakland's airport development plan for the Oakland International Airport, which was a multifaceted, long-range expansion proposal for the airport that would provide increased capacity for both air cargo and passenger operations. The court found that the EIR failed to use the most recent California Air Resources Board (ARB) speciation profile in estimating toxic air contaminants (TAC) emissions from jet aircraft, and did not support its decision to not evaluate the health risks associated with the emissions of TAC's with meaningful analysis.

The projects involved in court cases cited by the commenter are not relevant to the project type, emissions sources, or magnitude of emissions for this Project. Additionally, the court cases do not recommend or require that all projects analyzed under CEQA complete a quantitative HRA with dispersion modeling. Instead, the decisions require that EIRs provide meaningful analysis of potential impacts, and correlate health risks and environmental effects of adverse impacts identified. The project EIR does identify potential public health risks and environmental impacts of air pollutants (Draft EIR pages 4.2-4 through 4.2-8), and analyzes the project's potential air quality impacts, as required under CEQA (Draft EIR pages 4.2-20 through 4.2-34).

Potential for health risk from TACs is a complex interaction of pollutant type, concentration, exposure pathways, and exposure duration. Dr. Fox (in Exhibit A to this comment letter) states that projects with construction lasting more than 2 months are required to complete a quantitative Health Risk Analysis with dispersion modeling, citing modeling guidance from the OEHHA's 2015 Air Toxics Hot Spots Program Risk Assessment Guidelines; Guidance Manual for Preparation of HRAs. The 2015 Air Toxics Hot Spots Program Guidance Manual was prepared pursuant to the Air Toxics Hot Spots Information and Assessment Act to assist preparation of HRAs for permitting new or modified stationary sources. In contrast to the commenter's statement, the 2015 guidance does not state or 'require' that all projects or construction activities that would last 2 months or more complete a quantitative HRA, but instead provides modeling guidance for projects where the lead agency has decided to complete a quantitative HRA. As stated in the 2015 guidance, "local air pollution control districts sometimes use the risk assessment guidelines for the Hot Spots program in permitting decisions for short-term projects." There is no currently adopted or proposed statewide or local guidance that identifies the specific parameters for which a construction project would warrant preparation of a quantified HRA. Instead, decisions to prepare a quantified HRA for construction-generated health risks are assessed on a case-by-case basis. The Project EIR identifies the types and locations of off-site receptors, their distance to construction activity, the duration of the construction period, quantity and types of diesel-fueled equipment, hours of use, and location of use.

The commenter misconstrues the Project's construction activity and duration, simplistically stating that construction activity will be in proximity to sensitive receptors for 20 months and 18 months for Phase 1 and Phase 2, respectively. However, construction would occur both on the site of the desalination plant and throughout the project-wide delivery area. While some project construction activities would occur in close proximity, many construction activities would not. Therefore, project construction would expose sensitive receptors at different locations, at different times, and in different durations of emissions. For example, receptors along the Project's proposed raw water conveyance alignments would be exposed to emissions for only the duration of pipeline construction near their individual location. For example, HDPE pipeline construction in existing roadways typically proceeds at roughly 500 linear feet of pipeline per day. Given this linear nature of pipeline construction, exposure duration of any individual receptor is limited. In addition, a review of the anticipated construction schedule and activity provided in Draft EIR Appendix 10.3 for modeling purposes (Air Quality and Greenhouse Gas Calculations) shows the majority of the diesel-fueled off-road construction equipment activity would occur for slant well drilling and development, located at multiple locations along the shore and largely away from sensitive receptors. Please see Section 3, *Draft EIR Errata* regarding Section 3.6, Construction Schedule, for clarifying details regarding construction scheduling and assumed equipment usage.

Furthermore, the construction-period emissions estimates conservatively overestimate equipment emissions from the Project's onsite construction by using CalEEMod's full default 'building construction' equipment fleet for each individual building, electrical equipment installation, and mechanical equipment installation. Not only is the equipment type, quantity, and use in the model defaults higher than what is required for those construction components, but the emission analysis conservatively assumes no 'sharing' of equipment between each individual building on the Project site. Even with this conservative data in the CalEEMod emissions model, the data does not support preparation of a quantitative HRA for this project.

Dr. Fox states, "based on my experience, I expect that cancer health impacts from (diesel particulate matter) DPM may be significant." However, Dr. Fox provides no evidence, such as example cases, parameters of other projects that have generated significant cancer health impacts, to support that statement. Per CEQA Guidelines Section 15384(b), substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts. Dr. Fox's statement is opinion that is not supported by facts and, therefore, does not constitute substantial evidence.

Concerning evaluation of cumulative air quality and health impacts of construction, Dr. Fox states that the DEIR fails to evaluate construction emissions with, "countless other construction projects elsewhere in the air basin." The Draft EIR Section 4.0.4 describes the planned and future projects within the project area considered in the cumulative impact analysis, including growth contained in the City of Dana Point's

General Plan and the Doheny State Beach General Plan, among others. Table 4-1 of the Draft EIR summarizes cumulative projects and project summaries. The EIR incorporates by reference the City of Dana Point General Plan Final EIR and SCAG's 2016 RTP.SCS Program and Final EIR. The Air Quality section evaluates the Project's construction emissions against the SCAQMD's regional thresholds of significance, localized significance thresholds (LSTs), and qualitatively evaluates DPM emissions. The SCAQMD's regional thresholds of significance are based, in part, on the Federal New Source Review regulations, which take into account the area's nonattainment designation and severity. In other words, the SCAQMD considered the emission levels for which a Project's individual emissions would be cumulatively considerable in developing the thresholds of significance for air pollutants. If a project exceeds the identified significance thresholds, its emissions would be cumulatively considerable, resulting in significant adverse air quality impacts to the region's existing air quality conditions. Therefore, the design and structure of analyzing construction-generated regional pollutants is cumulative in nature.

As stated by the SCAQMD, LSTs represent the maximum emissions from a project that are not expected to cause or contribute to an exceedance of the most stringent applicable federal or state ambient air quality standard, and are developed based on the ambient concentrations of that pollutant for each source-receptor area and distance to the nearest sensitive receptor. To generate a cumulative impact, another construction project would have to occur at the same time and in close proximity to the project and/or the identified sensitive receptor. The nearest receptor to Project preliminary site work or expansion site preparation, which are the two phases subject to the LST analysis, would be the Del Obispo Community Park, as identified in the Draft EIR Appendix 10.3 (Air Quality and Greenhouse Gas Calculations). There are no other known construction projects that would be occurring within the same timeframe and in proximity to the Del Obispo Community Park. Therefore, the project's construction would not be contributing to a cumulative LST impact at the affected receptor location.

Similarly, cumulative DPM impacts are dependent on proximity, size, and duration, with risk of adverse health effects diminishing with distance. As described in RTC 01-7, above, construction would occur at different locations and at different times. The cumulative projects identified either have unknown construction timeframes or would be located at distance from the Project's construction activity; therefore, there would not be an anticipated significant cumulative DPM impact.

Dr. Fox's recommended mitigation, suspending construction activities during smog alerts, does not mitigate construction-generated DPM emissions, as smog is primarily an ozone issue, a different pollutant than DPM with different health effects. California regulation currently requires heavy-duty diesel vehicles to limit idling to 5 minutes or less. Additionally, ARB's In-Use Off-Road Diesel-Fueled Fleets Regulation has 5-minute idling limits for off-road equipment as well as labeling, emissions controls, performance standards, record-keeping, and reporting requirements that apply to large, medium and small fleets. Dr. Fox's other recommended measures, using alternative-fueled equipment and purchasing local GHG offsets that provide PM2.5 benefits, may reduce or avoid DPM emissions. However, DPM is already identified under Impact 4.2.4 in DEIR Section 4.02 as a less than significant impact. Under CEQA, mitigation measures applied to reduce impacts determined to be significant (CEQA Statute Section 21002.1). Measures included to reduce or avoid impacts that are not significant are considered avoidance or minimization measures. Mitigation measures are not required or warranted for impacts that are determined to be less than significant. Please note, Mitigation Measure AQ-1, which requires cleaner Tier 4 engines for construction equipment to reduce identified NO_X impacts to less than significant, further minimizes equipment-generated DPM. The District can rely upon its technical experts regarding desalination facility construction and operation and associated environmental impacts. The District's desalination program management firm, GHD, is an internationally recognized expert in desalination design, construction and operation, and was actively involved in the successful design and construction of the Carlsbad desalination facility. The District's slant well design firm, GEOSCIENCE Support Services, is a recognized expert in slant well design, construction and operation, having successfully designed and overseen construction and operation of slant wells at Doheny State Beach and in the City of Marina. The District is not aware of any significant public health impacts that occurred as a result of constructing the 50 MGD Carlsbad Desalination Plant or at either of the two slant well locations. The Doheny State Beach test slant well was constructed near the North Beach lifeguard towers with beach use continuing during construction. The District is not aware of any beach user health, noise or odor complaints during slant well construction and operation.

Criteria Pollutant Health Impacts

As previously discussed, localized effects of on-site Project emissions on nearby receptors were found to be less than significant. The LSTs represent the maximum emissions from a project that are not expected to cause or contribute to an exceedance of the most stringent applicable NAAQS or CAAQS. The LSTs were developed by the SCAQMD based on the ambient concentrations of that pollutant for each SRA and distance to the nearest sensitive receptor. The ambient air quality standards establish the levels of air quality necessary, with an adequate margin of safety, to protect public health, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. As shown above, Project-related emissions would not exceed the LSTs, and therefore would not exceed the ambient air quality standards or cause an increase in the frequency or severity of existing violations of air quality standards. Therefore, sensitive receptors would not be exposed to criteria pollutant levels in excess of the health-based ambient air quality standards.

Response O1-8

Regarding the assessment of odor impacts, the impact criteria under CEQA at the time of release of the DEIR to the public was, "e) Create objectionable odors affecting a substantial number of people?"[1] Dr. Fox does not provide evidence substantiating the assertion that a noticeable odor would be identifiable at 1,000 feet from the edge of construction. Dr. Fox states that her experience is "at construction sites," but provides no evidence of that experience. Instead, the commenter provides anecdotal evidence from an unnamed construction project. Although Dr. Fox provides what is represented as an expert opinion, she does not support that opinion with facts. Per CEQA Guidelines Section 15064(f) states:

[1] After release of the DEIR to the public, CEQA Guidelines, Appendix G, III.(e) was amended to now ask if a project would "[r]esult in other emissions (such as those leading to odors adversely affecting a substantial number of people?" Even with this revision, the DEIR's analysis still applies because the threshold of significance and analysis methodology remain the same.

"(4) The existence of public controversy over the environmental effects of a project will not require preparation of an EIR if there is no substantial evidence before the agency that the project may have a significant effect on the environment.

(5) Argument, speculation, **unsubstantiated opinion** or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and **expert opinion support by facts**." (emphasis added)

As evidence of potential impacts and possible mitigation measures, Dr. Fox identifies the Phillips 66 Company Rail Spur Extension and Crude Unloading Project EIR, which quantified odor impacts and application of mitigation. The Phillips 66 project includes a rail spur and cured oil unloading facility and associated above-ground pipelines. The Phillips 66 project's main source of odor, fugitive crude oil vapor from equipment leaks, is not applicable or relevant to the proposed Project. Similarly, Dr. Fox states that "clouds of chemicals" could "travel downwind for miles and drift into heavily populated areas." However, a review of the literature cited, *Digging Up Trouble* by the Union of Concerned Scientists, does not support the statement.

The commenter states that "the only way to conclude that odor impacts are insignificant is to use air dispersion modeling to estimate ambient concentrations of DPM at nearby sensitive receptors and compare the resulting concentrations to DPM odor thresholds." However, quantitative assessment of odor concentrations through dispersion modeling is not "the only way" to conclude odor impacts are less than significant; indeed, dispersion modeling of odor is not typical or common in environmental analyses, or even recommended by the SCAQMD. In fact, SCAQMD's adopted threshold of significance for odor is that a significant impact exists if a "Project creates an odor nuisance pursuant to SCAQMD Rule 402." Rule 402 provides that a person shall not discharge such quantities of air contaminants which, "cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property." As described in Draft EIR Impact 4.2-5, odor from Project construction and operation would not affect a substantial number of people. Therefore, the Project would not generate a substantial odor impact.

Similarly, CEQA does not require mitigation for all impacts, only impacts that are determined by the lead agency to be significant. Mitigation, even if readily available, is not required for impacts that are determined to be less than significant. The Project minimizes typical construction and operational odor by siting above-ground facilities at an existing industrial site owned by the District (with considerable separation from sensitive receptors as noted in the DEIR) and at Doheny State Beach where construction activities are limited in duration. The EIR analyzes and discloses the Project's potential to generate a significant odor impact during construction, to the extent required and appropriate under CEQA.

Response O1-9

Dr. Fox, in support of CURE's comments, provided speculative argument, argument unsupported by facts, and unsupported anecdotal evidence that has not been demonstrated to be representative of the Project.

Dr. Fox provides no factual evidence to support claims that significant amounts of PM10, PM2.5, valley fever or silica dust would be released; therefore, such claims provided are unsubstantiated and do not constitute substantial evidence. Construction emissions were properly analyzed consistent with SCAQMD recommendations and are fully disclosed in Draft EIR Section 4.2, Air Quality.

Dr. Fox states that calculations she has provided “in other cases” “frequently exceed the PM10 and PM2.5 thresholds.” However, Dr. Fox does not provide those calculations, identify the parameters of the other cases, or provide a rationale as to how those cases would be representative of the proposed Project. Therefore, the commenter does not provide substantial evidence that the Project may generate a significant level of PM10 or PM2.5.

Dr. Fox identifies that the CalEEMod model does not estimate fugitive dust from windblown sources such as storage piles, inactive disturbed areas, and off-road vehicle travel. As identified in the CalEEMod User’s Guide, this approach is consistent with approaches taken in other comprehensive models. Per the CalEEMod User’s Guide, Appendix A (Calculation Details):

> The program calculates fugitive dust associated with the site preparation and grading phases from three major activities: haul road grading, earth bulldozing, and truck loading. As recommended by SCAQMD, the fugitive dust emissions from the grading phase are calculated using the methodology described in USEPA AP-42.

Dr. Fox states that fugitive windblown dust must be calculated for storage piles, inactive disturbed areas, and off-road vehicle travel using AP42 emission factors. AP42 Section 13.2 (Fugitive Dust Sources) was reviewed for applicability. Of the emission factors, AP42 13.2.5 (Industrial Wind Erosion) and 13.2.2 (Unpaved Roads) are potentially applicable. AP42 13.2.5 contains emission factors and calculations for estimating dust emissions from wind erosion of open aggregate storage piles and exposed areas within an industrial facility. However, the calculations require specific details that cannot be known at this time, such as storage pile shape. Furthermore, AP42 13.2.5 provides that, “aggregate material surfaces are characterized by finite availability of erodible material (mass/area) referred to as the erosion potential. Any natural crusting of the surface binds the erodible material, thereby reducing the erosion potential. Additionally, AP42 13.2.2 requires specifics such as vehicle miles traveled over unpaved surfaces, which are unknown for the proposed construction site.

SCAQMD Rule 403, Fugitive Dust, requires adherence to strict dust control performance standards and implementation of specific dust control best available control measures (BACM). Rule 403 requires, among other things, that no person shall cause or allow emissions of fugitive dust from any active operation, open storage pile, or disturbed surface area such that: (A) the dust remains visible in the atmosphere beyond the property line of the emission source; or (B) the dust emission exceeds 20 percent opacity (as determined by the appropriate test method included in the Rule 403 Implementation Handbook), if the dust emission is the result of movement of a motorized vehicle. The rule also requires that no person shall conduct active operations without utilizing the applicable BACM for each fugitive dust source type, including (but not limited to) stabilizing stockpiled materials, staging areas, all off-road traffic and parking areas, and established haul routes. Rule 403 BACM have control efficacies of up to 90 percent depending on source and measure implemented (SCAQMD 2007).

Therefore, not only would it be speculative and inappropriate to utilize the AP42 emission factor guidance sheets for calculation of fugitive dust from wind erosion of storage piles, open area, and vehicle travel, but would also be inconsistent with emissions modeling procedures for projects under CEQA. Additionally, implementation of SCAQMD Rule 403, which is required, is highly effective at minimizing potential fugitive dust emissions from these sources.

Dr. Fox states that windblown dust from disturbed soils are of particular concern due to the Santa Ana Winds that occur in the area; that high wind events could entrain significant amounts of soil and the emissions analysis should account for risk of high wind events. Neither the SCAQMD nor the ARB require or recommend project-level CEQA analysis of potential construction-period fugitive dust emissions during maximum high-wind natural events such as Santa Ana winds. Instead, the SCAQMD recommends that, if site-specific dispersion modeling is conducted, the maximum daily average wind speeds from meteorological data be used (SCAQMD 2005).

As stated above, SCAQMD Rule 403 is required and highly effective at minimizing the potential fugitive dust emissions. In addition, the rule provides contingency measures and record keeping to be implemented during high wind events where instantaneous winds greater than 25 miles per hour occur. Implementation of SCAQMD Rule 403 is required, with project-level enhanced enforcement through Mitigation Measure AQ-3 and would reduce potential construction-period fugitive dust impacts to less than significant levels.

The DEIR emissions analysis follows the SCAQMD's guidance. Calculating construction-period fugitive dust emissions using AP-42 would not be accurate to the conditions under regulatory requirements of SCAQMD's Rule 403. SCAQMD Rule 403 requires fugitive dust control measures to be implemented that substantially reduce emissions of fugitive PM10 and PM2.5 from graded areas, storage piles, and off-road travel. SCAQMD Table XI-A, Fugitive Dust Mitigation Measures, Construction and Demolition, includes (but is not limited to) the following required measures (control factor in parenthesis). These measures are consistent with Mitigation Measure AQ-3 on pages 4.2-28 and 4.2-29.

- All unpaved demolition and construction areas shall be wetted at least three times daily during construction, and temporary dust covers shall be used to reduce dust emissions and meet SCAQMD District Rule 403 requirements (36-61 percent).
- The owner or contractor shall keep the construction area sufficiently dampened to control dust caused by construction and hauling, and at all times provide reasonable dust control of areas subject to windblown erosion (36 to 61 percent).
- All loads shall be secured by covering or use of at least two feet of freeboard to avoid carry-over (91 percent).
- All materials transported offsite shall be either sufficiently watered or securely covered (91 percent).
- All earthmoving or excavation activities shall be discontinued during period of high winds (i.e., greater than 25 mph) to prevent excessive amounts of fugitive dust generation (98 percent).

- All equipment shall be properly tuned and maintained in accordance with manufacturer's specifications.
- General contractors shall maintain and operate construction equipment to minimize exhaust emissions. During construction, trucks and vehicles in loading and unloading queues will have their engines turned off after five minutes when not in use.
- Construction activities will be phased and scheduled to avoid emission peaks, and equipment use will be curtailed during second-stage smog alerts.
- All areas where construction vehicles are parked, staged, or operating shall be visibly posted with signs stating "No idling in excess of 5 minutes."
- Catalytic converters shall be installed on all heavy construction equipment, where feasible.
- Deliveries will be scheduled during off-peak traffic periods to reduce trips during the most congested periods of the day.

Furthermore, Mitigation Measure AQ-3 enhances compliance with Rule 403 requirements and includes such measures as hydroseeding or applying soil stabilizers to inactive construction areas. Because of the above items, it is not common, nor recommended by the SCAQMD to separately quantify fugitive dust emissions from storage piles and fugitive dust from off-road travel for typical construction projects.

According to the Centers for Disease Control (CDC), Valley Fever is highly endemic to the southern Central Valley, established as endemic in the remainder of the Central Valley, and suspected as endemic in the Project area. Surveillance for Valley Fever shows the average incidence of valley fever for Orange County was between 0 and 5.9 per 10,000 individuals (CDC 2018[2]). Prevention for exposure to Valley Fever includes reducing the amount of exposure to disturbed soils. As identified above, compliance with SCAQMD Rule 403 is required and substantially reduces fugitive dust emissions from construction sites. With a very low local incidence of Valley Fever, and implementation of fugitive dust control measures, the potential exposure of construction workers to Valley Fever is less than significant.

The amount of soil movement was appropriately incorporated into the emissions analysis through the volume of soils movement and the grading duration. Dr. Fox states that the soil conditions will require "more aggressive use" of construction equipment but provides no factual evidence to support that conclusion. Furthermore, Dr. Fox states that the "default emission factors" should be adjusted to increase emissions for "these portions of the site." Dr. Fox provides no factual evidence that either the default emission factors (i.e., the tailpipe emission rates) or the load factors (i.e., ratio of the actual output to the maximum output of a piece of equipment) should be adjusted or by what amount.

The commenter states that the mitigation measures "do not include any method to validate that the construction equipment is emitting at the levels assumed in the DEIR and recommends the use of Portable

[2] Center for Disease Control (CDC). 2018. Coccidiodomyosis Valley Fever Maps. Website https://www.cdc.gov/fungal/diseases/coccidioidomycosis/maps.html. Accessed November 6, 2018.

Emission Measurement Systems to verify tailpipe emissions." DEIR Mitigation Measure AQ-1 requires the following:

- All off-road diesel-powered construction equipment greater than 50 horsepower must meet EPA-certified Tier 4 emissions standards,
- All construction equipment be outfitted with Best Available Control Technology (BACT) devices certified by the California Air Resources Board (ARB) to achieve emissions reductions that are no less than what would be achieved by a Level 3 diesel emissions control strategy.
- A copy of each unit's certified tier specification, BACT documentation, and ARB or SCAQMD operating permit shall be provided at the time of mobilization of each applicable unit of equipment.

Verification of tailpipe emissions occurs at engine certification. Per the ARB, requirements for off-road compression-ignition engine certification include provisions for demonstrating compliance with the applicable emission standards using specific test procedures, as well as emission labeling and warranty obligations. Furthermore, all self-propelled off-road diesel vehicles 25 horsepower (hp) or greater used in California are subject to the Regulation for In-Use Off-Road Diesel Fueled Fleets (Off-Road regulation), which requires (in part):

- limits on idling, requires a written idling policy, and disclosure when selling vehicles;
- all vehicles to be reported to ARB (using the Diesel Off-Road Online Reporting System, DOORS) and labeled;

Therefore, the mitigation measure includes clear requirements for verification and certification. Further need to verify tailpipe emissions rates is excessive and unnecessary. Any assumption that equipment will be operating outside of normal parameters is speculative and unsupported by any factual evidence.

Response O1-10

As background on power plant air emissions, criteria pollutant emissions from power plants within California are highly regulated through State-level and local air district permitting processes. New or modified power plants that will emit air pollutants typically must meet certain emission control requirements and obtain preconstruction and operating permits from the local air district. The local air district prepares an engineering analysis, and places conditions in the permits to ensure that the source will comply with the requirements of federal, State, and local air pollution regulations. For major power plants under the California Energy Commission's jurisdiction, the local air district's engineering analysis and proposed conditions, known as a Determination of Compliance, are used in the California Energy Commission's licensing process. After licensing by the Energy Commission, and upon completion of construction, the local air district issues and enforces a district-issued operating permit.

Furthermore, new or modified energy production facilities within California must comply with CEQA and, where applicable and warranted, conduct HRAs specific to that facility's proposed fuel type, energy production capabilities, local meteorology, and local sensitive receptor conditions. Operators of energy production facilities must demonstrate that they would not conflict with or obstruct implementation of applicable air quality management plans or expose sensitive receptors to substantial air pollutant concentrations.

Lastly, energy producers and utility districts in California are subject to (among other requirements) Senate Bill (SB) X1-2 or SB 350, which require a Renewable Portfolio Standards (RPS) of 33 percent by 2020, and 50 percent by 2030, respectively. The increase in renewable energy use further reduces emissions of air pollutants from energy production in California. Through compliance with applicable rules, regulations, and permit requirements, ARB and local air districts ensure that power plants do not individually or cumulatively contribute to significant health risks, as well as ensure additional future reduction in air pollutant generation through increased renewable energy production. Power plant emissions are under the jurisdiction of the local air district, California Energy Commission and/or California Public Utilities Commission.

For the reasons cited above, it is not typical or common for individual projects that are not energy production facilities to estimate criteria air pollutant emissions from off-site energy production. Concerning the proposed Project's impact, CEQA requires that a lead agency consider direct physical changes in the environment and reasonably foreseeable indirect physical changes in the environment. The Project is not anticipated to require the construction of new or modified power plants, or an increase in output of any existing power plants.

As shown above, estimation of off-site criteria pollutant emissions from energy production is neither warranted or recommended for the Project and is not required to appropriately assess the Project's potential direct and indirect air quality impacts under CEQA. However, even if estimation of off-site criteria pollutant emissions from energy production were required (which it is not), Dr. Fox's estimates of potential off-site criteria pollutant emissions associated with energy production are not representative of utility districts' emissions within California. Power to the Project would be provided by San Diego Gas and Electric (SDG&E). Dr. Fox cites a 2007 National Renewable Energy Laboratory (NREL) technical report as the source of her assumed emission factors for calculating indirect emissions of criteria pollutants from energy generation. The 2007 NREL report emission factors are not representative of the emission rates for SDG&E or other utility agencies in California. For example, the 2007 NREL emission factor for carbon dioxide (a greenhouse gas) is more than 200 percent higher than the known SDG&E carbon dioxide emission factor.

Consistent with standard practice and SCAQMD protocols, the DEIR includes indirect power plant emissions in the GHG analysis, as indirect GHG emissions are appropriate for inclusion in global climate change analysis. Also note that the Project's electrical power would come from "the grid" managed by the California Independent System Operator (Cal-ISO), and as such it is not possible to ascribe Project power to any specific power plant(s). Every power plant must meet strict licensing and environmental review requirements consistent with CEQA, the Clean Air Act, local air district regulations, and California Public Utilities Commission power plant regulations.

Response O1-11

General comments regarding the Draft EIR's biological resources assessment are noted for the record. Specific comments are addressed in the responses below. The District disagrees with the alleged inadequate impact analysis and therefore finds that recirculation is not warranted (see responses below to specific comments).

Response O1-12

CEQA Guidelines require an EIR to include only enough setting information necessary to provide a meaningful context for the discussions of environmental impacts, alternatives, and mitigation measures. The environmental setting was described in accordance with those guidelines, and was based on field surveys, published documents, and records of special-status species occurrences (as reported by state and federal agencies).

San Juan Creek is considered a viable wildlife corridor for movement between Doheny State Beach and the upper San Juan Creek watershed. Construction and operation of the Project will not prevent movement within the creek compared to existing conditions. Potential effects from noise generated during construction and operation are addressed in the DEIR, Section 4.3. See response to Comment O7-5 for additional detail regarding construction noise.

Response O1-13

The District identified special-status species identified by state and federal wildlife agencies (CDFW and USFWS) that could potentially occur at or near the Project site. The species in Table 1 of Smallwood (2018) includes (1) multiple birds of prey, which are afforded protection under Section 3503.5 of the California Fish and Game Code, (2) species designations that are eleven years old (from Shuford and Gardali [2008]), and (3) multiple species that do not occur near the Project site.

Section 3503.5 of the California Fish and Game Code states: "It is unlawful to take, possess, or destroy any birds in the orders Falconiformes or Strigiformes (birds-of-prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." This regulation is already noted in the Draft EIR at page 4.3-20, paragraph 3. Construction and operation of the proposed Project will not result in the take of any birds. Furthermore, Mitigation Measure BIO-1 was designed to prevent the disturbance of birds and nests.

The species designations from Shuford and Gardali (2008) are eleven years old. The DEIR used the most recent special-status species lists from the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

The species listed in Table 1 of Smallwood (2018) include multiple species that are not known to occur near the Project site. Examples include:

1. Zone-tailed hawk:

    Cornell Lab of Ornithology (allaboutbirds.org) – No published range in California.

Audubon Guide to N. American Birds (Audubon.org) – No published range in California.

2. Purple martin:

   Cornell Lab of Ornithology (allaboutbirds.org) – No published range in southern California.

   Audubon Guide to N. American Birds (Audubon.org) – Only published range in southern California is in San Diego County.

3. Summer tanager:

   Cornell Lab of Ornithology (allaboutbirds.org) – Only published range in southern California is inland, not near the coast, and considered uncommon.

   Audubon Guide to N. American Birds (Audubon.org) – Only published range in southern California is inland, not near the coast, and considered uncommon.

The species analyzed in Section 4.3 of the DEIR were those with special status (threatened, endangered, or special concern) and most likely to occur at or near the Project site. Detection surveys for each listed species are not required for evaluation in the DEIR. See also response to Comment O7-5.

Response O1-14

Mitigation Measure BIO-1 is designed to avoid or minimize impacts to birds, including from construction-related noise. The measure includes performance of bird and nest surveys, inclusion of construction buffer zones (with listed examples of 300 and 500 feet for non-listed and special-status bird species, respectively), and additional adaptive management measures to minimize noise at noise-sensitive receptors. See also Response O7-5.

Response O1-15

The proposed Project site and well sites are in developed areas, including on the District's property and in Doheny State Beach and Capistrano Beach Park, areas that are already subject to steady public use and traffic. The study cited in the comment (which described an increase in traffic to 20 cars per hour) is not comparable to the Project, which will have only 4 to 6 full-time employees and will not generate substantial amounts of traffic.

Response O1-16

The DEIR adequately characterized the proposed Project sites. The "likely movement routes of wildlife" presented in Figure 6 (Smallwood, 2018) includes hypothetical routes of volant birds and bats along the coast and is not based on any surveys or other evidence. Nonetheless, effects to birds and wildlife were addressed in Section 4.3 of the DEIR. Wildlife movement was addressed in Impact 4.3-4.

Response O1-17

The Draft EIR's conclusions with respect to the off-shore biological implications of slant wells are detailed in Section 4.3; Biological Resources. The basis of the analysis is several technical memoranda, including a

2010 study by Dr. Scott Jenkins from Scripps Institution of Oceanography. This memorandum, also summarized on page 3.0-10 of the Project Description, provides findings supporting the conclusion that potential impacts of subsurface slant wells to the seabed and benthic micro-organisms would be less than significant. The existing setting describing existing marine communities (benthic, demersal and pelagic) are found on pages 4.3-9 through 4.3-11.

Regarding consistency with the City of Dana Point General Plan, please see pages 4.3-23 through 4.3-25 of the draft EIR, as well as Section 4.9 (Land Use and Planning) which provides a detailed policy consistency analysis of the Project relative to City of Dana Point General Plan and other policies. As the use of slant wells will not result in significant impacts to biological resources as noted above and for the reasons cited, the Project is consistent with both the City of Dana Point General Plan and Ocean Plan policy.

The District properly relies on the assumption that the slant wells will not conflict with these policies because the conclusion is supported by the technical reports of the Draft EIR and its appendices. The DEIR conclusions are further supported by and based upon extensive regulatory agency consultation. Neither the City of Dana Point or the State Water Resources Control Board indicated any conflict with local or state plans or policies.

The hypothesis posed by Sobczynski is that: (1) dissolved organic matter (DOM) and suspended organic matter (SOM) are present in seawater at the site of the proposed slant wells; (2) sizes of DOM and SOM "are so small they will not get swept away by the wave action near the seafloor"; and (3) this material will then accumulate near the seafloor and be subject to "the sucking force of the slant well". While suspended material may not get swept by wave action, it is subject to long-shore and tidal current motion, which is not mentioned in the hypothesis. Dissolved material will not get swept away because it is dissolved within the water. Still, there is no basis to believe material will be accumulating at any perceptible rate because the infiltration rate is 0.000051 feet per second over the well field, and slower with distance away. Compared to ambient currents on the seafloor, there will not be a "sucking force."

The commenter also suggests that the extremely low infiltration rate will lead to anoxic sediment conditions. While the infiltration rate of the proposed Project is very low, the baseline is zero (i.e., there are no slant wells).

The anoxic subsurface sediment conditions described in the comment that will occur as a result of slant-well pumping is, in fact, a normal condition of marine sediments known as biogeochemical zonation. This is a vertical zonation, starting with an oxic zone at the sediment surface followed by a succession of bacterial communities with depth in suboxic and anoxic subsurface sediments (Eganhouse and Venkatesan 1993, Jørgensen and Kasten 2006). While depth of these layers varies considerably based on local conditions, the subsurface anoxic conditions described occur in marine sediments, and as described by Sobczynski slant-well pumping may result in a slightly deeper oxic sediment layer than currently exists.

In addition benthic infaunal organisms (those that live within marine sediments), play a role in both oxygenation of near-surface marine sediments through bioturbation and oxygen consumption in the same shallow subsurface sediments.

The commentator suggests that deposition of organic material on the seafloor results in the sequestration of those material into the sediments to either bind to sediments or enhance anoxic reduction of the organic material. The role that infaunal organisms play in nutrient cycling of organic material deposited on the seafloor is not discussed. Infaunal organisms, in general, employ one of three types of feeding strategies: filter feeding, deposit feeding or predation. Filter-feeding organisms include those that utilize adapted structures which they move through the water above the bottom to catch particulate organic matter (POM) which they ingest, those that use mucus nets to filter the water above them, and those that siphon water through internal structures for the same purpose. The second feeding type is deposit feeders which include organisms that specialize in scavenging POM from the sediment surface and those that actively ingest subsurface sediments and digest organic materials (DOM and SOM) that have become bound to inorganic particles as described by the commenter. Predators roam the surface or burrow through marine sediments and scavenge or prey on other infaunal organisms as they are encountered. All of these organisms in turn are susceptible to predation by fish and larger invertebrate species that cycle organic material back into the ecosystem. For informational purposes, densities of infaunal organisms found offshore of the Santa Margarita River (approximately 22 miles downcoast with similar nearshore habitat as the Project area) averaged 290 organisms per square meter (#/m^2) with up to 480/m^2 recorded in sediments at 35-feet (ft) depth, and averaged 753/m^2 and up to 920/m^2 at 90-ft depth (MBC 2013). These densities indicate that nearshore sediments are well utilized by infaunal organisms and that deposits of organic material on the seafloor are very likely to be cycled by these organisms.

Finally, neither the comment letter nor the supporting document explains how increased infiltration of organic material into seafloor sediments in the area of the slant wells as described would result in a negative impact to any sensitive species.

Response O1-18

General comments regarding feasibility of mitigation measures are noted, with responses to specific mitigation measure comments provided below. Regarding greenhouse gas mitigation, mitigation measures of the Draft EIR (GHG 1 and GHG-2) present feasible, quantifiable, and achievable strategies to reduce the GHG emissions of the Project. The use of an Energy Minimization and GHG Reduction Plan serves as a vehicle to refine, document and monitor the Project's emissions and reductions. Since GHG is a global issue, it is neither appropriate nor practical to provide "local" GHG mitigation. As detailed in the mitigation strategy, the Project will use a range of strategies to obtain a carbon-neutral project. In addition to offsets through a Renewable Power Purchase Agreement (PPA), the mitigation identifies additional measures such as alternative energy sources incorporated into the Project, reforestation, and energy-reducing design features. The primary performance standard is to achieve an offset of 5,959 $MTCO_2e$/year for the Phase I project. Mitigation Measure GHG-2 includes an annual third-party verification process to further ensure the effectiveness and implementation of GHG mitigation. Although not required to do so, the District continues to explore additional means of reducing GHG emissions, including consideration of fuel cells and establishing a "R&D pad" at the desalination facility to facilitate ongoing research into technologies that improve the desalination process and reduce environmental impacts.

Please see Response S1-12 regarding carbon neutrality. As noted in the Draft EIR (Mitigation Measure GHG-1), the District is proposing “net carbon neutrality” through mitigating the incremental increase in GHG emissions in comparison to baseline conditions, subjecting itself to independent third-party verification. This mitigation is considered fully compliant with CEQA and all current regulatory agency regulations at the local and State level. However, in keeping with the District’s well-established commitment to environmental stewardship, the District Board of Directors is currently considering committing to 100% carbon neutrality. While this commitment is beyond what is required by CEQA, the District recognizes that permitting agencies, such as the Coastal Commission, may seek additional mitigation beyond what is required by CEQA.

Response O1-19

The description of the existing environmental setting, including the use of available data as well as special study information, is adequate under CEQA and accurately characterizes current conditions. It is understood that environmental conditions in the Project area could change during the period between project approval and project initiation. A pre-construction survey would assess environmental conditions at the time of construction and conduct a survey accordingly. The mitigation measure assumes the competency of the surveyor to make these assessments, including the likelihood of occurrence of special status species. The comment also does not acknowledge that Mitigation Measure BIO-1 includes multiple measures to reduce the potential for impacts, including timing of construction to avoid nesting periods, reduction of disturbance if nesting is found, and tracking of nesting progress. Potential for impacts to bird nesting is associated with construction not operations, therefore a *“onetime effort to rescue special status species from crushing deaths under heavy construction machinery”* is appropriate for the construction period. Both DSB and Capistrano Beach Park are urban recreational settings that have been highly modified to accommodate recreational uses, generally consisting of sandy beach areas backed by developed areas including ornamental landscaping, parking lots, park walkways and roads, light poles, accessory structures, campground, and grass and picnic areas. Operational impacts will be less than those that currently exist in the Project area.

Mitigation Measure BIO-2 addresses the need to ensure that facilities at DSB avoid sensitive habitat along the banks of San Juan Creek lagoon through consultation with State Parks and applicable regulatory agencies. As noted above active Project planning would assess environmental conditions to assure the plans are consistent with protection of habitat at the time of construction.

Response O1-20

For the on-site work for the main desalination facility, haul routes will utilize Stonehill Drive headed eastward before entering the I-5 freeway. This trip will be roughly a quarter mile in a heavily traveled industrial area. For work done at Doheny State Beach, haul routes would travel westward on Park Lantern, turning northward on Dana Point Harbor Drive before turning eastward onto Pacific Coast Highway. An alternative route would begin by the Doheny State Beach campgrounds and travel westward on Park Lantern before entering Coast Highway going eastward. The route would then turn northward onto Doheny Park Road, continuing on there as it transitions into Camino Capistrano, and entering the I-5 freeway. These trips involve short travel distances to the freeway through heavily traveled and industrial areas with adjacent land uses that are not considered sensitive receptors. Construction and hauling would occur only during daylight hours and in compliance with the Noise Element of the City of Dana Point General Plan.

Response O1-21

The comment argues that the Draft EIR's Alternatives analysis is not adequate due to assertions of deficiencies in the biological resources analysis specific to the use and operation of slant wells. Please see Response O1-5 regarding this issue and the basis of the Draft EIR's conclusions regarding biological impacts. As the Project will not result in unavoidable significant environmental effects, the alternatives analysis evaluates options that could achieve the projects goals, including variations in design such as Alternative 5 (environmentally superior alternative) that could incrementally reduce the Project's impacts.

The commenter does not identify any other alternatives that should be considered. In fact, the Project utilizes intake and discharge technologies that have been determined by the State Water Resources Control Board to be the environmentally-preferred design.

Response O1-22

General summary comments are noted for the record. As set forth in the preceding responses, this comment letter does not provide substantial evidence indicating a new significant impact or substantially more severe impact, and as such, EIR recirculation is not necessary pursuant to CEQA Guidelines § 15088.5.

Attachments to Comment Letter

Please note that the comment letter summarizes the provided attachments, and responses address attachments as noted above.

Additional References

Eganhouse, R.P., Venkatesan, M.I., 1993. Chemical oceanography and geochemistry. In: Dailey, M.D., Persh, D.J., Anderson, Ž.J.W. Eds., Ecology of the Southern California Bight. A Synthesis and Interpretation. Univ. of California Press, Berkeley, pp. 71–189

Jørgensen, B.B. and S. Kasten. 2006. Sulfur Cycling and Methane Oxidation. Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Schematic-representation-of-the-biogeochemical-zonation-in-marine-sediments-The-names-of_fig1_226248577 [accessed 8 Apr, 2019]

MBC Applied Environmental Sciences (MBC). 2013. Marine Environment Studies Report- Final. San Diego County Water Authority Proposed Camp Pendleton Seawater Desalination Project Technical Studies. Prepared for RBF Consulting, San Diego, CA.

Nature Commission

July 27, 2018

TO:
South Coast Water District
31592 West St.
Laguna Beach, CA 92651-6907

FROM:
Kevin Nelson
Nature Commission
PO Box 73126 San Clemente CA 92673

Doheny Desalinization Project Manager,

Please accept these DEIR comments on the proposed facility.

While I strongly agree with securing greater water security from the inevitable shortages that will occur as a result of nature's inherent patterns, and desalinization as a technology to achieve these goals, the water from this project should be used only for drought relief, not for further population growth which only undermines that goal.

Water availability enables more housing and is therefore growth inducing. This factor and its effects on the last remnants of open space and wildlands in the region are not analyzed or discussed adequately in 1
the DEIR, if at all.

As required by Section 15126.2(d) of the California Environmental Quality Act, an Environmental Impact Report must consider the ways in which the Proposed Project could directly or indirectly foster economic or population growth, or the construction of either directly or indirectly, in the surrounding environment, and growth-inducing impacts can result from the elimination of obstacles to growth.

Further, this project's effects on the last percentages of open space left in the region must be set in context of the finality of the elimination of these resources.

The planning of other agencies clearly indicates that some growth plans hinge on the supplies of this project, yet the DEIR fails to mention or analyze these facts as well.

Points To Be Addressed In EIR:

-While there is little doubt that fresh water will continue to be in short supply, the project's effects on the last percentages of open space, nature and outdoor recreation at larger scale should be measured in context of the finality of those resources.

-If and as the final few open land areas consumed in the region, are we abdicating our generation's responsibility to share resources with future residents by leaving some resources for them to decide upon?

-If, as shown in planning by other local agencies, there is high likelihood that the project water will be
used by them in foreseeable future for uses outside of emergency drought relief, to what extent and 1
ways will this diminish the drought relief purpose?

-The actual and detailed use of the water on a regular basis should be detailed for growth inducing assessment, unless supplies are to be restricted from new development uses.

-If the project is likely to expand into phases 2 or 3, why should this not be classified as a piecemeal approach to permitting when it seems to be a classic example of such?

-Once water from the project plant is brought online locally, does this not enable current suppliers like MWD to supply water for more growth in their service areas, magnifying such effects?

Planning Statements by Local Agencies:

The statements below from official documents indicate the expected and planned-for growth in the region, and the role water supply from the proposed project qualifies as a growth-inducing impact.

TCA (Toll Road Agency)

"With Orange County's population expected to increase by more than 250,000 residents and traffic delays projected to increase by 66 percent by 2040, TCA is committed to identifying solutions that will relieve the traffic congestion on Interstate 5 through South Orange County." (see images, last page)

http://thetollroads.com/about/projects/long-range-planning

San Juan Capistrano 2

"Projected Population: While both Orange County and the City of San Juan Capistrano are expected to experience more growth during the next 30 years, future growth will be significantly lower than past growth. Between 2008 and 2035, Orange County is expected to grow by14.5 percent, a gain of 432,000 new residents. According to the forecasts made by SCAG for the Southern California region, San Juan Capistrano is forecasted to grow by 9.9 percent during that same time period, which would be a gain of 3,400 new residents.

Much of the community can be characterized as residential and rural residential. A large part of the remaining vacant land to be developed consists of parcels with environmental constraints, with topographic and drainage constraints, and with other limitations as identified in the Public Safety and Resource Management elements of the General Plan. In a tight housing market, achieving maximum density is financially feasible because the developer is able to recuperate the investment even at high density products that do not usually command the highest market value.

Ventanas Development San Juan Capistrano
(see images)
This 9-acre vacant site located east of Interstate 5 and north of San Juan Creek, has been identified as a potential site for housing development due to access to transit, schools, etc. The site additionally has a potential for mixed use. The site has a potential development capacity for 230 units. "For the purposes of this site inventory, capacity for the Ventanas site is based solely on the portion of the site allowing Very High Density residential and does not include portions of the site allowing commercial development. The Ventanas site was rezoned in January 2014 from Planned Community (Sector B-2 Industrial Park) to Planned Community (Sector B-3 Very High Density Residential). The new zoning designation allows for development of residential uses at 30 units per acre.

MNWD Metropolitan Water District of Southern California
Doheny Desalination Project –
In 2013, after five years and $6.2 million to investigate use of a slant well intake for the Doheny Desalination Project, it was concluded the project was feasible and could produce 15 MGD (16,800 AFY) of new potable water supplies to five participating agencies. These agencies consist of: SCWD, City of San Clemente, City of San Juan Capistrano, LBCWD and MNWD. 2
"SCWD anticipates leaving the option open for other agencies to participate in a larger, 15 MGD facility, with subsequent permitting and construction of additional slant wells and treatment capacity."

Developing local supplies within Metropolitan's service area, including supplies based on ocean desalination is part of their Integrated Water Resource Plan (IRP) goal of improving water supply reliability in the region.
On May 6th, 2015, the SWRCB approved an amendment to the state's Water Quality Control Plan for the Ocean Waters of California (California Ocean Plan) to address effects associated with the construction and operation of seawater desalination facilities (Desalination Amendment). The amendment supports the use of ocean water as a reliable supplement to traditional water supplies while protecting marine life and water quality.

If the following projects are developed, Metropolitan's imported water deliveries to Orange County could be reduced. These projects include the Huntington Beach Seawater Desalination Project, the Doheny Desalination Project, and the Camp Pendleton Seawater Desalination Project.

MWDOC Municipal Water District of Orange County
RELIABILITY OF WATER SUPPLIES
This section provides a description of Metropolitan's, MWDOC's, and MNWD's efforts in securing adequate water supply as well as reliability of the region and the District's normal, single dry year, and multiple dry year water supplies.
The Southern California region faces a challenge in satisfying its water requirements and securing its firm water supplies. Increased environmental regulations and the competition for water from outside the region have resulted in reduced supplies of imported water.
Continued population and economic growth correspond to increased water demands within the region, putting an even larger burden on local supplies.

Local Resources Programs (LRP)
•Providing incentives of up to $250 per acre-foot to expand water recycling and groundwater recovery programs. Eighty-six participating water recycling and groundwater recovery projects are expected to collectively produce about 363,000 AFY once fully implemented. Since inception of the LRP in 1982, Metropolitan has provided more than $244 million for the production of about 1.3 MAF of recycled water and recovered groundwater.
•Encouraging development of seawater desalination by promoting improved regional facilitation and funding.
•Updating policies to allow for an open process to accept and view project applications on a continuous basis, with a goal of development of an additional 174,000 acre-feet per year of local water resources.

Laguna Beach
MWDOC: 2015 Urban Water Management Plan:
Potential projects were identified during the development of the OC Water Reliability Study in 2015. Projects listed below could benefit individual agencies and the region.
-Huntington Beach Seawater Desalination Project
-Doheny Ocean Desalination Project
The planned desalinated water would be from either of the two projects with conveyance details to be 2
worked out at a later date.

Potential Impacts to San Mateo Watershed

In its "Proposed Range Extension for Endangered Steelhead in Southern California,
"The National Marine Fisheries Service identified increased groundwater extraction, loss of riparian vegetation, stream channel changes, surficial flow reductions, human-caused fires, and the introduction of non-native predator species as the main threats to steelhead in the San Mateo Creek watershed.

In the 1990's a Conjunctive Use Concept was considered that envisioned a joint venture between the Marine Corps Base Camp Pendleton and Tri-Cities MWD (was subsequently consolidated into South Coast Water District) that would utilize the potential groundwater basin yield of about 2,000 AF ± and also would also consider storage of imported water for use for emergency purposes in an arrangement with the Marine Base. No current discussions or contacts have been made with the Marine Base.

A project would also indirectly induce growth if it would remove a constraint on a required public service or utility or include the extension of infrastructure into previously undeveloped areas.

Source of Impacts on San Mateo

The Center for Demographic Research (CDR) estimates that the District had a December 2015 population of 156,949. The District has seen moderate growth within the service area, and its population is projected to increase 27 percent by 2035. Anticipated growth comes from continued development of Rancho Mission Viejo in the southeast portion of the service area.

Nature Commission

CEQA Terms:

Piecemeal
By examining the project only under the first third of an expected size, the CEQA prohibition against piecemeal applies.

Baselines on Full Buildout of Project
For the purposes of understanding its actual environmental effects, the baseline of a given project's likely buildout should be analyzed.

Less Than Significant
This term is so often used to excuse and write off actions that should not otherwise be minimized. However, the context here puts pressure on the last segments of some resources and cannot therefore be classified as "less than significant" on resources of importance such as wildlands and recreational open space.

Conditions Created by Past Actions
Environmental Law Reporter - DEMYSTIFYING CEQA'S CUMULATIVE IMPACT ANALYSIS REQUIREMENTS: The California Supreme Court has explained that the requirement to assess past projects "signifies an obligation to consider the present project in the context of a realistic historical account of an EIR's relevance to prior activities that have had significant environmental impacts." To do this effectively, an EIR "must reasonably include information about past projects to the extent such information is relevant to the understanding of the environmental impacts of the present project considered cumulatively with other pending and possible future projects".

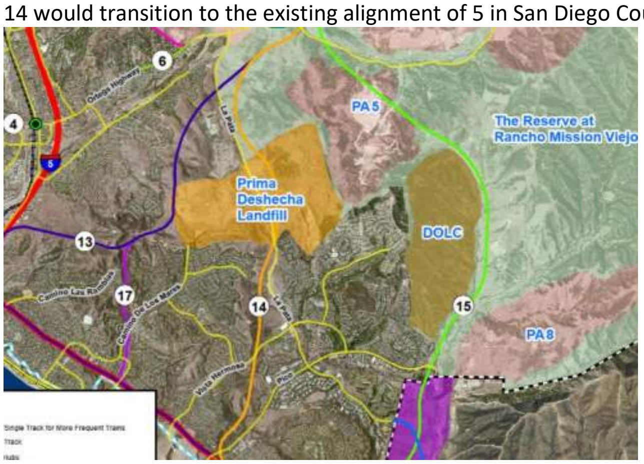
3

Images and Graphs

Toll Road Route 14 shown below greatly impacts multiple wildlands and arroyos, cutting directly through them.

Members: SOCMWG – South Orange County elected officials Caltrans, OCTA, TCA, the County of Orange, South Orange County Cities Public Works Planning Staff, Southern California Association of Governments (SCAG)

"CONNECT SRT 241 TO 5 VIA LA PATA AVENUE CROSSING AT AVENIDA PICO
14 would transition to the existing alignment of 5 in San Diego County and would end at Basilone Road."



4

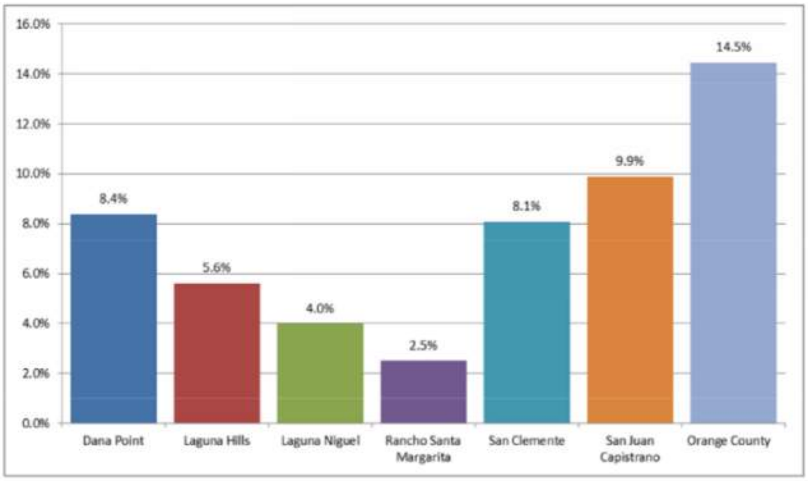
This habitat-rich near Ortega Hwy and LaPata would also be greatly affected
By the toll road, as one of the favored routes.

Ventanas Development San Juan Capistrano

This large site located east of Interstate 5 is used regularly by hikers and bike riders crossing the ridges between San Juan and San Clemente, making it a valuable recreational resource. This type of resource is much more valuable and important than more housing development




Growth Projection by So Cal Assoc of Governments



Source: SCAG. 2012 RTP Growth Forecast: City Projections. 4

Table 2-2: Population – Current and Projected

Retail: Population - Current and Projected						
Population Served	2015	2020	2025	2030	2035	2040
	156,949	169,628	187,826	194,951	199,028	200,026
NOTES: Source: Center for Demographic Research						

Table 4.2 MNWD Past, Current and Projected Water Demand by Water Use Sector

Fiscal Year Ending	Water Demand by Water Use Sectors (AFY)				
	Single Family	Multi-Family	CII	Landscape	Total Demand
2005	19,648	2,838	3,020	10,901	**36,407**
2010	17,589	2,600	2,678	10,980	**33,846**
2015	21,100	3,118	3,212	13,170	**40,600**
2020	19,748	2,919	3,006	12,327	**38,000**
2025	20,008	2,957	3,046	12,489	**38,500**
2030	20,268	2,995	3,085	12,652	**39,000**
2035	20,527	3,034	3,125	12,814	**39,500**

Thank you for your interest and answers in the EIR.

Regards,

Kevin Nelson

Founder, Nature Commission

Letter O2 Nature Commission

Kevin Nelson, Founder
July 27, 2018

Response O2-1

The commenter questions the Project's potential for growth-inducing impacts, and specifically how water availability could have an adverse effect on open space and wildlands. A discussion of potential growth-inducing impacts of the Project is included on pages 6.0-3 through 6.0-5 of the Draft EIR. As discussed in the Draft EIR, the District's recently completed Water Reliability Study (December 2017) further substantiated the need for the Project, given the region's reliance on imported water, hydrologic uncertainties due to prolonged drought conditions, and system vulnerability to interruption due to unplanned maintenance or seismic-induced damage. In other words, the Project is needed in the near-term to address existing vulnerabilities.

As further described on page 6.0-5 of the Draft EIR, the Project will provide a new source of potable water, which will replace imported water supplies.[1] Improving the reliability of local water supplies may be considered "growth-inducing" in that it may remove one "impediment" or barrier to growth. However, this is not considered a significant environmental impact for several reasons.

First, given the fragile and unreliable nature of imported water, and growing pressure on already constrained freshwater and groundwater resources, the provision of ocean desalination is not anticipated to significantly "increase" regional water supplies. One of the primary Project objectives is to reduce reliance on imported water sources, not simply divert the imported water sources elsewhere. With the Phase 1 "Local" Project and Regional Project, any product water would not be expected to increase the water supply portfolio of a given water provider; rather, the Project would allow the District or other water providers to develop a balanced water supply portfolio that places less demand on scarce imported water, freshwater and groundwater resources while promoting other options such as conservation and recycling in response to evolving laws and regulations.

Second, the District or other water suppliers do not have land use approval authority, and as such any future "growth" would be subject to local land use agency review and approval and appropriate CEQA compliance (in fact, numerous local, state and federal agencies have either land use approval or discretionary permit approval authority over any future development). Land use planning and local City and County general plans establish lands designated for open space and other uses based on a variety of factors besides water availability.

The Local Project could produce as much as 5 MGD for use by the District or potentially by other local agencies. The District's own peak demand goes as high or higher than 5 MGD,[2] and therefore the entire

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[1] The District's own service area is nearly fully developed. The only water supply assessment currently under review by the District for new development within its service territory is for the Doheny Village Project, which is a redevelopment project that proposes use of only 100 acre-feet-year of water beyond current use. See Draft EIR, Table 4-1: Cumulative Projects, p. 4.0-7; see also Dana Point, California, Doheny Village website, available at http://www.danapoint.org/businesses/doheny-village (accessed May 30, 2019).

[2] See, e.g., SCWD Comprehensive Annual Financial Report, For Fiscal Year Ended June 30, 2018 (2018 CAFP), p. 99, available online at https://www.scwd.org/depts/finance/financial_statements/audited_financial_statements.htm (accessed May 28, 2019); see also, Draft EIR p. 6.0-4 (Project water supply included in 2015 UWMP, and Capital Improvement Program, and substantiated by MWDOC's OC Water Reliability Study).

supply of desalinated water from the Local Project could be used to serve the District. At times when the District's demand is below 5 MGD, the District could store excess product water within its system, which currently allows for more than 20 million gallons of storage.[3] In addition or alternatively, the District could reduce production as the Local Project is designed to allow the District considerable flexibility in how much water is produced. During periods of lower demand, the facility production has the capability to be ramped down by shutting off one or two of the three active intake wells and one or two of the three downstream Reverse Osmosis Units. This would allow the facility's capacity to be temporarily reduced by one third to approximately 3.3 MGD, or two thirds to 1.7 MGD. Therefore, if the District's own demand is low and its storage facilities are maximized, it has the option to reduce production.

Alternatively, if agreements are reached in the future and further CEQA review is conducted, the District could provide excess product water to other local water agencies. However, it would be speculative at this point to hypothesize potential recipients of desalinated Project water other than the District, as no such partners are in place, no funding agreements are in place, and no such commitments have been made. It would also be speculative to hypothesize how much imported water would be taken (though the total between District use and use by other agencies would be no more than 5 MGD unless the Regional Project first goes through further environmental review), or how that water would be used. Provision of desalinated water outside of the District service area would require separate CEQA review and/or applicable discretionary review and approvals by one or more agencies. Any facilities that may require construction or modification to convey, pump or store desalinated Project water for other agencies would similarly require separate discretionary review and CEQA compliance. In addition, further study would be needed to be done before desalinated water can be newly introduced into the agency's water system.

Lastly, the Project's production of desalinated water for the District could "free up" imported water, which would otherwise be used by the District, for potential use by other local water agencies. However, the District does not control and cannot predict which, if any, other water agencies may use that imported water, or how much they would use, or how it would be used (whether to replace other less-reliable water supplies or to increase its water supply portfolio). No other local agency is necessarily required to take that water. Therefore, analysis of potential use of that imported water would be speculative and thus not required under CEQA.

The commenter also questions whether the DEIR "piecemeals" environmental review of the Project. Only the Phase I "Local" Project is under consideration for approval at this time, and the Local Project's up-to-5 MGD capacity is consistent with the District's Urban Water Management Plan as well as regional water supply planning documents (see Draft EIR Section 6.3.4, pages 6.0-4 and 6.0-5). The District's Urban Water Management Plan is limited to the Local Project because it does not need the Regional Project to meet capacity needs. The Regional Project is not under project-level review at this time because there are no project partners in place, thus a detailed description of the Regional Project and its likelihood of occurring are considered speculative. If the Regional Project is found to be necessary for future capacity needs and does find project partners to move forward in the future, then the Regional Project would require its own further review under CEQA.

[3] See, e.g., Id. at p. 100.

The commenter questions the Project's potential effects on open space and natural resources, but it is not clear what potential impacts the commenter is referring to or where such impacts could occur. The Draft EIR addresses growth inducement issues on pages 6.0-4 and 6.0-5. The Project would have no long-term effect on natural open space for pipeline and desalination facility construction due to the disturbed nature of these sites. For the slant wells, the Project would require temporary construction and associated impacts within Doheny State Beach or Capistrano Beach Park, which are addressed in detail within Section 4.12, Recreation. As discussed above, the Project would replace a less reliable water source within the District with a more reliable source and as such would not remove existing barriers to growth within or outside of District service boundaries. Therefore, any analysis linkage between the Project and any land use agency's open space plan would require speculation, which CEQA discourages.

With respect to the comment regarding project phasing ("piecemealing"), please see Master Response 2 and Response O1-4.

Response O2-2

Planning statements made by other agencies are noted for the record. The comment does not indicate in what way these statements may contradict Draft EIR analyses. Regional growth is acknowledged and addressed by the applicable local planning agencies including the Southern California Association of Governments, the County of Orange, City of Dana Point and other member agencies within the MWDOC service area. Please see above response regarding the land use authority of individual agencies. The statements demonstrate that the land use planning process of individual agencies is ongoing, based on growth and population trends in Orange County. The statements also reiterate that projects such as the Doheny Ocean Desalination Project and other water supply projects are being planned in response to existing vulnerabilities in the existing water systems. Each General Plan adopted by a land use agency considers the location and pattern of land uses, including open space, over an extended time horizon. The impacts of those land use plans, including the amount and location of open space, are analyzed within environmental documents adopted by the individual agencies. Also refer to the end of Response O2-1 above.

Responses O2-3 and O2-4

List of CEQA terms and images are noted for the record. The comment provides various graphs and figures related to future growth in south Orange County, which are also noted. The comment does not indicate how this information represents an inadequacy in Draft EIR analyses.

Comment Letter O3

ORANGE COUNTY
COASTKEEPER®
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South Coast Water District
31592 West St.
Laguna Beach, CA 92651

August 6, 2018

Re: Doheny Desalination Plant EIR Comments

Dear Ms. Morgan,

Orange County Coastkeeper is an environmental organization with the mission to promote and restore water resources that are drinkable, swimmable, fishable and sustainable. We have reviewed the proposed revised Term Sheet and have the following comments.

Orange County Coastkeeper appreciates the efforts of the South Coast Water District to design the proposed Doheny Desalination plant to in accordance with the California Ocean Plan requirements to utilize the best available best available site, design, technology, and mitigation measures to minimize intake and mortality of all forms of marine life.

We also want to take this opportunity to applaud the South Coast Water District, and other project proponents, for conducting a proper subsurface feasibility analysis as required by the California Ocean Plan. In 2003/04, project proponents undertook preliminary studies to assess intake options including a conventional open intake, a subsurface infiltration gallery, and various types of beach wells. To investigate the feasibility of a subsurface slant well intake, a phased hydrogeology and subsurface well technology investigation was undertaken. In 2004/05, four exploratory boreholes were drilled along the beach to a depth of 188 feet below the ground surface. In 2005/06, after a thorough review of several technologies it was determined that the most cost-effective approach for this location was the use of slant beach wells constructed with a dual rotary drill rig from the beach out under the ocean. 1

The Doheny Project demonstrates that conventional pretreatment is not necessary for subsurface intakes. From the four exploratory boreholes it was discovered that "…[t]he produced water showed a very low silt density index (average around 0.5 units) and turbidity (averaged around 0.1 NTU), indicating excellent filtration by the aquifer which eliminates the need for conventional pretreatment filtration and saves costs."[1] Furthermore, "…the produced water showed no presence of bacterial indicator organisms which were found to be present in high concentrations in the ocean and seasonal lagoon," and that "[b]iofilm growths by the end of the test were found to be less than 10 µ in thickness, a level of no concern for biofouling."[2] Pumped well water was run directly to the test RO units continuously for over four months. No fouling or performance deterioration was observed during the test or in the post-membrane autopsy as

[1] *See* Attachment Two: Municipal Water District of Orange County, Final Summary Report Doheny Ocean Desalination Project Phase 3 Investigation, pg. 14 (January 2014).
[2] *Id*.

all the dissolved iron and manganese was easily removed as anoxic conditions were maintained throughout the test period.[3]

The Doheny study concluded that subsurface intakes do not need full conventional pretreatment – the natural filtration by the aquifer eliminates the need for conventional pretreatment filtration. The Doheny study further demonstrated that the use of subsurface intakes – and the avoidance of full pretreatment – resulted in significant cost savings, including $56 million in capital costs and $1 million annually in O&M costs. And finally, the Doheny study determined that the Doheny project using subsurface intakes would produce water for $600 per AF cheaper than that of the Poseidon-Huntington Beach open ocean intake proposal. The Doheny project proponents should be commended for properly analyzing subsurface intake options. They conducted physical test wells, which resulted in feasible subsurface intakes and reduced capitol and operation costs – not to mention less impact on the environment. 1

We recognize that unlike the rest of Orange County, south Orange County relies on imported water for 85% to 100% of its supply and has only sixteen days of water storage capacity. With that in mind we support the proposed 5 MGD plant as a means to provide emergency backup water supplies. We want to emphasize that water from this plant should replace an equal portion of imported water and that other more environmentally friendly and less expensive water supply options are pursued to meet future water needs. Orange County Coastkeeper supports a loading order in which conservation is the top priority for water followed by stormwater capture and recycling, before an expansion of the proposed plant is considered.

We have the following specific comments on the EIR:

In the Enhanced Conservation Alternative discussion the EIR states that the 2015 URWMP water conservation strategies are being implemented in accordance with state laws and local ordinances. However a recent MS4 Discharge audit by the San Diego Regional Water Board found that every city in south Orange County has an inadequate program to eliminate runoff from over irrigation. Considering that landscape irrigation accounts for 60% to 70 % of potable water use in Orange County this is evidence that there is still a lot of water to be gained just by doing a better job of reducing irrigation waste. Further, the alternative review does not take into account the new requirements from SB 606 and AB 1668 that were signed on May 31 2018. This legislation includes requirements to substantially reduce urban water use including achieving a per capita indoor water use of 55 gallons per day by 2025 and 50 Gallons per day by 2030 along with water budgets for outdoor use. Meeting the legal requirements of the Regional Water Board and State legislation will result in substantial water savings that can reduce future water need and should be prioritized over an expanded desalination project. 2

In the Enhanced Recycled Water Alternative discussion the EIR states that the recycled water facilities envisioned in the 2015 URWMP would result in a total of 1.350 AFY of recycled water. There are certainly more opportunities for recycling water in than were considered in the 2015 UWMP. For instance the district could pursue a direct potable reuse system. The EIR discussion states that there is no current regulatory pathway in California for this, but that does not mean it can't be done. The district can legally apply for a permit from the state to implement such as system now. And the state is currently working on regulations to support direct potable reuse that will be complete in five years or so. Direct potable reuse should be considered a priority over any expanded desalination project.

[3] *Id.*

Seawater desalination is energy intensive. The EIR states that the project will be net carbon neutral based on existing conditions. Existing conditions includes imported water being pumped over long distances, which has a large carbon footprint. Since this project is designed to replace imported water it should fully mitigate for the water it is purported to replace, which will continue to be imported. The MWD has made it clear that it will continue to import all the water it is permitted regardless of new local supplies. 3

In closing Orange County Coastkeeper recognizes the effort that South Coast Water District has undertaken to design a desalination plant that meets the goals of the California Ocean Plan and that the proposed plant fills an important role for south Orange County in providing a emergency supply for the 4,400 AFY of water necessary to get through a emergency situation. We support the project on this basis.

Respectfully,

Ray Hiemstra
Associate Director
Orange County Coastkeeper

Letter O3 Orange County Coastkeeper

Ray Heimstra, Associate Director
August 6, 2018

Response O3-1

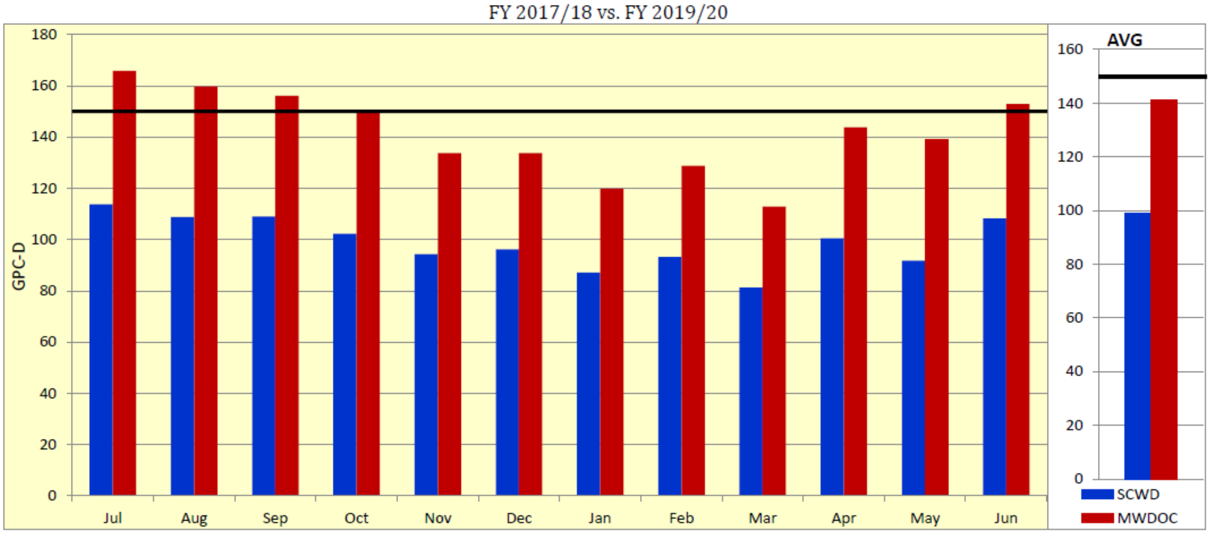
Comments supportive of the Project development process and proposed design are noted for the record. The Local Project (up to 5 MGD) is consistent with the District's Urban Water Management Plan to provide a reliable water supply in light of current imported water system vulnerabilities. Project water would be available in both emergency drought conditions and for normal operations. The District has a strong commitment to conservation, recycled water and groundwater reclamation, as discussed in Section 3 of the Draft EIR pages 3.0-2 through 3.0-8. The District is a partner with San Juan Basin Authority's (SJBA) San Juan Watershed project, which is a stormwater capture project. As confirmed by a stakeholder-led Water Reliability Working Group and a separate regional water supply reliability study prepared by MWDOC, the Doheny Ocean Desalination Project is the best choice to ensure local water reliability. Please also see Response O2-1 regarding the replacement of a less reliable water source with a more reliable, locally produced source.

Response O3-2

Comments supporting expanded conservation efforts consistent with State law as an alternative to further expansion of desalination are noted for the record. The Enhanced Conservation alternative in the Draft EIR provides a general comparative analysis to the impacts of the proposed Project and concludes that enhanced conservation efforts alone, while fully supported by the District, would not meet the water supply reliability and diversity goals of the Project. According to the Orange County Water Reliability Study, water demand for Orange County is projected to be 617,466 acre-feet per year in 2040, which translates to roughly 550 million gallons per day. The District remains committed to water conservation and achieved a 22% reduction in demand compared to 2016 consumption levels. The District has water conservation regulations in place as set forth in District Ordinance 222, including increased public outreach, and potential fines for improper usage. Although not directly related to the Project, the District also supports enhanced efforts by local municipalities to strengthen programs to reduce or eliminate runoff from over-irrigation, and to encourage urban landscapes that require less potable water.

A chart provided by the District outlines the water usage by SCWD and the MWDOC in gallons per capita per day (GPCD). The chart shows the water demand for the District GPCD and MWDOC GPCD trending below their goal of 150 GPCD. Specifically, the data within the chart shows that the District, using the State's formula of single family and multi-family demand divided by district population, is trending at approximately 94.4 GPCD. As well, the MWDOC formula of total water produced divided by total population is trending at approximately 132 GPCD.

SOUTH COAST WATER DISTRICT
Residential Water Usage (in Gallons Per Capita-Day)
FY 2017/18 vs. FY 2019/20



FY 2018	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Average[1]
2017/18[2] State Report	113.8	108.8	108.9	102.2	94.3	96.2	87.1	93.2	81.2	100.5	91.8	108.2	98.9
2017/18[2] MWDOC	165.8	159.7	156.1	150.5	133.8	133.7	119.8	128.8	112.8	143.8	139.2	152.8	141.4
2020/21 Target	150	150	150	150	150	150	150	150	150	150	150	150	150.0
Variance	15.78	9.66	6.1	0.49	-16.2	-16.28	-30.17	-21.18	-37.17	-6.22	-10.83	2.8	-8.6
Percent Difference	10.5%	6.4%	4.1%	0.3%	-10.8%	-10.9%	-20.1%	-14.1%	-24.8%	-4.1%	-7.2%	1.9%	-5.7%

[1] YTD where applicable SCWD calculation based on population of 35,004; MWDOC uses population of 34,415.
[2] State Report considers only residential water usage, while MWDOC uses overall water consumption.

Additional opportunities for expanded water recycling are also noted for the record. The water system will benefit from a diversity of sources including recycling, conservation, groundwater and desalination. The District is not precluding direct potable reuse, should that water supply option be available in the future; however, there is a present need for a reliable water supply and the Doheny Ocean Desalination Project has been found to be the best option. As noted above in Response O3-1, the District is a partner with SJBA in the San Juan Watershed Project, which includes stormwater capture during Phase I, and contemplates indirect potable reuse during potential future phases.

Response O3-3

Comments regarding carbon neutrality are noted. Please see Response. S1-12. Mitigation Measures GHG-1 and GHG-2 are designed to ensure that the Project is designed and operated in such a manner that there would be no net increase in GHG emissions, as compared to the baseline environmental setting (Draft EIR page 4.6-16). Carbon neutrality will be achieved through several pathways, including state of the art energy efficient design, alternative energy sources such as fuel cell technology and solar, in addition to the purchase of credit offsets. The Local Project is consistent with the District's Urban Water Management Plan. Once the Project is operational, the District would reduce its demand for imported water through MWDOC. The District has no control over what MWDOC or other agencies do in light of the District's reduced demand on imported water. This issue is further discussed in Draft EIR Section 6.3, Growth-Inducing Impacts of the Proposed Action, and in Response O2-1.

Concluding comments in support of the Project are noted for the record.

DATE: August 6, 2018 1pm

TO: South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, District Engineer
31592 West Street, Laguna Beach, CA 92651 949-499-4555
http://scwd.org/contact/directory/acting_general_manager_chief_engineer.htm

Partially Uploaded to Comments:
http://scwd.org/depts/engineering/projects/water_supply_projects/oceandesal3/environmental_documents/draft_eir_comment_form.htm
Submitted with formatting to: smorgan@scwd.org, cc: rshintaku@scwdd.org

FROM: Dr. Tom Williams, Sierra Club, Angeles Chapter, Water Comte.
Senior Techn. Adviser, Citizens Coalition for A Safe Community
4117 Barrett Rd. La, Ca 90032-1712
323-528-9682 ctwilliams2012@yahoo.com

SUBJECT: Doheny Ocean Desalination Project: **Draft Environmental Impact Report (EIR)**
State Clearinghouse No. 2016031038
RE: Comments on DEIR #1pm, more to come.

Thank you for the opportunity to review the proposed Project and the current Environmental Impact Report, and lengthy appendices. Our review as provided in the following comments indicates that the EIR is inadequate and incomplete and is of low quality. The current DEIR must be revised and recirculated

General Comments

Desalination would provide a reliable, drought-proof and locally controlled safe water supply, but like imported water uses reduces the providers concerns regarding the natural water resource constraints and dependencies for the area's existing water resources (e.g., groundwater/rainfall/runoff-recharge compared to imports from he Colorado or the Pacific).

If implemented, the Doheny Ocean Desalination Project could provide high quality, locally controlled and drought-proof water supply while protecting parts of the environment. Currently, South Coast Water District imports 85 to 100 percent of its drinking water, causing vulnerability during droughts, supply shortages and potentially during natural disasters and has given up on groundwater and rainfall. 1

Doheny facility with advanced slant wells for intakes is more environmentally considerate than other methods but may adversely affect shallower, fresher groundwater. Current groundwater computer modeling does not address impacts on inland groundwater moving westerly/seaward.

No adequate evaluation is available regarding power use for wedge-wire piped intake compared to well draw.

Nanno-/Micro-marine life is protected by wedge wire pipe intakes which are also used as well screens drawing water from beneath the ocean floor because of their power requirements (kw/gal).

The entire CEQA document, the applicant, and preparers appear not to have resolved whether the document is for the Local Project, only or both the Local and Regional Projects. Some Local elements appear to be capable of serving both levels of service.

Intake wells/pipes would extend toward the Newport-Inglewood Fault Zone, and Dana Point may be a remnant fault block related to this fault zone. Further geophysical/ground movement (0.1-0.6in) and seismic (-2 - +4 RM) monitoring should have been implemented for locating seismic activities as the imported water reliability is involved with seismic risks and activities.

Less than 1/2 page of setting and assessment for Environmental Justice with a 40,000 resident and 1000 businesses service area appears totally inadequate. 1

Various mentions of economics, finance, costs, and funding for Local and Regional Projects and for businesses and tourism require further, adequate, and complete financial/economic impact report, including rate structures and rate payers charges.

SPECIFIC COMMENTS

Form**at: **Copy of DEIR text with highlight with comments on DEIR text.

0.0 NOA **The Local Project,**

product water storage tank ***(5 MG rather than 1.6 MG)***
distribution system that would feed into the **District's local distribution system**
depending on **plant capacity and District demands**, other **adjacent local and regional transmission pipelines** that are located adjacent to the site. ***Preparers do not know or provide differences between transmission and distribution systems. Provide delineation of Regional, District's, local, and "Non-Local" pipes, lines, distribution, and transmission systems.*** 2
conveyed entirely using existing **District and local infrastructure** with **no off-site improvements** other than a short connection to the District's existing local transmission lines
Preparers do not know or provide differences between District and "Local" "infrastructure" and "local transmission lines (=pipes).
appurtenant facilities (e.g. pump stations, valves and metering)
all construction, operation and maintenance activities associated with **all** Project facilities.
Use of "all" suggests including both Local" and "Regional" Project facilities. Clarify and revise.

0.0 NOA **The Regional Project,** if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of **Regional Project** details.

Continuing references to the "Regional Project" distracts and confuses public reviewers and may become basis for claiming "Program Assessment" at a later date.

The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date.

1.0-3/1 The proposed Project aims...to secure water supply reliability by developing a drought-proof, hydrologically independent, water...to **meet the service area demands at either a local or regional scale**. The **Phase 1 project** capacity (up to 5 MGD) would help meet the service area's water demands at a **local scale**....
For the **potential future Regional Project** (up to 15 MGD), SCWD would look to involve **regional partners which would expand the service area of the facility and would help meet the water demands at a regional scale**…reducing the need for imported water… 3
…improving **overall regional supply reliability.**
The District **only** intends to pursue permitting and construction of the **Phase 1 Project** (up to 5 MGD) **at this time**.
Inconsistent use of Phases and Scenarios is confusing and distracting as they are not clearly defined and explained at first usage and consistently thereafter. Either remove or consistently use in a revised DEIR. The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date.

1.0-3/2 ….In addition to Project-level analysis for Phase I, **<u>this EIR also functions as a Program</u>**
<u>EIR</u>…providing a **<u>programmatic level analysis</u>** of a potential future Regional Project of up to 15 MGD….SCWD
only intends to seek regulatory permits and approvals for the Phase I Project at this time,
as there are no Regional Project partners in place, and
specific Regional conveyance facilities are dependent on Regional Partners and
as such cannot be identified at this time.
<u>A Program EIR is also appropriate,</u> 3
in that it evaluates a phased public works project where SCWD may implement one or more options, and
in that it evaluates a broad range of implementation options to accomplish SCWD's Project objectives.
The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR is a confused mess of Project and Programmatic DEIR for the Local and Regional Projects.
The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date.

Mixing discharge brine with treated sewage for outfall destroys "freshwater" (=treated sewage with TDS of <1.0ppt) from future Direct Potable Reuse, a significant adverse effect. As an alternative, such
freshwater may be replaced by recirculation of seawater into the ocean outfall with an improved diffuser 4
designs (e.g., inject seawater into outfall discharge flows to reduce TDS down to < 35ppt...from 60ppt + 30 > 45 + 30 > 38ppt +30 = 1 part brine + 3 parts seawater

The DEIR does not discuss the project's effects in the service area including Environmental Justice and Growth Inducements and no hydraulic model is provided for the service areas. The proposed project would be important to supplying lower elevations (<600ft elev.) and S+W sides (within 6 miles) with better water than those receiving "imported water" to the N+ E portions of the service areas.

The DEIR must be withdrawn revised, and recirculated with a full service model including service 5
parameters (pressures, flows, and qualities) for both the imported water and desal waters. Once the service area model is developed and validated, the model must be rerun as a "Growth Inducement Run" with all vacant land developed consistent with surrounding land uses. Once model runs have established service areas, the service area(s) must be reviewed and characterized for various Environmental Justice issues, e.g., income-assets/home ownership/education/ethnic origins. With the service area characterization, the supply benefits must be compared/assessed with the financial costs through rates for all users within the service area(s).

Desal projects are most efficient when operated under near constant operating conditions, full production load 24 hour every day, although demands/use may be variable which are usually
compensated for by storage (e.g., 8hr night-time low use: 10pm-6am = 30% to storage = 1.6MGD would be 6
stored). No quantified analysis has been provided for storage and nighttime service area/tanks to establish storage and service area backflows. Provide quantitative analyses of storage, pass-thru flows, and backflow for the production and storage facilities for the service area(s).

Intake wells may draw fresher inland groundwater - modelling required to prevent drawdown of near
shore groundwater 7

Seismicity
The geophysical setting and considerations clearly indicate that the proposed Project facilities are located closer to the Newport-Inglewood Fault Zone than the imported water transmission systems. Intake wells are further exposed to higher risks due to their orientation towards the Newport/Inglewood
Fault zone. Similarly geotechnical reports and other EIR related reports identify faults on the landward 8
side of the treatment facilities and within the service area of the Project, without assessments for risks and threats. Similarly mention is made of the Southern California Earthquake Center but without considerations of recorded seismic activities in the SCEC files and assessment of seismic shaking, rupture, and liquefaction on the treatment facilities, service pumps, and tubular systems. No consideration is provided for a design "earthquake", its probable locations, depths, and strength for

overall designs and for interactions between more flexible pipe/tubular system and their connections with more fixed facilities (e.g., pumps and treatment equipment).
Provide updates and revisions with quantified analyses for a design seismic event along with those previously experienced seism. Provide quantified listing of all recorded earthquakes for 1932 to date within 5 miles of the Project and service areas.

SCEC Catalog of Significant Earthquakes

8

#YYY/MM/DD	HH:mm	MAG	LAT	LON	DEPTH Km	
1933/05/04	23:14	2.29	33.45883	-117.62817	6.0	***First recorded***
1933/07/21	**04:58**	**2.58**	**33.43500**	**-117.70100**	**6.0**	
1933/08/04	**08:45**	**3.34**	**33.45600**	**-117.71800**	**6.0**	**- *First Significant/Strongest Local Quake***
1952/03/03	**16:14**	**3.29**	**33.45650**	**-117.73517**	**6.0**	**- *16,000ft WWSW***
1967/02/13	**05:55**	**2.99**	**33.44867**	**-117.71533**	**6.0**	
1970/07/26	**11:17**	**2.84**	**33.46900**	**-117.73250**	**6.0**	
1975/07/05	**06:52**	**2.60**	**33.44200**	**-117.71900**	**15.8**	
1982/06/06	**17:20**	**2.56**	**33.46800**	**-117.70900**	**11.0**	***6 in 1984, 30d***
2000/02/08	**21:59**	**2.15**	**33.44000**	**-117.67400**	**1.8**	***8400ft SSE of Mouth Shallowest***

List of qu**akes >2.5 RM and <3km deep.**

Total Number of events: 64

1.0-2 **Project Background** SCWD provides potable water, recycled water for irrigation, and sanitary sewer services to approximately 40,000 residents and 1,000 businesses...includes the **<u>communities of Dana Point, South Laguna Beach, and areas of San Clemente and San Juan Capistrano.</u>**
The DEIR does not provide a thorough description of the current and future service area populations (by ownership/tenancy, income, education, ethnicity, etc.) and their current, future, and Project levels of service by census tract levels (e.g., pressures, quality, and flows). The Revised DEIR must thoroughly develop a quantified setting (with computerized/GIS model) for the current, future without project, and Local and Regional (expected) service areas and the effects on levels of service with and without the Local and expected Regional Projects, given an assumed rate equivalence.

9

1.0-3/3 Because SCWD intends to seek **<u>State Revolving Fund (SRF)</u>** financing..., this EIR includes additional information required in a <u>"CEQA-Plus"</u> document, related to **<u>evaluation of certain federal "cross-cutter" regulations</u>**....
The current DEIR does not consider in setting or assessment the key community element of "Service area": "Environmental Justice" (Executive Order No. 12898), as all service area residents will be charged similar costs per 100 gallons but some near he Local Project may receive higher pressures, access to greater flows, and better water quality than those receiving some imported waters. Environmental Justice (EJ) has not been considered in setting and assessment of impacts as the service area effects are generally and totally avoided although the Project does not disconnect the SCWD service area from imported water systems.

Provide a thorough review of potential EJ issues, current and future EJ units, and effects of Local and potential future Regional Projects on the service areas in a Revised DEIR.

1.0-3/5 1.2 PROJECT OBJECTIVES CEQA Guidelines §15124(b) requires that an EIR contain a statement of the <u>Project objectives</u>, including the <u>Project's underlying purpose</u> *????*. The project objectives are:
1.0-4/1 To create a **<u>drought-proof</u>**, **<u>hydrologically independent</u>**, **<u>reliable</u>** and **<u>high-quality</u>** source of potable drinking water for the District. 10
To further **<u>diversify</u>** the District's water supply portfolio through
a locally-controlled supply,
combining conservation,
recycling, and
local supplies
to reduce dependence on imported water supplies.

To provide emergency backup water supplies, should
an earthquake,
system shutdown, or 10
other event disrupt
the delivery of imported water to the south Orange County area.
No quantified criteria or parameters are ***provided.***
No discussion of local EQs is provided....intake/outfall shutdown....other event...

2.0-4/3 **Additional SRF CEQA-Plus Requirements**
Additional environmental analyses are required for SRF loan applications, including:
▪ **Coastal Zone Management Act (CZMA)...** 11
▪ **Environmental Justice** – SRF loans require demonstration of compliance with Environmental Justice provisions pursuant to Executive Order 12898 and related NEPA integration policies established by the EPA's Office of Environmental Justice (addressed in **Section 4.9, Land Use and Planning)**.

4.9-9/2 **SRF CEQA-Plus Analysis** This EIR section also includes an evaluation of Coastal Zone Management Act (CZMA) compliance and **Environmental Justice**,...(…provided under Impact 4.9-1).

4.9-9/4 **4.9.4 IMPACTS AND MITIGATION** ***[EMPHASIS added]***
Impact 4.9-1: Would...project physically divide an established community?...*of Significance: No Impact.* **Construction and Operations** *All Components*

Projects that can divide an established community typically involve large scale linear infrastructure,...sited within economically depressed areas....The proposed intake wells, conveyance alignments, and brine disposal system **WOULD BE** subsurface, with most conveyance facilities within roadway rights-of-way (ROW)….proposed Project **WOULD NOT physically divide an established community**. No impact **WOULD OCCUR** in this regard.

Pursuant to CEQA-Plus SRF loan requirements..., the Project **WOULD NOT** have any disproportionate impact upon **minority, low-income or indigenous**…***4.9-10/1...*****populations or tribes**. The desalination facilities **are** in Dana Point, which is in a relatively affluent portion of south Orange County. Although at a **county level Orange County** is approximately 60% white, the **Census Tract (0422.01)** encompassing the Project is approximately **73.9% white** ***[26.1% non-white in census tract]*** with 9% at the poverty level 12 ***[Poverty = ???, = ??% of Median Income]*** ….The Project **WILL** provide for a reliable, drought-proof, locally controlled water supply, **which WILL benefit all local communities served by the District**,…**WILL** ensure long-term sustainability of housing, employment and community services....

Changes of conditional to affirmative verbs in the future appears purposeful and to provide emphasis as to "No EJ Impacts"; this shows potential bias of the preparers, editors, and circulators of the DEIR.
No setting was provided rendering the entire EJ assessment as useless, inadequate, and incomplete. Inadequate setting above with only, 3/4 : 1/4 with 40,000 residents = 30K white : 10K Non-White.
Provide a thorough, complete, and adequate setting with appropriate assessment and mitigation for Environmental Justice in a Revised DEIR

4.9-10/2 Therefore, the Project neither **DIVIDES** an established community nor **disproportionately AFFECTS** **a minority, low-income or indigenous population**. There **would not** be any significant impacts in this regard.

Changes of conditional to affirmative verbs in the future appears to be purposeful and to provide emphasis as to "No EJ Impacts"; this shows potential bias of the preparers, editors, and circulators of the DEIR.
Infrastructure includes the service area setting, assessment, and mitigation where levels of service can vary More attributes exist than ethnicity and income; add race, ownership/tenancy, education, family size, ages for the entire service area and the associated census tracts.

3.0-4/ **FN***3 SCWD Board of Directors Meeting, April 26, 2018, Agenda Item 8.* 13
Not readily accessible for public. Provide link to BOD minutes archive.

3.0-5/* FN4 *Presentation to the SCWD Board of Directors, May 25, 2017, and August 2, 2017,...on December 20 2017 at* **https://www.scwd.org/services/drinking/supply/water_reliability/presentations.htm**. *The draft report… December 21, 2017, and is available on the District's website at* ***https://www.scwd.org/civicax/filebank/blobdload.aspx?blobid=8044***.
Inadequate specificity for support of the noted statement and requires page references within 30+ pages.

3.0-6/2 The report also indicates...ranks well above all other available water supply options...for the following reasons:

1) As an individual Project,...ranks first by **high margins**, due to the following benefits...: 13
   a. High system and supply reliability benefits due to…independence and **climate change** resilience;
   b. High resiliency to unknowns (climate change; reductions in imported water supply; ...reduced access to imported water supplies);
   c. High level of local control over operations and **cost**; and
   d. Moderate implementation risks and moderate **cost-effectiveness**.

Comparisons cannot be properly evaluated as the three or four Project objectives have no quantitative/ranking bases. Statements regarding direct financial/costs issues have not been developed throughout the DEIR and general references only confuse and require much further development nott yet provided.
Introduction of "climate change" wihout

3.0-24/3 These percentages will be monitored throughout the Project's life. The brackish groundwater pumped by the Project is not usable freshwater and would require RO and other treatment processes in order to be used for domestic or even industrial purposes. 14
Inland groundwater would be drawn to the intake wells as designed and would contribute to increased downhill/seaward groundwater flows. Such increased out-flows would reduce fresh (<20ppt TDS) groundwater available for upstream users and may cause over-draft and reduced flows for current legitimate groundwater users. This would be an adverse environmental effect on existing well operators and their service areas.

3.0-27/6-7-8 *Product Water Storage Tank*
The product water storage tank...will provide storage and residual disinfection prior to distribution. The tank will contain baffles…to meet disinfection requirements for the **Phase I Project and ultimate facility capacity of up to 15 MGD.**
A 2.75 million gallon concrete tank was selected based on conservative design criteria....
….The 2.75-million-gallon tank will have an outside diameter of roughly 125 feet and a height of 37 feet.
Local Project onsite-element with capacity to expand for Regional Project. Typical 33% storage for 5MG would be 1.7MG or half the for Local Project production of 5MGD, while storage for 15MGD would be about 5MG or twice the proposed size. Proposed 2.75 MG appears to be an intermediate capacity which could be augmented by additional storage in more distance service area storage. This facility appears to be a Regional element incorporated into the Local Project and promote growth in the service area and supports future Regional development. 15
This element must be solely justified for local consideration and must be downsizedd or justified through other means and analyses.

3.0-28-1 *Product Water Pump Station* The drinking water will be delivered into the District's existing potable water distribution system. **As details about the final distribution of water are pending final design,** this EIR has conservatively assumed a set of distribution pumps and surge vessels to deliver water…to match pressure in the District's existing distribution system,... 16
No quantitative or organized information is provided although existing SOI systems would be incorporated into a model of the service area/distribution sytem

3.0-17 **FN** *The desalination facility could be located anywhere within the District's San Juan Creek Property, consisting of Lots A – F…The preferred location, as represented in the EIR, is on lots D, E and F…. The desalination site staging area is proposed adjacent and north, on Lot C (a 7.2-acre parcel). Source: District GIS, transmitted in email dated March 15, 2018.*
Source/email is not publicly available. Provide in DEIR appendices.

3.0-22 **FN***16 "Recovery rate" refers to the Reverse Osmosis process effectiveness, with a 50% recovery rate meaning that for every 100 gallons of raw ocean water received, the RO process produces 50 gallons of purified drinking water.*

17

3.0-27 **FN***19 RTW Model, American Water Works Assoc., Denver, CO.*
No dates, no links.

3.0-28 Tbl 3-6 Source: Preliminary Design Report, GHD, May 2018.
3.0-30 Tbl 3-7 Source: Preliminary Design Report, GHD, January 2018.
Same document? Different dates without links.
3.0-31 FN*22 South Coast Water District Capital Improvement Program Initial Study/Mitigated Negative Declaration, SCH# 2017081049, adopted October 2017.*
Introductory Web Page, useless without specific reference.
3.0-35 FN*24 https://www.fuelcellenergy.com/products/#SureSource4000 (accessed April 26, 2018).*
Introductory Web Page, useless without specific reference.

3.0-43 FN25 http://www.mwdh2o.com/PDF_About_Your_Water/2794_001.pdf (accessed May 9, 2018).
Provide as reference material but not included in DEIR/appendices references.

4.4-1- -38 **4.4 CULTURAL RESOURCES**
No EDR pre-2009 aerial photos were presented or available for review for historic resources, structures and foundations and historic uses. Review, setting, mitigation, and impacts are inadequate and incomplete as historic aerial photos which were included partially (referenced back to 1938, but not provided) in the Hazard/Phase 1 appendix were not reviewed for historic landuses for all Project site. Cultural/historic resources may be present but the preparers were ignorant of historic aerial photos for the Parks and all Project sites or they chose not to use them, the only direct evidence for historic resources consideration. 18
Provide all historic aerial photos, require an experienced historic archeologist with aerial photos background to review and revise all setting, assessment, and mitigation elements for a Revised DEIR.

4.4-2/**EXHIBIT 4.4-2: Paleontological Sensitivity Area** Source: Rincon, Cultural Resources Report, Attachment A - Figure 2. ***Two 2016/2017 reports in references; online introductory corporate pages without specific reference or titles.***
The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Fossil will be produced from borings for all the wells and some excavations, but they won't be dinosaurs although they may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. 19
Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR.

4.4-17/ *FN\10* National Parks Service. National Register Publications. https://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_8.htm. (accessed October 2, 2017). **Provide as reference material but not included in *revised* DEIR/appendices references.**

20

4.4-17/ 11 California Department of Transportation. Paleontology Laws, Regulations, and Guidance. http://www.dot.ca.gov/ser/vol1/sec3/physical/Ch08Paleo/chap08paleo.htm (accessed October 2, 2017).
Provide as reference material but not included in revised DEIR/appendices references.

4.4-23 FN\12
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/cwsrf_requirements.shtml (accessed on September 7, 2017). General Page for selecting from listing: Financial Assistance Funding - Grants and Loans ***Provide as reference material but not included in revised DEIR/appendices references.***

4.5-1 / 9.0 Geophysical Survey. 2017. **Geophysical Survey** ...California. **Prepared by Geoscience Support Services, Inc.** on May 8, 2017. ***Incorrect and inconsistent formatting and referencing of documents;*** 20
author???, Date, Title. Provide corrected reference included in revised DEIR/appendices references.

4.5-3/1 The alluvium, however, is mixed with cobbles, gravel, silty sand, and clay layers to a distance of approximately 2.3 miles off shore, with bedrock laying at an unknown depth **(Geoscience, 2016).**
Geoscience Support Services, Inc. 2016. *Foundational Actions Funding Program Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling for…Final Report.*
Incorrect and inconsistent formatting and referencing of documents; author???, Date, Title.
Provide corrected reference included in revised DEIR/appendices references.

4.5-3/2 The desalination facility site is located on a floodplain near the mouth of San Juan Creek. San Juan Creek floodplain is **underlain by Holocene era**,…. ***Holocene and Era have specific geological definitions,*** 21
change Holocene to Cenozoic or Era to Epoch or age. Revise entire Sec. 4.5 for consistent technical usage. Provide corrected terminology in revised DEIR/appendices.

4.5-3/3 A fault may be presumed to be inactive based on satisfactory **geologic evidence**; however, the **evidence** necessary to prove **inactivity is sometimes difficult to obtain and locally may not exist**.
Evidence does exist but was not used; no reference is made to the Southern California Earthquake Center (SCEC) in Sec. 4.5 nor in DEIR text references. Revise and include review of seismicity in the Project vicinity and service areas in Revised DEIR.

4.5-3/4 …affect Dana Point include the Whittier-Elsinore Fault, the San Andreas Fault, the Palos Verdes Fault, the San Clemente Fault and the Rose Canyon Fault…**(Cotton/Beland/Associates, Inc. 1991)**.
Referenced document not included in Sec.9, References, see below.
9.0-7 **Capistrano** Unified…. 2016. Facilities Master Plan. Available at…June 20, 2017.
County of Orange, 2011. *Subsequent Environmental Impact Report…*December 18, 2017.
The entire DEIR and all appendices must be revised and edited for consistent referencing, inclusion of references, and public accessibility for all documents. 22

4.5-3/4 Although **no known faults cross the City**, the Project site could be subjected to future seismic shaking during earthquakes generated by…surrounding **active faults**.
Referenced documents include faults east of the Dana Point prominence and with the proximity to the Newport/Inglewood fault zone, splinter faults from this zone would be expected. Total absence of use or reference to the Southern California Earthquake Center and thereby their documents and catalogs render this statement inadequate at best, or totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR.

4.5-4/1 The San Joaquin Hills and Oceanside **Blind Thrust Faults** (…Department of Conservation) extend from near Upper Newport Bay, south through the San Joaquin Hills, and stops approximately 12 miles from the northern portion of Laguna Beach **(Department of Conservation, 2010)**. ***By definition "blind thrust faults" are generally not visible on the surface but lie 1000s of feet below, and one end of the fault plane may stop/be truncated at the surface which is irrelevant to the other three edges of the plane. Total absence of use or reference to the Southern California Earthquake Center and thereby their documents and catalogs render this statement inadequate at best, or totally incomplete. Provide thorough review of all referenced and SCEC documents regarding blind faults and expected origins of recorded earthquakes for this section in the Revised DEIR.***

4.5-4/3 **Strong Seismic Ground Shaking** Strong ground shaking from an earthquake can result in **damage associated with landslides, ground lurching, structural damage, and liquefaction**. Major faults...that **have caused earthquakes** and **those that could result** in earthquakes and ground shaking...include those mentioned above, as well as the **Whittier Fault Zone, Norwalk and El Modena Fault Zone, San Andreas Fault, and the San Jacinto Fault Zone**. **Potential regional sources** for major groundshaking hazards include the **San Andreas, San Jacinto, and Elsinore fault zones**. ***Without mention of the Newport-Inglewood Fault regarding seismic activities, this discussion is rendered totally incomplete. Furthermore, total absence of use or reference to the Southern California Earthquake Center (and their files and catalogs) render this statement totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR.***
Provide in the Revised DEIR quantitative analyses of probability of occurrences for 5,6,& 7 RM events along the N-I Fault att 3, 4, and 5 miles distances with durations, frequencies, and strengths at the Project sites, especially for pipes joined to fixed/foundation structures. SCEC can provide assistance.

4.5-4/4 **Liquefaction** Based on...the **California Geologic Survey Seismic Hazard Zones Map** for the Project **vicinity**,...**Project area** is in an area **considered** susceptible to liquefaction **(California Geologic Survey, 2001).** ***Project area is not defined or delineated; likewise for "considered". Provide in a revised DEIR. Furthermore, total absence of use or reference to the Southern California Earthquake Center (and their files and catalogs) render this statement totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR.*** 23
Provide in the Revised DEIR quantitative analyses of liquefaction during 5,6,& 7 RM events along the N-I Fault att 3, 4, and 5 miles distances with durations, frequencies, and strengths at the Project sites, especially for pipes joined to fixed/foundation structures. SCEC can provide assistance.

Reference is incorrect or misplaced in a disorganized/unedited Sec. 9. Sec.9 is a mess: 9.0-3,-4, -5, e.g.,
California Department of Transportation. 2012. Standard Environmental Reference,...2017.
……***xxtxxx***
California State Parks (CSP). 2003. Doheny State Beach. Preliminary General Plan and....

California Environmental Protection Agency. State Water Resources Control board. *Federal, State...*2018.
California Geological Survey, 2001. *Earthquake Zones of Required Investigation Dana Point Quadrangle.* 2017.
California Legislative Information Website, Assembly Bill No. 685, http://leginfo.legislature.ca.gov/...2017.

California Department of Transportation. *Paleontology Laws, Regulations, and Guidance....*2017.
……***xxxxx***
California Regional Water Quality Control Board San Diego Region.
Provide a thoroughly revised and consistent Sec. 9 and all references in all appendices in the Revised DEIR.

4.5-13/3 **Project Design Features**
a) The desalination site design was created to minimize the total duration and volume of construction grading....
b) The design of the **desalination plant and its facilities**...so **future expansion would be minimal**. 24
This and other statements strongly imply that "Local" Project design includes elements suitable for the larger Regional Project and confuses the Project Description, alternatives, and mitigation.
Provide clear Project(s) or Program Descriptions in the Revised Project or Programmatic DEIR.

4.5-14/1 The **Christanitos fault** zone is..., located approximately 6 miles east of the site. **Available data reviewed** indicates that the Christanitos fault zone is **not likely** to be active….such, impacts to **all project components** would be less than significant and mitigation...would not be required (Ninyo & Moore, 2015).
No definition nor explanation is provided for "available data", "reviewed", "not likely", "all". Some local faults are reported, but not included, and no fault traces are provided for the "Newport-Inglewood Fault Zone", including those within 3 or 4 miles of the Project site. 25
Appendices do not provide structural geological setting for ALL elements of the Local Project and its service areas.

Provide complete structural geologic setting for all elements of the Local Project in a revised EIR, especially all known fault zones. Furthermore, total absence of use or reference to the Southern California Earthquake Center (SCEC, and their files and catalogs) render this statement totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR.

4.5-14/5 The Project is located...which is prone to ground shaking. **All** Project components **would be constructed** to the more recent Uniform Building Code standards and **would be designed** in conformance with **all applicable standards** to **resist the harmful effect of seismic ground shaking**.
No definition nor setting nor standards is provided for establishing design requirements for shaking (e.g., frequency, strength, and duration) to be in the DEIR project description and/or mitigation OR for "future" re-design. These requirements are especially important for all connections between more flexible piping and rigid fixed/foundation-supported/piled facilities.
Provide all engineering requirements to be included for all design levels prior to bidding and construction for the revised DEIR.

4.5-15/5 The Project components...due to the subsurface nature of the intake wells, impacts would be less than significant. There is a **possibility of strong seismic ground shaking** for all Project component due to the nature of the geographic region of Southern California and its seismic activity.
To reduce impacts, **compliance with mitigation Measure GEO-1** would require a qualified geologist and 25
geotechnical engineer to **prepare site-specific geotechnical hazard investigations and recommendations for design level measures.** This mitigation measure would ensure operation impacts to be less than significant in relationship to strong seismic ground shaking.
Provide engineering design risks (probability: 1/100yr, strength, duration, etc.) for ground shaking incorporated into the current Local Project and requirements for further engineering upgrades and mitigations in the Revised DEIR.

4.5-15/7 Therefore, **implementation of Mitigation Measure GEO-1**, along **with relevant civil engineering best practices**, would ensure that raw water conveyance facility impacts due to strong seismic ground shaking are less than significant.
Provide definitions, distinctions, and consistent use of "compliance", "recommendations", "relevant", and "best practices" in the revised DEIR.
Provide all engineering requirements to be included for all design levels prior to bidding and construction for the revised DEIR.

4.5-16/1 The Project components.... There is a **possibility** of **strong** seismic ground shaking for the desalination facility...and its seismic activity. To **reduce impacts**..., compliance with Mitigation Measure GEO-1 **would require** a **qualified geologist and geotechnical engineer to prepare site-specific geotechnical hazard investigations and recommendations for design level measures.** This mitigation measure would ensure operation impacts to be less than significant in relationship to strong seismic ground shaking.
It is unclear as to whether this mitigation has been or will be include in future design upgrade. Use of **"would require"** ***suggest that such mitigation has not been incorporated into the Project Design/Description.***
Provide all engineering requirements and "recommendations" to be included for all design levels prior to bidding and construction for the revised DEIR.

4.5-16/2 *Brine Disposal System* The brine disposal component is **not intended for human occupancy** and would **not result in a direct adverse impact to humans**..., therefore impacts would be less than significant.
Like all other elements in this section, brine disposal requires a designed/engineered disposal pipeline (5MGD flow) from the Project Site to the sewage treatment plant and connection to the existing outfall.
Any leaks/spills of brines (60ppt, TDS) into the channel or treatment plant could have significant impacts 26
to water quality and fisheries/wildlife/ecosystems. Current Project design/engineering requirements have not been provided and as no Mitigation is mentioned, this section requires revisions. Provide all engineering requirements and "recommendations" to be included for all design levels prior to bidding and construction for the revised DEIR.

4.6-21/6 **Goal CR 1: All significant historic features and sites at the park are preserved, protected from damage, and properly interpreted for public appreciation of the park's history.**
Guideline CR 1.1: Monitor the condition of the remaining CCC-period features in the park, such as through 27
annual photo documentation, and initiate measures to preserve and/or restore these features....

4.6-29/3 Subsurface Intake Wells The subsurface intake wells...with **undetermined paleontological sensitivity**. Unnamed Miocene **marine** sediments are mapped offshore in the shallow sub-surface and are **not known to contain fossils** but would be inspected if **construction activities bring them to the surface**. Construction of the subsurface intake wells **would not destroy** a unique paleontological resource or unique geologic feature with the implementation of **CUL-3**...would not destroy a unique paleontological resource or unique geologic feature and no impact would occur.
The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Designation of "undetermined" and "marine" conflict as he only way to determine "marine" designation is to find "marine" invertebrates or diatoms in the sediment. Therefore the "not known" conflicts with the marine designation.
Marine and perhaps estuarine or even freshwater fossils will be produced from borings for all the wells, but not dinosaurs. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR.

4.6-29/3 *Southeast Intake Wells* The southeast intake wells would be in an area with **low to no** 28
paleontological sensitivity. Unnamed Miocene marine sediments are mapped offshore in the shallow sub-surface and are **not known to contain fossils** but would be inspected if **construction activities bring them to the surface**. Construction...would not destroy a unique paleontological resource or unique geologic feature
The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Designation of "undetermined" and "marine" conflict as he only way to determine "marine" designation is to find "marine" invertebrates or diatoms in the sediment. Therefore the "not known" conflicts with the marine designation.
Marine and perhaps estuarine or even freshwater fossils will be produced from borings for all the wells, but not dinosaurs. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR.

4.6-30/5 *Brine Disposal System* No construction...required for the ocean discharge because the existing San Juan Creek Ocean **Outfall would be used for brine disposal**. Therefore, no impact would occur.
Connection between the Brine Lines and the outfall would require a Pipe which would require trenching or boring between the east and west side of the creek, and such work could encounter marine, estuarine, or freshwater fossils (e.g., MicroFossils: foraminifera, ostracodes, diatoms, and others. The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project.
Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR.

4.6-31/5 **CUL-3** Paleontological Construction Monitoring and Compliance Program. The following measures would be implemented to **reduce potential impacts to paleontological resources to less than significant**:

Retain a **Qualified Paleontologist**. Prior to initial ground disturbance, the South Coast Water District (SCWD) shall retain a project paleontologist, defined as a **paleontologist who meets the Society of Vertebrate Paleontology standards for Qualified Professional Paleontologist**, to direct all mitigation measures....
These considerations relate only to vertebrate paleontology (SVP, TW retired past member) and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Designation of "undetermined" and "marine" conflict as he only way to determine "marine"
designation is to find "marine" invertebrates or diatoms in the sediment. Therefore the "not known" 28
conflicts with the marine designation.
Marine and perhaps estuarine or even freshwater fossils will be produced from borings for all the wells, but not dinosaurs. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR.

4.6-33/2 **REGIONAL PROJECT**
Due to the **lack of specific Regional Project facilities identified**...and **uncertainty regarding Regional Project funding, partners and end users**, **it would be speculative** to provide a **detailed evaluation** of **potential cultural resource impacts** of a potential **future Regional Project**.
Generally, expansion of various **Phase I project components**…additional slant wells and additional raw water conveyance lines). Expansion at the desalination facility site would have no impacts on cultural resources.
The Regional Project…additional regional product water conveyance, pumping and **storage facilities**, the location or alignment of which has yet to be identified.
Mitigation Measures CUL-1 through CUL-3…to the Regional Project,...**standard practices** to avoid pipeline 29
trenching across natural open space lands where the potential for cultural resources is greater.
Evaluations of Regional Project settings and impacts thoroughly confuse the entire current DEIR, including in this Section, rendering this and other similar sections of the DEIR, erroneous, conflicting, and totally inadequate and incomplete.
Either provide a complete and adequate Project(s) or Program DIER(s), not this confused mess.
As the approach and contents for the Local Project setting, assessment, and mitigation are incomplete, inadequate, arbitrary, erroneous, contradictory, and inconsistent, those for any "Regional Project" must be considered as the same.
Provide two separate project or one programmatic DEIR(s), with thoroughly revised, adequate, and complete sections, suitable for public review, not this mess.

4.6-34/7 Similarly, **all future development**...would be required to demonstrate compliance with **applicable federal and state regulatory requirements**,…intended to reduce and/or avoid potential adverse environmental effects…analysis and mitigation for cumulative impacts within the jurisdiction of the affected agency)….**cumulative impacts**…**mitigated on a project-by-project level**, and in accordance with the
established regulatory framework, through the established regulatory review process. 30
As this DEIR has not complied with all requirements for a complete and adequate DEIR+CEQa-PLUS; "all future development" of the Regional Project and the Regional Service Areas must be assumed to suffer from the same inadequacies and over-generalizations. Revise this entire section and include in a Revised DEIR.

4.7-1/2 EDR photo package (see **Appendix 10.8.1**, Environmental Data Resources Radius Map Report with Geocheck*):* EDR Historical Topo Map Report with QuadMatch (EDR, July 24, 2017); Certified Sanborn Map Report (EDR, July 25, 2017); and **EDR Photo Decade Package (EDR, July 27, 2017)**.
Reference to the incomplete appendix clearly indicates preparers and editors, and District have either
knowingly circulated a deficient document or did not review the document prior to release to the public. 31
Apx10-8-1\pdf396/ - 5001976 9 pre-2010 not provided, including:

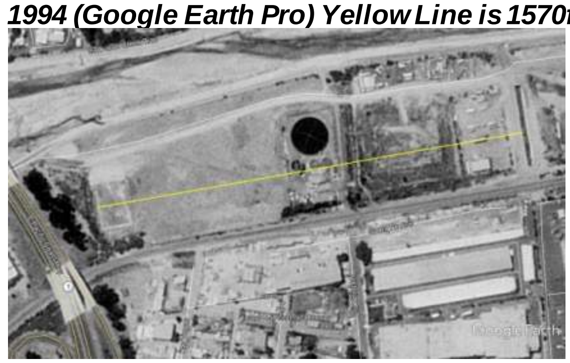
2009 1"=500' Flight Year: 2009 USDA/NAIP	2005 1"=500' Flight Year: 2005 USDA/NAIP
1994 1"=500' Acquisition Date: June 01, 1994 USGS	1990 1"=1000' Flight Date: January 01, 1990 USDA
1980 1"=1000' Flight Date: January 01, 1980 USGS	1977 1"=1000' Flight Date: January 01, 1977 Proprietary Brewster Pacific
1967 1"=1000' Flight Date: January 01, 1967 USGS	1952 1"=1000' Flight Date: January 01, 1952 USDA
1946 1"=1000' Flight Date: January 01, 1946 USGS	**1938 1"=1000' Flight Date: January 01, 1938 USDA**

Ten aerial photos have been referenced but not included.

Readily available satellite images clearly show the value of such historic images for identifications of resources and hazards.

2018

1994 (Google Earth Pro) Yellow Line is 1570ft



The Project site has been used for industrial and other uses which may have contaminated the site, but
the DEIR does not include documentation regarding soil contamination which may have been surficially 31
removed and covered by clean fill.

4.7-2 FN*1 State Water Resources Control Board Right to Divert and Use Water Permit 21138.*
The Document is available for public review but the connection to the noted text is not specific to a section of the permit. Provide specific section of the permit in the Revised DEIR.

4.7-7 *Table 4.3,* ***<u>Appendix 10.10.1</u>***. ***Unclear as to copy of table or derived from text.***
Provide specific section of text or portions of table in the Revised DEIR

4.7-7 FN*2*
*http://geotracker.waterboards.ca.gov/map/?CMD=runreport&myaddress=25300+Dana+Point+Harbor+Drive (accessed March 20, 2018). [*Notes: Database Acronyms are noted in *Appendix 10.8.1, Environmental Data Resources* (EDR) Radius Map Report with GeoCheck.]
Noted link does not connect to a specific location, therefore itte is rendder unavailable for public review and is not included in the appendix. Provide more specific publicly accessible link or in an appropriate appendix in the Revised DEIR.

4.7-12 Sources: Environmental Data Resources, *The EDR Radius Map Report with GeoCheck*, July 24, 2017; and Google Earth Pro 2017.
Provide reference to appropriate DEIR appendix in the Revised DEIR.

4.7-19/4 **Goal 3: Reduce the risk to the community's inhabitants from exposure to hazardous materials and wastes. Policy 3.2:** Cooperate with railroad operations to ensure that **<u>hazardous materials transported by rail</u>** do not pose a threat to life or property.
The historic railroad ROW lies immediately south of the Project site and trains are widely known to carry
hazardous materials, and ROWs, ballasts, and soils are often contaminated by leaks and spills. 32
Information that would have been available in historic aerial photos is incomplete due to the deletion of 2008-1938 (or even earlier, EDR has files going back to 1923).
The entire 4.7 section is incomplete due to lack of any soil borings/samplings of site immediately adjacent to the railroad ROW.
Provide reference to appropriate DEIR appendix in the Revised DEIR.

4.7-21 FN*3 California Department of Parks and Recreation, Doheny State Beach General Plan & Draft Environmental Impact Report, December 2003.*
As the noted document is over 100 pages specificity is required for public accessibility 33
4.7-21 FN*4 Instead of* ***<u>policies</u>****, the Doheny State Beach General Plan includes* ***<u>guidelines</u>****, which are a general set of parameters that provide directions towards accomplishing goals (page 3-3).*

The DSBGP contains both goals, policies, and guidelines; stated clarification seems out-of-place or purposefully confusing. Provide clarification and specificity to the Local Project, herein, in the Revised DEIR.. 33

4.7-23 FN*5 https://www.dir.ca.gov/title8/339.html (accessed March 14, 2018).* ***The 35 page FN reference requires greater specificity for public review. As presented the reference is not suitable for public review and thereby is inadequate for review. Provide more specific noted connection in the Revised DEIR.***

4.7-25 FN*6 Appendix 10.10.2 shows that pumping 8.6 MGD has little effect on the groundwater plume (page 37, and Figures 54, 55 and 56 of Appendix 10.10.2), as does pumping at even higher levels. In fact, groundwater modeling shows that the Project would improve plume conditions by causing the plume to dissipate faster.*
Plume dispersion or pumped-induced movement is often used as part of groundwater decontamination & remediation. However contaminants must be removed as part of pump/treat remediation, and thereby rapid flow and/or spreading of contaminated groundwater must be considered as a negative impact until much greater information and modeling has been conducted and provided. Therefore this text section and related appendix must be considered as incomplete and inadequate for impact assessment and mitigation. Provide a completely revised, quantitative setting for potential hazardous contamination of the Creek groundwater resources and assessment of impacts from changes caused or induced by the Project in the Revised DEIR. 34

4.7-37 FN*12* http://www.ocair.com/Commissions/ALUC/Docs/JWA_AELUP-April-17-2008.pdf.
174 pages, without pg. #, content cannot be verified. Provide specificity within noted file for the appropriate noted text in the Revised DEIR.

4.7-40 FN*13 City of Dana Point Building and Safety, Fire Hazard Severity Maps, Available at:* 35
http://www.danapoint.org/department/communitydevelopment/
building-safety/fire-hazard-severity-zones, (accessed February 21, 2018).
"Page Not Found... The page you are looking for,
http://www.danapoint.org/department/communitydevelopment/building-safety/fire-hazard-severity-zones, may have been removed, renamed, entered wrong, or is temporarily unavailable."
Provide specific appropriate reference for noted text in the Revised DEIR.

4.7-42/3 **SIGNIFICANT UNAVOIDABLE IMPACTS** The Project would not result in any significant unavoidable impacts concerning hazards and hazardous materials. ***This statement is founded on a totally incomplete, inadequate, and poorly documented assessment in both the DEIR section and supporting appendix.*** 36

EXHIBIT 4.7-2: Schools within 0.25 Miles of the Proposed Project
Intake and Conveyance areas are wrongly located in SJC District. 37

5.0-1/2 Per…Guidelines..., additional significant effects of the alternatives are discussed in less detail than the significant effects of the project as proposed. For each alternative, the analysis: 1)...; 4) assesses whether the alternative would meet **most of the basic project objectives**; and 5) **evaluates**…**comparative** merits.... 38
Since there are only 3-4 objectives, no distinction of "basic" and non-basic objectives has been or could be reasonably made. The verbal, non-numerical, non-quantifiable objectives cannot be numerically ranked nor "evaluated" for comparative merits or rankings. Additional and current objectives must be revised for quantifiable or numerical comparisons and included in a revised DEIR for review.

5.0-1/3 Key provisions of the…Guidelines on alternatives…are summarized below to explain the foundation and legal requirements for the alternatives analysis in the Draft EIR.

▪ "Among the factors that may be taken into account when addressing the **feasibility** of alternatives are site suitability, **economic viability**, availability of infrastructure, general plan consistency, other plans or regulatory limitations, jurisdictional boundaries (…), and whether the proponent...***-2/1***...can **reasonably** acquire, control or otherwise have access to the alternative site (or the site is already owned by the proponent)."....

▪ For…"[o]nly locations that would avoid or **substantially** lessen any of the significant effects...need be considered…."....

▪ "An…need not consider an alternative whose effect cannot be reasonably ascertained and whose implementation is **remote and speculative**."....

Only 3-4 objectives have been or could be reasonably made. Use of "reasonably", "feasibility", and "economic" clearly relate to financial aspects of the Project which has not been well developed and incorporated into the DEIR and alternative considerations and comparisons. The DEIR does not define "substantially", "remote", or "speculative" must be withdrawn, objectives revised and quantified, and alternative numerically and financially compared. 39

The verbal, non-numerical, non-quantifiable objectives cannot be numerically ranked nor "evaluated" for comparative merits or rankings. Additional and current objectives and clearly defined and enumerated comparisons must be revised and included in a revised DEIR for review.

5.0-4/6 **To meet these Project objectives**, the District has **identified the need** for a 5 MGD Phase I Project, consistent with **its** Urban Water Management Plan (UWMP) and Strategic Plan.

Goals are mentioned in Sec. 3.0 but not included in Sec.5

Although three objectives are bulleted (repeated from Sec.3), the following paragraph (/6) appears to be an "objective" (or "Goal") and is the only numerical objective provided in the DEIR.

No quantified criteria/parameters are provided in the objectives, and no quantified/numerical-ranked comparison of alternatives is provided.

No discussion of independence and reliability is presented regarding the future dependence and the total reliance on the performance of the Project system in close proximity of local EQ sources and potential tsunamis or intake/outfall/RO system shutdowns, or "other" events.

Imported water would remain available to the District, as no mention of closing such connections appear to be part of the Project, as described as "Emergency Back-Up". Thus both imported and desal waters would be inter-dependent and under normal operations, the desal waters would increase supply to the service area by 5MGD for an additional 50,000 users.

5.0-4 FN\1 https://www.scwd.org/about/governance/water_reliability_working_group/default.htm (accessed May 3, 2018). 40

Introductory Web Page useless without specific reference. Provide greater specificity and links.

5.0-5/3 The range of **feasible** alternatives identified under this EIR has been selected and discussed...intended to foster meaningful public participation and informed decision making....those that could feasibly accomplish most of the **basic objectives** of the Project and could avoid or substantially lessen one or more of the significant effects….factors that **may be taken into account** when addressing the **feasibility** of alternatives are **site suitability, economic viability, availability of infrastructure, General Plan consistency, other plans or regulatory limitations, jurisdictional boundaries**, and **whether the proponent can reasonably acquire, control, or otherwise have access to the alternative site (or the site is already owned by the proponent)**. 41

Since there are only 3-4 objectives, no distinction of "basic" and non-basic objectives has been or could be reasonably made. Use of "feasible", "feasibility", and "economic" clearly relate to financial aspects of the Project which has not been well developed and incorporated into the DEIR and alternative considerations and comparisons. The DEIR must be withdrawn, objectives revised and quantified, and alternative numerically and financially compared. 41
The verbal, non-numerical, non-quantifiable objectives cannot be numerically ranked nor "evaluated" for comparative merits or rankings. Additional and current objectives must be revised for quantifiable or numerical comparisons and included in a revised DEIR for review.

5.0-7 FN*2 http://www.catalanadeperforacions.com/pdf/Neodren%20English.pdf (accessed May 1, 2018).*
Advertisement without technical information for well-screens.
FN*3 http://ru.pall.com/pdfs/misc/WFC08_80cmx200cm.pdf (accessed May 1, 2018).*
Advertisement without technical information for well-screens. Provide specific technical notes and links

5.0-10/ FN5 SCWD Board of Directors Meeting, April 26, 2018, Agenda Item 8.
No link to a page.

5.0-10/ FN*6 Need for new system capacity during an* ***extended outage (up to 60 days)*** *of MWD's deliveries caused by an earthquake or emergency. For system gap, demands and supplies are presented in million gallons per day (MGD) as opposed to acre-feet per year (AFY) in order to account for* ***shortages that are less than a year*** *(South Coast Water District – Water Reliability Study, Technical Memorandum Report, December 21, 2017, page 13).* 42
No link to page.

5.0-11 FN8 As described in detail in the District's Water Reliability Working Group final report, available here (https://www.scwd.org/civicax/filebank/blobdload.aspx?blobid=8044), accessed May 17, 2018.
No date, nor page reference in 30+ pages for "DETAIL".

5.0-12 Tbl. 5-1 Source: SCWD, 2015 Urban Water Management Plan.
Not provided in Sec.9, References

7.0-1/1 7.0 Effects Found Not to Be Significant ….During the course of preparing the NOPs and this EIR, it was **determined** that the Project would result in "no impact" or a "less than significant impact" for **various issue areas**, due to the absence of Project characteristics producing effects of this type...following statements briefly indicate the reasons that the Project's possible significant effects concerning **these issue areas** were determined not to be significant,… 43
The Entire DEIR appears to have been prepared with a pre-determined concept that "no impacts" or "no significant impacts" would occur from either the Local or Regional Project(s). This appears to be a basic bias for the preparers who attempt to bias the public. Such bias must be removed and a fully objective and quantified comparison of alternatives must be prepared for public review.

2017   2800ft

 44

1994 2800ft

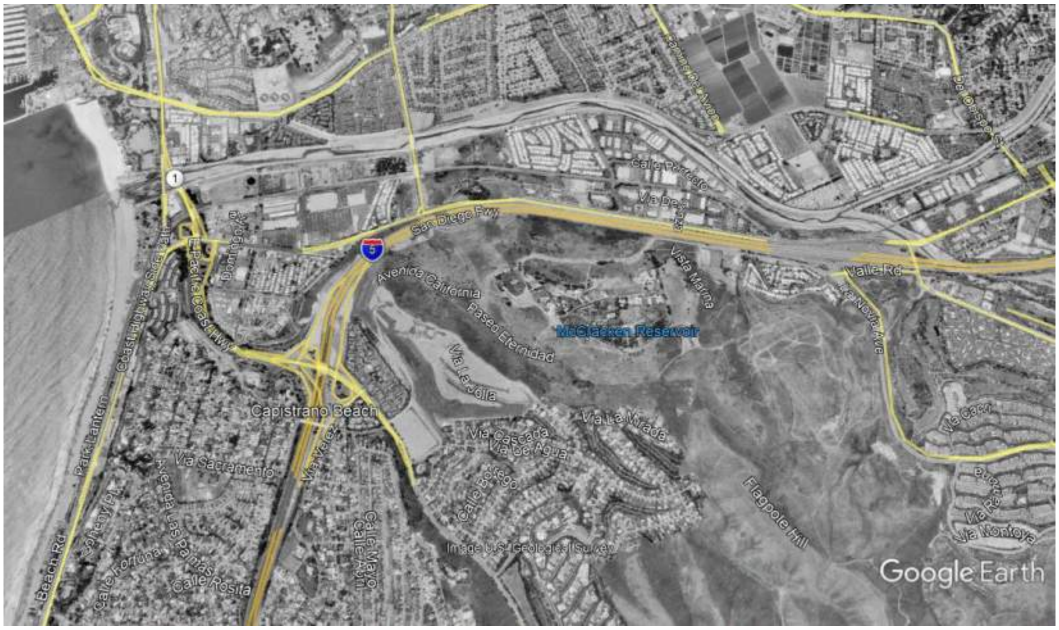
These Goggle Earth Pro satellite images and those missing from the EDR appendix for hazards and hazardous contaminations show industrial an storage uses of the Project site which would be expected to have contaminated the Project site. Missing EDR historic aerial photos and those above must be acquired, reviewed, and assessed regarding land uses and activities on the site and along the BNSF railroad ROW for possible contamination of the soil and underlying groundwaters.

9.0   References are incorrectly cited without consistent reference format and without being available for public review. Revise all references within Sec. 9 to single reference format and apply throughout section. Provide links or appendices for all reports not available directly to the public. 45
Provide text summary or recording for all "personal communications"

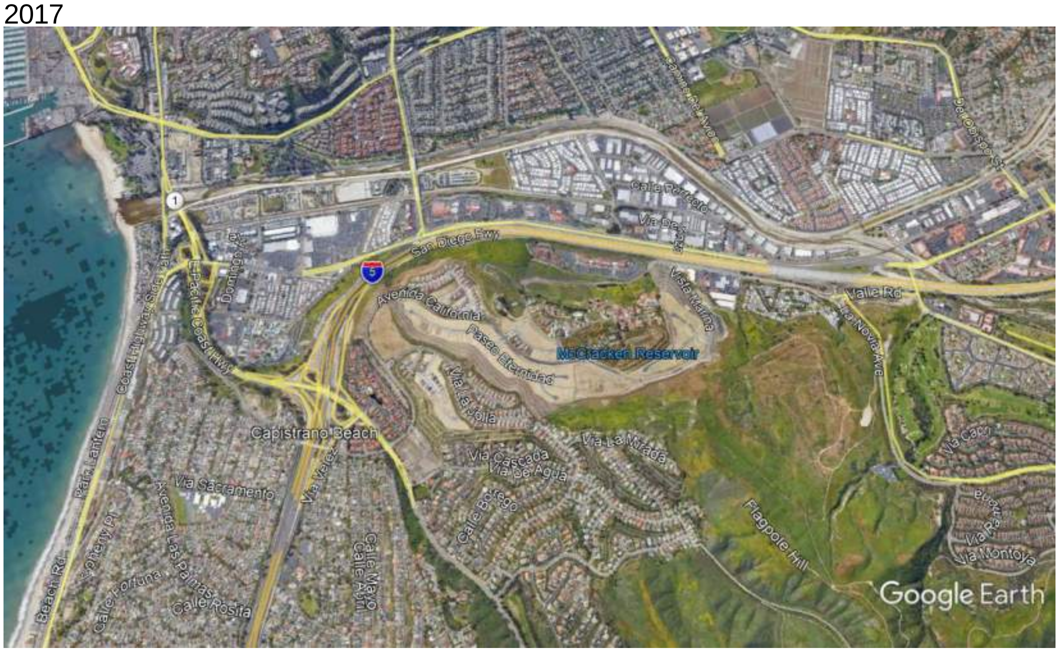
5.0-10/2 The potential loss of SWP and CRA...delivery outages of up to 18 months have been forecast. However, **<u>existing local water storage capacity</u>**...estimated to be limited to six months.**\4**
Six months of storage (6mgd x 183d = 1,098Mg). Provide sources of exiting storage for Orange County and Project service area.
5.-10/FN 4 **<u>Stanley, Mark, 2015. Seismic Considerations for Water Distribution Resiliency in California.</u>**
Not in Sec.9 References but in internet: https://www.hdrinc.com/sites/default/files/2017-05/hdr-seismic-considerations-for-water-distribution.pdf 46
Public access is fundamental to CEQa and the EIR, and this DEIR does not provide all referenced/cited documents and therefore the DEIR is incomplete. All references and citations must have a publicly accessible source for the document and included in Sec.9 and provide in a revised DEIR.

9.0-8 **<u>Environmental Data Resources (EDR) Radius Map Report with GeoCheck (EDR Report) (Environmental Data Resources (EDR), July 24, 2017).</u>**
Provided in appendices along with two other EDR documents, including some aerial photos but without all cited aerial photos. Withdraw, revise, and recirculate as RDEIR.

1994


San Diego Fwy
Avenida California
Paseo Eternidad
McCracken Reservoir
Via La Jolla
Vista Marina
Valle Rd
Capistrano Beach
Via Sacramento
Via Cascada
Flagpole Hill
Calle Rosita
Calle Fortuna
Avenida Las Palmas
Calle Mayo
Beach Rd
Park Lantern
Via Montoya
Google Earth

2017


San Diego Fwy
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Paseo Eternidad
McCracken Reservoir
Via La Jolla
Vista Marina
Valle Rd
Capistrano Beach
Via Sacramento
Via Cascada
Flagpole Hill
Calle Rosita
Calle Fortuna
Avenida Las Palmas
Calle Mayo
Beach Rd
Park Lantern
Via Montoya
Google Earth

46

Letter O4 Sierra Club

Dr. Tom Williams
August 6, 2018

Response O4-1

This comment provides a series of statements that either reiterates information from the Draft EIR or provide short comments and/or opinion with little context. The District's responses to these statements are provided below:

- Statements regarding the purpose of the Project and current reliance upon imported water are noted for the record.
- Regarding groundwater modeling, please see responses to Letter F2.
- The Draft EIR discusses "inland groundwater modeling" extensively, in Draft EIR Section 4.8, Hydrology and Water Quality. Further groundwater modeling was done at the request of several stakeholders (refer to responses to Letter F2 and Appendix 4.2.3). See also, Responses L6-10, L7-9.
- The Draft EIR addresses power supply components of the proposed Project in Sections 3 and 4.6, Greenhouse Gas Emissions. No power supply analysis is provided for wedgewire intakes, as these are only utilized for screened open ocean intakes which are neither proposed by the Project nor evaluated as an alternative, since screened ocean intakes are not favored by the Ocean Plan and environmental groups. There is also no existing intake tunnel that could be used for screened ocean intake, which would therefore require a new ocean intake tunnel, and associated significant marine impacts.
- Regarding analysis of the local (versus regional) Project, please see Master Response 2.
- Regarding seismic vulnerability, comments are correct that existing imported water facilities are vulnerable to seismic activity. Geologic and seismic risks associated with the proposed Project are analyzed in Draft EIR, Section 4.5.
- Environmental justice issues as required by the Project's CEQA-Plus SRF loan requirements begin on page 4.9-9 of the Draft EIR. This discussion provides the reasoning for the Draft EIR's conclusions. As stated in the Draft EIR:

  "Pursuant to CEQA-Plus SRF loan requirements (as described in Section 2, Introduction and Purpose), the Project would not have any disproportionate impact upon minority, low-income or indigenous populations or tribes. The desalination facilities are in Dana Point, which is in a relatively affluent portion of south Orange County. Although at a county level, Orange County is approximately 60% white, the Census Tract (0422.01) encompassing the Project is approximately 73.9% white with 9% at the poverty level. The desalination site is industrial, and is already physically isolated from the surrounding communities, with San Juan Creek forming its western border, PCH along its southern border, and the MetroLink railroad along its eastern border, with additional District property to the north. Similarly, the slant well locations are physically isolated already, being located within Doheny State Beach (DSB) and Capistrano Beach Park. The Project will provide for a reliable, drought-proof, locally controlled water supply, which will benefit all local communities served by the District, as it will ensure long-term sustainability of housing, employment and community services that are dependent upon a reliable potable water supply.

Therefore, the Project neither divides an established community nor disproportionately affects a minority, low-income or indigenous population. There would not be any significant impacts in this regard."

- Economic and financial issues, regarding Project economics or rates, are not environmental issues required to be addressed by the CEQA document. The District Board of Directors will consider a wide range of factors when deliberating on whether or not to approve the Project, and these factors can and will include factors outside of CEQA such as financial impact.
- This EIR is specifically for the local Project (up to 5 MGD). Some features of this Project are intended to be sized for compatibility with a potential future 15 MGD Regional Project (refer to Master Response 2).

Response O4-2

It is not clear from the comment what the specific confusion is. All local and regional conveyance lines serving the Project are owned by the District or by the Joint Regional Water Supply System of which the District is a member agency and the designated operator. Distribution of product water into the District's system is described on page 3.0-28 of the Draft EIR. Pipeline alignments are shown in Exhibit 3-3 at the end of Draft EIR Section 3.0 Project Description. The product water tank and pump locations are shown in Exhibit 3-6. Also refer to Master Response 2 that provides additional clarification regarding the Local Project as compared to Regional Project facilities.

Response O4-3

Please see Master Response 1 regarding the Project Description and Master Response 2 for further clarification regarding Local vs. Regional Project. The District is only considering approval of the Local Project (up to 5 MGD).

Response O4-4

It is not clear specifically what the commenter is requesting. Combining brine discharge with existing wastewater flows prior to outfall is the preferred method of discharge identified by the California Ocean Plan. There is no direct potable reuse planned, and the Project would not conflict with potential future direct potable reuse should it be implemented in the future, as the Project can meet California Ocean Plan requirements without blending with wastewater (see Draft EIR Section 4.8, Hydrology and Water Quality, and the brine modeling in Appendix 4.3.2). Refer to responses to Letter S7 re brine discharge modeling.

Response O4-5

Please see Responses O4-1 and O7-6 regarding environmental justice. Please see Section 6.3 of the Draft EIR for an evaluation of growth-inducing impacts, as well as response to Comment O2-1. As noted in the

Project Description, desalinated product water would be blended with existing imported water sources within the District's system. All sources of District water (imported, recycled, groundwater and proposed desalination water) would meet applicable local and state water quality standards.

Response O4-6

Project operations are described in Draft EIR Section 3.0, Project Description. The Project has been designed to operate 24 hours per day and facilities sized to accommodate fluctuations in demand, including onsite product water storage.

Response O4-7

The Draft EIR discusses inland groundwater withdrawals, which has been clarified and amplified as described in Appendix 4.2.3. See also, Responses L6-10, L7-9.

Response O4-8

While the Project is located approximately three miles from the Newport-Inglewood Fault Zone, please note that existing imported water conveyance infrastructure actually crosses the San Andreas Fault in several locations and therefore is susceptible to extreme groundshaking and/or ground rupture. Possible Project exposure to seismic activity is discussed in Section 4.5 of the Draft EIR. The District has a long history of constructing and maintaining water and wastewater facilities in seismically active Southern California. All Project facilities will be designed in accordance with applicable seismic design standards.

Response O4-9

The comment makes a number of assertions without specific critique of any Draft EIR analyses. With respect to service area, the Project would provide an additional source of reliable water to the District. The District's service area will not change with the Project. Existing and future water demands are described in Draft EIR Section 3.0, Project Description, and growth-inducing impacts are discussed in Section 6.3. Please see Response O4-1 regarding environmental justice, and O2-1 regarding growth-inducing impacts.

Response O4-10

Comments summarizing Project objectives are noted for the record. Local earthquakes are discussed in Section 4.5, Geology and Soils. A review of historical "significant" earthquakes indicates that none are known to have occurred in the Project area.[1]

Response O4-11 and O4-12

Please see Response O4-1 regarding environmental justice.

[1] California Institute of Technology, Southern California Earthquake Data Center, Significant Earthquakes and Faults, available at http://scedc.caltech.edu/significant/index.html (accessed March 23, 2019).

Response O4-13

All archived SCWD Board meeting minutes and videos can be found at www.scwd.org.

Footnote 4 on page 3.0-5 simply provides the location of SCWD Water Supply Reliability Report (December 2017).

Comments regarding page 3.0-6 provide a summary of statements within the Water Supply Reliability Report to document the purpose of the Project as proposed by SCWD. The comments do not raise environmental concerns to be addressed by the EIR.

As a general response regarding the use of footnotes, it is appropriate for an EIR to cite documents or web pages as sources of information. The entirety of every reference cited does not need to be included in the Technical Appendices of an EIR. Comments regarding the utility of references are noted for the record but do not warrant further response unless a specific comment has been made regarding the environmental analysis. The District has made its best effort to respond to all comments related to "significant environmental points" consistent with CEQA Guidelines Section 15132. It is not always possible to identify exact page references from website sources.

Response O4-14

Comments refer to changes in groundwater flows with project operation. Draft EIR page 4.8-30 explains that inland groundwater would make up approximately 5% of the total raw water source for the project. Based on the groundwater modeling conducted, impacts to the groundwater (up to 392 AFY) were found to be less than significant based upon the compromised quality (salinity) of that water source. The groundwater modeling has been updated following further coordination with SJBA on inland groundwater modeling, the results of which do not change Draft EIR conclusions. See also, Responses L6-10, L7-9.

Response O4-15

Regarding the product water storage tank, please see Master Response 2 regarding the explanation for sizing certain components of the Project. Draft EIR page 3.0-27 specifically states that the product water storage tank may be built to provide disinfection capacity for up to 15 MGD, in order to avoid constructing separate regional facilities at a later date, or tearing down a tank sized for the Local Project and replacing it with a regional-sized tank.

Response O4-16

It is not clear what this comment is requesting. Refer to Master Response 2 regarding clarifying Local Project and Regional Project facilities. The brine pump pad would be sized to accommodate additional pumps in future phases; however, product water pumps would be installed to match anticipated product water pumping volume, so the Local Project would only include product water pumps corresponding to Local Project product water volumes, in accordance with District Design Standards and Practices.

Response O4-17

Reference to page 3.0-17 does not correspond with the comment provided but appears to apply to footnote 17 on page 3.0-22. The email referenced is part of the administrative record for the Project but inconsequential to the description of the proposed Project.

References to the Preliminary Design report in Tables 3-6 and 3-7 are the May 2018 report by GHD included in the Draft EIR appendices.

Footnote 22 simply identifies a prior CEQA document as a factual statement. Footnotes 24 and 25 also identify the sources of information used or referenced in the Draft EIR.

Please see Response O4-13 regarding citations.

Response O4-18

The Cultural Resources Assessment includes references utilized in the report, including consultation with the Dana Point Historical Society and review of Dana Point historical resources inventories. The Draft EIR also cites to the San Juan Creek Property EIR and Doheny State Beach General Plan EIR. The comment alleges inadequate consideration of historic use of the Project sites but provides no information to indicate any additional known resources or specific inadequacies in the Draft EIR.

Response O4-19

The Draft EIR includes assessment of potential paleontological resources. No known paleontological resources have been recovered during any past construction within the desalination facility site or slant well sites (Draft EIR Appendix 10.5.1, Appendix A, page 7).

Response O4-20

Please see Response O4-13 regarding citations.

Response O4-21

The comments do not raise significant environmental issues and have no effect on impact analysis.

Response O4-22

The comment makes a number of assertions without substantial evidence to support the assertions. The Draft EIR included a preliminary geotechnical investigation (Appendix 10.6.1). Project grading and building plans will require site-specific final geotechnical investigations typical of any major construction project (see Draft EIR Mitigation Measure GEO-1 as modified by responses to comments).

See also Response O4-13 regarding citations.

Response O4-23

Refer to Responses O4-10, O4-19 and O4-22. See also Response O4-13 regarding citations.

Response O4-24

Please see Master Response 1 regarding the Project Description and Master Response 2 regarding the Local Project versus the Regional Project.

Response O4-25

The comment references Impact 4.5-1, which addresses risk due to ground rupture. The analysis that follows mentions the Christianitos fault zone approximately 6 miles away. At this distance the Project is not susceptible to ground rupture. Regarding ground shaking, the Draft EIR page 4.5-14 states that the Uniform Building Code is applicable. That statement does not draw conclusions that warrant a response.

With respect to the request for "engineering design risks," the Draft EIR appropriately calls for Project construction to meet established performance standards. Mitigation Measure GEO-1 applies to the Local Project (up to 5 MGD). As noted in Response O4-22, prior to construction the Project will require a final geotechnical report to demonstrate compliance with applicable building and District facility design standards.

Response O4-26

Comments regarding the brine disposal system are noted. All Project components are subject to Mitigation Measure GEO-1. The referenced DEIR text is with respect to risk of loss or injury due to seismic events. The brine system is entirely underground and will be installed to current industry design standards. The commenter provides no basis upon which to believe the brine pipeline (located within the desalination facility site) could expose persons to injury or death due to a potential future seismic event.

Response O4-27

The referenced DEIR section is from Section 4.4, rather than 4.6. This policy is a DSB policy for its ongoing monitoring of park development and is not a requirement for the Project.

Response O4-28

Refer to Response O4-19.

Response O4-29

Please see Master Response 1 regarding the Project Description and Master Response 2 regarding the Local Project versus the Regional Project.

Response O4-30

The comment makes general assertions without substantial evidence to support the comments. The Draft EIR provides a "CEQA-Plus" analysis where required, and as noted throughout the Draft EIR. The Project is presently being reviewed for SRF funding, part of which will include confirmation of adequate CEQA-Plus analysis. The District is not aware of any specific issue with respect to CEQA-Plus analysis in the Draft EIR. General comments regarding adequacy of the Draft EIR are noted. See also Master Response 1 regarding the Project Description and Master Response 2 regarding the Local Project versus the Regional Project.

Response O4-31

Regarding historical uses of the site, Draft EIR Section 4.7 documents the findings of the database searches and Phase I/Phase II ESAs, which included new soil borings and testing. The Phase I ESA (Appendix 10.8.2) details past uses on the site, including its prior use as the site of a wastewater treatment plant. Appendix 10.8.2 indicates that aerial photos are provided when available. In addition to the cited aerial photos, the EDR and corresponding Draft EIR analysis utilized historic Sanborn maps and other literature/records searches. No documentation was excluded from the Draft EIR that was provided by EDR.

Regarding footnotes, please see Response O4-13 regarding citations.

Response O4-32

Comments regarding railroad hazards are noted for the record. The EIR presents information relevant to the introduction of a desalination plant at this location and is not intended to evaluate all effects associated with existing conditions. Similar and even more intense uses are located along the length of this railroad line. Refer to comments above regarding historic aerial photos (Response O4-31). A final geotechnical report will be required prior to construction (Mitigation Measure GEO-1).

Response O4-33

Please see Response O4-13 regarding use of citations.

Response O4-34

The Draft EIR addresses existing groundwater contamination in Section 4.7, Hazards and Hazardous Materials and Section 4.8, Hydrology and Water Quality. Further clarification is provided in Response L5-1 through L5-4.

Response O4-35

Please see Response O4-13 regarding use of citations.

Response O4-36

The Draft EIR's conclusion that the Project would not result in any significant unavoidable impacts concerning hazards and hazardous materials is based on substantial evidence and analysis, including in Draft EIR Section 4.7.

Response O4-37

Exhibit 4.7-2 has been modified and is included in Section 3, *Draft EIR Errata*.

Response O4-38

With respect to Project alternatives, the alternatives evaluation was conducted consistent with CEQA requirements as explained starting on page 5.0-1 of the Draft EIR. Project objectives are considered reasonable and sufficiently broad so as to allow consideration of a reasonable range of alternatives, also consistent with the intent of CEQA.

Response O4-39

This comment makes a number of assertions and unsubstantiated claims without specifically offering any critique of the Draft EIR alternatives analysis, nor does the commenter provide any substantial evidence that the fundamental Draft EIR conclusions are in error, or that there are other alternatives that could meet basic Project objectives and reduce or eliminate the Project's unavoidable significant impacts. Note that, for the Local Project, there are no identified unavoidable significant impacts. Also note that the proposed Project was independently verified as the environmentally preferred alternative through multiple separate water supply reliability studies, including those conducted by a stakeholder-led Water Reliability Working Group, and a water supply reliability study prepared by the District (Water Supply Reliability Study, December 2017). The Project meets the goals and objectives as described in Section 3.0, Project Description, and is analyzed in Section 5.0, Alternatives. Please see Master Response 2 regarding the Local Project compared to the Regional Project, and Response O2-1 regarding the District's water portfolio with the Local Project.

Response O4-40

Please see Response O4-13 regarding use of citations.

Response O4-41

Please see Responses O4-38 and O4-39 regarding Project alternatives.

Response O4-42

Please see Response O4-13 regarding use of citations.

Response O4-43

This comment is opinion unsubstantiated by facts. The Draft EIR conclusions are substantiated with substantial evidence including several years of technical studies, public scoping, agency scoping, and successfully developing and operating a test well at DSB.

Response O4-44

See Response O4-31 regarding historic use of the site.

Response O4-45

Please see Response O4-13 regarding use of citations.

Response O4-46

The comment requests "sources" for local water storage capacity information on page 5.0-10 of the Draft EIR. The source of information is identified in footnote 4. Please also see Responses O4-31 and O4-13.

July 25, 2018

South Coast Water District
31592 West Street
Laguna Beach, CA 92651-6907

Subject: DRAFT ENVIRONMENTAL IMPACT REPORT
STATE CLEARINGHOUSE NO. 2016031038
Doheny Ocean Desalination Project

The purpose of the South Laguna Civic Association (SLCA), established in 1946, includes addressing issues affecting quality of life of residents of South Laguna, and those residents are customers and ratepayers of the South Coast Water District (SCWD). Since annexation of South Laguna by the City of Laguna Beach in 1987, the residents have continued to be well served by SCWD without having a direct voice in election of the Board of Directors of the district. Nevertheless, the Board of Directors of the SLCA appreciates the long working relationship with SCWD.

Purpose of the Proposed Project

The first paragraph of the Executive Summary of the Doheny Ocean Desalination Project Draft EIR states the project would provide a "high quality, locally-controlled, drought-proof water supply. The desalination facility would also provide emergency back-up water supplies, should an earthquake, system shutdown, or other event disrupt the delivery of imported water to the area." 1

SLCA has carefully followed the Doheny Ocean Desalination Project since its inception, and we agree with the project's premises: the increasing scarcity of water and the need for a back-up supply of water in an emergency. We further recognize and support the need to address concerns for an overall regional water-supply strategy that is reliable, available during emergencies and sustainable.

We believe that most would agree that development of a desalination plant is a somewhat aggressive, perhaps radical, but clearly capital intensive and controversial way to achieve those objectives. So, careful review and consideration of the impacts of the proposed project are appropriate.

We therefore offer the following comments and alternatives to the proposed project which are intended to lead toward a safe and reliable source of supply via a robust and sustainable approach to ensuring a sufficient long-term supply of potable water that will be in the best interests of all SCWD customers and ratepayers.

Scope of the Proposed Project

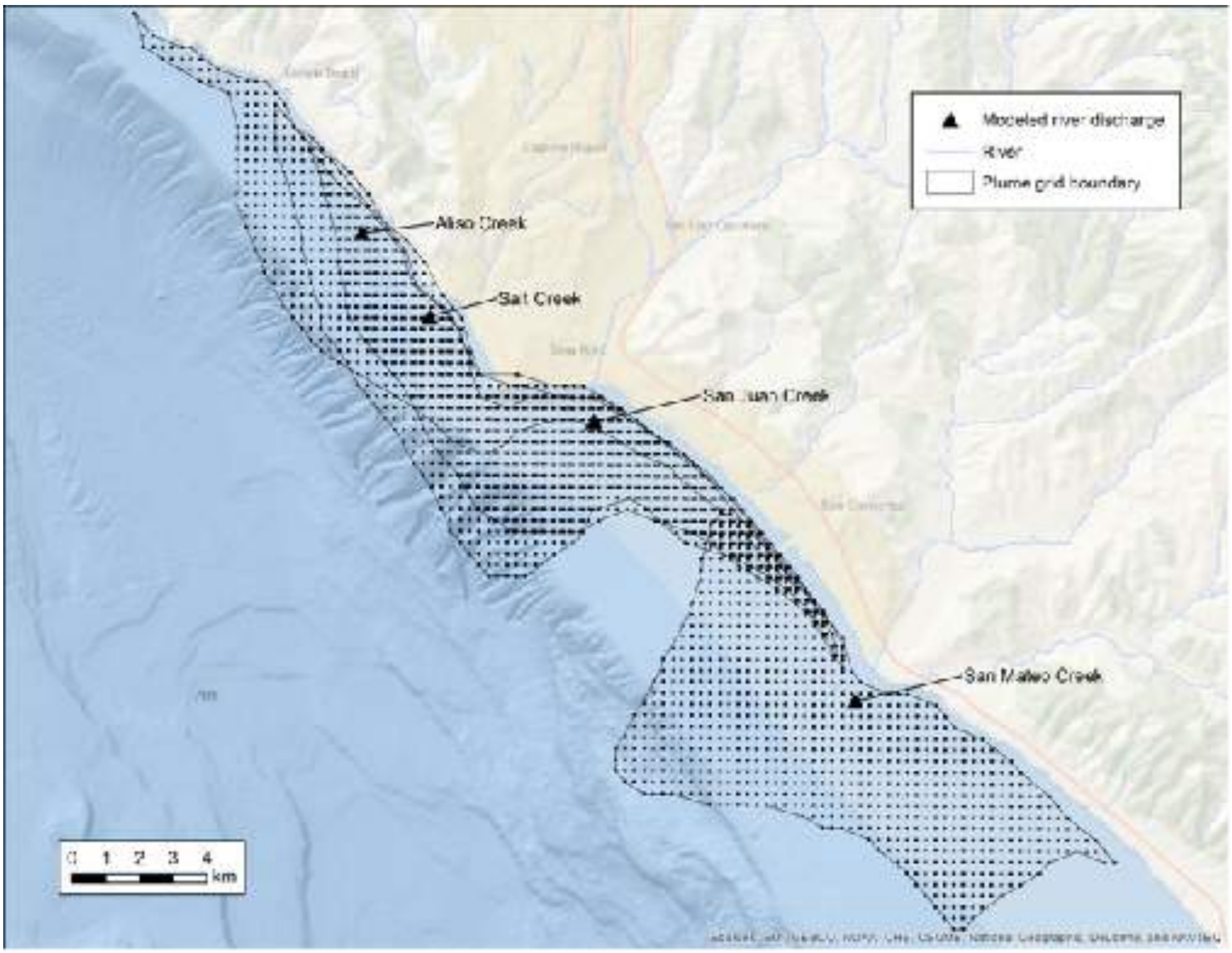
The Draft EIR Executive Summary states that "…SCWD has made investments in conservation, recycled water, and groundwater recovery. However, SCWD is currently relying on 85 to 100 percent of their water supply from imported sources. SCWD plans to use the desalination facility to decrease its reliance on imported water sources.

SLCA Comment #1: From what we can tell from information provided in the Draft EIR, the Phase 1 – 5MGD – facility would be able to do more than decrease reliance on imported water. It would appear to fully replace the need for any imported water. Therefore, rather than being scaled to fully replace all current imported water, the scale of the proposed project could be designed to only fill the gap between expected quantities of water available for purchase during times of drought, and potable water requirements remaining if there are improvements in the production of recycled water as well as emergency levels of potable water required in the event of a supply disruption. Numerous studies conclude as much as 50% of water demand can be met with local recycled water. 2

SLCA Comment #2: **Impacts on Ocean Water Quality and Marine Life**

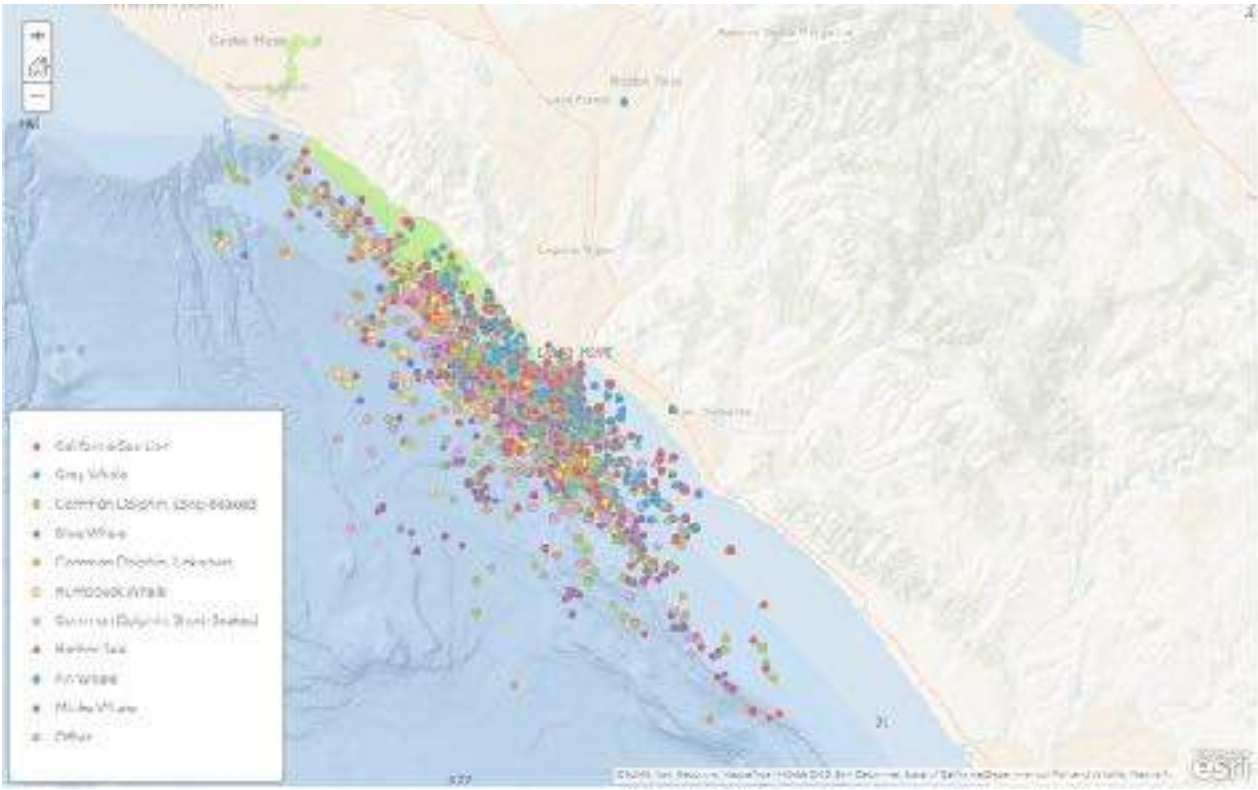
The proposed project will increase salinity of discharge and wastewater volumes on regulated coastal receiving waters frequented by federally protected migrating California grey whales, coastal dolphins and other marine life. Increased discharges at the San Juan Ocean Outfall (SJOO) will expand the wastefield plume to degrade larger areas and may represent “back-sliding” as it relates to the NPDES Permit. The Southern California Eddy Current and local ocean swells will transport brinewater discharges and likely migrate to South Laguna coastal waters and State Marine Protected Areas (SMCAs).

The highly saline brine that is a waste product of the process should probably not be returned to the ocean where it will surely have deleterious effects in whatever area is emerges: "The illusion of dilution creates contaminate bioaccumulation among sea life and chronic ocean pollution." 3



A more suitable alternative could be to dry the effluent and export to some off-site location where, chemically inert, it could do little harm. Camp Pendleton, for example, uses solar ponds to dewater brine water.

It appears if we are contaminating the ocean in the vicinity of the intake with the sewage effluent from San Juan Capistrano, Dana Point and Laguna Beach, then we are harvesting polluted water to remove not only the contaminants of that effluent including viruses and pharmaceuticals, but also the additional salts and naturally occurring chemicals, that make the ocean water undrinkable. Whereas the recycled water in from Aliso Canyon has many fewer contaminants to remove because it is much purer than the effluent they are presently discharging. The prohibition about not implementing toilet to tap is not satisfied in this proposal because with all the discharges, the ocean becomes only a conduit for transmitting the toilet effluent back into the domestic water system.



Mapping courtesy of Lei Lani Stelle, Ph.D., Professor, Chair of Department of Biology, University of Redlands

3

The cetacean mapping graphic depicts the project’s relation to the brinewater discharges and federally protected marine life as well as potential migration of the Doheny Project's wastefield plume into South Laguna coastal waters.

SLCA Comment #3: Impacts on Public Parks, Land and Beaches

The installation of well heads in the coastal parks and on the ocean floor, and the resulting and ongoing impacts on marine habitat are an intrusion on the use and enjoyment of public land for which mitigation may or may not be achievable. Such use should trigger the acquisition of a few small parcels that are not part of, or accessed through, the public realm. 4

Fiscal Impacts

SLCA comment #4: The fundamental premises of, and justification for, the proposed project stated are risk to SCWD customers and ratepayers of reduction in available supply due to drought or other causes and risk of interruption of supply due to earthquakes or other disaster. Few would disagree with the importance of having high quality, drought-proof supplies of water that would also offer emergency water supplies in the event of disruption of water imported to the area. A water supply disruption may likely include disruption to the power grid necessary for energy intensive ocean desalination and the ability to pump from sea level to users at higher, inland elevations to, thus, make the project inoperable when it is most needed. 5

This raises key questions:

1. Do the customers and ratepayers agree addressing the risk is worth the cost, both in environmental terms as well as financial terms?

2. If it is, is the proposed project the most appropriate solution?

As of June 30, 2017, the district reported annual gross revenue of under $40,000,000 and liabilities including
bond debt of over $50,000,000. However, with the cost of routine capital improvements and the Tunnel 5
Stabilization and Sewer Pipeline project the potential debt load of the district will soon exceed $100,000,000 by a substantial amount, and if the Doheny Ocean Desalination Project proceeds as proposed, the total debt of the district could easily exceed $200,000,000.

SLCA comment #5: We question whether it is appropriate for a district this size to assume such a large financial burden; and are there acceptable alternatives that would be less of a financial burden?

Unknown Impacts

The consensus among scientists and engineers has been that there are many chemicals for which we not
only do not test for in our drinking water but about which we have no data about their effects on human
health. Thus, we should be extremely skeptical about assuming they are benign. Over the years, thousands
of new chemicals have emerged, and will continue to emerge, all of which are sure to find their way into 6
water. There is no reason to presume that we are in a position to know their concentrations or their effect. The project will draw seawater from areas adjacent to Dana Point Harbor with possible unaccounted marina fuel and boat contaminates.

Alternatives Proposed in the Draft EIR

The Draft EIR considers four alternatives: “No Project,” “Enhanced Conservation,” “Enhanced Recycled Water,” and “Reduced Capacity.”

SLCA comments on the four alternatives proposed in the Draft EIR:

SLCA comment #6, on “No project”: “No project” would eliminate impacts, but would not achieve project objectives, may require finding alternative water supply sources, and would leave the district as vulnerable to disruptions of supply as it is today. In essence, “no project” is “no change” – so the issue is whether the project objectives are valid concerns, and whether the concerns warrant being addressed.

SLCA comment #7, on “Enhanced Conservation”: Though comments in the Draft EIR state that
enhanced conservation is not considered sustainable and would not provide emergency water supplies in 7
the event of outages or curtailment of supply due to drought or emergencies, SLCA would suggest that enhanced conservation be pursued as a part of any ongoing program to address the issues that led to the proposal. Enhanced conservation alone may not be the sole solution but should be a part of any ongoing program. Enhanced conservation can include increased storage in cisterns below streets, playing fields, parks and parking lots to decentralized water storage at higher elevations for gravity supplied water in an emergency similar to systems in San Francisco and elsewhere. Storage wells, groundwater recharge and even swimming pools can provide immediate water supplies during emergency events.

SLCA comment #8, on “Enhanced Recycled Water”: The document states that achieving the project supply goals through “enhanced recycled water” would require a four-fold increase in production of recycled water, but the bigger problem, it states, seems to be that there is no current regulatory pathway for use of “flange to flange” water as a potable water application. However, there is no proposal for direct potable use so the “flange to flange” concerns are irrelevant in the Draft EIR. The District contends it has insufficient recycled water production potential to make this alternative feasible. It is not clear whether this statement means there is no source of water to be processed in these quantities or if it means the plant capacity does

not exist. A proposal submitted to OC Public Works seeks State funding to double production of high purity recycled water at the successful $2.5 million Aliso Creek Water Reclamation Facility at the Coastal Treatment Plant to 1 million gallons per day with a wholesale value of $3,000 per day or $1 million each year in new revenues to the District. The Aliso Creek Ocean Outfall adjacent to the Laguna Beach State Marine Conservation Area (SMCA) discharges 10 million gallons daily of wasted wastewater as an immediate, affordable source for more recycled water to meet and exceed District demands. This point needs clarification. However, as with the comments above on enhanced conservation, SLCA suggests that increasing recycled water, consistent with the Laguna Beach Wastewater Task Force Adopted Resolution of September 16, 2014, should be a part of any ongoing solution.
(Exhibit A: Laguna Beach WTF Adopted Resolution - http://lagunabeachcity.granicus.com/MetaViewer.php?view_id=3&clip_id=400&meta_id=30776).

SLCA comment #9, on "Reduced Capacity": All-in-all, combining enhanced conservation and enhanced recycled water could allow for a reduction in the gap between water supplies available and water needs. Further, rather than being scaled to fully replace all current imported water, should the scale of the proposed project be designed to only fill the gap between expected quantities of water available for purchase during 7
times of drought, and potable water requirements remaining after improvements due to enhanced conservation and enhanced recycling as well as emergency levels of potable water required in the event of a supply disruption? It may be that the critical component in determining the size of a proposed desalination facility would be demand for potable water under emergency circumstances. If that were to be the case, the question would be whether the customers and ratepayers would be willing to accept the costs, both financial and environmental, to develop that facility. In an emergency, recycled water can be filtered to potable water quality standards at the Aliso Creek Water Reclamation Facility and elsewhere in the District.

SLCA comment #10, Customer and Rate Payer Inclusion

Before choosing one of the four proposed alternatives, SLCA believes the first step should be for the customers and ratepayers to express their opinion about whether there is a valid need for the project, whether the concerns warrant being addressed, and whether the proposed project is the most appropriate avenue to pursue. The risk of the debt, the change in monthly and annual costs to ratepayers, the risks of future reduced supplies due to droughts and other reasons, and the risk of interruption of supply due to earthquakes and other disasters, as well as environmental considerations should be explained to ratepayers, and all ratepayers – including South Laguna – should vote on whether to proceed or not. And it should not be a decision made solely by the SCWD Board. Absent a vote by South Laguna ratepayers, the project costs may constitute a "taxation (fee, rate increase, etc.) without representation".

SLCA comment #11, City of Laguna Beach's 2009 Climate Protection Plan

Laguna Beach City's Climate Protection Plan makes the following declaration:

> **2.6 Water Use Efficiency and Sustainable Sourcing**
>
> "The supply, conveyance, treatment, and distribution of water, and wastewater treatment, use significant amounts of electricity. The City should therefore strongly encourage reduction of
> water use. This will involve the development of landscape design and maintenance guidelines and the 8
> incorporation of water saving measures into green building standards. The City should also strongly encourage the development of less energy-intensive sources such as rainwater catchment and recycling."

The proposed project acknowledges desalination of ocean seawater at 35,000 tds to potable standards of 500 tds is inconsistent with City of Laguna Beach plan objectives. Although South Laguna citizens are non-voting SCWD ratepayers, as a distinct area within city limits, it is nonetheless likely subject to the City's Climate Protection Plan's mandates.

Other Alternatives Not Discussed in the Draft EIR 9

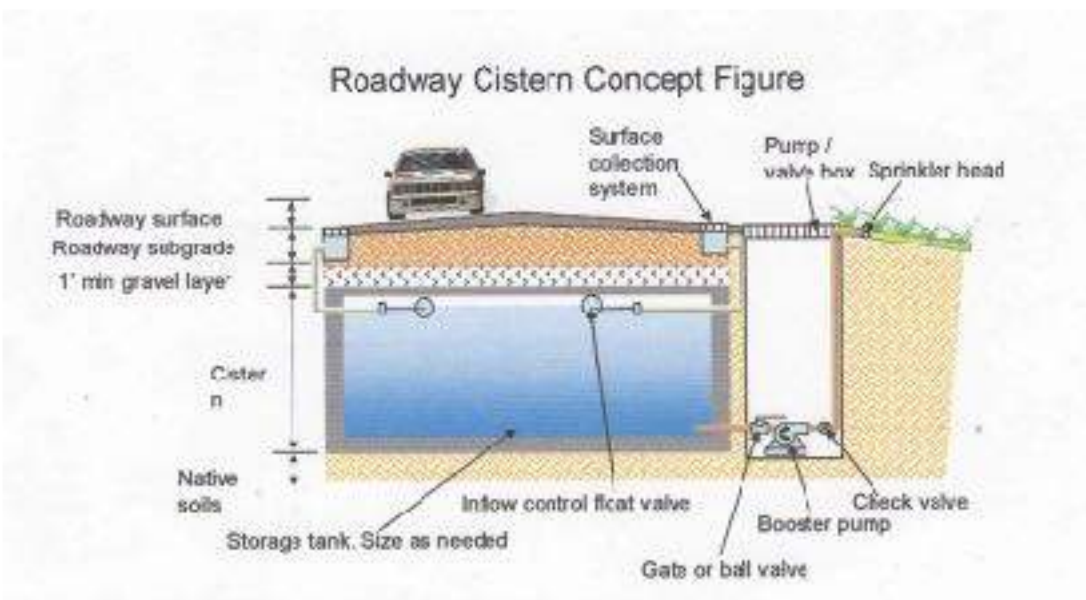
For a resource so fundamental as water supply we should have not only a significant contingency to cover multiple possible events, but perhaps even some redundancy. This points to the need for a more comprehensive water supply strategy.

Beyond the four alternatives proposed in the Draft EIR, are there other alternatives that should be considered?

- Mandated sharing or combining water districts: If the issue is sharing of water resources among a set of smaller, local, independent retail water agencies, would a more reasonable solution be either a combination of agencies, or, at least a mandated sharing of water supplies so that resources are more equitably shared. Note that the Laguna Beach County Water District (LBCWD) recent acquisition of certain water rights will benefit Laguna residents served by that district, but not by those citizens of Laguna Beach living in South Laguna. LBCWD is a subsidiary of the Laguna Beach City Council and presently recycles 0% of its 1.6 million gallons per day of wastewater.

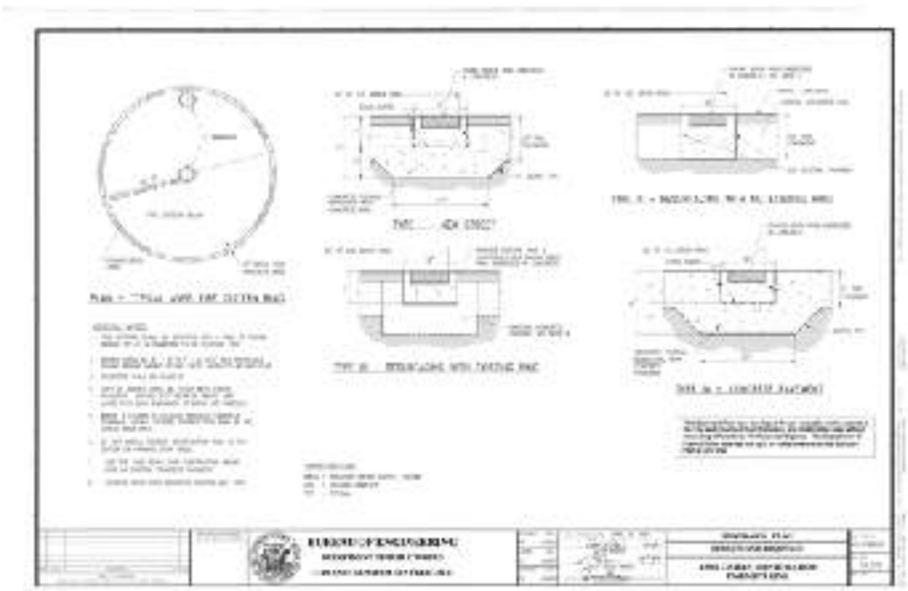
- In terms of adequacy of supply for urban uses, a more "global" approach would be to concentrate on making both California agriculture and Southern California region-wide consumption far more water-efficient, and creating incentives for doing so. Capturing agricultural irrigation runoff on-site for local beneficial reuse can increase regional water supplies while decreasing agricultural runoff contaminates to protected creek and coastal resources. 9

- Recycling from sources including Aliso Creek Water Reclamation Facility, rainwater and urban runoff harvesting, and a variety of cisterns warrants closer analysis (see concept diagrams below).



Designed by Geosyntec for the Athens Group's Aliso Redevelopment Plan

Using a sense of purpose in preparing for a regional emergency, multiple storage opportunities are present under parking lots, playing fields, under-utilized streets (e.g., behind Mission Hospital, Act V Parking Lot in Laguna Beach, Salt Creek Parking Lot, etc.) to facilitate water storage throughout the District.



9

Environmentally Superior Alternatives

From the Draft EIR:

“The ‘No Project’ Alternative would eliminate all of the potentially significant impacts associated with the environmental categories discussed. As such, it could be considered ‘environmentally superior’ to the Proposed Project.”

“The No Project Alternative would be the <u>environmentally superior alternative</u> because it would eliminate all of the potentially significant impacts of the proposed project. Section 15126.6(e)(2) of the State CEQA Guidelines states that if the ‘No Project’ alternative is found to be environmentally superior, ‘the EIR shall also <u>identify an environmentally superior alternative</u> among the other alternatives.’” 10

SLCA comment #12: Multiple studies conclude “upcycling” local wasted wastewater for reuse is more cost effective than water resources such as ocean desalination. Environmentally superior – and less costly – alternatives capable of achieving local water improvements include:

- Increased water recycling to underserved areas to include Laguna Beach for routine irrigation and wildfire suppression of mandated Fuel Modification Zones
- Domestic greywater systems certified and inspected annually
- Home rainwater cisterns
- Stormwater capture and groundwater replenishment

- Groundwater replenishment at the Chet Holifield Federal “Ziggurat” Building aquifer
- Aliso Canyon reforestation for stormwater capture, groundwater replenishment supplied by recycled water for irrigation and wildfire protection
- Groundwater replenishment wells

Alternative 3 in the Draft EIR is the “Enhanced Recycled Water Alternative.” From the Draft EIR:

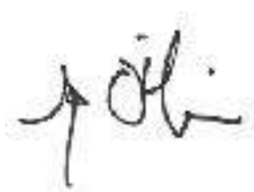
“In the absence of a desalination facility, the District would likely pursue even more aggressive conservation 10
and recycling…”

SLCA comment #13: SLCA supports improvement of ocean water quality by “upcycling” 10 million gallons per day at the Aliso Creek Ocean Outfall (ACOO) of wasted wastewater at 1200 tds versus seawater at 35,000 tds. Underserved areas include the Laguna Greenbelt Fuel Modification Zones for wildfire protection and similar areas throughout the SCWD District (Exhibit B: City of Laguna Beach Fuel Modification Zone Guidelines).

SLCA comment #14: With rapidly changing technology related to recycling, it is conceivable that regulatory restrictions could change in the foreseeable future. Therefore, considering the pace of change in technology related to recycling, before making such a large financial commitment to a desalination plant based on limitations on use of recycled water under the current regulatory climate, should the Draft EIR consider the difference in financial cost and environmental impact of recycling water during regional emergencies to potable standards versus desalination?

Conclusion

The South Laguna Civic Association enjoys a long partnership with SCWD and SOCWA members in advancing emerging solutions to local water shortage and ocean pollution. We remain ready to assist in developing the next generation of comprehensive new water management alternatives – not excluding
desalination options – to achieve a balanced water supply based on a combination of more storage, the 11
creation/extension of a recycled water system capable of providing sustainable water supplies while improving and protecting South Laguna’s rare environmental resources. To achieve ratepayer equity in determining the best path forward for the proposed expensive project, we urge the South Coast Water District to let all of the people vote.



Greg O’Loughlin

President

City of Laguna Beach
AGENDA BILL

No. **14**
Meeting Date: **9/16/14**

SUBJECT: WASTEWATER ADVISORY TASK FORCE RECOMMENDATIONS

SUMMARY OF THE MATTER:

The Wastewater Advisory Task Force was formed in July 2013 after consideration of potential environmental impacts related to the Coastal Treatment Plant Export Sludge Force-main Replacement Project located within Aliso Canyon. Concurrently, the State of California has been facing an extreme long-term drought that is impacting water use, but is also expanding the potential for advancing alternative water supplies. There is a need for holistic water management within South Orange County and the City of Laguna Beach to promote and champion alternative water sources, and reduce the impacts of water discharges on local receiving waters. The Wastewater Advisory Task Force considered these issues during the development of Task Force recommendations.

The initial Task Force goals were:

- To develop recommendations for South Orange County Wastewater Authority's (SOCWA) long-range strategic plan, focusing on sustainable, cost-effective, and environmentally sound wastewater management that respects the integrity of the Aliso and Wood Canyons Wilderness Park and coastal receiving waters.
- To gather and assess information on current operations and on twenty-first-century technologies through interviews with and presentation by SOCWA staff, University of California at Irvine faculty and graduate students, other invited speakers, and the Internet to present to City Council, recommendations for upgrades, improvements, and possible removal of sewer infrastructure from the Aliso and Wood Canyons Wilderness Park.
- The task force will consider and comment on the financial impacts of its recommendations.

The Task Force was comprised of two City Councilmembers (Councilmembers Whalen and Dicterow), five interested residents (Michael Beanan, Mark Christy, Jane Egly, Cathleen Greiner and Derek Plaza) and City Staff (David Shissler and Tracy Ingebrigtsen). In order to meet the Task Force goals, the group

RECOMMENDATIONS: It is recommended by the Wastewater Advisory Task Force that the City Council adopt the Wastewater Task Force Action Statements and Recommended Actions as stated beginning on Page 2.

Appropriations Requested: ____________

Fund: ____________

Attachments: ____________

Submitted by: ____________
Tracy Ingebrigtsen, Senior WQ Analyst

Coordinated with: ____________
David Shissler, Director of Water Quality

Approved: ____________
City Manager

invited expert speakers to describe wastewater treatment plant operations, possibilities and constraints for current water supplies, and explore alternative water supplies and reuse technologies. The Task Force membership met seven times and heard presentations from the following groups:

- SOCWA - Detailed understanding of the Coastal Treatment Plant - facilities overview, operating budget, capital improvement plan and facility plan.
- Laguna Beach County Water District – Recycled Water Potential
- South Coast Water District – Reclamation System Project at the Coastal Treatment Plant
- Fire Chief LaTendresse – Fuel Modification Zones
- Orange County Chapter of WateReuse - Direct Potable Reuse

Finding a continued long term solution to the task force goals will take ongoing collaboration among multiple agencies and groups as well as the development and use of alternative sources of water. The complexities of this issue require long-term consideration and action. The final recommendations are categorized into Action Statements and Specific Recommended Actions.

RECOMMENDATIONS:

The Wastewater Advisory Task Force recommends the City Council adopt the following Action Statements and Recommended Actions.

A. Adopt Wastewater Task Force <u>Action Statements</u>:

1. Quantify <u>Water Availability</u> of all potential sources (Potable, Recycled, Stormwater, and Direct Potable Reuse) for existing and future Laguna Beach uses.

2. Encourage <u>Self Reliance</u> by developing, supporting and participating in regional efforts for aggressive water conservation, full water reuse technologies, and other emerging water capture, use/re-use strategies that will stretch our current water supplies to the maximum extent possible.

3. Support <u>Interagency Collaboration</u> for regional expansion of existing, new, and future water supplies and reducing the waste of water.

4. Participate in the development of <u>Long-Range</u> strategic plans for sustainable, cost-effective, environmentally sound water and wastewater management. Establish metrics for measuring progress, and support economic incentives to promote the use of alternative water supplies.

5. Support <u>Outreach and Education</u> efforts to inform the public about their local water cycle including; water supply, availability and sources, water waste/urban runoff impacts, wastewater discharge impacts, and emerging water capture, use/re-use strategies.

B. Adopt Wastewater Task Force <u>Recommended Actions</u>:

1. Develop an area map showing Laguna Beach and surrounding area water sources including potable and recycled water.

2. Support and participate on the South Orange County Regional Recycled Water Committee to facilitate/develop a long range plan to maximize the re-use of wastewater supplies.

3. Request that the City of Laguna Beach become a participant in the SOCWA Recycled Water Permitting Committee (PC2 SO).

4. Send letters of support to State elected officials, the California Association of Sanitation Agencies and the Water Reuse Foundation supporting legislation, regulations, research and initiatives for the acceptance of Direct Potable Reuse.

5. Work with other agencies in the South Orange County Watershed Management Area (SOCWMA) to develop Feasibility Studies for the use of alternative water supplies (Direct Potable Reuse, Storm/Urban Water Capture and Reuse) within South Orange County and the City of Laguna Beach.

6. Request SOCWA to continue to evaluate the feasibility and costs of new technologies at Coastal Treatment Plant and other SOCWA facilities to minimize the environmental impacts on sewer infrastructure within the Aliso and Wood Canyon Wilderness Park and to provide an update to the City Council in May 2015.

City Of Laguna Beach

Fire Department

Landscape/Fuel Modification Guidelines and Maintenance Program

505 FOREST AVE . LAGUNA BEACH, CA 92651 . TEL (949) 497 0700 . FAX (949) 497 0784

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Landscape/Fuel Modification Guidelines and Maintenance

PURPOSE

The purpose of these guidelines is to provide information on how landscape and fuel modification zones are to be integrated, designed, installed, and maintained in order to meet safety requirements. The many variables involved with landscape and fuel modification make specific, uniform regulations impractical. Laguna Beach Fire Department (LBFD) will not require supporting data if these guidelines are followed to the satisfaction of LBFD. Compliance with these guidelines does not guarantee that homeowner's insurance may be secured. Furthermore, compliance with these guidelines may not prevent the loss of life and or real and personal property due to fire.

SCOPE

Landscape is considered to be any hardscape or softscape improvement not defined as a structure. A fuel modification zone is a strip of land where combustible vegetation has been removed and/or modified and partially or totally replaced with more adequately spaced, drought-tolerant, fire-resistant plants in order to provide a reasonable level of protection to structures from wildland. Development contiguous to or within 300' of an undeveloped vegetated area (urban wildland interface) requires modification of natural vegetation at the urban interface and an integrated landscape plan.

Properties required to follow these guidelines are identified in the City's GIS with a "FM" designation. All proposed new structures designated with an FM shall be required to follow the Landscape/Fuel Modification Guidelines. All existing structures with an FM designation which propose an addition alteration or repairs having a valuation of 50% or more of the valuation of the building prior to the additions, alterations, or repairs shall be required to follow the Landscape/Fuel Modification Guidelines. An integrated landscape and fuel modification plan varies in complexity and is dependent upon the type, quantity, and spacing of vegetation, as well as topography, degree/type of exposure, local weather conditions, and the construction, design, and placement of structures. A typical landscape/fuel modification installation consists of a 20-foot setback zone (Zone A), a minimum 50-foot zone typically irrigated (Zone B), with an additional 125-foot minimum of vegetation thinning zones (Zones C and D). The minimum width of a fuel modification area is 195 feet and in some cases the width increases due to type of terrain and/or type and mass of vegetation. The necessity of implementing a landscape/fuel modification plan does not release the owner from the responsibility to mitigate the impact of such modifications (e.g., erosion control, endangered species, etc.).

SUBMITTAL REQUIREMENTS

1. Landscape/Fuel Modification Plans

Landscape/fuel modification plans show the area and location of all hardscape/softscape improvements and fuel modification necessary to achieve the minimum acceptable level of risk to structures from combustible vegetation. Submit two sets of plans prepared by a licensed landscape architect or other design professional with equivalent credentials to the City of Laguna Beach Community Development Department for review.

The following shall be included on the fuel modification plan (also refer to Attachment 1):

A. Identify the design of the proposed development, showing all property lines, contour lines, and the proposed location of all new and existing structures including all hardscape/softscape improvements and the fuel modification area.

B. Delineation of each zone (setback, irrigated, and thinning) with a general description of each zone's dimensions and character; i.e., 50-foot - 70-foot Zone B, with existing vegetation removed, irrigated, and planted with adequately spaced plant material that is more drought-tolerant and fire-resistant (See Attachment 2).

C. Location and detail of permanent zone markers (See Attachment 4).

D. Identify the removal of undesirable plant species in accordance with the LBFD Fire Prone Plant Species List (See Attachment 7).

E. Plant palette to be installed in accordance with approved guidelines. Include a plant matrix for all trees, tree-form shrubs, shrubs, and shrub-like plants in irrigated zones showing the maximum height and width of mature plants and proposed spacing. NOTE: Care should be taken to select plants that provide limited habitant to rats and other rodents that may detract from the health and safety of residents. Contact Orange County Vector Control for further information.

F. Photographs of the area which show the type of vegetation that currently exists, including height and density, and the topography of the site.

G. Description of the methods to be used for vegetation removal, i.e., mechanical or manual.

H. Location of emergency and maintenance access easements within every 500 lineal feet of the fuel modification area. Access easements shall have a minimum 10-foot width; alternatively, 5-foot wide easements provided every 250 feet may be acceptable. Gates, if installed within the easement, shall be a minimum of 36 inches wide. The easements shall be maintained free of vegetation or any structures greater than 5 inches in height.

I. General description of what exists 300 feet beyond the development property lines in all directions; i.e., reserve lands, structures, natural vegetation, roads, parks, etc. (Note: LBFD may require additional information on a project-specific basis.)

J. Identify any proposed off-site fuel modification areas and provide appropriate legal agreements with adjacent property owners.

K. Irrigation plans and specifications, as requested.

L. All applicable maintenance requirements and assignment of responsibility (See Section 6).

M. Tract or project conditions, CC&R and/or deed restrictions relative to fuel modifications (See Attachment 5).

N. The integrated landscape/fuel modification plan shall be reviewed by LBFD and approved by the Design Review Board (DRB) prior to issuance of the building permit.

O. For large developments, fuel modification zones (especially zones B, C, and D)should be located within common lettered lots owned and maintained by associations representing common ownership; e.g., homeowners' associations. The integrity and longevity of the fuel modification zones shall be maintained with sufficient tract/project conditions and CC&Rs to specifically identify the restrictions within the fuel modification areas. Likewise, when fuel modification zones are located on private property, deed restrictions are required to specifically identify the restrictions on any portion of the property subject to fuel modification. (See Sections 6 and 8 and Attachments 2 and 5)

2. LBFD Plant Palette Information

The plant palette must be submitted containing both the botanical and common names of all plant materials that are to be used. In the irrigated zone areas (which commonly serve as a screening buffer between development and open space/park land), plants must be fire resistant and drought-tolerant. Plant materials used outside of the irrigated zones must be fire resistant and drought tolerant. There is no such thing as a plant that will not burn. The term fire resistant may be misleading. All plants will burn given sufficient heat and low moisture content. Vegetative fire resistance may be enhanced through adequate irrigation or precipitation.

Note: All plants in Zones A-D shall be selected from the LBFD list and specified for appropriate fuel modification zones.

The undesirable plant species approved by LBFD and various resource agencies responsible for environmental protection are provided in Attachment 7. Specific planting criteria are included for various plant materials. If alternate plant materials are proposed, the landscape architect shall provide a photograph, as well as data on the fire resistive characteristics and proposed uses (zones, number, spacing, etc.) and LBFD will make a case-by-case determination as to acceptability of the proposed material. The proposed plant must be spaced based on size and characteristics. If the plant materials are proposed to be planted within 300 feet' of reserve lands (except plants on the interior of the tract), concurrence from the applicable following agencies would be required: US Fish and Wildlife Service, California Department of Parks and Recreation, The Nature Conservancy, the Department of Fish and Game, Orange County Public Facilities and Resource Department, and the Orange County

Vector Control District. If the proposed plants have received previous resource agency approval, no concurrence letter will be required.

3. Zone A – Setback Irrigated Zone (See Attachments 2 & 3)

The purpose of the setback zone is to provide a defensible space for fire suppression forces and to protect structures from radiant and convective heat. **No combustible construction shall be allowed within the 20-foot setback zone (Zone A). <u>In no case shall Zone A be less than 20-foot minimum.</u> <u>This measurement shall be made horizontally from the point of the structure closest to Zone A.</u>** This zone is located between Zone B and the structure and in all directions (360°) surrounding the structure to include the front, side and rear yards.

Zone A – Specific Requirements

A. Automatic irrigation systems to maintain healthy vegetation with high moisture content.

B. Irrigation maintained outside the drip line of native oak trees.

C. Pruning of foliage to reduce fuel load, vertical continuity, and removal of plant litter and dead wood.

D. Complete removal of fire prone plant species (see Attachment 7), minimal allowance for retention of selected native vegetation.

E. Trees and tree form shrub species are not allowed within 10 feet of combustible structures (measured from the edge of a full growth crown).

F. Trees and tree form shrub species are not allowed to extend beyond the property line (measured from the edge of a full growth crown).

G. Tree and tree form shrub species are not allowed within 10 feet of adjacent tree species as measured from the edge of a full growth crown (see Attachment 6).

H. Special consideration should be given for rare and endangered species, geologic hazards, tree ordinances, or other conflicting restrictions.

I. Maintenance including ongoing removal and/or thinning of undesirable combustible vegetation, replacement of dead/dying fire resistant plantings, maintenance of the operations integrity and programming of the irrigation system, regular trimming to prevent ladder fuels.

J. A minimum of 36" of horizontal clearance and unlimited vertical clearance around the exterior of the structure (360°) shall be provided for Firefighter access. Firefighter access shall be made without the need for special tools (ladders) or ability and have permanent improvements installed when ascending or descending from street level (e.g., stairs).

L. No combustible construction shall be allowed in Zone A

M. No permanent or portable barbeques/grills, fire pits, fireplaces or other flame generating device shall be permitted within 30' of non-fire resistive plants/vegetation.

N. No vines shall be permitted on combustible structures (e.g., Type V non-rated structure).

4. Zone B – Irrigated Zone

This portion of landscape/fuel modification should be irrigated and planted with drought – tolerant, deep-rooted, moisture retentive plants. The plans must delineate that portion of the fuel modification area that will be permanently irrigated. Plant material selection, irrigation system design, and the landscape maintenance management plan shall sensitively address water conservation practices and include methods of erosion control to protect against slope failure. All irrigation shall be kept a minimum of 20 feet from the drip line of any existing native Quercus (oak) species. This irrigated zone is 50 feet to 75 feet in width. Zone B shall be cleared of all undesirable plant species, irrigated, and planted with plants from the approved LBFD Plant List. Exceptions to save desirable species may be submitted for approval by the Fire Chief on a site-specific basis. As in Zone A, combustible construction (i.e. gazebos, trellis's, shade covers etc.) is not allowed in Zone B.

Zone B – Specific Requirements

A. Groundcover shall be maintained at a height not to exceed 18 inches.

B. In order to maintain proper coverage, native grasses should be allowed to go to seed. Native grasses shall be cut after annual seeding. Cut heights shall not exceed 8 inches.

C. Irrigation shall be designed to supplement native vegetation, and establish and maintain planted natives and ornamentals.

D. Planting will be in accordance with planting guidelines and spacing standards established in this guideline (See Attachments 6 and 7).

E. In Zones B, C, and D, sensitive and/or protected plant species shall be identified on the landscape/fuel modification plans and dealt with per the City's Open Space/Conservation Plan.

F. Tree and tree-form shrub pruning and spacing will be in conformance with Attachment 6. Tree form shrubs are defined as shrubs that naturally exceed 4 feet in height.

G. Tree-form shrubs and other shrubs shall be spaced such that they do not create an excessive fuel mass and can be maintained in accordance with specified spacing as indicated on the plan.

H. Special consideration should be given for rare and endangered species, geological hazards, tree submitted for project approval, upon further review.

I. Removal of undesirable plant species (see Attachment 7).

5. Zones C & D – Thinning Zones – Non-Irrigated

Zone C is 50 to 75 feet in width and requires 50% thinning and removal of all dead and dying vegetation and undesirable species. Zone D is 75 to 130 feet in width and requires 30% thinning with removal of all dead and dying vegetation and undesirable species. Thinning zones are utilized to reduce the fuel load of a wildland area adjacent to urban developments, thereby reducing the radiant and convective heat of wildland fires. Thinning zones are located adjacent to the irrigated zone and can extend 125 feet or more into wildland areas. All dead and dying vegetation shall also be removed from the thinning zones. Additionally, undesirable plant species shall be removed from the thinning zones due to their susceptibility to wildland fire. As in Zones A and B, combustible construction (i.e. gazebos, trellis's, shade covers etc.) is not allowed in Zones C and D.

Zone C and D – Specific Requirements

A. Removal of all dead and dying vegetation, all fine fuels reduced to a maximum of 8-12 inches in height.

B. In order to maintain proper coverage, native grasses shall be allowed to go to seed. Native grasses shall be cut after annual seeding. Cut heights shall not exceed 8 inches.

C. Special consideration will be given for rare and endangered species, geologic hazards, tree ordinances, or other conflicting restrictions as identified in the environmental documents submitted for project approval review.

D. Reduce fuel loading by reducing the fuel in each remaining shrub or tree without substantial decrease in the canopy cover or removal of tree holding root systems.

E. In Zones B, C, and D, sensitive and/or protected plant species shall be identified on the fuel modification plans and tagged in the field for further disposition.

F. Tree and tree-form shrub pruning and spacing will be in conformance with Attachment 6. (See Attachment 6.) Tree form shrubs are defined as shrubs that do not naturally exceed four feet in height.

G. Tree-form shrubs less than 4' in height and other shrubs shall be spaced such that they do not create an excessive fuel mass and can be maintained in accordance with specified spacing as indicated on the plan.

H. Maintain sufficient cover to prevent erosion without requiring planting.

6. Off-Site Fuel Modification Requirements

Due to the variable and sometimes considerable amount of land necessary for fuel modification, development proposals often include a request to have the required fuel modification zones extend onto adjacent properties. However, off site fuel modification is not recommended due to problems inherent with enforcement of regulations on adjacent property and the potential for confusion regarding responsibility for fuel modification on areas outside of legal ownership. Proper on-site fuel modification design should determine where development can safely be located and should be an integral part of the development proposal.

Should off-site fuel modification be deemed a necessity, appropriate legally recorded instruments must be established that clearly state the responsibilities and rights of the parties involved relative to the establishment and maintenance of the fuel modification area. Appropriate recorded documents must include a recorded agreement between all parties and a grant of easement for the establishment and maintenance of the fuel modification area. It should be understood that the allowance of off-site fuel modification by an adjacent property owner may affect the rights and/or use of the off-site property. All agreements for any off-site fuel modifications shall be integrated into fuel modification plans with a letter from adjoining property owner giving rights to maintain fuels.

The City of Laguna Beach may grant fuel modification easements on city property to property owners in need of such agreements to complete the requirements of their fuel modification plan. City financed/maintained fuel modification programs (i.e. goat grazing, hand crews) may be utilized as a component of a fuel modification plan. The City of Laguna Beach shall not guarantee the continuation of current or future City sponsored fuel modification programs. Property owners shall remain responsible for maintaining their fuel modification plan regardless of the status of the City financed/maintained fuel modification programs.

7. Non-Compliant Properties

If the requirements of these guidelines cannot be met for any reason, documentation supporting the reason(s) shall be required at plan submittal. Alternate materials and methods may be considered in lieu of a complete landscape/fuel modification plan at the discretion of the Fire Chief and DRB. A Fire Protection Plan (CFC 8601) shall be submitted by a recognized fire protection engineer or individual with similar qualifications (subject to the Fire Chief's approval) when alternate materials and methods are proposed to meet the requirements of this guideline.

8. Fuel Modification Plan Revisions

Revisions to previously approved fuel modification plans shall follow procedures as established by the agency having jurisdiction. Note: Revisions to plans will not be reviewed without a copy of the original stamped LBFD approved plan for reference.

9. Fuel Modification Implementation & Required Inspections

This following information shall be placed on precise fuel modification plans, verbatim:

A. **<u>After Permit Issuance and Before Foundation Inspection</u>:** A Rough Fuel Modification Inspection shall be conducted. The developer/builder shall implement those portions of the approved landscape/fuel modification plan determined to be necessary by LBFD prior to the introduction of any combustible materials into the area (removal of undesirable species may meet this requirement). This generally involves removal and thinning of plant materials indicated on the approved plan. An inspection and/or release letter to the building department is required.

B. **Prior to Issuance of Utility Release:** The landscape and fuel modification zones adjacent to structures must be installed, irrigated, and inspected. This includes physical installation of features identified in the approved landscape/fuel modification plan (including, but not limited to, hardscape, softscape, plant establishment, thinning, irrigation, zone markers, access easements, etc). An LBFD Fire Inspector or designee will provide written approval to the Building Division after completion after this final inspection. The CC&R language for maintenance must also be provided and approved by LBFD.

C. **Prior to Home Owner Association (HOA) Acceptance (if applicable):** This activity must include an LBFD Fire Inspector and the following representatives:

- Landscape design professional
- Installing landscape contractor
- HOA management representative
- HOA landscape maintenance contractor

The fuel modification shall be maintained as originally installed and approved. A copy of the approved plans must be provided to the HOA representatives at this time. Landscape professionals must convey ongoing maintenance requirements to HOA representatives.

D. **Annual Inspection and Maintenance:** The property owner is responsible for all maintenance of the fuel modification. All areas must be maintained in accordance with approved fuel modification plans. This generally includes a minimum of two growth reduction maintenance activities throughout the fuel modification areas each year (spring and fall). Other activities include maintenance of irrigation systems, replacement of dead or dying vegetation with approved materials, removal of dead plant material, and removal of undesirable species. The LBFD conducts regular inspections of established fuel modification areas. Ongoing maintenance shall be conducted regardless of the date of these inspections. Disclosure of all landscape/fuel modification requirements shall be the responsibility of the property owner and or their agent upon transfer of ownership.

10. Fees

No additional fees are charged for plan reviews and site inspections.

No fees are currently charged for maintenance inspections of existing fuel modification areas. However, non-compliance fees are applied if identified deficiencies are not corrected within required time frames.

11. Glossary

CHARACTERISTICS OF FIRE-RESISTIVE VEGETATION – Growth with little or no accumulation of dead vegetation (either on ground or upright); non-resinous plants; low volume of total vegetation (e.g. grass vs. forest or shrub covered land); high live fuel moisture; drought tolerant; stands without ladder fuels (small limbs/braches between ground and canopy); low maintenance (slow-growing, require little care when maintained); plants with woody stems and branches that require prolonged heating to ignite.

CONDUCTION - Direct transfer of heat by objects touching each other.

CONVECTION HEAT - Transfer of heat by atmospheric currents, and is most critical under windy conditions and in steep terrain.

CROWN - Upper part of tree or other woody plant carrying the main branch system and foliage.

CANOPY - More or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees or other woody growth.

DEFENSIBLE SPACE - An area around the perimeter of structures or developments in the wildland which are key points of defense/attack against encroaching wildfires or escaping structure fires.

DESIRABLE PLANT LIST - List of plants exhibiting characteristics of low fuel volume, fire resistance, and drought tolerance which make them desirable for planting in areas of high fire danger.

DRIPLINE - Ground area at the outside edge of the canopy.

DROUGHT TOLERANCE - The ability of a plant or tree to survive on little water.

FINE FUELS - Fuels such as grass, leaves, and draped pine needles which, when dry, ignite readily and are consumed rapidly (also called flash fuels).

FIRE BREAK - Removal of growth, usually in strips, around housing developments to prevent a fire from spreading to the structures from open land or vice versa.

FIRE PROTECTION PLAN - A Fire Protection Plan (FPP) shall include mitigation measures consistent with the unique problems resulting from the location, topography, geology, flammable vegetation, and climate of proposed site. The FPP shall address water supply, access, building ignition and fire resistance, fire protection systems and equipment, defensible space and vegetation management.

FIRE RESISTANT - All plants will burn under extreme fire weather conditions such as drought. However, plants burn at different intensities and rate of consumption. Fire-resistive plants burn at a relatively low intensity, slow rates of spread and with short flame lengths.

FIRE RETARDANCE - Relative comparison of plant species related to differences in fuel volume, inherent flammability characteristics, and ease of fire spread.

FUEL BREAK - A wide strip or block of land on which the native or pre-existing vegetation has been permanently modified so that fires burning into it can be more readily extinguished.

FUEL LOAD - The weight of fuels in a given areas, usually expressed in tons per acre.

FUEL MODIFICATION ZONE - A strip of land where combustible native or ornamental vegetation has been modified and partially or totally replaced with drought tolerant, fire retardant, plants.

FUEL MOISTURE CONTENT - The amount of water in a fuel, expressed as a percentage of the oven dry weight of that fuel.

FUEL VOLUME - The amount of fuel in a plant in a given area of measurement. Generally an open-spaced plant will be low in volume.

HORIZONTAL CONTINUITY - The extent or horizontal distribution of fuels at various levels or planes.

LADDER FUELS - Fuels which provide vertical continuity between strata. Fire is able to carry from surface fuels by convection into the crowns with relative ease.

LANDSCAPE – Any improvement made to the property not classified as a structure.

LITTER - The uppermost layer of loose debris composed of freshly fallen or slightly decomposed organic material such as dead sticks, branches, twigs, leaves or needles.

LONG TERM - In perpetuity of the fuel modification plan requirement.

PROBABILITY OF IGNITION - A rating of the probability that a firebrand (glowing or flaming) will cause a fire, providing it lands on receptive fuels. It is calculated from air temperature, fuel shading, and fuel moisture.

RADIANT HEAT - Transfer of heat by electromagnetic waves and can, therefore, travel against the wind. For example, it can preheat the opposite side of a burning slope in a steep canyon or a neighboring home to the ignition point.

RESERVE LANDS – As defined by the Central Coastal and Southern Natural Communities Conservation Plan.

SUBDIVISION - A parcel of land that is subdivided to create multiple individual lots in accordance with the State of California Subdivision Map Act.

SPECIAL FIRE PROTECTION AREA – See Very High Fire Hazard Severity Zone

STRUCTURE – That which is built or constructed, an edifice or building of any kind or any piece of work artificially built up or composed of parts joined together in some manner.

TARGET SPECIES - Undesirable species that are generally removed as part of the fuel modification plan (see undesirable species).

TREE FORM SHRUB – Those shrub species exceeding 4' in height.

UNDESIRABLE SPECIES - Those species of plants with inherent characteristics which make them highly flammable. These characteristics can be either physical or chemical. Physical properties include large amounts of dead material retained within the plant, rough or peeling bark, and the production of large amounts of litter. Chemical properties include the presence of volatile substances such as oils, resins, wax, and pitch. These plants are sometimes referred to as target species.

URBAN INTERFACE - That line, area, or zone where structures and other human development meet or intermingles.

VERTICAL CONTINUITY - The proximity of fuels to each other that governs the fire's capability to sustain itself. Vertical continuity applies to the relationship of aerial fuels to surface fuels or fuels low to the ground.

VERY HIGH FIRE HAZARD SEVERITY ZONE - Any geographic area designated pursuant to Government Code Section 51178 and/or local ordinance to contain the type and condition of vegetation, topography, weather, and structure density due to increased possibility of conflagration fires. See 2001 UFC Section 1101.1, Appendix II-A.

ATTACHMENT 1

LANDSCAPE/FUEL MODIFICATION PLAN SUBMITTAL CHECKLIST

SUBMITTAL AND APPROVAL

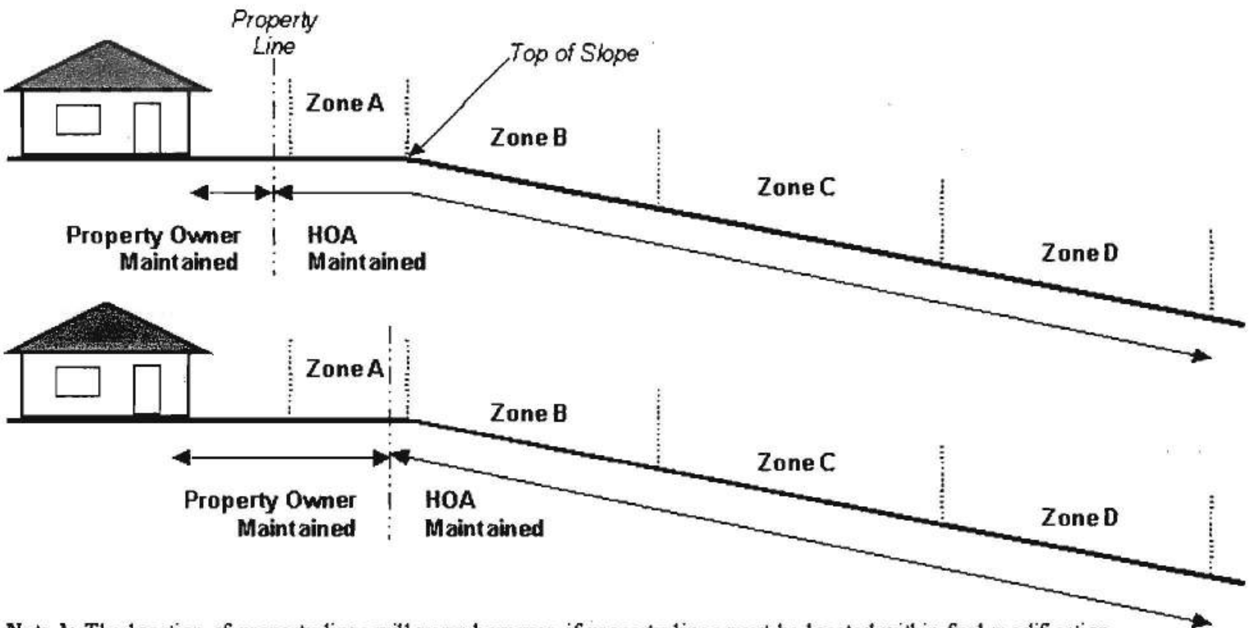
	PRECISE PLANS
☐ ***Prior to issuance of building permit***	**X**
☐ Minimum plan size 18" x 24" Maximum plan size 24" x 36" Scale to be 1/8" = 1'0"	X
☐ Number of plans sets to the Zoning Department	2 sets

PLAN REQUIREMENTS

☐ Delineation of each fuel modification zone – line indicating limit of combustible construction (start of Zone A)	X
☐ Scale Dimensions	X
☐ Site Characterization	X
☐ Photographs of area with emphasis on existing vegetation and topography	X
☐ Indication of permanent zone marker locations and detail	X
☐ Delineation of impacted existing vegetation	X
☐ Description of vegetation removal methodology	X
☐ Firefighter access routes around structure	X
☐ Plant palette & specifications, including a plant legend (botanical & common names) for existing and proposed plants. A matrix of typical spacing requirements, as well as the following information: planting lines, topography, wind direction, neighboring lot lines.	
☐ Designation of irrigated area	X
☐ Irrigation plans and specifications (engineer scale) shall be provided upon request	X
☐ Removal of undesirable species (Attachment 7)	X
☐ Property lines	X
☐ Contour lines	X
☐ Location of all new and existing improvements to include landscape (hardscape and softscape)	X
☐ Maintenance access easements (if required)	X
☐ Generally describe characteristics, existing improvements, land uses, wetland and riparian areas & vegetation for 300 feet beyond property lines in all directions	X
☐ Statement, on the plans, of ultimate maintenance responsibility requirement	X
☐ On title sheet, indicate tract/project conditions, CC&Rs, and/or deed restrictions relative to fuel modification areas	X
☐ Location of all proposed offsite fuel modification areas with easements	X

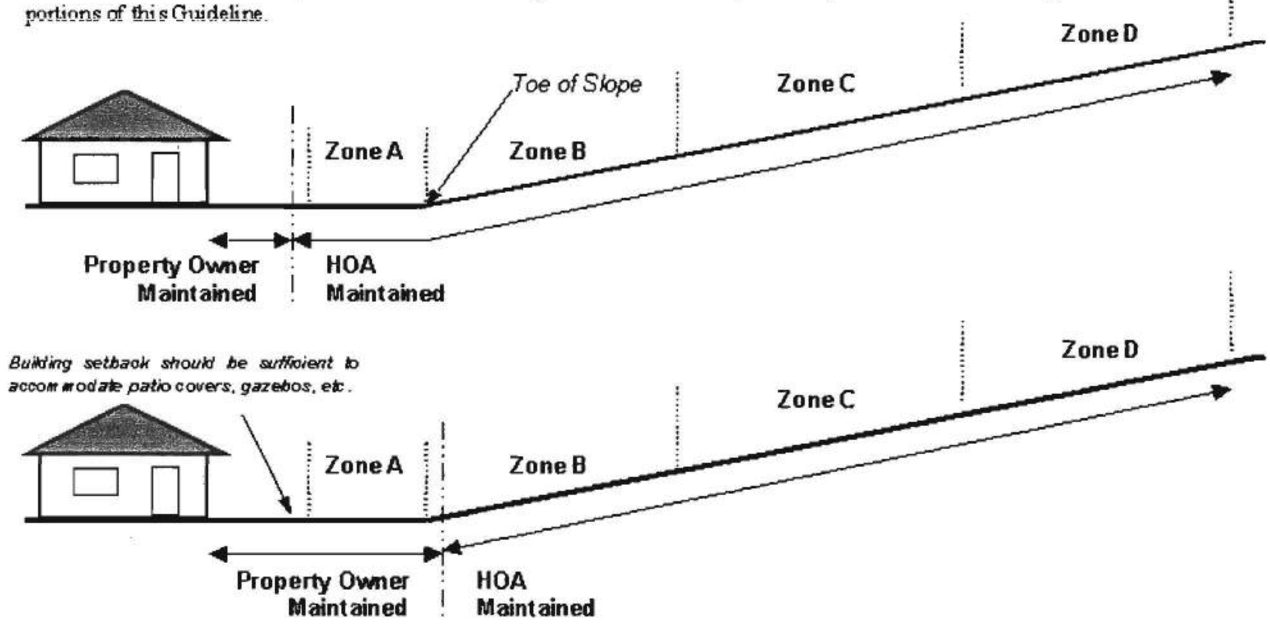
ATTACHMENT 2

FUEL MODIFICATION CONFIGURATION OPTIONS



Note 1: The location of property lines will vary; however, if property lines must be located within fuel modification areas, appropriate documentation (e.g., Maintenance easements and/or deed restrictions) shall be established to: 1) restrict certain activities and uses on those portions of any private property within the fuel modification area, and 2) identify those responsible for the establishment and continued maintenance of the fuel modification area located on private property.

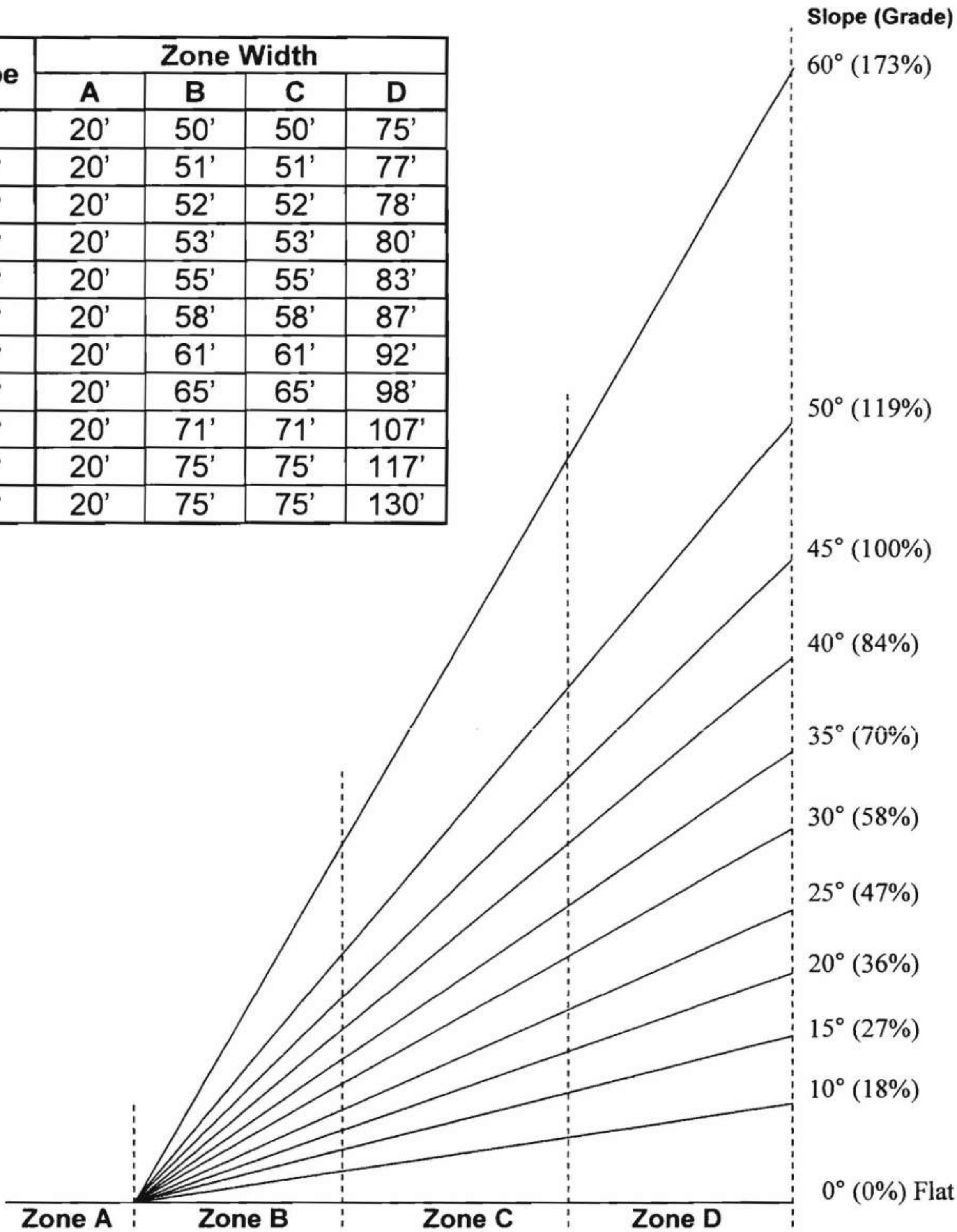
Note 2: Regardless of the entity responsible for fuel modification maintenance, the continued maintenance shall be in accordance with Section 10 "Fuel Modification Implementation & Required Inspections" and other applicable portions of this Guideline.



Attachment 3

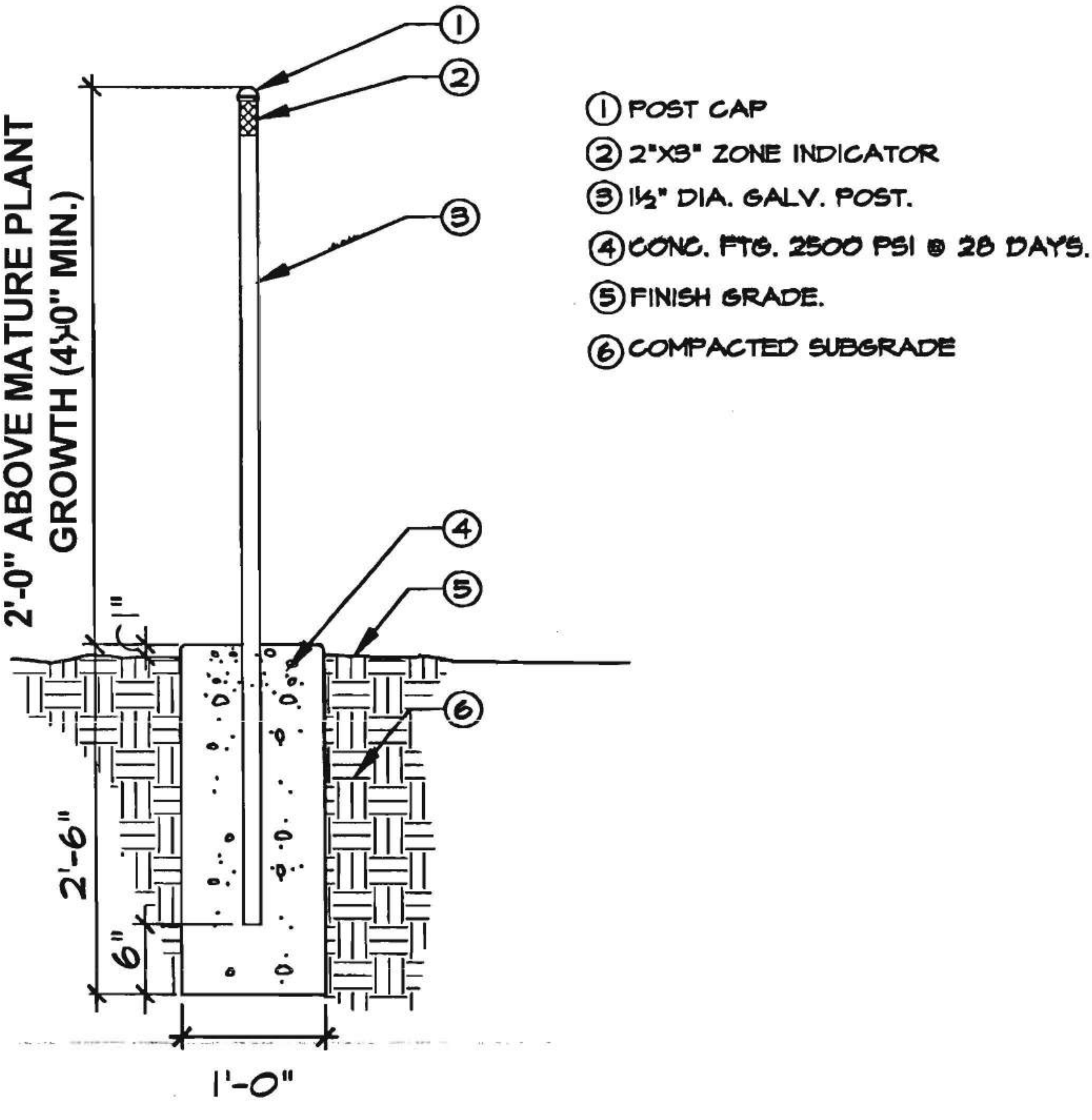
INCLINE MEASUREMENT FOR SELECTED SLOPES
(Measured Horizontal to Surface)

Slope	Zone Width			
	A	B	C	D
0°	20'	50'	50'	75'
10°	20'	51'	51'	77'
15°	20'	52'	52'	78'
20°	20'	53'	53'	80'
25°	20'	55'	55'	83'
30°	20'	58'	58'	87'
35°	20'	61'	61'	92'
40°	20'	65'	65'	98'
45°	20'	71'	71'	107'
50°	20'	75'	75'	117'
60°	20'	75'	75'	130'



Attachment 4

ZONE MARKER DETAILS



Zone markers shall identify each zone with min. 2" contrasting lettering (e.g. Zone A) and placed every 50 lineal feet along each zone. A minimum of two markers per zone shall be required. Zone markers shall be maintained and serviceable at all times.

Attachment 5

SAMPLE CC&R MAINTENANCE LANGUAGE

It is recommended that the following language be included in the CC&Rs recorded for a common interest development.

The duty of the homeowners' association to perform "Fire Prevention Maintenance" (as defined below) for all Fuel Modification Zones and manufactured interior slopes within the development shall be included as an express obligation in the recorded CC&Rs for the development. Similarly, each Owner whose Lot (or Condominium) is subject to Fuel Modification Zone restrictions (e.g., non-combustible structure setback, etc.) shall be obligated to comply with such restrictions.

1. LBFD will be designated as a third party beneficiary of a homeowners' association's duty to perform "Fire Prevention Maintenance" (as defined below) for all portions of the Association Property (or Common Area) that constitute Fuel Modification Zones and designated interior/manufactured slopes to be maintained by the homeowners' association, and of any Owner's duty to comply with any Fuel Modification Zone restrictions applicable to his Lot (or Condominium). Additionally, LBFD shall have the right, but not the obligation, to enforce the homeowners' association's duty to perform such Fire Prevention Maintenance, and to enforce compliance by any Owner with any Fuel Modification Zone restrictions applicable to his Lot (or Condominium). In furtherance of such right, LBFD shall be entitled to recover its costs of suit, including its actual attorneys' fees, if it prevails in an enforcement action against a homeowners' association and/or an individual Owner. (A sample third party beneficiary provision to be incorporated into the CC&Rs is attached hereto as Addendum "1").
2. As used herein, "Fire Prevention Maintenance" shall mean the following:

    (i) All portions of the Association Property (or Common Area) that constitute Fuel Modification Zones or designated interior/manufactured slopes shall be regularly maintained by the homeowners association on a year round basis in accordance with the Fuel Modification Plan on file with the property manager for the development.

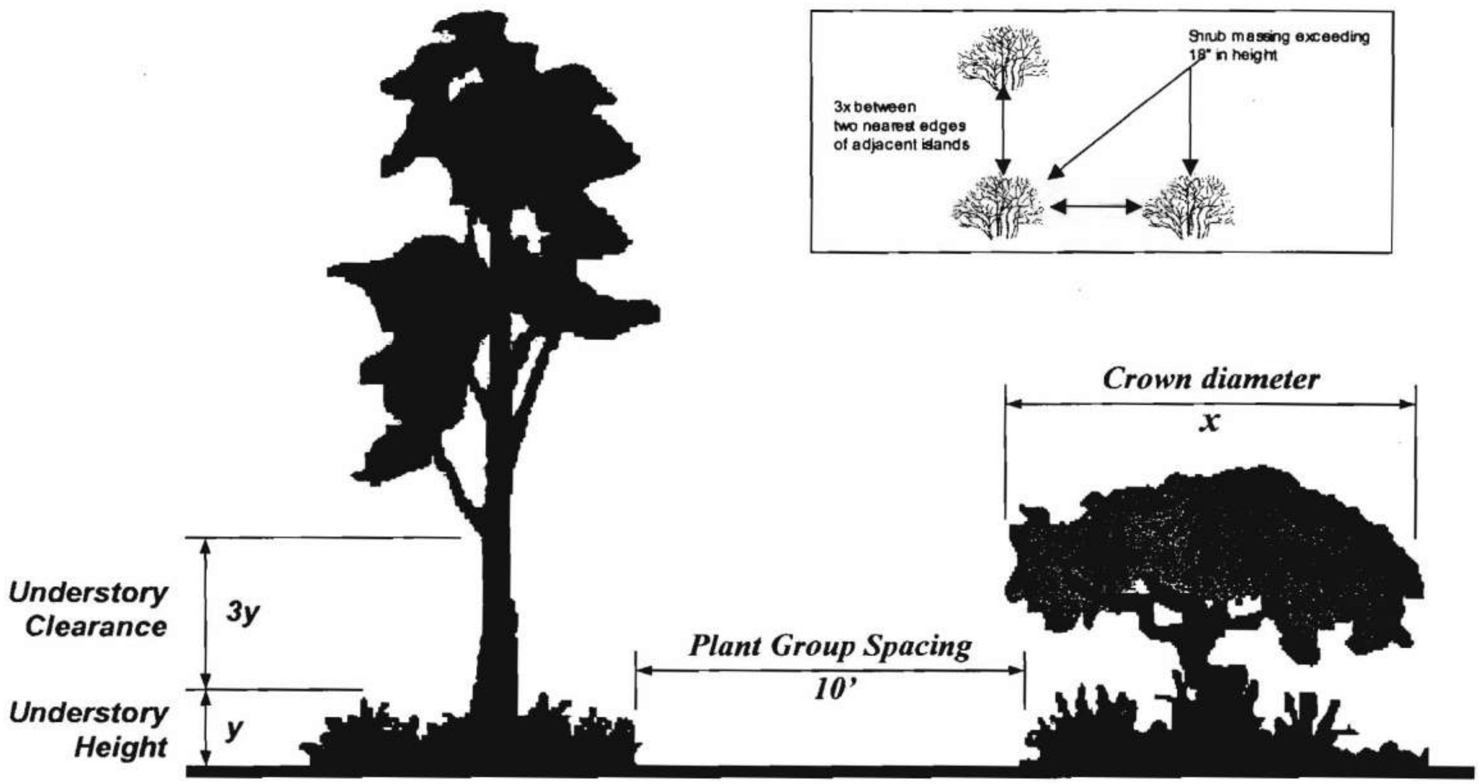
    (ii) The irrigation system for Fuel Modification Zones or designated interior/manufactured slopes shall be kept in good condition and proper working order at all times. The irrigation system shall not be turned off except for necessary repairs and maintenance.

ADDENDUM "1"

Enforcement by the City of Laguna Beach. The City of Laguna Beach (City) is hereby designated as an intended third party beneficiary of the Association's duties to perform Fire Prevention Maintenance for all portions of the Association Property (or Common Areas) consisting of Fuel Modification Zones or designated interior/manufactured slopes in accordance with the Fuel Modification Plan, and of each Owner's duty to comply with any Fuel Modification Zone or designated interior/manufactured slopes restrictions applicable to his Lot (or Condominium) as set forth in the Fuel Modification Plan. In furtherance thereof, the City shall have the right, but not the obligation, to enforce the performance by the Association of its duties and any other fire prevention requirements~~,~~ which were imposed by the City or other Public Agency as a condition of approval for the Development (e.g. , prohibition of parking in fire lanes, maintenance of the blue reflective markers indicating the location of fire hydrants, etc.) and shall also have the right, but not the obligation, to enforce compliance by any Owner with any Fuel Modification Zone or designated interior/manufactured slopes restrictions applicable to his Lot (or Condominium) as set forth in the Fuel Modification Plan. If, in its sole discretion, the City shall deem it necessary to take legal action against the Association or any Owner to enforce such duties or other requirements, and prevails in such action, the City shall be entitled to recover the full costs of said action, including its actual attorneys' fees, and to impose a lien against the Association Property, or an Owner's Lot (or Condominium), as the case may be, until said costs are paid in full.

Attachment 6

TREE AND TREE-FORM SHRUB PRUNING AND SPACING FOR NEW PLANTINGS AND THINNING ZONES



NOT TO SCALE

1. ***Vertical Continuity.*** New and existing trees and tree-form shrubs (naturally reaching 4' and taller), which are being retained with the approval of the Laguna Beach Fire Department, shall be pruned to provide clearance of three times the height of the understory plant material or 10 feet, whichever is greater (see figure above). New trees and tree-form shrubs may comply with the lesser if sufficient height is not available to achieve 10 feet. Dead and excessively twiggy growth shall be removed.

2. Plant Group Spacing.
   a. Trees and tree-form shrubs shall be single specimens or in a maximum grouping of three plants. Groupings shall be separated by a distance of 10' (see figure above). Other limited grouping arrangements and spacing may be acceptable if approved by LBFD.
   b. Trees shall be single specimens or in a maximum grouping of three plants. Groupings shall be separated by a distance of 10 feet (see figure above). Other limited grouping arrangements and spacing may be acceptable if approved by LBFD.
   c. Plant specimens listed in the LBFD "Approved Plant Palette-Qualification Statements for Select Plant Species" shall comply with plant groupings and spacing requirements specified in those restrictions (see pages 31 and 32).

Attachment 7

UNDESIRABLE PLANT SPECIES (Target Species)

Certain plants are considered to be undesirable in the landscape due to characteristics that make them highly flammable. Plants with these characteristics may not be planted in fuel modification zones, as listed below. Should these species already exist within these areas, they must be removed.

Plans should be submitted to the City for review without the target plants listed below. In cases where undesirable plants are included in a submittal for new planting or preservation, the Applicant must submit a request for use of alternative materials and methods as outlined in the City of Laguna Beach Fire Department *Guideline for Alternative Materials and Methods Requests.* The request will be evaluated by the Fire Department for acceptability.

The list of undesirable plants is comprehensive, but not complete. Closely related species and varieties having substantially similar flammable characteristics as the identified target species may also not be acceptable.

Applicants are encouraged to maximize fire safety by using plants with high water content, low fuel volume, succulent leaves and stems, low litter, and low amounts of flammable oils and resins. Avoidance of target species alone does not confer maximum fire safety.

Spacing requirements of Attachment 6 apply to all species and must be reflected in the planting design plan submitted to the City.

Vines are not allowed on combustible structures.

Extensive massing of grasses with heights greater than 12" high may not be acceptable.

Additional factors to consider when selecting plants for wildland interface areas include: deer and rabbit resistance, aesthetic compatibility with hillside character, erosion control, and drought tolerance.

TARGET SPECIES UNACCEPTABLE FOR USE IN ALL FUEL MODIFICATION ZONES (A, B, C, D):

Botanical Name	Common Name	Form
Acacia longifolia	Sydney Golden Wattle	Shrub
Acacia redolens	NCN	Shrub

Adenostoma fasciculatum	Chamise	Shrub
Artemisia californica	California Sagebrush	Shrub
Arundo donax	Giant Reed	Grass
Atriplex lentiformis	Quail Bush	Shrub
Bambusa species	Bamboo	Grass
Brassica nigra	Black Mustard	Annual
Brassica rapa	Yellow Mustard	Annual
Caprobotus edulis	Hot N Tot Fig	Groundcover
Cedrus species	Cedar	Tree
Cortaderia selloana	Pampas Grass	Grass
Cupressus sempervirens	Italian Cypress	Tree
Cynara cardunculus	Artichoke Thistle	Perennial
Cytisus species	Broom	Shrub
Delospermum species	Iceplant	Groundcover
Drosanthemum species	Iceplant	Groundcover
Eriogonum fasciculatum	Buckwheat	Shrub
Eucalyptus species	Gums	Tree
Fargesia species	Bamboo	Grass
Hedera canariensis	Algerian Ivy	Groundcover
Juniperus species (shrubs and trees)	Juniper	Shrub/Tree
Lampranthus species	Iceplant	Groundcover
Melaleuca linariifolia	Flaxleaf Paperbark	Tree
Melaleuca quinquenervia	Cajeput Tree	Tree

Nicotiana glauca	Tree tobacco	Perennial
Otatea acuminata	Mexican Weeping Bamboo	Grass
Pennisetum setaceum	Fountain Grass	Grass
Phyllostachys species	Bamboo	Grass
Pinus species	Pine	Tree
Ricinus communis	Castor Bean Plant	Perennial
Salvia (native species and varieties)	Sage	Shrub
Sascola austails	Russian Thistle/Tumbleweed	Annual
Semiarundinaria fastuosa	Narihira Bamboo	Grass
Schinus terebinthifolius	Brazilian Pepper	Grass
Thuja species	Arborvitae	Shrub
Umbellularia californica	California Bay	Tree
Vinca major	Periwinkle	Groundcover
Washingtonia species	Fan Palm	Palm

ADDITIONAL TARGET SPECIES UNACCEPTABLE FOR USE IN FUEL MODIFICATION ZONE A (Zone closest to combustible structures):

Unacceptable species for Zone A include those listed above for all zones plus the following:

Botanical Name	Common Name	Form
Acacia species	Acacia/Wattle	Various
Arctostaphylos species (shrubs and trees)	Manzanita	Shrub/Tree
Atriplex species	Saltbush	Shrub
Bougainvillea species	Bougainvillea	Shrub/Vine

Callistemon species	Bottlebrush	Tree
Cinnamomum camphora	Camphor	Tree
Cotoneaster species (shrubs and trees)	Cotoneaster	Shrub/Tree
Dodonea viscosa	Hopseed	Shrub
Hakea suavolens	Sweet Hakea	Shrub
Heteromeles arbutifolia	Toyon	Shrub/Tree
Laurus nobilis	Bay/Grecian Laurel	Shrub/Tree
Malosma laurina	Sugarbush	Shrub/Tree
Melaleuca nesophila	Pink Melaleuca	Tree
Miscanthus sinensis	Silver Grass	Grass
Muhlenbergia rigens	Deer Grass	Grass
Pennisetum rubrum	Purple Fountain Grass	Grass
Phoenix canariensis	Canary Island Date Palm	Palm
Phoenix dactylifera	Date Palm	Palm
Rhus integrifolia	Lemonade Berry	Shrub
Rosmarinus officianalis	Upright Rosemary	Shrub
Schinus molle	California Pepper	Tree

Letter O5 South Laguna Civic Association

Greg O'Loughlin, President
July 25, 2018

Response O5-1

Introductory comments and summary of Project objectives are noted for the record.

Response O5-2

Please see Responses O3-1 and O3-2 regarding Project design and the SCWD Water Supply Reliability Study (2017). The size of the Local Project (up to 5 MGD) considers anticipated gaps in supply and other Project objectives in addition to a drought-proof supply, including diversification of the District's supply portfolio and providing emergency backup supply in case of a significant disruption of service. The Project will provide a local reliable water supply to complement the District's existing water supply portfolio, including imported water, recycled water, conservation and groundwater.

Response O5-3

The Draft EIR (pages 4.3-31 through 4.3-36, and Section 4.8) provides a detailed evaluation of brine discharge, showing that the Project can meet California Ocean Plan objectives and will result in less than significant impacts to ocean water quality/salinity and ocean-dwelling biological resources. The Project would draw source water from 74 to 130 feet below the ocean floor with nearshore slant wells as illustrated in Exhibit 3-3 at the end of Section 3.0, Project Description. The San Juan Creek Ocean Outfall (SJCOO), which would combine brine with existing treated wastewater within the SJCOO, discharges approximately 2.2 miles offshore from Doheny State Beach. Based on the water quality modeling conducted for the Project (Section 4.8, Hydrology and Water Quality), the distance between the outfall and submerged slant well intakes pose no ambient water quality issues or risk of "harvesting polluted water." See, also Response S7-4 and S7-17. Amplified brine discharge modeling (Appendix 4.2.2) verifies that brine discharge, even without the SJCOO, will meet Ocean Plan standards.

The comment appears to suggest on-site brine evaporation ponds and then trucking the resultant solids to an offsite location. First, the proposed brine disposal solution does not have any significant impacts and therefore an alternative is not necessary (see Appendix 4.2.2). The suggested alternative would require considerable land area for evaporation, would represent additional on-site impacts associated with brine spraying and odors, and would represent significant off-site impacts in both the solids trucking and solids disposal. This alternative is not under consideration by the District.

Response O5-4

Potential impacts of construction of wells and wellhead clusters are identified in Section 4.12 of the Draft EIR. Construction would occur during off-season months to minimize temporary recreational impacts. No public, recreational space on the beach will be impacted beyond construction of the well and wellheads in parking or landscaped areas. As part of the encroachment permit process with State Parks or County Parks, the District anticipates providing compensation for temporary recreational facility impacts, as well as local enhancements to be determined through the permitting process. Potential impacts to marine habitat relative to the installation and operation of the slant wells are addressed in Section 4.3, Biological Resources and found to be less than significant. Section 5.0 of the DEIR, Alternatives, addresses alternatives sites and concluded that, through numerous policy, planning and facility siting studies, there are no other feasible locations for the Project (DEIR page 5.0-6).

Response O5-5

The District continues to evaluate power supply options for the proposed desalination project in an effort to increase overall reliability and reduce costs. One such option is to use a combination of grid electricity from the local provider (San Diego Gas and Electrical), which primarily comes from the south, and fuel cells operating on natural gas, which primarily comes from the north by a separate local provider (Southern California Gas Company). By potentially having power required to run the facility available from two distinct geographical areas, the risks associated with a disruptive natural disaster are reduced. Regarding Project costs and financial burden, these are issues outside the scope of the environmental review process, but will be considered by the District Board of Directors during Project deliberations.

Response O5-6

As with any new water supply project, contaminants of emerging concern are an important factor. One of the benefits of the proposed project is the robust treatment process. Not only do the subsurface intakes act as a natural filter by drawing water through the ocean floor, but the Reverse Osmosis (RO) technology that will be employed to remove the dissolved salts has also proven to be effective at removing many other chemical and biological contaminants. Furthermore, all Project raw ocean water will be treated pre and post RO to meet all applicable drinking water requirements for public health and safety, as required by District standards and the State of California Department of Water Resource's Division of Drinking Water.

Response O5-7

Please see Responses O2-1, O3-1 and O3-2 regarding enhanced conservation and broader water use. All Project alternatives are discussed and compared in Section 5.0 of the Draft EIR. The Draft EIR acknowledges that a combination of water sources in addition to desalination, including conservation and water recycling, would enhance diversity of the water system. The District water supplies also include imported water (which the Project would replace) and groundwater (which has had inconsistent availability in recent times). The District is also a partner with SMWD's San Juan Watershed Project (SJWP), which consists of stormwater capture in SJWP Phase I, and potential future SJWP phases including indirect potable reuse.

With respect to recycled water, the District is committed to expanding its recycled water program, with current estimated maximum demand of 1,350 AFY. However, as described in DEIR Section 5.0, enhanced recycling would not provide an immediate or reliable water source to meet Project objectives and would require significant expansion of recycled water infrastructure. Similarly, enhanced conservation would not meet the water supply reliability and diversity goals of the Project.

Comments regarding Project cost and ratepayer involvement are noted but do not address environmental issues. The environmental review process (as well as the planning and permitting process) provides several opportunities for public involvement and input.

Response O5-8

Citation of the City of Laguna Beach's Climate Protection Plan is noted. The policies are not applicable to the Project, as the District is not subject to City of Laguna Beach policy planning documents for facilities located in Dana Point. However, the District has demonstrated a commitment to conservation and recycling, as well as mitigating its energy demand for the Project. The District is also a partner with SMWD's San Juan Watershed Project, which consists of stormwater capture in SJWP Phase I and potential future indirect potable reuse in future SJWP phases.

Response O5-9

The range of alternatives considered, analyzed, and rejected from further analysis – and the basis of the discussion within the Draft EIR – is described in detail in Section 5.0. Separate water reliability studies found that the Project is the preferred solution for a local reliable water supply (including the stakeholder-led Water Reliability Working Group and recently updated regional water supply study by MWDOC). As prescribed by CEQA, the alternatives analysis need not be exhaustive, and must address alternatives that are both feasible and obtain most or all of the Project's objectives. The indicated alternatives are noted, although no evidence is provided to indicate that any of these alternatives are feasible, could achieve basic Project objectives, and eliminate or reduce the Project's significant impacts.

The District agrees with the comment that water supply plans should contain contingencies and even redundancy to address range of events that could affect supply. This is one of the primary objectives of the Project. See also Response O2-1. At this time it would be speculative to hypothesize potential recipients of desalinated project water other than the District, and therefore an alternative to "share" water between districts is not a feasible alternative at this time.

Response O5-10

Please see above comments regarding the scope and content of the alternatives analysis and the obligation for alternatives to achieve the basic objectives of the proposal. With respect to expanding recycling, this alternative is addressed in the Draft EIR, and further responded to in Response O5-7 above.

Response O5-11

Concluding remarks regarding long term water management alternatives are noted for the record.

Surfrider Foundation
PO Box 73550
San Clemente, CA
92673

August 6, 2018

South Coast Water District
31592 West St
Laguna Beach, CA
92651

RE: Doheny Ocean Desalination Project Draft EIR, State Clearinghouse No. 2016031038

Dear Sonja Morgan,

The Surfrider Foundation (Surfrider), on behalf of our 20 California based chapters, including the South Orange County Chapter, hereby respectfully submits these comments on the South Coast Water District's "Doheny Ocean Desalination Project Draft Environmental Impact Report" (DEIR). Surfrider is a non-profit 501(c)(3) organization that is dedicated to the protection and enjoyment of our ocean, waves, and beaches through a powerful activist network.

Surfrider would like to commend South Coast Water District (SCWD) for following the ocean desalination recommendations established by the 2015 amendments to the State Water Resources Control Board California Ocean Plan, developed to better protect the surrounding marine and coastal environments. These include the use of subsurface intakes and the discharge of brine through dilution and co-mingling with wastewater that would already be released through established ocean outfalls (III(M)2(d)2(A)). Surfrider would also like to commend SCWD's decision to have the plant use small scale production (5 MGD potable water), and be publicly owned and operated. Surfrider supports, in concept, the proposed design and operations elements of the project. 1

However, though the general methods of the proposed desalination plant are admirable, Surfrider would like to stress the importance of **fully maximizing water recycling and conservation before investing in ocean desalination**. We understand that increased conservation and recycling efforts will not meet the project goal "[t]o create a drought-proof, hydrologically independent, reliable and high-quality source of potable drinking water for the District" without more political action on direct potable reuse, yet enhanced conservation and recycling will reduce the estimated amount of potable drinking water needed for the District. Additionally, Surfrider is concerned that the DEIR does not adequately address mitigation for increased greenhouse gas emissions or assess impacts from coastal hazards including sea level rise. These concerns, and others, are addressed in more detail below.

1. Failure to maximize water conservation efforts and accurately estimate water needs

Currently, SCWD permits city owned properties to use expensive and scarce potable water for landscaping and other outdoor water uses. Stronger conservation requirements must be implemented before exposing ratepayers to increased costs from desalination construction and operations. One such method is to transition all city owned landscaping from grass lawns or non-native plants to Ocean Friendly Gardens. The principles of Ocean Friendly Gardens include maximizing the extent of permeable areas, using native plants, promoting water retention, and irrigating with recycled water, among others. These conservation efforts could save a significant amount of potable water, reducing the estimated District water needs.

Additionally, SCWD's analysis of District water needs does not account for the newly mandated water 2
conservation requirements established by California state Assembly Bill 1668 and Senate Bill 606, which mandate a 20 percent reduction in water use, and a per capita indoor water use maximum of 55 gallons per day through 2025, ratcheting down to a 50 gallon per day maximum by 2030. These bills also mandate urban water retailers to establish a state approved annual water use objective for indoor and outdoor water use limits, taking into consideration water availability and vulnerabilities. Accurate estimates of water use are necessary for the adequate review of the ability of the proposed plant and alternatives to meet the region's water needs. The 2016 OC Water Reliability Study estimated that the regional water needs would be between 3.2 MGD and 4.5 MGD by 2040, yet it is not clear what estimate the agency used for the per capita daily water use in these scenarios. If these long term water conservation mandates were not considered in "Scenario 1", the actual water need may be significantly lower than the current estimated gap of 4,400 AFY (3.9 MGD).

2. Failure to maximize the use of water recycling

The region's recycled water infrastructure and use is far from maximized. The SCWD water recycling facility has the capacity to produce 1,350 AFY of recycled water, yet only 800-850 AFY are provided. This
discrepancy is due to the lack of supporting infrastructure to transport recycled water to users. Surfrider 3
recommends that at the bare minimum, SCWD complete the recycled water expansion program to result in 100% build out of available recycled water, prior to constructing an ocean water desalination facility, instead of the current plan to complete the recycled water expansion program by 2030.

3. Inaccurate calculation for carbon neutrality

Surfrider commends SCWD's intention to make the proposed desalination plant carbon neutral; however, the calculation for obtaining carbon neutrality from proposed plant's greenhouse gas emissions may be inaccurate. For other desalination plants, such as Poseidon Water LLC's Carlsbad facility, a one to one reduction in imported water was not sufficient mitigation to achieve carbon
neutrality. This is because of a contractual agreement with between the California Department of Water 4
Resources and the Municipal Water District (MWD) which prohibits desalinated water from reducing MWD's State Water Project entitlements. The same prohibition applies to the proposed Doheny plant. Surfrider recommends the use of onsite renewable energy to the maximum extent feasible.

To truly obtain carbon neutrality for the fully operating plant, SCWD must calculate and mitigate the plant's complete greenhouse gas emissions, and not just the net incremental project emissions. Additionally, to adequately prepare ratepayers, Surfrider would like to highlight the necessity to include the cost of emissions mitigation in the estimation of post-construction SCWD water rates.

4. Necessity to conduct sea level rise vulnerability assessment using H++ scenario

The Ocean Protection Council's draft *State of California Sea Level Rise Guidance: 2018 Update* recommends that, "For highly vulnerable or critical assets that have a lifespan beyond 2050 and would result in significant consequences if damaged, the H++ scenario (extreme projection) should also be included in planning analyses." Since the proposed project will act as a main water source for the region, this facility and necessary supporting infrastructure will meet the description of critical infrastructure. As the DEIR currently stands, there is no reference to a sea level rise vulnerability assessment using any of 5
the necessary climate change scenarios (RCP 2.5, RCP 8.5, or H++), or consideration of other coastal hazards. A thorough sea level rise vulnerability assessment should consider wave runup, tidal impacts, increased frequency and magnitude of coastal hazards, and fluvial flooding. This sea level rise vulnerability assessment should also consider impacts to supporting infrastructure and access roads, including electricity distribution, potable water distribution, brine and wastewater pipelines, and influence on development in nearby coastal hazard areas.

5. Necessity to assess cumulative impacts

SCWD must assess the cumulative environmental impacts that would occur as a result of this desalination facility and accompanying structures, as well as other proposed developments sited in the project area, which currently include a boatyard storage facility, the Dana Point Harbor Revitalization Project, and the San Juan Watershed Project, among others. These additional developments are likely exacerbate stresses to the coastline, marine wildlife, and coastal water quality, beyond what has been identified in the DEIR.

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Finally, Surfrider would like to request additional mitigation measures for recreation impacts. This includes the expansion of REC-1 to include local recreation non-governmental associations in addition to the stated "affected recreational agencies" when conducting consultation, and the implementation of a multi-year monitoring program to determine if surfing waves are negatively impacted by hydro-geomorphology changes as a result of subsurface intake pipes.

The Surfrider Foundation appreciates the opportunity to provide these comments on behalf of our 20 California based chapters.

Sincerely,

Katie Day

Katie Day
Staff Scientist, Surfrider Foundation

A. Sackett

Mandy Sackett
California Policy Coordinator, Surfrider Foundation

Letter O6 Surfrider Foundation

Katie Day, Staff Scientist
August 6, 2018

Response O6-1

Introductory comments and support of the Project are noted for the record.

Response O6-2

Please see Responses O3-1 and O3-2 regarding the role of enhanced conservation in the diversification of the region's water supply. While the long-term effects of newly mandated water conservation requirements will no doubt be beneficial, water supply vulnerabilities in the District are present now and are expected to continue. While the stability of the system will be strengthened by an array of measures including desalination, enhanced conservation and other sources and strategies (such as public outreach) may positively factor into the timing and ultimate need for potential future desalination facility expansion.

Response O6-3

Comments recommending expansion of the existing SCWD recycled water facility are noted. Production at full design capacity would not bridge the existing water reliability gap (discussion of SCWD Water Supply Reliability Study, DEIR pages 3.0-5 through 3.0-8). However, the District continues to pursue water reliability improvement efforts including expanding recycled water and enhancing conservation. For recycled water expansion, the District intends to maximize its recycled water usage to 1,350 AFY, utilizing as much of the wastewater that they contribute to the Aliso Creek Water Reclamation Facility as they can. Please also see Response O3-2 regarding recycled water.

Response O6-4

With respect to carbon neutrality, please see Responses S1-12, S1-13, S4-13 and O1-18. Comments regarding the cost of emissions mitigation are noted but are not within the scope of the EIR. As described on pages 3.0-33 and 3.0-34 of the Draft EIR, the Project has analyzed a range of onsite energy options, including renewable energy, as well as sources that would lower GHG emissions. For additional information regarding the Project's energy requirements and alternative supplies, see also Response M3-1.

Response O6-5

Regarding sea level rise and facility vulnerability, please see Response S1-14. The Local Hazard Conditions and Drainage Study was clarified based on the latest sea level rise projection information in the California Coastal Commission Sea Level Rise Policy Guidance, Draft Science Update - October 2018. The study included assessment of sea level rise impacts to coastal flooding and fluvial flooding, using updated coastal hazard analysis contained in "Coastal Hazards Analysis for the Doheny Desalination Project" dated September 28, 2018. The drainage and coastal hazard studies (Appendices 4.2.1 and 4.2.4) utilized the latest Coastal Commission sea level rise guidance, based on the RCP 8.5 climate scenario. The H++ sea level rise scenario is not considered a reasonable design baseline under FEMA standards or any other credible coastal engineering design standard.[1] Project facilities will be buried below the scour depth to avoid facility damage associated with potential future coastal erosion and sea level rise. Project facilities will also be designed to be protected against the 100-year storm, with analysis for a hypothetical 500-year storm event provided in Appendix 4.2.4.

With respect to vulnerability of the supporting infrastructure and roads, the study showed that the proposed Project does not increase the flood risk in the floodplain. Therefore, vulnerability to sea level rise for the surrounding area and supporting infrastructure is no worse than a "no project" scenario.

Response O6-6

Cumulative effects of the proposal are detailed in each technical section of the Draft EIR. Assumptions for the cumulative analysis are described in Section 4.0, page 4.0-5. The assumptions for cumulative impacts include the Dana Point Harbor development, potential future development within the District's San Juan Creek Property, and the proposed San Juan Watershed Project. In particular, the District conducted a clarifying evaluation to model the potential future combined effects of the Project with the San Juan Watershed Project, with respect to impacts on the San Juan Creek seasonal lagoon (refer to Appendices 4.2.3, 4.2.4, and to Response F2).

With respect to the language of Mitigation Measure REC-1, the measure is tied to final design approvals and permitting, and therefore focused on review by affected agencies. As part of the construction and operational approvals needed from State Parks and/or Orange County Parks, the District would welcome participation by environmental groups, as determined appropriate by the regulatory agency(ies). The District would also welcome State Parks' inclusion of Surfrider in discussions regarding recreational facilities. The District does not believe that a long-term wave study is relevant to the proposed Project, as the Project proposes use of subsurface intakes with minimal effects on ocean benthic flows and have never been shown to have any effect on the nearshore coastal wave processes (Appendix 10.4, Biological Resources Reports, MBC Applied Environmental Science, May 2018).

[1] The November 2017 Sea Level Rise Guidance (California Coastal Commission) notes that global conditions are currently not following the H++ trajectory and that this is an "extreme scenario" (page 16). As noted on page 25 of the report, the District has considered relative risk/probabilities associated an extreme sea level rise scenario such as H++ and deems that risk to be acceptable. As noted in Response L5-8, Project facilities along the coast will be buried and protected from coastal erosion, and the desalination site has adequate freeboard even under a 500-year storm event (Response S1-3).

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April 4, 2019

VIA U.S. MAIL

Rick Shintaku
General Manager
South Coast Water District
31592 West Street
Laguna Beach, CA 92651

VIA EMAIL ONLY

Sonia Morgan
Public Information Officer
smorgan@scwd.org

Re: Supplemental Comments on the Doheny Ocean Desalination Project Draft Environmental Impact Report SCH No. 2016031038)

Dear Mr. Shintaku:

On behalf of California Unions for Reliable Energy ("CURE"), Doug Mangione, Jeff Gatlin, Thomas Duncan and Josh Vergason (collectively "Commenters"), we submit these supplemental comments on the Draft Environmental Impact Report ("DEIR") prepared by the South Coast Water District ("District"), pursuant to the California Environmental Quality Act, and its regulations ("CEQA"),[1] for the Doheny Ocean Desalination Project (SCH #2016031038) ("Project"). 1

The District is proposing to construct and operate an ocean water desalination facility and associated desalination subsurface intake system. The Project has an initial phase of up to 5 million gallons per day ("MGD") (also referred

[1] California Public Resources Code, §§ 21000 et seq.

to as "Phase I") with a possible expansion to 15 MGD (also referred to as "Regional Project").[2] At this time, the District states that it is only pursuing permits and approvals for the initial 5 MGD-phase of the Project.[3] According to the District, the Regional Project would require separate CEQA review, and will be subject to additional regulatory agency permits and approvals.[4] The proposed facilities are located in the City of Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately one-half mile inland, adjacent to San Juan Creek.[5]

Based on our review of the DEIR, we concluded in our August 6, 2018 comments ("Prior Comments") that the District fails to comply with CEQA and the DEIR must be withdrawn. Our Prior Comments explained that the District lacks substantial evidence to support the DEIR's conclusions with respect to public health, odor, air quality, greenhouse gas, and biological resources impacts. Our Prior Comments also explained that the DEIR contains inadequate mitigation measures to reduce impacts to less than significant and has a flawed alternatives analysis. 1

This comment provides further evidence to support our argument in the Prior Comments that the District has failed to properly disclose, analyze, and mitigate impacts to biological resources based on a visit to the site by Shawn Smallwood, Ph.D. This comment also explains that the District lacks substantial evidence to support the DEIR's conclusions regarding environmental justice and greenhouse gas impacts.

These comments were prepared with the assistance of Dr. Smallwood.[6] Dr. Smallwood provides substantial evidence of potentially significant impacts that have not been adequately disclosed, analyzed, or mitigated. His technical comment is attached hereto and is submitted to the District, in addition to the comments in

[2] Doheny Ocean Desalination Project Draft Environmental Impact Report (SCH No. 2016031038) ("DEIR"), § 1.0. pp. 1-2.
[3] DEIR, § 1.0. pp. 1-2.
[4] DEIR, § 1.0. p. 3.
[5] DEIR, § 1.0. pp. 1-2.
[6] Report from S. Smallwood (Feb. 15, 2019) RE: Doheny Ocean Desalination Project (hereinafter "Smallwood Report"), **Exhibit A.**

this letter. Accordingly, the District must address and respond to Dr. Smallwood's comment separately.[7]

Pursuant to CEQA Guidelines, section 15088.5, the District must revise the
DEIR consistent with these comments. The revisions will result in significant new 1
information regarding previously undisclosed impacts and required mitigation
measures. Therefore, the EIR must be recirculated to allow the public a meaningful
opportunity to comment upon a substantial adverse environmental effect of the
project or a feasible way to mitigate or avoid such an effect.[8]

I. STATEMENT OF INTEREST

CURE is a coalition of labor organizations whose members encourage
sustainable development of California's energy and natural resources. CURE's
members help solve the State's energy problems by building, maintaining, and
operating industrial facilities throughout California. Since its founding in 1997,
CURE has been committed to building a strong economy and a healthier
environment. CURE has helped cut smog-forming pollutants in half, reduced toxic
emissions, increased the use of recycled water for cooling systems, and pushed for
groundbreaking pollution control equipment as the standard for all new power
plants, all while helping to ensure that new industrial facilities are built with
highly trained, professional workers who live and raise families in nearby
communities. 2

CURE has an interest in enforcing environmental laws that encourage sustainable development and ensure a safe working environment for the members that they represent. Environmental degradation destroys cultural and wildlife areas, consumes limited fresh surface and ground water resources, causes water pollution, and imposes other stresses on the environmental carrying capacity of the state. This in turn jeopardizes future development by causing construction moratoriums and otherwise reducing future employment opportunities for the members of CURE's organizations. Additionally, the members of CURE's

[7] The Commenters reserve the right to supplement these comments at later hearings and proceedings related to this Project. Gov. Code § 65009(b); PRC § 21177(a); *Bakersfield Citizens for Local Control v. Bakersfield* (2004) 124 Cal. App. 4th 1184, 1199-1203; *see Galante Vineyards v. Monterey Water Dist*. (1997) 60 Cal. App. 4th 1109, 1121.
[8] 14 Cal. Code Regs., § 15088.5 ("CEQA Guidelines").

organizations live, recreate and work in the City of Dana Point, Capistrano Beach,
San Juan Capistrano and other areas of Orange County that suffer the impacts of
projects that are detrimental to human health and the environment. CURE
therefore has a direct interest in enforcing environmental laws to minimize the
adverse impacts of projects that would otherwise degrade the environment. Finally,
CURE members are concerned about projects that risk serious environmental harm
without providing countervailing economic benefits. For these reasons, CURE's
mission includes improving California's economy and the environment by ensuring
that new conventional and renewable power plants and their related transmission
facilities use the best practices to protect our clean air, land and water and to 2
minimize their environmental impacts and footprint.

Commenters Doug Mangione, Jeff Gatlin, Thomas Duncan and Josh Vergason live, work, and recreate in the vicinity of the Project. Mr. Mangione, Mr. Gatlin, Mr. Duncan and Mr. Vergason, are residents of Capistrano Beach, the City of Dana Point and San Juan Capistrano, California. These individuals will be directly impacted by the Project's unmitigated environmental impacts, and therefore have a direct interest in enforcing environmental laws to minimize the adverse impacts that the Project would otherwise have on the environment.

II. THE DEIR FAILS TO ADEQUATELY DISCLOSE, ANALYZE, AND MITIGATE SIGNIFICANT GREENHOUSE GAS, ENVIRONMENTAL JUSTICE, AND BIOLOGICAL RESOURCES IMPACTS

The District fails to adequately disclose, analyze, and mitigate impacts to
several resources, including public health, odor, air quality, greenhouse gases
("GHG"), and biological resources. CEQA requires that an agency analyze the
potential environmental impacts of its proposed actions in an EIR (except in certain 3
limited circumstances).[9] The EIR is the very heart of CEQA.[10] "The foremost
principle in interpreting CEQA is that the Legislature intended the act to be read so
as to afford the fullest possible protection to the environment within the reasonable
scope of the statutory language."[11]

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[9] See, e.g., Pub. Resources Code, § 21100.
[10] *Dunn-Edwards v. BAAQMD* (1992) 9 Cal.App.4th 644, 652.
[11] *Communities for a Better Environment v. Cal. Res. Agency* (2002) 103 Cal. App.4th 98, 109.

CEQA has two primary purposes. First, CEQA is designed to inform decision makers and the public about the potential, significant environmental effects of a project.[12] "Its purpose is to inform the public and its responsible officials of the environmental consequences of their decisions before they are made. Thus, the EIR 'protects not only the environment but also informed self-government.'"[13] The EIR has been described as "an environmental 'alarm bell' whose purpose it is to alert the public and its responsible officials to environmental changes before they have reached ecological points of no return."[14]

Second, CEQA requires public agencies to avoid or reduce environmental damage when "feasible" by requiring "environmentally superior" alternatives and all feasible mitigation measures.[15] The EIR serves to provide agencies and the public with information about the environmental impacts of a proposed project and to "identify ways that environmental damage can be avoided or significantly reduced."[16] If the project will have a significant effect on the environment, the agency may approve the project only if it finds that it has "eliminated or substantially lessened all significant effects on the environment where feasible" and that any unavoidable significant effects on the environment are "acceptable due to overriding concerns."[17] 3

While the courts review an EIR using an "abuse of discretion" standard, "the reviewing court is not to 'uncritically rely on every study or analysis presented by a project proponent in support of its position. *A clearly inadequate or unsupported study is entitled to no judicial deference*."[18] As the courts have explained, a prejudicial abuse of discretion occurs "if the failure to include relevant information

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[12] CEQA Guidelines, § 15002(a)(1).
[13] *Citizens of Goleta Valley v. Board of Supervisors* (1990) 52 Cal. 3d 553, 564.
[14] *Berkeley Keep Jets Over the Bay v. Bd. of Port Comm'rs*. (2001) 91 Cal. App. 4th 1344, 1354; *County of Inyo v. Yorty* (1973) 32 Cal.App.3d 795, 810.
[15] CEQA Guidelines, § 15002(a)(2) and (3); *see also Berkeley Jets*, 91 Cal.App.4th at 1354; *Citizens of Goleta Valley*, 52 Cal.3d at 564.
[16] CEQA Guidelines, §15002(a)(2).
[17] Pub. Resources Code, § 21081; CEQA Guidelines, § 15092(b)(2)(A) & (B).
[18] *Berkeley Jets*, 91 Cal. App. 4th 1344, 1355 (emphasis added), *quoting, Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 391 409, fn. 12.

precludes informed decision-making and informed public participation, thereby 3
thwarting the statutory goals of the EIR process."[19]

A. The DEIR Fails to Adequately Disclose, Analyze and Mitigate Significant Impacts to Biological Resources

Our Prior Comments explained how the DEIR contains numerous flaws with respect to its assessment of the Project's potentially significant impacts on biological resources. The DEIR does not contain a legally adequate description of the environmental setting, does not propose feasible or enforceable mitigation measures and lacks substantial evidence to support its conclusion that impacts to biological 4
resources would be less than significant with mitigation.

Specifically, the DEIR ignores the Project's site function as a critical juncture of migration corridors along San Juan Creek and the Pacific Ocean. The DEIR also contains an incomplete analysis of special-status species by determining only 5 special-status species of terrestrial wildlife as common at the Project site, 2 as uncommon, 4 as rare, and 1 as unlikely, thereby providing an incomplete assessment of existing biological resources. The DEIR also fails to describe, analyze, and mitigate impacts to species from construction noise and traffic.

Dr. Smallwood analyzed the likely movement routes of wildlife and provides substantial evidence that the Project's construction and operation will likely result in habitat fragmentation. Due to habitat fragmentation, the project would likely have substantial adverse effects on 75 species identified as candidate, sensitive, or special-status species in regulations enforced by the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service. Dr. Smallwood opined that the facility may block the wildlife movement bottleneck and concluded that the Project's 5
interference with wildlife movement in the region can be severe. Dr. Smallwood

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[19] *Berkeley Jets*, 91 Cal.App.4th at 1355; *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713, 722; *Galante Vineyards v. Monterey Peninsula Water Management Dist*. (1997) 60 Cal.App.4th 1109, 1117; *County of Amador v. El Dorado County Water Agency* (1999) 76 Cal.App.4th 931, 946.

also provided substantial evidence that impacts to species from noise and traffic will be significant. Dr. Smallwood recommended further detection surveys to fully address impacts to special-status species, including from noise and traffic, and appropriate mitigation to reduce those impacts below a level of significance.

Dr. Smallwood has since conducted a site visit on February 3, 2019 that bolsters his previous conclusions regarding the Project's impacts to special-status species.[20] Dr. Smallwood identified 27 species in three hours, indicating that the site has a high species richness.[21] Dr. Smallwood's conclusions that the Project site is a natural landscape bottleneck were reinforced by his sightings.[22] Further studies, especially studies designed to observe migratory birds during the spring or fall, would likely show that the site contains even more species than Dr. Smallwood observed.[23]

Dr. Smallwood was able to identify numerous bird species, with breeding plumage, near areas of wellhead construction that would be disturbed by the Project's proposed construction activities.[24] Dr. Smallwood also found species navigating around existing barriers.[25] This provides further evidence that the 5
Project's construction noise will harm special-status species and that further barriers can increase impacts to species.

Whereas the District lacks substantial evidence to support its less than significant with mitigation impact conclusion, Dr. Smallwood provides substantial evidence that the Project may have significant impacts, even with mitigation, from Project construction. The District must revise and recirculate the EIR to adequately disclose, analyze and mitigate significant impacts to biological resources.

[20] Smallwood Report, p. 1.
[21] Smallwood Report, p. 2.
[22] Smallwood Report, p. 10.
[23] Smallwood Report, pp. 2, 10.
[24] Smallwood Report, p. 9.
[25] Smallwood Report, p. 10.

B. The DEIR Fails to Adequately Disclose, Analyze and Mitigate Significant Impacts to Disadvantaged Communities

The District is proposing to fund the Project using funds from the United States Environmental Protection Agency's Clean Water State Revolving Fund Program ("SRF") for this Project.[26] SRF-funded projects must meet additional Federal requirements in what is commonly referred to as "CEQA Plus," in order to receive the Federal funds.[27] One "CEQA Plus" requirement is compliance with Executive Order 12898 which requires that Federal agencies identify and address any disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.[28] President Clinton's accompanying memorandum explained that analysis should consider social and economic effects of actions, in addition to health and environmental effects.[29]

1. The DEIR Fails to Establish the Existing Environmental Setting by Failing to Identify Minority and Low-Income Populations in the District 6

The existing environmental setting is the starting point from which the lead agency must measure whether a proposed Project may cause a significant environmental impact.[30] CEQA defines the environmental setting as the physical

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[26] DEIR, p. 1.0-3.
[27] DEIR, p. 1.0-3; State Water Resources Control Board, Environmental Review Process: Clean Water State Revolving Fund (CWSRF) Program, (Feb. 2014), p. 22, *available at* https://www.waterboards.ca.gov/water_issues/programs/grants_loans/docs/cwsrf_ceqa_plus_presentation.pdf (hereafter "CWSRF Presentation"); State Water Resources Control Board, Frequently Asked Questions: Environmental Review Requirements for the Clean Water State Revolving Fund, (Oct. 2017), p. 6 *available at* https://www.waterboards.ca.gov/water_issues/programs/grants_loans/docs/environmental_review/environmental_faq.pdf.
[28] CWSRF Presentation, p. 31; Exec. Order No. 12898, 59 Fed.Reg. 32 (Feb. 11, 1994).
[29] President William Clinton, Memorandum for the Heads of All Agencies: Executive Order on Federal Actions to Address Environmental Justice in Populations and Low-Income Populations, (Feb. 11, 1994), p. 1, *available at* https://www.epa.gov/sites/production/files/2015-02/documents/clinton_memo_12898.pdf.
[30] *See, e.g.*, *Communities for a Better Env't v. S. Coast Air Quality Mgmt. Dist.* (March 15, 2010) 48 Cal.4th 310, 316; *Fat v. City of Sacramento* (2002) 97 Cal.App.4th 1270, 1278, *citing* Remy, et al.; Guide to the Calif. Environmental Quality Act (1999) p. 165.

environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation is published, from both a local and regional perspective.[31]

Describing the environmental setting accurately and completely for each environmental condition in the vicinity of the Project is critical to an accurate and meaningful evaluation of environmental impacts. The importance of having a stable, finite and fixed environmental setting for purposes of an environmental analysis was recognized decades ago.[32] Today, the courts are clear that "[b]efore the impacts of a Project can be assessed and mitigation measures considered, an [EIR] must describe the existing environment. It is only against this baseline that any significant environmental effects can be determined."[33]

An EIR must also describe the existing environmental setting in sufficient detail to enable a proper analysis of project impacts.[34] The CEQA Guidelines provide that "[k]nowledge of the regional setting is critical to the assessment of environmental impacts."[35] This level of detail is necessary to "permit the significant effects of the project to be considered in the full environmental context."[36] 6

The DEIR identifies that 9 percent of the census tract where the Project is located is at the poverty level but fails to provide a determination of minority and low-income populations at the District level or the potential region for the Expanded Project.[37] Social and economic impacts of the Project will reverberate beyond the Project's census tract. Without determining how many people in the District are part of a minority or low-income population, decisionmakers and the public cannot properly determine whether the Project will have a disproportionate impact on those populations. The DEIR fails as an informational document and must be withdrawn and recirculated with this information provided.

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[31] CEQA Guidelines §15125, subd. (a); *Riverwatch v. City of San Diego* (1999) 76 Cal.App.4th 1428, 1453.
[32] *City of Inyo v. City of Los Angeles* (1977) 71 Cal.App.3d 185.
[33] *City of Amador v. El Dorado City Water Agency* (1999) 76 Cal.App.4th 931, 952.
[34] *Galante Vineyards v. Monterey Peninsula Water Mgmt. Dist.* (1997) 60 Cal.App.4th 1109, 1121-22.
[35] CEQA Guidelines § 15125, subd. (d).
[36] *Id.*
[37] DEIR, p. 4.9-10.

2. *The DEIR Fails to Address Disproportionate Economic Impacts of the Project on Minority and Low-Income Populations*

The DEIR only considers physical impacts of the Project but does not address social and economic impacts as required for a SRF project.[38] Desalination is one of the most expensive options to provide water in California, with costs of water up to over $2,000 per acre-foot.[39] Proposition 218 mandates proportionality between water district fees and the cost of providing water.[40] Proposition 218's proportionality requirement restricts water districts from introducing lower water rates for low-income customers.[41] Because of Proposition 218, low-income populations cannot be spared from the increased rates associated with the Project.

This impact could disproportionately impact low-income populations if they are not increasing overall demand in a way that creates the need for the Project's additional water supply. Half of urban water use in California is for outdoor landscape irrigation.[42] Owners of larger properties with more landscaping use more water per capita than those who live in apartments or have smaller lots, who also tend to be lower-income.[43] Without demonstrating that water rates will not require low-income populations to pay a water supply needed to meet larger demands of median and high-income populations, the District lacks substantial evidence to determine that the Project will not disproportionately impact low-income populations. The DEIR must be withdrawn and recirculated with this analysis included and mitigation measures to prevent a disproportionate impact on low-income populations. 6

[38] *See* DEIR, pp. 4.9-9-4.9-10.
[39] Public Policy Institute of California, Paying for Water in California, (Mar. 2014), p. 27, fn.41, *available at* https://www.ppic.org/content/pubs/report/R_314EHR.pdf (hereafter "Paying for Water").
[40] Paying for Water, p. 19.
[41] Paying for Water, p. 22.
[42] Public Policy Institute of California, Water for Cities, (Oct. 2016), p. 2, *available at* https://www.ppic.org/content/pubs/report/R_1016EH3R.pdf.
[43] *See* KPCC, Drought: Rich Southern California Cities Top Water Use Rankings, While Poor Cities Hover at the Bottom, (May 11, 2015) *available at* https://www.scpr.org/news/2015/05/11/51493/drought-rich-southen-california-cities-top-water-u/.

C. The DEIR Fails to Adequately Disclose, Analyze and Mitigate Significant Impacts from GHG Emissions

The DEIR also contains numerous flaws with respect to its assessment of the
Project's potentially significant impacts from GHG emissions. The DEIR improperly 7
reduces the Project's GHG emissions through credits, underestimates total GHG
emissions from the Project, and lacks substantial evidence to support its conclusion
that GHG emissions would be less than significant with mitigation or that the
Project would be carbon neutral.

1. The DEIR Improperly Credits a GHG Emissions Reduction for Replacing Imported Water Demand

The DEIR applies a credit to the Project's GHG emissions for assumed
imported water displacement based on water no longer being imported due to
increased supplies from the Project.[44] This assumption, however, is not supported
in the DEIR. Imported water is delivered to the District by the Metropolitan Water
District of Southern California ("MWD"), not the District. The decrease in demand
for water by the District by the Project or Orange County from the expanded Project 8
do not reduce the amount of water that MWD is entitled to receive from the State
Water Project or Colorado River Aqueduct. The District cannot ensure and does not
provide substantial evidence to support the claim that water controlled by MWD
will remain in the environment and MWD will not emit GHGs by providing that
water to other customers, nor could the District make this an enforceable provision
of Project approval as it lacks the jurisdiction to do so.

Because the District cannot ensure that the Project will replace imported water, it cannot give the Project a credit when calculating Project GHG emissions. As such, the DEIR must be recirculated to include a correct accounting of the Project's GHG emissions.

2. The DEIR Underestimates GHG Emissions from the Project

In addition to improperly reducing overall GHG emissions, the DEIR also 9
fails to account for all sources of GHG emissions from the whole of the action for

[44] DEIR, p. 4.6-20.

this Project. CEQA requires a lead agency to make a "good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate the 9
amount of greenhouse gas emissions resulting from a project."[45]

a) The DEIR Fails to Account for Energy Bound in Construction Materials

The DEIR acknowledges that energy is consumed during the production of construction materials, however it incorrectly assumes that sources of construction materials will not waste energy and makes no attempt to calculate this source of GHG emissions.[46] Construction materials are produced in facilities around the world, including jurisdictions that do not impose similar energy conservation standards or rely on cheaper and dirtier energy so that energy conservation may not be as profitable or make products as clean as the DEIR claims. In fact, 20-30% of global GHG emissions come from internationally traded goods and these emissions are not addressed without consumption-based accounting measures.[47]

Sustainable procurement strategies can be implemented to address GHG emissions from construction materials for the Project.[48] Methodologies to account 10
for GHG emissions per unit are available and many factories are certifying their products.[49] For example, Environmental Product Declarations ("EPD") are standardized forms that require third-party verification to determine environmental impacts at a factory level.[50] The State of California's Department of General Services has already begun to consider GHG emissions, based on information in EPDs, during procurement of materials for state projects.[51] Despite the availability of information and methods to calculate GHG emissions from

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[45] CEQA Guidelines § 15064.4(a).
[46] DEIR, pp. 6.0-12-6.0-13.
[47] Daniel Moran, Ali Hasanbeigi, and Cecilia Springer, The Carbon Loophole in Climate Policy: Quantifying the Embodied Carbon in Traded Products, (2018), p. 5, *available at* https://buyclean.org/media/2016/12/The-Carbon-Loophole-in-Climate-Policy-Final.pdf (hereafter "Carbon Loophole").
[48] *See* Carbon Loophole, p. 43.
[49] EPD International, What is an EPD, *available at* https://www.environdec.com/What-is-an-EPD/ (hereafter "EPD").
[50] EPD.
[51] *See* the Buy Clean California Act, Cal. Pub. Contract Code, § 3500 et seq.

construction materials, the DEIR makes no effort to calculate and mitigate these impacts.

Emissions from construction materials can represent a significant source of GHG emissions from the Project. The DEIR fails to disclose this information or provide mitigation for the emissions, thus failing as an informational document. It must be withdrawn and recirculated with this information included and feasible mitigation measures to reduce these emissions to a less than significant level. 10

Further, the District claims that its goal is a carbon neutral Project. To do so, the DEIR must identify and mitigate the large source of carbon emissions bound in construction materials and require carbon neutrality as mitigation.

b) Impacts from Pumping Water Across the Region from the Expanded Project are Potentially Significant

The DEIR's accounting for GHG emissions for the Expanded Project simply multiplies the emissions from the Project by three.[52] This method ignores that the expanded Project would have additional impacts beyond this Project. Providing water from the expanded Project across the region will involve transporting water from the desalination facility uphill, against the forces of gravity. Pumping of this water will create GHG emissions that the 5 MGD Project will not have, thus the simple multiplication method does not suffice. The DEIR must be withdrawn and recirculated with an actual attempt to calculate all sources of emissions from the expanded Project and mitigation for those emissions. 11

III. CONCLUSION

The DEIR contains legal errors and lacks substantial evidence to support its conclusions. Instead, substantial evidence shows that the Project will result in significant, unmitigated environmental justice, greenhouse gas, and biological resources impacts. Therefore, the District must prepare a revised EIR. The District 12

[52] DEIR, p. 4.6-20

must then recirculate the revised EIR to ensure that the public is not deprived of a meaningful opportunity to comment on the significant impacts and feasible ways to mitigate or avoid those impacts. 12

Sincerely,

Kyle Jones

KCJ:ljl

Exhibits

3499-058j

EXHIBIT A

Shawn Smallwood, PhD
3108 Finch Street
Davis, CA 95616

South Coast Water District
Mr. Rick Shintaku, PE – Acting General Manager/Chief Engineer
31592 West St
Laguna Beach, CA 92651

15 February 2019

RE: Doheny Ocean Desalination Project

Dear Mr. Rick Shintaku,

After visiting the site of the proposed Doheny Ocean Desalination Project, I write again to add to my comments of 3 August 2018 on the draft EIR (SCWD 2018) and supporting documents on biological resources (Chambers Group 2016, MBC Aquatic Sciences 2018). My CV and my qualifications for preparing expert comments were provided in my comment letter of 3 August 2018.

I visited the proposed project site on 3 February 2019 from 13:55 to 17:05 hours during intermittent rain showers, I walked around the site, using binoculars to scan for wildlife (Photo 1). I observed 27 species of vertebrate wildlife (Table 1).

***Photo 1**. California brown pelicans at Doheny State Beach, 3 February 2019.*

Table 1. *Species of wildlife I observed during my visit on 3 February 2019 at the site of the proposed Doheny Desalination Project, 13:55 to 17:05 hours.*

Species	***Scientific name***	**Status**[1]	**Minute**
California brown pelican	*Pelacanus occicentalis californicus*	SSC1	54
Double-crested cormorant	*Phalacrocorax auritus*	TWL	136
Great blue heron	*Ardea herodias*		20
Great egret	*Casmerodius albus*		16
Snowy egret	*Egretta thula*		19
Mallard	*Anas platyrhynchos*		190
Black-necked stilt	*Himantopus mexicanus*		46
Whimbrel	*Numenius phaeopus*	BCC	53
Willit	*Tringa semipalmata*		15
Sanderling	*Calidris alba*		15
Ring-billed gull	*Larus delawarensis*		18
California gull	*Larus californicus*	TWL	50
Heermann's gull	*Larus heermanni*		50
Mew gull	*Larus canus*		1
Rock pigeon	*Columba livea*	Non-native	14
Anna's hummingbird	*Calypte anna*		13
Cassin's kingbird	*Tyrannus vociferus*		102
White-throated swift	*Aeronautes saxatalis*		110
Common raven	*Corvus corax*		106
Cedar waxwing	*Bombycilla cedrorum*		66
Ruby-crowned kinglet	*Regulus calendula*		61
Yellow-rumped warbler	*Dendroica coronata*		5
White-crowned sparrow	*Zonotrichia leucophrys*		60
House finch	*Carpodacus mexicanus*		64
House cat	*Felis catus*	Non-native	102
California ground squirrel	*Otospermophilus beecheyi*		61
Desert cottontail	*Sylvilagis audobonii*		60

[1] Listed as BCC = federal Bird Species of Conservation Concern, CT = California threatened, CDFW 3503.5 = California Department of Fish and Wildlife Code 3503.5 (Birds of prey), TWL = Taxa to Watch List (Shuford and Gardali 2008).

Four of the species I saw were special-status species, and were listed as potentially occurring special-status species in my 3 August 2018 comment letter. I stopped my survey when my detections slowed; however, accumulating 27 species detections in 3 hours indicates a high species richness (Figure 1). Visiting on additional days would have added many more species detections. My visit confirmed my suspicion that the project site hosts many species of wildlife, including special-status species. Photos 2 through 18 show some of the wildlife I saw. Photo 19 shows an existing collision hazard to birds in the form of glass walls on the PCH bridge over San Juan Creek.

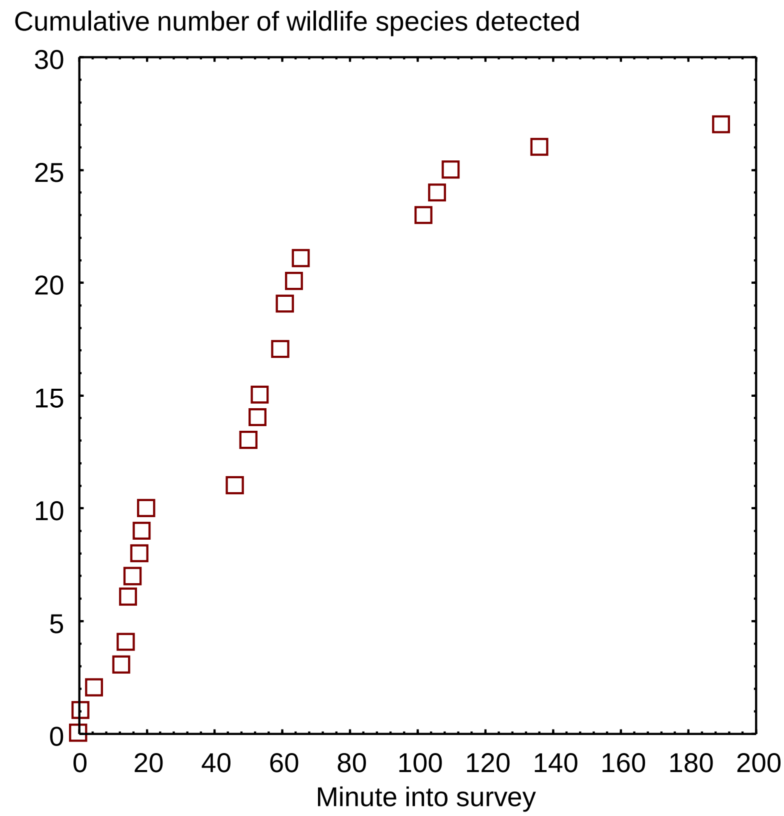

Figure 1. *Wildlife species detections with time into the survey on 3 February 2019.*

Photo 2. *Whimbrel on Doheny State Beach, 3 February 2019. Whimbrel is a federal Bird species of Conservation Concern.*

Photo 3. *California brown pelicans, a California Species of Special Concern priority level 1, on Doheny State Beach, 3 February 2019 at a location where one of the intake pipes would be constructed from wellhead D.*

Photos 4 & 5. *California brown pelicans foraging along San Juan Creek (left), and a double-crested cormorant – a species on California's Taxa to Watch list -- flying along Doheny State Beach (right), 3 February 2019.*

Photos 5 & 6. *Snowy egret (left) and American crow (right) foraging on Doheny State Beach, 3 February 2019, about where intake pipes are planned for construction from wellhead A.*

Photo 7. *One of a pair of black-necked stilts foraging in a pool where San Juan Creek meets the Pacific Ocean at Doheny State Beach, 3 February 2019.*

Photos 8 & 9. *Great blue heron (left) and great egret in breeding plumage (right) on Doheny State Beach, 3 February 2019, about where intake piles are planned for Wellhead A.*

Photo 10. *Cassin's kingbird along San Joaquin Creek where the desalination facility is planned near Doheny State Beach, 3 February 2019.*

Photos 11 & 12. *Desert cottontail (left) and California ground squirrel (right) near the planned wellhead C at Doheny State Beach, 3 February 2019.*

Photos 13 & 14. *Female (left) and male (right) house finches at Doheny State Beach, 3 February 2019, about where Wellhead C is planned.*

Photo 15. *Ring-billed gull on Doheny State Beach, 3 February 2019.*

Photo 16. *Sanderling of the hunt on Doheny State Beach, 3 February 2019.*

Photo 17. *A one-legged sanderling valiantly keeping up with the flock on Doheny State Beach, 3 February 2019.*

Photo 18. *White-crowned sparrow (right) near planned Wellhead C at Doheny State Beach, 3 February 2019.*

Photo 19. *California brown pelicans after delicately negotiating a glass wall along the PCH bridge over San Juan Creek at Doheny State Beach, 3 February 2019. These glass walls likely kill many birds.*

Many of the animals I saw were near planned wellheads, where operational noise will disrupt foraging and courtship. The DEIR needs to be revised to address these potentially significant impacts. I also saw multiple species at locations where excavation and construction will be needed to install intakes for the wellheads. Potential impacts from these excavations need to be addressed.

My site visit reinforced my conclusion that the project site is within a natural landscape bottleneck, where migrating wildlife following the coast or along San Juan Creek will encounter natural barriers requiring a course adjustment. It is a natural place for a stop-over. I am confident that had I performed a site visit during fall or spring, I would have seen migrants passing through or stopping over. The EIR needs to be revised to address potential impacts to migrants.

Thank you for your attention,

Shawn Smallwood

Shawn Smallwood, Ph.D.

REFERENCES CITED

Chambers Group, Inc. 2016. Lower San Juan Creek and seasonal coastal lagoon habitat assessment Orange County, California. Report to South Coast Water District, Laguna Beach, California.

SCWD 2018. Doheny Ocean Desalination Project Draft Environmental Impact Report. State Clearinghouse No. 2016031038. Prepared by Kimley-Horn & Associates, Inc. for South Coast Water District, Laguna Beach, California.

MBC Aquatic Sciences. 2018. Impact Assessment: South Coast Water District Doheny Desalination Project. Report to GHD Inc., Irvine, California.

Shuford, W. D., and T. Gardali, [eds.]. 2008. California bird species of special concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California.

Photo 20. *A California brown pelican flies over Doheny State Beach, 3 February 2019.*

Letter O7 CURE

Kyle Jones
April 4, 2019

The public comment period on the Draft EIR closed August 6, 2018. CURE submitted a comment letter during that public review period. CURE then submitted this supplemental comment letter on April 4, 2019. Though not required by CEQA to respond to late comments, the District provides the following response:

Response O7-1

These are introductory remarks which are noted for the record but that either do not require any further response or summarize comments on the Draft EIR that are responded to in more detail in the following responses.

Response O7-2

These are introductory remarks regarding the commenter's organization, CURE, which are noted for the record and do not require any further response.

Response O7-3

These comments summarize concerns that are addressed in more detailed comments that follow and are responded to in more detail in the following responses.

Response O7-4

These are introductory remarks regarding commenter's concerns regarding biological resources, that are addressed in response to more detailed comments that follow.

Response O7-5

Please see responses to comments O1-11 through O1-16 and O1-19 regarding biological resources and assessment of terrestrial species.

The commenter asserts that an exhaustive list of all species, including those with only rare occurrence in the past, or even only a potential for occurrence, in the Project area are needed to adequately describe the environmental setting of a project area. This is inconsistent with CEQA. Pursuant to CEQA Guidelines §15125(a), "[a]n EIR must include a description of the physical environmental conditions in the vicinity of the project. This environmental setting will normally constitute the baseline physical conditions by which a lead agency determines whether an impact is significant. ***The description of the environmental setting shall be no longer than is necessary to provide an understanding of the significant effects of the proposed project and its alternatives***. The purpose of this requirement is to give the public and decision-makers the most accurate and understandable picture practically possible of the project's likely near-term and long-term impacts." [emphasis added].[1]

[1] CEQA Guidelines Section 15125(a) was amended effective 2019, after preparation and release of the Draft EIR.

The EIR and biological support documents utilized existing information and field investigations to characterize the environmental setting based on site-specific studies in the Project area (DEIR page 4.3-1). The DEIR (page 4.3-6) identifies that up to 200 terrestrial wildlife species and 61 water-associated bird species have been reported or are known to occur within Doheny State Beach. Of these 61 bird species, the DEIR identifies that 20 species are listed as threatened or endangered or otherwise considered sensitive by State and federal resource agencies, and that at least seven of these bird species are known to nest in Doheny State Beach. Contrary to the comment that the DEIR contains an incomplete assessment of terrestrial wildlife, pages 4.3-1 through 4.3-15 provide an extensive description of locally occurring marine, terrestrial and aquatic species. Consistent with CEQA significance thresholds, the DEIR and Table 4.3-1 (Threatened, Endangered and Sensitive Marine Species) focus on special status species that are known to or could occur in the Project area. The review documented known occurrences of special-status species at the site, common species, and species dependent on habitat most likely to be exposed to long-term (i.e., operational) conditions.

As explained on pages 4.3-2 through 4.3-5, the environmental setting of the desalination facility site is heavily disturbed, urbanized and currently used for commercial and industrial uses. At the potential subsurface intake well locations within Doheny State Beach and Capistrano Beach Park, the “pods” or well clusters consist of rectangular areas up to 130 feet by 75 feet in size, located away from the beach, on developed lawn, parking, campground and similar areas (page 4.3-2 and Project Description Exhibits 3-3 through 3-5). Given the biological characterization of the areas as already disturbed and the degraded condition of the primary desalination facility site, there is no evidence that movement routes of wildlife could be affected by the Project. The hardened channel of San Juan Creek adjacent to the Project site, which represents the logical route for wildlife movement, provides little vegetative cover and will not be impacted by the Project. Additional wording will be added to the Connectivity and Migration Corridors section of the FEIR (see Section 3, *Draft EIR Errata*) that amplifies the discussion of existing site conditions and clarifies the DEIR’s findings as presented. The less than significant findings in the Draft EIR regarding wildlife movement remain unchanged and no additional mitigation measures are required.

Potential construction impacts to special status species are identified in detail on pages 4.3-26 through 4.3-30 of the DEIR. The DEIR discloses potentially significant impacts to protected avian species and requires preconstruction surveys, avoidance, construction buffers, resource agency consultation, monitoring, refined facility siting, groundwater monitoring and other performance-based measures to avoid potentially occurring species (Mitigation Measures BIO-1 through BIO-4 and OPA-1). Regarding construction, the site includes urbanized uses (desalination facility site) or is already an active recreation area (subsurface intake well pods) where ambient noise from surf, recreational visitors, commercial uses, the adjacent Pacific Coast Highway and an active railroad line provide an ambient noise environment influenced by human habitation. As identified on page 4.3-27, the drill rig work areas will also be screened for noise and light attenuation (as discussed in Section 4.10, Noise and Vibration and Section 4.1, Aesthetics, Light and Glare). Further, construction impacts would be short term and could be reduced to less than significant levels with mitigation (as noted in the Draft EIR Section 4.3, Mitigation Measure BIO-1).

The EIR emphasized the occurrence of special-status and water-associated species, those associated with the lagoon, shoreline, and nearshore habitats, those species more likely to be affected by either the slant well pumping or brine discharge impacts, and commonly occurring species in the area which would be more likely to occur during project operations. In the case of birds, known nesting status in the Project area for special status and water-associated species was also included. Information included in the EIR was sufficient to support the analysis of impacts based on the Project's Thresholds of Significance.

Response O7-6

The commenter asserts that the Draft EIR does not adequately address impacts of the Project to disadvantaged communities. However, the Draft EIR identifies low-income and minority populations in the associated Census tracts (Draft EIR page 4.9-10), which identifies that Census Tract 0422.01, where the Project is located, is 73.9% Caucasian (and therefore 26.1% other than Caucasian), with 9% of the population at the poverty level. Census tract information is an appropriate data set to identify the general demographics of the community that includes the Project site and represents the existing environmental condition in that respect. The District does not have specific demographic data for the population within District boundaries. The Draft EIR (pages 4.9-2 and 4.9-3) also describes the existing land use pattern immediately adjacent to the Project's components, which is primarily commercial, industrial and recreational. This mix of land uses do not support a cohesive residential population, minority, low-income or other, that would be negatively affected by the physical environmental changes of the Project.

It is not clear how identifying minority or socioeconomic data specific to the District would be relevant to decision-makers or the public relative to the Project's environmental impacts. Identifying minority or economic data specific to the larger Regional project, as suggested, would be speculative as the parameters of that project and area to be served cannot be clearly identified at this time. The Project would potentially provide numerous benefits to the local community and District population by providing clean, reliable potable water, in addition to safeguarding against loss of potable water in the event of an emergency condition. Prolonged disruption of potable water to the local community not only would directly impact the local population, but would lead to economic impacts to local businesses.

The commenter asserts without substantiation that socioeconomic impacts "will reverberate" beyond the local Census tracts. The comment provides no substantiation of any real physical or economic impact of the Project. The Project facilities are located at an existing public recreation area (DSB), within existing public rights-of-way (for conveyance pipelines), and at an existing District-owned industrial property. The desalination site is further buffered from adjacent uses by San Juan Creek to the west, PCH to the south, the SCRRA railroad to the east, and existing District parcels to the north.

Executive Order No. 12898, cited in the comments, requires that an applicant identify and address any disproportionality high and adverse human health or environmental effects of the project activities on minority, low-income, indigenous populations, or tribes. As described above, there are no established populations of any type near the Project that would be subject to disproportionately high or adverse human health or environmental effects of the Project.

CEQA Guidelines Section 15131, Economic and Social Effects, allows an agency to include economic and social information in environmental documents. However, this analysis is not required by CEQA, and such effects of a project shall not be treated as significant effects on the environment, unless the analysis can trace a chain of cause and effect from a proposed decision to physical environmental effects. The intent of any such analysis is intended to focus on the physical changes.

Contrary to the commenter's assertion that desalination is the "most expensive" water supply option, the District's Water Reliability Working Group found that the Project scored higher relative to cost than other available options,[2] and preliminary ratepayer impacts of the Project estimate an additional monthly ratepayer impact of approximately \$5 to \$7[3] per month, less than several other available options. The District has aggressively sought state and federal funding to further reduce the Project's costs and ratepayer impact, with a \$10 million state grant already awarded, and a federal grant pending. Furthermore, the financial impact is not inequitable, in that customers with less demand (for whatever reason), would have a lower water bill than customers that choose to utilize more water. All rate payers, including minority and low-income rate payers, would receive the Project's benefits of increased water reliability.

Response O7- 7

These are introductory remarks regarding commenter's concerns regarding GHG, that are addressed in responses to more detailed comments that follow.

Response O7-8

Refer to Response S1-12.

Response O7-9

These are introductory remarks regarding commenter's concerns regarding GHG, that are addressed in responses to more detailed comments that follow.

Response O7-10

The commenter states that the Project must provide, essentially, a life-cycle greenhouse gas analysis of construction materials used in the Project. Lifecycle analysis of building materials is neither required nor recommended by the State, regional agencies, or local air districts in regard to CEQA analysis. The Natural Resources Agency (CNRA), in amending the CEQA Statute and Guidelines in 2009 to include an analysis of greenhouse gas emissions, states that requiring a "lifecycle" analysis may not be consistent with CEQA. Per the CNRA's 2009 Final Statement of Reason, "As a general matter, the term [life-cycle] could refer to emissions beyond those that could be considered "indirect effects" of a project as that term [indirect effects] is defined in §15358 of the State CEQA Guidelines." (CNRA, 2009). Furthermore, the CNRA states:

> *CEQA only requires analysis of impacts that are directly or indirectly attributable to the project under consideration. (State CEQA Guidelines, §15064(d).) In some instances, materials may be*

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[2] SCWD, Water Reliability, Importance of Water Reliability, available at https://www.scwd.org/about/governance/water_reliability_working_group/default.htm (Table 18) (last viewed May 24, 2019).

[3] SCWD Board Meeting Presentation, November 15, 2017

manufactured for many different projects as a result of general market demand, regardless of whether one particular project proceeds. Thus, such emissions may not be "caused by" the project under consideration. Similarly, in this scenario, a lead agency may not be able to require mitigation for emissions that result from the manufacturing process. Mitigation can only be required for emissions that are actually caused by the project. (State CEQA Guidelines, §15126.4(a)(4).)[4]

In revising the CEQA Statute and Guidelines in 2018, the CNRA provided the following text additions to CEQA Guidelines Section 15126.2(b) (Consideration and Discussion of Significant Environmental Impacts) regarding energy impacts, which are integrally connected with greenhouse gas emissions:

…This analysis is subject to the rule of reason and shall focus on energy use that is caused by the project. This analysis may be included in related analyses of air quality, greenhouse gas emissions, transportation or utilities in the discretion of the lead agency.

CRNA provides in its 2018 Final Statement of Reasons, that the new text is "necessary to place reasonable limits on the analysis. Specifically, it signals that a full "lifecycle" analysis that would account for energy used in building materials and consumer products will generally not be required."[5]

Additionally, the building materials to be used for the Project are standardized and commonly available materials. The Project would not, itself, cause manufacture of specific construction materials for the sole use of the Project. The existence of procurement requirements for the State of California's Department of General Services and of third-party verification of emissions are irrelevant to what is required or warranted for appropriate analysis under CEQA.

Response O7-11

As shown in Draft EIR Table 3-8, product water pumping would account for a minor portion (13 percent) of the total Local Project's (up to 5 MGD) electrical energy use under normal operations. The majority (approximately 81 percent) of the energy demand for both the Local Project and the potential 15 MGD Regional Project would be from slant well pumping and on-site ocean water treatment processes. Therefore, the energy demand has been appropriately scaled from the up to 5 MGD Local Project to the 15 MGD Regional Project. The ultimate destination of water created by the Regional Project is unknown, as is the future rate of energy demand and source of supply for its pumping. While it could be that the offsite pumping for the 15 MGD Regional Project could result in a different energy demand than presented in the EIR, CEQA does not require technical perfection in an EIR, but rather adequacy, completeness, and a good-faith effort at disclosure. The EIR has made a good faith effort to address reasonably foreseeable impacts of a potential future Regional Project, and is not obligated to engage in speculation regarding unknown potential offsite Regional Project facilities (refer to Master Response 2).

Further, as described on page 1.0-3 of the Draft EIR, the EIR functions as a Program EIR pursuant to CEQA Guidelines §15168, providing a programmatic level analysis of a potential future Regional Project of up to 15 MGD. Under a Program EIR, subsequent activities approved under the program must be examined in the light of the Program EIR to determine whether any additional environmental document must be

4 California Natural Resources Agency. (CRNA) December 2009. Final Statement of Reasons for Regulatory Action.

5 California Natural Resources Agency. (CRNA) 2018. Final Statement of Reasons for Regulatory Action Amendments to the State CEQA Guidelines OAL Notice File No. Z-2018-0116-12.

prepared. As discussed further in DEIR Section 3.0, Project Description, SCWD only intends to seek regulatory permits and approvals for the Local Project at this time, as there are no Regional Project partners in place, and specific Regional conveyance facilities are dependent on Regional Partners and as such cannot be identified at this time. At such time when there is a partner for the potential Regional Project, the specific conveyance facilities associated with the Project would be reviewed in light of the Program EIR. If it were found that the potential Regional Project had new or substantially greater impacts than those evaluated in the Program EIR, a subsequent EIR could potentially be necessary to evaluate the impacts specific to the potential Regional Project.

Finally, implementation of Mitigation Measure GHG-1 includes a process for providing updated GHG emissions updates and a requirement to achieve carbon neutrality through a variety of measures, including purchase of third-party verifiable GHG offsets and/or renewable energy certificates. Implementation of Mitigation Measure GHG-2 includes preparation and publication of an annual GHG Verification Report in the first quarter of each year following project construction or operations to "true-up" the GHG emissions estimate by reporting on the actual estimated GHG emissions. As specified in the mitigation measure, the report shall be verified by an independent accredited verification entity, and the findings of the report shall be used to adjust the annual GHG offsets required for subsequent operational years. Mitigation Measure GHG-1 and GHG-2 are feasible mitigation of impacts from greenhouse gas emission of both the Local Project and Regional Project.

Therefore, the Draft EIR appropriately characterizes the energy demands of, analyzes the GHG impacts of, and mitigates the impacts of the potential Regional Project. Please see also response to comment O1-18.

Response O7-12

This is a conclusion to the comment letter, for which responses to specific comments have been provided above.

June 26, 2018 DEIR Public Meeting

M1 Richard Banister
M2 Richard Gardner
M3 Markus Lenger
M4 Richard Kanter
M5 Toni Nelson
M6 Ray Hiemstra

In the matter of:

SOUTH COAST WATER DISTRICT MEETING

DOHENY OCEAN DESALINATION PROJECT

06/26/2018

Reported by: Patricia S. Newton, CSR # 1385

Kramm Job No. 83598

SOUTH COAST WATER DISTRICT

DOHENY OCEAN DESALINATION PROJECT

PUBLIC MEETING

Capistrano Unified School District Board Room

33122 Valle Road

San Juan Capistrano, California 92675

TRANSCRIPT OF PROCEEDINGS

Tuesday, June 26, 2018, 6:42 p.m.

Reported by: Patricia S. Newton
California Certificate No. 1385

APPEARANCES

SOUTH COAST WATER DISTRICT:
WILLIAM GREEN
DENNIS ERDMAN
WAYNE RAYFIELD
RICK ERKENEFF
KARI NIEBLAS VOZENILEK, Esq.

REPORTS ON BEHALF OF SOUTH COAST WATER DISTRICT:
LEWIS MICHAELSON, Moderator
KEVIN THOMAS
MARK DONOVAN
RICK SHINTAKU

COMMENTS BY ATTENDEES:
RICHARD BANISTER
RICHARD GARDNER
RAY HIEMSTRA
RICHARD KANTER
LENGER MARKUS
TONI NELSON

ALSO PRESENT:
Interested Parties
In-Vue Media Video Productions

I N D E X

SAN JUAN CAPISTRANO, CALIFORNIA

TUESDAY, JUNE 26, 2018, 6:42 p.m.

--oOo--

MR. GREEN: Well, good evening, everybody, and we'd like to, on behalf of South Coast Water District board of directors, welcome everybody here this evening to hear about our Doheny desalinization, and it's basically an information meeting this evening. It's a posted public meeting, however, it's really for you, information on the project of a Draft EIR.

And at this time, I'm going to ask our legal counsel to come up and do the -- the housekeeping items so we're all staying somewhat consistent.

Thank you. Here you go.

MS. VOZENILEK: Thank you, Bill.

I'm Kari Vozenilek. I am the legal counsel for the District with respect to this project, and what I'm going to tell you tonight is that this meeting is to accept your comments and questions on the projects.

And I wanted to let you know that we've advised the board not to answer these questions tonight. We want to hear your comments and questions. If you have simple factual questions, we might be able to get answers from the District's staff or consultants, but the District board is going to just have a listening role tonight. So we're letting you know so you don't think that they're ignoring you. They're listening.

We will take all of your comments and questions under consideration and, you know, get full responses in the final EIR. That's where we prepare and provide responses to the questions that you'll ask after this presentation.

Thank you.

MR. GREEN: So at this time, we'd ask everybody to please stand for the pledge of allegiance.

And we're going to ask our director, Dennis Erdman, to lead us in the pledge of allegiance.

MR. ERDMAN: Repeat with me.

(Pledge of allegiance.)

MR. GREEN: Thank you.

And I will turn it over to Lewis.

MR. MICHAELSON: Thank you.

If I could have the panel join me up at the table now.

Good evening, and thank you for coming tonight. I'm Louis Michaelson, and I will be serving as the moderator for tonight's public meeting on the South Coast Water District Doheny Ocean Desalination Project Draft Environmental Impact Report. I was hoping I could get through that in one breath. It's a long document, too, so take your time.

Please be advised that the District is recording and live-streaming this meeting on YouTube for people who cannot attend tonight. And after it's live-streamed, the recording of the meeting will also be available on the South Coast Water District YouTube page.

Here to receive your comments tonight are David Shintaku, acting general manager --

Want to raise your hand? There you go.

-- for South Coast Water District.

Mark Donovan, the program manager for the Doheny Ocean Desalination Project, from GHD.

And Kevin Thomas, project manager for the Environmental Impact Report from Kimley-Horn. So he's the one up here directly involved in the preparation of the document that we're -- we're talking about tonight.

Hopefully -- and I know many of you did -- took the opportunity to take advantage of the poster stations. Some of you came here a little bit early and I think spent pretty much an hour there. So good for you. I hope you got all the questions you had answered during that process. We had a lot of people available to -- to answer them.

The primary purpose of this portion of the meeting is for the panel members to listen to your comments firsthand. And to reiterate, this comment session is not designed as a question-and-answer session; however, in accordance with the agenda, a presentation is going to be offered first to orient you to the project until the public comments session after the presentation.

If you did not already sign up, there are speaker registration cards that are these blue half-page. They're available at the -- at the registration table. We're asking anyone who would like to speak to sign up first, and then I've been -- I'll be calling on people in the order in which they signed up.

The background presentation is going to led off by Rich Shintaku and should only last about 30 minutes or perhaps a little bit less.

With that, Rick, I'll turn it over to you.

MR. SHINTAKU: Thank you, Lewis.

First of all, I want to thank everybody for taking time out of your busy schedules to come here and join us. It really makes a big difference. So thank you for doing that.

So I am Rich Shintaku, acting general manager for South Coast Water District. You did see or meet Mr. Bill Green, our president, here, but there are also three other board members here: Director Dennis Erdman, Director Wayne Rayfield, vice president, and director

Rick Erkeneff is here as well.

So with that, I also want to credit Andy Brunhart, who is our general manager, and he played a large part in the planning of this process and getting us to this point.

Note that this is a milestone in the process, but no decision has been made moving forward. I'm stressing the importance of public involvement here. So at the front, you had a chance to get a blue card. If you have it and you still wish to make a comment, please do so and fill out that speaker's card.

You also have the opportunity to submit written comments, and those are the white sheets of paper that you see in the back. So please feel free to do that.

And I'm a firm believer in public feedback. So as much feedback as you can give us, the better the project will end -- will be implemented at the very end.

So as you will see in this presentation, the District's primary focus is to plan a highly responsible project that minimizes environmental impacts, and we'll get into some of the details of that.

So this is what we're going to go through: The first bullet, I'm going to cover the first -- first two bullets: South Coast Water District introduction and why reliability is important to us in South -- in the South

Coast Water District area and South Orange County in general.

Mark Donovan, who is our program manager, will go through the remaining bullets, which will be the project description, the CEQA process, Draft EIR findings, Draft EIR alternative study, and the public comments session.

So this is the District service area. The -- the black line border is our total service territory. And we also have a contract to serve South Laguna Beach, as well.

We have -- we serve approximately 8.3 square miles, and we have roughly 12,500 service connections. We provide potable water, recycled water, and wastewater service to South Laguna Beach and Dana Point, and a small portion of San Clemente and San Juan Capistrano. The majority of our service area is residential, approximately 35,000 residents, with the remaining uses being commercial and institutional and, as you know, a number of resorts as well.

In addition to potable water and recycled water and wastewater service, we also have the contract -- or we -- we do the operations and plan the capital projects and implement the capital projects for the joint regional water supply system. So that --

I don't have an exhibit here, but basically, we -- we manage over 30 miles of pipeline, two large reservoirs, taking Metropolitan imported water from about the Irvine border -- so near that Kaiser Hospital and with the freeway interchange -- and we bring water all the way down through the north end of the San Diego County Water Authority service area and we serve the state parks down there on the San Onofre Plant area. So we have that the responsibility for the JPA.

So where do we get our water? Well, as -- we have -- we get approximately 85 to 100 percent of our potable water supply from the Metropolitan Water District of California, and Metropolitan, in turn, gets its water from Northern California through the state water project, as you see here, and the Colorado River -- through the Colorado River aqueduct here. And like I said, Met serves 85 to 100 percent of our potable water supply. So we're basically at -- at the end of the pipeline there.

So I'm going to spend a little bit of time on this slide. It's a very important slide for us. And I should have numbered these bullets, but it's basically a five-pronged approach that the District has taken to sustainability, or five slices of the pie, if you will. So we have that proven track record of sustainability and making those investments, and I'll go through a few of these here.

The groundwater recovery facility, it's -- it's a brackish water or high-TDS water -- groundwater recovery facility using reverse osmosis technology to treat the water and to put it into our water supply system. It's approximately one million gallons per day. And we also operate the well -- the production well that feeds that treatment plant.

We've made significant investments, in the second bullet, in maximizing recycled water use. We put approximately 1350 acre-feet a year into the coastal treatment plant -- of sewage into the coastal treatment plant. We've invested in an advanced water treatment facility that treats the water to recycled water standards, Title 22 standards.

And we've also added the Aliso Creek reclamation facility, which is a reverse osmosis facility, to further polish that water and bring the salt level down, and that's used for landscape irrigation in our service area.

So that's 1350 acre-feet a year that we put in, and currently we're using 900 acre-feet a year. So we've been facilitating those retrofits with -- with the end users -- the HOAs, the resorts, the schools, the parks, the city, et cetera -- and they've done a lot of help in getting us to that point as well.

And we have plans to retrofit more in the next seven years to get up and fully maximize that 1350 acre-feet a year. So that's the other prong.

The third prong there is the maximized water use efficiency, so long-term water conservation improvements. So the District would like to take all the credit for that, but the customers are the ones who really have made the advances in there.

So, for example, during the last drought, the customers were able to save 26 percent compared to 2013 levels, 26 percent. That was on the higher end of the spectrum. But what -- what makes that more remarkable is, fast-forward to 2017 and the customers are still serving 20 percent -- are still saving 20 percent. So there's literally no -- no real bounceback in the service area. So it tells you about the conservation ethic in the area and -- the investments that these customers, you know, whether they be business customers or residential customers, have made in their private side of their plumbing. So there's a lot of examples of, well, you know, water-efficient dishwashing facilities that they've installed at some of these resorts.

There's a lot of these resorts that have converted their turf to drought-tolerant plantings and artificial turf, even when the rebates weren't available. So they've made those investments and have been really progressive-thinking and really showing that water conservation ethic moving forward. So conservation has . . .

I have an interesting metric for you, as well. So over the past 25 years, the District's population increased by approximately 10 percent but the drinking water demands have dropped by over 30 percent. So that tells you the conservation ethic in this community. And we really appreciate that on the District's side.

It's kind of a unique business model: We pay folks to conserve water, and that's something that the District and the board have provided that leadership moving forward.

So the other thing that -- that we're proud of is minimizing water system losses and customer leaks. So South Coast Water District has approximately 2 to 3 percent water losses, so unaccounted-for water in the system. If -- for those who aren't in the water industry, that's very low. That's one of the best in the region locally and statewide, as well.

So we've also substantiated that or validated that by doing two water audits -- third-party water audits to validate that 2 to 3 percent level, and it validated that we are actually minimizing our water leaks in our system to that level. So it's something we focus on.

And the District has also on the customer side of the meter invested in automated meter-reading technology. So on a daily basis and weekly, we meet up as a staff to see what water leaks are apparent and -- on the private side of the system.

So many of you who live in our district will get those notifications right away. And the customers overall have been diligent in repairing those leaks right away. So on the private side, we've also minimized water leaks, as well. So --

And the last prong there is partnering with the Santa Margarita Water District on their San Juan Watershed project. So that's a stormwater capture project in the first phase. And there -- there -- it's a rubber dam concept where it takes stormwater, captures -- or the rubber dam will actually stop the water and recharge the groundwater basin and send . . .

South Coast Water District board has made a 20 percent commitment partnership in that project. So we do participate in stormwater capture, as well. So that's -- that's our five-pronged approach.

But after that -- after all those investments, we're still dependent on Metropolitan water for -- in part, for our potable water supplies. So we're still 85 to 9- -- to 100 percent dependent on Metropolitan Water District for our potable water supplies here. And that's approximately right now 5500 acre-feet a year. So that's one of the reasons why we're looking at alternative water supplies. So that's --

When you're looking at our -- as a map of potential fault locations in the state and the vulnerability of our statewide water system, which I think the majority of you are familiar with, from the Northern California aspect as well as the Colorado River. And I'm going to drill down into the next exhibit, which is a little more telling.

So Metropolitan receives its water at that Diemer Filtration Plant near that No. 1, and that's where it's treated and sent down here to South Orange County.

You can see the fault lines on this exhibit, the Whittier fault being the most -- northernmost fault, Puente Hills fault, Peralta Hills fault, San Joaquin Hills fault, and Newport-Inglewood fault. So basically five fault lines south of the Diemer treatment plant heading to our service area, which is down in this area down here. So that's the other reason why we're doing this project, and -- I'll go into the -- the next slide.

So -- so you saw that slide, you saw the earthquake faults, the vulnerability. And what the region asked us to plan for is the potential for a 60-day outage from Metropolitan Water District. So you can imagine, 60 days without water, and we're 85 to 100 percent dependent on Metropolitan for potable water, puts us in a really vulnerable situation.

So what we did was, MWDOC took the lead for the region and did an Orange County Reliability Study where they looked at a number of water supply alternative projects for the region that would meet supply gaps during drought -- extreme drought periods and would meet system gaps during a catastrophic emergency, such as an earthquake.

So MWDOC did that study and we followed suit and did our own drilldown South Coast Water District Reliability Study, hired the same consultant MWDOC did, and they came up with this average supply shortage.

So during a drought situation, South Coast Water District would need on the average 2.8 million gallons per day from an alternative water supply to assist us during that drought or to meet that gap, the 2.8 million gallons per day.

Keep in mind, the project that you have in front of you today is a 5-million-gallon-per-day desal

Phase 1 project, to put that in perspective.

And on the system side down here, this -- and what -- what we're looking at again is a 60-day outage from Metropolitan Water District, and what type of capacity of an alternative supply we would need is 3.9 million gallons per day. So that was what the study resulted in. And it's -- I'm boiling it down to the -- the results and -- a lot went into it in terms of evaluating alternative supplies. But the big picture is that all of the alternative water supplies available that MWDOC was looking at -- Municipal Water District of Orange County -- are necessary in Orange County, but what's -- what would best meet our supply gap needs and system gap needs is the Doheny Ocean Desalination Project. So that's why we -- we are pushing forward on the planning for this project.

Let me back up real quick. So what I forgot to mention and what you'll see up there at one of the tables is, on top of that, once we finish the study, we -- we -- the board helped us and -- and we went out and solicited the public to have a work group -- a public work group that would evaluate our water reliability situation in the South Coast District area. So that work group looked at the study itself. They had presentations and looked at other alternative water supplies, and they came up with a number of findings that also recommended that we pursue the Doheny Ocean Water Desal Project. And that information can be found in that first table, as well. So feel free to take some of that information on the way out.

Early project history: So partner agencies way back when -- when MWDOC took -- took this project -- it started way back in 2003, and a number of studies were done because of the -- the whole slant well concept.

And so back in 2004-2005, they did a number of hydrogeologic studies -- studies of the groundwater basin and -- and the aquifer adjacent and within the ocean, and -- and this Phase 1 included test borings in 2004-2005 along Doheny State Beach.

Phase 2, in '04 through '07, included the pump test for the slant wells and also a hydro- -- hydrogeologic or groundwater modeling -- model was developed during that period.

And in '08 to 2013, we had a number of member agencies -- or partner agencies, I should say, back then that were working cooperatively with MWDOC: Laguna Beach Water District, San Clemente, South Coast, San Juan Capistrano, Moulton Niguel.

On Phase -- Phase 3, I'm looking at the -- the actual slant well pump test along with the hydrogeologic model.

So in 2014 through 2016, there were additional studies done on the hydrogeologic model, and that's where South Coast Water District came in and took the lead and continued with the planning for this project. And that's what you see in front you, the 5 MGD project that's being presented tonight.

So once South Coast took it on in 2015, we initiated the conceptual design process -- this is the preliminary design -- and the environmental document that's -- that you have before you tonight or are meeting about tonight.

In March 2016, we kicked off the public scoping meeting. In 2017 -- the spring of 2017, we started the water reliability study that I talked to you about and the results that we just saw in those slides.

In the summer of 2017, we had the water reliability working group to vet through the study and confirm some of the results that the consultant came up with.

In November 2017, we had a second public scoping meeting. And in June 2018, we actually released the Draft EIR. And today is the public meeting, and we are -- comments are due by August 6th of 2018. So there's actually more than a 60-day period -- or 60-day period that we wanted to at least give the public some time to review the document and provide us comments.

So that's where we are. I'm going to turn over the presentation to Mark Donovan, who is our program right now. Thank you very much.

MR. DONAVAN: Thank you, Rick.

Okay. So now we get to actually talk a little bit about the projects and where we are today.

So the Doheny Ocean Desalination Project: The high-level project goals, so first and foremost, to provide a safe, high-quality, locally controlled, and drought-proof water supply while protecting the environment.

Also as Rick mentioned, the project -- we want to essentially just reduce dependence on imported water, not -- not be so vulnerable to that -- that water supply, and also be able to continue to -- to provide water in the event of an emergency.

The project components: So essentially starting at the beach, we -- we take in the ocean water with a subsurface water intake system. And then once we collect the water in the slant wells, we need to convey it to the District's site. So we have a raw ocean water pipeline that would deliver the water to the plant site.

And then on the District's own facility

adjacent to San Juan Creek is where the desalination facility would be located. And also at that -- at that location is where we would dispose of the brine, the RO concentrate, by blending it through an existing wastewater outfall.

Also at that location would be a drinking water storage tank and pumping system to deliver it into the local communities.

And also at the -- at the site of -- and typical support facilities, administration building for the -- the workers and the staff, on-site small lab, things like that.

And also outside electricity -- electrical transmission facilities would be needed to bring SDG&E power to the site.

All right. I'll take kind of a closer look at each of the main components.

So the subsurface water intake system: So Rick had showed some of the project history, and a lot of that project history was really studying and verifying that slant wells could work on Doheny State Beach. So based on all that successful testing, the District has committed to moving forward with a subsurface intake, and that intake method is preferred by regulators and by the California Ocean Planning Desalination Amendment. It's a very important aspect. You know, we're lucky enough to have the favorable geology there at the site, because what that does is, you know, by doing subsurface, we're not impacting any marine organisms out in the ocean, unlike a traditional open-water ocean intake. That's a very key feature of the project in terms of the environmental benefits.

The slant wells will be fully buried either at Doheny State Beach or Capistrano Beach Park, so there will be no visual impacts for the slant wells.

And then, also, submersible pumps would be located well down into the wells themselves, so no -- no noise impacts, as well, from the slant wells intake system.

So what we're looking at here is kind of a -- you see these various number -- letters down at the -- along Doheny State Beach, A through E. And then down at Capo Beach Park, you see F, G, and H. So these are potential locations for slant wells to be located.

So for the first 5 MGD facility, it would require, most likely, up to about four wells, and those four other wells could be located at any one of those locations. Probably two pods, as we call them. Essentially, wells could be built and the other locations could be -- well, you know, as I was saying, there --

What happened? There we go. Yeah, keep me on my toes.

So essentially, wells could be built anywhere within that A through G -- H -- H locations. And we're going to let the EIR run its course to help us determine where the best course is to put those wells, because there's pros and cons for each of those well locations that, you know, Kevin will talk about a little bit more going forward.

In terms of the -- the raw water pipeline, we kind of boiled some previous studies down to two main alignments for the pipeline: a northern pipeline alignment, which would run along Dana Point, Harbor Drive, and then Del Obispo, and then it would cut across, under the creek, over to the plant site. But the preferred alignment is actually the south alignment where it would run through Doheny Park Road and go under PCH, and then cut across Las -- Las Vegas Street over to the site.

And the majority of the -- the piping would be open trench. It would be in existing streets or other disturbed areas. So the blue lines indicate where the open -- open trench pipe. And the yellow lines, for example, under the creek or under the railway is where it would be trenches; so like a horizontal type -- HDD drilling type of procedure. So to give you an indication where the potential pipelines are going to be run (indicating).

The pipeline material would be, most likely, HDPE. So this pipe is not only suitable for -- compatible as far as seawater, the corrosion from seawater, but also it's a very flexible -- flexible pipe material, so it would be resilient towards earthquakes. So it would be -- if the earthquakes did hit, that pipeline would most likely be fine and we'd be able to keep the desal plant running and functional.

Okay. So the desalination facility itself: So this is a conceptual rendering of what the desalination facility may look like. And in this rendering, we've actually sized various components for the 15 MGD facility. So the District may choose, if the project goes forward, to build certain parts of the project to 15 MGD just to allow expansion to -- to be used here. For example, the -- the RO building may be built for ultimate capacity, but only 5 MGD worth of desalination equipment may be placed in it, but really just to make future expansions less costly.

You see also that there's solar panels located on the RO building and other flat surfaces. So we've -- we've envisioned that solar panels can be used where feasible on -- on the project.

The site itself, we did a flood mitigation study and recognized that that site is susceptible to flooding both from water coming down San Juan Creek and also from, you know, ocean storms and things like that. So the obvious -- one of the obvious solutions/ alternatives is to simply raise the grade of that site. The site is fairly undulating right now. Some spots are high, some spots are low. It's really leveling it out, bringing it up to protect the site from flooding and seems to be the most logical choice there.

A couple of other components here on the facility site: The -- we have carved out an area -- a small area, what we call the R&D pad. So if the project does go forward, the District would like to use this -- this facility as a -- as a showcase and a test bed to test new technologies, refining the operations and optimization of the plant going forward. So that's something that the District has expressed an interest in, so we've carved out some footprint on that to make sure the District can stay at the forefront of desalinization technology.

So once the -- once the water is processed through the facility, roughly for every two gallons of seawater that you bring in, you'll produce one gallon of drinking water and you have one gallon of concentrated brine that you have to dispose of.

This site is fortunate enough to be located very close to the JB Latham Wastewater Treatment Plant. So there's an existing ocean outfall that goes two miles offshore which currently discharges municipal wastewater to the ocean. So we would simply blend the brine into the existing outfall, and it will be diluted with wastewater as it goes to the ocean. This also is one of the preferred methods by regulators and in the California Ocean Plan for the desalination.

And, actually, in the -- all likely operating scenarios for Phase 1, the blended brine and wastewater were actually less salty than the ocean by the time it reaches the diffuser portion of the outfall.

So those are the main project components. And with that, I'm going to hand it over to Kevin and he will talk more about the EIR tests.

MR. THOMAS: Thanks, Mark.

My name is Kevin Thomas with Kimley-Horn. I've been working with the District staff for the last two and a half years on this environmental process. I just wanted to quickly walk through the CEQA process -- California Environmental Quality Act -- and some -- some summary of findings from the EIR. We're not going to go through all 3,000 pages here, I promise, but we'll cover some highlights.

I think, really, from Mark and Rick's presentation, they covered most of the environmental issues in the project design process. So I'm going to go through this a little bit quickly.

And then, of course, as Kari mentioned, the primary purpose for tonight is not to answer detailed questions but really to give the public an opportunity to comment.

We'll have a court reporter here recording your comments as your -- if you submitted a speaker card up here at the podium.

We also -- you can submit written comments. There's comment cards in the back. We highly encourage you -- even though we have a court reporter who will be taking notes, we highly encourage you to submit written comments. You can submit comments online at the District website and you can mail them a letter. So there's a number of ways to participate in terms of submitting a comment.

As Rick and Mark both mentioned, we've had a number of public scoping meetings in the last couple of years, both in March of 2016, then in November of 2017. We've been meeting with stakeholders periodically over the last couple of years. And we're right now in the middle -- I'm not sure where the highlighter is -- so right now -- right now we're during -- about 30 days into the -- the draft -- the public review period.

As Kari mentioned, we will receive all written comments, oral comments from the court reporter. We will prepare written responses to comments. Those written responses to comments, together with the Draft EIR, will be part of what's called the Final EIR, and that will be available to the public before the South Coast board considers the EIR and the project. So you will be notified of that date in advance.

Again, just to -- to walk through a few of the -- of the primary findings -- this is not intended to be comprehensive, and so please refer to the EIR for details -- but in essence, the Draft EIR found that the Phase 1 project up to 5 MGD would not have any unavoidable significant impacts. What that means is, there are some significant impacts, but they can be mitigated either through mitigation measures or through actually project design features.

And one thing I think that Mark mentioned, a great deal of work has gone into this project by the District to essentially design the project to avoid impacts. So as you --

The reason the presentation was a little bit long on the project and the history was to provide that context.

So we've been meeting with stakeholders, regulators. We've made a number of changes to the project. We've shifted the slant wells back off the beach to avoid impacts to the beach. We've moved slant well locations based on stakeholder comments. We've identified another potential intake location that Mark pointed out at Capistrano Beach Park. This is an alternative. We've actually shifted some of those slant well pods within Capistrano Beach Park based on talking to county parks.

So, really, the project has been designed to meet Ocean Plan requirements and really avoid, where possible, all of the impacts.

The EIR does look at a potential future regional project up to 15 MGD that is not evaluated at project approval level of detail in the EIR. There's just too many unknowns right now. So if that project should move forward in the future, it would require a separate public process, a separate CEQA process. Really, the District's focus right now is on the -- the Phase 1 project.

And as indicated, there's approximately 40 mitigation measures in the EIR on top of project design features to avoid or minimize potential impacts.

I want to just click through these a little bit quick, because, again, a lot of this has been covered, but just to summarize some of the main topical areas.

With respect to recreation and aesthetics, really the primary impacts, at least on the coastline, will be all temporary. At Doheny State Beach or Capistrano Beach Park, we've minimized those impacts by talking to state parks and county parks. Essentially moved the majority of the construction staging off the beach to the San Juan Creek property on the other side of PCH.

As I said, we shifted the slant wells back, limiting the construction periods and, of course, all the required coordination with all the stakeholders.

Relative to noise, air quality, and traffic, again, the construction-related impacts will all be temporary. The operational equipment that will be louder will be inside in closed buildings, primarily the reverse osmosis pumps at the District's San Juan Creek property inside the building you see there on the bottom.

There will be no significant odors from the facility. It's a water treatment plant. And, again, there's a number of mitigation measures identified, including the use of truck trenchless technology, meaning not open trenching across sensitive transportation corridors, like the railway, the PCH, and also underneath San Juan Creek lagoon, if that was needed, so to -- to avoid those impacts.

With respect to biology, cultural, and geology and soils, again, Mark pretty much addressed this. The entire project has been designed to meet Ocean Plan Amendment requirements through the subsurface intake wells, which avoids marine life impact and as well as blending the brine with the existing ocean outfall, all -- all to avoid or minimize impacts.

I believe Mark also covered this. Mark covered a lot of my topics. That's good. So with respect to hydrology and water quality, again, the project has been designed really to minimize or avoid all these impacts that meet the state water resource control boards, Ocean Plan Amendment requirements.

There were a few questions during the poster session here, the -- the informal part before the presentation on greenhouse gas emissions. So it's important to emphasize, as Rick did, the District is committed to what's called net carbon neutral. So, essentially, if you look at the District's greenhouse gas emissions from its current water supply portfolio importing water or using imported water, the District has committed to calculating the additional emissions created by using desalinated water, which is higher-energy-intensive and then offsetting that incremental increase in emissions. And that would be through a number of features: rooftop solar, where it's practical; using energy-recovery devices at the desalination plant.

The District's seriously evaluating using natural gas fuel cells for power, which essentially sequesters methane gas or moves that from -- from the system, as well as other potential options.

Mark also identified the R&D pad which could be used to evaluate that.

A number of other topics were evaluated in the EIR. And growth impacts, land use compatibility, hazards, those are all in the EIR in detail.

One of the main topics often addressed or -- or of interest for state COLR (phon) as alternatives. So the EIR is focused on these five alternatives, so you will see that in the Environmental Impact Report.

In addition to these alternatives, I just wanted to highlight, as Mark and Rick did, the District partnered and looked at a number of water supply alternatives which were studied in which the Doheny project was found to be the -- the -- the most ideal to meet the District's need.

In addition, the District has -- the District, and then MWDOC prior to the District, has invested considerable energy in evaluating design options, which are reflected in the EIR. There's alternative water supply or ocean water conveyance alignments that are addressed in the EIR. There's alternative subsurface intake well locations addressed throughout the EIR. So those also were considered. But of the five evaluated in the EIR, the -- the EIR looked at supply alternatives. No project conservation and enhanced recycled water. Rick, I think, touched on those in his presentation.

And then the EIR also evaluated two project design alternatives, a 3.9-million-gallon-per-day alternative, and then also a slant-well-location alternative to focus the slant wells at the San Juan Creek lagoon, which would enhance protection against seawater intrusion.

So -- so in conclusion, I wanted to reemphasize the close of the public comment period on August 6th and a variety of means to participate in the public process.

And with that, I believe I'll turn it over to Lewis.

MR. MICHAELSON: Thank you, Kevin.

Thank you very much for your attention. That the was a little over 30 minutes. I misjudged. They had a lot to say and say it again and again, so we -- we got it. I'll poke you guys a little bit. Thank you very much.

We are now going to begin the comments session. If you have not done so already, these were the speaker cards that were available at the front registration if you'd like to speak tonight.

Have there been any more turned in since then? Okay.

UNIDENTIFIED FEMALE VOICE: One.

MR. MICHAELSON: So we don't have a large number of them. Just in time. Thank you.

To ensure we get an accurate record -- and that's really important in these proceedings. That's why we have the court reporter here -- she just needs to be able to hear what you're saying. And so if you'll speak clearly and slowly enough for her to keep up. If you've seen her fingers are really fast, but it is possible to talk too fast even for her.

So what I'd like to make sure is to speak clearly and slowly. If you represent a -- give us your name, if you would. If you represent an organization, you'd like to mention that, please mention that as well.

Each person is going to have four minutes to speak. If you have a written statement and you would like to turn it in to the registration table, you can do that in addition to, but if you're going to read it out loud -- sometimes people have very long written statements and they start reading it and don't realize they're going to take 10, 20 minutes before they're done. So I need you to keep it within that four, if you would.

Please honor any requests I make to stop. And to make it really easy, I do two things: One, I call on the names ahead of time. That way we don't have to have a big, long cue of people waiting to come up. You'll know when your turn is going to come. That makes it a lot more comfortable, I find, for most people.

The second thing is, it's hard to know when you've spoken for four minutes. So when you've spoken for three and a half minutes, if you make it that far -- some people don't -- I just hold up a very simple sign. So you will be addressing the panel and me and kind of keeping track of that, that will help it go really smoothly. And then when the four minutes is up, I put up that sign and then we're done, and then it's time to move on to the next person.

So the people who have signed up to speak so far -- and I'll apologize if I mispronounce any of these names -- Richard Banister, Melissa T. W. Hurd, who may or may not choose to come up. She was kind of on the fence about whether --

UNIDENTIFIED FEMALE VOICE: That actually doesn't apply. That was me, and that should really go to the other box.

MR. MICHAELSON: All right. So you --

UNIDENTIFIED FEMALE VOICE: It's environmental related so . . .

MR. MICHAELSON: Okay. Perfect. So you're going to pass on that. Got it. Thank you very much, Melissa, for letting me know that.

Richard Gardner, followed by Lenger Markus, then Robert Kanter, and then Toni Nelson.

So first up is Richard Banister.

MR. BANISTER: Where do we go?

MR. MICHAELSON: I'm sorry, I did not make that clear. Here's the lectern, and there's the mike -- and it should be live -- and you will hear yourself loud and clear.

MR. BANISTER: Okay. My name is Richard Banister. I'm a resident of Dana Point. I represent myself.

I -- I won't be anywhere near four minutes. M1

I have two questions. The first question is, is there going to be any redundancy provided between the groundwater facility and this new facility? In other words, if you -- if you got the -- the filters that go out in the new one, can you run salt water into the other facility, and vice versa? Will we be able to use that groundwater facility?

M1-1

And my second question is, is there any new technology that's not been used anywhere else that's going to be used in this plan?

M1-2

MR. MICHAELSON: Great.

MR. BANISTER: And that's it.

MR. MICHAELSON: Thank you. Well, those will be in the record and they'll be responded to. So thank you very much for that.

Next up is Richard Gardner.

MR. GARDNER: Richard Gardner from -- from Capistrano Beach, a longtime supporter of the District.

I -- I am not going to try to collect all my thoughts at this time, but maybe make a couple of comments.

M2-1

One is, it's very obvious to me that we're trying to do the right thing. We've got slant wells, we've got the combined outfall, but we have a miniature plant. None of the other plants on the California coast are this tiny.

In Carlsbad, the only way in which a fairly economically feasible facility could be built was to have the San Diego County Water Authority become the lead agency and provide the water to all of the member regional.

So it was made clear early on that none of the other partners wanted to participate with South Coast. And so I thought that meant we needed to find partners or we needed to have the support of a larger entity. So that -- that's a comment. It -- it --

M2-1
cont'd

The same is true in Huntington Beach, which that plant, if it goes forward, it will have to go forward with the Orange County Water District and perhaps MWDOC also involved. So I'm interested in what -- what we're doing now.

The second thing is, I don't necess- -- personally, I think you should have one whole chapter or column or appendix that says, "What are you, South Coast Water District, going to do for the people who live in our area above and beyond just providing water that we're going to pay through the nose for?"

M2-2

So will we have a trail along the creek? You're going to build a -- obviously many, many millions of dollars of a facility. Will people from Capo Beach be able to come across and go to the creek or go down to the beach? Will we have coastal access in your project?

So I don't think I've heard anything, outside of you're afraid we're going to lose our water sources and you're going to build a desal and it's going to be a little one that will just supply the -- the people of South Coast.

My thought is, say I live San Juan Capistrano and they -- and they have the earthquake. Are those people all going to go dry up there and we're going to be out on our slip and slides and enjoying the same levels of water use that we did? That doesn't -- that doesn't work. What about the people in Laguna Niguel? M2-3

How are we going to move this water? Do we have an agreement? I don't think it's there. I don't see it in this design. Can you supply this water to Santa Margarita Water District?

So that's just a -- kind of the start. This is the beginning. If somebody asks you can you build an ocean desalt -- desalting facility on 30 acres next to the beach, the answer is yes, of course, but the rest of the situation is -- needs a lot of work.

So that's a start.

MR. MICHAELSON: Thank you very much.

The next speaker is Lenger Markus. M3-1

MR. LENGER: Good evening. My name Is Markus Lenger and I'm a resident of Capo Beach. I'm also a federally appointed expert on water reuse, so I will be talking to you not necessarily as a layman.

I have quite a few questions about it. One of them that's been brushed over quite nicely is the energy consumption. This plant uses a massive amount of energy. I don't think the public really understands energy the way one needs to understand it to see this. M3-1 *cont'd*

Also, I understand the premise of this is water safety. So since, yeah, 90 percent of the water is being imported, we import 100 percent of the energy. So while it's kind of uncomfortable to be without power, it is deadly to be without water. Why on earth would you trade that security and have somebody be completely dependent on power that you have to bring in? This is not a smart idea.

Second of all is the slant well. It's never been done, period, and we all know that. So you're basing a lot of faith on something that hasn't been done. They don't talk as an engineer. So the Environmental Impact Study and all of it has been done on an incomplete set of data. That is also a problem. M3-2

Now, I'm not against desal, but I am questioning the wisdom of going straight for the most expensive way to make water -- 10 times more expensive than anything else -- when we're not looking at gray water, we're not looking at water reuse, we're not looking at a lot of things that we need.

And if there is an emergency, what makes you think you have power but not water?

First of -- furthermore, if there is an emergency, we don't need that much water. All you need is water to drink and maybe take a bath. You don't need that full amount of water. Not everybody is going to go on. If there's, like, buildings destroyed, no power, no water, all you need is water. And Richard Gardner brought that nicely up. They need to share the water. M3-2 *cont'd*

So while I'm absolutely in favor of diversifying our water security, I think going for the most expensive thing right away, just follow the money. Who is going to make money selling us the energy that it needs to run this plant, leave alone the enormous cost of building that.

I am really questioning the project; I am questioning the environmental impact. You cannot make the statement there is no environmental impact, especially if -- since you don't even have all of the data. That is not very serious, and I'm sorry to say that as a ratepayer.

Thank you.

MR. MICHAELSON: Thank you very much.

The next speaker is Robert Kanter.

MR. KANTER: Yes. I'm Robert Kanter, a resident of Dana Point.

First of all, I'd like to commend the District for having the foresight to plan ahead. I think it is prudent and I think we owe you a debt of gratitude.

You know, a couple of the comments I'm going to make have been touched on. I do have concerns that we get through this entire process, we build a plant, and in fact, we don't have Plan B for some of these areas that I am concerned about. The brine impact is number one in my -- my mind, and it has been a problem historically at other desal plants around the world, but particularly along our coast. And so what my concern is, is that we have an outfall and we have statements that say we're going to dilute it with the wastewater and it's going to be fine. M4-1

Well, I'm -- I'm the one that is, "Show me," and, "Don't just give me calculations but show me." And what if it doesn't work? You've got a plant that's already been built. So I'd like to hear something in the environmental document that deals with a contingency, and that is, what do you do if you can't dilute the brine?

I'd also like to see some alternatives looked at that are ways to dispose of brine that are not in the ocean. And there are those technologies that have been used throughout the world; in the Middle East particularly, where they have actually done treatment on land and disposed of it in a different form. So I believe that's important. M4-1 cont'd

The previous speaker talked about energy. Well, I'll talk about it in a little different sense. We talked about being carbon neutral. CO2 -- this is such an energy-intensive process, that we are going to be generating a lot of carbon, and I would like to make sure that the District has a way of, if you will, guaranteeing that they're going to be net neutral, carbon neutral. So how do we as ratepapers -- ratepayers get that assurance? What is there going to be that holds the District -- its feet to the fire if in fact we can't come up with a way of carbon neutrality? M4-2

So those are my two comments, main ones, and I thank you very much.

MR. MICHAELSON: Thank you very much.

The next and currently the last speaker I have signed up is Toni Nelson, if I am reading this correctly.

MS. NELSON: Good evening. Toni Nelson, Capistrano Beach.

I'm also the founder of Capo Cares. We're an advocacy group for Capistrano Beach, so our residents are M5-1 going to be very impacted by this. We are very conscious of the fact that we're right on the coast. Many of us live right on the block from the Palisades. We're very concerned about the impact on Capistrano Beach Park, on Doheny Beach, where we all surf and enjoy our lifestyle. So this is kind of scary stuff to us.

I'm by no means an engineer. I don't know anything about water, other than I drink it and bathe in it, but the residents have some questions, and some of them have been communicating to me about some of their concerns. So I'll try to deal with them briefly. M5-1

A big concern seems to be the idea of all this brine being deposited two miles offshore. We're very conscious in Dana Point that we have this very rich resource with all our beautiful whales that come by. I think we had about 1500 whales come by our coast last year. We don't want to do anything that adversely impacts them, and so we're concerned about that.

I'm -- I'm wondering why you're disposing of this two miles offshore. I know as boaters, that we have -- we can't even empty our tanks except three miles offshore. And I think most of us are -- are a little more environmentally sensitive and we actually pump our tanks, but that concerns me. That's a lot of waste and a lot of brine being put into this delicate ecosystem. So

M5-1 cont'd

I'm -- I'm worried about that.

The other thing that has been brought up is, why are little water district -- you know, we represent 35,000 people and we have a relatively small water district here. Why aren't we doing sort of a joint power association -- authority with other water districts? Why aren't they all pitching in? Because as a couple of speakers mentioned, we will be probably required to share the scarce resource if there is an emergency. So shouldn't they also be coming to the table and participating in this project instead of all of it being on -- a burden on our ratepayers.

M5-2

The other thing people have talked about is, again, the possibility of doing a joint venture with something like Huntington Beach. Like, why are we dotting all the way up the coast with different -- I'm not sure how the technology works, but does that make sense or are we better off building one larger facility and creating some kind of shared resource?

The other thing I'm concerned about as a financial person is the -- and I talked to your CFO, who was wonderful in explaining to me about the various financial models that she's looked at, and so on. And I would really like to look at those. But I'm concerned that for ratepayers, that many people don't understand that we pay for water through our actual water bill from South Coast Water District, but we also pay through our property taxes. So we want to know what's the total cost, what's the real impact on us financially. M5-2 cont'd

And the -- my other main concern is, where can we visit something like this? I mean, we live in Capistrano Beach. We're going to all be impacted quite amazingly by this project. I'd like to be able to visit a plant where you've done this, where this technology has been used. I want to see what a slant well looks like; I want to stand by a plant and hear how much real noise comes out of it and how much smell and odor and whatever. I'm hoping that there really is no impact. I really -- and I trust you that you're doing everything you can to -- to mitigate that. But those are big concerns. M5-3

And then finally, the impact on Doheny Village and on Capistrano Beach is really severe. So, you know, you're talking about, first of all, a huge, honking concrete structure in the middle of -- you know, at the back of Doheny Village, an area that we've been trying to revitalize. So that -- that concerns us.

The aesthetics, the noise. Can you hide the building with some plants? You know, there are ways to -- to make the plant be a little less obvious and little more aesthetically pleasing, and I'm sure you'll look at those things. I just want to make sure you're thinking about us as residents.

I'll be one more second.

The digging up of Doheny Park Road, digging up Las Vegas, all of those things are -- are significant to us. M5-3 *cont'd*

So I hope you'll talk to the community and include us as stakeholders, and I hope you'll talk to our City Council as well and make sure that we're all on board. Thank you.

MR. MICHAELSON: Thank you very much.

Is there anyone else who has turned in a card since then? Oh, great.

Ray Hiemstra is our next speaker.

MR. HIEMSTRA: Hi, Ray Hiemstra. I'm the associate director of Orange County Coastkeeper.

I'd like to say, first of all, it's refreshing to see a desalination plant that, you know, follows the guidelines from -- from the State, so that -- that makes my job a lot easier. M6-1

I wanted to just bring up a couple of things to your attention. One -- one thing is on the issue of need. As we're all aware, the Governor recently signed new legislation that's going to result in substantially reduced water use indoors. So that's something just to take into account.

The MWDOC numbers that were used are great, but they weren't predicated on that, so that's just something -- something to think about.

The other -- the other thing is, what we've seen and I heard here tonight is the -- on the greenhouse -- greenhouse gas mitigation is that that would be incremental based on -- on the idea that there -- I guess it would replace water that's coming over the Tehachapis. Maybe I'm mistaken on that, but I think we're all aware that the water is still going to come over the Tehachapis. M6-1 cont'd

So, you know, what -- what our request would be -- would be to make sure -- make sure that the plant is actually completely carbon neutral from its -- from its actual -- actual power use.

That's just -- that's just it for right now. We'll submit written comments by the deadline. But thank you very much.

MR. MICHAELSON: Thank you, Ray.

Is there anyone else who has been inspired to speak? All of those great comments, and I mean that sincerely. I'm -- I've done about 500 of these meetings over the years, and this is as good as it gets in terms of people making really relevant, pointed, factual kinds of questions that really relate to the project and relate to the documents. So you've done a fine job tonight. I have to congratulate you on that.

So if -- I'll ask one more time: Is there anyone else who has been moved to speak? And if not, I just want to remind you of a couple of things.

Again, thank you very much. These were very, very cogent comments. This concludes the oral comments session.

The comment period, as was mentioned earlier, on the Draft Environmental Impact Statement will continue until August 6th. It was mentioned all the different ways you can provide written comments. You can still fill one out tonight at the written comments table, you can mail them in, you can give them online. All of those addresses can be found on the handout when you came in this evening. Please make sure we get them by the deadline.

And, again, thank you for your participation. We are officially adjourned. Thank you.

(Applause)

(The proceedings were concluded at 7:44 p.m.)

REPORTER'S CERTIFICATE

I, Patricia S. Newton, CSR No. 1385, hereby certify that I reported the above proceedings on Tuesday, June 26, 2018, in San Juan Capistrano, California.

I further certify that the above and foregoing pages contain a true and correct transcript of all said proceedings.

DATED: July 9, 2018.

Patricia S. Newton
Patricia S. Newton
California Certificate No. 1385

Public Comment M1 Richard Bannister

June 26, 2018

Note that none of the June 26 public meeting comments indicated any specific objections to the Draft EIR adequacy.

The following is a summary of public meeting comments. Please refer to the public meeting transcript (preceding these responses) for a transcript of the public meeting held on June 26, 2018.

Comment M1-1

Will there be redundancy between the groundwater facility and this new facility?

Response to M1-1

The comment appears to be referencing the District's Groundwater Recovery Facility (GRF), which uses a Reverse Osmosis (RO) system to treat brackish water to drinking water standards. The Doheny Ocean Desalination Project, and all related components, would operate independently and is not designed to operate in conjunction with the GRF. The District will utilize all available water production resources to develop a balanced water supply portfolio in compliance with applicable regulatory permits and approvals. Use of the GRF has historically been constrained due to groundwater limitations. The District's intent would be to utilize the GRF in combination with the Project, conservation and recycling programs, provided such use is consistent with the GRF's NPDES permit and the Project's applicable permits and approvals.

Comment M1-2

Is there any new technology that's not been used anywhere else that's going to be used in this plan?

Response M1-2

Please see response to Web Comment W6 and Master Response 4. The proposed slant well technology is not a new drilling technology and has been tested in pilot programs. Slant wells are a technology that has been demonstrated at slant well test facilities at Doheny State Beach and in the City of Marina, California. This technology involves subsurface intakes, consistent with the recommended approach per the California Ocean Plan. In addition to slant wells, the District is exploring utilization of fuel cells as an alternative energy supply (see Section 3.0, Project Description). The Project also includes a research and development ("R&D") pad to allow the District and potentially other interested parties to evaluate new technologies, consistent with applicable permits and approvals.

Public Comment M2 Richard Gardner

June 26, 2018

Comment M2-1

Comments note that other larger facilities involved multiple partners, but that the District is operating independently for this Project. Commenter assumed that the Project would need partners or to have the support of a larger entity.

Response M2-1

General support for the District and scale of the Project is noted for the record. As noted on pages 3.0-14 and 3.0-36 of the Draft EIR, the District is only seeking approval of the Local (up to 5 MGD) Project at this time. At this time, there are no partners in place for the Local Project. Please see Master Response 2 and Response O2-1 regarding this issue. The larger Regional Project would require one or more regional partners as well as additional facilities to convey regional Project water and would require further CEQA review.

Comment M2-2

Comment inquires if the Project will provide other, secondary benefits to District customers such as trails or coastal access.

Response M2-2

No recreational or trail access is planned at this time, as the desalination facility is located on an existing District-owned industrial site, and the majority of facilities within Doheny State Beach (or Capistrano Beach Park) would be below-ground, except for a small electrical station and an access manhole. As part of the lease agreement process with State Parks and/or Orange County Parks, the District anticipates providing some form of park enhancement or amenities such as restriping or resurfacing parking and bicycle paths that are affected during temporary Project construction activities.

Comment M2-3

Comments inquire about the relatively small size of the Project and its ability to service and supply more far-reaching areas.

Response M2-3

Only the Local Project (up to 5 MGD) is under consideration at this time. As described in Section 3, Project Description (Table 3-1, SCWD Current and Future Water Supply Portfolio), the Local Project could meet approximately 77% of the District's 2035 water demand. Also refer to Response M2-1 above regarding potential Project partners, and Response O2-1 regarding potential broader use of the Project's water. There are no agreements in place to "share" the Project's water with other districts or partners, and the water produced would be needed for the District's own water supply needs.

Public Comment M3 Markus Lenger

June 26, 2018

Comment M3-1

Comments address Project energy consumption relative to water security and question the increased dependence upon imported energy sources.

Response M3-1

The Project's energy requirements are summarized beginning on page 3.0-31 of the Draft EIR and are described in greater detail in Draft EIR Appendix 10.1. Alternative on-site power supplies, including a fuel cell power system, are also being investigated, as described on page 3.0-33. Emergency backup power would likely be through one or more redundant systems: 1) either SDG&E electrical power with fuel cells; or 2) SDG&E electrical power with emergency diesel backup generators. The Project would include typical emergency diesel generators as a backup power supply for both the desalination facility and the slant wells.

While no project is immune to catastrophic emergencies, the SCWD Water Supply Reliability Study (2017) and prior studies highlighted the vulnerability of South Orange County to prolonged interruptions of imported water deliveries, such as what occurred in December 1999 with the failure of the Allen-McColloch Pipeline. The 2017 final report identified a projected 3.9 MGD water system supply gap based on a 60-day outage of imported MWD supplies. Being at the southern end of MWDOC's imported water delivery system, the SCWD service area is particularly vulnerable to disruption such as what could occur due to a major earthquake. While power systems may also be vulnerable in an emergency, the Project will provide diversification of water sources in South County with higher reliability. As most major urban water systems rely on power to run pumps for distribution, this Project would be no more vulnerable to interruptions in power supply if connected to SDG&E, and would be less vulnerable with implementation of an on-site source of generation.

Comment M3-2

Comments question slant well technology, completeness of the EIR, and expense of producing water through desalination.

Response M3-2

Please refer to Response O3-2 regarding conservation and recycling as alternatives to pursuing desalination. Please see Master Response 4 and responses to Web Comment W6, Response O1-5, and Response M1-2 above regarding slant wells. Extensive slant well study and testing has been conducted as documented in the Test Slant Well Extended Pumping Pilot Plan Report (2013) for the test slant well at Doheny State Beach, in addition to extensive slant well testing by California American Water for its proposed slant well system in the City of Marina (refer to Master Response 4 regarding slant well design and feasibility).

Regarding the tone of the EIR, CEQA requires EIRs be prepared in such a way as to inform the general public regarding potential significant impacts and other information. For this reason, this EIR distills volumes of technical information, engineering studies and reporting (see EIR Appendices) in order to provide an informative yet readable document for public consumption.

An EIR is also charged with focusing on the environmental effects of a proposal, not necessarily economic considerations. While financial feasibility may be essential for Project success, the purpose of the EIR is to identify potentially significant environmental consequences. The District's Board of Directors will consider the EIR along with other factors, including financing, risk and related economics.

Public Comment M4 Robert Kanter

June 26, 2018

Comment M4-1

Comments are concerned with brine disposal impacts, assurances that impacts will not be significant, and brine disposal alternatives.

Response M4-1

As discussed in detail in Section 4.8 Hydrology and Water Quality, the brine discharge from the Project will meet applicable water quality requirements as established in either a new or modified NPDES permit from the RWQCB for the use of the existing SOCWA SJCOO discharge (ORDER NO. R9-2012-0012; NPDES NO. CA0107417). Detailed brine modeling calculations are provided in Appendix 10.11, Brine Discharge Modeling, are summarized in Tables 4.8-3 and 4.8-4 in the Draft EIR, and have been clarified and amplified as part of the Final EIR in response to comments from the San Diego Regional Water Quality Control Board (see Response S7). Based on that modeling (contained in Appendix 4.2.2), Draft EIR mitigation measure HWQ-3 is no longer required to ensure that minimum SJCOO flows are occurring, as the Phase I "Local" Project has been shown to meet California Ocean Plan requirements without any wastewater dilution (refer to Section 3, *Draft EIR Errata*).

As far as assurances, it is necessary for an EIR to rely on engineering studies, technical memoranda and a certain degree of forecasting to predict the significance of environmental effects. In addition to data presented in the EIR, it is the Project's permit conditions that must be met for continued compliance with established thresholds.

With respect to brine disposal alternatives, please see Response to Comment O5-3.

Comment M4-2

Comments are concerned with generation of carbon dioxide and assurances of carbon neutrality.

Response M4-2

Please see Draft EIR Section 4.6, Greenhouse Gas Emissions. This section (and Appendix 10.3) quantify the Project's projected greenhouse gas emissions (including CO_2). Mitigation Measures GHG-1 and GHG-2 are required to reduce the Project's impacts and result in no net increase in GHG emissions with Project operations. The assurances are set forth in the annual reporting requirements, which will be used to adjust GHG offsets if necessary. Additional discussion regarding the Project's GHG impacts and proposed mitigation is provided in Response S1-12.

Public Comment M5 Toni Nelson

June 26, 2018

Comment M5-1

Comments are concerned with brine disposal and related effects.

Response M5-1

Please see Response M4-1 above. The project will use the existing San Juan Creek Ocean Outfall, which is currently used to discharge treated wastewater. The brine will be mixed with existing wastewater flows to dilute salinity, which is the preferred method as set forth in the California Ocean Plan. The existing outfall extends 2 miles offshore, which meets legal requirements, and a brine dilution study (EIR Appendix 10.11, as clarified with brine modeling contained in Appendix 4.2.2) confirms that the project would comply with the requirements set forth in the California Ocean Plan. For context, Draft EIR Section 4.8, Hydrology and Water Quality, Table 4.8-4 demonstrates that the salinity at the point of discharge rapidly dilutes to natural background levels for all analysis scenarios, well within the Ocean Plan limit of 100 meters from the outfall. The Draft EIR brine discharge modeling was clarified at the request of the Regional Board, and now shows an overall reduction in marine life impacts associated with diffuser jets compared to "no project" conditions (see Response S7-4 and Tables 3 and 4 in Appendix 4.2.2).

Comment M5-2

Comments are concerned with the Project relative to the size of the District (partnerships) and Project financing.

Response M5-2

Please see Response M2-1 above regarding this issue.

Comment M5-3

Commenter seeks to visit a similar facility to better understand its potential effects, including noise, odor and aesthetics.

Response M5-3

While not a comment on the EIR, the District notes that each facility is unique as to its configuration and physical location, and the design of this proposed facility is unique. The commenter may wish to inquire if public tours are available at the Carlsbad facility, although this is not a subsurface intake nor a commingled brine discharge facility. The proposed Project would be one of the first of its kind as fully compliant with Ocean Plan recommended intake and discharge methods. As noted throughout the Draft EIR, the subsurface slant wells and pumps will not result in significant unavoidable noise impacts on publicly accessible lands, and there is no processing of wastewater at the site.

In terms of aesthetics, the Draft EIR contains detailed mitigation measures to address the physical appearance and landscaping of the property, which is currently used for a range of light industrial and storage uses. Draft EIR Section 4.1, Aesthetics provides a number of visual simulations depicting the post-project visual condition.

Temporary pipeline construction will have brief periods of traffic disruption, noise and aesthetic impacts, as addressed in the applicable Draft EIR sections. In responses to comments from the City of Dana Point, the District has modified construction Mitigation Measures TRF-1 and TRF-2 to further clarify and amplify the measures to avoid or reduce temporary impacts to less than significant levels (refer to Section 3, *Draft EIR Errata* and corresponding Draft EIR sections pertaining to Aesthetics, Noise and Traffic).

Public Comment M6 Ray Hiemstra

June 26, 2018

Comment M6-1

Comments addressed need for the Project in light of new water conservation legislation. Comments also note the Project's carbon neutrality addressed for the plant's actual power usage, given the fact that water (and the energy it requires) will continue to be imported.

Response M6-1

Please see Responses O3-1 through O3-3 regarding water conservation. Please see Response S1-12 regarding carbon emissions. Please see also Section 3, *Draft EIR Errata* (text changes to DEIR page 4.6-22, Mitigation Measure GHG-1).

Web Comment Letters

W1 Robert & Toni Bancroft
W2 Joy Berry
W3 Steven Carpenter
W4 Kim Day
W5 Dan and Penny Elia
W6 David Goldberg
W7 Gordon Grannis
W8 Kathy Hartl
W9 Carolyn Keatinge
W10 Brian/Kathleen Knott
W11 Rebecca Mansfield
W12 Elizabeth Meehan
W13 Christopher Moore
W14 Stan Morgan
W15 Bennie F. Petty
W16 Hal & Mary Schaffer
W17 Dave Schroeder
W18 Michael Scott
W19 Aaron Simmons
W20 Bob & Betsey Unger
W21 David L. Whitaker
W22 Bendush William
W23 Bobby Young
W24 Chris Zamoscianyk
W25 California Cultural Resources Preservation Alliance, Inc., Patricia Martz
W26 Citizens Coalitions for a Safe Community, Dr. Tom Williams
W27 Citizens Coalitions for a Safe Community and Sierra Club
W28 Doheny Village Merchants Association, James Schad
W29 Orange County Coastkeeper, Ray Heimstra
W30 R&R Technologies, Inc/Biosphere Carbon Group LLC, Tim O'Connor
W31 San Juan Basin Authority, Norris Brandt
W32 Surfrider Foundation, Katie Day

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Robert & Toni Bancroft
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Received 6/6/2018 19:31

My wife and I have been permanent residents of Capistrano Beach since 2003 (15 years). As a young man out of college, I was a Naval Officer serving 4-1/2 years on 2 combat ships. I have been all the way across the Pacific twice. Part of my training was engineering and I saw first hand the technology of desalination, as all Naval ships "make their own" fresh water from the ocean. This technology has been used by ocean going ships for a long time. Why not employ the same technology in our beautiful community on the coast. We fully support this project. Robert & Toni Bancroft

Web Comment W1 Robert and Toni Bancroft
Capistrano Beach
June 6, 2018

Comments in support of the Project are noted for the record.

SOUTH COAST WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Joy Berry
joy.berry@luxehotels.com
19495007009
22361 3rd Ave, Laguna Beach

Received 7/24/2018 11:04

I am opposed. In my line of work for hotels I have traveled the world. They did these plants in the middle east and the oceans & beaches are ruined. What makes people want to live and visit southern California are our beautiful beaches and clean water; please don't mess with Mother Nature. People need to live with less - not more! I AM OPPOSED

Web Comment W2 **Joy Berry**
Laguna Beach
July 24, 2018

General comments opposed to the Project and desalination are noted for the record. The comment appears to be concerned with water quality and the quality of beaches. The EIR addresses the Project's potential impacts on water quality in Section 4.8 and potential impacts to recreational facilities in Section 4.12. As discussed in Section 4.8 and 4.12, the Project would not result in any significant and unavoidable impacts to water quality or recreational facilities.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Steven Carpenter
steve.carpenter@flash.net
7147158784
26716 Calle Los Alamos, Capistrano Beach

Received 5/29/2018 14:20

On your website at: http://scwd.org/depts/engineering/projects/water_supply_projects/oceandesal3/public_meetings/default.htm It states the meeting on June 26th will be held in TWO different locations? At Top: CUSD Education Center, 33132 Valle Road, SJC In Middle: Location: Dana Hills High School Gymnasium, 33333 Golden Lantern, Dana Point Which location will it be at and please update the webpage and website? Thanks You, Steven Carpenter

Web Comment W3 Steven Carpenter
Capistrano Beach
May 29, 2018

The District appreciates this comment. On June 13, 2018, the District published a corrected public meeting notice clarifying that the June 26 meeting would be held at the CUSD Education Center and updated the District's website accordingly. This comment does not raise any issues with Draft EIR adequacy.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Kim Day
chelseapointe25@gmail.com
Dana Point

Received 6/26/2018 10:05

I think this is a very forward thinking idea and applaud SCWD for investigating it.

Web Comment W4 **Kim Day**
Dana Point
June 26, 2018

Comments in support of the Project are noted.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Dan and Penny Elia
greenp1@cox.net
949-499-4499
30632 Marilyn Drive, Laguna Beach

Received 8/6/2018 12:24

Sending DEIR comments via email to include CCC, SDRWQCB and City of Laguna Beach Water Quality. Please reply to email and advise that you have received. Thank you.

Web Comment W5 Dan and Penny Elia

Laguna Beach

August 6, 2018

Comments from this party are responded to in responses to Letter P3.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

David Goldberg
dgoldberg624@gmail.com
23652 Tampico Bay, Dana Point

Received 6/27/2018 15:54

The slant well technology I understand is new. Discussed briefly at open meeting and impression I got was engineers are viewing this as a water well technology and not a sand filter. Upon further reflection I am unsure this is correct. Concern is silt buildup on sand bed. No data was provided on silt deposition before and after test at site, nor was any underwater topographic looks provided to decide if sand was building into sandbar, which would disrupt surfing,increase pressure(decrease flow) ...Wells often pull from aquifer that sometimes are thousands of years old,not from flowing pull out of ocean usually. If this technology is so viable why is it not in use already in middle east ,which leads desalination technology and is next to oceans. If slant wells are proven out who owns rights to this technology? If it does not hold up and well lose flow after 5 years what guarantees are provided? If it is a test design for new technology should be heavily subsidized by owner of technology World scale plants include vacuum systems. None were part of this design. Significant funds can be saved by buying "off the shelf" design avoiding fresh engineering work. If not available should make sure who has rights to sell this new design? If engineering firm wants to keep rights they should discount price slightly. FYI Background: I am retired engineering supervisor. At one point supervised utilities technical support group (six engineers) for very large petrochemical complex. We processed about 20,000 GPM (about seven times your plant size),including waste treatment. We made about 6,000 GPM ultra pure demineralized water through demin and RO units, 1,000 GPM softened water and rest was clarified and/or sand filters. We had dynamic sand filter, gravity filters, pressurized filters, multimedia bed filters....Had at least one law suit with a very reputable engineering firm with decades experience in water over mis-designed filter ($5 Mill settlement) .Just to point out water treatment field is not as simple as it seems.

Letter W6 **David Goldberg**
Dana Point Resident
June 27, 2018

With respect to the slant well technology, the Doheny Ocean Desalination Project has been studied for over 15 years with extensive prior feasibility studies, technical studies and a successfully installed and operated test slant well at Doheny State Beach. Slant well technology itself is not brand new and has been applied to several drilling and extraction industries over the years, and has been tested for ocean desalination use at other locations including Marina, CA. The District prepared a design and feasibility study as early as 2003 to evaluate the use of this technology for a desalination project (Draft EIR page 3.0-9). Also refer to Master Response 4 for additional discussion regarding slant well technology.

Please see Draft EIR, starting at page 3.0-10, for a summary of the body of environmental work conducted to consider impacts to the sea floor. Technical memoranda concluded that the vertical infiltration rate of ocean water migrating downward through the seafloor during slant well operation is quite low (0.000052 feet per second directly over the well screens) and would be imperceptible to benthic organisms or benthic marine environment. The wells casings that would draw water would be located between 74 and 130 feet below the ocean floor. Suspended material in the water column would be subject to long-shore and tidal current motion, which are orders of magnitude larger than the infiltration rate from the slant well intakes. This infiltration rate would not provide sufficient force to overcome ambient currents and entrain suspended material to form a sandbar on the ocean floor. The low impact of this technology is one of the reasons it is the preferred intake approach by regulatory agencies.

With respect to the concern about slant well pumping causing a sand bar, please note that the San Juan Creek seasonal lagoon mouth is typically enclosed due to the sand bar being present, as a result of infrequent storm events that are large enough to remove the sand bar. An extensive discussion of the Project's effects on steelhead fish passage days addressed this issue, showing that the Project has a less than significant effect on the total duration of time the lagoon is open for steelhead migration (see Response F2-6). The District is not aware of any data, nor does the commenter provide any data, substantiating a potentially significant impact upon local surfing conditions. The slant wells are subsurface, and there is no marine construction proposed as part of the Project.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Gordon Grannis
gordongrannis@me.com
Capistrano Beach

Received 6/19/2018 15:06

I think it sounds great. nice job.

Web Comment W7 Gordon Grannis

Capistrano Beach
June 19, 2018

Comments in support of the Project are noted.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Kathy Hartl
kathy@hartlwrites.com
3347 Calle La Veta, San Clemente

Received 8/6/2018 20:00

Desalination facilities are the most expensive method for replacing imported water and should only be considered after South Coast Water District has implemented all cost-effective water conservation and efficiency measures. Orange County has pioneered groundwater replenishment systems which provide locally controlled clean water at MUCH lower prices than desalination. The energy use of desalination facilities is very high which both subjects us to the impact of price increases and increases energy demand. Finally, desalination facilities are harmful to ocean life. This is a costly, environmentally damaging project that we simply don’t need.

Web Comment W8 Kathy Hartl

San Clemente
August 6, 2018

These comments are addressed in responses to Letter P4.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Carolyn Keatinge
keatinge@pepperdine.edu
Laguna Beach

Received 8/3/2018 2:37

great idea long overdue what about using solar power to power project.I hope you are considering using gas not diesel powered cranes and vehicles given their success on the sewer project thank you carolyn keatinge resident south laguna

Web Comment W9 Carolyn Keatinge
Laguna Beach
August 3, 2018

General comments in favor of the Project are noted. This comment does not raise any specific objections regarding Draft EIR adequacy. Regarding power sources, the Project's energy requirements are discussed beginning on page 3.0-31 of the Draft EIR and Appendix 10.1. While the EIR assumes the Project will utilize a conventional power connection to SDG&E, several alternative onsite power options have been evaluated, including natural gas turbines, fuel cells, solar, wind, and others. As specified by mitigation measure AQ-1, all diesel-powered construction equipment greater than 50 horsepower shall meet EPA-Certified Tier 4 emissions standards and other performance criteria to minimize diesel emission impacts.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Brian / Kathleen Knott
elskel@aol.com
9494222090
31562 Catalina Ave., Laguna Beach

Received 8/2/2018 17:49

We as, S.C.W.D. users here in South Laguna, are in favor of the Doheny Ocean Desalination Project. As imported water becomes less abundant and more expensive, it is time for us to move forward with the desalination plant. This will protect us with a future water source. Brian and Kathleen Knott 31562 Catalina Ave. Laguna Beach CA 92651

Web Comment W10 Brian and Kathleen Knott

Laguna Beach
August 2, 2018

General comments in favor of the Project are noted for the record.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Rebecca Mansfield
rebeccamansfield79@yahoo.com
435 881 5358
33855 Diana Dr,Dana Point

Received 6/18/2018 22:23

I think it is a great idea, but for the benefit of the residents overlooking the facility - you would need to design it to be a pleasant view. Granted - the view is not great now, but it should be presented as a benefit to them, with drawings for their proposed view. Either really good looking buildings or a screen of vegetation, palm trees, etc.

Web Comment W11 Rebecca Mansfield

Dana Point
June 18, 2018

Comments expressing support of the Project are noted for the record. This comment does not raise any specific objections regarding Draft EIR adequacy. Changes to aesthetics and visual character are addressed in detail in Section 4.1 of the Draft EIR. A series of visual simulations from key viewing areas depict the appearance of the Project and changes to the visual environment from several viewpoints during construction and operation. The EIR also requires a detailed screening plan to mitigate impacts and achieve screening and landscaping to soften the Project's visual effects in this industrial area.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Elizabeth Meehan
elizmeehan@gmail.com
Dana Point

Received 6/26/2018 0:16

Regarding the salt extracted from the water, what will be its disposition? Will the removal of the salt upset the ocean's composition?

Web Comment W12 Elizabeth Meehan

Dana Point

June 26, 2018

This comment does not raise any specific objections regarding Draft EIR adequacy. Removal of salt (saltwater intake) will not significantly impact ocean salinity. As described in Section 3.0 Project Description and Section 4.8 Hydrology and Water Quality, brine (salts) extracted from water will be returned to the ocean via a disposal system that will mix the brine with treated wastewater. Evaluation of this process in the DEIR and water quality modeling concluded that brine discharge would have no significant effects on background salinity, regardless of whether it is combined with other flows. Such discharge is heavily regulated to ensure compliance with State planning and permitting requirements. See also response to comment S7-7.

SOUTH COAST WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Christopher Moore
c.stephen.moore@gmail.com
562-371-7474
31441 Monterey St, Laguna Beach

Received 7/23/2018 0:13

I am 100% in support of desalination but this project could be bigger so we become a net exporter, and we need a nuclear power plant to power the desalination plant.

Web Comment W13 Christopher Moore

Laguna Beach

July 23, 2018

Comments in support of the Project are noted for the record. Local power infrastructure was found to be capable of supporting the Phase 1 Project (up to 5 MGD), as discussed on page 3.0-33 of the DEIR. With the 15 MGD Regional Project demanding roughly three times the energy of the Phase 1 Project, additional offsite power line extensions would be required, and would be placed underground. Energy for the Project may be provided by alternate means including natural gas turbines and natural gas fuel cells. Power from SDG&E may be used to supplement these or other alternative energy sources that do not fully meet the Regional Project's demand. The alternative power generation options are discussed in pages 3.0-33 through 3.0-35 of the DEIR.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Stan Morgan
stan2295@gmail.com
949-499-2198
Laguna Beach

Received 6/27/2018 13:41

I think it is a great idea. Count me as a supporter.

Web Comment W14 Stan Morgan
Laguna Beach
June 27, 2018

Comments in support of the Project are noted in the record.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Bennie F. Petty
bbpetty@cox.net
949 661-9781
34702 CALLE LAS FLORES, CAPISTRANO BEACH, CA 92624

Received 6/5/2018 21:30

I believe we need this project now and especially for our future water needs. I wish it had ben built long ago. We can't change the past but we can move forward. BUILD IT !

Web Comment W15 Bennie F. Petty

Capistrano Beach Resident
June 5, 2018

Comments in support of the Project are noted for the record.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Hal and Mary Schaffer
Retired
schaffer@csulb.edu
949-973-4527
23961 Tasman Bay, Dana Point

Received 6/24/2018 20:00

Reference: Comments for proposed desalinization facility in Dana Point, CA First of all, what a great idea for the SCWD. We wish to commend you on your forward thinking. As stakeholders, we have some questions which you will no doubt have answers for. Here are our concerns: 1. Since the proposed project site is located close to the ocean and adjacent to a flood control drainage to the ocean, what plans have you made in the event of a tsunami and or a five hundred year flood? 2. If we have a major power grid failure, what alternative power sources do you propose to have available? If diesel and/or solar supplemental power is available, how would they be protected from a tsunami or flood? 3.It appears that the proposed facility is across the flood control ditch to the South Orange County Wastewater Authority. What precautions are you taking to ensure that Cryptosporidium etc. is not in our drinking water system. 4. We are concerned about radioactive materials in our drinking water. Since we are approximately ten miles north of San Onofree Nuclear Power Plant which stores all of its waste on site and appears to be vulnerable to earthquake and tsunami. How are you planning to monitor our water and protect us from possible radioactive contamination?

Web Comment W16 Hal and Mary Schaffer

Dana Point

June 24, 2018

Comments in support of the Project are noted for the record.

Draft EIR Section 4.8 Hydrology and Water Quality includes an analysis of coastal hazards, including tsunami and flood risk. Please note that 100-year flood hazard is the threshold of significance for CEQA purposes. The project proposes to raise the base elevation of the site to elevate the desalination plant above the 100-year flood zone. These changes will modify the flood plain and improve protection over existing conditions. See analysis beginning on page 4.8-32 of the Draft EIR. Though not required by CEQA, the Local Hazard Conditions and Drainage Study includes a sensitivity analysis to evaluate flooding conditions under a 500-year storm event. Critical infrastructure at the project site would be designed to be floodproofed from a 500-year storm event (refer to Appendix 4.2.4 to the FEIR, which includes the Local Hazard Conditions and Drainage Study report).

The Project site is subject to coastal hazards, including winter high surf and tsunami (DEIR page 4.8-36). Table 4.8-7 shows facilities that are most vulnerable to future coastal hazards through year 2100, accounting for projected rises in sea level. These facilities are well heads and pumps, which do not begin to see effects until year 2100. Tsunami impacts are addressed beginning on page 4.8-41 and conclude that, based on the tsunami event scenarios, the only impacted facilities are those below ground. These issues are addressed by mitigation measures HWQ-2 and HWQ-7. The coastal hazard analysis was clarified since the circulation of the DEIR, although fundamental significance conclusions were not changed (refer to Appendix 4.2.1, Coastal Hazard Assessment). Appendix 4.2.1, Tables 8.1 and 8.2, edits DEIR Tables 4.8-7 and 4.8-8 to clarify and affirm the lack of significant coastal hazard impacts at DSB (although projected future Year 2100 worst-case coastal hazard levels are slightly higher for facilities located along the coast, as shown in Appendix 4.2.1 Tables 8.1 and 8.2, the DEIR conclusions do not change, and no significant impacts would occur with implementation, and in consideration of Project Design Features).

As stated in page 3.0-33 of the DEIR,_the District is continuing to evaluate power supply options that include SDG&E, an alternative power supply, or a combination of the two. Natural gas-powered turbines are being considered, which would provide an independent and reliable power source. The Project would include diesel backup generators which are standard for municipal water supply facilities. The desalination facility will include solar photovoltaic (PV) panels on flat rooftops where feasible and practical. Other alternative energy sources being evaluated include natural-gas turbines and fuel cells to maximize efficiency and minimize energy cost.

Water quality is addressed in Section 4.8 Hydrology and Water Quality. This section identifies that all product water is heavily regulated and must meet or exceed State Water Resources Control Board (SWRCB) drinking water quality standards. The final "product" of the desalination facility would be distributed through the District's existing water distribution system and therefore would be required to meet rigorous potable drinking water regulations as administered by the SWRCB's Drinking Water Program. In addition, product water would be conveyed through various local and potentially regional water conveyance systems, with most of the water ending up being treated at local wastewater treatment facilities following end-user consumption and subsequent discharge into the local sanitary sewer system.

The San Onofre Nuclear Generating Station (SONGS) is now out of service and planned for decommissioning. Decommissioning is a well-defined Nuclear Regulatory Commission (NRC) process that involves transferring the used fuel into safe storage, followed by the removal and disposal of radioactive components and materials. Longer term, this process calls for reducing residual radioactivity to a level that supports termination of the NRC license. As such, the SONGS' radioactive materials will not contaminate the Project's waters.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Dave Schroeder
chester.love1@gmail.com
Dana Point

Received 6/23/2018 20:15

From information currently available, I completely support the proposed ocean water desalination facility & location.

Web Comment W17 Dave Schroeder

Dana Point

June 23, 2018

Comments in support of the Project are noted for the record.

SOUTH COAST WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Michael Scott
ajaxsurf@gmail.com
Dana Point

Received 6/20/2018 17:40

I have a few questions I would like to raise at the meeting

Web Comment W18 Michael Scott

Dana Point
June 20, 2018

No specific comments on the Draft EIR are provided, and no significant environmental issues are raised. The Final EIR provides responses to oral comments made during the recorded public comment portion of the June 26, 2018 meeting on the DEIR. However, the transcript of those oral comments do not include any comments by this commenter, and thus, no further response is required.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Aaron Simmons
legopacific@gmail.com
34842 Doheny Pl, Capistrano Beach

Received 6/5/2018 15:41

This entire project looks to be a boondoggle. It is an expensive experiment and ratepayers would object to it if the true benefits and costs were exposed. Even if the experiment runs flawlessly, the project will have negligible impact on overall reliability. The entire project should be abandoned.

Web Comment W19 Aaron Simmons

Capistrano Beach
June 5, 2018

Comments in opposition to the Project are noted for the record. This comment does not raise any specific objections regarding Draft EIR adequacy and does not raise any significant environmental issue. Regardless, South Coast Water District has published studies regarding water reliability and desalination costs, which are available on its website, at www.scwd.org/desal under "Technical Library."[1]

[1] http://scwd.org/depts/engineering/projects/water_supply_projects/oceandesal3/technical_library/default.htm (accessed May 6, 2019).

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Bob and Betsey Unger
bob@platterivercapital.com
#3 Lagunita Drive, Laguna

Received 6/28/2018 13:10

I am opposed because any invasion into our ocean is not acceptable.. I know there is also a very large project going in south of calfornia in Mexico

Web Comment W20 Bob and Betsey Unger

Laguna Beach Resident

June 28, 2018

Comments in opposition to the Project are noted for the record.

The EIR analyzes potential impacts of the Project on several environmental resources relating to the ocean and beach, including aesthetics (Section 4.1), biological resources (Section 4.3), hydrology and water quality (Section 4.8), and recreational facilities (Section 4.12). The EIR concludes the Project will have no significant unavoidable impacts with respect to these resources.

Additionally, the EIR considers the potential cumulative impacts of the Project with other projects in Section 4.0.4, Cumulative Impacts Analysis, and within analysis of impacts for each resource category. The cumulative impacts analysis considers potential environmental impacts of past, present and probable future projects, in combination with the proposed Project. Table 4-1, Cumulative Projects, describes other projects that could result in cumulative impacts when combined with the Project, focusing on the local onshore cumulative environment as well as the regional offshore environment. The EIR concludes the Project will have no significant unavoidable cumulative impacts.

SOUTH COAST WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

David L Whitaker
davewhitaker@cox.net
31532 Valido Rd, Laguna Beach

Received 7/1/2018 17:22

I am in full support of the Doheny Ocean Desalination Project. I am glad we are moving forward with the project. The only concern I have is that we don't use its capacity for allowing more housing growth - it should be used to backup and support for current housing in times of drought.

Web Comment W21 David Whitaker
Laguna Beach
July 1, 2018

Comments in support of the Project are noted for the record. Section 4.9 of the EIR analyzes the compatibility of the Project with local and regional land use plans, including the Project's ability to serve projected population growth for the area. Growth-inducing impacts are discussed in Section 6.3 of the Draft EIR. See Response O2-1. The EIR concludes the Project will have no significant unavoidable impacts on these resource categories.

SOUTH COAST WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Bendush William
bbendush@icloud.com
9494939192
3 Monarch Cove, Monarch Beach

Received 6/25/2018 15:52

What a great idea, I fully support it! The population of California keeps growing. We can not meet the states water needs by conservation alone. We need to develop new sources such as this. If it means our rates go up, I'm still all for it.

Web Comment W22 Bendush William

Monarch Beach

June 25, 2018

Comments in support of the Project are noted for the record.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Bobby Young
by4golden@yahoo.com
Capistrano Beach

Received 8/3/2018 10:28

How will the Desal project affect the Joint Regional Water Supply System water quality? Will more flushing be required, similar to when SONGS went off-line, due to slower turnover and longer detention time?

Web Comment W23 Bobby Young
Capistrano Beach
August 3, 2018

This comment does not raise any specific objections regarding Draft EIR adequacy. Please refer to Response L3-1, which addresses potential impacts to the Joint Regional Water Supply System.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Chris Zamoscianyk
czammail@gmail.com
San Juan Capistrano

Received: 6/30/2018 18:58

I think it is important for the desal plant to have the intake tube buried in the sand so as not to disturb sealife.

Web Comment W24 **Chris Zamoscianyk**
San Juan Capistrano
June 30, 2018

This comment does not raise any specific objections regarding Draft EIR adequacy. As identified in the Draft EIR (Table 3-5, page 3.0-20), the intake slant wells are estimated to be buried between 74 and 130 feet below the sea floor and will avoid impacts to the sea bottom and marine environment.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Patricia Martz
California Cultural Resources Preservation Alliance, Inc.
p.martz@cox.net
9495596490
1 Songsparrow, Irvine

Received 6/16/2018 20:24

I reviewed the cultural resources report and the cultural resources section in the Draft EIR. I concur with the findings, recommendations and Cultural Resource Mitigation Measures except for the recommended treatment of CA-ORA-1337/H Serra Railroad Depot. It is adjacent to the South Site and the treatment should be changed from no further work to avoidance as there is potential for buried historic artifacts. This should be included in the cultural resources mitigation measures.

Web Comment W25 California Cultural Resources Preservation Alliance, Inc.

Patricia Martz

June 16, 2018

Thank you for your review of the cultural resources analysis. Based on the project footprint and location of CA-ORA-1337, the Draft EIR concludes that the Project will not have direct or indirect significant and unavoidable impacts on this or other historical resources. CA-ORA-1337 is outside of the Project's area of disturbance, as CA-ORA-1337 is located within the existing railroad right-of-way (ROW). The Project raw water conveyance line is planned within Las Vegas Street, using trenchless construction to run beneath the railroad ROW. Mitigation Measure CUL-2 requires that, prior to construction, the District (or its designee) shall retain a Cultural Resource Specialist (CRS) that meets the minimum qualifications of the U.S. Secretary of Interior Guidelines (NPS 1983). The CRS shall be present during initial deep excavations for pipeline trenches, vaults and desalination facility structures that penetrate below native ground surface. The CRS and the Construction Manager shall have the authority to halt construction if previously unknown cultural resource sites or materials are encountered. As such, the Project would avoid impacts associated with CA-ORA-1337 without any additional mitigation measures.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Dr. Tom Williams
Citizens Coalitions for A Safe Community
ctwilliams2012@yahoo.com
3235289682
4117 Barret Road, Los Angeles

Comments & Requests all formatting has been removed...please provide direct email address for submission of formatted file... DATE: August 6, 2018 TO: South Coast Water District Attn: Mr. Rick Shintaku, PE â€“ Acting General Manager, District Engineer 31592 West Street, Laguna Beach, CA 92651 949-499-4555 http://scwd.org/contact/directory/acting_general_manager_chief_engineer.htm

Uploaded to Comments: http://scwd.org/depts/engineering/projects/water_supply_projects/oceandesal3/environmental_documents/draft_eir_comment_form.htm

FROM: Dr. Tom Williams, Sierra Club, Angeles Chapter, Water Comte. Senior Techn. Adviser, Citizens Coalition for A Safe Community 4117 Barrett Rd. La, Ca 90032-1712 323-528-9682 ctwilliams2012@yahoo.com

SUBJECT: Doheny Ocean Desalination Project: Draft Environmental Impact Report (EIR) State Clearinghouse No. 2016031038 RE: Comments on DEIR Thank you for the opportunity to review the proposed Project and the current Environmental Impact Report, and lengthy appendices. Our review as provided in the following comments indicates that the EIR is inadequate and incomplete and is of low quality. The current DEIR must be revised and recirculated General Comments Desalination would provide a reliable, drought-proof and locally controlled safe water supply, but like imported water uses reduces the providers concerns regarding the natural water resource constraints and dependencies for the area's existing water resources (e.g., groundwater/rainfall/runoff-recharge compared to imports from he Colorado or the Pacific). If implemented, the Doheny Ocean Desalination Project could provide high quality, locally controlled and drought-proof water supply while protecting parts of the environment. Currently, South Coast Water District imports 85 to 100 percent of its drinking water, causing vulnerability during droughts, supply shortages and potentially during natural disasters and has given up on groundwater and rainfall. Doheny facility with advanced slant wells for intakes is more environmentally considerate than other methods but may adversely affect shallower, fresher groundwater. Current groundwater computer modeling does not address impacts on inland groundwater moving westerly/seaward. No adequate evaluation is available regarding power use for wedge-wire piped intake compared to well draw. Nanno-/Micro-marine life is protected by wedge wire pipe intakes which are also used as well screens drawing water from beneath the ocean floor because of their power requirements (kw/gal). The entire CEQA document, the applicant, and preparers appear not to have resolved whether the document is for the Local Project, only or both the Local and Regional Projects. Some Local elements appear to be capable of serving both levels of service. Intake wells/pipes would extend toward the Newport-Inglewood Fault Zone, and Dana Point may be a remnant fault block related to this fault zone. Further geophysical/ground movement (0.1-0.6in) and seismic (-2 - 4 RM) monitoring should have been implemented for locating seismic activities as the imported water reliability is involved with seismic risks and activities. Less than 1/2 page of setting and assessment for Environmental Justice with a 40,000 resident and 1000 businesses service area appears totally inadequate. Various mentions of economics, finance, costs, and funding for Local and Regional Projects and for businesses and tourism require further, adequate, and complete financial/economic impact report, including rate structures and rate payers charges. SPECIFIC COMMENTS Format: Copy of DEIR text with highlight with comments on DEIR text. 0.0 NOA The Local Project, product water storage tank (5 MG rather than 1.6 MG) distribution system that would feed into the Districtâ€™s local distribution system depending on plant capacity and District demands, other adjacent local and regional transmission pipelines that are located adjacent to the site. Preparers do not know or provide differences between transmission and distribution systems. Provide delineation of Regional, District's, local, and "Non-Local" pipes, lines, distribution, and transmission systems. conveyed entirely using existing District and local infrastructure with no off-site improvements other than a short connection to the Districtâ€™s existing local transmission lines Preparers do not know or provide differences between District and "Local" "infrastructure" and "local transmission lines (=pipes). appurtenant facilities (e.g. pump stations, valves and metering) all construction, operation and maintenance activities associated with all Project facilities. Use of "all" suggests including both Local" and "Regional" Project facilities. Clarify and revise. 0.0 NOA The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details. Continuing references to the "Regional Project" distracts and confuses public reviewers and may become basis for claiming "Program Assessment" at a later date. The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date. 1.0-3/1 The proposed Project aims...to secure water supply reliability by developing a drought-proof, hydrologically independent, water...to meet the service area demands at either a local or regional scale. The Phase 1 project capacity (up to 5 MGD) would help meet the service areaâ€™s water demands at a local scale.... For the potential future Regional Project (up to 15 MGD), SCWD would look to involve regional partners which would expand the service area of the facility and would help meet the water demands at a regional scale...reducing the need for imported water... ...improving overall regional supply reliability. The District only intends to pursue permitting and construction of the Phase 1 Project (up to 5 MGD) at this time. Inconsistent use of Phases and Scenarios is confusing and distracting as they are not clearly defined and explained at first usage and consistently thereafter. Either remove or consistently use in a revised DEIR. The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date. 1.0-3/2 ....In addition to Project-level analysis for Phase I, this EIR also functions as a Program EIR...providing a programmatic level analysis of a potential future Regional Project of up to 15 MGD....SCWD only intends to seek regulatory permits and approvals for the Phase I Project at this time, as there are no Regional Project partners in place, and specific Regional conveyance facilities are dependent on Regional Partners and as such cannot be identified at this time. A Program EIR is also appropriate, in that it evaluates a phased public works project where SCWD may implement one or more options, and in that it evaluates a broad range of implementation options to accomplish SCWDâ€™s Project objectives. The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR is a confused mess of Project and Programmatic DEIR for the Local and Regional Projects. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date. Mixing discharge brine with treated sewage for outfall destroys "freshwater" (=treated sewage with TDS of < 35ppt...from 60ppt 30 > 45 30 > 38ppt 30 = 1 part brine 3 parts seawater The DEIR does not discuss the project's effects in the service area including Environmental Justice and Growth Inducements and no hydraulic model is provided for the service areas. The proposed project would be important to supplying lower elevations (2.5 RM and

Web Comments W26 and W27 Citizens Coalitions for a Safe Community

Dr. Tom Williams

The comments submitted are addressed in responses to Letter O4 (Sierra Club).

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

James Schad
Doheny Village Merchants Association member
emjackdad@gmail.com
949-315-5653
34190 Sepulveda Avenue, Dana Point

Received 8/4/2018 0:42

In general, I like the idea of the desal plant and it's location in Dana Point. What I don't like is the fact that the Doheny Village Merchants Association (DVMA) have had little to no contact regarding this project, while Capo Cares seem to be intimately involved. Contrary to popular belief, Capo Cares does not speak for Doheny Village and DVMA, and at times Doheny Village and DVMA are not in favor of issues that Capo Cares supports in Doheny Village. DVMA meets regularly and has been working with Dana Point to re-write some zoning, use and code issues that affect Doheny Village. I would like to work with your representatives and the community to share thoughts on the desal plant. One main point would be to see if we could work together to improve beach access from the Las Vegas Avenue area to Doheny Beach. This would require a working relationship between SCWD, Cal Trans, Coastal Commission, etc. Please contact me at your convenience if you are interested in sharing ideas. Thank you for the opportunity to share my thoughts.

Web Comment W28 Doheny Village Merchants Association (member)

James Schad

August 4, 2018

Comments of general support for the Project are noted for the record. The District welcomes input and comments from DVMA and other organizations, as public input and participation are central to the CEQA review process. Note that DVMA was included in the invitations to the original NOP scoping meetings and Draft EIR public meeting. In response to this comment, District staff reached out directly to the commenter and offered to meet to discuss DVMA concerns.

With respect to beach access, Section 4.12 of the Draft EIR evaluates the potential impacts to existing park and recreation facilities caused by Project construction and provides mitigation to minimize Project-related impacts. While the EIR evaluates only the Project components as proposed, enhanced coastal access is strongly supported by the California Coastal Commission, State Parks, Orange County Parks and the City of Dana Point's Local Coastal Program. Through the encroachment permit process with the City of Dana Point and State Parks, the District may provide further community enhancements beyond what is required by CEQA.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR)
Public Comment

Ray Hiemstra
Orange County Coastkeeper
ray@coastkeeper.org
7148501965
3151 Airway Ave. Suite F-110, Costa Mesa

Received 8/6/2018 16:56

I have submitted our comments directly to Ms. Morgan as this comment form lacks the ability to include attachments.

Web Comment W29 Orange County Coastkeeper

Ray Hiemstra

August 6, 2018

Please see responses to Letter O3.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Tim O'Connor
R&R Technologies, Inc./Biosphere Carbon Group LLC
tim@biospherecarbon.com
Dana Point

Received 6/25/2018 19:48

June 25, 2018 Board of Directors South Coast Water District Mr. Bill Green, Mr. Wayne Rayfield, Mr. Douglas Erdman, Mr. Denis Erdman, and Mr. Rick Erkeneff Re: Dana Point Desalination Plant Gentlemen, The desal project in Dana Point seems to be gathering steam! Speaking of steam, we at R&R, after several meetings with yourselves and a site visit a late last year, are wondering if you are still considering powering the plant with steam created by renewable energy? As you may know, the State of California has closed all of the wood fired boilers in the State that process crop waste for commercial growers, leaving farmers with few options to dispose of the millions of tons of organic material building up throughout the State. The point is that there are tons of organic waste available which could serve as feed stock to power the DP plant, and using proper feedstock create an alternative revenue stream could be created in the form the high-grade USDA certified Biochar to offset the cost of the plant. See: https://www.youtube.com/watch?v=htc_SVhGoDU). Biochar introduced to soil has been shown to cut water usage by 30%-50%, increase crop yields, and remediate and enrich soils. We are presently working with a few of the large nut growers and fruit farmers in CA and the demand for Biochar in on the riseâ€¦in California and world-wide and we are in the forefront of that industry. Using our patented technology to power the desal plant is in lock-step with the environmental benefits to slant drilling, saving millions of sea creatures and would create several other benefits: â€¢ Create the necessary energy to operate the plant, independent of SDG&E. â€¢ Create alternative revenue streams in the form of excess power, tipping fees, sales of biochar (another place we can assist) â€¢ Cut water usage by initiating City-wide biochar awareness and usage â€¢ Create Carbon Credits through using clean technology â€¢ Help address drought problems and organic waste problems via biochar â€¢ Staying well within air quality standards We hope you will still consider our proposal as a power option for the plant and would be happy to meet again to discuss in more detail as the project progresses. Sincerely, Tim Oâ€™Connor VP. R&R Technologies Inc

Web Comment W30 R&R Technologies, Inc./Biosphere Carbon Group, LLC

Tim O'Connor
June 25, 2018

For purposes of analysis, the Draft EIR assumes that the Project will be powered conventionally via connection to expanded SDG&E infrastructure. However, alternative power sources are identified in the Draft EIR in Section 3.0, Project Description. The District continues to pursue alternative power supply options, although steam energy is presently not under consideration (the Draft EIR notes the power supply study conducted for the Project, on pages 3.0-33 through 3.0-35, and rationale for currently planned power supplies).

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Norris Brandt
San Juan Basin Authority
norris.brandt@sjbauthority.com
949.293.6236
South Orange County

Received 8/6/2018 0:44

San Juan Basin Authority's comment letter is being sent via email to Rick Shintaku, Acting General Manager.

Web Comment W31 San Juan Basin Authority

Norris Brandt

August 6, 2018

Please see responses to Letter L6.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

Katie Day
Surfrider Foundation
kday@surfrider.org
Dana Point, CA

Received 8/6/2018 18:21

Dear Sonja Morgan, The Surfrider Foundation (Surfrider), on behalf of our 20 California based chapters, including the South Orange County Chapter, hereby respectfully submits these comments on the South Coast Water Districtâ€™s â€œDoheny Ocean Desalination Project Draft Environmental Impact Reportâ€� (DEIR). Surfrider is a non-profit 501(c)(3) organization that is dedicated to the protection and enjoyment of our ocean, waves, and beaches through a powerful activist network. Surfrider would like to commend South Coast Water District (SCWD) for following the ocean desalination recommendations established by the 2015 amendments to the State Water Resources Control Board California Ocean Plan, developed to better protect the surrounding marine and coastal environments. These include the use of subsurface intakes and the discharge of brine through dilution and co-mingling with wastewater that would already be released through established ocean outfalls (III(M)2(d)2(A)). Surfrider would also like to commend SCWDâ€™s decision to have the plant use small scale production (5 MGD potable water), and be publicly owned and operated. Surfrider supports, in concept, the proposed design and operations elements of the project. However, though the general methods of the proposed desalination plant are admirable, Surfrider would like to stress the importance of fully maximizing water recycling and conservation before investing in ocean desalination. We understand that increased conservation and recycling efforts will not meet the project goal â€œ[t]o create a drought-proof, hydrologically independent, reliable and high-quality source of potable drinking water for the Districtâ€œ without more political action on direct potable reuse, yet enhanced conservation and recycling will reduce the estimated amount of potable drinking water needed for the District. Additionally, Surfrider is concerned that the DEIR does not adequately address mitigation for increased greenhouse gas emissions or assess impacts from coastal hazards including sea level rise. These concerns, and others, are addressed in more detail below. 1. Failure to maximize water conservation efforts and accurately estimate water needs Currently, SCWD permits city owned properties to use expensive and scarce potable water for landscaping and other outdoor water uses. Stronger conservation requirements must be implemented before exposing ratepayers to increased costs from desalination construction and operations. One such method is to transition all city owned landscaping from grass lawns or non-native plants to Ocean Friendly Gardens. The principles of Ocean Friendly Gardens include maximizing the extent of permeable areas, using native plants, promoting water retention, and irrigating with recycled water, among others.

These conservation efforts could save a significant amount of potable water, reducing the estimated District water needs. Additionally, SCWDâ€™s analysis of District water needs does not account for the newly mandated water conservation requirements established by California state Assembly Bill 1668 and Senate Bill 606, which mandate a 20 percent reduction in water use, and a per capita indoor water use maximum of 55 gallons per day through 2025, ratcheting down to a 50 gallon per day maximum by 2030. These bills also mandate urban water retailers to establish a state approved annual water use objective for indoor and outdoor water use limits, taking into consideration water availability and vulnerabilities. Accurate estimates of water use are necessary for the adequate review of the ability of the proposed plant and alternatives to meet the regionâ€™s water needs. The 2016 OC Water Reliability Study estimated that the regional water needs would be between 3.2 MGD and 4.5 MGD by 2040, yet it is not clear what estimate the agency used for the per capita daily water use in these scenarios. If these long term water conservation mandates were not considered in â€œScenario 1â€, the actual water need may be significantly lower than the current estimated gap of 4,400 AFY (3.9 MGD). 2. Failure to maximize the use of water recycling The regionâ€™s recycled water infrastructure and use is far from maximized. The SCWD water recycling facility has the capacity to produce 1,350 AFY of recycled water, yet only 800-850 AFY are provided. This discrepancy is due to the lack of supporting infrastructure to transport recycled water to users. Surfrider recommends that at the bare minimum, SCWD complete the recycled water expansion program to result in 100% build out of available recycled water, prior to constructing an ocean water desalination facility, instead of the current plan to complete the recycled water expansion program by 2030. 3. Inaccurate calculation for carbon neutrality Surfrider commends SCWDâ€™s intention to make the proposed desalination plant carbon neutral; however, the calculation for obtaining carbon neutrality from proposed plantâ€™s greenhouse gas emissions may be inaccurate. For other desalination plants, such as Poseidon Water LLCâ€™s Carlsbad facility, a one to one reduction in imported water was not sufficient mitigation to achieve carbon neutrality. This is because of a contractual agreement with between the California Department of Water Resources and the Municipal Water District (MWD) which prohibits desalinated water from reducing MWDâ€™s State Water Project entitlements. The same prohibition applies to the proposed Doheny plant. Surfrider recommends the use of onsite renewable energy to the maximum extent feasible. To truly obtain carbon neutrality for the fully operating plant, SCWD must calculate and mitigate the plantâ€™s complete greenhouse gas emissions, and not just the net incremental project emissions. Additionally, to adequately prepare ratepayers, Surfrider would like to highlight the necessity to include the cost of emissions mitigation in the estimation of post-construction SCWD water rates. 4. Necessity to conduct sea level rise vulnerability assessment using H scenario The Ocean Protection Councilâ€™s draft State of California Sea Level Rise Guidance: 2018 Update recommends that, â€œFor highly vulnerable or critical assets that have a lifespan beyond 2050 and would result in significant consequences if damaged, the H scenario (extreme projection) should also be included in planning analyses.â€ Since the proposed project will act as a main water source for the region, this facility and necessary supporting infrastructure will meet the description of critical infrastructure. As the DEIR currently stands, there is no reference to a sea level rise vulnerability assessment using any of the necessary climate change scenarios (RCP 2.5, RCP 8.5, or H), or consideration of other coastal hazards. A thorough sea level rise vulnerability assessment should consider wave runup, tidal impacts, increased frequency and magnitude of coastal hazards, and fluvial flooding. This sea level rise vulnerability assessment should also consider impacts to supporting infrastructure and access roads, including electricity distribution, potable water distribution, brine and wastewater pipelines, and influence on development in nearby coastal hazard areas. 5. Necessity to assess cumulative impacts SCWD must assess the cumulative environmental impacts that would occur as a result of this desalination facility and accompanying structures, as well as other proposed developments sited in the project area, which currently include a boatyard storage facility, the Dana Point Harbor Revitalization Project, and the San Juan Watershed Project, among others. These additional developments are likely exacerbate stresses to the coastline, marine wildlife, and coastal water quality, beyond what has been identified in the DEIR. Finally, Surfrider would like to request additional mitigation measures for recreation impacts. This includes the expansion of REC-1 to include local recreation non-governmental associations in addition to the stated â€œaffected recreational agenciesâ€� when conducting consultation, and the implementation of a multi-year monitoring program to determine if surfing waves are negatively impacted by hydro-geomorphology changes as a result of subsurface intake pipes. The Surfrider Foundation appreciates the opportunity to provide these comments on behalf of our 20 California based chapters. Sincerely, Katie Day Staff Scientist, Surfrider Foundation Mandy Sackett California Policy Coordinator, Surfrider Foundation

Web Comment W32 Surfrider Foundation

Katie Day

August 6, 2018

Please see responses to Letter O6.

Public Comment Letters

Dear Water Dist,

SOUTH COAST
WATER DISTRICT

Partnering With The Community

Isn't this where

May/June 2018

river severage comes in? 1

Doheny Ocean Desalination Project

Terrible

South Coast Water District is considering a project to build an ocean water desalination facility in Dana Point. The facility would have an initial capacity of up to five million gallons per day (MGD) with potential for future expansions up to 15 MGD.

The project would create a critical community benefit: a reliable, local and drought-proof water supply that does not rely on expensive imported water and is environmentally friendly. In addition to providing a local, reliable and secure water supply for the District, the desalination facility would also provide emergency backup water supplies, should delivery of imported water be disrupted.

Using environmental friendly slant well technology, located beneath the ocean floor, the proposed project would draw water from beneath the ocean floor to the desalination facility site, located on the District's property behind the Doubletree Hotel.

Proposed Project Location

The proposed project site is located o
used as a storage lot. No proposed fa

Current aerial view of proposed proje
on the District's property on Stone

Ms. Rowena Anderson
Monarch Beach
8 Monaco
Dana Point, CA 92629

Letter P1 Dana Point

Rowena Anderson
(undated)

Response P1-1

Refer to the Draft EIR Section 4.8, Hydrology and Water Quality, which notes the existing surface water quality at Doheny State Beach (DSB) and associated ongoing monitoring programs. The water at this location is also closely monitored due to its public use for recreation, ensuring that it is safe enough for human contact. Further, source water monitoring will be continuously performed to ensure water health and quality. Brine, a by-product of seawater desalination, will be combined with wastewater flows within the existing outfall pipe which discharges in the ocean, and would not affect water quality at DSB.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

From: harold breen [mailto:hacksaw.dood@cox.net]
Sent: Monday, August 06, 2018 4:59 PM
To: Jody Brennan <jbrennan@scwd.org>
Subject: harold Breen

Harold Breen
34862 Calle Loma,
Capistrano Beach, CA 92624
(310) 486-2358
FAX (866) 469-7016
Email: hacksaw.dood@cox.net
August 6, 2018

District Board
South Coast Water District
Via email: Jody Brennan, Exec. Assistant to General Manager jbrennan@scwd.org

Dear Board Members:

My wife and I live in Dana Point and we are SCWD customers. SDGE is our provider for electric power.

I have reviewed large sections of the Draft Environmental Impact Report for the Doheny Ocean DeSal Project (the DeSal). I have also reviewed the 2006 MRW Report on Assessment of (electric) Power Options. I have also read the 2007 GHD report, Power Supply Analysis.

It appears the writers of the GHD Analysis lean toward a plan for the District to create or lease an on-site natural gas powered electric generating station with SDGE back-up or a plan to hook-up to SDGE more or less permanently and buy electricity at $0.12/kWh moving up to a forecasted rate of $0.15 by 2031 and up to $0.20/kWh by 2041. See GHD Analysis, p. 20-22. 1

In the DEIR, Project Description, p. 3.0-32 the total Estimated Energy Use is 15.61 kWh/kgal (per gallon). That is 15,610 watts per hour, which gets 1000 gal. of water.

15,610 Whour X 24 hours = 374,640 watts a day.

374,640 W per day X $0.12 SDGE prices = $44,956.80 a day.

364 days X $44,956.80 = $16,409,232 1

For 15 years, the number is: $246,135,000

We live in a dense urban environment in this part of South OC. The GHD analysts did a good job of considering a large solar array, but quickly moved on to other options and possible solutions. They missed one very significant option. A serious plan to encourage the 40,000 residents, mostly homeowners, to go solar and install roof-top solar panels. The District can do this by, in a way similar to the tiering water uses/charges, give homeowners a 5% lower water bill (continually moving higher) when they install solar. The District will have and has at this moment considerable leverage with SDGE in negotiating rates and terms with SDGE. Part of
this would be to improve the terms for home owners who are installing solar equipment to get 2
better terms on excess electricity sold to SDGE. The Water District and SDGE and others can also help with work with lenders to make getting solar easier and quicker and at slightly lower interest rates. Many other water districts and cities could come on board with similar efforts and plans. There is strength in numbers; but these ideas need leadership. Solar always cuts down pollution, here in D.Pt. and elsewhere; like sulfur dioxide and nitrous oxide. In general, the DeSal directly and indirectly will be generating millions of tons of CO_2 (in time, billions of tons) and other polluting gases. California wants to do this, and has led the nation on reducing greenhouse gases from cars and trucks and other initiatives. 40,000 D.Pt. residents and citizens and businesses can participate in these goals in a very large way with non-polluting solar panels throughout all the cities and neighborhoods of the Water District. All of this could spread quickly throughout Orange County, with little nudges, here, then there.

Good luck and planning on this project,

Harold Breen

Letter P2 Harold Breen

Capistrano Beach
August 6, 2018

Response P2-1

Comments regarding the Project's energy usage, potential energy costs and alternative power supply analysis are noted for the record.

Response P2-2

Comments recommending District-sponsored solar incentives to customers are appreciated. In general, the expansion and diversification of alternative energy sources will benefit south Orange County and help reduce greenhouse gas emissions. See Section 4.6 of the Draft EIR for information regarding the Project's projected GHG emissions and mitigation strategies.

August 6, 2018

South Coast Water District
31592 West Street
Laguna Beach, CA 92651-6907

Re: Draft Environmental Impact Report for the Doheny Ocean Desalination Project STATE CLEARINGHOUSE NO. 2016031038

The following comments are submitted as long-time residents and concerned environmental advocates of South Laguna, as well as customers/ratepayers of the South Coast Water District (SCWD) for over three decades. Since annexation of South Laguna by the City of Laguna Beach in 1987, we have been unable to participate in the election of the District's Board of Directors, yet have participated robustly in board meetings and attempts to assist SCWD with the critical, much needed and required component of water conservation, which they seem unable to come to grips with, thus are set on a course to force desalination on its customer and ratepayers. We have also attempted to create a partnership between the District and the City of Laguna Beach Water Quality Department, but have been unsuccessful in these attempts as well. With the issue of water conservation at the forefront of any discussion about desalination, we strongly oppose SCWD pursuing a desalination facility of any type or scope until all existing and potential conservation remedies have been not only explored, but implemented. 1

As a long-standing member of the Sierra Club, we will defer to their Water Committee on the majority of comments to this DEIR, but felt strongly we needed to personally address 1) Conservation, 2) Cumulative Impacts, and 3) Site Overview and Permit Consolidation.

1. CONSERVATION

SCWD has done little to assist the areas that it serves with conservation, thus the supposed need for desalination to fulfill the areas' water needs. As has been stated in many emails and during public comment, we understand that SCWD is in the business of making a profit from water use. SCWD has little interest in curtailing water waste because there is no profit in this conservation effort. The San Diego Regional Water Quality Control Board recently issued the results of an audit as briefly described below using the City of Laguna Beach's audit as an example: 2

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Laguna Beach (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program.

The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,1 Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- • II.B.3 Water Quality Improvement Strategies and Schedules;
- • II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- • II.E.1 Legal Authority Establishment and Enforcement; 2
- • II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- • II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- • II.E.6 Enforcement of Legal Authority;
- • II.E.7 Public Education and Participation; and
- • II.F.2 JRMP Document Update of provision II.E.

As a result of this audit, the Regional Board found that not only SCWD's entire service area, but the entire County of Orange failed in the majority of categories audited. Attached is a zip file of the entire audit for SCWD Board review. This audit was sent to Rick Shintaku, Acting General Manager of SCWD, when it was first released, but there was never any response to the content of this important audit, nor any action taken to help improve water conservation. Water waste continues on a daily basis while SCWD continues to profit from this very waste, all the while declaring an urgent need for desalination.

2. CUMULATIVE IMPACTS

The following paragraph from the DEIR identifies why a careful scrutiny of cumulative impacts is so critical to this project.

Most of the vacant land that presently exists in the planning area is designated for industrial and open space uses along San Juan Creek. The General Plan would also result in the development of over 3 million square feet of commercial, industrial and public facilities, which represents a 35 percent increase over existing conditions. These increases in land use intensity will create long-term effects such as increased energy use, loss of nonrenewable resources, and increased vehicular traffic on roadways. Some are considered to be irreversible, especially impacts to air quality. 3

The District has identified the need to prepare a comprehensive Development Plan for the San Juan Creek Property, however there has not been any attempt on the part of the District to complete this plan thus far. Furthermore, utilizing an outdated EIR from 2002 is not acceptable given the new threats to natural resources based on Climate Change and Sea Level Rise.

The mere mention of “potential future uses” does not adequately define those potential future uses that could and would impact the proposed desal project. See attached site overview which will be addressed in more detail later in these comments.

Providing just a listing of the other impacts/projects in the surrounding vicinity is not 3
adequate. Listed below are just some of the issues related to cumulative impacts that have not been taken into account by the District in this DEIR. This is far from a complete list, but it is the responsibility of SCWD to thoroughly analyze ALL cumulative impacts.

- **Boat and R/V Storage**

This was a proposal that went as far as being agendized at a 2016 California Coastal Commission (CCC) hearing, only to be withdrawn at the very last minute at great cost to the ratepayers of SCWD by Andy Brunhart, General Manager at the time. Any notion about including a boat and R/V storage facility on this acreage should be more carefully analyzed given all of the other plans SCWD has for this 30 acres. According
to a meeting held with Andy Brunhart, Wayne Rayfield, Penny Elia of Sierra Club, Rick 4
Wilson of Surfrider, and Roger Butow of Clean Water Now, shortly after the boat and R/V storage CDP application was withdrawn in 2016, SCWD plans on relocating its corporate facilities from West Street on to this property (West Street property will be sold for revenue), constructing a laydown yard, and a host of other projects in addition to this proposed desal facility, none of which have been analyzed nor discussed with the CCC who has permit jurisdiction over a large portion of the 30 acres being considered for development. See attached diagram for an overview of what was described for future development by Andy Brunhart.

- **Dana Point Harbor Revitalization**

To begin this discussion, one must first understand the permitting aspect:

The City has permit authority for the landside portion of the harbor and the CCC retains original coastal development permit jurisdiction over the water. If a new CDP for the landside portion is being proposed, the City would be the permit issuing entity. The
CDP would be appealable to the CCC. 5

If the City plans changes to the Dana Point Harbor Revitalization Plan LCP, they would have to come to the CCC for those changes.

Has SCWD had a meaningful conversation regarding the total rebuild of the Harbor or analyzed the placement of intakes in the Harbor area keeping in mind the complete rebuild of the Harbor that’s being planned?

• Doheny State Beach
This state park already suffers from cracked sewer lines and ongoing sewer leaks that are polluting receiving waters. Has this been analyzed or taken into account? Has an easement been approved by State Parks? What mitigation does SCWD plan to clean 6
up Doheny State Beach's problems since any additional infrastructure added to this already polluted area would only exacerbate the existing problems.

• Other Ocean Desalination Facilities

The following ocean desalination projects are in the vicinity of the proposed SCWD desal project. All are subject to the Ocean Plan Amendment and other applicable regulations, but this DEIR does not include the information necessary to evaluate the current status of the projects nor their actual feasibility. The following is a very brief, yet incomplete analysis of these other facilities. SCWD must do more research and analysis, and learn from the hard lessons taught. However, we see no willingness on the part of SCWD to learn and implement conservation measures that would provide its service area with more than ample water supply.

▪ Carlsbad – 50 MGD (Operational)

Since Poseidon's Carlsbad desalination plant became operational, it has been notably unreliable. In 2017, the company published operating reports containing the following information capacity shortfalls:

Q1	84%
Q2	59%
Q3	42%
Q4	96%

7

- See Municipal Securities Rulemaking Board, California Pollution Control Financing Authority Water Furnishing Revenue Bonds, Series 2012 (Poseidon Resources (Channelside) LP Desalination Project) ("Series 2012 Plant Bonds"). Continuing Disclosures. https://bit.ly/2HkieGd

The facility has also failed to comply with the required Marine Life Mitigation/wetland restoration that was a condition of the permit.

Since Poseidon's Carlsbad desalination plant became operational, it has been responsible for repeated water quality violations.

In April 2016, the San Diego Regional Water Quality Control Board issued a notice of violation (NOV) finding that Poseidon's Carlsbad facility had failed to comply with several provisions of its permit, including failures to comply with discharge prohibitions, failures to comply with receiving water limitations, failure to comply with effluent limitations, and failure to monitor in accordance with permit provisions.

In December 2016, the board issued a staff enforcement letter describing 19 occasions on which Poseidon had exceeded daily maximum toxicity limits.
- See San Diego Regional Water Quality Control Board, Notice of Violation No. R9-2016-0112 (April 7, 2016), http://bit.ly/2oChL8L; id., San Diego Region - Enforcement Actions for December 2016, http://bit.ly/2oWoK00.

In its annual permit discharge monitoring report for 2016, which Poseidon submitted in February 2017, Poseidon stated that it had exceeded chronic toxicity limits in 35 out of 116 or 30% of chronic toxicity tests.
-See Poseidon Channelside, Cover letter for NPDES Discharge Monitoring Report – Annual 2016 NPDES No. CA019223 (February 28, 2017), http://bit.ly/2pb3pQH.

In its annual permit discharge monitoring report for 2017, which Poseidon submitted in March 2018, Poseidon stated that it had exceeded chronic toxicity limits in 36 out of 90 or 40% of chronic toxicity tests. In its monthly reporting for 2018, Poseidon has exceeded chronic toxicity limits in 11 out of 21 or over 50% of chronic toxicity tests available to date.
-See Poseidon Channelside, Cover letter for NPDES Discharge Monitoring Report – Annual 2017 NPDES No. CA019223 (March 1, 2017), https://bit.ly/2HnvppG
-State Water Resources Control Board, California Integrated Water Quality System Project (CIWQS), https://bit.ly/2LpHj54

Short recap of failures and downfalls*:*
- Failure to comply with:
    - Discharge prohibitions
    - Receiving waters limitations
    - Effluent limitations
    - Monitor in accordance with permit provisions
- Exceeded daily maximum toxicity levels on 19 occasions in 2017 resulting in a Notice 7
  of Violation from the SDRWCB. Chronic toxicity levels as follows:
- 2016 - 35 violations
- 2017 - 36 violations
- 2018 - to date, 11 violations and a Category I pollutant violation

<u>• Huntington Beach – 50 MGD (Entitlement)</u>

Upcoming decisions regarding the Project are of precedential importance as California considers how to make its water supply more safe, resilient, equitable, and cost-effective into our collective long-term future. We oppose the Project as proposed because it is not consistent with these goals, and instead would:
(1) Impose significant and unnecessary costs on Orange County water districts and ratepayers;
(2) Set back California's efforts to advance climate-smart water policy;
(3) Fail to alleviate reliance upon, or impacts to, freshwater ecosystems, including the Bay-Delta; and
(4) Fail to comply with California law and regulations that govern seawater desalination facilities.

Upon review of permit application materials and other documents associated with the proposed Project, as well as claims made by the Project's agents and lobbyists, it is believed the Project is not compatible with the common-sense approaches, policies, and regulations that California has established to guide its water investments and, more specifically, to guide the introduction of seawater desalination into the state's water supply portfolio.

• Santa Margarita Water District (SMWD) proposed San Juan Watershed Project (SJWP)

Final EIR and project approval planned for SMWD Board of Director's consideration sometime this Summer (2018). The SJWP proposes several rubber dams upstream of the Doheny Ocean Desalination Project, in San Juan Creek and Trabuco Creek. The SJWP would impact downstream flows into San Juan Creek Lagoon.

The following comments were submitted to SMWD by the Sierra Club's Orange County Conservation Committee:

The EIR for this project needs to do a better job of describing how the project will improve the function of these creeks to support beneficial uses not just maintain current degraded conditions.

The EIR should discuss how the project will deal with upstream illicit dry weather runoff inputs and stormwater pollution discharges. This discussion should include confirmation that this project is not a pollution BMP and will not provide regulatory relief to upstream agencies to meet all water requirements at their discharge sites. This project should not be seen as an excuse to neglect water quality above the project area. 7

The project should include creek restoration such as roosting trees along the creek above the banks and low lying native vegetation in the channel as mitigation for aesthetic and environmental impacts. Contributing funds to a mitigation bank for off-site mitigation should be avoided.

The EIR should include specific information on the potential impacts to the Arroyo Toad and its habitat. It should also include a discussion on potential mitigation for these impacts.

Redirecting storm water and urban runoff to flow into the groundwater reservoirs may cause de-watering of the area below the project area. The discussion in section 3.8-3 on page 3.8-24 should include detail on how much de-watering may happen below the project area and what the affects may be on biological resources, geology and air quality (e.g. cause drying of the earth and dust in the air), and surrounding water sources.

Recycled water that "meets state regulations" is mentioned as a potential input to the creek for infiltration. It is critical that this recycled water match or exceed the quality of the ambient creek water in order to protect wildlife and avoid backsliding on water quality in the creek.

It would appear from the Doheny DEIR that SCWD has not given any thought to the potential impacts of this upstream project.

Given the multiple, impactful projects planned for this entire watershed a complete analysis of all projects is needed along with a timeline as to when these projects are proposed for initial construction and completion, and how they will impact the proposed SCWD desal project:

• Led by Orange County Public Works (OCPW), the San Juan Creek Levee Improvements project 7
• The South Orange County Water Management Area Integrated Regional Water Management (SOC WMA IRWMP)
• The NPDES permit covers waste discharge requirements for the South Orange County Wastewater Authority (SOCWA) discharge to the Pacific Ocean through the San Juan Creek Ocean Outfall. The SOCWA J.B. Latham Wastewater Plant is a conventionally activated sludge treatment facility. All effluent from the SOCWA J.B. Latham WP is discharged to the Pacific Ocean through the SJCOO.

3. Site Overview and Permit Consideration

Included in this submission is a site overview detailing the planned use of the proposed 30-acre site as described by Andy Brunhart in 2016 at the meeting previously mentioned, along with the permit requirements for each area. Given SCWD's and the City of Dana Point's poor environmental track record, it is highly advised that SCWD consult early and frequently with the CCC on all aspects of this project, and that a consolidated permit be the focal point of some of these discussions if SCWD insists on moving forward with an expensive and unneeded desal facility versus simply implementing needed conservation efforts that would provide the District's service area with more than adequate water supply.

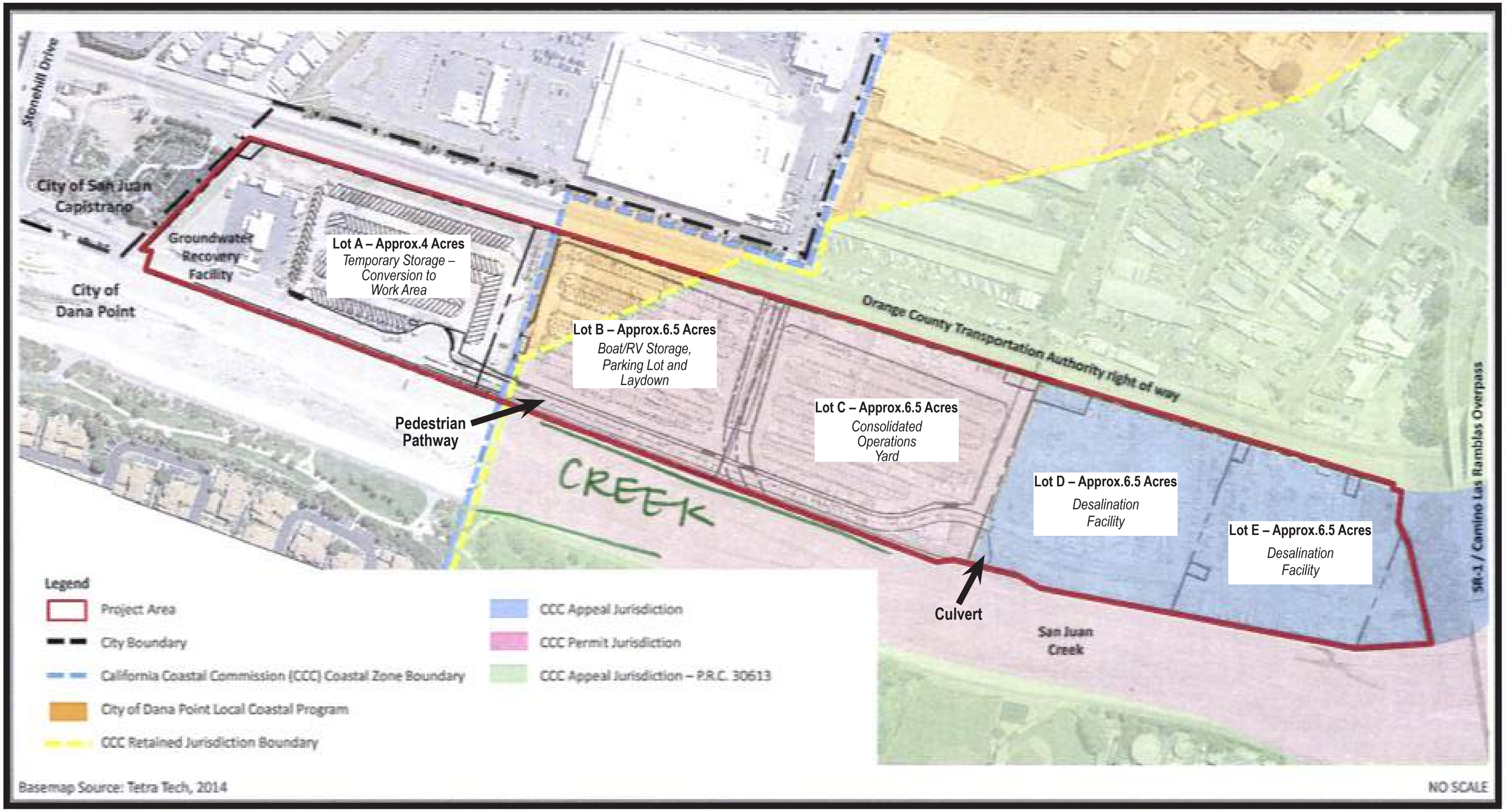
Thank you for the opportunity to submit these comments and we once again reiterate that CONSERVATION is the key to any perceived lack of water in this district and throughout Orange County as evidenced by the attached audit from the Regional Board. 8

Sincerely,

Dan and Penny Elia
Environmental Advocates and 33-year SCWD customers and ratepayers

Attached: • Zip file SDRWQCB Orange County Audit
• SCWD 30-acre site overview

Copied: Tom Luster and Amber Dobson - California Coastal Commission
Laurie Walsh and Roger Mitchell - SDRWQCB
David Shissler and Mike Phillips - City of Laguna Beach Water Quality



SOUTH COAST WATER DISTRICT
DOHENY DESALINATION FACILITY SITE
CUMULATIVE IMPACTS

From: Mitchell, Roger@Waterboards
To: Moy Yahya (myahya@cityofalisoviejo.com)
Cc: Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject: CITY OF ALISO VIEJO OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date: Wednesday, June 20, 2018 11:56:05 AM
Attachments: ATTACHMENT 1_City of Aliso Viejo.pdf

Mr. Yahya,

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is <u>actively and effectively</u> implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Aliso Viejo are included in Attachment 1 =o this e-mail. A written response to any identified recommendations for pr=gram improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or "=*Ineffective*" program elements must be submitted to the San Di=go Water Board in the City's next JRMP Annual Report. An explanation=of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questio=s regarding this program audit, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
Engineering Geologist
San Diego Regional Water Quality Control Board<=o:p>
Surface Water Protection Branch
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San Diego, CA 92108
Roge=.Mitchell@waterboards.ca.gov
Phone 619-521-5898

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PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance [2]**	**Program Element**
✖	✖	*1. Legal Authority Updated to Prohibit Over-Irrigation*
✖	✖	*2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited*
!	!	*3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented*
!	!	*4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition*
!	!	*5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition*
✖		**Overall Program Assessment**
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*

[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a*

Audit Rating Legend			
	Assessment Category		
Symbol	**Program Implementation**	**Permit Compliance**	**Overall Program Assessment**
✖	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	Ineffective Program-Audit findings result in **five or more Program Elements** not implemented or permit compliant
!	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	Potentially Ineffective Program-Audit findings result in **four or less Program Elements** not implemented
✔	All Audit Questions "Yes"	Meets Permit Provision Requirements	Effective Program-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Aliso Viejo (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluates the City's ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, JRMP, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

The San Diego Water Board reviewed Title 7.35, "Stormwater Management" and Title 7.40, "Storm Drains" from the City's Municipal Code. The City identifies in Title 7.40.030 "Waste-Irrigation Water*"* that "*No person owning, occupying or having control of lands adjoining any portion of the storm drain system of the city shall cause or permit waste or irrigation water to flow into such storm drains or upon the right-of-way of the same, except through catch basins constructed for such purpose."* This City ordinance appears to be in violation of provision E.1 and fails to address the requirements of the Regional MS4 Permit because it does not prohibit over-irrigation. Attachment C of the Regional MS4 Permit clearly defines an MS4 to be "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" The City's ordinance to prohibit irrigation water from entering the MS4 authorizes over-irrigation water to enter catch basins when catch basins are clearly a part of the City's MS4. Therefore, the City's ordinance does not appear to have the legal authority to effectively prohibit over-irrigation as required to comply with provision II.E.1.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page and *Storm Water Program* web page were reviewed. Neither of these web pages provides the option to translate the information on the page into another language. Not having the option to translate the City's home page or Storm Water Program web page creates a communication barrier for the non-English speaking residents of the City.

The City's home page does not have information on the over-irrigation prohibition. Nor does the City have a specific link on its home page to assist the public in reporting water pollution. The City's website lacks a reporting system or contact information for over-irrigation reporting. Instead, the City has a *Complaint Form* that can be found on the City's website under the "About Aliso Viejo" tab and in "Forms, Permits and Regulations." This form is a general complaint form that must be printed out and mailed to the City's Code Enforcement Division.

The City's *Storm Water Program* web page shows the posted date of January 20, 2015. This date calls into question whether or not the City is actively updating their website and whether or not the City is actively implementing provision II.E.2 and provision II.E.7. The *Storm Water Program* web page has no information identifying that over-irrigation is an illicit discharge. The web page lists storm water pollutants like "*trash, pet waste, cigarette butts, motor oil, anti-freeze, runoff from pesticides and fertilizers, paint from brushes and containers rinsed in the gutter and toxic household chemicals,*" but does not mention over-irrigation. There is a document on this web page titled "Landscape Maintenance" under the Best Management Practices for Pollution Prevention section that encourages residents to "*properly manage Irrigation runoff*," but this document does not address the over-irrigation prohibition. The City's "Pollution Prevention for Residents" web page lists landscaping as a source of pollution and suggests residents to "*Use the proper procedures for gardening, collection of green waste and application of fertilizers and pesticides. Adjust the sprinklers for minimum water use to eliminate irrigation runoff*." Although it suggests eliminating irrigation runoff, there is no mention of over-irrigation being a prohibited or illicit discharge.

Additionally, there is no link on the City's website or *Storm Water Program* web page to the water district's webpage that identifies prohibitions for over-irrigation or drought information. Nor does the

City's website or *Storm Water Program* web page have a link to the South Orange County WQIP. Instead, the South Orange County WQIP can be found after thoroughly searching the Local Implementation Plan, which opens when the Local Implementation Plan link on the City's *Storm Water Program* web page is activated.

Section A-6.3.2 "Action Campaigns" of the City's Local Implementation Plan, also known as the JRMP, provides information on educational programs for the City, including *Overwatering is Out* action campaign. According to the City's JRMP, "*The ultimate goal of the Overwatering is Out action campaign is to improve water quality through eliminating residential irrigation runoff*." The City's JRMP states that "*The City of Aliso Viejo supports the Overwatering is Out action campaign by hosting outreach booths at city events, posting outreach material on the city website, distributing outreach material at the front counter, and via e-news distribution system."* Based on the City's home page and Storm Water Program web page review, no information was found on the City's web pages that mentions the *Overwatering is Out* action campaign. The only place where information on the *Overwatering is Out* action campaign can be found is in the last link at the bottom of the City's Storm Water Program web page. The link is for the Orange County Watershed Program (www.OCwatershed.com) and can be found under the "Best Management Practices for Mobile Businesses" section of the *Storm Water Program* web page. When this link is activated the Orange County Watershed Program web page appears and an *Overwatering is Out* action campaign banner appears on the web page. The fact that this link is only provided under the "Best Management Practices for Mobile Businesses" section shows that the City does not have an effective method to promote the *Overwatering is Out* action campaign using their *Storm Water Program* web page. The implementation actions identified in section A-6.3.2 of the City's JRMP do not seem to be connected throughout the City's public education and outreach platforms visible to the public on the City website.

Based on the City's inconsistent information available to the public that over-irrigation is a prohibited discharge and the City's lack of reporting system for illicit discharges, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**

- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**

- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**

- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**

- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**

- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

  The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Exhibit A-4. I of the City's' JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, table A-4.2 *Independent Water/Sewer Agency Pollution Prevention Related Ordinances/Programs,* of the JRMP, identifies that the City coordinates with the Moulton Niguel Water District and El Toro Water District to address irrigation runoff control. However, there was no clear statement found on the City's website that communicates to the public that over-irrigation is a prohibited and illicit discharge. The City's web page does not include a mechanism for the public to report over-irrigation as an illicit discharge. Without the ability for the public to easily identify and report over-irrigation as a prohibited discharge, the City and the water districts are likely not made aware of instances of over-irrigation that they can investigation through the IDDE Program.

  Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **<u>Water Quality Improvement Plan (Provisions II.B.3, II.D.2)</u>** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Aliso Viejo is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges

have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the South Orange County WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of Aliso Viejo does not provide any information on its home page or *Storm Water Program* web page about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**
- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the City's March 2017 JRMP that identifies or describes the over-irrigation prohibition. Section A-9.5.4 states, "…*the implementation of the residential program will rely on education and outreach to notify and urge residents to observe the designated sets of BMPs for each of the high threat activities. The City will encourage the implementation of the designated BMPs for each residence within its jurisdiction by conducting the following as appropriate: …Updating the City's Website (http://www.cityofalisoviejo.com/) by providing the BMP fact sheets and information on residential stormwater pollution prevention."* The JRMP contains minimum BMPs (Table A-9.3) that the City finds to be appropriate to prevent or mitigate pollution from residential land uses. The JRMP has BMP factsheets that identify common methods to addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. These factsheets can also be found on the City's *Storm Water Program* web page.

The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

   The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

   Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for provision B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Of significant concern is the fact that there is no mechanism for the public to report over-irrigation to the City. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through its various JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach

on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From:	Mitchell, Roger@Waterboards
To:	LISA ZAWASKI
Cc:	Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject:	CITY OF DANA POINT OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date:	Wednesday, June 20, 2018 11:56:12 AM
Attachments:	ATTACHMENT 1_City of Dana Point.pdf

Ms. Zawaski,=/p>

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is actively and effectively implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==" >[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1] *Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

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For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program eff=ctiveness ratings out of a total of ten.

The San Diego Water Boa=d audit findings for the City of Dana Point are included in Attachment 1 t=

this e-mail. A written response to any identified recommendations for pro=ram improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or "*Inef=ective*" program elements must be submitted to the San Diego Wate= Board in the City's next JRMP Annual Report. An explanation of the =udit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
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San Diego Regional Water Quality Control Board<=o:p>
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of Dana Point
WDID No.: 9 30M1000287; Place ID: 219073
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance**[2]	**Program Element**
✖	✖	*1. Legal Authority Updated to Prohibit Over-Irrigation*
✖	!	*2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited*
!	!	*3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented*
!	!	*4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition*
!	!	*5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition*
✖		**Overall Program Assessment**
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*
[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2, II.F.2.a*

Audit Rating Legend			
Symbol	**Assessment Category**		
	Program Implementation	**Permit Compliance**	**Overall Program Assessment**
✖	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
!	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
✔	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Dana Point (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluated the City's JRMP, ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County).
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

   Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? ***No***

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* ***No***

   The San Diego Water Board reviewed Title 14 "Streets and Sidewalks" and Title 15 "Water and Sewers" from the City's Municipal Code. The City identifies in Title 14.01.290 "Water" that "*It shall be and is hereby declared unlawful for any person to run, or to allow to run, upon any highway or right of way thereof, any private irrigation, pool effluent which has not been dechlorinated, private waste or other water, provided that such water may be allowed to run upon or in any drainage ditch along the side of such highway or right-of-way thereof if the same does not fill or overflow such ditch or run upon or percolate into or under the base of the paved or traveled portion of such highway."*

   The City's ordinance inappropriately excludes drainage ditches next to the street from being a part of the MS4. Attachment C of the Regional MS4 Permit clearly defines an MS4 to include ditches "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" Based on an inappropriate definition of MS4, the City does not appear to have effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**
- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**
- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**
- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**
- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**
- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page, *Ocean Water Quality/Surface Runoff* web page, and *Water Conservation* web page were reviewed. Neither of these web pages provides the option to translate the information on the page into another language. Not having the option to translate the City's web pages creates a communication barrier for the non-English speaking residents of the City.

The City's "How to Report a Problem" web page, found under the Public Works and Engineering Department section, provides information on who to contact for water quality concerns; "*If you have a question regarding water quality or other environmental concerns, or want to report a pollutant discharge please contact Lisa Zawaski at (949) 248-3584 or lzawaski@danapoint.org or the 24-hour complaint hotline at (949) 248-3573. 24-hour after hours emergency at (877) 89-SPILL.*" However, the over-irrigation prohibition is not identified or listed as a reportable prohibited discharge through the City's hotline reporting system.

The City's *Water Conservation* web page can be found under the "Environmental" section of the Public Works and Engineering Department. The web page contains newsletters from the South Coast Water District and provides a link to the *Overwatering is Out* action campaign home page. According to Section 6.3.1 of the City's Local Implementation Plan, "*The ultimate goal of the Overwatering is Out action campaign is to improve water quality through eliminating residential irrigation runoff*." The City of Dana Point is one of the few Copermittees in Orange County to promote the *Overwatering is Out* campaign directly on their web pages. The web page also provides information on irrigation runoff: "*Did you know that one of the biggest sources of water pollution is irrigation runoff from our yards and landscaped areas? Conserving water at home will save money and protect our beaches and ocean at the same time*." However, there is no clear statement on the City's web page that over-irrigation is a prohibited and illicit discharge. The City's web page also includes links and contact information for the South Coast Water District, Moulton Niguel Water District and San Juan Capistrano Water and Sewer Utilities. When these links are activated, the water district's home page appears, but the web pages do not identify prohibitions for over-irrigation or drought information. On the *Water Conservation* web page there is a link to a PDF factsheet titled "Outdoor Water Saving

Tips" that provides tips for landscape irrigation, but the PDF does not identify over-irrigation as a prohibited and illicit discharge.

The City's *Ocean Water Quality/Surface Runoff* web page provides contact information for the department and provides a number to report illicit discharges. There is a link on this web page titled *Regulations*, when this link is activated a new page opens and information on illicit discharges, Total Maximum Daily Loads Water Quality Management Plan and BMPs is shown. The web page identifies: "*Illegal discharges are discharges from business and residential activities that enter the streets and storm drain system resulting in pollution at our beaches and ocean. Some examples of illegal discharges include: Wash water from cleaning or hosing parking lots, streets, sidewalks, driveways, patios, plazas, work yards and outdoor eating or drinking areas*." This statement does not identify irrigation water as an illicit discharge.

There is another link on this web page titled *Tips and Requirements for Residents*, when this link is activated a new page appears where the *Water Quality Requirements for Landscape Irrigation* PDF can be found. The PDF provides information on irrigation: "*To comply with required State storm water regulations (Order No. R9-2009-0002) which prohibit water runoff from your property due to irrigation activities, the following Best Management Practices (BMPs) are required for all irrigation systems. Please be aware, however, that implementation of these strategies by themselves does not necessarily guarantee compliance. Additional actions may be needed to fully control surface water runoff. The BMPs, along with the "Implementation Strategies" and "Other Tips & Techniques" are designed to prevent water runoff from your property from entering the public storm drain system. Please remember that these requirements are in place to protect and improve our beaches, creeks, and the ocean. Please contact Lisa Zawaski at 949-248-3584 for more info."* This PDF provides useful information on BMPs to prevent irrigation runoff.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**

- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**

- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**

- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**

- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

  The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Exhibit 4.1 of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, table 4.2 *Independent Water/Sewer Agency Pollution Prevention Related Ordinances/Programs*, of the JRMP, identifies that the City coordinates with the South Coast Water District, the Moulton Niguel Water District, and the San Juan Capistrano Water and Sewer Utilities to address irrigation runoff control. However, there was only one statement found on the City's website that communicates to the public that over-irrigation is a prohibited discharge; "*To comply with required State storm water regulations (Order No. R9-2009-0002) which prohibit water runoff from your property due to irrigation activities…"* This statement can be found in the *Water Quality Requirements for Landscape Irrigation* link on the City's website in PDF format, but is not directly stated on the City's web page. Without the ability for the public to easily identify over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

  Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **<u>Water Quality Improvement Plan (Provisions II.B.3, II.D.2)</u>** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Dana Point is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify

and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the Watershed Management Area (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the South Orange County WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." The City of Dana Point does indeed promote the *Overwatering is Out* campaign on two of its web pages; the *Water Conservation* and the *Ocean Water Quality/Surface Runoff* web page, but the City's web pages are missing crucial information that over-irrigation is both a prohibited and illicit discharge.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**

- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**

- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the City's April 2017 draft JRMP that identifies or describes the over-irrigation prohibition. The City's JRMP, includes Table 4.1 *City of Dana Point Pollution Prevention Related Codes* which identifies Ordinance 14.01.290, but does not identify an ordinance specifically for over-irrigation. The JRMP identifies BMP requirements for the City's residential program. JRMP section 9.3.1 *Residential/Homeowner Association and Pollutant Source Inventory* states that "*Residential pollutants and activities that have potential to impact water quality and the HPWQCs, as identified in the South Orange County Water Quality Management Plan, are the focus of the residential program, and include: Non-storm water discharges including sprinkler runoff, car wash washwater, and other residential washwater."* Thus, the City's JRMP identifies sprinkler runoff as a residential activity that generates pollutants having potential to impact water quality, but does not communicate that the discharge is prohibited. Section 9.3.2 of the JRMP provides minimum activity-specific BMPs for residential activities. Table 9.4 BMPs for Homeowner's Association (HOAs) shows that there is a BMP factsheet, *Landscape Maintenance BMPs*, for the activity of "landscape maintenance including irrigation and fertilization." Section 4.4 of the City's JRMP identifies "*Most significantly, each of the three water districts, which serve Dana Point have adopted enforceable ordinances or programs that prohibit irrigation runoff into the storm drain."* Exhibit 5.6 of the JRMP includes a document titled "Water Quality Requirements for Landscape Irrigation" which provides tips for managing and controlling irrigation runoff. Additionally, Exhibit 7.1, a document titled "Low Impact Development and Source Control BMP for All Redevelopment/Development Projects," states the goal to "*Prevent illicit discharges into the MS4, including sprinkler/irrigation runoff*." The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through some of its JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From: Mitchell, Roger@Waterboards <Roger.Mitchell@waterboards.ca.gov>
Sent: Wednesday, June 20, 2018 11:56 AM
To: Mary Vondrak
Cc: Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject: CITY OF LAGUNA BEACH OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Attachments: ATTACHMENT 1_City of Laguna Beach.pdf

Ms. Vondrak,=/p>

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is actively and effectively implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==" >[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code
2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>

4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]Order R9-2013-0001, as amended

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Laguna Beach are included in *Attachment 1* to this e-mail. A written response to any identified re=ommendations for program improvements or Program Audit Summary Findings of="*Potentially Ineffective*" or "*Ineffective*&=8221; program elements must be submitted to the San Diego Water Board in the City's next JRMP Annual Report. An explanation of=the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
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Roge=.Mitchell@waterboards.ca.gov
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of Laguna Beach
WDID No.: 9 37M1000313; Place ID: 236118
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	Permit Compliance[2]	Program Element
✖	✖	*1. Legal Authority Updated to Prohibit Over-Irrigation*
✖	!	*2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited*
!	!	*3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented*
!	!	*4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition*
!	!	*5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition*
✖		**Overall Program Assessment**
Ineffective Program		

[1] See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings
[2] Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a

Audit Rating Legend			
	Assessment Category		
Symbol	Program Implementation	Permit Compliance	Overall Program Assessment
✖	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
!	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
✔	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Laguna Beach (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluated the City's JRMP, ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

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[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County).
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended.
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

   Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

   The San Diego Water Board reviewed Title 16.0, "Water Quality Control" and Title 19.0, "Water Efficient Landscape" from the City's Municipal Code. The City's Municipal Code states, "*"Illicit discharge" means a discharge to the city's storm water drainage system that is not entirely composed of storm water except discharges pursuant to a separate NPDES/MS4 permit (other than the NPDES/MS4 permit for discharges) and discharges resulting from emergency firefighting activities."* Title 16.0 and 19.0, do not specifically identify over-irrigation as a prohibited or illicit discharge.

   Based on the lack of designation in the City's ordinance that over-irrigation is a prohibited discharge, the City does not appear to demonstrate effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**
- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**
- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**
- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**
- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**
- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page, *Water Quality Department* web page, and *Water Quality Division* web page were reviewed. Neither of these web pages provides the option to translate the information on the page into another language. Not having the option to translate the City's web pages creates a communication barrier for the non-English speaking residents of the City.

The City's home page has an "ASKLAGUNA" tab, found towards the bottom of the page. The *Water Quality Department* web page and the *Water Quality Division* web page also have an "ASKLAGUNA" tab on the left-hand side of the web pages. When this tab is activated a new page appears to submit a request. Through this request a water pollution problem can be reported. There is the option to choose the issue of "Irrigation Overspray" under the "Wastewater and Water Quality" tab in the request page. The City's "ASKLAGUNA" request page serves as a useful tool for the public to report over-irrigation, however, the City's web pages do not identify or list that over-irrigation is both a prohibited and illicit discharge. Thus, it would be unclear for the public to know whether over-irrigation is a reportable prohibited discharge.

The *Water Quality* Department web page provides a hotline reporting number "to report sewer spills." However, the over-irrigation prohibition is not clearly identified or listed as a reportable prohibited discharge through the Copermittee's hotline reporting system. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information. Nor does the City's web page include information on the *Overwatering is Out* action campaign. The *Water Quality Division* web page does not provide information identifying that over-irrigation is a prohibited and illicit discharge. The web page provides links to the Orange County MS4 Permit, the South Orange County WQIP and to the City's Local Implementation Plan, also known as the JRMP. Although these links serve as useful resources, when the links are activated no immediate information on the over-irrigation prohibition appears.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**
- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**
- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**
- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**
- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Attachment A-3 of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, table 4.4.1 *Separate Agency Pollution Prevention Ordinances*, of the JRMP, identifies that the City coordinates with the South Coast Water District to address irrigation runoff control. However, there was no clear statement found on the City's website that communicates to the public that over-irrigation is prohibited. Nor do the City's ordinances describe over-irrigation as an illicit discharge. Without the ability for the public to easily identify over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Laguna Beach is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flows into and from the MS4, as specified in section 3.3.1.2 of the South Orange County WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."*

The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of Laguna Beach does not provide any information on its home page, *Water Quality Department* web page, or *Water Quality Division we*b page about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**
- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the City's March 2017 draft JRMP that identifies or describes the over-irrigation prohibition. The City updated their JRMP and has identified minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. The City's JRMP, section A.3.4

High Priority Pollutants and Potential Sources, identifies irrigation runoff as a non-exempt discharge; "*In accordance with the Fourth Term Permit's requirement that landscape irrigation runoff be re-categorized as a non-exempt discharge, landscape irrigation runoff is also defined as a high priority pollutant in the City*." The JRMP has BMP factsheets that identify common methods to addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. Table A-9.5 shows BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance BMPs" for the activity of "landscape maintenance including irrigation and fertilization." This factsheet was not found in the JRMP and was not evaluated. Through a few sections of the JRMP the City promotes efficient water saving tips to reduce irrigation runoff. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for provision B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through some of its JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From: Mitchell, Roger@Waterboards
To: Ken Rosenfield_Laguna hills
Cc: Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject: CITY OF LAGUNA HILLS OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date: Wednesday, June 20, 2018 11:56:29 AM
Attachments: ATTACHMENT 1_City of Laguna Hills.pdf

Mr. Rosenfield,

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction’s program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board’s Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee’s jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is actively and effectively implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *“Non-storm water discharges into MS4s are to be effectively prohib=ted…”* The program audit assessed each Copermittee’s =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee’s resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Laguna Hills are included in Attachment

1=to this e-mail. A written response to any identified recommendations for p=ogram improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or "=*Ineffective*" program elements must be submitted to the San Di=go Water Board in the City's next JRMP Annual Report. An explanation=of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questio=s regarding this program audit, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
Engineering Geologist
San Diego Regional Water Quality Control Board<=o:p>
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Roge=.Mitchell@waterboards.ca.gov
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PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
		1. Legal Authority Updated to Prohibit Over-Irrigation
		2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited
		3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented
		4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition
		5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition
		Overall Program Assessment
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*
[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a*

Audit Rating Legend			
	Assessment Category		
Symbol	**Program Implementation**	**Permit Compliance**	**Overall Program Assessment**
	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Laguna Hills (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluated the City's JRMP, ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

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[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

   Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? ***No***

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* ***No***

   The San Diego Water Board reviewed Chapter 12-20 "Obstructions" under Title 12 "Streets and Sidewalks" of the City's Municipal Code. The City identifies in Ordinance 12-20.030 "Water" that "*It is unlawful for any person, firm or corporation to run, or to allow to run, upon any highway or right-of-way thereof, any irrigation, waste or other water, provided that such water may be allowed to run upon or in any drain ditch along the side of such highway or right-of-way thereof if the same does not fill or overflow such ditch or run upon or percolate under the base of the paved or traveled portion of such highway."*

   The City's ordinance inappropriately excludes drainage ditches next to the street from being a part of the MS4. Attachment C of the Regional MS4 Permit clearly defines an MS4 to include ditches "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" Based on an inappropriate definition of MS4, the City does not appear to have effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page and *Water Quality* web page were reviewed. The City's web pages provide the public with the option to translate the information on the page into another language. Having the option to translate the City's web pages allows the non-English speaking public to have access to valuable information and results in better communication to the City's residents.

The City's home page does not identify the over-irrigation prohibition. The City's home page has a "Report an Issue" link on the right-hand side of the home page. When this link is activated a new web page is opened titled "RequestTracker." The "RequestTracker" has the option to report a "Storm Drain or Water Quality Issue," however, over-irrigation is not identified as a reportable prohibited discharge through the reporting system. Thus, it would be unclear for the public to know whether over-irrigation is a reportable prohibited discharge.

The City's *Water Quality* web page can be found in the "Public Works" section under the Public Services Department. The link to "Report an Issue" can be found on the left-hand side of the web page. The web page also contains a link to the Orange County Watershed website, contact numbers for reporting water quality issues, and provides several PDF documents about water quality. There are about 43 PDF documents that fall under the sections of: "Water Quality Documents," "Construction and New Development Projects," "Industrial Commercial," and Residential BMP's.*"* The *"R4 Home and Garden Care" and "R8 Water Conservation"* PDFs were thoroughly reviewed and although the PDFs have useful information regarding irrigation practices, there is no information that over-irrigation is prohibited and an illicit discharge. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information. Nor does the City's web page include information on the *Overwatering is Out* action campaign.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**

- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**

- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**

- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**

- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**

- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The San Diego Water Board reviewed the City's JRMP and did not find an Enforcement Response Plan attachment. Section A-10 *Illegal Discharges/Illicit Connections* states "*In order to be consistent countywide, the City of staff use the Enforcement Response Plan (Exhibit A-4.1) to assist them in determining which type of enforcement action should be used for any given incident*." This statement makes reference to the Enforcement Response Plan being attached as Exhibit A-4.1, however, there is no attachment. Section A-10 of the City's JRMP provides information about the enforcement of illicit discharges and illicit connections, but does not define over-irrigation as an illicit discharge. Additionally, table A-4.2 *Independent Water/Sewer Agency Pollution Prevention Related Ordinances/Programs*, of the JRMP, identifies that the City coordinates with the Moulton Niguel Water District and El Toro Water District to address irrigation runoff control. However, there was no clear statement found on the City's website or IDDE program that communicates to the public that over-irrigation is a prohibited and illicit discharge. Without the ability for the public to easily identify over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan (WQIP) that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Laguna Hills is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the South Orange County WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are* *exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of Laguna Hills does not provide any information on its home page or *Water Quality* web page about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**
- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the City's April 2017 JRMP that identifies or describes the over-irrigation prohibition. The City's JRMP identifies minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. The JRMP has BMP factsheets that identify common methods for addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. Table A-9.5 shows BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance BMPs" for the activity of "landscape maintenance including irrigation and fertilization." Factsheet FP-2 *Landscape Maintenance* promotes efficient water saving tips to reduce irrigation runoff. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Additionally, section A-6.3.2 "Action Campaigns" of the City's JRMP states "*The City of Laguna Hills supports the Overwatering is Out action campaign by promoting the program's event in City newsletters and including a link to www.overwateringisout.org on the City website*." However, there was no link or reference to the *Overwatering is Out* action campaign on the City's websites.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Loads schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through its various JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that the City's JRMP includes an Enforcement Response Plan, the City demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From:	Mitchell, Roger@Waterboards
To:	Hal Ghafari
Cc:	Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject:	CITY OF LAGUNA NIGUEL OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date:	Wednesday, June 20, 2018 11:56:37 AM
Attachments:	ATTACHMENT 1_City of Laguna Niguel.pdf

Mr. Ghafari,

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is actively and effectively implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title===">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

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For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Laguna Niguel are included in Attachment =

to this e-mail. A written response to any identified recommendations for =rogram improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or "=*Ineffective*" program elements must be submitted to the San Di=go Water Board in the City's next JRMP Annual Report. An explanation=of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
Engineering Geologist
San Diego Regional Water Quality Control Board<=o:p>
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PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
✖	✖	*1. Legal Authority Updated to Prohibit Over-Irrigation*
✖	!	*2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited*
!	!	*3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented*
!	!	*4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition*
!	!	*5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition*
✖		**Overall Program Assessment**
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*

[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2, II.F.2.a*

Symbol	Audit Rating Legend		
	Assessment Category		
	Program Implementation	**Permit Compliance**	**Overall Program Assessment**
✖	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
!	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
✔	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Laguna Niguel (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluated the City's JRMP, ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

   Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

  The San Diego Water Board reviewed Title 7, "Highways, Rights-of-Way and Vehicles" of the City's Municipal Code. Section 7-1-58 "Permitting Water to Run Over Street" states "*It shall be and is hereby declared unlawful for any person to run or to allow to run upon any highway or street or right-of-way thereof any irrigation, waste or other water, provided that such water may be allowed to run upon or in any drain ditch along the side of such highway or street or right-of-way thereof if the water does not fill or overflow such ditch or run upon or percolate under the base of the paved or traveled portion of such highway or street."*

  The City's ordinance inappropriately excludes drainage ditches next to the street from being a part of the MS4. Attachment C of the Regional MS4 Permit clearly defines an MS4 to include ditches "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" Based on an inappropriate definition of MS4, the City does not appear to have effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page, *Urban Runoff Management* web page, and the *eTrakit Permit and Request System* web page were reviewed. Neither of these web pages provide the option to translate the information on the page into another language. Not having the option to translate the City's web pages creates a communication barrier for the non-English speaking residents of the City.

The City's home page does not have information on the over-irrigation prohibition. The City's home page provides the option to report a problem through the *eTrakit Permit and Request System* web page. To submit a request, a user would have to hover over the "How Do I…?" tab of the City's home page and select "Request" and "Service or Report a Problem." The *eTrakit Permit and Request System* web page requires log in information for a request to be submitted. The over-irrigation prohibition is not addressed or listed as a reportable discharge through the City's reporting system. Thus, it would be unclear for the public to know whether over-irrigation is a reportable prohibited discharge.

The City's *Urban Runoff Management* web page can be found under the Public Works Department. On the right-hand side of the web page a "Report a Spill" link is available for the public to report a water pollution problem. When the link is activated the County of Orange Public Works web page appears. Contact numbers for reporting water pollution problems are provided in this web page. The *Urban Runoff Management* web page contains a link to the South Orange County WQIP and provides links to other City web pages; *Water Quality Laws, Construction, New Development* and *Best Management Practices*. The City's *Water Quality Laws* web page does not provide information about the over-irrigation prohibition. The City's *Best Management Practices* web page provides BMP brochures for residential and commercial purposes. There is a BMP factsheet titled "Landscape Services" that provides information on irrigation runoff being prohibited; "*Please note that it is unlawful for wash water or other non-storm water, generated by landscapers, to enter storm drains."* Although this brochure states irrigation runoff is prohibited, it does not make a direct correlation to include over-irrigation as a prohibited discharge. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information. Nor does the City's web page include information on the *Overwatering is Out* action campaign.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**
- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**
- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**
- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**
- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Exhibit 4.III of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, the City does not identify an active coordination with the local water agency in the City's JRMP nor in the City's website. There was no clear statement found on the City's website that communicates to the public that over-irrigation is a prohibited and illicit discharge. Without the ability for the public to easily identify over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Laguna Niguel is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry* *weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of Laguna Niguel does not provide any information on its home page or *Urban Runoff Management* web page about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**

- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**

- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**
The San Diego Water Board did not find information in the City's April 2017 draft JRMP that identifies or describes the over-irrigation prohibition. Section 4.3.1 of the City's JRMP states, "*The City's*

ordinance requires that irrigation of all existing landscaped areas comply with the Water Waste Prohibitions in Moulton Niguel Water District's Water Conservation and Drought Response Regulations applicable to potable water, and to MNWD's Design Standards and Regulations Governing Users of Recycle Water. LNMC Article 2, Sections 7-1-56 through 7-1-57 make it unlawful for any person to place, track, deposit or allow the flood of clay, mud, oil, petroleum, irrigation water or other waste-water onto the street. The detection, elimination and enforcement activities undertaken by the City are described further in Section 10." Although this statement mentions ordinances related to prohibiting irrigation runoff, there was no specific ordinance in the City's JRMP that prohibits over-irrigation from entering the MS4.

The City's JRMP contains minimum BMPs for commercial and industrial activities (Table 9.1), for residential activities (Table 9.2), and for municipal activities (Section 5.3.4). The JRMP also has BMP factsheets that identify methods to addressing irrigation runoff, specifically BMP factsheet "IC21. Irrigation Runoff" and "R8. Irrigation Runoff." Exhibit 5.II *Activity-Specific BMP Checklists* includes checklists titled "FP-2 Landscape Maintenance" and "FP-2A Irrigation Runoff Elimination" that also provide information on irrigation runoff management. Although these factsheets provide useful information, these factsheets do not include information on over-irrigation being a prohibited and illicit discharge. Section 10.2 *Prevention and Detection* of the City's JRMP lists "*Coordination with the Moulton Niguel Water District (MNWD) to publicize water conservation regulations and penalties and City ordinances prohibiting landscape irrigation runoff"* as one of the City's activities to "*assist in the prevention and detection of illegal discharges and illicit connections*." However, there was no link or reference to the Moulton Niguel Water District on the City's *Urban Runoff Management* web page. This calls into question whether or not the City is actively coordinating with the local water agency to address over-irrigation. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Loads schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through its various JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From: Mitchell, Roger@Waterboards <Roger.Mitchell@waterboards.ca.gov>
Sent: Wednesday, June 20, 2018 11:57 AM
To: 'Chris Macon - Laguna Woods'
Cc: Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject: CITY OF LAGUNA WOODS OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Attachments: ATTACHMENT 1_City of Laguna Woods.pdf

Mr. Macon,

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is <u>actively and effectively</u> implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code
2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>

4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

1Order R9-2013-0001, as amended

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Laguna Woods are included in Attachment 1=to this e-mail. A written response to any identified recommendations for p=ogram improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or "*=Ineffective*" program elements must be submitted to the San Di=go Water Board in the City's next JRMP Annual Report. An explanation=of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of Laguna Woods
WDID No.: 9 30M1000290; Place ID: 236148
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
		1. Legal Authority Updated to Prohibit Over-Irrigation
		2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited
		3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented
		4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition
		5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition
		Overall Program Assessment
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*
[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a*

Audit Rating Legend			
	Assessment Category		
Symbol	**Program Implementation**	**Permit Compliance**	**Overall Program Assessment**
	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Laguna Woods (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluates the City's ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, JRMP, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County).
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended.
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

The San Diego Water Board reviewed Title 9, "Streets, Highways, and Public Places" from the City's Municipal Code. Section 9.02.030 "Water" states "*It shall be and is hereby declared unlawful for any person, firm or corporation to run, or to allow to run, upon any highway or right-of-way thereof, any irrigation, waste or other water, provided that such water may be allowed to run upon or in any drain ditch along the side of such highway or right-of-way thereof if the same does not fill or overflow such ditch or run upon or percolate under the base of the paved or traveled portion of such highway*."

The City's ordinance inappropriately excludes drainage ditches next to the street from being a part of the MS4. Attachment C of the Regional MS4 Permit clearly defines an MS4 to include ditches "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" Based on an inappropriate definition of MS4, the City does not appear to have effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. The City's web pages provide the public with the option to translate the information on the page into another language. Having the option to translate the City's web pages allows the non-English speaking public to have access to valuable information and results in better communication to the City's residents.

The City does not have a storm water program web page nor does the City have a web page about water quality. No information regarding the over-irrigation prohibition was found on any of the City's web pages. The City's home page has a tab titled "Contact Us" with contact information and a section where questions or comments can be submitted. This section requires information from the person submitting the request and does not provide the option to categorize the type of request. For example, there is no option for the public to choose to submit a water pollution problem. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information. Nor does the City's web page include information on the *Overwatering is Out* action campaign.

Based on the lack of storm water program information available to the public on the City's website, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation to the MS4 is ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established

pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**

- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**

- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**

- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**

- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**

- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Exhibit A-4. I of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, table A-4.2 *Independent Water/Sewer Agency Pollution Prevention Related Ordinances/Programs*, of the JRMP, identifies that the City coordinates with the El Toro Water District to address irrigation runoff control. However, there was no clear statement found on the City's website that communicates to the public that over-irrigation is a prohibited and illicit discharge. Without the ability for the public to easily identify or report over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Laguna Woods is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA

strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "a*s part of this Plan, the Permittees will continue this initiative and adapt or* *expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of Laguna Woods does not provide any information on its web pages about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**
- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the City's March 2017 JRMP that identifies or describes the over-irrigation prohibition. Table A-9.5 lists BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance BMPs" for the activity of "landscape maintenance including irrigation and fertilization." Two factsheets, *FP-2 Landscape Maintenance* and *IC-7 Landscape Maintenance*, include information on reducing irrigation runoff, but do not provide information on over-irrigation being a prohibited discharge. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program that is visible to the public does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through some of its JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From:	Mitchell, Roger@Waterboards
To:	Slaven, Devin (dslaven@lakeforestca.gov)
Cc:	Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject:	CITY OF LAKE FOREST OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date:	Wednesday, June 20, 2018 11:56:51 AM
Attachments:	ATTACHMENT 1_City of Lake Forest.pdf

Mr. Slaven,<=p>

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is <u>actively and effectively</u> implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Lake Forest are included in Attachment 1

=o this e-mail. A written response to any identified recommendations for pr=gram improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or "=*Ineffective*" program elements must be submitted to the San Di=go Water Board in the City's next JRMP Annual Report. An explanation=of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
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San Diego Regional Water Quality Control Board<=o:p>
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of Lake Forest
WDID No.: 9 30M1000291; Place ID: 236212
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
		1. Legal Authority Updated to Prohibit Over-Irrigation
		2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited
		3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented
		4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition
		5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition
		Overall Program Assessment
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*
[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2, II.F.2.a*

Audit Rating Legend			
	Assessment Category		
Symbol	**Program Implementation**	**Permit Compliance**	**Overall Program Assessment**
	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Lake Forest (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluates the City's ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, JRMP, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

The San Diego Water Board reviewed Title 14 "Streets and Sidewalks" of the City's Municipal Code. The City identifies in Title 14.24.030 "Water" that "*It shall be and is hereby declared unlawful for any person, firm or corporation to run, or to allow to run, upon any highway or right-of-way thereof, any irrigation, waste or other water, provided that such water may be allowed to run upon or in any drain ditch along the side of such highway or right-of-way thereof if the same does not fill or overflow such ditch or run upon or percolate under the base of the paved or traveled portion of such highway*."

The City's ordinance inappropriately excludes drainage ditches next to the street from being a part of the MS4. Attachment C of the Regional MS4 Permit clearly defines an MS4 to include ditches "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" Based on an inappropriate definition of MS4, the City does not appear to have effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page, *Water Quality* web page, *BMPs* web page, and *Residential Activities* web page. Neither of these web pages provides the option to translate the information on the page into another language. Not having the option to translate the City's web pages creates a communication barrier for the non-English speaking residents of the City.

The City's home page does not have information on the over-irrigation prohibition. The City's web page has a tab on the left-hand side titled "Ask Lake Forest Contact Us." When this link is activated, a list of reportable categories appears. The categories associated with water are *General Water Inquiries*, *Water Provider, and Pollution Prevention/Water Quality.* To submit a request, the log in system requires a log in. The over-irrigation prohibition is not addressed or listed as a reportable discharge through the City's reporting system. Thus, it would be unclear for the public to know whether over-irrigation is a reportable prohibited discharge. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information.

The City's *Water Quality* web page provides a list of BMP activities and links to factsheets associated with each activity. The web page also provides a link to the Orange County Watersheds division of the Orange County Public Works Department. The web page lists common storm drain pollutants and includes a link to the *Overwatering is Out* action campaign under the *Lawn and Garden* section. The City of Lake Forest is one of the few Copermittees in Orange County to promote the *Overwatering is Out* campaign directly on its web pages. Finally, the web page also provides contact numbers for reporting water pollution. The *Water Quality* web page does not identify over-irrigation as a prohibited and illicit discharge.

The *BMPs* web page provides links to BMP factsheets within the sections of: Common Interest Area/Homeowner Associations, Construction Activities, Industrial and Commercial Business Activities, Municipal Activity, New Development/Significant Redevelopment and Residential Activities. The *Residential Activities* web page provides BMP factsheets to eight types of residential activities. Factsheet *R-04 Home and Garden Care Activities* and *R-08 Water Conservation* were reviewed. None of these factsheets address the over-irrigation prohibition.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

   Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**
- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**
- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**
- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**
- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **No**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The San Diego Water Board does not have a final JRMP from the City of Lake Forest, therefore, the San Diego Water Board reviewed the City's draft JRMP from April 1, 2017. This draft JRMP addresses an Enforcement Response Plan that the City follows to enforce their legal authority. However, there was no documents attached as part of the Enforcement Response Plan in the City's draft JRMP. The draft JRMP provides a cover letter to Exhibit A-4.1 *Enforcement Response Plan*, but the Enforcement Response Plan document is missing. The City of Lake Forest is in **violation** of provision II.E.6 of the Regional MS4 Permit, which requires that the City implement an Enforcement

Response Plan as part of its JRMP. This violation may be subject to enforcement actions from the San Diego Water Board.

Additionally, the City does not identify an active coordination with the local water agency in the City's JRMP nor in the City's website. There was no clear statement found on the City's website that communicates to the public that over-irrigation is a prohibited and illicit discharge. Without the ability for the public to easily identify over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Lake Forest is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The

South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." The City of Lake Forest does indeed promote the *Overwatering is Out* campaign on its *Water Quality* page, but the City's web pages are missing crucial information that over-irrigation is both a prohibited and illicit discharge.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**

- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

  The San Diego Water Board did not find information in the City's April 2017 draft JRMP that identifies or describes the over-irrigation prohibition. The draft JRMP has BMP factsheets, listed in Table A-9.5, associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance BMPs" for the activity of "landscape maintenance including irrigation and fertilization." Factsheet *FP-2 Landscape Maintenance* and *IC-7 Landscape Maintenance* promote efficient water saving tips to reduce irrigation runoff. The City's draft JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the draft JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's draft JRMP or any of the public education and outreach materials reviewed as part of this audit.

  Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its draft JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The City of Lake Forest is a Copermittee under Order No. R9-2013-0001, and any subsequent orders issued by the San Diego Water Board, until the California Regional Water Quality Control Board, Santa Ana Region (Santa Ana Water Board) adopts their own order. At the time of this audit, the Santa Ana Water Board has not adopted their own MS4 permit, therefore, the City of Lake Forest is required to fully comply with the provisions in Order No. R9-2013-0001.

2. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

   The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

   Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

3. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

4. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

5. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and draft JRMP are consistent with the City's South Orange County WQIP strategies.

6. For this audit, the review of the City's ordinances and draft JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through its various draft JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

7. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next draft JRMP annual report. The San Diego Water Board expects the City to include in its draft JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its draft JRMP accordingly.

From:	Mitchell, Roger@Waterboards
To:	"Joe Ames (james@cityofmissionviejo.org)"
Cc:	Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject:	CITY OF MISSION VIEJO OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date:	Wednesday, June 20, 2018 11:57:00 AM
Attachments:	ATTACHMENT 1_City of Mission Viejo.pdf

Mr. Ames,

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is <u>actively and effectively</u> implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted..."* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

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For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Mission Viejo are included in Attachment =

to this e-mail. A written response to any identified recommendations for =rogram improvements or Program Audit Summary Findings of “*Potentially Ineffective*” or “=*Ineffective*” program elements must be submitted to the San Di=go Water Board in the City’s next JRMP Annual Report. An explanation=of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of Mission Viejo
WDID No.: 9 30M1000292; Place ID: 240995
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
		1. Legal Authority Updated to Prohibit Over-Irrigation
		2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited
		3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented
		4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition
		5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition
	Overall Program Assessment	
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*

[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2, II.F.2.a*

Symbol	**Audit Rating Legend**		
	Assessment Category		
	Program Implementation	**Permit Compliance**	**Overall Program Assessment**
	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	Ineffective Program-Audit findings result in **five or more Program Elements** not implemented or permit compliant
	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	Potentially Ineffective Program-Audit findings result in **four or less Program Elements** not implemented
	All Audit Questions "Yes"	Meets Permit Provision Requirements	Effective Program-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Mission Viejo (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluates the City's ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, JRMP, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

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[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

The San Diego Water Board reviewed Ordinance 10-285 from the City's Municipal Code. The City identifies in section 6.65.200 "Prohibition on illicit connections and prohibited discharges" that *"(a) No person shall: (1) Construct, maintain, operate and/or utilize any illicit connection. (2) Cause, allow, or facilitate any prohibited discharge…*" This ordinance and other City ordinances do not identify over-irrigation as being a prohibited and illicit discharge.

Based on the lack of designation in the City's ordinances that over-irrigation is a prohibited discharge, the City does not demonstrate an effective legal authority program to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page and *Pollution Prevention* web page were reviewed. None of the City's web pages provide the option to translate the information on the page into another language. Not having the option to translate the City's web pages creates a communication barrier for the non-English speaking residents of the City.

The City's home page does not identify over-irrigation as a prohibited discharge. The City's home page provides the option to report an issue via the link "Report an Issue" under the "Services" section. When this link is activated a new page appears with a list of categories to report an issue. Some of the categories include "Landscaping," which has the topic of "Landscape Concerns," and "Streets," which has the topic of "Storm Drains." When the topic is activated specific information about the issue is required for the request to be submitted. The over-irrigation prohibition is not addressed or listed as a reportable discharge through the City's reporting system. Thus, it would be unclear for the public to know whether over-irrigation is a reportable prohibited discharge.

The City's *Pollution Prevention* web page can be found in the "Environmental Programs" section under the Public Works Department. The *Pollution Prevention* web page makes reference to the City's Storm Water Management Program and provides contact information to the Public Works Department; "*If you have questions or concerns regarding stormwater issues, contact the Public Works Department at 949-470-3056 or publicworks@cityofmissionviejo.org."* The web page also provides information and BMP factsheets in the following sections: *Commercial and Industrial, Development and Construction, Mobile Businesses, Our Watersheds, Residents What You Need to Know, Regulatory Information and Report, Report Polluters,* and *Orange County's Stormwater Program.* The brochures "Tips for Landscaping and Gardening" and "Tips to Prevent Overwatering" found on the *Pollution Prevention* web page were reviewed. Although these brochures provide useful information for the public to reduce irrigation runoff from going into the storm drains, these brochures did not include information on over-irrigation being a prohibited discharge. The PDF titled *Requirements for Home and Garden Care Activities* was also reviewed and no information on the over-irrigation prohibition was identified. The web page also provides links to the Mission Viejo Local Implementation Plan, the Mission Viejo Water Quality Ordinance 10-285, the Orange County Drainage Area Management Plan, and the San Diego Water Board web page. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information. Nor does the City's web page include information on the *Overwatering is Out* action campaign.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **<u>Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)</u>** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

<u>Core Audit Question Results:</u>

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**
- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**
- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**
- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**
- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Exhibit 4.1 of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit.*" The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, table 4.2 *Independent Water/Sewer Agency Pollution Prevention Related-Ordinances/Programs*, of the JRMP, identifies that the City coordinates with the El Toro Water District, the Moulton Niguel Water District, the Santa Margarita Water District, and the Trabuco Canyon Water District. However, there was no clear statement found on the City's website that communicates to the public that over-irrigation is a prohibited and illicit discharge. Without the ability for the public to easily identify or report over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of the IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges to actively implement City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Mission Viejo is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry* *weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of Mission Viejo does not provide any information on its home page or *Pollution Prevention* web page about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **<u>JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)</u>** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

<u>Core Audit Question Results:</u>

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**

- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**

- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**
The San Diego Water Board did not find information in the City's April 2017 JRMP that identifies or describes the over-irrigation prohibition. The City updated their JRMP and has identified minimum

BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. The JRMP has BMP factsheets that identify common methods to addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. Table 9.5 shows BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance BMPs" for the activity of "landscape maintenance including irrigation and fertilization." Factsheet FP-2 *Landscape Maintenance* and IC-7 *Landscape Maintenance* promote efficient water saving tips to reduce irrigation runoff. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Additionally, section 6.3.2 "Action Campaigns" of the City's JRMP states "*The City supports the Overwatering is Out action campaign by promoting the program at city events and including a link to www.overwateringisout.org on the city website*." However, no link to the *Overwatering is Out* action campaign was located in the City's home page or *Pollution Prevention* web page.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through its various JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From:	Mitchell, Roger@Waterboards
To:	"Joe Ames (james@cityofmissionviejo.org)"
Cc:	Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject:	CITY OF RANCHO SANTA MARGARITA OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date:	Wednesday, June 20, 2018 11:57:08 AM
Attachments:	ATTACHMENT 1 City of Rancho Santa Margarita.pdf

Mr. Ames,

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s to be effectively prohibite=, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is actively and effectively implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted..."* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

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For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee’s active and effective=prohibition of over-irrigation. Based on the number of “*yes*” or “*no*” response= to the core audit questions, each Copermittee’s program element was=given a rating of “*Effective,*” “*Potentially In=ffective,*” or “*Ineffective.*” Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of “*Ineffective Program,<=i>” “Potentially Ineffective Program,” or “=i>Effective Program”* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of Rancho Santa Margarita are included in At=achment 1 to this e-mail. A written response to any identified recommendat=ons for program improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or =#8220;*Ineffective*" program elements must be submitted to the =an Diego Water Board in the City's next JRMP Annual Report. An expla=ation of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
Engineering Geologist
San Diego Regional Water Quality Control Board<=o:p>
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Roge=.Mitchell@waterboards.ca.gov
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of Rancho Santa Margarita
WDID No.: 9 30M1000295; Place ID: 251715
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
		*1. Legal Authority Updated to Prohibit Over-Irrigation*
		*2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited*
		*3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented*
		*4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition*
		*5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition*
		**Overall Program Assessment**
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*

[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a*

Audit Rating Legend			
	Assessment Category		
Symbol	**Program Implementation**	**Permit Compliance**	**Overall Program Assessment**
	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of Rancho Santa Margarita (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluated the City's JRMP, ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

   Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? ***No***

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* ***No***

   The San Diego Water Board reviewed Title 11 "Streets and Sidewalks" from the City's Municipal Code. The City identifies in section 11.03.010 "Water" that "*It shall be and is hereby declared unlawful for any person, firm or corporation to run, or to allow to run, upon any highway or right-of-way thereof, any irrigation, waste, or other water, provided that such water may be allowed to run upon or in any drain ditch along the side of such highway or right-of-way thereof if the same does not fill or overflow such ditch or run upon or percolate under the base of the paved or traveled portion of such highway*."

   The City's ordinance inappropriately excludes drainage ditches next to the street from being a part of the MS4. Attachment C of the Regional MS4 Permit clearly defines an MS4 to include ditches "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" Based on an inappropriate definition of MS4, the City does not appear to have effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page and *Stormwater Program* web page were reviewed. The City's web pages provide the public with the option to translate the information on the page into another language. Having the option to translate the City's web pages allows the non-English speaking public to have access to valuable information and results in better communication to the City's residents.

The City's home page does not identify over-irrigation as a prohibited discharge. The City's home page has a reporting mechanism titled "Citizen Request Tracker" for general requests and concerns. When the link to the "Citizen Request Tracker" is activated, a new page appears with a list of departments. There is a link titled "General Requests and Concerns" under the Public Works Department. When this link is activated a request can be submitted after completing the sections of the request form. The over-irrigation prohibition is not listed as a reportable concern through the City's reporting system. Thus, it would be unclear for the public to know whether over-irrigation is a reportable prohibited discharge. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information. Nor does the City's web page include information on the *Overwatering is Out* action campaign.

The City's *Stormwater Program* web page can be found under the "Government" tab of the City's home page. The *Stormwater Program* web page provides information about the City's responsibility to comply with the Regional MS4 Permit. The web page also provides contact information to report a water pollution problem and provides a link to the "Public Education" web page of the Orange County Watersheds program. No information on the over-irrigation prohibition is provided in the *Stormwater Program* web page.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**
- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**
- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**
- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**
- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Exhibit 4.1 of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, table 4.2 *Independent Water/Sewer Agency Pollution Prevention Related Ordinances/Programs*, of the JRMP, identifies that the City coordinates with the Santa Margarita Water District and the Trabuco Canyon Water District to address irrigation runoff control. However, there was no clear statement found on the City's website that communicates to the public that over-irrigation is a prohibited and illicit discharge. Without the ability for the public to easily identify over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement the City's IDDE program with regards to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of Rancho Santa Margarita is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the South Orange County WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are* *exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of Rancho Santa Margarita does not provide any information on its home page or *Stormwater Program* web page about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**
- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the City's April 2017 JRMP that identifies or describes the over-irrigation prohibition. The City updated their JRMP and has identified minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. The JRMP has BMP factsheets that identify common methods to addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. Table 9.5 *BMPs for CIAs/HOAs with Publicly-Owned and –Maintained Streets and Storm Drains* shows BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance BMPs" for the activity of "landscape maintenance including irrigation and fertilization." Factsheet FP-2 *Landscape Maintenance* and IC-7 *Landscape Maintenance* promote efficient water saving tips to reduce irrigation runoff. The *Best Management Practices for Eliminating Irrigation Runoff* brochure, found on Exhibit 9-2 Page 58, and *Best Management Practices for Landscaping Services* brochure, found on Exhibit 9-2 Page 60, provide information on BMPs for preventing irrigation runoff. The *Best Management Practices for Landscaping Services* explains "*Please note that it is unlawful for wash water or other non-storm water, generated by landscapers, to enter storm drains*." Although these brochures contain information to reduce irrigation runoff, the brochures do not provide a clear statement that communicates over-irrigation discharges are prohibited. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Additionally, section 6.3.2 "Action Campaigns" of the City's JRMP states "*The City supports the Overwatering is Out action campaign by promoting the program at city events and including a link to www.overwateringisout.org on the city website*." However, no link to the *Overwatering is Out* action campaign was located on the City's home page or *Stormwater Program* web page.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through some of its JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From:	Mitchell, Roger@Waterboards
To:	Cynthia Mallett
Cc:	Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject:	CITY OF SAN CLEMENTE OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date:	Wednesday, June 20, 2018 11:57:20 AM
Attachments:	ATTACHMENT 1 City of San Clemente.pdf

Ms. Mallett,=/p>

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is actively and effectively implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of San Clemente are included in Attachment

1=to this e-mail. A written response to any identified recommendations for p=ogram improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or "=*Ineffective*" program elements must be submitted to the San Di=go Water Board in the City's next JRMP Annual Report. An explanation=of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
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San Diego Regional Water Quality Control Board<=o:p>
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of San Clemente
WDID No.: 9 30M1000296; Place ID: 255215
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
✖	✖	*1. Legal Authority Updated to Prohibit Over-Irrigation*
✖	!	*2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited*
!	!	*3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented*
!	!	*4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition*
!	!	*5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition*
✖		**Overall Program Assessment**
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*
[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a*

Audit Rating Legend			
	Assessment Category		
Symbol	**Program Implementation**	**Permit Compliance**	**Overall Program Assessment**
✖	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
!	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
✔	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of San Clemente (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluates the City's ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, JRMP, and jurisdictional strategies in the South Orange County Watershed Management Area[33] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

The San Diego Water Board reviewed Chapter 12.16 "Excavations and Obstructions" and Chapter 13.40 "Stormwater Runoff Control" from the City's Municipal Code. The City identifies in Ordinance 12.16.080 "Control of Irrigation and Stormwater" that "*No person shall allow or permit any irrigation water (except from lawns), stormwater drained from buildings or water drained from swimming pools to run upon or over the surface of any sidewalk in the City, or upon or into the roadway of any street therein except in the gutters thereof, or properly controlled channels which may be approved at the discretion of the Street Superintendent*." The City's ordinance to prohibit irrigation water from entering the MS4 authorizes over-irrigation water to enter catch basins when catch basins are clearly a part of the City's MS4. Therefore, the City's ordinance does not appear to have the legal authority to effectively prohibit over-irrigation as required to comply with provision II.E.1.

The City's ordinance should address non-storm water discharges, including over-irrigation, to any part of the City's MS4 as illicit discharges. Attachment C of the Regional MS4 Permit clearly defines an MS4 to be "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" The City's ordinance does not address the entire MS4 system because the ordinance specifically exempts gutters.

Based on the lack of designation in the City's ordinance that over-irrigation is a prohibited discharge, the City does not appear to demonstrate effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the

City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page, *Mandatory Restrictions on Water Waste* web page, *Water Conservation* web page, *Urban Water Management* Plan web page, and *Water Quality* web page were reviewed. The City's web pages provide the public with the option to translate the information on the page into another language. Having the option to translate the City's web pages allows the non-English speaking public to have access to valuable information and results in better communication to the City's residents.

The City's home page does not identify the over-irrigation prohibition. The City's home page has a link titled "Graffiti and Code Complaints" on the right-hand side of the home page. When the link is activated a new page appears titled "Code Compliance." The page allows for an issue to be reported. Some of the issue types available for reporting are "Water Conservation, "Storm Drains," and "Water Pollution." The page also provides contact information for the City's Code Compliance Department. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information. Nor does the City's web page include information on the *Overwatering is Out* action campaign.

The City's *Mandatory Restrictions on Water Waste* web page provides information on the City's requirement to restrict water waste. One of the requirements listed on the page states "When irrigating, avoid excess irrigation causing runoff into the storm drain system." The page also contains a link to the City's Water Conservation Ordinance. Although the web page makes an attempt to educate the public by encouraging the avoidance of "excess irrigation," the web page does not identify that over-irrigation is prohibited. The City's *Water Conservation* page provides tips and resources for water conservation, but does not have information on the over-irrigation prohibition. The *Urban Water*

Management Plan does not provide information on over-irrigation being prohibited either. The *Water Quality* page contains information on water quality reports, but does not identify over-irrigation as a prohibited discharge.

Based on the City's inconsistent information available to the public that over-irrigation is prohibited, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**

- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**

- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**

- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**

- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**

- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Appendix G of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, the City does not identify an active coordination with the local water agency in the City's JRMP nor in the City's website. There was no clear statement found on the City's website that communicates to the public that over-irrigation is a prohibited and illicit discharge. Without the ability for the public to easily identify or report over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints. In addition, it does not appear that there is an active coordination with the local water agency to address over-irrigation.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program specific to eliminating over-irrigation. The City's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of San Clemente is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from their MS4, as specified in section 3.3.1.2 of the South Orange County WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." Although the South Orange County WQIP addresses the Permittees initiatives to promote the *Overwatering is Out* campaign, the City of San Clemente does not provide any information on its home page, *Mandatory Restrictions on Water Waste* web page, *Water Conservation* web page, *Urban Water Management* Plan web page, or *Water Quality* web page about the campaign.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **<u>JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)</u>** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

<u>Core Audit Question Results:</u>

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**

- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

  The San Diego Water Board did not find information in the City's April 2017 JRMP that identifies or describes the over-irrigation prohibition. Section 4.3 "Local Regulations" provides ordinances related to the regulation of pollutant discharges. Section 4.3.7 "Water Service System: Chapter 13.04" explains the ordinance in the City's Municipal Code related to a pricing system and its relation to over-irrigation; "This pricing system encourages water conservation, which helps to reduce urban runoff by reducing the amount of water from over-irrigation, hard/impervious surface hosing (i.e. driveways) and car washing, etc." Although this ordinance encourages the reduction of over-irrigation, the ordinance does not prohibit over-irrigation.

  The City updated their JRMP and has identified minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. The JRMP has BMP factsheets that identify common methods to addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. Table 9-4 *CIAs/HOAs with Publicly Owned/Maintained Streets and Storm Drains* shows BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance" for the activity of "landscape maintenance including irrigation and fertilization." BMP factsheet IC-6 *Landscape Maintenance* promotes efficient water saving tips to reduce irrigation runoff, but does not mention that over-irrigation is prohibited. Factsheets FP-2, FF-5, R-4 *Home and Garden Care Activities* and R-8 *Water Conservation* also provide information and tips on how to manage irrigation runoff, but do not identify over-irrigation as a prohibited and illicit discharge. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP or any of the public education and outreach materials reviewed as part of this audit.

  Additionally, section 6.1.6 "Action Campaigns" of the City's JRMP states "*The City supports the Overwatering is Out action campaign by utilizing print media advertisements and distribution of eNewsletters, and an online retargeting campaign that directs users to the www.overwateringisout.com website of the City's stormwater website www.sccleanocean.org."* However, there was no link or reference to the *Overwatering is Out* action campaign in the City's web pages on its website.

  Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the

approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through its various JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From:	Mitchell, Roger@Waterboards
To:	Hossein Ajideh (HAjideh@sanjuancapistrano.org)
Cc:	Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject:	CITY OF SAN JUAN CAPISTRANO OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date:	Wednesday, June 20, 2018 11:57:30 AM
Attachments:	ATTACHMENT 1 City of San Juan Capistrano.pdf

Mr. Ajideh,<=p>

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-storm water discharges through a program of public promotion and facilita=ion, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is actively and effectively implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted…"* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the City of San Juan Capistrano are included in

Attac=ment 1 to this e-mail. A written response to any identified recommendation= for program improvements or Program Audit Summary Findings of "*Potentially Ineffective*" or =#8220;*Ineffective*" program elements must be submitted to the =an Diego Water Board in the City's next JRMP Annual Report. An expla=ation of the audit ratings are included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

&nbs=;

Respectfully,

Roger N. Mitchell, P.G. 8867
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
City of San Juan Capistrano
WDID No.: 9 30M1000297; Place ID: 255344
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
		1. Legal Authority Updated to Prohibit Over-Irrigation
		2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited
		3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented
		4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition
		5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition
	Overall Program Assessment	
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*
[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a*

Audit Rating Legend			
	Assessment Category		
Symbol	**Program Implementation**	**Permit Compliance**	**Overall Program Assessment**
	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	**Ineffective Program**-Audit findings result in **five or more Program Elements** not implemented or permit compliant
	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	**Potentially Ineffective Program**-Audit findings result in **four or less Program Elements** not implemented
	All Audit Questions "Yes"	Meets Permit Provision Requirements	**Effective Program**-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the City of San Juan Capistrano (City) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The purpose of the audit was to assess if the City is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluates the City's ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, JRMP, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

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[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the City's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the City's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the City establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The City's legal authority must, at a minimum, authorize the City to prohibit and eliminate all illicit discharges into its MS4.

   Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

  The San Diego Water Board reviewed Title 6 "Sanitation and Health" and Title 9 "Land Use" of the City's Municipal Code. Section 6-12.05.b.4 "Mandatory Restrictions on Water Waste at All Times" states "*Landscape irrigation system(s) shall be adjusted and operated to eliminate overspray and/or runoff onto impervious surfaces such as sidewalks, driveways, V-ditches, gutters and roadway."* This statement refers to irrigation systems and does not prohibit over-irrigation. Also, Section 9-3.527 "Landscape (Water Conservation Standards)" establishes standards for landscaping and irrigation systems, but does not prohibited over-irrigation as an illicit discharge.

  Based on the lack of designation in the City's ordinance that over-irrigation is a prohibited discharge, the City does not appear to demonstrate effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the City implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the City must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the City to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**
- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **Yes**
- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **Yes**
- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**
- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**
- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the City's web pages, reporting hotline, public outreach information, and programs available on the City's website. Specifically, the City's home page, *Water Quality* web page, and *Water Conservation* web page were reviewed. Neither of these web pages provides the option to translate the information on the page into another language. Not having the option to translate the City's home page, *Water Quality* web page, or *Water Conservation* web page creates a communication barrier for the non-English speaking residents of the City.

The City's home page does not have information on the over-irrigation prohibition. The City's home page provides contact information to different departments under the "About Us" tab. The City's home page has a link titled "Report a Maintenance Issue" under the "City Services" tab. When this link is activated, a new page appears with the option to submit a service request. The service request does not provide the option to choose a water pollution problem, but does have the option to select "Other." The City's request page can serve as a useful tool for the public to report over-irrigation, however, the request page does not identify over-irrigation as a reportable prohibited discharge. Additionally, the City's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information.

The City's *Water Quality* web page provides information on the MS4 Permit and the San Diego Water Board, but does not identify that over-irrigation is prohibited. The City's *Water Conservation* page makes reference to the City's Municipal Code Title 6, Chapter 12 for water conservation measures. The web page also provides a contact number to report water waste, a link to the City's maintenance reporting website and an email address to report water issues. The web page lists activities and measures to avoid water waste and also prohibits irrigation runoff; "*Runoff to the street is prohibited. This includes water from any hose, pipe, valve, faucet, sprinkler, or irrigation device into any storm water drainage system, drain, gutter or street. Routinely, monitor and adjust irrigation systems to eliminate overspray*." The City of San Juan Capistrano is the only Copermittee in Orange County to address the prohibition of over-irrigation runoff directly on its web page. The web page also provides tips for saving water and a link to the *Overwatering is Out* action campaign website. The City of San Juan Capistrano is one of the few Copermittees in Orange County to promote the *Overwatering is Out* campaign directly on their web pages. Overall, the City's web pages provide useful information for irrigation management.

Based on the City's inconsistent information about over-irrigation being a prohibited discharge, the City's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the City implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**
- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**
- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**
- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**
- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the City's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the City web pages. The Enforcement Response Plan, found in Exhibit 10.1 of the City's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the City's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge. Additionally, section 2.4 *External Partnerships*, of the JRMP, states "*The Tri-City Water Savings group is formed by the City of San Juan Capistrano, City of Dana Point, City of San Clemente and South Coast Water District. This group meets monthly and coordinate on programs that affect the constituents of the 3 jurisdictional geographical areas, as it relates to water conservation, irrigation and stormwater*." Although the JRMP says there is coordination between the City and the local water district, the City's website did not include links to the South Coast Water District. Most importantly, the City's web pages do not include a mechanism for the public to specifically report over-irrigation as an illicit discharge. Without the ability for the public to easily report over-irrigation as a prohibited discharge, the City does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints.

Based on the San Diego Water Board's review, the City's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The City's public education and outreach program web pages do not support a conclusion that the City is using public identification and reporting of over-irrigation discharges as a means to actively implement City's IDDE program specific to eliminating over-irrigation.

4. **Water Quality Improvement Plan (Provisions II.B.3, II.D.2)** Provision II.B.3 requires the City to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The City of San Juan Capistrano is responsible for implementing the South Orange County WQIP. The City must identify jurisdictional and WMA strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The City is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the City to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

Core Audit Question Results:

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the Watershed Management Area (WQIP, Table 2-3).

The City's strategies to reduce dry weather flow into and from their MS4, as specified in section 3.3.1.2 of the WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." The City of San Juan Capistrano does indeed promote the *Overwatering is Out* campaign on the *Water Conservation* web page.

Based on the San Diego Water Board's review, the City has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the City's public education and outreach program found on its web pages are inconsistent with the City's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the City's active implementation of the South Orange County WQIP strategies and minimum BMPs is potentially ineffective.

5. **JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)** Provisions II.B.3, II.E.5 and II.F.2.a require the City to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**
- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the City's April 2017 draft JRMP that identifies or describes the over-irrigation prohibition. The City's JRMP, section 3.3 High Priority Water Quality Problems and Sources, states; "*In accordance with the Fourth Term Permit's requirement that landscape irrigation runoff be re-categorized as a non-exempt discharge, landscape irrigation runoff is also defined as a high priority water quality problem in the City*." The JRMP has BMP factsheets that identify common methods to addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. Table 9-4 *HOAs with Publicly Owned/Maintained Streets and Storm Drains* shows BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape Maintenance" for the activity of "landscape maintenance including irrigation and fertilization." Factsheet IC-6 *Landscape Maintenance* promotes efficient water saving tips to reduce irrigation runoff. The City's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the City's JRMP.

Based on the San Diego Water Board's review, the City has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the City's program implementation on its public education and outreach web pages, City Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The City does not have a written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the City's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The City's public education and outreach program, that is visible to the public, does identify over-irrigation as a prohibited discharge. The City's reporting system does not identify over-irrigation as a reportable illicit discharge. This calls into question whether or not the City is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the City's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the City will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the City's South Orange County WQIP strategies.

5. For this audit, the review of the City's ordinances and JRMP were not comprehensive. The City's implementation of the over-irrigation prohibition through its various JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the City's overall program of prohibiting over-irrigation is ineffective. Overall, the City's public education and outreach on its web pages will need improvement if the City is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The City should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The City shall provide an update to the San Diego Water Board in the City's next JRMP annual report. The San Diego Water Board expects the City to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The City should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

From: Mitchell, Roger@Waterboards
To: Cindy Rivers; Chris Crompton
Cc: Walsh, Laurie@Waterboards; Ryan, Erica@Waterboards; Garcia, Mireille@Waterboards; Barker, David@Waterboards
Subject: COUNTY OF ORANGE AND ORANGE COUNTY FLOOD CONTROL DISTRICT OVER-IRRIGATION PROHIBITION PROGRAM IMPLEMENTATION AUDIT SUMMARY
Date: Wednesday, June 20, 2018 11:57:54 AM
Attachments: ATTACHMENT 1 Orange County and OCFCD.PDF

Ms. Rivers and Mr. Crom=ton

The San Diego Water Boa=d completed a program audit of Orange County Copermittees to assess each j=risdiction's program effectiveness to prohibit over-irrigation. The =rogram audit is consistent with the goals of the San Diego Water Board's Practical Vision. The Practical Visio= goal for achieving a sustainable local water supply includes controlling =ollutant discharges in over-irrigation flows for water quality improvement= to achieve the beneficial use of municipal water supply and enhance water conservation to reduce water demand. The Sa= Diego Water Board will advance its vision to maintain and improve water q=ality and provide sufficient water to meet the demands of the Region throu=h Jurisdictional Runoff Management Programs (JRMPs) that effectively prohibit over-irrigation and water waste=through active implementation of public promotion, prevention, detection, =limination, and local agency ordinances and enforcement.

The San Diego Water Boa=d audit evaluated the ability of each Copermittee's jurisdictional p=ogram to effectively prohibit over-irrigation according to the requirement= of provision II.A.1.b, Discharge Prohibitions, and provision II.E.2, Illicit Discharge Detection and Elimination. Provisi=n II.A.1.b specifically requires non-storm water discharges into Copermitt=e Municipal Separate Storm Sewer Systems (MS4s) to be effectively prohibit=d, through the implementation of provision II.E.2, unless such discharges are authorized by a separate Nati=nal Pollutant Discharge Elimination System permit.

Provision II.E.2 requir=s each Copermittee to actively prevent, detect and/or eliminate illicit no=-stormwater discharges through a program of public promotion and facilitat=on, investigation, and elimination through an effective combination of its legal authority, enforcement, loca= ordinances and standards, and the JRMP. If the San Diego Water Board find= that a Copermittee is <u>actively and effectively</u> implementing the requirements in provision =I.E.2 through their JRMPs, then the Copermittee is deemed in compliance wi=h provision II.A.1.b, which states *"Non-storm water discharges into MS4s are to be effectively prohib=ted..."* The program audit assessed each Copermittee's =evel of implementation in five general JRMP categories defined by specific=provisions in the Regional MS4 Permit. The table below summarizes the five JRMP program categories, the associated Regional MS4 P=rmit provisions, and the Copermittee's resources reviewed during the=audit:

JRMP=Program Audit Summary

JRMP Program =ategory	Provision(s)<= style="mso-footnote-id:ftn1" href="#_ftn1" name="_ftnref1" title==">[1]=/span>	Copermittee R=sources Reviewed
1. Legal Authority=/span>	II.E.1	Municipal Code

2. Public Education and Outre=ch	II.E.2, II.E.7	Website, JRMP, Hotline Reporting<=p>
3. Illicit Discharge Detectio= and Elimination (IDDE)/Enforcement	II.E.2, II.E.6	Website, JRMP, Hotline Reporting<=p>
4. Watershed Management Area =ater Quality Improvement Plan (WQIP)	II.B.3, II.D.2	Accepted Watershed Management Area Water Quality Im=rovement Plan(s) High Priority Water Quality Conditions, Priority Water Qu=lity Conditions, Numeric Goals and Schedules, and MS4 Outfall Persistent Dry-Weather Flow
5. JRMP Strategies=/span>	II.B.3, II.E.5, II.F.2.a	Accepted Watershed Management Area Water Quality Im=rovement Plan, Website, JRMP

[1]*Order R9-2013-0001, as amended*

The San Diego Water Boa=d based its audit findings on the following general assessment questions i= the five JRMP program categories:

1. **LEGAL AUTHORITY:** *Does the Copermittee have the legal authority in=its municipal ordinances to prohibit over-irrigation?*

2. **PUBLIC EDUCATION AND OUTREACH:** *Is the over-irrigation prohibition=clearly identified and easily located by the public through the Copermitte= web page information and hotline reporting?*

- **IDDE/ENFORCEMENT:** *Does the Copermittee actively enforce the over-=rrigation prohibition through its IDDE investigation and enforcement proce=s?*
- **WQIP:** *Does the Copermittee rely on over-irrigation reduction, eli=ination, and prohibition strategies to address the High Priority Water Qua=ity Conditions, Priority Water Quality Conditions or persistent dry weathe= flow from the MS4 in its JRMP and/or WQIP(s)?*
- **JRMP:** *Does the Copermittee identify over-irrigation prohibition s=rategies and minimum BMPs in its updated JRMP?*

<=ol>

For each of these gener=l audit assessment categories, the San Diego Water Board developed specifi= core audit questions to rate the Copermittee's active and effective=prohibition of over-irrigation. Based on the number of "*yes*" or "*no*" response= to the core audit questions, each Copermittee's program element was=given a rating of "*Effective,*" "*Potentially In=ffective,*" or "*Ineffective.*" Each of the five=program elements has a program implementation and a permit compliance component resulting in a to=al of ten effectiveness ratings. The *Overall Program Assessment* rating of "*Ineffective Program,<=i>" "Potentially Ineffective Program," or "=i>Effective Program"* is based on the total number of program effectiveness ratings out of a =otal of ten.

The San Diego Water Boa=d audit findings for the County of Orange and Orange County Flood

Control =istrict are included in Attachment 1 to this e-mail. A written response to=any identified recommendations for program improvements or Program Audit Summary Findings of "*Potent=ally Ineffective*" or "*Ineffective"* program elements must be submitted to the San Diego Water Board in the =ity's next JRMP Annual Report. An explanation of the audit ratings a=e included in the *Audit Rating Legend* in Attachment 1.

If you have any questions regarding this program aud=t, please contact Roger Mitchell at roger.mitchell@waterbo=rds.ca.gov or 619-521-5898.

Respectfully,

Roger N. Mitchell, P.G. 8867
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San Diego Regional Water Quality Control Board<=o:p>
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ATTACHMENT 1
Regional MS4 Permit Audit of Discharge Prohibition
County of Orange and Orange County Flood Control District
WDID No.: 8 30M1000240; Place ID: 246113 and 246115
Provision II.A.1.b, and Jurisdictional Program Provisions II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.F.2.a, II.D.2 and II.B.3

PROGRAM AUDIT SUMMARY

Program Audit Summary [1]		
Program Implementation	**Permit Compliance[2]**	**Program Element**
X	X	*1. Legal Authority Updated to Prohibit Over-Irrigation*
X	!	*2. Public Education/Outreach Platforms Clearly Identify Over-Irrigation is Prohibited*
!	!	*3. IDDE/Enforcement of Over-Irrigation Prohibition is Implemented*
!	!	*4. WQIP HPWQC, PWQC, or Persistent Dry Weather Outfall Flow Numeric Goals or Strategies Rely on Over-Irrigation Prohibition*
!	!	*5. JRMP Strategies/Minimum BMPs Identify Over-Irrigation Prohibition*
X		**Overall Program Assessment**
Ineffective Program		

[1] *See Audit Rating Legend in Attachment 1, Program Audit, for Explanation of Audit Ratings*

[2] *Order R9 2013-0001, as amended, prov. II.A.1.b, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, II.B.3, II.D.2,II.F.2.a*

Symbol	**Audit Rating Legend**		
	Assessment Category		
	Program Implementation	**Permit Compliance**	**Overall Program Assessment**
X	All Audit Questions "No"	Does not meet Permit provision and Response Required in Annual Report	Ineffective Program-Audit findings result in **five or more Program Elements** not implemented or permit compliant
!	Audit Questions "Yes" and "No"	Permit provision potentially not met and Response Required in Annual Report	Potentially Ineffective Program-Audit findings result in **four or less Program Elements** not implemented
✓	All Audit Questions "Yes"	Meets Permit Provision Requirements	Effective Program-Audit findings result in **three or less Program Elements** not implemented

A. PURPOSE

In January 2018, the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) conducted an audit of the County of Orange (County) Jurisdictional Runoff Management Program (JRMP), an element of the Municipal Separate Storm Sewer System (MS4) program. The San Diego Water Board evaluated the County of Orange and the Orange County Flood Control District in one audit. The purpose of the audit was to assess if the County is implementing its storm water management program in compliance with the requirements of the San Diego Water Board Regional Municipal Storm Water Permit,[1] Order No. R9-2013-0001 (Regional MS4 Permit) for the active and effective implementation of the over-irrigation prohibition. A Copermittee's compliance with the discharge prohibition, specified in provision II.A.1.b of the Regional MS4 Permit, requires an active and effective implementation of the following Regional MS4 Permit provisions:

- II.B.3 Water Quality Improvement Strategies and Schedules;
- II.D.2 Dry Weather MS4 Outfall Discharge Monitoring;
- II.E.1 Legal Authority Establishment and Enforcement;
- II.E.2 Illicit Discharge Detection and Elimination (IDDE);
- II.E.5 Existing Development Best Management Practice (BMP) Implementation and Maintenance;
- II.E.6 Enforcement of Legal Authority;
- II.E.7 Public Education and Participation; and
- II.F.2 JRMP Document Update of provision II.E.

B. REGIONAL MS4 PERMIT

The Regional MS4 Permit, Order No. R9-2013-0001, was adopted on May 8, 2013 and initially covered the San Diego County Copermittees. Subsequently, Order No. R9-2015-0001 was adopted on February 11, 2015, amending the Regional MS4 Permit to extend coverage to the Orange County Copermittees. Order No. R9-2015-0100 was adopted on November 18, 2015, further amending the Regional MS4 Permit to also extend coverage to the Riverside County Copermittees. The Regional MS4 Permit, as amended, revises previous requirements and adds new requirements that are applicable to all 39 municipal agencies in San Diego, Orange, and Riverside Counties. All Copermittees are required to develop jurisdictional plans that detail how control programs will comply with the new requirements. The Regional MS4 Permit requires that the Copermittees also effectively implement the jurisdictional plans.

One of the significant changes that occurred with the adoption of the Regional MS4 Permit in 2013 was the removal of irrigation runoff as an exempt non-storm water discharge. Non-storm water discharges resulting from over-irrigation are a source of pollutants (e.g., nutrients, bacteria, pesticides, sediment) to receiving waters. The San Diego Water Board and the Copermittees have identified non-storm water discharges associated with over-irrigation as a source of pollutants into the MS4 and a conveyance of pollutant from the MS4 to waters of the United States.[2] Non-storm water discharges to the MS4 from over-irrigation must be addressed as illicit discharges by the Copermittees pursuant to the requirements of provision E.2.

The San Diego Water Board's audit evaluates the County's ordinances, public outreach and education program (available on its website), implementation of its IDDE and enforcement program, JRMP, and jurisdictional strategies in the South Orange County Watershed Management Area[3] Water Quality Improvement Plan (South Orange County WQIP)[4] for active and effective implementation of provisions II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a.

[1] As amended by Orders Nos. R9-2015-0001 (Orange County) and R9-2015-0100 (Riverside County)
[2] pp F-93 -F-94. Attachment F, Fact Sheet/Technical Report for Order No. R9-2013-0001, as amended
[3] Table B-1 of the Regional MS4 Permit shows that South Orange County Watershed Management Area lies within the San Juan Hydrologic Unit.
[4] The San Diego Water Board reviewed the South Orange County WQIP, accepted on June 15, 2018.

This Audit Report does not attempt to comprehensively describe all aspects of the County's programs to effectively prohibit over-irrigation discharges into the MS4. The findings listed in section III below provide recommendations and potential non-compliance with the Regional MS4 Permit. Potential non-compliance areas are identified by program element audit ratings of "potentially ineffective" or "ineffective" in any of the five categories for either the "*Program Implementation*" or "*Permit Compliance*" component of that category. The audit also notes observations of inefficiencies or inconsistencies in the County's programs for effective prohibition of over-irrigation discharges to the MS4. Mr. Roger Mitchell, Engineering Geologist, Storm Water Management Unit, served as the lead auditor for the San Diego Water Board.

C. FINDINGS

1. **Legal Authority (Provision II.E.1)** Provision II.E.1 requires that the County establish, maintain and enforce adequate legal authority within its jurisdiction to control pollutant discharges into and from its MS4 through statute, ordinance, permit, contract, order, or similar means. The County's legal authority must, at a minimum, authorize the County to prohibit and eliminate all illicit discharges into its MS4.

   Core Audit Question Results:

- *Does the Copermittee have the legal authority in its municipal ordinances to prohibit over-irrigation*? **No**

- *Has the Copermittee updated its municipal ordinance(s) to reflect the requirements of the Regional MS4 Permit?* **No**

  The San Diego Water Board reviewed Title 6 "Highways, Bridges, Rights-of-Way, Vehicles" and Title 9 "Water Quality-Orange County Flood Control District" from the County's Municipal Code. Section 6-1-58 "Water" states "*It shall be and is hereby declared unlawful for any person, firm or corporation to run, or to allow to run, upon any highway or right-of-way thereof, any irrigation, waste or other water, provided that such water may be allowed to run upon or in any drain ditch along the side of such highway or right-of-way thereof if the same does not fill or overflow such ditch or run upon or percolate under the base of the paved or traveled portion of such highway.*" Additionally, section 9-1-30.p "Definitions" defines "*Discharge Exception shall mean the group of activities not restricted or prohibited by this Ordinance, including only... p. Runoff from landscape, lawn and agricultural irrigation allowed by the NPDES Permit applicable to that portion of the Stormwater Drainage System in which the discharge occurs*."

  The County's ordinance inappropriately excludes drainage ditches next to the street from being a part of the MS4. Attachment C of the Regional MS4 Permit clearly defines an MS4 to include ditches "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) …" Based on an inappropriate definition of MS4, the County does not appear to have effective legal authority to actively and effectively implement an over-irrigation prohibition program.

2. **Public Education and Outreach (Provisions II.E.2, II.E.7)** Provision II.E.2 requires that the County implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4 in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, the County must promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges to or from the MS4. Provision II.E.7 requires the County to implement, individually or with other Copermittees, a public education and participation program in accordance with the strategies identified in the Water Quality Improvement Plan to

promote and encourage the development of programs, management practices, and behaviors that reduce the discharge of pollutants in storm water to the maximum extent practicable, prevent controllable non-storm water discharges from entering the MS4, and protect water quality standards in receiving waters.

Core Audit Question Results:

- *Is the over-irrigation prohibition clearly identified and easily located by the public on the home page of the Copermittee's web page?* **No**

- *Is the over-irrigation prohibition clearly identified and easily located as a reportable prohibited discharge by the public through the Copermittee's hotline reporting system, complaint form, and/or application?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public in the Copermittee's storm water program web page information?* **No**

- *Is the over-irrigation prohibition clearly identified, easily located and described for the public on the Copermittee's public information outreach documents, handouts, or brochures?* **No**

- *Does the Copermittee identify local water district prohibitions for over-irrigation and provide direct links to the water district web page drought information?* **No**

- *Does the Copermittee identify prohibitions for over-irrigation in its JRMP?* **No**

The San Diego Water Board reviewed the County's web pages, reporting hotline, public outreach information, and programs available on the County's website. Specifically, the County's home page, the *Orange County Public Works OC Watersheds* web page, the *Water Quality Tips* web page, the *OC Stormwater Program* web page and the Orange County Flood Division web page were reviewed. None of these web pages provides the option to translate the information on the page into another language. Not having the option to translate the County's home page or *Orange County Public Works OC Watersheds* web page creates a communication barrier for the non-English speaking residents of the County.

The County's home page does not have information on the over-irrigation prohibition. The County's home page provides the option to submit a water pollution problem by choosing the "How Do I" and then selecting the "Water Pollution" link. When the link is activated a new page appears titled "myOCeServices" with a map of Orange County and a service request to fill out. The service request is very detailed and requires specific information about the type of water pollution issue being reported. The page also provides a contact number to the Water Pollution Hotline. Additionally, the County's web page does not include links to the water district's webpage that identify prohibitions for over-irrigation or drought information.

The *Orange County Public Works OC Watersheds* web page provides tabs titled; *Water Pollution Hotline*, *Public Education*, *Watershed Programs*, *Rain/Water Quality Data*, *Documents* and *Contact Us*. The "myOCeServices" reporting system can also be accessed through this web page. The *Orange County Public Works OC Watersheds* web page also includes a link to the *Overwatering is Out* action campaign. The County is one of the few Copermittees in Orange County to promote the *Overwatering is Out* campaign directly on its web pages. The *Water Quality Tips* web page includes useful information on water conservation. The web page lists water conservation tips such as: "*Don't over water your lawn*" and "*Do not over-water your lawn or garden. Over-watering may increase* *leaching of fertilizers to ground water*." The *OC Stormwater Program* web page provides information on the Clean Water Act and the County's responsibility to implement the National Pollution Discharge Elimination System permit in the San Diego region. Although the County's websites provide tips to eliminating irrigation runoff and useful information about the Regional MS4 Permit, the websites do not clearly address over-irrigation as a prohibited and illicit discharge.

The Orange County Flood Division web page provides tabs titled; *OC Public Works, About Us, Santa Ana River, Neighborhood Flood Control, Flood Protection,* and *Contact Us.* The web page also includes a link to the "myOCeServices" reporting system. The web page provides a variety of useful resources, but no information that describes over-irrigation as a prohibited discharge is displayed.

Based on the County's inconsistent information available to the public that over-irrigation is prohibited, the County's active implementation of its public education and outreach program to prohibit over-irrigation and discharge of pollutants from over-irrigation is potentially ineffective.

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3. **Illicit Discharge Detection and Elimination/Enforcement (Provisions II.E.2, II.E.6)** Provision II.E.2 requires that each Copermittee must implement a program to actively detect and eliminate illicit discharges and improper disposal into the MS4, or otherwise require the discharger to apply for and obtain a separate National Pollutant Discharge Elimination System permit. The IDDE program must be implemented in accordance with the strategies in the Water Quality Improvement Plan. At a minimum, each Copermittee must address all non-storm water discharges as illicit discharges unless a non-storm water discharge is either identified as a discharge authorized by a separate National Pollutant Discharge Elimination System permit, or identified as a category of non-storm water discharges or flows that must be addressed as an illicit discharge. Provision II.E.6 requires that the County implement an Enforcement Response Plan as part of its JRMP. The Enforcement Response Plan must describe the applicable approaches and options to enforce its legal authority established pursuant to provision II.E.1, as necessary, to achieve compliance with the requirements of the Regional MS4 Permit. The Enforcement Response Plan must be in accordance with the strategies in the Water Quality Improvement Plan.

Core Audit Question Results:

- *Does the Copermittee actively investigate over-irrigation complaints and implement its enforcement response plan?* **No**
- *Does the Copermittee actively coordinate over-irrigation complaints with the local water agency?* **No**
- *Does the Copermittee actively enforce the over-irrigation prohibition through its enforcement process?* **No**
- *Does the Copermittee actively coordinate its over-irrigation prohibition program with local water district programs?* **No**
- *Does the Copermittee specifically identify enforcement of the over-irrigation prohibition in its JRMP?* **No**
- *Does the Copermittee identify IDDE and enforcement of prohibited discharges in its JRMP and Enforcement Response Plan?* **Yes**

The San Diego Water Board's review of the County's active implementation of its IDDE program and enforcement of the over-irrigation prohibition was limited to publicly available documents and the

County web pages. The Enforcement Response Plan, found in Exhibit A-4. I of the County's JRMP, identifies enforcement on prohibited discharges. Section 3 "Illicit Discharge Detection and Elimination Enforcement Component" of the County's Enforcement Response Plan states "*An Illegal Discharge (or "Prohibited Discharge") is any discharge to the Stormwater Drainage System that is not composed entirely of stormwater and that is not covered by an NPDES permit."* The Enforcement Response Plan lists types of prohibited discharges, but does not explicitly identify over-irrigation as a prohibited discharge within the San Diego Water Board Region. Additionally, the County does not identify an active coordination with the local water agency in the County's JRMP nor in the County's website. There was no clear statement found on the County's website that communicates to the public that over-irrigation is a prohibited and illicit discharge within the San Diego Region. Without the ability for the public to easily identify over-irrigation as a prohibited discharge, the County does not appear to have an effective IDDE program and cannot actively investigate over-irrigation complaints and eliminate over-irrigation discharges within the San Diego Region.

Based on the San Diego Water Board's review, the County's active implementation of an IDDE program and enforcement of the over-irrigation prohibition is potentially ineffective. The County's public education and outreach program web pages do not support a conclusion that the County is using public identification and reporting of over-irrigation discharges as a means to actively implement County's IDDE program with regards to eliminating over-irrigation. The County's web pages do not reflect that over-irrigation is both a prohibited and illicit discharge.

4. **<u>Water Quality Improvement Plan (Provisions II.B.3, II.D.2)</u>** Provision II.B.3 requires the County to develop and implement a Water Quality Improvement Plan that identifies and develops specific water quality improvement goals and strategies to address the highest priority water quality conditions identified within a Watershed Management Area (WMA). The County of Orange is responsible for implementing the South Orange County WQIP. The County must identify jurisdictional and watershed management area strategies in the South Orange County WQIP for residential, commercial, industrial, and municipal areas or sources. These strategies are to be implemented within its jurisdiction as part of its JRMP requirements to effectively prohibit non-storm water discharges into its MS4 (pursuant to provisions II.E.2 through II. E.7) and achieve the interim and final numeric goals identified in the South Orange County WQIP. The County is also required to include BMPs, education programs, incentives, and enforcement in the South Orange County WQIP for the areas or sources within its jurisdiction that contribute to the highest priority water quality conditions. Provision II.D.2 requires the County to identify and prioritize its MS4 outfalls with persistent dry weather flows based on the highest priority water quality conditions identified in the South Orange County WQIP until the non-storm water discharges have either been effectively eliminated, identified as not being required to be addressed as an illicit discharge, or is authorized by a separate National Pollutant Discharge Elimination System permit.

<u>Core Audit Question Results:</u>

- *Does the Copermittee identify strategies for over-irrigation prohibition in the South Orange County WQIP*? **Yes**

- *Does the Copermittee have a numeric goal or strategy in the accepted Water Quality Improvement Plan(s) to address pollutant reduction through prohibition of over- irrigation?* **Yes**

- *Does the Copermittee identify over-irrigation strategies to address the High Priority Water Quality Conditions (HPWQCs), Priority Water Quality Conditions (PWQCs) or persistent dry weather flow from the MS4?* **Yes**

- *Does the Copermittee actively and effectively implement the over-irrigation strategies to address the HPWQCs, PWQCs or persistent dry weather flow from the MS4?* **No**

  The San Diego Water Board reviewed the South Orange County WQIP which identifies proposed strategies to meet the Plan numeric goals and schedules, and makes other watershed commitments to prohibit over-irrigation and eliminate flow from persistently flowing outfalls during dry weather. The South Orange County WQIP identifies HPWQCs and PWQCs for pathogens, unnatural water balance, and channel erosion and associated geomorphic impacts in various geographic areas in the WMA (WQIP, Table 2-3).

  The County's strategies to reduce dry weather flow into and from the MS4, as specified in section 3.3.1.2 of the South Orange County WQIP, consist of "*identifying and eliminating unnatural and unpermitted, non-exempted dry weather flows from the MS4 into inland receiving waters, with priority for the locations where unnatural dry weather inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes."* The South Orange County WQIP makes reference to over-irrigation when defining the types of unnatural water flows; *"Some types of unnatural conditions are clear (for example, irrigation excess forming the sole flow in a stream that would otherwise be ephemeral) and will be the primary focus of initial efforts."* The South Orange County WQIP clearly identifies over-irrigation as an "unnatural and unpermitted" discharge. Additionally, section 3.3.2.1 describes, "*An unnatural dry weather flow from the MS4 is defined as any unpermitted and/or non-exempted discharge from a MS4 outfall with hydrologic connectivity to a receiving water that occurs during dry weather and is not primary of groundwater origin."* Additionally, the South Orange County WQIP has identified numeric goals and a schedule to eliminate unnatural water balance.

  Section 3.3.3.3 of the South Orange County WQIP makes reference to the *Overwatering is Out* action campaign stating that "*as part of this Plan, the Permittees will continue this initiative and adapt or expand it to continue to promote water conservation and reduction of excess irrigation*." The County does indeed promote the *Overwatering is Out* campaign on the *Orange County Public Works Watersheds* web page, but most of the County's web pages are missing crucial information that over-irrigation is both a prohibited and illicit discharge.

  Based on the San Diego Water Board's review, the County has identified in the South Orange County WQIP strategies and minimum BMPs to actively and effectively implement an over-irrigation prohibition program to address the HPWQCs, PWQCs and the persistent dry weather MS4 flow requirement. However, the County's public education and outreach program found on its web pages are inconsistent with the County's strategies and do not reflect actual implementation of the strategies to address over-irrigation in the HPWQCs areas or primary sources of over-irrigation (i.e. residential areas). Therefore, the County's active implementation of the South Orange County WQIP strategies and minimum BMPs through its public education and outreach program and website is potentially ineffective.

5. **<u>JRMP Strategies (Provisions II.B.3, II.E.5, and II.F.2.a)</u>** Provisions II.B.3, II.E.5 and II.F.2.a require the County to update its JRMP and identify minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. Each Copermittee must implement an existing development management program in accordance with the strategies in the Water Quality Improvement Plan, including designating a minimum set of BMPs required for all inventoried existing development, including special event venues. The designated minimum BMPs must be specific to facility or area types and pollutant generating activities to address the priorities and strategies in the Water Quality Improvement Plan. In addition, each Copermittee must properly operate and maintain, or require the proper operation and maintenance of designated BMPs in its inventoried existing development.

Core Audit Question Results:

- *Did the Copermittee update the JRMP in accordance with II.F.2.a?* **Yes**
- *Does the Copermittee identify minimum BMPs for over-irrigation prohibition in the JRMP?* **No**
- *Did the Copermittee identify and implement the South Orange County WQIP strategies in the JRMP to address persistent dry weather flow and the over-irrigation prohibition?* **No**

The San Diego Water Board did not find information in the County's April 2017 JRMP that identifies or describes the over-irrigation prohibition. The County updated their JRMP and has identified minimum BMPs for existing development areas that must be implemented and maintained for residential, industrial, commercial, and municipal activities and areas. The JRMP has BMP factsheets that identify common methods to addressing common types of non-storm water discharges, but does not include information on over-irrigation being a prohibited discharge. Table A-9.5 *BMPs for CIAs/HOAs with Publicly-Owned and Maintained Streets and Stormdrains* shows BMP factsheets associated with specific activities related to public streets and storm drains. One of the BMPs listed is "Landscape maintenance BMPs" for the activity of "landscape maintenance including irrigation and fertilization." Factsheet FP-2 and IC-7 *Landscape Maintenance* promote efficient water saving tips to reduce irrigation runoff, but do not prohibit over-irrigation. Additionally, section A-6.3.2 "Action Campaigns" from the County's JRMP states "*The County supports the Overwatering is Out action campaign by promoting the program at County events, utilizing program iconography on public information handouts, and including a link to www.overwateringisout.org on the County's website*." The County's website does promote the *Overwatering is Out* action campaign on the *Orange County Public Works Watersheds* web page. The County's JRMP correlates with the BMP strategies in the South Orange County WQIP. However, the JRMP is inconsistent with the South Orange County WQIP strategy to eliminate unnatural water balance because there is no clear statement that communicates over-irrigation is prohibited in the County's JRMP or any of the public education and outreach materials reviewed as part of this audit.

Based on the San Diego Water Board's review, the County has not identified minimum BMPs in its JRMP to actively and effectively implement an over-irrigation prohibition program that addresses the HPWQCs and the persistent dry weather MS4 flows. Inconsistencies with the County's program implementation on its public education and outreach web pages, County Ordinances, and the JRMP make its program potentially ineffective.

D. SUMMARY

1. The South Orange County Copermittees have incorporated provision B.3.c of the Regional MS4 Permit, Order No. R9-2013-0001, for the South Orange County WMA Plan. Provision B.3.c is an optional pathway for Copermittees to be deemed in compliance with receiving water prohibitions and limitations in provisions A.1.a, A.1.c, A.1.d, A.2, and A.3.b of the Regional MS4 Permit within the South Orange County WMA Plan. The South Orange County WMA Plan implements the Prohibitions and Limitations Compliance Option and establishes numeric goals, strategies, and annual milestones to meet the requirements of provision B.3.c for the HPWQCs and PWQCs, as specified in the approved South Orange County WQIP, and associated pollutants for estuaries, lagoons, ocean waters, and inland receiving waters.

The South Orange County Copermittees are relying on compliance with the requirements of provision B.3.c through a significant level of non-structural BMP strategies inclusive of the reduction of over-irrigation, the *Overwatering is Out* campaign, and implementation of their JRMP programs. The South

Orange County Copermittees also rely on these non-structural BMP strategies to meet the requirements of the Bacteria Total Maximum Daily Load schedules.

Based on the findings of this audit, the San Diego Water Board will closely be reviewing the South Orange County Copermittees implementation of the strategies and milestones identified for B.3.c requirements in the South Orange County Copermittees next Water Quality Improvement Plan annual report and JRMP annual reports. The evaluation by the San Diego Water Board will include whether or not the South Orange County Copermittees should remain enrolled under provision B.3.c.

2. The County does not have a clear written ordinance that effectively identifies over-irrigation as a prohibited discharge. Establishment of ordinances and legal authority to enforce those ordinances is fundamental to the County's ability to adequately implement a pollutant control program and be in compliance with the requirements of the Regional MS4 Permit.

3. The County's public education and outreach program, that is visible to the public, does not identify over-irrigation as a prohibited discharge. This calls into question whether or not the County is actively implementing the Regional MS4 Permit over-irrigation prohibition. Controlling pollutants discharged through over-irrigation requires an effective and active implementation of the County's public education and outreach program in order to meet the numeric goals and strategies identified for the HPWQCs and PWQCs.

4. The San Diego Water Board is concerned that the County will not make progress towards reducing identified priority water quality condition pollutants of pathogens, unnatural water balance, and channel erosion without making significant changes to the implementation of its jurisdictional program so that its web pages and JRMP are consistent with the County's South Orange County WQIP strategies.

5. For this audit, the review of the County's ordinances and JRMP were not comprehensive. The County's implementation of the over-irrigation prohibition through its various JRMP programs do not appear to be fully implemented in compliance with the requirements of Discharge Prohibition provision II.A.1.b, and Jurisdictional Program provisions, II.A.1.b, II.B.3, II.D.2, II.E.1, II.E.2, II.E.5, II.E.6, II.E.7, and II.F.2.a. of the Regional MS4 Permit.

6. Based on 10 out of 10 implementation and compliance program elements being rated as "*potentially ineffective or ineffective,*" the San Diego Water Board has made the assessment that the County's overall program of prohibiting over-irrigation is ineffective. Overall, the County's public education and outreach on its web pages will need improvement if the County is to achieve an effective over-irrigation prohibition program.

E. RECOMMENDATIONS

1. The County should re-evaluate and adapt its jurisdictional program elements specific to implementing the over-irrigation prohibition based on this audit. The County shall provide an update to the San Diego Water Board in the County's next JRMP annual report. The San Diego Water Board expects the County to include in its JRMP annual report documentation that demonstrates program changes were made and that the Regional MS4 Permit provisions are being adequately and actively implemented.

2. The County should take this opportunity to review the other components of its storm water program to ensure they meet the requirements of the Regional MS4 Permit prior to additional audits by the San Diego Water Board and update its JRMP accordingly.

Letter P3 Dan and Penny Elia

August 6, 2018

Response P3-1

Introductory comments supporting conservation over desalination are noted for the record. Comments regarding the commenter's participation in District Board meetings and efforts to communicate with the District are noted and appreciated.

Response P3-2

Comments regarding conservation efforts by the District and other agencies are noted for the record. Draft EIR Section 3.0, Project Description, provides additional information regarding project goals and objectives, need for the project, and supply reliability as background. The primary purpose of the EIR, however, is to evaluate the potential environmental effects of the Project as proposed. The Draft EIR provides background on the District's conservation commitments and current levels of conservation, which are estimated at 26% compared to 2015 levels. (Draft EIR page 5.0-12). The District's Water Reliability Working Group found that, in addition to continuing to maximize conservation and recycling, the District needs a reliable new water supply source and recommended the Project as the preferred solution. (Draft EIR pages 3.0-5 and 3.0-6).

Response P3-3

With respect to the EIR's cumulative analysis, Section 4.0.4 of the Draft EIR documents the CEQA requirements and methods to be used to assess cumulative effects. The District's 2002 San Juan Creek Property EIR was not relied upon solely as the basis for the cumulative analysis. Instead, as discussed in the Draft EIR (DEIR, p. 4.0-6), the EIR uses a hybrid approach (list of projects and a summary of land use projections) to analyze cumulative impacts. Please also see Response F2-13. This is an appropriate approach given the geographic scope and importance of the proposal.

Response P3-4

The comment is correct that the Draft EIR, Table 4-1 Cumulative Impacts, identifies the potential for boatyard storage on Lot B of the San Juan Creek Property. Projects listed are those considered to be reasonably foreseeable for purposes of the evaluation. As noted on page 4.0-5 of the Draft EIR, an EIR's cumulative assessment need not provide a level of detail as great as the analysis of the project itself. It is not the intent of this CEQA requirement for an EIR to provide an equivalent assessment or consideration of nearby projects. Timing of future projects at the San Juan Creek Property is uncertain at this time. The site's isolated nature (in an industrial/business park area separated from residential, and business uses by San Juan Creek to the west, the SCRRA railroad to the east, the District's GRF to the north, and PCH to the south), will minimize impacts of potential future development of the District's San Juan Creek Property. In addition, District-related uses (such as a boatyard or District offices) would have considerably less traffic and related impacts than development that could occur under current site zoning.

Response P3-5

The Dana Point Harbor Revitalization project is listed as a potential contributor to cumulative environmental effects (Draft EIR, Table 4-1). Potential future changes to the Harbor's CDP is speculative, and outside the control of the District. Slant well intakes are not planned within Dana Point Harbor; they are proposed at Doheny State Beach (DSB).

Response P3-6

The DEIR notes the current conditions of DSB. State Parks is a Responsible Agency under CEQA and would consider permits or approvals of the Project only if and after the District Board of Directors certifies the Final EIR as adequate under CEQA and approves the Project, neither of which has happened yet. The Draft EIR provides mitigation for all Project-related impacts, including for water-quality impacts (Draft EIR Section 4.8). Additional DSB enhancements may be included as part of the State Parks encroachment permit and operational agreement(s) for the Project.

Response P3-7

With respect to other desalination projects, the list of California Ocean Desalination Projects is listed in Draft EIR Table 4-1. These other desalination facilities are not considered "in the vicinity" of the Project, as Carlsbad is located nearly 30 miles southeast, and Huntington Beach is located over 20 miles northwest. Each section of the Draft EIR considers the cumulative effects of these projects within the analysis discussion. Comments regarding permit violations at other facilities (such as Carlsbad) or general opposition to new facilities (such as Huntington Beach) are noted for the record but are not specific to the analysis of the Draft EIR.

Comments provided on Santa Margarita Water District's (SMWD) proposed San Juan Watershed Project (SJWP) are noted. Please note that groundwater modeling and potential changes to hydrology and groundwater conditions, including the San Juan Creek Lagoon, are addressed throughout the Doheny Ocean Desalination Project Draft EIR. As part of this Final EIR Responses to Comments document, the District engaged in consultation and coordination with SMWD and San Juan Basin Authority (SJBA) on the SJWP, including preparing groundwater modeling to reflect potential cumulative impacts of the two projects (refer to Response Nos. F2-12, F2-13 and Appendix 4.2.3.1). Comments regarding SJWP potential impacts are noted. Refer to Response No. O4 (Sierra Club) for additional discussion.

The San Juan Creek Levee Improvements Project, South Orange County Water Management Area Integrated Regional Water Management Project, and the NPDES permit that covers waste discharge from the San Juan Creek Ocean Outfall are all projects listed in Table 4-1 of the Draft EIR (Cumulative Projects). The Draft EIR has considered the cumulative environmental effects of these and other projects consistent with CEQA requirements.

Response P3-8

Comments in support of conservation and the Project's permitting process are noted. The Project will require close coordination with numerous local, state and federal agencies. The District has engaged in extensive agency outreach, including recent briefings with Coastal Commission staff. As noted in Response

No. L1-3, the District will be pursuing a consolidated permit review for the proposed Phase 2 Desalination Project.

From: Sonja Morgan [mailto:smorgan@scwd.org]
Sent: Monday, August 6, 2018 5:01 PM
To: Thomas, Kevin <Kevin.Thomas@kimley-horn.com>; Mark Donovan (Mark.Donovan@ghd.com) <Mark.Donovan@ghd.com>
Subject: FW: Public Comment - Doheny Desal Draft EIR

From: custserv@scwd.org [mailto:custserv@scwd.org]
Sent: Monday, August 06, 2018 5:00 PM
To: CustServ <CustServGroup@scwd.org>; Robin Rockey <rrockey@scwd.org>; Sonja Morgan <smorgan@scwd.org>
Subject: Public Comment - Doheny Desal Draft EIR

Someone has submitted the comment below via the South Coast Water District Doheny Ocean Desalination Project Draft EIR Public Comment form.

View the original form here: www.scwd.org/eircomment

Name Kathy Hartl
Organization (if applicable):
Email address: kathy@hartlwrites.com
Phone number:
Street address: 3347 Calle La Veta
City: San Clemente
I have questions, concerns or comments about the Draft EIR: Desalination facilities are the most expensive method for replacing imported water and should only be considered after South Coast Water District has implemented all cost-effective water conservation and efficiency measur es. Orange County has pioneered groundwater replenishment systems which provide locally controlled clean water at MUCH lower prices than desalination. The energy use of desalination facilities is very high which both subjects us to the impact of price increases and increases energy demand. Finally, desalination facilities are harmful to ocean life. This is a costly, environmentally damaging project that we simply don't need. 1

Letter P4 **Kathy Hartl**
San Clemente
August 6, 2018

Response P4-1

Comments in opposition to the Project in favor of alternative water sources, concerns with cost, energy demand and environmental concerns are noted for the record. As described in the Draft EIR pages 3.0-5 through 3.0-8, the District prepared a Water Supply Reliability Study (2017) that evaluated a range of supply alternatives to meet the water supply and reliability needs into the future, with and without desalination. The study concluded that a diverse "water supply portfolio" that includes the Doheny Desalination Plant provides the best option to reduce reliance on imported water sources. This conclusion, weighed system reliability, cost, supply reliability, level of control, resiliency, and ability to be implemented. Please also see Draft EIR section 4.3 (Biological Resources), and responses to comments O1-17, S7-4 and S7-10 regarding potential impacts on ocean life and habitat.

SOUTH COAST WATER DISTRICT

Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

From: Gillian Martin [mailto:gillian.martin@cavityconservation.com]
Sent: Thursday, June 28, 2018 9:11 AM
To: Sonja Morgan <smorgan@scwd.org>
Subject: Desalination project at Doheny

Sonja,
Can you tell me how far below the ocean floor the slant well extraction would occur? And do we know about the microorganisms that may be in the extracted water? Has this been studied? I am questioning what unintended impacts may occur long term as a result of removing these microorganisms.

The reason I ask is that Pulitzer Prize winning scientist, Edward O. Wilson, author of Half Earth, has said that beneath the earth's surface there are microorganisms that are essential for the earth's carbon cycle in the water and earth above. On a global scale they are estimated to make up more than half of all microorganisms on the planet. The deepest at which such microbes have been found to date is 2.8 kilometers. At this depth, for example, a new species has been identified (Desulforudis audaxviator) which exists by reducing sulfate and fixing carbon nitrogen from its surrounding inorganic environment. 1

And what do we know about the long term impact of returning the brine (combined with treated waste water) to the ocean? Have any long-term studies been conducted to determine this?

Thank you for your time.
Gillian Martin
Program Director
Cavity Conservation Initiative
949-412-0588
www.cavityconservation.com
Facebook page
http://treecareforbirds.com
Facebook Page

Letter P5 Cavity Conservation Initiative

Gillian Martin
June 28, 2018

Response P5-1

Figure 3-7 of the Draft EIR provides a schematic of the slant well depth relative to the ocean floor. Table 3-5 (Draft EIR page 3.0-20) indicates that the well casings will be located between 74 and 130 feet below the ocean floor based on preliminary design. The design is intended to avoid impacts to microorganisms in sea water and along the seabed, as confirmed by the studies conducted for the EIR (see DEIR Appendix 10.4.1, Biological Resources Assessment, MBC Aquatic Sciences, May 2018). Also refer to Response No. O1-17 for additional discussion regarding slant well effects on the ocean floor.

Response P5-2

The potential effects of brine discharge are detailed in Draft EIR Section 4.8, with additional information addressing biological resources contained in Section 4.3. Brine modeling conducted for the response to comments (Appendix 4.2.2) clarifies and amplifies the Project's lack of significant unavoidable brine impacts.

June 21, 2018

Re: Desalination

Dear Sir:

I am unable to come
to the meeting however,
I do want to give you
my go ahead! It would
be wonderful for the 1
people of Dana Point.
We would rely on
no one. Thank you!

Mrs. Fred Mintie
33801 Old Bridge Rd.
D.P. - 92629

Mrs. Ann M. Mintie
33801 Oldbridge Rd
Dana Point, CA 92629

SANTA ANA CA 926
22 JUN 2018 PM 10 L

USA FOREVER

South Coast Water District
31592 West St,
Laguna Beach, Ca.
92651

92651-690792

Letter P6 Ann Mintie

Dana Point
June 21, 2018

Response P6-1

Comments in support of the Project are noted for the record.

SOUTH COAST
WATER DISTRICT
Partnering With The Community

Doheny Ocean Desalination Project Draft Environmental Impact Report (EIR) Public Comment

From: Nick S [mailto:soskou42@gmail.com]
Sent: Wednesday, June 27, 2018 8:30 PM
To: Sonja Morgan <smorgan@scwd.org>
Subject: Dana Point desalination project

Dear Ms. Sonja Morgan,

Could you please provide an approximate chemical analysis showing the water quality of the treated water following desalination and treatment (with lime) as it will be available for distribution in homes in the area? 1

Thank you

Nick Skoularikis

Letter P7 Nick Skoularikis

June 27, 2018

Response P7-1

Treatment processes at the desalination facility will be designed to provide finished water quality that achieves or is superior to the required standards for drinking water as set forth by the State Water Resources Control Board's Division of Drinking Water.

Characteristics of the product water quality are described on page 3.0-26 of the Draft EIR. Exact chemical characteristics cannot be provided until the water is produced; however, in addition to the drinking water standards, other finished water quality goals have been developed based on the Claude "Bud" Lewis Carlsbad Desalination Plant, which is currently blending its product water with MWD water. Relevant goals are summarized in Table 3-6 of the Draft EIR.

Comment Letter P8

DAVID V. WHITING

P.O. Box 1108 • Tustin, California 92781

June 25, 2018

South Coast Water District
31592 West Street
Laguna Beach, CA 92651

To Whom It May Concern:

I want you to know how happy I was to see the environmental process put forth. I think it is critical for our future water needs. We seem to have a site that works and I just want you to know how much I back this proposal. 1

Sincerely,

David V. Whiting

DAVID V. WHITING

P.O. Box 1108 • Tustin, California 92781

June 25, 2018

South Coast Water District
31592 West Street
Laguna Beach, CA 92651

To Whom It May Concern:

I want you to know how happy I was to see the environmental process put forth. I think it is critical for our future water needs. We seem to have a site that works and I just want you to know how much I back this proposal.

Sincerely,

David V. Whiting

SANTA ANA CA 926

letter re: ~~[illegible]~~ Desal

David whiting @ 2 Hillhaven Ranch Way.

92651-690792

Letter P8 **David Whiting**
Tustin Resident
June 25, 2018

Response P8-1

Comments in support of the Project are noted for the record.

From: Sonja Morgan [mailto:smorgan@scwd.org]
Sent: Monday, August 6, 2018 2:35 PM
To: Thomas, Kevin <Kevin.Thomas@kimley-horn.com>; Mark Donovan (Mark.Donovan@ghd.com) <Mark.Donovan@ghd.com>; Rick Shintaku <rshintaku@scwd.org>
Subject: FW: Public Comment - Doheny Desal Draft EIR

From: Shawna Pickle
Sent: Monday, August 06, 2018 12:17 PM
To: Sonja Morgan <smorgan@scwd.org>
Subject: FW: Public Comment - Doheny Desal Draft EIR

From: custserv@scwd.org [mailto:custserv@scwd.org]
Sent: Monday, August 06, 2018 12:16 PM
To: CustServ <CustServGroup@scwd.org>; Robin Rockey <rrockey@scwd.org>; Sonja Morgan <smorgan@scwd.org>
Subject: Public Comment - Doheny Desal Draft EIR

Someone has submitted the comment below via the South Coast Water District Doheny Ocean Desalination Project Draft EIR Public Comment form.

View the original form here: www.scwd.org/eircomment

Name Dr. Tom Williams
Organization (if applicable): Citizens Coalitions for A Safe Community
Email address: ctwilliams2012@yahoo.com
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City: Los Angeles

I have questions, concerns or comments about the Draft EIR: Comments & Requests all formatting has been removed...please provide direct email address for submission of formatted file... DATE: August 6, 2018 TO: South Coast Water District Attn: Mr. Rick Shintaku, PE - Acting General Manager, District Engineer 31592 West Street, Laguna Beach, CA 92651 949-499-4555 http://scwd.org/contact/directory/acting_general_manager_chief_engineer.htm Uploaded to Comments: http://scwd.org/depts/engineering/projects/water_supply_projects/oceandesal3/environmental_documents/draft_eir_comment_form.htm FROM: Dr. Tom Williams, Sierra Club, Angeles Chapter, Water Comte. Senior Techn. Adviser, Citizens Coalition for A Safe Community 4117 Barrett Rd. La, Ca 90032-1712 323-528-9682 ctwilliams2012@yahoo.com SUBJECT: Doheny Ocean Desalination Project: Draft Environmental Impact Report (EIR) State Clearinghouse No. 2016031038 RE: Comments on DEIR Thank you for the opportunity to review the proposed Project and the current Environmental Impact Report, and lengthy appendices. Our review as provided in the following comments indicates that the EIR is inadequate and incomplete and is of low quality. The current DEIR must be revised and recirculated General Comments Desalination would provide a reliable, drought-proof and locally controlled safe water supply, but like imported water uses reduces the providers concerns regarding the natural water resource constraints and dependencies for the area's existing water resources (e.g., groundwater/rainfall/runoff-recharge compared to imports from he Colorado or the Pacific). If implemented, the Doheny Ocean Desalination Project could provide high quality, locally controlled and drought-proof water supply while protecting parts of the environment. Currently, South Coast Water District imports 85 to 100 percent of its drinking water, causing vulnerability during droughts, supply shortages and potentially during natural disasters and has given up on groundwater and rainfall. Doheny facility with advanced slant wells for intakes is more environmentally considerate than other methods but may adversely affect shallower, fresher groundwater. Current groundwater computer modeling does not address impacts on inland groundwater moving westerly/seaward. No adequate evaluation is available regarding power use for wedge-wire piped intake compared to well draw. Nanno-/Micro-marine life is protected by wedge wire pipe intakes which are also used as well screens drawing water from beneath the ocean floor because of their power requirements (kw/gal). The entire CEQA document, the applicant, and preparers appear not to have resolved whether the document is for the Local Project, only or both the Local and Regional Projects. Some Local elements appear to be capable of serving both levels of service. Intake wells/pipes would extend toward the Newport-Inglewood Fault Zone, and Dana Point may be a remnant fault block related to this fault zone. Further geophysical/ground movement (0.1-0.6in) and seismic (-2 - 4 RM) monitoring should have been implemented for locating seismic activities as the imported water reliability is involved with seismic risks and activities. Less than 1/2 page of setting and assessment for Environmental Justice with a 40,000 resident and 1000 businesses service area appears totally inadequate. Various mentions of economics, finance, costs, and funding for Local and Regional Projects and for businesses and tourism require further, adequate, and complete financial/economic impact report, including rate structures and rate payers charges. SPECIFIC COMMENTS Format: Copy of DEIR text with highlight with comments on DEIR text. 0.0 NOA The Local Project, product water storage tank (5 MG rather than 1.6 MG) distribution system that would feed into the District's local distribution system depending on plant capacity and District demands, other adjacent local and regional transmission pipelines that are located adjacent to the site. Preparers do not know or provide differences between transmission and distribution systems. Provide delineation of Regional, District's, local, and "Non-Local" pipes, lines, distribution, and transmission systems. conveyed entirely using existing District and local infrastructure with no off-site improvements other than a short connection to the District's existing local transmission lines Preparers do not know or provide differences between District and "Local" "infrastructure" and "local transmission lines (=pipes). appurtenant facilities (e.g. pump stations, valves and metering) all construction, operation and maintenance activities associated with all Project facilities. Use of "all" suggests including both Local" and "Regional" Project facilities. Clarify and revise. 0.0 NOA The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details. Continuing references to the "Regional Project" distracts and confuses public reviewers and may become basis for claiming "Program Assessment" at a later date. The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date. 1.0-3/1 The proposed Project aims...to secure water supply reliability by developing a drought-proof, hydrologically independent, water...to meet the service area demands at either a local or regional scale. The Phase 1 project capacity (up to 5 MGD) would help meet the service area's water demands at a local scale.... For the potential future Regional Project (up to 15 MGD), SCWD would look to involve regional partners which would expand the service area of the facility and would help meet the water demands at a regional scale...reducing the need for imported water... ...improving overall regional supply reliability. The District only intends to pursue permitting and construction of the Phase 1 Project (up to 5 MGD) at this time. Inconsistent use of Phases and Scenarios is confusing and distracting as they are not clearly defined and explained at first usage and consistently thereafter.

Either remove or consistently use in a revised DEIR. The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date. 1.0-3/2 ....In addition to Project-level analysis for Phase I, this EIR also functions as a Program EIR...providing a programmatic level analysis of a potential future Regional Project of up to 15 MGD....SCWD only intends to seek regulatory permits and approvals for the Phase I Project at this time, as there are no Regional Project partners in place, and specific Regional conveyance facilities are dependent on Regional Partners and as such cannot be identified at this time. A Program EIR is also appropriate, in that it evaluates a phased public works project where SCWD may implement one or more options, and in that it evaluates a broad range of implementation options to accomplish SCWD's Project objectives. The DEIR does not clearly separate "Local" and "Regional" projects and thereby confuses and renders incomplete the current and future CEQA considerations. The current DEIR is a confused mess of Project and Programmatic DEIR for the Local and Regional Projects. The current DEIR must be revised to clearly restrict all considerations to the Local Project, and clearly identify where any facility is suitable for expansion as part of a larger Regional Project. Remove all references of "regional" project and clearly state the need for a new Project EIR at a later date. Mixing discharge brine with treated sewage for outfall destroys "freshwater" (=treated sewage with TDS of <1.0ppt) from future Direct Potable Reuse, a significant adverse effect. As an alternative, such freshwater may be replaced by recirculation of seawater into the ocean outfall with an improved diffuser designs (e.g., inject seawater into outfall discharge flows to reduce TDS down to < 35ppt...from 60ppt 30 > 45 30 > 38ppt 30 = 1 part brine 3 parts seawater The DEIR does not discuss the project's effects in the service area including Environmental Justice and Growth Inducements and no hydraulic model is provided for the service areas. The proposed project would be important to supplying lower elevations (<600ft elev.) and S W sides (within 6 miles) with better water than those receiving "imported water" to the N E portions of the service areas. The DEIR must be withdrawn revised, and recirculated with a full service model including service parameters (pressures, flows, and qualities) for both the imported water and desal waters. Once the service area model is developed and validated, the model must be rerun as a "Growth Inducement Run" with all vacant land developed consistent with surrounding land uses. Once model runs have established service areas, the service area(s) must be reviewed and characterized for various Environmental Justice issues, e.g., income-assets/home ownership/education/ethnic origins. With the service area characterization, the supply benefits must be compared/assessed with the financial costs through rates for all users within the service area(s). Desal projects are most efficient when operated under near constant operating conditions, full production load 24 hour every day, although demands/use may be variable which are usually compensated for by storage (e.g., 8hr night-time low use: 10pm-6am = 30% to storage = 1.6MGD would be stored). No quantified analysis has been provided for storage and nighttime service area/tanks to establish storage and service area backflows. Provide quantitative analyses of storage, pass-thru flows, and backflow for the production and storage facilities for the service area(s). Intake wells may draw fresher inland groundwater - modelling required to prevent drawdown of near shore groundwater Seismicity The geophysical setting and considerations clearly indicate that the proposed Project facilities are located closer to the Newport-Inglewood Fault Zone than the imported water transmission systems. Intake wells are further exposed to higher risks due to their orientation towards the Newport/Inglewood Fault zone. Similarly geotechnical reports and other EIR related reports identify faults on the landward side of the treatment facilities and within the service area of the Project, without assessments for risks and threats. Similarly mention is made of the Southern California Earthquake Center but without considerations of recorded seismic activities in the SCEC files and assessment of seismic shaking, rupture, and liquefaction on the treatment facilities, service pumps, and tubular systems. No consideration is provided for a design "earthquake", its probable locations, depths, and strength for overall designs and for interactions between more flexible pipe/tubular system and their conn ections with more fixed facilities (e.g., pumps and treatment equipment). Provide updates and revisions with quantified analyses for a design seismic event along with those previously experienced seism. Provide quantified listing of all recorded earthquakes for 1932 to date within 5 miles of the Project and service areas. SCEC Catalog of Significant Earthquakes #YYY/MM/DD HH:mm MAG LAT LON DEPTH Km 1933/05/04 23:14 2.29 33.45883 -117.62817 6.0 First recorded 1933/07/21 04:58 2.58 33.43500 -117.70100 6.0 1933/08/04 08:45 3.34 33.45600 -117.71800 6.0 - First Significant/Strongest Local Quake 1952/03/03 16:14 3.29 33.45650 -117.73517 6.0 - 16,000ft WWSW 1967/02/13 05:55 2.99 33.44867 -117.71533 6.0 1970/07/26 11:17 2.84 33.46900 -117.73250 6.0 1975/07/05 06:52 2.60 33.44200 -117.71900 15.8 1982/06/06 17:20 2.56 33.46800 -117.70900 11.0 6 in 1984, 30d 2000/02/08 21:59 2.15 33.44000 -117.67400 1.8 8400ft SSE of Mouth Shallowest List of quakes >2.5 RM and <3km deep. Total Number of events: 64 1.0-2 Project Background SCWD provides potable water, recycled water for irrigation, and sanitary sewer services to approximately 40,000 residents and 1,000 businesses...includes the communities of Dana Point, South Laguna Beach, and areas of San Clemente and San Juan Capistrano. The DEIR does not provide a thorough description of the current and future service area populations (by ownership/tenancy, income, education, ethnicity, etc.) and their current, future, and Project levels of service by census tract levels (e.g., pressures, quality, and flows). The Revised DEIR must thoroughly develop a quantified setting (with computerized/GIS model) for the current, future without project, and Local and Regional (expected) service areas and the effects on levels of service with and without the Local and expected Regional Projects, given an assumed rate equivalence. 1.0-3/3 Because SCWD intends to seek State Revolving Fund (SRF) financing..., this EIR includes additional information required in a "CEQA-Plus" document, related to evaluation of certain federal "cross-cutter" regulations.... The current DEIR does not consider in setting or assessment the key community element of "Service area": "Environmental Justice" (Executive Order No. 12898), as all service area residents will be charged similar costs per 100 gallons but some near he Local Project may receive higher pressures, access to greater flows, and better water quality than those receiving some imported waters. Environmental Justice (EJ) has not been considered in setting and assessment of impacts as the service area effects are generally and totally avoided although the Project does not disconnect the SCWD service area from imported water systems. Provide a thorough review of potential EJ issues, current and future EJ units, and effects of Local and potential future Regional Projects on the service areas in a Revised DEIR. 1.0-3/5 1.2 PROJECT OBJECTIVES CEQA Guidelines §15124(b) requires that an EIR contain a statement of the Project objectives, including the Project's underlying purpose ????. The project objectives are: 1.0-4/1 To create a drought-proof, hydrologically independent, reliable and high-quality source of potable drinking water for the District. To further diversify the District's water supply portfolio through a locally-controlled supply, combining conservation, recycling, and local supplies to reduce dependence on imported water supplies. To provide emergency backup water supplies, should an earthquake, system shutdown, or other event disrupt the delivery of imported water to the south Orange County area. No quantified criteria or parameters are provided. No discussion of local EQs is provided....intake/outfall shutdown....other event... 2.0-4/3 Additional SRF CEQA-Plus Requirements Additional environmental analyses are required for SRF loan applications, including: ? Coastal Zone Management Act (CZMA)... ? Environmental Justice - SRF loans require demonstration of compliance with Environmental Justice provisions pursuant to Executive Order 12898 and related NEPA integration policies established by the EPA's Office of Environmental Justice (addressed in Section 4.9, Land Use and Planning). 4.9-9/2 SRF CEQA-Plus Analysis This EIR section also includes an evaluation of Coastal Zone Management Act (CZMA) compliance and Environmental Justice,...(...provided under Impact 4.9-1). 4.9-9/4 4.9.4 IMPACTS AND MITIGATION [EMPHASIS added] Impact 4.9-1: Would...project physically divide an established community?...of Significance: No Impact. Construction and Operations All Components Projects that can divide an established community typically involve large scale linear infrastructure,...sited within economically depressed areas....The proposed intake wells, conveyance alignments, and brine disposal system WOULD BE subsurface, with most conveyance facilities within roadway rights-of-way (ROW)....proposed Project WOULD NOT physically divide an established community. No impact WOULD OCCUR in this regard. Pursuant to CEQA-Plus SRF loan requirements..., the Project WOULD NOT have any disproportionate impact upon minority, low-income or indigenous...4.9-10/1...populations or tribes. The desalination facilities are in Dana Point, which is in a relatively affluent portion of south Orange County. Although at a county level Orange County is approximately 60% white, the Census Tract (0422.01) encompassing the Project is approximately 73.9% white [26.1% non-white in census tract] with 9% at the poverty level [Poverty = ???, = ??% of Median Income] ....The Project WILL provide for a reliable, drought-proof, locally controlled water supply, which WILL benefit all local communities served by the District,...WILL ensure long-term sustainability of housing, employment and community services.... Changes of conditional to affirmative verbs in the future appears purposeful and to provide emphasis as to "No EJ Impacts"; this shows potential bias of the preparers, editors, and circulators of the DEIR. No setting was provided rendering the entire EJ assessment as useless, inadequate, and incomplete. Inadequate setting above with only, 3/4 : 1/4 with 40,000 residents = 30K white : 10K Non-White. Provide a thorough, complete, and adequate setting with appropriate assessment and mitigation for Environmental Justice in a Revised DEIR 4.9-10/2 Therefore, the Project neither DIVIDES an established community nor disproportionately AFFECTS a minority, low-income or indigenous population. There would not be any significant impacts in this regard. Changes of conditional to affirmative verbs in the future appears to be purposeful and to provide emphasis as to "No EJ Impacts"; this shows potential bias of the preparers, editors, and circulators of the DEIR. Infrastructure includes the service area setting, assessment, and mitigation where levels of service can vary More attributes exist than ethnicity and income; add race, ownership/tenancy, education, family size, ages for the entire service area and the associated census tracts. 3.0-4/ FN\3 SCWD Board of Directors Meeting, April 26, 2018, Agenda Item 8. Not readily accessible for public. Provide link to BOD minutes archive. 3.0-5/ FN\4 Presentation to the SCWD Board of Directors, May 25, 2017, and August 2, 2017,...on December 20 2017 at https://www.scwd.org/services/drinking/supply/water_reliability/presentations.htm. The draft report... December 21, 2017, and is available on the District's website at https://www.scwd.org/x/filebank/blobdload.aspx?blobid=8044. Inadequate specificity for support of the noted statement and requires page references within 30 pages. 3.0-6/2 The report also indicates...ranks well above all other available water supply options...for the following reasons: 1) As an individual Project,...ranks first by high margins, due to the following benefits...: a. High system and supply reliability benefits due to...independence and climate change resilience; b. High resiliency to unknowns (climate change; reductions in imported water supply; ...reduced access to imported water supplies); c. High level of local control over operations and cost; and d. Moderate implementation risks and moderate cost-effectiveness. Comparisons cannot be properly evaluated as the three or four Project objectives have no quantitative/ranking bases. Statements regarding direct financial/costs issues have not been developed throughout the DEIR and general references only confuse and require much further development nott yet provided. Introduction of "climate change" wihout 3.0-24/3 These percentages will be monitored throughout the Project's life. The brackish groundwater pumped by the Project is not usable freshwater and would require RO and other treatment processes in order to be used for domestic or even industrial purposes. Inland groundwater would be drawn to the intake wells as designed and would contribute to increased downhill/seaward groundwater flows. Such increased out-flows would reduce fresh (<20ppt TDS) groundwater available for upstream users and may cause over-draft and reduced flows for current legitimate groundwater users. This would be an adverse environmental effect on existing well operators and their service areas. 3.0-27/6-7-8 Product Water Storage Tank The product water storage tank...will provide storage and residual disinfection prior to distribution. The tank will contain baffles...to meet disinfection requirements for the Phase I Project and ultimate facility capacity of up to 15 MGD. A 2.75 million gallon concrete tank was selected based on conservative design criteria.... ....The 2.75-million-gallon tank will have an outside diameter of roughly 125 feet and a height of 37 feet. Local Project onsite-element with capacity to expand for Regional Project. Typical 33% storage for 5MG would be 1.7MG or half the for Local Project production of 5MGD, while storage for 15MGD would be about 5MG or twice the proposed size. Proposed 2.75 MG appears to be an intermediate capacity which could be augmented by additional storage in more distance service area storage. This facility appears to be a Regional element incorporated into the Local Project and promote growth in the service area and supports future Regional development. This element must be solely justified for local consideration and must be downsizedd or justified through other means and analyses. 3.0-28-1 Product Water Pump Station The drinking water will be delivered into the District's existing potable water distribution system. As details about the final distribution of water are pending final design, this EIR has conservatively assumed a set of distribution pumps and surge vessels to deliver water...to match pressure in the District's existing distribution system,... No quantitative or organized information is provided although existing SOI systems would be incorporated into a model of the service area/distribution sytem 3.0-17 FN\ The desalination facility could be located anywhere within the District's San Juan Creek Property, consisting of Lots A - F...The preferred location, as represented in the EIR, is on lots D, E and F.... The desalination site staging area is proposed adjacent and north, on Lot C (a 7.2-acre parcel). Source: District GIS, transmitted in email dated March 15, 2018. Source/email is not publicly available. Provide in DEIR appendices. 3.0-22 FN\16 "Recovery rate" refers to the Reverse Osmosis process effectiveness, with a 50% recovery rate meaning that for every 100 gallons of raw ocean water received, the RO process produces 50 gallons of purified drinking water. 3.0-27 FN\19 RTW Model, American Water Works Assoc., Denver, CO. No dates, no links. 3.0-28 Tbl 3-6 Source: Preliminary Design Report, GHD, May 2018. 3.0-30 Tbl 3-7 Source: Preliminary Design Report, GHD, January 2018. Same document? Different dates without links. 3.0-31 FN\22 South Coast Water District Capital Improvement Program Initial Study/Mitigated Negative Declaration, SCH# 2017081049, adopted October 2017. Introductory Web Page, useless without specific reference. 3.0-35 FN\24 https://www.fuelcellenergy.com/products/#SureSource4000 (accessed April 26, 2018). Introductory Web Page, useless without specific reference. 3.0-43 FN\25 http://www.mwdh2o.com/PDF_About_Your_Water/2794_001.pdf (accessed May 9, 2018). Provide as reference material but not included in DEIR/appendices references. 4.4-1- -38 4.4 CULTURAL RESOURCES No EDR pre-2009 aerial photos were presented or available for review for historic resources, structures and foundations and historic uses. Review, setting, mitigation, and impacts are inadequate and incomplete as historic aerial photos which were included partially (referenced back to 1938, but not provided) in the Hazard/Phase 1 appendix were not reviewed for historic landuses for all Project site. Cultural/historic resources may be present but the preparers were ignorant of historic aerial photos for the Parks and all Project sites or they chose not to use them, the only direct evidence for historic resources consideration. Provide all historic aerial photos, require an experienced historic archeologist with aerial photos background to review and revise all setting, assessment, and mitigation elements for a Revised DEIR. 4.4-2/EXHIBIT 4.4-2: Paleontological Sensitivity Area Source: Rincon, Cultural Resources Report, Attachment A - Figure 2. Two 2016/2017 reports in references; online introductory corporate pages without specific reference or titles. The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Fossil will be produced from borings for all the wells and some excavations, but they won't be dinosaurs although they may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR. 4.4-17/ FN\10 National Parks Service. National Register Publications. https://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_8.htm. (accessed October 2, 2017). Provide as reference material but not included in revised DEIR/appendices references. 4.4-17/ 11 California Department of Transportation. Paleontology Laws, Regulations, and Guidance. http://www.dot.ca.gov/ser/vol1/sec3/physical/Ch08Paleo/chap08paleo.htm (accessed October 2, 2017). Provide as reference material but not included in revised DEIR/appendices references. 4.4-23 FN\12 http://www.waterboards.ca.gov/water_issues/programs/grants_loans/cwsrf_requirements.shtml (accessed on September 7, 2017). General Page for selecting from listing: Financial Assistance Funding - Grants and Loans Provide as reference material but not included in revised DEIR/appendices references. 4.5-1 / 9.0 Geophysical Survey. 2017. Geophysical Survey ...California. Prepared by Geoscience Support Services, Inc. on May 8, 2017. Incorrect and inconsistent formatting and referencing of documents; author???, Date, Title. Provide corrected reference included in revised DEIR/appendices references. 4.5-3/1 The alluvium, however, is mixed with cobbles, gravel, silty sand, and clay layers to a distance of approximately 2.3 miles off shore, with bedrock laying at an unknown depth (Geoscience, 2016). Geoscience Support Services, Inc. 2016. Foundational Actions Funding Program Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling for...Final Report. Incorrect and inconsistent formatting and referencing of documents; author???, Date, Title. Provide corrected reference included in revised DEIR/appendices references. 4.5-3/2 The desalination facility site is located on a floodplain near the mouth of San Juan Creek. San Juan Creek floodplain is underlain by Holocene era,.... Holocene and Era have specific geological definitions, change Holocene to Cenozoic or Era to Epoch or age. Revise entire Sec. 4.5 for consistent technical usage. Provide corrected terminology in revised DEIR/appendices. 4.5-3/3 A fault may be presumed to be inactive based on satisfactory geologic evidence; however, the evidence necessary to prove inactivity is sometimes difficult to obtain and locally may not exist. Evidence does exist but was not used; no reference is made to the Southern California Earthquake Center (SCEC) in Sec. 4.5 nor in DEIR text references. Revise and include review of seismicity in the Project vicinity and service areas in Revised DEIR. 4.5-3/4 ...affect Dana Point include the Whittier-Elsinore Fault, the San Andreas Fault, the Palos Verdes Fault, the San Clemente Fault and the Rose Canyon Fault...(Cotton/Beland/Associates, Inc. 1991). Referenced document not included in Sec.9, References, see below. 9.0-7 Capistrano Unified.... 2016. Facilities Master Plan. Available at...June 20, 2017. County of Orange, 2011. Subsequent Environmental Impact Report...December 18, 2017. The entire DEIR and all appendices must be revised and edited for consistent referencing, inclusion of references, and public accessibility for all documents. 4.5-3/4 Although no known faults cross the City, the Project site could be subjected to future seismic shaking during earthquakes generated by...surrounding active faults. Referenced documents include faults east of the Dana Point prominence and with the proximity to the Newport/Inglewood fault zone, splinter faults from this zone would be expected. Total absence of use or reference to the Southern California Earthquake Center and thereby their documents and catalogs render this statement inadequate at best, or totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR. 4.5-4/1 The San Joaquin Hills and Oceanside Blind Thrust Faults (...Department of Conservation) extend from near Upper Newport Bay, south through the San Joaquin Hills, and stops approximately 12 miles from the northern portion of Laguna Beach (Department of Conservation, 2010). By definition "blind thrust faults" are generally not visible on the surface but lie 1000s of feet below, and one end of the fault plane may stop/be truncated at the surface which is irrelevant to the other three edges of the plane. Total absence of use or reference to the Southern California Earthquake Center and thereby their documents and catalogs render this statement inadequate at best, or totally incomplete. Provide thorough review of all referenced and SCEC documents regarding blind faults and expected origins of recorded earthquakes for this section in the Revised DEIR. 4.5-4/3 Strong Seismic Ground Shaking Strong ground shaking from an earthquake can result in damage associated with landslides, ground lurching, structural damage, and liquefaction. Major faults...that have caused earthquakes and those that could result in earthquakes and ground shaking...include those mentioned above, as well as the Whittier Fault Zone, Norwalk and El Modena Fault Zone, San Andreas Fault, and the San Jacinto Fault Zone. Potential regional sources for major groundshaking hazards include the San Andreas, San Jacinto, and Elsinore fault zones. Without mention of the Newport-Inglewood Fault regarding seismic activities, this discussion is rendered totally incomplete. Furthermore, total absence of use or reference to the Southern California Earthquake Center (and their files and catalogs) render this statement totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR. Provide in the Revised DEIR quantitative analyses of probability of occurrences for 5,6,& 7 RM events along the N-I Fault att 3, 4, and 5 miles distances with durations, frequencies, and strengths at the Project sites, especially for pipes joined to fixed/foundation structures. SCEC can provide assistance. 4.5-4/4 Liquefaction Based on...the California Geologic Survey Seismic Hazard Zones Map for the Project vicinity,...Project area is in an area considered susceptible to liquefaction (California Geologic Survey, 2001). Project area is not defined or delineated; likewise for "considered". Provide in a revised DEIR. Furthermore, total absence of use or reference to the Southern California Earthquake Center (and their files and catalogs) render this statement totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR. Provide in the Revised DEIR quantitative analyses of liquefaction during 5,6,& 7 RM events along the N-I Fault att 3, 4, and 5 miles distances with durations, frequencies, and strengths at the Project sites, especially for pipes joined to fixed/foundation structures. SCEC can provide assistance. Reference is incorrect or misplaced in a disorganized/unedited Sec. 9. Sec.9 is a mess: 9.0-3,-4, -5, e.g., California Department of Transportation. 2012. Standard Environmental Reference,...2017. ....xxtxxx California State Parks (CSP). 2003. Doheny State Beach. Preliminary General Plan and.... California Environmental Protection Agency. State Water Resources Control board. Federal, State...2018. California Geological Survey, 2001. Earthquake Zones of Required Investigation Dana Point Quadrangle. 2017. California Legislative Information Website, Assembly Bill No. 685, http://leginfo.legislature.ca.gov/...2017. California Department of Transportation. Paleontology Laws, Regulations, and Guidance....2017. ....xxxxx California Regional Water Quality Control Board San Diego Region. Provide a thoroughly revised and consistent Sec. 9 and all references in all appendices in the Revised DEIR. 4.5-13/3 Project Design Features a) The desalination site design was created to minimize the total duration and volume of construction grading.... b) The design of the desalination plant and its facilities...so future expansion would be minimal. This and other statements strongly imply that "Local" Project design includes elements suitable for the larger Regional Project and confuses the Project Description, alternatives, and mitigation. Provide clear Project(s) or Program Descriptions in the Revised Project or Programmatic DEIR. 4.5-14/1 The Christanitos fault zone is..., located approximately 6 miles east of the site. Available data reviewed indicates that the Christanitos fault zone is not likely to be active....such, impacts to all project components would be less than significant and mitigation...would not be required (Ninyo & Moore, 2015). No definition nor explanation is provided for "available data", "reviewed", "not likely", "all". Some local faults are reported, but not included, and no fault traces are provided for the "Newport-Inglewood Fault Zone", including those within 3 or 4 miles of the Project site. Appendices do not provide structural geological setting for ALL elements of the Local Project and its service areas. Provide complete structural geologic setting for all elements of the Local Project in a revised EIR, especially all known fault zones. Furthermore, total absence of use or reference to the Southern California Earthquake Center (SCEC, and their files and catalogs) render this statement totally incomplete. Provide thorough review of all referenced and SCEC documents regarding faults and expected origins of recorded earthquakes for this section in the Revised DEIR. 4.5-14/5 The Project is located...which is prone to ground shaking. All Project components would be constructed to the more recent Uniform Building Code standards and would be designed in conformance with all applicable standards to resist the harmful effect of seismic ground shaking. No definition nor setting nor standards is provided for establishing design requirements for shaking (e.g., frequency, strength, and duration) to be in the DEIR project description and/or mitigation OR for "future" re-design. These requirements are especially important for all connections between more flexible piping and rigid fixed/foundation-supported/piled facilities. Provide all engineering requirements to be included for all design levels prior to bidding and construction for the revised DEIR. 4.5-15/5 The Project components...due to the subsurface nature of the intake wells, impacts would be less than significant. There is a possibility of strong seismic ground shaking for all Project component due to the nature of the geographic region of Southern California and its seismic activity. To reduce impacts, compliance with mitigation Measure GEO-1 would require a qualified geologist and geotechnical engineer to prepare site-specific geotechnical hazard investigations and recommendations for design level measures. This mitigation measure would ensure operation impacts to be less than significant in relationship to strong seismic ground shaking. Provide engineering design risks (probability: 1/100yr, strength, duration, etc.) for ground shaking incorporated into the current Local Project and requirements for further engineering upgrades and mitigations in the Revised DEIR. 4.5-15/7 Therefore, implementation of Mitigation Measure GEO-1, along with relevant civil engineering best practices, would ensure that raw water conveyance facility impacts due to strong seismic ground shaking are less than significant. Provide definitions, distinctions, and consistent use of "compliance", "recommendations", "relevant", and "best practices" in the revised DEIR. Provide all engineering requirements to be included for all design levels prior to bidding and construction for the revised DEIR. 4.5-16/1 The Project components.... There is a possibility of strong seismic ground shaking for the desalination facility...and its seismic activity. To reduce impacts..., compliance with Mitigation Measure GEO-1 would require a qualified geologist and geotechnical engineer to prepare site-specific geotechnical hazard investigations and recommendations for design level measures. This mitigation measure would ensure operation impacts to be less than significant in relationship to strong seismic ground shaking. It is unclear as to whether this mitigation has been or will be include in future design upgrade. Use of "would require" suggest that such mitigation has not been incorporated into the Project Design/Description. Provide all engineering requirements and "recommendations" to be included for all design levels prior to bidding and construction for the revised DEIR. 4.5-16/2 Brine Disposal System The brine disposal component is not intended for human occupancy and would not result in a direct adverse impact to humans..., therefore impacts would be less than significant. Like all other elements in this section, brine disposal requires a designed/engineered disposal pipeline (5MGD flow) from the Project Site to the sewage treatment plant and connection to the existing outfall. Any leaks/spills of brines (60ppt, TDS) into the channel or treatment plant could have significant impacts to water quality and fisheries/wildlife/ecosystems. Current Project design/engineering requirements have not been provided and as no Mitigation is mentioned, this section requires revisions. Provide all engineering requirements and "recommendations" to be included for all design levels prior to bidding and construction for the revised DEIR. 4.6-21/6 Goal CR 1: All significant historic features and sites at the park are preserved, protected from damage, and properly interpreted for public appreciation of the park's history. Guideline CR 1.1: Monitor the condition of the remaining CCC-period features in the park, such as through annual photo documentation, and initiate measures to preserve and/or restore these features.... 4.6-29/3 Subsurface Intake Wells The subsurface intake wells...with undetermined paleontological sensitivity. Unnamed Miocene marine sediments are mapped offshore in the shallow sub-surface and are not known to contain fossils but would be inspected if construction activities bring them to the surface. Construction of the subsurface intake wells would not destroy a unique paleontological resource or unique geologic feature with the implementation of CUL-3...would not destroy a unique paleontological resource or unique geologic feature and no impact would occur. The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Designation of "undetermined" and "marine" conflict as he only way to determine "marine" designation is to find "marine" invertebrates or diatoms in the sediment. Therefore the "not known" conflicts with the marine designation. Marine and perhaps estuarine or even freshwater fossils will be produced from borings for all the wells, but not dinosaurs. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR. 4.6-29/3 Southeast Intake Wells The southeast intake wells would be in an area with low to no paleontological sensitivity. Unnamed Miocene marine sediments are mapped offshore in the shallow sub-surface and are not known to contain fossils but would be inspected if construction activities bring them to the surface. Construction...would not destroy a unique paleontological resource or unique geologic feature The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Designation of "undetermined" and "marine" conflict as he only way to determine "marine" designation is to find "marine" invertebrates or diatoms in the sediment. Therefore the "not known" conflicts with the marine designation. Marine and perhaps estuarine or even freshwater fossils will be produced from borings for all the wells, but not dinosaurs. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR. 4.6-30/5 Brine Disposal System No construction...required for the ocean discharge because the existing San Juan Creek Ocean Outfall would be used for brine disposal. Therefore, no impact would occur. Connection between the Brine Lines and the outfall would require a Pipe which would require trenching or boring between the east and west side of the creek, and such work could encounter marine, estuarine, or freshwater fossils (e.g., MicroFossils: foraminifera, ostracodes, diatoms, and others. The entire paleontological considerations relate only to vertebrate paleontology and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR. 4.6-31/5 CUL-3 Paleontological Construction Monitoring and Compliance Program. The following measures would be implemented to reduce potential impacts to paleontological resources to less than significant: Retain a Qualified Paleontologist. Prior to initial ground disturbance, the South Coast Water District (SCWD) shall retain a project paleontologist, defined as a paleontologist who meets the Society of Vertebrate Paleontology standards for Qualified Professional Paleontologist, to direct all mitigation measures.... These considerations relate only to vertebrate paleontology (SVP, TW retired past member) and exclude both botanical and invertebrate paleontology and hereby renders comments down to incomplete and inadequate. Designation of "undetermined" and "marine" conflict as he only way to determine "marine" designation is to find "marine" invertebrates or diatoms in the sediment. Therefore the "not known" conflicts with the marine designation. Marine and perhaps estuarine or even freshwater fossils will be produced from borings for all the wells, but not dinosaurs. The little fossils (="MicroFossils") may be important to understanding of the marine/freshwater sand/silt deposition and buried paleo-channels for sourcing feed water for the Project. Provide all remaining boring cores for a qualified and experienced invertebrate paleontologist to review and evaluate materials for micro-fossils, including diatoms. Then revise all setting, assessments, and mitigation elements for all subsurface activities and documentation as part of a fully Revised DEIR. 4.6-33/2 REGIONAL PROJECT Due to the lack of specific Regional Project facilities identified...and uncertainty regarding Regional Project funding, partners and end users, it would be speculative to provide a detailed evaluation of potential cultural resource impacts of a potential future Regional Project. Generally, expansion of various Phase I project components...additional slant wells and additional raw water conveyance lines). Expansion at the desalination facility site would have no impacts on cultural resources. The Regional Project...additional regional product water conveyance, pumping and storage facilities, the location or alignment of which has yet to be identified. Mitigation Measures CUL-1 through CUL-3...to the Regional Project,...standard practices to avoid pipeline trenching across natural open space lands where the potential for cultural resources is greater. Evaluations of Regional Project settings and impacts thoroughly confuse the entire current DEIR, including in this Section, rendering this and other similar sections of the DEIR, erroneous, conflicting, and totally inadequate and incomplete. Either provide a complete and adequate Project(s) or Program DIER(s), not this confused mess. As the approach and contents for the Local Project setting, assessment, and mitigation are incomplete, inadequate, arbitrary, erroneous, contradictory, and inconsistent, those for any "Regional Project" must be considered as the same. Provide two separate project or one programmatic DEIR(s), with thoroughly revised, adequate, and complete sections, suitable for public review, not this mess. 4.6-34/7 Similarly, all future development...would be required to demonstrate compliance with applicable federal and state regulatory requirements,...intended to reduce and/or avoid potential adverse environmental effects...analysis and mitigation for cumulative impacts within the jurisdiction of the affected agency)....cumulative impacts...mitigated on a project-by-project level, and in accordance with the established regulatory framework, through the established regulatory review process. As this DEIR has not complied with all requirements for a complete and adequate DEIR CEQa-PLUS; "all future development" of the Regional Project and the Regional Service Areas must be assumed to suffer from the same inadequacies and over-generalizations. Revise this entire section and include in a Revised DEIR. 4.7-1/2 EDR photo package (see Appendix 10.8.1, Environmental Data Resources Radius Map Report with Geocheck): EDR Historical Topo Map Report with QuadMatch (EDR, July 24, 2017); Certified Sanborn Map Report (EDR, July 25, 2017); and EDR Photo Decade Package (EDR, July 27, 2017). Reference to the incomplete appendix clearly indicates preparers and editors, and District have either knowingly circulated a deficient document or did not review the document prior to release to the public. Apx10-8-1\pdf396/ - 5001976 9 pre-2010 not provided, including: 2009 1"=500' Flight Year: 2009 USDA/NAIP 2005 1"=500' Flight Year: 2005 USDA/NAIP 1994 1"=500' Acquisition Date: June 01, 1994 USGS 1990 1"=1000' Flight Date: January 01, 1990 USDA 1980 1"=1000' Flight Date: January 01, 1980 USGS 1977 1"=1000' Flight Date: January 01, 1977 Proprietary Brewster Pacific 1967 1"=1000' Flight Date: January 01, 1967 USGS 1952 1"=1000' Flight Date: January 01, 1952 USDA 1946 1"=1000' Flight Date: January 01, 1946 USGS 1938 1"=1000' Flight Date: January 01, 1938 USDA Ten aerial photos have been referenced but not included. Readily available satellite images clearly show the value of such historic images for identifications of resources and hazards. 2018 1994 (Google Earth Pro) Yellow Line is 1570ft The Project site has been used for industrial and other uses which may have contaminated the site, but the DEIR does not include documentation regarding soil contamination which may have been surficially removed and covered by clean fill. 4.7-2 FN\1 State Water Resources Control Board Right to Divert and Use Water Permit 21138. The Document is available for public review but the connection to the noted text is not specific to a section of the permit. Provide specific section of the permit in the Revised DEIR. 4.7-7 Table 4.3, Appendix 10.10.1. Unclear as to copy of table or derived from text. Provide specific section of text or portions of table in the Revised DEIR 4.7-7 FN\2 http://geotracker.waterboards.ca.gov/map/?CMD=runreport&myaddress=25300 Dana Point Harbor Drive (accessed March 20, 2018). [Notes: Database Acronyms are noted in Appendix 10.8.1, Environmental Data Resources (EDR) Radius Map Report with GeoCheck.] Noted link does not connect to a specific location, therefore itte is rendder unavailable for public review and is not included in the appendix. Provide more specific publicly accessible link or in an appropriate appendix in the Revised DEIR. 4.7-12 Sources: Environmental Data Resources, The EDR Radius Map Report with GeoCheck, July 24, 2017; and Google Earth Pro 2017. Provide reference to appropriate DEIR appendix in the Revised DEIR. 4.7-19/4 Goal 3: Reduce the risk to the community's inhabitants from exposure to hazardous materials and wastes. Policy 3.2: Cooperate with railroad operations to ensure that hazardous materials transported by rail do not pose a threat to life or property. The historic railroad ROW lies immediately south of the Project site and trains are widely known to carry hazardous materials, and ROWs, ballasts, and soils are often contaminated by leaks and spills. Information that would have been available in historic aerial photos is incomplete due to the deletion of 2008-1938 (or even earlier, EDR has files going back to 1923). The entire 4.7 section is incomplete due to lack of any soil borings/samplings of site immediately adjacent to the railroad ROW. Provide reference to appropriate DEIR appendix in the Revised DEIR. 4.7-21 FN\3 California Department of Parks and Recreation, Doheny State Beach General Plan & Draft Environmental Impact Report, December 2003. As the noted document is over 100 pages specificity is required for public accessibility 4.7-21 FN\4 Instead of policies, the Doheny State Beach General Plan includes guidelines, which are a general set of parameters that provide directions towards accomplishing goals (page 3-3). The DSBGP contains both goals, policies, and guidelines; stated clarification seems out-of-place or purposefully confusing. Provide clarification and specificity to the Local Project, herein, in the Revised DEIR.. 4.7-23 FN\5 https://www.dir.ca.gov/title8/339.html (accessed March 14, 2018). The 35 page FN reference requires greater specificity for public review. As presented the reference is not suitable for public review and thereby is inadequate for review. Provide more specific noted connection in the Revised DEIR. 4.7-25 FN\6 Appendix 10.10.2 shows that pumping 8.6 MGD has little effect on the groundwater plume (page 37, and Figures 54, 55 and 56 of Appendix 10.10.2), as does pumping at even higher levels. In fact, groundwater modeling shows that the Project would improve plume conditions by causing the plume to dissipate faster. Plume dispersion or pumped-induced movement is often used as part of groundwater decontamination & remediation. However contaminants must be removed as part of pump/treat remediation, and thereby rapid flow and/or spreading of contaminated groundwater must be considered as a negative impact until much greater information and modeling has been conducted and provided. Therefore this text section and related appendix must be considered as incomplete and inadequate for impact assessment and mitigation. Provide a completely revised, quantitative setting for potential hazardous contamination of the Creek groundwater resources and assessment of impacts from changes caused or induced by the Project in the Revised DEIR. 4.7-37 FN\12 http://www.ocair.com/Commissions/ALUC/Docs/JWA_AELUP-April-17-2008.pdf. 174 pages, without pg. #, content cannot be verified. Provide specificity within noted file for the appropriate noted text in the Revised DEIR. 4.7-40 FN\13 City of Dana Point Building and Safety, Fire Hazard Severity Maps, Available at: http://www.danapoint.org/department/communitydevelopment/ building-safety/fire-hazard-severity-zones, (accessed February 21, 2018). "Page Not Found... The page you are looking for, http://www.danapoint.org/department/communitydevelopment/building-safety/fire-hazard-severity-zones, may have been removed, renamed, entered wrong, or is temporarily unavailable." Provide specific appropriate reference for noted text in the Revised DEIR. 4.7-42/3 SIGNIFICANT UNAVOIDABLE IMPACTS The Project would not result in any significant unavoidable impacts concerning hazards and hazardous materials.

This statement is founded on a totally incomplete, inadequate, and poorly documented assessment in both the DEIR section and supporting appendix. EXHIBIT 4.7-2: Schools within 0.25 Miles of the Proposed Project Intake and Conveyance areas are wrongly located in SJC District.

Letter P9 Dr. Tom Williams

August 6, 2018

Response P9-1

Dr. Williams' comments are addressed in response to letter O4 (Sierra Club).

RECEIVED
JUL 09 2018
BY: ....

June 25, 2018

South Coast Water District
31592 West Street
Laguna Beach, CA 92651

Reference: Doheny Ocean Desalination Project

I am thrilled to hear of this proposed work. It is so very needed and critical to our future. You have my full support in undertaking this as it will be an immeasurable insurance policy for the future of our wonderful area. Thank you! 1

Sincerely,

Betty Yount

Betty Youndt

Letter P10 Betty Youndt

June 25, 2018

Response P10-1

Comments in support of the Project are noted for the record.

3.0 Draft EIR Errata

Changes to the Doheny Desalination Project (Project) Draft EIR are noted below. The changes to the Draft EIR do not affect the overall conclusions of the environmental document, and instead represent changes to the Draft EIR that provide clarification, amplification and/or insignificant modifications as needed as a result of public and responsible agency comments on the Draft EIR. These clarifications and corrections do not warrant Draft EIR recirculation pursuant to CEQA Guidelines §15088.5. As set forth further below and elaborated upon in the respective Response to Comments, none of the Errata below reflect a new significant environmental impact, a "substantial increase" in the severity of an environmental impact for which mitigation is not be adopted to reduce the impact to a level of insignificance, or a new feasible project alternative or mitigation measure considerably different from others previously analyzed that would clearly lessen significant environmental impacts but is not adopted, nor do the Errata reflect a "inadequate" or "conclusory" Draft EIR.

Changes in this Errata Section are listed by chapter, page, and (where appropriate) by paragraph. Added or modified text is shown with double underline (example) while deleted text is shown with strikethrough (~~example~~).

SECTION 3.0 PROJECT DESCRIPTION

This Errata makes edits that clarify, amplify or make insignificant modifications to the Project Description, but that do not add significant new information to the EIR.

Page 3.0-2, Section 3.1, Subsection "Project Summary", second bullet, fourth sentence

"A concentrate (brine) disposal system…. … regional treatment plants. A brine discharge holding tank allows for sufficient storage during low flow outfall periods; typically late at night and early morning. Mixing desalination brine …."

Page 3.0-4, Section 3.1, Subsection "South Coast Water District Background," first full paragraph on p. 3.0-4

"Despite significant efforts toward creating a balanced water supply portfolio, the District is currently relying on imported water for approximately ~~85-100~~77% percent of its water supply needs, as summarized below in Figure 3-2, MWDOC and SCWD Current Water Supply Portfolios (with the District relying on up to 100% of its potable water from imported sources during periods when the GRF is not producing groundwater). The water supplied to SCWD by MWDOC is 100 percent imported water."

Page 3.0-6, Section 3.2, Subsection "SCWD Water Supply Reliability Study (December 2017 Final Report)," first bullet on p. 3.0-6

- "Projected year 2040 potable water demand increase to 6,940 AFY (this is a planning assumption projecting an increase of 645 AFY to allow for 90% demand "bounce-back" and climate change)."

Page 3.0-14, Section 3.4, First full paragraph on page 3.0-14

"The Doheny Ocean Desalination Project would consist of the following main components: a subsurface water intake system, a raw (ocean) water conveyance pipeline, a desalination facility, a concentrate (brine) disposal system and brine discharge tank, a product water storage tank and distribution system, appurtenant facilities, and Offsite Electrical Transmission Facilities. …"

Page 3.0-15, Section 3.4, Subsection "Project Site", Paragraph 3

"The subsurface intake wells, desalination facility site and portions of the conveyance lines are within the California Coastal Zone, under the jurisdiction of the City of Dana Point and its Local Coastal Program (LCP). Although much of the project's coastal facilities are within the City of Dana Point's LCP authority, ~~the project's facilities in the Coastal Zone are also appealable to the~~the City's LCP allows for consolidated permit review where the Project's Coastal Act conistency and associated CDP review is undertaken by the California Coastal Commission (CCC)…."

Page 3.0-15, Section 3.4.1, New Subsection added before Subsection "Production Capacity/Project Phasing"

"**Project Facility Siting Criteria**

The Project has been designed to further avoid sensitive resources, as reflected in the Project design plans and in Project Design Features noted in respective Draft EIR sections. The following Project Design Features noted in Section 4 of the Draft EIR specifically relate to Project facility siting criteria:

- Construction staging and laydown areas utilize existing disturbed or developed sites to avoid disruption to existing sensitive resources;
- The subsurface slant well vaults have been moved inland, as far as practicable from the active beach recreation areas, to reduce both visual and recreation impacts;
- Project facilities are sited at existing developed or disturbed sites, avoiding impacts to sensitive natural habitat;
- Pipeline installation will utilize trenchless construction to avoid potential impacts to San Juan Creek and San Juan Creek Lagoon; and
- Slant well construction drill rig work areas are set back from the beach to minimize potential conflicts with shorebirds;
- The District is no longer pursuing Pod F due to potential impacts to the Class I bike trail connecting PCH to the DSB Class III bicycle route along Park Lantern; and
- The Project proposes uses of trenchless pipeline construction under sensitive transportation facilities, including Class I bike paths, PCH, and SCRRA MetroLink ROW.

The Project design avoids impacts to specific sensitive resources as noted below:

- No direct sandy beach construction at DSB;
- No direct impacts to the DSB North Creek drainage channel; and

Trenchless construction to avoid direct impacts to San Juan Creek Lagoon, San Juan Creek, local drainage channel L01S02, PCH, the SCRRA railroad, and major intersections such as Dana Point Harbor Drive and PCH."

Page 3.0-16, Section 3.4.1, Subsection "Production Capacity/Project Phasing," first bullet

- **"Phase 1 Local Project:** Up to 5 MGD, which equates to ~~up to~~ approximately 5,320~~3,192~~ AFY at 95% utilization."

Page 3.0-19, Section 3.4.2, Subsection "Subsurface Intake Wells/Southeast Intake Wells – Southeast Intake Wells," paragraph 1, fourth sentence

"…This study area is composed of a paleochannel[14] that would feed the Southeast Intake Wells (pods ~~F~~ G and~~, G~~H ~~and H~~ as shown in Exhibit 3-3, Project Facility Locations and Appendix 10.1), and is distinct from the paleochannel offshore of DSB at the mouth of San Juan Creek Creek and hydrologically separated from the San Juan Groundwater Basin, which avoids the Project's effects on inland groundwater and the lagoon, as demonstrated by the modeling work presented in Section 3.3.…"

Page 3.0-21, Section 3.4.2, Subsection "Raw Water Conveyance Alignment," Third full paragraph on p. 3.0-21

"**South Alignment**: … This alignment would connect the wells west of the lagoon via a conveyance section utilizing either the existing Beach Road ("Beach Road" or "Park Lantern") bridge deck over San Juan Creek or through trenchless construction under San Juan Creek lagoon. Mitigation has been developed to facilitate the construction of this alignment with the PCH bridge's seismic stability. This mitigation can be found in TRF-2 on page 4.13-20 of this document…".

Page 3.0-23, Section 3.1.2, Subsection "Desalination Facility," Second full paragraph on p. 3.0-23, Sentence 2

"…The conceptual desalination facility layout includes flocculators, sedimentation basins, backwash water clarifier, chemical storage area, media filter backwash tank, brine ~~storage~~discharge tank, a Research & Development pad[18], RO flush tank, product water pump station, product water tank, RO membrane building, carbon dioxide feed system, media filters, electrical building, calcite contractors, and an admin/lab/operations/public outreach building. …"

Page 3.0-24, Section 3.1.2, Subsection "Desalination Facility – Pretreatment," Second full paragraph on p. 3.0-24, Sentence 3

"… At steady state, groundwater modeling supports that the Project will only be drawing in approximately 6.6% of brackish groundwater (full equilibrium is estimated to be achieved in approximately four years at Doheny State Beach, where slant well production water salinity is fairly constant, as discussed in detail in Appendix 10.1). …"

Page 3.0-26, Section 3.1.2, Subsection "Desalination Facility – Seawater Reverse Osmosis (First Pass)," Second full paragraph on p. 3-0-26, Last sentence

"…The brine will be sent to the brine discharge tank to be disposed of into the ocean through diffusers at the end of SOCWA's existing SJCOO. The product water will proceed to the next step in the process."

Page 3.0-29, Section 3.1.2, Subsection "Chemicals and Discharge", Paragraph 5

"Table 3-7, Chemical Use and Application Summary, provides a summary of the chemicals, application points, ~~and~~ average chemical doses, and chemical quantities to be stored onsite based on preliminary design for the Doheny Ocean Desalination Project."

Page 3.0-29, Section 3.1.2, Subsection "Chemicals and Discharge – Brine Disposal System," Paragraph 6, New sentence after Sentence 2

"The brine disposal system would utilize the existing SJCOO to return brine and treated process waste streams to the ocean with negligible impact on coastal and marine water quality. This would be achieved in part through blending in the outfall pipe with the existing wastewater stream from the J.B. Latham Wastewater Treatment Plant, and other regional treatment plants. A brine discharge holding tank would allow for sufficient storage during low flow outfall periods, typically late at night and early morning. This connection would be from the Desalination Facility to the existing SJCOO that currently runs through the southwest corner of the desalination facility Project site (the connection location is shown on Exhibit 3-1, Regional Vicinity)…."

Page 3.0-30, Section 3.4.2, Subsection "Chemicals and Discharge – Brine Disposal System," Table 3-7

Table 3-7: Chemical Use and Application Summary

Chemical	Description of Use	Application Points	Suggested Dose (mg/L)	Chemical Quantities to be Stored on Site
Antiscalant	Minimize scaling and iron fouling in SWRO membranes.	+1st Pass RO Feed +2nd Pass RO Feed	3 3	330 gallons
Aqueous Ammonia	Generation of chloramines in the presence of chlorine for residual disinfection in product water distribution system.	+Distribution System Feed	1	5,000 gallons
Calcite (Calcium Carbonate)	Increase calcium hardness and pH in RO permeate during post-treatment.	+RO Permeate Post pH Adjustment with Carbon Dioxide	100	Variable
Carbon Dioxide	Alkalinity addition and pH reduction to improve calcium uptake in post-treatment calcite contactors.	+Calcite Contactor Feed	23	36 tons

Chemical	Description of Use	Application Points	Suggested Dose (mg/L)	Chemical Quantities to be Stored on Site
Caustic Soda (Sodium Hydroxide)	Adjust pH to optimize pretreatment oxidation of Mn/Fe, improve boron rejection, for cleaning and neutralization, and control product water pH.	+Pretreatment Feed +2nd Pass RO Feed +Product Water Tank Feed +Cleaning and Neutralization Tanks	10 20 5 As Needed	20,000 gallons
Fluorosilicic Acid	Fluoride supplement for dental health in drinking water.	+Product Water Tank Feed	0.7	1,000 gallons
Polymer	Coagulant aid for onsite clarification	+Pretreatment Feed +Sludge Thickening Feed	0.5	330 gallons
Sodium Bisulfite	Dechlorinate RO feed water and neutralize chlorinated discharges and cleaning solutions before disposal. Preservative for RO membranes during downtime.	+1st Pass RO Feed +Cleaning and Neutralization Tanks	0.2 As Needed	5,000 gallons
Sodium Hypochlorite	Oxidation of Fe/Mn before pretreatment and residual disinfection in product water.	+Pretreatment Feed +Calcite Contactor Feed +Product Water Tank Feed	20 (Intermittent) 3	20,000 gallons
Sulfuric Acid	Periodic cleaning of RO membranes.	+1st Pass RO Feed	5	1,200 gallons

Page 3.0-37, Section 3.5, Subsection "Desalination Facility Expansion," Paragraph 1

"The following desalination facility components are anticipated to be sized initially to accommodate an eventual expansion up to 15 MGD of desalination capacity: the chemical storage area, research and development (R&D) pad, RO membrane building, electrical building, administration/operations/lab building, RO suck-back (flush) tank, product water tank, brine discharge ~~holding~~ tank, and several key components of the seawater intake pipeline."

Page 3.0-38, Section 3.6, Subsection "Phases of Construction / Timeline", entire section

~~Phases of~~ Construction Schedule~~/ Timeline~~

~~The Project is not yet final, and as such, the final construction schedule has not been prepared. In lieu of a finalized construction schedule and scope, conservative parameters and estimates are identified below for Project construction.~~

~~**Phase I** – start October 2019 and complete by December 2021~~

~~**Regional Project** – Depending on regional partnership, phasing and other factors~~

"Phase I of this Project, and the focus of this EIR consists of a Local facility (up to 5 MGD). Per discussions with State Parks and County Parks, construction at DSB will only be allowable during the "off-season" to minimize impacts to beach access and recreation (the specific timeframes are subject to further discussion with State Parks and County Parks staff as part of the Project's permitting process, but for the purposes of this EIR it is assumed to be from October 1 through May 1 to avoid the peak Summer season and also to minimize conflict with special events in the Fall and early Summer; this is discussed further in Section 4.12, Recreation). It is estimated that it will take 2-3 months to drill and develop a 1000-foot slant well. Following well construction, the "well development" process (pumping the well to remove sands prior to initiating production) will require approximately one month. Therefore, it is anticipated that two wells can be constructed during one off-season construction window using a single drill rig and a separate well development rig. A conceptual schedule for the Project has been prepared and is outlined in Table 3-9.1.-"

Table 3-9.1: Conceptual Phase 1 Construction Schedule

No.[1]	Construction Phase	Approximate Start Date[2]	Duration (Working Days)
1	Preliminary Site Work	10/01/2019	30
2	Slant Wells 1-2 Drilling	10/04/2019	180
3	Slant Well 1 Development	01/01/2020	30
4	Slant Well 2 Development	04/02/2020	30
5	Raw Water Pipeline	10/20/2019	350
6	Preliminary Site Work 2	11/15/2019	70
7	Project-Wide Pipework Excavation[3]	02/01/2020	427
8	Yard Piping	02/01/2020	200
9	Floc/Sed Basins	02/01/2020	210
10	Chemical Storage Area	04/01/2020	210
11	Brine Holding Tank	04/01/2020	210
12	Product Holding Tank	04/01/2020	210
13	Outside Process Equipment Concrete Pads	06/01/2020	100
14	RO Building Foundation	06/01/2020	100
15	R&D Pad	07/01/2020	100
16	Administrative Building Foundation	07/01/2020	100
17	Electrical Building Foundation	07/01/2020	90
18	Electrical Building	11/01/2020	120
19	Outside Process Equipment Mechanical/Electrical Installation	10/01/2020	365
20	RO Building	10/01/2020	150
21	Administrative Building	10/01/2020	180
22	Electrical Equipment Installation	01/01/2021	240
23	Electrical Equipment Mechanical Installation	03/01/2021	240
24	Slant Wells 3-4 Drilling	10/01/2020	180
25	Slant Well 3 Development	01/10/2021	30
26	Slant Well 4 Development	04/01/2021	30
27	RO Building Mechanical/Electrical Installation	03/01/2021	200
28	Architectural Finishes	04/02/2021	60

No.[1]	Construction Phase	Approximate Start Date[2]	Duration (Working Days)
29	Process Equipment Corrosion Protection	07/01/2021	60

Notes:
[1] Construction activity estimates are consistent with the Air Quality modeling found in Appendix 10.3.
[2] Changes to the approximate start dates are expected to change from those presented; though these changes will not affect the results of the analysis of the DEIR.
[3] Phase 1, Construction no. 7, Project-Wide Pipework Excavation, accounts for material removal during trenching. All import/export for soils and demolition materials has been assumed in this phase.

Page 3.0-38, Section 3.6, New Subsection "Construction Equipment" before Subsection "Staging Areas"

Construction Equipment

"Construction materials for Phase I of the Project will include materials and equipment necessary to construct the local scale facility (up to 5 MGD). In an effort to increase efficiency, construction equipment assumptions for both the currently sought up-to5 MGD local facility and trenching for raw water conveyance pipelines for the potential future expansion 15 MGD regional facility have been identified. For clarity, the material and equipment assumptions for the current Project (up to 5 MGD) and project-wide pipework excavation are included in Table 3-9.2."

Table 3-9.2: Phase 1 Construction Equipment Assumptions

No.[1]	Construction Phase	Equipment	Number	Hours Per Day
1	Preliminary Site Work	Concrete/Industrial Saws	1	8
		Excavators	3	8
		Rubber Tired Dozers	2	8
2	Slant Wells 1-2 Drilling	Air Compressors	1	24
		Bore/Drill Rigs	1	24
		Cranes	1	8
		Forklifts	1	24
		Generator Set	2	12
		Pumps	1	12
		Tractors/Loaders/Backhoes	1	8
		Welders	2	12
3	Slant Well 1 Development	Air Compressors	1	24
		Bore/Drill Rigs	1	24
		Cranes	1	8
		Generator Set	2	12
		Pumps	1	24
4	Slant Well 2 Development	Air Compressors	1	24
		Bore/Drill Rigs	1	24
		Cranes	1	8
		Generator Set	2	12
		Pumps	1	24
5	Raw Water Pipeline	Bore/Drill Rigs	1	8

No.[1]	Construction Phase	Equipment	Number	Hours Per Day
		Excavators	1	8
6	Preliminary Site Work 2	Excavators	2	8
		Graders	1	8
		Rubber Tired Dozers	1	8
		Scrapers	2	8
		Tractors/Loaders/Backhoes	2	8
7	Project-Wide Pipework Excavation[2]	Rubber Tired Dozers	1	8
		Tractors/Loaders/Backhoes	1	8
8	Yard Piping	Bore/Drill Rigs	1	8
		Excavators	1	8
9	Floc/Sed Basins	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
10	Chemical Storage Area	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
11	Brine Holding Tank	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
12	Product Holding Tank	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
13	Outside Process Equipment Concrete Pads	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
14	RO Building Foundation	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
15	R&D Pad	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7

No.[1]	Construction Phase	Equipment	Number	Hours Per Day
		Welders	1	8
16	Administrative Building Foundation	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
17	Electrical Building Foundation	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
18	Electrical Building	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
19	Outside Process Equipment Mechanical/Electrical Installation	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
20	RO Building	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
21	Administrative Building	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
22	Electrical Equipment Installation	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
23	Electrical Equipment Mechanical Installation	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
24	Slant Wells 3-4 Drilling	Air Compressors	1	24
		Bore/Drill Rigs	1	24
		Cranes	1	8

No.[1]	Construction Phase	Equipment	Number	Hours Per Day
		Forklifts	1	8
		Generator Set	2	12
		Pumps	1	12
		Tractors/Loaders/Backhoes	1	8
		Welders	2	12
25	Slant Well 3 Development	Air Compressors	1	24
		Bore/Drill Rigs	1	24
		Cranes	1	8
		Generator Set	2	12
		Pumps	1	24
26	Slant Well 4 Development	Air Compressors	1	24
		Bore/Drill Rigs	1	24
		Cranes	1	8
		Generator Set	2	12
		Pumps	1	24
27	RO Building Mechanical/Electrical Installation	Cranes	1	7
		Forklifts	3	8
		Generator Sets	1	8
		Tractors/Loaders/Backhoes	3	7
		Welders	1	8
28	Architectural Finishes	Air Compressors	1	6
29	Process Equipment Corrosion Protection	Air Compressors	1	6

Notes:
[1] Activity numbers are consistent with the Air Quality modeling found in Appendix 10.3.
[2] Phase 1, Construction no. 7, Project-Wide Pipework Excavation, accounts for material removal during trenching. All import/export for soils and demolition materials has been assumed in this phase.

Page 3.0-38, Section 3.6, Subsection "Staging Areas," Paragraph 2

~~Construction equipment and materials would be stored in the construction work areas. Construction staging for the subsurface slant wells on Doheny State Beach and Capistrano Beach Park, the SCWD desalination facility, the product water conveyance alignment, and the raw water conveyance alignment would be within the Project area boundary. To facilitate these activities and provide access in a tight area, a construction zone around the slant well drill rig (the "drill rig work area") will be required, estimated at 130 feet by 75 feet for DSB, and 100 feet by 75 feet for Capistrano Beach Park. The drill rig work areas will be screened to minimize noise, lighting and aesthetic impacts.~~

"Construction of the slant wells will occur during the beach off-season from October 1 to May 1. This will allow for construction of the necessary wells over two seasons, or up to two wells per season, for the Phase 1 Local Project. Construction equipment and materials will be stored in their respective construction work areas. To facilitate construction and development of the subsurface slant wells, restrict access, and minimize public impacts, a contained construction area around the slant well drill rig (the "installation area") will be required, estimated at 130 feet by 75 feet for potential wells at DSB, and 100 feet by 75 feet for potential wells at Capistrano Beach Park, as indicated in Exhibit 3-4, Southeast Intake Well Study Area, and Exhibit 3-5, Doheny State Beach Intake Well Installation and Staging Area. The installation areas will be screened to minimize noise, lighting and aesthetic impacts. Drilling of the wells will occur consecutively, with only one well being drilled at any given time within the beach construction window due to limited availability of specialized equipment, to allow for ongoing monitoring, to minimize impacts."

Page 3.0-38, Section 3.6, Subsection "Staging Areas," Paragraph 3, Sentence 1

"In addition to the ~~drill rig work~~ installation areas, ~~the~~ slant well construction will require staging ~~areas~~ for equipment laydown and storage…."

Page 3.0-38, Section 3.6, Subsection "Staging Areas," Paragraph 3, Sentence 5

"…~~Conceptual locations~~ Feasible staging areas, based on preliminary discussions with State and County Parks are shown on Exhibit 3-5, Doheny State Beach Intake Well Installation and Staging Area, and include a potential 240 foot by 125 foot staging area in the south portion of the DSB North Day Use Area (where the test slant well modular units were located), and/or a narrow staging area within the DSB South Day Use Area, such that through traffic within DSB is maintained."

Page 3.0-39, Section 3.6, Subsection "Staging Areas – High Surf Mitigation," Paragraph 5, Sentence 2 and 3

"…However, due to the ~~more narrow~~ narrower beach conditions, subsurface slant well construction at Capistrano Beach Park would be exposed to high surf conditions during the winter off-season construction period ~~running from October 1 to May 1, to minimize beach recreational and access impacts~~. Therefore, the following special construction measures are anticipated for ~~High Surf~~ high surf conditions, subject to further refinement during final design and regulation agency permitting."

Page 3.0-39, Section 3.6, Subsection "Staging Areas – High Surf Mitigation," Fifth paragraph, Modification of first bullet list item in last paragraph

"…The skid-mounted drill rig will be supported by four pilings, which will be keyed in to underlying competent materials and will be grouted in place. It is anticipated the pilings will be on the order of 20-30 feet deep. The drill rig necessary for constructing the slant wells requires anchoring for normal operations independent of high surf conditions. The anchors are constructed by drilling a 10-inch borehole using a truck-mounted hollow-stem auger rig and cementing in a metal bar with eyelet in place. The anchors are needed to stabilize the rig when drilling and when pulling the drill casings. The augering for the installation would not require pile driving and therefore would not result in noise or vibration impacts associated with that process. The platform portion…"

Page 3.0-40, Section 3.6, Subsection "Staging Areas - Raw Water Conveyance Alignment", First full paragraph, Last sentence

"The tunnel construction will require a steel casing sized at 66 inches to accommodate ~~the ultimate pipe size.~~ sufficient pipe size for the Regional Project, which avoids further tunneling across sensitive rights-of-way in the event the Regional Project moves forward in the future. "

Page 3.0-41, Section 3.6, Subsection "Staging Areas – Raw Water Conveyance Alignment," First paragraph continued from p. 3.0-40, First full sentence on p. 3.0-41

"…approximately 570 LF to the intersection of Las Vegas and Doheny Park Road. ~~The alignment of the raw water pipeline beneath the Caltrans PCH bridge assumes the bents (columns/piles of the bridge) have been seismically retrofitted which will allow a transverse crossing within 10 feet of the footings.~~

Page 3.0-41, Section 3.6, Subsection "Staging Areas – Desalination Facility Site," Second full paragraph on p. 3.0-41, New last sentence

"…The Project would require the transport of approximately 79,600 CY of dirt, with 15,000 CY to be hauled from the site and 64,600 CY to be hauled to the site. Further site grading would not be required in the event the Regional Project moved forward in the future, because it would use the same facility site as the Phase 1 Project."

Page 3.0-41, Section 3.6, Subsection "Staging Areas – Brine Disposal System" Third full paragraph on p. 3.0-41

"The pipe which connects the Brine ~~Disposal~~ Discharge Tank to the existing SJCOO will be sized for the ~~ultimate~~ Regional Project 15 MGD capacity so that multiple connections are not required to the SJCOO if the Regional Project moves forward in the future. Accordingly, a pipe diameter of 24~~"~~ inches has been assumed based on design criteria of 8 fps for piping. "

Page 3.0-42, Section 3.6, Subsection "Construction Schedule," First full paragraph in p. 3.0-42, Renamed (with Schedule Discussed Above)

"~~Construction Schedule~~ Maintenance

~~There are two phases of development for the proposed Project: Phase I which would consist of up to an initial 5 MGD facility, and Regional Project consist of up to a 15 MGD facility. Per discussions with State Parks and County Parks, construction at the beach would only be allowable during the "off-season" to minimize impacts to beach access and recreation (the specific timeframes are subject to further discussion with State Parks and County Parks staff as part of the Project's permitting process, but for the purposes of this EIR has assumed to be from 10/1 through 5/1 to avoid the peak Summer season and also to minimize conflict with special events in the Fall and early Summer). It is estimated that it will take 2-3 months to drill and develop a 1000 foot slant well. Following well construction, the "well development" process (pumping the well to remove sands prior to initiating production) would require approximately one month. Therefore, during this off-season construction period, two wells could be constructed with a single drill rig and a separate well development rig, depending on the available construction period based on State Parks and County Parks requirements (the actual available construction period may be less, particularly for DSB, due to relatively steady visitor demand year-round, as discussed in Section 4.12, Recreation). During Phase 1, for example, 2 wells could be drilled during the first winter period and the other 2 wells could be drilled during the second winter period. Overall, the Phase 1 project is expected to last from October 2019 to December 2021. Future expansions of the Regional Project, up to 15 MGD, have yet to be determined by the District, therefore construction schedules are not yet determined."~~

Pages 3.0-44 and 45, Section 3.7, Table 3-10, Row 9, Second bullet in the third column

California Coastal Commission (CCC)	Coastal Development Permit in accordance with the California Coastal Act (Pub. Res. Code §30000 et seq.)	▪ Required for marine-related improvements that change the intensity of land use within the Coastal Zone. Required for Project development proposed on tidelands, submerged lands, and public trust lands (i.e., intake wells and brine discharge facilities). ▪ ~~With~~ The City of Dana Point's LCP incorporates "consolidated permit review"~~,~~ automatically, which allows the entire CDP to be processed directly by the Coastal Commission. In this case, the City's LCP is advisory and the Project will be reviewed for consistency with the Coastal Act. ~~may also act as Coastal Act reviewing authority for onshore areas within the jurisdiction of the City of Dana Point.~~

Pages 3.0-44 and 45, Section 3.7, Table 3-10, New Row 19

California Department of Parks and Recreation (State Parks)	Encroachment Permit	▪ Required for construction activities within or adjacent to Doheny State Beach
	License Agreement	▪ Required for further operations and maintenance activities within or adjacent to Doheny State Beach

SECTION 4.0 ENVIRONMENTAL ANALYSIS

This Errata makes edits that clarify, amplify or make insignificant modifications to the Environmental Analysis, but that do not add significant new information to the EIR.

Page 4.0-8, Table 4-1: Cumulative Projects, Row 8

Table 4-1: Cumulative Projects

Project Name	Project Summary
Cumulative Local Projects	
California Ocean Desalination Projects	The following ocean desalination projects are in the vicinity of the proposed Project. All are subject to the Ocean Plan Amendment and other applicable regulations. Each facility's approximate production capacity and status is noted as follows: ▪ Carlsbad – 50 MGD (Operational) ▪ Oceanside – 4.5 MGD (Feasibility Study – currently not planned for implementation) ▪ Camp Pendleton – 50 to 150 MGD (Feasibility Study/Pilot Project – currently on hold); Pilot facility with 20 gpm open ocean intake flow, and 20 gpm subsurface intake flow (currently on indefinite hold) ▪ Santa Catalina Island – ~~0.325~~0.202 MGD (Operational) ▪ Huntington Beach – 50 MGD (Entitlement)

Page 4.0-7, Table 4-1, Footnote Corrections (table references and footnotes were inadvertently mixed)

"Doheny Village[1]
Dana Point Harbor Revitalization Project[2]
SCWD CIP MND[3]
San Juan Watershed Project[4]
San Juan Creek Levee Improvement Project[5]
Final EIS for San Juan Creek Watershed Special Area Management Plan (SAMP)[6]
South OC WMA Integrated Regional Water Management Plan[7]

1 http://www.danapoint.org/businesses/doheny-village
2 http://www.danapoint.org/Home/ShowDocument/12553
3 South Coast Water District, 2017 Update to Infrastructure Master Plan, Available at https://www.scwd.org/about/plansanddocs/infrastructure.asp, (accessed January 26, 2018).
4 http://sanjuanwatershed.com/
5 Orange County Public Works Flood Division, San Juan Creek Levee Improvement Project, Available at http://www.ocflood.com/nfc/projects_a/sjcleveeimp#overview, (accessed January 26, 2018); updated website available at http://www.ocflood.com/gov/pw/flood/nfc/projects_a/san_juan_creek_levee_improvement_project/default.asp (accessed April 30, 2019).
6 US Army Corps of Engineers Los Angeles District, Draft Environmental Impact Statement San Juan Creek and Western San Mateo Creek Watershed Special Area Management Plan (SAMP) December 2006.
7 http://www.ocwatersheds.com/programs/ourws/wmaareas/wmasouthoc/soc_wma_irwmp (accessed May 3, 2018)."

SECTION 4.1 AESTHETICS

Page 4.1-13, Section 4.1.4, Subsection "Mitigation Measures," Mitigation Measure AES-2, New final sentence

"AES-2 SCWD shall prepare a Site Architectural, Landscape and Lighting Plan Prior to the start of construction, for the purposes of minimizing aesthetic and light/glare impacts from all above-ground facilities, including the electrical control panel near the slant wells, and the desalination facility. Given the desalination facility site's visibility from areas west of San Juan Creek and from PCH, the desalination facility architecture and building elevations shall be designed to create an aesthetically appropriate appearance, as determined by the City of Dana Point and/or California Coastal Commission through the facility's Coastal Development Permit review process. Architectural design shall favor natural appearing materials that blend with the surrounding areas, as well as use of non-reflective glass to minimize glare. A Lighting Plan shall be prepared, demonstrating use of directional lighting and lighting that is limited to intensity needed for site security and safety, in order to minimize light/glare impacts to viewers west of San Juan Creek. All rooftop mechanical and electrical equipment will be screened or placed in areas that are not highly visible from residential and public areas, where feasible. A Landscape Plan shall be prepared, to provide adequate site landscaping for aesthetic enhancement, using non-invasive, drought-tolerant native species. The landscape plan shall be consistent with City of Dana Point's MS4s Permit requirements and City of Dana Point Municipal Code Chapter 9.55 on Water Efficient Landscape Standards and Requirements."

SECTION 4.2 AIR QUALITY

Page 4.2-22, Section 4.2.4, Subsection "Mitigation Measures," Entire section

~~"No mitigation measures are required.~~ Mitigation Measures AQ-1 through AQ-3 regarding Project construction will mitigate this impact to a less than significant level."

Page 4.2-29, Section 4.2.4, Subsection "Mitigation Measures," Mitigation Measure AQ-3, new bullets added to end of mitigation measure on p. 4.2-29

- "Wheel washers shall be installed and used by truck operators at the exits of the construction sites.
- The applicant (District), or its designee, shall apply for and obtain a haul route permit from the City of Dana Point for all truck activity for the proposed construction activities. The haul route for all activities shall be outlined in the permit application.
- During the construction phase, District, or its designee, shall ensure all construction materials, waste, grading or demolition debris, and stockpiles of soil, aggregates, soil amendment, or similar material, shall be properly covered, stored, managed, secured and disposed to prevent transport into the streets, gutters, storm drains, creeks and/or coastal waters by wind, rain, tracking, tidal erosion or dispersion."

Page 4.2-31, Section 4.2.4, Subsection "Construction – Toxic Air Contaminants", New language added to the end of the first paragraph

"…According to the Office of Environmental Health Hazard Assessment (OEHHA), health risk assessments, which determine the health risk relative to exposure of sensitive receptors to TAC emissions, should be based on a 24 hour a day, 7 days per week, 365 days per year, 30-year exposure period (i.e., chronic lifetime) when assessing TACs (such as DPM) that have cancer or chronic non-cancer health effects.[2] The Project will not be emitting TACs in large concentrations, nor on a 24-hour basis. The totality of air quality emissions or "doses" from the project (from both construction and operation) are so low and infrequent, as shown in the modeling for the impact analysis, that there are no significant health risk impacts associated with the Project. "

SECTION 4.3 BIOLOGICAL RESOURCES

Page 4.3-11, Section 4.3.1, Subsection "Marine Communities – Pelagic Community," Third full paragraph on p. 4.3-11, New final sentence

"…Other species that are likely present in the area that were in habitats similar to that of the Project area include croaker (SCIAENIDAE), Silversides (ATHERINOPSIDAE), California grunion, blennies (BLENNIIDAE), and gobies (GOBIIDAE). The California grunion is not a special status species under the Federal Endangered Species Act or California Endangered Species Act. Further, it is not identified as a sensitive animal species with known or potential occurrence within or near Doheny State Beach by the Doheny State Beach General Plan or General Plan EIR."

Page 4.3-11, Section 4.3.1, Subsection "Connectivity and Migration Corridors," New first sentence in the fifth full paragraph on p. 4.3-11

"The terrestrial environmental setting of the desalination facility Project, as described previously, is heavily disturbed, urbanized and currently used for commercial, industrial and recreational uses. Opportunities for wildlife movement in the immediate area may be present within the San Juan Creek channel, although the channel adjacent to the project site is hardened and lined for flood control, and provides little vegetative cover before the creek reaches the lagoon area downstream. California gray whales (*Eschrichtius robustus*) pass offshore of southern California annually during their migration between the Bering Sea and birthing lagoons in Baja California, and are the most frequently observed northward migrating whale in the Project vicinity…."

Page 4.3-12, Section 4.3.1, Subsection "Connectivity and Migration Corridors," New paragraph at the end of subsection "Connectivity and Migration Corridors"

"…Blue whales are known to be slightly further from shore than gray whales, but do still tend to remain fairly close to land during their migration.

Terrestrial biological corridors are areas of continuous habitat or landscape that provide a connection for wildlife passage between areas of natural or relatively undisturbed habitat. In the Project area there are two terrestrial biological corridors (DSB General Plan, 2003). San Juan Creek passes through a highly urbanized landscape to connect the lower creek in the Project area to natural habitat in the upper San Juan Creek Watershed, including the Cleveland National Forest. The San Juan Creek corridor intercepts the shoreline, the second terrestrial biological corridor in the Project area, and the Pacific Ocean. Shorelines and beaches along the Pacific coast provide stopover sites for migratory shorebirds, while vegetated coastal areas, including natural and ornamental landscapes, pockets of riparian habitat, and coastal wetlands, support migration of upland and water-associated birds. In the Project area, a strip of highly disturbed native and ornamental vegetation along Pacific Coast Highway supports movement of resident and migrant wildlife between higher-quality coastal habitat (DSB General Plan, 2003)."

Page 4.3-17, Section 4.3.2, Table 4.3-2: Managed Fish Species Found in the Project site, Sources in last column

"Sources:
~~a: Love 2011; Miller and Lea 1972; Eschmeyer et al. 1983~~
~~b: MBC and Tenera 2005; MBC 2007, 2013~~
~~c: CDFW 2016; Weston 2011, 2015; MBC 2013; Tetra Tech 2010, CSP 2003; Allen and DeMartini 1983.~~
Appendix 10.4.1, Table 6, page 16."

Page 4.3-26, Section 4.3.3, Subsection "Project Design Features," First bullet under subsection

- "The subsurface intakes are the preferred ocean water intake method by the SWRCB's Ocean Plan Amendment, as they ~~avoid~~ eliminate marine life impingement and entrainment impacts;…"

Page 4.3-36, Section 4.3.4, Subsection "Mitigation Measures," Mitigation Measure BIO-4

"**BIO-4 DSB Groundwater Monitoring** (for SJC Lagoon). The District shall monitor San Juan Creek Lagoon water levels and salinity following commencement of pumping for the first slant well installed at DSB. The monitoring reports shall be submitted monthly to the Coastal Commission, SJBA and NOAA NMFS (at minimum), and shall be used to site any future slant wells at DSB, in consultation with the San Juan Basin Authority, Coastal Commission and NOAA NMFS, such that Phase I slant wells at DSB do not create a significant impact to San Juan Creek Lagoon water levels or salinity relative to southern steelhead trout, as determined by NOAA NMFS."

Pages 4.3-36, Section 4.3.4, Subsection "Mitigation Measures," New mitigation measure beneath Mitigation Measure BIO-4

"**BIO-5 Black Abalone Protection** (Capistrano Beach Park only). If construction is proposed in locations that will result in the disturbance of existing riprap structures (e.g. Capistrano Beach Park) the District will consult with a qualified biologist to determine if the work area has potential for the occurrence of black abalone based on the elevation and depth distribution of the construction zone. If a potential for occurrence is identified, then the District contractor will conduct a black abalone survey no more than 90 days prior to initiation of construction work. The District will ensure a survey of the existing riprap structures be conducted at both intertidal and subtidal habitats to the base of the riprap wall to determine if black abalone is present on the structures. The survey team will include qualified divers and biologists experienced in identifying abalone. Survey results will be provided to the District and to the National Marine Fisheries Service (NMFS). If black abalone are determined to be present, the District contractor will consult with NMFS to develop and implement a black abalone protection plan. If necessary and feasible, the District contractor will develop a transplantation plan acceptable to NMFS that includes the identification of a suitable transplant location nearby, temporary holding and transport methods, and reporting requirements."

SECTION 4.4 CULTURAL RESOURCES

Page 4.4-29, Section 4.4.5, Subsection "Mitigation Measures," Final paragraph of Mitigation Measure CUL-2, New final sentence

" …The public repository or museum must meet the standards and requirements for the curation of cultural resources set forth at Federal Code of Regulations, Part 79, Title 36. Title to abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the state and under the jurisdiction of the State Lands Commission. Should any cultural resources on state lands be discovered during construction, the District shall contact appropriate Commission staff. The final disposition of archaeological, historical, and paleontological resources recovered on state lands under the jurisdiction of the California State Lands Commission must be approved by the Commission."

SECTION 4.5 GEOLOGY AND SOILS

Page 4.5-16, Section 4.5.4, Subsection "Operations – All Components," Last Paragraph, Fourth sentence.

"…The component with the most extensive facility infrastructure is the desalination facility, which is located on the east side of San Juan Creek. The creek is supported by an existing concrete channel wall ~~to~~, which reduces the potential for impacts due to ~~erosion and~~ liquefaction by providing a structurally stable site…."

Page 4.5-19, Section 4.5.4, Subsection "Mitigation Measures," Mitigation Measure GEO-1, New language added to the end of the mitigation measure

"GEO-1 Prior to ground disturbing activities, a site-specific soils engineering report as required by California Building Standards Code § 1803 shall be prepared by a registered geologist. The soils engineering report shall detail existing soils and geologic conditions and shall be required for all Project components located within Liquefaction Investigation Zones, Landslide Investigation Zones or Alquist-Priolo designated Earthquake Fault Rupture Hazard Zones. The soils engineering report shall specifically include laboratory test data, associated geotechnical engineering analysis, and a thorough discussion of seismicity, liquefaction, landslide, dynamic compaction, compressible soils, corrosive soils, and tsunami (as applicable). The soils engineering report shall include any recommendations for ground improvement and/or foundation systems necessary to mitigate potential geologic hazards, as necessary. Recommendations shall be reflected in Project grading and design plans as appropriate.

Prior to operations, the District (or its designee) shall ensure that a complete final Geotechnical Report shall be prepared by the Project geotechnical consultant, in accordance with City of Dana Point standards. A copy of the final geotechnical report shall be distributed to all stakeholders including the City of Dana Point.

Prior to operations, the District (or its designee) shall ensure that an As-Built Grading Plan shall be prepared by the Civil Engineer of Record. A copy of the as-built grading plans shall be distributed to all stakeholders including the City of Dana Point.

Further mitigation requires that:

a) The applicant (District), or its designee, shall provide a complete site-specific geotechnical engineering report for review by the City of Dana Point City Engineer

b) That geotechnical report shall provide a statement that on-site observation and testing shall be provided to allow the Engineer of Record to certify all work completed.

c) That geotechnical report shall also provide geotechnical recommendations for constructing retaining walls and/or associated temporary slopes as applicable."

SECTION 4.6 GHG

Page 4.6-22, Section 4.6.4, Subsection "Mitigation Measures," Mitigation Measure GHG-1, New number 2

"….The Plan shall, at a minimum, include the following elements:

1) **Project GHG Emissions** – updated GHG emission estimates based upon final design plans;

2) **Construction GHG Emissions** – provide GHG offsets for construction-related GHG emissions in the first year of operation, to be estimated and offset prior to construction and verified following construction, rather than amortizing these emissions over a 30-year period;"…

Page 4.6-22, Section 4.6.4, Subsection "Mitigation Measures," Mitigation Measure GHG-1, Number 4, New fourth sentence

"4) GHG Mitigation Options – the Plan shall identify specific strategies to be implemented which shall, at minimum, be sufficient to reduce or offset the Project's incremental GHG emissions to a "no net increase" performance standard. Strategies shall be verifiable and feasible to acquire and implement over the Project life. The Plan shall identify how each strategy shall be implemented, and the emission reductions associated with strategy. The Plan shall identify the measure prioritization, with onsite measures preferred over Carbon Offsets. Subject to review and modification by other permitting agencies (including the California Coastal Commission and State Lands Commission), SCWD may include any/or all of the following strategies in the Plan:…

Page 4.6-24, Section 4.6.4, Subsection "Mitigation Measures," Final sentence of Mitigation Measure GHG-2 on p. 4.6-24

"…The findings of the Report shall be used to adjust the annual GHG offsets required for the subsequent Project operational years. Additional offsets, if required, shall be in place by the end of the next operational year~~.~~, with verification and validation of any additional offsets included in the following year's Report."

SECTION 4.7 HAZARDS

Page 4.7-29, Section 4.7.4, Subsection "Mitigation Measures," New paragraph added to the end of Mitigation Measure HAZ-3 on p. 4.7-29

"**HAZ-3** Registered Professional Engineer or Geologist. The District shall have a Registered Professional Engineer or Geologist, with experience in remedial investigation and feasibility studies, available for consultation during soil excavation and grading activities. The Registered Professional Engineer or Geologist shall be given full authority to oversee any drilling, microtunneling, jack and bore, excavation, trenching, or other earthmoving activities that have the potential to disturb contaminated soil or groundwater and provide recommendations for remediation and/or prevention should it be necessary.

Slant well construction and operation shall include ongoing groundwater monitoring, both for lagoon surface water levels (BIO-4) and groundwater quality. Groundwater quality will be monitored both for slant well product water quality to ensure drinking water quality standard compliance, as well as groundwater levels and quality in existing and new groundwater monitoring wells. Groundwater modeling in Draft EIR Appendix 10.10.2 (pages 52-62) indicates that the Project is anticipated to have a beneficial effect on existing groundwater plumes. Should the Project adversely affect existing groundwater plumes based on groundwater quality monitoring, the District shall implement a Remedial Action Plan for review and approval by applicable regulatory agencies including the SDRWQCB and DTSC, such that Project drinking water will meet applicable drinking water standards, and existing groundwater pumpers are not adversely affected by Project pumping. A copy of the final hydrology or other studies related to Project slant well construction and monitoring shall be distributed to appropriate stakeholders including the City of Dana Point."

Page 4.7-33, Section 4.7.4, Subsection "Mitigation Measures," New Paragraph at the end of mitigation measure HAZ-4

"…The District is responsible for implementing all recommended actions.

If soil contamination is suspected or observed in the Project area, then excavated soil will be sampled prior to export and disposal. If the soil is contaminated, it will be disposed of in accordance with all applicable and relevant laws and regulations. Contaminated soil will be included as a potential waste stream in the Hazardous Waste Management Plan (HAZ-2). All soil sampling will be conducted under the oversight of the Registered Professional Engineer or Geologist (Haz-3).

Any imported soil used for backfill and any backfill soil that will be imported will be properly screened or evaluated to ensure the backfill material is free from contamination. Soils imported from a quarry will be sampled and certified by the quarry prior to acceptance. Soils to be imported from other locations will be evaluated per the Department of Toxic Substance Control's "Information Advisory Clean Imported Fill Material" dated October 2001."

Page 4.7-35, Section 4.7.7, Subsection "Mitigation Measures," New paragraph added to end of Mitigation Measure HAZ-8 on p. 4.7-35

"…The Operation Injury and Illness Prevention Plan, Emergency Action Plan, and Personal Protective Equipment Program shall be submitted to the Cal/OSHA Consultation Service, for review and comment concerning compliance of the program with all applicable Safety Orders for approval. The Operation Fire Protection Plan and the Emergency Action Plan shall also be submitted to the City of Dana Point Fire Department for review and comment. The Project Operations Fire Protection and Prevention Plan and Emergency Action Plan shall address:

a) Provision of remote annunciation for all fire alarm and automatic suppression devices and the placement of remote annunciation at applicable project sites.
b) Provision of fire alarm system and automatic fire sprinklers for all new structures.
c) Adequate emergency access for Fire Department operations.

Prior to construction, the applicant (District), or its designee, shall prepare a Fire Master Plan and submit said plan to the Orange County Fire Authority (OCFA) and the City of Dana Point Public Works for review and approval. Hydrant locations shall be designated as part of the Plan. A Fire Master Plan shall be required for the proposed facility and slant well location as deemed necessary by OCFA."

Page 4.7-44, modified Exhibit 4.7-2

See attached modified Exhibit 4.7-2.

SECTION 4.8 HYDROLOGY AND WATER QUALITY

Page 4.8-18, Section 4.8.2, Subsection "State – Sustainable Groundwater Management Act", Paragraph 1

"The State of California currently lists the subterranean stream underlying San Juan ~~Basin~~ Creek as a "very low" priority groundwater basin relative to SGMA, which means that a date for GSA formation and GSP preparation has not been set by DWR."

Page 4.8-28, Section 4.8.3, Subsection "Mitigation Measures," Mitigation Measure HWQ-1, New final sentence and final paragraph at the end of Mitigation Measure HWQ-1

"HWQ-1 Prior to any ground disturbance activities, SCWD shall manage stormwater pollution from construction activities by complying with State Water Resources Control Board's National Pollutant Discharge Elimination System (NPDES) Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction Activities. At least 30 days prior to construction, SCWD (or its designee) shall develop and implement a construction Stormwater Pollution Prevention Plan (SWPPP) for the construction of the Project that identifies project-specific best management practices (BMPs) to be implemented during the construction phase. The SWPPP shall include applicable erosion control measures, with the intent to satisfy Erosion Control Plan requirements of regulatory permitting agencies including the California Coastal Commission, State Parks, County Parks and City of Dana Point. District (or its designee) shall ensure that construction activities are coordinated with the City of Dana Point, City of San Juan Capistrano and State Parks relative to ongoing efforts related to dry weather runoff monitoring.

During the construction phase, the District (or its designee) shall ensure that all construction materials, waste, grading or demolition debris, and stockpiles of soil, aggregates, soil amendments, or similar material are properly covered, stored, managed, secured and disposed to prevent transport into the streets, gutters, storm drains, creeks and/or coastal waters by wind, rain, tracking, tidal erosion or dispersion."

Page 4.8-29, Section 4.8.3, Subsection "Mitigation Measures," Mitigation Measures HWQ-3 and HWQ-4

~~**"HWQ-3** Minimum SJCOO Flow – As part of the Project's NPDES Permit application for brine discharge, the District stipulates that the Project will comply with applicable OPA requirements. If required to meet OPA requirements, the District, as a SOCWA member agency with shared responsibility in managing SJCOO discharges, will ensure that SJCOO~~

~~wastewater discharges are at least 0.35 MGD where required to provide adequate blending of the Project's brine discharge."~~

"HWQ-4: ~~Prior to construction~~ Early in the design/planning, the District (or its designee) shall prepare a Preliminary Water Quality Management Plan (WQMP) for review and approval by the City of Dana Point in conformance with *Model Water Quality Management Plan (Model WQMP) for South Orange County (2017)* and associated *Technical Guidance Document (2017)*, identifying applicable site design BMPs, which address low impact development and designing the site in sustainable ways, source control BMPs, which are operation, management, LID/Treatment Control BMPs (Harvest & Reuse, On-site retention and/or biofiltration), and Hydromodification Management BMPs, as applicable. Prior to final approval and operations, the District (or its designee) shall prepare and submit a Final WQMP and Operations and Maintenance (O&M) Plan pursuant to the City's Water Quality Development Standards to the City for review and approval, including:~~and~~ housekeeping activities which control pollutants at the source, include staff and contractor training, street sweeping, storm drain system maintenance, efficient irrigation practices, litter management, etc.; and treatment BMPS, which remove pollutants from runoff prior to discharge. All these BMPs will be implemented for comprehensive pollutant management program and management and treatment of the runoff generated from the project.

District (or its designee) shall ensure that final certification for all improvements associated with water quality and the Project WQMP for review shall be submitted to the City Engineer by separate submittal by the project's Civil Engineer. The submittal shall indicate that the improvements are substantially completed and in conformance with the approved WQMP. The City's WQMP Construction Certification letter template, including photos, shall be completed by the project's Civil Engineer, certifying that all structural best management practices (BMPs) described in the Project's WQMP have been constructed and installed in conformance with approved plans and specifications after field inspection has been conducted."

Page 4.8-29, Section 4.8.3, Subsection Construction – All Components," Second to last paragraph on p. 4.8-29

*"*In the event that interim pumping for iron and manganese removal is required, it would not have any different impact than that evaluated for normal operating conditions, as the pumping rate would be similar. ~~For extended slant well pumping to remove iron and manganese, the net effect on local groundwater supplies would be higher than the steady state condition achieved after 18 months or so of pumping. This initial higher portion of inland groundwater is not considered a significant impact, as it would be temporary, the affected groundwater is not usable due to high salinity levels, and the Project's long-term effect would be to protect groundwater resources by providing a new source of potable water.~~ As discussed below and in Appendix 10.10.1, temporary extended pumping at Capistrano Beach Park

(slant well pods F, G, and H) would not have any impact on ~~San Juan Basin~~ groundwater in the subterranean channel underlying San Juan Creek."

Page 4.8-30, Section 4.8.3, Subsection "Operations – All Components," Final paragraph on p. 4.8-30

Slant wells at DSB have the potential to reduce annual ~~San Juan Basin~~ groundwater yield in the subterranean channel underlying San Juan Creek by up to 392 AFY, and the nearshore shallow aquifer groundwater levels could be reduced by as much as 13.96 feet for the Phase I Project during dry geologic periods. (See Table 1 and Table 4-3 in Appendix 10.10.1). This is not considered a significant impact given that in the absence of the Project slant well pumping, seawater intrusion would require inland pumping to be significantly reduced, as demonstrated by the water quality change which occurred during the most recent drought period. SCWD was required to take its groundwater well off-line which in order to improve water quality in the subterranean channel.[1] Moreover, the majority of potential impact would be on SCWD's groundwater wells (approximately 217 AFY of the 392 AFY reduction would affect SCWD's wells) and SCWD could also possibly adjust its production if needed to account for inland pumping effects. ~~as the affected groundwater is not potable due to elevated salinity levels, and t~~The DSB slant wells will actually create a pumping "trough" which will reduce further seawater intrusion into the subterranean channel~~San Juan Basin~~.[22] The maintenance of a seaward gradient from the Project slant wells will act to inhibit seawater intrusion and prevent degradation to water quality of inland groundwater even while maintaining inland pumping. ~~In addition,~~ Note that the District has a current groundwater right of up to 1,300 AFY (or approximately 1.15 MGD).[23] ~~Subject to confirmation by the San Juan Basin Authority and State Water Resources Control Board, t~~The District is not anticipated to need new or modified water rights, as the inland groundwater drawn in by the slant wells would be less than the District's current groundwater rights (0.6 MGD compared to an existing right of 1.15 MGD)[23]. ~~, and the groundwater drawn into the slant wells is "undeveloped" and available for extraction (since it is not usable due to high salinity levels).[24] The nearshore shallow aquifer groundwater levels could be reduced by as much as 13.96 feet for the Phase I Project. However, there are no local potable groundwater wells that would be adversely affected by this change (refer to Section 4.3, Biological Resources, for a discussion of groundwater level effects on the San Juan Creek Lagoon and associated wildlife).~~

Page 4.8-30, Footnotes 22, 23, 24

" [22] ~~Appendix 10.10.1, page 53.~~ Draft EIR Appendix 10.10.2, pages 4 and 7.

~~[23] South Coast Water District 2015 Urban Water Management Plan, page 3-8.~~

[1] In September 2014, during the recent drought, SCWD shutdown its Groundwater Recovery Facility (GRF) as a response to water quality results that demonstrated elevated levels of specific constituents, as requested by SJBA based on the parameters of SCWD's diversion permit (Permit 21138). In the twelve months before the shutdown, approximately 1,100 AFY was extracted from the Stonehill well, and GRF production placed into the distribution system for beneficial use was approximately 880 AFY. (See, SCWD Well Water Extraction Reports, 2013-2014; see also, Permit for Diversion and Use of Water, Permit 21138, Application 30337 of SCWD (filed March 4, 1995)

~~[24] State Water Resource Control Board Final Review of California American Water Company's Monterey Peninsula Water Supply Project, July 31, 2013, Section 6.4~~."

Page 4.8-40, Section 4.8.3, Subsection "Mitigation Measures," Mitigation Measure HWQ-6, New final sentence

"HWQ-6 Prior to constructing the electrical control building, the District shall prepare a final hydrology study that demonstrates the facility is adequately protected from flood hazards. The facility should be sited as far as practicable from extreme flood hazard potential areas, recognizing the coastal location may make this challenging. In the event the facility is sited in a flood hazard zone, the building shall be designed to withstand reasonably foreseeable future flood hazard events, to the satisfaction of State Parks. The District (or its designee) will make available the final hydrology study, consistent with other studies and information generated through the final design stages, to Project stakeholders including the City of Dana Point."

Page 4.8-48, modified Exhibit 4.8-2

See attached modified Exhibit 4.8-2.

SECTION 4.10 NOISE

Page 4.10-24, Section 4.10.4, Subsection "Mitigation Measures," Mitigation Measure NOI-1, New bullets added after the last bullet on p. 4.10-24

"NOI-1 Prior to construction, SCWD (or its designee) shall ensure that the Grading Plan, Building Plans, and specifications stipulate that:

- All construction equipment, fixed or mobile, is equipped with properly operating and maintained mufflers and other State-required noise attenuation devices.
- When feasible, construction haul routes shall avoid noise sensitive uses (e.g., residences, convalescent homes, etc.).
- During construction, stationary construction equipment shall be placed such that emitted noise is directed away from the nearest noise sensitive receptors.
- Construction activities that generate noise shall not take place outside of the allowable hours specified by the City of Dana Point Municipal Code Chapter 11.10.014 (8:00 p.m. to 7:00 a.m. on weekdays, including Saturdays, or at any time on Sunday or Federal holiday, with exception on PCH between San Juan Creek Bridge and Crystal Lantern)
- SCWD (or its designee) or the Project contractor shall, to the extent feasible, schedule construction activities to avoid simultaneous operation of construction equipment so as to minimize noise levels resulting from operating several pieces

of high noise levels resulting from operating several pieces of high-noise-level-emitting equipment.

- SCWD (or its designee) shall ensure that construction noise reduction methods such as shutting off idling equipment, construction of a temporary noise barrier, maximizing the distance between construction equipment staging areas and adjacent residences, and use of electric air compressors and similar power tools, rather than diesel equipment, are used where feasible.
- SCWD (or its designee) shall ensure that construction hours, allowable workdays, and the phone number of the job superintendent are clearly posted at all construction entrances to allow surrounding property owners to contact the job superintendent if necessary. In the event the City receives a complaint, SCWD (or its designee) shall ensure appropriate corrective actions are implemented and a report of the action provided to the reporting party."

SECTION 4.13 TRANSPORTATION AND TRAFFIC

Page 4.13-13, Section 4.13.4, Subsection "Construction – City of Dana Point/Caltrans," Second full paragraph on p. 4.13-13, Third sentence

"…Municipal Code 12.04.115 exempts truck limitations for use on designated truck routes and necessary travel from local streets to the nearest truck route, which include ~~Del Prado (north end to south end),~~ Del Obispo (from PCH to Northern City Boundary), and PCH (from San Juan Creek to Camino Capistrano)…."

Page 4.13-15, Section 4.13.4, Subsection "Construction – Capistrano Beach Park," Paragraph 1, Sentence 2

"… As this planned future improvement is intended to use ~~railroad right-of-way~~ Coast Highway and the slant well construction would not utilize rail right-of-way (and would be temporary), the Project would not conflict with this future planned City bike trail improvement."

Page 4.13-15, Section 4.13.4, Subsection "Construction – City of Dana Point/Caltrans," Paragraph 4, Sentence 2

"…As noted above, Capistrano Beach Park has direct access to ~~PCH~~Coast Highway, which is a designated truck route with ready access to I-5.…"

Page 4.13-16, , Section 4.13.4, Subsection "Construction – City of Dana Point," Third full paragraph on p. 4.13-15, New sentence after the fifth sentence

"…As noted in Section 3.0.0, Project Description, the North Alignment is presently not the preferred alignment, due to an existing repaving moratorium on Del Obispo Street. The City of Dana Point notes additional concerns for the North Alignment, including traffic impacts to heavily traveled roads including PCH, Dana Point Harbor Drive, and Del Obispo, as well as potential impacts to City parks and facilities due to trenching. Should the South Alignment be determined as infeasible or otherwise undesirable, SCWD would pursue the North Alignment and resolve appropriate compensation…"

Pages 4.13-19, Section 4.13.4, Subsection "Mitigation Measures," Mitigation Measure TRF-1, New final paragraph

"TRF-1 Prior to commencing Project construction, SCWD (or its designee) shall develop and implement a Parking and Staging Plan for all phases of construction to require that all Project-related parking occurs on-site or in pre-designated off-site parking areas. The Staging Area[5] shall maintain through park access for motor vehicles, bicycles and pedestrians. To accommodate peak parking demand for Special Events during the offseason, SCWD (or its designee) shall coordinate with State Parks to reschedule Special Events to alternate venues or to outside the off-season construction period, and if not possible, shall arrange for sufficient off-site parking and shuttles such that the displaced parking stalls are offset. The contractor shall utilize shuttles to transport workers to and from any off-site staging/parking areas (if utilized) and Project construction areas. At least 60 days prior to start of site mobilization, SCWD (or its designee) shall submit the Plan to each affected jurisdiction for review and approval.

<u>If off-site staging/parking areas are utilized, and are outside of SCWD property, such as in the City of Dana Point, SCWD (or its designee) shall notify and coordinate with the City or other affected jurisdiction(s), on the location and duration of use of the off-site staging/parking area(s).</u>"

Pages 4.13-20, Section 4.13.4, Subsection "Mitigation Measures," New language added to the end of Mitigation Measure TRF-2 and the addition of a new TRF-3

"TRF-2 Prior to construction, SCWD (or its designee) shall submit for review and approval a **Construction Traffic Control Plan** (TCP) to each affected jurisdiction (including State Parks, Caltrans, County Parks, and City of Dana Point), as part of the encroachment permit or related approval process. The TCP shall address, at minimum, the following issues:

- Controlling construction traffic flow by use of a flag person at construction site entrances on public roads, including Stonehill Drive/SCWD Access Road, Dana Point Harbor Drive/Park Lantern, and Palisades Drive/PCH;
- Signage, lighting, and traffic control device placement if required;[2]
- Need, if any, for construction work hours and arrival/departure times outside of peak traffic periods;
- Maintaining access for emergency vehicles;
- Advanced notice to local agencies, transit providers, school districts, and emergency service providers regarding the anticipated schedule, location, and

[2] *SCRRA made comments on the Amended NOP (letter dated December 18, 2017), requesting consideration of a signal at the intersection of Stonehill Drive and the SCWD access road paralleling San Juan Creek. However, SCWD had previously investigated the potential for a permanent signal at this location and determined it to be infeasible due to the short distance (less than 700 feet) between the access road and Camino Capistrano, as well as potential turning movement conflicts with the hotel and commercial center driveways located less than 200 feet from the SCWD access road.*

duration of any temporarily reduced through lanes, including clear plans for temporary detours and alternate routes, if applicable;

- Main through access in each direction on any public road;
- Maintain access to adjacent properties during the construction;
- Specify construction related haul routes for any material import/export;
- Timing of heavy equipment and building materials deliveries;
- Identify specific contractor training and related safety procedures for construction vehicles exiting and entering work areas from public roads.
- **For construction-related activities of all project components:** The extent and duration of open trench construction activities, including the timing of construction work shifts, nighttime construction activities (if any), and whether roadway plates will be used when construction is ceased for the day (and re-opened during construction), or used during the weekday AM and PM peak commute hours
- **For the preferred South Alignment of Raw Water Conveyance:** SCWD shall confirm with Caltrans and the City of Dana Point that the bents (columns/piles) of the PCH bridge over Doheny Park Road are seismically stable to allow for the transverse crossing of the raw water pipeline within 10 feet of the footings. If the bents are not seismically stable for the transverse crossing, SCWD shall develop an alternate plan to meet the seismic requirements of crossing under the bridge, or, consider use of the North Alignment, via Del Obispo Street.
- **For the alternate North Alignment of Raw Water Conveyance:** SCWD shall reimburse the City of Dana Point for loss of the City's Pavement Grant Funds if the North Alignment is selected and construction activities occur before fall 2021. The City completed a major paving project on Del Obispo Street in 2016. The paving was grant funded with a 5-year moratorium on construction. The North Alignment will only be considered should the South Alignment be determined infeasible and if SCWD elects to offset the City's loss of grant funds (which the City would forfeit if repaving occurs prior to fall 2021).

During Construction activities, the applicant (SCWD), or its designee, shall coordinate all traffic, site ingress and egress and construction parking along Shoreline Drive with the City of Dana Point. The coordination shall address and minimize any potential impact to PCH."

"TRF-3 Prior to construction, SCWD (or its designee) shall submit an encroachment permit application to the City of Dana Point for review. SCWD shall work with the City of Dana Point to address impacts expected with the work per the City's Municipal Code, Encroachment Permit Standard Conditions and Detail, and other applicable regulations, and secure an encroachment permit prior to commencement of any work activities. The encroachment permit shall address at a minimum the required traffic control (also included in TRF-1), required asphalt and concrete repairs to City streets, storage of equipment and materials, water quality regulations, dust control, street sweeping, construction hours, and all other impacts/requirements."

SECTION 9.0 REFERENCES

This Errata makes edits that clarify, amplify or make insignificant modifications to the reference, but that do not add significant new information to the EIR.

Page 9.0-1

Abercrombie, Tyler ~~2017~~(January 3, 2018). RE: Doheny Operational Solid Waste Handling System. Personal Communication Email Tyler Abercrombie, Process Engineer to Brian Leung, Planning Analyst.

Bolt, Be~~a~~ranek and Newman, 1971. Noise from Construction Equipment and Operations, Building Equipment and Home Appliances, December 31, 1971.

Page 9.0-2

California Air Resources Board. ~~AB 32 Scoping Plan~~California's 2017 Climate Change Scoping Plan. https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf ~~https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm.~~ Accessed January 26, 2018

~~California Air Resources Board for the State of California. 2008. *Climate Change Scoping Plan*. Available at https://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.~~

California-American Water Company (CalAm). 2018~~7~~. CalAm Monterey Peninsula Water Supply Project Final~~Draft~~ EIR/EIS.

Page 9.0-3

~~California Department of Transportation. 2014. Traffic Volumes on California State Highways. Accessed September 13, 2017.~~

California Department of Transportation (Caltrans). 2013~~4~~. Transportation and Construction Vibration Manual. Available at http://www.dot.ca.gov/hq/env/noise/pub/TCVGM_Sep13_FINAL.pdf.

California Department of Transportation (Caltrans). 2015~~09~~. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Final Report. Prepared for California Department of Transportation by David Buehler, P.E., Rick Oestman, James Reyff, Keith Pommerenck, Bill Mitchell. ~~by ICF Jones & Stokes and Illingworth and Rodkin, Inc.~~

Page 9.0-5

~~California Department of Transportation. 2014. Traffic Volumes on California State Highways. Accessed September 13, 2017.~~

Page 9.0-6

City of Dana Point. 2010. Dana Point Harbor Revitalization Plan & District Regulations: Implementation Plan Component. Revitalization Plan and District Regulations Implementation Plan Component.

Page 9.0-8

~~Dolinka Group (for Capistrano Unified School District), Commercial/Industrial Development School Fee Justification Study, Table 13, (Total Student Generation Impacts per 1,000 Square Feet CID), March 10, 2016.~~

United States Drought Monitor. *http://droughtmonitor.unl.edu/services/data/summary/html/usdm_summary_20180213.html (accessed February 21, 2018).*

~~Environmental Data Resources (EDR) Radius Map Report with GeoCheck (EDR Report) (Environmental Data Resources (EDR), July 24, 2017)~~

~~Eschmeyer, W. N., E. S. Herald, and H. H. Hammann. 1983. A field guide to Pacific coast fishes of North America. Houghton Mifflin, Boston.~~

~~Geophysical Survey. 2017. Geophysical Survey Results and Revised Preliminary Full-Scale Slant Well Locations, Doheny State Beach and Capistrano Beach, Near Dana Point, California. Prepared by Geoscience Support Services, Inc. on May 8, 2017.~~

Page 9.0-9

~~Geoscience Support Services, Inc. 2017. Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data.~~

Page 9.0-10

~~Leighton Consulting, Inc. *Geotechnical Engineering Exploration and Analysis for the Proposed Renovation to Dana Point Harbor, City of Dana Point, California*. January 2008.~~

~~Municipal Water District of Orange County, Engineering Feasibility Report – Dana Point Ocean Desalination Project. March 2007.~~

National Oceanic and Atmospheric Administration (NOAA), 201~~3~~6. Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals; Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts. Draft published December 23.

Page 9.0-11

Orange County Parks. 2018. Capistrano Beach Park. Available at http://www.ocparks.com/beaches/capistrano/. Accessed January 30, 2018.

Page 9.0-12

California State Parks. 2018. Doheny State Beach. http://www.parks.ca.gov/?page_id=645. Accessed January 30, 2018.

~~Revitalization Plan. 2010. Dana Point Harbor Revitalization Plan. Adopted February 8, 2010.~~

~~Rincon Consultants, Inc. 2016 (August). *Cultural Resources Report*. http://www.smwd.com/assets/downloads/meeting-agenda/2015-11-04_BDM_Attachment1.pdf. Accessed April 3, 2018.~~

~~SCWD Doheny Ocean Desalination Project, *Cultural Resources Report*. December 2017. Rincon Consultants, Inc.~~

Page 9.0-13

~~South Coast Water District. 2017. Doheny Desalination Project DRAFT Local Hazard Conditions and Drainage Study. Prepared by GHD Inc. August 23, 2017.~~

SCWD Board of Directors Meeting, April 26, 2018, Agenda Item 8, http://scwd.granicus.com/GeneratedAgendaViewer.php?view_id=3&clip_id=1989 (accessed on July 31, 2018).

APPENDIX 10.7.1 COASTAL HAZARD ANALYZIS FOR THE DOHENY DESALINATION PROJECT

This Errata makes edits that clarify, amplify or make insignificant modifications to the technical study, but that does not add significant new information to the EIR.

Appendix slipsheet, new final paragraph

"The following technical appendix has been modified in response to Draft EIR comments. Refer to Appendix 4.2.1 in Section 4.2 of the Final EIR for the clarified analysis."

APPENDIX 10.7.2 COASTAL HAZARD SUPPLEMENTAL ANALYSIS FOR THE DOHENY DESALINATION PROJECT

This Errata makes edits that clarify, amplify or make insignificant modifications to the technical study, but that does not add significant new information to the EIR.

Appendix slipsheet, new final paragraph

"The following technical appendix has been modified in response to Draft EIR comments. Refer to Appendix 4.2.1 in Section 4.2 of the Final EIR for the clarified analysis."

APPENDIX 10.9 LOCAL HAZARD CONDITIONS AND DRAINAGE STUDY (HYDROLOGY STUDY)

This Errata makes edits that clarify, amplify or make insignificant modifications to the technical study, but does not add significant new information to the EIR.

Appendix slipsheet, new final paragraph

"The following technical appendix has been modified in response to Draft EIR comments. Refer to Appendix 4.2.4 in Section 4.2 of the Final EIR for the clarified analysis."

Page ii, Subsection "Figure Index"

"…

Page iii, Subsection "Figure Index"

Page iii, Subsection "Table Index"

Page 1, Section 1, Subsection 1.1 "Introduction," First bullet

- "Coastal Analysis: A Local Hazard Conditions assessment evaluated the potential coastal flooding under the projected sea level rise scenarios. The assessment was conducted pursuant to the California Coastal Commission Sea Level Rise Policy Guidance, (~~August, 2015~~2018)."

Page 3, Section 2, Subsection 2.1 "Introduction," Paragraph 1, Last sentence.

"This study was conducted pursuant to the California Coastal Commission Sea Level Rise Policy Guidance ~~(August, 2015) and the~~, 2018. The following is a summary of the Local Hazard Conditions assessment based on the process outlined in Appendix B of the Sea Level Rise Policy Guidance, and the sea level rise projections in Appendix G, Table G-11 (California Coastal Commission 2018)."

Page 3, Section 2, Subsection 2.1 "Introduction," Paragraph 2, Sentence 1

"The study was completed by Michael Baker International and presented in the ~~February 2017~~updated September 2018 report titled Coastal Hazards Analysis for the Doheny Desalination Project by Scott A. Jenkins (Appendix B)...."

Page 3, Section 2, Subsection 2.1 "Introduction," Paragraph 4, Sentence 2

"...A critical infrastructure planning horizon of Year 2100 was used ~~as the National Research Council (NRC) sea level projections (NRC, 2012), which form the basis of the sea level projections along the California Shoreline, do not extend beyond Year 2100. Significant uncertainties and variables render reliable sea level projections beyond Year 2100 difficult~~.

Page 3, Section 2, Subsection 2.1"Introduction," Paragraph 5, Sentence 2

...For additional detail refer to GHD May 1, 2017 memo Doheny Desalination Plant Historical Shoreline Assessment (Appendix A), and, Michael Baker International (~~2017~~2018) Coastal Hazards Analysis for the Doheny Desalination Project by Scott A. Jenkins (Appendix B)."

Page 3, Section 2, Subsection 2.2.1 "Sea Level Rise Projection," Paragraph 6, Sentence 1

"Sea level rise projections were based on the water level province tabulation from NOAA tide gauge stations with extended periods of record (California Coastal Commission ~~best fit equations (CCC, 2015~~2018). The Doheny Desalination Project falls within the La Jolla tide gauge water level province. Sea level rise projections are provided in Table G-11 in Appendix ~~b) for a 50 year planning horizon at Year 2100.~~G of the California Coastal Commission 2018. Sea level rise projections for the lower and upper ranges are provided in Table 2.1."

Page 4, Section 2, Subsection 2.2.1 " Sea Level Rise Projection," Table 2.1

Table 2.1 Sea Level Rise Projections

Planning Time Period (Year)		Best Fit Equation	
		Lower Range (feet)	Upper Range (feet)
50 year planning horizon (CCC, 2018)	2070	~~0.7~~2.0	~~3.2~~3.6
Critical Infrastructure Planning Horizon (CCC, 2018)	2100	~~1.4~~3.6	~~5.5~~7.1

Page 4, Section 2, Subsection 2.2.2 "Tidal Range and Future Inundation," Entire section

"Tidal datums were based on water level measurements from the Scripps Pier tide gauge station, NOAA #9410230 for the 1983 – 2001 tidal epoch. Projected sea level rise for 2070 and 2100 were available from Table G-11 in Appendix G of California Coastal Commission 2018. Tidal datums and future datums based on lower and upper sea level rise projections are provided in Table 2.2."

Table 2.2 Tidal Datums at Scripps Pier NOAA Tide Gage Station 1983-2001 with Projected Sea Level Rise

Datum	Elevation (ft NAVD)	SLR 2070 lower range (ft NAVD)	SLR 2070 upper range (ft NAVD)	SLR 2100 lower range (ft NAVD)	SLR 2100 upper range (ft NAVD)
~~Highest Observed~~EHY (Extreme High Water)	7.47	~~8.17~~9.47	~~10.68~~11.07	~~8.84~~11.07	~~12.97~~14.57
MHHW (Mean Higher High Water)	5.13	~~5.83~~7.13	~~8.34~~8.73	~~6.5~~8.73	~~10.63~~12.23
MHW (Mean High Water)	4.41	~~5.11~~6.41	~~7.62~~8.01	~~5.78~~8.01	~~9.91~~11.51
~~MTL (Mean Tide Level)~~	~~2.56~~	~~3.26~~	~~5.77~~	~~3.93~~	~~8.06~~
MSL (Mean Sea Level)	2.54	~~3.24~~4.54	~~5.75~~6.14	~~3.91~~6.14	~~8.04~~9.64
~~MLW (Mean Low Water)~~	~~0.71~~	~~1.41~~	~~3.92~~	~~2.08~~	~~6.21~~
~~MLLW (Mean Lower Low Water)~~	~~-0.19~~	~~0.51~~	~~3.02~~	~~1.18~~	~~5.31~~
~~Lowest Observed~~	~~-3.06~~	~~-2.36~~	~~0.15~~	~~-1.69~~	~~2.44~~

Page 5, Section 2, Subsection 2.2.5 "Waves, Wave Runup and Flooding Conditions," Paragraph 6, Sentence 1

"Future flooding levels were determined by Michael Baker International ~~(2017) as outlined in Appendix B of CCC (2015),~~2018, based on California Coastal Commission 2018."…

Page 6, Section 2, Subsection 2.2.5 "Waves, Wave Runup and Flooding Conditions," First paragraph continued from p. 5

"…The potential future flooding extent for the different scenarios are shown in Figures 2.2 ~~and 2.3~~ based on topography generated from USACE 2014 LiDAR data. The figure shows total water levels for the accreted beach conditions for each event since these were higher water levels than the eroded beach condition. Note that the flood extent based on the extremal total water levels is a worst case approach since it includes wave runup. Wave runup is a short term process and therefore may not result in flooding to the full extent of the runup elevation. Also note that the mapping shows flooding for all areas below the given flood elevation even though there may not be a direct flow path to all locations. It can be seen ~~only~~ that the extremal total water level for the low and high range sea level rise for 2100 may reach a very small portion at the very seaward tip of the project site where there is no proposed infrastructure. It also may flood along an existing South Drainage Swale due to backwater from the creek to the low grade area along the swale. The potential for flooded wellheads and overtopping rates for each scenario are summarized in Table ES-1 in Appendix B.

Page 6, Section 2, Subsection 2.2.5 "Waves, Wave Runup and Flooding Conditions," First full paragraph on p. 6, First two sentences

"Alternative flood extent predictions with sea level rise were available from CoSMoS 3.0 (~~Erikson~~Barnard et al., ~~2017~~2018). Flooding extents at the study site for the 0.5 m, 2 m and 5 m sea level rise scenarios for a 100-year storm event are presented in Figure 2.4~~3.~~…"

Page 6, Section 2, Subsection 2.2.6 "Extreme Flooding Events Due to Tsunami," Second full paragraph on p. 6, Final two sentences

"…Flooding extents of the low and high range ~~2070 and~~ 2100 sea level projection scenarios are illustrated in Figure 2.~~5~~4. Flood limits were very similar to the 100-year wave storm event for the 2100 low and high range sea level rise predictions (Figure 2.~~6~~2). Flood levels were approximately 0.4 ft higher for the low range and high range sea level rise limits for a 100-year event. It can be seen that ~~only~~ the tsunami for the 2100 low and high range sea level rise scenarios may reach a very small portion at the seaward tip of the property where there is no proposed infrastructure. Flooding also impacts the area around the existing South Drainage Swale due to backwater from the creek to the low grade area along the swale. "

Page 6, Section 2, Subsection 2.2.6 "Extreme Flooding Events Due to Tsunami," Fourth full paragraph on p. 6

"The assessment shows that the projected sea level rise scenarios considered in this study does not pose significant flood risk to the project site. The backwater ponding shown along the South Drainage Swale can be mitigated by site design to regrade the low ground area along the swale."

Page 8, Section 3, Subsection 3.2.2 "Boundary Condition at Pacific Ocean," Table 3.1

Table 3.1 Tidal Boundary Elevations Used in HEC-RAS Model

Pacific Ocean Tidal Boundary Condition	Tidal Elevation (NGVD 29)	Tidal Elevation (NAVD 88)
Mean Higher High Water (MHHW)	~~1.87~~2.87	~~4.13~~5.13
2070 Low Sea Level Rise Projection under MHHW	~~3.58~~4.87	~~5.84~~7.13
2070 High Sea Level Rise Projection under MHHW	~~6.08~~6.47	~~8.34~~8.73
2100 Low Sea Level Rise Projection under MHHW	6.47	8.73
2100 High Sea Level Rise Projection under MHHW	9.97	12.23

Page 9, Section 3, Subsection 3.2.4 "Analysis Results," New paragraph 1

"The HEC RAS model also simulated the Year 2100 High MHHW Sea Level Rise projection for the 100-year storm event, to determine if it had any effect on the water surface elevation in San Juan Creek upstream of the Highway 1 Bridge. Using the high sea level rise projection, the water surface elevation in the creek did change upstream of the bridge, however only during the receding limb of the streamflow hydrograph beginning at hour 30 of the simulation (note: the peak discharge in San Juan Creek occurs at hour 17.25). At this time, the flow in the stream is approximately 300 cfs, which is just a fraction of the flow that occurs at the peak of the storm (approximately 45,000 cfs for the peak of the 100-year storm). The change in water surface elevation only persists for about 500 feet upstream of the bridge, after that there is no effect that the boundary condition has on the water surface elevation at any point in time."

APPENDIX 10.10.2 DOHENY DESALINATION PROJECT - MODEL UPDATE AND REFINEMENT USING RESULTS FROM ONSHORE AND OFFSHORE GEOPHYSICAL SURVEYS AND EXPLORATORY BOREHOLE DATA

This Errata makes edits that clarify, amplify or make insignificant modifications to the technical study, but does not add significant new information to the EIR.

Appendix slipsheet, new final paragraph

"The following technical appendix has been modified in response to Draft EIR comments. Refer to Appendices 4.2.3.1 and 4.2.3.2 in Section 4.2 of the Final EIR for the clarified analysis."

APPENDIX 10.10.2 MODELING OF SLANT WELL FEED WATER SUPPLY, IMPACTS AND MITIGATION APPROACHES

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Appendix slipsheet, new final paragraph

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APPENDIX 10.10.3 GEOPHYSICAL SURVEY RESULTS

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Appendix slipsheet, new final paragraph

"The following technical appendix has been modified in response to Draft EIR comments. Refer to Appendices 4.2.3.1 and 4.2.3.2 in Section 4.2 of the Final EIR for the clarified analysis."

APPENDIX 10.11 BRINE DISCHARGE

This Errata makes edits that clarify, amplify or make insignificant modifications to the technical study, but does not add significant new information to the EIR.

Appendix slipsheet, new final paragraph

"The following technical appendix has been modified in response to Draft EIR comments. Refer to Appendices 4.2.2, 4.2.5.1, and 4.2.5.2 in Section 4.2 of the Final EIR for the clarified analysis."

Page 4.7-44, modified Exhibit 4.7-2

See attached modified Exhibit 4.7-2.

Page 4.8-48, modified Exhibit 4.8-2

See attached modified Exhibit 4.8-2.

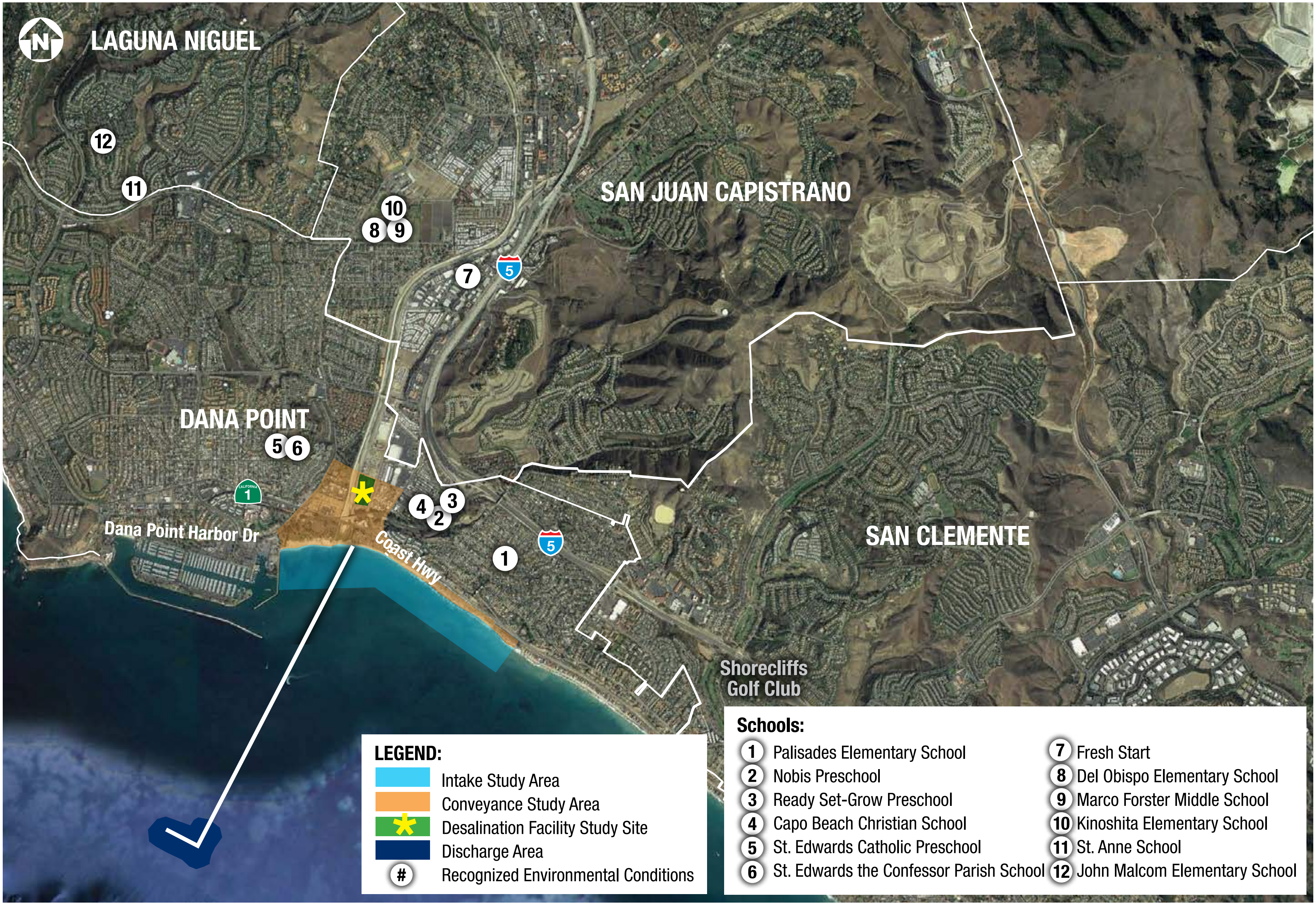
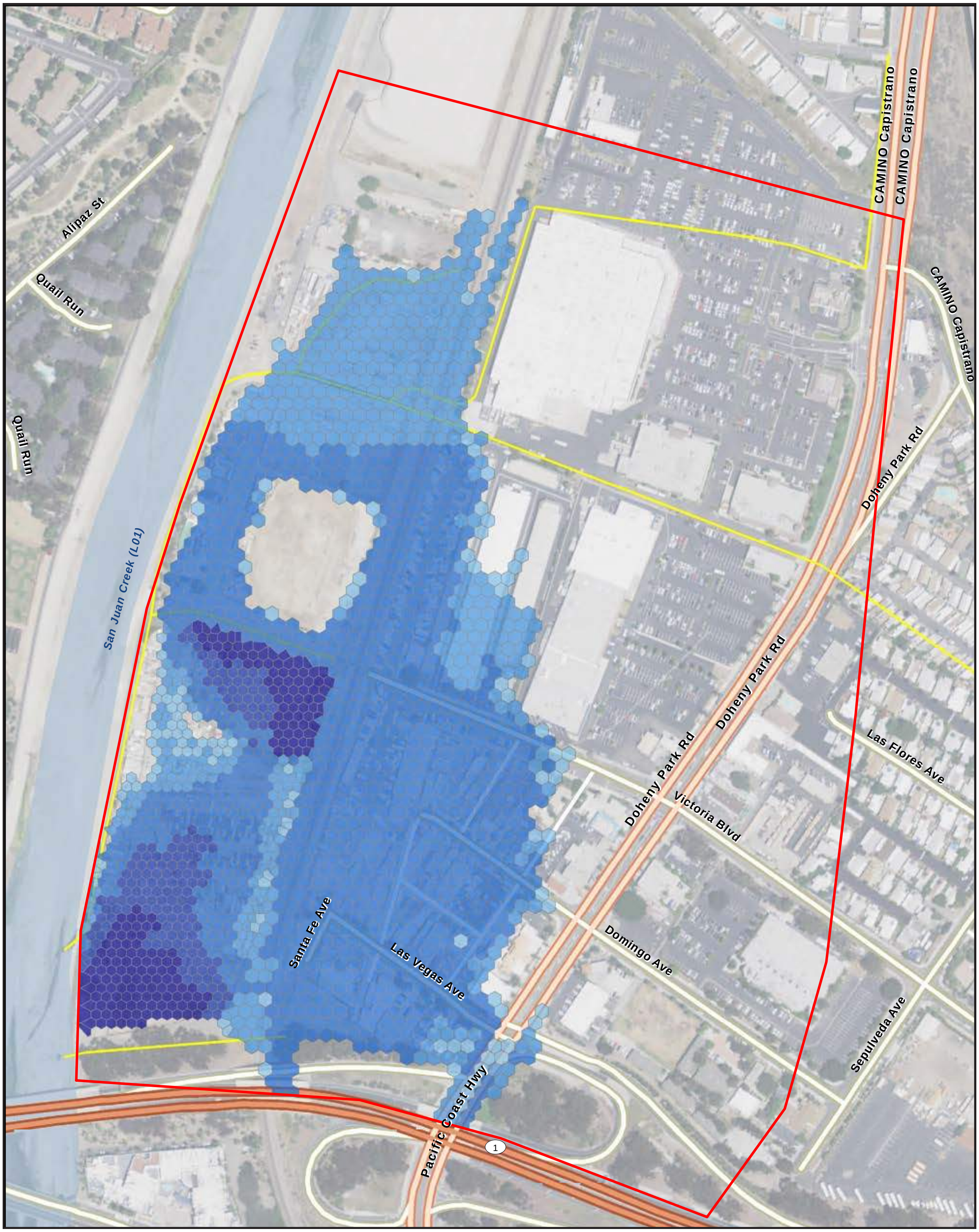


EXHIBIT 4.7-2: Schools within 0.25 Miles of the Proposed Project

South Coast Water District

Doheny Ocean Desalination Project

GHD Kimley»Horn



Storm Water Conduits (in model) Two-Dimensional Model Boundary

Source: GHD Written Correspondence, March 5, 2018.

Maximum Flooding Depth

2-6" 6-12" 1-2' 2-3' >3'

EXHIBIT 4.8-2: Change in Flood Inundation Existing Condition vs. Alternative 1

South Coast Water District - *Doheny Ocean Desalination Project*

GHD Kimley»Horn

4.0 Final EIR Appendices

4.1 Draft EIR Distribution

4.2 Final EIR Technical Analyses

4.2.1 Coastal Hazards Analysis for Final EIR

4.2.2 Brine Discharge Analysis for Final EIR

4.2.3 Hydrogeologic Analyses

4.2.3.1 Groundwater Modeling for Final EIR

4.2.3.2 San Juan Creek Lagoon Technical Memo

4.2.4 Local Hazard and Drainage Calculations for Final EIR

4.2.5 Marine Biology Technical Memos

4.2.5.1 Diffuser Entrainment Memo for Final EIR

4.2.5.2 Brine Discharge Memo for Final EIR

Attachment A: Comment Letter O1 Exhibits

- *Exhibit D – Water Well Standards*
- *Exhibit E – Water Well Standards*
- *Exhibit F – IDA Technical Paper (Dennis Williams, 2015)*
- *Exhibit G – Extended Pumping and Pilot Test (MWDOC, 2014)*
- *Exhibit H – CalEEMod User Manual (2017)*

Section 4.1

Draft EIR Distribution

DOHENY OCEAN DESALINATION PROJECT

Notice of Availability and Public Meeting Notice

Affidavit of Distribution

Kimley-Horn and Associates, Inc.
3880 Lemon Street, Suite 420
Riverside, CA 92501

Table of Contents

Affidavit of Distribution

AFFIDAVIT OF MAILING

Date: May 23, 2018

Subject: Doheny Ocean Desalination Project NOA and Public Meeting Notice

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AFFIDAVIT OF POSTING

I, Amanda McCallum, do hereby certify that a copy of the attached Notice of Availability and Public Meeting Notice was posted at the City of Dana Point Public Library, 33841 Niguel Road, Dana Point, CA 92629, the South Coast Water District, 31592 West Street, Laguna Beach, CA 92651, and with the County Clerks for Orange, Los Angeles, San Diego, San Bernardino, and Riverside Counties, May 23, 2018. I declare under penalty of perjury that the foregoing is true and correct.

Amanda McCallum
Kimley-Horn and Associates

AFFIDAVIT OF MAILING

I, Amanda McCallum, do hereby certify that a copy of the attached Notice of Availability and Public Meeting Notice was mailed via USPS or sent via FedEx to each and every person on the attached distribution lists on May 23, 2018. Copies of the NOA distribution lists are attached. FedEx delivery receipts are on file. I declare under penalty of perjury that the foregoing is true and correct.

Amanda McCallum
Kimley-Horn and Associates

AFFIDAVIT OF NEWSPAPER PUBLICATION

I, Amanda McCallum, do hereby certify that a copy of the attached Notice of Availability and Public Meeting Notice was published in the OC Register on May 24, 2018 and the Dana Point Times on May 25, 2018. I declare under penalty of perjury that the foregoing is true and correct.

Amanda McCallum
Kimley-Horn and Associates

NOA and Public Meeting Notice Posting

- Orange County Clerk Filing Copy

- San Diego County Clerk Filing Copy

- Los Angeles County Clerk Filing Copy

- San Bernardino County Clerk Filing Copy

- Riverside County Clerk Filing Copy

NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

POSTED
MAY 22 2018
ORANGE COUNTY CLERK-RECORDER DEPARTMENT
BY: HB DEPUTY

Date: May 23, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (Project). This Notice of Availability (NOA) has been issued to notify interested parties that a Draft EIR is publicly available for review and comment. The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087).

PROJECT SUMMARY:

The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek. The District is only proposing to pursue permits and approvals for the initial Phase I Project, which would provide up to 5 million-gallons-per-day (MGD) of potable water, and is therefore addressed at a "project level" of CEQA review. The EIR also evaluates a potential future Regional Project of up to 15 MGD, at a programmatic level, since specific Regional Project partners, financing, and facilities have yet to be defined. Specific Project component descriptions are provided below and on the District's website at: **www.scwd.org/desal**.

- **A subsurface water intake system** consisting of subsurface slant wells that draw ocean water from offshore subsurface alluvial material (located below the ocean floor), while providing natural sand bed filtration and eliminating the entrainment and impingement of marine biota. This subsurface intake system is the recommended approach by state and federal regulators, and is consistent with the State Water Resource Control Board's (State Board or SWRCB) recently adopted Ocean Plan Amendment. The slant wells would be located and fully buried near the beach, in a study area encompassing Doheny State Beach and Capistrano Beach Park.

- **A raw (ocean) water conveyance pipeline** that would deliver the subsurface intake system's ocean water to the desalination facility site.
- **A desalination facility** that would receive ocean feedwater at approximately 10 to 30 MGD, with a recovery rate of ~50% resulting in up to 5 to 15 MGD of potable drinking water (for the Phase I and Regional Project, respectively). The proposed desalination facility is located on the District's existing San Juan Creek Property site, on an industrial site located away from the beach but in close proximity to the subsurface intake wells. This facility siting is also consistent with state and federal regulator preference to minimize desalination facilities on the coast while being close enough to avoid lengthy raw water and brine conveyance pipelines. The desalination facility includes a variety of typical desalination process equipment and appurtenant facilities, such as pretreatment, seawater reverse osmosis (SWRO) membranes, an energy recovery system, post-treatment conditioning, solids handling and disposal, product water storage, electrical equipment, staff facilities, and connections to off-site brine disposal, sanitary sewer, and product water conveyance facilities. It is assumed there will be a utility power connection required; however, the District is also evaluating the feasibility of supplementing or replacing that supply with an alternative energy source. The desalination facility will include solar photovoltaic panels on flat rooftops where feasible. Other alternative energy sources being evaluated include natural-gas turbines and fuel cells to maximize efficiency and minimize energy costs.
- **A concentrate (brine) disposal system** that would utilize the existing San Juan Creek Ocean Outfall (SJCOO), to return brine and treated process waste streams to the ocean with negligible impact on coastal and marine water quality. This would be achieved in part through blending in the outfall pipe with the existing wastewater stream from the J.B. Latham Wastewater Treatment Plant, and other regional treatment plants. Mixing desalination brine with existing wastewater treatment plant flow (a "comingled discharge") is the preferred method by state and federal regulators and is consistent with the State Board's Ocean Plan Amendment.
- **A product water storage tank and distribution system** that would feed into the District's local distribution system and, depending on plant capacity and District demands, other adjacent local and regional transmission pipelines that are located adjacent to the site. Desalinated product water from the Phase I Project could be conveyed entirely using existing District and local infrastructure with no off-site improvements other than a short connection to the District's existing local transmission lines.
- **All appurtenant facilities** (e.g. pump stations, valves and metering) as well as all construction, operation and maintenance activities associated with all Project facilities.
- **Offsite Electrical Transmission Facilities** provided by San Diego Gas & Electric Company (SDG&E). At this time, SDG&E has indicated that electrical service can be provided to the Phase I Project using existing facilities, with a short connection from the desalination site to underground electrical lines in Stonehill Drive.

POSTED

MAY 22 2018

ORANGE COUNTY CLERK-RECORDER DEPARTMENT

BY: HB DEPUTY

SIGNIFICANT ENVIRONMENTAL IMPACTS:

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

The District requests each Responsible and Trustee agency review the Draft EIR relevant to the agency's statutory responsibilities in connection with the proposed Project, in a manner consistent with California Code of Regulations, Title 14, Section 15087. Each agency may use the EIR prepared by the District when considering any permits that the agency must issue, or other approvals for the Project.

PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **May 23, 2018 to July 23, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

An electronic PDF of the Draft EIR is available for download on the District's Project website at www.scwd.org/desal. In addition, during the 60-day public review period, hard copies of the Draft EIR and the documents referenced in the EIR will be available at the following locations:

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LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, Chief Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

PUBLIC MEETING:

The District will conduct a public meeting in order to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:00 p.m.
(ending no later than 8:00 p.m. or when discussion concludes)
Capistrano Unified School District
CUSD Education Center
33122 Valle Road, San Juan Capistrano, CA 92675
Phone: (949) 234-9200

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).

POSTED
MAY 22 2018
ORANGE COUNTY CLERK-RECORDER DEPARTMENT
BY: HB DEPUTY

NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

Date: May 23, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Notice of Availability & Public Meeting Notice***

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- **A subsurface water intake system** consisting of subsurface slant wells that draw ocean water from offshore subsurface alluvial material (located below the ocean floor), while providing natural sand bed filtration and eliminating the entrainment and impingement of marine biota. This subsurface intake system is the recommended approach by state and federal regulators, and is consistent with the State Water Resource Control Board's (State Board or SWRCB) recently adopted Ocean Plan Amendment. The slant wells would be located and fully buried near the beach, in a study area encompassing Doheny State Beach and Capistrano Beach Park.

- **A raw (ocean) water conveyance pipeline** that would deliver the subsurface intake system's ocean water to the desalination facility site.
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(949) 499-4555

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Tuesday, June 26, 2018
6:00 p.m.
(ending no later than 8:00 p.m. or when discussion concludes)
Capistrano Unified School District
CUSD Education Center
33122 Valle Road, San Juan Capistrano, CA 92675
Phone: (949) 234-9200

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).

FILED
Ernest J Dronenburg, Jr. Recorder County Clerk
MAY 22 2018
BY Carmelo Mendoza
DEPUTY

FILED IN THE OFFICE OF THE COUNTY CLERK
San Diego County on MAY 22 2018
Posted MAY 22 2018 Removed
Returned to agency on
Deputy Carmelo Mendoza

NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

ORIGINAL FILED
MAY 22 2018
LOS ANGELES, COUNTY CLERK

Date: May 23, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

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- **All appurtenant facilities** (e.g. pump stations, valves and metering) as well as all construction, operation and maintenance activities associated with all Project facilities.
- **Offsite Electrical Transmission Facilities** provided by San Diego Gas & Electric Company (SDG&E). At this time, SDG&E has indicated that electrical service can be provided to the Phase I Project using existing facilities, with a short connection from the desalination site to underground electrical lines in Stonehill Drive.

SIGNIFICANT ENVIRONMENTAL IMPACTS:

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

The District requests each Responsible and Trustee agency review the Draft EIR relevant to the agency's statutory responsibilities in connection with the proposed Project, in a manner consistent with California Code of Regulations, Title 14, Section 15087. Each agency may use the EIR prepared by the District when considering any permits that the agency must issue, or other approvals for the Project.

PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **May 23, 2018 to July 23, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

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PUBLIC COMMENTS:

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LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

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Attn: Mr. Rick Shintaku, PE – Acting General Manager, Chief Engineer
31592 West Street, Laguna Beach, CA 92651
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NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

Date: May 23, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Notice of Availability & Public Meeting Notice***

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State Clearinghouse No. 2016031038

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SOUTH COAST WATER DISTRICT
Partnering With The Community

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Assessor-County Clerk-Recorder
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05/23/2018 08:39 AM Fee: $ 0.00
Page 1 of 4
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NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

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Distribution Lists

- Government Agencies

- Non-Government Organizations

- Interested Parties

Government Agencies

Organization	Attention	Address	Phone Number	Email
FEDERAL				
NOAA National Marine Fisheries Services	Bryant Chesney	501 West Ocean Blvd. Suite 4200 Long Beach, CA 90802	562-980-4000 562-980-4197	bryant.chesney@noaa.gov Eric.Chavez@noaa.gov
NOAA National Marine Fisheries Services	Anthony P. Spina	501 West Ocean Blvd. Suite 4200 Long Beach, CA 90802		
U.S. Army Corps of Engineers	Regulatory Permitting-Orange County	U.S. Army Corps of Engineers 915 Wilshire Boulevard Suite 930 LOS ANGELES, CA 90017	213-452-3417	
U.S. Army Corps of Engineers	Therese O'Rourke-Bradford ACOE, Carlsbad Field Office	5900 La Place Court, Carlsbad, California, 92008		therese.o.bradford@usace.army.mil
U.S. Army Corps of Engineers	Cori Farrar ACOE Carlsbad Field Office	5900 La Place Court, Carlsbad, California, 92008		Corice.J.Farrar@usace.army.mil
U.S. Fish & Wildlife Service, Region 8	Environmental Services, April Evenas	Federal Building 2800 Cottage Way, Room W-2606 Sacramento, CA 95825	916-414-6464	april_evans@usace.army.mil stephen.M.Estes@usace.army.mil
Federal Emergency Mangement Agency	CEQA Review	1111 Broadway, Suite 1200, Oakland, CA 94607-4052		
STATE				
California Coastal Commission	Tom Luster	45 Fremont St #1900, San Francisco, CA 94105	(415) 904-5248	tluster@coastal.ca.gov
California Coastal Commission, South Coast District Office	Karl Schwing, South Coast District Manager	South Coast Area Office 200 Oceangate, Suite 1000 Long Beach, California 90802-4302	562-590-5071	Karl.Schwing@coastal.ca.gov
California Coastal Commission, South Coast District Office	Deborah Lee	South Coast Area Office 200 Oceangate, Suite 1000 Long Beach, California 90802-4302		DLee@coastal.ca.gov
California Department of Fish & Wildlife	Bill Paznokas	4949 Viewridge Avenue San Diego, CA 92123	(858) 467-4218	William.Paznokas@wildlife.ca.gov WPaznokas@dfg.ca.gov
California Department of Fish & Wildlife	Jennifer Edwards	3883 Ruffin Rd. San Diego, CA 92123	858-467-2717	jennifer.edwards@wildlife.ca.gov
California Department of Fish & Wildlife	Jennifer Turner	3883 Ruffin Rd. San Diego, CA 92123		Jennifer.Turner@wildlife.ca.gov
California Department of Fish & Wildlife	Loni Adams, Marine Environmental Scientist	3883 Ruffin Rd. San Diego, CA 92123	858-627-3985	loni.adams@wildlife.ca.gov
California Department of Fish & Wildlife, South Coast Region	Ed Pert, Regional Manager	3883 Ruffin Rd. San Diego, CA 92123	858-467-4201	epert@dfg.ca.gov
California Department of Parks and Recreation, Orange Coast District	Steve Scott	3030 Avenida del Presidente San Clemente, CA 92672	949-492-0802	sscott@parks.ca.gov
California Department of Transportation (Caltrans), Division 12	Maureen El Harake, Branch Chief	3347 Michelson Dr. Suite 100 Irvine, CA 92612	949-724-2000	Maureen.el.harake@dot.ca.gov
	Yatman Kwan			
California Department of Water Resources	Richard Mills, Section Chief, Water Recycling and Desalination	901 P Street, Room 313A , Third Floor. Sacramento, CA 94236-0001	(916) 651-0715	richard.mills@water.ca.gov
California Natural Resources Agency	Amy Vierra, Deputy Director, Ocean Protection Council	1416 Ninth Street, Suite 1311 Sacramento, CA 95814		Amy.Vierra@resources.ca.gov
California Public Utilities Commission	Chi Cheung To, P.E. Utilities Engineer	505 Van Ness Ave San Francisco, CA 94102	213.576.5766	cct@cpuc.ca.gov
California State Parks	Rich Haydon, State Park Superintendent	3030 Avenida del Presidente San Clemente, CA 92672	949-366-4895	rhaydon@parks.ca.gov; rich.haydon@parks.ca.gov
California State Parks, Orange County District	James Newland, Park and Recreation Specialist	3030 Avenida del Presidente San Clemente, CA 92672	949-607-9510	james.newlandd@parks.ca.gov
California Toxic Substances Control Department		5796 Corporate Ave, Cypress, CA 90630		
Native American Heritage Commission	Gayle Totton, Associate Analyst	1550 Harbor Blvd, Suite 100 West Sacramento, CA 95691	916-373-3710	nahc@nahc.ca.gov
Regional Water Quality Control Board, San Diego	David Gibson, Executive Officer	2375 Northside Drive, Suite 100 San Diego, CA 92108-2700	619-516-1990	David.Gibson@waterboards.ca.gov
Regional Water Quality Control Board, San Diego	Ben Neill, Brandi Outwin-Beals	2375 Northside Drive, Suite 100 San Diego, CA 92108-2700	(619) 521-3376	Ben.Neill@waterboards.ca.gov; Brandi.Outwin-Beals@waterboards.ca.gov
Southern California Regional Rail Authority		2703 Melbourne Ave, Pomona, CA 91767		
State Clearinghouse	Scott Morgan, Director	1400 Tenth Street, PO Box 3044 Sacramento, CA 95812-3044	916-445-0613	Scott.Morgan@opr.ca.gov
State Lands Commission	Cy Oggins, Chief, Environmental Planning and Management	100 Howe Avenue, Suite 100 South Sacramento, CA 95825	916-574-1900	cy.oggins@slc.ca.gov
State Lands Commission	Eric Gillies	100 Howe Avenue, Suite 100 South Sacramento, CA 95825		eric.gillies@slc.ca.gov
State Lands Commission	Alexandra Borack	100 Howe Avenue, Suite 100 South Sacramento, CA 95825		Alexandra.Borack@slc.ca.gov
State Office of Historic Preservation	CEQA Notice	1725 23rd Street, Suite 100 Sacramento, CA 95816	916-445-7000	
State Water Resources Control Board	Daniel Ellis	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		Daniel.Ellis@waterboards.ca.gov
State Water Resources Control Board	Scott Seyfried	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		Scott.Seyfried@waterboards.ca.gov
State Water Resources Control Board	Claire Waggoner and Kimberly Tenggardjaja	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815	(916) 341-5858	Claire.Waggoner@waterboards.ca.gov Kimberly.Tenggardjaja@waterboards.ca.gov
State Water Resources Control Board	Mariela Carpio Obeso, Chief, Ocean Standards Unit	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		MarielaPaz.Carpio-Obeso@waterboards.ca.gov
State Water Resources Control Board - Division of Drinking Water	Oliver Pacifico	605 West Santa Ana Blvd, Building #28, Room 325 Santa Ana CA 92701	(714) 558-4410	oliver.pacifico@waterboards.ca.gov
State Water Resources Control Board - Drinking Water Revolving Fund	James Garrett	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		James.Garrett@waterboards.ca.gov
State Water Resources Control Board	Carol Atkins	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		Carol.Atkins@Waterboards.ca.gov
LOCAL				
California Air Resources Board	CEQA Notice	P.O. Box 2815 Sacramento, CA 95812		
Capistrano Bay District		35000 Beach Road, Capistrano Beach, CA 92624	9149-496-6576	drussell@capobay.org

Government Agencies

Organization	Attention	Address	Phone Number	Email
City of Brea, Water Division	CEQA Notice	One Civic Center Circle Brea, CA 92821	714-990-7687	
City of Buena Park, Water Services	CEQA Notice	6650 Beach Blvd. Buena Park, CA 90620	714-562-3721	
City of Dana Point, Community Development	CEQA Notice c/o Ursula Luna, Community Development Director	33282 Golden Lantern Dana Point, CA 92629	949-248-3567	mschneider@danapoint.org uluna@danapoint.org msinacori@danapoint.org
City of Dana Point, City Council	Richard Viczorek, Mayor	33282 Golden Lantern, Dana Point, CA 92629	(949) 248-3500	rviczorek@danapoint.org
City of Dana Point	Matt Schneider, Planning Manager	33282 Golden Lantern Dana Point, CA 92629	949 248 3560	
City of Dana Point	Matt Sinacori, Public Works Director	33282 Golden Lantern Dana Point, CA 92629	949 248 3574	
City of Fountain Valley, Water Department	CEQA Notice	18240 Ward Street Fountain Valley, CA 92708	714-593-4420	
City of Garden Grove, Water Services	CEQA Notice	13802 Newhope Street Garden Grove, CA 92843	714-741-5395	
City of Huntington Beach, Water Division	CEQA Notice	19001 Huntington St. Huntington Beach, CA 92648	714-536-5431	
City of La Habra, Water/Sewer Division	CEQA Notice	621 W Lambert Road La Habra, CA 90633	562-383-4170	
City of La Palma, Water Division	CEQA Notice	7822 Walker Street La Palma, CA 90623	714-690-3310	
City of Laguna Beach	IGR/CEQA Review	505 Forest Avenue, Laguna Beach, CA 92651		
City of Laguna Niguel	IGR/CEQA Review	30111 Crown Valley Parkway, Laguna Niguel, CA 92677		
City of Newport Beach, Public Works	CEQA Notice	100 Civic Center Drive, Bay 2D Newport Beach, CA 92660	949-644-3330	
City of Orange, Public Works	Water Service, CEQA Notice	189 S. Water Street Orange, CA 92866	714-288-2475	
City of San Clemente	IGR/CEQA Review	910 Calle Negocio # 100, San Clemente, CA 92673		
City of San Clemente, Utilities Services	CEQA Notice	100 Avenida Presidio 3, San Clemente, CA 92672	949-361-8200	
City of San Juan Capistrano	IGR/CEQA Review	32400 Paseo Adelanto, San Juan Capistrano, CA 92675		lmaravilla@planning.lacounty.gov
City of San Juan Capistrano, Utilities Department	Steve May, Public Works and Utilities Director	32400 Paseo Adelanto, San Juan Capistrano, CA 92675	949-234-4400	
City of Seal Beach, Public Works Department	Administrative & Engineering Division, CEQA Notice	211 8th Street Seal Beach, CA 90740	562-631-2527	
City of Tustin, Water Operations	CEQA Notice	300 Centennial Way, Tustin, CA 92780	714-573-3000	
City of Westminster, Water Division	CEQA Notice	8200 Westminster Blvd. Westminster, CA 92683	714-895-2876	
County of Los Angeles	IGR/CEQA Review	320 W Temple St, Los Angeles, CA 90012		kristi lovelady
County of Orange Planning	CEQA Notice	300 N. Flower St. Santa Ana, CA 92702	(714) 667-8845	chris.uzodiribe@ocpw.ocgov.com
County of Riverside	IGR/CEQA Review, Wendel Bugtai	4080 Lemon St. Riverside, CA 92501		
County of San Bernardino	IGR/CEQA Review, Tom Hudson	385 N Arrowhead Ave, San Bernardino, CA 92415		Tom.Hudson@lus.sbcounty.gov
County of San Diego	IGR/CEQA Review, Marc Cass	5510 Overland Ave, San Diego, CA 92123		Marc.Cass@sdcounty.ca.gov
East Orange County Water District	Lisa Ohlund, General Manager	185 N. McPherson Road Orange, CA 92869 2451	714-538-5815	lohlund@eocwd.com
El Toro Water District	CEQA Notice-Dennis Cafferty	Los Alisos Blvd. Lake Forest, CA 92630	949-837-7050	dcafferty@etwd.com
Emerald Bay Service District	Michael Dunbar, General Manager	600 Emerald Bay Laguna Beach, CA 92651	949-494-8571	mdunbar@ebservicedistrict.com
Golden State Water Company, West Orange County District	Dino Orbiso	1920 West Corporate Way Anaheim, CA 92801	714-535-8010	Dino.orbiso@gswater.com
Irvine Ranch Water District	Jo Ann Corey	15600 Sand Canyon Ave. Irvine, CA 92619-7000	949-453-5300	corey@irwd.com
Laguna Beach County Water District	CEQA Notice - David Youngblood	306 Third Street Laguna Beach, CA 92651	949-494-1041	dyoungblood@lbcwd.org
Mesa Water District	CEQA Notice	1965 Placentia Ave. Costa Mesa, CA 92627	949-631-1200	
MetroLink	Christos Sourmelis	One Gateway Plaza, 12th Floor, Los Angeles, CA 90012	909.392.8463	sourmelisc@scrra.net
MetroLink	Ron Mathieu	One Gateway Plaza, 12th Floor, Los Angeles, CA 90012		
Metropolitan Water District	Dee Bradshaw	700 North Alameda Street Los Angeles, CA 90012	(213) 217-6028	VBradshaw@mwdh2o.com
Metropolitan Water District	Warren Teitz	700 North Alameda Street Los Angeles, CA 90012	(213) 217-7418	wteitz@mwdh2o.com
Moulton Niguel Water District	Matt Collings, Asst. General Manager	27500 La Paz Road Laguna Niguel, CA 92677	949-448-4032	mcollings@mnwd.com
Municipal Water District of Orange County	Karl Seckel, Assistant Manager	18700 Ward Street Fountain Valley, CA 92708	714-963-3058	kseckel@mwdoc.com
Orange County Board of Supervisors	Supervisor Lisa Bartlett	34145 Pacific Coast Highway, Suite 710 Dana Point, Ca 92629	949-232-8882	Info@lisaforsupervisor.com
Orange County Board of Supervisors		333 W. Santa Ana Blvd., Santa Ana, CA 92701		
Orange County Transportation Authority	CEQA Notice	550 S. Main Street Orange, CA 92868		dphu@octa.net
Orange County Flood Control District	Ariel Corpuz	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		ariel.corpuz@ocpw.ocgov.com
Orange County Health Care Agency	Anna Peters	405 W. Fifth Street Santa Ana, CA 92701	714-834-5150	apeters@ochca.com
Orange County Public Works	Robert McLean	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		Robert.McLean@ocpw.ocgov.com
Orange County Public Works	Penny Lew	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-3990	Penny.Lew@ocpw.ocgov.com
Orange County Public Works	James Tyler	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-667-3210	James.Tyler@ocpw.ocgov.com
Orange County Public Works	Jeff Dickman	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		jeff.dickman@ocpw.ocgov.com
Orange County Public Works	William Fegley	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	949-923-2289	william.fegley@ocparks.com
Orange County Public Works	James Volz	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-3904	james.volz@ocpw.ocgov.com
Orange County Public Works	Andy Ngo	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-726-4297	andy.ngo@ocpw.ocgov.com
Orange County Public Works	Duc Nguyen	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-955-0676	duc.nguyen@ocpw.ocgov.com
Orange County Public Works	Richard Vuong	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		
Orange County Public Works	Laree Alonso	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-9649	Laree.alonso@ocpw.ocgov.com
Orange County Public Works	Nardy Khan	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-3906	nardy.khan@ocpw.ocgov.com
Orange County Parks	Susan Brodeur	13042 Old Myford Rd. Irvine, CA 92602	949-585-6448	susan.brodeur@ocparks.com
Orange County Parks	Kory McCain	13042 Old Myford Rd. Irvine, CA 92602	714-856-5772	kory.mccain@ocparks.com

Government Agencies

Organization	Attention	Address	Phone Number	Email
Orange County Parks	Eric E. Hull	13043 Old Myford Rd. Irvine, CA 92602		
Orange County Parks	Tom Townsend	13042 Old Myford Rd. Irvine, CA 92602	949-923-3747	tom.townsend@ocparks.com
Orange County Water District	CEQA Notice	18700 Ward St. Fountain Valley, CA 92708	714-378-3200	chris.uzodiribe@ocpw.ocgov.com
San Diego Gas and Electric		662 Camino de Los Mares, San Clemente, CA		
San Juan Basin Authority	Daniel Ferons-c/o Santa Margarita Water District	26111 Antonio Parkway Rancho Santa Margarita, CA 92688	949-459-6400	
	Norris Brandt			
Santa Margarita Water District	Dan Ferons, Don Bunts	26111 Antonio Parkway, Rancho Santa Margarita, CA 92688	949-459-6400	danf@smwd.com; donb@smwd.com
Serrano Water District	CEQA Notice	18021 East Lincoln Street Villa Park, CA 92861	714-538-0079	
South Orange County Wastewater Authority	Amber Baylor	34156 Del Obispo Street Dana Point, CA 92629	949-234-5400	abaylor@socwa.com
South Orange County Wastewater Authority	Jim Burror	34156 Del Obispo Street Dana Point, CA 92629	949-234-5400	jburror@socwa.com
South Coast Air Quality Management District	Jillian Wong, Program Supervisor	21865 East Copley Drive Diamond Bar, CA 91765-4178	909-396-2000	jcheng@aqmd.gov
	Lijin Sun			
South Orange County Wastewater Authority	Betty Burnett, General Manager	34156 Del Obispo St. Dana Point, CA 92629	949-234-5400	bburnett@socwa.com
Southern California Association of Governments	Attn: Intergovernmental Review	900 Wilshire Blvd, 17th floor, Los Angeles, California 90017	(213) 236-1800	sunl@scag.ca.gov
Trabuco Canyon Water District	CEQA Notice	32003 Dove Canyon Drive Trabuco Canyon, CA 92679	949-858-0277	
Yorba Linda Water District	CEQA Notice	1717 East Miraloma Ave. Placentia, CA 92870	714-777-3018	
TRIBES				
Juaneno Band of Mission Indians Acjachemen Natior	Matias Belardes, Chairperson	32161 Avenida Los Amigos, San Juan Capistrano, CA 92675	949-293-8522 949-444-4340	
Juaneno Band of Mission Indians Acjachemen Natior	Joyce Perry, Tribal Manager	4955 Paseo Segovia, Irvine, CA 92612	949-293-8522	kaamalam@gmail.com
Juaneno Band of Mission Indians Acjachemen Natior	Teresa Romero, Chairwoman	31411-A La Matanza Street, San Juan Capistrano, CA 92675	949-488-3484 530-354-5876	
Juaneno Band of Mission Indians	Sonia Johnston, Tribal Chairperson	P.O. Box 25628, Santa Ana, CA 92799		sonia.johnston@sbcglobal.net
San Gabriel Band of Mission Indians	Anthony Morales, Chief	P.O. Box 693 San Gabriel, CA 91778	626-483-3564	GTTribalcouncil@aol.com

Non-Government Agencies

NAME	CONTACT	ADDRESS	PHONE	EMAIL
California Coastal Protection Network	Susan Jordan	Po Box 30290, Santa Barbara, CA 93130	(805) 637-3037	left a message
California Coastkeeper Alliance	Sara Aminzadeh	156 Second Street, San Francisco, CA 94105	(415) 794-8422	sara@cacoastkeeper.org
California Union for Reliable Energy (CURE)	Sheila Sannadan	601 Gateway Boulevard, Suite 1000, South San Francisco CA 94080	650-589-1660	ssannadan@adambroadwell.com
California Union for Reliable Energy (CURE)	Alisha C. Pember	601 Gateway Boulevard, Suite 1000, South San Francisco CA 94080	650-589-1660	apember@adamsbroadwell.com
California Union for Reliable Energy (CURE)	Linda T. Sobczynski	601 Gateway Boulevard, Suite 1000, South San Francisco CA 94080	650-589-1660	lsobczynski@adamsbroadwell.com
Capo Bay CSD	Don Russell	35000 Beach Rd, Capistrano Beach, CA 92624		drussell@capobay.org
Capo Cares				capocares@gmail.com
Center for Biological Diversity	Ilene Anderson	660 S. Figueroa St., Suite 1000, Los Angeles, CA 90017	(323) 654-5943	ianderson@biologicaldiversity.org
Clean Water Now!	Roger Von Butow	P.O. Box 4711, Laguna Beach CA 92652 2796 Victoria Drive "B", Laguna Beach, CA 92651	(949) 280-2225	info@clean-water-now.org; rogerbutow@me.com
Coastal Environmental Rights Foundation	Monika Whisenhunt	1140 South Coast Hwy 101, Encinitas, CA 92024	(760) 942-8505	monika@coastlawgroup.com
Dana Point Headlands Conservancy		34681 Calle Paso Robles, Capo Beach, CA 92624	(949) 248-3527	left a message
Dana Point Library		33841 Niguel Road, Dana Point, CA 92629		
Doheny Longboard Surfing Association		P.O. Box 664, Dana Point, CA 92629	949-413-6250	no email, for inquiries only
Earth Resource Foundation	Stephanie Barger, Executive Dir.	1706 Newport Blvd. Ste. B, Costa Mesa, CA 95627	(949) 645-5163	stephanie.barger@earthresource.org
Ecology Center	Meg Hiesinger	32701 Alipaz St., San Juan Capistrano, CA 92675	(949) 443-4223	meg@theecologycenter.org
Endangered Habitats League	Dan Silver	8424 Santa Monica Blvd., Ste. A 592, Los Angeles, CA 90069	(213) 804-2750	dsilverla@me.com
Heal the Bay	Rita Kampalath	1444 9th St. Santa Monica, CA 90401	(310) 451-1500	rkampalath@healthebay.org
Laguna Ocean Foundation		P.O. Box 5247 Laguna Beach, CA 92652	no phone number	lagunaoceanfoundation@gmail.com
Marlborough Seaside Villas, Homeowners Association	Lazar Skundric, Vice President	910 Calle Negocio, Suite 200 San Clemente, CA 92763	949-661-7767	
MetroLink	Christos Sourmelis	One Gateway Plaza , 12th Floor, Los Angeles, CA 90012		
Mi Ocean	Patrick Fuscoe	16795 Von Karman Ave, Ste 100, Irvine, CA 92606	(949) 271-4386	left a message
Natural Resources Defense Council	Joe Geever	1314 Second St., Santa Monica, CA 90401	(310) 434-2300	nrdcinfo@nrdc.org
Orange County Coastkeeper	Colin Kelly, Senior Staff Attorney	3151 Airway Ave. Suite F-110, Costa Mesa, CA 92626	(714) 850-1965	colin@coastkeeper.org
Pacific Marine Mammal Center		20612 Laguna Canyon Rd, Laguna Beach, CA 92651	(949) 494-3050	info@pacificmmc.org
Planning and Conservation League	Jonas Minton	1107 9th St., Ste. 901, Sacramento, CA 95814	(916) 822-5631	pclmail@pcl.org
Residents for Responsible Desalination	Dave Hamilton	P.O. Box 5422, Huntington Beach, CA 92615-5422		de.hamilton@verizon.net
Residents for Responsible Desalination - Huntington Beach	Don Shultz	21352 Yarmouth Ln, Huntington Beach, CA 92646	(714) 840-8901	info@r4rd.org
San Clemente Green	Bill Hart	2837 Penasco, San Clemente, CA 92673	emailed for number	bill@sanclementegreen.org
Sea and Sage Audubon Society	Dr. Victor Leipzig	Audubon House, 5 Riparian View, Irvine, CA 92612	(714) 848-5394	vicleipzig@aol.com
Sierra Club	Penny Elia	3435 Wilshire Blvd. Ste. 660, Los Angeles, CA 90010	(213) 387-4287	greenp1@cox.net
Soto Resources	Me Joey Soto			joey@sotoresources.com
South Laguna Civic Association	Greg O'Loughlin	31558 Eagle Rock Way, Laguna Beach, CA 92651	(949) 415-1312	GregO@SouthLaguna.org
South Orange County Economic Coalition		27758 Santa Margarita Parkway #378 Mission Viejo, CA 92691	949.600.5470	brian@communicationslab.com
Southern California Coastal Water Research Project	Dr. Stephen Weisberg, Executive Dir.	3535 Harbor Blvd., Costa Mesa, CA 92626	(714) 755-3200	christinas@sccwrp.org
Southern California Watershed Alliance, Desal Response Group	Aubrey Bettencourt	PO Box 1267, Hanford, CA 93232	(559) 816-8691	aubrey@californiawateralliance.org
Surfrider Foundation	Rick Wilson Katie Day Mandy Sackett	P.O. Box 6010, San Clemente, CA 92674	(949) 492-8170	rwilson@surfrider.org kday@surfrider.org Mandy Sackett <msackett@surfrider.org>
Transition Laguna Beach		1215 Bluebird Canyon Dr. Laguna Beach, CA 92561	emailed for number	ecolagunabeach@gmail.com
Trout Unlimited	Robert Blankenship	P.O. Box 1977, Costa Mesa, CA 92628	(703) 522-0500	bob@hremcleanup.com; SouthCoastTU@gmail.com
Trout Unlimited	George Sutherland	419 Via Presa, San Clemente, CA 92672	(703)522-0500	scgsland@gmail.com
Wyland Foundation	Greg Stone	6b Macon, Irvine, CA 92620	(949) 643-7070	info@wylandfoundation.org

Interested Parties

NAME	ADDRESS	EMAIL	PHONE
Robert Campbell	33231 Mesa Vista Drive, Dana Point, CA 92629	rsbobcamp@aol.com	
Richard Ciampa	25582 Mainsail Way, Dana Point, CA 92629	rciampa@cox.net	
Pam Enqille	33701 Surfside Dana Point, CA 92629	pabenqelke@gmail.com	
Richard Gardner		capopalm@hotmail.com	
Catherine Gick	27045 Mill Pond Road, Capistrano Beach, CA 92624	geoplex@earthlink.net	
Dennis Heider	34112 Bedford Lane, Dana Point, CA 92629	dheider@heiderinspection.com	909-673-0292
Jim Mahaney		Mahaney.jim@sbcglobal.net	
Jan Mestion		jan@citysun.com	
George Miller	24005 Atun, Dana Point, CA 92629	papageo13@aol.com	
Bobby Young		by4golden@yahoo.com	
Matt Allaire	24911 Sea Aire, Dana Point, CA 92629	mallaire2112@gmail.com	
Jonelle Malloy	33112 Palo Alto Street, Dana Point 92629	jonelle1malloy@gmail.com	
Irene Bowie	31582 Wildwood Rd, Laguna Beach CA 92651	huladog1@earthlink.net	
Ray Hiemstra		ray@coastkeeper.org	
Kaye Romo	24351 La Cresta Drive, Dana Point, CA		
Bob Oakley		bob_oakley@msn.com	

Proof of Publication

- Orange County Register

- Dana Point Times

AFFIDAVIT OF PUBLICATION

STATE OF CALIFORNIA,)
) ss.
County of Orange)

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of **The Orange County Register**, a newspaper of general circulation, published in the city of Santa Ana, County of Orange, and which newspaper has been adjudged to be a newspaper of general circulation by the Superior Court of the County of Orange, State of California, under the date of November 19, 1905, Case No. A-21046, that the notice, of which the annexed is a true printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

May 24, 2018

"I certify (or declare) under the penalty of perjury under the laws of the State of California that the foregoing is true and correct":

Executed at Santa Ana, Orange County, California, on

Date: May 24, 2018

Sandra Campos

Signature: **Sandra Campos**

The Orange County Register
2190 S. Towne Centre Place
Anaheim, CA 92806
(714) 796-2209

PROOF OF PUBLICATION

Notice of Availability & Public Meeting Notice
Doheny Ocean Desalination Project Environmental Impact Report

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (project). This Notice of Availability (NOA) has been issued to notify interested parties that a Draft EIR is publicly available for review and comment. The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087). The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility of up to 15 million gallons per day (MGD) of potable drinking water, with an initial phase of up to 5 MGD. The proposed facilities are located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek.

The Notice of Availability and Draft EIR are available for review at the Orange County Public Library located in the City of Dana Point (Dana Point Library, 33841 Niguel Road, Dana Point, CA 92629). The documents may also be reviewed online at the District's website: www.scwd.org/desal

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

Public Meeting: The South Coast Water District will conduct a public meeting to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:00 p.m. (ending no later than 8:00 p.m. or when discussion concludes)
Capistrano Unified School District, CUSD Education Center
33122 Valle Road, San Juan Capistrano, CA 92675
Phone: (949) 234-9200

Public Review Period: The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **May 23, 2018 to July 23, 2018.**

Public Comments: The District requests your careful review and consideration of the Draft EIR, and invites **written comments** from interested agencies, persons, and organizations regarding environmental issues identified in the Draft EIR. Please indicate a contact person for your agency or organization. You may also provide oral or written comments in person at the **Public Meeting** noted above. Comments in response to this notice must be submitted to the District through close of business (5:00 PM) on **July 23, 2018**.

Lead Agency Contact: All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE - Acting General Manager, Chief Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

Publish: Orange County Register May 24, 2018 11125261

DOUG APPLEGATE, Democrat

• Has vowed to work with federal legislators to remove spent nuclear waste from San Onofre Nuclear Generating Station

• Wants to bring more power back to Congress to approve U.S. military engaging in combat missions and wars

• Is in favor of having 100 percent renewable energy in the U.S. in the next 10 years

• Advocates for a single-payer health care system

JOSHUA SCHOONOVER, Republican

• Vows to help keep the ocean and environment clean by providing incentives to businesses to use sustainable materials and waste removal practices

• Wants to decrease the cost of health care

• Advocates to fix illegal immigration problems

• Wants to remove cannabis from the Drug Enforcement Administration's schedule of illegal drugs

MIKE SCHMITT, Republican

• Advocates for health care reform to repeal the Affordable Care Act, return control to patients and doctors

• Opposes offshore drilling by 2024 off U.S. coasts

• Supports gun rights and is a "strong" proponent of the Second Amendment

• Advocates immigration policies to accept based on merit and skill sets

DANIELLE ST. JOHN, Green

• Is in favor of bringing harmonizing discussions to Congress in an effort to make collaborative legislation

• Wants to drive a "cooperative economy" that is accountable for all members, eliminating any kind of greed in the marketplace

• Advocates for a complete reform of the U.S. education system, increasing teachers' salaries and better physical health and creative curriculum

• Advocates for gun laws that allow responsible ownership

ROCKY J. CHÁVEZ, Republican

• Wants to scale back federal regulations and intervention into business to create an easier market on small businesses and industry

• Advocates creating programs to crack down on human trafficking and other violent felony-level crimes

• Has stayed neutral on federal and state gun-reform policies

• Favors creating a stronger national defense

DIANE L. HARKEY, Republican

• Wants to make changes to the federal tax code

• Advocates for strengthening California's resources of water, power and transportation

• Is in favor of reducing the national deficit by cutting federal spending

• Supports stronger national defense

JOSHUA L. HANCOCK, Libertarian

• Seeks to address the growing homeless populations in California and U.S.

• Supports increasing funding for U.S. border security

• Wants to dramatically cut federal spending to decrease the national debt

• Supports responsible gun ownership, would not ban assault rifles

BRIAN MARYOTT, Republican

• Wants more national security measures in place; would vote to authorize more authority to the president to engage in foreign conflicts, such as with North Korea

• Does not support off-shore oil drilling, advocates for environmental protection, but wants a balance of responsibility

• Favors repealing the Affordable Care Act

• Opposes California's "Sanctuary State" laws

JORDAN P. MILLS, Peace and Freedom

• Opposes the Trump administration's proposed wall along the Mexican border as well as deportations

• Is in favor of outlawing high-caliber rifles for public purchase; opposes all war

• Supports pro-choice policies for women

• Wants to strengthen Social Security and social services

DAVID MEDWAY, Republican

• Aims to lower the national debt

• Favors affordable health care across the spectrum

• Is a pro-choice candidate and is pro women's rights to access health care services

• Wants to find "innovative" solutions to stop gun violence

CRAIG A. NORDAL, Republican

• Supports the Trump administration's plan to increase offshore oil drilling by 2024 in an effort to boost U.S. trade status

• Advocates for a more Christian-based Legislature, religious freedom and liberty

• Is in favor of overturning Roe V. Wade

• Supports building and completing a wall along the Mexican border

DOHENY OCEAN DESALINATION PROJECT

AMENDED

Notice of Availability and Public Meeting Notice

Affidavit of Distribution

Kimley-Horn and Associates, Inc.
3880 Lemon Street, Suite 420
Riverside, CA 92501

Table of Contents

Affidavit of Distribution

AFFIDAVIT OF MAILING

Date: June 6, 2018

Subject: Doheny Ocean Desalination Project Amended NOA and Public Meeting Notice

Note: *Due to a digital file error which occurred on CDs distributed on May 23rd, this amended version was distributed to ensure all parties were properly notified and received all materials related to the project and details.*

AFFIDAVIT OF POSTING

I, Amanda McCallum, do hereby certify that a copy of the attached Notice of Availability and Public Meeting Notice was posted at the City of Dana Point Public Library, 33841 Niguel Road, Dana Point, CA 92629, the South Coast Water District, 31592 West Street, Laguna Beach, CA 92651, and with the County Clerks for Orange, Los Angeles, San Diego, San Bernardino, and Riverside Counties, on June 6, 2018. I declare under penalty of perjury that the foregoing is true and correct.

Amanda McCallum
Kimley-Horn and Associates

AFFIDAVIT OF MAILING

I, Amanda McCallum, do hereby certify that a copy of the attached Notice of Availability and Public Meeting Notice was mailed via USPS or sent via FedEx to each and every person on the attached distribution lists on June 6, 2018. Copies of the NOA distribution lists are attached. FedEx delivery receipts are on file. I declare under penalty of perjury that the foregoing is true and correct.

Amanda McCallum
Kimley-Horn and Associates

AFFIDAVIT OF NEWSPAPER PUBLICATION

I, Amanda McCallum, do hereby certify that a copy of the attached Notice of Availability and Public Meeting Notice was published in the OC Register on June 6, 2018 and the Dana Point Times on June 8, 2018. I declare under penalty of perjury that the foregoing is true and correct.

Amanda McCallum
Kimley-Horn and Associates

AMENDED NOA and Public Meeting Notice Posting

- Orange County Clerk Filing Copy

- San Diego County Clerk Filing Copy

- Los Angeles County Clerk Filing Copy

- San Bernardino County Clerk Filing Copy

- Riverside County Clerk Filing Copy

AMENDED NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

Date: June 4, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Amended Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (Project). This ***Amended*** Notice of Availability (***Amended*** NOA) has been issued to notify interested parties that the District is re-releasing the Draft EIR for public review and comment. The District initially released the Draft EIR on May 23, 2018. The printed copies of the Draft EIR, including those available at the library and District office, were complete. However, the District since discovered that at least some of the electronic copies of the Draft EIR did not contain certain exhibits due to a reprographic error. Therefore the District is re-releasing the Draft EIR, containing all exhibits. The Project itself is unchanged. The date of the public meeting (see details below) is unchanged. To ensure full opportunity for public review and comment, the District is extending the public comment period accordingly. ***The District is extending the deadline for public comment from July 23, 2018 to August 6, 2018 to allow for a full 60-day review period of the complete Draft EIR.*** The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087). The original Notice of Availability, dated May 23, 2018, is attached to this ***Amended*** NOA.

PROJECT SUMMARY:

The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek. The District is only proposing to pursue permits and approvals for the initial Phase I Project, which would provide up to 5 million-gallons-per-day (MGD) of potable water, and is therefore addressed at a "project level" of CEQA review. The EIR also evaluates a potential future Regional Project of up to 15 MGD, at a programmatic level, since specific Regional Project partners, financing, and facilities have yet to be defined. Specific Project component descriptions are provided below and on the District's website at: www.scwd.org/desal.

- **A subsurface water intake system** consisting of subsurface slant wells that draw ocean water from offshore subsurface alluvial material (located below the ocean floor), while providing natural sand bed filtration and eliminating the entrainment and impingement of marine biota. This subsurface intake system is the recommended approach by state and federal regulators, and is consistent with the State Water Resource Control Board's (State Board or SWRCB) recently adopted Ocean Plan Amendment. The slant wells would be located and fully buried near the beach, in a study area encompassing Doheny State Beach and Capistrano Beach Park.
- **A raw (ocean) water conveyance pipeline** that would deliver the subsurface intake system's ocean water to the desalination facility site.
- **A desalination facility** that would receive ocean feedwater at approximately 10 to 30 MGD, with a recovery rate of ~50% resulting in up to 5 to 15 MGD of potable drinking water (for the Phase I and Regional Project, respectively). The proposed desalination facility is located on the District's existing San Juan Creek Property site, on an industrial site located away from the beach but in close proximity to the subsurface intake wells. This facility siting is also consistent with state and federal regulator preference to minimize desalination facilities on the coast while being close enough to avoid lengthy raw water and brine conveyance pipelines. The desalination facility includes a variety of typical desalination process equipment and appurtenant facilities, such as pretreatment, seawater reverse osmosis (SWRO) membranes, an energy recovery system, post-treatment conditioning, solids handling and disposal, product water storage, electrical equipment, staff facilities, and connections to off-site brine disposal, sanitary sewer, and product water conveyance facilities. It is assumed there will be a utility power connection required; however, the District is also evaluating the feasibility of supplementing or replacing that supply with an alternative energy source. The desalination facility will include solar photovoltaic panels on flat rooftops where feasible. Other alternative energy sources being evaluated include natural-gas turbines and fuel cells to maximize efficiency and minimize energy costs.
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- **Offsite Electrical Transmission Facilities** provided by San Diego Gas & Electric Company (SDG&E). At this time, SDG&E has indicated that electrical service can be provided to the Phase I Project using existing facilities, with a short connection from the desalination site to underground electrical lines in Stonehill Drive.

SIGNIFICANT ENVIRONMENTAL IMPACTS:

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

The District requests each Responsible and Trustee agency review the Draft EIR relevant to the agency's statutory responsibilities in connection with the proposed Project, in a manner consistent with California Code of Regulations, Title 14, Section 15087. Each agency may use the EIR prepared by the District when considering any permits that the agency must issue, or other approvals for the Project.

PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **June 6, 2018 to August 6, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

An electronic PDF of the Draft EIR is available for download on the District's Project website at www.scwd.org/desal. In addition, during the 60-day public review period, hard copies of the Draft EIR and the documents referenced in the EIR will be available at the following locations:

- South Coast Water District Offices, address noted below
- Orange County Public Library, Dana Point Branch, 33841 Niguel Rd. Dana Point, CA 92629

POSTED

JUN 05 2018

ORANGE COUNTY CLERK-RECORDER DEPARTMENT

BY: ________ DEPUTY

PUBLIC COMMENTS:

The District requests your careful review and consideration of the Draft EIR, and invites ***written comments*** from interested agencies, persons, and organizations regarding environmental issues identified in the Draft EIR. Please indicate a contact person for your agency or organization. You may also provide oral or written comments in person at the ***Public Meeting*** noted below. Comments in response to this notice must be submitted to the District through close of business (5:00 PM) on **August 6, 2018.**

LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, District Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

PUBLIC MEETING:

The District will conduct a public meeting in order to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:30 p.m.
(ending no later than 8:00 p.m. or when discussion concludes)
Dana Hills High School - Gym
33333 Golden Lantern St, Dana Point, CA 92629
Phone: (949) 496-6666

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).

POSTED

JUN 05 2018

ORANGE COUNTY CLERK-RECORDER DEPARTMENT

BY: _____________ DEPUTY

NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

Date: May 23, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (Project). This Notice of Availability (NOA) has been issued to notify interested parties that a Draft EIR is publicly available for review and comment. The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087).

PROJECT SUMMARY:

The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek. The District is only proposing to pursue permits and approvals for the initial Phase I Project, which would provide up to 5 million-gallons-per-day (MGD) of potable water, and is therefore addressed at a "project level" of CEQA review. The EIR also evaluates a potential future Regional Project of up to 15 MGD, at a programmatic level, since specific Regional Project partners, financing, and facilities have yet to be defined. Specific Project component descriptions are provided below and on the District's website at: www.scwd.org/desal.

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The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

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PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **May 23, 2018 to July 23, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

An electronic PDF of the Draft EIR is available for download on the District's Project website at www.scwd.org/desal. In addition, during the 60-day public review period, hard copies of the Draft EIR and the documents referenced in the EIR will be available at the following locations:

- South Coast Water District Offices, address noted below
- Orange County Public Library, Dana Point Branch, 33841 Niguel Rd. Dana Point, CA 92629

PUBLIC COMMENTS:

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LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, Chief Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

PUBLIC MEETING:

The District will conduct a public meeting in order to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:00 p.m.
(ending no later than 8:00 p.m. or when discussion concludes)
Capistrano Unified School District
CUSD Education Center
33122 Valle Road, San Juan Capistrano, CA 92675
Phone: (949) 234-9200

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).

AMENDED NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

FILED
Ernest J Dronenburg, Jr. Recorder County Clerk
JUN 05 2018
BY ________ DEPUTY

Date: June 4, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Amended Notice of Availability & Public Meeting Notice***

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33333 Golden Lantern St, Dana Point, CA 92629
Phone: (949) 496-6666

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).

AMENDED NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

Date: June 4, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Amended Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (Project). This ***Amended*** Notice of Availability (***Amended*** NOA) has been issued to notify interested parties that the District is re-releasing the Draft EIR for public review and comment. The District initially released the Draft EIR on May 23, 2018. The printed copies of the Draft EIR, including those available at the library and District office, were complete. However, the District since discovered that at least some of the electronic copies of the Draft EIR did not contain certain exhibits due to a reprographic error. Therefore the District is re-releasing the Draft EIR, containing all exhibits. The Project itself is unchanged. The date of the public meeting (see details below) is unchanged. To ensure full opportunity for public review and comment, the District is extending the public comment period accordingly. ***The District is extending the deadline for public comment from July 23, 2018 to August 6, 2018 to allow for a full 60-day review period of the complete Draft EIR.*** The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087). The original Notice of Availability, dated May 23, 2018, is attached to this ***Amended*** NOA.

PROJECT SUMMARY:

The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek. The District is only proposing to pursue permits and approvals for the initial Phase I Project, which would provide up to 5 million-gallons-per-day (MGD) of potable water, and is therefore addressed at a "project level" of CEQA review. The EIR also evaluates a potential future Regional Project of up to 15 MGD, at a programmatic level, since specific Regional Project partners, financing, and facilities have yet to be defined. Specific Project component descriptions are provided below and on the District's website at: **www.scwd.org/desal**.

- **A subsurface water intake system** consisting of subsurface slant wells that draw ocean water from offshore subsurface alluvial material (located below the ocean floor), while providing natural sand bed filtration and eliminating the entrainment and impingement of marine biota. This subsurface intake system is the recommended approach by state and federal regulators, and is consistent with the State Water Resource Control Board's (State Board or SWRCB) recently adopted Ocean Plan Amendment. The slant wells would be located and fully buried near the beach, in a study area encompassing Doheny State Beach and Capistrano Beach Park.
- **A raw (ocean) water conveyance pipeline** that would deliver the subsurface intake system's ocean water to the desalination facility site.
- **A desalination facility** that would receive ocean feedwater at approximately 10 to 30 MGD, with a recovery rate of ~50% resulting in up to 5 to 15 MGD of potable drinking water (for the Phase I and Regional Project, respectively). The proposed desalination facility is located on the District's existing San Juan Creek Property site, on an industrial site located away from the beach but in close proximity to the subsurface intake wells. This facility siting is also consistent with state and federal regulator preference to minimize desalination facilities on the coast while being close enough to avoid lengthy raw water and brine conveyance pipelines. The desalination facility includes a variety of typical desalination process equipment and appurtenant facilities, such as pretreatment, seawater reverse osmosis (SWRO) membranes, an energy recovery system, post-treatment conditioning, solids handling and disposal, product water storage, electrical equipment, staff facilities, and connections to off-site brine disposal, sanitary sewer, and product water conveyance facilities. It is assumed there will be a utility power connection required; however, the District is also evaluating the feasibility of supplementing or replacing that supply with an alternative energy source. The desalination facility will include solar photovoltaic panels on flat rooftops where feasible. Other alternative energy sources being evaluated include natural-gas turbines and fuel cells to maximize efficiency and minimize energy costs.
- **A concentrate (brine) disposal system** that would utilize the existing San Juan Creek Ocean Outfall (SJCOO), to return brine and treated process waste streams to the ocean with negligible impact on coastal and marine water quality. This would be achieved in part through blending in the outfall pipe with the existing wastewater stream from the J.B. Latham Wastewater Treatment Plant, and other regional treatment plants. Mixing desalination brine with existing wastewater treatment plant flow (a "comingled discharge") is the preferred method by state and federal regulators and is consistent with the State Board's Ocean Plan Amendment.
- **A product water storage tank and distribution system** that would feed into the District's local distribution system and, depending on plant capacity and District demands, other adjacent local and regional transmission pipelines that are located adjacent to the site. Desalinated product water from the Phase I Project could be conveyed entirely using existing District and local infrastructure with no off-site improvements other than a short connection to the District's existing local transmission lines.
- **All appurtenant facilities** (e.g. pump stations, valves and metering) as well as all construction, operation and maintenance activities associated with all Project facilities.

- **Offsite Electrical Transmission Facilities** provided by San Diego Gas & Electric Company (SDG&E). At this time, SDG&E has indicated that electrical service can be provided to the Phase I Project using existing facilities, with a short connection from the desalination site to underground electrical lines in Stonehill Drive.

SIGNIFICANT ENVIRONMENTAL IMPACTS:

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

The District requests each Responsible and Trustee agency review the Draft EIR relevant to the agency's statutory responsibilities in connection with the proposed Project, in a manner consistent with California Code of Regulations, Title 14, Section 15087. Each agency may use the EIR prepared by the District when considering any permits that the agency must issue, or other approvals for the Project.

PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **June 6, 2018 to August 6, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

An electronic PDF of the Draft EIR is available for download on the District's Project website at www.scwd.org/desal. In addition, during the 60-day public review period, hard copies of the Draft EIR and the documents referenced in the EIR will be available at the following locations:

- South Coast Water District Offices, address noted below
- Orange County Public Library, Dana Point Branch, 33841 Niguel Rd. Dana Point, CA 92629

PUBLIC COMMENTS:

The District requests your careful review and consideration of the Draft EIR, and invites ***written comments*** from interested agencies, persons, and organizations regarding environmental issues identified in the Draft EIR. Please indicate a contact person for your agency or organization. You may also provide oral or written comments in person at the ***Public Meeting*** noted below. Comments in response to this notice must be submitted to the District through close of business (5:00 PM) on **August 6, 2018**.

LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, District Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

PUBLIC MEETING:

The District will conduct a public meeting in order to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:30 p.m.
(ending no later than 8:00 p.m. or when discussion concludes)
Dana Hills High School - Gym
33333 Golden Lantern St, Dana Point, CA 92629
Phone: (949) 496-6666

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).

NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

Date: May 23, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (Project). This Notice of Availability (NOA) has been issued to notify interested parties that a Draft EIR is publicly available for review and comment. The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087).

PROJECT SUMMARY:

The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek. The District is only proposing to pursue permits and approvals for the initial Phase I Project, which would provide up to 5 million-gallons-per-day (MGD) of potable water, and is therefore addressed at a "project level" of CEQA review. The EIR also evaluates a potential future Regional Project of up to 15 MGD, at a programmatic level, since specific Regional Project partners, financing, and facilities have yet to be defined. Specific Project component descriptions are provided below and on the District's website at: www.scwd.org/desal.

- **A subsurface water intake system** consisting of subsurface slant wells that draw ocean water from offshore subsurface alluvial material (located below the ocean floor), while providing natural sand bed filtration and eliminating the entrainment and impingement of marine biota. This subsurface intake system is the recommended approach by state and federal regulators, and is consistent with the State Water Resource Control Board's (State Board or SWRCB) recently adopted Ocean Plan Amendment. The slant wells would be located and fully buried near the beach, in a study area encompassing Doheny State Beach and Capistrano Beach Park.

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- **All appurtenant facilities** (e.g. pump stations, valves and metering) as well as all construction, operation and maintenance activities associated with all Project facilities.
- **Offsite Electrical Transmission Facilities** provided by San Diego Gas & Electric Company (SDG&E). At this time, SDG&E has indicated that electrical service can be provided to the Phase I Project using existing facilities, with a short connection from the desalination site to underground electrical lines in Stonehill Drive.

SIGNIFICANT ENVIRONMENTAL IMPACTS:

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

The District requests each Responsible and Trustee agency review the Draft EIR relevant to the agency's statutory responsibilities in connection with the proposed Project, in a manner consistent with California Code of Regulations, Title 14, Section 15087. Each agency may use the EIR prepared by the District when considering any permits that the agency must issue, or other approvals for the Project.

PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **May 23, 2018 to July 23, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

An electronic PDF of the Draft EIR is available for download on the District's Project website at www.scwd.org/desal. In addition, during the 60-day public review period, hard copies of the Draft EIR and the documents referenced in the EIR will be available at the following locations:

- South Coast Water District Offices, address noted below
- Orange County Public Library, Dana Point Branch, 33841 Niguel Rd. Dana Point, CA 92629

PUBLIC COMMENTS:

The District requests your careful review and consideration of the Draft EIR, and invites ***written comments*** from interested agencies, persons, and organizations regarding environmental issues identified in the Draft EIR. Please indicate a contact person for your agency or organization. You may also provide oral or written comments in person at the ***Public Meeting*** noted below. Comments in response to this notice must be submitted to the District through close of business (5:00 PM) on **July 23, 2018.**

LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, Chief Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

PUBLIC MEETING:

The District will conduct a public meeting in order to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:00 p.m.
(ending no later than 8:00 p.m. or when discussion concludes)
Capistrano Unified School District
CUSD Education Center
33122 Valle Road, San Juan Capistrano, CA 92675
Phone: (949) 234-9200

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).

AMENDED NOTICE OF AVAILABILITY PUBLIC MEETING NO SCH# 2016031038

Date: June 4, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Amended Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

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PROJECT SUMMARY:

The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek. The District is only proposing to pursue permits and approvals for the initial Phase I Project, which would provide up to 5 million-gallons-per-day (MGD) of potable water, and is therefore addressed at a "project level" of CEQA review. The EIR also evaluates a potential future Regional Project of up to 15 MGD, at a programmatic level, since specific Regional Project partners, financing, and facilities have yet to be defined. Specific Project component descriptions are provided below and on the District's website at: www.scwd.org/desal.

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SIGNIFICANT ENVIRONMENTAL IMPACTS:

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

The District requests each Responsible and Trustee agency review the Draft EIR relevant to the agency's statutory responsibilities in connection with the proposed Project, in a manner consistent with California Code of Regulations, Title 14, Section 15087. Each agency may use the EIR prepared by the District when considering any permits that the agency must issue, or other approvals for the Project.

PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **June 6, 2018 to August 6, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

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PUBLIC COMMENTS:

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LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, District Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

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Phone: (949) 496-6666

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NOTICE OF AVAILABILITY OF A DRAFT EIR & PUBLIC MEETING NOTICE

SCH# 2016031038

Date: May 23, 2018

To: Reviewing Agencies, Organizations, and Interested Parties

Lead Agency: South Coast Water District

Subject: ***Notice of Availability & Public Meeting Notice***

DOHENY OCEAN DESALINATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT
State Clearinghouse No. 2016031038

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (Project). This Notice of Availability (NOA) has been issued to notify interested parties that a Draft EIR is publicly available for review and comment. The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087).

PROJECT SUMMARY:

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CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

AGENCIES:

The District requests each Responsible and Trustee agency review the Draft EIR relevant to the agency's statutory responsibilities in connection with the proposed Project, in a manner consistent with California Code of Regulations, Title 14, Section 15087. Each agency may use the EIR prepared by the District when considering any permits that the agency must issue, or other approvals for the Project.

PUBLIC REVIEW PERIOD:

The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **May 23, 2018 to July 23, 2018.**

LOCATIONS WHERE DRAFT EIR IS AVAILABLE FOR PUBLIC REVIEW

An electronic PDF of the Draft EIR is available for download on the District's Project website at www.scwd.org/desal. In addition, during the 60-day public review period, hard copies of the Draft EIR and the documents referenced in the EIR will be available at the following locations:

- South Coast Water District Offices, address noted below
- Orange County Public Library, Dana Point Branch, 33841 Niguel Rd. Dana Point, CA 92629

PUBLIC COMMENTS:

The District requests your careful review and consideration of the Draft EIR, and invites ***written comments*** from interested agencies, persons, and organizations regarding environmental issues identified in the Draft EIR. Please indicate a contact person for your agency or organization. You may also provide oral or written comments in person at the ***Public Meeting*** noted below. Comments in response to this notice must be submitted to the District through close of business (5:00 PM) on **July 23, 2018.**

LEAD AGENCY CONTACT:

All comments should be submitted in writing to:

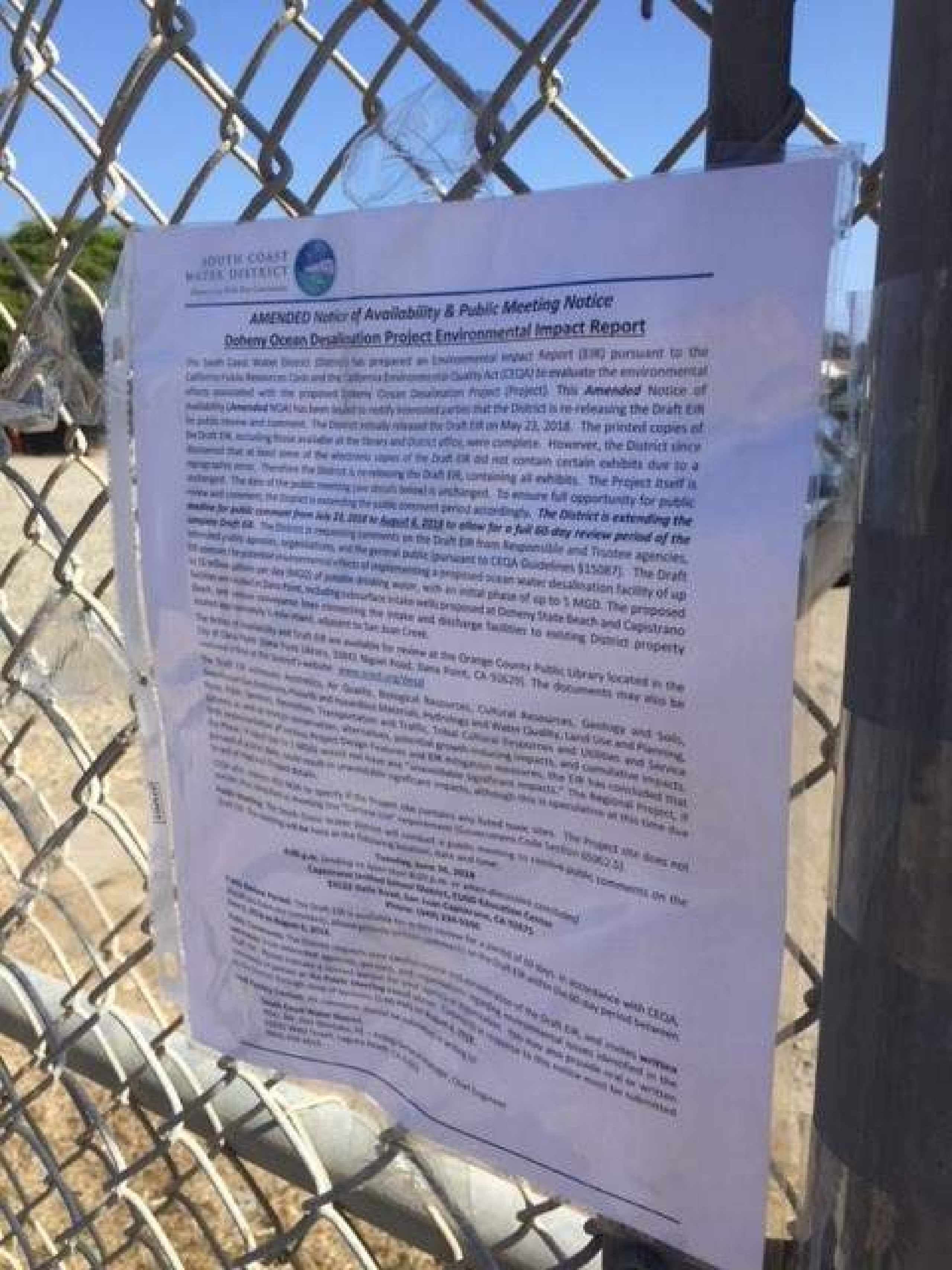
South Coast Water District
Attn: Mr. Rick Shintaku, PE – Acting General Manager, Chief Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

PUBLIC MEETING:

The District will conduct a public meeting in order to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:00 p.m.
(ending no later than 8:00 p.m. or when discussion concludes)
Capistrano Unified School District
CUSD Education Center
33122 Valle Road, San Juan Capistrano, CA 92675
Phone: (949) 234-9200

Special Accommodations. Should you require special accommodations at the public meeting, such as for the hearing impaired or an English translator, please contact South Coast Water District no later than **June 19, 2018** (see contact information above).


SOUTH COAST WATER DISTRICT
AMENDED Notice of Availability & Public Meeting Notice
Doheny Ocean Desalination Project Environmental Impact Report

Transmittal Letters

- General

- State Clearinghouse

SOUTH COAST **WATER DISTRICT**

June 4, 2018

RE: *Amended* Notice of Availability for Doheny Ocean Desalination Project Draft Environmental Impact Report (Draft EIR) (SCH # 2016031038)

To Whom It May Concern:

On behalf of the South Coast Water District (District), please see the enclosed *Amended* Notice of Availability (*Amended* NOA) for the Draft EIR for the Doheny Ocean Desalination Project. The District has discovered that at least some of the electronic copies of the Draft EIR, released May 23, 2018, did not contain certain exhibits. Therefore, the enclosed CD, labeled "Updated Release June 4, 2018," contains the complete Draft EIR and associated appendices, including all exhibits. Please utilize the enclosed CD for your review of the Draft EIR. As explained in the *Amended* NOA, the District has extended the deadline for public comment to ***August 6, 2018***. Thank you.

Very truly yours,

Jody Brennan

Jody Brennan
Clerk of the Board

Mailing Address: *P.O. Box 30205, Laguna Niguel, CA 92607-0205*
Street Address: *31592 West Street, Laguna Beach, CA 92651*
Fax: *(949) 499-4256* ***Phone:*** *(949) 499-4555*

SOUTH COAST WATER DISTRICT

June 4, 2018

State Clearinghouse
1400 Tenth Street
Sacramento, California 95814

RE: *Amended* Notice of Availability for Doheny Ocean Desalination Project Draft Environmental Impact Report (Draft EIR) (SCH # 2016031038)

To Whom It May Concern:

On behalf of the South Coast Water District (District), please see the enclosed Amended Notice of Availability (Amended NOA) for the Draft EIR for the Doheny Ocean Desalination Project. The District has discovered that at least some of the electronic copies of the Draft EIR, released May 23, 2018, did not contain certain exhibits. Therefore, the enclosed CDs, labeled "Updated Release June 4, 2018," contain the complete Draft EIR and associated appendices, including all exhibits. Please distribute the enclosed CDs for state agency review of the Draft EIR.

Further, as explained in the Amended NOA, the District has extended the deadline for public comment to **August 6, 2018.** The District requests that the State Clearinghouse also extend the deadline for state agency review to the same date.

Very truly yours,

Jody Brennan

Jody Brennan
Clerk of the Board

Mailing Address: *P.O. Box 30205, Laguna Niguel, CA 92607-0205*
Street Address: *31592 West Street, Laguna Beach, CA 92651*
Fax: *(949) 499-4256* ***Phone:*** *(949) 499-4555*

Distribution Lists

- Government Agencies

- Non-Government Organizations

- Interested Parties

Government Agencies

Organization	Attention	Address	Phone Number	Email
FEDERAL				
NOAA National Marine Fisheries Services	Bryant Chesney	501 West Ocean Blvd. Suite 4200 Long Beach, CA 90802	562-980-4000 562-980-4197	bryant.chesney@noaa.gov Eric.Chavez@noaa.gov
NOAA National Marine Fisheries Services	Anthony P. Spina	501 West Ocean Blvd. Suite 4200 Long Beach, CA 90802		
U.S. Army Corps of Engineers	Regulatory Permitting-Orange County	U.S. Army Corps of Engineers 915 Wilshire Boulevard Suite 930 LOS ANGELES, CA 90017	213-452-3417	
U.S. Army Corps of Engineers	Therese O'Rourke-Bradford ACOE, Carlsbad Field Office	5900 La Place Court, Carlsbad, California, 92008		therese.o.bradford@usace.army.mil
U.S. Army Corps of Engineers	Cori Farrar ACOE Carlsbad Field Office	5900 La Place Court, Carlsbad, California, 92008		Corice.J.Farrar@usace.army.mil
U.S. Fish & Wildlife Service, Region 8	Environmental Services, April Evenas	Federal Building 2800 Cottage Way, Room W-2606 Sacramento, CA 95825	916-414-6464	april_evans@usace.army.mil stephen.M.Estes@usace.army.mil
Federal Emergency Mangement Agency	CEQA Review	1111 Broadway, Suite 1200, Oakland, CA 94607-4052		
STATE				
California Coastal Commission	Tom Luster	45 Fremont St #1900, San Francisco, CA 94105	(415) 904-5248	tluster@coastal.ca.gov
California Coastal Commission, South Coast District Office	Karl Schwing, South Coast District Manager	South Coast Area Office 200 Oceangate, Suite 1000 Long Beach, California 90802-4302	562-590-5071	Karl.Schwing@coastal.ca.gov
California Coastal Commission, South Coast District Office	Deborah Lee	South Coast Area Office 200 Oceangate, Suite 1000 Long Beach, California 90802-4302		DLee@coastal.ca.gov
California Department of Fish & Wildlife	Bill Paznokas	4949 Viewridge Avenue San Diego, CA 92123	(858) 467-4218	William.Paznokas@wildlife.ca.gov WPaznokas@dfg.ca.gov
California Department of Fish & Wildlife	Jennifer Edwards	3883 Ruffin Rd. San Diego, CA 92123	858-467-2717	jennifer.edwards@wildlife.ca.gov
California Department of Fish & Wildlife	Jennifer Turner	3883 Ruffin Rd. San Diego, CA 92123		Jennifer.Turner@wildlife.ca.gov
California Department of Fish & Wildlife	Loni Adams, Marine Environmental Scientist	3883 Ruffin Rd. San Diego, CA 92123	858-627-3985	loni.adams@wildlife.ca.gov
California Department of Fish & Wildlife, South Coast Region	Ed Pert, Regional Manager	3883 Ruffin Rd. San Diego, CA 92123	858-467-4201	epert@dfg.ca.gov
California Department of Parks and Recreation, Orange Coast District	Steve Scott	3030 Avenida del Presidente San Clemente, CA 92672	949-492-0802	sscott@parks.ca.gov
California Department of Transportation (Caltrans), Division 12	Maureen El Harake, Branch Chief	3347 Michelson Dr. Suite 100 Irvine, CA 92612	949-724-2000	Maureen.el.harake@dot.ca.gov
	Yatman Kwan			
California Department of Water Resources	Richard Mills, Section Chief, Water Recycling and Desalination	901 P Street, Room 313A , Third Floor. Sacramento, CA 94236-0001	(916) 651-0715	richard.mills@water.ca.gov
California Natural Resources Agency	Amy Vierra, Deputy Director, Ocean Protection Council	1416 Ninth Street, Suite 1311 Sacramento, CA 95814		Amy.Vierra@resources.ca.gov
California Public Utilities Commission	Chi Cheung To, P.E. Utilities Engineer	505 Van Ness Ave San Francisco, CA 94102	213.576.5766	cct@cpuc.ca.gov
California State Parks	Rich Haydon, State Park Superintendent	3030 Avenida del Presidente San Clemente, CA 92672	949-366-4895	rhaydon@parks.ca.gov; rich.haydon@parks.ca.gov
California State Parks, Orange County District	James Newland, Park and Recreation Specialist	3030 Avenida del Presidente San Clemente, CA 92672	949-607-9510	james.newlandd@parks.ca.gov
California Toxic Substances Control Department		5796 Corporate Ave, Cypress, CA 90630		
Native American Heritage Commission	Gayle Totton, Associate Analyst	1550 Harbor Blvd, Suite 100 West Sacramento, CA 95691	916-373-3710	nahc@nahc.ca.gov
Regional Water Quality Control Board, San Diego	David Gibson, Executive Officer	2375 Northside Drive, Suite 100 San Diego, CA 92108-2700	619-516-1990	David.Gibson@waterboards.ca.gov
Regional Water Quality Control Board, San Diego	Ben Neill, Brandi Outwin-Beals	2375 Northside Drive, Suite 100 San Diego, CA 92108-2700	(619) 521-3376	Ben.Neill@waterboards.ca.gov; Brandi.Outwin-Beals@waterboards.ca.gov
Southern California Regional Rail Authority		2703 Melbourne Ave, Pomona, CA 91767		
State Clearinghouse	Scott Morgan, Director	1400 Tenth Street, PO Box 3044 Sacramento, CA 95812-3044	916-445-0613	Scott.Morgan@opr.ca.gov
State Lands Commission	Cy Oggins, Chief, Environmental Planning and Management	100 Howe Avenue, Suite 100 South Sacramento, CA 95825	916-574-1900	cy.oggins@slc.ca.gov
State Lands Commission	Eric Gillies	100 Howe Avenue, Suite 100 South Sacramento, CA 95825		eric.gillies@slc.ca.gov
State Lands Commission	Alexandra Borack	100 Howe Avenue, Suite 100 South Sacramento, CA 95825		Alexandra.Borack@slc.ca.gov
State Office of Historic Preservation	CEQA Notice	1725 23rd Street, Suite 100 Sacramento, CA 95816	916-445-7000	
State Water Resources Control Board	Daniel Ellis	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		Daniel.Ellis@waterboards.ca.gov
State Water Resources Control Board	Scott Seyfried	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		Scott.Seyfried@waterboards.ca.gov
State Water Resources Control Board	Claire Waggoner and Kimberly Tenggardjaja	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815	(916) 341-5858	Claire.Waggoner@waterboards.ca.gov Kimberly.Tenggardjaja@waterboards.ca.gov
State Water Resources Control Board	Mariela Carpio Obeso, Chief, Ocean Standards Unit	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		MarielaPaz.Carpio-Obeso@waterboards.ca.gov
State Water Resources Control Board - Division of Drinking Water	Oliver Pacifico	605 West Santa Ana Blvd, Building #28, Room 325 Santa Ana CA 92701	(714) 558-4410	oliver.pacifico@waterboards.ca.gov
State Water Resources Control Board - Drinking Water Revolving Fund	James Garrett	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		James.Garrett@waterboards.ca.gov
State Water Resources Control Board	Carol Atkins	1001 I Street - P.O. Box 2815 Sacramento, CA 95812-2815		Carol.Atkins@Waterboards.ca.gov
LOCAL				
California Air Resources Board	CEQA Notice	P.O. Box 2815 Sacramento, CA 95812		
Capistrano Bay District		35000 Beach Road, Capistrano Beach, CA 92624	9149-496-6576	drussell@capobay.org

Government Agencies

Organization	Attention	Address	Phone Number	Email
City of Brea, Water Division	CEQA Notice	One Civic Center Circle Brea, CA 92821	714-990-7687	
City of Buena Park, Water Services	CEQA Notice	6650 Beach Blvd. Buena Park, CA 90620	714-562-3721	
City of Dana Point, Community Development	CEQA Notice c/o Ursula Luna, Community Development Director	33282 Golden Lantern Dana Point, CA 92629	949-248-3567	mschneider@danapoint.org uluna@danapoint.org msinacori@danapoint.org
City of Dana Point, City Council	Richard Viczorek, Mayor	33282 Golden Lantern, Dana Point, CA 92629	(949) 248-3500	rviczorek@danapoint.org
City of Dana Point	Matt Schneider, Planning Manager	33282 Golden Lantern Dana Point, CA 92629	949 248 3560	
City of Dana Point	Matt Sinacori, Public Works Director	33282 Golden Lantern Dana Point, CA 92629	949 248 3574	
City of Fountain Valley, Water Department	CEQA Notice	18240 Ward Street Fountain Valley, CA 92708	714-593-4420	
City of Garden Grove, Water Services	CEQA Notice	13802 Newhope Street Garden Grove, CA 92843	714-741-5395	
City of Huntington Beach, Water Division	CEQA Notice	19001 Huntington St. Huntington Beach, CA 92648	714-536-5431	
City of La Habra, Water/Sewer Division	CEQA Notice	621 W Lambert Road La Habra, CA 90633	562-383-4170	
City of La Palma, Water Division	CEQA Notice	7822 Walker Street La Palma, CA 90623	714-690-3310	
City of Laguna Beach	IGR/CEQA Review	505 Forest Avenue, Laguna Beach, CA 92651		
City of Laguna Niguel	IGR/CEQA Review	30111 Crown Valley Parkway, Laguna Niguel, CA 92677		
City of Newport Beach, Public Works	CEQA Notice	100 Civic Center Drive, Bay 2D Newport Beach, CA 92660	949-644-3330	
City of Orange, Public Works	Water Service, CEQA Notice	189 S. Water Street Orange, CA 92866	714-288-2475	
City of San Clemente	IGR/CEQA Review	910 Calle Negocio # 100, San Clemente, CA 92673		
City of San Clemente, Utilities Services	CEQA Notice	100 Avenida Presidio 3, San Clemente, CA 92672	949-361-8200	
City of San Juan Capistrano	IGR/CEQA Review	32400 Paseo Adelanto, San Juan Capistrano, CA 92675		lmaravilla@planning.lacounty.gov
City of San Juan Capistrano, Utilities Department	Steve May, Public Works and Utilities Director	32400 Paseo Adelanto, San Juan Capistrano, CA 92675	949-234-4400	
City of Seal Beach, Public Works Department	Administrative & Engineering Division, CEQA Notice	211 8th Street Seal Beach, CA 90740	562-631-2527	
City of Tustin, Water Operations	CEQA Notice	300 Centennial Way, Tustin, CA 92780	714-573-3000	
City of Westminster, Water Division	CEQA Notice	8200 Westminster Blvd. Westminster, CA 92683	714-895-2876	
County of Los Angeles	IGR/CEQA Review	320 W Temple St, Los Angeles, CA 90012		kristi lovelady
County of Orange Planning	CEQA Notice	300 N. Flower St. Santa Ana, CA 92702	(714) 667-8845	chris.uzodiribe@ocpw.ocgov.com
County of Riverside	IGR/CEQA Review, Wendel Bugtai	4080 Lemon St. Riverside, CA 92501		
County of San Bernardino	IGR/CEQA Review, Tom Hudson	385 N Arrowhead Ave, San Bernardino, CA 92415		Tom.Hudson@lus.sbcounty.gov
County of San Diego	IGR/CEQA Review, Marc Cass	5510 Overland Ave, San Diego, CA 92123		Marc.Cass@sdcounty.ca.gov
East Orange County Water District	Lisa Ohlund, General Manager	185 N. McPherson Road Orange, CA 92869 2451	714-538-5815	lohlund@eocwd.com
El Toro Water District	CEQA Notice-Dennis Cafferty	Los Alisos Blvd. Lake Forest, CA 92630	949-837-7050	dcafferty@etwd.com
Emerald Bay Service District	Michael Dunbar, General Manager	600 Emerald Bay Laguna Beach, CA 92651	949-494-8571	mdunbar@ebservicedistrict.com
Golden State Water Company, West Orange County District	Dino Orbiso	1920 West Corporate Way Anaheim, CA 92801	714-535-8010	Dino.orbiso@gswater.com
Irvine Ranch Water District	Jo Ann Corey	15600 Sand Canyon Ave. Irvine, CA 92619-7000	949-453-5300	corey@irwd.com
Laguna Beach County Water District	CEQA Notice - David Youngblood	306 Third Street Laguna Beach, CA 92651	949-494-1041	dyoungblood@lbcwd.org
Mesa Water District	CEQA Notice	1965 Placentia Ave. Costa Mesa, CA 92627	949-631-1200	
MetroLink	Christos Sourmelis	One Gateway Plaza, 12th Floor, Los Angeles, CA 90012	909.392.8463	sourmelisc@scrra.net
MetroLink	Ron Mathieu	One Gateway Plaza, 12th Floor, Los Angeles, CA 90012		
Metropolitan Water District	Dee Bradshaw	700 North Alameda Street Los Angeles, CA 90012	(213) 217-6028	VBradshaw@mwdh2o.com
Metropolitan Water District	Warren Teitz	700 North Alameda Street Los Angeles, CA 90012	(213) 217-7418	wteitz@mwdh2o.com
Moulton Niguel Water District	Matt Collings, Asst. General Manager	27500 La Paz Road Laguna Niguel, CA 92677	949-448-4032	mcollings@mnwd.com
Municipal Water District of Orange County	Karl Seckel, Assistant Manager	18700 Ward Street Fountain Valley, CA 92708	714-963-3058	kseckel@mwdoc.com
Orange County Board of Supervisors	Supervisor Lisa Bartlett	34145 Pacific Coast Highway, Suite 710 Dana Point, Ca 92629	949-232-8882	Info@lisaforsupervisor.com
Orange County Board of Supervisors		333 W. Santa Ana Blvd., Santa Ana, CA 92701		
Orange County Transportation Authority	CEQA Notice	550 S. Main Street Orange, CA 92868		dphu@octa.net
Orange County Flood Control District	Ariel Corpuz	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		ariel.corpuz@ocpw.ocgov.com
Orange County Health Care Agency	Anna Peters	405 W. Fifth Street Santa Ana, CA 92701	714-834-5150	apeters@ochca.com
Orange County Public Works	Robert McLean	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		Robert.McLean@ocpw.ocgov.com
Orange County Public Works	Penny Lew	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-3990	Penny.Lew@ocpw.ocgov.com
Orange County Public Works	James Tyler	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-667-3210	James.Tyler@ocpw.ocgov.com
Orange County Public Works	Jeff Dickman	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		jeff.dickman@ocpw.ocgov.com
Orange County Public Works	William Fegley	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	949-923-2289	william.fegley@ocparks.com
Orange County Public Works	James Volz	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-3904	james.volz@ocpw.ocgov.com
Orange County Public Works	Andy Ngo	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-726-4297	andy.ngo@ocpw.ocgov.com
Orange County Public Works	Duc Nguyen	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-955-0676	duc.nguyen@ocpw.ocgov.com
Orange County Public Works	Richard Vuong	300 N. Flower Street, Suite 716 Santa Ana, CA 92703		
Orange County Public Works	Laree Alonso	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-9649	Laree.alonso@ocpw.ocgov.com
Orange County Public Works	Nardy Khan	300 N. Flower Street, Suite 716 Santa Ana, CA 92703	714-647-3906	nardy.khan@ocpw.ocgov.com
Orange County Parks	Susan Brodeur	13042 Old Myford Rd. Irvine, CA 92602	949-585-6448	susan.brodeur@ocparks.com
Orange County Parks	Kory McCain	13042 Old Myford Rd. Irvine, CA 92602	714-856-5772	kory.mccain@ocparks.com

Government Agencies

Organization	Attention	Address	Phone Number	Email
Orange County Parks	Eric E. Hull	13043 Old Myford Rd. Irvine, CA 92602		
Orange County Parks	Tom Townsend	13042 Old Myford Rd. Irvine, CA 92602	949-923-3747	tom.townsend@ocparks.com
Orange County Water District	CEQA Notice	18700 Ward St. Fountain Valley, CA 92708	714-378-3200	chris.uzodiribe@ocpw.ocgov.com
San Diego Gas and Electric		662 Camino de Los Mares, San Clemente, CA		
San Juan Basin Authority	Daniel Ferons-c/o Santa Margarita Water District	26111 Antonio Parkway Rancho Santa Margarita, CA 92688	949-459-6400	
	Norris Brandt			
Santa Margarita Water District	Dan Ferons, Don Bunts	26111 Antonio Parkway, Rancho Santa Margarita, CA 92688	949-459-6400	danf@smwd.com; donb@smwd.com
Serrano Water District	CEQA Notice	18021 East Lincoln Street Villa Park, CA 92861	714-538-0079	
South Orange County Wastewater Authority	Amber Baylor	34156 Del Obispo Street Dana Point, CA 92629	949-234-5400	abaylor@socwa.com
South Orange County Wastewater Authority	Jim Burror	34156 Del Obispo Street Dana Point, CA 92629	949-234-5400	jburror@socwa.com
South Coast Air Quality Management District	Jillian Wong, Program Supervisor	21865 East Copley Drive Diamond Bar, CA 91765-4178	909-396-2000	jcheng@aqmd.gov
	Lijin Sun			
South Orange County Wastewater Authority	Betty Burnett, General Manager	34156 Del Obispo St. Dana Point, CA 92629	949-234-5400	bburnett@socwa.com
Southern California Association of Governments	Attn: Intergovernmental Review	900 Wilshire Blvd, 17th floor, Los Angeles, California 90017	(213) 236-1800	sunl@scag.ca.gov
Trabuco Canyon Water District	CEQA Notice	32003 Dove Canyon Drive Trabuco Canyon, CA 92679	949-858-0277	
Yorba Linda Water District	CEQA Notice	1717 East Miraloma Ave. Placentia, CA 92870	714-777-3018	
TRIBES				
Juaneno Band of Mission Indians Acjachemen Natior	Matias Belardes, Chairperson	32161 Avenida Los Amigos, San Juan Capistrano, CA 92675	949-293-8522 949-444-4340	
Juaneno Band of Mission Indians Acjachemen Natior	Joyce Perry, Tribal Manager	4955 Paseo Segovia, Irvine, CA 92612	949-293-8522	kaamalam@gmail.com
Juaneno Band of Mission Indians Acjachemen Natior	Teresa Romero, Chairwoman	31411-A La Matanza Street, San Juan Capistrano, CA 92675	949-488-3484 530-354-5876	
Juaneno Band of Mission Indians	Sonia Johnston, Tribal Chairperson	P.O. Box 25628, Santa Ana, CA 92799		sonia.johnston@sbcglobal.net
San Gabriel Band of Mission Indians	Anthony Morales, Chief	P.O. Box 693 San Gabriel, CA 91778	626-483-3564	GTTribalcouncil@aol.com

Non-Government Agencies

NAME	CONTACT	ADDRESS	PHONE	EMAIL
California Coastal Protection Network	Susan Jordan	Po Box 30290, Santa Barbara, CA 93130	(805) 637-3037	left a message
California Coastkeeper Alliance	Sara Aminzadeh	156 Second Street, San Francisco, CA 94105	(415) 794-8422	sara@cacoastkeeper.org
California Union for Reliable Energy (CURE)	Sheila Sannadan	601 Gateway Boulevard, Suite 1000, South San Francisco CA 94080	650-589-1660	ssannadan@adambroadwell.com
California Union for Reliable Energy (CURE)	Alisha C. Pember	601 Gateway Boulevard, Suite 1000, South San Francisco CA 94080	650-589-1660	apember@adamsbroadwell.com
California Union for Reliable Energy (CURE)	Linda T. Sobczynski	601 Gateway Boulevard, Suite 1000, South San Francisco CA 94080	650-589-1660	lsobczynski@adamsbroadwell.com
Capo Bay CSD	Don Russell	35000 Beach Rd, Capistrano Beach, CA 92624		drussell@capobay.org
Capo Cares				capocares@gmail.com
Center for Biological Diversity	Ilene Anderson	660 S. Figueroa St., Suite 1000, Los Angeles, CA 90017	(323) 654-5943	ianderson@biologicaldiversity.org
Clean Water Now!	Roger Von Butow	P.O. Box 4711, Laguna Beach CA 92652 2796 Victoria Drive "B", Laguna Beach, CA 92651	(949) 280-2225	info@clean-water-now.org; rogerbutow@me.com
Coastal Environmental Rights Foundation	Monika Whisenhunt	1140 South Coast Hwy 101, Encinitas, CA 92024	(760) 942-8505	monika@coastlawgroup.com
Dana Point Headlands Conservancy		34681 Calle Paso Robles, Capo Beach, CA 92624	(949) 248-3527	left a message
Dana Point Library		33841 Niguel Road, Dana Point, CA 92629		
Doheny Longboard Surfing Association		P.O. Box 664, Dana Point, CA 92629	949-413-6250	no email, for inquiries only
Earth Resource Foundation	Stephanie Barger, Executive Dir.	1706 Newport Blvd. Ste. B, Costa Mesa, CA 95627	(949) 645-5163	stephanie.barger@earthresource.org
Ecology Center	Meg Hiesinger	32701 Alipaz St., San Juan Capistrano, CA 92675	(949) 443-4223	meg@theecologycenter.org
Endangered Habitats League	Dan Silver	8424 Santa Monica Blvd., Ste. A 592, Los Angeles, CA 90069	(213) 804-2750	dsilverla@me.com
Heal the Bay	Rita Kampalath	1444 9th St. Santa Monica, CA 90401	(310) 451-1500	rkampalath@healthebay.org
Laguna Ocean Foundation		P.O. Box 5247 Laguna Beach, CA 92652	no phone number	lagunaoceanfoundation@gmail.com
Marlborough Seaside Villas, Homeowners Association	Lazar Skundric, Vice President	910 Calle Negocio, Suite 200 San Clemente, CA 92763	949-661-7767	
MetroLink	Christos Sourmelis	One Gateway Plaza , 12th Floor, Los Angeles, CA 90012		
Mi Ocean	Patrick Fuscoe	16795 Von Karman Ave, Ste 100, Irvine, CA 92606	(949) 271-4386	left a message
Natural Resources Defense Council	Joe Geever	1314 Second St., Santa Monica, CA 90401	(310) 434-2300	nrdcinfo@nrdc.org
Orange County Coastkeeper	Colin Kelly, Senior Staff Attorney	3151 Airway Ave. Suite F-110, Costa Mesa, CA 92626	(714) 850-1965	colin@coastkeeper.org
Pacific Marine Mammal Center		20612 Laguna Canyon Rd, Laguna Beach, CA 92651	(949) 494-3050	info@pacificmmc.org
Planning and Conservation League	Jonas Minton	1107 9th St., Ste. 901, Sacramento, CA 95814	(916) 822-5631	pclmail@pcl.org
Residents for Responsible Desalination	Dave Hamilton	P.O. Box 5422, Huntington Beach, CA 92615-5422		de.hamilton@verizon.net
Residents for Responsible Desalination - Huntington Beach	Don Shultz	21352 Yarmouth Ln, Huntington Beach, CA 92646	(714) 840-8901	info@r4rd.org
San Clemente Green	Bill Hart	2837 Penasco, San Clemente, CA 92673	emailed for number	bill@sanclementegreen.org
Sea and Sage Audubon Society	Dr. Victor Leipzig	Audubon House, 5 Riparian View, Irvine, CA 92612	(714) 848-5394	vicleipzig@aol.com
Sierra Club	Penny Elia	3435 Wilshire Blvd. Ste. 660, Los Angeles, CA 90010	(213) 387-4287	greenp1@cox.net
Soto Resources	Me Joey Soto			joey@sotoresources.com
South Laguna Civic Association	Greg O'Loughlin	31558 Eagle Rock Way, Laguna Beach, CA 92651	(949) 415-1312	GregO@SouthLaguna.org
South Orange County Economic Coalition		27758 Santa Margarita Parkway #378 Mission Viejo, CA 92691	949.600.5470	brian@communicationslab.com
Southern California Coastal Water Research Project	Dr. Stephen Weisberg, Executive Dir.	3535 Harbor Blvd., Costa Mesa, CA 92626	(714) 755-3200	christinas@sccwrp.org
Southern California Watershed Alliance, Desal Response Group	Aubrey Bettencourt	PO Box 1267, Hanford, CA 93232	(559) 816-8691	aubrey@californiawateralliance.org
Surfrider Foundation	Rick Wilson Katie Day Mandy Sackett	P.O. Box 6010, San Clemente, CA 92674	(949) 492-8170	rwilson@surfrider.org kday@surfrider.org Mandy Sackett <msackett@surfrider.org>
Transition Laguna Beach		1215 Bluebird Canyon Dr. Laguna Beach, CA 92561	emailed for number	ecolagunabeach@gmail.com
Trout Unlimited	Robert Blankenship	P.O. Box 1977, Costa Mesa, CA 92628	(703) 522-0500	bob@hremcleanup.com; SouthCoastTU@gmail.com
Trout Unlimited	George Sutherland	419 Via Presa, San Clemente, CA 92672	(703)522-0500	scgsland@gmail.com
Wyland Foundation	Greg Stone	6b Macon, Irvine, CA 92620	(949) 643-7070	info@wylandfoundation.org

Interested Parties

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Richard Gardner		capopalm@hotmail.com	
Catherine Gick	27045 Mill Pond Road, Capistrano Beach, CA 92624	geoplex@earthlink.net	
Dennis Heider	34112 Bedford Lane, Dana Point, CA 92629	dheider@heiderinspection.com	909-673-0292
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Jonelle Malloy	33112 Palo Alto Street, Dana Point 92629	jonelle1malloy@gmail.com	
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Kaye Romo	24351 La Cresta Drive, Dana Point, CA		
Bob Oakley		bob_oakley@msn.com	

Proof of Publication

- Orange County Register

- Dana Point Times

AFFIDAVIT OF PUBLICATION

STATE OF CALIFORNIA,)
) ss.
County of Orange)

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of **The Orange County Register**, a newspaper of general circulation, published in the city of Santa Ana, County of Orange, and which newspaper has been adjudged to be a newspaper of general circulation by the Superior Court of the County of Orange, State of California, under the date of November 19, 1905, Case No. A-21046, that the notice, of which the annexed is a true printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

June 6, 2018

"I certify (or declare) under the penalty of perjury under the laws of the State of California that the foregoing is true and correct":

Executed at Santa Ana, Orange County, California, on

Date: June 6, 2018

Signature: **Sandra Campos**

The Orange County Register
2190 S. Towne Centre Place
Anaheim, CA 92806
(714) 796-2209

PROOF OF PUBLICATION

AMENDED Notice of Availability & Public Meeting Notice
Doheny Ocean Desalination Project Environmental Impact Report

The South Coast Water District (District) has prepared an Environmental Impact Report (EIR) pursuant to the California Public Resources Code and the California Environmental Quality Act (CEQA) to evaluate the environmental effects associated with the proposed Doheny Ocean Desalination Project (Project). This **Amended** Notice of Availability (**Amended** NOA) has been issued to notify interested parties that the District is re-releasing the Draft EIR for public review and comment. The District initially released the Draft EIR on May 23, 2018. The printed copies of the Draft EIR, including those available at the library and District office, were complete. However, the District since discovered that at least some of the electronic copies of the Draft EIR did not contain certain exhibits due to a reprographic error. Therefore the District is re-releasing the Draft EIR, containing all exhibits. The Project itself is unchanged. The date of the public meeting (see details below) is unchanged. To ensure full opportunity for public review and comment, the District is extending the public comment period accordingly. **The District is extending the deadline for public comment from July 23, 2018 to August 6, 2018 to allow for a full 60-day review period of the complete Draft EIR.** The District is requesting comments on the Draft EIR from Responsible and Trustee agencies, interested public agencies, organizations, and the general public (pursuant to CEQA Guidelines §15087). The Draft EIR assesses the potential environmental effects of implementing a proposed ocean water desalination facility of up to 15 million gallons per day (MGD) of potable drinking water, with an initial phase of up to 5 MGD. The proposed facilities are located in Dana Point, including subsurface intake wells proposed at Doheny State Beach and Capistrano Beach, and various conveyance lines connecting the intake and discharge facilities to existing District property located approximately ½ mile inland, adjacent to San Juan Creek.

The Notice of Availability and Draft EIR are available for review at the Orange County Public Library located in the City of Dana Point (Dana Point Library, 33841 Niguel Road, Dana Point, CA 92629). The documents may also be reviewed online at the District's website: www.scwd.org/desal

The Draft EIR addresses Aesthetics, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Noise, Public Services, Recreation, Transportation and Traffic, Tribal Cultural Resources and Utilities and Service Systems, as well as energy conservation, alternatives, potential growth-inducing impacts, and cumulative impacts. With implementation of various Project Design Features and EIR mitigation measures, the EIR has concluded that the Phase I Project (up to 5 MGD) would not have any "unavoidable significant impacts." The Regional Project, if pursued at a later date, could result in unavoidable significant impacts, although this is speculative at this time due to lack of Regional Project details.

CEQA also requires this NOA to specify if the Project site contains any listed toxic sites. The Project site does not contain sites identified as meeting the "Cortese List" requirement (Government Code Section 65962.5).

Public Meeting: The South Coast Water District will conduct a public meeting to receive public comments on the Draft EIR. The meeting will be held at the following location, date and time:

Tuesday, June 26, 2018
6:00 p.m. (ending no later than 8:00 p.m. or when discussion concludes)
Capistrano Unified School District, CUSD Education Center
33122 Valle Road, San Juan Capistrano, CA 92675
Phone: (949) 234-9200

Public Review Period: The Draft EIR is available for public review for a period of 60 days. In accordance with CEQA, should you have any comments, please provide written comments on the Draft EIR within the 60-day period between **June 6, 2018 to August 6, 2018.**

Public Comments: The District requests your careful review and consideration of the Draft EIR, and invites **written comments** from interested agencies, persons, and organizations regarding environmental issues identified in the Draft EIR. Please indicate a contact person for your agency or organization. You may also provide oral or written comments in person at the **Public Meeting** noted above. Comments in response to this notice must be submitted to the District through close of business (5:00 PM) on **August 6, 2018.**

Lead Agency Contact: All comments should be submitted in writing to:

South Coast Water District
Attn: Mr. Rick Shintaku, PE - Acting General Manager, Chief Engineer
31592 West Street, Laguna Beach, CA 92651
(949) 499-4555

Publish: Orange County Register June 6, 2018 11131580

(Cont. from page 8)

Monday | 11

KUNDALINI YOGA AND MEDITATION
8-9 a.m. Enjoy this ancient uplifting blend of spiritual and physical practice with Sukhmani, E-RYT. Kundalini Yoga incorporates physical movement to strengthen the nervous system and balance the glandular system as well as breathing techniques, meditation and the chanting of mantras to help process emotions and feelings, release stress, and help develop concentration and discipline of the mind. All levels are welcome and encouraged. Donation based – suggested $15. MindBody Wellness Club. 34207 Pacific Coast Hwy., Dana Point. www.dharmayogahouse.com.

Tuesday | 12

OCEAN INSTITUTE DISTINGUISHED SPEAKER SERIES: DR. GEOFF SHESTER
6 p.m. Join the Ocean Institute in the Samueli Conference Center for The Nicholas Endowment Distinguished Speaker Series with Dr. Geoff Shester. Dr. Geoff Shester is the senior scientist and California campaign director for Oceana, where he advocated for seafloor protection, including leading an expedition to gather footage and data on never-before-seen seafloor habitats. Light appetizers and refreshments from Above All Catering is included in the ticket price. For persons over the age of 21, your ticket will include one adult beverage, and a cash bar will be available for additional beverages. Tickets are $10. The Ocean Institute. 24200 Dana Point Harbor Dr. www.ocean-institute.org.

VETERANS OF FOREIGN WARS MEETING
6 p.m. All veterans who served in a combat zone are invited to attend their meeting on the second Tuesday of each month. Cannons Restaurant. 34344 Green Lantern, Dana Point. 949.248.1419. www.vfwpost9934.org.

Wednesday | 13

DOHENY STATE BEACH VISITOR CENTER
10 a.m.-4 p.m. Join the volunteer team at the Doheny State Beach Visitor Center. It's fun and easy. Open every day. If you have a few hours a month to come and welcome Doheny's many visitors, contact Kathy at volunteer@dohenystatebeach.org or Vicki at vicki.wiker@parks.ca.gov.

Thursday | 14

YAPPY HOUR
5 -8 p.m. Bark your calendar to join other canines and their companions to sniff and schmooze at Yappy Hour. Haute hounds enjoy lapping up libations, thanks to water in his favorite flavor – bacon, chicken, beef or vegan – while human guests relax with a glass of Mutt Lynch Unleashed Chardonnay, Merlot Over and Play Dead, Chateau d'Og Cabernet Sauvignon or a refreshing cocktail featuring Tito's Vodka. Beer and a selection of barbecue items are also available for purchase. Proceeds support The Veterans Initiative of Canine Companions for Independence. The Ritz-Carlton, Laguna Niguel. One Ritz Carlton Dr., Dana Point. 949.240.2000. www.ritzcarlton.com.

On Stage at the Coach House: Shannon Rae

Photo: Courtesy of Shannon Rae

BY EMILY RASMUSSEN, DANA POINT TIMES

Local country musician Shannon Rae, of San Clemente, is coming to The Coach House on Saturday, June 9, after recently releasing her second album *Lucky 13*.

Although *Lucky 13* was released Friday, June 1, Rae's performance at The Coach House will also be the official album release party. Rae's music is described as country rock, "similar to Keith Urban, Shania Twain and Carrie Underwood," according to a press release.

"It is my debut at The Coach House and I will be sharing the stage with The PettyBreakers, the No. 1 tribute band to Tom Petty," Rae said. "I play for one hour with my band and will also perform 'Stop Draggin My Heart Around' with The PettyBreakers."

Rae is accompanied by Dave Polich, producer, songwriter and keyboardist; Rick Gagliano with guitar and backing vocals; Ted Mentry on guitar; Rick Thibodeau on bass and backing vocals; and Tony Scarbrough on drums.

The six-piece band brings a rockin' high energy performance with tunes including "Both Guns Blazin'" and "Get Lucky" with Rae on lead vocals.

Rae has been a San Clemente resident for 16 years and also performs with her band 100 Proof. Tickets for The Coach House performance can be purchased directly through her website at www.shannonrae.com.

The doors open for the show at 6 p.m. and it starts at 8 p.m. on Saturday, June 9 at The Coach House, located at 33157 Camino Capistrano. Tickets are $20 and can also be bought by calling 949.496.8930 or online at www.thecoachhouse.com. **DP**

Section 4.2

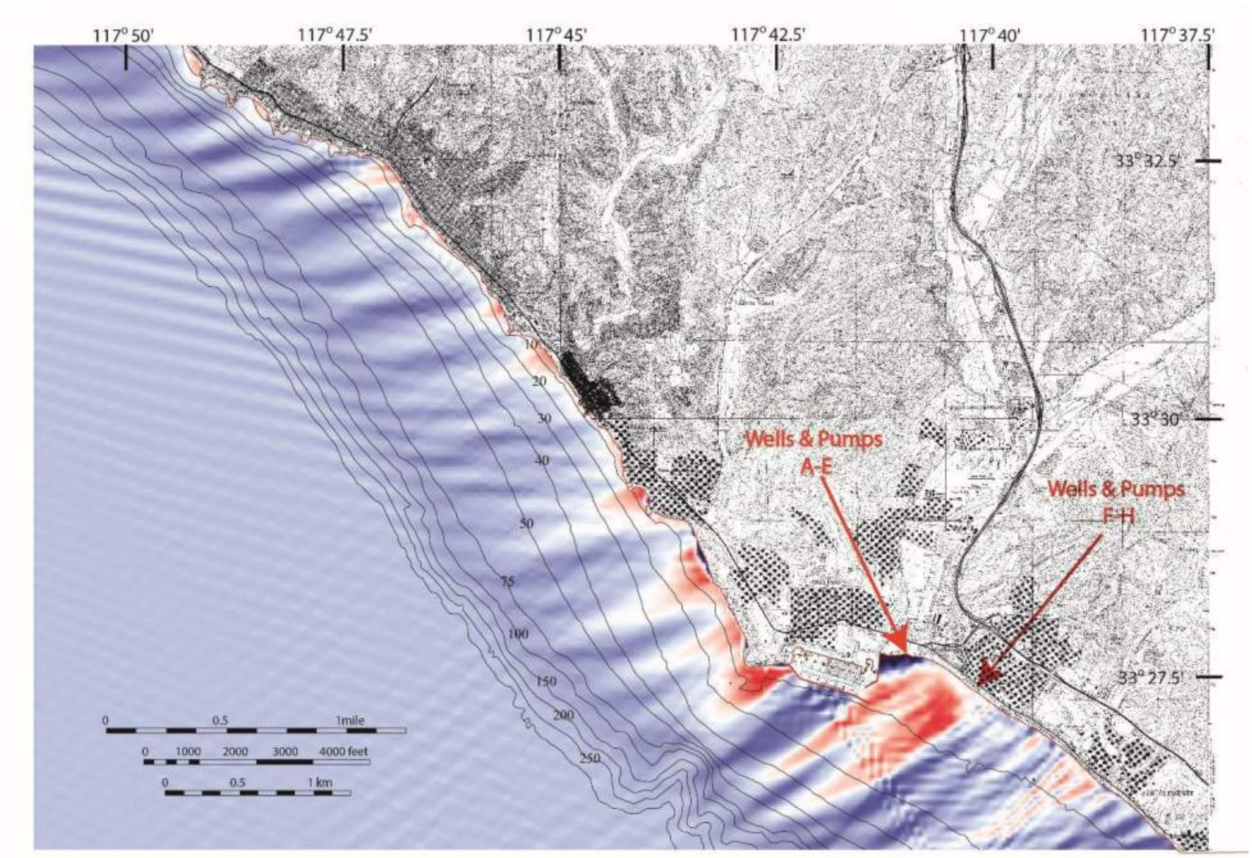
Final EIR Technical Analyses

APPENDIX 4.2.1

COASTAL HAZARDS ANALYSIS FOR THE FINAL EIR

Coastal Hazards Analysis for the Doheny Desalination Project for the Final EIR

By Scott A. Jenkins, Ph.D.



Dana Point wave refraction for the 25 January 1983 storm
Wave height at offshore control point = 2.1 m, T=19.5 sec, from 246°.

Submitted by:
Scott A. Jenkins, Ph.D.
Technical Manager, Coastal Sciences & Engineering
Michael Baker International

Submitted to:
Mark Donovan, PE
Senior Process Engineer
GHD
175 Technology Drive, Suite 200
Irvine CA 92618 USA

TABLE OF CONTENTS

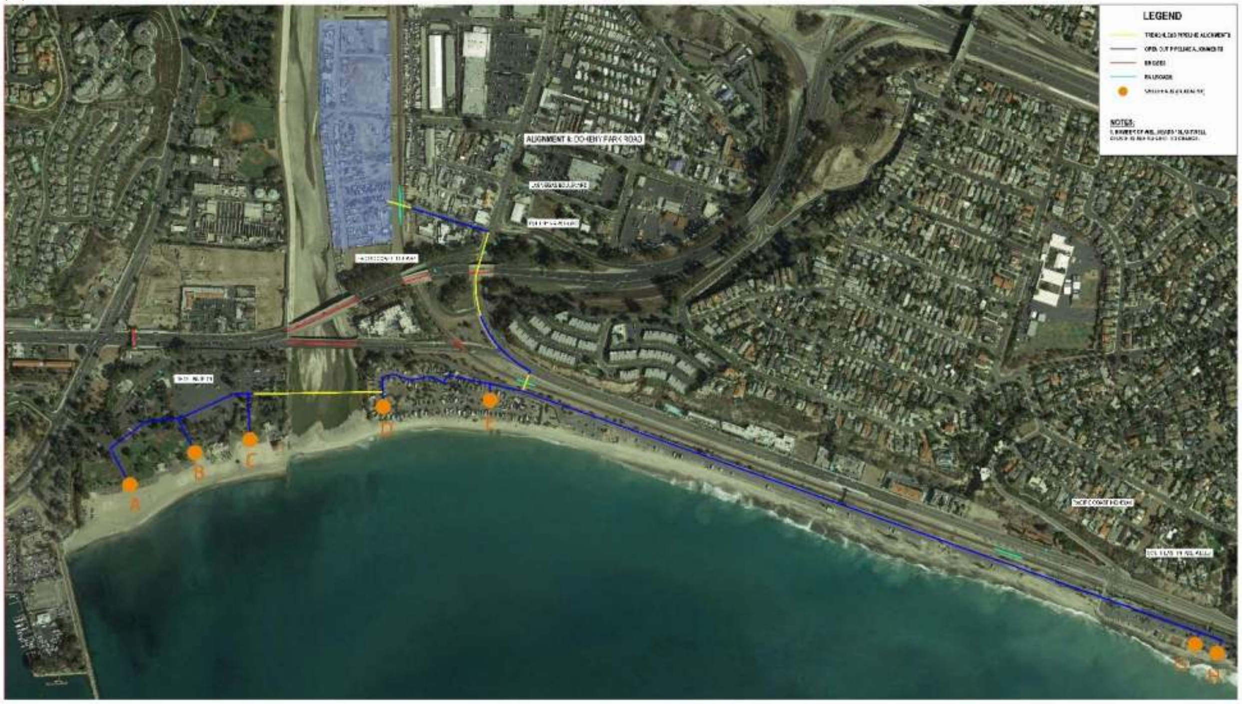
EXECUTIVE SUMMARY:

This 2019 study, prepared in response to comments for the Final EIR, provides further analysis to amplify the Coastal Hazards Analysis prepared in 2017 for the Draft EIR of the Doheny Desalination Project (DDP). That earlier work is being amplified herein in response to a revision of the *California Coastal Commission Sea Level Rise Policy Guidance* document that was originally released in August 2015, (CCC, 2015), but has been updated in July 2018 with new sea level rise projections. In addition, there have been minor adjustments in the locations of a number of the well heads and pump stations being proposed for the Doheny Desalination Project. The following study accounts for these intervening changes in policy guidance and minor modifications to the project description.

The primary analysis tool used in this study is the *Coastal Evolution Model* (CEM) developed at the Scripps Institution of Oceanography was used to evaluate Appendix-B requirements of the *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2015) for a sea level rise/coastal hazards analysis of the DDP. The Coastal Evolution Model is public domain and available from the University of California Digital Library at: http://repositories.cdlib.org/sio/techreport/58/. The Coastal Evolution Model employs algorithms consistent with the U.S. Army Corps of Engineers *Coastal Engineering Manual*, (USACE, 2006), but employs the latest generation equilibrium beach profile algorithms from Jenkins and Inman (2006) that provide 3-dimensional predictive and mapping capability of the wave run-up field, beach erosion and shoreline recession under the effects of wave climate variability, climate cycles and sea level rise. The CEM input files were populated with National Ocean Survey digital bathymetry in the offshore domain; beach profiles sediment grain size measurements by the U.S. Army Corps of Engineers, Coastal Environments and Coastal Frontiers; long-term wave data from the Coastal Data Information Program; long-term ocean water level measurements by the National Oceanic and Atmospheric Administration (NOAA); and stream flow and sediment flux for the San Juan Creek from the United States Geological Survey (USGS) and the Federal Emergency Management Agency (FEMA). Sea level rise projections used in this study were based on the *best fit equation* from Appendix-B of the *California Coastal Commission Sea Level Rise Policy Guidance* document for a 50 year project planning horizon (year 2070) and for a *critical infrastructure* planning horizon (year 2100). Critical project infrastructure subject to potential flooding by extreme event waves or tsunami concurrent with extreme ocean water levels and sea level rise are placed at two sites, namely Doheny State Beach and Capistrano Beach Park (cf. Figure ES-1a & b). At the Doheny Beach site, five potential locations are being evaluated for vaulted well heads with submersible pumps, including: ***Well Head A***, elevation 17 ft. NAVD, at 33°27'44.38"N, 117°41'16.32"W; ***Well Head B***, elevation 17 ft. NAVD, at 33°27'45.07"N, 117°41'10.30"W; ***Well Head C***, elevation 17 ft. NAVD at 33°27'45.12"N, 117°41'6.62"W; ***Well Head D***, at elevation 18 ft. NAVD at 33°27'44.48"N, 117°40'55.30"W; and ***Well Head E***, at elevation 18 ft. NAVD at 33°27'42.45"N, 117°40'47.33"W; (see Figure ES-1a). Two additional vaulted well heads with submersible pumps are being evaluated at the Capistrano Beach site (Figure ES-1b), which includes: ***Well Head G***, at elevation 18 ft. NAVD at 33°27'14.94"N, 117°39'59.91"W; and ***Well Head H***, at elevation 19 ft. NAVD at 33°27'13.17"N, 117°39'57.15"W.

This study is based on sea level rise projections appearing in Appendix-G, Table G-11, of the recently updated *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2018). This document provides no specific guidance on the redline frequency for flooding or inundation. In the absence of such guidance we have adopted FEMA standards for flooding

(a)



(b)

Figure ES-1: Critical shore-front infrastructure locations for the Doheny Desalination Project: a) Doheny State Beach site; and b) Capistrano Beach Park site frequency and set redline planning frequency at the 100 year event (1% probability of recurrence). The 100 year wave event was the two day storm of 17-18 January, 1988, which produced deep water significant wave heights off Doheny State Beach reaching 15.5 ft., approaching the beach from 270^0 with 14 second significant wave periods. An analysis of extremal total water levels, (TWL's), based on the occurrence of extreme waves concurrent with extreme ocean water levels at present and at year 2100 sea levels, is summarized in Table ES-1a for structures at the Doheny Beach site and Table ES-1 b for the Capistrano Beach site. Inspection of Table ES-1a & b reveals that all the beach front well sites for the Doheny Desalination Project (Figure ES-1) are safe from flooding or inundation at present sea levels by extreme event waves concurrent with extreme ocean water levels for event return periods between 1 yr. and 100 yr. However, once we admit to 2100 sea level rise projections, a number of the beach front facilities for the Doheny Desalination Project will suffer some flooding and overtopping to varying degrees.

For the low-range 2100 sea level projections, the three well sites on the north side of San Juan Creek (Well Heads A-C) and one of the wells at the Capistrano Beach site (Well Head G) will experience minor overtopping, even for a 1 year event if the beaches have been accreted by additional sands from water shed floods or still retain a built-out summer equilibrium beach profile, with overtopping rates of about Q'(1yr) = 0.038 cfs per lineal ft. of shoreline. However, if a 100-yr total water level event occurs during the low-range projection of 2100 sea levels, then all of the well sites will be overtopped to varying degrees if the beaches remain in an accreted condition with elevated berms and steep beach slopes. Under these beach conditions, overtopping rates will range from a high of Q'(100yr) = 0.094 cfs per lineal ft. of shoreline at Well Heads A- C, to a low of Q'(100yr) = 0.014 cfs/ft at Well Head H. Interestingly enough, none of the well heads would experience overtopping during a 100 year event when occurring during the low range 2100 sea levels if the beach were eroded, which would be the most likely condition during a 100-year event. Total water levels for eroded beach conditions are always less, because these beaches have flatter slopes and are more dissipative of wave set-up and run-up than the steeper accreted beaches.

For the high-range 2100 sea level projections, Table ES-1a indicates the 100 year total water level events at the Doheny Beach site reach TWL(100) = 21.9 ft. NAVD for the steeply sloping accreted beach conditions and TWL(100) = 20.2 ft. NAVD for the eroded beach conditions. At the Capistrano Beach site, shoaling wave heights are higher and total water levels for a 100 year event superimposed on the high range projections for 2100 sea levels produce total water levels reaching TWL(100) = 22.7 ft. NAVD for the steeply sloping accreted beach conditions and TWL(100) = 21.1 ft. NAVD for the eroded beach conditions. Consequently, all beach front well head vaults for the Doheny Desalination Project will be overtopped when extreme waves happen concurrently with extreme ocean water levels that are superimposed on the high range of 2100 sea levels. The lowest lying well heads (Well Heads A-C) would experience the highest overtopping rates, ranging from Q'(100yr) = 0.216 cfs/ft. to 0.331 cfs/ft. depending on the eroded or accreted condition of Doheny State Beach. According Table VI-5-6 in the Coastal Engineering Manual (USACE, 2006) overtopping rates of this order of magnitude are very dangerous for pedestrian and vehicle traffic, and may cause structural damage to adjacent buildings, but the well heads and pumps for the Doheny Desalination project will be protected by steel vault enclosures. The smallest overtopping rates during the 100-year event at the high range

Table ES-1a: Doheny Beach Extremal Total Water Level (*TWL) and Overtopping Rates (Q')

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
*$TWL(1)$ Present Sea Level (eroded/accreted)	8.7/10.5 ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry
*$Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = dry	15.8/17.6 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ Present Sea Level (eroded/accreted)	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry
**$Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach
**$Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.027 cfs/ft.	0.0/0.027 cfs/ft.
**$TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded
**$Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.149/0.263 cfs/ft.	0.149/0.263 cfs/ft.

*Evaluated for the 1-yr return period; ** Evaluated for the 100-yr return period

Table ES-1b: Capistrano Beach Extremal Total Water Level (TWL) and Overtopping Rates (Q')

	Well Head-G Elevation = 18 ft. NAVD	Well Head-H Elevation = 19 ft. NAVD
$*TWL(1)$ Present Sea Level (eroded/accreted)	9.7/11.5 ft. NAVD status = dry	9.7/11.5 ft. NAVD status = dry
$*Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	13.3/15.1 ft. NAVD status = dry	13.3/15.1 ft. NAVD status = dry
$*Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	16.8/18.6 ft. NAVD status = flooded accreted beach	16.8/18.6 ft. NAVD status = dry
$*Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.00 cfs/ft.
$**TWL(100)$ Present Sea Level (eroded/accreted)	14.0/15.6 ft. NAVD status = dry	14.0/15.6 ft. NAVD status = dry
$**Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$**TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	17.6/19.2 ft. NAVD status = flooded accreted beach	17.6/19.2 ft. NAVD status = flooded accreted beach
$**Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.081 cfs/ft.	0.0/0.014 cfs/ft.
$**TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	21.1/22.7 ft. NAVD status = flooded	21.1/22.7 ft. NAVD status = flooded
$**Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.209/0.318 cfs/ft.	0.142/0.250 cfs/ft.

*Evaluated for the 1-yr return period; ** Evaluated for the 100-yr return period

2100 sea level projections will occur at the highest located well head (Well Head H) at the Capistrano Beach site where overtopping rates will range from Q'(100yr) = 0.142 cfs/ft. to 0.250 cfs/ft. While these overtopping rates are still dangerous to pedestrian and vehicle traffic, they are easily managed by the steel vault enclosures of the well heads and pumps being placed at Capistrano Beach.

Tsunami induced erosion, runup, and inundation were analyzed for the Doheny and Capistrano Beaches and shore-side facilities associated with the Doheny Desalination Project for present and future sea levels according to low and high range sea level rise predictions. The analysis was based on numerical refraction/diffraction codes for a shoaling solitary wave. The tsunami event scenario is based on a 2m high solitary wave approaching Doheny Beach from 165 degrees true, as could be anticipated for a catastrophic tsunami event arising from a major landside on the east side of San Clemente Island. The local refraction/diffraction pattern from the solitary wave reveals the tsunami wave height begins to increase at 50 m of water depth due to shoaling, and reaches 6m of height before breaking along the shores of Doheny and Capistrano Beaches. Because the tsunami wave begins shoaling in much deeper water than typical storm-induced waves, it causes seabed scour and erosion to occur out to very deep-water depths. Therefore, all run-up and total water level solutions are based eroded beach profile conditions.

Tsunami TWL inundation calculations are summarized Table ES-2a for the Doheny Beach site, and Table ES-2b for the Capistrano Beach site. These tables indicate that all of the shore facilities of the Doheny Desalination Project are above tsunami inundation levels at present sea level. However, all of the well heads at both Doheny and Capistrano Beaches would suffer some degree of tsunami overtopping if concurrent with 2100 sea levels, and the overtopping rates could be quite severe, especially for the high 2100 sea level rise projections. At the low range of 2100 sea level projections, total water levels would reach *TWL* = 18.82 ft. NAVD at Doheny Beach and *TWL* = 18.83 ft. NAVD at Capistrano Beach. Well Heads A-C at Doheny Beach would experience the highest overtopping surges of Q' = 1.142 cfs/ft while Well Head G at Capistrano Beach would remain high and dry. However, if the tsunami occurred atop the high range sea level rise projections for year 2100, then total water levels would reach *TWL* = 22.31 ft. NAVD at Doheny Beach and *TWL* = 22.4 ft. NAVD at Capistrano Beach, sufficient to overtop all the well sites of the Doheny Desalination project. In this case the tsunami surge could produce very high, although short-lived, overtopping rates reaching a maximum of Q' = 5.691 cfs/ft at Well Heads A-C on Doheny Beach and a minimum of Q' = 2.916 cfs/ft at Well Head H on Capistrano Beach. Undoubtedly, the steel vault enclosures of the well heads can be designed to withstand these high surge rates, but particular attention should be given to the foundations of the vaults to assure those foundations have adequate depth to prevent undercutting by scour. These findings are consistent with the FEMA tsunami flood map which show that all of the Doheny Beach/San Juan Creek corridor extending several miles inland will be inundated by a shoaling tsunami solitary wave.

Table ES-2a: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Doheny Beach Site

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
TWL Present Sea Level	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry
Q' Present Sea Level	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.
TWL 2100 Sea Level Low Range Projection	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded
Q' 2100 Sea Level Low Range Projection	1.142 cfs/ft.	1.142 cfs/ft.	1.142 cfs/ft.	0.345 cfs/ft.	0.345 cfs/ft.
TWL @ 2100 Sea Level High Range Projection	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded
Q' 2100 Sea Level High Range Projection	5.691 cfs/ft.	5.691 cfs/ft.	5.691 cfs/ft.	4.162 cfs/ft.	4.162 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Doheny State Beach from 165 degrees true

Table ES-2b: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Capistrano Beach Site

	Well Head-G Elevation = 18 ft. NAVD eroded/accreted	Well Head-H Elevation = 19 ft. NAVD eroded/accreted
*TWL Present Sea Level (eroded)	15.3 ft. NAVD status = dry	15.3 ft. NAVD status = dry
*Q' Present Sea Level (eroded)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*TWL 2100 Sea Level Low Range Projection (eroded)	18.83 ft. NAVD status = flooded	18.83 ft. NAVD status = dry
*Q' 2100 Sea Level Low Range Projection (eroded)	0.352 cfs/ft.	0.0/0.0 cfs/ft.
*TWL 2100 Sea Level High Range Projection (eroded)	22.4 ft. NAVD status = flooded	22.4 ft. NAVD status = flooded
*Q' 2100 Sea Level High Range Projection (eroded)	4.293 cfs/ft.	2.916 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Capistrano Beach from 165 degrees true

Coastal Hazards Analysis for the Doheny Desalination Project for the Final EIR

by Scott A. Jenkins, Ph.D.

1) Introduction: The source water for the Doheny Desalination Project will be drawn from an array of slant wells that extract pore water from marine sediments that were deposited in a paleo-channel cut by the San Juan Creek across the continental shelf during the previous low-stand of sea level (ca. 18,000 yr B.P.; Inman et al, 2003). With the subsequent rise in sea level during the Flandrian Transgression, the paleo-channel in-filled with fluvial sediments from the San Juan Creek and littoral sediments from the adjacent nearshore, (Jenkins and Wasyl, 2005), leaving only the expression of a modern sand delta at the mouth of the San Juan Creek (denoted by light brown contours in Figure 1). Thus a large formation of marine valley-fill sediments is available seaward of the mouth of the San Juan Creek to provide sub-bottom filtration of ocean source water harvested by slant wells. Desalination of this source water by reverse osmosis (RO) is expected to present several possible discharge scenarios for disposal of the concentrated seawater by-product (brine), depending upon the production rate and recovery ratio. The Doheny Desalination Project will blend brine with treated wastewater and will discharge the combined effluent through the San Juan Creek Ocean Outfall (SJCOO). The SJCOO extends seaward 10,334 ft. from the mouth of the San Juan Creek, (Figure 1), in a 1,488 ft. total length L-shaped linear diffuser with a 216 ft long shoreline-normal section and a right angle dog-leg with a 1,272 ft diffuser section employing 125 discharge ports. The diffuser= discharges at local depths of 95 ft MSL (29 m MSL), at a distance of roughly 4,415 ft (1,346 m) from the edge of the continental shelf.

The coastal hazards analysis evaluates potential impacts of combinations of extreme waves and ocean water levels on these structures at both present and future sea levels; and conversely, potential impacts of these structures on nearshore erosion, sediment transport and shoreline stability. The study includes assimilation of long-term wave climate data bases to evaluate inundation by extreme wave and tsunami run-up that may affect stability and operations of subsurface desalination plant intake structures, (slant wells), as well as supporting shore facilities. The essential requirements for this study, as stated in the California Coastal Commission guidance document for Coastal Development Permits Applications are: 1) quantify the magnitude and extent to which the subsurface intake and associated shore zone structures could be subject to sea level rise, erosion, wave attack or wave run-up due to wave refraction/diffraction over local nearshore and shelf bathymetry over a projected lifespan; 2) quantify the of the frequency of such events; and 3) evaluate the consequences of such events should they be determined significant, and pose remedial options for avoiding such consequences. In evaluating these potential hazards for this study, the study will also: 4) evaluate potential impacts to the adjacent shoreline due to sea level rise, erosion and wave diffraction and reflection from the subsurface intake structures. The latter requirement entails a sediment budget and transport analysis of both the near- and far-field of the study area.

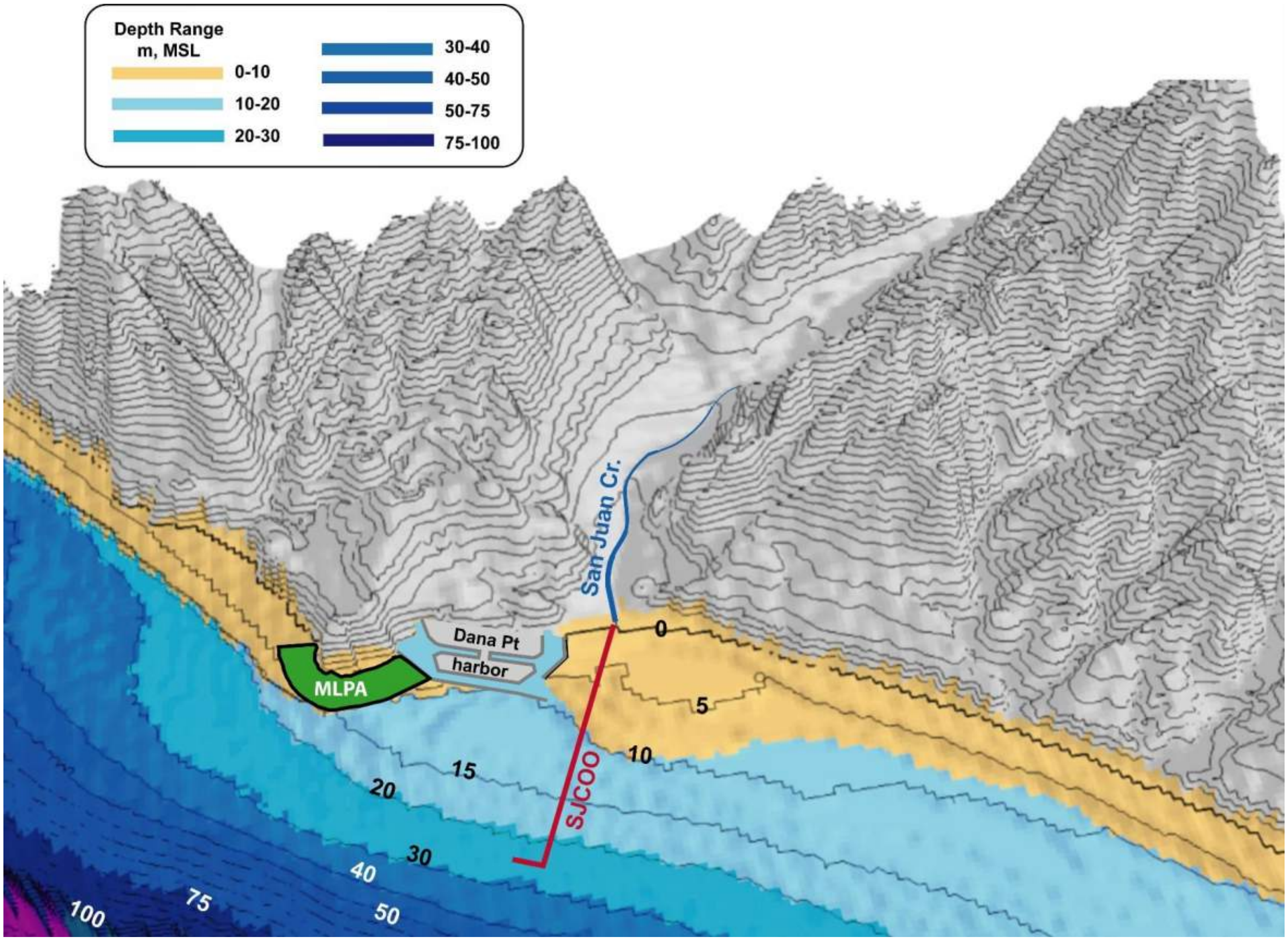


Figure 1.1: Project site map in GIS. Bathymetry contours in meters MSL. Data from GEODAS 3 arc-second database

2) Regulatory Requirements:

The *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2015) and CCC (2018) provides specific guidance on the analysis protocals of a sea level rise/coastal hazards analysis. These are:

Step 1 – Develop temporally- and spatially-appropriate sea level rise projections

Two methods are recommended for establishing a projection value for a specific year: 1) conduct a linear interpolation[100], or 2) use the "best fit" equations that are provided below. At this time, both are acceptable for Coastal Commission purposes

Step 2 – Determine tidal range and future inundation

This step requires the determination the future intersections of mean sea level or other tidal datums with the shoreline. Erosion must be accounted for in these determinations.

Step 3 – Determine still water changes from surge, El Niño events, and PDOs

Estimates of surge, El Niño, and PDO water elevation changes are to be developed primarily from historical records. There are no state-wide resources for this information,

Step 4 – Estimate beach, bluff, and dune change from erosion

There is no single specific accepted method for predicting future beach erosion. At a minimum, projects should assume that there will be inundation of dry beach and that the beach will continue to experience seasonal and inter-annual changes comparable to historical amounts. When there is a range of erosion rates from historical trends, the high rate should be used to project future erosion with rising sea level conditions (unless future erosion will encounter more resistant materials, in which case lower erosion rates may be used). For beaches that have had a relatively stable long-term width, it would be prudent to also consider the potential for greater variability or even erosion as a future condition.

Step 5 – Determine wave, storm wave, wave runup, and flooding conditions

Wave impacts to the coast, to coastal bluff erosion and inland development, should be analyzed under the conditions most likely to cause harm. Those conditions normally occur in winter when most of the sand has moved offshore leaving only a reduced dry sand beach to dissipate wave energy (this seasonal change in beach width is often referred to as short-term or seasonal erosion). On beaches that will experience long-term erosion, trends expected to occur over the entire expected life of the development should also be considered. Since water levels will increase over the life of the development due to rising sea level, the development should be examined for the amount of sea level rise (or a scenario of sea level rise conditions) that is likely to occur throughout the expected life of the development. Then, the wave impact analysis should examine the consequences of a 100-year design storm event using the combined water levels that are likely to occur with high water conditions and sea level rise, as well as a long-term and seasonally eroded beach.

Step 6 – Examine potential flooding from extreme events

Extreme events, by their very nature, are those beyond the normal events that are considered in most shoreline studies. Tsunami should be among the extreme events evaluated. Planning and project analysis need to consider and anticipate the consequences of these outlier events. Projections of potential flooding from extreme events are the principle outcome of Step-6.

3) Temporally- and Spatially-Appropriate Sea Level Rise Projections

This section adresses Step-1 of a sea level rise/coastal hazards analysis as outlined in Section 2. The *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2015) requires that coastal hazards analyses consider sea level rise impacts over the project lifetime. Precedence from antecedant desalination projects have typically used project lifspans of 50 years (SEIR, 2010). With a potential start date of 2020, a fifty year project life for the Doheney Desalination Project (DDP) would extend the sea level rise analysis out to 2070. However, the present analysis will use 2100 as the ultimate planning horizon for a critical infrastructure project.

Originally, CCC, (2015) permits either of two methods derived from the NRC report (NRC, 2012) for making sea level projections, 1) the *linear interpolation method*, and 2) the *best fit equation.* Sea level projection estimates using the "best-fit" equation are slightly less than estimations based on linear interpolation because the NRC's sea level curves are concave upward (sea level rise is expected to accelerate over the 21st Century). In our previous study, we selected the best-fit equation method for the sea level rise projections used in this study. Since the Doheny Desalination Project is located well south of Cape Mendocino, the appropriate best fit equation for use in the DDP coastal hazards analysis is:

$$SLR = 0.0093t^2 + 0.7457t \quad \text{(upper-range projection)} \qquad (1)$$

$$SLR = 0.0038t^2 + 0.039t \quad \text{(lower-range projection)} \qquad (2)$$

Here, *SLR* is the sea level rise in centimeters (cm) and *t* is the time in years after the year 2000 baseline. Figure 3.1 plots the sea level rise projections from equations (1) & (2), which appear as the cyan colored curve in Figure 3.1 for the low-range projection; and the magenta colored curve for the high range projection. For the 2100 planning horizon, sea level rise was originally projected to range from 1.37 ft to 5.50 ft. However, in the updated sea level rise policy guidance document, (CCC, 2018), equations (1) and (2) were abandoned in favor of a water level province tabulation centered around NOAA tide gage stations having long periods of record. The Doheny Desalination Projects lies in the La Jolla tide gage water level province, for which sea level rise projections are listed in Table G-11 in Appendix-G of CCC (2018). These new projections are plotted in Figure 3.1 as the blue curve for the low range projections and the red curve for the high range projections. Clearly the clarified sea level rise curves in Figure 3.1 project significantly higher future sea levels, particularly for the low range estimates. For the 2100 planning horizon sea level rise is projected range from 3.6 ft to 7.1 ft. The low range projection represents a 17% probability that sea level rise exceeds these values; while the high range projection represents a 0.5% probability that sea level rise exceeds these values. These values will be used in the calculations of extreme total water levels (TWL's) in the following sections.

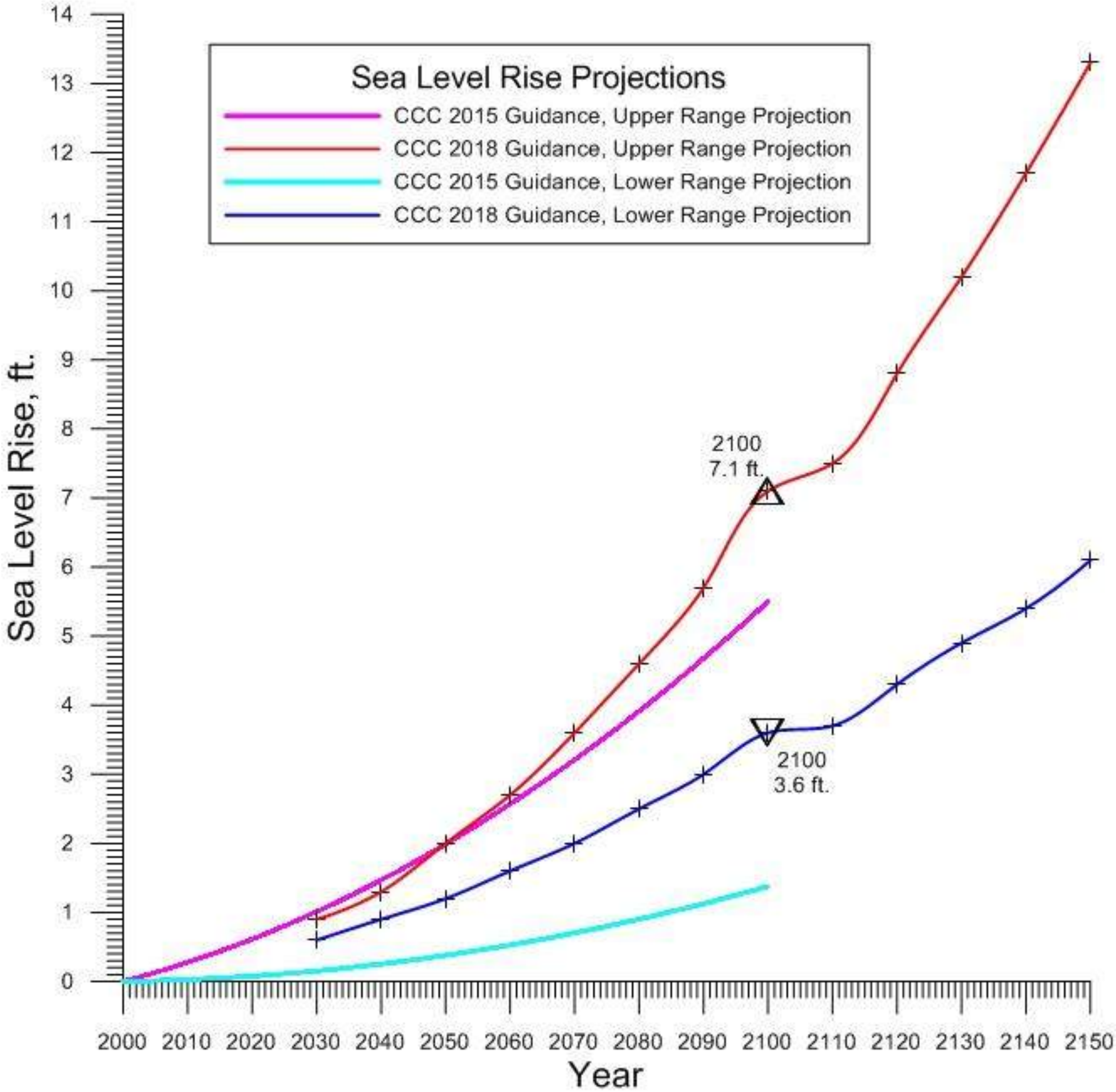


Figure 3.1: Range of sea level rise projections from the California Coastal Commission sea level rise guidance document, (CCC, 2018, Appendix-G). The 2100 planning horizon is indicated by symbols on the upper and lower range curves. Blue curve represents a 17% probability that sea level rise exceeds these values; red curve represents a 0.5% probability that sea level rise exceeds these values

4) Tidal range and Still Water Levels

This section adresses Steps-2 & 3 of a sea level rise/coastal hazards analysis as outlined in Section 2. This is accomplished by leveraging a long standing effort of NOAA who has deployed tide gages up and down the California coast (NOAA, 2016) to continuously monitor ocean and bay water levels, and who has periodically verified those water levels for multi-decadal periods referred to as "*tidal epochs*". NOAA has deployed continuously active tide gages along the California coast, which typically record water levels every 6 minutes, and those measurements account for all the combined astronomical, meteorological and climatic effects that have effected water levels in the coastal regions of California since the tide gages were installed. These effects include climate cycles such as El Niño /Southern Oscillation (ENSO) and the longer period Pacific Decadal Oscillation (PDO), as specifically cited for consideration in a coastal hazards analysis in CCC, (2015) and CCC (2018). The two closest NOAA tide gage stations to the Doheny Desalination Project site are at Newport (NOAA #9410580) and Scripps Pier in La Jolla (NOAA#9410230). The period of record for the Newport tide gage ends in 1994, and was not used as the basis for a water level province in Appendix-G of CCC (2018). Therefore we base our tidal range and static water level analysis on the Scripps Pier tide gage, whose period of record extends from 1924 until present, and its vertical datum elevations have also been verified by NOAA for the most recent tidal epoch 1983-2001. Those vertical datum elevations are listed in Table-1.

Water level recurrence statistics are derived from the record of ocean water levels at the NOAA Scripps Pier tide gage based on calculating a stage frequency curve called a "*hydroperiod function*". The hydroperiod function provides a continuous relationship between ocean water levels measured at 6 minute time intervals and the recurrence probability for each observed water level increment. The computations involves N_0 time steps in the NOAA water level files. Each time sep is at 6 minute intervals, over the period of record (1924-2016). Conditional if statements embedded in counting loops of the *hydro-pr_caltrans* software (developed for Caltrans coastal culvert design, cf. Jenkins and Taylor, 2016) calculate the number time steps, $N(\eta \le Z_i)$, for which the ocean water level, η, was at least as high as a potential still-water elevation Z_i at or above mean sea level. The percent time that elevation Z_i is wet due to ocean inundation is calculated as:

$$\hat{E}_i = \frac{100\%}{\hat{N}_o} \sum N(\eta \ge Z_i) \tag{3}$$

$$\text{where: } \hat{N}_0 = \sum_i N_i(\eta \ge MSL)$$

Time averaging Equation (3) over yearly increments and then ensemble averaging the yearly averages gives an *annualized hydroperiod function* $H_{i,j}$ that represents the annualized probability of ocean water levels reaching a still-water elevation Z_i

Table 4.1: Tidal Datums at Scripps Pier NOAA Tide Gage Station:
Elevations on Station Datum
Station: 9410230, La Jolla, CA
Status: Accepted (Oct 6 2011)
Units: Feet
T.M.: 120
Epoch: 1983-2001
Datum: STND

Datum	Value	Description
MHHW	9.69	Mean Higher-High Water
MHW	8.97	Mean High Water
MTL	7.12	Mean Tide Level
MSL	7.10	Mean Sea Level
DTL	7.03	Mean Diurnal Tide Level
MLW	5.27	Mean Low Water
MLLW	4.37	Mean Lower-Low Water
NAVD88	4.56	North American Vertical Datum of 1988
STND	0.00	Station Datum
GT	5.33	Great Diurnal Range
MN	3.69	Mean Range of Tide
DHQ	0.73	Mean Diurnal High Water Inequality
DLQ	0.91	Mean Diurnal Low Water Inequality
HWI	5.01	Greenwich High Water Interval (in hours)
LWI	11.07	Greenwich Low Water Interval (in hours)
Maximum	12.03	Highest Observed Water Level
Max Date & Time	01/11/2005 17:00	Highest Observed Water Level Date and Time
Minimum	1.50	Lowest Observed Water Level
Min Date & Time	12/17/1933 23:36	Lowest Observed Water Level Date and Time
HAT	11.51	Highest Astronomical Tide
HAT Date & Time	08/09/1987 03:54	HAT Date and Time
LAT	2.49	Lowest Astronomical Tide
LAT Date & Time	01/28/1987 22:48	LAT Date and Time

Tidal Datum Analysis Periods : 01/01/1983 - 12/31/2001

Tidal Datums:
EHW = 7.47 ft NAVD
HAT = 6.95 ft. NAVD
MHHW = 5.13 ft NAVD
MHW = 4.41 ft NAVD
MSL = 2.54 ft NAVD
MTL = 2.56 ft NAVD
MLLW = 0.00 ft. NAVD
ELW = -3.06 ft NAVD
NGVD 1929 = 2.35 ft. NAVD

$$P_{i,j} = \frac{1}{k} \sum_{j=1}^{j=k} \left[\frac{1}{\tau_j} \int_0^{\tau_j} \hat{E}_i \, dt \right] \tag{4}$$

Here τ_j is the length of tidal record in *year-j* and k is the number of years in the period of record of the tide gage. The annualized hydroperiod function of still-water level elevations at present sea level is plotted in Figure 4.1, based on the NOAA Scripps Pier ocean water level data (surrogate for the Doheny Desalination Project site). Inspection of Figure 4.1 indicates that recurrence probability for mean higher high water levels are *P*(MHHW) = 13% and *P*(MHW) = 28% for mean high water levels; while intuitively the recurrence probability for mean sea level is *P*(MSL) = 100%. The extreme high water level event is a less than 1% event at *P*(EHW) = 0.06%.

Table 1 reveals that the extreme high water level, (EHW = 7.47 ft. NAVD, occurring 1 November 2005) exceeds the highest astronomical tide, (HAT = 6.95 ft NAVD, occurring 9 August 1987). The largest exceedance of daily high water levels above the astronomic tides in the period of record of the NOAA #9410230 occurred during the 1997-98 El Niño on 13 November 1997, when the daily high water level was 1.47 ft above the astronomic tides (Figure 4.2). This discrepancy occurs as a result of climate cycle effects that warm the coastal ocean creating an increase in *steric* sea level due to thermal expansion of the water mass, which can persist for as long as 8-10 months. Climate cycles involve intense global modifications that are signaled by anomalies in the pressure fields between the tropical eastern Pacific Ocean and Australia/Malaysia known as the ***Southern Oscillation***. The intensity of the oscillation is often measured in terms of the ***Southern Oscillation Index (SOI)***, defined as the monthly mean sea level pressure anomaly in mb normalized by the standard deviation of the monthly means for the period 1951-1980 at Tahiti minus that at Darwin, Australia. The Southern Oscillation is in turn, modulated over multi-decadal periods by the ***Pacific Decadal Oscillation***, which results in alternating decades of strong and weak El Niño.

The long-term variability of the Pacific Decadal Oscillation (PDO) is shown in Figure 4.3 and the cumulative residual of the Southern Oscillation Index, between 1882 and 1996, is plotted in Figure 4.4, where cumulative residuals SOI_n are taken as the continued cumulative sum of departures of annual values of a time series SOI_j from their long-term mean values $\overline{SOI}$, such that :

$$SOI_n = \sum_{o}^{n} (SOI_i - \overline{SOI}) \tag{5}$$

Here n is the sequential value of a time series of n years. Southern Oscillation effects give rise to enhancements and protractions of the inter-annual seasonal cycles, and their two extremes are referred to as El Niño (SOI negative) and La Niña (SOI positive). Inspection of Figure 5a reveals a number of large positive oscillations in the SOI between 1944 and 1978 corresponding to La Niña dominated climate; and a series of very large negative oscillations occurring between 1978 and 1995 which correspond with El Niño dominated climate.

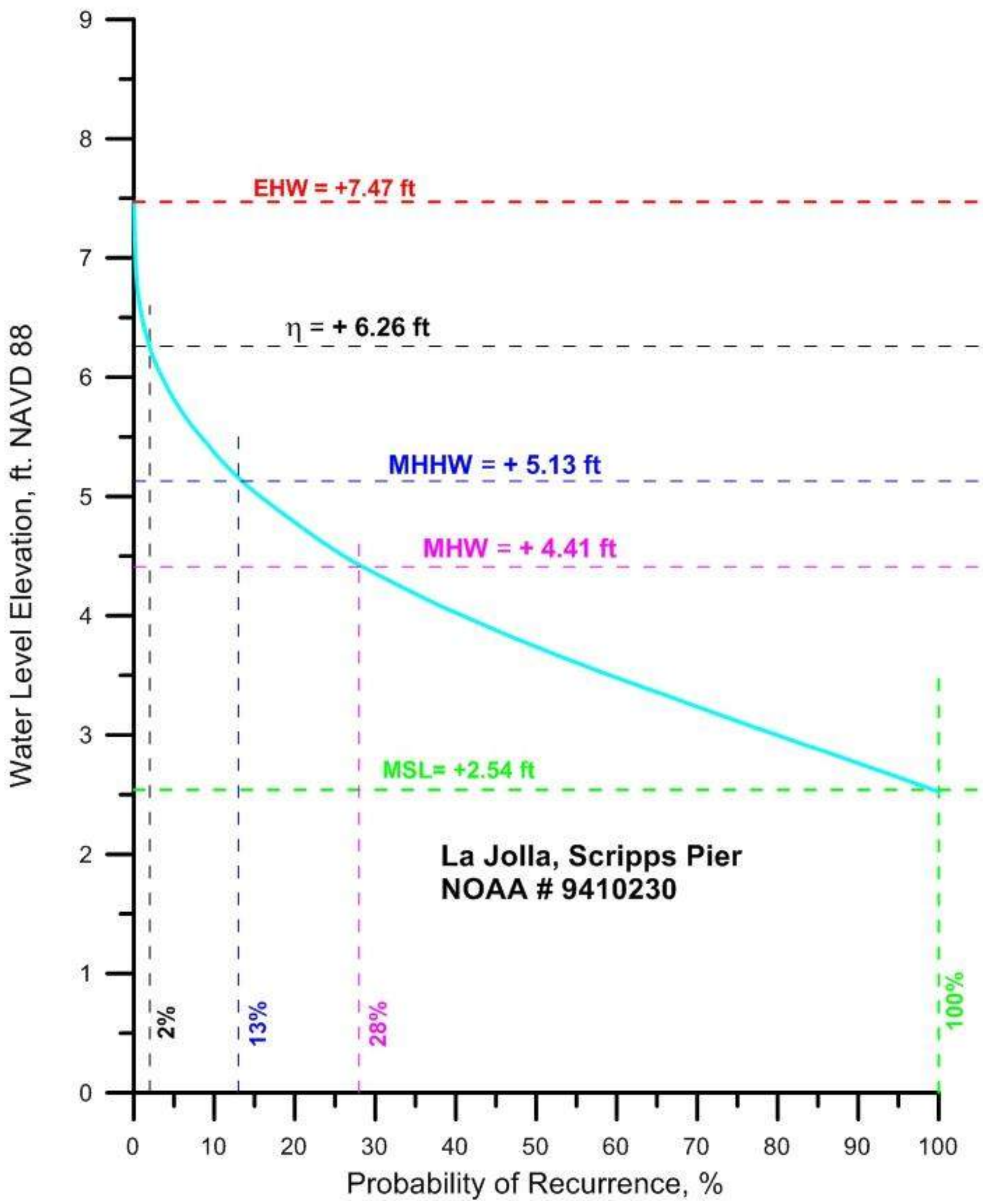


Figure 4.1: Hydroperiod function of still-water level elevations at present sea level, based on ocean water level measurements at the Scripps Pier tide gage station, NOAA #9410230, for the period of record 1924-2016. Tidal datums based on the 1983-2001 tidal epoch (latest datum analysis period).

Along the southern California coast, a period of mild-stable La Niña dominated pressure systems prevailed between 1944 and 1978. The average SOI for this period was +0.1,with strong La Niña events in 1950, (SOI = +1.4); 1955/56, (+1.2); 1970/71, (+1.0); 1973/74, (+1.0); and 1975/76 (+1.4). Winters were moderate with low rainfall, and winds were predominantly from the west-northwest. The principal wave energy was from Aleutian lows having storm tracks which usually did reach southern California. Summers were mild and dry with sea surface temperatures seldom exceeding 20^{0}C. The North Pacific High dominated the coastal transport by strengthening the California Current and promoting coastal upwelling of cold bottom water. The effect of these cool dry La Niña dominated climate periods was to promote negative anomalies in the steric sea level, augmented by depression of sea level by the inverse barometer effects of a strong North Pacific High.

The climate in southern California changed, beginning with the El Niño years of 1978/79 and extending at least until 1999. The average SOI for this period was -0.5, with the 1978/79 El Niño averaging -1.2, the 1982/83 El Niño averaging a record -1.7 and the 1993/94 El Niño recording a mean of -1.0. During these periods, the North Pacific High was weakened and transport of warm equatorial water masses into the Southern California Bight were promoted by topographically trapped Kelvin waves. The North Pacific High was weak and the prevailing north-westerly winter waves were replaced by high energy waves approaching from the west or southwest, while the previous southern hemisphere swell waves of summer were replaced by shorter period tropical storm waves during late summer months from the more immediate waters off Central America. These dynamics promoted positive sea level anomalies in steric sea level as a consequence of thermal expansion of the warm coastal ocean water mass, augmented by inverse barometer effects under strong frontal cyclones during winter.

These climate effects on the hydroperiod function are proportioned schematically in Figure 4.5. Basically, ocean water levels result from the astronomic tides oscillating around the steric sealevel, which itself varies slowly in response to seasonal warming and cooling of the coastal water mass, and longer term warming and cooling from ENSO and PDO. While the highest astronomic tides have reached HAT = +6.95 ft NAVD, astronomic tides typically do not exceed η = +6.0 ft NAVD during a typical spring-neap cycle. Seasonal warming of the coastal ocean can cause an increase in steric sea levels by as much as $\Delta\eta$ = +0.5 ft. As Figure 4.2 reveals, a strong El Niño event can create as much as $\Delta\eta$ =+1.47 ft. increase in steric sea level, but more typically El Niño events cause positive sea level anomalies on the order of $\Delta\eta$ =+1.47 ft. Because PDO re-enforces El Niño events during a multi-decadal warm wet climate period as occurred during the 1978-1998 epoch, just how much of these anomalies is due to PDO is uncertain, but generally it is believed that about 10% to 15% of an El Niño sea level anomaly is due to a positive PDO cycle. On the other hand, La Niña events depress steric sea levels and typically produce negative sea level anomalies on the order of $\Delta\eta$ = -0.6 ft.

Because the hydroperiod function in Figure 4.1 is based on multi decadal ocean water level measurements (1924-2016), it captures the combined effects of PDO, ENSO, and astronomic tides. It also captures the transient storm surge events. Storm surge is a wind-set-up phenomena, but because California is a collision coastline with a very narrow continental shelf, it does not develop the large storm surges of tens of feet that occur on the broad shelf environments of the Gulf and Atlantic coastlines during hurricanes. Storm surge on the California coast is primarily due to the inverse barometer effect, which causes the sea surface to bulge upwards under low pressure weather systems approaching the coastline, and typically lasts a few days during the passage of

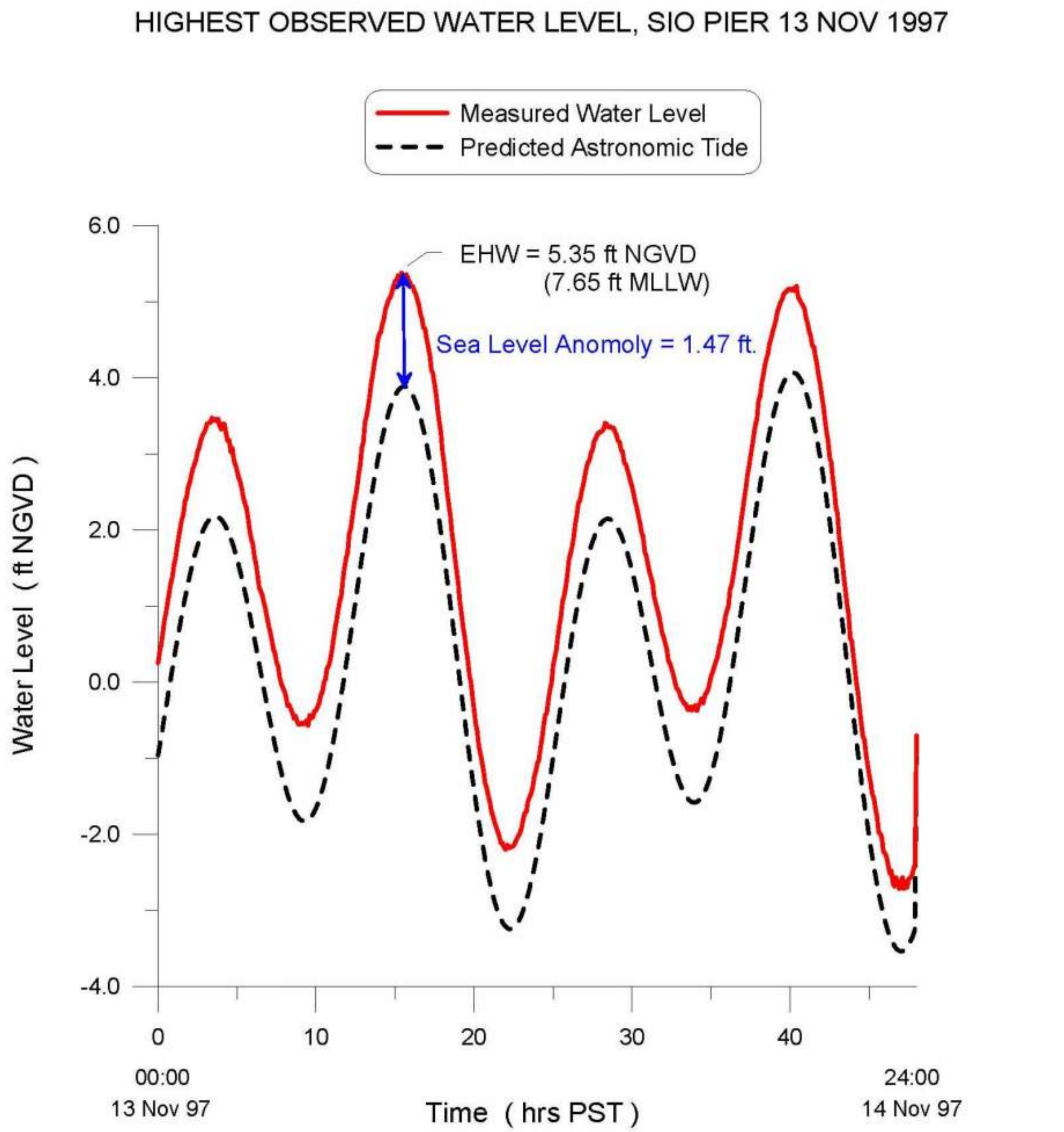


Figure 4.2: Comparison of measured ocean water level (red) at the Scripps Pier tide gage vs. predicted water level based on tidal constituents (black dashed) for the extreme high water event of 13 November 1997 (from Jenkins and Wasyl, 2005).

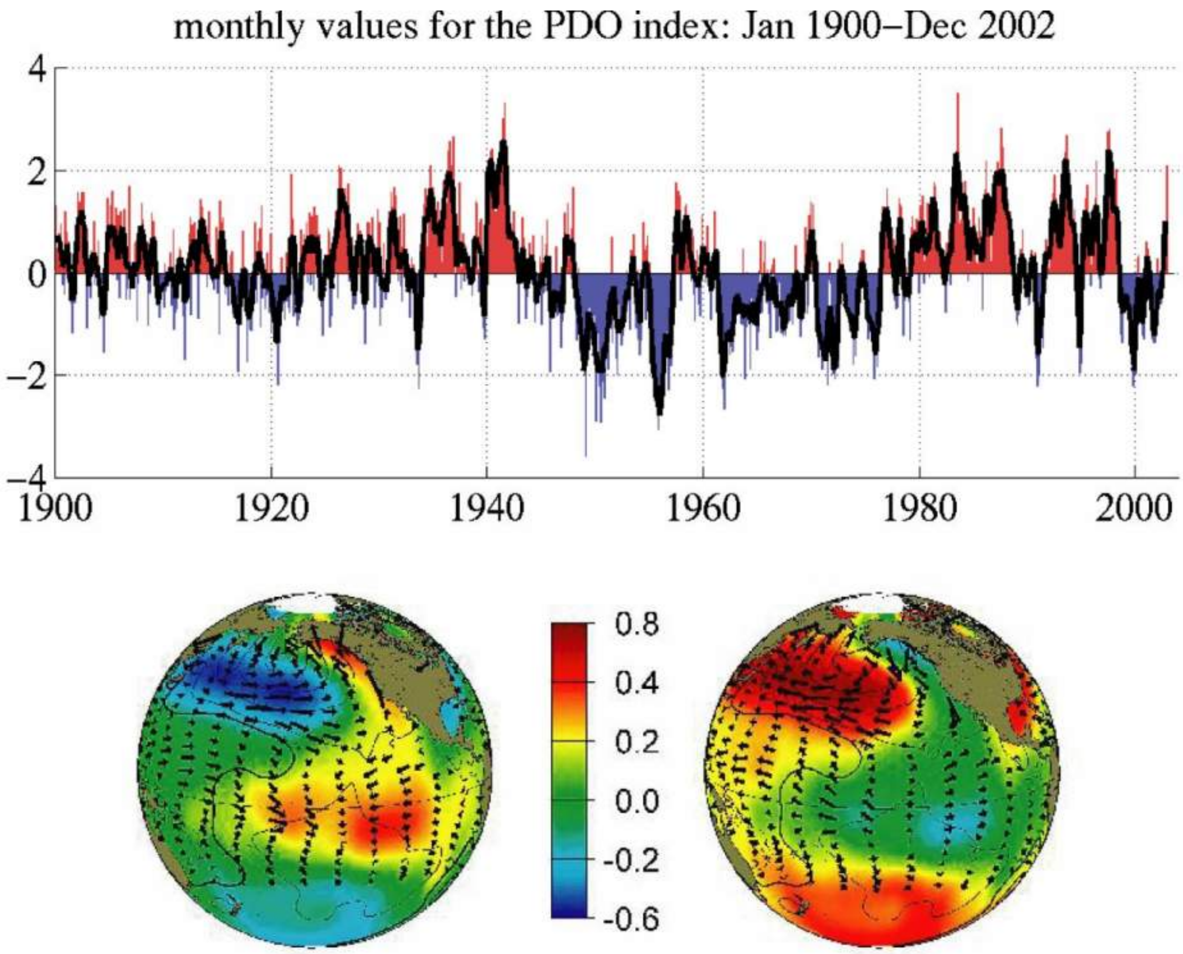


Figure 4.3. Typical wintertime Sea Surface Temperature (colors), Sea Level Pressure (contours) and surface wind stress (arrows) anomaly patterns during warm and cool phases of PDO.

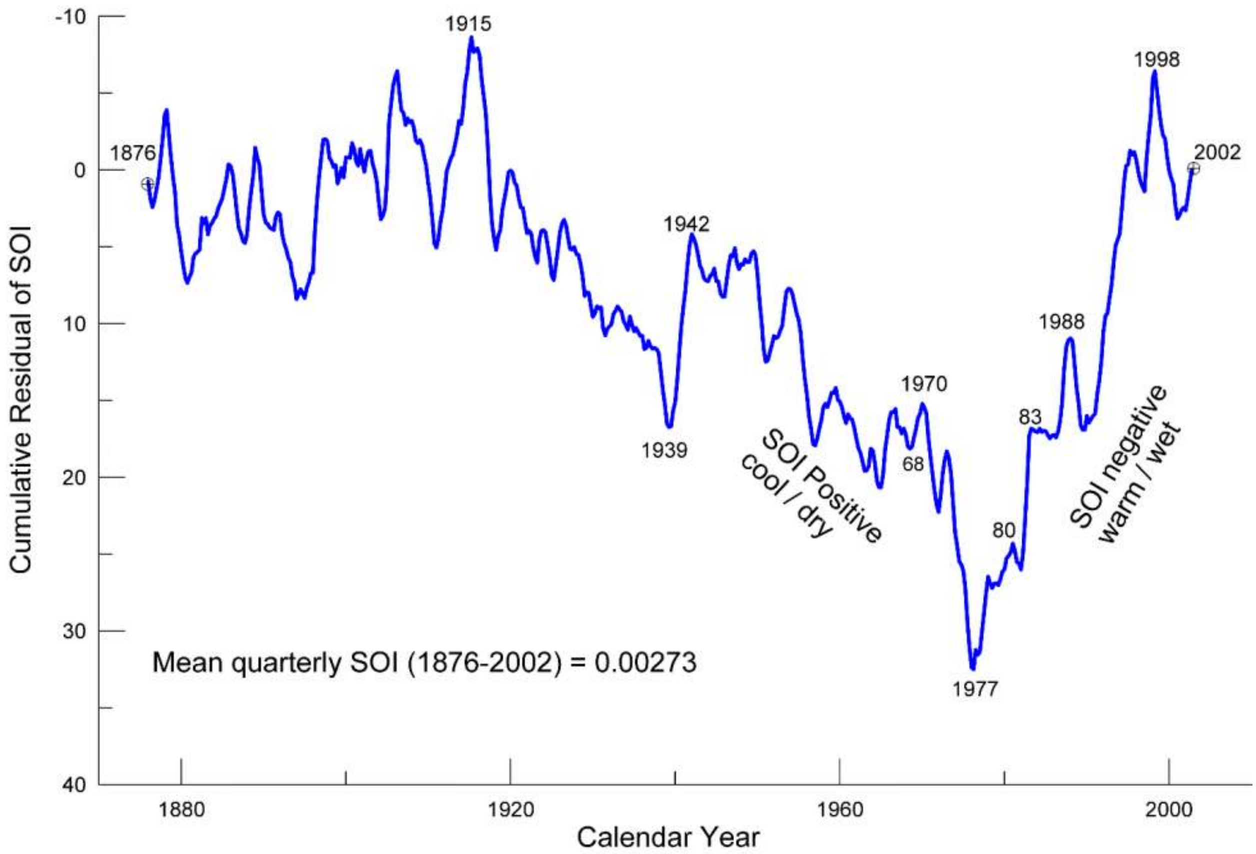


Figure 4.4. Cumulative residual of quarterly values of Southern Oscillation Index (SOI) [data from Australian Commonwealth Bureau of Meteorology].

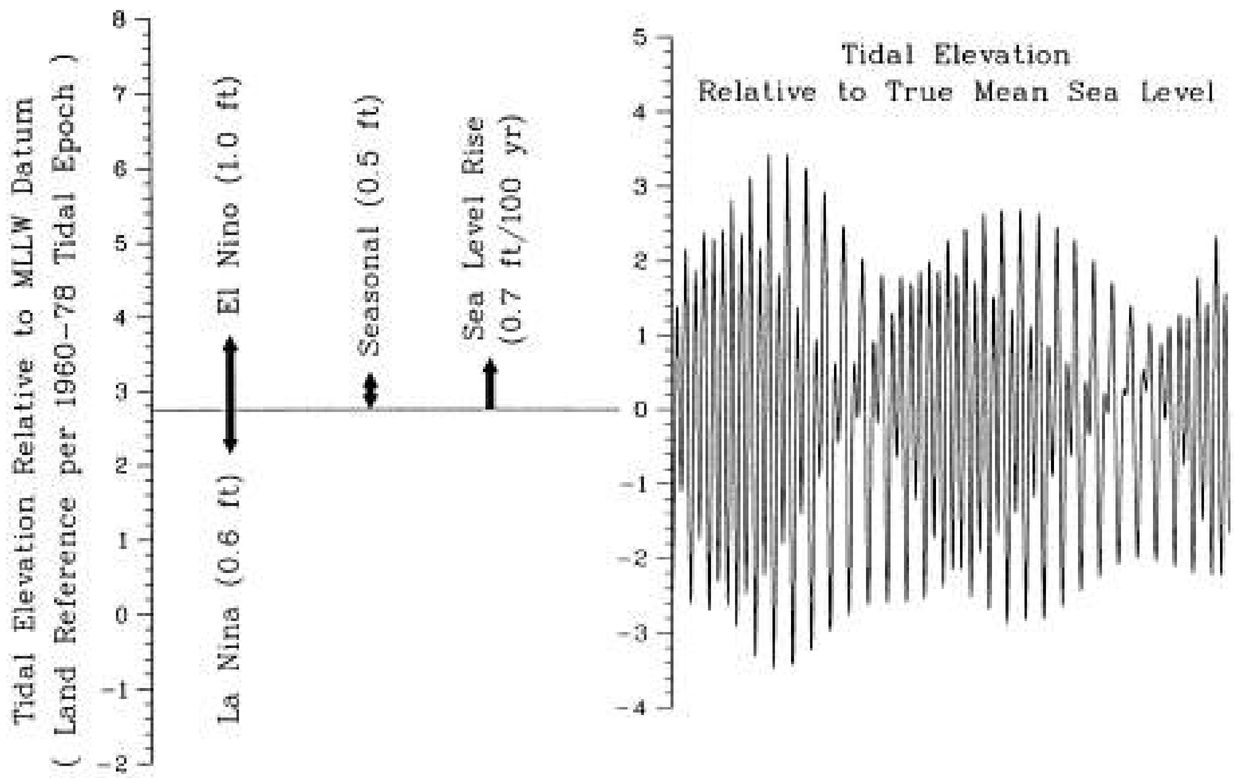


Figure 4.5 Schematic decomposition ocean water levels according to astronomic tides, and seasonal and ENSO/PDO cycle effects on steric sea levels.

winter cold fronts. The sea surface rises 1 cm for every millibar drop in atmospheric pressure. The atmospheric pressure during strong El Niño storms may drop to as low as 993 millibars, (as compared to 1,013 millibars standard atmospheric pressure); which equates to a 20 cm rise in ocean water level during the passage of the storm due to the inverse barometer effect. That short term rise is captured by the NOAA tide gage at the end of Scripps Pier, and is built into the hydroperiod function in Figure 4.1. But, because the Scripps Pier tide gages is located in a stilling well considerably seaward of the surf zone, the hydroperiod function derived from its water level measurements do not include dynamic effects from wave set-up or runup. Consequently the hydroperiod function maps the probabilities of still water levels at or above mean sea level.

Because both the Scripps Pier NOAA tide gage and the Doheny Desalination Project are sited in locations with narrow continental shelfs of only about 4.5 km in width, it is reasonable to assume that the local tidal dynamics will not be altered by higher future sea levels (ie, sea level rise will not cause any new resonance or damping effects of the astronomic tides across the continental shelf). It is not known how ENSO or PDO climate cycles might be altered by global warming and higher sealevels, but for now it is resonable to assume that the hydroperiod function of still water elevations at future sealevels can be obtained by linear superposition of the present hydroperiod function in Figure 4.1 and the sea level rise projections in Figure 3.1. By that approach, the hydroperiod function of still-water level elevations was obtained at 2100 sea level in Figure 4.6.

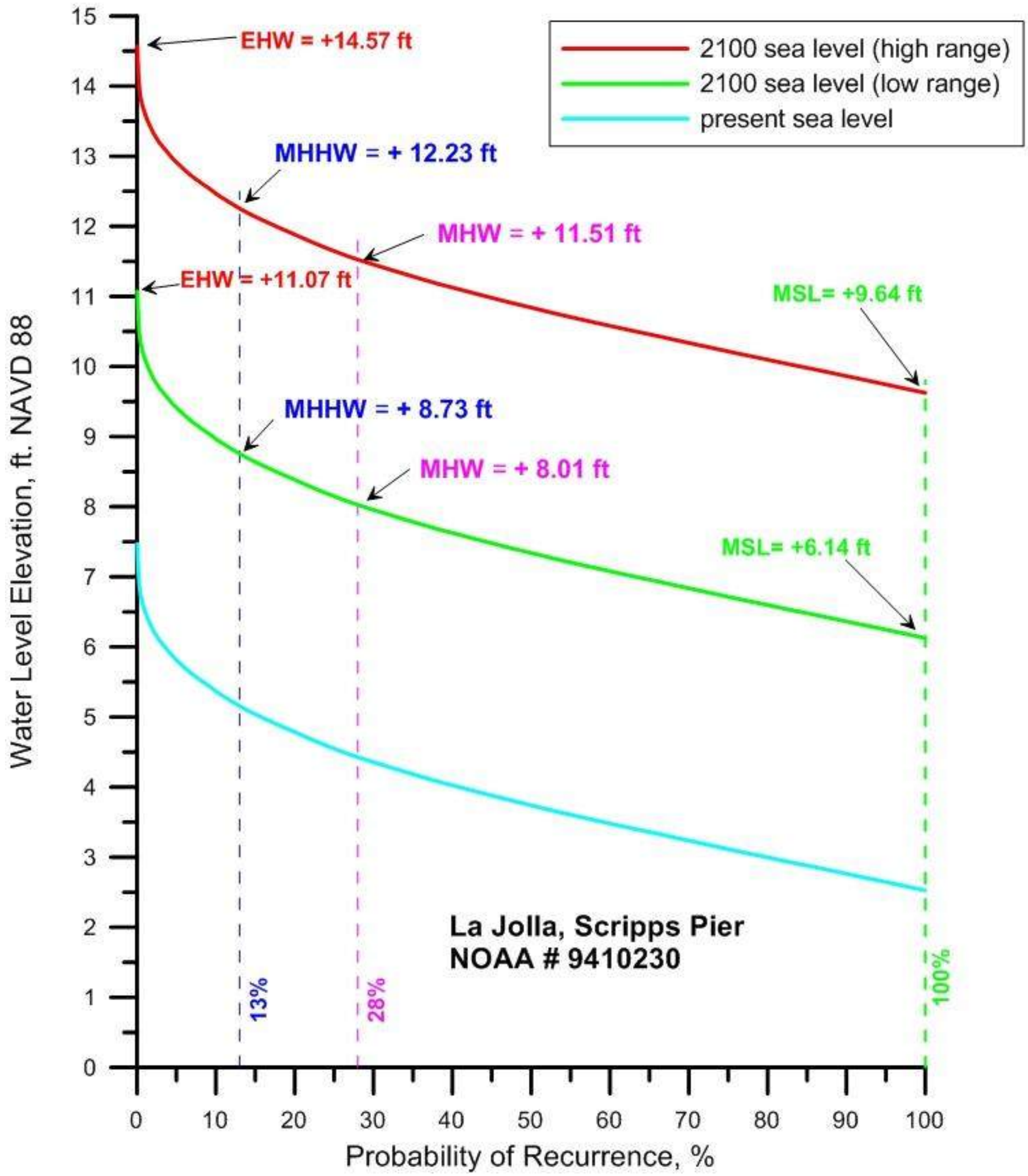


Figure 4.6: Hydroperiod function of still-water level elevations at 2100 sea level, based on ocean water level measurements at the Scripps Pier tide gage station, NOAA #9410230, for the period of record 1924-2016. Tidal datums based on the 1983-2001 tidal epoch (latest datum analysis period). Sea level rise component from Appendix-G, Table G-11 in CCC (2018)

At the year 2100 planning horizon for desalination projects, low range projections in Figure 4.6. indicate that mean sea level increases to MSL = +6.14 ft NAVD while extreme high water increases to EHW = +11.07 ft. NAVD, while mean higher high water increases to MHHW = + 8.73 ft. NAVD. At the high range 2100 projections, mean sea level increases to MSL = +9.64 ft. NAVD; extreme high water increases to an astonishing EHW = +14.57 ft. NAVD, and mean higher high water increases to MHHW = + 12.23 ft. NAVD. The still water elevations inferred at future sea levels from the linear superposition assumption are summarized in Table 4.2 below. It is interesting to note that under the updated policy guidance (CCC,2018) water levels for the high range sea level rise projections for 2070 are the same as water levels for the low range sea level rise projections for year 2100.

Table 4.2: Still Water elevations at present and future sea levels. Based on NOAA #941-0230 tide gage records and sea level rise from Appendix-G, Table G-11 in CCC (2018)

Tidal Datums	Present Sea Level (ft. NAVD 88)	2070 Sea Level Low Range Projection (ft. NAVD 88)	2070 Sea Level High Range Projection (ft. NAVD 88)	*2100 Sea Level Low Range Projection (ft. NAVD 88)	*2100 Sea Level High Range Projection (ft. NAVD 88)
Mean Sea Level (MSL)	2.54	4.54	6.14	6.14	9.64
Mean High Water (MHW)	4.41	6.41	8.01	8.01	11.51
Mean Higher-HighWater (MHHW)	5.13	7.13	8.73	8.73	12.23
Extreme High Water (EHW)	7.47	9.47	11.07	11.07	14.57

*Planning horizon for the Doheny Desalination Project.

5) Technical Approach for Erosion and Dynamic Water Level Analysis:

This section establishes the technical approach for evaluating Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2. The total run-up, R, is composed of three main components: Static wave setup, $\overline{\eta}$, Dynamic wave setup, η_{rms}; Incident wave run-up, R_{inc}. The total water level (TWL) is defined as the sum of the total run-up and the SWL, referenced to an established vertical datum.

5.1 Models: To quantitatively evaluate the problems of implementing subsurface intake technology at SJCOO, we invoke a numerical seabed stability analysis utilizing the *Coastal Evolution Model* (Figure 5.1) applied to the Oceanside Littoral Cell (Figure 5.2). The Coastal Evolution Model was commissioned by the Kavli Foundation to make forecast predictions of the effects of sea level rise on the coastline of California (Jenkins and Wasyl, 2005).

The Coastal Evolution Model (CEM) is a process-based numerical model. It consists of a Littoral Cell Model (LCM) and a Bedrock Cutting Model (BCM), both coupled and operating in varying time and space domains (Figure 5.1.) determined by sea level and the coastal boundaries of the littoral cell at that particular sea level and time. At any given sea level and time, the LCM accounts for erosion of uplands by rainfall and the transport of mobile sediment along the coast by waves and currents, while the BCM accounts for the cutting of bedrock by wave action in the absence of a sedimentary cover.

In both the LCM and BCM, the coastline of the Oceanside Littoral Cell (the region of coastline between Dana Point and Point La Jolla, Figure 5.2) is divided into a series of coupled control cells. Each control cell is a small coastal unit of uniform geometry where a balance is obtained between shoreline change and the inputs and outputs of mass and momentum. The model sequentially integrates over the control cells in a down-drift direction so that the shoreline response of each cell is dependent on the exchanges of mass and momentum between cells, giving continuity of coastal form in the down-drift direction. Although the overall computational domain of the littoral cell remains constant throughout time, there is a different coastline position at each time step in sea level. For each coastline position there exists a similar set of coupled control cells that respond to forcing by waves and current. Time and space scales used for wave forcing and shoreline response (applied at 6 hour intervals) and sea level change (applied annually) are very different. To accommodate these different scales, the model uses multiple nesting in space and time, providing small length scales inside large, and short time scales repeated inside of long time scales. The LCM (Figure 5.1, upper) has been used to predict the change in shoreline width and beach profile resulting from extreme wave run-up, sea level rise, erosion, accretion and longshore transport of sand by wave action, where sand source is from river runoff or from tidal exchange at lagoon and bay inlets (e.g., Jenkins and Inman, 1999). More recently it has been used to compute the sand level change (Farfield Effect) in the prediction of mine burial (Jenkins and Inman, 2002; Inman and Jenkins, 2002). Time-splitting logic and feedback loops for climate cycles and sea level change were added to the LCM together with long run time capability to give numerically stable long term predictions.

5.2: Computational Approach: The presently adopted procedure for wave run-up analysis for the design of coastal structures, (as set forth in the *U.S. Army Corps of Engineers Coastal Engineering Manual* (USACE, 2006), and its software counterpart, the *Automated Coastal Engineering System*, known as *ACES*), is based on the assumption of rigid boundaries. The Coastal Evolution Model described in Section 3.1 is utilized for this analysis and employs algorithms consistent with the U.S. Army Corps of Engineers Coastal Engineering Manual, but employs the

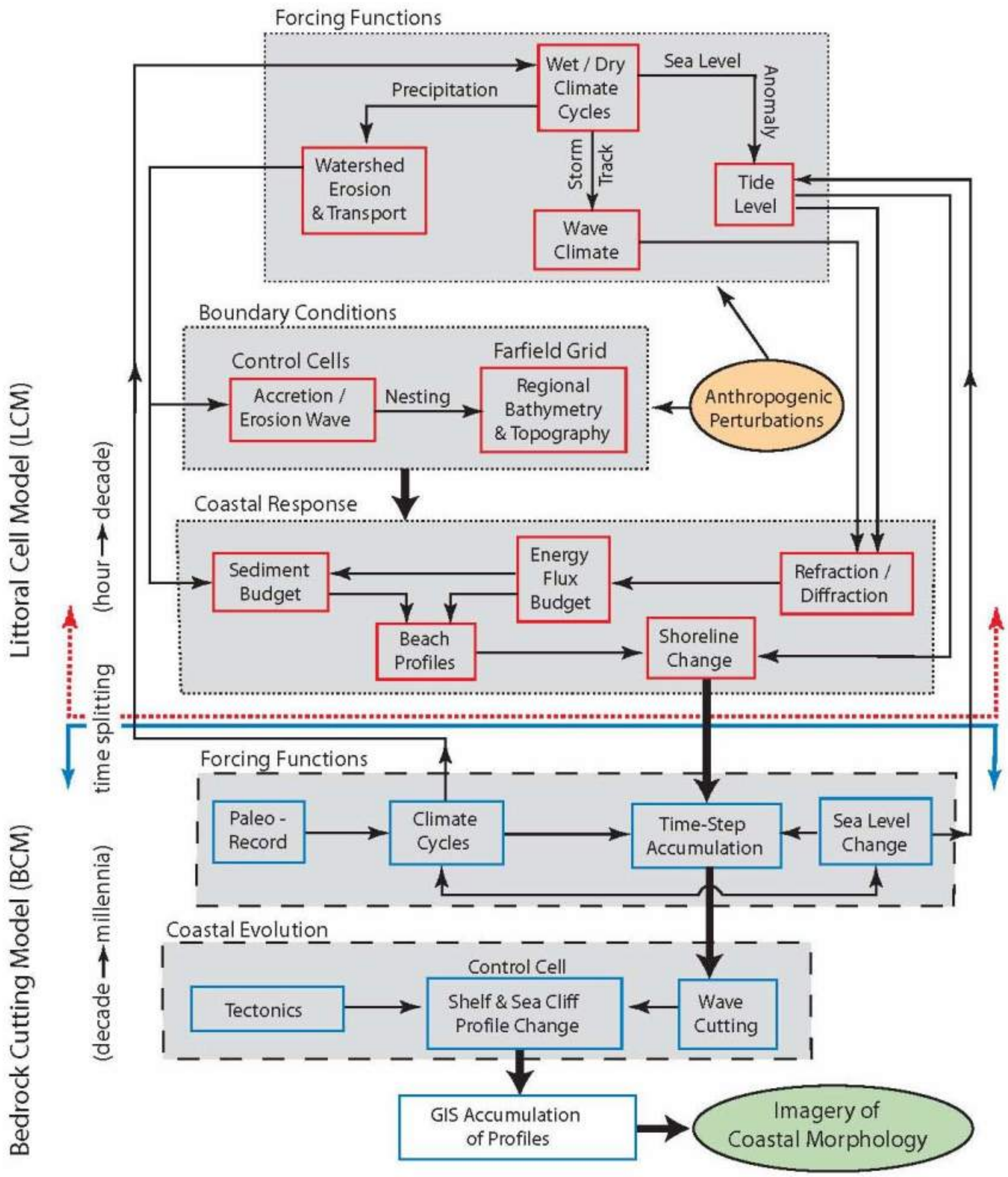


Figure 5.1: Architecture of the Coastal Evolution Model consisting of the Littoral Cell Model (above) and the Bedrock Cutting Model (below). Modules (shaded) are formed of coupled primitive process models. (Jenkins and Wasyl, 2005).

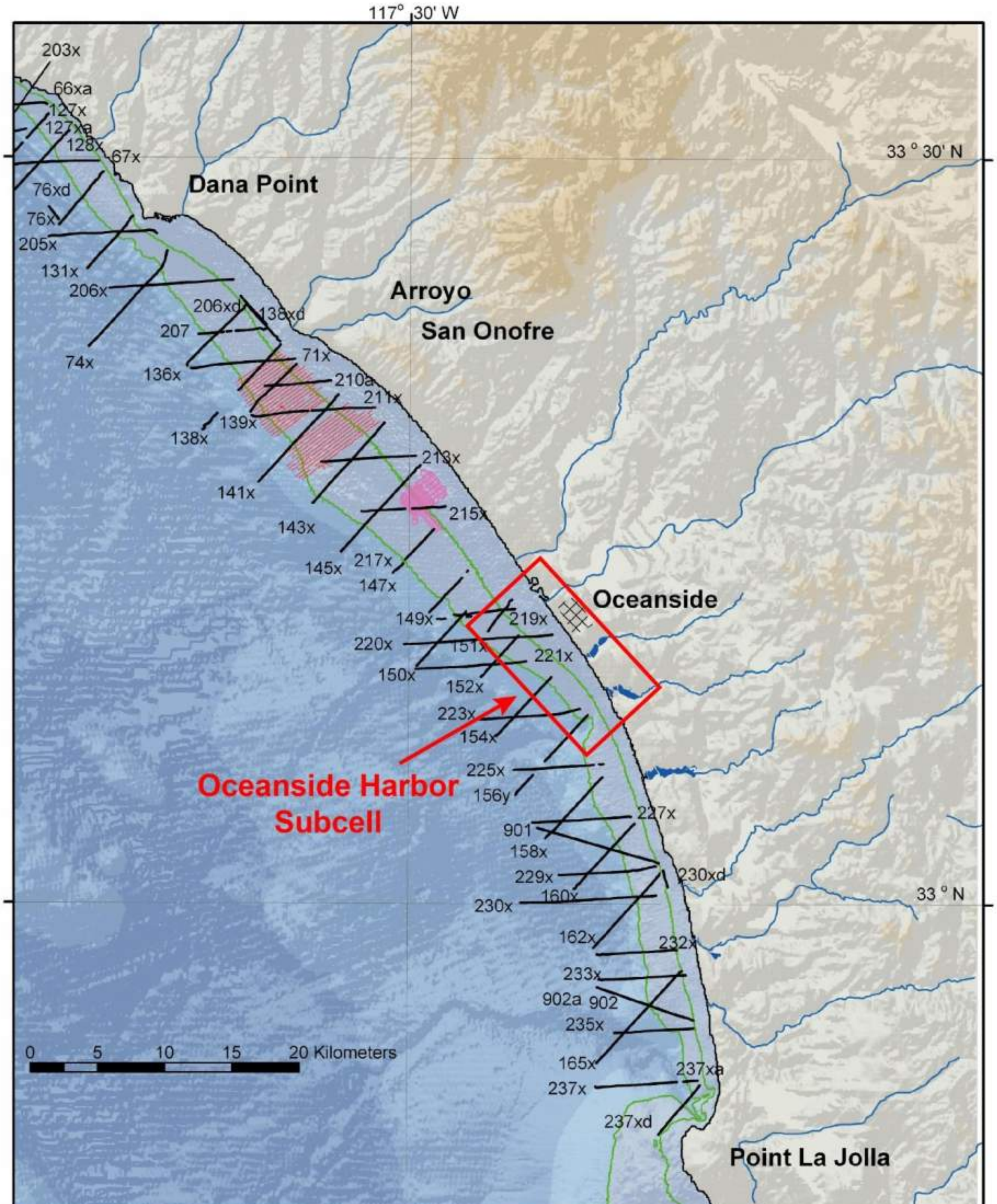


Figure 5.2: Oceanside Littoral Cell and Oceanside Harbor Sub-Cell. Composite bathymetry from NOS data base and equilibrium profiles after Jenkins and Inman (2006) for wave conditions of wet weather scenario. Depth contours shown in meters mean sea level. USGS cross-shelf survey tracks shown as numbered black line segments.

add-on features of latest generation equilibrium beach profile algorithms from Jenkins and Inman (2006) and supporting bathymetric data bases for the entire shore and continental shelf of California.

5.3) Wave Setup and Run-up: Wave setup is an increased elevation of the water level due to the effects of wave momentum being transferred to the surf zone. In wave systems composed of more than one wave component, as occurs in the Pacific Ocean, the setup oscillates and comprises a static and a dynamic component. Wave runup is the culmination of the wave breaking process, whereby the wave surges up the beach, bluff, or structure face along the shoreline. Overtopping occurs when the wave runup exceeds the profile crest elevation, which can result in flooding landward of the crest. Runup is a function of several key parameters. These include the wave height, H the wave period, T, the wave length, L, the profile slope, m, and the surf similarity parameter (Iribarren number), ξ defined as: $\xi = m/\sqrt{H/L}$. The total water level (TWL) is defined as the sum of the total runup and the SWL, referenced to an established vertical datum. The results for this study are referenced to the North American Vertical Datum of 1988 (NAVD88) vertical datum. The total runup, R, is composed of three main components: Static wave setup, $<\eta>$, Dynamic wave setup, η_{rms}; Incident wave runup, R_{inc}.

Wave setup and runup are typically computed at hourly time steps from an historic record of wave monitoring, (see Section 6.0). Wave setup and runup are combined with still water level values (from hydroperiod functions, see Jenkins, 2015) to develop the TWL values. It should be noted that the increase in sea level for future scenarios should be added to each hourly SWL over the 32-year wave record (see Section 4.2) for the analysis of TWLs, with the 1-percent-annual-chance results derived statistically from the resultant 32 annual maxima as explained in Section 2.6.

Annual maxima TWLs are computed for each sea level rise (SLR) scenario, and a statistical Generalized Extreme Value (GEV) analysis is performed on these values to determine the 1-percent-annual-chance TWL for two example problems. The overtopping rate is calculated for instances where the TWL exceeded the engineered barrier crest and overtopping occurred. Each step used to evaluate hazards is described in detail in the following subsections.

Both static and dynamic components of wave setup were calculated using the Direct Integration Method (DIM) which uses a parameterized set of equations that consider wave and bathymetric characteristics, specifically the shape of the wave energy spectrum and the nearshore shorerise and bar-berm beach slope (m_{DIM}). The wave setup equations include factors for wave height (F_H and G_H), wave period (F_T and G_T), JONSWAP spectral narrowness factor (F_{Gamma} and G_{Gamma}), and nearshore slope (F_{Slope} and G_{Slope}).

Static wave setup is calculated as:

$$<\eta> = 4.0 F_H F_T F_{Gamma} F_{Slope} = 4.0 \left(\frac{H_0'}{26.2} \right)^{0.8} \left(\frac{T_P}{20.0} \right)^{0.4} \left(\frac{m_{DIM}}{0.01} \right)^{0.2} \qquad (6)$$

Dynamic wave setup is calculated as:

$$\eta_{rms} = 4.0 G_H G_T G_{Gamma} G_{Slope} = 4.0 \left(\frac{H_0'}{26.2} \right)^{0.8} \left(\frac{T_P}{20.0} \right)^{0.4} (Gamma)^{0.16} \left(\frac{m_{DIM}}{0.01} \right)^{0.2} \qquad (7)$$

The wave parameters required as input for DIM are the deepwater equivalent significant wave height, in feet, (H'_0) and the spectral peak wave period (T_P), as well as a measure of the spectral shape (*Gamma*). The spectral peak parameter, *Gamma*, was computed via a polynomial fit between the spectral width parameter ν and *Gamma*, according to:

$$Gamma = 2047\nu^4 - 3083\nu^3 + 1782\nu^2 - 4769.9\nu + 507.1 \qquad (8)$$

Values of are computed directly from the spectral moments ($\beta_0, \beta_1, \beta_2$) based on the Longuet-Higgins (1973) definition of the spectral narrowness:

$$\nu = \left[\frac{\beta_0 \beta_2}{\beta_1} - 1 \right]^{1/2} \qquad (9)$$

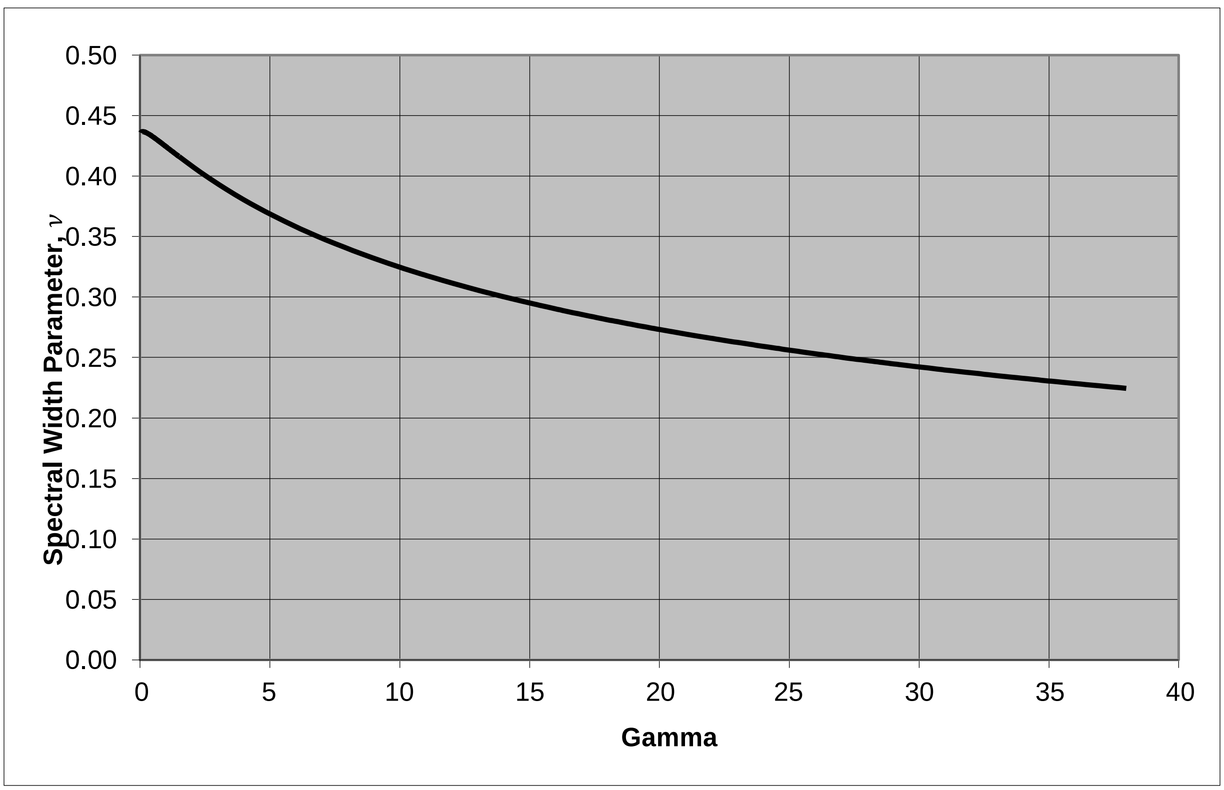


Figure 5.3 *Gamma* values are limited from 1 to 38, based on the range of wave data used (Section 4.4) to relate the spectral narrowness, ν , to the peak parameter, *Gamma*, as shown in Figure 3.3.

The deepwater equivalent significant wave height, H'_0, and the peak wave period, T_P, are provided as output from the CDIP wave monitoring data (CDIP, 2015) and are input directly into Equations 8 and 9. The nearshore slope, m_{DIM}, is taken from nearshore and beach surveys by Coastal Environments, et al., (2014) that were used to calibrate extreme event computations of profile slope using the elliptic cycloid algorithms of Jenkins and Inman (2006). The slope term, m_{DIM}. Used in the TWL computations is calculated from the average slope between the landward limit of wave runup and the location offshore where the water depth is two times the depth at which the deepwater significant wave height would be subject to depth-limited breaking (van der Meer, 2002). The landward limit of wave runup is calculated iteratively, with the initial approximation being the SWL.

5.4 Wave Runup: Wave runup was calculated using either the DIM or the Technical Advisory Working Group (TAW) method (van der Meer, 2002), depending upon the dynamic water level relative to the toe of the coastal structure and the shoreline (bar-berm) slope, m_{TAW}, calculated iteratively across the surf zone. The DIM is used to calculate runup for transects with natural, gently sloping (m_{DIM} < 0.125) profiles. For shorelines with shore protection structures and steeply sloping ($m_{TAW} \geq 0.125$) natural shorelines where the dynamic water level exceeds the toe of the structure, the TAW method was used to calculate runup. If the dynamic water level does not reach the toe of the structure or bluff face, the DIM is used. The total swash level, including wave setup and incident wave runup, is added to the *still water level* (SWL) to determine the *total water level*, (TWL), see Figure 5.4). Each of these methods is described in detail in the following subsections.

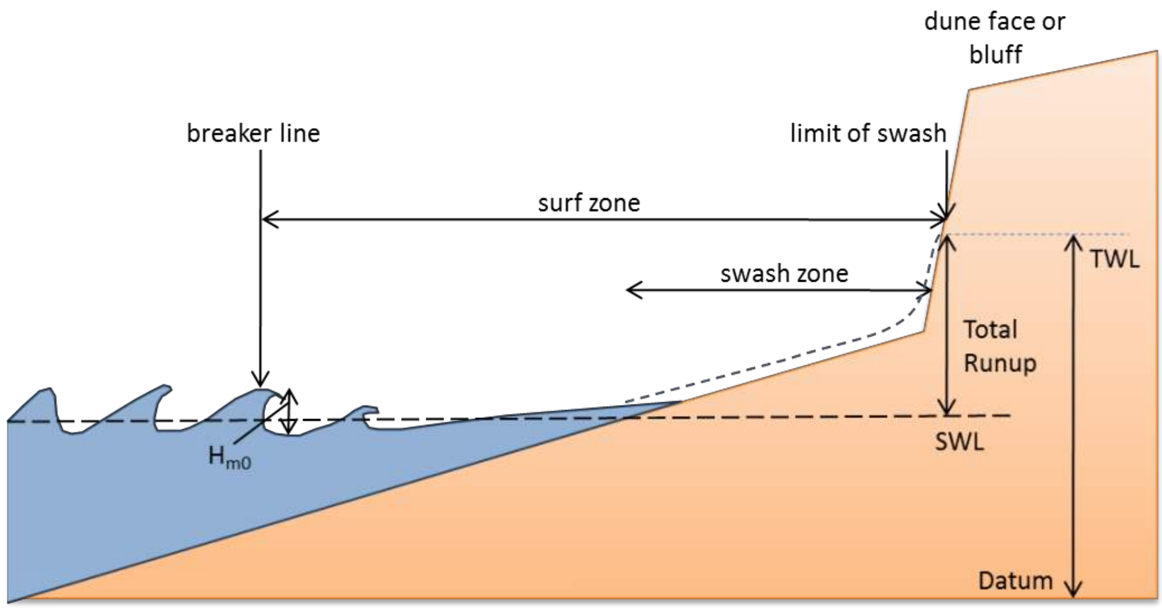


Figure 5.4: Conceptual Model Showing the Components of Wave Runup Associated with Incident Waves.

5.5 DIM Runup Calculations: Runup on gently sloping, natural shorelines, and beaches seaward of a structure or bluff toe, is calculated using the *direct integration method* (DIM). The runup calculation is based on the standard deviations of the oscillating wave setup and the incident wave runup components, and is a continuation of the DIM approach for wave setup. The dynamic setup η_{rms} is defined as the standard deviation of setup fluctuations, calculated from Equation 2. The standard deviation of the incident wave oscillations (wave runup), σ_2 on natural beaches is:

$$\sigma_2 = 0.3\xi_0 H_0' \qquad (10)$$

Where, H'_0 is the deep water significant wave height, m_{DIM} is the nearshore (shorerise) bottom slope, $L_0 = gT_P^2 / 2\pi$ is the deep water wave length, and ξ_0 is the deep water Iribarren number:

$$\xi_0 = \frac{m_{DIM}}{\sqrt{H_0' / L_0}}$$

The oscillating component of the total wave runup or *swash*, $\hat{\eta}_T$, is determined from the combination of the two standard deviations of the fluctuating components:

$$\hat{\eta}_T = 2.0\sqrt{\eta_{rms}^2 + \sigma^2} \qquad (11)$$

Combining the results from Equations 6 & 11 yields the total wave runup, which when superimposed with the SWL yields the total water level, TWL:

$$TWL = <\eta> + \hat{\eta}_T + SWL \qquad (12)$$

Where SWL is the still water level derived from the hydroperiod function given by Jenkins, (2015).

5.6 TAW Runup Calculations: Runup on barriers, including steep (m_{TAW} > 0.125) dune features, bluffs, and coastal armoring structures such as revetments, are calculated using the TAW method (van der Meer, 2002). Wave runup on barriers is a function of the geometry and roughness of the structure, as well as the height and steepness of the incident wave. The TAW method provides a mechanism for calculating wave runup with adjustments made through reduction factors to account for surface roughness and the effects associated with the angle of wave approach.

With the TAW methodology the wave setup component of the TWL is calculated at the toe of the structure, and wave setup landward of the toe of the structure is not included. Wave setup seaward of the toe of the structure is computed with the DIM, using the nearshore slope, m_{DIM} . Wave setup is not included for cases where waves would not have broken prior to reaching the toe of the structure.

The reference water level at the toe of the structure for runup calculations using the TAW method is defined as the 2-percent Dynamic Water Level (DWL2%). The dynamic water level is the sum of the measured SWL, the static wave setup, $\overline{\eta}$, and the dynamic wave setup, η_{rms}. Because DIM provides the static setup at the shoreline and not the barrier toe, and the magnitude of static wave setup varies significantly with depth across the surf zone, from a maximum at the shoreline to approximately zero seaward of the breaking point, a reduction to the static setup component is applied for cases where the barrier toe elevation is inundated by the SWL and the TAW method is used for computing wave runup. The dynamic setup, however, varies insignificantly across the surf zone and requires no adjustment.

This procedure involves computing the static wave setup at the shoreline and at the toe location to determine a static setup reduction factor to be applied to the static wave setup calculated using DIM. The wave setup at the shoreline and toe location and subsequent reduction factor are based on the root mean square of the breaking significant wave height $\left(H_b\right)_{rms}$, and the depth at the toe of the barrier relative to SWL, h. The $\left(H_b\right)_{rms}$ is determined using the deepwater equivalent significant wave height, H'_0, and the peak wave period, T_P , according to:

$$\left(H_b\right)_{rms} = 0.714\left(\frac{\kappa}{g}\right)^{1/5}\left(\frac{H_0'^2 C_0}{2}\right)^{2/5} \qquad (13)$$

Where κ is the breaker criterion equal to 0.78 and C_0 is the deepwater wave celerity, $C_0 = L_0 / T_P$. The static wave setup at the SWL shoreline is:

$$\overline{\eta}_0 = 0.189\left(H_b\right)_{rms} \qquad (14)$$

And the static wave setup at the toe of the engineered barrier is:

$$\overline{\eta}(h) = 0.189\left(H_b\right)_{rms} - 0.186h \qquad (15)$$

The static wave setup reduction factor, γ_η is then a ratio of the static wave setup at the toe to the static wave setup at the SWL shoreline, or:

$$\gamma_\eta = \frac{\overline{\eta}(h)}{\overline{\eta}_0} \qquad (16)$$

This reduction factor is then applied to the DIM static wave setup to compute a depth-adjusted static wave setup at the toe of the engineered barrier,

$$\overline{\eta}' = \gamma_\eta \overline{\eta} \tag{17}$$

The 2-percent Dynamic Water Level ($DWL_{2\%}$) is thus calculated as:

$$DWL_{2\%} = \overline{\eta}' + 2\eta_{rms} + SWL \tag{18}$$

The next step is to compute the wave height at the toe of the barrier and the resultant wave runup on the barrier. Let H_{m0} represent the spectral significant wave height at the toe of the structure. If the $DWL_{2\%}$ depth at the structure toe is found to be too shallow to support the calculated wave height, the wave was assumed to be depth-limited and the incident wave height was calculated using a breaker index of 0.78, whence $H_{m0} = 0.78\ h_{toe}$. The average slope for use in the TAW methodology, m_{TAW}, is calculated iteratively across the surf zone between the still water line minus $1.5H_{m0}$ and the runup limit. The lower slope point must never be below the toe, however, even if SWL - $1.5H_{m0}$ falls below the toe (van der Meer, 2014). In these cases, the lower slope point is set at the toe. Since the runup limit is initially unknown, the still water level plus $1.5H_{m0}$ is chosen as a first estimate (Figure 5.5). If the runup limit exceeded the selected crest, the runup limit was set at the crest. The general formula of TAW for calculating the 2-percent wave runup on barriers is

$$R_{2\%} = 1.77 H_{m0}\, \gamma_r \gamma_b \gamma_\beta\, \xi_{0m} \qquad \text{if: } 0.5 \le \gamma_\beta\, \xi_{0m} < 1.8$$

or:

$$R_{2\%} = H_{m0}\, \gamma_r \gamma_b \gamma_\beta \left(4.3 - \frac{1.6}{\sqrt{\xi_{0m}}} \right) \qquad \text{if: } 1.8 \le \gamma_\beta\, \xi_{0m} \tag{14}$$

Where, $R_{2\%} = 2\sigma_2$ is the wave runup height exceeded by 2 percent of the incoming waves; H_{m0} is the spectral significant wave height at the structure toe; γ_r is the influence coefficient for roughness element of slope; γ_b is the influence coefficient for a berm; γ_β is the influence coefficient for oblique wave attack; $\xi_{0m} = m_{TAW} / \left(H_{m0} / L_m\right)^{0.5}$ is the Iribarren number based on wave parameters at the toe of the structure. Influence factors for roughness, the presence of a berm, and oblique wave attack are selected according to Table D.4.5-3 in the Final Draft *Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States* (FEMA, 2005), hereafter referred to as the Pacific Guidelines. The roughness reduction factor is set to 1.0 for a smooth concrete seawall or sheet pile barrier.

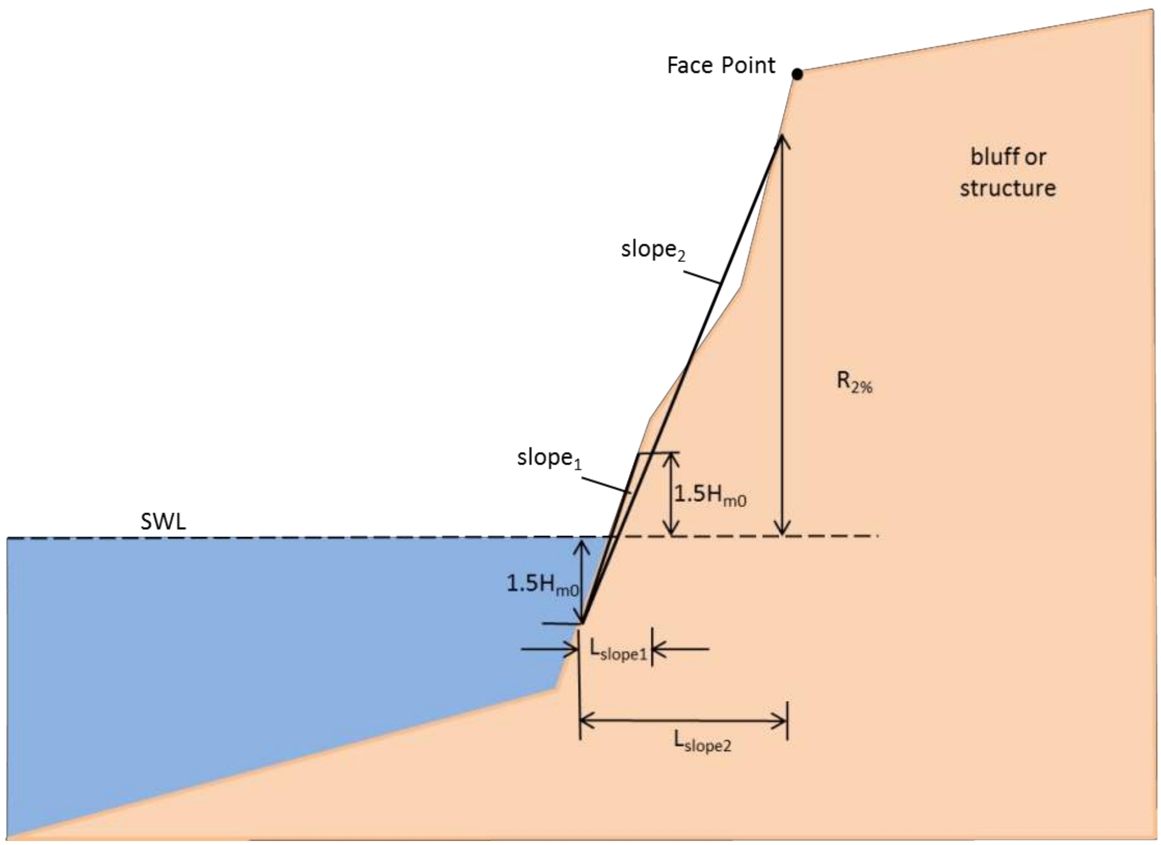


Figure 5.5: Determination of an Average Slope of Hard Back-Shore Formations (Bluff or Barriers) Based on an Iterative Approach, (Corrected from van der Meer, 2002)

The influence factor for oblique wave attack is calculated at each time step in the CDIP wave record (see Section 6). The spectral significant wave height H_{m0} is shoaled and refracted from a deep water point to the structure toe. The wave direction at the toe is compared to the transect orientation, perpendicular to the shoreline, to determine the angle of wave attack. For cases in which waves break seaward of the structure toe, the wave direction is taken from the point of breaking; i.e., where the incident wave height at the toe is depth-limited and calculated using a breaker index of 0.78, whence: $H_{m0} = 0.78\, h_{toe}$.

Incident wave runup, $R_{2\%} = 2\sigma_2$ is then statistically combined with the reduced dynamic wave setup as with the application of DIM, and added to SWL and static wave setup to yield the total water level, TWL, or:

$$TWL = SWL + \overline{\eta}' + 2.0\sqrt{\eta_{rms}^2 + \left(\frac{R_{2\%}}{2}\right)^2} \qquad (15)$$

For non-vertical structures with slopes greater than 1:1, the TAW manual after van der Meer (2002) suggests using the TAW method with an additional vertical wall reduction factor, γ_v, to account for runup on very steep (but not vertical) slopes. With steep slopes, the Iribarren number $\xi_{0m} = m_{TAW} / (H_{m0} / L_m)^{0.5}$ becomes large which means that the waves will not break. To keep the relationship between the type of breaking and the Iribarren number, the vertical wall must be schematized as a 1:1 slope. Therefore, the barrier slope was set to 1:1 for the Iribarren number calculation, and a vertical wall reduction factor for steep slopes was applied:

$$\gamma_v = 1.35 - 0.0078 \tan^{-1} m_{face} \tag{16}$$

where the face slope, m_{face} measured between the selected toe and face locations, is the angle of the actual slope in degrees (van der Meer, 2002). While this approach is based on work done for vertical walls atop dikes, sensitivity testing showed that it compared well with the TAW method and the Shore Protection Method (SPM) (USACE, 1984) for vertical walls as an intermediate approach to calculating runup on steep slopes. The use of this vertical wall reduction factor accounts for wave reflection expected on slopes greater than 45 degrees, and this approach generates results that fall between those for a 45- degree slope and those for a vertical wall.

Wave overtopping occurs when a potential runup elevation exceeds a structure's profile crest elevation. When wave runup is shown to exceed the barrier crest, the severity of wave overtopping is evaluated based on the mean overtopping rate, *q*. The required input parameters for computing the mean overtopping discharge are the wave height and freeboard, defined as the difference between the DWL2% and the structure crest. The 1-percent-annual- chance TWL available from the wave runup and extreme value analyses is a statistical value and is not associated with either a specific wave height or DWL2%. Therefore, the maximum wave height at the structure toe and the maximum and average DWL2% associated with the 32 annual maximum TWLs were chosen for use with the 1-percent TWL to estimate the 1-percent overtopping hazard.

Mean overtopping rates, *q*, were computed following Table VI-5-8 in the Coastal Engineering Manual (USACE, 2006) which presents an overtopping formula for impermeable and permeable barriers and structures according to:

$$Q' = a\, gH_s T_{om} \exp\left(-\frac{bR_c}{H_s \gamma_r} \sqrt{\frac{s_{om}}{2\pi}} \right) \tag{17}$$

Where H_s, is the significant wave height at the structure, R_c is the freeboard, γ_r is the influence factor for surface roughness, T_{om} is the wave period associated with the spectral peak in deep water, s_{om} is the wave steepness associated with the spectral peak in deep water, and a and b are empirical constants based on beach slope and berm width as determined from measured beach profiles plotted in Section 6.4. To conservatively maximize the overtopping potential, H_s and R_c are selected as the maximum wave height at the structure and the minimum freeboard between the highest DWL2% and the barrier crest elevation.

5.7) Beach Profile Calculations: A critical set of inputs to the wave setup, total runup and total water level (TWL) computations are the profile slope terms, m_{DIM} , m_{TAW} , and m_{face} . These are calculated from the beach and shore rise profiles during extremal wave events. Since there are only a limited set of beach profile measurements at Doheny State Beach, (and virtually none of these measurements have been performed during extremal wave events), the beach profile and its slope must be represented by model calculations that have been calibrated using the available set of beach profile measurements. Beach profile measurements at Doheny State Beach have been conducted by the US Army Corps of Engineers, USACOE (1991), Coastal Environments, (2014), and Coastal Frontiers (2014).

It is well known that beach and nearshore bottom profiles change seasonally in response to seasonal wave climate variations as shown in Figure 5.6, (cf: Inman et al, 1993; Jenkins and Inman 2006); and that seasonal transitions between summer and winter equilibrium states cause seasonal changes in the mean shoreline (Equation 7).

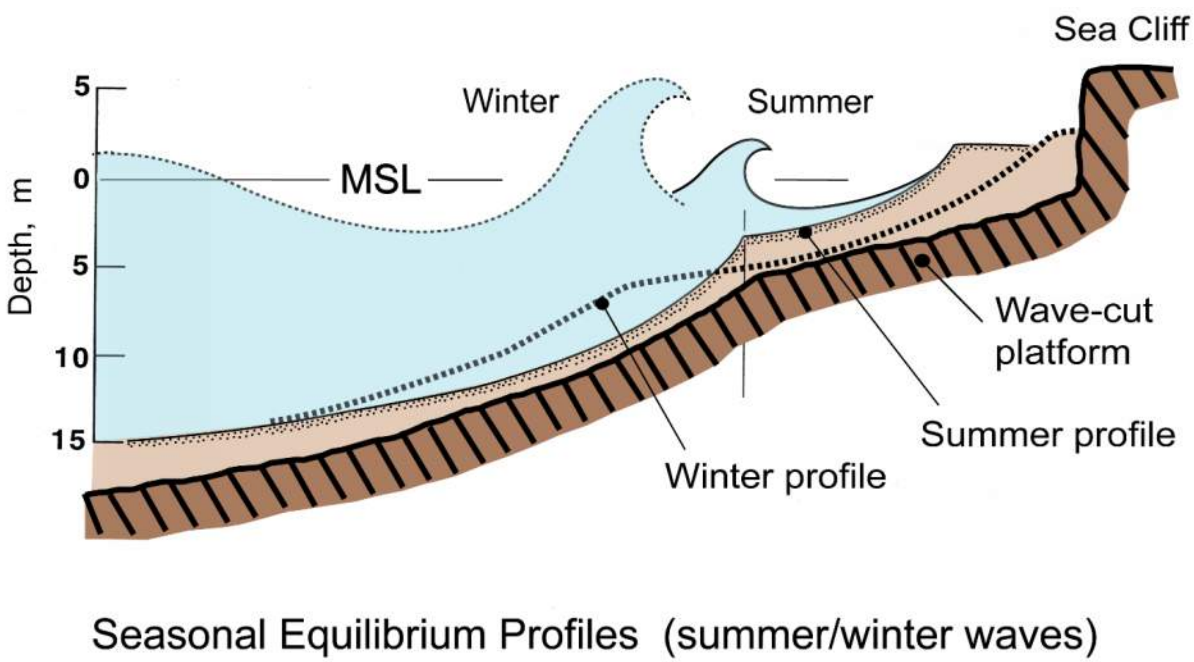


Figure 5.6: Schematic of summer and winter equilibrium beach profiles, from Inman, et al (1993).

Short period waves during summer (from the spin up of winds from the local North Pacific High) cause the inner bar-berm section of the beach profile to build up and steepen; while long period storm swells during winter from the Aleutian low cause the bar-berm profile to flatten, and transfer beach sand to the outer shore-rise profile. These changes between summer and winter equilibrium states are predicted from the long-term wave record (Section 6) applied to the well-tested elliptic cycloid solutions after Jenkins and Inman (2006). The elliptic cycloid represents the equilibrium beach profile with a curve that is traced out by following a point on the circumference of a rolling ellipse (Figure 5.7)

The elliptic cycloid solutions were developed for beach profiles by Jenkins and Inman, (2006) using equilibrium principles of thermodynamics applied to very simply representations of the nearshore fluid dynamics. Equilibrium beaches are posed as isothermal shorezone systems of constant volume that dissipate external work by incident waves into heat given up to the surroundings. By the maximum entropy production formulation of the second law of thermodynamics (the law of entropy increase), the shorezone system achieves equilibrium with profile shapes that maximize the rate of dissipative work performed by wave-induced shear stresses. Dissipative work is assigned to two different shear stress mechanisms prevailing in separate regions of the shorezone system, an outer solution referred to as the *shorerise* and a *bar-berm* inner solution (Figure 5.7a). The equilibrium shorerise solution extends from closure depth (zero profile change) to the breakpoint, and maximizes dissipation due to the rate of working by bottom friction. In contrast, the equilibrium bar-berm solution between the breakpoint and the berm crest maximizes dissipation due to work by internal stresses of a turbulent surf zone. Both shorerise and bar-berm equilibria were found to have an exact general solution belonging to the class of elliptic cycloids.

The elliptic cycloid solution is a curve allows all the significant features of the equilibrium profile to be characterized by the eccentricity and the size of one of the two ellipse axes. These two basic ellipse parameters are related herein to both process-based algorithms and to empirically based parameters for which an extensive literature already exists. The elliptic cycloid solutions reproduce realistic and validated wave height, period and grain size dependence and demonstrated generally good predictive skill in point-by-point comparisons with measured profiles (Jenkins and Inman, 2006 display).

To understand the formulation of the elliptic cycloid representation of the nearshore bottom profile and sensitivity to ocean conditions, we first review the nomenclature of the shorezone as shown schematically in Figure 5.7a. The seaward boundary of the shorezone is a vertical plane at the critical closure depth $\hat{h}_c$ (Figure 8a) corresponding to the maximum incident wave [e.g., *Kraus and Harikai*, 1983]. The landward boundary is a vertical plane at the berm crest (cross), a distance $\hat{X}_1$ from a bench mark. The cross-shore length of the system from the berm crest to closure depth is $\hat{X}_c$. The distance from the point of wave breaking to closure depth is $\hat{X}_{c2}$ such that $\hat{X}_c = \hat{X}_{c2} + \hat{X}_2$, where $\hat{X}_2$ is the distance from the berm crest to the origin of the shorerise profile near the wave breakpoint.

We consider equilibrium over time scales that are long compared with a tidal cycle and profiles that remain in the wave dominated regime where the relative tidal range (tidal range/H) < 3 [*Short*, 1999]. Under these conditions, the curvilinear solution to the bottom profile which satisfies the maximum entropy production formulation of the *Second Law of Thermodynamics* can be expressed in polar coordinates (r, θ) as:

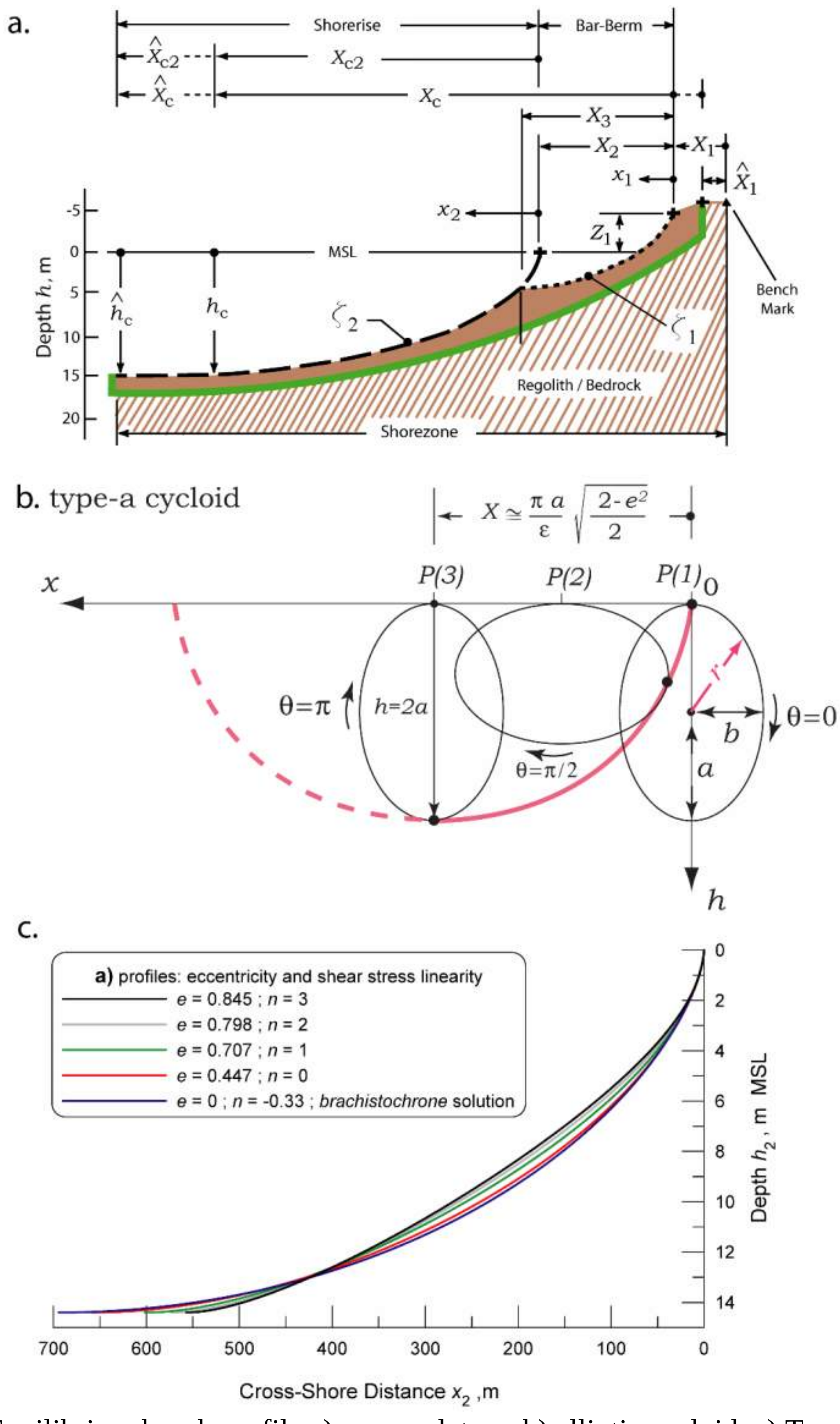


Figure 5.7. Equilibrium beach profile a) nomenclature, b) elliptic cycloid, c) Type-a cycloid solution.

$$x = x_2 = \frac{2r\, I_{\mathrm{e}}^{(k_{1,2})}}{\pi\, \varepsilon}\, (\theta - \sin\theta\,) \tag{18}$$

where r is the radius vector measured from the center of an ellipse whose semi-major and semi-minor axes are a, b and $I_{\mathrm{e}}^{(k)}$ is the elliptic integral of the first or second kind. This curve is what a point on the circumference of an ellipse would trace by rolling through some angle θ , (Figure 3.8b); hence the name elliptic cycloid. The polar equivalent of the type-a cycloid shown in Figure 3.8b has a radius vector whose magnitude is:

$$r \;= r_{\mathrm{a}} = \left[\frac{a^2\, b^2}{a^2 \sin^2\theta + b^2 \cos^2\theta} \right]^{1/2} = \frac{a\sqrt{1-e^2}}{\sqrt{\sin^2\theta + (1-e^2)\cos^2\theta}} \tag{19}$$

where e is the eccentricity of the ellipse given by $e = \sqrt{1-(b^2/a^2)}$. The polar form of the type-a cycloid in Figure 5.7b is based on the elliptic integral of the second kind that has an analytic approximation, $I_{\mathrm{e}}^{(2)} = (\pi/2)\sqrt{(2-e^2)/2}$, see *Hodgman* [1947]. The inverse of (18) for the type-a elliptic cycloid gives the companion solution in terms of local water depth, h, as:

$$h = h_2 = \frac{\pi\varepsilon\; x_2}{2 I_e^{(k_{1,2})}} \left(\frac{1-\cos\theta}{\theta - \sin\theta} \right) = r\left(1-\cos\theta\;\right) \tag{20}$$

The depth of water at the seaward end of the profile ($\theta = \pi$) is $h = 2a$ in the case of the type-a cycloid. The length of the profile X is equal to the semi-circumference of the ellipse,

$$X \;= \frac{2aI_{\mathrm{e}}^{(2)}}{\varepsilon} \cong \frac{\pi\; a}{\varepsilon} \sqrt{\frac{2-e^2}{2}} \qquad \text{at} \quad \theta = \pi \quad \text{(type-a cycloid)} \tag{21}$$

With (21) the bottom slope can be solved as:

$$m = \frac{\sin\theta_b + e^2(\cos\theta_b - 1)\sin\theta_b \cos\theta_b}{1 - \cos\theta_b + e^2(\sin\theta_b - \theta_b)\sin\theta_b \cos\theta_b} \tag{22}$$

$$\text{Where: } \theta_b = \arccos\left[1 - 2\left(\frac{H_0'}{\Lambda\gamma\, h_c} \right)^{\alpha} \right] \tag{23}$$

The shoaling factor assumed for these bar-berm solutions ($\Lambda =$ 0.81) was based on uniform shoaling of the incident wave conditions, while a mean value was chosen for gamma ($\gamma\; = 0.8$) from the data reported by *Raubenheimer et al.* [1996]. In equation (23) the term h_{c} is the *closure depth*, which represents the closest point to the shoreline where a stable seabed can be found, because it is the point beyond which all changes in the beach profiles cease. It is calculated from Jenkins and Inman (2006) by the following parametric relation:

$$h_{\mathbf{c}} = \frac{K_{\mathbf{e}} H_{\infty}}{\sinh k h_{\mathbf{c}}} \left(\frac{D_{\mathrm{o}}}{D_{\mathbf{2}}} \right)^{\psi} \tag{24}$$

where K_e and ψ are non-dimensional empirical parameters, D_2 is the shorerise median grain size; and D_o is a reference grain size. With $K_e \sim 2.0, \psi \sim 0.33$ and $D_o \sim 100\mu\text{m}$, the empirical closure depths reported in *Inman et al.* [1993] are reproduced by Figure 5.8. From Figure 5.8 we find closure depth increases with increasing wave height and decreasing grain size, as shown in Figure 3.7. Because of the wave number dependence of (8), closure depth also increases with increasing wave period.

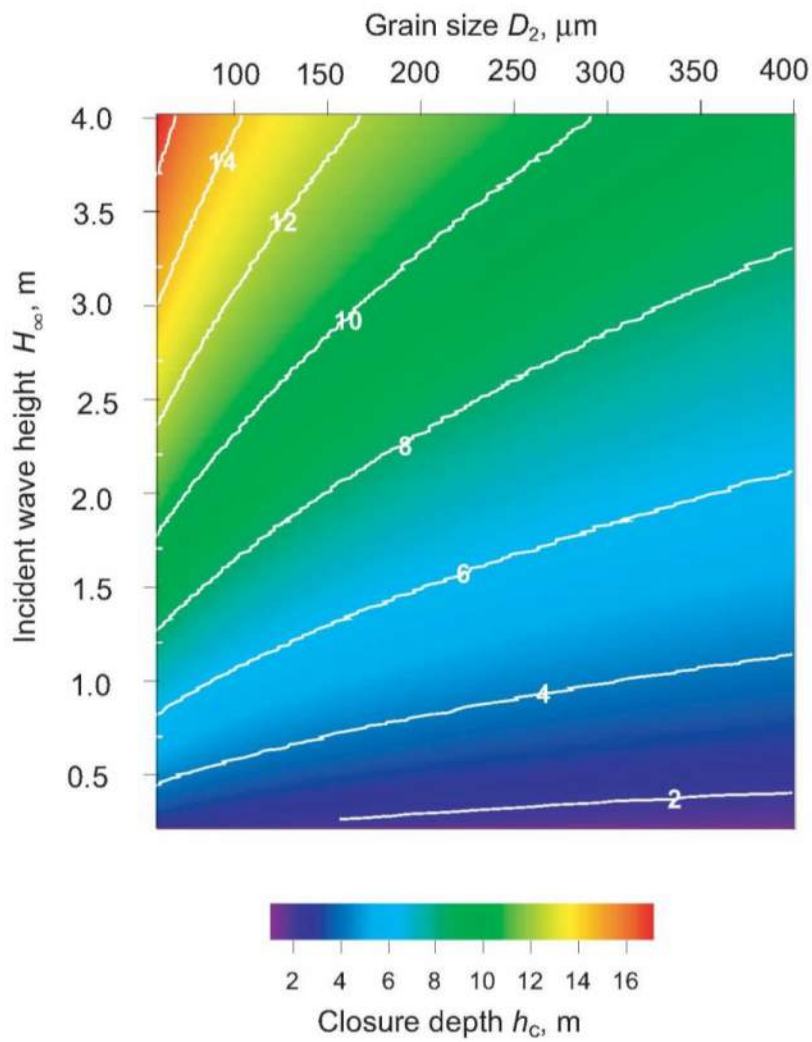


Figure 5.8: Closure depth contoured versus incident wave height and sediment grain size for waves of 15 second period, with $K_e \sim 2.0, \psi \sim 0.33$ and $D_o \sim 100\mu\text{m}$. D_2 is the shorerise median grain size; and D_o is a reference grain size.

6) Model Initialization:

This section develops the data bases necessary to evaluate Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2.

6.1) Bathymetry: Bathymetry provides a controlling influence on all of the coastal processes that affect dispersion and dilution. The bathymetry consists of two parts: 1) a stationary component in the offshore where depths are roughly invariant over time; and 2) a non-stationary component in the nearshore where depth variations do occur over time. The stationary bathymetry generally prevails at depths that exceed closure depth which is the depth at which net on/offshore transport vanishes. Closure depth is typically -12 m to -15 m MSL in the Oceanside Littoral Cell, (Inman et al. 1993). The stationary bathymetry was derived from the National Ocean Survey (NOS) digital database. Gridding is by latitude and longitude with a 1 x 1 arc second grid cell resolution yielding a computational domain of 30.9 km x 18.5 km. Grid cell dimensions along the x-axis (longitude) are 25.7 meters and 30.9 meters along the y-axis (latitude).

For the non-stationary bathymetry data inshore of closure depth (less than -15 m MSL) nearshore and beach surveys were conducted by the US Army Corps of Engineers in 1985, 1990, 1996, 2001 and have been compiled in USACE (2001). These nearshore and beach survey data were used to update the NOS database for contemporary nearshore and shoreline changes that have occurred following the most recent NOS surveys.

To perform both the required wave shoaling and transport computations in the farfield of the SJCOO outfall diffusers, a large-domain grid is required to compute the effects of island sheltering and regional scale refraction and circulation due to the shallow banks of the continental margin (Figure 6.1). A nearfield grid (Figure 6.2) in the immediate neighborhood of the diffuser is nested inside the farfield grid and is used to calculate the brine discharge dilution and dispersion.

6.2 Shore-side Structures: Wave runup, and overtopping were analyzed at the shore-side facilities associated with the Doheny Desalination Project assuming present conditions and two future scenarios including sea level rise. These facilities included: ***Well Head A***, elevation 17 ft.NAVD, at 33°27'44.38"N, 117°41'16.32"W; ***Well Head B***, elevation 17 ft. NAVD, at 33°27'45.07"N, 117°41'10.30"W; ***Well Head C***, elevation 17 ft. NAVD at 33°27'45.12"N, 117°41'6.62"W; ***Well Head D***, at elevation 18 ft. NAVD at 33°27'44.48"N, 117°40'55.30"W; and ***Well Head E***, at elevation 18 ft. NAVD at 33°27'42.45"N, 117°40'47.33"W; (see Figure 6.3a). Two additional vaulted well heads with submersible pumps will be placed at the Capistrano Beach site (Figure 6.3b), which includes: ***Well Head G***, at elevation 18 ft. NAVD at 33°27'14.94"N, 117°39'59.91"W; and ***Well Head H***, at elevation 19 ft. NAVD at 33°27'13.17"N, 117°39'57.15"W.

6.3) Wave Forcing: Waves in deep water generally do not cause significant mixing. But shoaling waves produces bottom currents (referred to as *bottom wind*), cause scrubbing action against intake and discharge structures that result in vertical mixing of the nearfield water mass, and cause longshore and rip current circulation as a result of along shore variation in shoaling wave heights due to refraction over shelf bathymetry.

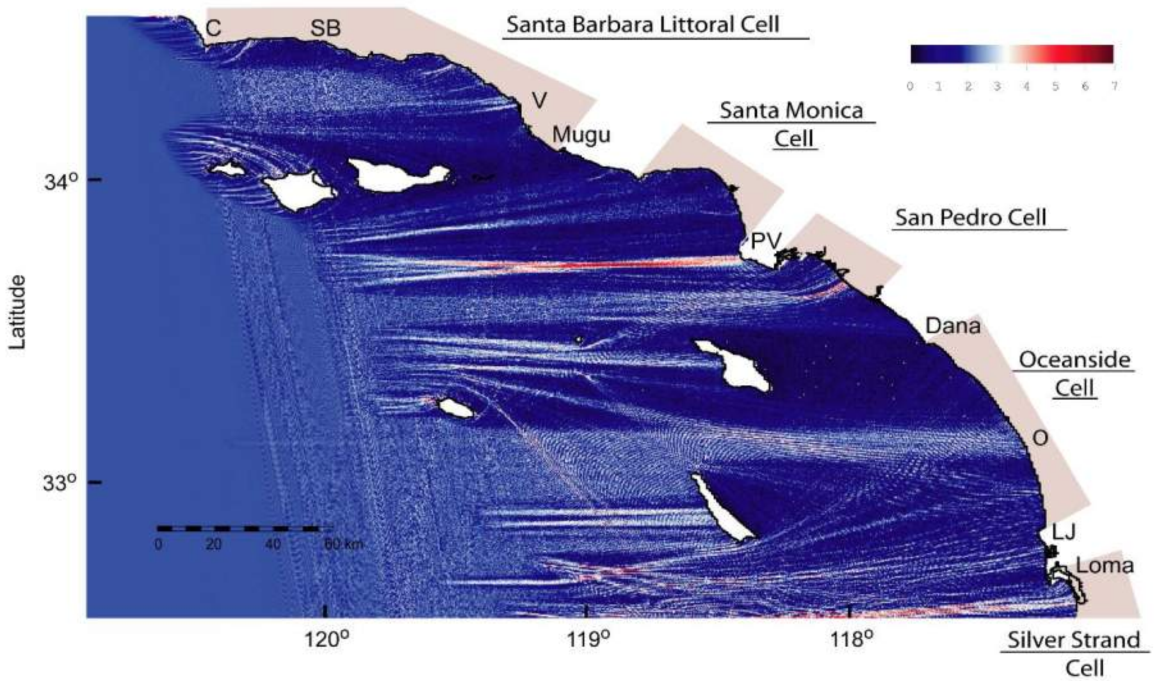
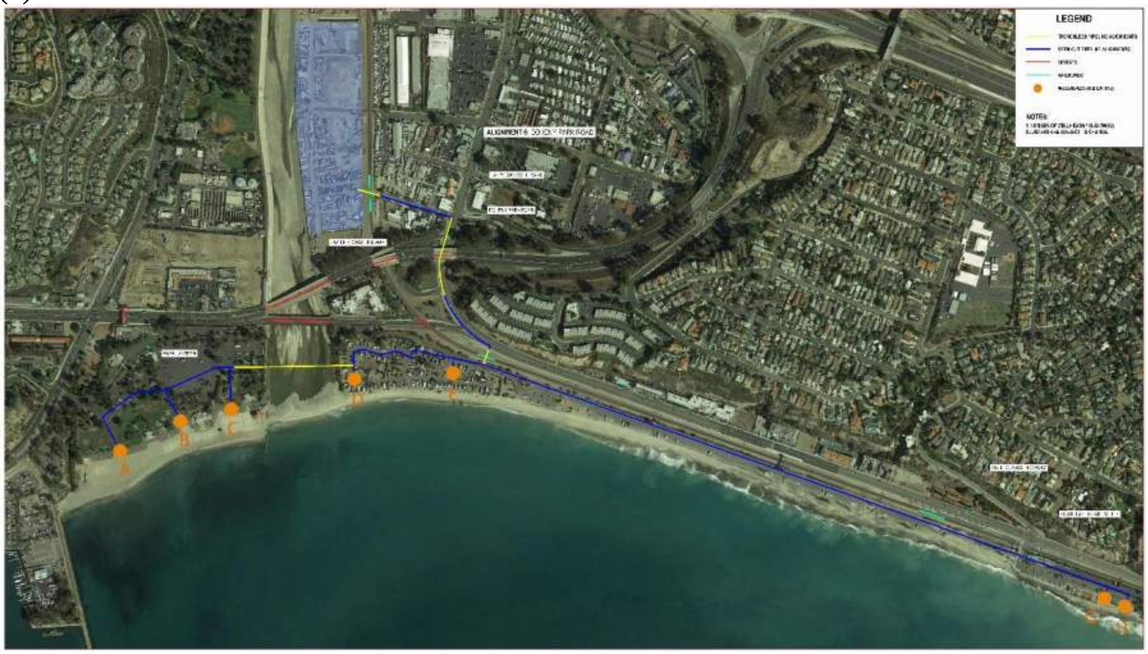


Figure 6.1: Far-field refraction/diffraction grid to simulate shoaling waves entering the Southern California Bight and Oceanside Littoral Cell. Results based on the 5 largest storms of the 1998 El Nino winter (from Jenkins and Wasyl, 2008b).

Figure 6.2: Near-field refraction/diffraction grid to simulate shoaling waves in the immediate neighborhood of Dana Point, SJCOO and Doheny Beach.

(a)



(b)

Figure 6.3: Critical shore-front infrastructure locations for the Doheny Desalination Project: a) Doheny Beach site; and b) Capistrano Beach site

Wave forcing to the Coastal Evolution Model (CEM) were derived from archival measurements of waves for the period 1980-2010, supplemented by wave burst measurements from the Acoustic Doppler Current Profiler (ADCP) measurements taken under the MBC *Applied Environmental Sciences* (MBC) marine environment studies. The archival wave records were obtained from the Oceanside, Dana Point, San Clemente, and Huntington Beach monitoring stations maintained by the Coastal Data Information Program, [CDIP, 2012, http://cdip.ucsd.edu]. To correct the archival data from widely spaced offshore monitoring sites to the nearshore of the SJCOO, raw data were entered into a refraction/diffraction numerical code, back-refracted out into deep water to remove local refraction and island sheltering effects, and subsequently forward refracted into the immediate neighborhood of the proposed Project. The backward and forward refractions of CDIP data were done using a numerical refraction-diffraction computer code called OCEANRDS. The primitive equations for this code are lengthy, but a listing of the codes for OCEANRDS are in Jenkins and Wasyl (2005).

An example of a reconstruction of the wave field throughout the Bight from the CDIP Oceanside buoy data is shown in Figures 6.1 for the 5 largest storms of the 1998 El Nino winter. Wave heights are contoured in meters according to the color bar scale and represent 6 hour averages, not an instantaneous snapshot of the sea surface elevation. Note how the sheltering effects of Catalina and San Clemente Islands have induced considerable variations in the neighborhood of the SJCOO and Dana Point Harbor. The wave height and direction parameters inside the Channel Islands are the values used as the deep water boundary conditions along the seaward face of the nearfield grid for the SJCOO Dana Point shoaling analysis.

Figure 6.4 gives the local forward refraction calculation into the nearfield domain of the SJCOO and the Doheny Desalination Project site (green box), due to the 100-year storm-wave event of 17-18 January 1998 after passing through the gaps in the continental margin and Channel Islands, (island sheltering effects, cf.Figure 6.1). Figure 6.4 gives extremal wave height variations along an 18.5 km section of coastline in the in the Dana Point region, including wave shoaling and reflection effects induced by the Dana Pt Harbor breakwater. Replication of the backward/forward refraction analysis on each of the 3 hour increments of the CDIP monitoring data produced continuous, unbroken records of the wave height, period and direction in the nearfield of the Doheny Desalination Project throughout the 1980-2010 period of record, as shown in Figure 6.5. The data in Figure 6.5 were supplemented by wave burst measurements from the Acoustic Doppler Current Profiler (ADCP) measurements taken at the SJCOO monitoring stations (MBC, 1998). Figure 6.6 gives the wave refraction/diffraction field in the SJCOO/Dana Pt. Harbor Littoral Sub-cell derived from these ADCP wave burst measurements. We find in Figures 6.4 & 6.6 that the refraction effects over local bathymetry create areas (indicated by red) where wave heights increase locally to 4 -5 m. In these areas, the shelf bathymetry has focused the incident wave energy and these regions of intensified wave energy are referred to as “bright spots”. The increased wave heights in these bright spots increases the wave run-up and induces local wave erosion. Conversely, the dark areas in Figures 6.4 & 6.6 (indicated by dark blue) where wave heights have been diminished are termed “shadows,” and represent areas of reduced run up and potential beach accretion For the January 1998 storm in Figure 6.6, the area around the SJCOO discharge site is indeed a bright spot in the local refraction pattern while the slant well sites for the Doheny Desalination Project are located in a shadow zone. Another wave shoaling phenomena at the slant well site is divergence of drift. Wave-driven longshore currents flow away from areas of high waves (away from bright spots) and converge on shadow regions. This convergence of the longshore current leads induces seaward flowing rip currents. Rip currents are advantages to shallow nearshore intake sites

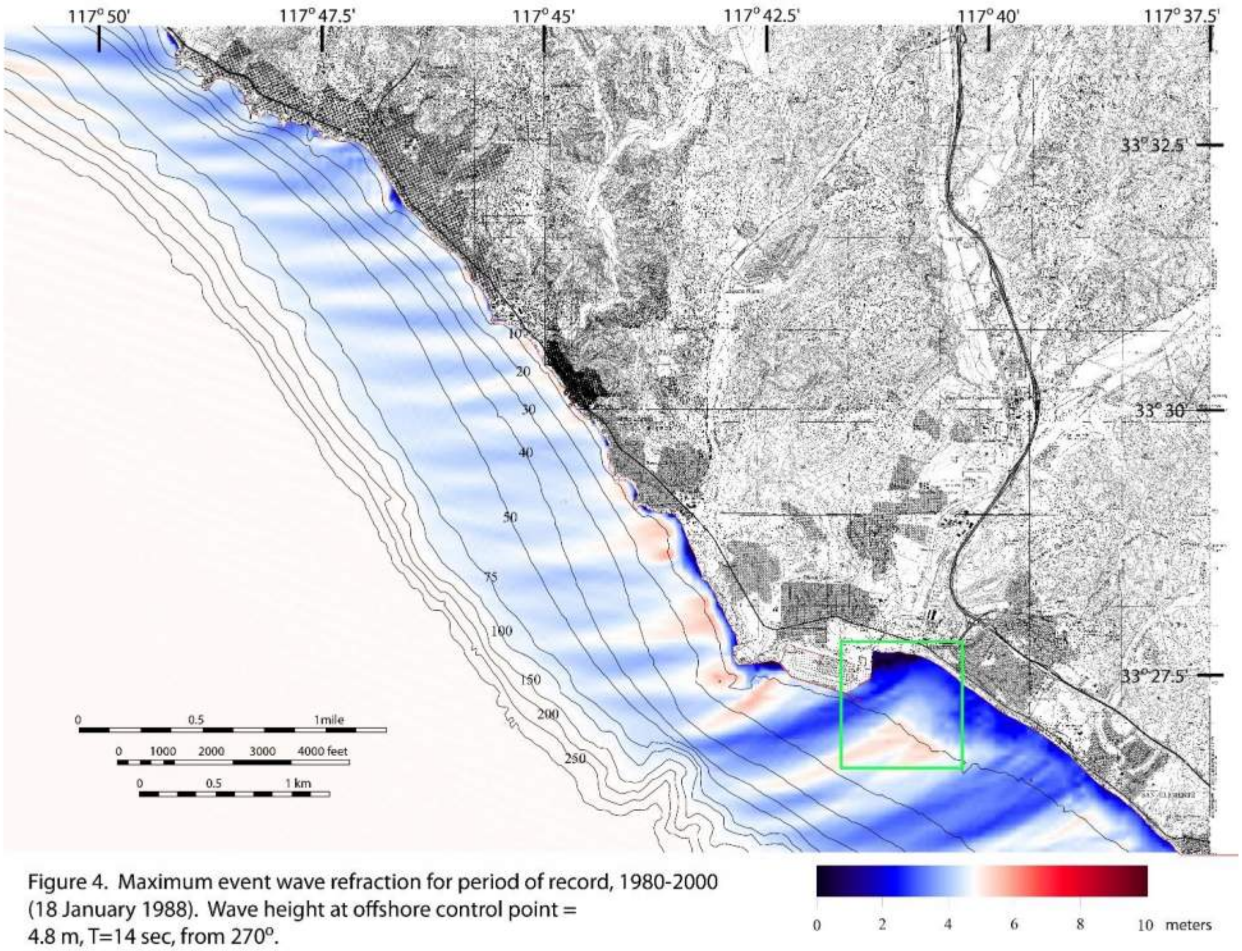


Figure 6.4: Forward wave refraction/diffraction for the 100-year storm-wave event of 17-18 January 1998. These local refraction results are used to provide the point-to-point initializations for the wave setup and runup inputs to the total water level problem. The nearfield domain of the SJCOO and the Doheny Desalination Project is designated by the green box.

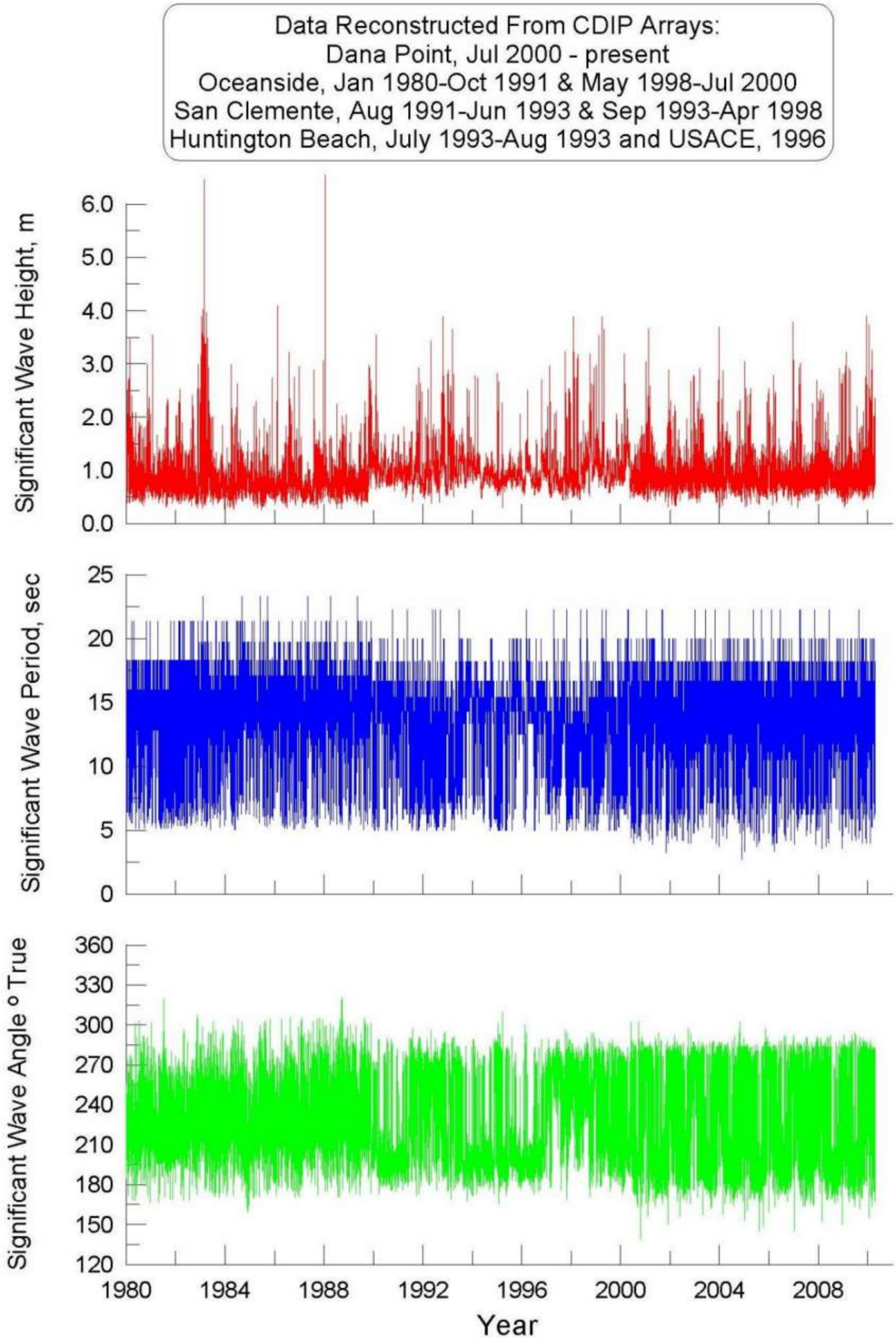


Figure 6.5: Archival wave forcing data 1980-2010 reconstructed for the SJCOO and Doheny Desalination Project modeling, from backward/forward refraction of regional CDIP wave monitoring data.

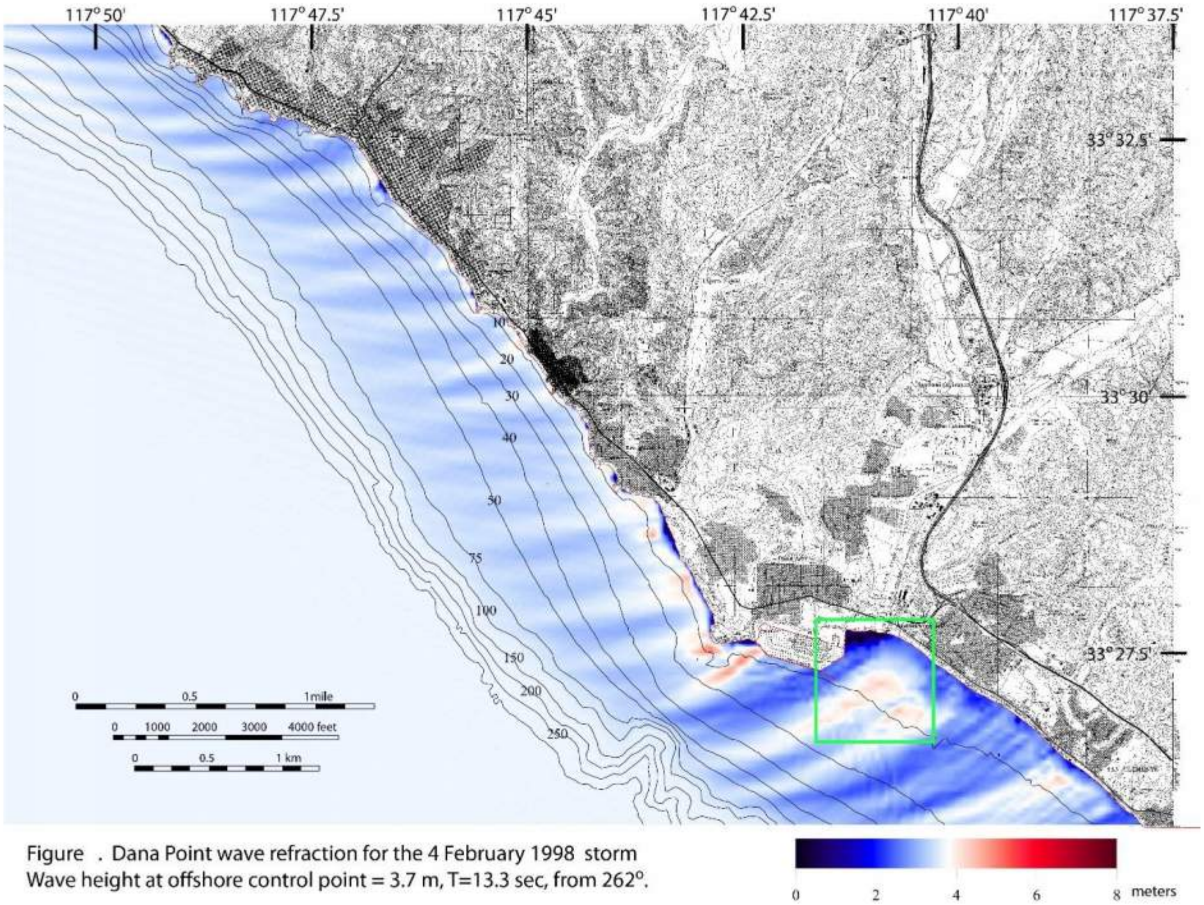


Figure 6.6: Wave refraction/diffraction field around the SJCOO site and the Doheny Desalination Project site derived from wave burst measurements from the Acoustic Doppler Current Profiler (ADCP) records taken under the MBC Applied Environmental Sciences (MBC) NPDES monitoring studies. Nearfield domain of the SJCOO and the Doheny Desalination Project site designated by green box.

because rip currents would advect storm water and urban run-off away from the shoreline and disperse it offshore in deeper water, thereby reducing potential for marine life impacts to nearshore and beach ecology. On the other hand, these same seaward flowing rip currents can also carry beach sand offshore, resulting in local beach erosion. Wave refraction/diffraction analyses of the 15 largest storm events in the 1980-2010 period of record are presented in Appendix-A. The 100 year event (1% event) was the two day storm of 17-18 January, 1988, and refraction/diffraction patterns for both days are also included in Appendix-A.

The composite 30-year wave record obtained from the CDIP archival data for 1980-2010 (Figure 6.5) was iteratively fit to Weibull (Type III) distributions with a range of *K-values* to find the best overall fit (highest correlation coefficient). A *K-value* of K = 1 was found to give an R-squared = 0.98, resulting in the extremal analysis curve shown in Figure 6.7. The red-line in Figure 6.5 is the Weibull Type III best fit and the crosses are the data points at the control point in 12 m water depth from Appendix-A refraction/diffraction analyses used to produce the best fit distribution. The Weibull Type III best fit projects a maximum significant wave height of $H_0' =$ 19.9 ft. with a probability of recurrence of 0.04% (return period = 2,500 yr); but such a wave has never been measured. The highest wave that was recovered from the refraction analysis in 12 m

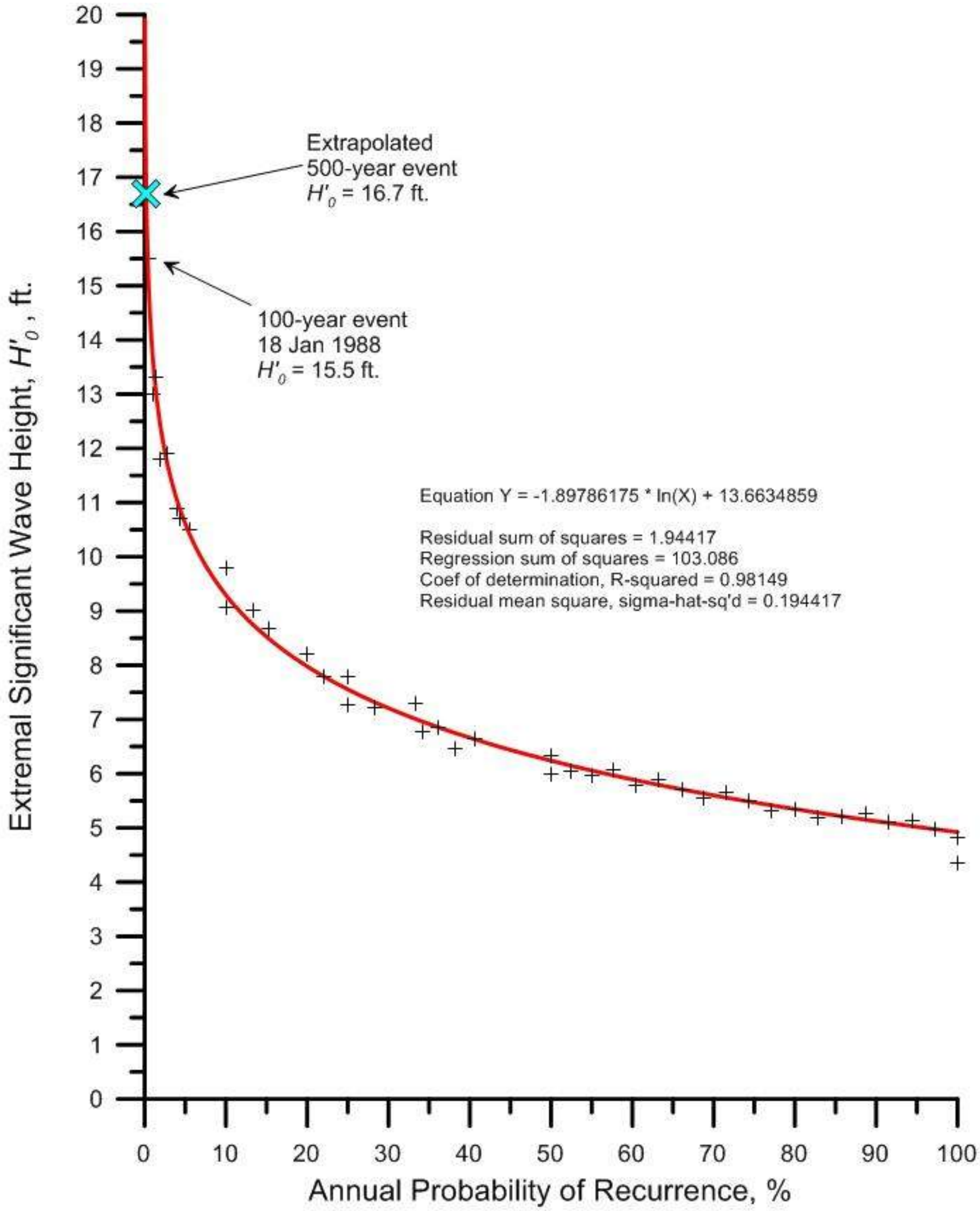


Figure 6.7 : Probability of recurrence of design wave heights based on Weibull extremal analysis of significant wave heights at Doheny & Capistrano Beaches. Analysisbased on Weibull Type III distribution applied to 12 m local water depth with K = 1.0. Recurrence Probability $P(H)$ = 100%/T, where T = return period

of water depth was due to the 18, January, 1988 storm (Figure 6.4) with a significant wave height H_0' = 15.5 ft. and a probability of recurrence of 1.0% (return period = 100 yr). The extremal analysis curve in Figure 6.7 will be the computational basis of the extreme value analysis of wave setup, total runup and total water level (TWL) in Section 7.

6.4) Beach Erosion: Another critical set of inputs to the wave setup, total runup and total water level (TWL) computations are the profile slope terms, m_{DIM}, m_{TAW}, and m_{face}. These are calculated from equations (22) – (24) using measured beach profiles to calibrate the empirical factors in these equations, which include the shoaling factor, Λ, and the non-dimensional empirical parameters: K_e and ψ. Beach profile measurements at Doheny State Beach have been conducted by the US Army Corps of Engineers, USACOE (1991), Coastal Environments, (2014), and Coastal Frontiers (2014). Plots of the beach profiles measured by the US Army Corps of Engineers, USACOE (1991) and Coastal Environments, (2014) are shown in Figures 6.8 & 6.9. Figure 6.8 shows the shore rise and bar berm sections of the beach profiles immediately west of Well Heads # 2 and #1; where profile ranges R4 & R5 bracket beach slope conditions in front of Well Head # 2, and range DB 1890 measured by the US Army Corps of Engineers give slope conditions in front of Well Head # 1 (cf. Figure 6.3). Figure 6.9 shows the shore rise and bar berm sections of the beach profiles immediately west of Well Heads # 2 and #3; where profile range R5 provides beach slope conditions in front of Well Head # 2, and range R7 gives slope conditions in front of Well Head # 3 (cf. Figure 6.3).

Figures 6.10 and 6.11 give seasonal profile changes at Doheny State Beach immediately west of Well Head #3 over a number of years between 2001 and 2007. Figure 6.10 provides a generalization of the winter profiles, indicating an average nearshore slope, m_{DIM} = 0.066, (proxy slope for an *eroded beach*). Figure 6.11 indicates that the average nearshore slope in summer steepens to m_{DIM} = 0.10, (proxy slope for an *accreted beach*). Using these values to calibrate the elliptic cycloidal slope algorithms in equations (22)-(24), the variation of beach slope with on/offshore position in response to the potential range of extremal wave height was calculated according to Figure 6.12. Generally, across the inner portion of the beach profile closest to the DDP well heads the beach slopes become flatter in winter and steeper in summer, while both types of seasonal profiles develop offshore bars offshore during higher extremal wave conditions. This response is consistent with the well- known response of sandy beaches to increasing levels of incident wave energy; whereby the exposed inner section of the beach profile (the bar-berm profile) erodes and flattens in slope during winter or periods of high waves, while outer submerged portion of the profile (the shore-rise profile) develops offshore sand bar formations. Review of the composite surveys in Figures 6.8-6.11 reveals that variations in the beach widths around the well heads between summer and winter profiles are on the order of 50 ft. to150 ft. These relatively small range of seasonal variation in beach width indicates that Doheny State Beach is stable, as a consequence of being located at a sediment source, i.e. the San Juan Creek. The San Juan Creek is the second largest source of sediment for the Oceanside Littoral Cell and provides an average of 51,000 metric tons of beach grade sand to Doheny State Beach annually (Figure 6.13). This supply of new sediment provides adequate sediment cover for the beach to establish and maintain equilibrium profile adjustments throughout the most high energy El Nino winter/summer seasonal cycles.

Variations in the beach widths and sediment cover with time are modeled in the LCM module of the Coastal Evolution Model (Figure 5.1) using time-stepped solutions to the sediment continuity equation (otherwise known as the *sediment budget*) applied to the boundary conditions of the coupled control cell mesh diagramed schematically in Figure 6.14. The sediment continuity equation is written (Jenkins, et al, 2007):

$$\frac{\partial q}{\partial t} = \frac{\partial}{\partial y}\left(\varepsilon \frac{\partial q}{\partial y}\right) - V_l \frac{\partial q}{\partial y} + J(t) - R(t) \qquad (25)$$

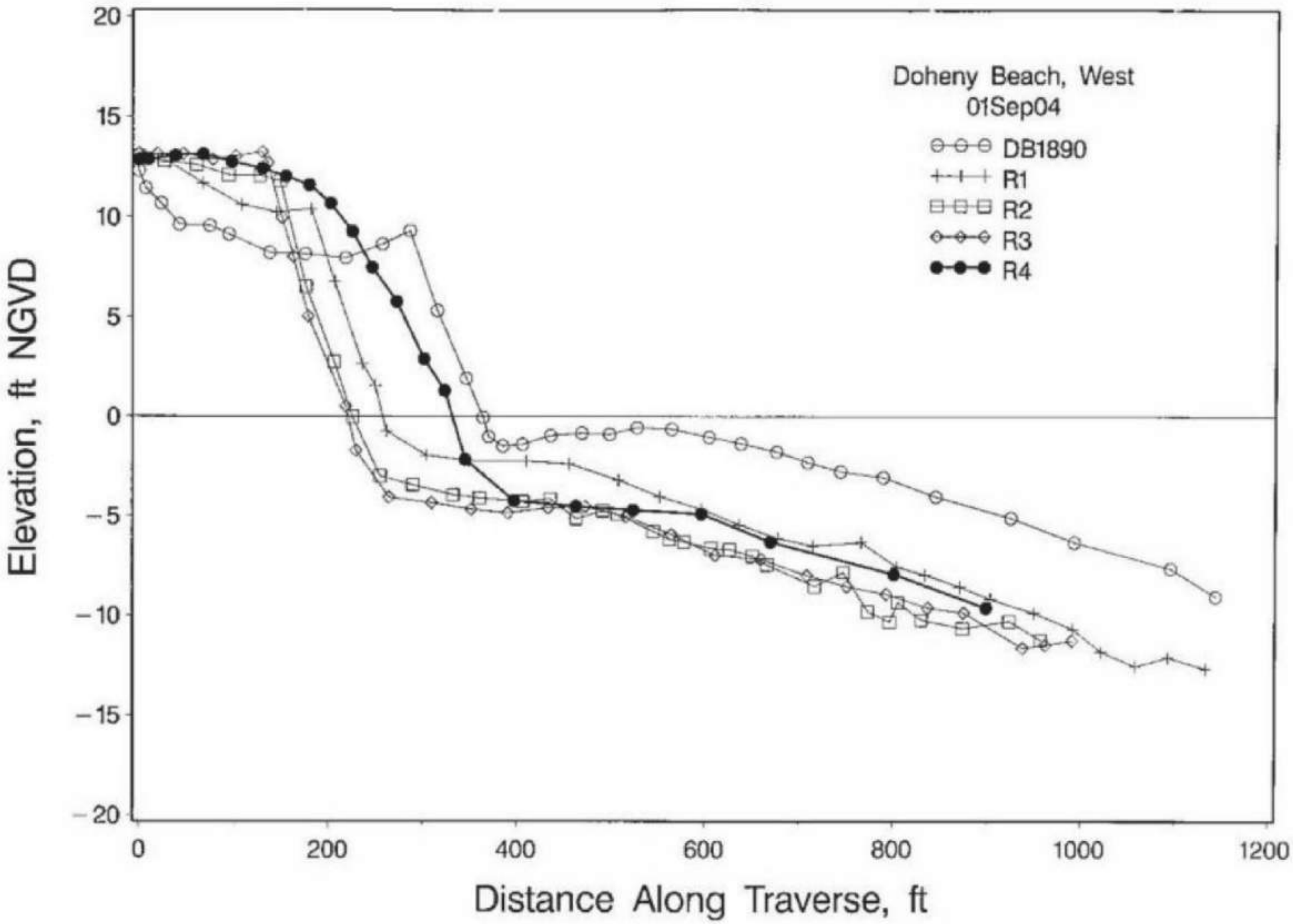


Figure 6.8: Beach profile surveys of Doheny Beach range lines adjacent to Well Heads A & B. Data from Coastal Environments, (2014).

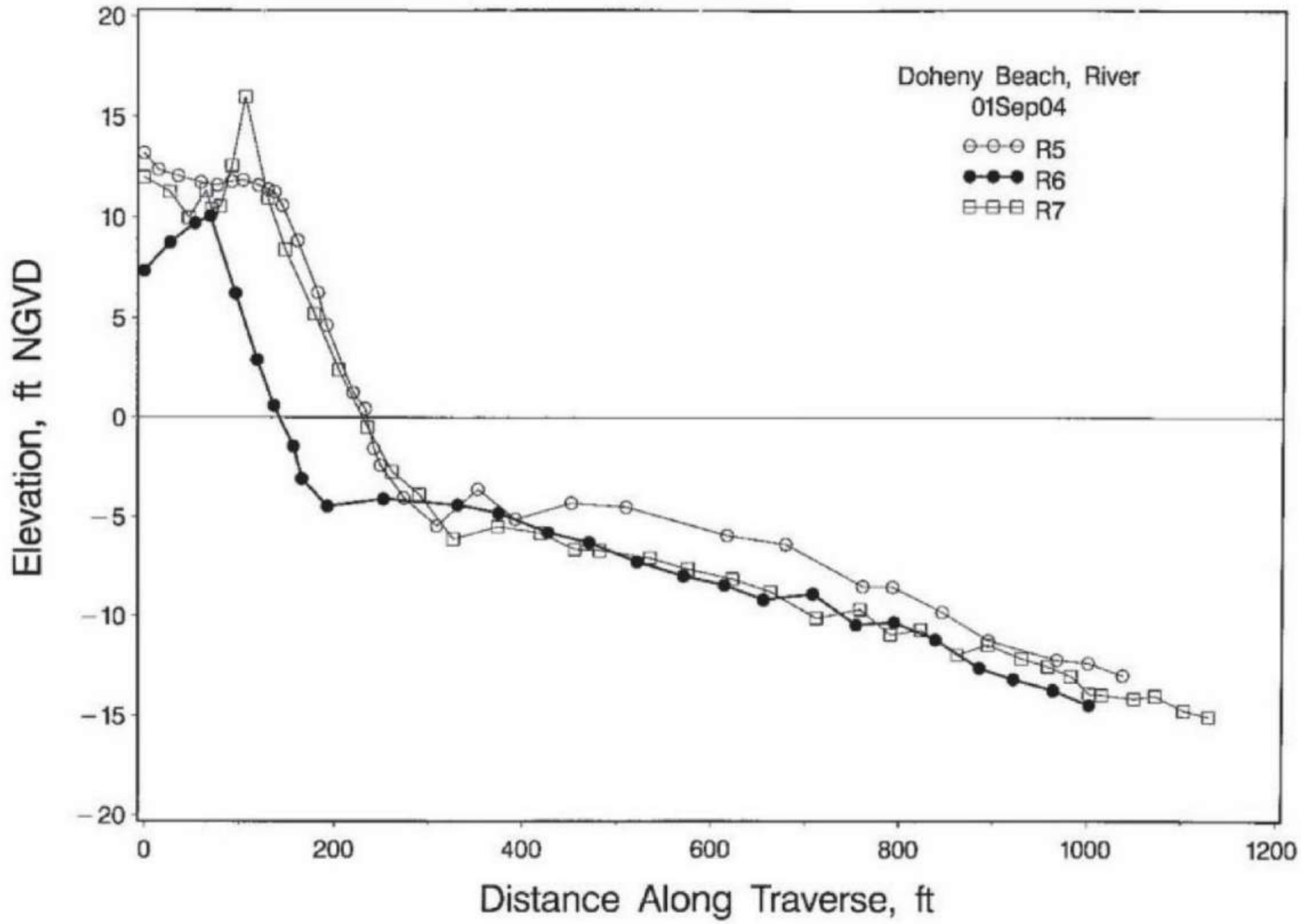


Figure 6.9: Beach profile surveys of Doheny Beach range lines adjacent to Well Heads C & D. Data from Coastal Environments, (2014).

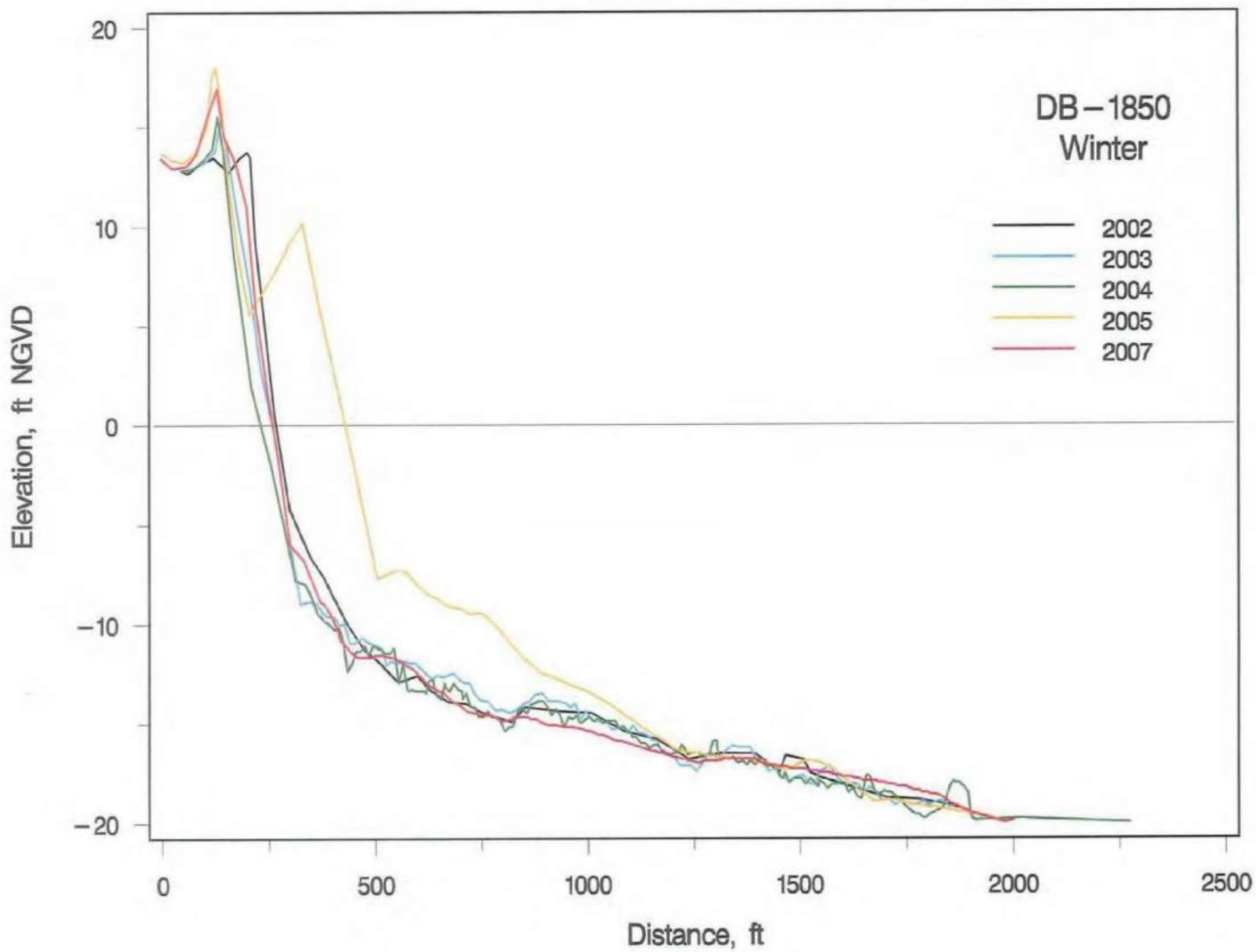


Figure 6.10: Winter beach profile surveys of Doheny Beach range lines adjacent to Well Heads D & E. Surveys due to the US Army Corps of Engineers. Data provided by Coastal Frontiers, (2014).

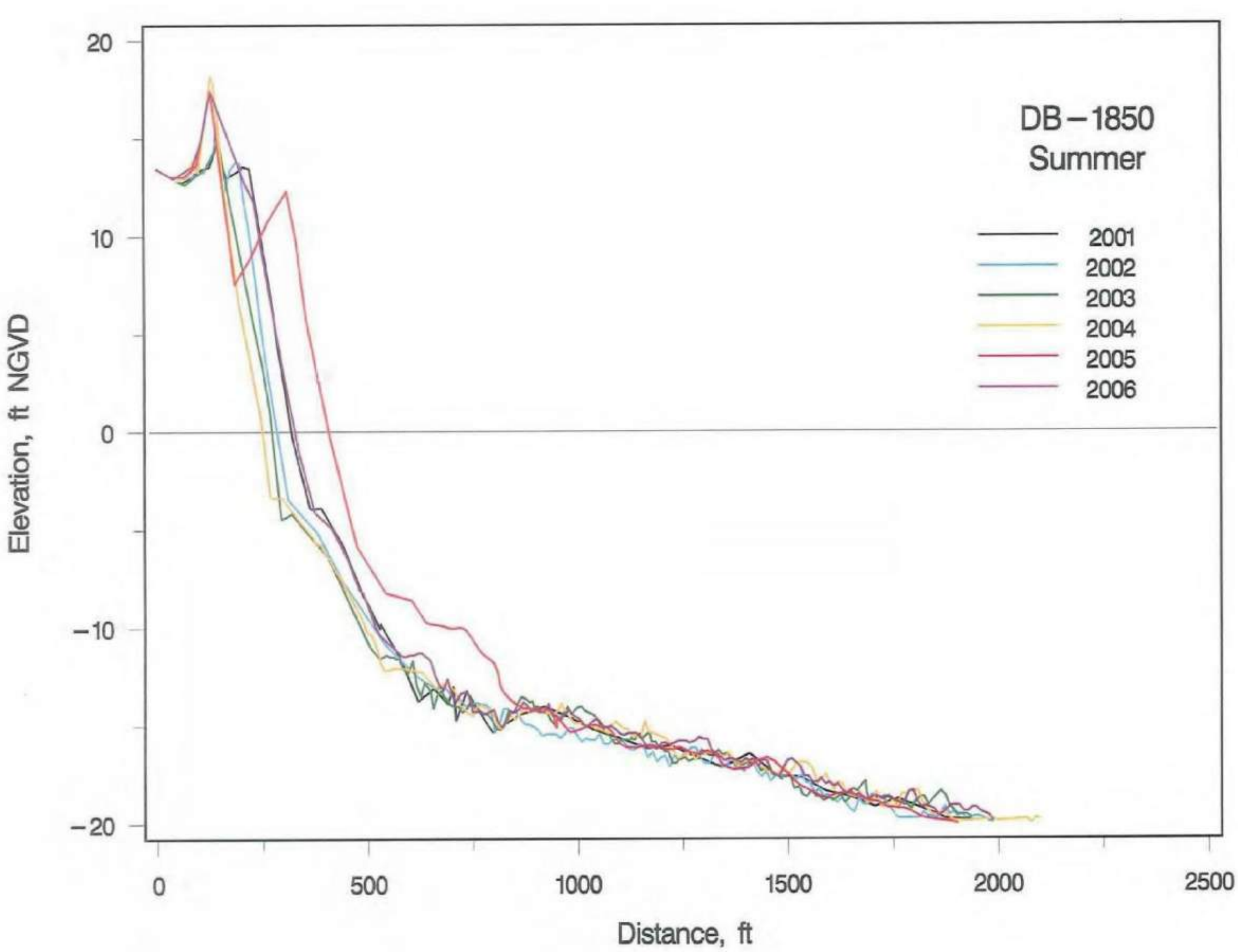


Figure 6.11: Summer beach profile surveys of Doheny Beach range lines adjacent to Well Heads D & E. Surveys due to the US Army Corps of Engineers. Data provided by Coastal Frontiers, (2014).

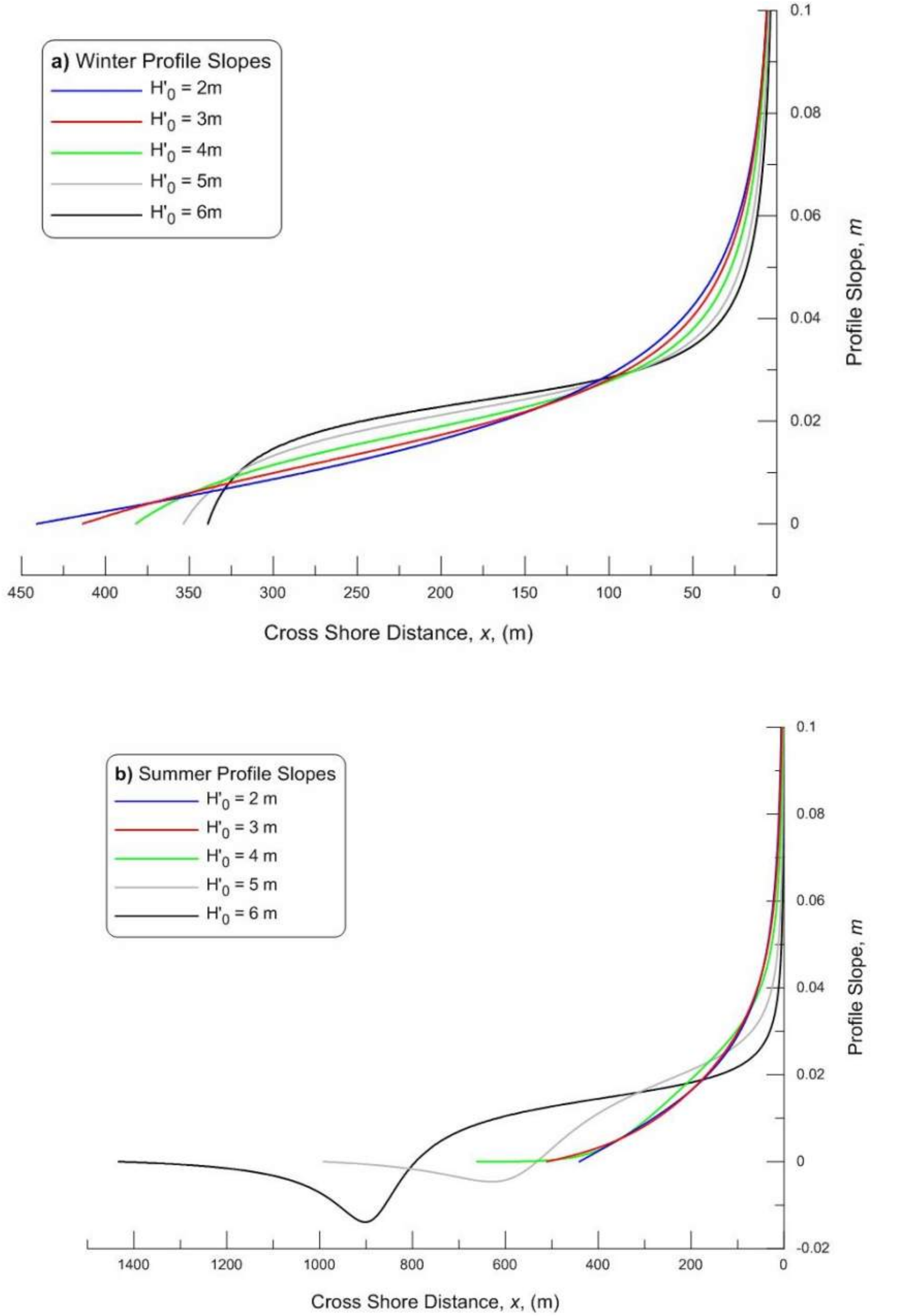


Figure 6.12. Family of elliptic cycloid slope solutions in the bar berm: a) type-a cycloids; b) type-b cycloids. Cycloids scaled for : H'_0 = 2 - 6 m; T = 15 sec; m_{DIM} = 0.06 (winter); m_{DIM} = 0.1 (summer); γ = 0.8; Γ = 0.76; Λ = 0.81

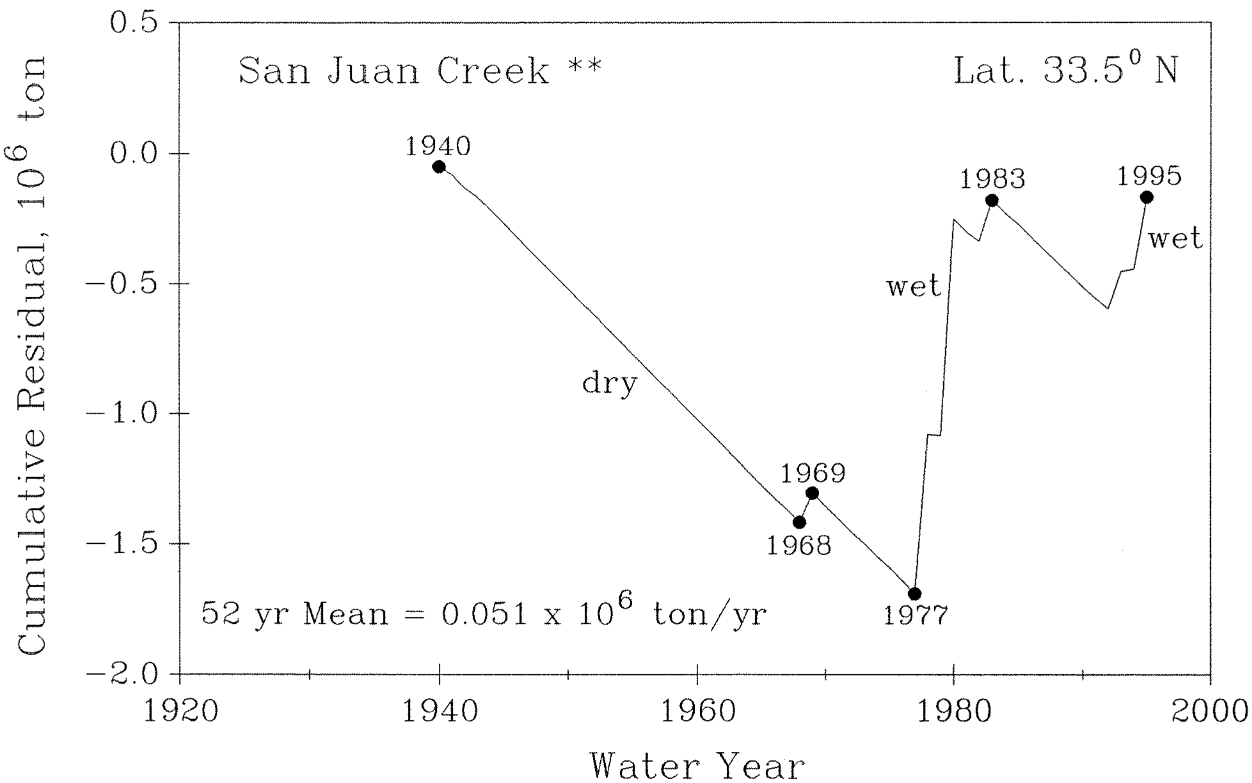


Figure 6.13. Cumulative residual time series of sediment flux for the San Juan Creek calculated using a 56-year mean (1940-1995), from Inman and Jenkins (1999).

In equation (25) q is the sediment volume per unit length of shoreline (m^3/m) and *dq/dt* is the sediment volume flux (m^3/m/day), ε is the mass diffusivity, V_l is the longshore current, *J(t)* is the flux of new sediment from the San Juan Creek, and *R(t)* is the flux of sediment lost to sinks , in this case, the scour holes near the mouth of the San Juan Creek following river floods. The first term in (1) is the surf diffusion term while the second is the advective term due to the longshore current. For any given control cell along Doheny State Beach, equation (25) may be discretized in terms of the rate of change of "beach volume", Λ, in time increment Δt , given by:

$$\frac{d\Lambda}{dt} = J(t) + \frac{q_{in} + q_{out}}{\Delta t} \qquad (26)$$

Sediment is supplied to the control cells in Figure 6.14 by the sediment yield from the rivers and beach nourishment, $J(t)$ by the influx of sediment volume due to littoral drift from up-coast sources, q_{in} (beach-fill). Sediment is lost from the control cell due to the action of wave erosion

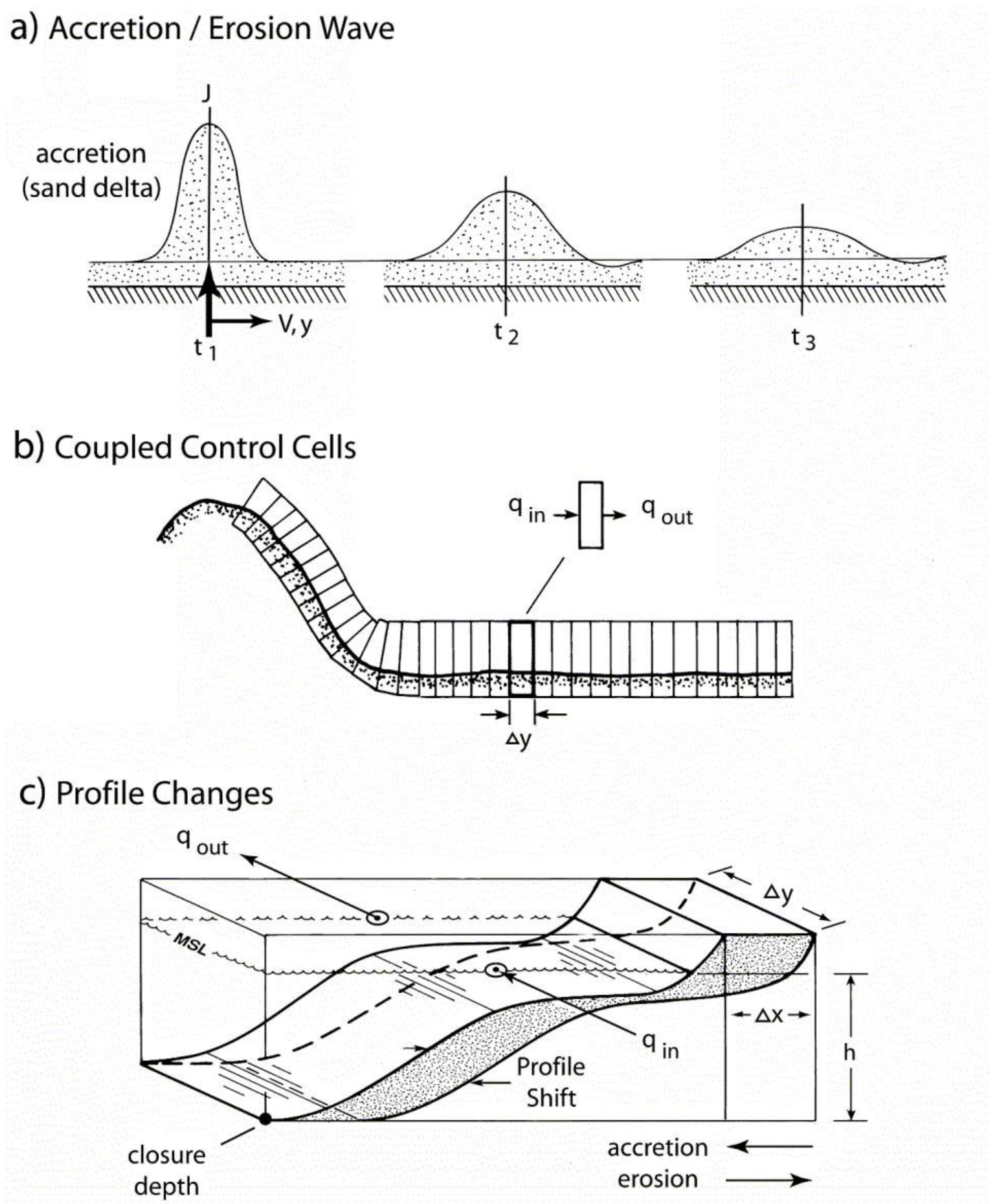


Figure 6.14: Computational approach for modeling changes in beach width and shoreline positon after Jenkins, et. al., (2007).

and expelled from the control cell by exiting littoral drift, q_{out}. Here fluxes into the control cell (*J(t)* and $q_{in}/\Delta t$) are positive and fluxes out of the control cell,
($q_{out}/\Delta t$), are negative.

The beach and nearshore sand volume change, *dq/dt*, is related to the change in shoreline position, *dX/dt*, according to:

$$\frac{dV}{dt} \cong \frac{d\Lambda}{dt} = \frac{dX}{dt} \cdot Z \cdot l \qquad (27)$$

where
$$Z = Z_1 + h_c \qquad (28)$$

Here, Z is the height of the shoreline flux surface equal to the sum of the closure depth below mean sea level, h_c, (equation 24), and the height of the berm crest, Z_1, above mean sea level; and l is the length of the shoreline flux surface. Hence, beaches and the offshore bottom profile out to closure depth remain stable if a mass balance is maintained such that the flux terms on the right-hand side of equation (2) sum to zero; otherwise the shoreline will move during any time step increment as:

$$\Delta x(t) = \frac{1}{\Delta y(Z_1 + h_c)} \int \left(\frac{\partial}{\partial y}\left(\varepsilon \frac{\partial q}{\partial y} \right) - V \frac{\partial q}{\partial y} + J(t) \right) dt \qquad (29)$$

where ε is the mass diffusivity, V is the longshore drift , J is the flux of sediment from river sources, Δy is the alongshore length of the control cell, and Z_1 is the maximum run-up elevation from Hunt's Formula. River sediment yield, *J*, from is calculated from streamflow, *Q*, based on the power law formulation of that river's sediment rating curve after Inman and Jenkins, (1999), or

$$J = \xi\, Q^{\omega} \qquad (30)$$

where ξ, ω are empirically derived power law coefficients of the sediment rating curve from best fit (regression) analysis (Inman and Jenkins,1999). When San Juan Creek floods produce large episodic increases in *J*, a river delta is initially formed. Over time the delta will widen and reduce in amplitude under the influence of surf diffusion and advect (move) down-coast with the longshore drift, forming an accretion erosion wave (Figure 6.14a). The local sediment volume varies in response to the net change of the volume fluxes, between any given control cell and its neighbors, referred to as divergence of drift = q_{in} - q_{out} , see Figure 6.14b and 6.14c. The mass balance of the control cell responds to a non-zero divergence of drift with a compensating shift, Δx, in the position of the equilibrium profile (Jenkins and Inman, 2006). This is equivalent to a net change in the beach entropy of the equilibrium state. The divergence of drift is given by the continuity equation of volume flux, requiring that *dq/dt* is the net of advective and diffusive fluxes of sediment plus the influx of new sediment, *J*. The rate of change of volume flux through the control cell causes the equilibrium profile to shift in time according to (29), producing the net change in beach widths shown by the surveys in Figures 6.8 – 6.11. Changes in sea level also cause the shoreline to move (retreat) which are calculated in the LCM module of the Coastal Evolution Model using *Bruun's Rule*, (Bruun, 1962, 1983):

$$\Delta x = X_c \left(\frac{SLR}{h_c + Z_1} \right) \tag{31}$$

Where SLR is the increment of sea level rise, and X_c is the distance offshore to closure depth given by the elliptic cycloid formulation to the equilibrium profile (Jenkins and Inman, 2006) according to:

$$X_{c2} = \frac{h_c I_e^{(2)}}{\varepsilon} \cong \frac{\pi\, h_c}{2\varepsilon} \sqrt{\frac{2 - e^2}{2}} \tag{32}$$

$$\text{With: } \varepsilon = \frac{\sigma}{N} \left(\frac{H_b}{\gamma\, g} \right)^{1/2} \cong \frac{\sigma^{4/5}}{2^{1/5} N} \left(\frac{H_0'}{g\gamma} \right)^{2/5}$$

Because Bruuns Rule merely produces a self-similar landward shift to profile in response to sea level rise (with no change to the shape of the profile or to the elliptic cycloid parameters); sea level rise does not effect the intrinsic slope parameters of the profile on which the total run-up elevation depends. This response is based on an assumption that the beach has adequate sand volume and sediment cover to execute the profile shift required under Bruun's Rule. This assumption appears to be well founded at Doheny State Beach due to the fact that it is continually re-nourished by the flux of new sediment from San Juan Creek, (*J* = 51,000 ton/yr)**.**

7.0 Wave Run-up and Overtopping Statistical Analysis:

This section uses the data bases described in Section 6 to evaluate Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2. We seek to quantify the probability of occurrences of *extremal total water levels* where the total water level (TWL) is the sum of the total run-up and the still water level (SWL). The total run-up, *R*, is a dynamic water level variation caused by wave shoaling and breaking, and is composed of three components: wave setup, $< \eta >$, dynamic wave setup, η_{rms} ; and incident wave run-up, R_{inc}. We will begin in Section 7.1 by setting the still water level equal to present or future mean sea level, which will allow us to isolate the total runup as an independent dynamic process whose probability is uniquely determined by the extremal wave height curve in Figure 6.7. We will then solve for *extremal total water levels* (TWL_{max}) by admitting to probability of occurrences of still water levels higher than mean sea level; which results in a joint probability analysis of occurrence of extremal wave heights concurrent with extreme ocean water levels.

7.1) Total Water Level Analysis for Constant Still Water Levels: Total water level is a multi-variant function determined by the combined effects of stationary processes (processes vary slowly in time) and dynamic processes (processes that vary rapidly with time). The still water level component of the total water level is a relatively stationary process when compared to the total run-up component, where the latter varies rapidly in time at the frequency of surface gravity waves. At lowest order approximation, we can solve for the probability of recurrence of potential total water levels by assuming the stationary processes are fixed in time. By that approach, we adopt a common practice in coastal engineering by setting the still water level at mean sea level and then solve for the potential total water levels as a conditional probability using Bayes' theorem:

$$P(TWL_{\max}) = P[R, Z_i] = P[R(H'_T] \bullet P_{i,j}(Z_i = MSL) \qquad (33)$$

Here, $P_{i,j'}(Z_i)$ is the annualized probability of ocean water levels reaching an elevation of Z_i feet NAVD 88 from equations (3) and (4), where $P_{i,j'}(Z_i = MSL)$ = 1, (cf. Figures 4.1, 4.6 & 4.7); $P[R(H'_T)]$ is the annualized probability of total run-up from the sum of equations (6) and (11) based on the probability of extremal wave heights with return frequency of once every T years, $P(H'_T) = 1/T$, (cf. Figure 6.7). The total run-up calculations using extremal wave heights are based on the direct integration method (DIM) from Section 5.5 because the beach slopes at Doheny State Beach for both eroded (winter) and summer (accreted) conditions are always than 12.5%. (Here beach slope, m_{DIM}, is taken as the average slope between the landward limit of wave run-up and the location offshore where the water depth is two times the depth at which the deep water significant wave height would be subject to depth-limited breaking, cf. Van der Meer, 2002). Figures 6.8 – 6.12 show generally that average nearshore beach slopes at Doheney State Beach range from $\overline{m}_{DIM}$ = 0.006 for eroded beach profiles, and steepen to $\overline{m}_{DIM}$ = 0.10 for accreted beach profiles. One advantage of the approach taken by equation (25) is that it allows us to separate the individual dynamic components to the total water level solutions.

Figures 7.1-7.3 give the annualized probability of recurrence of total run-up and its components of static wave setup, dynamic wave setup, and the total oscillatory swash component based on the extremal wave analysis curve in Figure 6.7 as applied to equations (6)- (12). For each component of total wave runup, there are two sets of curves, representing eroded and accreted conditions at Doheny and Capistrano State Beaches. In all cases, the maximum water elevations are greater for the accreted beach conditions than for the eroded beach conditions. This is due to the fact that eroded beaches have flatter slopes in the bar-berm section of the profile where waves are breaking and producing run-up. Flatter beach slopes are intrinsically more dissipative, resulting in less residual energy after breaking to produce runup. Inspection of Figure 7.3 indicates that maximum run-up is 15.4 ft. for the accreted beach conditions and 13.1 ft. for the eroded beach conditions, with a probability of recurrence of 0.04% (return period = 2,500 yr). But the maximum wave run-up is based on a statistical projection from the Weibull Type III best fit to the extremal wave results from refraction/diffraction analysis in Figure 6.7. The highest wave that was recovered from the refraction analysis in 12 m of water depth was due to the100-year storm of 18, January, 1988 (Figure 6.4) with a significant wave height H'_0 = 15.5 ft. and a probability of recurrence of 1.0%. The 1% runup up event in Figure 7.2 actually gives maximum total wave run-up of 11.88 ft. for the accreted beach conditions at Doheny Beach and 9.98 ft. for the eroded beach conditions. At Capistrano Beach, shoaling wave heights are greater and maximum total wave run-up is 12.73 ft. for the accreted beach conditions and 10.83 ft. for the eroded beach conditions

The annualized probability of recurrence of total water level is plotted in Figures 7.4 and 7.5 at Doheny and Capistrano Beaches, respectively, under the stationary hypothesis for still

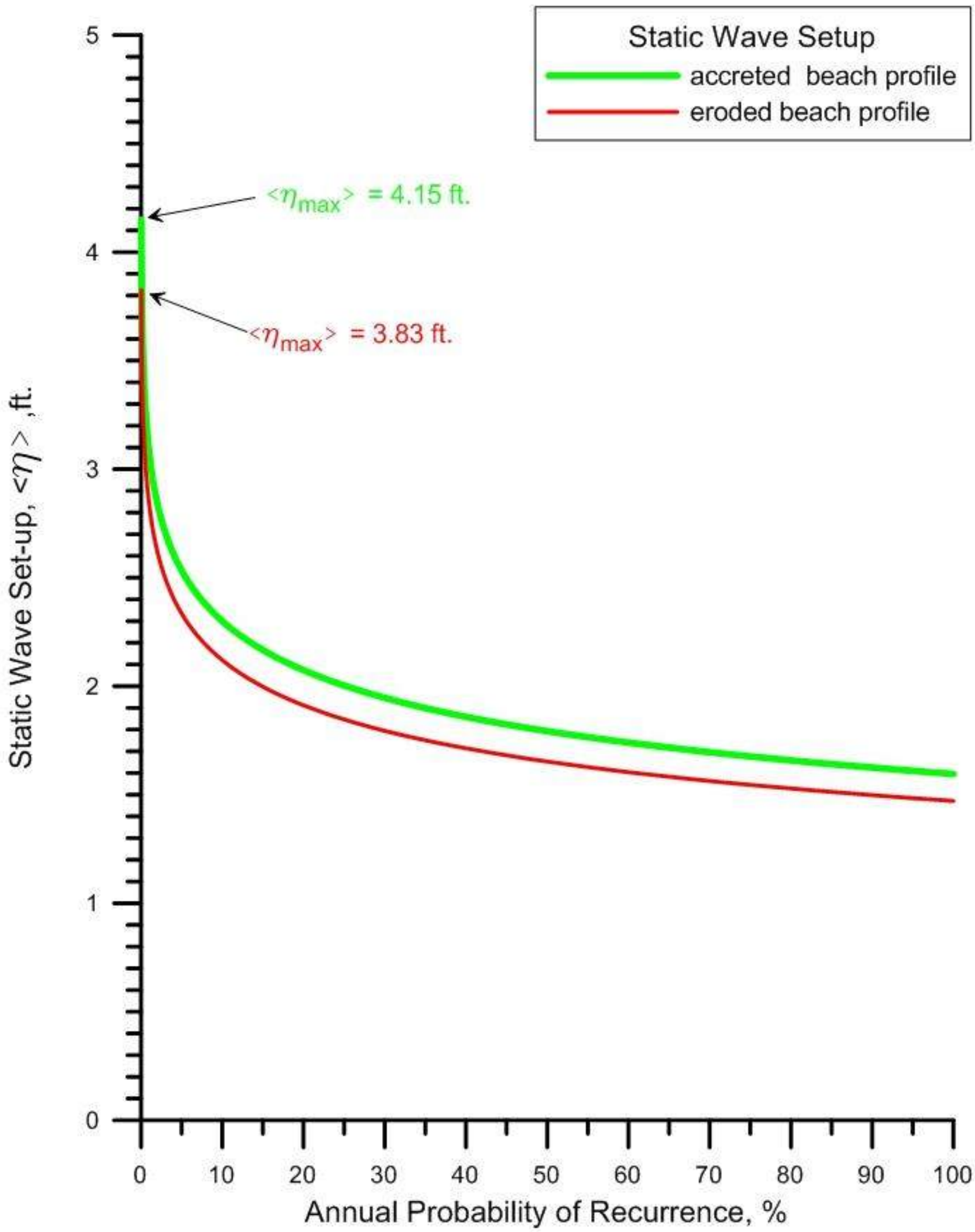


Figure 7.1: Probability of recurrence of static wave setup based on on extremal design wave heights from Weibull Type III distribution and beach profiles from Figures 6.8 - 6.11.

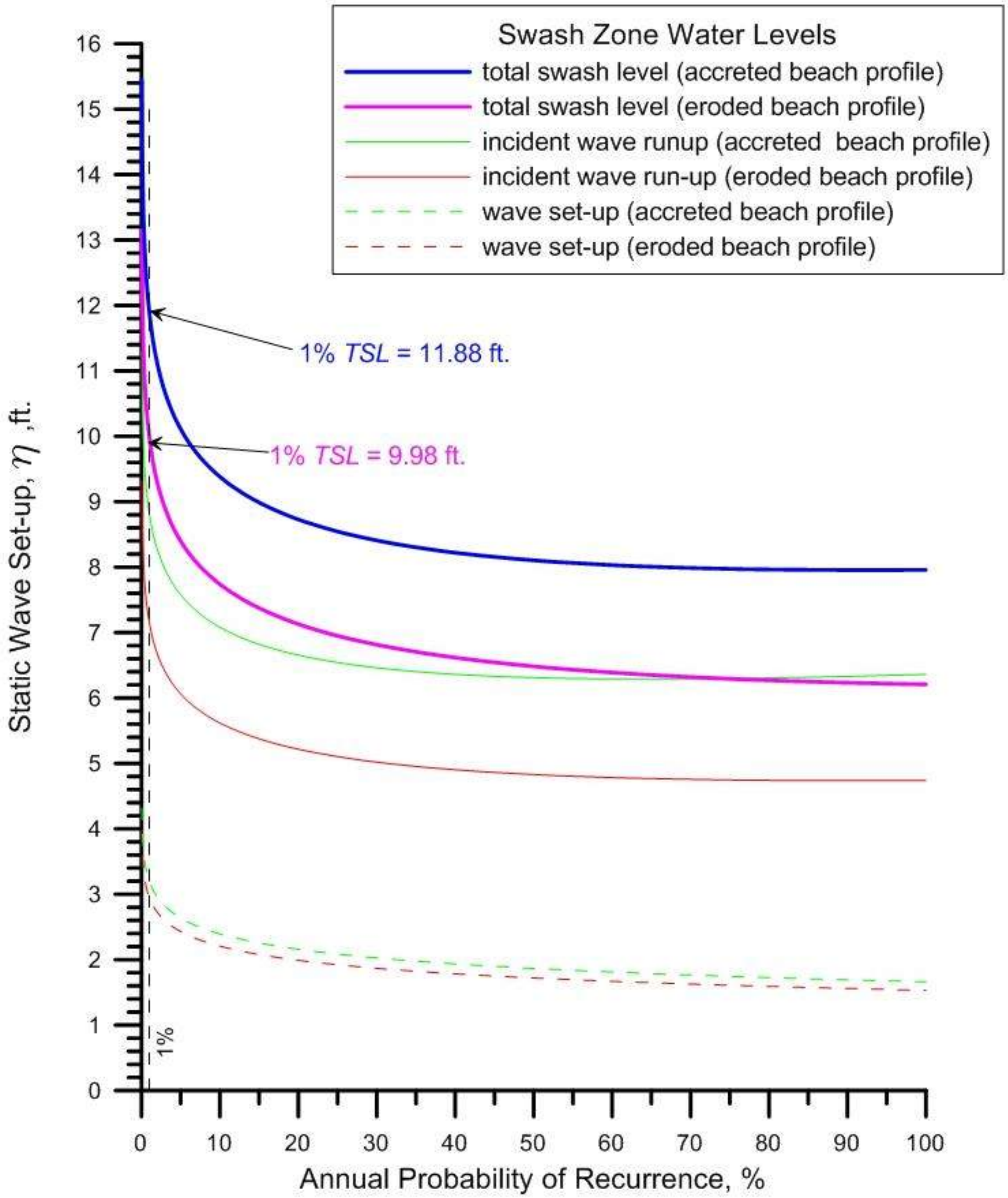


Figure 7.2 : Probability of recurrence of total swash level (*TSL*) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution

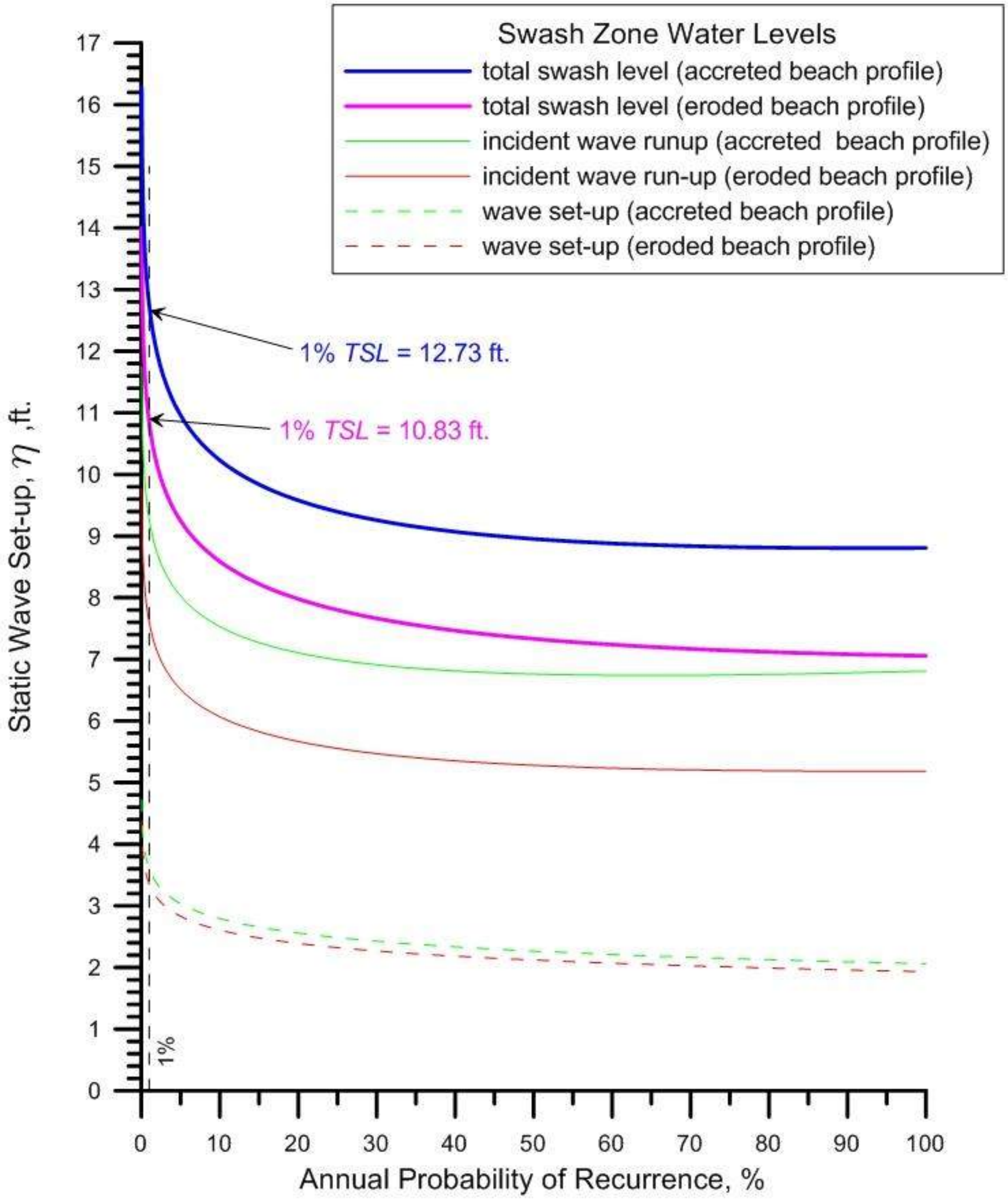


Figure 7.3 : Probability of recurrence of total swash level (*TSL*) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution

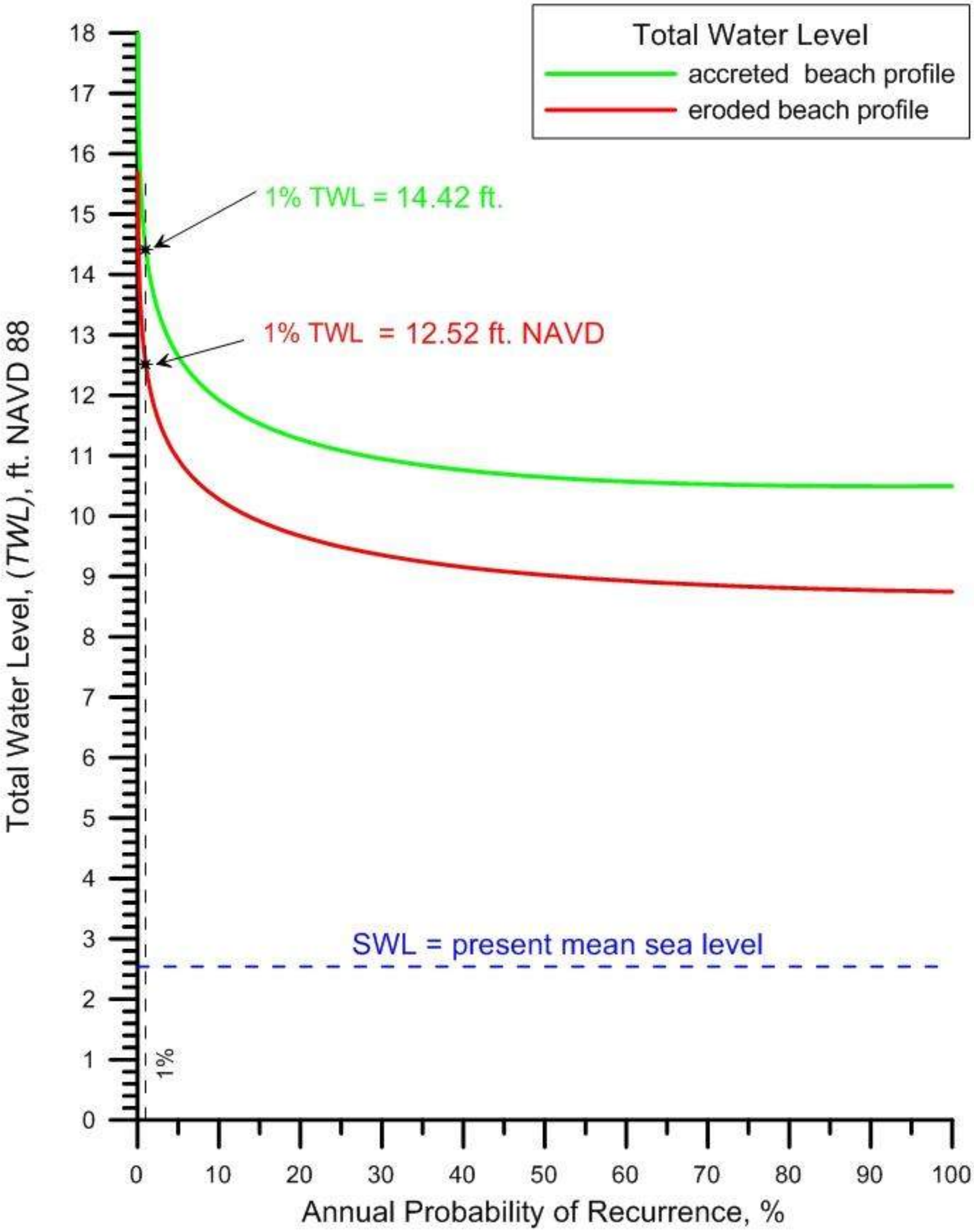


Figure 7.4: Annualized probability of recurrence of total water level at Doheny State Beach based on present sea level and extremal design wave heights from Weibull Type III distribution. SWL = MSL

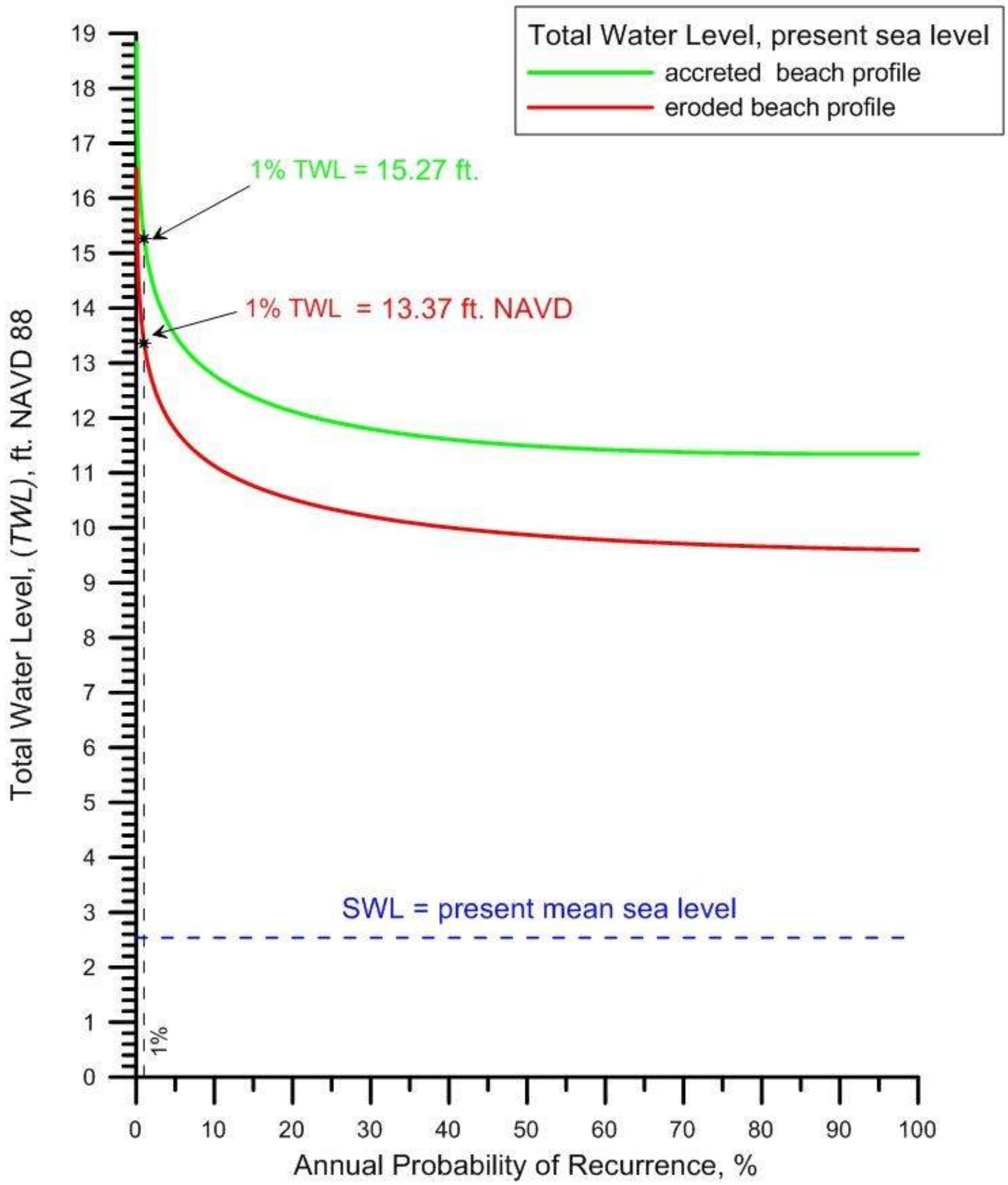


Figure 7.5 : Probability of recurrence of total water level at Capistrano State Beach for still water level at persent mean sea level based on extremal design wave heights from Weibull Type III distribution; SWL = MSL

water level according to equation (33). Under this assumption (where still water level is fixed at present mean sea level), the maximum total water level at Doheny Beach is *TWL* = 17.98 ft. NAVD for the accreted beach conditions and *TWL* = 15.69 ft. NAVD for the eroded beach conditions. At Capistrano Beach (Figure 7.5), the maximum total water level is *TWL* = 18.83 ft. NAVD for the accreted beach conditions and *TWL* = 16.54 ft. NAVD for the eroded beach conditions. (Total water levels are higher at Capistrano Beach because shoaling waves during the 100-year event are higher at that location, cf. Figure 6.4). The total water level achieved under accreted beach conditions at present sea level exceeds the elevations of well heads A, B, C and G, which are located at Z_i == 17 ft. NAVD and Z_i == 17 ft. NAVD, respectively; but the probability of this occurring is only 0.04% (return period = 2,500 yr). Appendix-B of the *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2015) provides no specific guidance on the redline frequency for flooding or inundation. In the absence of such guidance we will adopt Federal Emergency Management Agency (FEMA) standards for flooding frequency and set redline planning frequency at the 100 year event (1% probability of recurrence). Accordingly, Figures 7.4 & 7.5 have been annotated to highlight the 1% total water level events which indicate is *TWL*(1%) = 14.42 ft. NAVD for the accreted beach conditions and *TWL*(1%) = 12.52 ft. NAVD for the eroded beach conditions at Doheny Beach. At Capistrano Beach. The 1% probability (100-yr event) yields *TWL*(1%) = 15.27 ft. NAVD for the accreted beach conditions and *TWL*(1%) = 13.37 ft. NAVD for the eroded beach conditions.. Consequently we conclude that all the beach front facilities for the Doheny Desalination Project (Figure 6.3a & b) are safe from flooding or inundation by extreme event waves under the stationary hypothesis for still water level at present mean sea level.

We repeat the total water level analysis in Figures 7.6 and 7.7 for 2100 sea levels under the stationary hypothesis for still water level (where still water level is fixed at 2100 mean sea level for the low and high range projections). For the low-range 2100 sea level projections at Doheny Beach, (Figure 7.6), the 1% total water level events reach *TWL*(1%) = 18.02 ft. NAVD for the accreted beach conditions and *TWL*(1%) = 16.12 ft. NAVD for the eroded beach conditions; indicating that all the beach front facilities for the Doheny Desalination Project (Figure 6.3) are safe from flooding or inundation by extreme event waves if the beach is in an eroded winter condition. However, in the unlikely event that the 100 year storm occurs while the beach is still in a summer equilibrium condition (accreted beach), then Well Heads A-C will be overtopped by about 1 ft of excess runup, while Well Heads D and E would be partially wetted. At Capistrano Beach, the 1% total water level events at the low range projection for 2100 sea level, (Figure 7.7), reach *TWL*(1%) = 18.87 ft. NAVD for the accreted beach conditions and *TWL*(1%) = 16.97 ft. NAVD for the eroded beach conditions. While both well heads at Capistrano Beach would be safe from overtopping if Capistrano Beach were in an eroded winter state, Well Head G would be overtopped by about 0.87 ft. of runup if the beach remained in an accreted summer condition.

For the high-range 2100 sea level projections, (Figures 7.8 and 7.9) the 1% total water level events will overtop all of the well sites. At Doheny Beach, (Figure 7.8), the 1% total water level events reach *TWL*(1%) = 21.52 ft. NAVD for the accreted beach conditions and *TWL*(1%) = 19.62 ft. NAVD for the eroded beach conditions, exceeding the elevations of all well sites regardless of beach erosion or accretion. Similarly, at Capistrano Beach (Figure 7.9), the 1% total water level events reach *TWL*(1%) = 22.37 ft. NAVD for the accreted beach conditions and *TWL*(1%) = 20.47 ft. NAVD for the eroded beach conditions, again exceeding the elevations of all well sites regardless of beach erosion or accretion.

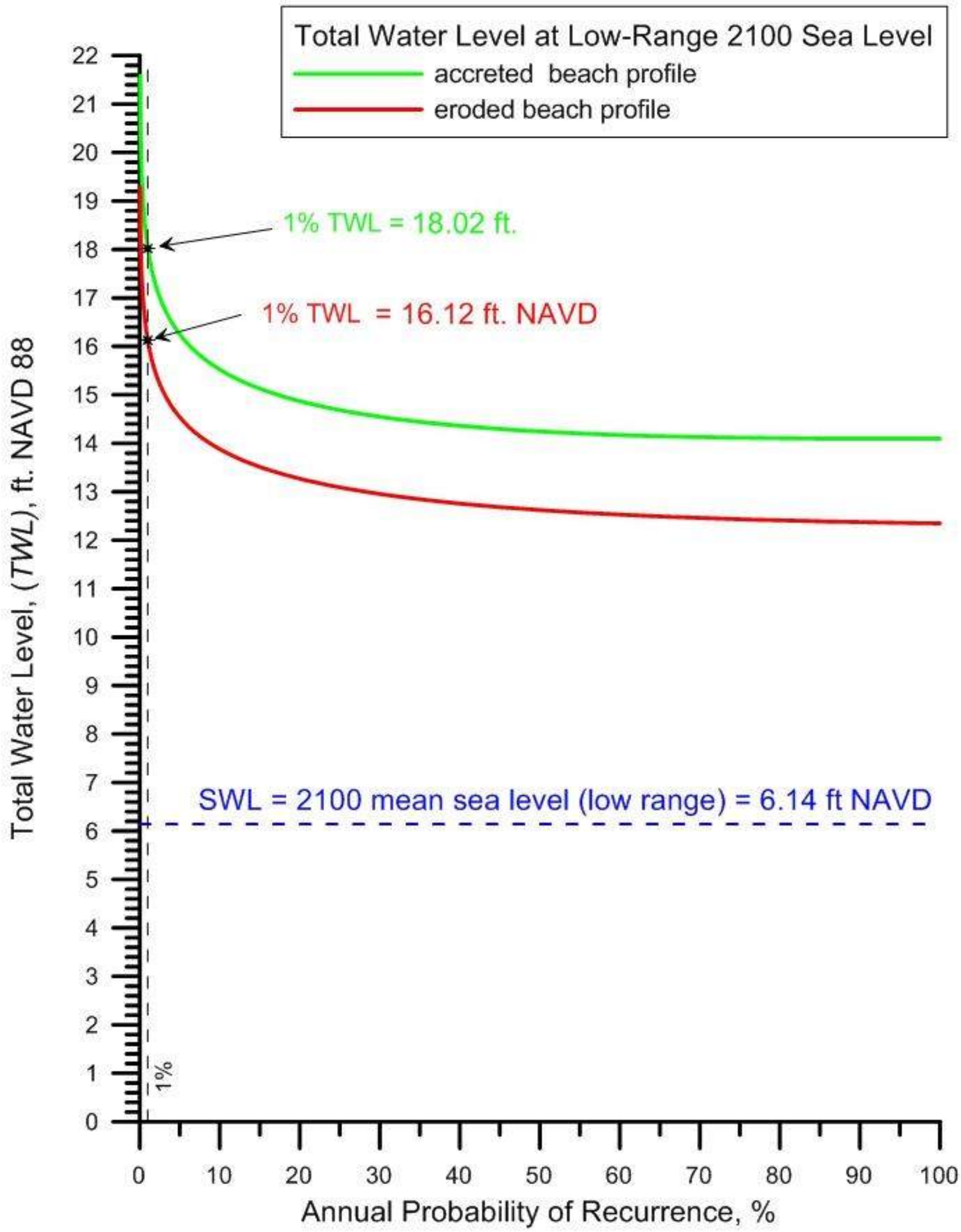


Figure 7.6: Annualized probability of recurrence of total water level at Doheny State Beach for still water level at 2100 (low range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

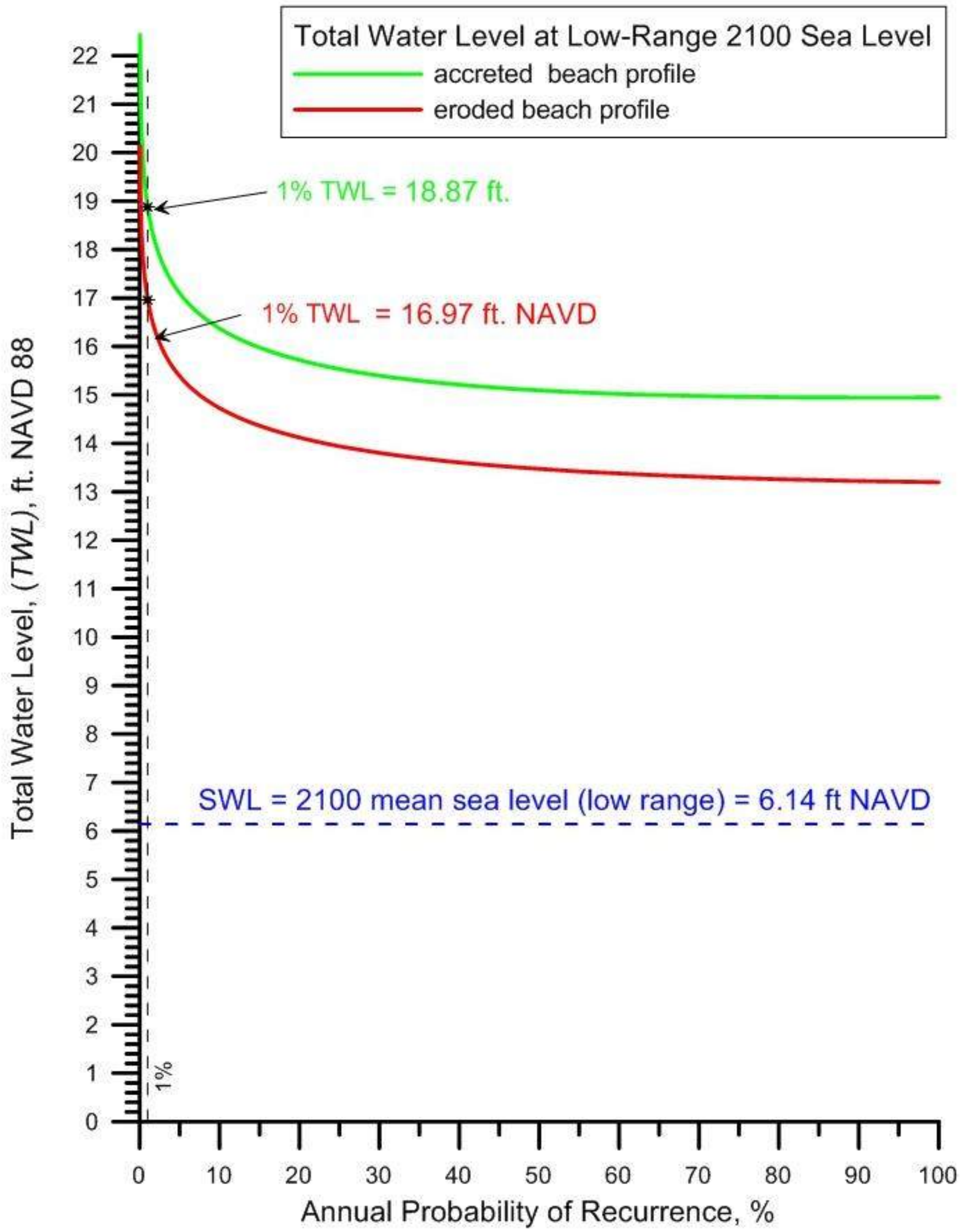


Figure 7.7: Annualized probability of recurrence of total water level at Capistrano State Beach for still water level at 2100 (low range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

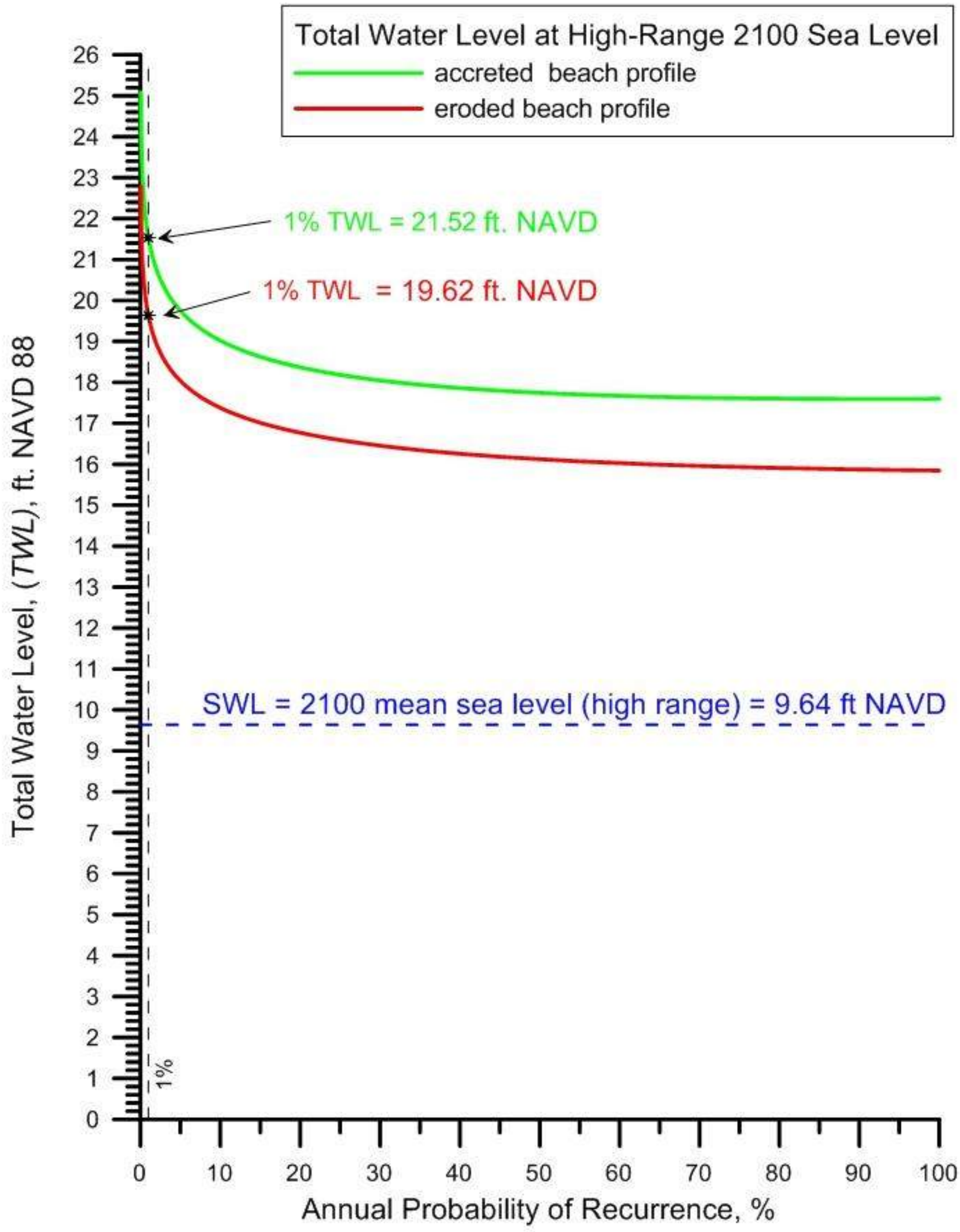


Figure 7.8: Annualized probability of recurrence of total water level at Doheny State Beach for still water level at 2100 (high range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

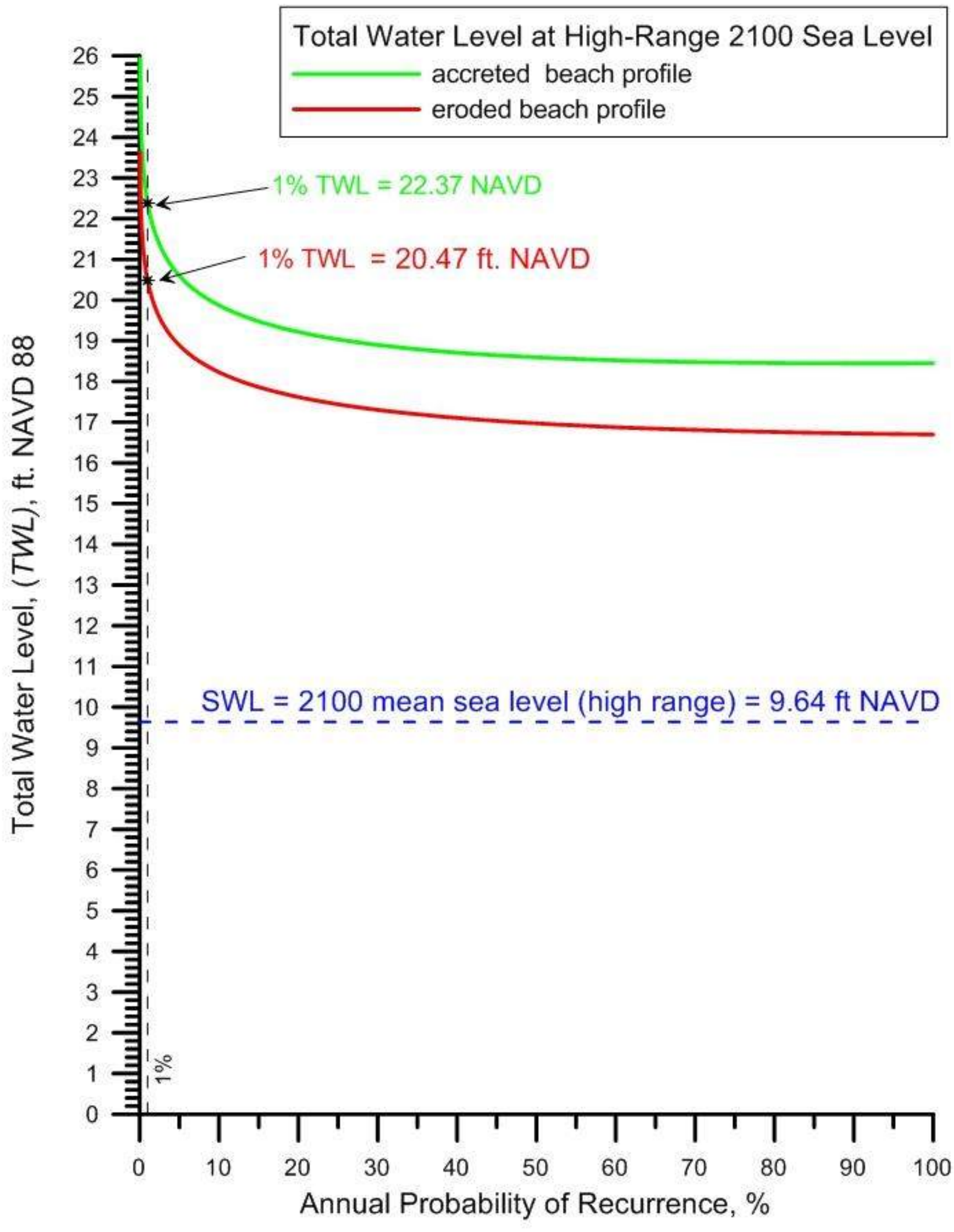


Figure 7.9: Annualized probability of recurrence of total water level at Capistrano State Beach for still water level at 2100 (high range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

7.2) Total Water Level Analysis for Extremal Still Water Levels: In this section we relax the stationary hypothesis for still water level and allow it to vary according to the hydroperiod functions for present and future sea levels in Figures 4.1, 4.6, and 4.7. This will provide an analysis of total water levels due to extreme waves concurrent with extreme ocean water levels (extremal TWL's). The recurrence frequency (or return period) for these extremal TWL's is given by the joint probability of occurrence of extremal wave heights concurrent with extreme ocean water levels, or:

$$P(TWL_{\max}) = P[R, Z_i] = P[R(H'_T] \bullet P_{i,j}(Z_i) \qquad (34)$$

where H'_T is the extremal significant wave height with return period of T years, and $P_{i,j}(Z_i)$ is the annualized probability of ocean water levels η reaching an elevation of Z_i feet NAVD 88 at or above mean sea level, as derived from the annualized hydroperiod function, equations (3) and (4). The results for return periods $T_r = 1/P[R, Z_i]$ of extremal total water levels at present sea level are plotted in Figure 7.10 & 7.11 for Doheny and Capistrano Beaches, respectively, while those for 2100 sea levels are found in Figures 7.12 – 7.15. Comparing these results with the total water level results in Figures 7.4-7.9 (that were based on the stationary hypothesis for still water level) indicates that the joint probability analysis for extreme waves concurrent with extreme ocean water levels gives TWL's that are about 0.5 ft. higher for the 1% recurrence event (100 year return period). For example the extremal TWL's at present sea level at Doheny Beach in Figure 7.10 give the TWL(100) = 13.1 ft for eroded conditions and TWL(100) = 14.8 ft. for accreted conditions at present sea levels. On the other hand, when SWL is set at present mean sea level per Section 7.1, as shown in Figure 7.4, the 1% TWL = 12.5 ft for eroded conditions and 1% TWL = 14.4 ft. for accreted conditions at present sea levels. Therefore, we adopt the extremal still water formulation per equation (34) as the redline analysis method for assessing Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2.

Inspection of Figures 7.10 & 7.11 indicates that all the beach front facilities for the Doheny Desalination Project (Figure 6.3) are safe from flooding or inundation by extreme event waves, even for event return periods as long as 500 yr, when extreme waves happen concurrently with extreme ocean water levels in an environment of present sea levels. However, once we admit to 2100 sea level rise projections, a number of the beach front facilities for the Doheny Desalination Project will suffer some flooding and overtopping to varying degrees. For the low-range 2100 sea level projections, (Figures 7.12 &7.13) the three well sites at Doheny Beach on the north side of San Juan Creek (Well Heads A-C) and one of the wells at the Capistrano Beach site (Well Head G) will experience minor overtopping, even for a 1 year event if the beaches have been accreted by additional sands from water shed floods or still retain a built-out summer equilibrium beach profile, with overtopping rates of about Q'(1yr) = 0.038 cfs per lineal ft. of shoreline, per equation (17). If a 100-yr total water level event occurs during the low-range projection of 2100 sea levels, then Figures 7.12 & 7.13 indicate that all of the well sites will be overtopped to varying degrees if the beaches remain in an accreted condition (i.e.,with elevated berms and steep beach slopes). Under these beach conditions, overtopping rates will range from a high of Q'(100yr) = 0.094 cfs per lineal ft. of shoreline at Well Heads A- C on Doheny Beach, to a low of Q'(100yr) = 0.014 cfs/ft at Well Head H on Capistrano Beach, while overtopping rates at Well Heads D & E would be Q'(100yr) = 0.027 cfs/ft at Doheny Beach and Q'(100yr) = 0.081 cfs/ft at Well Head G on Capistrano Beach. Interestingly enough, none of the well heads would experience overtopping during a 100 year event when occurring during the low range 2100 sea levels if the beach were eroded, which would be the most likely condition during a 100-

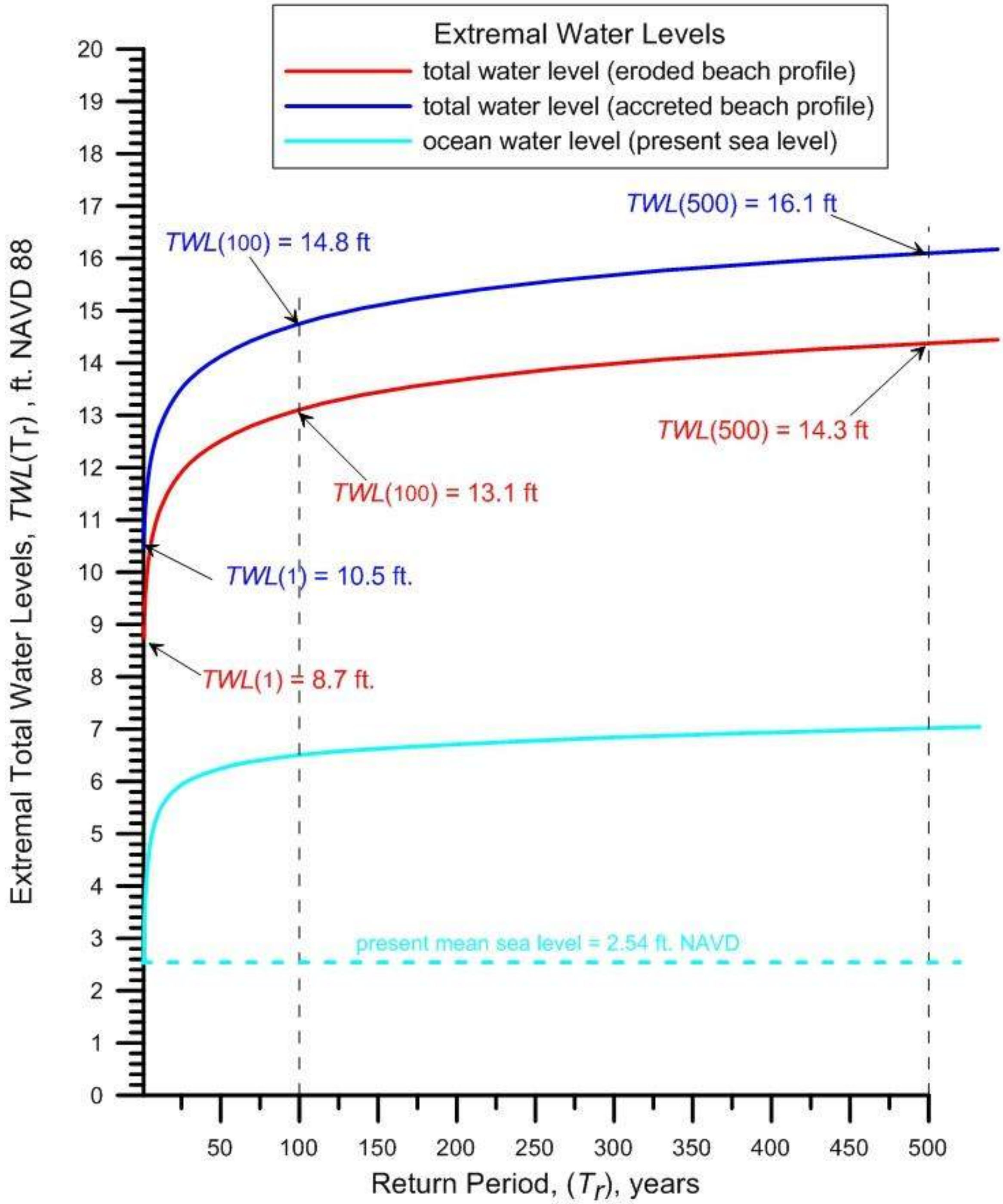


Figure 7.10: Return period of extremal total water level (TWL) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for present sea level, per NOAA tide gage #941-0230

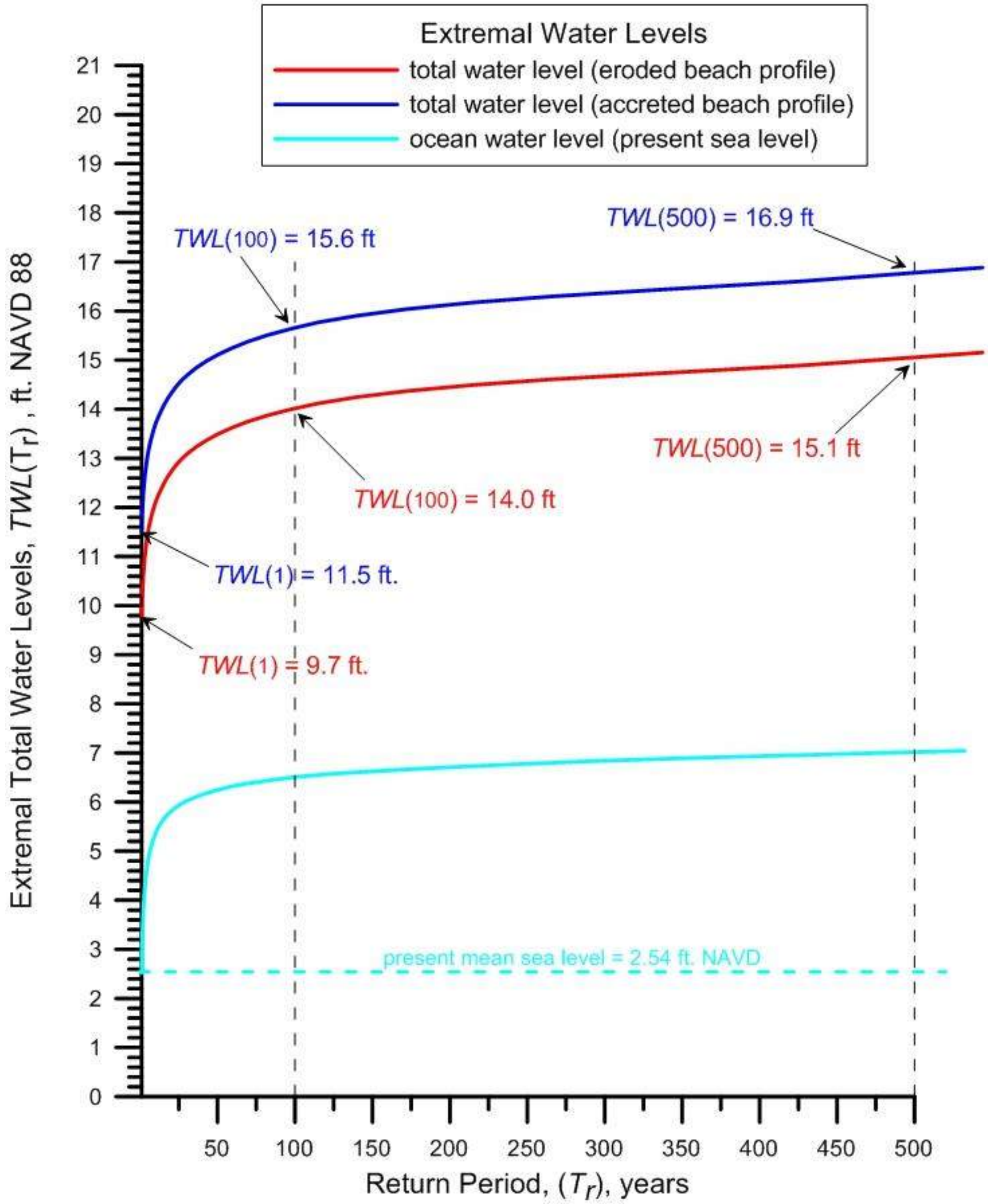


Figure 7.11: Return period of extremal total water level (TWL) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for present sea level, per NOAA tide gage #941-0230.

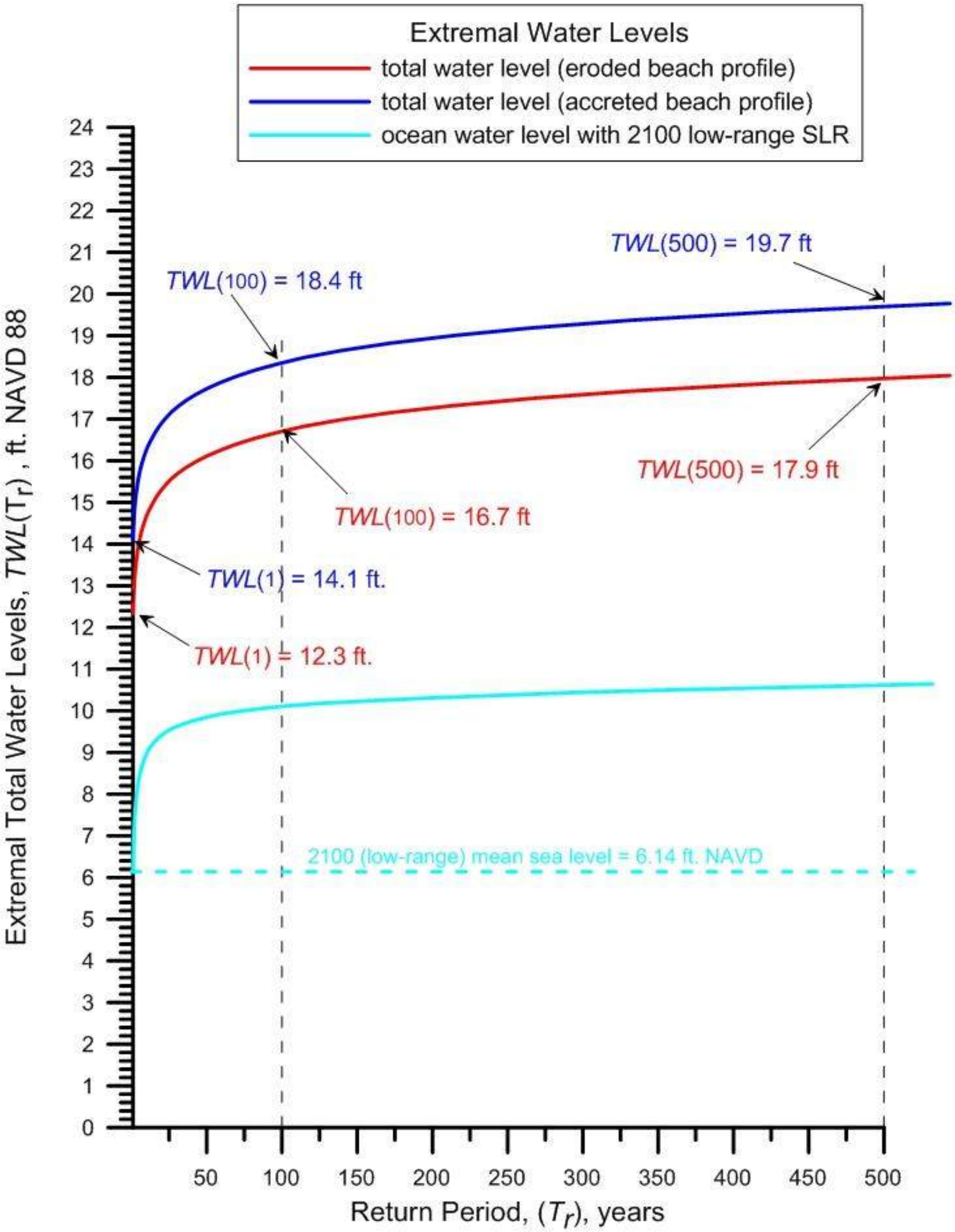


Figure 7.12: Return period of extremal total water level (TWL) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the low-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

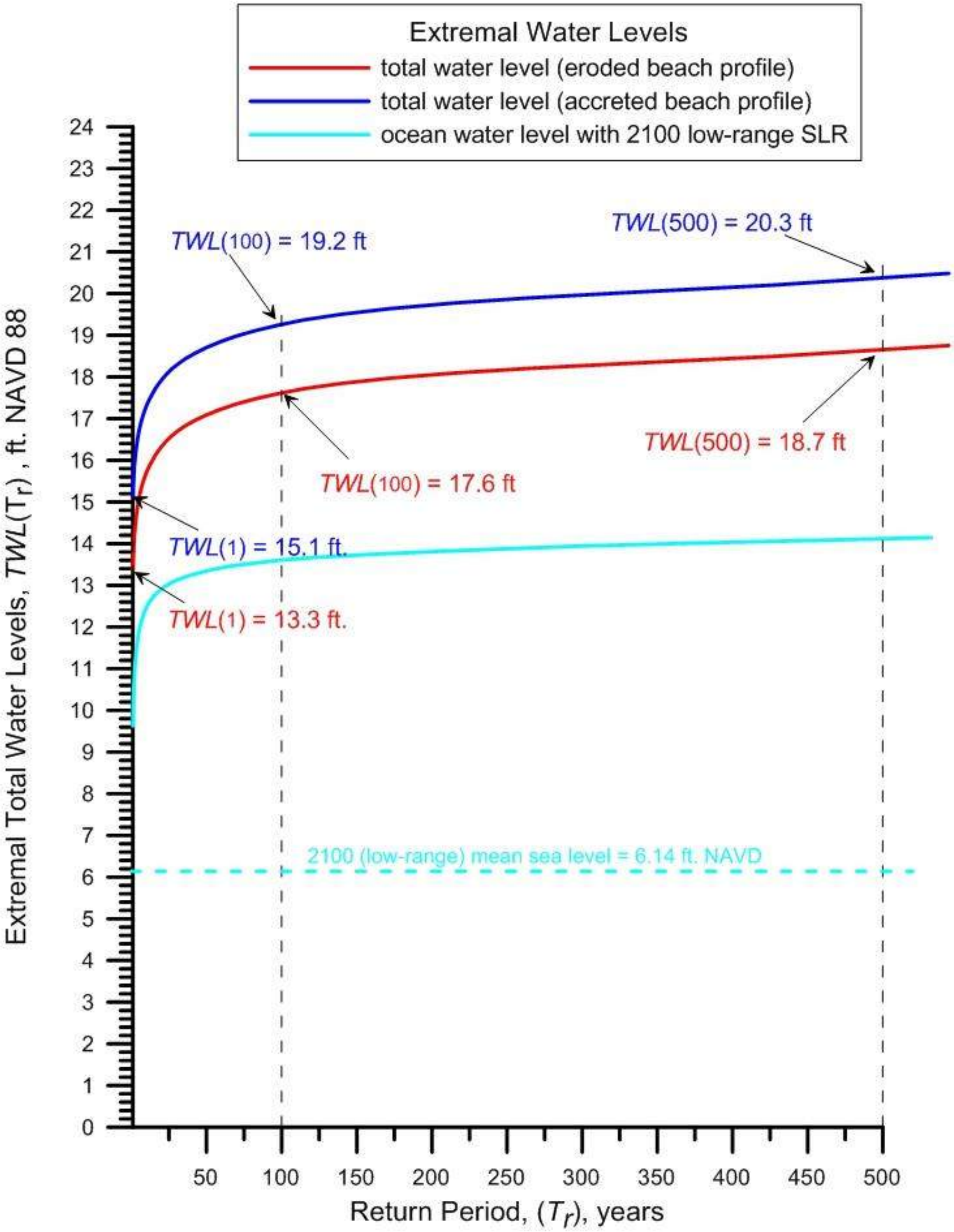


Figure 7.13: Return period of extremal total water level (TWL) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the low-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

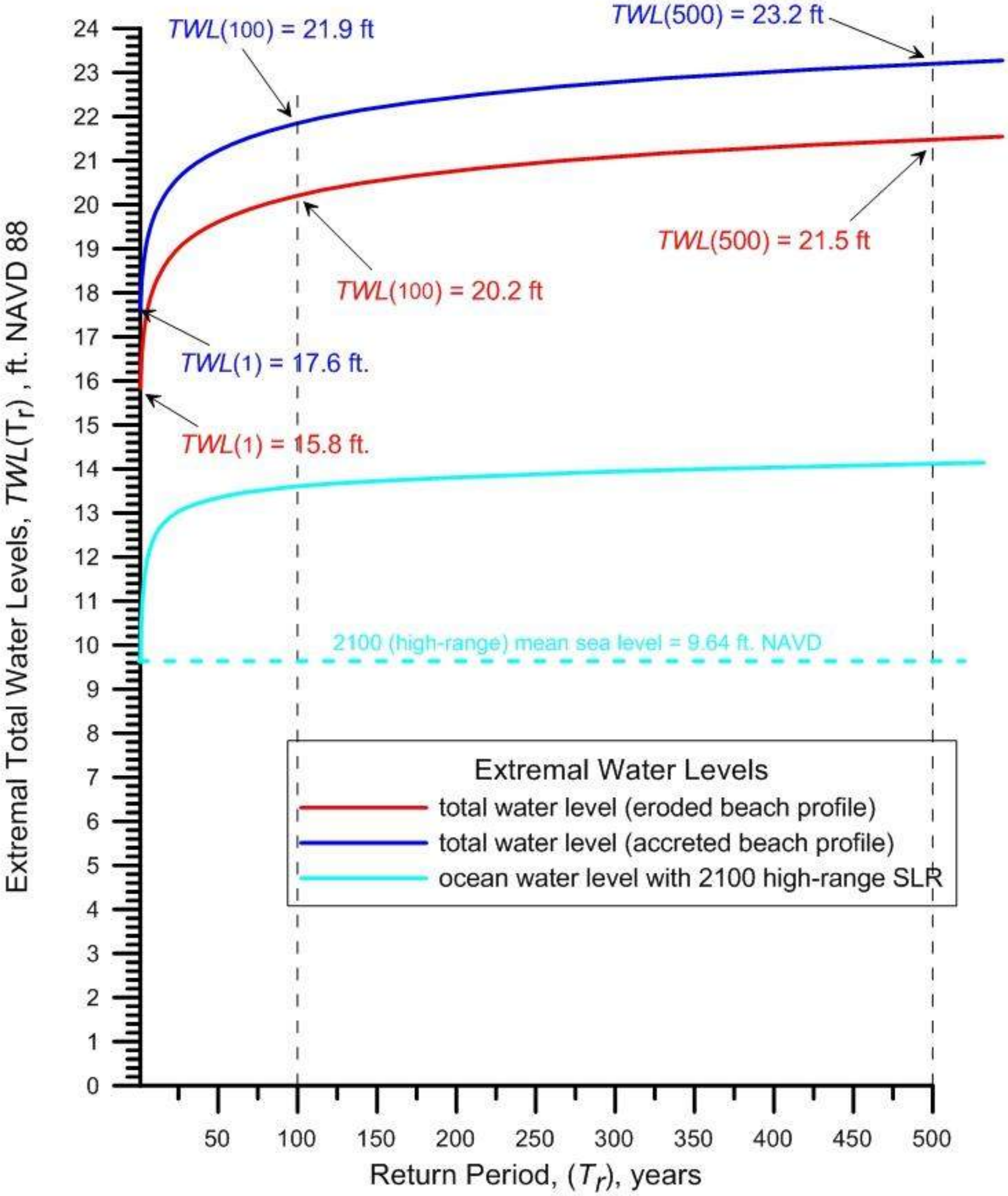


Figure 7.14: Return period of extremal total water level (TWL) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the high-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

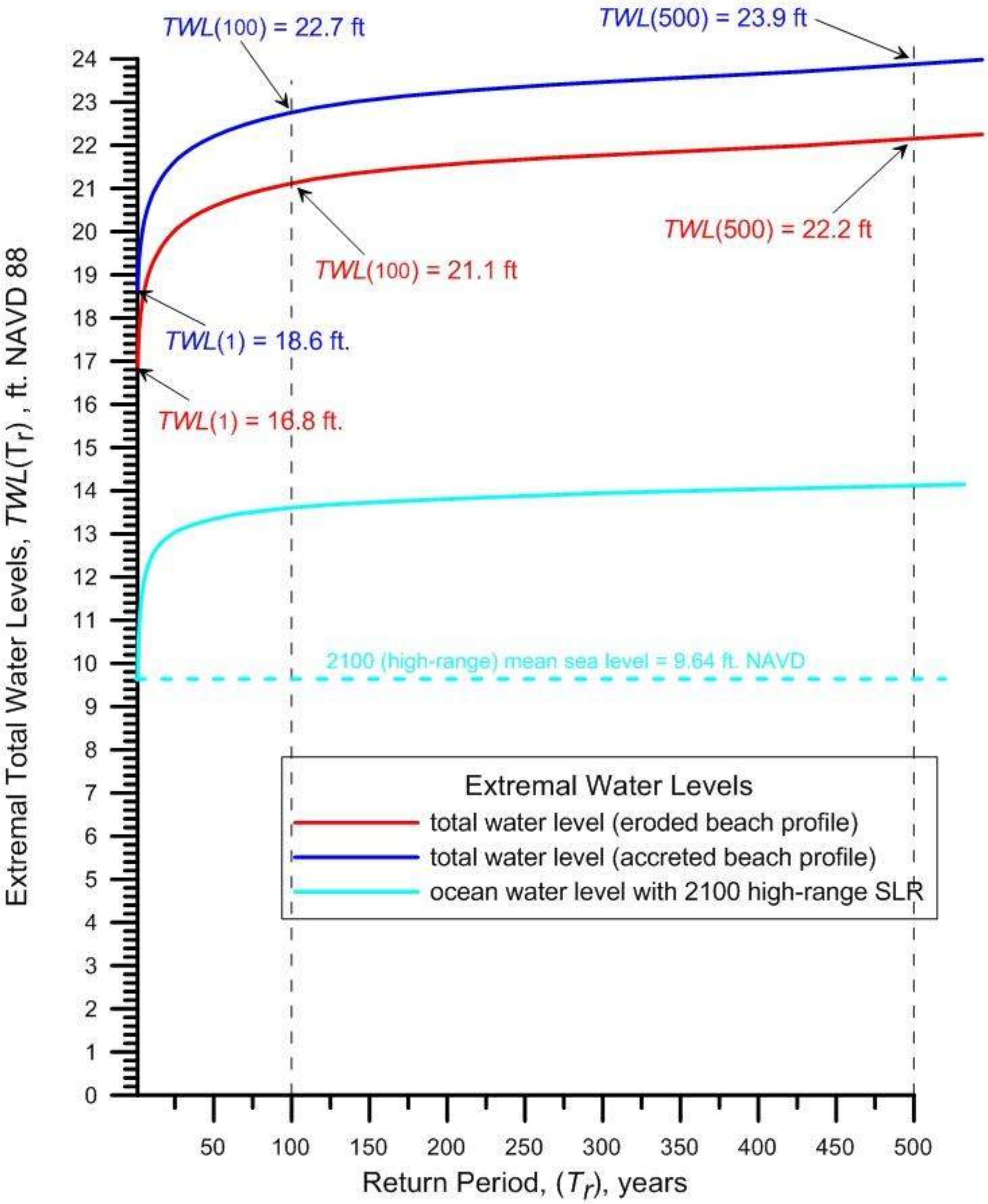


Figure 7.15: Return period of extremal total water level (TWL) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the high-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

year event. Total water levels for eroded beach conditions are always less, because these beaches have flatter slopes and are more dissipative of wave set-up and run-up than the steeper accreted beaches.

For the high-range 2100 sea level projections at Doheny Beach (Figure 7.14), the 100 year total water level events reach $TWL(100)$ = 21.9 ft. NAVD for the accreted beach conditions and $TWL(100)$ = 20.2 ft. NAVD for the eroded beach conditions; while at Capistrano Beach, (Figure 7.15), $TWL(100)$ = 22.7 ft. NAVD for the accreted beach conditions and $TWL(100)$ = 21.1 ft. NAVD for the eroded beach conditions. Consequently all beach front facilities for the Doheny Desalination Project would be vulnerable to flooding by the 100-year event if it were occur during 2100 high range sea level projections. The lowest lying well heads (Well Heads A-C at Doheny Beach) would experience the highest overtopping rates, ranging from Q'(100yr) = 0.216 cfs/ft. to 0.331 cfs/ft. depending on the eroded or accreted condition of Doheny State Beach. According Table VI-5-6 in the Coastal Engineering Manual (USACE, 2006) overtopping rates of this order of magnitude are very dangerous for pedestrian and vehicle traffic, and may cause structural damage to adjacent buildings; but the well heads and pumps for the Doheny Desalination project will be protected by steel vault enclosures. The smallest overtopping rates during the 100-year event at the high range 2100 sea level projections will occur at the highest located well head (Well Head H) at the Capistrano Beach site where overtopping rates will range from Q' (100yr) = 0.142 cfs/ft. to 0.250 cfs/ft., with overtopping rates at Well Heads D & E on Doheny Beach ranging from Q'(100yr) = 0.149 cfs/ft to 0.263cfs/ft and Q'(100yr) = 0.209 cfs/ft to 0.318 cfs/ft at Well Head G on Capistrano Beach. While these overtopping rates are still dangerous to pedestrian and vehicle traffic, they are easily mitigated by the steel vault enclosures of the well heads and pumps being placed at Capistrano Beach. The results for total water levels and overtopping rates based on extremal still water levels analysis methods are summarized in Table 7.1 for the Doheny Beach well sites, and in Table 7.2 for the Capistrano Beach well sites.

Table 7.1:Doheny Beach Extremal Total Water Level (*TWL) and Overtopping Rates (Q')

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
*$TWL(1)$ Present Sea Level (eroded/accreted)	8.7/10.5 ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry
*$Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = dry	15.8/17.6 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ Present Sea Level (eroded/accreted)	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry
**$Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach
**$Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.027 cfs/ft.	0.0/0.027 cfs/ft.
**$TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded
**$Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.149/0.263 cfs/ft.	0.149/0.263 cfs/ft.

*Evaluated for the 1-yr return period; ** Evaluated for the 100-yr return period

Table 7.2: Capistrano Beach Extremal Total Water Level (*TWL*) and Overtopping Rates (Q')

	Well Head-G Elevation = 18 ft. NAVD	Well Head-H Elevation = 19 ft. NAVD
$*TWL(1)$ Present Sea Level (eroded/accreted)	9.7/11.5 ft. NAVD status = dry	9.7/11.5 ft. NAVD status = dry
$*Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	13.3/15.1 ft. NAVD status = dry	13.3/15.1 ft. NAVD status = dry
$*Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	16.8/18.6 ft. NAVD status = flooded accreted beach	16.8/18.6 ft. NAVD status = dry
$*Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.00 cfs/ft.
$**TWL(100)$ Present Sea Level (eroded/accreted)	14.0/15.6 ft. NAVD status = dry	14.0/15.6 ft. NAVD status = dry
$**Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$**TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	17.6/19.2 ft. NAVD status = flooded accreted beach	17.6/19.2 ft. NAVD status = flooded accreted beach
$**Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.081 cfs/ft.	0.0/0.014 cfs/ft.
$**TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	21.1/22.7 ft. NAVD status = flooded	21.1/22.7 ft. NAVD status = flooded
$**Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.209/0.318 cfs/ft.	0.142/0.250 cfs/ft.

*Evaluated for the 1-yr return period
** Evaluated for the 100-yr return period

8.0 Tsunami Run-up and Overtopping Analysis:

Tsunami induced erosion, runup, and inundation were analyzed for the Doheny State Beach bottom profiles (Figures 6.8- 6.12) and shore-side facilities associated with the Doheny Desalination Project for present and future sea levels according to low and high range sea level rise predictions as shown in Figure 3.1. Because of the uncertainty of the probability of occurrence of such a tsunami event, and the absense of specific guidance on the redline frequency for flooding considerations in the *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2018), we will carry forward the total water level analysis based on the stationary still water level hypothesis; whereby the still water level in the shoaling and runup equations is fixed at whatever mean sea level is for each sea level rise scenario.

The tsunami event scenario is based on a 2m high solitary wave approaching Doheny Beach from 165 degrees true, as could be anticipated for a catastrophic tsunami event arising from a major landside on the east side of San Clemente Island. The local refraction/diffraction pattern from the solitary wave is calculated in Figure 8.1 for present mean sea level. Inspection of Figure 8.1 reveals the tsunami wave height begins to increase at 50 m of water depth due to shoaling and reaches 6m of height before breaking along the shores of Doheny Beach. Because the tsunami wave begins shoaling in much deeper water than typical storm-induced waves, it causes seabed scour and erosion to occur out to very deep water depths. Therefore all run-up and total water level solutions are based eroded beach profile conditions. The critical mass thickness computed by the CEM in Figure 8.2 for this tsunami shoaling scenario reveals that seabed erosion occurs offshore to depths of -124 to -137 ft. MSL; and the volume of eroded sediment can be as high as 1,827 m^3 per meter of shoreline. Figure 8.2 also shows that a tsunami of this magnitude is capable of eroding as much as 4 ft to 6 ft of seabed offshore, to depths of -120 to -130 ft. MSL, and could erode as much as 12 ft . of beach sediment cover in a single tsunami wave breaking event.

Tsunami runup and TWL inundation calculations in Tables 8.1 & 8.2 also indicate that all of the shore facilities of the Doheny Desalination Project are above tsunami inundation levels at present sea level. However, all of the well heads at both Doheny and Capistrano Beaches would suffer some degree of tsunami overtopping if concurrent with 2100 sea levels, and the overtopping rates could be quite severe, especially for the high 210 sea level rise projections. At the low range of 2100 sea level projections, total water levels would reach TWL = 18.82 ft. NAVD at Doheny Beach and TWL = 18.83 ft. NAVD at Capistrano Beach. Well Heads A-C at Doheny Beach would experience the highest overtopping surges of Q' = 1.142 cfs/ft while Well Head G at Capistrano Beach would remain high and dry. However, if the tsunami occurred atop the high range sea level rise projections for year 2100, then total water levels would reach TWL = 22.31 ft. NAVD at Doheny Beach and TWL = 22.4 ft. NAVD at Capistrano Beach, sufficient to overtop all the well sites of the Doheny Desalination Project. In this case the tsunami surge could produce very high, although short-lived, overtopping rates reaching a maximum of Q' = 5.691 cfs/ft at Well Heads A-C on Doheny Beach and a minimum of Q' = 2.916 cfs/ft at Well Head H on Capistrano Beach. Undoubtedly, the steel vault enclosures of the well heads can be designed to withstand these high surge rates, but particular attention should be given to the foundations of the vaults to assure the foundations have adequate depth to prevent undercutting by scour. These findings are consistent with the FEMA tsunami flood map which show that all of the Doheny Beach/San Juan Creek corridor extending several miles inland will be inundated by a shoaling tsunami solitary wave.

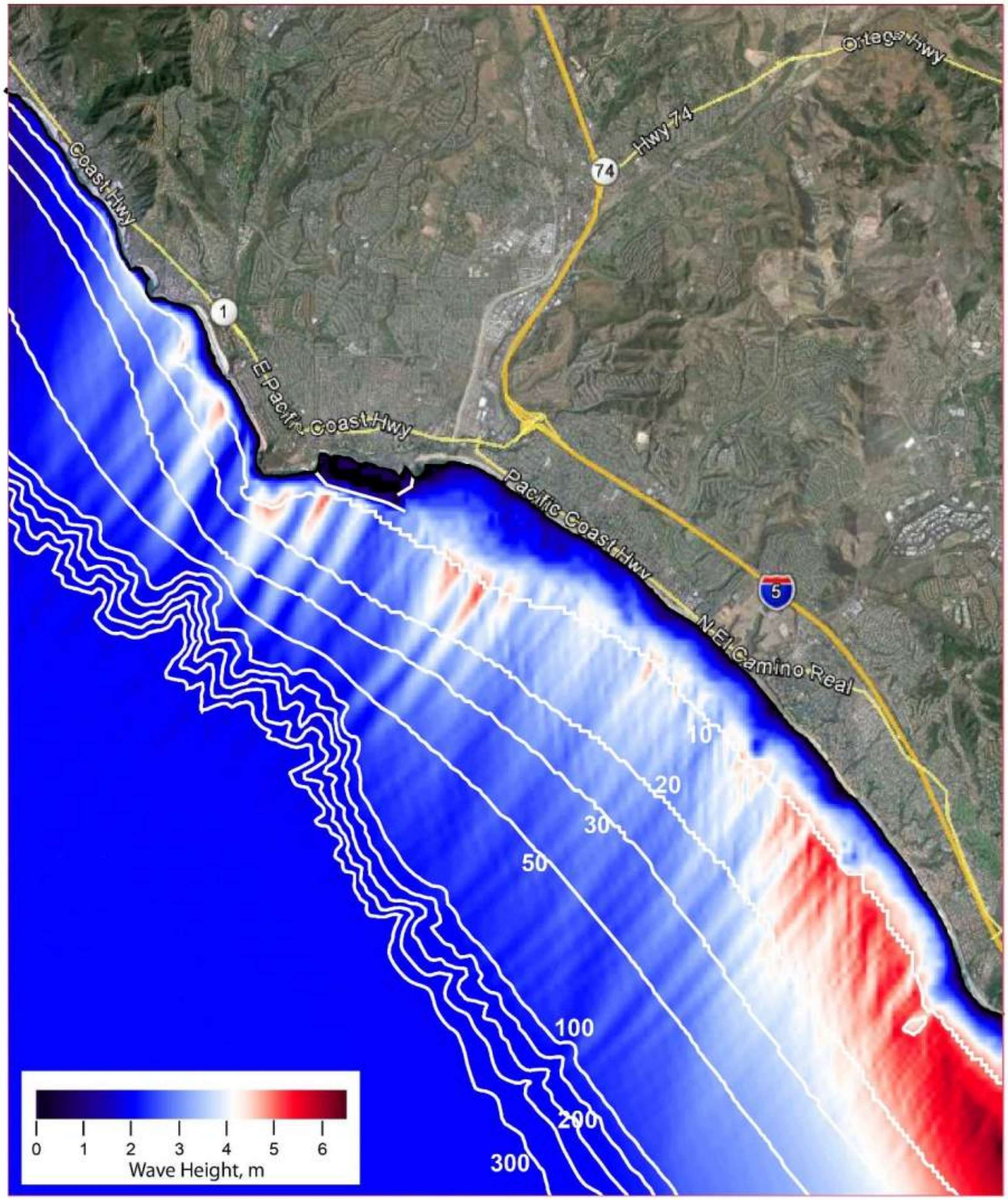


Figure 8.1: High resolution refraction/diffraction computation for a 2m high solitary tsunami wave approaching Doheny Beach from 165 degrees true.

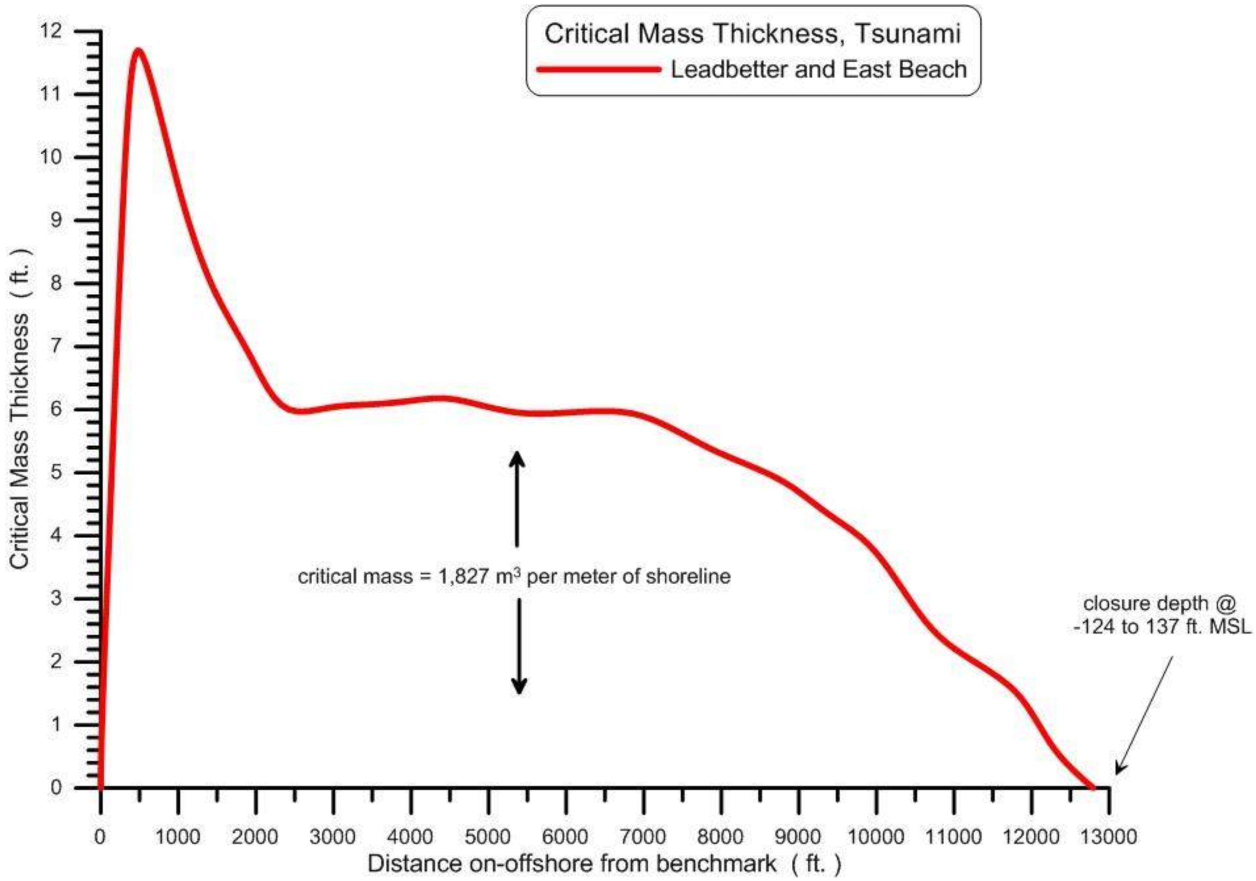


Figure 8.2: Thickness of critical mass envelope at historic survey ranges Doheny Beach, calculated by the calibrated CEM sediment budget based a 2m high solitary tsunami wave approaching Doheny Beach from 165 degrees true. Closure depth = -124 to -137 ft. MSL; critical mass volume = 1,827 m^3 per meter of shoreline.

Table 8.1: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Doheny Beach Site

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
TWL Present Sea Level	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry
Q' Present Sea Level	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.
TWL 2100 Sea Level Low Range Projection	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded
Q' 2100 Sea Level Low Range Projection	1.142 cfs/ft.	1.142 cfs/ft.	1.142 cfs/ft.	0.345 cfs/ft.	0.345 cfs/ft.
TWL @ 2100 Sea Level High Range Projection	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded
Q' 2100 Sea Level High Range Projection	5.691 cfs/ft.	5.691 cfs/ft.	5.691 cfs/ft.	4.162 cfs/ft.	4.162 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Doheny State Beach from 165 degrees true

Table ES-2b: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Capistrano Beach Site

	Well Head-G Elevation = 18 ft. NAVD eroded/accreted	Well Head-H Elevation = 19 ft. NAVD eroded/accreted
**TWL* Present Sea Level (eroded)	15.3 ft. NAVD status = dry	15.3 ft. NAVD status = dry
$*Q'$ Present Sea Level (eroded)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**TWL* 2100 Sea Level Low Range Projection (eroded)	18.83 ft. NAVD status = flooded	18.83 ft. NAVD status = dry
$*Q'$ 2100 Sea Level Low Range Projection (eroded)	0.352 cfs/ft.	0.0/0.0 cfs/ft.
**TWL* 2100 Sea Level High Range Projection (eroded)	22.4 ft. NAVD status = flooded	22.4 ft. NAVD status = flooded
$*Q'$ 2100 Sea Level High Range Projection (eroded)	4.293 cfs/ft.	2.916 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Capistrano Beach from 165 degrees true.

9) Summary and Conclusions:

This 2019 study, prepared in response to comments for the Final EIR, provides further analysis to amplify the Coastal Hazards Analysis prepared in 2017 for the Draft EIR of the Doheny Desalination Project. That earlier work is being amplified herein in response to a revision of the *California Coastal Commission Sea Level Rise Policy Guidance* document that was originally released in August 2015, (CCC, 2015), but has been updated in July 2018 with new sea level rise projections. In addition, there have been minor adjustments in the locations of a number of the well heads and pump stations being proposed for the Doheny Desalination Project. The following study accounts for these intervening changes in policy guidance and minor modifications to the project description.

The primary analysis tool used in this study is the *Coastal Evolution Model* (CEM) developed at the Scripps Institution of Oceanography was used to evaluate Appendix-B requirements of the *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2015) for a sea level rise/coastal hazards analysis of the Doheny Desalination Project (DDP). The Coastal Evolution Model is public domain and available from the University of California Digital Library at: http://repositories.cdlib.org/sio/techreport/58/. The Coastal Evolution Model employs algorithms consistent with the U.S. Army Corps of Engineers *Coastal Engineering Manual*, (USACE, 2006), but employs the latest generation equilibrium beach profile algorithms from Jenkins and Inman (2006) that provide 3-dimensional predictive and mapping capability of the wave run-up field, beach erosion and shoreline recession under the effects of wave climate variability, climate cycles and sea level rise. The CEM input files were populated with National Ocean Survey digital bathymetry in the offshore domain; beach profiles sediment grain size measurements by the U.S. Army Corps of Engineers, Coastal Environments and Coastal Frontiers; long-term wave data from the Coastal Data Information Program; long-term ocean water level measurements by the National Oceanic and Atmospheric Administration; and stream flow and sediment flux for the San Juan Creek from the United States Geological Survey and the Federal Emergency Management Agency. Sea level rise projections used in this study were based on the *best fit equation* from Appendix-B of the *California Coastal Commission Sea Level Rise Policy Guidance* document for a 50 year project planning horizon (year 2070) and for a *critical infrastructure* planning horizon (year 2100). Critical project infrastructure subject to potential flooding by extreme event waves or tsunami concurrent with extreme ocean water levels and sea level rise are placed at two sites, namely Doheny State Beach and Capistrano State Beach. At the Doheny Beach site, five potential locations are being evaluated for vaulted well heads with submersible pumps, including : ***Well Head A***, elevation 17 ft. NAVD, at 33°27'44.38"N, 117°41'16.32"W; ***Well Head B***, elevation 17 ft. NAVD, at 33°27'45.07"N, 117°41'10.30"W; ***Well Head C***, elevation 17 ft. NAVD at 33°27'45.12"N, 117°41'6.62"W; ***Well Head D***, at elevation 18 ft. NAVD at 33°27'44.48"N, 117°40'55.30"W; and ***Well Head E***, at elevation 18 ft. NAVD at 33°27'42.45"N, 117°40'47.33"W. Two additional vaulted well heads with submersible pumps are being evaluated at the Capistrano Beach site, which includes: ***Well Head G***, at elevation 18 ft. NAVD at 33°27'14.94"N, 117°39'59.91"W; and ***Well Head H***, at elevation 19 ft. NAVD at 33°27'13.17"N, 117°39'57.15"W.

This study is based on sea level rise projections appearing in Appendix-G, Table G-11, of the recently updated *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2018). This document provides no specific guidance on the redline frequency for flooding or inundation. In the absence of such guidance we have adopted Federal Emergency Management Agency standards for flooding frequency and set redline planning frequency at the 100 year event (1% probability of recurrence). The 100 year wave event was the two day storm of 17-18 January, 1988, which produced deep water significant wave heights off Doheny State Beach reaching 15.5 ft., approaching the beach from 270^0 with 14 second significant wave periods.

An analysis of extremal total water levels, (TWL's), based on the occurrence of extreme waves concurrent with extreme ocean water levels at present and at year 2100 sea levels, is summarized in Table 7.1 for structures at the Doheny Beach site and Table 7.2 for the Capistrano Beach site. Inspection of Table 7.1 & 7.2 reveals that all the beach front well sites for the Doheny Desalination Project are safe from flooding or inundation at present sea levels by extreme event waves concurrent with extreme ocean water levels for event return periods between 1 yr. and 100 yr. However, once we admit to 2100 sea level rise projections, a number of the beach front facilities for the Doheny Desalination Project will suffer some flooding and overtopping to varying degrees.

For the low-range 2100 sea level projections, the three well sites on the north side of San Juan Creek (Well Heads A-C) and one of the wells at the Capistrano Beach site (Well Head G) will experience minor overtopping, even for a 1 year event if the beaches have been accreted by additional sands from water shed floods or still retain a built-out summer equilibrium beach profile, with overtopping rates of about $Q'(1\text{yr}) = 0.038$ cfs per lineal ft. of shoreline. However, if a 100-yr total water level event occurs during the low-range projection of 2100 sea levels, then all of the well sites will be overtopped to varying degrees if the beaches remain in an accreted condition with elevated berms and steep beach slopes. Under these beach conditions, overtopping rates will range from a high of $Q'(100\text{yr}) = 0.094$ cfs per lineal ft. of shoreline at Well Heads A- C, to a low of $Q'(100\text{yr}) = 0.014$ cfs/ft at Well Head H. Interestingly enough, none of the well heads would experience overtopping during a 100 year event when occurring during the low range 2100 sea levels if the beach were eroded, which would be the most likely condition during a 100-year event. Total water levels for eroded beach conditions are always less, because these beaches have flatter slopes and are more dissipative of wave set-up and run-up than the steeper accreted beaches.

For the high-range 2100 sea level projections, Table 7.1 indicates the 100 year total water level events at the Doheny Beach site reach $TWL(100) = 21.9$ ft. NAVD for the steeply sloping accreted beach conditions and $TWL(100) = 20.2$ ft. NAVD for the eroded beach conditions. At the Capistrano Beach site, shoaling wave heights are higher and total water levels for a 100 year event superimposed on the high range projections for 2100 sea levels produce total water levels reaching $TWL(100) = 22.7$ ft. NAVD for the steeply sloping accreted beach conditions and $TWL(100) = 21.1$ ft. NAVD for the eroded beach conditions. Consequently, all beach front well heads for the Doheny Desalination Project will be overtopped and flooded when extreme waves happen concurrently with extreme ocean water levels that are superimposed on the high range of 2100 sea levels. The lowest lying well heads (Well Heads A-C) would experience the highest overtopping rates, ranging from $Q'(100\text{yr}) = 0.216$ cfs/ft. to 0.331 cfs/ft. depending on the eroded or accreted condition of Doheny State Beach. According Table VI-5-6 in the Coastal Engineering Manual (USACE, 2006) overtopping rates of this order of magnitude are very dangerous for pedestrian and vehicle traffic, and may cause structural damage to adjacent buildings, but the well heads and pumps for the Doheny Desalination project will be protected by steel vault enclosures. The smallest overtopping rates during the 100-year event at the high range2100 sea level projections will occur at the highest located well head (Well Head H) at the Capistrano Beach site where overtopping rates will range from $Q'(100\text{yr}) = 0.142$ cfs/ft. to 0.250 cfs/ft. While these overtopping rates are still dangerous to pedestrian and vehicle traffic, they are easily mitigated by the steel vault enclosures of the well heads and pumps being placed at Capistrano Beach.

Tsunami induced erosion, runup, and inundation were analyzed for the Doheny and Capistrano State Beaches and shore-side facilities associated with the Doheny Desalination Project for present and future sea levels according to low and high range sea level rise predictions. The analysis was based on numerical refraction/diffraction codes for a shoaling solitary wave. The tsunami event scenario is based on a 2m high solitary wave approaching Doheny Beach from 165 degrees true, as could be anticipated for a catastrophic tsunami event arising from a major landside on the east side of San Clemente Island. The local refraction/diffraction pattern from the solitary wave reveals the tsunami wave height begins to increase at 50 m of water depth due to shoaling, and reaches 6m of height before breaking along the shores of Doheny and Capistrano Beaches. Because the tsunami wave begins shoaling in much deeper water than typical storm-induced waves, it causes seabed scour and erosion to occur out to very deep-water depths. Therefore, all run-up and total water level solutions are based eroded beach profile conditions.

Tsunami TWL inundation calculations are summarized Table 8.1 for the Doheny Beach site, and Table 8.2 for the Capistrano Beach site. These tables indicate that all of the shore facilities of the Doheny Desalination Project are above tsunami inundation levels at present sea level. However, all of the well heads at both Doheny and Capistrano Beaches would suffer some degree of tsunami overtopping if concurrent with 2100 sea levels, and the overtopping rates could be quite severe, especially for the high 210 sea level rise projections. At the low range of 2100 sea level projections, total water levels would reach TWL = 18.82 ft. NAVD at Doheny Beach and TWL = 18.83 ft. NAVD at Capistrano Beach. Well Heads A-C at Doheny Beach would experience the highest overtopping surges of Q' = 1.142 cfs/ft while Well Head G at Capistrano Beach would remain high and dry. However, if the tsunami occurred atop the high range sea level rise projections for year 2100, then total water levels would reach TWL = 22.31 ft. NAVD at Doheny Beach and TWL = 22.4 ft. NAVD at Capistrano Beach, sufficient to overtop all the well sites of the Doheny Desalination project. In this case the tsunami surge could produce very high, although short-lived, overtopping rates reaching a maximum of Q' = 5.691 cfs/ft at Well Heads A-C on Doheny Beach and a minimum of Q' = 2.916 cfs/ft at Well Head H on Capistrano Beach. Undoubtedly, the steel vault enclosures of the well heads can be designed to withstand these high surge rates, but particular attention should be given to the foundations of the vaults to assure those foundations have adequate depth to prevent undercutting by scour. These findings are consistent with the FEMA tsunami flood map which show that all of the Doheny Beach/San Juan Creek corridor extending several miles inland will be inundated by a shoaling tsunami solitary wave.

10) References:

Bromirski, P., Miller, A., Flick, R., and G. Auad, 2011. “Dynamical suppression of sea level rise along the Pacific coast of North America,” *Jour Geophysical Res*., 116

Bruun, P.,1962, “Sea level rise as a cause of shore erosion,” *Jour Waterways and Harbors Division*, ASCE, vol. 88, 116

Bruun, P., 1983, ‘Review of conditions for use of the Bruuns Rule of erosion”, *Coastal Eng*., vol 7, p. 77-89.

CalCOFI, 2014, “California Cooperative Oceanic Fisheries Investigation”, Southern California Coastal Ocean Observation System, SCOOS Data: http://www.calcofi.org/data/sccoos/sccoos-data.html

CCC, 2015, “*California Coastal Commision Sea Level Rise Policy Guidance”,* adopted 12 August 2015, 254 pp.

CCC, 2018, “*California Coastal Commision Sea Level Rise Policy Guidance: Draft Science Update”,* adopted July 2018, 305 pp.

CDIP, 1984-1988, "Coastal data information program, monthly reports," U. S. Army Corps of Engineers, California Department of Boating and Waterways, Monthly Summary Reports #97-#150.

CDIP, 1976-1995, "Coastal Data Information Program, Monthly Reports," U. S. Army Corps of Engineers, California Department of Boating and Waterways, SIO Reference Series, 76-20 through 95-20.

CDIP, 1993-1994, "Monthly Summary Report," SIO Reference Series (93-27) through (94-19).

CDIP, 2016, “Coastal Data Information Program” http://cdip.ucsd.edu/

Coastal Frontiers, 2014, “Doheny State Beach: Beach Profiles West of San Juan Creek”, personal communications.

Coastal Environments,2014, “Updated Coastal Processes and Hydraulic/Hydrology Studies for Doheny State Beach, Technical Report,” submitted to South Coast Water District, 164 pp.

Gacia, E., O. Invers, M. Manzaneera, E. Ballesteros and AJ. Romero. 2007. Impact of the brine from a desalination plant on a shallow seagrass (*Posidonia oceanic*) meadow. *Estuarine and Coastal Shelf Science* 72:579-590.

Graham, J. B., 2004, “Marine biological considerations related to the reverse osmosis desalination project at the Applied Energy Sources, Huntington Beach Generating Station," Appendix-S in REIR, 2005, 100 pp.

Jenkins, S. A. and J. Wasyl, 2005, "Coastal evolution model," Scripps Institution of Oceanography Tech Report No. 58, 179 pp + appendices. http://repositories.cdlib.org/sio/techreport/58/

Jenkins, S. A. and D. L. Inman, 2006, "Thermodynamic solutions for equilibrium beach profiles", *Jour. Geophys. Res.*, v.3, C02003, doi:10.1029/2005JC002899, 2006. 21pp.

National Research Council (NRC). 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Report by the Committee on Sea Level Rise in California, Oregon, and Washington. National Academies Press, Washington, DC. 250 pp. http://www.nap.edu/catalog/13389/sea-level-rise-for-the-coasts-of-california-oregon-and-washington.

NOAA, 2016, "Historic Water Levels - Station Selection," https://tidesandcurrents.noaa.gov/stations.html?type=Historic+Water+Levels http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=9410230%20La%20 Jolla,%20CA&type=Bench%20Mark%20Sheets

Raubenheimer, B., R. T. Guza, and S. Elgar (1996), Wave transformation across the inner surf zone, *J. Geophys. Res.*, *101*(11), 25589–25597.

RWQCB, 2014a, "ORDER NO. R9-2012-0012, NPDES NO. CA0107417 WASTE DISCHARGE REQUIREMENT FOR THE SOUTH ORANGE COUNTY WASTEWATER AUTHORITY, DISCHARGE TO THE PACIFIC OCEAN THROUGH THE SAN JUAN CREEK OCEAN OUTFALL," CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD SAN DIEGO REGION, 157 pp.

RWQCB, 2014b, "ORDER NO. R9-2012-0012, NPDES NO. CA0107417 WASTE DISCHARGE REQUIREMENT FOR THE SOUTH ORANGE COUNTY WASTEWATER AUTHORITY, DISCHARGE TO THE PACIFIC OCEAN THROUGH THE SAN JUAN CREEK OCEAN OUTFALL, APPENDIX-H DILUTION MODEL INFORMATION" CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD SAN DIEGO REGION, 8 pp.

SCCOOS, 2014, "Southern California Coastal Ocean Observation System", Current Data, SJCOO: http://www.sccoos.org/data/hfrnet/

SEIR, 2010, "Subsequent Environmental Impact Report Sea Water Desalination Project at Huntington Beach," #2001051092, City of Huntington Beach, prepared by Dudek Consulting, May, 2010, 9 sections + append.

SWRCB, 2015, Amendment to the Water Quality Control Plan For Ocean Waters of

California Addressing: "DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND THE INCORPORATION OF OTHER NON-SUBSTANTIVE CHANGES", cf. Appendix-A: "Ocean Plan with the May 6, 2015 Final Desalination Amendment", 1303 pp.

Star-CD, 1998 Manuals Version 3.1, *Computational Dynamics*. 1999.

U.S. Army Corps of Engineers, 1985, "Littoral zone sediments, San Diego Region, October 1983 – June 1984", Coast of California Storm and Tidal Wave Study, CCSTWS 85-11.

U. S. Army, Corps of Engineers (USACE), 1991, "State of the Coast Report, San Diego Region," Los Angeles District, CA: Coast of California Storm and Tidal Waves Study, Final Report 1.

U. S. Army, Corps of Engineers (USACE), 2006, "Coastal Engineering Manual," Engineering Manual 1110-2-1100, U. S. Army, Corps of Engineers, Washington, DC, (in 6 volumes).

U.S. Department of Commerce National Ocean Service, 1986, "Tide tables 1986, high and low water predictions for west coast of North and South America", 234 pp.

USGS, 1997, "USGS Digital Data Series DDS-37 at INTERNET URL," http://wwwrvares.er.usgs.gov/wgn96cd/wgn/wq/region18/hydrologic unit code.

Van der Meer, J.W., 2002. *Wave Run-up and Overtopping at Dikes.* Technical Report, Technical Advisory Committee for Water Retaining Structures (TAW), Delft, the Netherlands.

Appendix-A: Refraction/Diffraction Plots for Extreme Event Waves:

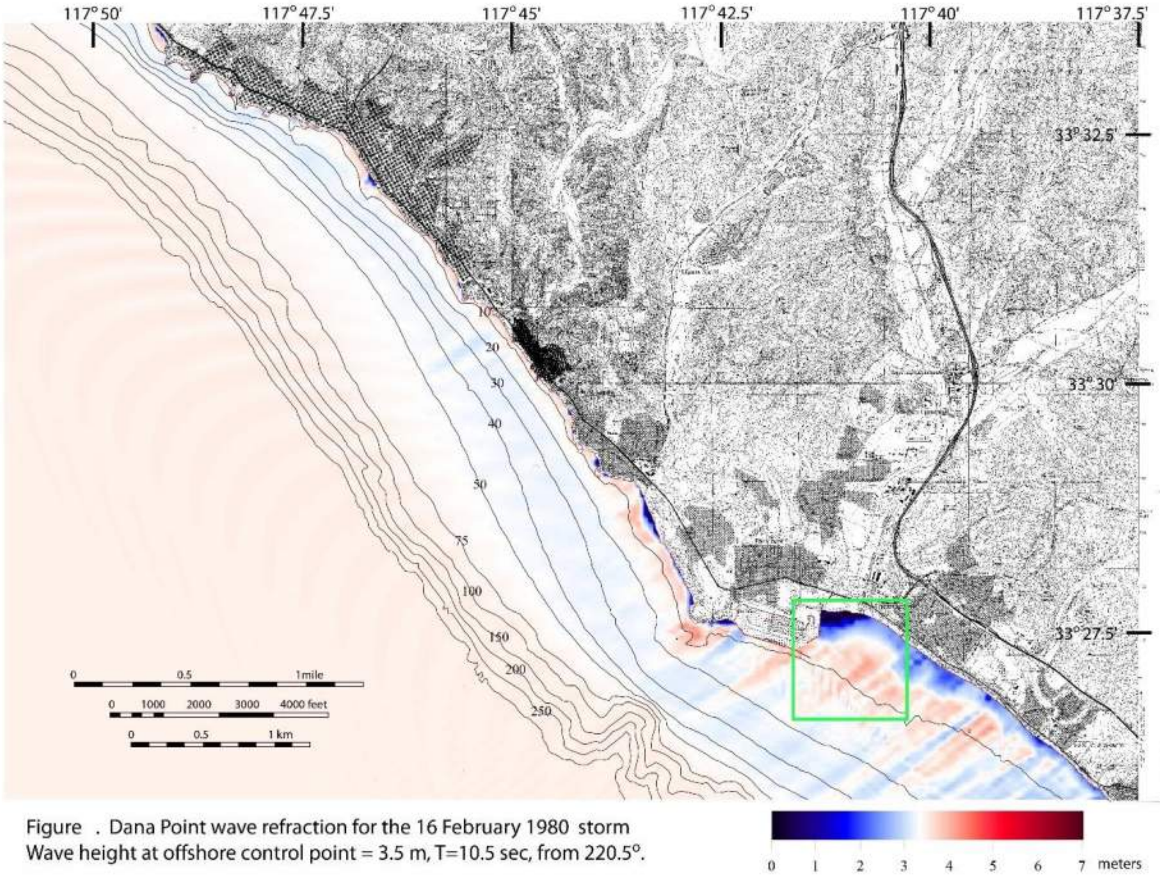


Figure . Dana Point wave refraction for the 16 February 1980 storm
Wave height at offshore control point = 3.5 m, T=10.5 sec, from 220.5°.

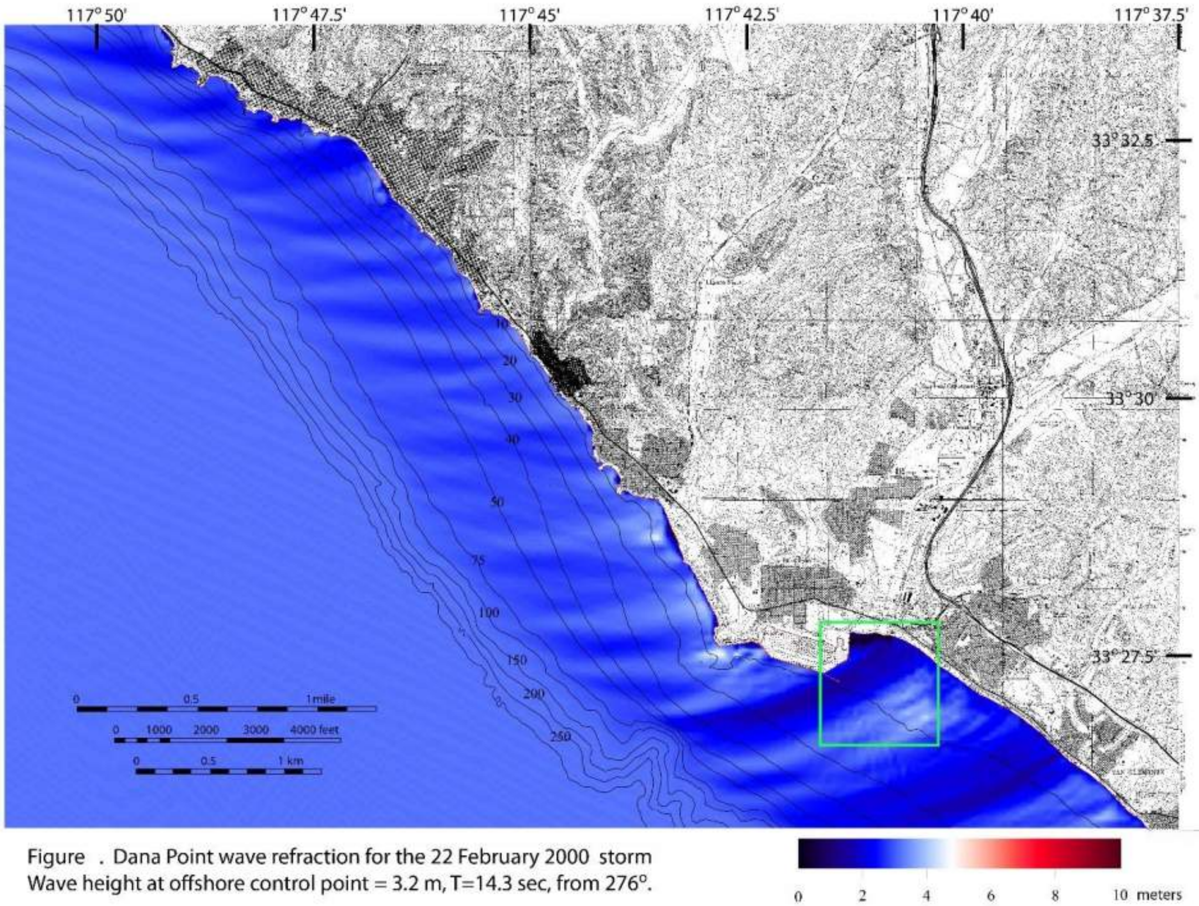


Figure . Dana Point wave refraction for the 22 February 2000 storm
Wave height at offshore control point = 3.2 m, T=14.3 sec, from 276°.

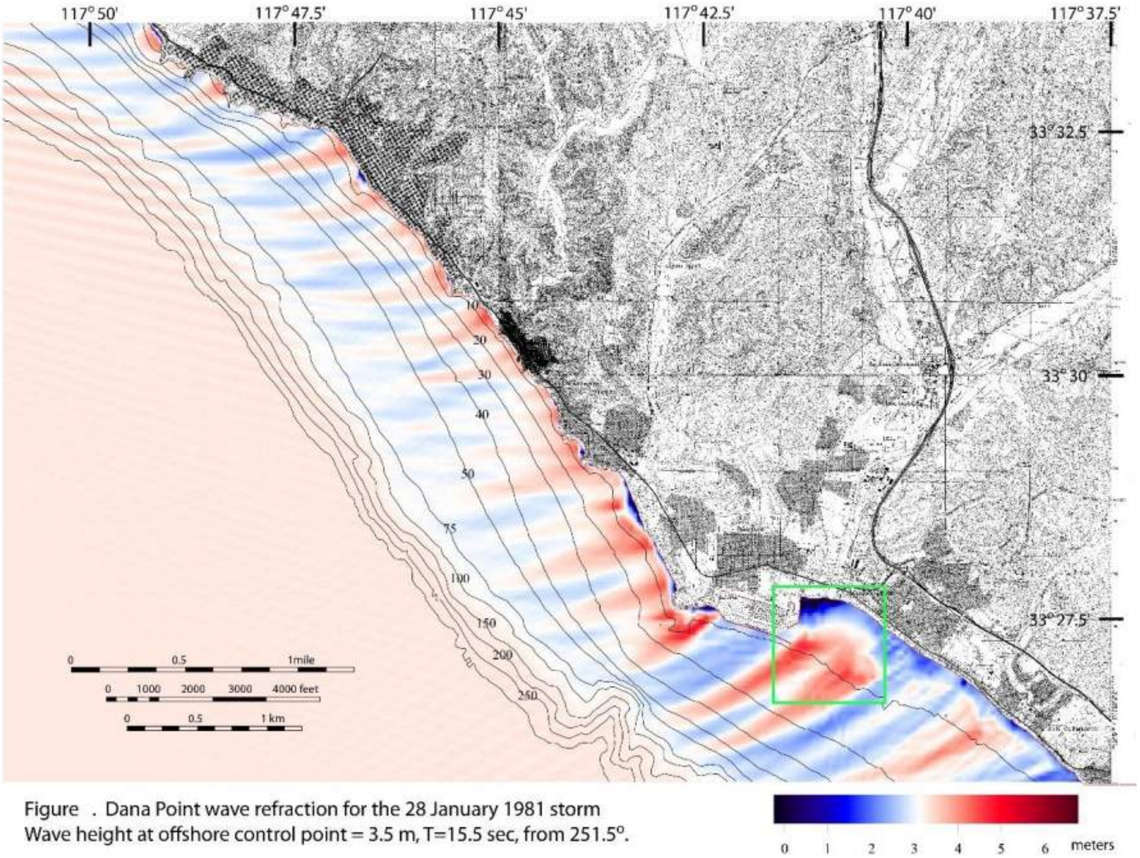


Figure . Dana Point wave refraction for the 28 January 1981 storm
Wave height at offshore control point = 3.5 m, T=15.5 sec, from 251.5°.

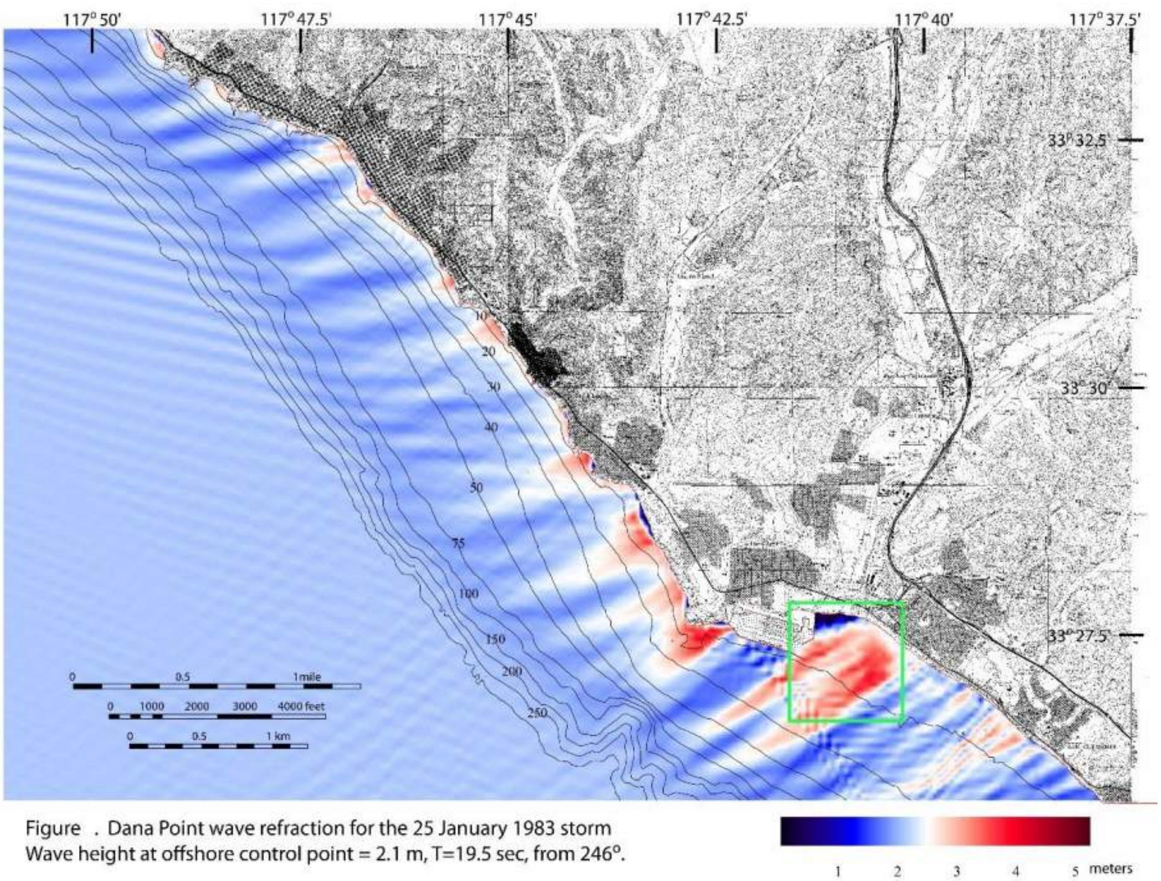


Figure . Dana Point wave refraction for the 25 January 1983 storm
Wave height at offshore control point = 2.1 m, T=19.5 sec, from 246°.

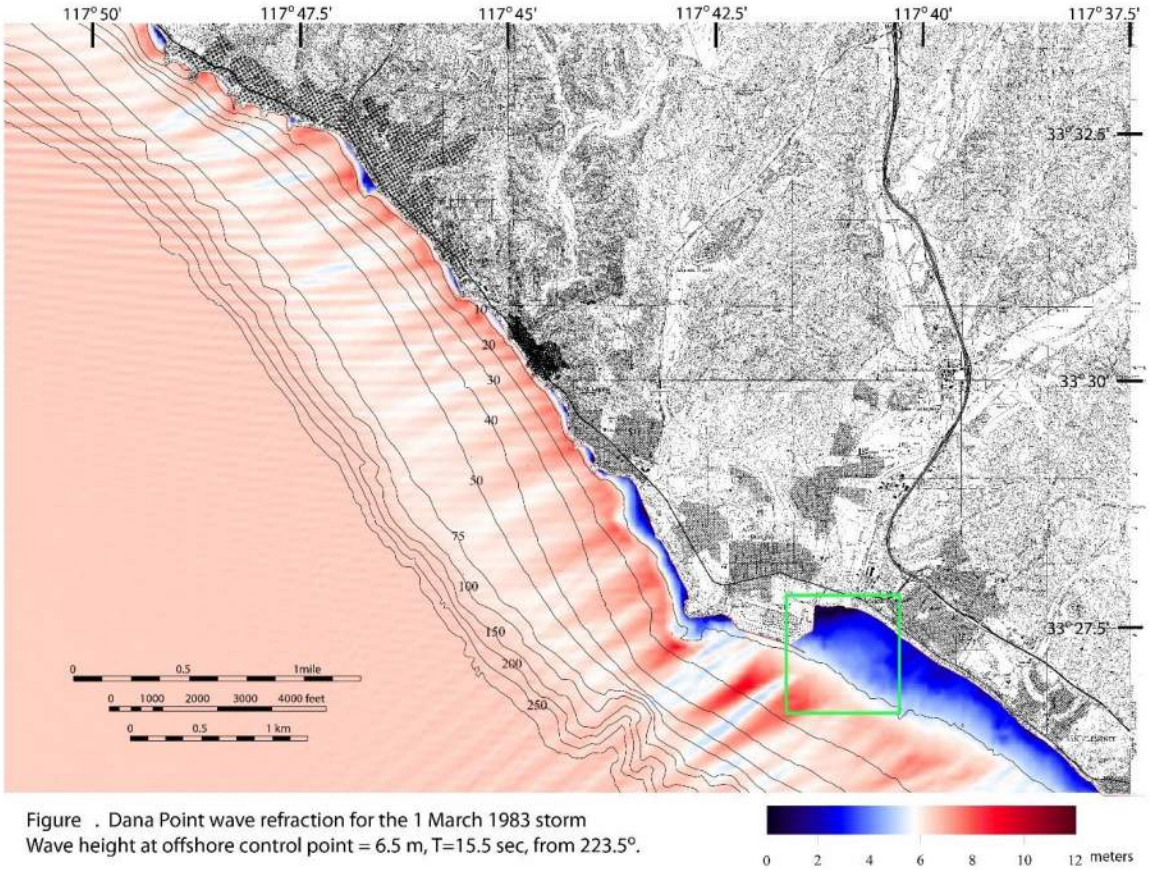


Figure . Dana Point wave refraction for the 1 March 1983 storm
Wave height at offshore control point = 6.5 m, T=15.5 sec, from 223.5°.

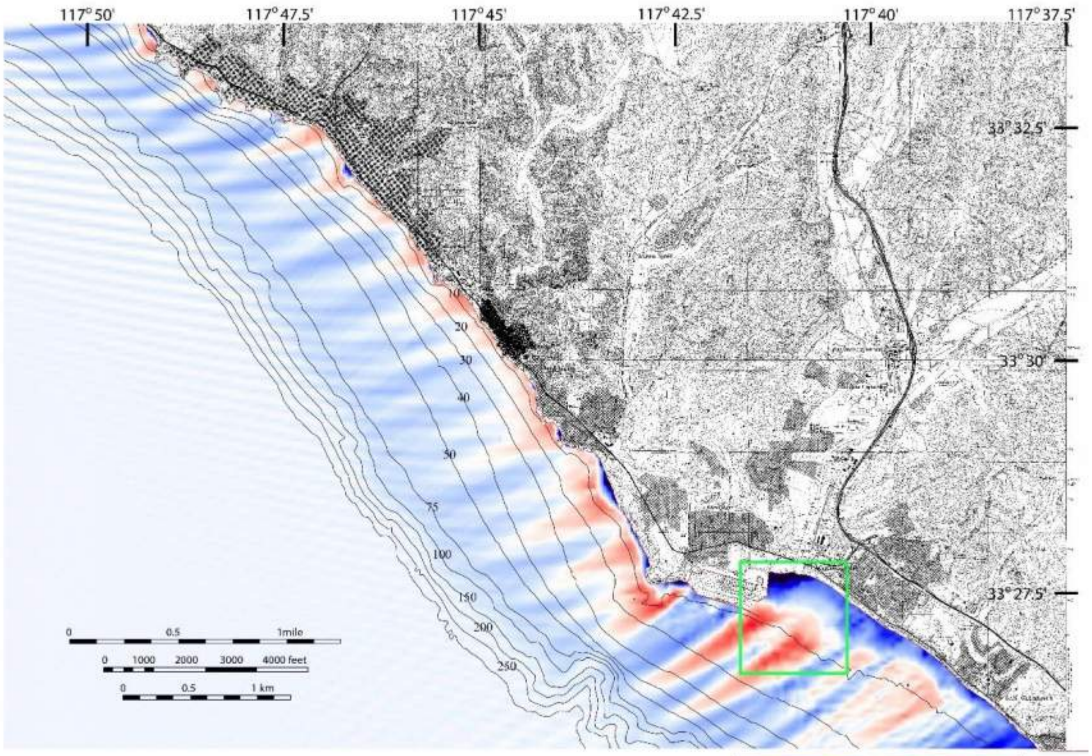


Figure . Dana Point wave refraction for the 14 February 1986 storm.
Wave height at offshore control point = 3.7 m, T=16.5 sec, from 238.5°.

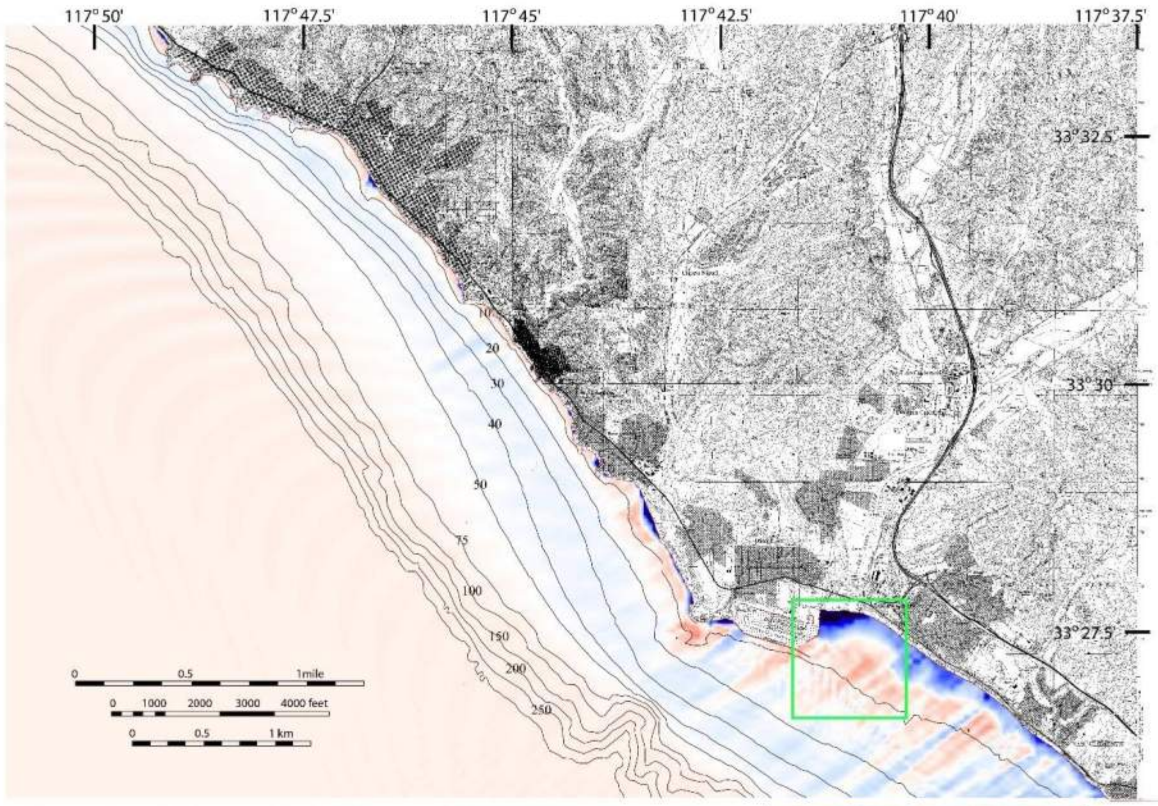


Figure . Dana Point wave refraction for the 16 February 1980 storm
Wave height at offshore control point = 3.5 m, T=10.5 sec, from 220.5°.

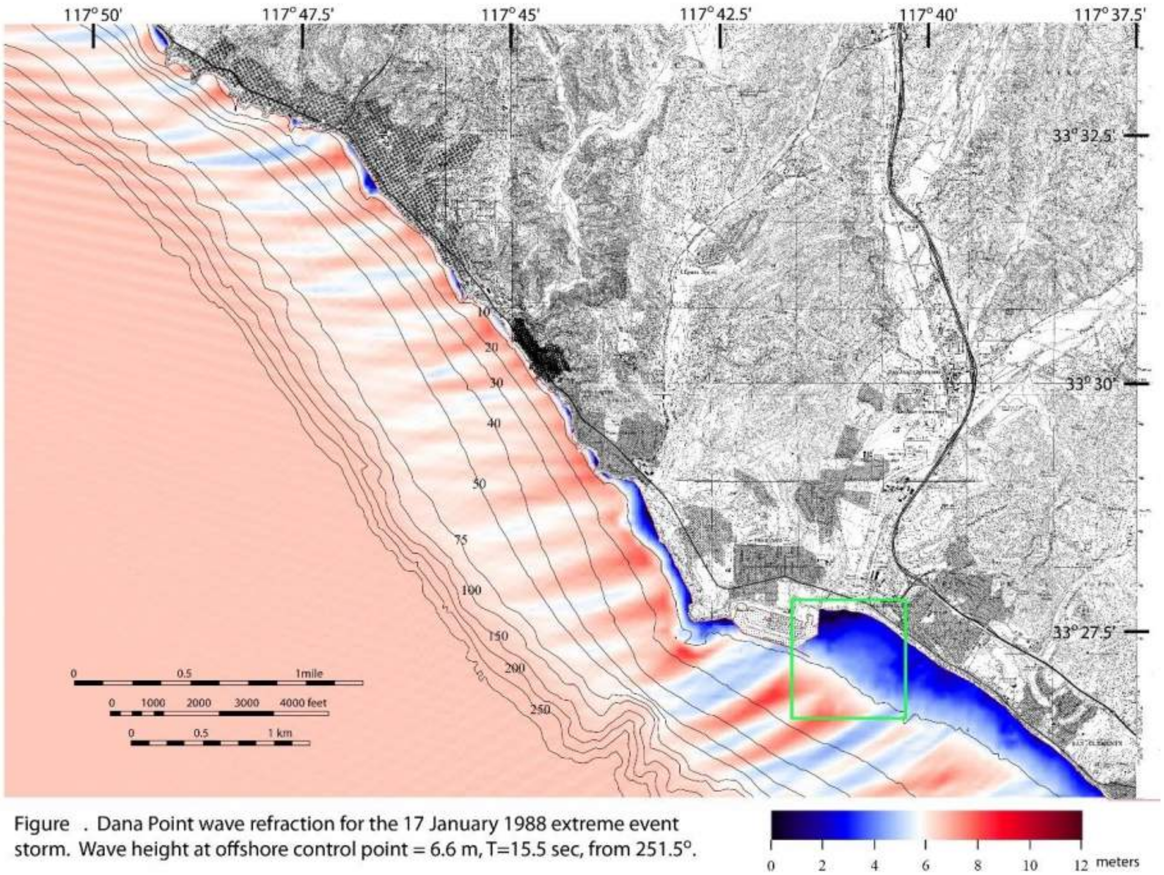


Figure . Dana Point wave refraction for the 17 January 1988 extreme event storm. Wave height at offshore control point = 6.6 m, T=15.5 sec, from 251.5°.

The 100 year (1%) Storm, Day-1

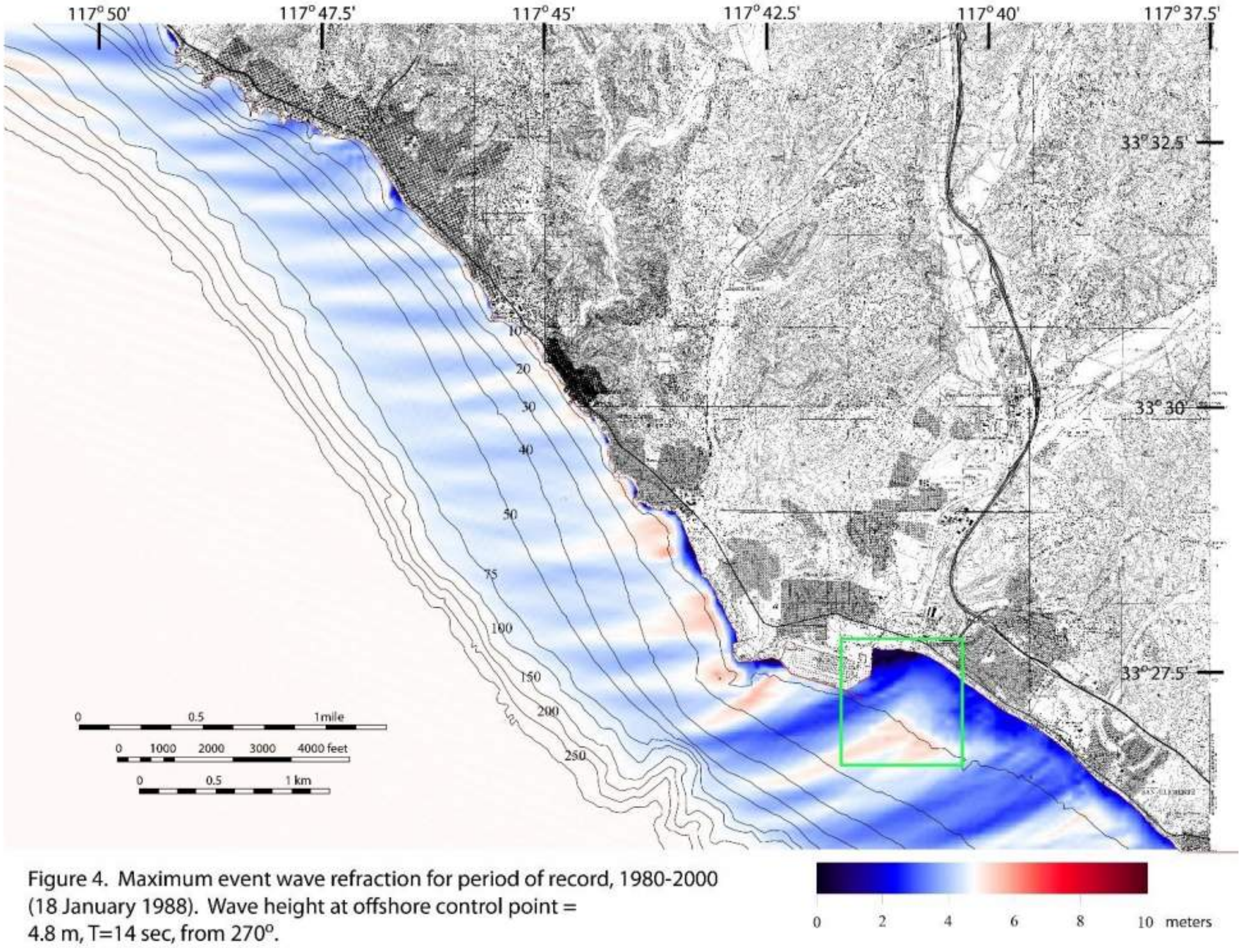


Figure 4. Maximum event wave refraction for period of record, 1980-2000 (18 January 1988). Wave height at offshore control point = 4.8 m, T=14 sec, from 270°.

The 100 year (1%) Storm, Day-2

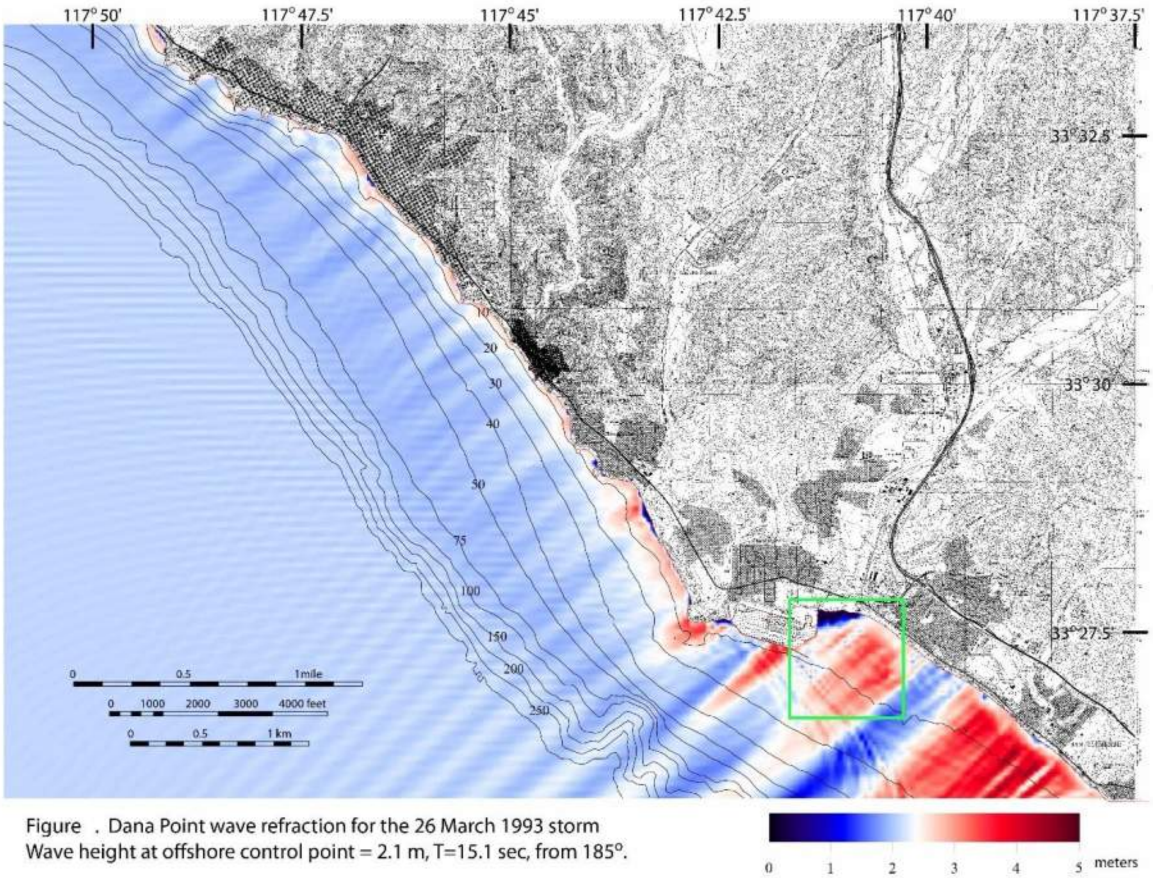


Figure . Dana Point wave refraction for the 26 March 1993 storm
Wave height at offshore control point = 2.1 m, T=15.1 sec, from 185°.

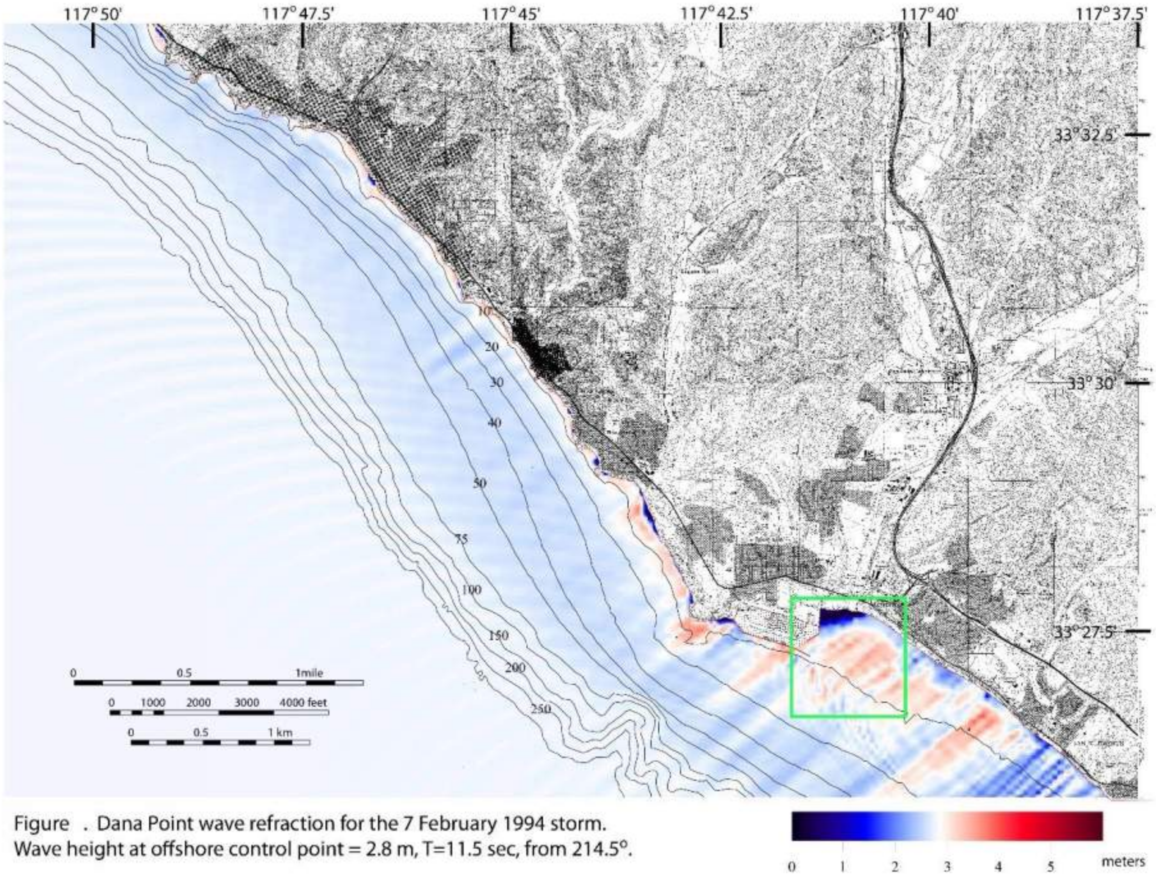


Figure . Dana Point wave refraction for the 7 February 1994 storm.
Wave height at offshore control point = 2.8 m, T=11.5 sec, from 214.5°.

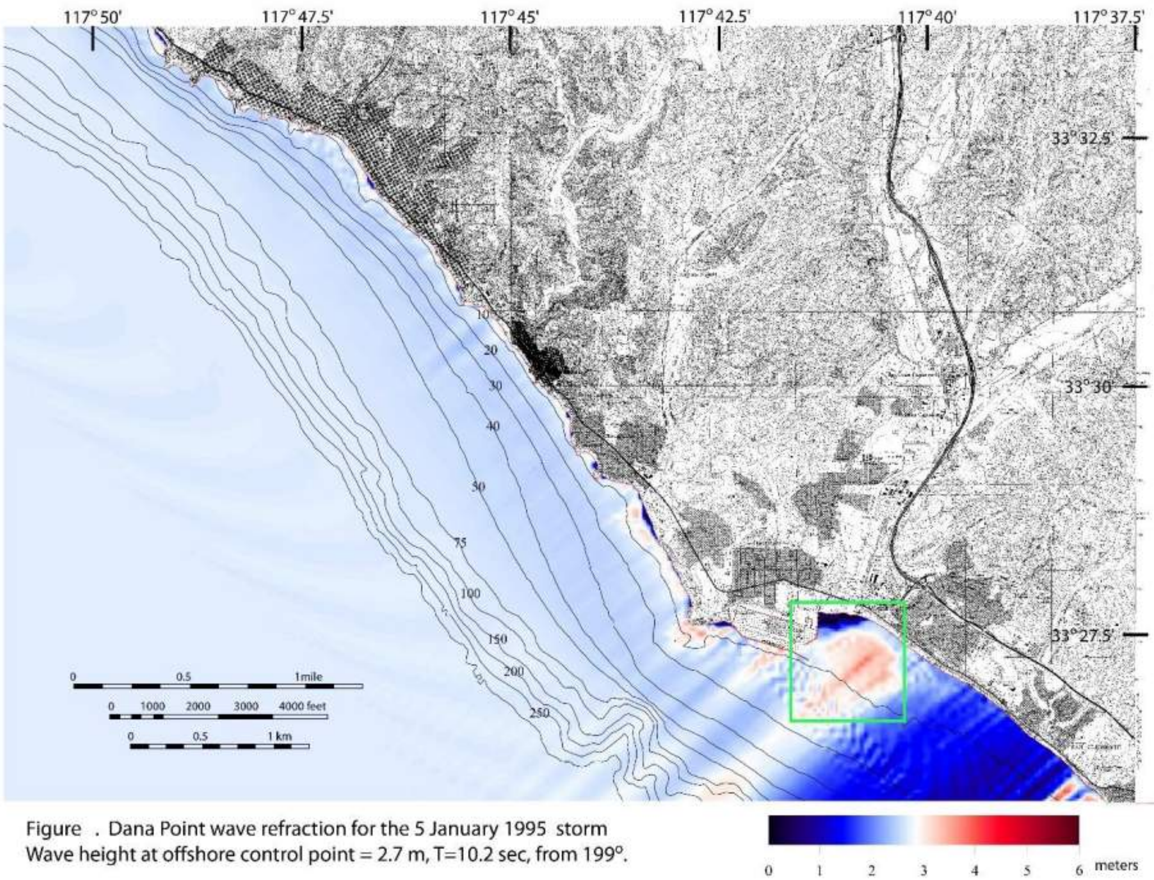


Figure . Dana Point wave refraction for the 5 January 1995 storm
Wave height at offshore control point = 2.7 m, T=10.2 sec, from 199°.

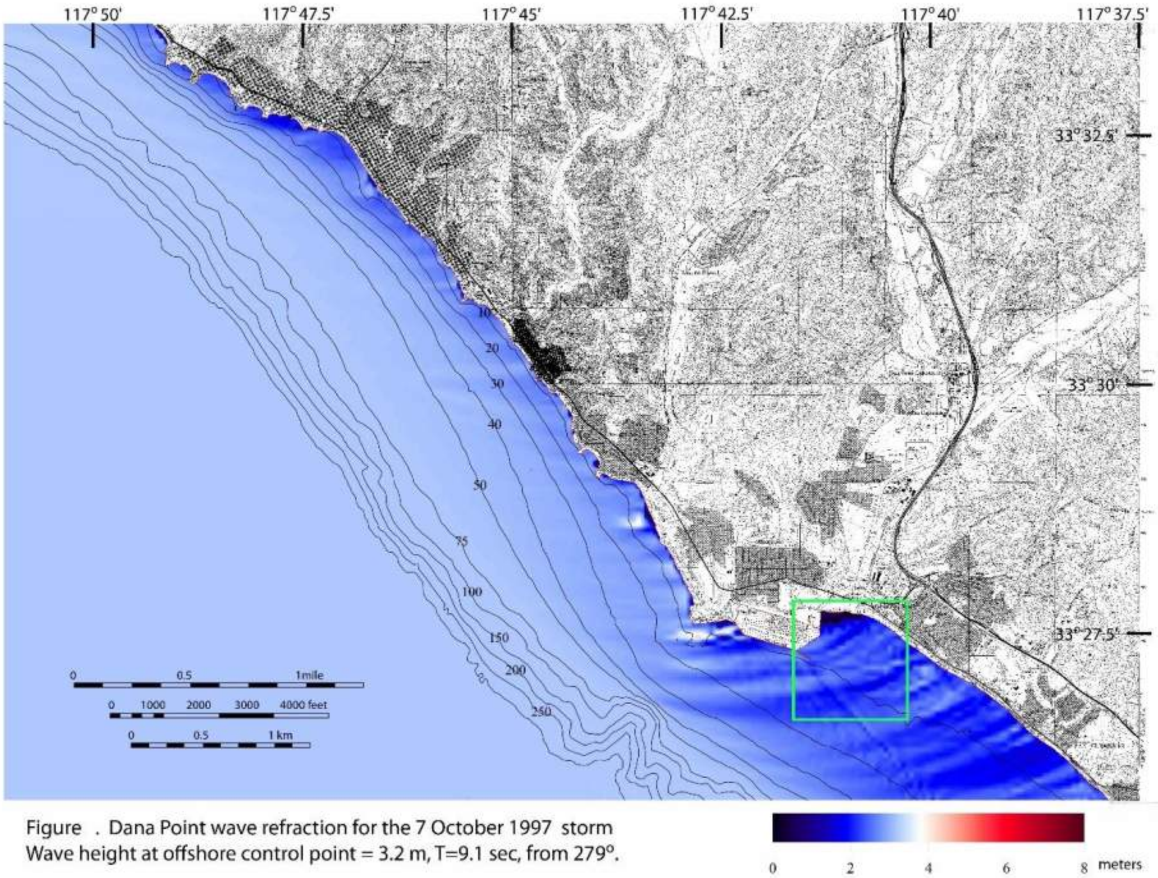


Figure . Dana Point wave refraction for the 7 October 1997 storm
Wave height at offshore control point = 3.2 m, T=9.1 sec, from 279°.

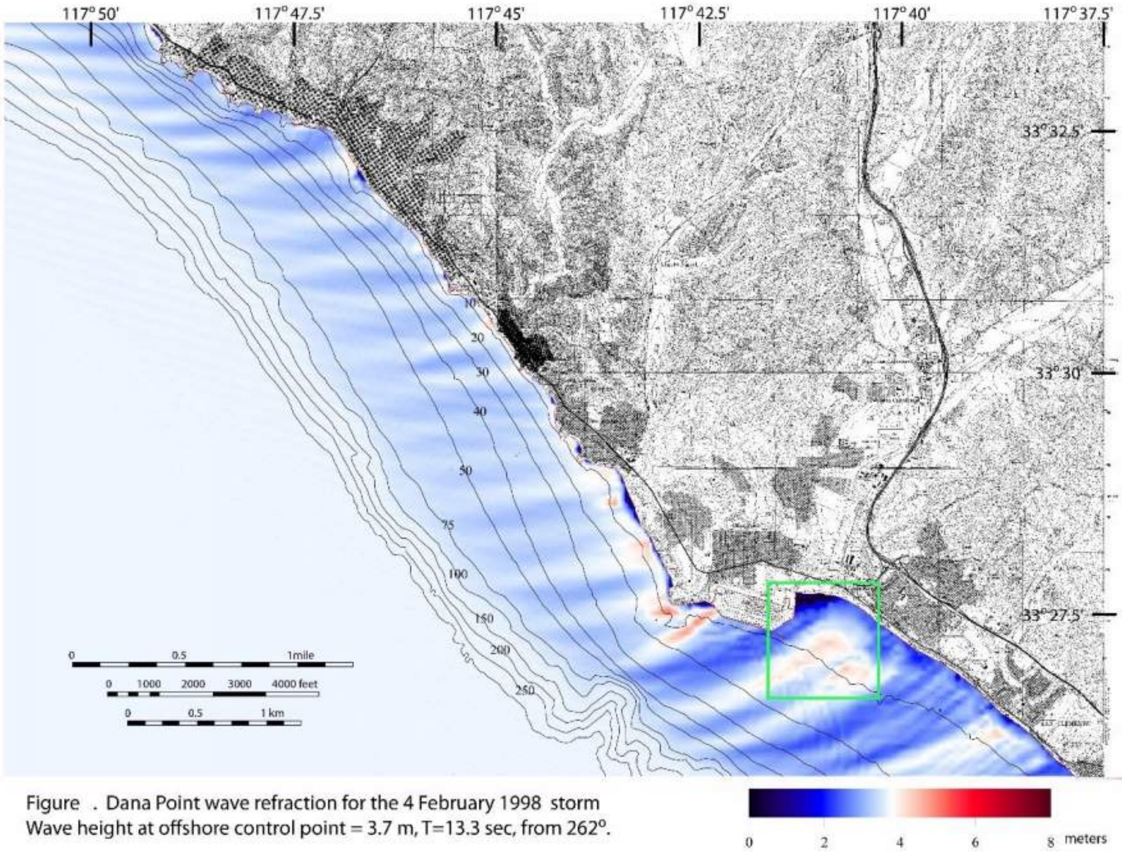


Figure . Dana Point wave refraction for the 4 February 1998 storm
Wave height at offshore control point = 3.7 m, T=13.3 sec, from 262°.

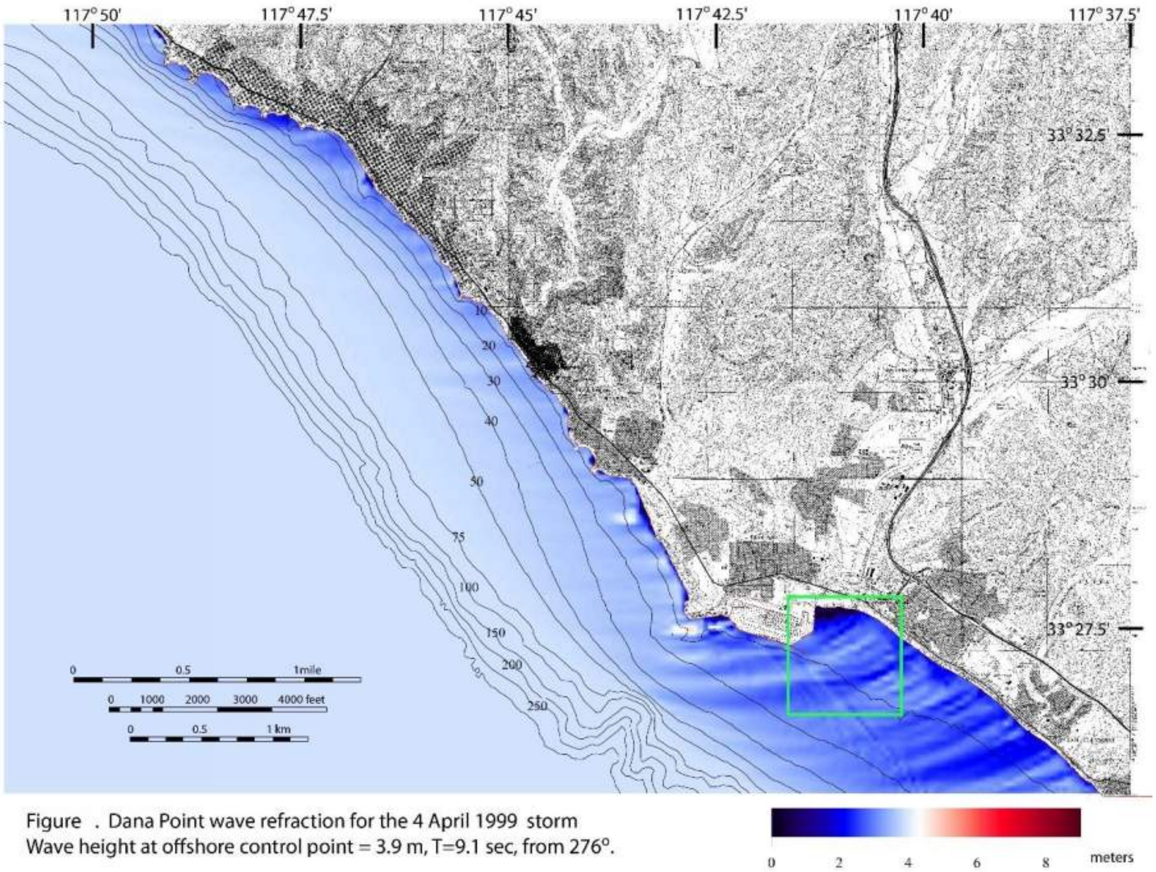


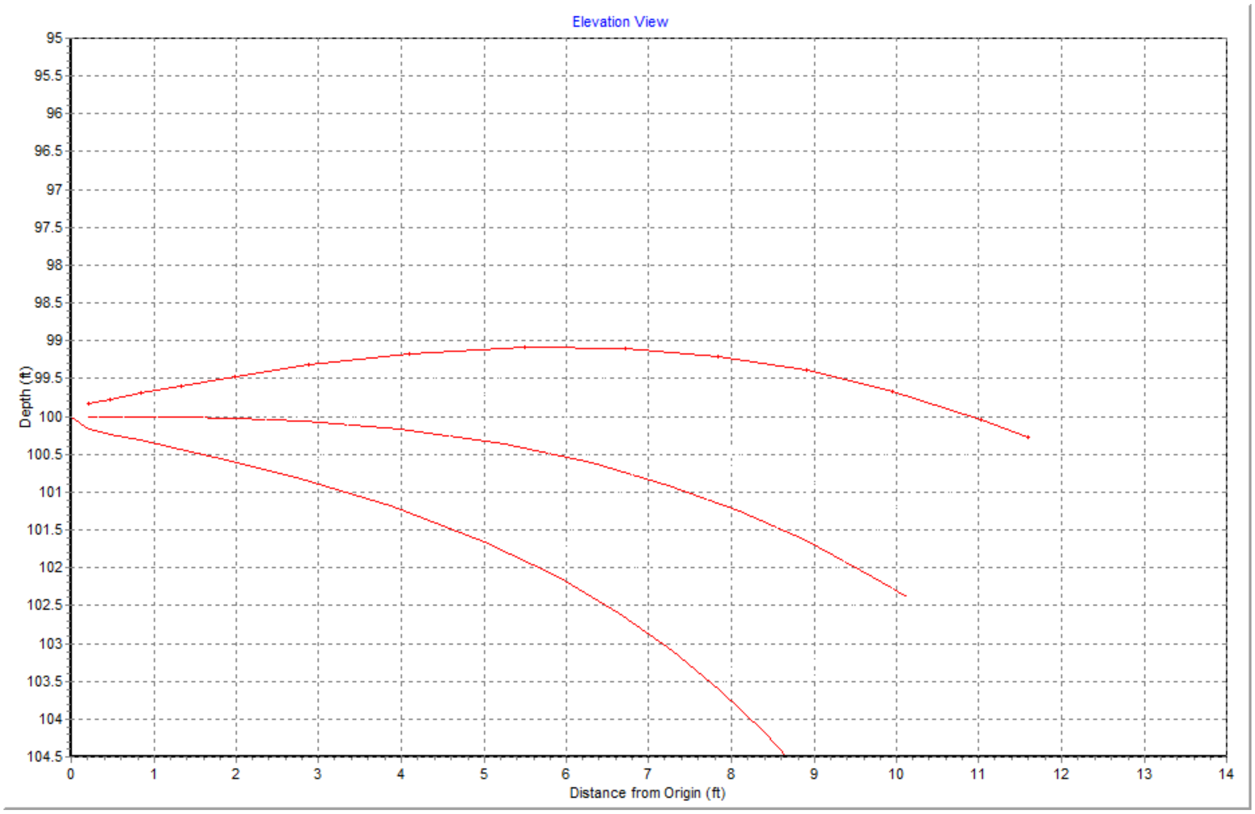
Figure . Dana Point wave refraction for the 4 April 1999 storm
Wave height at offshore control point = 3.9 m, T=9.1 sec, from 276°.

APPENDIX 4.2.2

BRINE DISCHARGE ANALYSIS FOR THE FINAL EIR

Plumes 18b Modeling Assessment of Deleterious Diffuser Entrainment for the Doheny Desalination Project

By Scott A. Jenkins, Ph.D.



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15 January 2019

ABSTRACT: Diffusers intrinsically generate strong turbulent jets in order to produce mixing and rapid dilution of effluent, and the shearing action of those turbulent jets can potentially damage or kill small delicate organisms entrained into those jets (sometimes referred to as *diffuser turbulence mortality*). The implementation section of the brine amendment to the California Ocean Plan, Section III.M.2 (b), requires that brine diffusers must minimize and mitigate for such marine life impacts, and the California State Water Resources Control Board has released newly defined protocols that require the use of a specific hydrodynamic mixing model (referred to as *Plumes 18b*) to assess those impacts. Plumes 18b is not supported by US EPA, but the State Water Board has made executable files for this model publicly available on their web site, along with a technical guidance document on how to assess deleterious entrainment from brine diffusers. These protocols using the Plumes 18b model are implemented in this study to assess potential injury or mortality to small marine organisms entrained by discharges from the diffuser of the San Juan Creek Ocean Outfall (SJCOO) that is being proposed as the discharge structure for brine by-product from the Doheny Desalination Project (DDP).

In general, Plumes 18b predicted higher *Minimum Initial Dilution*, and smaller *Zones of Initial Dilution*, ZID at deeper depths than was reported previously by DDP dilution studies using the US EPA supported Visual Plumes (UM3). Using Plumes 18b, all of the buoyant DDP discharge scenarios are found to achieve the required 101 to 1 minimum initial dilution required under the current NPDES permit for the SJCOO, (No. CA 0107417, Order No. R9-2012-0012 as amended by Order No. R9-2014-0105). For any given amount of SOCWA wastewater, the addition of any amount of DDP brine reduces both the minimum initial dilution as well as the effective (average or bulk) dilution at the maximum rise of the plume, while reducing the size of the ZID. This is not altogether a bad result, so long as there remains adequate dilution to satisfy present or future NPDES permit requirements for minimum initial dilution; which indeed appears to be the case. The reduction of buoyant effluent dilution caused by adding brine to SOCWA wastewater has a favorable effect on potentially deleterious diffuser entrainment, even though buoyant discharges appear to be exempt from requirements to assess, minimize or mitigate for diffuser turbulence mortality impacts to entrained marine organisms under the present structure of the amended Ocean Plan (SWRCB,2015). The Plumes 18b results show that for any given amount of SOCWA wastewater, the addition of any amount of DDP brine reduces the deleterious diffuser entrainment rate, thus improving upon an existing condition that is not mitigatable under present implementation practices of the Ocean Plan. Therefore, no mitigation should be required for DDP operational scenarios that result in buoyant combined discharges with SOCWA wastewater. The net turbulence mortality benefit achieved by combining DDP brine with SOCWA wastewater increases with decreasing combined discharge rate, as smaller jet velocities with larger Kolmogorov turbulent eddies occur at lower combined discharge rates.

The Plumes 18b dilution modeling results for the combinations of SOCWA wastewater and DDP brine that produce dense (negatively buoyant) discharges involve either brine-only or high-brine ratio discharges, typical of conditions anticipated during dry-weather wastewater effluent streams or future water reclamation conditions. Again, Plumes 18b has predicted higher effective dilution and shorter distances to the 2 ppt over natural background compliance threshold than was reported previously in DDP dilution studies using the US EPA supported Visual Plumes (UM3). Based on long term averages of ambient salinity records, natural background salinity at the SJCOO is 33.52 ppt, so that the compliance threshold 35.52 ppt under Appendix-A brine amendment provisions of the California Ocean Plan (SWRCB, 2015). Plumes

18b results indicate this compliance threshold is met in less than 2.5 ft. from the point of discharge by all DDP dense discharge operating conditions; whereas the Ocean Plan requires this compliance threshold is reached within 100 m from the discharge point. Thus, the DDP would be fully compliant with Ocean Plan brine discharge limits by a wide margin of safety, according to Plumes 18b dilution simulations. The jets of the SJCOO diffuser discharge parallel to the bottom and the ports are only 4.5 ft. above the bottom. Consequently the trajectories of these dense DDP discharges travel relatively short distances before reaching maximum rise or bottom hit points. This behavior, in turn, causes the Kolmogorov eddy scales in the diffuser jets to remain small (less than 0.2 mm), and presumably injurious according to the injury hypothesis advanced in the State Water Boards turbulence mortality guidance document. But these short trajectories also limit the effective (bulk or average) dilution and therefore limit the deleterious diffuser entrainment. By the literal interpretation of the State Water Board’s guidance document mitigation scaling for brine diffuser turbulence mortality should only be based on the entrainment at the maximum rise of the plume, which range from 67 mgd to 729 mgd for dense DDP discharges.

Plumes 18b Modeling Assessment of Deleterious Diffuser Entrainment for the Doheny Desalination Project

By Scott A. Jenkins, Ph.D.

1) Introduction:

This is a hydrodynamic modeling analysis to assess potential injury or mortality to small marine organisms entrained by discharges from the diffuser of the San Juan Creek Ocean Outfall (SJCOO) that is being proposed as the discharge structure for brine by-product from the Doheny Desalination Project (DDP). Diffusers intrinsically generate strong turbulent jets in order to produce mixing and rapid dilution of effluent, and the shearing action of those turbulent jets can potentially damage or kill small delicate organisms entrained into those jets, phenomena referred to herein as *turbulence mortality*. The present analysis is based on newly defined protocols by the California State Water Resources Control Board as outlined in Roberts (2018a). These protocols require the use of a specific hydrodynamic mixing model referred to as *Plumes 18b*. Plumes 18b is not supported by the USEPA, but is a derivative of the *Visual Plumes (UM3)* model which USEPA does support, (cf. Frick, et al, 2003); and both models share the same principal developer, Dr. Walter Frick. The antecedent dilution modeling for the Doheny Desalination Project appearing in Jenkins (2016 & 2017) was performed using the Visual Plumes (UM3) model; but implementation of the methods in Roberts (2018) technical guidance document require that dilution be recalculated using Plumes 18b. Some differences were found between the dilution estimates originally calculated in Jenkins (2016 & 2017) using Visual Plumes (UM3) versus those calculated herein using Plumes 18b, but those differences did not change the fundamental conclusion that the 14 brine discharge scenarios in Table 1 that span the proposed operating range of the Doheny Desalination Project, are all compliant with requirements for both buoyant and dense discharges under the California Ocean Plan, (SWRCB, 2015).

A careful read of the *Appendix-A brine amendment* of the California Ocean Plan indicates that combining indicates that combining brine from desalination plants with wastewater from municipal wastewater treatment facilities, and utilizing existing treated wastewater outfalls is the preferred discharge technology, and that discharge strategy is exactly what is proposed for the Doheny Desalination Project. The implementation section of the brine amendment to the California Ocean Plan, Section III.M.2 (b), requires that:

> *Multiport diffusers shall be engineered to maximize dilution, minimize the size of the brine mixing zone, minimize suspension of benthic sediments, and mortality of all forms of marine life*

This requirement appears only in the *Appendix-A brine amendment* of the California Ocean Plan, and therefore, implicitly applies only to the dense (negatively buoyant) discharge scenarios that appear as the red or black entries in Table-1. Buoyant discharges, such as wastewater discharges are regulated under a completely different set of compliance standards found in *Appendix I* of the *California Ocean Plan*. There are no implementation provisions in Appendix-I that require diffusers discharging buoyant effluent to minimize turbulence mortality; and no wastewater

Table 1 Plumes 18b Modeling Scenarios for the Doheny Desalination Project

SOCWA Wastewater Flow Rates (MGD)	Brine Discharge Rate (MGD)	Combined Discharge Rate (MGD)	Combined Discharge Salinity (ppt)	Density Anomaly $\Delta\rho/\rho$
0	**3.0**	***3.0***	***67.0***	**-0.0268**
1.8*	***3.0***	***4.8***	***54.43***	***-0.0167***
0.0	**5.0**	**5.0**	**67.0**	**-0.0268**
0.35	**5**	**5.35**	**62.63**	**-0.0233**
0.0	**10.0**	**10.0**	**67.0**	**-0.0268**
0.0	**15.0**	**15.0**	**67.0**	**-0.0268**
8.0	**15.0**	**23.0**	**43.69**	**-0.00839**
13.0	**15.0**	**28.0**	**35.89**	**-0.00197**
8.0	**5.0**	**13.0**	**25.77**	**+0.00636**
13.0	**5.0**	**18.0**	**18.61**	**+0.01225**
18.9	**5.0**	**23.9**	**14.02**	**+0.0160**
18.9	**15.0**	**33.9**	**29.64**	**+0.0032**
31.0	**5.0**	**36.0**	**9.30**	**+0.0199**
31.0	**15.0**	**46.0**	**21.85**	**+0.0096**

Notes:
*****well water from Doheny and Capistrano beaches substituted for SOCWA wastewater
Red & Black = dense (negatively buoyant) discharges
Blue = buoyant discharges

authority or sanitation district in California has been required to assess or mitigate for deleterious entrainment by the wastewater outfall diffusers. Consequently, many readers of the Ocean Plan have inferred that turbulence mortality assessment and mitigation would not be required for blended brine/wastewater operating conditions that result in a buoyant combined effluent (such as the blue entries in Table-1). Nonetheless we will apply herein the State Water Board turbulence mortality assessment criteria outlined in Roberts (2108a) to the 6 buoyant effluent operating scenarios in Table-1; and demonstrate net incremental changes over present SOCWA wastewater-only operating conditions would be reductions in potentially deleterious entrainment due to additions of brine, and consequently the Doheny Desalination Project would have no net mitigatable impact for those combined buoyant effluent cases. For the remaining 8 dense effluent discharge cases in Table 1 (red and black entries), turbulence mortality assessment criteria are applied as outlined in Roberts (2108a), leading to results for potentially deleterious entrainment, which will be throughput to a subsequent ETM/APF (Empirical Transport Model/Area of Production Foregone) analysis in a companion study to compute the mitigation scaling for diffuser turbulent shear impact.

2) Turbulence Mortality Technical Approach:

The calculus presented in Roberts, (2018a) to assess injury or mortality to organisms entrained by brine diffuser discharges (aka, turbulence mortality) has three components:

1) *Injury Hypothesis* based on the notion that injury or mortality occurs when entrained organisms are exposed to a specific type of diffuser-induced turbulent eddy that is smaller than what is found in ambient ocean turbulence yet comparable to the size of the organism. Therefore, the smallest naturally occurring eddies in ambient ocean turbulence establish the injury threshold, which is assumed to be 1 mm.

2*) Empirical Relations* that relate the size of that specific type of diffuser-induced eddy to the distance from the point of discharge.

3) *Entrainment Calculations* based on dilution-trajectory results from the Plumes 18b that yield the entrainment rate between the point of discharge and the point where a specific type of diffuser-induced eddy becomes comparable to or larger than what is found in ambient ocean turbulence. This entrainment rate is presumed to be deleterious and is throughput to the ETM/APF (Empirical Transport Model/Area of Production Foregone) calculus to compute the mitigation scaling for diffuser turbulent shear impact. (Note the ETM/APF is not a component of the Roberts calculus)

The injury hypothesis is based on the notion that only those entrained organisms which are comparable to, or smaller than, Kolmogorov turbulence scales will suffer injury or mortality. To isolate the incremental injury and mortality due to the diffuser from what occurs naturally in ambient ocean turbulence, diffuser entrainment impacts are assumed to occur only in those regions of the diffuser discharge where the Kolmogorov scales are smaller than the natural Kolmogorov scale in the ocean water mass around the diffuser. This limits the size of the entrained organism that are assumed to be impacted by the diffuser to only the smallest, most fragile, populations in the receiving waters. However, this assumption also makes implementation of this theory reliant on a highly site-specific parameter that is extremely difficult and costly to measure, namely Kolmogorov scale ocean turbulence. Walter, et al., (2014) measured Kolmogorov scale ocean turbulence in a massive field effort that deployed Doppler velocimeters and fast-response conductivity-temperature sensors mounted on an underwater turbulence flux tower located in the far southern end of Monterey Bay, (offshore of the Hopkins Marine Station in Pacific Grove). These measurements suggest the smallest naturally occurring turbulent eddies in Monterey Bay are about 1 mm in size. No such direct measurements of Kolmogorov scale ocean turbulence exist anywhere else in California, and collecting such data would be a significant research effort. We note turbulence measurements off Vancouver Island by Grant, et al. (1962) found that Kolmogorov scale ocean turbulence was on the order of 2 cm, 20 times greater than the Monterey Bay measurements. The uncertainty of how Kolmogorov scale ocean turbulence varies throughout the coastal waters of California will radically impact the final calculations of volume of entrained water that is considered to be deleterious, because it dictates the injury threshold of the entire turbulence mortality assessment.

Nonetheless, we are compelled herein to adopt the nearest neighbor assessment of ocean Kolmogorov scales, and base our turbulence mortality assessments on the Monterey Bay measurements.

The second component in the Roberts method for turbulent mortality assessment are *empirical relations* that relate the size of a specific type of diffuser-induced eddy (the Kolmogorov scale) to the distance from the point of discharge. The Kolmogorov eddy size is calculated with a simple empirical relation derived from laboratory measurements of turbulent jet:

$$\eta_c = 0.24\, x\, \mathrm{Re}^{-3/4} \qquad (1)$$

Where η_c is the Kolmogorov eddy size along the jet centerline, x is the distance from the discharge point, $\mathrm{Re} = u\,d\,/\,\nu$ is the Reynolds number based on the discharge velocity, *u*, the jet port diameter, *d*, and the kinematic viscosity, $\nu = 1.17 \times 10^{-6}$ m^2/s. However, in both Roberts (2018 a & b) the calculations of Kolmogorov eddy scales and the associated deleterious entrainment are stopped at the maximum rise height (apex) of the brine plume trajectory, even though the Kolmogorov scale eddies at the apex are still very much smaller than the injury threshold of 1 mm. The reason for this truncation of the calculation is because equation (1) is based on measurements of laboratory scale jets by Wygnanski and Fiedler (1969), which omitted buoyancy effects. Beyond the apex of a brine discharge trajectory buoyancy forces begin to exceed the inertial forces and the discharge transitions from being a jet to becoming a negatively buoyant plume. In the application to the 8 dense (negatively buoyant) discharge cases in Table 1 (red and black entries), we not only estimate deleterious entrainment from Kolmogorov eddy scales at the apex of the trajectory, but also carry the calculation all the way to the point where the Plumes 18b model finds the trajectory hits the bottom. We do so because the jets of the SJCOO diffuser discharge parallel to the bottom and the ports are only 4.5 ft. above the bottom, whence the discharge trajectory probably remains a jet at the point of contact with the bottom. The decisive issue with proceeding with the equation (1) is that the Kolmogorov scale remains less than 1 mm at either the apex of the trajectory or at the point where the trajectory makes contact with the bottom

The third component of the turbulence mortality assessment (as set forth in the Roberts (2018a) turbulent mortality guidance document) are *entrainment calculations*, most accurately made using hydrodynamic mixing models to determine dilution at the maximum rise or bottom hit points of the discharge trajectory. Until April 2018, the California State Water Resources Control Board had been following a procedure where dilution credits for ocean outfall diffusers, and other diffuser related issues were evaluated using only those models that had been fully vetted by US EPA. The last time US EPA went through this formal vetting processes was 2003 (cf. Frick et al., 2003), and only three mixing models emerged with EPA certifications: *PDSWIN*, *Visual Plumes* or *CORMIX*. However, Roberts (2018a) is recommending use of a model that US EPA has not formally vetted, namely *UM3 version 17b*, aka *Plumes 17b*. US EPA does not support Plumes 17b, and the executable files for that model were only made publicly available by the State Water Resources Control Board on their web site for a brief time in late April and early May 2018. When it was discovered that Plumes17b had programming bugs, it was replaced with Plumes 18b on the State Water Resources Control Board web site, circa 30 May 2018. There is no written documentation specific to the implementation of Plumes 18b and the “Help” buttons in the model do not work. However, Plumes 18b has been graciously supported by Dr. Walter Frick (US EPA retired), the Plumes 17b and Plumes 18b developer, who has answered many questions by e-mails and phone calls that has allowed us to become proficient in running this model.

The key outputs of the Plumes 18b are the trajectories of discharge and the dilution calculated along those trajectories. Plumes 18b is used to find the distance to the point of maximum rise of the discharge trajectory, X_a or the distance to the point where the plume contacts the bottom, X_b; and these values are inserted in equation (1) to determine if the Kolmogorov scale eddies remain less than the injury threshold of 1 mm. Once this condition has been verified, the deleterious entrainment by the diffuser is calculated by:

$$Q_c = S_{a(x=X_a)} Q_j \tag{2}$$

or:

$$Q_c = S_{a(x=X_b)} Q_j \tag{3}$$

where Q_c is the deleterious entrainment rate, Q_j is the total discharge rate of all 125 jets of the SJCOO diffuser; $S_{a(x=X_a)}$ is the effective (average or bulk) dilution at the maximum rise of the discharge trajectory, and $S_{a(x=X_b)}$ is the effective (average or bulk) dilution where the discharge trajectory makes contact with the bottom. The solutions to equations (2) and (3) are then passed on to the ETM/APF model to compute the mitigation scaling for diffuser turbulent shear impact.

3) Initialization of Plumes 18b:

Plumes 18b provides data entry with three main input tabs: 1) Diffuser, 2) Ambient, and 3) Special Settings. The input fields for these three tabs are listed at the top of the text output files of each of the modeling scenarios appearing in Appendices A-C. The input fields for are listed below with applicable explanations for the input into each field:

3.1) Diffuser Input Tab: Diffuser and effluent characteristics are necessary to determine the momentum of the effluent as it enters the receiving water and the density of the effluent (which will affect its buoyancy in the receiving water).

3.1.1. Port Diameter: Plumes 18b data entry limitations only allow a single input for "Port Diameter". Thus, a single port diameter must be determined. This

was done by taking an average port size of all the ports as summarized in Table 1. Using the information contained in Table 1, one may compute the average port area (7.30 in^2) and average port diameter (3.05 inches) for the SJCOO diffuser. A port diameter of 3.05 inches was input to Plumes 18b.

3.1.2. Vertical Angle: The vertical angle is defined in the Visual Plumes manual (http://www.epa.gov/ceampubl/swater/vplume/) as the discharge angle relative to the horizontal with zero being horizontal, 90 being vertical upward, and -90 being vertically downward. Appendix-A drawings indicate that the ports are located on the diffuser facing opposing directions, 180 degrees away from each other. A data entry limitation of Plumes 18b is that only one vertical angle may be entered. In cases where there is potential for two plumes emitted from different angles on the diffuser to merge within

the water column, the Visual Plumes manual suggests modeling the diffuser as if all ports are on one side of the diffuser and with half the spacing. In situations where the potential for plume merging is considered to be negligible, an alternative approach is to model one-half of the diffuser (i.e., one plume) and assume no cross-merging of plumes. Because the plumes from each side of the diffuser are assumed to have the potential to merge, both sides of the diffuser have been included in the simulation (i.e., all ports are treated as if they are on one side of the diffuser and with half the spacing). A single vertical angle of 0 degrees was used in all runs of the Plumes 18b model.

3.1.3. Horizontal Angle: Appendix-A drawings indicate that the ports are located on the diffuser with no horizontal deflection. Therefore a single horizontal angle of 0 degrees was used on each leg in the model.

3.1.4. Source Coordinates: these entries establish the origin of the Plumes 18b coordinate system. These were set at x-coord = 0, y-coord = 0, consistent with the values used in the Plumes 17b simulation examples appearing in Appendix-B of Roberts (2018a).

3.1.5. Number of Ports: The number of ports specified in the Appendix A drawings of the most recent NPDES permit for the SJCOO outfall (cf: RWQCB, 2014) is 125 ports. The outfall rehabilitation report indicated all obstructed ports were cleared in April and May of 2015. 125 ports was entered into the model.

3.1.6. Port Spacing: The Appendix A drawings in the most recent NPDES permit for the SJCOO outfall (cf: RWQCB, 2014) indicate that the ports were approximately 24 feet apart. Both sides of the diffuser are being modeled on one side of the diffuser; a value of 12 feet was entered into the model.

3.1.7. n/r: This entry defines the maximum run time allowed by the model. A value of 3600 s on the advice of Dr. Walter Frick, (Plumes 18b developer).

3.1.8. Mix Zone Distance: This value is not relevant to the final initial dilution calculations and has no impact on model output. The Plumes 18b software requires that a value be entered into these fields. Therefore, 1000ft was entered based on the size of the monitoring zone under the present NPDES permit (cf; RWQCB, 2014)

3.1.9. Isopleth Value: This value is not relevant to the final initial dilution calculations. A value of concent = 0 was entered, consistent with the values used in the Plumes 17b simulation examples appearing in Appendix-B of Roberts (2018a).

3.1.10. Port Depth: Appendix A and Figure 1 of the most recent NPDES permit for the SJCOO outfall (cf: RWQCB, 2014) indicate that the diffuser discharge depth is 100 feet at the inshore end of the diffuser. A value of 100 feet was used in the model.

3.1.11. Effluent Flow: These values were separately entered into the effluent flow field for each of the modeling scenarios listed in Table-1.

3.1.12. Effluent Salinity: These values were separately entered into the effluent saliity field for each of the modeling scenarios listed in Table-1.

3.1.13) Effluent Temperature: SOCWA provided average monthly temperature data from January 2014 through September 2016. The density of water is a function of temperature. Therefore, a smaller difference in temperature between the effluent and receiving waters will produce a relatively smaller difference between the densities of the effluent and receiving waters and less dilution is likely to occur. Effluent temperatures ranged from a maximum of 29.44^0C to a minimum of 21.66^0C, with a mean effluent temperature of 25.62^0C. Receiving water temperatures are significantly lower than the temperature of the effluent discharged from the SJCOO. Thus, a lower effluent temperature is likely to result in lower dilution. The lowest monthly average temperature of 71°F ($21.66\ ^0$ C) was entered into the data field.

3.1.14) Effluent Concentration: This data field does not have an effect on the final initial dilution calculated. However a value must be entered into this field for the model to run, and a default value equivalent to the salinity field expressed in parts per million (ppm) was entered.

3.2 Ambient Input Tab: This tap specifies ambient profiles for neafield current speeds and directions, salinity, temperature, background concentrations, pollutant decay rates, the n/r run-time parameter, and the far-field diffusion coefficient. The tab only excepts nine depth increments to specify the ambient profiles. The current is always set to zero when running models for the Ocean Plan, and the background concentrations, pollutant decay rates, the n/r run-time parameter, and the far-field diffusion coefficients are irrelevant entries, and the values used for these entries are the same as those used in the Plumes 17b simulation examples appearing in Appendix-B of Roberts (2018a). However, the depth profiles for ambient salinity and temperature are most important as these entries define the natural stratification of the receiving waters.

The receiving water salinity/temperature profile from September 2008 was used to define worst case scenario for determination of "*the lowest average initial dilution within any single month of the year*" per Provision III.C.4.d of the Ocean Plan. This is the same profile used in the Appendix H dilution study of the most recent NPDES permit for the SJCOO outfall (cf: RWQCB, 2014). These profiles are plotted in Figure 1. While the salinity profile is fairly uniform with depth of water over the SJCOO, (with an average salinity of 33.37 ppt), the temperature is found to gradually decline with water depth, varying between $19.9\ ^0$ C on the surface to 13.4^0 C at the seafloor around the outfall. Normally there is a very abrupt change in water temperature between the warm surface mixed layer and the cold bottom water; and this

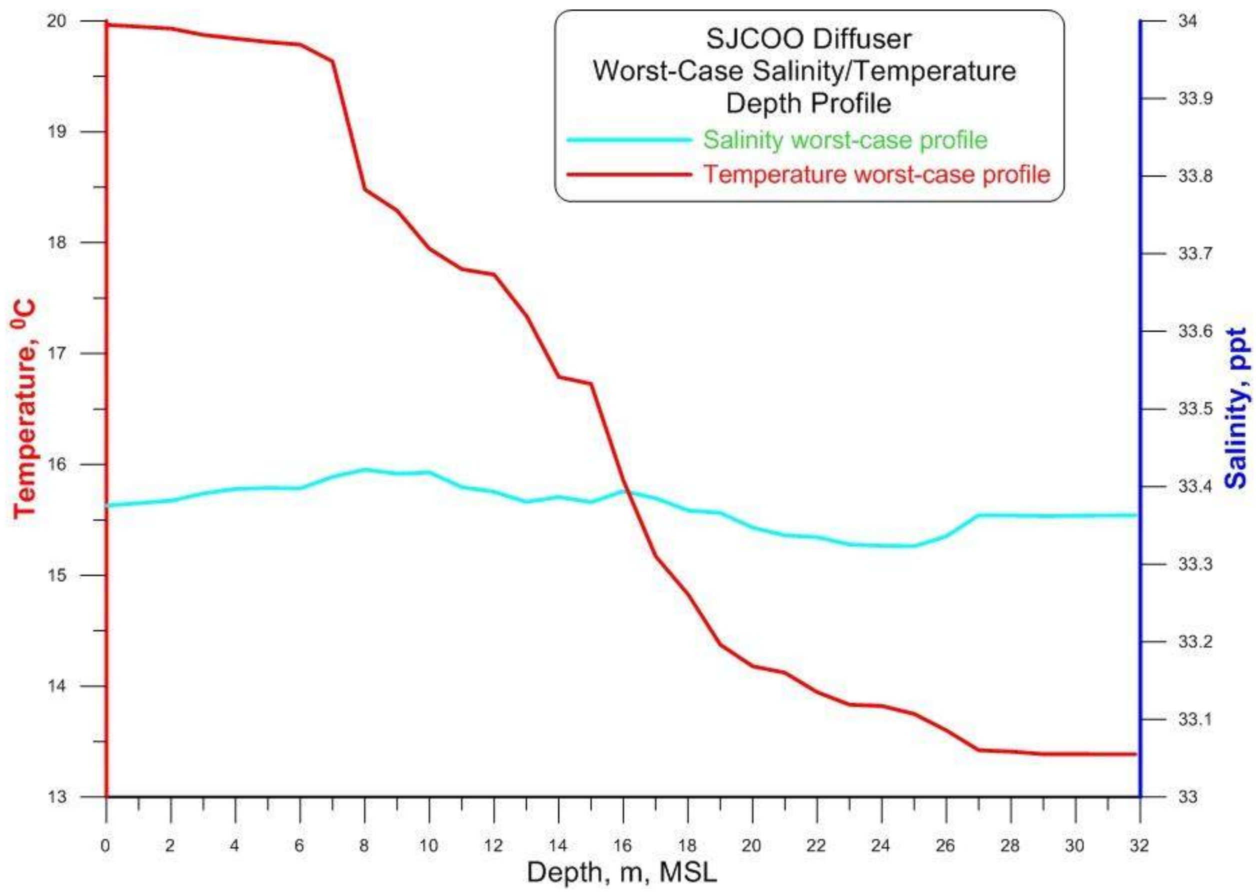

Figure 1: Worst-case temperature salinity profile as presented in Appendix-H of RWCQB (2014) for update of the diffuser performance and minimum dilution assessment of the SJCOO. Profiles based on 17 September 2008 upwelling and discharge conditions.

abrupt change referred to as a thermocline produces a trapping layer at the thermocline interface, where the partially diluted discharge plume no longer has sufficient positive buoyancy to penetrate the thermocline, and instead spreads out horizontally along the thermocline interface resulting in a trapping level beneath the sea surface. However, the temperature profile in Figure 1 varies so gradually that there is not a well-defined pycnocline and the trapping layer is poorly formed; whence the buoyant wastewater is able to rise to the sea surface, 29 m above the deepest sections of the SJCOO diffuser. As a result the ZID boundary becomes the sea surface and the distance from the point of discharge where minimum dilution is defined defaults to 29 m, in spite of the fact that the plume still has residual momentum and kinetic energy imparted to it by the discharge jets.

There is a minor difference in the particular portions of the Figure 1 ambient profile that were used for the Plumes 18b simulations of the buoyant discharge scenarios versus that used for the dense (negatively buoyant) simulations. Plumes 18b only allows 9 depth entries to specify the ambient profile, and yet there are 30 depth entries in the field data for the September 2008 ambient profile in Figure 1. Consequently, some selective judgement was used in deciding which of the 30 measured depth increments in Figure 1 ambient profile should be loaded into the ambient input tab of Plumes 18b. It is notable that there is little variability in both the salinity or temperature profiles in Figure-1 below a depth of 28 m MSL. For the buoyant discharge scenarios in Table-1, where the discharge trajectory is essentially vertically upward from the discharge point, the last depth entry in the ambient tab was set at a depth of 29 m, about 1.5 m above the depth of the discharge ports. However, when this same ambient tab profile was used on the dense (negatively buoyant) scenarios, The Plumes 18b simulations would continue down through the bottom and beyond. (This same problem is found in the Plumes 17b simulations of the Huntington Beach diffuser in Roberts, 2018b). The seabed at the SJCOO outfall is at a depth of 104.5 ft. MSL, or 31.85 m MSL, and yet some of the negatively buoyant simulations would continue on to depths of several hundred meters. This problem arises from the fact that Plumes 18b (unlike Visual Plumes), has no data entry for the elevation of the discharge ports above the seabed, and thus the model really doesn't know where the bottom is! After consulting with Dr. Walter Frick (Plumes 18b developer), the solution to this problem was achieved by setting the last depth entry in the Plumes 18b ambient tab at precisely the depth of the seabed, and selecting "stop at bottom hit" under special settings. This insures that Plumes 18b does not generate spurious solutions that extend below the seabed. Therefore, all of the dense (negatively buoyant) scenarios from Table-1 were run with the 29 m depth entry to the ambient profile replaced with a 31.85 m depth entry.

3.2.1) Far-field Diffusion Coefficient: The Visual Plumes manual recommends the use of 0.0003 $m^{0.67}/s^2$. This value was used in the data field as a constant (not extrapolated as the ambient temperature and density were).

3.3 Special Settings:

3.3.1) Tidal Pollutant Build-up, Channel Width : This data field does not have an effect on the final initial dilution calculated. A value of 100 was entered, consistent with the values used in the Plumes 17b simulation examples appearing in Appendix-B of Roberts (2018a).

3.3.2) Diffuser Port Contraction Coefficient: The shape of the diffuser ports is specified in the Appendix-A drawings in the most recent NPDES permit for the SJCOO outfall (cf: RWQCB, 2014). Accordingly, a diffuser port contraction coefficient of 1.0 was used, consistent with the values used in the Plumes 17b simulation examples appearing in Appendix-B of Roberts (2018a).

3.3.3) Standard Light Adsorption Coefficient: The value of 0.16 is recommended in the Visual Plumes manual as a conservative value. This is not relevant to final initial dilution, and is for the Mancini bacteria model applications of the model.

3.3.4) Far-field Increment: This value controls the number of lines output by the Brooks far-field algorithm. A small value produces more lines and graphic output than large values. A value between 100 to 1000 m is recommended by the Plumes 18b manual. This field has little effect on the final calculated initial dilution; a value of 100 m was used in the data field.

3.3.5) UM3 Aspiration Coefficient: This is the rate at which ambient fluid is entrained (diluted) into the plume. The default value of 0.1 is an average that is rarely changed. A larger value causes more rapid plume spreading and affects other characteristics, like plume rise. The default value of 0.1 was used in the data field.

3.3.6) Output Settings: Output settings were configured for “standard text output format” with a group of selected variables that included: “depth, Amb-cur, P-dia, Eff-sal, Polutnt, Dilutn, x-posn, y-posn, Iso dia”. The most relevant of these variables for proceeding with the turbulence mortality assessment are “depth”, “Eff-sal,” “Dilutn”, “x-posn” and “y-posn.” In particular, the “x-posn” and “y-posn” output variables are used to quantify the distances to the maximum rise and bottom hit points of the trajectories, while the “Dilutn” output variable quantifies the effective (average or bulk) dilution at those points.

3.3.5) UM3 Options and Controls: Under the vertical reversals options, “to max rise or fall” and “allow induced currents (multiport)” were selected. For the dense (negatively buoyant) discharge scenarios, the “stop on bottom hit” setting was selected in order to prevent the simulations from running through the seabed.

4) Results

Text file and graphical output from Plumes 18b for each of the Doheny Desalination Project (DDP) modeling scenarios in Table-1 are found in Appendices A-C. The results for the buoyant discharge scenarios are found in Appendix-B, while those for the dense (negatively buoyant) discharge scenarios are in Appendix-C. In order to resolve incremental turbulence mortality impacts of the buoyant discharge scenarios, it was necessary to run a separate set of wastewater-only baseline cases using the particular flow volumes for the each wastewater increment used in the buoyant discharge scenarios. The Plumes 18b text and graphics results for these wastewater-only baseline cases are Found in Appendix-A.

4.1) Results for Buoyant DDP Discharge Scenarios: The Plumes 18b dilution modeling results for the combinations of SOCWA wastewater and DDP brine that produce buoyant discharges are summarized in Table 2, and contrasted there with wastewater-only baseline results. In general, Plumes 18b has predicted higher *Minimum Initial Dilution*, Dm, and smaller *Zones of Initial Dilution*, ZID at deeper depths than was reported previously by Jenkins (2016 & 2017) using the US EPA supported Visual Plumes (UM3). All of the buoyant DDP discharge scenarios are found to achieve the required Dm = 101 to 1 minimum initial dilution required under the current NPDES permit (No. CA 0107417, Order No. R9-2012-0012 as amended by Order No. R9-2014-0105). For any given amount of SOCWA wastewater, the addition of any amount of DDP brine reduces both the minimum initial dilution as well as the effective (average or bulk) dilution at the maximum rise of the plume, while reducing the size of the ZID. This occurs because the addition of any amount of DDP brine to SOCWA wastewater reduces the buoyancy of the discharge plume, causing it to cease rising at a lower altitude (deeper depth) in the water column, thereby reducing the amount of lateral spreading of the plume with associated reductions in dilution and the size of the ZID. This is not altogether a bad result, so long as there remains adequate dilution to satisfy present or future NPDES permit requirements for minimum initial dilution; which indeed appears to be the case. The lowest minimum initial dilutions and smallest ZIDs occur for operating conditions when the combined discharge rate is high with high proportions of brine relative to wastewater, such as the combination of 15 mgd of brine and 18.9 mgd of wastewater that resulted in a minimum initial dilution of Dm = 107.6 to 1 with a ZID = 63 m. All the other DDP operating scenarios producing buoyant combined effluent result in minimum initial

Table 2: Plumes 18b Modeling of Doheny Buoyant Discharge Scenarios

Discharge Scenario Brine + Wastewater = Total Flow Rate (MGD)	Combined Discharge Salinity (ppt)	Discharge Velocity m/sec	Densimetric Froude Number $F_r = u / \sqrt{g' d}$	Depth of 101 to 1 dilution factor (ft)	Depth of maximum rise of plume (ft)	Distance to maximum rise of plume, Z_a (m)	effective dilution at maximum rise of plume, S_a	Minimum Initial Dilution, Dm	Diameter of ZID (m)
8 mgd wastewater-only baseline	***1.25***	***0.595***	***4.231***	***86.96***	***56.35***	***13.304***	***375.5***	***383.1***	***196***
5 + 8 = 13	***25.77***	***0.967***	***12.95***	***70.89***	***62.90***	***11.308***	***130.9***	***133.9***	***78***
13 mgd wastewater-only baseline	***1.25***	***0.967***	***6.875***	***84.51***	***52.82***	***14.380***	***315.4***	***321.9***	***165***
5 + 13 = 18.0	***18.61***	***1.338***	***13.62***	***71.72***	***53.98***	***14.026***	***175.2***	***178.7***	***160***
18.9 mgd wastewater-only baseline	***1.25***	***1.405***	***9.996***	***82.69***	***50.81***	***14.992***	***273.8***	***279.5***	***143***
5 + 18.9 = 23.9	***14.02***	***1.777***	***16.02***	***71.01***	***50.90***	***14.965***	***185.4***	***189.1***	***135***
15 + 18.9 = 33.9	***29.64***	***2.521***	***43.40***	***68.94***	***68.94***	***9.467***	***105.0***	***107.6***	***63***
31 mgd wastewater-only baseline	***1.25***	***2.305***	***16.39***	***79.853***	***48.50***	***15.696***	***226.6***	***231.3***	***123.0***
5 + 31 = 36.0	***9.30***	***2.677***	***21.83***	***78.03***	***50.05***	***15.224***	***192.7***	***196.6***	***110.0***
****15 + 31 = 46.0***	***21.85***	***3.420***	***38.72***	***67.04***	***55.57***	***13.542***	***152.0***	***155.1***	***109***

Red = dry-weather
Blue = average conditions
Green = wet-weather
*Exceeds maximum permitted combined discharge rate of 38.78 mgd under NPDES permit (No. CA 0107417, Order No. R9-2012-0012 as amended by Order No. R9-2014-0105)

dilutions that exceed present NPDES permit requirements by a factor of 1.5 to 3.2 with ZIDs well over 100 m in diameter.

The reduction of buoyant effluent dilution caused by adding brine to SOCWA wastewater has a favorable effect on potentially deleterious diffuser entrainment, even though buoyant discharges appear to be exempt from requirements to assess, minimize or mitigate for turbulence mortality impacts to entrained marine organisms under the present structure of the amended Ocean Plan (SWRCB,2015). Table-3 summarizes all the parameters and results for deleterious diffuser entrainment for both the DDP buoyant discharge operating scenarios as well as the SOCWA wastewater-only baseline simulations. The results show that for any given amount of SOCWA wastewater, the addition of any amount of DDP brine reduces the deleterious diffuser entrainment rate, thus improving upon an existing condition that is presently not mitigatable under present implementation practices of the Ocean Plan. Therefore, no mitigation should be required for DDP operational scenarios that result in buoyant combined discharges with SOCWA wastewater. Inspection of Table-3 indicates that the net turbulence mortality benefit achieved by combining DDP brine with SOCWA wastewater increases with decreasing combined discharge rate, as smaller jet velocities with larger Kolmogorov turbulent eddies occur at lower combined discharge rates.

4.2) Results for Dense (Negatively Buoyant) DDP Discharge Scenarios: The Plumes 18b dilution modeling results for the combinations of SOCWA wastewater and DDP brine that produce dense (negatively buoyant) discharges are summarized in Table 4. All of the dense discharge cases in Table-4 involve either brine-only or high-brine ratio discharges, typical of conditions anticipated dry-weather wastewater effluent streams or future water reclamation conditions. Again, Plumes 18b has predicted higher effective dilution, S_a, and shorter distances to the 2 ppt over natural background compliance threshold than was reported previously by Jenkins (2016 & 2017) using the US EPA supported Visual Plumes (UM3). Based on long term averages of ambient salinity records reported in Jenkins (2016), natural background salinity at the SJCOO is 33.52 ppt, so that the compliance threshold 35.52 ppt under Appendix-A brine amendment provisions of the California Ocean Plan (SWRCB, 2015). Plumes 18b results in Table 4 indicate this compliance threshold is met in less than 2.5 ft. from the point of discharge by all DDP dense discharge operating conditions; whereas the Ocean Plan requires this compliance threshold is reached within 100 m from the discharge point. Thus the DDP would be fully compliant with Ocean Plan brine discharge limits by a wide margin of safety, according to Plumes 18b dilution simulations. As mentioned in Section 2, the jets of the SJCOO diffuser discharge parallel to the bottom and the ports are only 4.5 ft. above the bottom. Consequently, dense discharges from the SJCOO diffuser only rise a couple of feet above the discharge point (due to vertical spreading of the discharge jets by the action of turbulent mixing), before the trajectory bends downward under the action of negative buoyancy and makes contact with the bottom. By the literal interpretation of the State Water Board's guidance document (Roberts, 2018a) deleterious diffuser entrainment should only be based on the entrainment at the maximum rise of the plume. But, Table-5 indicates that the Kolmogorov eddy scales remain substantially less than the injury threshold of 1 mm all the way until the discharge trajectory makes contact with the bottom. Therefore, Table 4 includes trajectory analysis of the distances to both the

Table 3: Deleterious Diffuser Entrainment for Doheny Buoyant Discharge Scenarios

Discharge Scenario Brine + Wastewater = Total Flow Rate (MGD)	Discharge Velocity, u m/sec	*Jet Reynolds Number $\mathrm{Re} = u\,d/\nu$	Depth of maximum rise of plume (ft)	Distance to maximum rise of plume, X_a (m)	Kolmogorov scale at maximum rise of plume** (mm)	effective dilution at maximum rise of plume, S_a	Deleterious diffuser entrainment at maximum rise of plume (MGD)	Incremental Impact of Deleterious diffuser entrainment (MGD)	Diameter of ZID (m)	Incremental Impact on Diameter of ZID (m)
8 mgd wastewater-baseline	0.595	39,397.1	56.35	13.304	1.142	375.5	3,004	N/A	196	N/A
5 + 8 = 13	0.967	64,028.6	62.90	11.308	0.674	130.9	1,701.7	-1,302.3	78	-188
13 mgd wastewater-baseline	0.967	64,028.6	52.82	14.380	0.857	315.4	4,100.2	N/A	165	N/A
5 + 13 = 18.0	1.338	88,593.8	53.98	14.026	0.656	175.2	3,153.6	-946.6	160	-5
18.9 mgd wastewater-baseline	1.405	93,030.2	50.81	14.992	0.675	273.8	5,174.82	N/A	143	N/A
5 + 18.9 = 23.9	1.777	117,661.7	50.90	14.965	0.565	185.4	4,431.06	-743.76	135	-8
15 + 18.9 = 33.9	2.521	166,924.6	68.94	9.467	0.275	105.0	3,559.5	-1,615.32	63	-80
31 mgd wastewater-baseline	2.305	152,622.5	48.50	15.696	0.487	226.6	7,024.6	N/A	123.0	N/A
5 + 31 = 36.0	2.677	177,254.0	50.05	15.224	0.422	192.7	6,937.2	-87.4	110.0	-13
15 + 31 = 46.0	3.420	226,450.7	55.57	13.542	0.313	152.0	6,992	-32.6	109	-14

*****Based on jet diameter d = 3.05 in. and kinematic viscosity, ν = 1.17 X 10^{-6} m^2/s

******Based on Kolmogorov scale $\eta_c = 0.24\, X_a\, \mathrm{Re}^{-3/4}$, per equation (22) in Roberts, (2018a)

Table 4: Plumes 18b Modeling of Doheny Dense (Negatively Buoyant) Discharge Scenarios

Discharge Scenario Brine + Wastewater = Total Flow Rate (MGD)	Combined Discharge Salinity (ppt)	Discharge Velocity m/sec	Densimetric Froude Number $F_r = u / \sqrt{g' d}$	Horizontal Distance to within 2 ppt of *Natural Background (ft)	Distance to bottom hit, X_b (ft)	Depth of maximum rise of plume (ft)	Distance to maximum rise of plume, X_a (ft)	effective dilution at maximum rise of plume, $S_a(x=X_a)$	effective dilution at bottom hit, $S_a(x=X_b)$
3 + 0 = 3	***67.0***	***0.223***	***1.678***	***0.566***	***0.876***	***99.8***	***0.750***	***26.03***	***40.26***
3 + 1.8* = 4.8	***54.44***	***0.357***	***3.468***	***0.260***	***1.423***	***99.0***	***0.735***	***17.19***	***36.66***
5 + 0 = 5	***67.0***	***0.372***	***2.796***	***0.653***	***1.252***	***99.3***	***0.800***	***19.08***	***37.94***
5 + 0.35 = 5.35	***62.63***	***0.398***	***3.226***	***1.095***	***1.348***	***99.1***	***0.462***	***12.53***	***37.18***
10 + 0 = 10	***67.0***	***0.744***	***5.593***	***1.346***	***2.555***	***99.2***	***1.704***	***20.92***	***34.96***
15 + 0 = 15	***67.0***	***1.115***	***8.389***	***2.466***	***4.076***	***99.2***	***2.803***	***19.42***	***31.83***
15 + 8 = 23	***43.69***	***1.710***	***25.36***	***2.176***	***10.14***	***99.1***	***6.038***	***12.09***	***21.26***
15 + 13 = 28.0	***35.89***	***2.082***	***165.0***	***0.116***	***19.76***	***96.8***	***20.10***	***26.04***	***26.04***

Black = dry-weather with well water substituted for SOCWA wastewater
Red = dry-weather or future water reclamation conditions
*Natural background salinity at the SJCOO is 33.5 ppt.
**Fails to dilute to within 2 ppt of natural background salinity within a horizontal distance of 100 m

Table 5: Deleterious Diffuser Entrainment for Doheny Dense (Negatively Buoyant) Discharge Scenarios

Discharge Scenario Brine + Wastewater = Total Flow Rate (MGD)	Discharge Velocity, u m/sec	*Jet Reynolds Number $\mathrm{Re} = u\,d/\nu$	Distance to maximum rise of plume, X_a (ft)	Distance to plume bottom hit, X_b (ft)	Kolmogorov scale at maximum rise of plume** (mm)	Kolmogorov scale at plume bottom hit*** (mm)	effective dilution at maximum rise of plume, $S_a(x=X_a)$	effective dilution at bottom hit, $S_a(x=X_b)$	Deleterious diffuser entrainment at maximum rise of plume (MGD)	Deleterious diffuser entrainment at bottom hit of plume (MGD)
3 + 0 = 3	0.223	14,765.6	0.750	0.876	0.041	0.048	26.03	40.26	78.09	120.78
3 + 1.8[a] *= 4.8*	0.357	23,638.2	0.735	1.423	0.028	0.054	17.19	36.66	82.512	175.968
5 + 0 = 5	0.372	24,631.4	0.800	1.252	0.029	0.046	19.08	37.94	95.4	189.7
5 + 0.35 = 5.35	0.398	26,353.0	0.462	1.348	0.016	0.048	12.53	37.18	67.0355	198.913
10 + 0 = 10	0.744	49,262.9	1.704	2.555	0.038	0.057	20.92	34.96	209.2	349.6
15 + 0 = 15	1.115	73,828.2	2.803	4.076	0.046	0.066	19.42	31.83	291.3	477.45
15 + 8 = 23	1.710	113,225.3	6.038	10.14	0.072	0.120	12.09	21.26	278.07	488.98
15 + 13 = 28.0	2.082	137,856.8	20.10	19.76	0.21	0.202	26.04	26.04	729.12	729.12

*****Based on jet diameter d = 3.05 in. and kinematic viscosity, ν = 1.17 X 10^{-6} m^2/s

******Based on Kolmogorov scale $\eta_c = 0.24\,X_a\,\mathrm{Re}^{-3/4}$, per equation (22) in Roberts, (2018a)

******Based on Kolmogorov scale $\eta_c = 0.24\,X_b\,\mathrm{Re}^{-3/4}$, per equation (22) in Roberts, (2018a)

[a] well water substituted for SOCWA wastewater

maximum rise and bottom hit points, and the associated effective (bulk or average) dilutions at both of those points. While no clear relationships appear to emerge from Table-4 entries for effective dilution at the maximum rise points of the trajectory; effective dilution at the bottom hit points increases with decreasing salinity and flow rates of the combined brine/wastewater effluent.

Table-5 summarizes all the parameters and results for deleterious diffuser entrainment for the dense (negatively buoyant) DDP discharge operating scenarios. Because of the relatively short distances traveled by the dense discharges before reaching maximum rise or bottom hit points, the Kolmogorov eddy scales remain small (less than 0.2 mm), and presumably injurious according to the injury hypothesis advanced in the State Water Boards turbulence mortality guidance document (Roberts, 2018a). But these short trajectories also limit the effective (bulk or average) dilution and therefore limit the deleterious diffuser entrainment. Again, by the literal interpretation of the State Water Board's guidance document (Roberts, 2018a) mitigation scaling for brine diffuser turbulence mortality should only be based on the entrainment at the maximum rise of the plume, as indicated by the deleterious entrainment numbers appearing in the second to last column in Table-5 that range from 67 mgd to 729 mgd. But, the short travel distances to bottom hit points and small Kolmogorov eddy scales may deviate the assessment to the entrainment numbers at the bottom hit points, appearing in the last column of Table-5. In either case, deleterious diffuser entrainment increases with increasing combined discharge rate, (as would be expected with associated increasing discharge velocities); while the deleterious entrainment numbers at the bottom hit points are about a factor of 1.7 to 2.1 larger at the bottom hit points than at the maximum rise point of the discharge trajectories. These deleterious entrainment rates are to be throughput to the ETM/APF (Empirical Transport Model/Area of Production Foregone) calculus to compute the mitigation scaling for DDP diffuser turbulent shear impact

5) Conclusions:

Diffusers intrinsically generate strong turbulent jets in order to produce mixing and rapid dilution of effluent, and the shearing action of those turbulent jets can potentially damage or kill small delicate organisms entrained into those jets (sometimes referred to as *diffuser turbulence mortality*). The implementation section of the brine amendment to the California Ocean Plan, Section III.M.2 (b), requires that brine diffusers must minimize and mitigate for such marine life impacts, and the California State Water Resources Control Board has released newly defined protocols that require the use of a specific hydrodynamic mixing model (referred to as *Plumes 18b*) to assess those impacts. Plumes 18b is not supported by US EPA, but the State Water Board has made executable files for this model publicly available on their web site, along with a technical guidance document on how to assess deleterious entrainment from brine diffusers. These protocols using the Plumes 18b model are implemented in this study to assess potential injury or mortality to small marine organisms entrained by discharges from the diffuser of the San Juan Creek Ocean Outfall (SJCOO) that is being proposed as the discharge structure for brine by-product from the Doheny Desalination Project (DDP).

In general, Plumes 18b predicted higher *Minimum Initial Dilution,* and smaller *Zones of Initial Dilution,* ZID at deeper depths than was reported previously by DDP dilution studies using the US EPA supported Visual Plumes (UM3). Using Plumes 18b, all of the buoyant DDP discharge scenarios are found to achieve the required 101 to 1 minimum initial dilution required under the current NPDES permit for the SJCOO, (No. CA 0107417, Order No. R9-2012-0012 as amended by Order No. R9-2014-0105). For any given amount of SOCWA wastewater, the addition of any amount of DDP brine reduces both the minimum initial dilution as well as the effective (average or bulk) dilution at the maximum rise of the plume, while reducing the size of the ZID. This is not altogether a bad result, so long as there remains adequate dilution to satisfy present or future NPDES permit requirements for minimum initial dilution; which indeed appears to be the case. The reduction of buoyant effluent dilution caused by adding brine to SOCWA wastewater has a favorable effect on potentially deleterious diffuser entrainment, even though buoyant discharges appear to be exempt from requirements to assess, minimize or mitigate for diffuser turbulence mortality impacts to entrained marine organisms under the present structure of the amended Ocean Plan (SWRCB,2015). The Plumes 18b results show that for any given amount of SOCWA wastewater, the addition of any amount of DDP brine reduces the deleterious diffuser entrainment rate, thus improving upon an existing condition that is not mitigatable under present implementation practices of the Ocean Plan. Therefore, no mitigation should be required for DDP operational scenarios that result in buoyant combined discharges with SOCWA wastewater. The net turbulence mortality benefit achieved by combining DDP brine with SOCWA wastewater increases with decreasing combined discharge rate, as smaller jet velocities with larger Kolmogorov turbulent eddies occur at lower combined discharge rates.

The Plumes 18b dilution modeling results for the combinations of SOCWA wastewater and DDP brine that produce dense (negatively buoyant) discharges involve either brine-only or high-brine ratio discharges, typical of conditions anticipated during dry-weather wastewater effluent streams or future water reclamation conditions. Again, Plumes 18b has predicted higher effective dilution and shorter distances to the 2 ppt over natural background compliance threshold than was reported previously in DDP dilution studies using the US EPA supported Visual Plumes (UM3). Based on long term averages of ambient salinity records, natural background salinity at the SJCOO is 33.52 ppt, so that the compliance threshold 35.52 ppt under Appendix-A brine amendment provisions of the California Ocean Plan (SWRCB, 2015). Plumes 18b results indicate this compliance threshold is met in less than 2.5 ft. from the point of discharge by all DDP dense discharge operating conditions; whereas the Ocean Plan requires this compliance threshold is reached within 100 m from the discharge point. Thus, the DDP would be fully compliant with Ocean Plan brine discharge limits by a wide margin of safety, according to Plumes 18b dilution simulations. The jets of the SJCOO diffuser discharge parallel to the bottom and the ports are only 4.5 ft. above the bottom. Consequently the trajectories of these dense DDP discharges travel relatively short distances before reaching maximum rise or bottom hit points. This behavior, in turn, causes the Kolmogorov eddy scales in the diffuser jets to remain small (less than 0.2 mm), and presumably injurious according to the injury hypothesis advanced in the State Water Boards turbulence mortality guidance document. But these short trajectories also limit the effective (bulk or average) dilution and therefore limit the deleterious diffuser entrainment. By the literal interpretation of the State Water Board’s guidance document mitigation scaling for brine diffuser turbulence mortality should only be based on the entrainment at the maximum rise of the plume, which range from 67 mgd to 729 mgd for dense DDP discharges.

6) References and Bibliography:

Abessi, O., and Roberts, P. J. W. (2014). "Multiport Diffusers for Dense Discharges." *J.Hydraul. Eng.*, 140(8) http://dx.doi.org/10.1061/(ASCE)HY.1943-7900.0000882

Abessi, O., and Roberts, P. J. W. (2015). "Effect of nozzle orientation on dense jets in stagnant environments." J. Hydraul. Eng., 141(8).

Abessi, O., and Roberts, P. J. W. (2017). "Multiport Diffusers for Dense Discharges in Flowing Ambient Water." J. Hydraul. Eng., 143(6).

Abessi, O., Roberts, P. J. W., and Ghandi, V. (2016). "Rosette Diffusers for Dense Effluents." J. Hydraul. Eng., 143(4) 10.1061/(ASCE)HY.1943-7900.0001268

Baumgartner, D. J., Frick, W. E., and Roberts, P. J. W. (1994). "Dilution Models for Effluent Discharges (Third Edition)." U.S. Environmental Protection Agency, Office of Research and Development,.EPA/600/R-94/086

BenSaid, H., Mompean, G., and H., Naji, 2012, "On the Evaluation of Linear and Non-Linear Models Using DNS Data of Turbulent Channel Flows," *Jour. Baz. Soc. Mech. Sci. & Eng.*, Vol XXXIV, No. 4, p. 462-476.

Breidenthal, R., 1981, "Structure in turbulent mixing layers and wakes using a chemical reaction", Jour. Fluid Mech., vol 109, pp 1-24.

Doneker, R. L., and Jirka, G. H. (1999). "Discussion of mixing of inclined dense jets" by Roberts, P. J. W., Ferrier, A., and Daviero, G." (1997)." J. Hydraul. Eng., 125(3), 317–319.

Doneker, R. L. and Jirka, G. H. (2017). "CORMIX User Manual." MixZon, Portland, Oregon. Updated February 2017.

Cada, G.F., J.M. Loar, L.A. Garrison, R.K. Fisher, and D. Neitzel. 2006. Efforts to Reduce Mortality to Hydroelectric Turbine-Passed Fish: Locating and Quantifying Damaging Shear Stresses. *Environmental Management* 37(6): 898-906.

Cada, G.F, L.A. Garrison, and R.K. Fisher Jr. 2007. Determining the Effects of Shear Stress on Fish Mortality during Turbine Passage. *Hydro Review*, November 2007, p 52-58.

Foster, M.S., Roberts, J.W., Cailliet, G.M., Callaway, J., Raimondi, P. and K. Mead-Vetter. 2013. "Desalination Plant Entrainment Impacts and Mitigation Mititation", Report to California State Water Resources Control Board, Sacramento, 50 pp.

Frick, W.E., Roberts, P., Davis, L., Keyes, J., Baumgartner, D., George, K., 2003, "Dilution models for effluent discharges, Forth Addition", U.S. Environmental Protection Agency, Standards and Applied Science Division Office of Science and Technology, 148 pp.

Frick, W. E. (2004). "Visual Plumes mixing zone modeling software." Environmental

Modelling & Software, 19, 645-654.

Frick, W., Ahmed, A., George, K., Laputz, A., Pelletie, G., and Roberts, P. (2010). "On Visual Plumes and Associated Applications." MWWD 2010 6th International Conference on Marine Waste Water Discharges and Coastal Environment, C. Avanzini, ed. Langkawi, Malaysia.

Frick, W. E., and Roberts, P. J. W. (2016). "Visual Plumes 2016: An Updated Public-Domain Plume Model Suite." Proc., International Symposium on Outfall Systems, ISOS2016, IWA. 10 - 13 May 2016.

Greenewelt, C., H., 1962, "Dimensional relationships for flying and swimming animals", *Smithsonian Miscellaneous Collections*, no. 144, 28 pp.

Grant, G., H., Stewert, R., W., and A. Moilliet, "Turbulence spectra from a tidal channel," *J. Fluid Mech*., vol. 12, 1962, pp.

Jenkins, S. A., 2016, "Hydrodynamic Modeling of Brine Dilution Assessment for the Doheny Desalination Project", submitted to the South Coast Water District, submitted by Michael Baker International, San Diego, 101 pp.

Jenkins, S. A., 2017, "Part II Supplemental Hydrodynamic Modeling of Brine Dilution Assessment for the Doheny Desalination Project", submitted to the South Coast Water District, submitted by Michael Baker International, San Diego, 9 pp.

Jenkins, S. A. (2017a)."Dilution Analysis Alden 3-Jet Duckbill Diffuser Retrofit at Huntington Beach Desalination Facility (HBDF)", submitted to Poseidon Resources Surfside, 7 June 2017, 33 pp.

Jenkins, S. A. (2017b). "Alternative Hydrodynamic Model Analysis of the Alden Designed 3-Port Duckbill Diffuser Retrofit at Huntington Beach Desalination Facility (HBDF)-Version 2." Michael Baker International. 29 November 2017. *Appendix KKKK3 - Michael Baker Dilution Analysis CORMIX Model Update 2017.11.29 FINAL.pdf*

Jenkins, S. A. (2017c). "Taylor Micro-Scale Methods for Estimating Injury and Mortality to Marine Organisms Entrained by a Diffuser at Huntington Beach Desalination Facility (HBDF). Michael Baker International. 7 December 2017. *Appendix WWWW - Memo - HBDF Turbulence Impact Assessment 2017.12.07 FINAL.pdf*

Jenkins, S., A., Cartamil, D., D'Spain, G., and J. Wasyl, (in press), "Hydrodynamic Impacts on Marine Life Due to Brine Dilution Strategies for Seawater Desalination with Open Ocean Intakes," Environmental Science and Technology, 15 pp.

Jessopp, M. J. (2007) The quick and the dead: larval mortality due to turbulent tidal transport. J. Mar. Biol. Ass. U.K. 87, 675-680.

Kolmogorov, A. N., 1941, *C.R. Acad. Sci., USSR.*, vol 30, no.301.

Landahl, M.T. and E. Mollo-Christensen, 1992, *Turbulence and Random Processes in Fluid Mechanics*, Cambridge Press, 2ed, ISBN-13: 978-0521422130

Marcy, B.C., Jr., A.D. Beck, and R.E. Ulanowicz. 1978. Effects and Impacts of Physical Stress on Entrained Organisms. In: Schubel, J. R. and Marcy, B.C., Jr. (eds.) Power Plant Entrainment: a Biological Assessment. NY, Academic Press, pp. 135-188.

Morgan, R.P., R.E. Ulanowicz, V.J. Rasin, L.A. Noe, and G. B. Gray. 1974. Effects of Shear on Eggs and Larvae of Striped Bass, *Morone saxatilis*, and White Perch, *M. americana*. *Transactions of the American Fisheries Society* 105(1): 149-154.

Neitzel, D.A., M.C. Richmond, D.D. Dauble, R.P. Mueller, R.A. Moursund, C.S. Abernethy, G.R. Guensch, and G.F. Cada. 2000. Laboratory Studies on the Effects of Shear on Fish. U. S. Department of Energy, Idaho Operations Office, DOE/ID-10822, Idaho Falls, Idaho.

Neitzel, D.A. , D. D. Dauble , G. F. ada , M. C. Richmond , G. R. Guensch , R. P. Mueller , C. S. Abernethy & Brett Amidan, (2004) "Survival Estimates for Juvenile Fish Subjected to a Laboratory-Generated Shear Environment," *Transactions of the American Fisheries Society,* 133:2, 447-454, DOI: 10.1577/02-021

Palomar, P., Lara, J. L., and Losada, I. J. (2012). "Near field brine discharge modeling Part 2: Validation of commercial tools." Desalination, 290(0), 28-42.

Rehmann, C. R., J.A. Stoeckel, and D.W. Schneider (2003a). Effect of turbulence on the mortality of zebra mussel veligers. Can. J. Zool. 81: 1063–1069

Roberts, P. (2016) "Appendix D1 – Modeling Brine Disposal into Monterey Bay", submitted to ESA/Environmental Science Associates, July 6, 2016, 72 pp + app.

Roberts, P. (2017), "Response to Memoranda from TWB Environmental and HDR concerning Huntington Beach desalination plant", submitted to California State Lands Commission, 26 July 2017, 4 pp.

Roberts, P.J.W., 2018a, "Brine Diffusers and Shear Mortality, prepared for Eastern Research Group, April 18, 2018, 62 pp.

Roberts, P.J.W., 2018b, "Brine Diffusers and Shear Mortality: Application to Huntington Beach, prepared for Eastern Research Group, April 18, 2018, 35 pp.

RWQCB, 2014, California Regional Water Quality Control Board, San Diego Region, "ORDER NO. R9-2012-0012 as Amended by Order No. R9-2014-0105 NPDES NO. CA 0107417 WASTE DISCHARGE REQUIREMENTS FOR THE SOUTH ORANGE COUNTY WASTEWATER AUTHORITY DISCHARGE TO THE PACIFIC OCEAN THROUGH THE SAN JUAN CREEK OCEAN OUTFALL, APPENDIX-H DILUTION MODEL INFORMATION", p H-1 - p. H-9; 151 pp.

SCCWRP (2012), Jenkins, S. A., J. Paduan, P. Roberts, D. Schlenk, and J. Weis, “Management of Brine Discharges to Coastal Waters; Recommendations of a Science Advisory Panel”, submitted at the request of the California Water Resources Control Board, Southern California Coastal Water Research Project, Tech. Rpt. 694, March, 2012, 56 pp. + App.

SWRCB, 2014, “DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND THE INCORPORATION OF OTHER NONSUBSTANTIVE CHANGES”, Draft Staff Report Including the Draft Substitute Environmental Documentation Amendment to the Water Quality Control Plan For Ocean Waters of California, 206 pp.

SWRCB, 2015, State Water Resources Control Board. Final Staff Report Including the Final Substitute Environmental Documentation, Adopted May 6, 2017. Amendment to the Water Quality Control Plan For Ocean Waters of California Addressing: “DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND THE INCORPORATION OF OTHER NON-SUBSTANTIVE CHANGES”, cf. Appendix-A: “Ocean Plan with the May 6, 2015 Final Desalination Amendment”, 1303 pp.

Tennekes, H. and J. Lumley. 1972. *A First Course in Turbulence*, MIT Press, ISBN: 9780262200196, 320 pp.

Wygnanski, I., and Fiedler, H. E. (1969). "Some Measurements in the Self-Preserving Jet." J. Fluid Mech., 38(3), 577-612

Zhang, C., Xu, M., Wang, Z., Liu, W., and Yu, D. (2017). "Experimental study on the effect of turbulence in pipelines on the mortality of Limnoperna fortunei veligers." Ecological Engineering, 109(Part A), 101-118 https://doi.org/10.1016/j.ecoleng.2017.08.024.

APPENDIX-A: Wastewater Only Baseline Results

A.1: Plumes 18b Results for SJCOO discharges of 31 mgd Wastewater Only:

SJCOO discharging 31 mgd of wastewater at TDS = 1.25
ppt

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/9/2019 2:49:23 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW31mgd_b0mgd_T-12.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	Spacing	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	12.000	1000.0	0.0	100.00	31.000	1.2500	20.660	1250.0

Simulation:
Froude No: 16.39; Strat No: 1.48E-4; Spcg No: 47.21; k: 2.31E+5; eff den (sigmaT) -0.921168; eff vel 2.305(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	1.250	1250.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.104	2.385	1206.9	1.036	0.0219	0.0	0.07884; bottom hit;
10	100.00	0.0	3.732	7.442	1014.0	1.233	0.112	0.0	0.09479;
20	100.00	0.0	4.541	12.10	835.0	1.497	0.230	0.0	0.1153;
30	100.00	0.0	5.527	15.92	687.1	1.819	0.375	0.0	0.1404;
40	100.00	0.0	6.728	19.05	565.0	2.212	0.551	0.0	0.1709;
50	99.99	0.0	8.193	21.62	464.5	2.691	0.766	0.0	0.2081;
60	99.99	0.0	9.977	23.73	381.7	3.275	1.028	0.0	0.2534;
70	99.97	0.0	12.15	25.46	313.5	3.987	1.347	0.0	0.3086;
80	99.95	0.0	14.79	26.88	257.5	4.854	1.733	0.0	0.3757;
90	99.90	0.0	17.99	28.05	211.4	5.912	2.198	0.0	0.4570;
100	99.83	0.0	21.64	28.95	175.6	7.120	2.714	0.0	0.5496;
110	99.75	0.0	25.13	29.58	150.7	8.294	3.166	0.0	0.6384;
120	99.65	0.0	28.51	30.04	132.2	9.453	3.567	0.0	0.7242;
130	99.54	0.0	31.82	30.41	117.7	10.62	3.931	0.0	0.8082;
140	99.42	0.0	35.07	30.70	106.0	11.80	4.267	0.0	0.8907;
150	99.29	0.0	38.27	30.95	96.18	13.00	4.583	0.0	0.9722;
160	99.15	0.0	41.43	31.16	87.88	14.22	4.883	0.0	1.0523;
170	99.00	0.0	44.53	31.34	80.73	15.48	5.172	0.0	1.1311;
180	98.83	0.0	47.57	31.49	74.51	16.78	5.453	0.0	1.2083;
190	98.65	0.0	50.53	31.63	69.03	18.11	5.729	0.0	1.2835;
200	98.45	0.0	53.41	31.75	64.15	19.48	6.004	0.0	1.3565;
210	98.22	0.0	56.19	31.86	59.78	20.91	6.280	0.0	1.4272;
220	97.97	0.0	58.88	31.96	55.81	22.40	6.560	0.0	1.4955;
230	97.68	0.0	61.47	32.05	52.17	23.96	6.847	0.0	1.5614;
240	97.35	0.0	63.99	32.14	48.79	25.62	7.145	0.0	1.6253;
250	96.97	0.0	66.45	32.22	45.61	27.41	7.456	0.0	1.6878;
260	96.53	0.0	68.90	32.30	42.56	29.37	7.786	0.0	1.7500;
270	96.00	0.0	71.40	32.37	39.59	31.57	8.139	0.0	1.8137;
280	95.36	0.0	74.06	32.44	36.65	34.11	8.521	0.0	1.8812;
290	94.57	0.0	77.02	32.52	33.67	37.13	8.940	0.0	1.9562;
300	93.58	0.0	80.48	32.60	30.60	40.85	9.403	0.0	2.0441;
310	92.32	0.0	84.76	32.68	27.39	45.63	9.923	0.0	2.1529;
320	90.66	0.0	90.35	32.76	24.01	52.06	10.52	0.0	2.2950;
330	88.40	0.0	98.05	32.85	20.43	61.18	11.20	0.0	2.4904;
340	85.34	0.0	108.7	32.94	16.83	74.29	11.97	0.0	2.7606;
350	81.84	0.0	121.7	33.02	13.80	90.55	12.70	0.0	3.0903;
360	77.85	0.0	138.3	33.07	11.32	110.4	13.41	0.0	3.5138;
363	76.54	0.0	144.2	33.09	10.67	117.1	13.62	0.0	3.6619; merging;
370	72.54	0.0	164.5	33.12	9.290	134.6	14.23	0.0	4.1793;
380	64.76	0.0	215.6	33.16	7.621	164.0	15.28	0.0	5.4760;
389	56.09	0.0	298.6	33.19	6.377	196.0	16.35	0.0	7.5853; trap level;
390	55.05	0.0	311.9	33.19	6.252	199.9	16.48	0.0	7.9222;
398	50.15	0.0	517.9	33.21	5.726	218.3	17.17	0.0	13.156; begin overlap;
400	49.88	0.0	565.6	33.21	5.702	219.2	17.22	0.0	14.366;
410	49.15	0.0	765.5	33.21	5.648	221.3	17.38	0.0	19.444;
420	48.83	0.0	952.5	33.21	5.617	222.6	17.46	0.0	24.193;
430	48.65	0.0	1135.6	33.21	5.592	223.5	17.52	0.0	28.845;
440	48.55	0.0	1315.7	33.21	5.571	224.4	17.56	0.0	33.418;

450	48.51	0.0	1439.4	33.21	5.556	225.0	17.58	0.0	36.562;
460	48.50	0.0	1460.1	33.21	5.542	225.5	17.58	0.0	37.087;
470	48.50	0.0	1467.7	33.21	5.529	226.1	17.58	0.0	37.279;
480	48.50	0.0	1474.7	33.21	5.516	226.6	17.58	0.0	37.456; local maximum rise or fall;
487	51.72	0.0	1493.0	33.22	5.403	231.3	18.25	0.0	37.921;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 5.5640
Lmz(m): 5.5640
forced entrain 1 0.0 14.72 37.92 0.409
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3818
;
2:49:24 PM. amb fills: 4

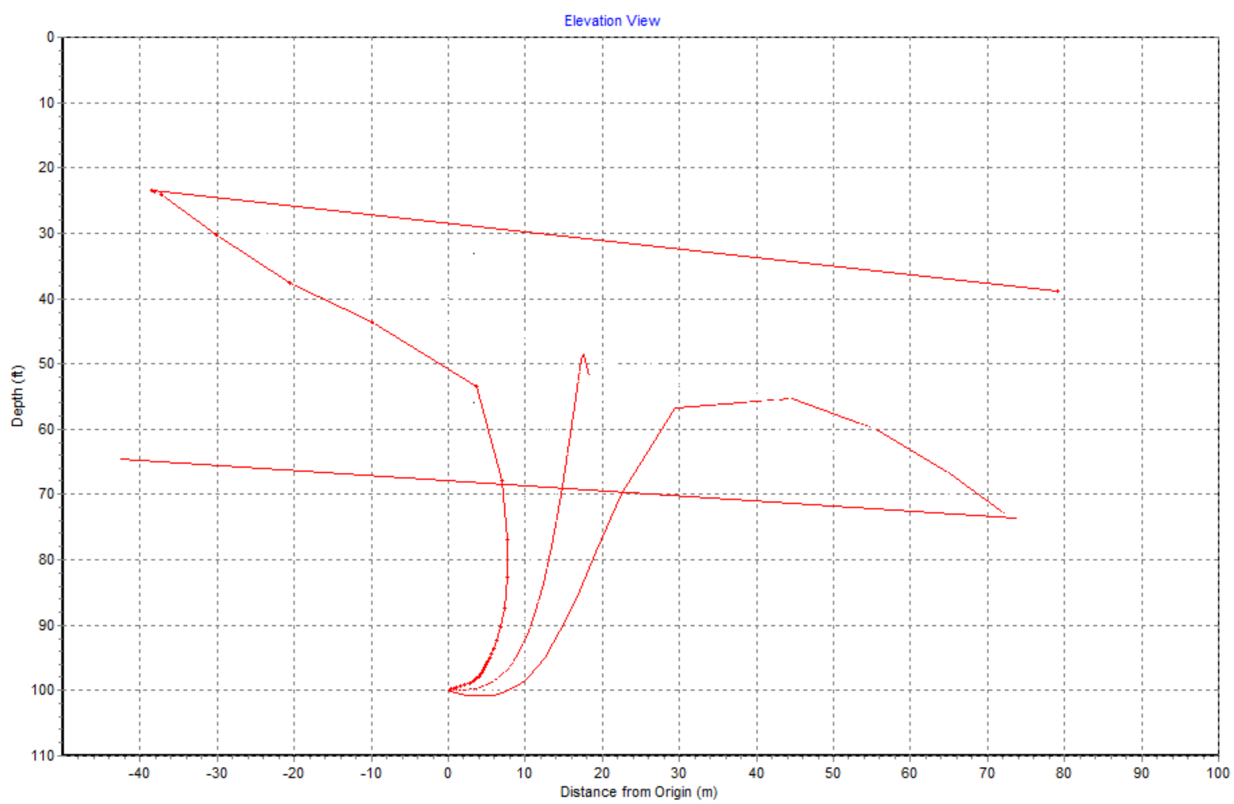

Figure A.1.1: Plumes 18b solution of discharge plume trajectories for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -43 m to *X* = +80 m so that ZID = 123 m

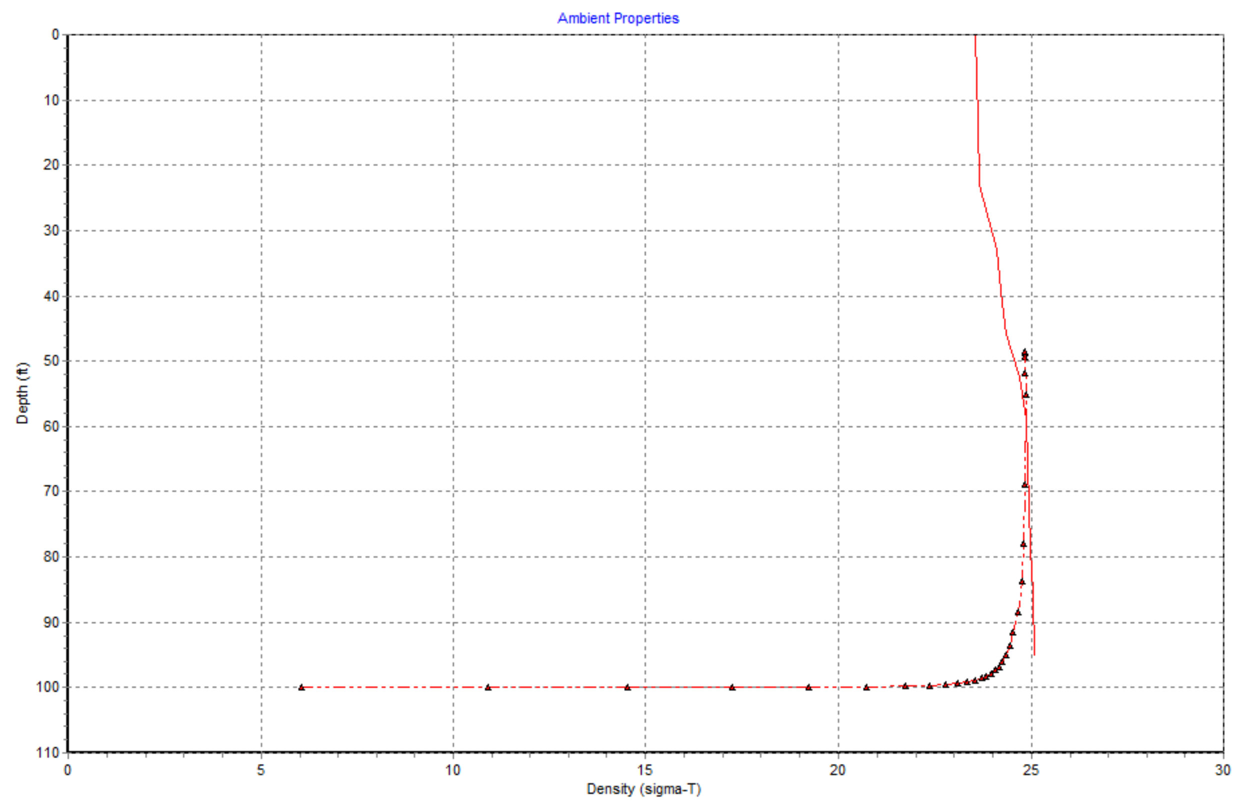

Figure A.1.2: Plumes 18b solution of vertical density profile for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

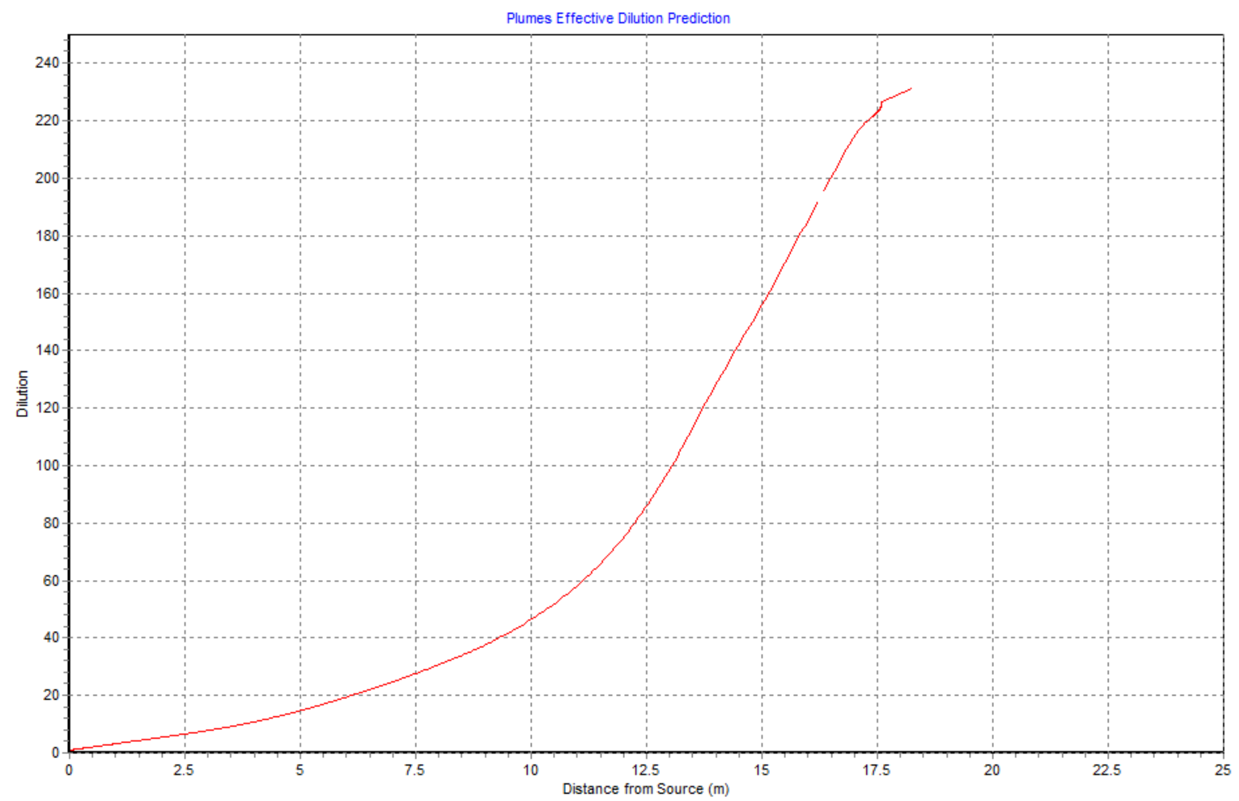

Figure A.1.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt.

A.2: Plumes 18b Results for SJCOO discharges of 18.9 mgd Wastewater Only:

SJCOO discharging 18.9 mgd of wastewater at TDS = 1.25
ppt

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/9/2019 3:16:57 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW18.9mgd_b0mgd_T-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	Spacing	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	12.000	1000.0	0.0	100.00	18.900	1.2500	20.660	1250.0

Simulation:

Froude No: 9.996; Strat No: 1.48E-4; Spcg No: 47.21; k: 1.41E+5; eff den (sigmaT) -0.921168; eff vel 1.405(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	1.250	1250.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.083	1.952	1223.4	1.022	0.0135	0.0	0.07831; bottom hit;
10	100.00	0.0	3.681	7.079	1027.9	1.216	0.0809	0.0	0.0935;
20	100.00	0.0	4.479	11.80	846.4	1.477	0.166	0.0	0.1138;
30	100.00	0.0	5.451	15.67	696.5	1.795	0.271	0.0	0.1385;
40	100.00	0.0	6.635	18.85	572.9	2.182	0.400	0.0	0.1685;
50	99.99	0.0	8.078	21.46	470.9	2.654	0.556	0.0	0.2052;
60	99.98	0.0	9.834	23.60	387.0	3.230	0.747	0.0	0.2498;
70	99.96	0.0	11.96	25.35	317.9	3.932	0.978	0.0	0.3039;
80	99.93	0.0	14.50	26.77	262.0	4.770	1.250	0.0	0.3682;
90	99.89	0.0	17.09	27.79	221.7	5.638	1.497	0.0	0.4342;
100	99.84	0.0	19.71	28.55	191.4	6.530	1.713	0.0	0.5007;
110	99.79	0.0	22.38	29.15	167.7	7.455	1.905	0.0	0.5683;
120	99.73	0.0	25.09	29.63	148.5	8.420	2.079	0.0	0.6372;
130	99.67	0.0	27.84	30.03	132.6	9.426	2.240	0.0	0.7071;
140	99.60	0.0	30.62	30.37	119.3	10.48	2.390	0.0	0.7777;
150	99.53	0.0	33.40	30.65	108.1	11.57	2.532	0.0	0.8484;
160	99.45	0.0	36.16	30.89	98.48	12.69	2.668	0.0	0.9186;
167	99.39	0.0	38.07	31.04	92.57	13.50	2.761	0.0	0.9670; begin overlap;
170	99.37	0.0	38.87	31.10	90.25	13.85	2.800	0.0	0.9873;
180	99.27	0.0	41.37	31.27	83.38	14.99	2.929	0.0	1.0507;
190	99.17	0.0	43.67	31.42	77.50	16.13	3.059	0.0	1.1091;
200	99.06	0.0	45.82	31.55	72.32	17.28	3.189	0.0	1.1638;
210	98.93	0.0	47.87	31.67	67.63	18.48	3.322	0.0	1.2158;
219	98.80	0.0	49.66	31.76	63.70	19.62	3.446	0.0	1.2613; end overlap;
220	98.78	0.0	49.85	31.78	63.28	19.75	3.460	0.0	1.2662;
230	98.61	0.0	51.68	31.87	59.33	21.07	3.604	0.0	1.3127;
240	98.42	0.0	53.32	31.96	55.72	22.43	3.756	0.0	1.3544;
250	98.18	0.0	54.79	32.05	52.37	23.87	3.920	0.0	1.3916;
260	97.89	0.0	56.11	32.13	49.18	25.42	4.098	0.0	1.4253;
270	97.54	0.0	57.37	32.21	46.05	27.14	4.295	0.0	1.4571;
280	97.09	0.0	58.66	32.29	42.88	29.15	4.516	0.0	1.4899;
290	96.51	0.0	60.15	32.37	39.55	31.60	4.768	0.0	1.5278;
300	95.74	0.0	62.10	32.46	35.93	34.79	5.060	0.0	1.5774;
310	94.66	0.0	64.93	32.56	31.89	39.20	5.405	0.0	1.6493;
320	93.13	0.0	69.35	32.68	27.32	45.76	5.819	0.0	1.7616;
330	90.97	0.0	76.09	32.80	22.49	55.58	6.293	0.0	1.9328;
340	88.52	0.0	84.34	32.90	18.45	67.75	6.733	0.0	2.1423;
350	85.78	0.0	94.01	32.98	15.14	82.58	7.142	0.0	2.3878;
360	82.69	0.0	105.4	33.05	12.42	100.7	7.527	0.0	2.6770;
370	79.20	0.0	119.8	33.10	10.19	122.7	7.902	0.0	3.0441;
380	75.20	0.0	138.1	33.14	8.357	149.6	8.283	0.0	3.5083;
383	73.88	0.0	144.2	33.15	7.875	158.7	8.400	0.0	3.6615; merging;
390	69.82	0.0	165.8	33.18	6.856	182.3	8.736	0.0	4.2112;
400	61.78	0.0	231.8	33.21	5.624	222.3	9.349	0.0	5.8881; trap level;
410	52.59	0.0	428.0	33.23	4.707	265.6	10.10	0.0	10.872;
413	51.93	0.0	546.2	33.23	4.655	268.5	10.18	0.0	13.874; begin overlap;
420	51.33	0.0	768.8	33.23	4.625	270.2	10.27	0.0	19.527;
430	51.03	0.0	1051.1	33.23	4.608	271.3	10.32	0.0	26.699;
440	50.89	0.0	1324.1	33.24	4.595	272.0	10.36	0.0	33.633;
450	50.82	0.0	1588.6	33.24	4.585	272.6	10.38	0.0	40.351;

460	50.81	0.0	1690.5	33.24	4.578	273.0	10.38	0.0	42.938;
470	50.81	0.0	1699.5	33.24	4.571	273.4	10.38	0.0	43.167;
480	50.81	0.0	1704.4	33.24	4.565	273.8	10.38	0.0	43.293; local maximum rise or fall;
485	57.56	0.0	1723.7	33.24	4.473	279.5	10.91	0.0	43.782;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 3.3248
Lmz(m): 3.3248
forced entrain 1 0.0 12.94 43.78 0.323
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3837
;
3:16:57 PM. amb fills: 4

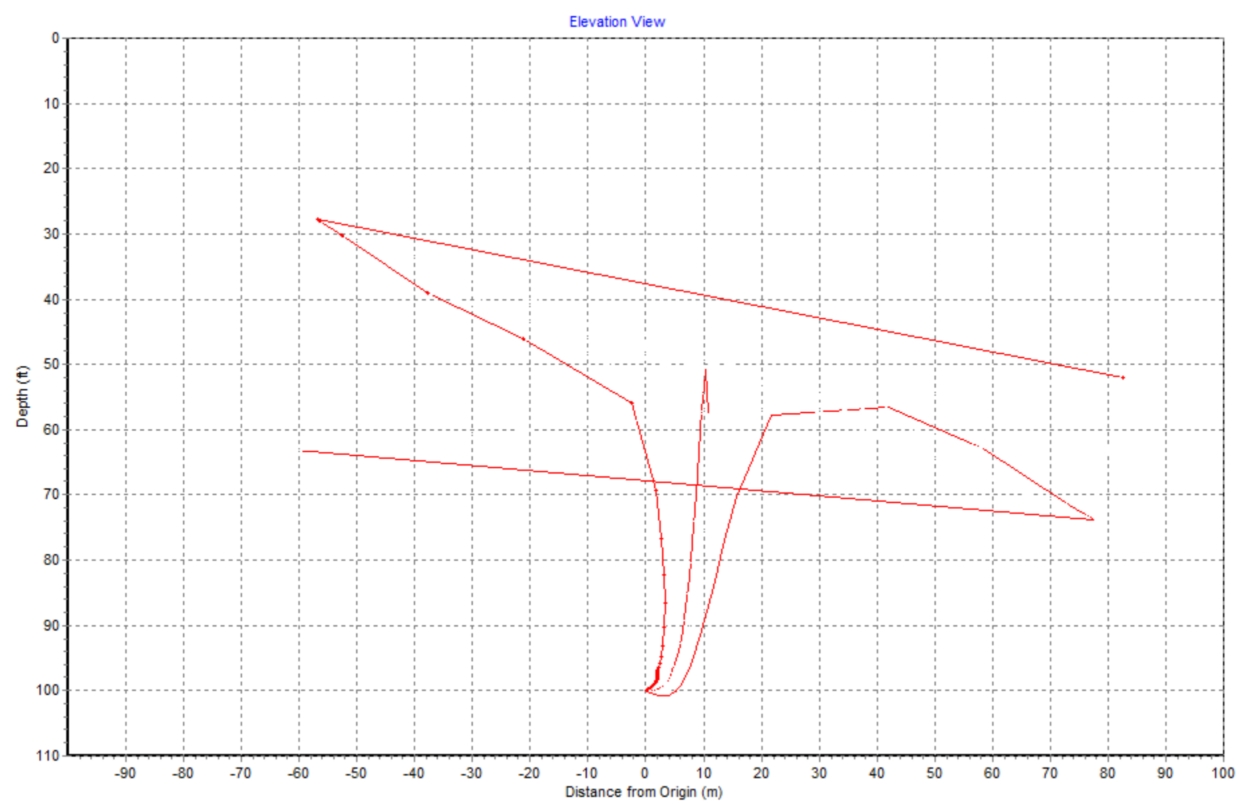

Figure A.2.1: Plumes 18b solution of discharge plume trajectories for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from X = -60 m to X = +83 m so that ZID = 143 m

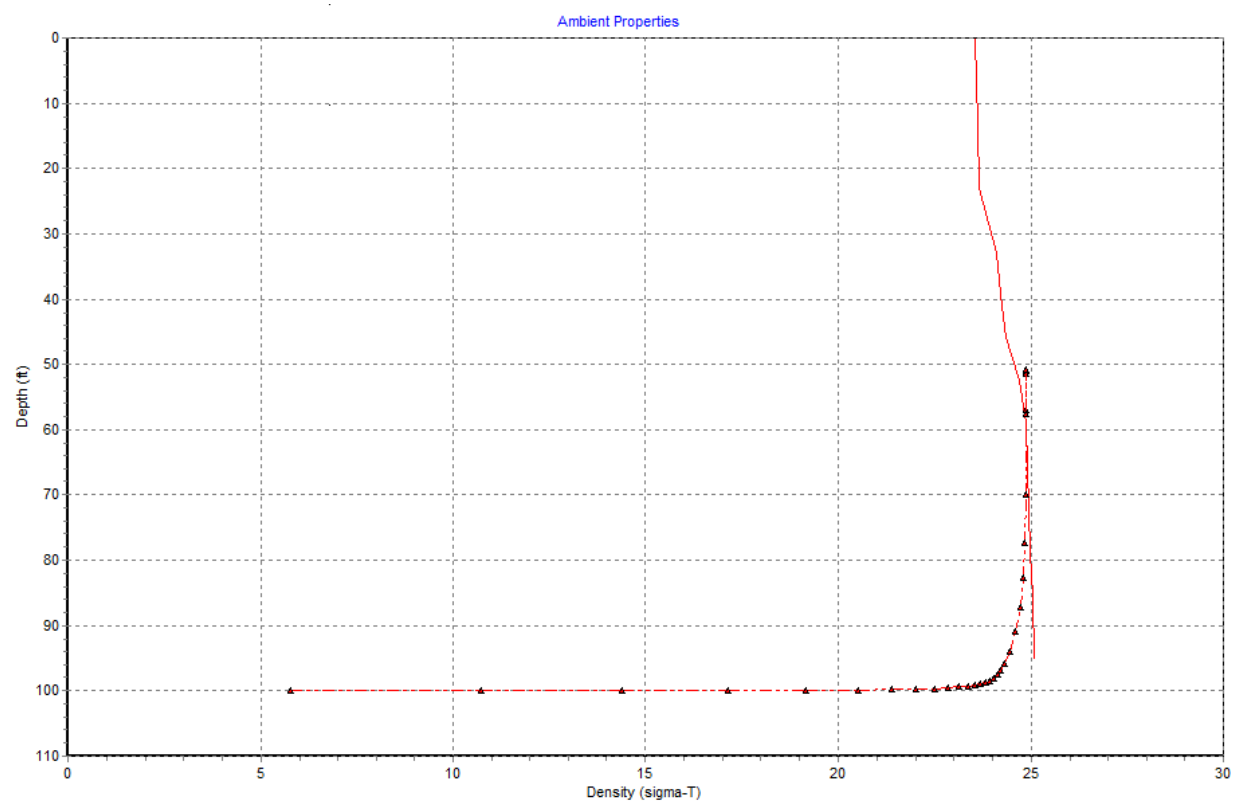

Figure A.2.2: Plumes 18b solution of vertical density profile for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

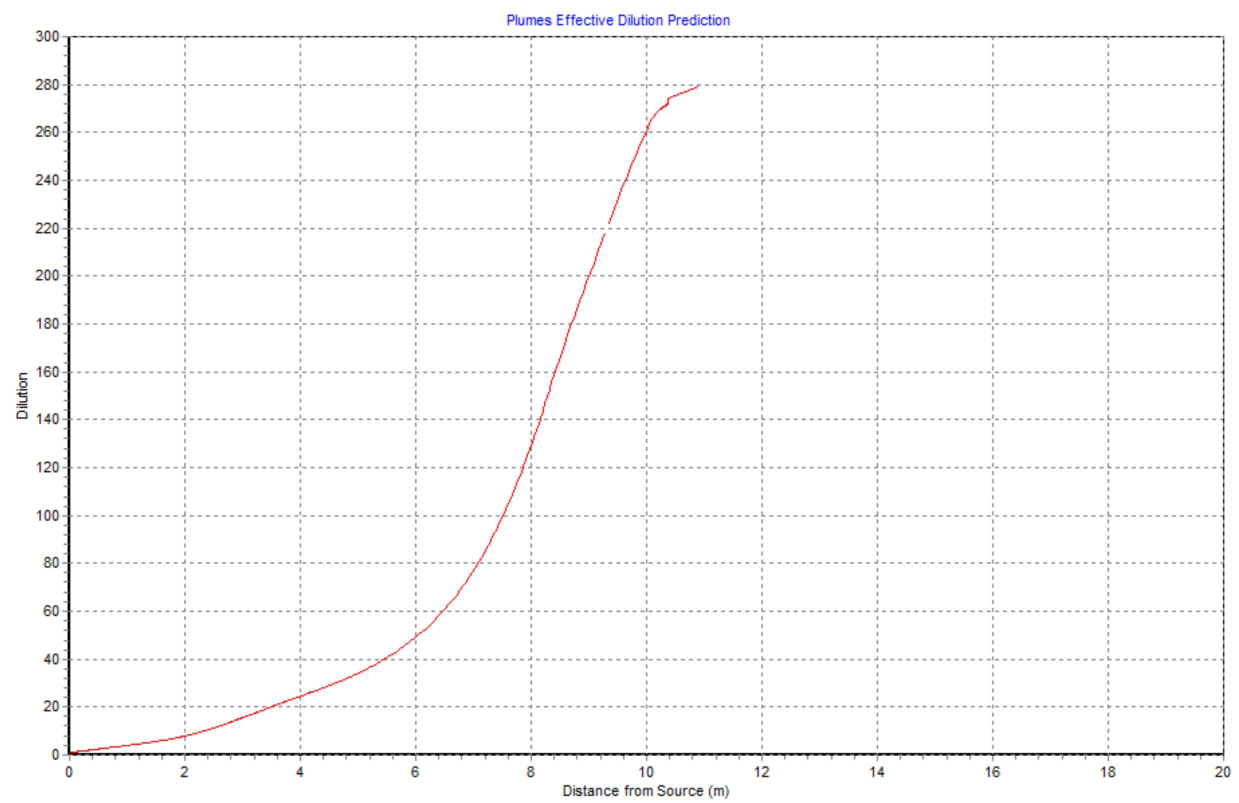

Figure A.2.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt.

A.3: Plumes 18b Results for SJCOO discharges of 13 mgd Wastewater Only:

SJCOO discharging 13 mgd of wastewater at TDS = 1.25
ppt

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 10:42:10 AM
Case 1; ambient file C:\Plumes18\SJCOO_WW13mgd_b0mgd_T-2.001.db; Diffuser table record 1: -------------------
----

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	Spacing	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	12.000	1000.0	0.0	100.00	13.000	1.2500	20.660	1250.0

Simulation:
Froude No: 6.875; Strat No: 1.48E-4; Spcg No: 47.21; k: 96666.1; eff den (sigmaT) -0.921168; eff vel
0.967(m/s);

Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	1.250	1250.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.073	1.736	1231.6	1.015	0.00937	0.0	0.07805; bottom hit;
10	100.00	0.0	3.656	6.899	1034.8	1.208	0.053	0.0	0.09287;
20	100.00	0.0	4.448	11.65	852.2	1.467	0.103	0.0	0.1130;
30	100.00	0.0	5.414	15.55	701.3	1.783	0.164	0.0	0.1375;
40	100.00	0.0	6.590	18.75	576.7	2.167	0.239	0.0	0.1674;
50	99.99	0.0	8.022	21.38	474.1	2.636	0.331	0.0	0.2038;
60	99.99	0.0	9.762	23.53	389.6	3.208	0.444	0.0	0.2480;
70	99.97	0.0	11.87	25.30	320.1	3.905	0.582	0.0	0.3015;
80	99.95	0.0	14.22	26.65	266.8	4.686	0.723	0.0	0.3611;
90	99.93	0.0	16.71	27.67	226.1	5.528	0.844	0.0	0.4245;
100	99.90	0.0	19.38	28.49	194.0	6.444	0.949	0.0	0.4922;
110	99.87	0.0	22.22	29.14	168.0	7.439	1.042	0.0	0.5644;
112	99.87	0.0	22.81	29.26	163.5	7.647	1.059	0.0	0.5794; begin overlap;
120	99.84	0.0	25.00	29.64	148.3	8.429	1.126	0.0	0.6350;
130	99.81	0.0	27.40	30.00	134.1	9.324	1.204	0.0	0.6960;
140	99.77	0.0	29.53	30.27	123.0	10.16	1.278	0.0	0.7502;
150	99.74	0.0	31.45	30.50	114.1	10.96	1.350	0.0	0.7989;
160	99.69	0.0	33.20	30.69	106.5	11.73	1.421	0.0	0.8433;
170	99.64	0.0	34.80	30.85	99.99	12.50	1.492	0.0	0.8840;
180	99.59	0.0	36.28	31.00	94.19	13.27	1.563	0.0	0.9215;
190	99.53	0.0	37.65	31.13	88.95	14.05	1.636	0.0	0.9563;
200	99.46	0.0	38.93	31.25	84.13	14.86	1.710	0.0	0.9888;
210	99.38	0.0	40.14	31.37	79.60	15.70	1.788	0.0	1.0195;
220	99.29	0.0	41.29	31.47	75.29	16.60	1.870	0.0	1.0488;
230	99.18	0.0	42.42	31.58	71.10	17.58	1.957	0.0	1.0776;
240	99.06	0.0	43.57	31.68	66.94	18.67	2.049	0.0	1.1068;
248	98.94	0.0	44.54	31.77	63.59	19.66	2.129	0.0	1.1314; end overlap;
250	98.90	0.0	44.77	31.79	62.78	19.91	2.150	0.0	1.1373;
260	98.72	0.0	45.81	31.89	58.89	21.23	2.259	0.0	1.1635;
270	98.48	0.0	46.65	31.98	55.22	22.64	2.382	0.0	1.1848;
280	98.18	0.0	47.38	32.07	51.60	24.22	2.522	0.0	1.2034;
290	97.77	0.0	48.14	32.16	47.84	26.13	2.685	0.0	1.2227;
300	97.22	0.0	49.16	32.27	43.72	28.59	2.878	0.0	1.2487;
310	96.42	0.0	50.83	32.39	38.97	32.08	3.112	0.0	1.2911;
320	95.22	0.0	53.83	32.53	33.34	37.49	3.403	0.0	1.3673;
330	93.53	0.0	58.72	32.68	27.39	45.63	3.730	0.0	1.4915;
340	91.64	0.0	64.84	32.80	22.47	55.62	4.028	0.0	1.6469;
350	89.53	0.0	72.10	32.90	18.44	67.80	4.302	0.0	1.8314;
360	87.17	0.0	80.54	32.98	15.13	82.64	4.558	0.0	2.0457;
370	84.51	0.0	90.23	33.05	12.41	100.7	4.800	0.0	2.2918;
380	81.53	0.0	102.0	33.11	10.18	122.8	5.033	0.0	2.5900;
390	78.12	0.0	117.0	33.15	8.352	149.7	5.265	0.0	2.9726;
400	74.18	0.0	135.7	33.18	6.851	182.4	5.506	0.0	3.4465;
405	71.98	0.0	146.1	33.19	6.205	201.4	5.631	0.0	3.7107; merging;
410	69.06	0.0	162.8	33.20	5.620	222.4	5.789	0.0	4.1340;
416	64.56	0.0	199.7	33.22	4.991	250.5	6.022	0.0	5.0723; trap level;
420	61.00	0.0	241.4	33.23	4.611	271.1	6.209	0.0	6.1323;
430	53.65	0.0	568.5	33.25	4.011	311.7	6.682	0.0	14.439; begin overlap;
440	53.08	0.0	982.9	33.25	3.991	313.2	6.753	0.0	24.965;
450	52.92	0.0	1354.7	33.25	3.982	313.9	6.783	0.0	34.410;
460	52.84	0.0	1716.3	33.25	3.975	314.5	6.801	0.0	43.594;
470	52.82	0.0	1953.0	33.25	3.970	314.8	6.807	0.0	49.607;

480	52.82	0.0	1973.2	33.25	3.967	315.1	6.807	0.0	50.119;
490	52.82	0.0	1977.2	33.25	3.963	315.4	6.807	0.0	50.221; local maximum rise or fall;
497	63.67	0.0	1999.3	33.25	3.883	321.9	7.268	0.0	50.782;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 2.2154
Lmz(m): 2.2154
forced entrain 1 0.0 11.07 50.78 0.283
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3841
;
10:42:10 AM. amb fills: 4

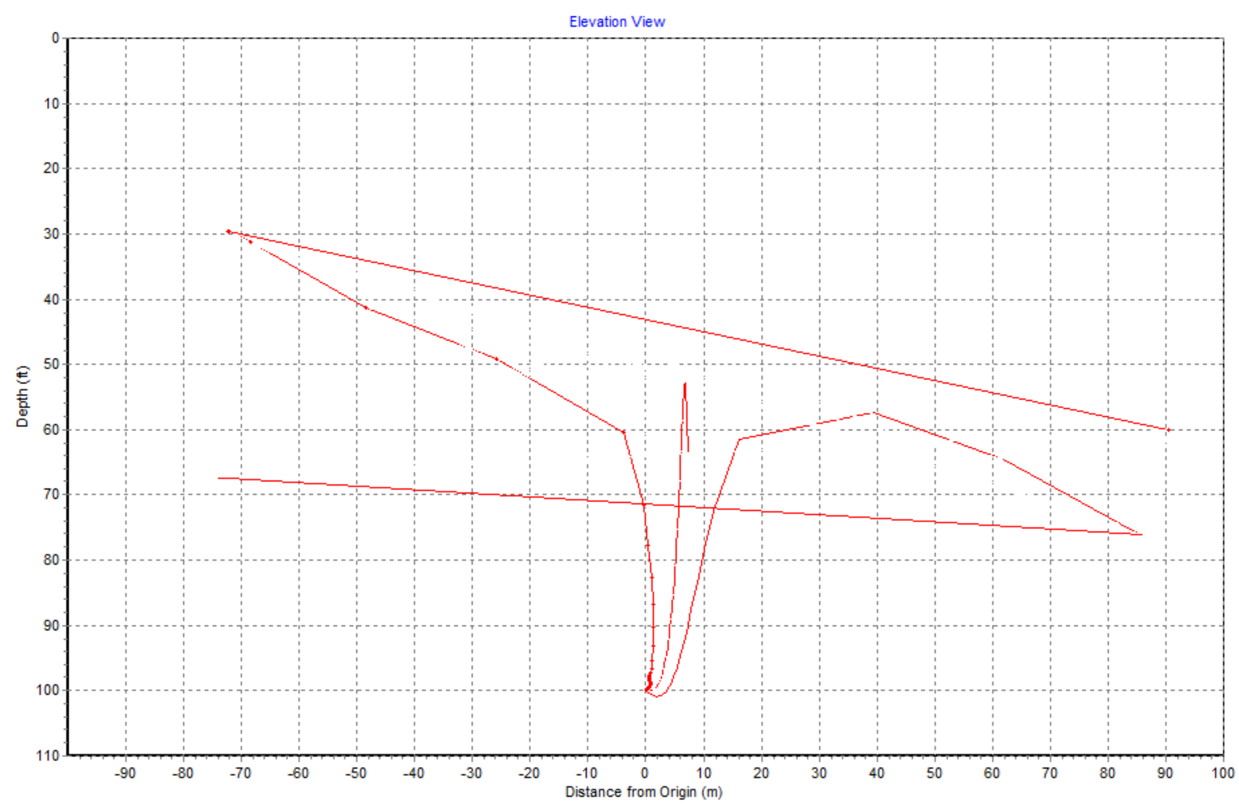

Figure A.3.1: Plumes 18b solution of discharge plume trajectories for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -74 m to *X* = +91 m so that ZID = 165 m

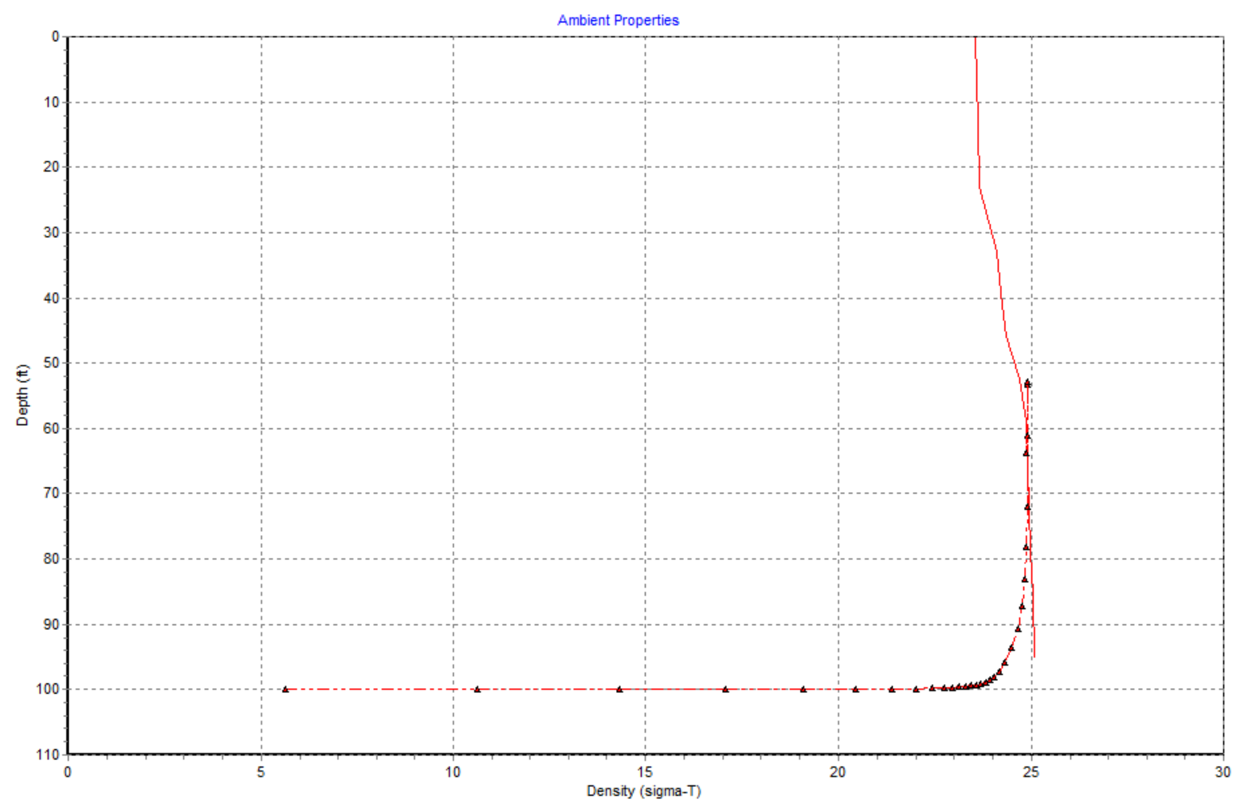

Figure A.3.2: Plumes 18b solution of vertical density profile for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

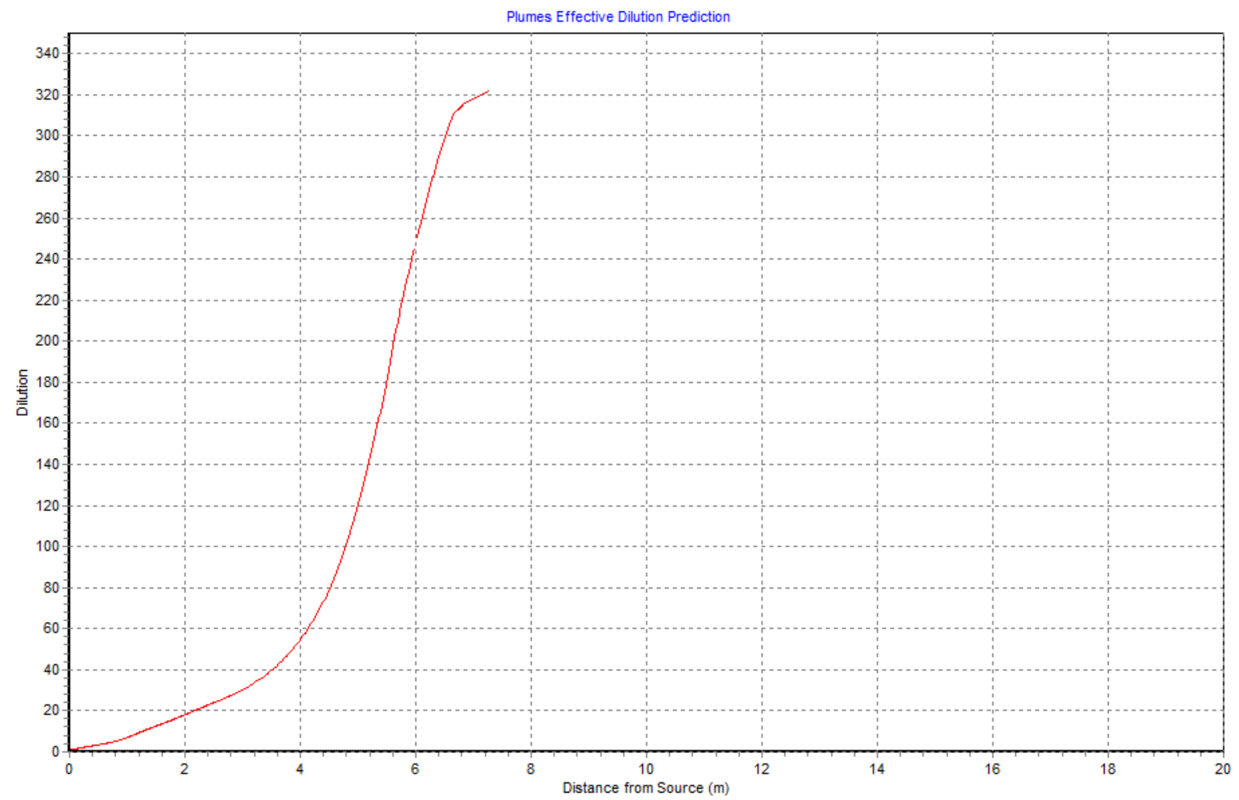

Figure A.3.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt.

A.4: Plumes 18b Results for SJCOO discharges of 8 mgd Wastewater Only:

SJCOO discharging 8 mgd of wastewater at TDS = 1.25 ppt

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 11:08:09 AM
Case 1; ambient file C:\Plumes18\SJCOO_WW8mgd_b0mgd_T-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	Spacing	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	12.000	1000.0	0.0	100.00	8.0000	1.2500	20.660	1250.0

Simulation:
Froude No: 4.231; Strat No: 1.48E-4; Spcg No: 47.21; k: 59486.8; eff den (sigmaT) -0.921168; eff vel 0.595(m/s);

Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	1.250	1250.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.064	1.551	1238.6	1.009	0.0058	0.0	0.07783; bottom hit;
10	100.00	0.0	3.635	6.744	1040.8	1.201	0.0201	0.0	0.09233;
20	100.00	0.0	4.423	11.53	857.1	1.458	0.0234	0.0	0.1123;
30	100.00	0.0	5.383	15.45	705.3	1.772	0.0244	0.0	0.1367;
40	100.00	0.0	6.553	18.67	580.1	2.155	0.0248	0.0	0.1665;
50	100.00	0.0	7.980	21.31	476.9	2.621	0.025	0.0	0.2027;
60	100.00	0.0	9.719	23.47	391.9	3.190	0.0251	0.0	0.2469;
70	100.00	0.0	11.84	25.25	321.9	3.883	0.0251	0.0	0.3007;
76	100.00	0.0	13.32	26.15	286.2	4.367	0.0251	0.0	0.3384; begin overlap;
80	100.00	0.0	14.31	26.64	267.0	4.682	0.0251	0.0	0.3634;
90	100.00	0.0	16.50	27.53	232.0	5.388	0.0251	0.0	0.4192;
100	100.00	0.0	18.44	28.13	208.0	6.010	0.0251	0.0	0.4683;
110	100.00	0.0	20.18	28.58	190.2	6.572	0.0251	0.0	0.5126;
120	100.00	0.0	21.79	28.93	176.3	7.090	0.0251	0.0	0.5534;
130	100.00	0.0	23.27	29.21	165.2	7.567	0.0251	0.0	0.5910;
140	100.00	0.0	24.73	29.46	155.5	8.038	0.0251	0.0	0.6282;
150	99.98	0.0	25.95	29.68	146.5	8.530	0.140	0.0	0.6591;
160	99.97	0.0	27.18	29.86	139.3	8.972	0.160	0.0	0.6905;
170	99.97	0.0	28.39	30.03	132.9	9.405	0.176	0.0	0.7210;
180	99.96	0.0	29.54	30.17	127.1	9.832	0.192	0.0	0.7502;
190	99.96	0.0	30.61	30.30	121.9	10.26	0.213	0.0	0.7775;
200	99.95	0.0	31.53	30.42	117.2	10.67	0.238	0.0	0.8009;
210	99.93	0.0	32.37	30.53	112.9	11.07	0.263	0.0	0.8222;
220	99.92	0.0	33.13	30.63	108.9	11.48	0.288	0.0	0.8416;
230	99.91	0.0	33.83	30.72	105.1	11.89	0.314	0.0	0.8593;
240	99.89	0.0	34.46	30.81	101.6	12.31	0.340	0.0	0.8753;
250	99.87	0.0	35.02	30.90	98.17	12.73	0.367	0.0	0.8896;
260	99.85	0.0	35.52	30.98	94.90	13.17	0.396	0.0	0.9022;
270	99.82	0.0	35.95	31.06	91.73	13.63	0.426	0.0	0.9132;
280	99.79	0.0	36.32	31.14	88.62	14.10	0.457	0.0	0.9226;
290	99.75	0.0	36.64	31.22	85.56	14.61	0.491	0.0	0.9306;
300	99.71	0.0	36.89	31.29	82.49	15.15	0.528	0.0	0.9371;
310	99.65	0.0	37.11	31.37	79.40	15.74	0.568	0.0	0.9425;
320	99.59	0.0	37.29	31.45	76.21	16.40	0.612	0.0	0.9471;
330	99.51	0.0	37.46	31.53	72.86	17.16	0.661	0.0	0.9515;
340	99.40	0.0	37.68	31.63	69.24	18.05	0.716	0.0	0.9571;
350	99.27	0.0	38.04	31.73	65.19	19.17	0.779	0.0	0.9661; end overlap;
360	99.09	0.0	38.30	31.83	61.14	20.45	0.853	0.0	0.9729;
370	98.85	0.0	38.38	31.93	57.11	21.89	0.941	0.0	0.9749;
380	98.50	0.0	38.47	32.04	52.73	23.71	1.050	0.0	0.9772;
390	97.95	0.0	38.93	32.17	47.47	26.33	1.189	0.0	0.9889;
400	97.05	0.0	40.47	32.34	40.68	30.73	1.372	0.0	1.0278;
410	95.78	0.0	43.60	32.53	33.38	37.44	1.575	0.0	1.1075;
420	94.38	0.0	47.83	32.68	27.39	45.64	1.753	0.0	1.2150;
430	92.82	0.0	53.00	32.80	22.47	55.63	1.915	0.0	1.3462;
440	91.09	0.0	59.06	32.90	18.44	67.80	2.066	0.0	1.5002;
450	89.14	0.0	66.07	32.98	15.12	82.65	2.207	0.0	1.6781;
460	86.96	0.0	74.08	33.05	12.41	100.7	2.341	0.0	1.8817;
470	84.50	0.0	83.22	33.11	10.18	122.8	2.469	0.0	2.1138;
480	81.73	0.0	94.33	33.15	8.351	149.7	2.592	0.0	2.3960;
490	78.57	0.0	108.7	33.18	6.851	182.5	2.717	0.0	2.7621;
500	74.89	0.0	127.3	33.21	5.620	222.4	2.849	0.0	3.2327;

508	71.50	0.0	144.5	33.23	4.797	260.6	2.963	0.0	3.6706; merging;
510	70.49	0.0	149.8	33.23	4.610	271.1	2.995	0.0	3.8059;
515	67.29	0.0	174.0	33.24	4.176	299.3	3.097	0.0	4.4204; trap level;
520	63.22	0.0	224.9	33.25	3.782	330.5	3.233	0.0	5.7134;
529	56.84	0.0	640.9	33.26	3.348	373.4	3.537	0.0	16.278; begin overlap;
530	56.76	0.0	717.8	33.26	3.346	373.6	3.544	0.0	18.232;
540	56.46	0.0	1308.9	33.26	3.339	374.3	3.578	0.0	33.246;
550	56.38	0.0	1837.7	33.26	3.336	374.7	3.592	0.0	46.677;
560	56.35	0.0	2290.4	33.26	3.333	375.1	3.598	0.0	58.177;
570	56.35	0.0	2354.0	33.26	3.331	375.3	3.599	0.0	59.791;
580	56.35	0.0	2357.4	33.26	3.329	375.5	3.599	0.0	59.877; local maximum rise or fall;
587	76.20	0.0	2382.9	33.27	3.263	383.1	3.988	0.0	60.525;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 1.2157
Lmz(m): 1.2157
forced entrain 1 0.0 7.253 60.52 0.238
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3739
;
11:08:09 AM. amb fills: 4

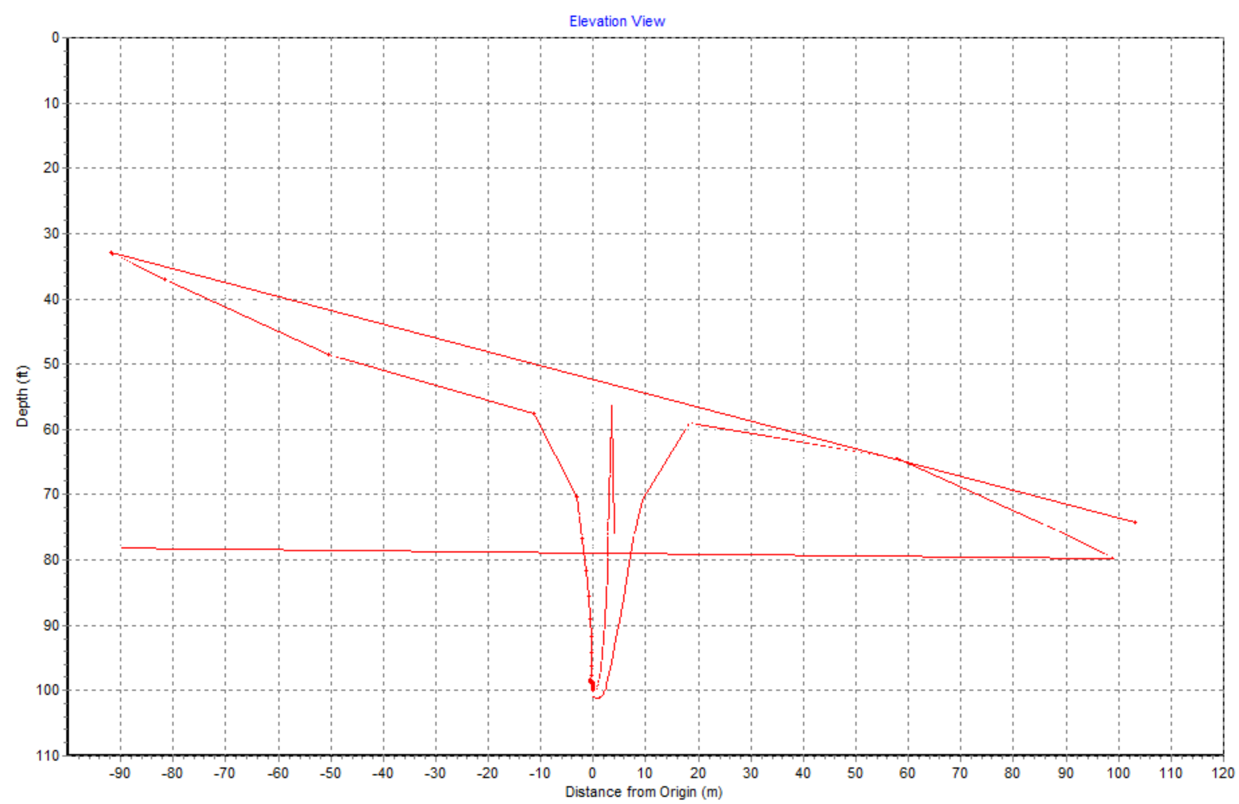

Figure A.4.1: Plumes 18b solution of discharge plume trajectories for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -92 m to *X* = +104 m so that ZID = 196 m

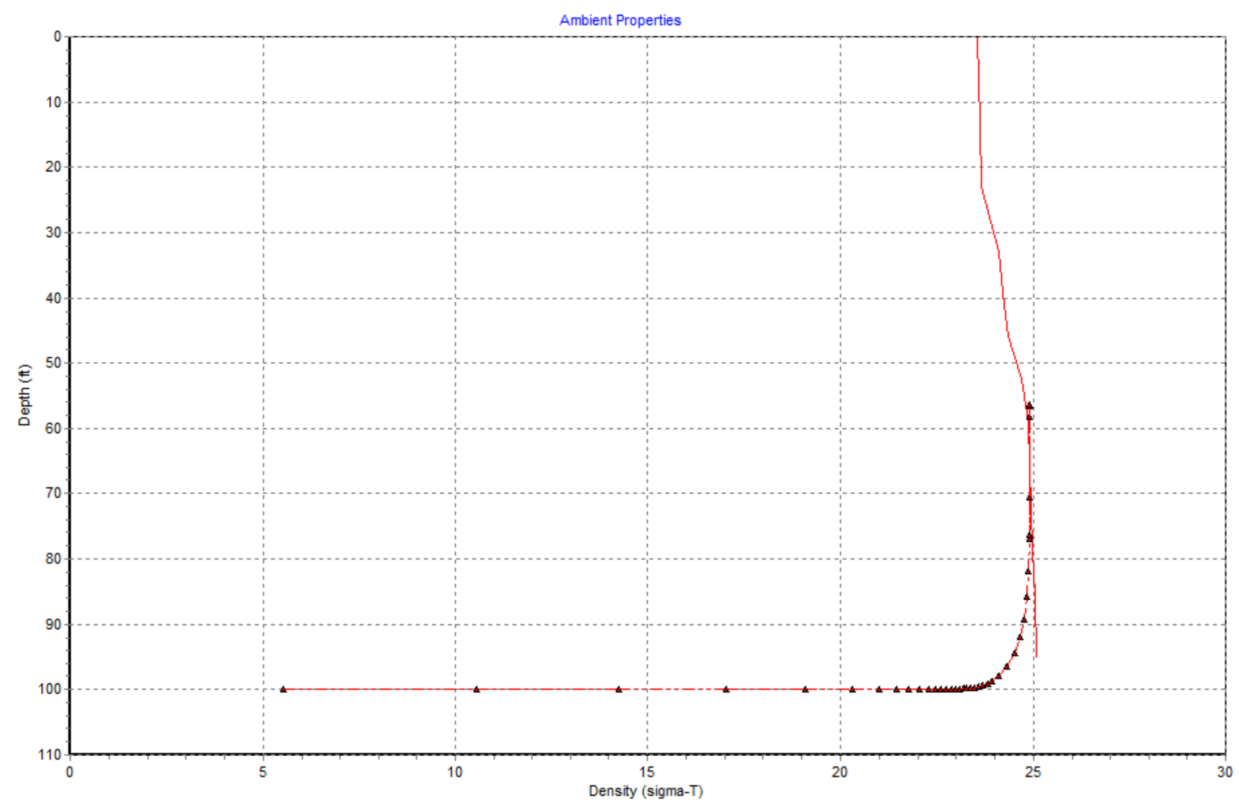

Figure A.4.2: Plumes 18b solution of vertical density profile for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

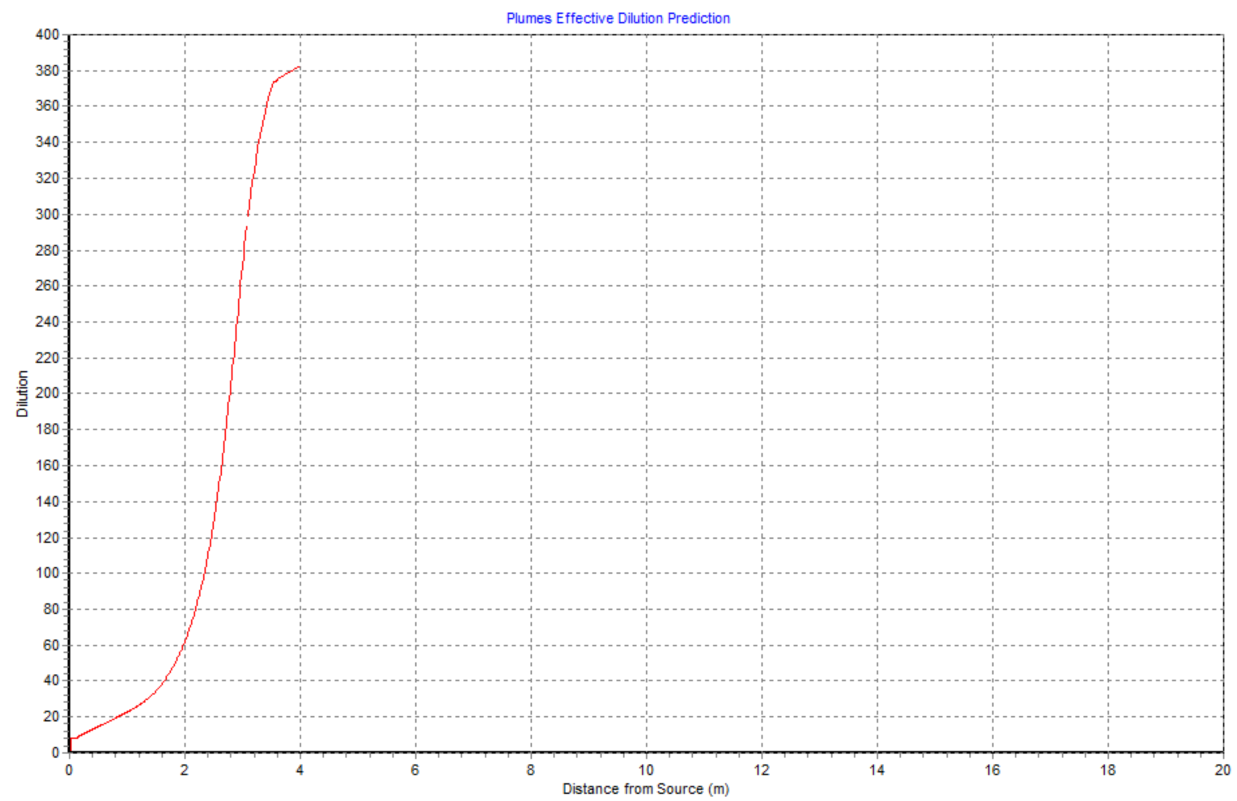

Figure A.4.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt.

A.5: Plumes 18b Results for SJCOO discharges of 0.35 mgd Wastewater Only:

SJCOO discharging 0.35 mgd of wastewater at TDS = 1.25
ppt

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 11:27:04 AM
Case 1; ambient file C:\Plumes18\SJCOO_WW0.35mgd_b0mgd_T-2.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	Spacing	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	12.000	1000.0	0.0	100.00	0.3500	1.2500	20.660	1250.0

Simulation:

Froude No: 0.185; Strat No: 1.48E-4; Spcg No: 47.21; k: 2602.5; eff den (sigmaT) -0.921168; eff vel 0.026(m/s);
Current is very small, flow regime may be transient.
Absolute value Froude No. < 1, possible intrusion and/or plume diameter reduction

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	1.250	1250.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.051	1.263	1249.5	1.000	0.000256	0.0	0.07749; bottom hit;
2	100.00	0.0	3.052	1.285	1248.7	1.001	0.000266	0.0	0.07751; begin overlap;
10	99.98	0.0	2.365	2.302	1210.1	1.033	0.0124	0.0	0.06008;
20	99.97	0.0	2.263	4.671	1119.9	1.116	0.0169	0.0	0.05747;
30	99.96	0.0	2.323	7.904	996.3	1.255	0.0205	0.0	0.0590;
40	99.95	0.0	2.438	11.12	872.5	1.433	0.0238	0.0	0.06193;
50	99.95	0.0	2.872	14.54	740.4	1.688	0.0239	0.0	0.07295;
57	99.94	0.0	2.896	16.44	666.8	1.875	0.0273	0.0	0.07355; end overlap;
60	99.94	0.0	3.058	17.42	628.8	1.988	0.0274	0.0	0.07766;
62	99.94	0.0	3.177	18.03	604.8	2.067	0.0275	0.0	0.0807; begin overlap;
70	99.94	0.0	3.637	19.96	529.8	2.360	0.0275	0.0	0.09237;
80	99.94	0.0	4.143	21.58	466.2	2.681	0.0275	0.0	0.1052;
85	99.92	0.0	3.876	22.41	433.7	2.882	0.0316	0.0	0.09844; end overlap;
90	99.91	0.0	4.114	23.44	393.2	3.179	0.0329	0.0	0.1045;
100	99.89	0.0	4.330	25.09	328.0	3.810	0.0374	0.0	0.1100;
110	99.81	0.0	4.227	26.44	274.8	4.549	0.0452	0.0	0.1074;
120	99.70	0.0	4.281	27.69	225.6	5.540	0.0534	0.0	0.1087;
130	99.57	0.0	4.556	28.71	185.2	6.748	0.0603	0.0	0.1157;
140	99.43	0.0	4.961	29.54	152.1	8.220	0.0663	0.0	0.1260;
150	99.27	0.0	5.469	30.23	124.8	10.01	0.0717	0.0	0.1389;
160	99.09	0.0	6.074	30.79	102.4	12.20	0.0767	0.0	0.1543;
170	98.89	0.0	6.777	31.25	84.06	14.87	0.0814	0.0	0.1721;
180	98.67	0.0	7.584	31.63	68.98	18.12	0.0858	0.0	0.1926;
190	98.42	0.0	8.503	31.94	56.60	22.08	0.090	0.0	0.2160;
200	98.14	0.0	9.546	32.20	46.44	26.91	0.094	0.0	0.2425;
210	97.82	0.0	10.73	32.41	38.11	32.80	0.0978	0.0	0.2725;
220	97.47	0.0	12.06	32.58	31.27	39.98	0.102	0.0	0.3064;
230	97.07	0.0	13.57	32.72	25.65	48.73	0.105	0.0	0.3447;
240	96.62	0.0	15.27	32.83	21.04	59.40	0.108	0.0	0.3879;
250	96.11	0.0	17.19	32.93	17.27	72.40	0.112	0.0	0.4367;
260	95.54	0.0	19.35	33.01	14.16	88.25	0.115	0.0	0.4916;
270	94.89	0.0	21.79	33.07	11.62	107.6	0.118	0.0	0.5536;
280	94.16	0.0	24.54	33.12	9.533	131.1	0.121	0.0	0.6234;
290	93.35	0.0	27.65	33.17	7.821	159.8	0.123	0.0	0.7022;
300	92.43	0.0	31.14	33.20	6.416	194.8	0.126	0.0	0.7911;
310	91.39	0.0	35.09	33.23	5.263	237.5	0.129	0.0	0.8913;
320	90.22	0.0	39.55	33.25	4.318	289.5	0.131	0.0	1.0046;
330	88.90	0.0	44.59	33.27	3.542	352.9	0.133	0.0	1.1326;
340	87.41	0.0	50.29	33.29	2.906	430.2	0.136	0.0	1.2775;
350	85.74	0.0	56.76	33.30	2.384	524.4	0.138	0.0	1.4418;
360	83.84	0.0	64.53	33.31	1.956	639.2	0.140	0.0	1.6390;
367	82.35	0.0	72.65	33.32	1.703	734.2	0.142	0.0	1.8453; trap level;
370	81.65	0.0	77.39	33.32	1.604	779.2	0.142	0.0	1.9658;
380	78.93	0.0	114.5	33.32	1.316	949.8	0.146	0.0	2.9083;
382	78.49	0.0	152.0	33.32	1.265	988.2	0.148	0.0	3.8607; merging;
383	78.61	0.0	293.5	33.32	1.263	990.0	0.149	0.0	7.4546; local maximum rise or fall;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 0.0454
Lmz(m): 0.0454
forced entrain 1 0.0 6.520 7.455 0.00893

Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3233
;
11:27:04 AM. amb fills: 4

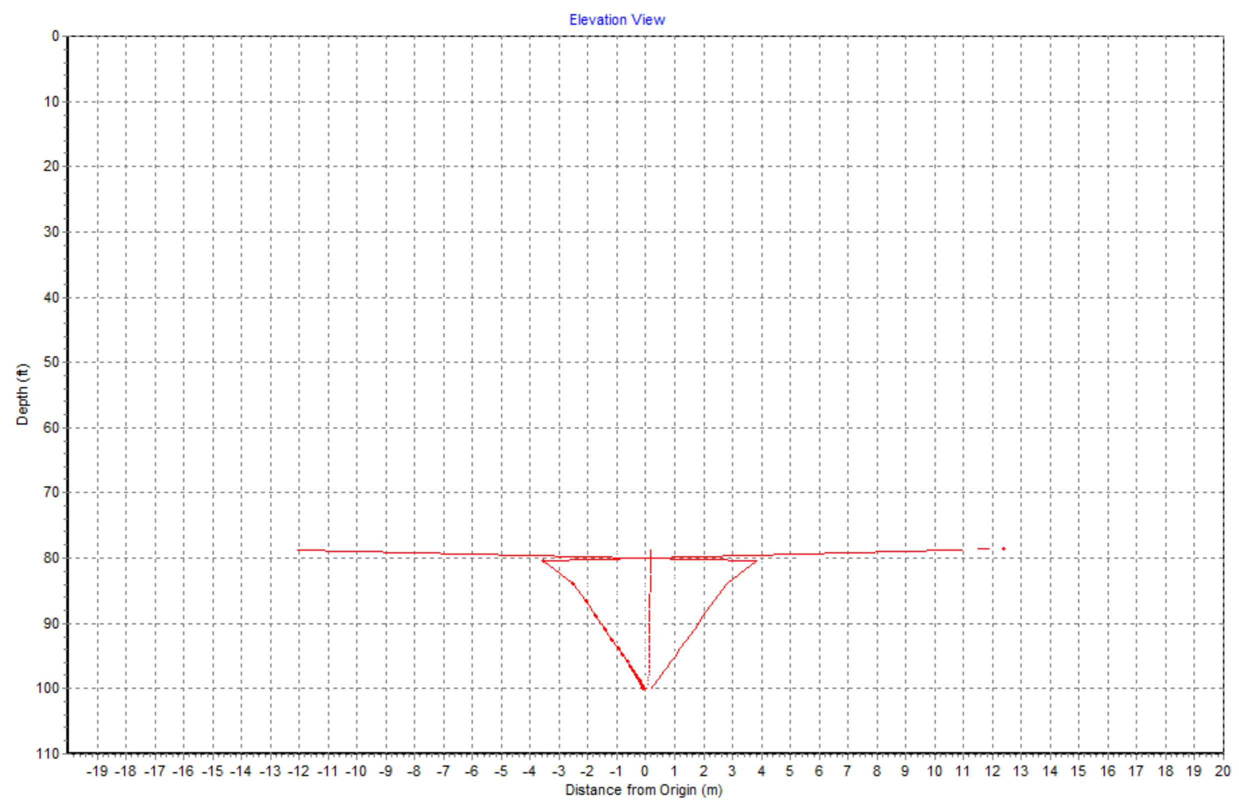

Figure A.5.1: Plumes 18b solution of discharge plume trajectories for discharges of 0.35 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -12 m to *X* = +12.5 m so that ZID = 24.5 m

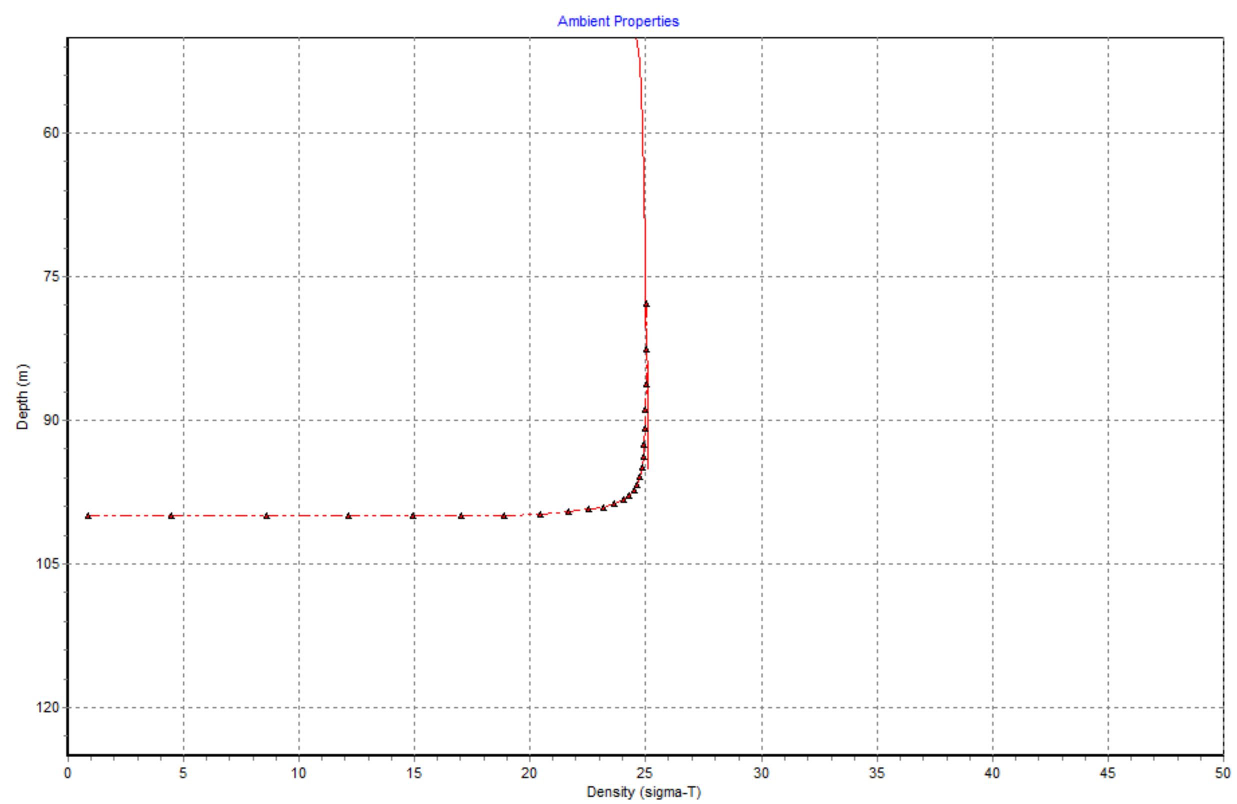

Figure A.5.2: Plumes 18b solution of vertical density profile for discharges of 0.35 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

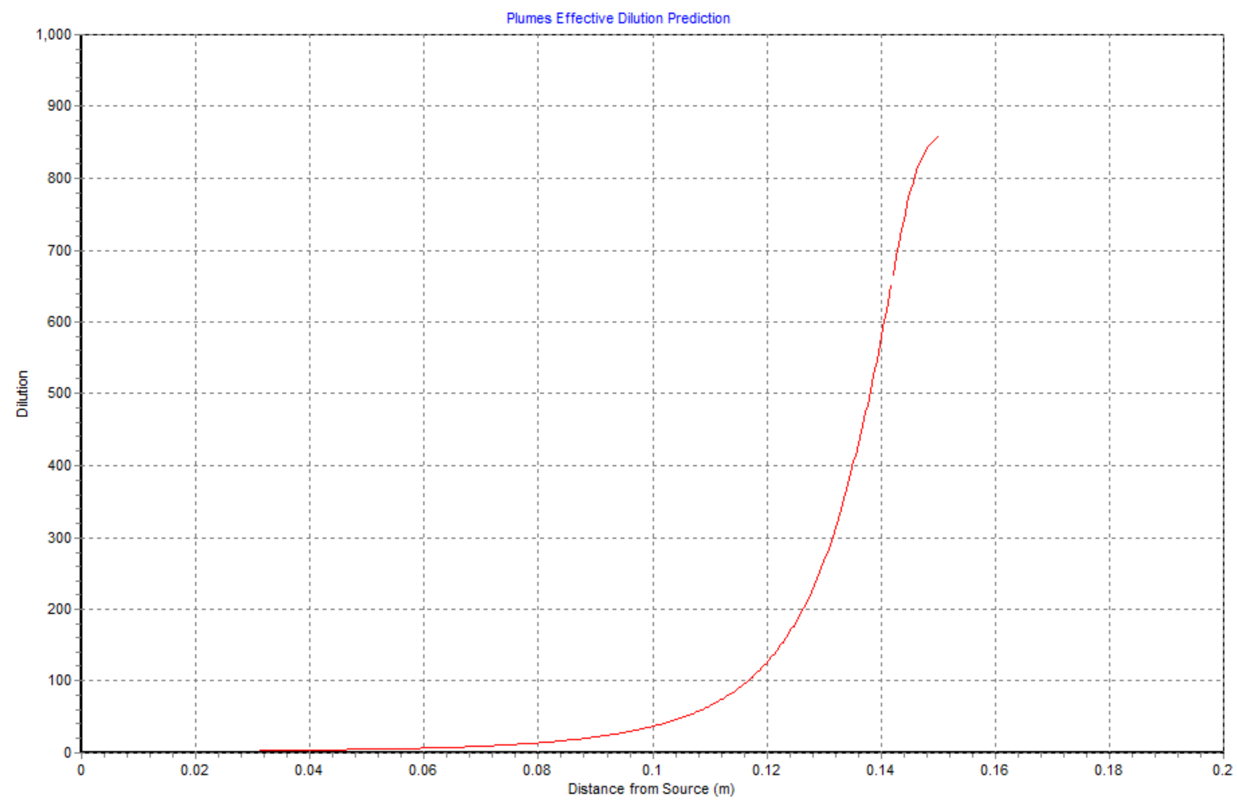

Figure A.5.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 0.35 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt.

APPENDIX-B: Results for Buoyant Combined Discharges of Brine and Wastewater

B.1: Plumes 18b Results for SJCOO discharges of 31 mgd Wastewater and 5 mgd Brine:

Project "C:\Plumes18\SJCOO_WW31mgd_b5mgd_T-3"
memo
SJCOO discharging 31 mgd wastewater and 5 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 11:52:37 AM
Case 1; ambient file C:\Plumes18\SJCOO_WW31mgd_b5mgd_T-3.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	Spacing	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	12.000	1000.0	0.0	100.00	36.000	9.3000	20.660	9300.0

Simulation:
Froude No: 21.83; Strat No: 1.94E-4; Spcg No: 47.21; k: 2.68E+5; eff den (sigmaT) 5.178451; eff vel 2.677(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	9.300	9300.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.113	10.28	8929.9	1.041	0.0253	0.0	0.07906; bottom hit;
10	100.00	0.0	3.754	14.04	7495.2	1.241	0.129	0.0	0.09536;
20	100.00	0.0	4.570	17.52	6166.1	1.508	0.265	0.0	0.1161;
30	100.00	0.0	5.565	20.36	5070.1	1.834	0.432	0.0	0.1413;
40	100.00	0.0	6.777	22.70	4167.2	2.232	0.635	0.0	0.1721;
50	99.99	0.0	8.254	24.61	3423.8	2.716	0.883	0.0	0.2097;
60	99.99	0.0	10.05	26.18	2812.3	3.307	1.185	0.0	0.2554;
70	99.98	0.0	12.25	27.47	2309.5	4.027	1.552	0.0	0.3111;
80	99.96	0.0	14.92	28.53	1896.2	4.904	1.998	0.0	0.3790;
90	99.93	0.0	18.17	29.40	1556.7	5.974	2.538	0.0	0.4615;
100	99.87	0.0	22.11	30.11	1277.7	7.278	3.189	0.0	0.5615;
110	99.77	0.0	26.64	30.67	1058.7	8.784	3.923	0.0	0.6766;
120	99.64	0.0	30.91	31.05	910.0	10.22	4.573	0.0	0.7851;
130	99.51	0.0	34.93	31.32	801.4	11.60	5.151	0.0	0.8873;
140	99.35	0.0	38.79	31.54	717.2	12.97	5.679	0.0	0.9852;
150	99.18	0.0	42.51	31.71	649.2	14.33	6.169	0.0	1.0799;
160	98.99	0.0	46.14	31.86	592.5	15.70	6.631	0.0	1.1720;
170	98.79	0.0	49.69	31.98	544.2	17.09	7.073	0.0	1.2620;
180	98.56	0.0	53.15	32.09	502.4	18.51	7.500	0.0	1.3500;
190	98.32	0.0	56.54	32.18	465.6	19.97	7.917	0.0	1.4361;
200	98.05	0.0	59.86	32.26	432.8	21.49	8.329	0.0	1.5204;
210	97.74	0.0	63.11	32.34	403.2	23.06	8.740	0.0	1.6031;
220	97.41	0.0	66.31	32.41	376.3	24.72	9.153	0.0	1.6843;
230	97.03	0.0	69.47	32.47	351.4	26.47	9.572	0.0	1.7645;
240	96.60	0.0	72.61	32.53	328.1	28.34	10.00	0.0	1.8442;
250	96.11	0.0	75.75	32.58	306.2	30.37	10.45	0.0	1.9242;
260	95.55	0.0	78.96	32.64	285.2	32.61	10.91	0.0	2.0056;
270	94.90	0.0	82.29	32.69	264.8	35.12	11.40	0.0	2.0903;
280	94.12	0.0	85.85	32.74	244.8	38.00	11.92	0.0	2.1805;
290	93.19	0.0	89.75	32.79	224.8	41.37	12.48	0.0	2.2797;
300	92.06	0.0	94.20	32.84	204.7	45.44	13.08	0.0	2.3926;
310	90.66	0.0	99.46	32.89	184.2	50.50	13.75	0.0	2.5262;
320	88.88	0.0	105.9	32.95	163.1	57.03	14.49	0.0	2.6908;
330	86.57	0.0	114.3	33.00	141.3	65.80	15.32	0.0	2.9024;
340	83.44	0.0	125.6	33.06	118.8	78.29	16.27	0.0	3.1913;
350	79.39	0.0	142.1	33.11	97.46	95.43	17.32	0.0	3.6105;
351	78.96	0.0	144.1	33.12	95.55	97.34	17.42	0.0	3.6596; merging;
360	73.60	0.0	174.1	33.15	79.95	116.3	18.61	0.0	4.4226;
370	65.40	0.0	232.9	33.18	65.59	141.8	20.21	0.0	5.9165;
375	60.57	0.0	281.7	33.20	59.40	156.6	21.10	0.0	7.1559; trap level;
380	55.25	0.0	353.2	33.21	53.80	172.8	22.10	0.0	8.9724;
387	52.25	0.0	505.5	33.22	51.00	182.4	22.75	0.0	12.839; begin overlap;
390	51.81	0.0	554.7	33.22	50.63	183.7	22.86	0.0	14.090;
400	51.01	0.0	696.1	33.23	50.08	185.7	23.09	0.0	17.680;
410	50.61	0.0	827.2	33.23	49.76	186.9	23.23	0.0	21.012;
420	50.38	0.0	955.2	33.23	49.50	187.9	23.32	0.0	24.262;
430	50.23	0.0	1080.8	33.23	49.28	188.7	23.39	0.0	27.451;
440	50.12	0.0	1203.9	33.23	49.09	189.5	23.45	0.0	30.578;

450	50.06	0.0	1313.3	33.23	48.92	190.1	23.48	0.0	33.358;
460	50.05	0.0	1349.8	33.23	48.78	190.6	23.49	0.0	34.285;
470	50.05	0.0	1359.6	33.23	48.65	191.1	23.49	0.0	34.534;
480	50.05	0.0	1367.0	33.23	48.53	191.7	23.49	0.0	34.722;
490	50.05	0.0	1374.2	33.23	48.40	192.2	23.49	0.0	34.905;
500	50.05	0.0	1382.3	33.23	48.26	192.7	23.49	0.0	35.111; local maximum rise or fall;
502	52.48	0.0	1396.7	33.23	47.32	196.6	24.42	0.0	35.475;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 7.4435
Lmz(m): 7.4435
forced entrain 1 0.0 14.49 35.48 0.533
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3831
;
11:52:38 AM. amb fills: 4

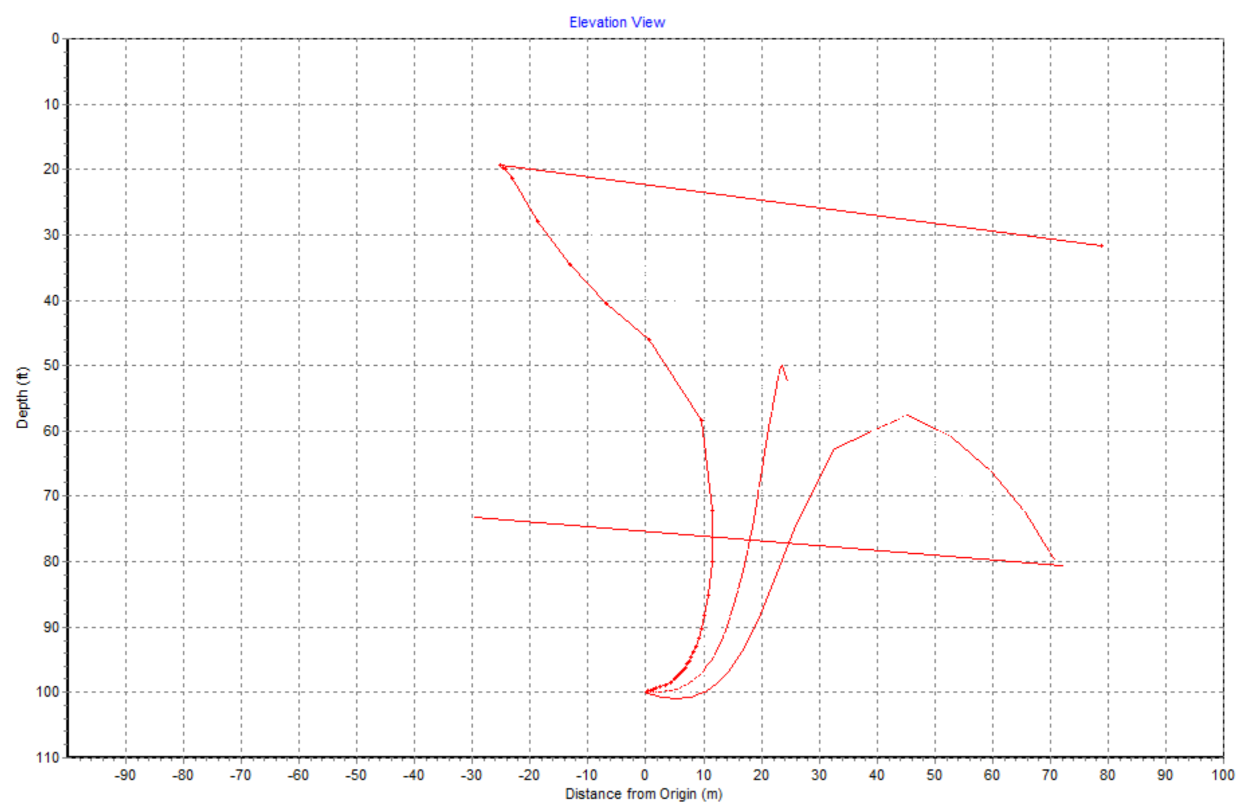

Figure B.1.1: Plumes 18b solution of discharge plume trajectories for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from X = -30 m to X = +80 m so that ZID = 110 m

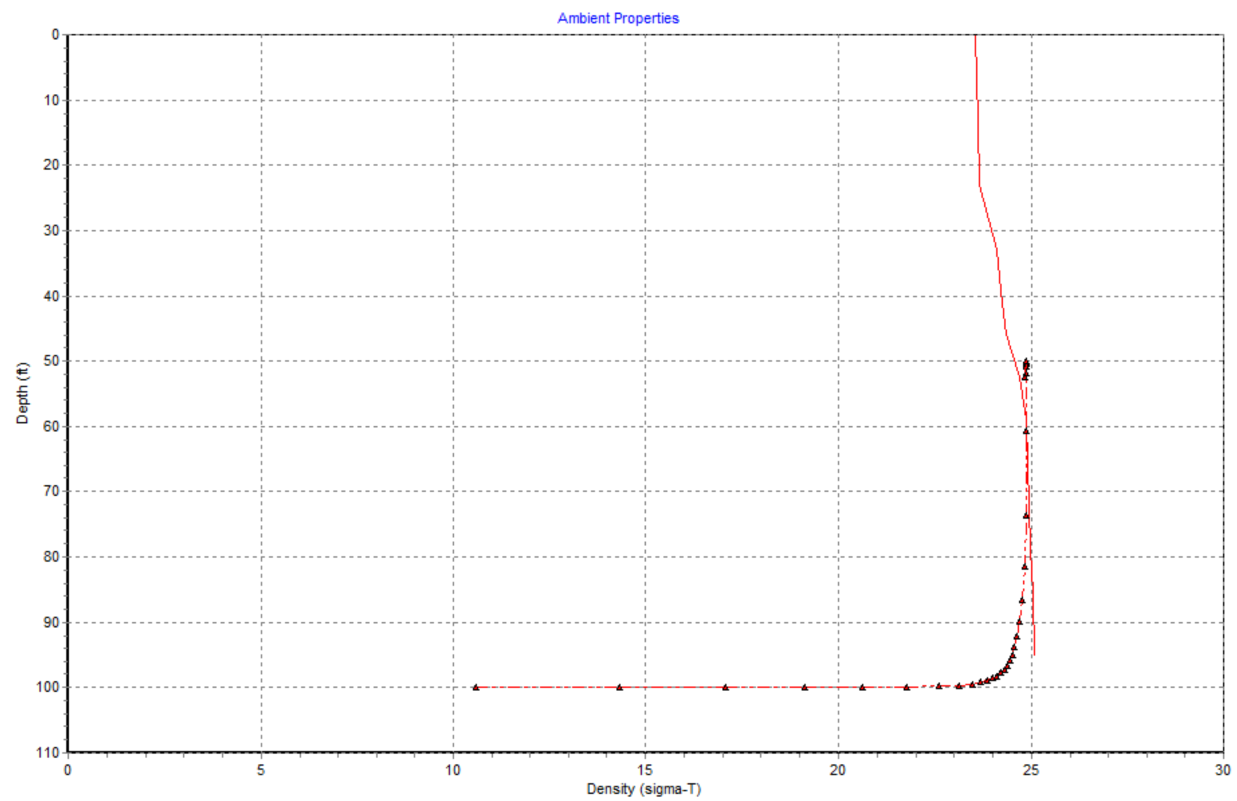

Figure B.1.2: Plumes 18b solution of vertical density profile for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

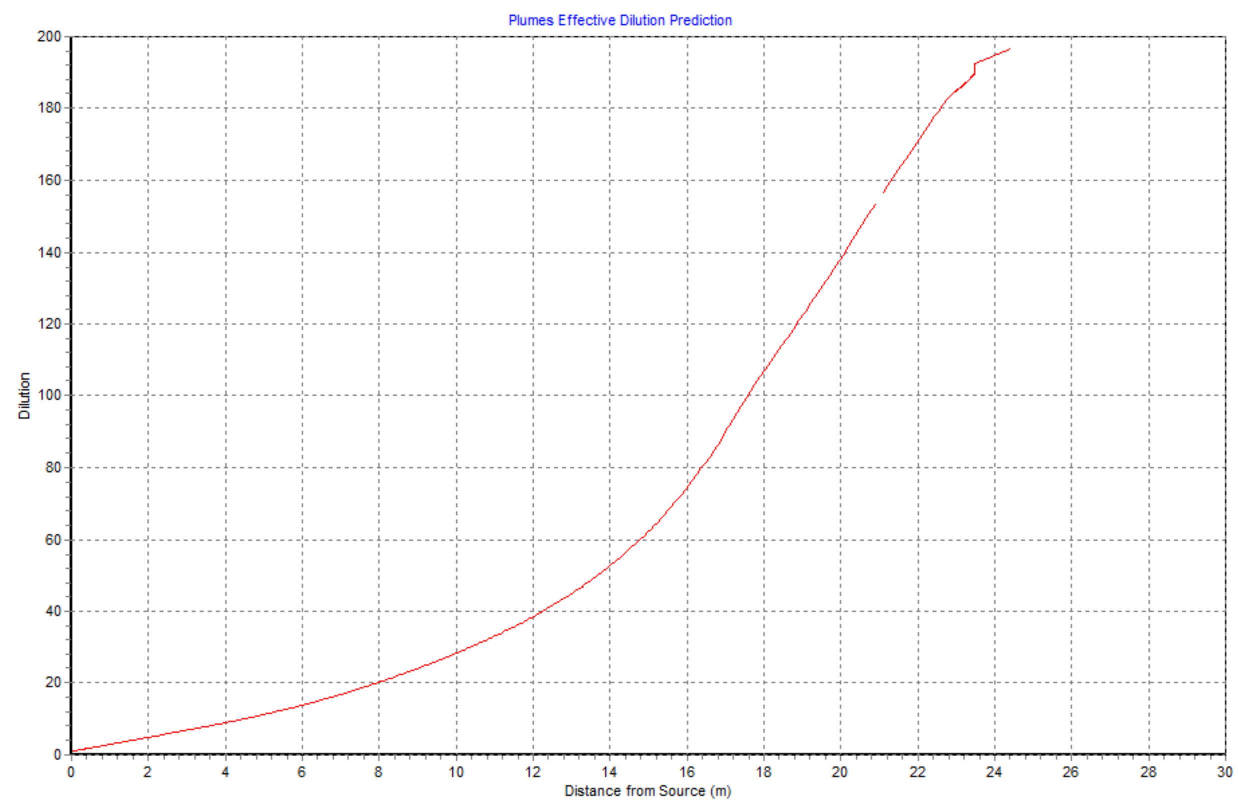

Figure B.1.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt.

B.2: Plumes 18b Results for SJCOO discharges of 31 mgd Wastewater and 15 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW31mgd_b15mgd_T-1"
memo
SJCOO discharging 31 mgd wastewater and 15 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 12:20:30 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW31mgd_b15mgd_T-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	46.000	21.850	20.660	21850.0

Simulation:
Froude No: 38.72; Strat No: 3.70E-4; Spcg No: 14.39; k: 3.42E+5; eff den (sigmaT) 14.65328; eff vel 3.420(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	21.85	21850.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.130	22.43	20750.8	1.053	0.032	0.0	0.0795; bottom hit;
10	100.00	0.0	3.798	24.22	17391.1	1.256	0.151	0.0	0.09648;
20	100.00	0.0	4.627	25.86	14287.7	1.529	0.310	0.0	0.1175;
30	100.00	0.0	5.637	27.21	11734.9	1.862	0.503	0.0	0.1432;
40	100.00	0.0	6.867	28.31	9636.2	2.267	0.739	0.0	0.1744;
50	100.00	0.0	8.368	29.22	7911.4	2.762	1.027	0.0	0.2125;
60	100.00	0.0	10.20	29.96	6494.3	3.364	1.378	0.0	0.2590;
70	99.99	0.0	12.43	30.57	5330.5	4.099	1.806	0.0	0.3156;
80	99.98	0.0	15.14	31.08	4374.8	4.995	2.326	0.0	0.3847;
90	99.97	0.0	18.46	31.49	3590.1	6.086	2.958	0.0	0.4688;
100	99.94	0.0	22.49	31.82	2946.0	7.417	3.727	0.0	0.5712;
110	99.89	0.0	27.40	32.10	2417.4	9.039	4.658	0.0	0.6959;
120	99.81	0.0	33.36	32.33	1983.5	11.02	5.782	0.0	0.8473;
130	99.65	0.0	40.57	32.51	1627.6	13.42	7.130	0.0	1.0304;
135	99.55	0.0	44.35	32.58	1488.1	14.68	7.820	0.0	1.1266; merging;
140	99.44	0.0	47.81	32.64	1387.2	15.75	8.463	0.0	1.2144;
150	99.18	0.0	54.23	32.71	1241.0	17.61	9.655	0.0	1.3776;
160	98.89	0.0	60.48	32.77	1131.6	19.31	10.76	0.0	1.5363;
170	98.55	0.0	66.79	32.82	1042.9	20.95	11.80	0.0	1.6965;
180	98.17	0.0	73.29	32.86	967.2	22.59	12.80	0.0	1.8617;
190	97.75	0.0	80.09	32.89	900.8	24.26	13.77	0.0	2.0342;
200	97.29	0.0	87.24	32.92	841.2	25.98	14.71	0.0	2.2160;
210	96.77	0.0	94.84	32.95	786.7	27.77	15.64	0.0	2.4089;
220	96.19	0.0	102.9	32.98	736.4	29.67	16.57	0.0	2.6144;
230	95.54	0.0	111.6	33.00	689.5	31.69	17.49	0.0	2.8342;
240	94.82	0.0	120.9	33.03	645.3	33.86	18.42	0.0	3.0698;
250	94.01	0.0	130.8	33.05	603.6	36.20	19.36	0.0	3.3234;
260	93.10	0.0	141.6	33.07	563.8	38.75	20.33	0.0	3.5971;
270	92.06	0.0	153.3	33.09	525.7	41.56	21.32	0.0	3.8945;
280	90.87	0.0	166.1	33.11	488.9	44.69	22.35	0.0	4.2200;
290	89.48	0.0	180.4	33.13	453.2	48.21	23.44	0.0	4.5810;
300	87.85	0.0	196.4	33.14	418.1	52.26	24.59	0.0	4.9883;
310	85.92	0.0	214.9	33.16	383.4	56.99	25.81	0.0	5.4594;
320	83.53	0.0	237.6	33.18	348.1	62.77	27.17	0.0	6.0361;
330	79.75	0.0	276.0	33.20	305.5	71.52	29.07	0.0	7.0103;
340	73.12	0.0	367.9	33.22	251.4	86.90	32.09	0.0	9.3445;
347	67.93	0.0	466.2	33.24	218.9	99.82	34.32	0.0	11.842; trap level;
350	65.60	0.0	525.6	33.24	206.3	105.9	35.32	0.0	13.350;
360	60.46	0.0	788.2	33.26	179.6	121.7	37.70	0.0	20.021;
361	60.18	0.0	812.7	33.26	177.9	122.8	37.84	0.0	20.643; begin overlap;
370	58.29	0.0	1001.1	33.26	169.1	129.2	38.85	0.0	25.428;
380	57.30	0.0	1163.5	33.27	164.6	132.8	39.44	0.0	29.552;
390	56.74	0.0	1314.1	33.27	161.1	135.6	39.82	0.0	33.379;
400	56.46	0.0	1442.8	33.27	158.4	137.9	40.03	0.0	36.646;
410	56.43	0.0	1500.7	33.27	156.3	139.8	40.06	0.0	38.119;
420	56.42	0.0	1540.9	33.27	154.3	141.6	40.06	0.0	39.140;
430	56.42	0.0	1579.5	33.27	152.4	143.3	40.06	0.0	40.118;
440	56.42	0.0	1621.8	33.27	150.4	145.2	40.06	0.0	41.194;

442	55.79	0.0	1834.6	33.28	147.5	148.2	40.77	0.0	46.599; surface;
450	55.78	0.0	2082.0	33.28	147.0	148.7	40.78	0.0	52.884;
460	55.57	0.0	2818.3	33.28	143.8	152.0	41.80	0.0	71.584; local maximum rise or fall;
465	66.22	0.0	2875.3	33.28	140.9	155.1	45.81	0.0	73.033;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 13.963
Lmz(m): 13.963
forced entrain 1 0.0 10.30 73.03 0.981
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3761
;
12:20:30 PM. amb fills: 4

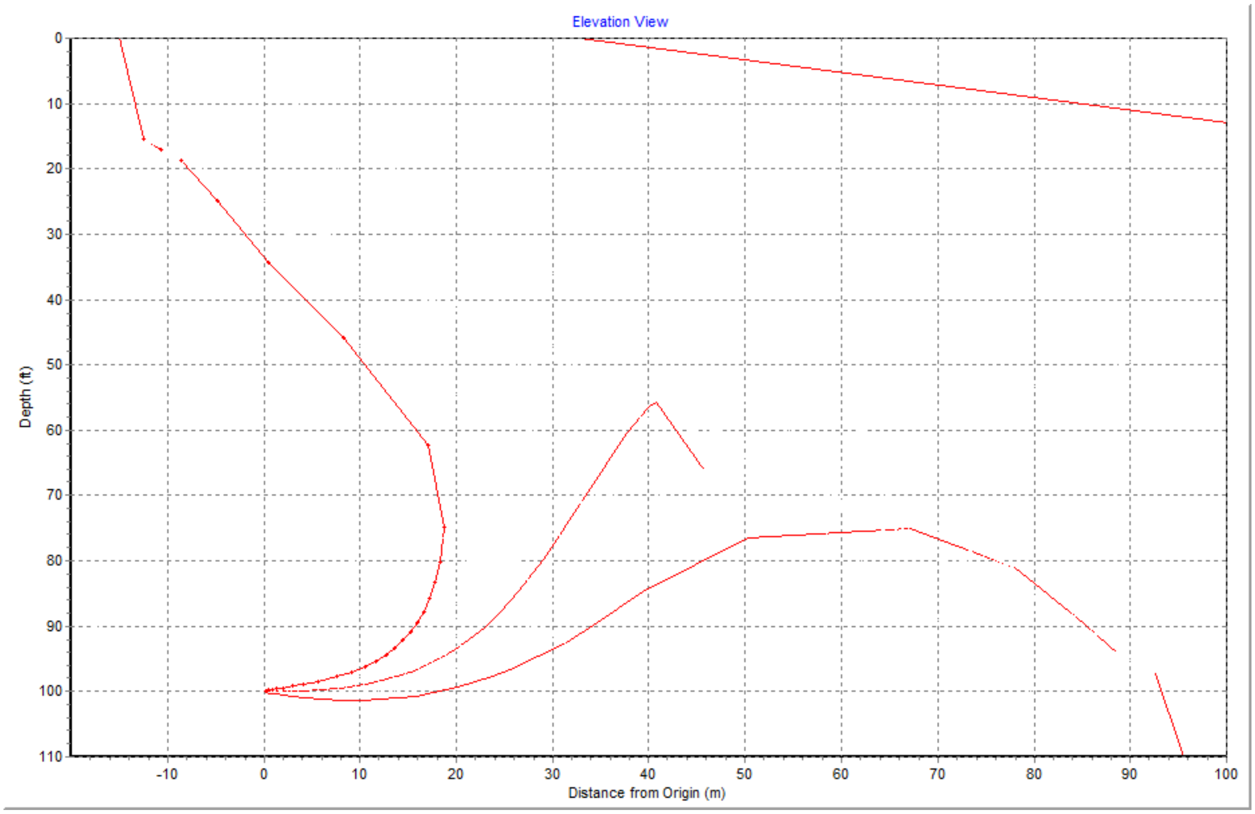

Figure B.2.1: Plumes 18b solution of discharge plume trajectories for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -15 m to *X* = +94 m so that ZID = 109 m

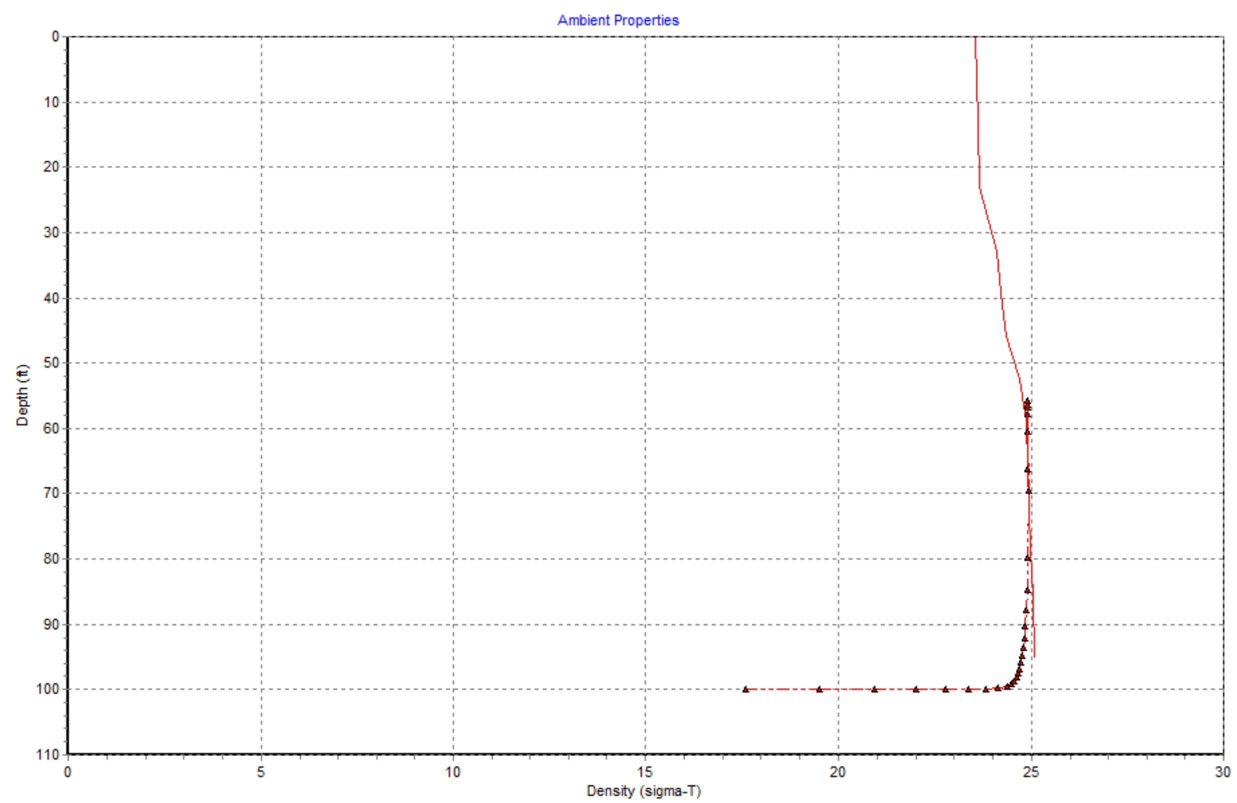

Figure B.2.2: Plumes 18b solution of vertical density profile for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

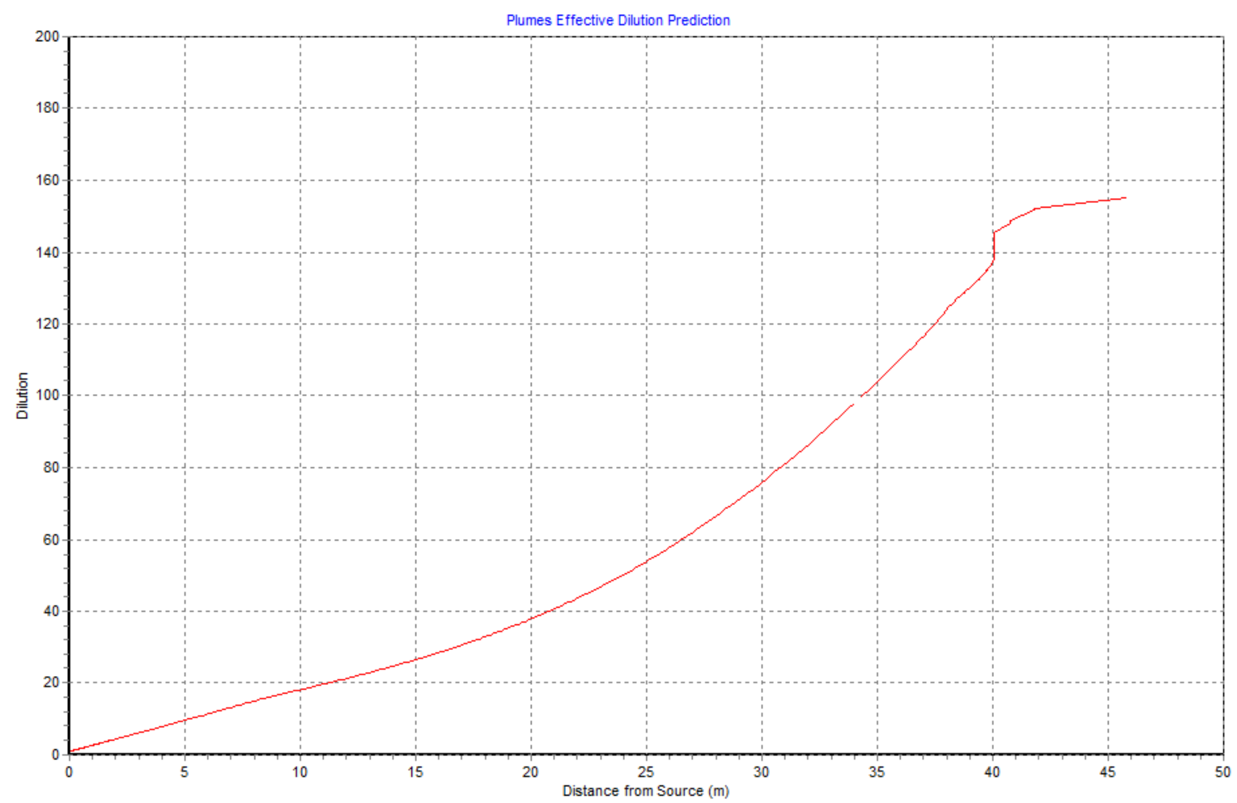

Figure B.2.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 31 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt.

B.3: Plumes 18b Results for SJCOO discharges of 18.9 mgd Wastewater and 5 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW18.9mgd_b5mgd_T-1"
memo
SJCOO discharging 18.9 mgd wastewater and 5 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 12:59:47 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW18.9mgd_b5mgd_T-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	23.900	14.020	20.660	14020.0

Simulation:

Froude No: 16.02; Strat No: 2.36E-4; Spcg No: 14.39; k: 1.78E+5; eff den (sigmaT) 8.743853; eff vel 1.777(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	14.02	14020.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.092	14.55	13644.5	1.028	0.017	0.0	0.07853; bottom hit;
10	100.00	0.0	3.705	17.62	11446.4	1.225	0.113	0.0	0.09409;
20	100.00	0.0	4.510	20.45	9412.2	1.490	0.241	0.0	0.1146;
30	100.00	0.0	5.493	22.77	7736.2	1.812	0.397	0.0	0.1395;
40	100.00	0.0	6.690	24.67	6356.4	2.206	0.587	0.0	0.1699;
50	99.99	0.0	8.149	26.23	5221.2	2.685	0.818	0.0	0.2070;
60	99.98	0.0	9.927	27.51	4287.7	3.270	1.100	0.0	0.2522;
70	99.97	0.0	12.09	28.56	3520.5	3.982	1.441	0.0	0.3071;
80	99.94	0.0	14.72	29.43	2890.1	4.851	1.854	0.0	0.3739;
90	99.89	0.0	17.90	30.13	2372.3	5.910	2.352	0.0	0.4547;
100	99.81	0.0	21.31	30.65	1990.2	7.044	2.861	0.0	0.5413;
110	99.72	0.0	24.50	31.02	1724.7	8.129	3.304	0.0	0.6224;
120	99.62	0.0	27.57	31.29	1525.1	9.193	3.701	0.0	0.7002;
130	99.50	0.0	30.54	31.50	1367.3	10.25	4.065	0.0	0.7756;
140	99.38	0.0	33.44	31.68	1238.2	11.32	4.403	0.0	0.8493;
150	99.24	0.0	36.28	31.83	1130.0	12.41	4.724	0.0	0.9214;
160	99.09	0.0	39.06	31.95	1037.5	13.51	5.030	0.0	0.9921;
170	98.93	0.0	41.79	32.06	957.2	14.65	5.327	0.0	1.0614;
178	98.79	0.0	43.92	32.14	900.0	15.58	5.560	0.0	1.1157; merging;
180	98.75	0.0	44.45	32.16	886.8	15.81	5.618	0.0	1.1291;
190	98.56	0.0	47.09	32.24	826.7	16.96	5.906	0.0	1.1961;
200	98.34	0.0	49.76	32.31	773.1	18.13	6.194	0.0	1.2638;
210	98.09	0.0	52.44	32.38	724.4	19.35	6.486	0.0	1.3321;
220	97.81	0.0	55.15	32.44	679.5	20.63	6.785	0.0	1.4009;
230	97.50	0.0	57.87	32.50	637.7	21.98	7.094	0.0	1.4700;
240	97.13	0.0	60.60	32.55	598.5	23.42	7.415	0.0	1.5393;
250	96.70	0.0	63.35	32.60	561.4	24.97	7.755	0.0	1.6091;
260	96.20	0.0	66.13	32.65	525.7	26.67	8.116	0.0	1.6798;
270	95.60	0.0	69.01	32.69	490.8	28.56	8.506	0.0	1.7529;
280	94.86	0.0	72.09	32.74	456.3	30.73	8.932	0.0	1.8310;
290	93.95	0.0	75.53	32.79	421.3	33.28	9.404	0.0	1.9185;
300	92.78	0.0	79.65	32.84	385.1	36.41	9.932	0.0	2.0230;
310	91.26	0.0	84.92	32.89	347.0	40.40	10.53	0.0	2.1571;
320	89.22	0.0	92.23	32.95	306.3	45.78	11.23	0.0	2.3427;
330	86.36	0.0	103.2	33.01	262.3	53.45	12.05	0.0	2.6210;
340	82.32	0.0	120.9	33.07	216.5	64.76	13.01	0.0	3.0701;
350	77.55	0.0	149.4	33.12	177.6	78.94	13.96	0.0	3.7946;
360	72.06	0.0	192.2	33.15	145.7	96.22	14.93	0.0	4.8807;
370	65.85	0.0	254.3	33.19	119.5	117.3	15.90	0.0	6.4600;
378	60.31	0.0	336.5	33.21	102.0	137.4	16.73	0.0	8.5480; trap level;
380	58.84	0.0	363.7	33.22	98.06	143.0	16.95	0.0	9.2392;
390	52.96	0.0	618.0	33.24	83.72	167.5	17.91	0.0	15.697; begin overlap;
400	51.76	0.0	876.1	33.24	81.02	173.0	18.17	0.0	22.253;
410	51.31	0.0	1107.1	33.25	79.66	176.0	18.30	0.0	28.121;
420	51.19	0.0	1255.4	33.25	78.79	177.9	18.34	0.0	31.887;
430	51.19	0.0	1286.0	33.25	78.09	179.5	18.34	0.0	32.665;
440	51.19	0.0	1308.8	33.25	77.41	181.1	18.34	0.0	33.244;
446	50.90	0.0	2033.2	33.25	75.64	185.3	18.63	0.0	51.643; surface;
450	50.90	0.0	3055.0	33.25	75.63	185.4	18.63	0.0	77.598; local maximum rise or fall;
453	56.95	0.0	3160.3	33.26	74.15	189.1	19.60	0.0	80.271;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 5.9730
Lmz(m): 5.9730
forced entrain 1 0.0 13.12 80.27 0.724
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3837
;
12:59:47 PM. amb fills: 4

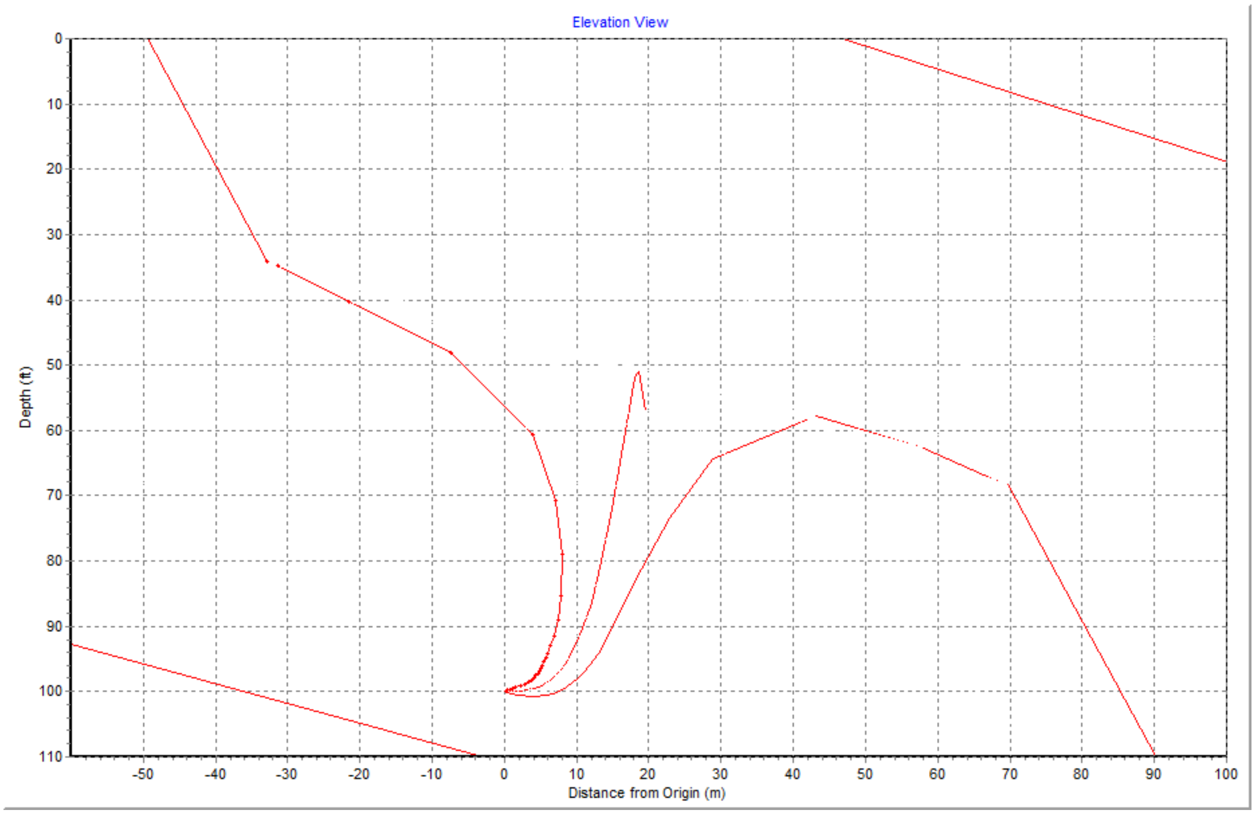

Figure B.3.1: Plumes 18b solution of discharge plume trajectories for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -50 m to *X* = +85 m so that ZID = 135 m

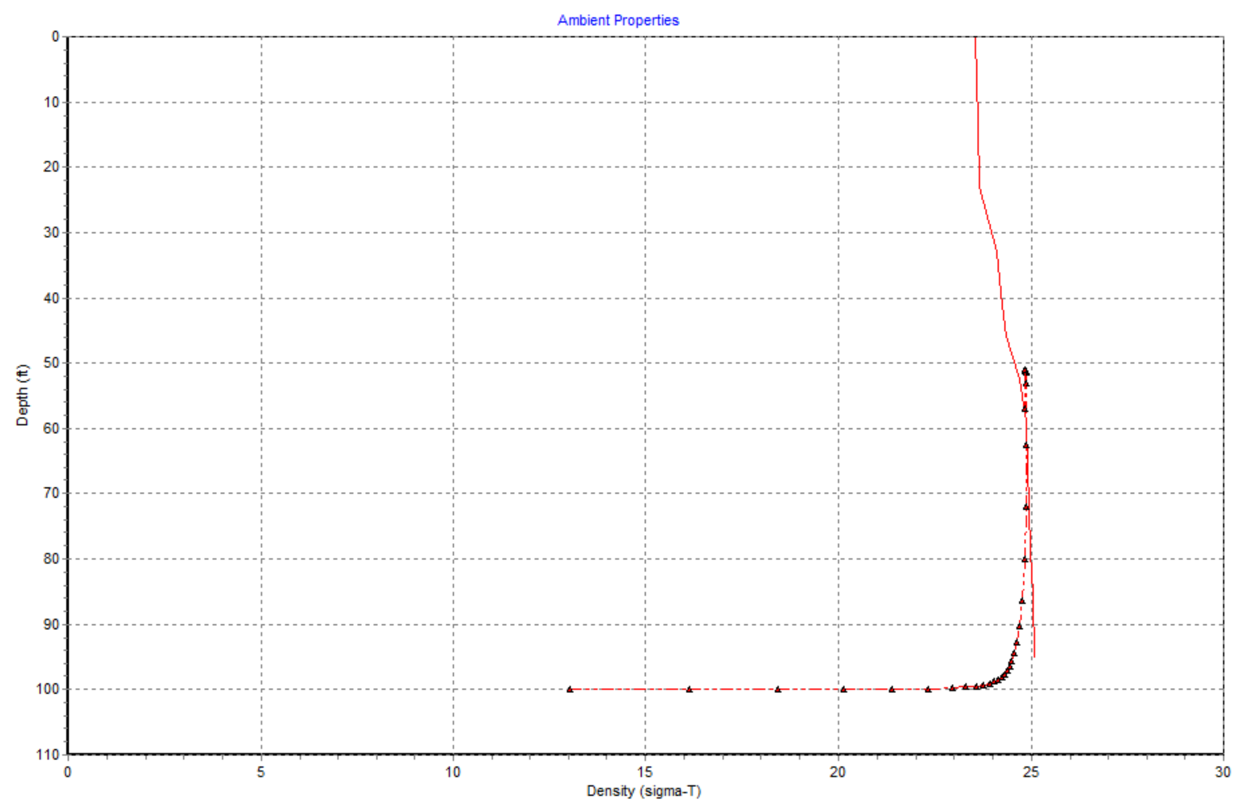

Figure B.3.2: Plumes 18b solution of vertical density profile for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

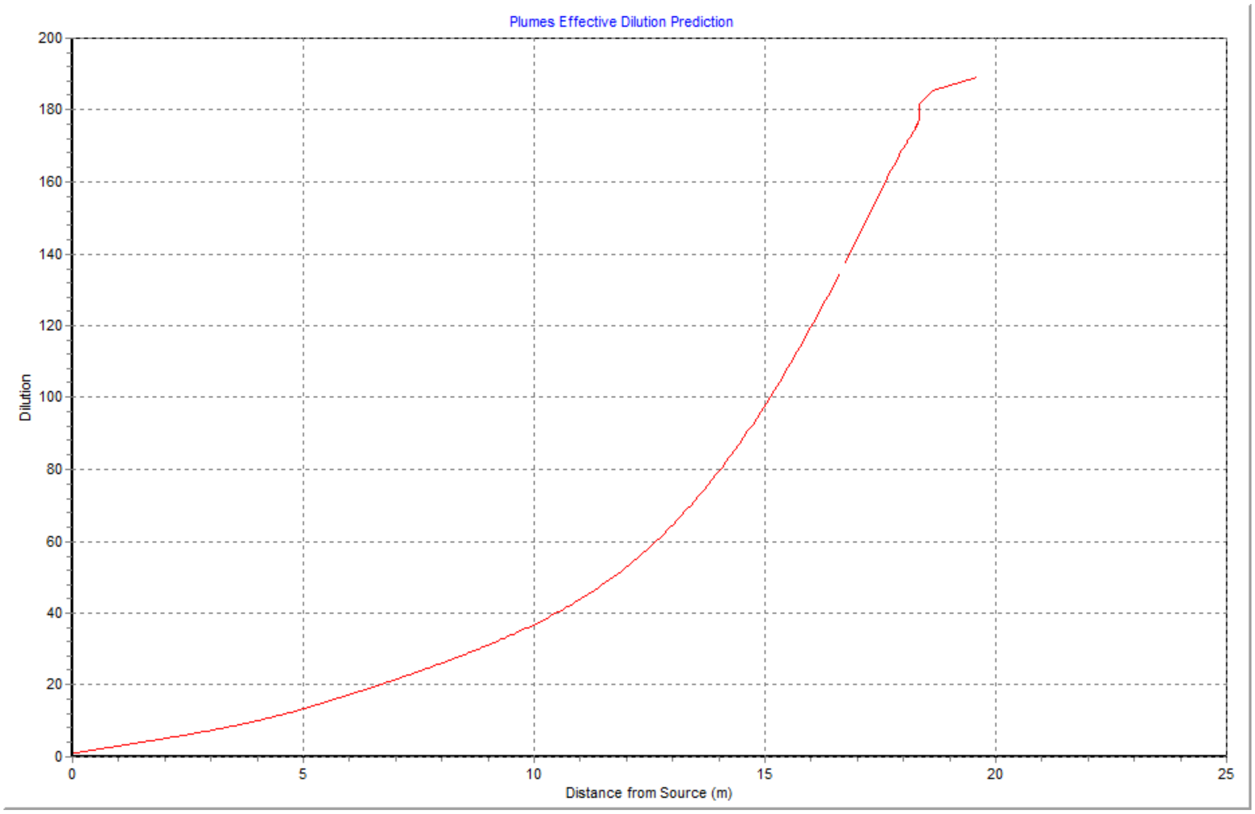

Figure B.3.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt.

B.4: Plumes 18b Results for SJCOO discharges of 18.9 mgd Wastewater and 15 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW18.9mgd_b15mgd_T-1"
memo
SJCOO discharging 18.9 mgd wastewater and 15 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 1:29:39 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW18.9mgd_b15mgd_T-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	33.900	29.640	20.660	29640.0

Simulation:

Froude No: 43.40; Strat No: 8.51E-4; Spcg No: 14.39; k: 2.52E+5; eff den (sigmaT) 20.54180; eff vel 2.521(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	29.64	29640.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.109	29.78	28526.4	1.039	0.0239	0.0	0.07897; bottom hit;
10	100.00	0.0	3.749	30.37	23886.8	1.241	0.146	0.0	0.09522;
20	100.00	0.0	4.569	30.90	19608.3	1.512	0.308	0.0	0.1160;
30	100.00	0.0	5.568	31.34	16094.2	1.842	0.507	0.0	0.1414;
40	100.00	0.0	6.785	31.71	13208.5	2.244	0.749	0.0	0.1723;
50	100.00	0.0	8.270	32.00	10839.4	2.734	1.044	0.0	0.2101;
60	100.00	0.0	10.08	32.25	8894.6	3.332	1.404	0.0	0.2560;
70	99.99	0.0	12.29	32.45	7298.4	4.061	1.842	0.0	0.3120;
80	99.99	0.0	14.97	32.61	5988.4	4.950	2.376	0.0	0.3803;
90	99.97	0.0	18.25	32.75	4913.3	6.033	3.025	0.0	0.4636;
100	99.95	0.0	22.24	32.86	4031.1	7.353	3.814	0.0	0.5650;
110	99.91	0.0	27.10	32.95	3307.3	8.962	4.771	0.0	0.6884;
120	99.84	0.0	33.02	33.02	2713.4	10.92	5.930	0.0	0.8386;
130	99.72	0.0	40.19	33.08	2226.1	13.32	7.326	0.0	1.0208;
135	99.62	0.0	44.32	33.11	2016.3	14.70	8.124	0.0	1.1257; merging;
140	99.50	0.0	48.45	33.13	1856.9	15.96	8.945	0.0	1.2307;
150	99.23	0.0	55.90	33.16	1642.4	18.05	10.45	0.0	1.4199;
160	98.91	0.0	62.94	33.18	1490.7	19.88	11.82	0.0	1.5988;
170	98.54	0.0	69.90	33.19	1371.7	21.61	13.12	0.0	1.7755;
180	98.11	0.0	76.94	33.20	1272.6	23.29	14.35	0.0	1.9542;
190	97.64	0.0	84.16	33.21	1186.9	24.97	15.55	0.0	2.1378;
200	97.10	0.0	91.68	33.22	1110.7	26.69	16.72	0.0	2.3286;
210	96.50	0.0	99.55	33.23	1041.5	28.46	17.86	0.0	2.5286;
220	95.84	0.0	107.9	33.24	977.7	30.32	19.00	0.0	2.7397;
230	95.09	0.0	116.7	33.25	918.1	32.28	20.15	0.0	2.9642;
240	94.26	0.0	126.2	33.25	861.8	34.39	21.30	0.0	3.2045;
250	93.31	0.0	136.4	33.26	808.1	36.68	22.46	0.0	3.4637;
260	92.25	0.0	147.5	33.27	756.6	39.18	23.66	0.0	3.7458;
270	91.03	0.0	159.7	33.27	706.6	41.95	24.89	0.0	4.0564;
280	89.64	0.0	173.3	33.28	657.8	45.06	26.18	0.0	4.4030;
290	88.03	0.0	188.9	33.29	609.7	48.62	27.52	0.0	4.7970;
300	86.13	0.0	206.9	33.29	562.0	52.74	28.95	0.0	5.2551;
310	83.81	0.0	229.1	33.30	513.0	57.78	30.52	0.0	5.8200;
319	79.50	0.0	277.7	33.30	444.6	66.66	33.18	0.0	7.0529; trap level;
320	78.85	0.0	287.9	33.30	435.9	68.00	33.57	0.0	7.3118;
330	75.07	0.0	400.7	33.31	387.5	76.48	36.01	0.0	10.177;
340	73.17	0.0	496.5	33.31	361.5	81.98	37.40	0.0	12.612; begin overlap;
350	71.91	0.0	583.6	33.31	345.5	85.79	38.42	0.0	14.822;
360	71.06	0.0	657.2	33.31	335.8	88.27	39.18	0.0	16.692;
370	70.48	0.0	724.0	33.31	328.6	90.21	39.75	0.0	18.389;
380	70.06	0.0	787.9	33.31	322.5	91.89	40.22	0.0	20.013;
390	69.74	0.0	850.1	33.31	317.2	93.44	40.62	0.0	21.593;
400	69.48	0.0	910.9	33.31	312.4	94.88	40.96	0.0	23.137;
410	69.28	0.0	970.3	33.31	307.9	96.26	41.26	0.0	24.646;
420	69.12	0.0	1028.2	33.31	303.7	97.58	41.53	0.0	26.117;
430	69.00	0.0	1083.3	33.31	299.9	98.83	41.76	0.0	27.516;
440	68.95	0.0	1124.0	33.31	296.6	99.94	41.87	0.0	28.549;
450	68.94	0.0	1152.3	33.31	293.5	101.0	41.90	0.0	29.267;
460	68.93	0.0	1176.6	33.31	290.5	102.0	41.90	0.0	29.886;
470	68.93	0.0	1200.0	33.31	287.7	103.0	41.90	0.0	30.479;

480	68.93	0.0	1223.0	33.31	285.0	104.0	41.90	0.0	31.065;
490	68.93	0.0	1245.8	33.31	282.4	105.0	41.90	0.0	31.643; local maximum rise or fall;
498	68.99	0.0	1274.4	33.31	275.3	107.6	43.60	0.0	32.371;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 13.290
Lmz(m): 13.290
forced entrain 1 0.0 9.452 32.37 0.908
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3361
;
1:29:39 PM. amb fills: 4

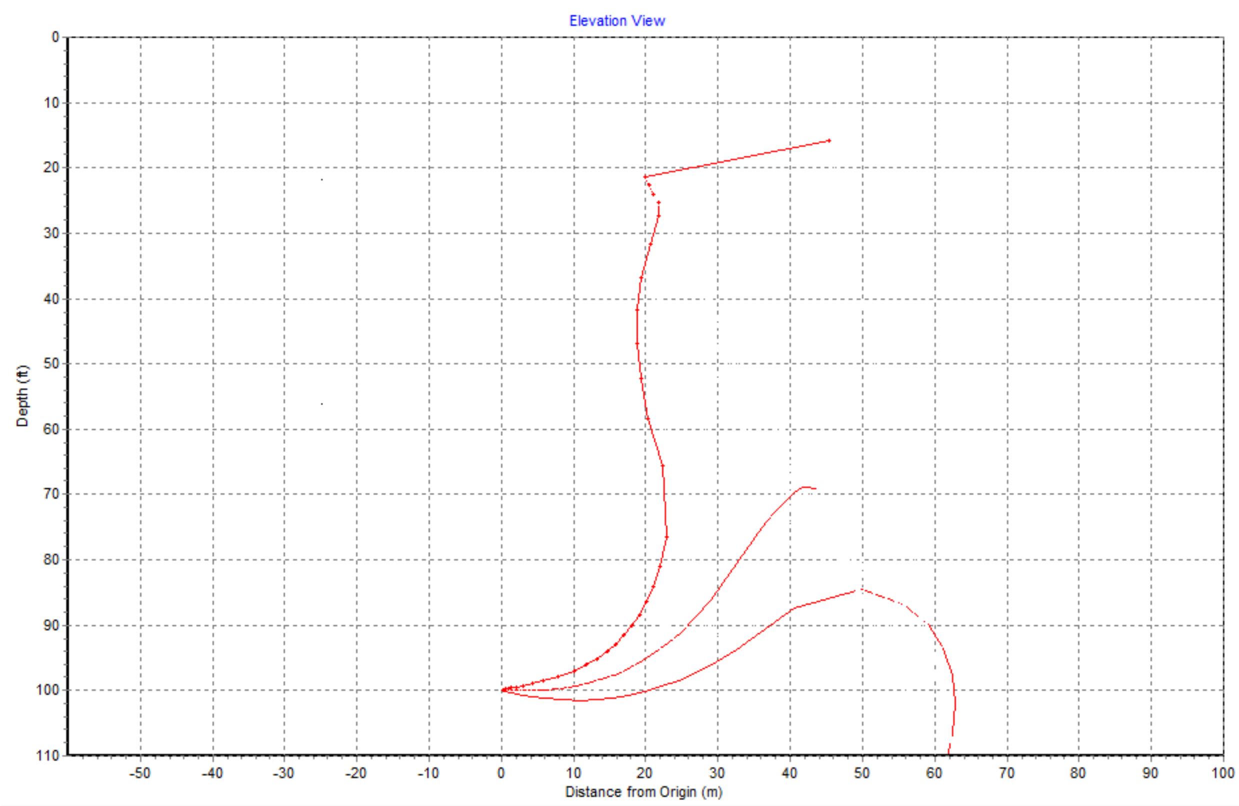

Figure B.4.1: Plumes 18b solution of discharge plume trajectories for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -0 m to *X* = +63 m so that ZID = 63 m

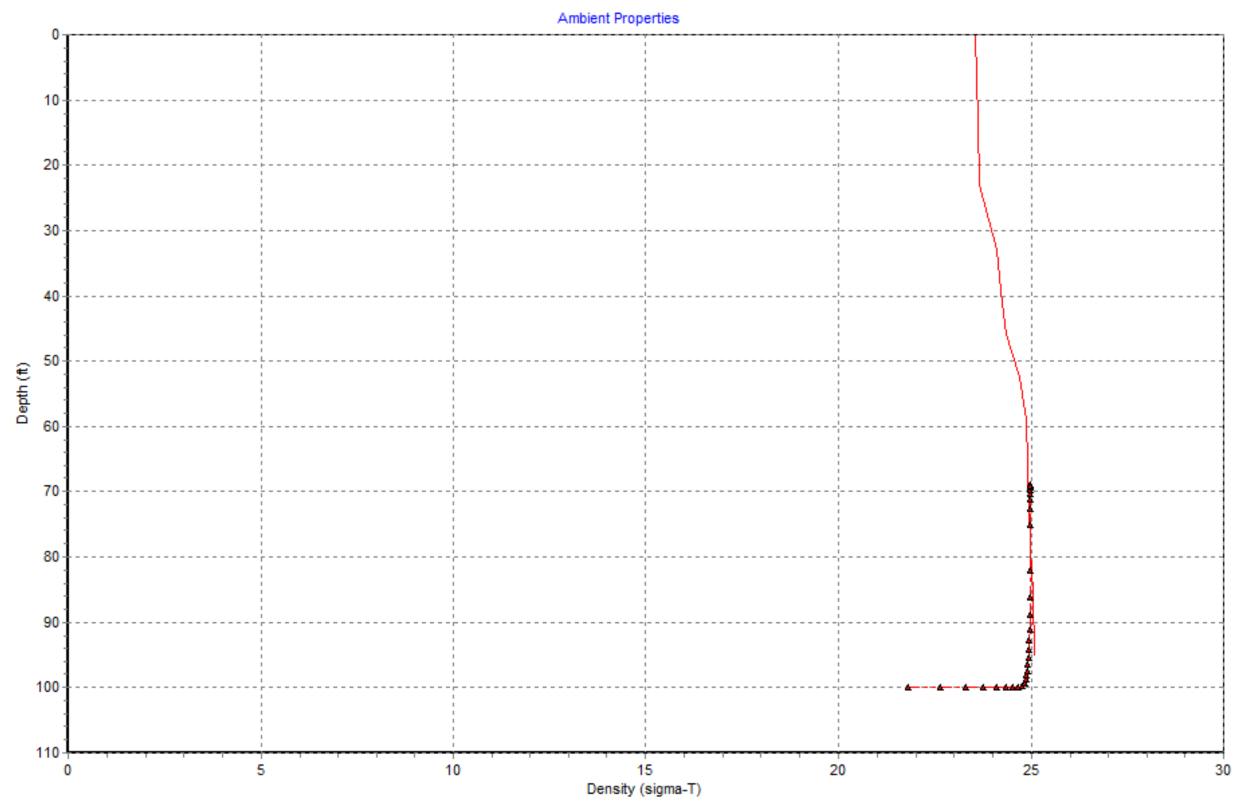

Figure B.4.2: Plumes 18b solution of vertical density profile for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

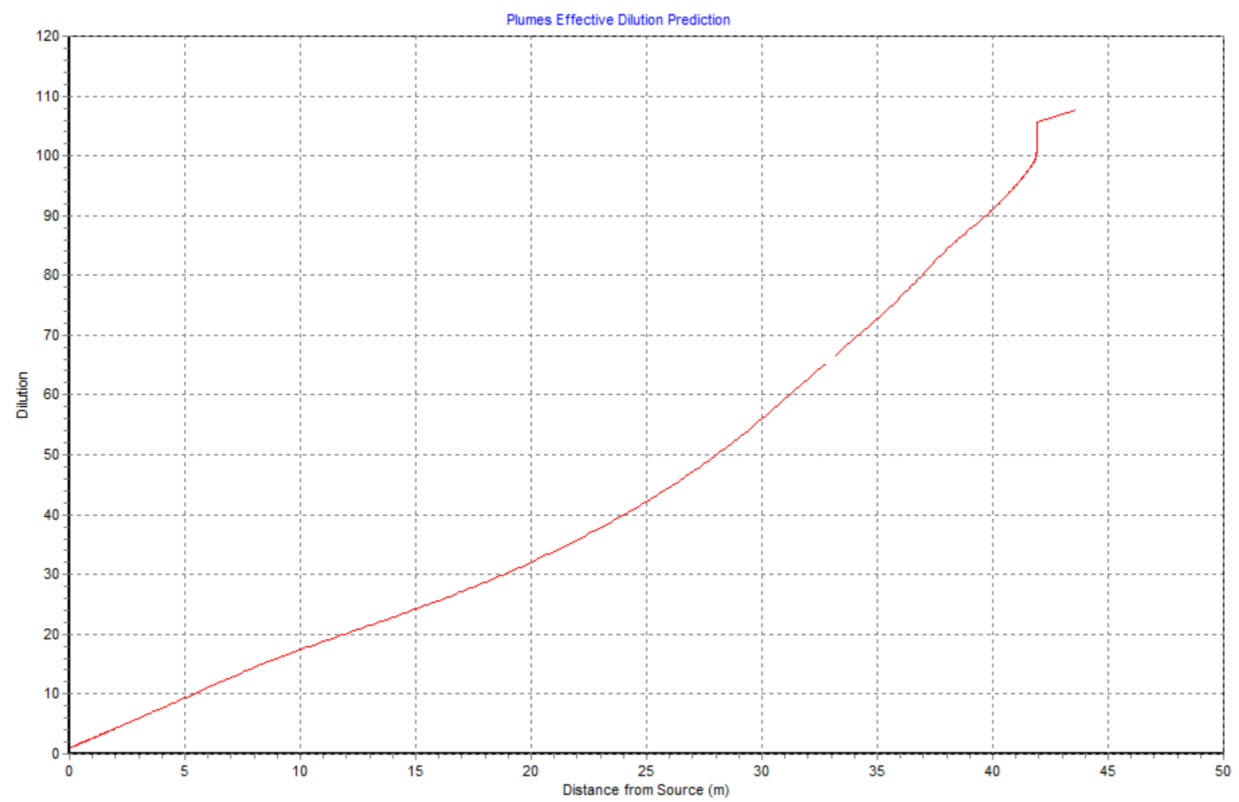

Figure B.4.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 18.9 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt.

B.5: Plumes 18b Results for SJCOO discharges of 13 mgd Wastewater and 5 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW13mgd_b5mgd_T-1"
memo
SJCOO discharging 13 mgd wastewater and 5 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 1:51:56 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW13mgd_b5mgd_T-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	18.000	18.610	20.660	18610.0

Simulation:
Froude No: 13.62; Strat No: 3.00E-4; Spcg No: 14.39; k: 1.34E+5; eff den (sigmaT) 12.20791; eff vel 1.338(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	18.61	18610.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.081	18.91	18232.1	1.021	0.0129	0.0	0.07827; bottom hit;
10	100.00	0.0	3.681	21.27	15286.9	1.217	0.107	0.0	0.09349;
20	100.00	0.0	4.482	23.44	12564.0	1.481	0.233	0.0	0.1139;
30	100.00	0.0	5.460	25.23	10322.6	1.803	0.386	0.0	0.1387;
40	99.99	0.0	6.651	26.69	8478.7	2.195	0.573	0.0	0.1689;
50	99.99	0.0	8.102	27.89	6962.6	2.673	0.800	0.0	0.2058;
60	99.98	0.0	9.869	28.87	5716.6	3.255	1.076	0.0	0.2507;
70	99.96	0.0	12.02	29.68	4692.8	3.966	1.409	0.0	0.3052;
80	99.92	0.0	14.62	30.34	3851.9	4.831	1.812	0.0	0.3714;
90	99.86	0.0	17.56	30.85	3202.8	5.811	2.253	0.0	0.4460;
100	99.78	0.0	20.34	31.20	2757.0	6.750	2.639	0.0	0.5166;
110	99.70	0.0	23.00	31.46	2426.4	7.670	2.983	0.0	0.5841;
120	99.61	0.0	25.58	31.66	2167.7	8.585	3.296	0.0	0.6496;
130	99.51	0.0	28.09	31.83	1957.6	9.507	3.587	0.0	0.7136;
140	99.39	0.0	30.56	31.96	1782.4	10.44	3.860	0.0	0.7763;
150	99.27	0.0	32.98	32.08	1633.4	11.39	4.121	0.0	0.8378;
160	99.14	0.0	35.36	32.18	1504.5	12.37	4.373	0.0	0.8981;
170	98.99	0.0	37.68	32.27	1391.7	13.37	4.618	0.0	0.9570;
180	98.83	0.0	39.95	32.35	1291.8	14.41	4.861	0.0	1.0146;
190	98.65	0.0	42.16	32.42	1202.3	15.48	5.102	0.0	1.0708;
199	98.47	0.0	44.10	32.48	1129.1	16.48	5.320	0.0	1.1200; merging;
200	98.45	0.0	44.31	32.48	1121.5	16.59	5.344	0.0	1.1254;
210	98.23	0.0	46.40	32.54	1050.7	17.71	5.591	0.0	1.1786;
220	97.98	0.0	48.47	32.59	986.2	18.87	5.845	0.0	1.2311;
230	97.68	0.0	50.51	32.64	926.2	20.09	6.109	0.0	1.2831;
240	97.34	0.0	52.56	32.68	869.6	21.40	6.387	0.0	1.3349;
250	96.94	0.0	54.61	32.72	815.2	22.83	6.683	0.0	1.3872;
260	96.47	0.0	56.73	32.76	762.3	24.41	7.001	0.0	1.4409;
270	95.89	0.0	58.97	32.81	709.8	26.22	7.347	0.0	1.4979;
280	95.17	0.0	61.46	32.85	656.8	28.34	7.729	0.0	1.5612;
290	94.26	0.0	64.40	32.89	602.1	30.91	8.156	0.0	1.6358;
300	93.08	0.0	68.10	32.94	544.8	34.16	8.640	0.0	1.7298;
310	91.52	0.0	73.09	32.98	483.8	38.47	9.198	0.0	1.8565;
320	89.35	0.0	80.34	33.03	418.3	44.49	9.852	0.0	2.0406;
330	86.22	0.0	91.68	33.09	348.3	53.43	10.63	0.0	2.3286;
340	82.35	0.0	108.2	33.14	285.7	65.13	11.42	0.0	2.7478;
350	77.85	0.0	134.5	33.17	234.4	79.39	12.21	0.0	3.4160;
360	72.61	0.0	175.6	33.20	192.3	96.77	13.03	0.0	4.4605;
370	66.57	0.0	237.5	33.22	157.8	118.0	13.89	0.0	6.0325;
371	65.92	0.0	246.1	33.23	154.7	120.3	13.98	0.0	6.2519; trap level;
380	59.69	0.0	365.8	33.25	129.4	143.8	14.90	0.0	9.2922;
388	55.64	0.0	587.5	33.26	116.0	160.4	15.59	0.0	14.923; begin overlap;
390	55.38	0.0	637.5	33.26	115.2	161.5	15.64	0.0	16.192;
400	54.63	0.0	846.1	33.26	113.0	164.7	15.82	0.0	21.491;
410	54.28	0.0	1044.1	33.26	111.6	166.8	15.93	0.0	26.521;
420	54.13	0.0	1206.9	33.26	110.6	168.3	15.98	0.0	30.656;
430	54.12	0.0	1244.3	33.27	109.8	169.5	15.98	0.0	31.606;
440	54.12	0.0	1261.9	33.27	109.1	170.6	15.98	0.0	32.052;
450	54.12	0.0	1278.7	33.27	108.4	171.7	15.98	0.0	32.479;

453 53.98 0.0 2141.7 33.27 106.2 175.2 16.30 0.0 54.400; surface; local maximum rise or fall;
459 87.41 0.0 3571.6 33.27 104.1 178.7 18.45 0.0 90.719;
Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 5.6237
Lmz(m): 5.6237
forced entrain 1 0.0 3.837 90.72 0.923
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3807
;
1:51:56 PM. amb fills: 4

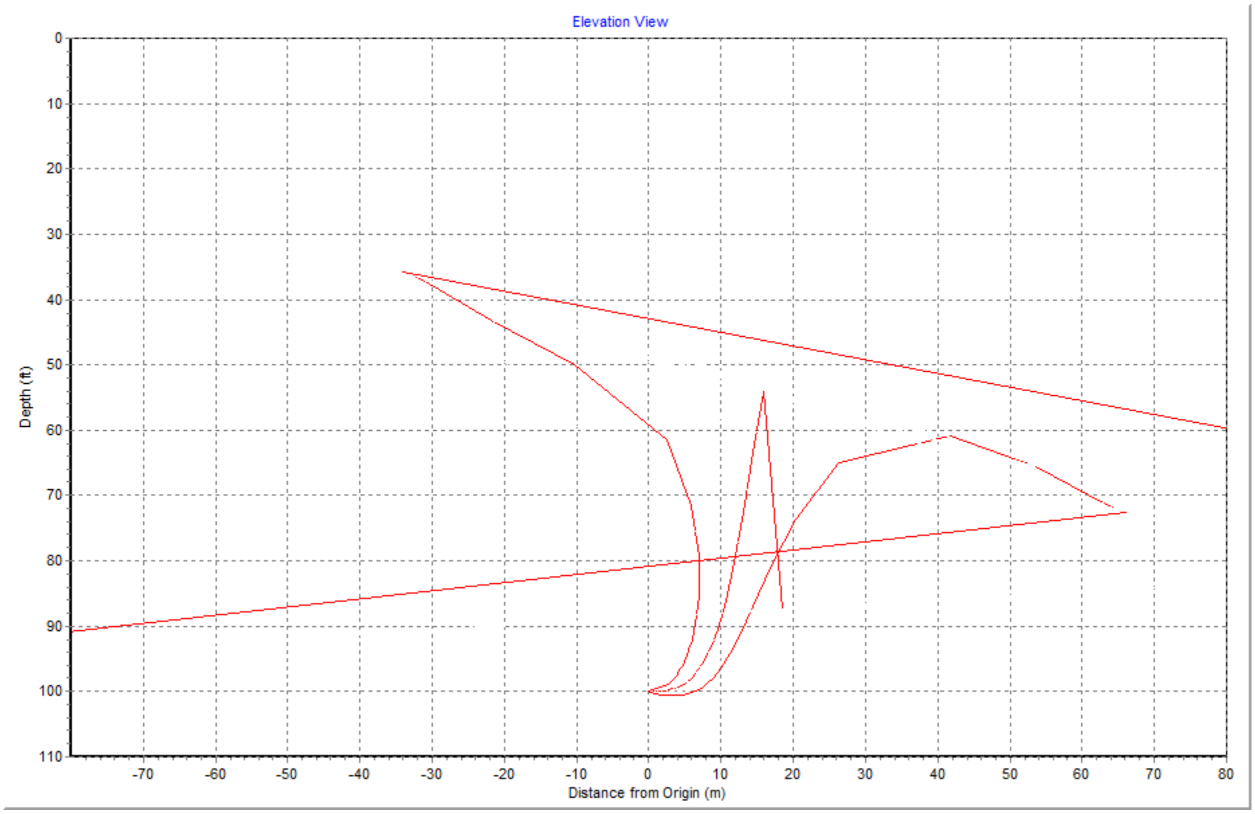

Figure B.5.1: Plumes 18b solution of discharge plume trajectories for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from X = -80 m to X = +80 m so that ZID = 160 m

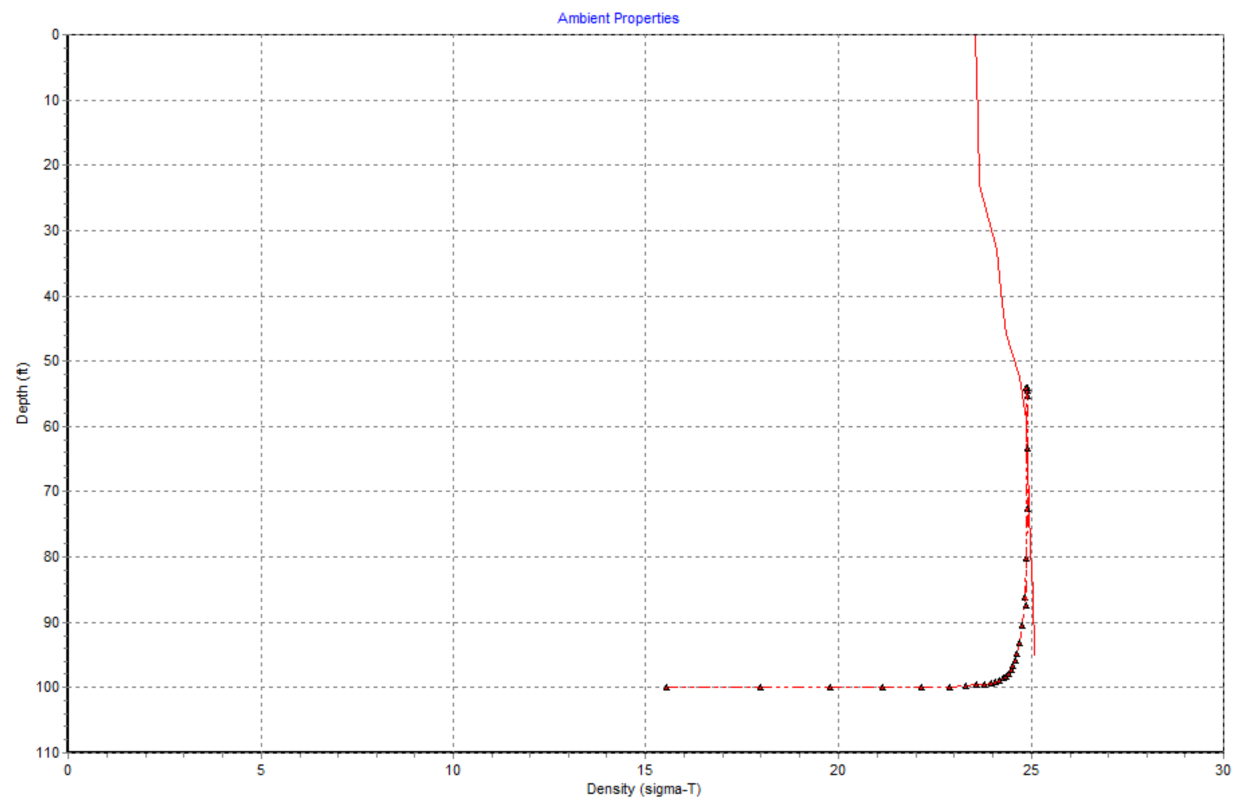

Figure B.5.2: Plumes 18b solution of vertical density profile for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

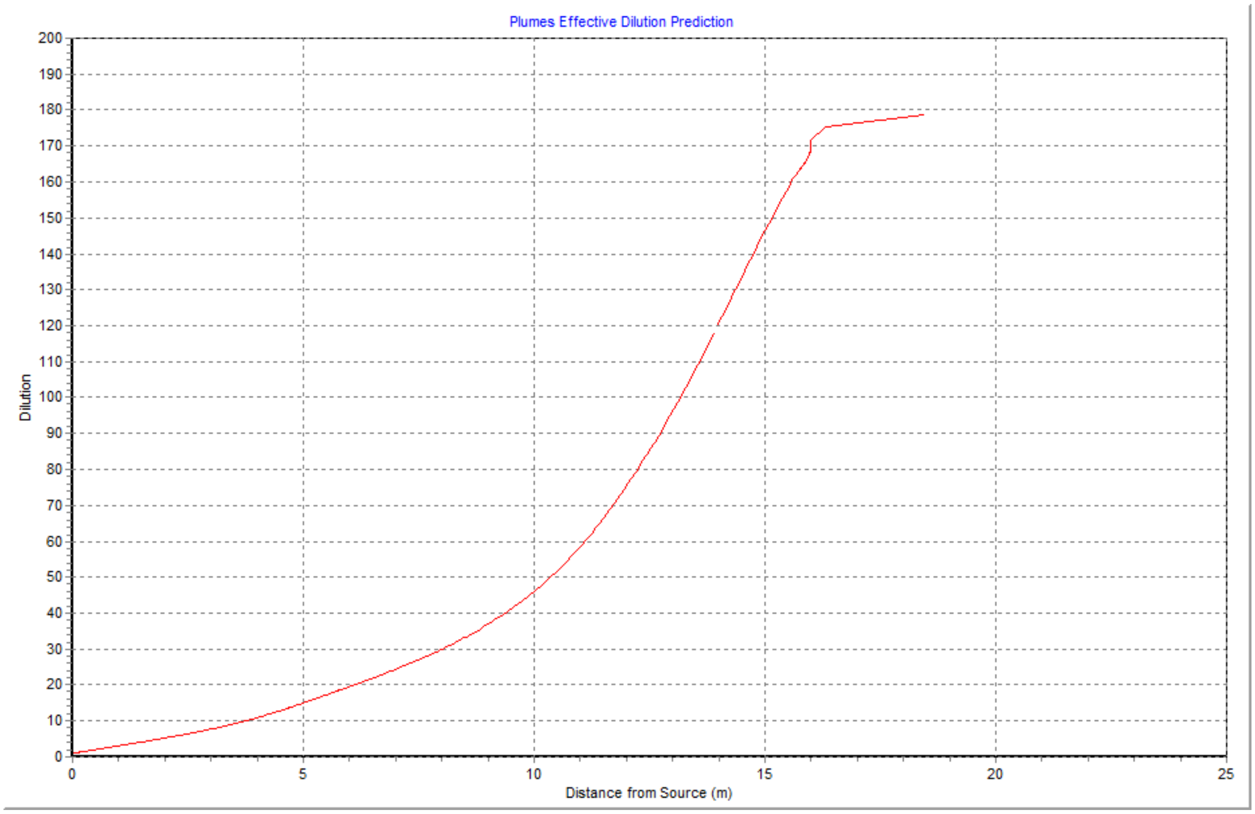

Figure B.5.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt.

B.6: Plumes 18b Results for SJCOO discharges of 13 mgd Wastewater and 5 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW8mgd_b5mgd_T-1"
memo
SJCOO discharging 8 mgd wastewater and 5 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 10
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/10/2019 2:20:30 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW8mgd_b5mgd_T-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
29.00	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07096

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	13.000	25.770	20.660	25770.0

Simulation:
Froude No: 12.95; Strat No: 5.17E-4; Spcg No: 14.39; k: 96666.1; eff den (sigmaT) 17.61415; eff vel 0.967(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (m)	y-posn (m)	Iso dia (m)
0	100.0	1.000E-5	3.050	25.77	25770.0	1.000	0.0	0.0	0.07747;
1	100.00	0.0	3.073	25.88	25389.9	1.015	0.00937	0.0	0.07805; bottom hit;
10	100.00	0.0	3.661	27.10	21270.5	1.212	0.109	0.0	0.09299;
20	100.00	0.0	4.460	28.23	17468.3	1.475	0.243	0.0	0.1133;
30	100.00	0.0	5.435	29.15	14342.9	1.797	0.406	0.0	0.1380;
40	99.99	0.0	6.622	29.91	11774.7	2.189	0.604	0.0	0.1682;
50	99.99	0.0	8.068	30.53	9665.1	2.666	0.845	0.0	0.2049;
60	99.97	0.0	9.828	31.04	7932.6	3.249	1.138	0.0	0.2496;
70	99.95	0.0	11.97	31.45	6510.1	3.958	1.492	0.0	0.3040;
80	99.90	0.0	14.55	31.80	5343.5	4.823	1.917	0.0	0.3696;
90	99.83	0.0	17.21	32.04	4510.5	5.713	2.334	0.0	0.4372;
100	99.76	0.0	19.69	32.21	3928.3	6.560	2.699	0.0	0.5002;
110	99.67	0.0	22.05	32.34	3488.9	7.386	3.028	0.0	0.5601;
120	99.58	0.0	24.32	32.44	3140.6	8.206	3.330	0.0	0.6178;
130	99.47	0.0	26.53	32.53	2854.6	9.028	3.614	0.0	0.6739;
140	99.36	0.0	28.69	32.60	2613.7	9.860	3.883	0.0	0.7286;
150	99.23	0.0	30.79	32.66	2406.7	10.71	4.142	0.0	0.7821;
160	99.09	0.0	32.85	32.71	2226.1	11.58	4.393	0.0	0.8344;
170	98.94	0.0	34.87	32.76	2066.2	12.47	4.640	0.0	0.8856;
180	98.77	0.0	36.84	32.80	1922.9	13.40	4.885	0.0	0.9357;
190	98.58	0.0	38.78	32.84	1793.1	14.37	5.129	0.0	0.9849;
200	98.37	0.0	40.68	32.87	1674.1	15.39	5.377	0.0	1.0333;
210	98.13	0.0	42.57	32.90	1563.8	16.48	5.629	0.0	1.0812;
218	97.92	0.0	44.07	32.93	1480.6	17.41	5.836	0.0	1.1193; merging;
220	97.86	0.0	44.44	32.93	1461.0	17.64	5.888	0.0	1.1287;
230	97.55	0.0	46.26	32.96	1368.5	18.83	6.158	0.0	1.1749;
240	97.19	0.0	48.08	32.99	1281.5	20.11	6.443	0.0	1.2213;
250	96.77	0.0	49.97	33.01	1197.5	21.52	6.746	0.0	1.2692;
260	96.26	0.0	51.98	33.04	1114.8	23.12	7.073	0.0	1.3202;
270	95.64	0.0	54.19	33.06	1032.1	24.97	7.430	0.0	1.3765;
280	94.86	0.0	56.76	33.08	947.8	27.19	7.823	0.0	1.4417;
290	93.88	0.0	59.89	33.11	860.7	29.94	8.263	0.0	1.5213;
300	92.61	0.0	63.94	33.14	769.6	33.48	8.763	0.0	1.6241;
310	90.89	0.0	69.51	33.16	673.5	38.26	9.339	0.0	1.7654;
320	88.49	0.0	77.70	33.19	571.8	45.07	10.02	0.0	1.9736;
330	85.18	0.0	90.09	33.22	470.2	54.81	10.79	0.0	2.2883;
340	81.30	0.0	108.3	33.25	385.7	66.81	11.54	0.0	2.7506;
350	76.70	0.0	142.8	33.26	316.4	81.44	12.34	0.0	3.6277;
353	75.14	0.0	158.3	33.27	298.2	86.42	12.61	0.0	4.0211; trap level;
360	71.13	0.0	205.9	33.27	259.6	99.27	13.30	0.0	5.2296;
370	65.96	0.0	341.8	33.28	221.3	116.5	14.29	0.0	8.6817;
375	65.09	0.0	413.3	33.28	215.0	119.9	14.50	0.0	10.497; begin overlap;
380	64.53	0.0	476.2	33.29	211.6	121.8	14.64	0.0	12.096;
390	63.85	0.0	590.2	33.29	208.0	123.9	14.85	0.0	14.990;
400	63.46	0.0	699.5	33.29	205.6	125.3	15.00	0.0	17.766;
410	63.21	0.0	807.2	33.29	203.8	126.5	15.10	0.0	20.503;
420	63.04	0.0	913.8	33.29	202.2	127.5	15.18	0.0	23.210;
430	62.93	0.0	1016.2	33.29	200.8	128.3	15.25	0.0	25.812;
440	62.90	0.0	1064.4	33.29	199.8	129.0	15.26	0.0	27.037;
450	62.90	0.0	1078.8	33.29	198.8	129.6	15.26	0.0	27.401;

460	62.90	0.0	1089.5	33.29	197.9	130.2	15.26	0.0	27.672;
470	62.90	0.0	1099.9	33.29	196.9	130.9	15.26	0.0	27.936; local maximum rise or fall;
477	62.96	0.0	1118.2	33.29	192.5	133.9	15.78	0.0	28.401;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 4.8084
Lmz(m): 4.8084
forced entrain 1 0.0 11.29 28.40 0.513
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3550
;
2:20:30 PM. amb fills: 4

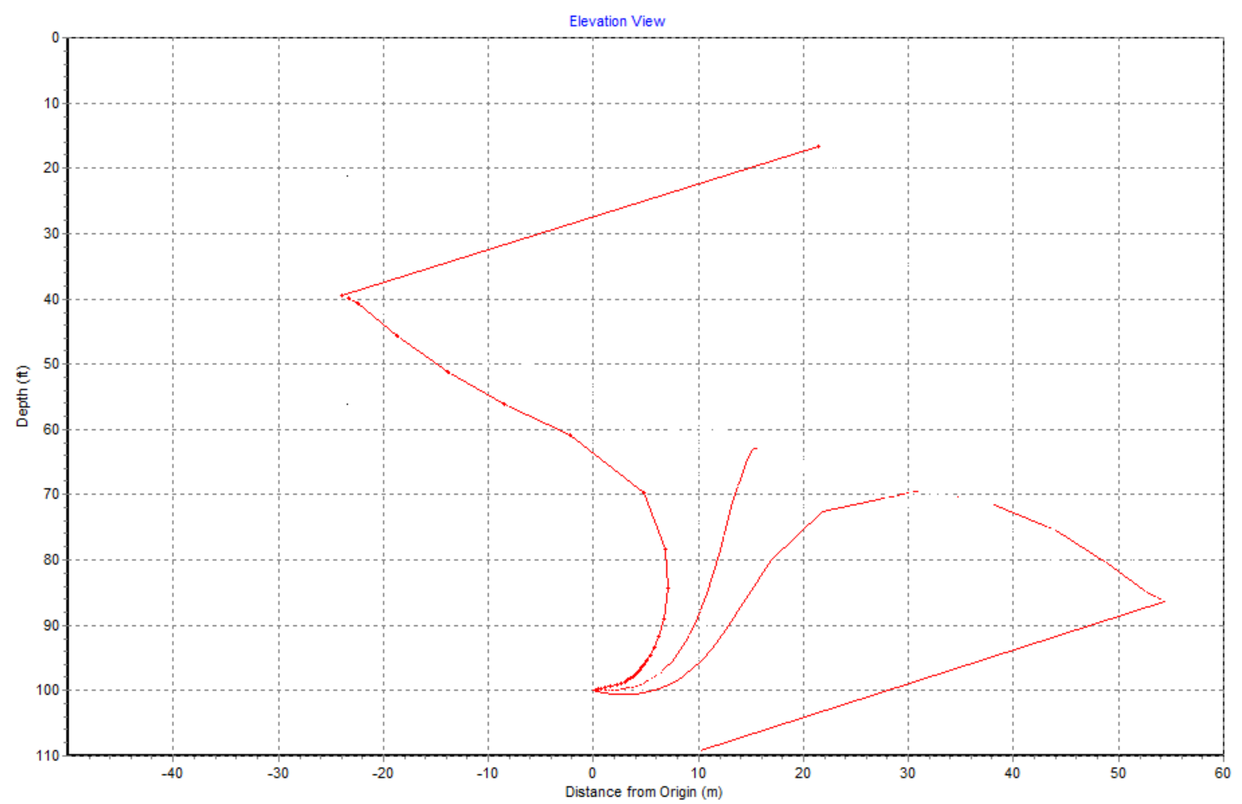

Figure B.6.1: Plumes 18b solution of discharge plume trajectories for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. ZID is defined by the maximum horizontal excursion of trajectories from the origin. From the maximum horizontal spreading of the plume, the ZID extends from *X* = -24 m to *X* = +54 m so that ZID = 78 m

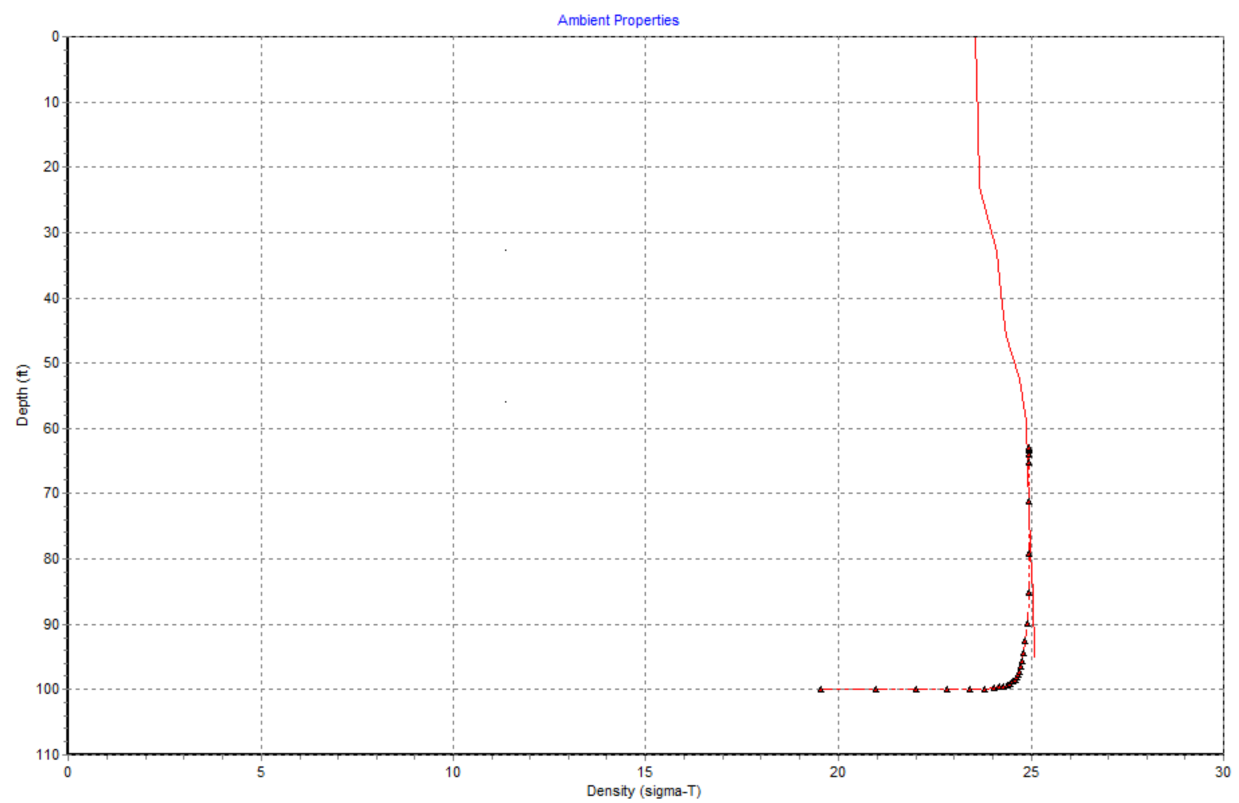

Figure B.6.2: Plumes 18b solution of vertical density profile for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

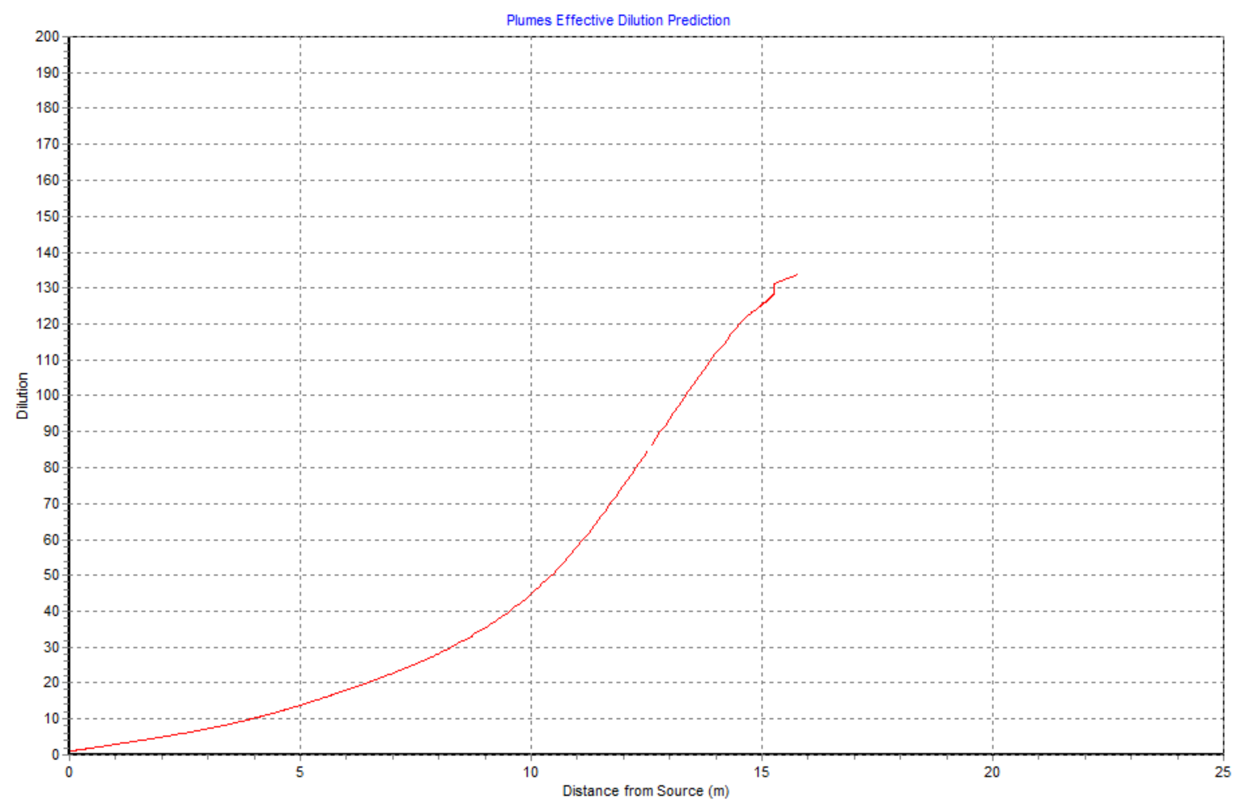

Figure B.6.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt.

APPENDIX-C: Results for Dense (Negatively Buoyant) Combined Discharges of Brine and Wastewater

C.1: Plumes 18b Results for SJCOO discharges of 13 mgd Wastewater and 15 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW13mgd_b15mgd_T-4"
memomemomemo
SJCOO discharging 13 mgd wastewater and 15 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 11:25:09 AM
Case 1; ambient file C:\Plumes18\SJCOO_WW13mgd_b15mgd_T-4.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt

(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	28.000	35.890	20.660 35890.0

Simulation:
Froude No: -165.0; Strat No:-0.01789; Spcg No: 14.39; k: 2.08E+5; eff den (sigmaT) 25.28520; eff vel 2.082(m/s);
Current is very small, flow regime may be transient.

	Depth	Amb-cur	P-dia	Eff-sal	Polutnt	Dilutn	x-posn	y-posn	Iso dia
Step	(ft)	(m/s)	(in)	(psu)	(ppm)	()	(ft)	(ft)	(m)
0	100.0	1.000E-5	3.050	35.89	35890.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.099	35.81	34769.0	1.032	0.0199	0.0	0.07871;
2	100.0	0.0	3.180	35.76	34087.2	1.053	0.0329	0.0	0.08076;
3	100.0	0.0	3.243	35.72	33418.9	1.074	0.0461	0.0	0.08238;
4	100.0	0.0	3.308	35.67	32763.6	1.095	0.0596	0.0	0.08403;
5	100.0	0.0	3.374	35.62	32121.2	1.117	0.0733	0.0	0.08571;
6	100.0	0.0	3.442	35.58	31491.3	1.140	0.0874	0.0	0.08742;
7	100.0	0.0	3.511	35.54	30873.8	1.162	0.102	0.0	0.08917;
8	100.0	0.0	3.581	35.49	30268.4	1.186	0.116	0.0	0.09095;
9	100.0	0.0	3.652	35.45	29674.9	1.209	0.131	0.0	0.09277;
10	100.0	0.0	3.725	35.41	29093.0	1.234	0.146	0.0	0.09463;
11	100.0	0.0	3.800	35.37	28522.6	1.258	0.162	0.0	0.09652;
12	100.0	0.0	3.876	35.33	27963.3	1.283	0.178	0.0	0.09845;
13	100.0	0.0	3.954	35.29	27414.9	1.309	0.194	0.0	0.1004;
14	100.0	0.0	4.033	35.26	26877.4	1.335	0.210	0.0	0.1024;
15	100.0	0.0	4.113	35.22	26350.3	1.362	0.227	0.0	0.1045;
16	100.0	0.0	4.196	35.18	25833.6	1.389	0.244	0.0	0.1066;
17	100.0	0.0	4.279	35.15	25327.0	1.417	0.261	0.0	0.1087;
18	100.0	0.0	4.365	35.11	24830.4	1.445	0.279	0.0	0.1109;
19	100.0	0.0	4.452	35.08	24343.5	1.474	0.297	0.0	0.1131;
20	100.0	0.0	4.541	35.04	23866.1	1.504	0.316	0.0	0.1154;
21	100.0	0.0	4.632	35.01	23398.1	1.534	0.335	0.0	0.1177;
22	100.0	0.0	4.725	34.98	22939.3	1.565	0.354	0.0	0.1200;
23	100.0	0.0	4.819	34.95	22489.5	1.596	0.373	0.0	0.1224;
24	100.0	0.0	4.916	34.92	22048.5	1.628	0.393	0.0	0.1249;
25	100.0	0.0	5.014	34.89	21616.1	1.660	0.414	0.0	0.1274;
26	100.0	0.0	5.114	34.86	21192.2	1.694	0.435	0.0	0.1299;
27	100.0	0.0	5.217	34.83	20776.6	1.727	0.456	0.0	0.1325;
28	100.0	0.0	5.321	34.80	20369.2	1.762	0.478	0.0	0.1352;
29	100.0	0.0	5.427	34.77	19969.8	1.797	0.500	0.0	0.1379;
30	100.0	0.0	5.536	34.74	19578.2	1.833	0.522	0.0	0.1406;
31	100.0	0.0	5.647	34.71	19194.3	1.870	0.545	0.0	0.1434;
32	100.0	0.0	5.760	34.69	18817.9	1.907	0.569	0.0	0.1463;
33	100.0	0.0	5.875	34.66	18448.8	1.945	0.592	0.0	0.1492;
34	100.0	0.0	5.992	34.64	18087.1	1.984	0.617	0.0	0.1522;
35	100.0	0.0	6.112	34.61	17732.4	2.024	0.642	0.0	0.1552;
36	100.0	0.0	6.234	34.59	17384.7	2.064	0.667	0.0	0.1584;
37	100.0	0.0	6.359	34.56	17043.7	2.106	0.693	0.0	0.1615;
38	100.0	0.0	6.486	34.54	16709.5	2.148	0.719	0.0	0.1648;
39	100.0	0.0	6.616	34.52	16381.8	2.191	0.746	0.0	0.1680;
40	100.0	0.0	6.748	34.49	16060.6	2.235	0.774	0.0	0.1714;
41	100.0	0.0	6.883	34.47	15745.7	2.279	0.802	0.0	0.1748;
42	100.0	0.0	7.021	34.45	15436.9	2.325	0.830	0.0	0.1783;
43	100.0	0.0	7.161	34.43	15134.2	2.371	0.859	0.0	0.1819;
44	100.0	0.0	7.305	34.41	14837.4	2.419	0.889	0.0	0.1855;
45	100.0	0.0	7.451	34.39	14546.4	2.467	0.919	0.0	0.1893;
46	100.0	0.0	7.600	34.37	14261.2	2.517	0.950	0.0	0.1930;

47	100.0	0.0	7.752	34.35	13981.5	2.567	0.982	0.0	0.1969;
48	100.0	0.0	7.907	34.33	13707.3	2.618	1.014	0.0	0.2008;
49	100.0	0.0	8.065	34.31	13438.5	2.671	1.047	0.0	0.2049;
50	100.0	0.0	8.226	34.29	13175.0	2.724	1.080	0.0	0.2089;
51	100.0	0.0	8.391	34.27	12916.7	2.779	1.114	0.0	0.2131;
52	100.0	0.0	8.559	34.25	12663.4	2.834	1.149	0.0	0.2174;
53	100.0	0.0	8.730	34.24	12415.0	2.891	1.185	0.0	0.2217;
54	100.0	0.0	8.904	34.22	12171.6	2.949	1.221	0.0	0.2262;
55	100.0	0.0	9.083	34.20	11932.9	3.008	1.258	0.0	0.2307;
56	100.0	0.0	9.264	34.19	11698.9	3.068	1.295	0.0	0.2353;
57	100.0	0.0	9.450	34.17	11469.5	3.129	1.334	0.0	0.2400;
58	100.0	0.0	9.639	34.15	11244.6	3.192	1.373	0.0	0.2448;
59	100.0	0.0	9.831	34.14	11024.1	3.256	1.413	0.0	0.2497;
60	100.0	0.0	10.03	34.12	10807.9	3.321	1.454	0.0	0.2547;
61	100.0	0.0	10.23	34.11	10596.0	3.387	1.495	0.0	0.2598;
62	100.0	0.0	10.43	34.09	10388.2	3.455	1.538	0.0	0.2650;
63	100.0	0.0	10.64	34.08	10184.5	3.524	1.581	0.0	0.2703;
64	100.0	0.0	10.85	34.07	9984.8	3.594	1.625	0.0	0.2757;
65	100.0	0.0	11.07	34.05	9789.0	3.666	1.670	0.0	0.2812;
66	100.0	0.0	11.29	34.04	9597.0	3.740	1.716	0.0	0.2868;
67	100.0	0.0	11.52	34.03	9408.8	3.815	1.763	0.0	0.2926;
68	100.0	0.0	11.75	34.01	9224.3	3.891	1.811	0.0	0.2984;
69	100.0	0.0	11.98	34.00	9043.4	3.969	1.859	0.0	0.3044;
70	100.0	0.0	12.22	33.99	8866.1	4.048	1.909	0.0	0.3105;
71	100.0	0.0	12.47	33.98	8692.2	4.129	1.960	0.0	0.3167;
72	100.0	0.0	12.72	33.96	8521.8	4.212	2.011	0.0	0.3230;
73	100.0	0.0	12.97	33.95	8354.7	4.296	2.064	0.0	0.3295;
74	100.0	0.0	13.23	33.94	8190.8	4.382	2.118	0.0	0.3361;
75	100.0	0.0	13.50	33.93	8030.2	4.469	2.173	0.0	0.3428;
76	100.0	0.0	13.77	33.92	7872.8	4.559	2.229	0.0	0.3497;
77	100.0	0.0	14.04	33.91	7718.4	4.650	2.286	0.0	0.3567;
78	100.0	0.0	14.32	33.90	7567.0	4.743	2.344	0.0	0.3638;
79	100.0	0.0	14.61	33.89	7418.6	4.838	2.403	0.0	0.3711;
80	100.0	0.0	14.90	33.88	7273.2	4.935	2.464	0.0	0.3785;
81	100.0	0.0	15.20	33.87	7130.5	5.033	2.525	0.0	0.3861;
82	100.0	0.0	15.50	33.86	6990.7	5.134	2.588	0.0	0.3938;
83	100.0	0.0	15.81	33.85	6853.6	5.237	2.653	0.0	0.4017;
84	100.0	0.0	16.13	33.84	6719.2	5.341	2.718	0.0	0.4097;
85	100.0	0.0	16.45	33.83	6587.5	5.448	2.785	0.0	0.4179;
86	100.0	0.0	16.78	33.82	6458.3	5.557	2.853	0.0	0.4262;
87	100.0	0.0	17.12	33.81	6331.7	5.668	2.923	0.0	0.4348;
88	100.0	0.0	17.46	33.80	6207.5	5.782	2.993	0.0	0.4435;
89	100.0	0.0	17.81	33.79	6085.8	5.897	3.066	0.0	0.4523;
90	100.0	0.0	18.16	33.78	5966.4	6.015	3.140	0.0	0.4614;
91	100.0	0.0	18.53	33.78	5849.4	6.136	3.215	0.0	0.4706;
92	100.0	0.0	18.90	33.77	5734.7	6.258	3.291	0.0	0.4800;
93	100.0	0.0	19.28	33.76	5622.3	6.384	3.370	0.0	0.4896;
94	100.0	0.0	19.66	33.75	5512.0	6.511	3.450	0.0	0.4994;
95	100.0	0.0	20.06	33.74	5404.0	6.641	3.531	0.0	0.5094;
96	100.0	0.0	20.46	33.74	5298.0	6.774	3.614	0.0	0.5196;
97	100.0	0.0	20.87	33.73	5194.1	6.910	3.699	0.0	0.5300;
98	100.0	0.0	21.28	33.72	5092.3	7.048	3.785	0.0	0.5406;
99	100.0	0.0	21.71	33.71	4992.4	7.189	3.873	0.0	0.5514;
100	100.0	0.0	22.14	33.71	4894.5	7.333	3.963	0.0	0.5624;
101	100.0	0.0	22.59	33.70	4798.5	7.479	4.055	0.0	0.5737;
102	100.0	0.0	23.04	33.69	4704.4	7.629	4.148	0.0	0.5851;

103	100.0	0.0	23.50	33.69	4612.2	7.782	4.243	0.0	0.5968;
104	100.0	0.0	23.97	33.68	4521.7	7.937	4.341	0.0	0.6088;
105	100.0	0.0	24.45	33.68	4433.1	8.096	4.440	0.0	0.6210;
106	100.0	0.0	24.94	33.67	4346.2	8.258	4.541	0.0	0.6334;
107	100.0	0.0	25.43	33.66	4260.9	8.423	4.644	0.0	0.6460;
108	100.0	0.0	25.94	33.66	4177.4	8.592	4.749	0.0	0.6590;
109	100.0	0.0	26.46	33.65	4095.5	8.763	4.856	0.0	0.6721;
110	100.0	0.0	26.99	33.65	4015.2	8.939	4.966	0.0	0.6856;
111	100.0	0.0	27.53	33.64	3936.4	9.117	5.077	0.0	0.6993;
112	100.0	0.0	28.08	33.63	3859.2	9.300	5.191	0.0	0.7133;
113	100.0	0.0	28.64	33.63	3783.6	9.486	5.307	0.0	0.7276;
114	100.0	0.0	29.22	33.62	3709.4	9.675	5.426	0.0	0.7421;
115	100.0	0.0	29.80	33.62	3636.6	9.869	5.547	0.0	0.7569;
116	100.0	0.0	30.40	33.61	3565.3	10.07	5.670	0.0	0.7721;
117	100.0	0.0	31.00	33.61	3495.4	10.27	5.795	0.0	0.7875;
118	100.0	0.0	31.62	33.60	3426.9	10.47	5.923	0.0	0.8033;
119	100.0	0.0	32.26	33.60	3359.7	10.68	6.054	0.0	0.8193;
120	100.0	0.0	32.90	33.60	3293.8	10.90	6.187	0.0	0.8357;
121	100.0	0.0	33.56	33.59	3229.2	11.11	6.323	0.0	0.8524;
122	100.0	0.0	34.23	33.59	3165.9	11.34	6.462	0.0	0.8695;
123	100.0	0.0	34.92	33.58	3103.8	11.56	6.603	0.0	0.8869;
124	100.0	0.0	35.61	33.58	3043.0	11.79	6.747	0.0	0.9046;
125	100.0	0.0	36.33	33.57	2983.3	12.03	6.894	0.0	0.9227;
126	100.0	0.0	37.05	33.57	2924.8	12.27	7.044	0.0	0.9411;
127	100.0	0.0	37.79	33.57	2867.4	12.52	7.197	0.0	0.9600;
128	100.0	0.0	38.55	33.56	2811.2	12.77	7.352	0.0	0.9792;
129	100.0	0.0	39.32	33.56	2756.1	13.02	7.511	0.0	0.9987;
130	100.0	0.0	40.11	33.55	2702.0	13.28	7.673	0.0	1.0187;
131	100.0	0.0	40.91	33.55	2649.1	13.55	7.839	0.0	1.0391;
132	100.1	0.0	41.73	33.55	2597.1	13.82	8.007	0.0	1.0599;
133	100.1	0.0	42.56	33.54	2546.2	14.10	8.179	0.0	1.0810;
134	100.1	0.0	43.41	33.54	2496.3	14.38	8.354	0.0	1.1027;
135	100.1	0.0	44.28	33.54	2447.3	14.67	8.533	0.0	1.1247; merging;
136	100.1	0.0	45.17	33.53	2399.3	14.96	8.727	0.0	1.1474;
137	100.1	0.0	46.12	33.53	2352.3	15.26	8.937	0.0	1.1716;
138	100.1	0.0	47.12	33.53	2306.2	15.56	9.159	0.0	1.1968;
139	100.1	0.0	48.16	33.52	2260.9	15.87	9.394	0.0	1.2232;
140	100.1	0.0	49.24	33.52	2216.6	16.19	9.640	0.0	1.2507;
141	100.1	0.0	50.36	33.52	2173.1	16.52	9.899	0.0	1.2792;
142	100.1	0.0	51.53	33.51	2130.5	16.85	10.17	0.0	1.3088;
143	100.1	0.0	52.74	33.51	2088.8	17.18	10.45	0.0	1.3397;
144	100.1	0.0	54.00	33.51	2047.8	17.53	10.75	0.0	1.3717;
145	100.1	0.0	55.31	33.50	2007.6	17.88	11.05	0.0	1.4049;
146	100.1	0.0	56.67	33.50	1968.3	18.23	11.37	0.0	1.4394;
147	100.2	0.0	58.08	33.50	1929.7	18.60	11.71	0.0	1.4753;
148	100.2	0.0	59.55	33.50	1891.8	18.97	12.05	0.0	1.5126;
149	100.2	0.0	61.08	33.49	1854.7	19.35	12.42	0.0	1.5513;
150	100.2	0.0	62.66	33.49	1818.4	19.74	12.79	0.0	1.5916;
151	100.2	0.0	64.31	33.49	1782.7	20.13	13.18	0.0	1.6335;
152	100.2	0.0	66.02	33.49	1747.8	20.53	13.58	0.0	1.6770;
153	100.3	0.0	67.80	33.48	1713.5	20.95	14.00	0.0	1.7222;
154	100.3	0.0	69.66	33.48	1679.9	21.36	14.44	0.0	1.7693;
155	100.3	0.0	71.59	33.48	1647.0	21.79	14.89	0.0	1.8183;
156	100.3	0.0	73.59	33.48	1614.7	22.23	15.36	0.0	1.8693;
157	100.4	0.0	75.68	33.47	1583.0	22.67	15.85	0.0	1.9223;
158	100.4	0.0	77.86	33.47	1552.0	23.13	16.35	0.0	1.9776;

159	100.4	0.0	80.12	33.47	1521.5	23.59	16.87	0.0	2.0350;
160	100.5	0.0	82.48	33.47	1491.7	24.06	17.41	0.0	2.0949;
161	100.5	0.0	84.93	33.47	1462.4	24.54	17.97	0.0	2.1572;
162	100.6	0.0	87.48	33.46	1433.8	25.03	18.55	0.0	2.2221;
163	100.6	0.0	90.14	33.46	1405.7	25.53	19.14	0.0	2.2897;
164	100.7	0.0	92.91	33.46	1378.2	26.04	19.76	0.0	2.3599; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 6.0215
Lmz(m): 6.0215
forced entrain 1 0.0 -0.209 2.360 0.996
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632
;
11:25:10 AM. amb fills: 4

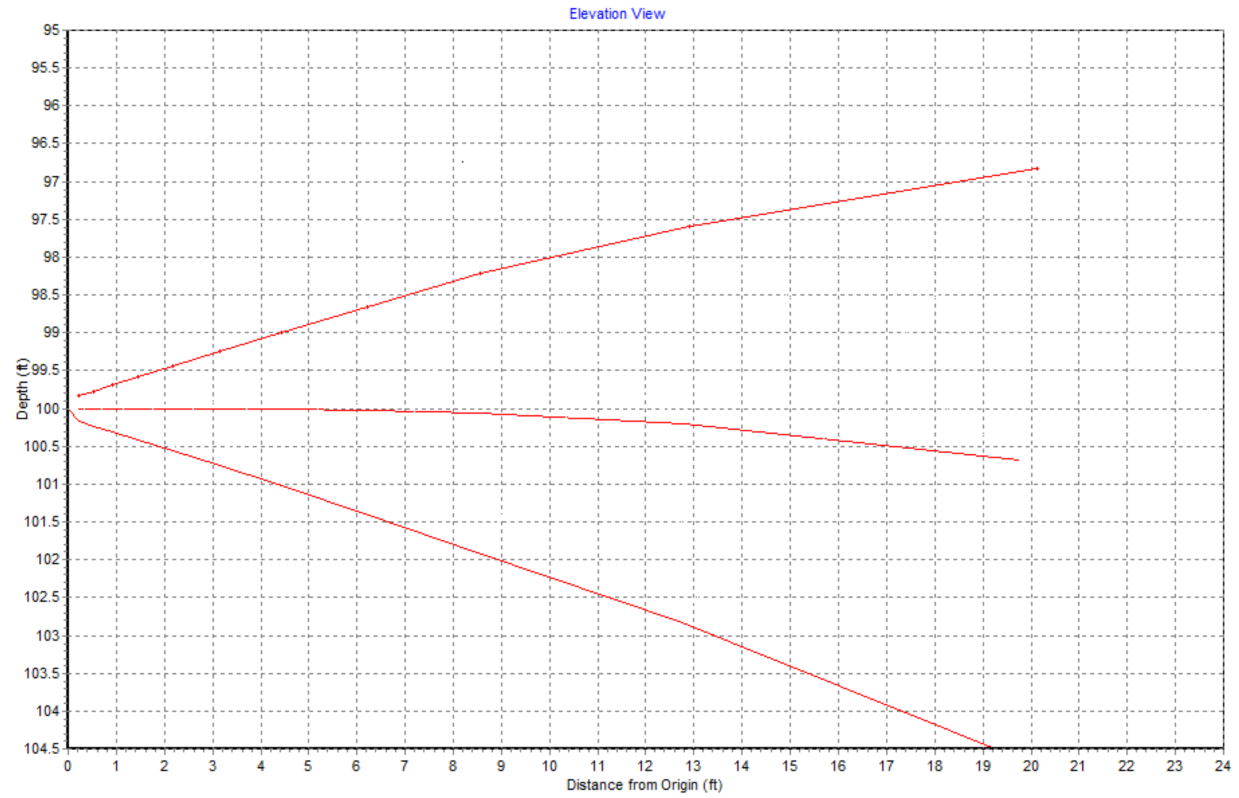

Figure C.1.1: Plumes 18b solution of discharge plume trajectories for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 96.8 ft. at X_a = 20.1 ft from the point of discharge. The centerline of the plume is at an average distance of X_b = 19.76 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

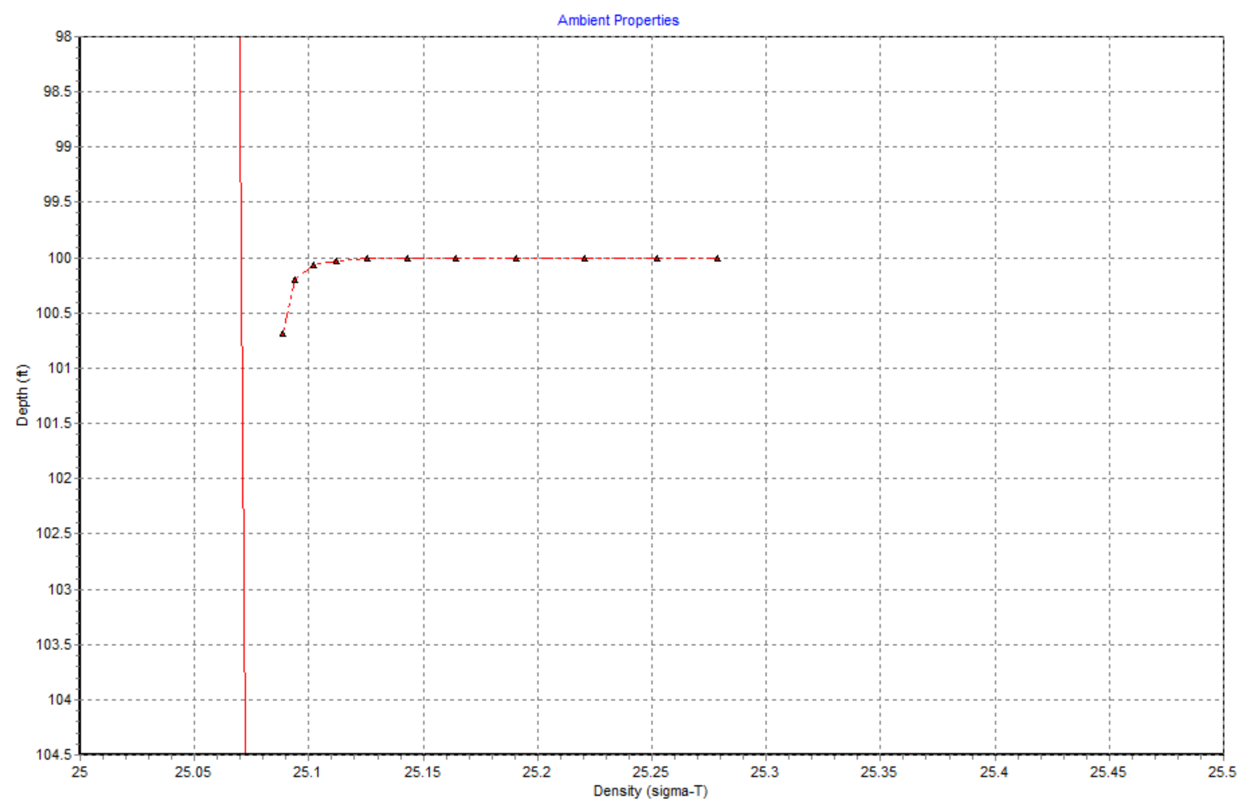

Figure C.1.2: Plumes 18b solution of vertical density profile for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

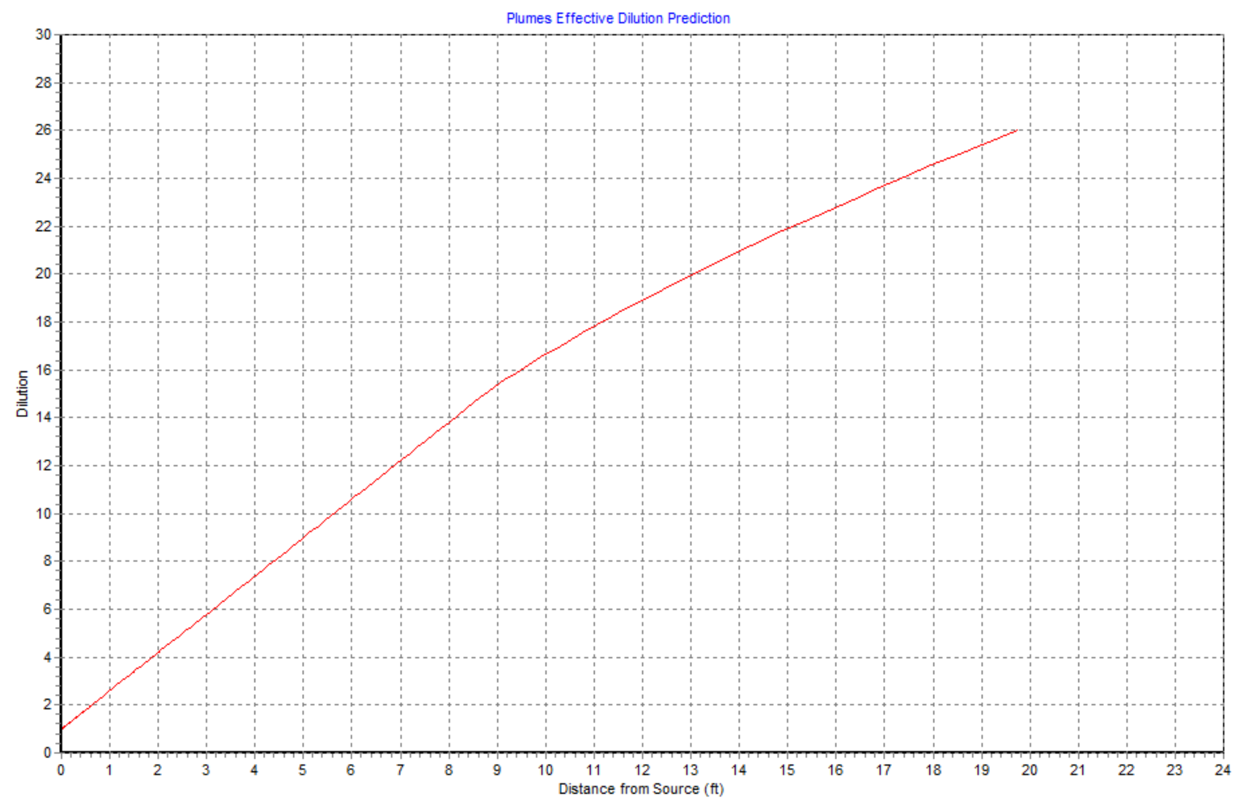

Figure C.1.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 13 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. As the plume begins to impact the bottom, the plume centerline is at a distance of X_b = 19.76 ft from the point of discharge, where the effective dilution reaches S_a = 26.04.

C.2: Plumes 18b Results for SJCOO discharges of 8 mgd Wastewater and 15 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW8mgd_b15mgd_D-1"
memo
SJCOO discharging 8 mgd wastewater and 15 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 1:05:33 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW8mgd_b15mgd_D-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	23.000	43.690	20.660	43690.0

Simulation:

Froude No: -25.36; Strat No:-6.23E-4; Spcg No: 14.39; k: 1.71E+5; eff den (sigmaT) 31.24414; eff vel 1.710(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (ft)	y-posn (ft)	Iso dia (m)
0	100.0	1.000E-5	3.050	43.69	43690.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.090	43.43	42562.8	1.026	0.0164	0.0	0.07849;
2	100.0	0.0	3.162	43.23	41723.7	1.047	0.0286	0.0	0.08031;
3	100.0	0.0	3.225	43.03	40901.2	1.068	0.0407	0.0	0.08192;
4	100.0	0.0	3.290	42.84	40095.0	1.090	0.053	0.0	0.08357;
5	100.0	0.0	3.356	42.66	39304.7	1.112	0.0656	0.0	0.08524;
6	100.0	0.0	3.423	42.48	38530.1	1.134	0.0784	0.0	0.08695;
7	100.0	0.0	3.492	42.30	37770.8	1.157	0.0914	0.0	0.08869;
8	100.0	0.0	3.562	42.12	37026.6	1.180	0.105	0.0	0.09047;
9	100.0	0.0	3.633	41.95	36297.1	1.204	0.118	0.0	0.09229;
10	100.0	0.0	3.706	41.78	35582.0	1.228	0.132	0.0	0.09414;
11	100.0	0.0	3.780	41.62	34881.1	1.253	0.146	0.0	0.09602;
12	100.0	0.0	3.856	41.46	34194.0	1.278	0.161	0.0	0.09795;
13	100.0	0.0	3.934	41.30	33520.6	1.303	0.175	0.0	0.09991;
14	100.0	0.0	4.012	41.14	32860.4	1.330	0.190	0.0	0.1019;
15	100.0	0.0	4.093	40.99	32213.3	1.356	0.206	0.0	0.1040;
16	100.0	0.0	4.175	40.84	31579.0	1.384	0.221	0.0	0.1060;
17	100.0	0.0	4.258	40.69	30957.2	1.411	0.237	0.0	0.1082;
18	100.0	0.0	4.344	40.55	30347.7	1.440	0.253	0.0	0.1103;
19	100.0	0.0	4.431	40.41	29750.3	1.469	0.270	0.0	0.1125;
20	100.0	0.0	4.520	40.27	29164.7	1.498	0.287	0.0	0.1148;
21	100.0	0.0	4.610	40.13	28590.6	1.528	0.304	0.0	0.1171;
22	100.0	0.0	4.703	40.00	28027.9	1.559	0.321	0.0	0.1194;
23	100.0	0.0	4.797	39.87	27476.3	1.590	0.339	0.0	0.1218;
24	100.0	0.0	4.893	39.74	26935.5	1.622	0.357	0.0	0.1243;
25	100.0	0.0	4.991	39.62	26405.5	1.655	0.376	0.0	0.1268;
26	100.0	0.0	5.091	39.50	25885.9	1.688	0.395	0.0	0.1293;
27	100.0	0.0	5.193	39.38	25376.6	1.722	0.414	0.0	0.1319;
28	100.0	0.0	5.297	39.26	24877.3	1.756	0.434	0.0	0.1345;
29	100.0	0.0	5.403	39.14	24387.9	1.791	0.454	0.0	0.1372;
30	100.0	0.0	5.511	39.03	23908.2	1.827	0.475	0.0	0.1400;
31	100.0	0.0	5.622	38.92	23437.9	1.864	0.496	0.0	0.1428;
32	100.0	0.0	5.734	38.81	22976.8	1.901	0.517	0.0	0.1457;
33	100.0	0.0	5.849	38.70	22524.9	1.940	0.539	0.0	0.1486;
34	100.0	0.0	5.966	38.60	22081.9	1.979	0.561	0.0	0.1515;
35	100.0	0.0	6.086	38.50	21647.7	2.018	0.583	0.0	0.1546;
36	100.0	0.0	6.208	38.39	21221.9	2.059	0.607	0.0	0.1577;
37	100.0	0.0	6.332	38.30	20804.6	2.100	0.630	0.0	0.1608;
38	100.0	0.0	6.459	38.20	20395.6	2.142	0.654	0.0	0.1641;
39	100.0	0.0	6.588	38.10	19994.5	2.185	0.678	0.0	0.1673;
40	100.0	0.0	6.720	38.01	19601.4	2.229	0.703	0.0	0.1707;
41	100.0	0.0	6.855	37.92	19216.1	2.274	0.729	0.0	0.1741;
42	100.0	0.0	6.992	37.83	18838.3	2.319	0.755	0.0	0.1776;
43	100.0	0.0	7.132	37.74	18468.0	2.366	0.781	0.0	0.1812;
44	100.0	0.0	7.275	37.66	18104.9	2.413	0.808	0.0	0.1848;
45	100.0	0.0	7.421	37.57	17749.1	2.462	0.836	0.0	0.1885;
46	100.0	0.0	7.569	37.49	17400.2	2.511	0.864	0.0	0.1923;
47	100.0	0.0	7.721	37.41	17058.2	2.561	0.892	0.0	0.1961;
48	100.0	0.0	7.875	37.33	16723.0	2.613	0.922	0.0	0.2000;
49	100.0	0.0	8.033	37.25	16394.3	2.665	0.951	0.0	0.2040;
50	100.0	0.0	8.194	37.18	16072.1	2.718	0.982	0.0	0.2081;

51	100.0	0.0	8.358	37.10	15756.3	2.773	1.013	0.0	0.2123;
52	100.0	0.0	8.525	37.03	15446.7	2.828	1.044	0.0	0.2165;
53	100.0	0.0	8.696	36.96	15143.2	2.885	1.076	0.0	0.2209;
54	100.0	0.0	8.870	36.89	14845.6	2.943	1.109	0.0	0.2253;
55	100.0	0.0	9.047	36.82	14553.9	3.002	1.143	0.0	0.2298;
56	100.0	0.0	9.229	36.75	14268.0	3.062	1.177	0.0	0.2344;
57	100.0	0.0	9.413	36.68	13987.7	3.123	1.212	0.0	0.2391;
58	100.0	0.0	9.602	36.62	13712.9	3.186	1.247	0.0	0.2439;
59	100.0	0.0	9.794	36.55	13443.5	3.250	1.283	0.0	0.2488;
60	100.0	0.0	9.990	36.49	13179.4	3.315	1.320	0.0	0.2537;
61	100.0	0.0	10.19	36.43	12920.5	3.381	1.358	0.0	0.2588;
62	100.0	0.0	10.39	36.37	12666.7	3.449	1.396	0.0	0.2640;
63	100.0	0.0	10.60	36.31	12417.9	3.518	1.435	0.0	0.2693;
64	100.0	0.0	10.81	36.25	12174.0	3.589	1.475	0.0	0.2747;
65	100.0	0.0	11.03	36.20	11934.9	3.661	1.516	0.0	0.2802;
66	100.0	0.0	11.25	36.14	11700.5	3.734	1.557	0.0	0.2858;
67	100.0	0.0	11.48	36.09	11470.7	3.809	1.599	0.0	0.2915;
68	100.0	0.0	11.71	36.03	11245.4	3.885	1.643	0.0	0.2973;
69	100.0	0.0	11.94	35.98	11024.6	3.963	1.686	0.0	0.3033;
70	100.0	0.0	12.18	35.93	10808.1	4.042	1.731	0.0	0.3093;
71	100.0	0.0	12.42	35.88	10595.8	4.123	1.777	0.0	0.3155;
72	100.0	0.0	12.67	35.83	10387.8	4.206	1.823	0.0	0.3218;
73	100.0	0.0	12.92	35.78	10183.8	4.290	1.871	0.0	0.3283;
74	100.0	0.0	13.18	35.73	9983.8	4.376	1.919	0.0	0.3348;
75	100.0	0.0	13.45	35.69	9787.8	4.464	1.969	0.0	0.3415;
76	100.0	0.0	13.71	35.64	9595.6	4.553	2.019	0.0	0.3483;
77	100.0	0.0	13.99	35.60	9407.2	4.644	2.070	0.0	0.3553;
78	100.0	0.0	14.27	35.55	9222.5	4.737	2.123	0.0	0.3624;
79	100.0	0.0	14.55	35.51	9041.5	4.832	2.176	0.0	0.3697;
80	100.0	0.0	14.84	35.47	8864.0	4.929	2.230	0.0	0.3770;
81	100.0	0.0	15.14	35.43	8689.9	5.028	2.285	0.0	0.3846;
82	100.0	0.0	15.44	35.39	8519.3	5.128	2.342	0.0	0.3923;
83	100.0	0.0	15.75	35.35	8352.1	5.231	2.399	0.0	0.4001;
84	100.0	0.0	16.07	35.31	8188.1	5.336	2.458	0.0	0.4081;
85	100.1	0.0	16.39	35.27	8027.4	5.443	2.518	0.0	0.4162;
86	100.1	0.0	16.71	35.23	7869.8	5.552	2.579	0.0	0.4245;
87	100.1	0.0	17.05	35.20	7715.3	5.663	2.641	0.0	0.4330;
88	100.1	0.0	17.39	35.16	7563.9	5.776	2.704	0.0	0.4416;
89	100.1	0.0	17.73	35.12	7415.4	5.892	2.768	0.0	0.4504;
90	100.1	0.0	18.09	35.09	7269.9	6.010	2.834	0.0	0.4594;
91	100.1	0.0	18.45	35.06	7127.2	6.130	2.901	0.0	0.4686;
92	100.1	0.0	18.82	35.02	6987.3	6.253	2.969	0.0	0.4779;
93	100.1	0.0	19.19	34.99	6850.2	6.378	3.038	0.0	0.4874;
94	100.1	0.0	19.57	34.96	6715.7	6.506	3.109	0.0	0.4971;
95	100.1	0.0	19.96	34.93	6583.9	6.636	3.181	0.0	0.5070;
96	100.1	0.0	20.36	34.90	6454.7	6.769	3.255	0.0	0.5171;
97	100.1	0.0	20.76	34.87	6328.0	6.904	3.330	0.0	0.5274;
98	100.1	0.0	21.18	34.84	6203.8	7.042	3.406	0.0	0.5379;
99	100.1	0.0	21.60	34.81	6082.1	7.183	3.483	0.0	0.5486;
100	100.1	0.0	22.03	34.78	5962.7	7.327	3.562	0.0	0.5594;
101	100.1	0.0	22.46	34.75	5845.7	7.474	3.643	0.0	0.5705;
102	100.1	0.0	22.91	34.72	5731.0	7.623	3.725	0.0	0.5819;
103	100.2	0.0	23.36	34.70	5618.5	7.776	3.808	0.0	0.5934;
104	100.2	0.0	23.82	34.67	5508.3	7.932	3.893	0.0	0.6051;
105	100.2	0.0	24.29	34.65	5400.2	8.090	3.980	0.0	0.6171;
106	100.2	0.0	24.77	34.62	5294.2	8.252	4.068	0.0	0.6293;

107	100.2	0.0	25.26	34.60	5190.3	8.418	4.157	0.0	0.6417;
108	100.2	0.0	25.76	34.57	5088.5	8.586	4.248	0.0	0.6543;
109	100.2	0.0	26.26	34.55	4990.9	8.754	4.339	0.0	0.6671;
110	100.2	0.0	26.76	34.53	4898.2	8.920	4.428	0.0	0.6797;
111	100.2	0.0	27.25	34.51	4809.9	9.083	4.516	0.0	0.6921;
112	100.3	0.0	27.73	34.49	4725.7	9.245	4.602	0.0	0.7044;
113	100.3	0.0	28.21	34.47	4645.2	9.405	4.687	0.0	0.7165;
114	100.3	0.0	28.68	34.45	4568.1	9.564	4.770	0.0	0.7284;
115	100.3	0.0	29.14	34.43	4494.2	9.721	4.852	0.0	0.7403;
116	100.3	0.0	29.61	34.41	4423.3	9.877	4.933	0.0	0.7520;
117	100.3	0.0	30.06	34.40	4355.2	10.03	5.013	0.0	0.7636;
118	100.3	0.0	30.51	34.38	4289.7	10.18	5.092	0.0	0.7750;
119	100.4	0.0	30.96	34.37	4226.6	10.34	5.170	0.0	0.7864;
120	100.4	0.0	31.40	34.35	4165.8	10.49	5.247	0.0	0.7976;
121	100.4	0.0	31.84	34.34	4107.1	10.64	5.323	0.0	0.8088;
122	100.4	0.0	32.28	34.33	4050.4	10.79	5.398	0.0	0.8198;
123	100.4	0.0	32.71	34.31	3995.5	10.93	5.472	0.0	0.8307;
124	100.4	0.0	33.13	34.30	3942.5	11.08	5.546	0.0	0.8416;
125	100.4	0.0	33.56	34.29	3891.1	11.23	5.618	0.0	0.8524;
126	100.5	0.0	33.98	34.28	3841.3	11.37	5.690	0.0	0.8631;
127	100.5	0.0	34.40	34.26	3793.0	11.52	5.761	0.0	0.8737;
128	100.5	0.0	34.81	34.25	3746.2	11.66	5.831	0.0	0.8842;
129	100.5	0.0	35.22	34.24	3700.7	11.81	5.901	0.0	0.8946;
130	100.5	0.0	35.63	34.23	3656.4	11.95	5.970	0.0	0.9050;
131	100.5	0.0	36.04	34.22	3613.4	12.09	6.038	0.0	0.9153;
132	100.6	0.0	36.44	34.21	3571.5	12.23	6.105	0.0	0.9256;
133	100.6	0.0	36.84	34.20	3530.8	12.37	6.172	0.0	0.9357;
134	100.6	0.0	37.24	34.19	3491.1	12.51	6.239	0.0	0.9459;
135	100.6	0.0	37.63	34.18	3452.4	12.66	6.305	0.0	0.9559;
136	100.6	0.0	38.03	34.17	3414.6	12.79	6.370	0.0	0.9659;
137	100.7	0.0	38.42	34.17	3377.8	12.93	6.435	0.0	0.9758;
138	100.7	0.0	38.81	34.16	3341.8	13.07	6.499	0.0	0.9857;
139	100.7	0.0	39.19	34.15	3306.7	13.21	6.563	0.0	0.9955;
140	100.7	0.0	39.58	34.14	3272.4	13.35	6.626	0.0	1.0053;
141	100.7	0.0	39.96	34.13	3238.9	13.49	6.689	0.0	1.0150;
142	100.7	0.0	40.34	34.13	3206.1	13.63	6.751	0.0	1.0247;
143	100.8	0.0	40.72	34.12	3174.0	13.76	6.813	0.0	1.0344;
144	100.8	0.0	41.10	34.11	3142.6	13.90	6.874	0.0	1.0439;
145	100.8	0.0	41.48	34.10	3111.9	14.04	6.935	0.0	1.0535;
146	100.8	0.0	41.85	34.10	3081.8	14.18	6.996	0.0	1.0630;
147	100.8	0.0	42.22	34.09	3052.3	14.31	7.056	0.0	1.0724;
148	100.9	0.0	42.59	34.08	3023.4	14.45	7.116	0.0	1.0818;
149	100.9	0.0	42.96	34.08	2995.0	14.59	7.176	0.0	1.0912;
150	100.9	0.0	43.33	34.07	2967.2	14.72	7.235	0.0	1.1005;
151	100.9	0.0	43.69	34.06	2939.9	14.86	7.294	0.0	1.1098;
152	100.9	0.0	44.06	34.06	2913.1	15.00	7.352	0.0	1.1191; merging;
153	101.0	0.0	44.42	34.05	2887.6	15.13	7.411	0.0	1.1282;
154	101.0	0.0	44.77	34.04	2863.2	15.26	7.468	0.0	1.1373;
155	101.0	0.0	45.13	34.04	2839.4	15.39	7.526	0.0	1.1463;
156	101.0	0.0	45.48	34.03	2816.3	15.51	7.583	0.0	1.1552;
157	101.1	0.0	45.83	34.03	2793.8	15.64	7.641	0.0	1.1641;
158	101.1	0.0	46.18	34.02	2771.8	15.76	7.698	0.0	1.1729;
159	101.1	0.0	46.52	34.02	2750.3	15.89	7.754	0.0	1.1817;
160	101.1	0.0	46.87	34.01	2729.3	16.01	7.811	0.0	1.1905;
161	101.1	0.0	47.22	34.01	2708.6	16.13	7.867	0.0	1.1993;
162	101.2	0.0	47.56	34.00	2688.4	16.25	7.923	0.0	1.2080;

163	101.2	0.0	47.90	34.00	2668.5	16.37	7.979	0.0	1.2167;
164	101.2	0.0	48.25	33.99	2649.0	16.49	8.035	0.0	1.2254;
165	101.2	0.0	48.59	33.99	2629.8	16.61	8.090	0.0	1.2341;
166	101.3	0.0	48.93	33.98	2610.9	16.73	8.146	0.0	1.2428;
167	101.3	0.0	49.27	33.98	2592.3	16.85	8.201	0.0	1.2515;
168	101.3	0.0	49.61	33.98	2574.1	16.97	8.256	0.0	1.2602;
169	101.3	0.0	49.95	33.97	2556.0	17.09	8.311	0.0	1.2688;
170	101.4	0.0	50.29	33.97	2538.3	17.21	8.366	0.0	1.2775;
171	101.4	0.0	50.63	33.96	2520.8	17.33	8.421	0.0	1.2861;
172	101.4	0.0	50.98	33.96	2503.5	17.45	8.475	0.0	1.2948;
173	101.5	0.0	51.32	33.95	2486.5	17.57	8.530	0.0	1.3034;
174	101.5	0.0	51.66	33.95	2469.7	17.69	8.584	0.0	1.3121;
175	101.5	0.0	52.00	33.95	2453.2	17.81	8.638	0.0	1.3208;
176	101.5	0.0	52.34	33.94	2436.8	17.93	8.692	0.0	1.3294;
177	101.6	0.0	52.68	33.94	2420.6	18.05	8.746	0.0	1.3381;
178	101.6	0.0	53.02	33.93	2404.7	18.17	8.800	0.0	1.3468;
179	101.6	0.0	53.36	33.93	2388.9	18.29	8.854	0.0	1.3555;
180	101.6	0.0	53.71	33.93	2373.3	18.41	8.908	0.0	1.3642;
181	101.7	0.0	54.05	33.92	2357.9	18.53	8.962	0.0	1.3729;
182	101.7	0.0	54.39	33.92	2342.6	18.65	9.016	0.0	1.3816;
183	101.7	0.0	54.74	33.92	2327.6	18.77	9.069	0.0	1.3903;
184	101.8	0.0	55.08	33.91	2312.6	18.89	9.123	0.0	1.3990;
185	101.8	0.0	55.42	33.91	2297.9	19.01	9.176	0.0	1.4078;
186	101.8	0.0	55.77	33.91	2283.3	19.13	9.230	0.0	1.4165;
187	101.9	0.0	56.11	33.90	2268.8	19.26	9.283	0.0	1.4253;
188	101.9	0.0	56.46	33.90	2254.5	19.38	9.337	0.0	1.4341;
189	101.9	0.0	56.81	33.90	2240.3	19.50	9.390	0.0	1.4429;
190	101.9	0.0	57.15	33.89	2226.3	19.62	9.444	0.0	1.4517;
191	102.0	0.0	57.50	33.89	2212.4	19.75	9.497	0.0	1.4605;
192	102.0	0.0	57.85	33.89	2198.6	19.87	9.550	0.0	1.4694;
193	102.0	0.0	58.20	33.88	2185.0	20.00	9.604	0.0	1.4782;
194	102.1	0.0	58.55	33.88	2171.4	20.12	9.657	0.0	1.4871;
195	102.1	0.0	58.90	33.88	2158.0	20.25	9.710	0.0	1.4960;
196	102.1	0.0	59.25	33.87	2144.7	20.37	9.763	0.0	1.5049;
197	102.2	0.0	59.60	33.87	2131.6	20.50	9.817	0.0	1.5139;
198	102.2	0.0	59.95	33.87	2118.5	20.62	9.870	0.0	1.5228;
199	102.3	0.0	60.31	33.86	2105.5	20.75	9.923	0.0	1.5318;
200	102.3	0.0	60.66	33.86	2092.7	20.88	9.977	0.0	1.5408;
201	102.3	0.0	61.02	33.86	2079.9	21.01	10.03	0.0	1.5498;
202	102.4	0.0	61.37	33.85	2067.3	21.13	10.08	0.0	1.5588;
203	102.4	0.0	61.73	33.85	2054.7	21.26	10.14	0.0	1.5679; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 3.0898
Lmz(m): 3.0898
forced entrain 1 0.0 -0.730 1.568 0.827
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632
;
1:05:33 PM. amb fills: 4

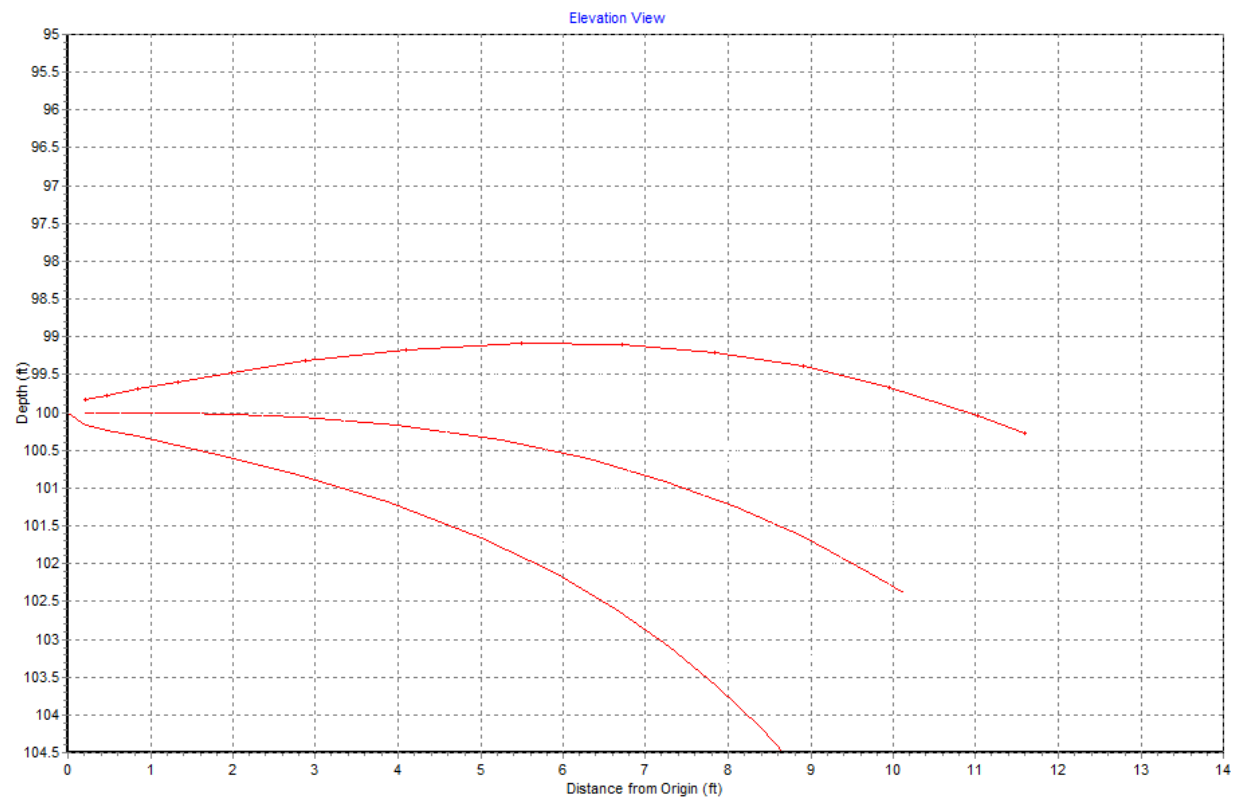

Figure C.2.1: Plumes 18b solution of discharge plume trajectories for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 99.1 ft. at X_a = 6.038 ft from the point of discharge. The centerline of the plume is at an average distance of X_b = 10.14 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

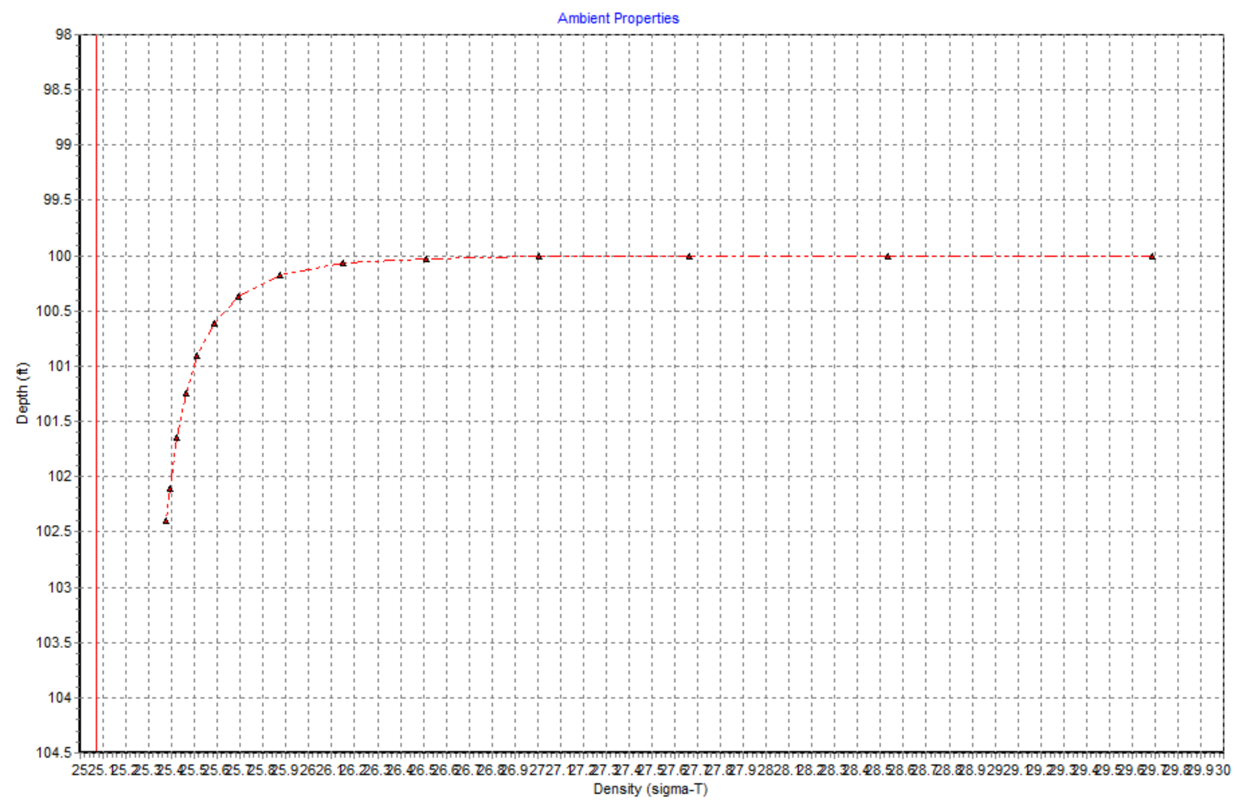

Figure C.2.2: Plumes 18b solution of vertical density profile for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

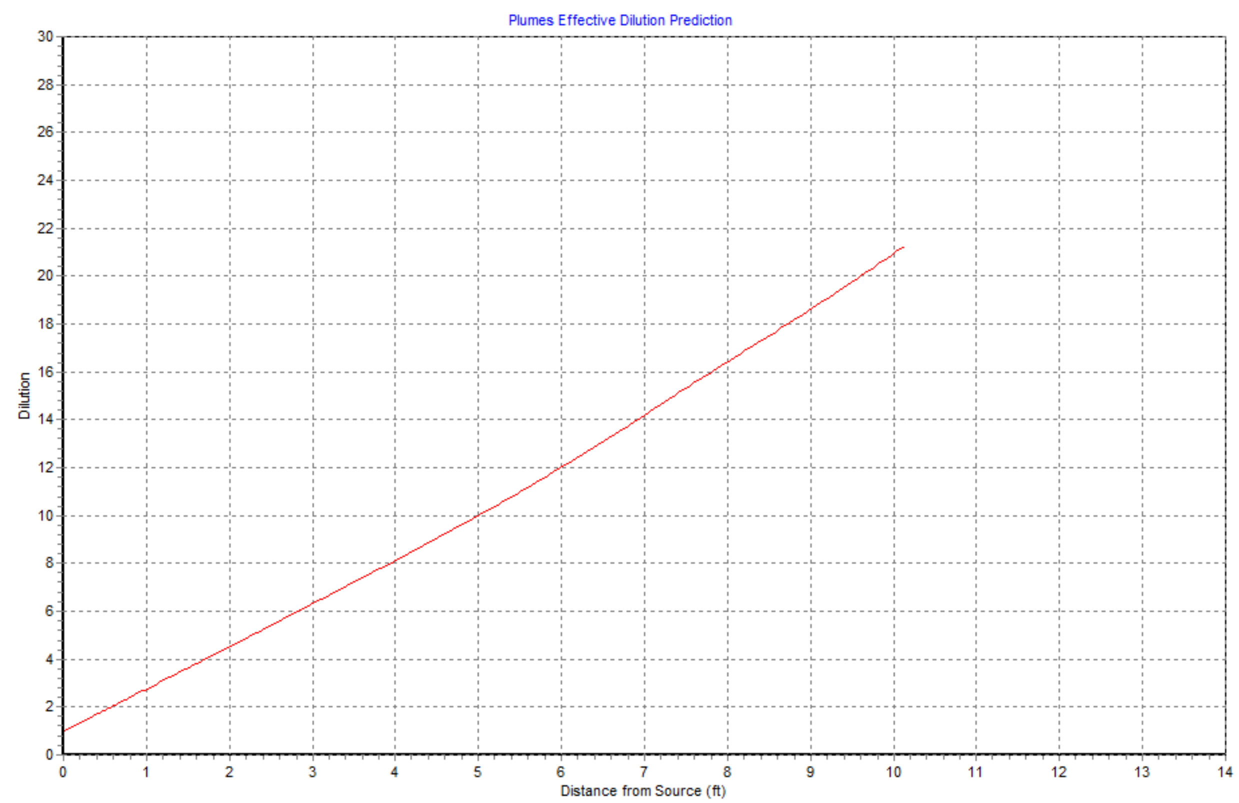

Figure C.2.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 8 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Effective dilution is S_a = 12.09 at the maximum rise of the plume at X_a = 6.038 ft. from the point of discharge. As the plume begins to impact the bottom, the plume centerline is at a distance of X_b = 10.14 ft from the point of discharge, where the effective dilution reaches S_a = 21.26.

C.3: Plumes 18b Results for SJCOO discharges of 0 mgd Wastewater and 15 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW0mgd_b15mgd_D-1"
memo
SJCOO discharging 0 mgd wastewater and 15 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 1:30:39 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW0mgd_b15mgd_D-1.001.db; Diffuser table record 1: --------
----

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	15.000	67.000	20.660	67000.0

Simulation:
Froude No: -8.389; Strat No:-1.57E-4; Spcg No: 14.39; k: 1.11E+5; eff den (sigmaT) 49.48870; eff vel 1.115(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (ft)	y-posn (ft)	Iso dia (m)
0	100.0	1.000E-5	3.050	67.00	67000.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.076	66.44	65862.4	1.017	0.0108	0.0	0.07814;
2	100.0	0.0	3.134	65.79	64541.7	1.038	0.0189	0.0	0.07959;
3	100.0	0.0	3.197	65.16	63248.1	1.059	0.0261	0.0	0.0812;
4	100.0	0.0	3.262	64.53	61981.0	1.081	0.0331	0.0	0.08285;
5	100.0	0.0	3.328	63.92	60739.7	1.103	0.0399	0.0	0.08452;
6	100.0	0.0	3.395	63.32	59523.8	1.126	0.0468	0.0	0.08623;
7	100.0	0.0	3.463	62.74	58332.8	1.149	0.0538	0.0	0.08797;
8	100.0	0.0	3.533	62.16	57166.1	1.172	0.0609	0.0	0.08975;
9	100.0	0.0	3.605	61.60	56023.1	1.196	0.0681	0.0	0.09156;
10	100.0	0.0	3.678	61.04	54903.4	1.220	0.0754	0.0	0.09341;
11	100.0	0.0	3.752	60.50	53806.5	1.245	0.0828	0.0	0.0953;
12	100.0	0.0	3.828	59.97	52731.9	1.271	0.0904	0.0	0.09722;
13	100.0	0.0	3.905	59.45	51679.2	1.296	0.0982	0.0	0.09918;
14	100.0	0.0	3.984	58.93	50647.8	1.323	0.106	0.0	0.1012;
15	100.0	0.0	4.064	58.43	49637.4	1.350	0.114	0.0	0.1032;
16	100.0	0.0	4.146	57.94	48647.4	1.377	0.122	0.0	0.1053;
17	100.0	0.0	4.230	57.46	47677.6	1.405	0.131	0.0	0.1074;
18	100.0	0.0	4.315	56.99	46727.3	1.434	0.139	0.0	0.1096;
19	100.0	0.0	4.402	56.52	45796.3	1.463	0.148	0.0	0.1118;
20	100.0	0.0	4.491	56.07	44884.2	1.493	0.157	0.0	0.1141;
21	100.0	0.0	4.581	55.62	43990.5	1.523	0.165	0.0	0.1164;
22	100.0	0.0	4.674	55.19	43114.8	1.554	0.175	0.0	0.1187;
23	100.0	0.0	4.768	54.76	42256.8	1.586	0.184	0.0	0.1211;
24	100.0	0.0	4.864	54.34	41416.1	1.618	0.193	0.0	0.1235;
25	100.0	0.0	4.962	53.93	40592.4	1.651	0.203	0.0	0.1260;
26	100.0	0.0	5.062	53.53	39785.3	1.684	0.213	0.0	0.1286;
27	100.0	0.0	5.163	53.13	38994.5	1.718	0.223	0.0	0.1312;
28	100.0	0.0	5.267	52.74	38219.5	1.753	0.233	0.0	0.1338;
29	100.0	0.0	5.373	52.36	37460.2	1.789	0.244	0.0	0.1365;
30	100.0	0.0	5.482	51.99	36716.2	1.825	0.254	0.0	0.1392;
31	100.0	0.0	5.592	51.62	35987.1	1.862	0.265	0.0	0.1420;
32	100.0	0.0	5.704	51.27	35272.7	1.899	0.276	0.0	0.1449;
33	100.0	0.0	5.819	50.92	34572.6	1.938	0.287	0.0	0.1478;
34	100.0	0.0	5.936	50.57	33886.5	1.977	0.299	0.0	0.1508;
35	100.0	0.0	6.055	50.23	33214.3	2.017	0.311	0.0	0.1538;
36	100.0	0.0	6.177	49.90	32555.5	2.058	0.322	0.0	0.1569;
37	100.0	0.0	6.301	49.58	31910.0	2.100	0.335	0.0	0.1601;
38	100.0	0.0	6.428	49.26	31277.3	2.142	0.347	0.0	0.1633;
39	100.0	0.0	6.557	48.95	30657.4	2.185	0.360	0.0	0.1665;
40	100.0	0.0	6.689	48.64	30049.8	2.230	0.372	0.0	0.1699;
41	100.0	0.0	6.823	48.34	29454.5	2.275	0.385	0.0	0.1733;
42	100.0	0.0	6.960	48.05	28871.0	2.321	0.399	0.0	0.1768;
43	100.0	0.0	7.100	47.76	28299.2	2.368	0.412	0.0	0.1803;
44	100.0	0.0	7.242	47.48	27738.9	2.415	0.426	0.0	0.1840;
45	100.0	0.0	7.387	47.20	27189.7	2.464	0.440	0.0	0.1876;
46	100.0	0.0	7.536	46.93	26651.5	2.514	0.455	0.0	0.1914;
47	100.0	0.0	7.687	46.67	26124.1	2.565	0.469	0.0	0.1952;
48	100.0	0.0	7.841	46.41	25607.2	2.616	0.484	0.0	0.1992;
49	100.0	0.0	7.998	46.15	25100.6	2.669	0.499	0.0	0.2031;

50	100.0	0.0	8.158	45.90	24604.1	2.723	0.515	0.0	0.2072;
51	100.0	0.0	8.321	45.65	24117.5	2.778	0.530	0.0	0.2114;
52	100.0	0.0	8.488	45.41	23640.7	2.834	0.546	0.0	0.2156;
53	100.0	0.0	8.658	45.18	23173.3	2.891	0.563	0.0	0.2199;
54	100.0	0.0	8.831	44.94	22715.2	2.950	0.579	0.0	0.2243;
55	100.0	0.0	9.008	44.72	22266.3	3.009	0.596	0.0	0.2288;
56	100.0	0.0	9.188	44.49	21826.3	3.070	0.614	0.0	0.2334;
57	100.0	0.0	9.371	44.28	21395.1	3.132	0.631	0.0	0.2380;
58	100.0	0.0	9.558	44.06	20972.4	3.195	0.649	0.0	0.2428;
59	100.0	0.0	9.749	43.85	20558.2	3.259	0.667	0.0	0.2476;
60	100.0	0.0	9.943	43.65	20152.2	3.325	0.686	0.0	0.2526;
61	100.0	0.0	10.14	43.44	19754.2	3.392	0.705	0.0	0.2576;
62	100.0	0.0	10.34	43.25	19364.2	3.460	0.724	0.0	0.2627;
63	100.0	0.0	10.55	43.05	18981.9	3.530	0.744	0.0	0.2680;
64	100.0	0.0	10.76	42.86	18607.3	3.601	0.764	0.0	0.2733;
65	100.0	0.0	10.97	42.68	18240.0	3.673	0.784	0.0	0.2787;
66	100.0	0.0	11.19	42.49	17880.1	3.747	0.805	0.0	0.2843;
67	100.0	0.0	11.41	42.32	17527.3	3.823	0.826	0.0	0.2899;
68	100.0	0.0	11.64	42.14	17181.5	3.900	0.848	0.0	0.2956;
69	100.0	0.0	11.87	41.97	16842.6	3.978	0.870	0.0	0.3015;
70	100.0	0.0	12.10	41.80	16510.4	4.058	0.892	0.0	0.3074;
71	100.0	0.0	12.34	41.64	16196.3	4.137	0.914	0.0	0.3134;
72	100.1	0.0	12.57	41.49	15893.1	4.216	0.936	0.0	0.3193;
73	100.1	0.0	12.80	41.34	15600.4	4.295	0.957	0.0	0.3252;
74	100.1	0.0	13.04	41.19	15317.3	4.374	0.978	0.0	0.3312;
75	100.1	0.0	13.27	41.05	15043.5	4.454	0.998	0.0	0.3371;
76	100.1	0.0	13.51	40.92	14778.4	4.534	1.018	0.0	0.3430;
77	100.1	0.0	13.74	40.79	14521.5	4.614	1.038	0.0	0.3490;
78	100.1	0.0	13.98	40.66	14272.5	4.694	1.058	0.0	0.3550;
79	100.1	0.0	14.21	40.54	14030.9	4.775	1.077	0.0	0.3610;
80	100.1	0.0	14.45	40.42	13796.4	4.856	1.096	0.0	0.3670;
81	100.1	0.0	14.68	40.30	13568.7	4.938	1.114	0.0	0.3730;
82	100.1	0.0	14.92	40.19	13347.4	5.020	1.133	0.0	0.3790;
83	100.1	0.0	15.16	40.08	13132.2	5.102	1.151	0.0	0.3851;
84	100.1	0.0	15.40	39.97	12922.9	5.185	1.169	0.0	0.3912;
85	100.1	0.0	15.64	39.87	12719.2	5.268	1.186	0.0	0.3972;
86	100.1	0.0	15.88	39.77	12520.9	5.351	1.204	0.0	0.4034;
87	100.1	0.0	16.12	39.67	12327.7	5.435	1.221	0.0	0.4095;
88	100.1	0.0	16.36	39.58	12139.4	5.519	1.238	0.0	0.4156;
89	100.1	0.0	16.61	39.48	11955.9	5.604	1.255	0.0	0.4218;
90	100.1	0.0	16.85	39.39	11776.9	5.689	1.271	0.0	0.4280;
91	100.1	0.0	17.10	39.30	11602.3	5.775	1.287	0.0	0.4342;
92	100.1	0.0	17.34	39.21	11431.9	5.861	1.303	0.0	0.4405;
93	100.1	0.0	17.59	39.13	11265.6	5.947	1.319	0.0	0.4467;
94	100.1	0.0	17.83	39.05	11103.2	6.034	1.335	0.0	0.4530;
95	100.1	0.0	18.08	38.97	10944.5	6.122	1.350	0.0	0.4593;
96	100.1	0.0	18.33	38.89	10789.5	6.210	1.366	0.0	0.4656;
97	100.1	0.0	18.58	38.81	10637.9	6.298	1.381	0.0	0.4720;
98	100.1	0.0	18.83	38.73	10489.8	6.387	1.396	0.0	0.4783;
99	100.1	0.0	19.08	38.66	10344.9	6.477	1.411	0.0	0.4847;
100	100.2	0.0	19.34	38.59	10203.2	6.567	1.425	0.0	0.4911;
101	100.2	0.0	19.59	38.52	10064.5	6.657	1.440	0.0	0.4976;
102	100.2	0.0	19.84	38.45	9928.9	6.748	1.454	0.0	0.5040;
103	100.2	0.0	20.10	38.38	9796.0	6.840	1.468	0.0	0.5105;
104	100.2	0.0	20.35	38.31	9666.0	6.932	1.482	0.0	0.5170;
105	100.2	0.0	20.61	38.25	9538.7	7.024	1.496	0.0	0.5235;

106	100.2	0.0	20.87	38.19	9413.9	7.117	1.510	0.0	0.5301;	
107	100.2	0.0	21.13	38.12	9291.7	7.211	1.523	0.0	0.5366;	
108	100.2	0.0	21.39	38.06	9172.0	7.305	1.537	0.0	0.5432;	
109	100.2	0.0	21.65	38.00	9054.7	7.399	1.550	0.0	0.5498;	
110	100.2	0.0	21.91	37.94	8939.7	7.495	1.563	0.0	0.5565;	
111	100.2	0.0	22.17	37.89	8827.0	7.590	1.577	0.0	0.5631;	
112	100.2	0.0	22.43	37.83	8716.4	7.687	1.590	0.0	0.5698;	
113	100.2	0.0	22.70	37.77	8608.0	7.783	1.602	0.0	0.5765;	
114	100.2	0.0	22.96	37.72	8501.7	7.881	1.615	0.0	0.5832;	
115	100.2	0.0	23.23	37.67	8397.4	7.979	1.628	0.0	0.5899;	
116	100.2	0.0	23.49	37.61	8295.1	8.077	1.640	0.0	0.5967;	
117	100.2	0.0	23.76	37.56	8194.7	8.176	1.653	0.0	0.6035;	
118	100.2	0.0	24.03	37.51	8096.1	8.276	1.665	0.0	0.6103;	
119	100.2	0.0	24.29	37.46	7999.4	8.376	1.677	0.0	0.6171;	
120	100.2	0.0	24.56	37.41	7904.5	8.476	1.689	0.0	0.6239;	
121	100.2	0.0	24.83	37.37	7811.3	8.577	1.701	0.0	0.6307;	
122	100.3	0.0	25.10	37.32	7719.8	8.679	1.713	0.0	0.6376;	
123	100.3	0.0	25.37	37.27	7630.0	8.781	1.725	0.0	0.6445;	
124	100.3	0.0	25.64	37.23	7541.8	8.884	1.737	0.0	0.6514;	
125	100.3	0.0	25.92	37.18	7455.1	8.987	1.748	0.0	0.6583;	
126	100.3	0.0	26.19	37.14	7370.0	9.091	1.760	0.0	0.6652;	
127	100.3	0.0	26.46	37.10	7286.4	9.195	1.771	0.0	0.6721;	
128	100.3	0.0	26.74	37.06	7204.2	9.300	1.783	0.0	0.6791;	
129	100.3	0.0	27.01	37.02	7123.5	9.406	1.794	0.0	0.6860;	
130	100.3	0.0	27.28	36.97	7044.2	9.511	1.805	0.0	0.6930;	
131	100.3	0.0	27.56	36.93	6966.2	9.618	1.816	0.0	0.7000;	
132	100.3	0.0	27.83	36.90	6889.6	9.725	1.827	0.0	0.7070;	
133	100.3	0.0	28.11	36.86	6814.3	9.832	1.838	0.0	0.7140;	
134	100.3	0.0	28.39	36.82	6740.3	9.940	1.849	0.0	0.7210;	
135	100.3	0.0	28.66	36.78	6667.5	10.05	1.860	0.0	0.7281;	
136	100.3	0.0	28.94	36.75	6596.0	10.16	1.871	0.0	0.7351;	
137	100.3	0.0	29.22	36.71	6525.6	10.27	1.882	0.0	0.7421;	
138	100.3	0.0	29.49	36.67	6457.2	10.38	1.892	0.0	0.7491;	begin overlap;
139	100.3	0.0	29.77	36.64	6390.8	10.48	1.903	0.0	0.7561;	
140	100.3	0.0	30.04	36.61	6326.2	10.59	1.914	0.0	0.7629;	
141	100.3	0.0	30.30	36.58	6263.3	10.70	1.924	0.0	0.7696;	
142	100.4	0.0	30.56	36.54	6202.2	10.80	1.935	0.0	0.7763;	
143	100.4	0.0	30.82	36.51	6142.6	10.91	1.945	0.0	0.7828;	
144	100.4	0.0	31.08	36.48	6084.5	11.01	1.955	0.0	0.7893;	
145	100.4	0.0	31.33	36.45	6027.9	11.12	1.966	0.0	0.7957;	
146	100.4	0.0	31.58	36.43	5972.6	11.22	1.976	0.0	0.8021;	
147	100.4	0.0	31.82	36.40	5918.6	11.32	1.986	0.0	0.8083;	
148	100.4	0.0	32.07	36.37	5865.9	11.42	1.997	0.0	0.8145;	
149	100.4	0.0	32.31	36.35	5814.3	11.52	2.007	0.0	0.8206;	
150	100.4	0.0	32.55	36.32	5763.9	11.62	2.017	0.0	0.8267;	
151	100.4	0.0	32.78	36.29	5714.6	11.72	2.027	0.0	0.8327;	
152	100.4	0.0	33.02	36.27	5666.4	11.82	2.037	0.0	0.8386;	
153	100.4	0.0	33.25	36.25	5619.1	11.92	2.047	0.0	0.8445;	
154	100.4	0.0	33.47	36.22	5572.8	12.02	2.057	0.0	0.8502;	
155	100.4	0.0	33.70	36.20	5527.4	12.12	2.067	0.0	0.8560;	
156	100.4	0.0	33.92	36.18	5482.9	12.22	2.077	0.0	0.8617;	
157	100.4	0.0	34.15	36.15	5439.2	12.32	2.087	0.0	0.8673;	
158	100.4	0.0	34.36	36.13	5396.4	12.42	2.097	0.0	0.8729;	
159	100.5	0.0	34.58	36.11	5354.3	12.51	2.107	0.0	0.8784;	
160	100.5	0.0	34.80	36.09	5313.0	12.61	2.117	0.0	0.8838;	
161	100.5	0.0	35.01	36.07	5272.4	12.71	2.127	0.0	0.8893;	

162	100.5	0.0	35.22	36.05	5232.5	12.80	2.137	0.0	0.8946;
163	100.5	0.0	35.43	36.03	5193.3	12.90	2.147	0.0	0.8999;
164	100.5	0.0	35.64	36.01	5154.7	13.00	2.157	0.0	0.9052;
165	100.5	0.0	35.84	35.99	5116.8	13.09	2.167	0.0	0.9104;
166	100.5	0.0	36.05	35.97	5079.4	13.19	2.176	0.0	0.9156;
167	100.5	0.0	36.25	35.95	5042.7	13.29	2.186	0.0	0.9207;
168	100.5	0.0	36.45	35.93	5006.5	13.38	2.196	0.0	0.9258;
169	100.5	0.0	36.65	35.91	4970.8	13.48	2.206	0.0	0.9308;
170	100.5	0.0	36.84	35.90	4935.7	13.57	2.216	0.0	0.9358;
171	100.5	0.0	37.04	35.88	4901.1	13.67	2.226	0.0	0.9408;
172	100.5	0.0	37.23	35.86	4867.0	13.77	2.236	0.0	0.9457;
173	100.6	0.0	37.43	35.84	4833.3	13.86	2.246	0.0	0.9506;
174	100.6	0.0	37.62	35.83	4800.1	13.96	2.255	0.0	0.9554;
175	100.6	0.0	37.80	35.81	4767.3	14.05	2.265	0.0	0.9602;
176	100.6	0.0	37.99	35.79	4735.0	14.15	2.275	0.0	0.9650;
177	100.6	0.0	38.18	35.78	4703.1	14.25	2.285	0.0	0.9697;
178	100.6	0.0	38.36	35.76	4671.6	14.34	2.295	0.0	0.9744;
179	100.6	0.0	38.55	35.74	4640.5	14.44	2.305	0.0	0.9791;
180	100.6	0.0	38.73	35.73	4609.7	14.53	2.315	0.0	0.9837;
181	100.6	0.0	38.91	35.71	4579.3	14.63	2.325	0.0	0.9883;
182	100.6	0.0	39.09	35.70	4549.3	14.73	2.335	0.0	0.9929;
183	100.6	0.0	39.27	35.68	4519.6	14.82	2.345	0.0	0.9974;
184	100.6	0.0	39.45	35.67	4490.2	14.92	2.355	0.0	1.0019;
185	100.6	0.0	39.62	35.65	4461.2	15.02	2.365	0.0	1.0064;
186	100.7	0.0	39.80	35.64	4432.4	15.12	2.375	0.0	1.0108;
187	100.7	0.0	39.97	35.62	4404.0	15.21	2.385	0.0	1.0153;
188	100.7	0.0	40.14	35.61	4375.8	15.31	2.395	0.0	1.0196;
189	100.7	0.0	40.31	35.59	4348.0	15.41	2.405	0.0	1.0240;
190	100.7	0.0	40.49	35.58	4320.4	15.51	2.415	0.0	1.0283;
191	100.7	0.0	40.66	35.57	4293.0	15.61	2.425	0.0	1.0326;
192	100.7	0.0	40.82	35.55	4266.0	15.71	2.435	0.0	1.0369;
193	100.7	0.0	40.99	35.54	4239.1	15.81	2.445	0.0	1.0412;
194	100.7	0.0	41.16	35.53	4212.5	15.90	2.455	0.0	1.0454;
195	100.7	0.0	41.32	35.51	4186.2	16.01	2.466	0.0	1.0496;
196	100.7	0.0	41.49	35.50	4160.0	16.11	2.476	0.0	1.0538;
197	100.8	0.0	41.65	35.48	4134.1	16.21	2.486	0.0	1.0580;
198	100.8	0.0	41.82	35.47	4108.4	16.31	2.497	0.0	1.0621;
199	100.8	0.0	41.98	35.46	4082.9	16.41	2.507	0.0	1.0663;
200	100.8	0.0	42.14	35.45	4057.5	16.51	2.517	0.0	1.0704;
201	100.8	0.0	42.30	35.43	4032.4	16.62	2.528	0.0	1.0745;
202	100.8	0.0	42.46	35.42	4007.4	16.72	2.538	0.0	1.0785;
203	100.8	0.0	42.62	35.41	3982.7	16.82	2.549	0.0	1.0826;
204	100.8	0.0	42.78	35.39	3958.0	16.93	2.559	0.0	1.0866;
205	100.8	0.0	42.94	35.38	3933.6	17.03	2.570	0.0	1.0907;
206	100.8	0.0	43.10	35.37	3909.3	17.14	2.580	0.0	1.0947;
207	100.9	0.0	43.26	35.36	3885.2	17.25	2.591	0.0	1.0987;
208	100.9	0.0	43.41	35.35	3861.2	17.35	2.602	0.0	1.1027;
209	100.9	0.0	43.57	35.33	3837.3	17.46	2.612	0.0	1.1067;
210	100.9	0.0	43.73	35.32	3813.6	17.57	2.623	0.0	1.1106;
211	100.9	0.0	43.88	35.31	3790.0	17.68	2.634	0.0	1.1146;
212	100.9	0.0	44.04	35.30	3766.5	17.79	2.645	0.0	1.1185; merging;
213	100.9	0.0	44.19	35.28	3743.3	17.90	2.656	0.0	1.1225;
214	100.9	0.0	44.35	35.27	3720.2	18.01	2.667	0.0	1.1265;
215	101.0	0.0	44.51	35.26	3697.3	18.12	2.678	0.0	1.1305;
216	101.0	0.0	44.67	35.25	3674.5	18.23	2.689	0.0	1.1345;
217	101.0	0.0	44.82	35.24	3651.8	18.35	2.700	0.0	1.1385;

218	101.0	0.0	44.98	35.23	3629.2	18.46	2.711	0.0	1.1426;
219	101.0	0.0	45.14	35.21	3606.7	18.58	2.722	0.0	1.1467;
220	101.0	0.0	45.31	35.20	3584.2	18.69	2.734	0.0	1.1508;
221	101.0	0.0	45.47	35.19	3561.9	18.81	2.745	0.0	1.1549;
222	101.0	0.0	45.63	35.18	3539.5	18.93	2.756	0.0	1.1590;
223	101.1	0.0	45.79	35.17	3517.3	19.05	2.768	0.0	1.1631;
224	101.1	0.0	45.96	35.16	3495.1	19.17	2.779	0.0	1.1673;
225	101.1	0.0	46.12	35.15	3473.0	19.29	2.791	0.0	1.1715;
226	101.1	0.0	46.29	35.13	3450.9	19.42	2.803	0.0	1.1757;
227	101.1	0.0	46.46	35.12	3428.8	19.54	2.814	0.0	1.1800;
228	101.1	0.0	46.62	35.11	3406.8	19.67	2.826	0.0	1.1843;
229	101.1	0.0	46.79	35.10	3384.9	19.79	2.838	0.0	1.1885;
230	101.2	0.0	46.96	35.09	3363.2	19.92	2.850	0.0	1.1928; end overlap;
231	101.2	0.0	47.13	35.08	3341.8	20.05	2.862	0.0	1.1970;
232	101.2	0.0	47.29	35.07	3320.6	20.18	2.874	0.0	1.2012;
233	101.2	0.0	47.45	35.06	3299.6	20.31	2.887	0.0	1.2053;
234	101.2	0.0	47.61	35.05	3278.8	20.43	2.899	0.0	1.2094;
235	101.2	0.0	47.77	35.04	3258.2	20.56	2.911	0.0	1.2134;
236	101.3	0.0	47.93	35.03	3237.7	20.69	2.924	0.0	1.2174;
237	101.3	0.0	48.08	35.02	3217.5	20.82	2.936	0.0	1.2213;
238	101.3	0.0	48.23	35.00	3197.5	20.95	2.949	0.0	1.2252;
239	101.3	0.0	48.39	34.99	3177.6	21.08	2.962	0.0	1.2290;
240	101.3	0.0	48.53	34.98	3158.0	21.22	2.975	0.0	1.2327;
241	101.4	0.0	48.68	34.97	3138.4	21.35	2.988	0.0	1.2364;
242	101.4	0.0	48.82	34.96	3119.1	21.48	3.001	0.0	1.2401;
243	101.4	0.0	48.96	34.95	3099.9	21.61	3.014	0.0	1.2437;
244	101.4	0.0	49.10	34.95	3080.9	21.75	3.027	0.0	1.2472;
245	101.4	0.0	49.24	34.94	3062.1	21.88	3.040	0.0	1.2507;
246	101.5	0.0	49.37	34.93	3043.4	22.02	3.054	0.0	1.2541;
247	101.5	0.0	49.51	34.92	3024.8	22.15	3.068	0.0	1.2575;
248	101.5	0.0	49.64	34.91	3006.4	22.29	3.081	0.0	1.2608;
249	101.5	0.0	49.76	34.90	2988.1	22.42	3.095	0.0	1.2640;
250	101.5	0.0	49.89	34.89	2970.0	22.56	3.109	0.0	1.2672;
251	101.6	0.0	50.01	34.88	2951.9	22.70	3.124	0.0	1.2703;
252	101.6	0.0	50.13	34.87	2934.0	22.84	3.138	0.0	1.2734;
253	101.6	0.0	50.25	34.86	2916.2	22.97	3.152	0.0	1.2764;
254	101.6	0.0	50.37	34.85	2898.5	23.12	3.167	0.0	1.2794;
255	101.7	0.0	50.48	34.84	2881.0	23.26	3.182	0.0	1.2823;
256	101.7	0.0	50.60	34.83	2863.5	23.40	3.197	0.0	1.2851;
257	101.7	0.0	50.71	34.82	2846.1	23.54	3.212	0.0	1.2879;
258	101.7	0.0	50.81	34.82	2828.8	23.68	3.227	0.0	1.2907;
259	101.8	0.0	50.92	34.81	2811.6	23.83	3.242	0.0	1.2934;
260	101.8	0.0	51.02	34.80	2794.4	23.98	3.258	0.0	1.2960;
261	101.8	0.0	51.12	34.79	2777.4	24.12	3.274	0.0	1.2986;
262	101.9	0.0	51.22	34.78	2760.4	24.27	3.290	0.0	1.3011;
263	101.9	0.0	51.32	34.77	2743.4	24.42	3.306	0.0	1.3036;
264	101.9	0.0	51.42	34.76	2726.5	24.57	3.322	0.0	1.3060;
265	102.0	0.0	51.51	34.75	2709.6	24.73	3.339	0.0	1.3084;
266	102.0	0.0	51.61	34.75	2692.8	24.88	3.356	0.0	1.3108;
267	102.0	0.0	51.70	34.74	2676.0	25.04	3.373	0.0	1.3131;
268	102.1	0.0	51.79	34.73	2659.3	25.19	3.390	0.0	1.3154;
269	102.1	0.0	51.87	34.72	2642.5	25.35	3.407	0.0	1.3176;
270	102.1	0.0	51.96	34.71	2625.8	25.52	3.425	0.0	1.3198;
271	102.2	0.0	52.05	34.70	2609.0	25.68	3.443	0.0	1.3220;
272	102.2	0.0	52.13	34.69	2592.3	25.85	3.461	0.0	1.3242;
273	102.2	0.0	52.22	34.69	2575.5	26.01	3.479	0.0	1.3263;

274	102.3	0.0	52.30	34.68	2558.7	26.18	3.498	0.0	1.3284;
275	102.3	0.0	52.38	34.67	2541.9	26.36	3.517	0.0	1.3305;
276	102.4	0.0	52.47	34.66	2525.1	26.53	3.536	0.0	1.3326;
277	102.4	0.0	52.55	34.65	2508.2	26.71	3.556	0.0	1.3347;
278	102.5	0.0	52.63	34.64	2491.2	26.89	3.575	0.0	1.3368;
279	102.5	0.0	52.71	34.63	2474.2	27.08	3.595	0.0	1.3389;
280	102.5	0.0	52.80	34.63	2457.1	27.27	3.616	0.0	1.3410;
281	102.6	0.0	52.88	34.62	2440.0	27.46	3.636	0.0	1.3431;
282	102.6	0.0	52.96	34.61	2422.7	27.66	3.657	0.0	1.3452;
283	102.7	0.0	53.05	34.60	2405.3	27.85	3.679	0.0	1.3474;
284	102.8	0.0	53.13	34.59	2387.8	28.06	3.701	0.0	1.3496;
285	102.8	0.0	53.22	34.58	2370.2	28.27	3.723	0.0	1.3518;
286	102.9	0.0	53.31	34.57	2352.5	28.48	3.745	0.0	1.3541;
287	102.9	0.0	53.40	34.56	2334.6	28.70	3.768	0.0	1.3564;
288	103.0	0.0	53.50	34.55	2316.6	28.92	3.791	0.0	1.3588;
289	103.0	0.0	53.59	34.54	2298.4	29.15	3.815	0.0	1.3613;
290	103.1	0.0	53.69	34.53	2280.1	29.38	3.839	0.0	1.3638;
291	103.2	0.0	53.80	34.52	2261.5	29.63	3.863	0.0	1.3664;
292	103.2	0.0	53.90	34.52	2242.8	29.87	3.888	0.0	1.3692;
293	103.3	0.0	54.02	34.51	2223.9	30.13	3.913	0.0	1.3720;
294	103.4	0.0	54.13	34.50	2204.7	30.39	3.939	0.0	1.3750;
295	103.5	0.0	54.25	34.49	2185.3	30.66	3.966	0.0	1.3780;
296	103.5	0.0	54.38	34.48	2165.7	30.94	3.992	0.0	1.3813;
297	103.6	0.0	54.51	34.47	2145.8	31.22	4.020	0.0	1.3846;
298	103.7	0.0	54.65	34.45	2125.7	31.52	4.048	0.0	1.3882;
299	103.8	0.0	54.80	34.44	2105.3	31.83	4.076	0.0	1.3919; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 1.2424

Lmz(m): 1.2424

forced entrain 1 0.0 -1.159 1.392 0.312

Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632

;

1:30:39 PM. amb fills: 4

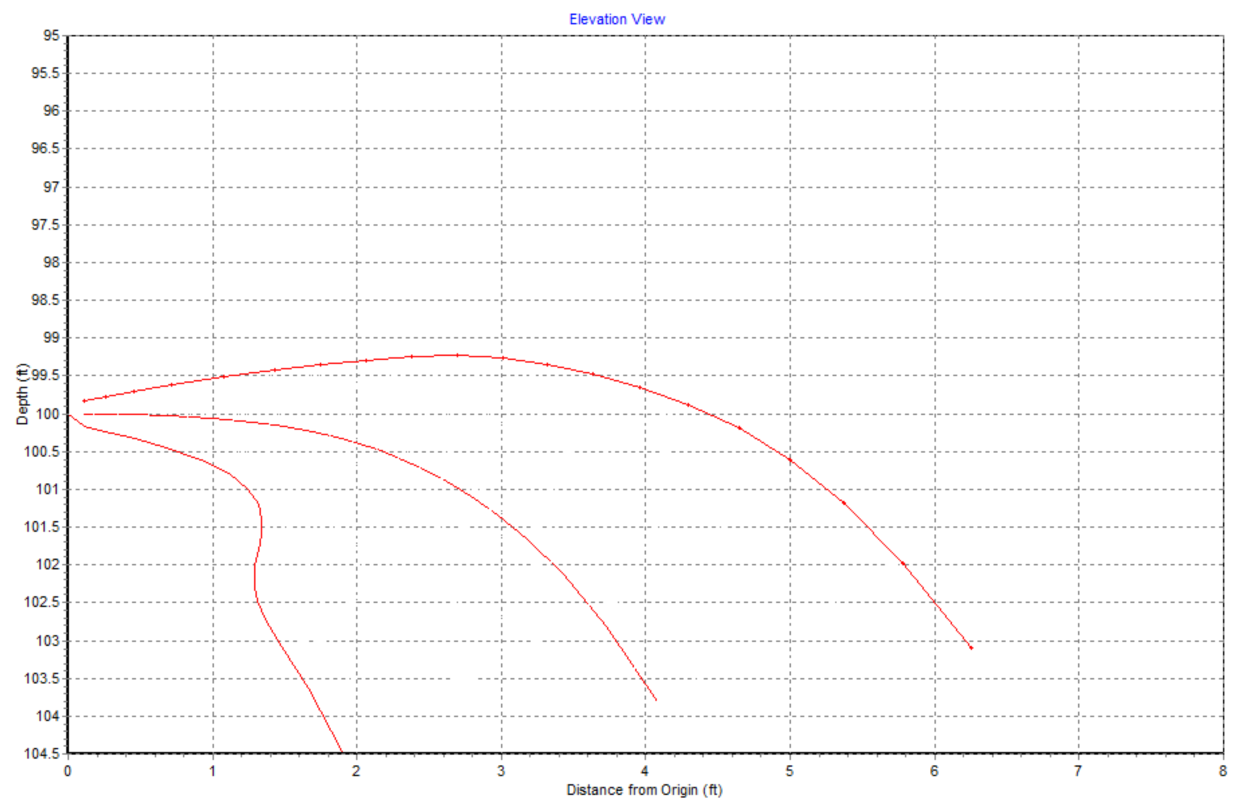

Figure C.3.1: Plumes 18b solution of discharge plume trajectories for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 99.2 ft. at Xa = 2.803 ft from the point of discharge. The centerline of the plume is at an average distance of Xb = 4.076 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

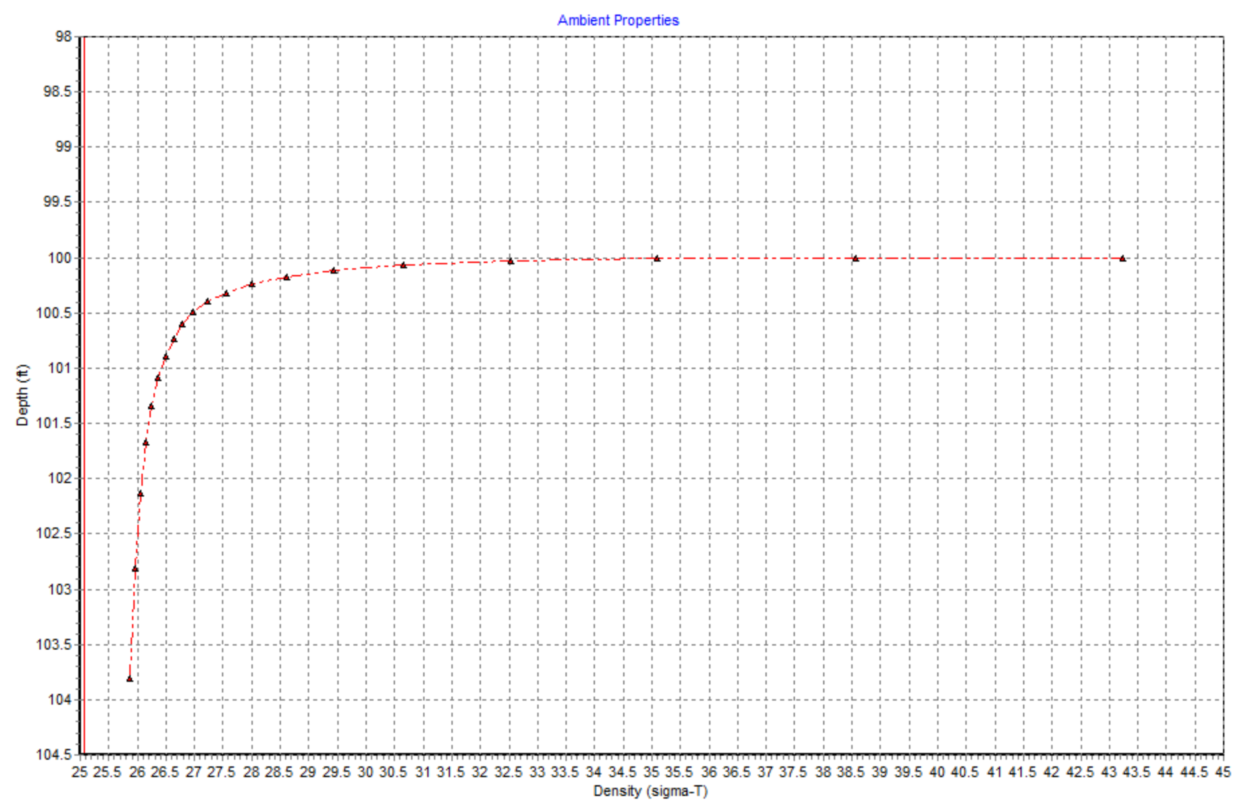

Figure C.3.2: Plumes 18b solution of vertical density profile for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

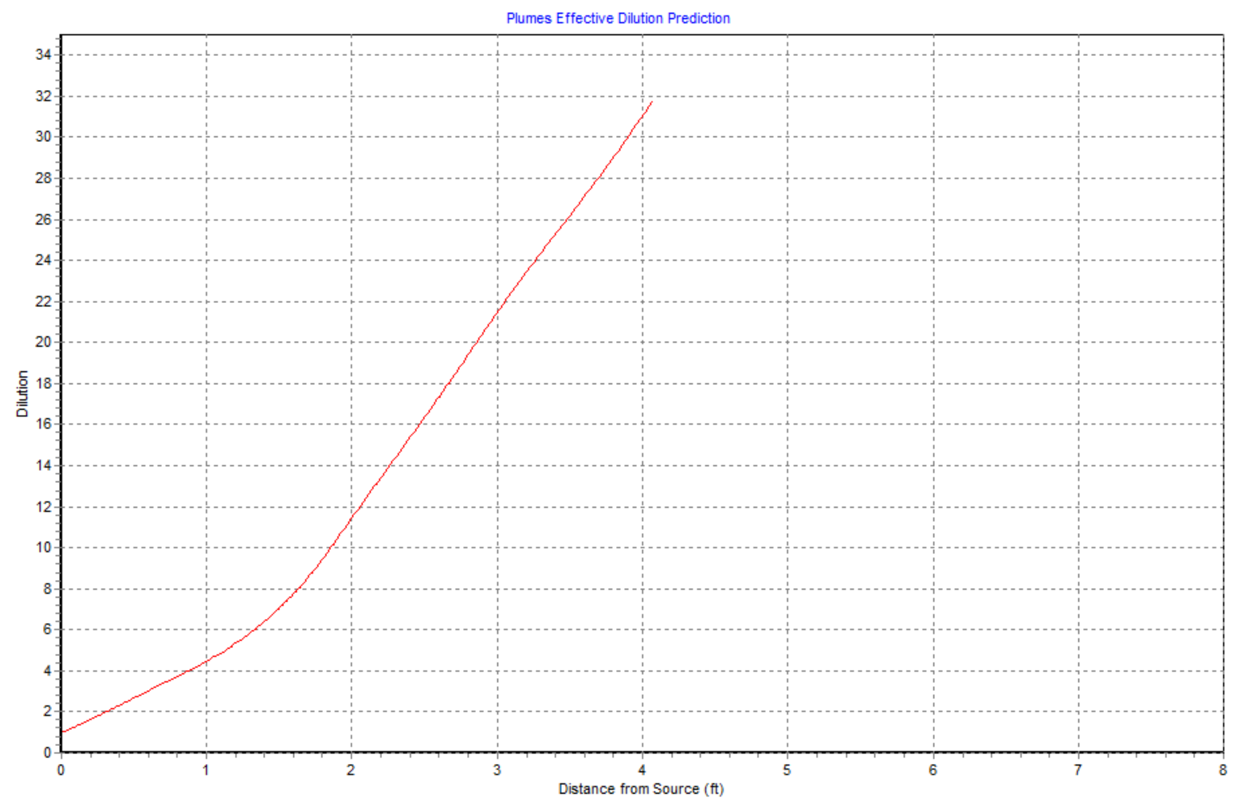

Figure C.3.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 15 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Effective dilution is S_a = 19.42 at the maximum rise of the plume at Xa = 2.803 ft. from the point of discharge. As the plume begins to impact the bottom, the plume centerline is at a distance of Xb = 4.076 ft from the point of discharge, where the effective dilution reaches S_a = 31.83.

C.4: Plumes 18b Results for SJCOO discharges of 0 mgd Wastewater and 10 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW0mgd_b10mgd_D-1"
memomemo
SJCOO discharging 0 mgd wastewater and 10 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 1:47:00 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW0mgd_b10mgd_D-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	10.000	67.000	20.660	67000.0

Simulation:

Froude No: -5.593; Strat No:-1.57E-4; Spcg No: 14.39; k: 74358.5; eff den (sigmaT) 49.48870; eff vel 0.744(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (ft)	y-posn (ft)	Iso dia (m)
0	100.0	1.000E-5	3.050	67.00	67000.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.068	66.63	66237.3	1.012	0.00724	0.0	0.07791;
2	100.0	0.0	3.116	65.97	64908.9	1.032	0.0127	0.0	0.07915;
3	100.0	0.0	3.179	65.33	63607.8	1.053	0.0174	0.0	0.08075;
4	100.0	0.0	3.243	64.71	62333.3	1.075	0.0215	0.0	0.08238;
5	100.0	0.0	3.309	64.09	61084.8	1.097	0.0255	0.0	0.08405;
6	100.0	0.0	3.376	63.49	59861.9	1.119	0.0292	0.0	0.08575;
7	100.0	0.0	3.444	62.90	58664.0	1.142	0.0329	0.0	0.08748;
8	100.0	0.0	3.514	62.32	57490.5	1.165	0.0364	0.0	0.08925;
9	100.0	0.0	3.585	61.75	56340.9	1.189	0.040	0.0	0.09105;
10	100.0	0.0	3.657	61.20	55214.7	1.213	0.0435	0.0	0.09289;
11	100.0	0.0	3.731	60.65	54111.5	1.238	0.0471	0.0	0.09477;
12	100.0	0.0	3.806	60.12	53030.7	1.263	0.0507	0.0	0.09668;
13	100.0	0.0	3.883	59.59	51971.9	1.289	0.0543	0.0	0.09863;
14	100.0	0.0	3.961	59.08	50934.6	1.315	0.0579	0.0	0.1006;
15	100.0	0.0	4.041	58.57	49918.3	1.342	0.0616	0.0	0.1027;
16	100.0	0.0	4.123	58.08	48922.7	1.370	0.0653	0.0	0.1047;
17	100.0	0.0	4.206	57.59	47947.2	1.397	0.0691	0.0	0.1068;
18	100.0	0.0	4.291	57.12	46991.6	1.426	0.0729	0.0	0.1090;
19	100.0	0.0	4.377	56.65	46055.2	1.455	0.0768	0.0	0.1112;
20	100.0	0.0	4.466	56.20	45137.8	1.484	0.0808	0.0	0.1134;
21	100.0	0.0	4.556	55.75	44239.0	1.515	0.0848	0.0	0.1157;
22	100.0	0.0	4.647	55.31	43358.3	1.545	0.0889	0.0	0.1180;
23	100.0	0.0	4.741	54.88	42495.4	1.577	0.093	0.0	0.1204;
24	100.0	0.0	4.837	54.46	41649.9	1.609	0.0973	0.0	0.1228;
25	100.0	0.0	4.934	54.04	40821.5	1.641	0.102	0.0	0.1253;
26	100.0	0.0	5.033	53.64	40009.7	1.675	0.106	0.0	0.1278;
27	100.0	0.0	5.135	53.24	39214.4	1.709	0.110	0.0	0.1304;
28	100.0	0.0	5.238	52.85	38435.0	1.743	0.115	0.0	0.1330;
29	100.0	0.0	5.343	52.47	37671.4	1.779	0.119	0.0	0.1357;
30	100.0	0.0	5.451	52.09	36923.1	1.815	0.124	0.0	0.1385;
31	100.0	0.0	5.561	51.73	36189.8	1.851	0.129	0.0	0.1412;
32	100.0	0.0	5.673	51.37	35471.3	1.889	0.134	0.0	0.1441;
33	100.0	0.0	5.787	51.01	34767.2	1.927	0.139	0.0	0.1470;
34	100.0	0.0	5.903	50.67	34077.3	1.966	0.144	0.0	0.1499;
35	100.0	0.0	6.022	50.33	33401.2	2.006	0.149	0.0	0.1529;
36	100.0	0.0	6.143	50.00	32738.7	2.047	0.154	0.0	0.1560;
37	100.0	0.0	6.266	49.67	32089.5	2.088	0.159	0.0	0.1592;
38	100.0	0.0	6.392	49.35	31453.3	2.130	0.165	0.0	0.1624;
39	100.0	0.0	6.520	49.04	30829.8	2.173	0.170	0.0	0.1656;
40	100.0	0.0	6.651	48.73	30218.8	2.217	0.176	0.0	0.1689;
41	100.0	0.0	6.785	48.43	29620.0	2.262	0.181	0.0	0.1723;
42	100.0	0.0	6.921	48.13	29033.3	2.308	0.187	0.0	0.1758;
43	100.0	0.0	7.060	47.84	28458.2	2.354	0.193	0.0	0.1793;
44	100.0	0.0	7.202	47.56	27894.7	2.402	0.199	0.0	0.1829;
45	100.0	0.0	7.346	47.28	27342.4	2.450	0.205	0.0	0.1866;
46	100.0	0.0	7.494	47.01	26801.2	2.500	0.211	0.0	0.1903;
47	100.0	0.0	7.644	46.74	26270.8	2.550	0.217	0.0	0.1942;
48	100.0	0.0	7.797	46.48	25750.9	2.602	0.224	0.0	0.1980;
49	100.0	0.0	7.953	46.22	25241.5	2.654	0.230	0.0	0.2020;
50	100.0	0.0	8.113	45.97	24742.2	2.708	0.237	0.0	0.2061;

51	100.0	0.0	8.275	45.72	24252.8	2.763	0.244	0.0	0.2102;	
52	100.0	0.0	8.441	45.48	23773.3	2.818	0.251	0.0	0.2144;	
53	100.0	0.0	8.610	45.24	23303.3	2.875	0.258	0.0	0.2187;	
54	100.0	0.0	8.782	45.01	22842.6	2.933	0.265	0.0	0.2231;	
55	100.0	0.0	8.958	44.78	22391.1	2.992	0.272	0.0	0.2275;	
56	100.0	0.0	9.137	44.56	21948.7	3.053	0.279	0.0	0.2321;	
57	100.0	0.0	9.319	44.34	21515.0	3.114	0.287	0.0	0.2367;	
58	100.0	0.0	9.505	44.12	21089.9	3.177	0.295	0.0	0.2414;	
59	100.0	0.0	9.695	43.91	20673.4	3.241	0.303	0.0	0.2463;	
60	100.0	0.0	9.889	43.70	20265.1	3.306	0.310	0.0	0.2512;	
61	100.0	0.0	10.09	43.50	19864.9	3.373	0.319	0.0	0.2562;	
62	100.0	0.0	10.29	43.30	19472.7	3.441	0.327	0.0	0.2613;	
63	100.0	0.0	10.49	43.11	19088.2	3.510	0.335	0.0	0.2665;	
64	100.0	0.0	10.70	42.92	18711.5	3.581	0.344	0.0	0.2718;	
65	100.0	0.0	10.91	42.73	18342.2	3.653	0.353	0.0	0.2772;	
66	100.0	0.0	11.13	42.55	17980.2	3.726	0.362	0.0	0.2827;	
67	100.0	0.0	11.35	42.37	17625.4	3.801	0.371	0.0	0.2883;	
68	100.0	0.0	11.58	42.19	17277.7	3.878	0.380	0.0	0.2940;	
69	100.0	0.0	11.81	42.02	16936.8	3.956	0.389	0.0	0.2998;	
70	100.0	0.0	12.04	41.85	16602.8	4.035	0.399	0.0	0.3058;	
71	100.0	0.0	12.28	41.68	16276.6	4.116	0.409	0.0	0.3118;	
72	100.0	0.0	12.51	41.52	15967.8	4.196	0.418	0.0	0.3178;	
73	100.0	0.0	12.75	41.37	15667.2	4.276	0.428	0.0	0.3238;	
74	100.0	0.0	12.99	41.22	15374.5	4.358	0.437	0.0	0.3299;	
75	100.0	0.0	13.23	41.08	15089.3	4.440	0.446	0.0	0.3360;	
76	100.0	0.0	13.47	40.94	14811.3	4.524	0.455	0.0	0.3422;	
77	100.0	0.0	13.72	40.80	14540.4	4.608	0.464	0.0	0.3485;	
78	100.0	0.0	13.97	40.66	14276.2	4.693	0.473	0.0	0.3548;	
79	100.0	0.0	14.22	40.53	14018.5	4.779	0.481	0.0	0.3611;	
80	100.0	0.0	14.47	40.40	13767.1	4.867	0.490	0.0	0.3676;	
81	100.0	0.0	14.73	40.28	13521.7	4.955	0.498	0.0	0.3741;	
82	100.0	0.0	14.99	40.16	13282.2	5.044	0.506	0.0	0.3807;	
83	100.0	0.0	15.25	40.04	13048.4	5.135	0.514	0.0	0.3873;	
84	100.0	0.0	15.51	39.92	12820.1	5.226	0.522	0.0	0.3941;	
85	100.0	0.0	15.78	39.81	12597.1	5.319	0.530	0.0	0.4009;	
86	100.0	0.0	16.05	39.70	12379.2	5.412	0.537	0.0	0.4077;	
87	100.0	0.0	16.32	39.59	12166.3	5.507	0.545	0.0	0.4146;	
88	100.0	0.0	16.60	39.48	11958.2	5.603	0.552	0.0	0.4216;	
89	100.0	0.0	16.88	39.38	11754.8	5.700	0.560	0.0	0.4287;	
90	100.0	0.0	17.16	39.28	11556.0	5.798	0.567	0.0	0.4359;	
91	100.1	0.0	17.44	39.18	11361.6	5.897	0.574	0.0	0.4431;	
92	100.1	0.0	17.73	39.08	11171.4	5.997	0.581	0.0	0.4504;	
93	100.1	0.0	18.02	38.99	10990.6	6.096	0.588	0.0	0.4576;	begin overlap;
94	100.1	0.0	18.30	38.90	10818.5	6.193	0.594	0.0	0.4647;	
95	100.1	0.0	18.57	38.82	10654.5	6.288	0.601	0.0	0.4717;	
96	100.1	0.0	18.84	38.74	10497.9	6.382	0.608	0.0	0.4785;	
97	100.1	0.0	19.10	38.66	10348.1	6.475	0.614	0.0	0.4852;	
98	100.1	0.0	19.36	38.59	10204.7	6.566	0.621	0.0	0.4918;	
99	100.1	0.0	19.62	38.52	10067.1	6.655	0.627	0.0	0.4983;	
100	100.1	0.0	19.87	38.45	9934.9	6.744	0.633	0.0	0.5047;	
101	100.1	0.0	20.12	38.39	9807.8	6.831	0.640	0.0	0.5109;	
102	100.1	0.0	20.36	38.32	9685.5	6.918	0.646	0.0	0.5171;	
103	100.1	0.0	20.60	38.26	9567.5	7.003	0.652	0.0	0.5232;	
104	100.1	0.0	20.83	38.21	9453.8	7.087	0.658	0.0	0.5291;	
105	100.1	0.0	21.06	38.15	9343.9	7.170	0.664	0.0	0.5350;	
106	100.1	0.0	21.29	38.10	9237.7	7.253	0.670	0.0	0.5408;	

107	100.1	0.0	21.52	38.04	9134.9	7.334	0.676	0.0	0.5465;
108	100.1	0.0	21.74	37.99	9035.4	7.415	0.682	0.0	0.5522;
109	100.1	0.0	21.96	37.94	8939.0	7.495	0.688	0.0	0.5578;
110	100.1	0.0	22.17	37.90	8845.5	7.574	0.694	0.0	0.5632;
111	100.1	0.0	22.39	37.85	8754.7	7.653	0.699	0.0	0.5687;
112	100.1	0.0	22.60	37.80	8666.6	7.731	0.705	0.0	0.5740;
113	100.1	0.0	22.81	37.76	8580.9	7.808	0.711	0.0	0.5793;
114	100.1	0.0	23.01	37.72	8497.6	7.885	0.716	0.0	0.5845;
115	100.1	0.0	23.22	37.68	8416.5	7.961	0.722	0.0	0.5897;
116	100.1	0.0	23.42	37.64	8337.5	8.036	0.728	0.0	0.5948;
117	100.1	0.0	23.61	37.60	8260.6	8.111	0.733	0.0	0.5998;
118	100.1	0.0	23.81	37.56	8185.6	8.185	0.739	0.0	0.6048;
119	100.1	0.0	24.00	37.52	8112.5	8.259	0.744	0.0	0.6097;
120	100.1	0.0	24.19	37.48	8041.1	8.332	0.750	0.0	0.6145;
121	100.1	0.0	24.38	37.45	7971.5	8.405	0.755	0.0	0.6193;
122	100.1	0.0	24.57	37.41	7903.4	8.477	0.760	0.0	0.6241;
123	100.1	0.0	24.76	37.38	7836.9	8.549	0.766	0.0	0.6288;
124	100.1	0.0	24.94	37.35	7771.9	8.621	0.771	0.0	0.6335;
125	100.1	0.0	25.12	37.31	7708.3	8.692	0.777	0.0	0.6381;
126	100.1	0.0	25.30	37.28	7646.0	8.763	0.782	0.0	0.6426;
127	100.1	0.0	25.48	37.25	7585.1	8.833	0.787	0.0	0.6471;
128	100.1	0.0	25.65	37.22	7525.5	8.903	0.792	0.0	0.6516;
129	100.1	0.0	25.83	37.19	7467.0	8.973	0.798	0.0	0.6560;
130	100.1	0.0	26.00	37.16	7409.7	9.042	0.803	0.0	0.6604;
131	100.1	0.0	26.17	37.13	7353.6	9.111	0.808	0.0	0.6647;
132	100.1	0.0	26.34	37.10	7298.5	9.180	0.813	0.0	0.6690;
133	100.1	0.0	26.51	37.08	7244.5	9.248	0.819	0.0	0.6732;
134	100.1	0.0	26.67	37.05	7191.5	9.317	0.824	0.0	0.6774;
135	100.1	0.0	26.83	37.02	7139.4	9.384	0.829	0.0	0.6816;
136	100.1	0.0	27.00	37.00	7088.3	9.452	0.834	0.0	0.6857;
137	100.1	0.0	27.16	36.97	7038.1	9.520	0.839	0.0	0.6898;
138	100.1	0.0	27.32	36.95	6988.8	9.587	0.844	0.0	0.6939;
139	100.1	0.0	27.47	36.92	6940.3	9.654	0.849	0.0	0.6979;
140	100.2	0.0	27.63	36.90	6892.6	9.721	0.855	0.0	0.7018;
141	100.2	0.0	27.79	36.87	6845.7	9.787	0.860	0.0	0.7058;
142	100.2	0.0	27.94	36.85	6799.6	9.854	0.865	0.0	0.7097;
143	100.2	0.0	28.09	36.83	6754.2	9.920	0.870	0.0	0.7135;
144	100.2	0.0	28.24	36.80	6709.6	9.986	0.875	0.0	0.7174;
145	100.2	0.0	28.39	36.78	6665.6	10.05	0.880	0.0	0.7212;
146	100.2	0.0	28.54	36.76	6622.3	10.12	0.885	0.0	0.7249;
147	100.2	0.0	28.69	36.74	6579.6	10.18	0.890	0.0	0.7286;
148	100.2	0.0	28.83	36.72	6537.6	10.25	0.895	0.0	0.7323;
149	100.2	0.0	28.98	36.69	6496.2	10.31	0.900	0.0	0.7360;
150	100.2	0.0	29.12	36.67	6455.4	10.38	0.905	0.0	0.7396;
151	100.2	0.0	29.26	36.65	6415.1	10.44	0.910	0.0	0.7432;
152	100.2	0.0	29.40	36.63	6375.5	10.51	0.915	0.0	0.7468;
153	100.2	0.0	29.54	36.61	6336.3	10.57	0.920	0.0	0.7503;
154	100.2	0.0	29.68	36.59	6297.7	10.64	0.925	0.0	0.7538;
155	100.2	0.0	29.81	36.57	6259.6	10.70	0.930	0.0	0.7573;
156	100.2	0.0	29.95	36.55	6222.0	10.77	0.935	0.0	0.7607;
157	100.2	0.0	30.08	36.54	6184.9	10.83	0.940	0.0	0.7642;
158	100.2	0.0	30.22	36.52	6148.2	10.90	0.945	0.0	0.7675;
159	100.2	0.0	30.35	36.50	6112.1	10.96	0.950	0.0	0.7709;
160	100.2	0.0	30.48	36.48	6076.3	11.03	0.956	0.0	0.7742;
161	100.2	0.0	30.61	36.46	6041.0	11.09	0.961	0.0	0.7775;
162	100.2	0.0	30.74	36.44	6006.1	11.16	0.966	0.0	0.7808;

163	100.2	0.0	30.87	36.43	5971.6	11.22	0.971	0.0	0.7841;
164	100.2	0.0	30.99	36.41	5937.5	11.28	0.976	0.0	0.7873;
165	100.2	0.0	31.12	36.39	5903.8	11.35	0.981	0.0	0.7905;
166	100.2	0.0	31.25	36.37	5870.5	11.41	0.986	0.0	0.7936;
167	100.2	0.0	31.37	36.36	5837.5	11.48	0.991	0.0	0.7968;
168	100.2	0.0	31.49	36.34	5804.9	11.54	0.996	0.0	0.7999;
169	100.2	0.0	31.61	36.32	5772.6	11.61	1.001	0.0	0.8030;
170	100.2	0.0	31.73	36.31	5740.7	11.67	1.006	0.0	0.8060;
171	100.2	0.0	31.85	36.29	5709.1	11.74	1.011	0.0	0.8091;
172	100.3	0.0	31.97	36.28	5677.9	11.80	1.016	0.0	0.8121;
173	100.3	0.0	32.09	36.26	5646.9	11.86	1.021	0.0	0.8151;
174	100.3	0.0	32.21	36.24	5616.2	11.93	1.026	0.0	0.8180;
175	100.3	0.0	32.32	36.23	5585.9	11.99	1.032	0.0	0.8210;
176	100.3	0.0	32.44	36.21	5555.8	12.06	1.037	0.0	0.8239;
177	100.3	0.0	32.55	36.20	5526.0	12.12	1.042	0.0	0.8268;
178	100.3	0.0	32.66	36.18	5496.5	12.19	1.047	0.0	0.8296;
179	100.3	0.0	32.78	36.17	5467.3	12.25	1.052	0.0	0.8325;
180	100.3	0.0	32.89	36.15	5438.3	12.32	1.057	0.0	0.8353;
181	100.3	0.0	33.00	36.14	5409.5	12.39	1.063	0.0	0.8381;
182	100.3	0.0	33.11	36.12	5381.0	12.45	1.068	0.0	0.8409;
183	100.3	0.0	33.21	36.11	5352.8	12.52	1.073	0.0	0.8437;
184	100.3	0.0	33.32	36.09	5324.8	12.58	1.078	0.0	0.8464;
185	100.3	0.0	33.43	36.08	5297.0	12.65	1.084	0.0	0.8491;
186	100.3	0.0	33.53	36.07	5269.4	12.71	1.089	0.0	0.8518;
187	100.3	0.0	33.64	36.05	5242.0	12.78	1.094	0.0	0.8545;
188	100.3	0.0	33.74	36.04	5214.9	12.85	1.099	0.0	0.8571;
189	100.3	0.0	33.85	36.02	5187.9	12.91	1.105	0.0	0.8597;
190	100.3	0.0	33.95	36.01	5161.2	12.98	1.110	0.0	0.8623;
191	100.3	0.0	34.05	36.00	5134.6	13.05	1.115	0.0	0.8649;
192	100.3	0.0	34.15	35.98	5108.3	13.12	1.121	0.0	0.8675;
193	100.3	0.0	34.25	35.97	5082.1	13.18	1.126	0.0	0.8700;
194	100.3	0.0	34.35	35.96	5056.1	13.25	1.132	0.0	0.8726;
195	100.4	0.0	34.45	35.94	5030.3	13.32	1.137	0.0	0.8751;
196	100.4	0.0	34.55	35.93	5004.6	13.39	1.142	0.0	0.8776;
197	100.4	0.0	34.65	35.92	4979.1	13.46	1.148	0.0	0.8801;
198	100.4	0.0	34.74	35.90	4953.8	13.53	1.153	0.0	0.8825;
199	100.4	0.0	34.84	35.89	4928.6	13.59	1.159	0.0	0.8849;
200	100.4	0.0	34.94	35.88	4903.5	13.66	1.165	0.0	0.8874;
201	100.4	0.0	35.03	35.87	4878.6	13.73	1.170	0.0	0.8898;
202	100.4	0.0	35.12	35.85	4853.9	13.80	1.176	0.0	0.8921;
203	100.4	0.0	35.22	35.84	4829.2	13.87	1.181	0.0	0.8945;
204	100.4	0.0	35.31	35.83	4804.7	13.94	1.187	0.0	0.8969;
205	100.4	0.0	35.40	35.82	4780.4	14.02	1.193	0.0	0.8992;
206	100.4	0.0	35.49	35.80	4756.1	14.09	1.198	0.0	0.9015;
207	100.4	0.0	35.58	35.79	4732.0	14.16	1.204	0.0	0.9038;
208	100.4	0.0	35.67	35.78	4708.0	14.23	1.210	0.0	0.9061;
209	100.4	0.0	35.76	35.77	4684.1	14.30	1.216	0.0	0.9084;
210	100.4	0.0	35.85	35.75	4660.2	14.38	1.221	0.0	0.9106;
211	100.4	0.0	35.94	35.74	4636.5	14.45	1.227	0.0	0.9129;
212	100.4	0.0	36.03	35.73	4612.9	14.52	1.233	0.0	0.9151;
213	100.5	0.0	36.12	35.72	4589.4	14.60	1.239	0.0	0.9173;
214	100.5	0.0	36.20	35.71	4566.0	14.67	1.245	0.0	0.9195;
215	100.5	0.0	36.29	35.69	4542.6	14.75	1.251	0.0	0.9217;
216	100.5	0.0	36.37	35.68	4519.4	14.83	1.257	0.0	0.9239;
217	100.5	0.0	36.46	35.67	4496.2	14.90	1.263	0.0	0.9261;
218	100.5	0.0	36.54	35.66	4473.1	14.98	1.269	0.0	0.9282;

219	100.5	0.0	36.63	35.65	4450.0	15.06	1.275	0.0	0.9304;	
220	100.5	0.0	36.71	35.64	4427.0	15.13	1.282	0.0	0.9325;	
221	100.5	0.0	36.80	35.62	4404.1	15.21	1.288	0.0	0.9346;	
222	100.5	0.0	36.88	35.61	4381.2	15.29	1.294	0.0	0.9368;	
223	100.5	0.0	36.96	35.60	4358.4	15.37	1.300	0.0	0.9389;	
224	100.5	0.0	37.05	35.59	4335.6	15.45	1.307	0.0	0.9410;	
225	100.5	0.0	37.13	35.58	4312.8	15.53	1.313	0.0	0.9431;	
226	100.6	0.0	37.21	35.56	4290.1	15.62	1.319	0.0	0.9452;	
227	100.6	0.0	37.29	35.55	4267.5	15.70	1.326	0.0	0.9472;	
228	100.6	0.0	37.37	35.54	4244.8	15.78	1.332	0.0	0.9493;	
229	100.6	0.0	37.46	35.53	4222.2	15.87	1.339	0.0	0.9514;	
230	100.6	0.0	37.54	35.52	4199.6	15.95	1.346	0.0	0.9535;	
231	100.6	0.0	37.62	35.51	4177.0	16.04	1.352	0.0	0.9555;	
232	100.6	0.0	37.70	35.50	4154.5	16.13	1.359	0.0	0.9576;	
233	100.6	0.0	37.78	35.48	4131.9	16.22	1.366	0.0	0.9597;	
234	100.6	0.0	37.86	35.47	4109.3	16.30	1.372	0.0	0.9617;	
235	100.6	0.0	37.94	35.46	4086.8	16.39	1.379	0.0	0.9638;	
236	100.6	0.0	38.03	35.45	4064.2	16.49	1.386	0.0	0.9659;	
237	100.6	0.0	38.11	35.44	4041.6	16.58	1.393	0.0	0.9679;	
238	100.7	0.0	38.19	35.43	4019.0	16.67	1.400	0.0	0.9700;	
239	100.7	0.0	38.27	35.41	3996.3	16.77	1.407	0.0	0.9721;	
240	100.7	0.0	38.35	35.40	3973.7	16.86	1.414	0.0	0.9742;	
241	100.7	0.0	38.44	35.39	3951.0	16.96	1.422	0.0	0.9763;	
242	100.7	0.0	38.52	35.38	3928.2	17.06	1.429	0.0	0.9784;	
243	100.7	0.0	38.60	35.37	3905.5	17.16	1.436	0.0	0.9805;	
244	100.7	0.0	38.69	35.36	3882.6	17.26	1.444	0.0	0.9826;	
245	100.7	0.0	38.77	35.34	3859.7	17.36	1.451	0.0	0.9848;	
246	100.7	0.0	38.86	35.33	3836.8	17.46	1.459	0.0	0.9869;	
247	100.8	0.0	38.94	35.32	3813.8	17.57	1.466	0.0	0.9891;	
248	100.8	0.0	39.03	35.31	3790.7	17.67	1.474	0.0	0.9913;	
249	100.8	0.0	39.11	35.30	3767.5	17.78	1.482	0.0	0.9935;	
250	100.8	0.0	39.20	35.29	3744.2	17.89	1.489	0.0	0.9957;	
251	100.8	0.0	39.29	35.27	3720.9	18.01	1.497	0.0	0.9980;	
252	100.8	0.0	39.38	35.26	3697.4	18.12	1.505	0.0	1.0003;	
253	100.8	0.0	39.47	35.25	3673.8	18.24	1.513	0.0	1.0026;	
254	100.8	0.0	39.57	35.24	3650.1	18.36	1.521	0.0	1.0050;	
255	100.9	0.0	39.66	35.22	3626.3	18.48	1.530	0.0	1.0074;	
256	100.9	0.0	39.76	35.21	3602.4	18.60	1.538	0.0	1.0098;	
257	100.9	0.0	39.85	35.20	3578.6	18.72	1.546	0.0	1.0122;	
258	100.9	0.0	39.94	35.19	3555.1	18.85	1.555	0.0	1.0146;	end overlap;
259	100.9	0.0	40.04	35.18	3531.8	18.97	1.563	0.0	1.0169;	
260	100.9	0.0	40.12	35.16	3508.7	19.10	1.572	0.0	1.0191;	
261	101.0	0.0	40.21	35.15	3485.8	19.22	1.581	0.0	1.0213;	
262	101.0	0.0	40.29	35.14	3463.1	19.35	1.589	0.0	1.0234;	
263	101.0	0.0	40.37	35.13	3440.6	19.47	1.598	0.0	1.0255;	
264	101.0	0.0	40.45	35.12	3418.3	19.60	1.607	0.0	1.0275;	
265	101.0	0.0	40.53	35.11	3396.1	19.73	1.617	0.0	1.0294;	
266	101.0	0.0	40.60	35.10	3374.1	19.86	1.626	0.0	1.0313;	
267	101.1	0.0	40.67	35.08	3352.3	19.99	1.635	0.0	1.0331;	
268	101.1	0.0	40.74	35.07	3330.5	20.12	1.645	0.0	1.0349;	
269	101.1	0.0	40.81	35.06	3308.9	20.25	1.654	0.0	1.0366;	
270	101.1	0.0	40.88	35.05	3287.4	20.38	1.664	0.0	1.0383;	
271	101.1	0.0	40.94	35.04	3266.0	20.51	1.674	0.0	1.0399;	
272	101.2	0.0	41.00	35.03	3244.7	20.65	1.684	0.0	1.0415;	
273	101.2	0.0	41.06	35.02	3223.5	20.79	1.694	0.0	1.0430;	
274	101.2	0.0	41.12	35.01	3202.3	20.92	1.704	0.0	1.0445;	

275	101.2	0.0	41.18	35.00	3181.2	21.06	1.715	0.0	1.0459;
276	101.2	0.0	41.23	34.99	3160.1	21.20	1.725	0.0	1.0473;
277	101.3	0.0	41.29	34.97	3139.0	21.34	1.736	0.0	1.0487;
278	101.3	0.0	41.34	34.96	3118.0	21.49	1.747	0.0	1.0501;
279	101.3	0.0	41.39	34.95	3096.9	21.63	1.758	0.0	1.0514;
280	101.3	0.0	41.45	34.94	3075.9	21.78	1.769	0.0	1.0527;
281	101.4	0.0	41.50	34.93	3054.8	21.93	1.780	0.0	1.0540;
282	101.4	0.0	41.55	34.92	3033.7	22.09	1.792	0.0	1.0553;
283	101.4	0.0	41.60	34.91	3012.5	22.24	1.804	0.0	1.0565;
284	101.5	0.0	41.64	34.90	2991.3	22.40	1.816	0.0	1.0578;
285	101.5	0.0	41.69	34.89	2969.9	22.56	1.828	0.0	1.0590;
286	101.5	0.0	41.74	34.88	2948.5	22.72	1.840	0.0	1.0603;
287	101.6	0.0	41.79	34.87	2927.0	22.89	1.853	0.0	1.0615;
288	101.6	0.0	41.84	34.85	2905.4	23.06	1.866	0.0	1.0628;
289	101.6	0.0	41.89	34.84	2883.6	23.23	1.879	0.0	1.0640;
290	101.7	0.0	41.94	34.83	2861.7	23.41	1.892	0.0	1.0653;
291	101.7	0.0	41.99	34.82	2839.6	23.60	1.905	0.0	1.0666;
292	101.7	0.0	42.05	34.81	2817.3	23.78	1.919	0.0	1.0680;
293	101.8	0.0	42.10	34.80	2794.8	23.97	1.933	0.0	1.0694;
294	101.8	0.0	42.16	34.79	2772.1	24.17	1.947	0.0	1.0708;
295	101.8	0.0	42.22	34.77	2749.1	24.37	1.962	0.0	1.0723;
296	101.9	0.0	42.28	34.76	2725.9	24.58	1.977	0.0	1.0739;
297	101.9	0.0	42.34	34.75	2702.4	24.79	1.992	0.0	1.0755;
298	102.0	0.0	42.41	34.74	2678.6	25.01	2.007	0.0	1.0772;
299	102.0	0.0	42.48	34.73	2654.5	25.24	2.023	0.0	1.0790;
300	102.1	0.0	42.55	34.71	2630.1	25.47	2.039	0.0	1.0809;
301	102.1	0.0	42.63	34.70	2605.3	25.72	2.055	0.0	1.0828;
302	102.2	0.0	42.71	34.69	2580.1	25.97	2.072	0.0	1.0849;
303	102.2	0.0	42.80	34.68	2554.6	26.23	2.089	0.0	1.0872;
304	102.3	0.0	42.90	34.66	2528.6	26.50	2.106	0.0	1.0896;
305	102.4	0.0	43.00	34.65	2502.3	26.78	2.124	0.0	1.0921;
306	102.4	0.0	43.10	34.63	2475.4	27.07	2.142	0.0	1.0948;
307	102.5	0.0	43.21	34.62	2448.1	27.37	2.161	0.0	1.0977;
308	102.6	0.0	43.34	34.61	2420.3	27.68	2.180	0.0	1.1007;
309	102.6	0.0	43.47	34.59	2392.0	28.01	2.199	0.0	1.1040;
310	102.7	0.0	43.60	34.58	2363.1	28.35	2.219	0.0	1.1075;
311	102.8	0.0	43.75	34.56	2333.7	28.71	2.239	0.0	1.1113;
312	102.9	0.0	43.91	34.55	2303.7	29.08	2.260	0.0	1.1153; merging;
313	102.9	0.0	44.08	34.53	2273.5	29.47	2.281	0.0	1.1196;
314	103.0	0.0	44.25	34.52	2243.2	29.87	2.303	0.0	1.1240;
315	103.1	0.0	44.43	34.50	2212.7	30.28	2.325	0.0	1.1285;
316	103.2	0.0	44.62	34.48	2181.8	30.71	2.348	0.0	1.1333;
317	103.3	0.0	44.82	34.47	2150.4	31.16	2.372	0.0	1.1383;
318	103.4	0.0	45.02	34.45	2118.6	31.62	2.396	0.0	1.1436;
319	103.5	0.0	45.25	34.43	2086.3	32.11	2.420	0.0	1.1493;
320	103.7	0.0	45.48	34.42	2053.5	32.63	2.446	0.0	1.1553;
321	103.8	0.0	45.74	34.40	2020.1	33.17	2.472	0.0	1.1618;
322	103.9	0.0	46.01	34.38	1986.2	33.73	2.499	0.0	1.1686;
323	104.0	0.0	46.30	34.37	1951.7	34.33	2.526	0.0	1.1760;
324	104.2	0.0	46.61	34.35	1916.5	34.96	2.555	0.0	1.1839; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 0.7787
Lmz(m): 0.7787
forced entrain 1 0.0 -1.278 1.184 0.198
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632
;
1:47:00 PM. amb fills: 4

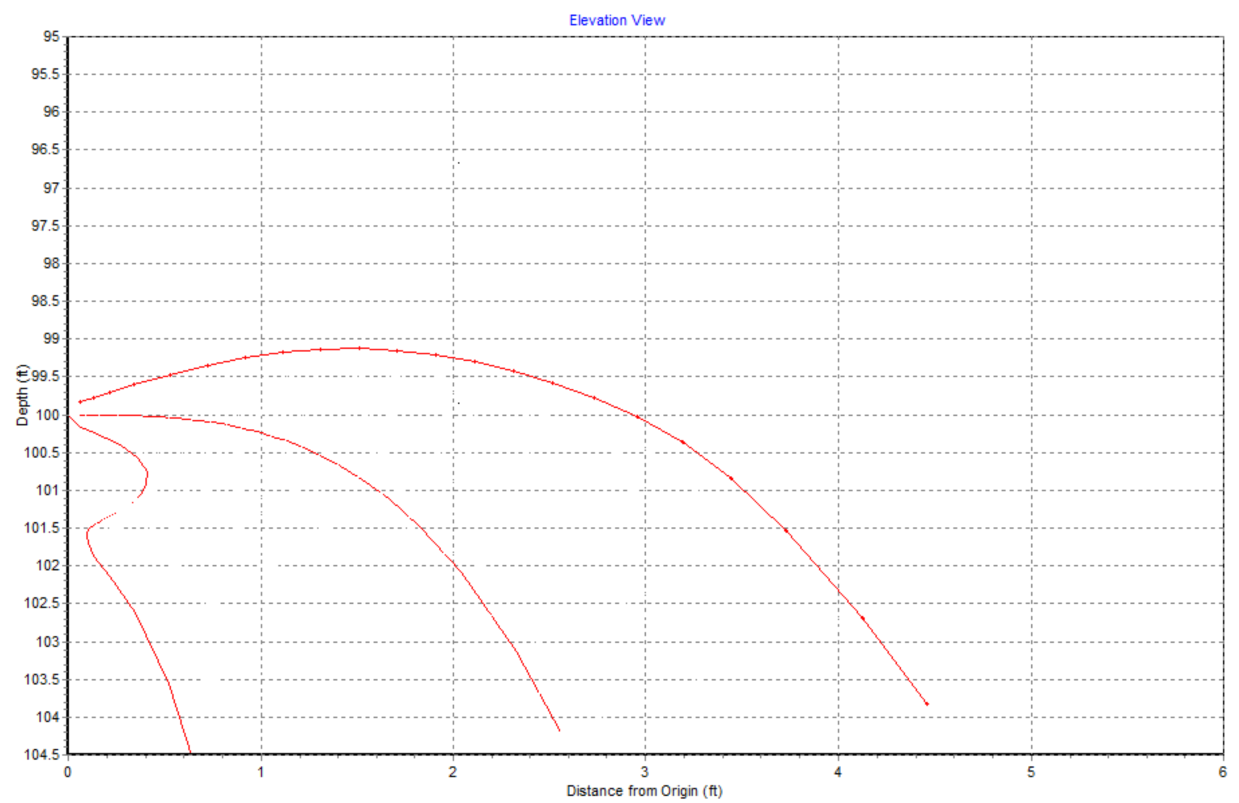

Figure C.4.1: Plumes 18b solution of discharge plume trajectories for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 10 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 99.2 ft. at Xa = 1.704 ft from the point of discharge. The centerline of the plume is at an average distance of Xb = 2.555 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

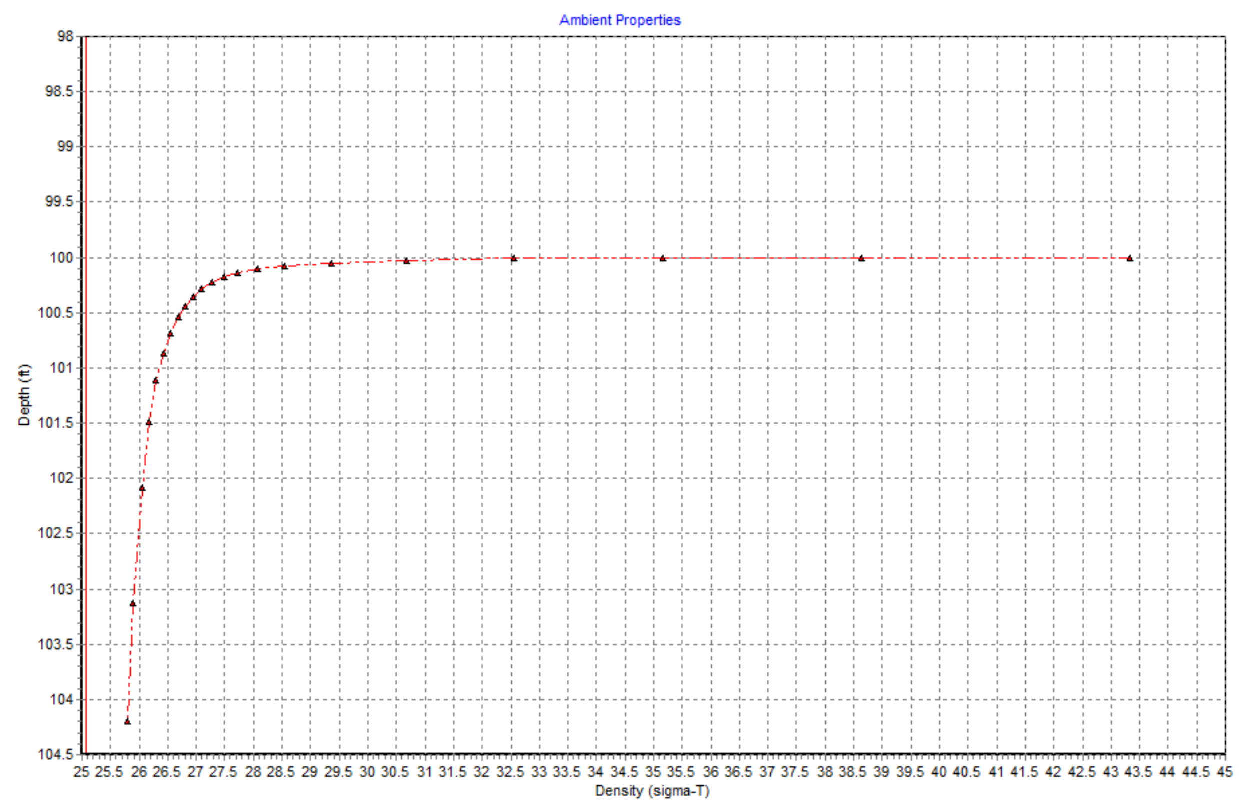

Figure C.4.2: Plumes 18b solution of vertical density profile for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 10 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

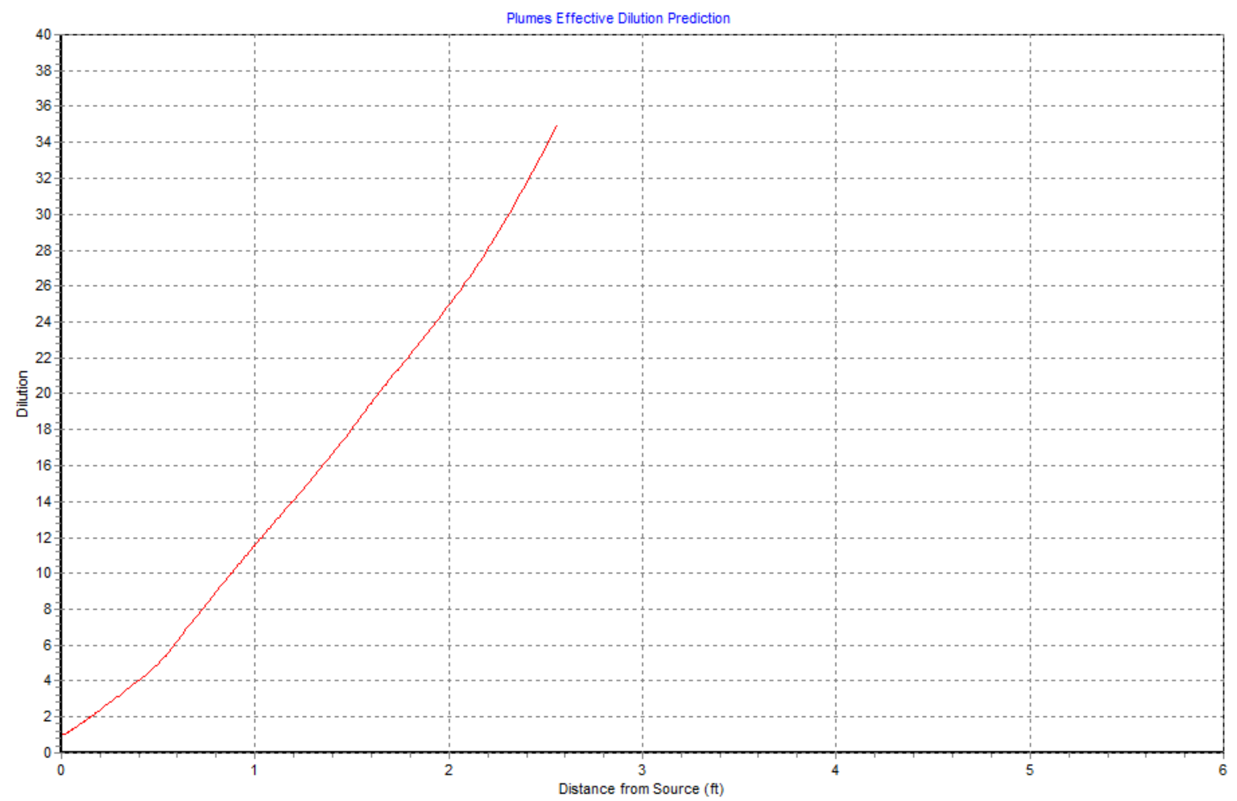

Figure C.4.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 10 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Effective dilution is S_a = 20.92 at the maximum rise of the plume at Xa = 1.704 ft. from the point of discharge. As the plume begins to impact the bottom, the plume centerline is at a distance of Xb = 2.55 ft from the point of discharge, where the effective dilution reaches S_a = 34.96.

C.5: Plumes 18b Results for SJCOO discharges of 0 mgd Wastewater and 5 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW0mgd_b5mgd_D-1"
memo
SJCOO discharging 0 mgd wastewater and 5 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 2:07:00 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW0mgd_b5mgd_D-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	5.0000	67.000	20.660	67000.0

Simulation:
Froude No: -2.796; Strat No:-1.57E-4; Spcg No: 14.39; k: 37179.3; eff den (sigmaT) 49.48870; eff vel 0.372(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (ft)	y-posn (ft)	Iso dia (m)
0	100.0	1.000E-5	3.050	67.00	67000.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.059	66.81	66616.5	1.006	0.00364	0.0	0.07769;
2	100.0	0.0	3.099	66.16	65280.3	1.026	0.00565	0.0	0.0787;
3	100.0	0.0	3.161	65.51	63971.6	1.047	0.00684	0.0	0.0803;
4	100.0	0.0	3.225	64.88	62689.6	1.069	0.00758	0.0	0.08192;
5	100.0	0.0	3.290	64.26	61433.9	1.091	0.00804	0.0	0.08358;
6	100.0	0.0	3.357	63.66	60203.8	1.113	0.00834	0.0	0.08527;
7	100.0	0.0	3.425	63.06	58998.9	1.136	0.00853	0.0	0.08699;
8	100.0	0.0	3.494	62.48	57818.6	1.159	0.00865	0.0	0.08875;
9	100.0	0.0	3.565	61.91	56662.3	1.182	0.00873	0.0	0.09054;
10	100.0	0.0	3.637	61.35	55529.6	1.207	0.00879	0.0	0.09237;
11	100.0	0.0	3.710	60.80	54420.0	1.231	0.00882	0.0	0.09423;
12	100.0	0.0	3.785	60.26	53332.9	1.256	0.00884	0.0	0.09614;
13	100.0	0.0	3.861	59.74	52267.9	1.282	0.00885	0.0	0.09808;
14	100.0	0.0	3.939	59.22	51224.6	1.308	0.00886	0.0	0.1001;
15	100.0	0.0	4.019	58.71	50202.5	1.335	0.00887	0.0	0.1021;
16	100.0	0.0	4.100	58.22	49201.1	1.362	0.00887	0.0	0.1041;
17	100.0	0.0	4.183	57.73	48220.0	1.389	0.00888	0.0	0.1062;
18	100.0	0.0	4.267	57.25	47258.8	1.418	0.00888	0.0	0.1084;
19	100.0	0.0	4.353	56.78	46317.0	1.447	0.00888	0.0	0.1106;
20	100.0	0.0	4.441	56.32	45394.3	1.476	0.00888	0.0	0.1128;
21	100.0	0.0	4.530	55.87	44490.3	1.506	0.00888	0.0	0.1151;
22	100.0	0.0	4.622	55.43	43604.5	1.537	0.00888	0.0	0.1174;
23	100.0	0.0	4.715	55.00	42736.7	1.568	0.00888	0.0	0.1198;
24	100.0	0.0	4.810	54.57	41886.3	1.600	0.00888	0.0	0.1222;
25	100.0	0.0	4.907	54.16	41053.1	1.632	0.00888	0.0	0.1246;
26	100.0	0.0	5.005	53.75	40236.7	1.665	0.00888	0.0	0.1271;
27	100.0	0.0	5.106	53.35	39436.8	1.699	0.00888	0.0	0.1297;
28	100.0	0.0	5.209	52.96	38653.0	1.733	0.00888	0.0	0.1323;
29	100.0	0.0	5.314	52.58	37884.9	1.769	0.00888	0.0	0.1350;
30	100.0	0.0	5.421	52.20	37132.3	1.804	0.00888	0.0	0.1377;
31	100.0	0.0	5.530	51.83	36394.9	1.841	0.0317	0.0	0.1405;
32	100.0	0.0	5.618	51.61	35964.4	1.863	0.0371	0.0	0.1427;
33	100.0	0.0	5.707	51.26	35250.4	1.901	0.0401	0.0	0.1450;
34	100.0	0.0	5.822	50.90	34550.8	1.939	0.0419	0.0	0.1479;
35	100.0	0.0	5.939	50.56	33865.2	1.978	0.0429	0.0	0.1508;
36	100.0	0.0	6.058	50.22	33193.4	2.018	0.0436	0.0	0.1539;
37	100.0	0.0	6.180	49.89	32535.0	2.059	0.0441	0.0	0.1570;
38	100.0	0.0	6.304	49.57	31889.9	2.101	0.0443	0.0	0.1601;
39	100.0	0.0	6.431	49.25	31257.6	2.143	0.0445	0.0	0.1633;
40	100.0	0.0	6.560	48.94	30638.1	2.187	0.0446	0.0	0.1666;
41	100.0	0.0	6.692	48.63	30030.9	2.231	0.0447	0.0	0.1700;
42	100.0	0.0	6.827	48.33	29435.9	2.276	0.0447	0.0	0.1734;
43	100.0	0.0	6.964	48.04	28852.8	2.322	0.0447	0.0	0.1769;
44	100.0	0.0	7.104	47.75	28281.4	2.369	0.0448	0.0	0.1804;
45	100.0	0.0	7.247	47.47	27721.4	2.417	0.0448	0.0	0.1841;
46	100.0	0.0	7.392	47.19	27172.6	2.466	0.0448	0.0	0.1878;
47	100.0	0.0	7.541	46.92	26634.8	2.516	0.0448	0.0	0.1915;
48	100.0	0.0	7.692	46.66	26107.7	2.566	0.0448	0.0	0.1954;
49	100.0	0.0	7.847	46.40	25591.1	2.618	0.0448	0.0	0.1993;

50	100.0	0.0	8.005	46.14	25084.8	2.671	0.0448	0.0	0.2033;	
51	100.0	0.0	8.166	45.89	24588.7	2.725	0.0448	0.0	0.2074;	
52	100.0	0.0	8.330	45.65	24102.4	2.780	0.0448	0.0	0.2116;	
53	100.0	0.0	8.497	45.40	23625.8	2.836	0.0448	0.0	0.2158;	
54	100.0	0.0	8.667	45.17	23162.2	2.893	0.0448	0.0	0.2201;	begin overlap;
55	100.0	0.0	8.836	44.95	22725.1	2.948	0.0448	0.0	0.2244;	
56	100.0	0.0	9.002	44.74	22314.3	3.003	0.0448	0.0	0.2286;	
57	100.0	0.0	9.163	44.55	21931.1	3.055	0.0448	0.0	0.2327;	
58	100.0	0.0	9.321	44.36	21560.8	3.107	0.0448	0.0	0.2367;	
59	100.0	0.0	9.484	44.17	21180.5	3.163	0.0448	0.0	0.2409;	
60	100.0	0.0	9.643	44.00	20854.3	3.213	0.0448	0.0	0.2449;	
61	100.0	0.0	9.782	43.86	20576.3	3.256	0.0448	0.0	0.2485;	
62	100.0	0.0	9.911	43.73	20316.3	3.298	0.0448	0.0	0.2517;	
63	100.0	0.0	10.01	43.66	20178.5	3.320	0.0448	0.0	0.2542;	
64	100.0	0.0	10.05	43.64	20137.9	3.327	0.0448	0.0	0.2553;	
65	100.0	0.0	10.16	43.44	19740.2	3.394	0.0857	0.0	0.2581;	
66	100.0	0.0	10.25	43.41	19689.8	3.403	0.0886	0.0	0.2604;	
67	100.0	0.0	10.33	43.27	19417.1	3.451	0.0905	0.0	0.2624;	
68	100.0	0.0	10.47	43.14	19153.7	3.498	0.0916	0.0	0.2660;	
69	100.0	0.0	10.61	43.01	18900.6	3.545	0.0923	0.0	0.2696;	
70	100.0	0.0	10.75	42.89	18657.2	3.591	0.0928	0.0	0.2731;	
71	100.0	0.0	10.89	42.77	18423.0	3.637	0.0931	0.0	0.2766;	
72	100.0	0.0	11.03	42.66	18197.4	3.682	0.0933	0.0	0.2801;	
73	100.0	0.0	11.16	42.55	17979.9	3.726	0.0934	0.0	0.2835;	
74	100.0	0.0	11.29	42.44	17770.1	3.770	0.0935	0.0	0.2869;	
75	100.0	0.0	11.42	42.34	17567.5	3.814	0.0935	0.0	0.2902;	
76	100.0	0.0	11.55	42.24	17371.7	3.857	0.0936	0.0	0.2935;	
77	100.0	0.0	11.68	42.14	17182.4	3.899	0.0936	0.0	0.2967;	
78	100.0	0.0	11.81	42.05	16999.3	3.941	0.0936	0.0	0.3000;	
79	100.0	0.0	11.94	41.96	16821.8	3.983	0.0936	0.0	0.3032;	
80	100.0	0.0	12.06	41.87	16649.9	4.024	0.0936	0.0	0.3063;	
81	100.0	0.0	12.18	41.79	16483.2	4.065	0.0936	0.0	0.3094;	
82	100.0	0.0	12.30	41.70	16321.5	4.105	0.0936	0.0	0.3125;	
83	100.0	0.0	12.42	41.62	16164.4	4.145	0.0936	0.0	0.3156;	
84	100.0	0.0	12.54	41.55	16011.8	4.184	0.0936	0.0	0.3186;	
85	100.0	0.0	12.66	41.47	15863.5	4.224	0.0936	0.0	0.3216;	
86	100.0	0.0	12.78	41.40	15719.3	4.262	0.0936	0.0	0.3246;	
87	100.0	0.0	12.89	41.33	15579.0	4.301	0.0936	0.0	0.3275;	
88	100.0	0.0	13.01	41.26	15442.4	4.339	0.0936	0.0	0.3304;	
89	100.0	0.0	13.12	41.19	15309.4	4.376	0.0936	0.0	0.3333;	
90	100.0	0.0	13.24	41.12	15179.9	4.414	0.0936	0.0	0.3362;	
91	100.0	0.0	13.35	41.06	15054.2	4.451	0.0936	0.0	0.3390;	
92	100.0	0.0	13.46	41.00	14932.5	4.487	0.0936	0.0	0.3418;	
93	100.0	0.0	13.56	40.94	14815.1	4.522	0.0936	0.0	0.3445;	
94	100.0	0.0	13.67	40.88	14698.3	4.558	0.0936	0.0	0.3473;	
95	100.0	0.0	13.79	40.81	14570.1	4.598	0.0936	0.0	0.3502;	
96	100.0	0.0	13.92	40.73	14412.4	4.649	0.0936	0.0	0.3536;	
97	100.0	0.0	14.05	40.68	14312.3	4.681	0.0936	0.0	0.3568;	
98	100.0	0.0	14.14	40.64	14228.7	4.709	0.0936	0.0	0.3591;	
99	100.0	0.0	14.32	40.50	13948.3	4.803	0.149	0.0	0.3637;	
100	100.0	0.0	14.29	40.49	13938.1	4.807	0.152	0.0	0.3630;	
101	100.0	0.0	14.34	40.44	13831.6	4.844	0.153	0.0	0.3643;	
102	100.0	0.0	14.45	40.38	13726.8	4.881	0.154	0.0	0.3669;	
103	100.0	0.0	14.55	40.33	13624.1	4.918	0.155	0.0	0.3696;	
104	100.0	0.0	14.66	40.28	13523.5	4.954	0.155	0.0	0.3723;	
105	100.0	0.0	14.76	40.23	13425.0	4.991	0.155	0.0	0.3750;	

106	100.0	0.0	14.87	40.18	13328.6	5.027	0.156	0.0	0.3777;
107	100.0	0.0	14.97	40.13	13234.2	5.063	0.156	0.0	0.3803;
108	100.0	0.0	15.08	40.09	13141.7	5.098	0.156	0.0	0.3830;
109	100.0	0.0	15.18	40.04	13051.1	5.134	0.156	0.0	0.3857;
110	100.0	0.0	15.29	39.99	12962.4	5.169	0.156	0.0	0.3883;
111	100.0	0.0	15.39	39.95	12875.5	5.204	0.156	0.0	0.3909;
112	100.0	0.0	15.49	39.91	12790.3	5.238	0.156	0.0	0.3935;
113	100.0	0.0	15.60	39.86	12706.7	5.273	0.156	0.0	0.3961;
114	100.0	0.0	15.70	39.82	12624.8	5.307	0.156	0.0	0.3987;
115	100.0	0.0	15.80	39.78	12544.5	5.341	0.156	0.0	0.4013;
116	100.0	0.0	15.90	39.74	12465.7	5.375	0.156	0.0	0.4038;
117	100.0	0.0	16.00	39.70	12388.3	5.408	0.156	0.0	0.4064;
118	100.0	0.0	16.10	39.66	12312.4	5.442	0.156	0.0	0.4089;
119	100.0	0.0	16.20	39.63	12237.9	5.475	0.156	0.0	0.4114;
120	100.0	0.0	16.29	39.59	12164.7	5.508	0.156	0.0	0.4139;
121	100.0	0.0	16.39	39.55	12092.8	5.540	0.156	0.0	0.4163;
122	100.0	0.0	16.49	39.52	12022.2	5.573	0.156	0.0	0.4188;
123	100.0	0.0	16.58	39.48	11952.8	5.605	0.156	0.0	0.4212;
124	100.0	0.0	16.68	39.45	11884.6	5.638	0.156	0.0	0.4236;
125	100.0	0.0	16.77	39.41	11817.6	5.670	0.156	0.0	0.4261;
126	100.0	0.0	16.87	39.38	11751.7	5.701	0.156	0.0	0.4285;
127	100.0	0.0	16.96	39.34	11687.0	5.733	0.156	0.0	0.4308;
128	100.0	0.0	17.06	39.31	11623.3	5.764	0.156	0.0	0.4332;
129	100.0	0.0	17.15	39.28	11560.0	5.796	0.156	0.0	0.4356;
130	100.0	0.0	17.24	39.25	11497.8	5.827	0.156	0.0	0.4379;
131	100.0	0.0	17.33	39.22	11440.0	5.857	0.156	0.0	0.4402;
132	100.0	0.0	17.42	39.19	11382.9	5.886	0.156	0.0	0.4424;
133	100.0	0.0	17.52	39.15	11304.4	5.927	0.156	0.0	0.4451;
134	100.0	0.0	17.64	39.11	11233.6	5.964	0.156	0.0	0.4480;
135	100.0	0.0	17.74	39.08	11174.7	5.996	0.156	0.0	0.4506;
136	100.0	0.0	17.82	39.06	11133.0	6.018	0.156	0.0	0.4526;
137	100.1	0.0	18.03	38.95	10913.9	6.139	0.221	0.0	0.4580;
138	100.1	0.0	17.63	38.95	10909.7	6.141	0.223	0.0	0.4477;
139	100.1	0.0	17.66	38.92	10844.3	6.178	0.224	0.0	0.4486;
140	100.1	0.0	17.75	38.88	10779.6	6.215	0.226	0.0	0.4509;
141	100.1	0.0	17.85	38.85	10715.6	6.253	0.226	0.0	0.4533;
142	100.1	0.0	17.94	38.82	10652.5	6.290	0.227	0.0	0.4558;
143	100.1	0.0	18.04	38.79	10590.4	6.327	0.228	0.0	0.4583;
144	100.1	0.0	18.14	38.75	10529.1	6.363	0.228	0.0	0.4608;
145	100.1	0.0	18.24	38.72	10468.8	6.400	0.228	0.0	0.4633;
146	100.1	0.0	18.34	38.69	10409.4	6.436	0.229	0.0	0.4659;
147	100.1	0.0	18.44	38.66	10351.0	6.473	0.229	0.0	0.4685;
148	100.1	0.0	18.54	38.63	10293.4	6.509	0.229	0.0	0.4710;
149	100.1	0.0	18.65	38.61	10236.8	6.545	0.229	0.0	0.4736;
150	100.1	0.0	18.75	38.58	10181.1	6.581	0.229	0.0	0.4762;
151	100.1	0.0	18.85	38.55	10126.2	6.616	0.229	0.0	0.4787;
152	100.1	0.0	18.95	38.52	10072.2	6.652	0.229	0.0	0.4813;
153	100.1	0.0	19.05	38.49	10019.1	6.687	0.229	0.0	0.4838;
154	100.1	0.0	19.15	38.47	9966.7	6.722	0.229	0.0	0.4863;
155	100.1	0.0	19.25	38.44	9915.2	6.757	0.229	0.0	0.4889;
156	100.1	0.0	19.35	38.42	9864.5	6.792	0.229	0.0	0.4914;
157	100.1	0.0	19.44	38.39	9814.5	6.827	0.229	0.0	0.4939;
158	100.1	0.0	19.54	38.36	9765.3	6.861	0.230	0.0	0.4964;
159	100.1	0.0	19.64	38.34	9716.8	6.895	0.230	0.0	0.4988;
160	100.1	0.0	19.74	38.32	9669.0	6.929	0.230	0.0	0.5013;
161	100.1	0.0	19.83	38.29	9621.9	6.963	0.230	0.0	0.5038;

162	100.1	0.0	19.93	38.27	9575.5	6.997	0.230	0.0	0.5062;
163	100.1	0.0	20.03	38.24	9529.8	7.031	0.230	0.0	0.5086;
164	100.1	0.0	20.12	38.22	9484.7	7.064	0.230	0.0	0.5111;
165	100.1	0.0	20.22	38.20	9440.3	7.097	0.230	0.0	0.5135;
166	100.1	0.0	20.31	38.18	9396.5	7.130	0.230	0.0	0.5159;
167	100.1	0.0	20.40	38.15	9353.2	7.163	0.230	0.0	0.5183;
168	100.1	0.0	20.50	38.13	9310.6	7.196	0.230	0.0	0.5207;
169	100.1	0.0	20.59	38.11	9268.6	7.229	0.230	0.0	0.5230;
170	100.1	0.0	20.68	38.09	9227.1	7.261	0.230	0.0	0.5254;
171	100.1	0.0	20.78	38.07	9186.2	7.294	0.230	0.0	0.5277;
172	100.1	0.0	20.87	38.05	9145.8	7.326	0.230	0.0	0.5301;
173	100.1	0.0	20.96	38.03	9105.9	7.358	0.230	0.0	0.5324;
174	100.1	0.0	21.05	38.01	9066.6	7.390	0.230	0.0	0.5347;
175	100.1	0.0	21.14	37.99	9027.8	7.422	0.230	0.0	0.5370;
176	100.1	0.0	21.23	37.97	8989.4	7.453	0.230	0.0	0.5393;
177	100.1	0.0	21.32	37.95	8951.6	7.485	0.230	0.0	0.5416;
178	100.1	0.0	21.41	37.93	8914.2	7.516	0.230	0.0	0.5439;
179	100.1	0.0	21.50	37.91	8877.3	7.547	0.230	0.0	0.5461;
180	100.1	0.0	21.59	37.89	8840.9	7.578	0.230	0.0	0.5484;
181	100.1	0.0	21.68	37.87	8804.9	7.609	0.230	0.0	0.5506;
182	100.1	0.0	21.77	37.86	8769.4	7.640	0.230	0.0	0.5529;
183	100.1	0.0	21.85	37.84	8734.3	7.671	0.230	0.0	0.5551;
184	100.1	0.0	21.94	37.82	8699.7	7.701	0.230	0.0	0.5573;
185	100.1	0.0	22.03	37.80	8665.4	7.732	0.230	0.0	0.5595;
186	100.1	0.0	22.12	37.79	8631.5	7.762	0.230	0.0	0.5617;
187	100.1	0.0	22.20	37.77	8597.4	7.793	0.230	0.0	0.5639;
188	100.1	0.0	22.29	37.75	8564.3	7.823	0.230	0.0	0.5661;
189	100.1	0.0	22.38	37.73	8528.5	7.856	0.230	0.0	0.5684;
190	100.1	0.0	22.47	37.72	8496.4	7.886	0.230	0.0	0.5707;
191	100.1	0.0	22.55	37.70	8465.4	7.915	0.230	0.0	0.5728;
192	100.1	0.0	22.64	37.68	8431.8	7.946	0.230	0.0	0.5750;
193	100.1	0.0	22.73	37.67	8399.2	7.977	0.230	0.0	0.5772;
194	100.1	0.0	22.81	37.65	8372.3	8.003	0.230	0.0	0.5793;
195	100.1	0.0	22.89	37.64	8340.0	8.034	0.230	0.0	0.5813;
196	100.1	0.0	22.97	37.62	8313.1	8.060	0.230	0.0	0.5834;
197	100.1	0.0	23.24	37.54	8149.6	8.221	0.303	0.0	0.5902;
198	100.1	0.0	21.90	37.54	8147.5	8.223	0.305	0.0	0.5562;
199	100.1	0.0	21.92	37.52	8101.6	8.270	0.307	0.0	0.5569;
200	100.1	0.0	22.01	37.49	8055.7	8.317	0.309	0.0	0.5590;
201	100.1	0.0	22.09	37.47	8010.1	8.364	0.311	0.0	0.5611;
202	100.1	0.0	22.18	37.45	7964.6	8.412	0.313	0.0	0.5632;
203	100.1	0.0	22.26	37.42	7920.2	8.459	0.315	0.0	0.5653;
204	100.1	0.0	22.33	37.40	7877.2	8.506	0.317	0.0	0.5672;
205	100.1	0.0	22.40	37.38	7834.6	8.552	0.319	0.0	0.5691;
206	100.1	0.0	22.48	37.36	7792.3	8.598	0.321	0.0	0.5709;
207	100.1	0.0	22.55	37.34	7750.5	8.645	0.323	0.0	0.5728;
208	100.1	0.0	22.62	37.31	7709.1	8.691	0.325	0.0	0.5746;
209	100.1	0.0	22.69	37.29	7668.0	8.738	0.327	0.0	0.5764;
210	100.1	0.0	22.76	37.27	7627.2	8.784	0.329	0.0	0.5782;
211	100.1	0.0	22.83	37.25	7586.8	8.831	0.331	0.0	0.5800;
212	100.1	0.0	22.90	37.23	7546.8	8.878	0.333	0.0	0.5817;
213	100.1	0.0	22.97	37.21	7507.1	8.925	0.335	0.0	0.5834;
214	100.1	0.0	23.04	37.19	7467.7	8.972	0.337	0.0	0.5852;
215	100.1	0.0	23.10	37.17	7428.6	9.019	0.339	0.0	0.5869;
216	100.2	0.0	23.17	37.15	7389.8	9.067	0.341	0.0	0.5885;
217	100.2	0.0	23.24	37.13	7351.3	9.114	0.343	0.0	0.5902;

218	100.2	0.0	23.30	37.11	7313.1	9.162	0.345	0.0	0.5919;
219	100.2	0.0	23.37	37.09	7275.2	9.209	0.348	0.0	0.5935;
220	100.2	0.0	23.43	37.07	7237.5	9.257	0.350	0.0	0.5951;
221	100.2	0.0	23.49	37.05	7200.2	9.305	0.352	0.0	0.5967;
222	100.2	0.0	23.55	37.04	7163.1	9.354	0.354	0.0	0.5983;
223	100.2	0.0	23.62	37.02	7126.2	9.402	0.356	0.0	0.5999;
224	100.2	0.0	23.68	37.00	7089.6	9.450	0.358	0.0	0.6014;
225	100.2	0.0	23.74	36.98	7053.3	9.499	0.361	0.0	0.6029;
226	100.2	0.0	23.80	36.96	7017.1	9.548	0.363	0.0	0.6045;
227	100.2	0.0	23.86	36.94	6981.2	9.597	0.365	0.0	0.6060;
228	100.2	0.0	23.92	36.92	6945.6	9.646	0.367	0.0	0.6075;
229	100.2	0.0	23.97	36.91	6910.1	9.696	0.369	0.0	0.6089;
230	100.2	0.0	24.03	36.89	6874.9	9.746	0.372	0.0	0.6104;
231	100.2	0.0	24.09	36.87	6839.8	9.796	0.374	0.0	0.6118;
232	100.2	0.0	24.14	36.85	6805.0	9.846	0.376	0.0	0.6133;
233	100.2	0.0	24.20	36.83	6770.4	9.896	0.378	0.0	0.6147;
234	100.2	0.0	24.25	36.82	6735.9	9.947	0.381	0.0	0.6161;
235	100.2	0.0	24.31	36.80	6701.6	9.998	0.383	0.0	0.6174;
236	100.2	0.0	24.36	36.78	6667.5	10.05	0.385	0.0	0.6188;
237	100.2	0.0	24.42	36.76	6633.6	10.10	0.388	0.0	0.6202;
238	100.2	0.0	24.47	36.75	6599.9	10.15	0.390	0.0	0.6215;
239	100.2	0.0	24.52	36.73	6566.3	10.20	0.393	0.0	0.6228;
240	100.2	0.0	24.57	36.71	6532.8	10.26	0.395	0.0	0.6241;
241	100.2	0.0	24.62	36.70	6499.5	10.31	0.397	0.0	0.6254;
242	100.2	0.0	24.67	36.68	6466.4	10.36	0.400	0.0	0.6267;
243	100.2	0.0	24.72	36.66	6433.4	10.41	0.402	0.0	0.6280;
244	100.2	0.0	24.77	36.65	6400.5	10.47	0.405	0.0	0.6292;
245	100.2	0.0	24.82	36.63	6367.8	10.52	0.407	0.0	0.6304;
246	100.2	0.0	24.87	36.61	6335.1	10.58	0.410	0.0	0.6317;
247	100.2	0.0	24.92	36.60	6302.6	10.63	0.412	0.0	0.6329;
248	100.2	0.0	24.96	36.58	6270.3	10.69	0.415	0.0	0.6341;
249	100.2	0.0	25.01	36.56	6238.0	10.74	0.417	0.0	0.6353;
250	100.2	0.0	25.06	36.55	6205.8	10.80	0.420	0.0	0.6364;
251	100.2	0.0	25.10	36.53	6173.7	10.85	0.422	0.0	0.6376;
252	100.3	0.0	25.15	36.51	6141.7	10.91	0.425	0.0	0.6387;
253	100.3	0.0	25.19	36.50	6109.8	10.97	0.428	0.0	0.6399;
254	100.3	0.0	25.24	36.48	6078.0	11.02	0.430	0.0	0.6410;
255	100.3	0.0	25.28	36.46	6046.2	11.08	0.433	0.0	0.6421;
256	100.3	0.0	25.32	36.45	6014.6	11.14	0.436	0.0	0.6432;
257	100.3	0.0	25.37	36.43	5982.9	11.20	0.439	0.0	0.6443;
258	100.3	0.0	25.41	36.42	5951.4	11.26	0.441	0.0	0.6454;
259	100.3	0.0	25.45	36.40	5919.9	11.32	0.444	0.0	0.6464;
260	100.3	0.0	25.49	36.38	5888.4	11.38	0.447	0.0	0.6475;
261	100.3	0.0	25.53	36.37	5857.0	11.44	0.450	0.0	0.6485;
262	100.3	0.0	25.57	36.35	5825.6	11.50	0.453	0.0	0.6496;
263	100.3	0.0	25.61	36.34	5794.3	11.56	0.456	0.0	0.6506;
264	100.3	0.0	25.65	36.32	5762.9	11.63	0.458	0.0	0.6516;
265	100.3	0.0	25.69	36.30	5731.6	11.69	0.461	0.0	0.6526;
266	100.3	0.0	25.73	36.29	5700.3	11.75	0.464	0.0	0.6536;
267	100.3	0.0	25.77	36.27	5669.0	11.82	0.467	0.0	0.6546;
268	100.3	0.0	25.81	36.26	5637.7	11.88	0.471	0.0	0.6556;
269	100.3	0.0	25.85	36.24	5606.3	11.95	0.474	0.0	0.6566;
270	100.3	0.0	25.89	36.22	5575.0	12.02	0.477	0.0	0.6576;
271	100.3	0.0	25.93	36.21	5543.6	12.09	0.480	0.0	0.6585;
272	100.3	0.0	25.96	36.19	5512.2	12.15	0.483	0.0	0.6595;
273	100.3	0.0	26.00	36.17	5480.7	12.22	0.486	0.0	0.6605;

274	100.4	0.0	26.04	36.16	5449.2	12.30	0.490	0.0	0.6614;
275	100.4	0.0	26.08	36.14	5417.6	12.37	0.493	0.0	0.6624;
276	100.4	0.0	26.12	36.13	5386.0	12.44	0.496	0.0	0.6633;
277	100.4	0.0	26.15	36.11	5354.3	12.51	0.500	0.0	0.6643;
278	100.4	0.0	26.19	36.09	5322.5	12.59	0.503	0.0	0.6653;
279	100.4	0.0	26.23	36.08	5290.6	12.66	0.506	0.0	0.6662;
280	100.4	0.0	26.27	36.06	5258.6	12.74	0.510	0.0	0.6672;
281	100.4	0.0	26.31	36.04	5226.4	12.82	0.513	0.0	0.6682;
282	100.4	0.0	26.34	36.03	5194.2	12.90	0.517	0.0	0.6691;
283	100.4	0.0	26.38	36.01	5161.8	12.98	0.521	0.0	0.6701;
284	100.4	0.0	26.42	35.99	5129.2	13.06	0.524	0.0	0.6711;
285	100.4	0.0	26.46	35.98	5096.5	13.15	0.528	0.0	0.6721;
286	100.4	0.0	26.50	35.96	5063.6	13.23	0.532	0.0	0.6731;
287	100.4	0.0	26.54	35.94	5030.5	13.32	0.536	0.0	0.6742;
288	100.4	0.0	26.58	35.93	4997.2	13.41	0.540	0.0	0.6752;
289	100.5	0.0	26.62	35.91	4963.7	13.50	0.543	0.0	0.6763;
290	100.5	0.0	26.67	35.89	4929.9	13.59	0.547	0.0	0.6774;
291	100.5	0.0	26.71	35.88	4895.9	13.69	0.551	0.0	0.6785;
292	100.5	0.0	26.76	35.86	4861.6	13.78	0.556	0.0	0.6796;
293	100.5	0.0	26.80	35.84	4827.0	13.88	0.560	0.0	0.6808;
294	100.5	0.0	26.85	35.82	4792.1	13.98	0.564	0.0	0.6820;
295	100.5	0.0	26.90	35.80	4756.9	14.08	0.568	0.0	0.6832;
296	100.5	0.0	26.95	35.79	4721.3	14.19	0.573	0.0	0.6844;
297	100.5	0.0	27.00	35.77	4685.4	14.30	0.577	0.0	0.6858;
298	100.5	0.0	27.05	35.75	4650.0	14.41	0.581	0.0	0.6870; end overlap;
299	100.6	0.0	27.10	35.73	4615.1	14.52	0.586	0.0	0.6882;
300	100.6	0.0	27.14	35.71	4580.6	14.63	0.591	0.0	0.6894;
301	100.6	0.0	27.18	35.70	4546.5	14.74	0.595	0.0	0.6904;
302	100.6	0.0	27.22	35.68	4512.8	14.85	0.600	0.0	0.6914;
303	100.6	0.0	27.26	35.66	4479.4	14.96	0.605	0.0	0.6923;
304	100.6	0.0	27.29	35.64	4446.3	15.07	0.610	0.0	0.6931;
305	100.6	0.0	27.32	35.63	4413.5	15.18	0.615	0.0	0.6939;
306	100.6	0.0	27.35	35.61	4381.0	15.29	0.620	0.0	0.6946;
307	100.7	0.0	27.37	35.59	4348.7	15.41	0.625	0.0	0.6952;
308	100.7	0.0	27.39	35.58	4316.7	15.52	0.630	0.0	0.6958;
309	100.7	0.0	27.41	35.56	4284.8	15.64	0.636	0.0	0.6963;
310	100.7	0.0	27.43	35.55	4253.0	15.75	0.641	0.0	0.6967;
311	100.7	0.0	27.45	35.53	4221.3	15.87	0.647	0.0	0.6971;
312	100.7	0.0	27.46	35.51	4189.7	15.99	0.653	0.0	0.6975;
313	100.8	0.0	27.47	35.50	4158.1	16.11	0.659	0.0	0.6978;
314	100.8	0.0	27.48	35.48	4126.6	16.24	0.665	0.0	0.6980;
315	100.8	0.0	27.49	35.46	4095.0	16.36	0.671	0.0	0.6983;
316	100.8	0.0	27.50	35.45	4063.3	16.49	0.677	0.0	0.6985;
317	100.8	0.0	27.51	35.43	4031.6	16.62	0.683	0.0	0.6986;
318	100.9	0.0	27.51	35.42	3999.6	16.75	0.690	0.0	0.6988;
319	100.9	0.0	27.52	35.40	3967.5	16.89	0.697	0.0	0.6989;
320	100.9	0.0	27.52	35.38	3935.2	17.03	0.703	0.0	0.6990;
321	100.9	0.0	27.53	35.37	3902.6	17.17	0.710	0.0	0.6992;
322	100.9	0.0	27.53	35.35	3869.7	17.31	0.718	0.0	0.6993;
323	101.0	0.0	27.54	35.33	3836.4	17.46	0.725	0.0	0.6994;
324	101.0	0.0	27.54	35.32	3802.7	17.62	0.732	0.0	0.6996;
325	101.0	0.0	27.55	35.30	3768.5	17.78	0.740	0.0	0.6997;
326	101.1	0.0	27.56	35.28	3733.8	17.94	0.748	0.0	0.7000;
327	101.1	0.0	27.57	35.26	3698.6	18.11	0.756	0.0	0.7002;
328	101.1	0.0	27.58	35.24	3662.8	18.29	0.765	0.0	0.7005;
329	101.2	0.0	27.59	35.22	3626.2	18.48	0.773	0.0	0.7009;

330	101.2	0.0	27.61	35.21	3589.0	18.67	0.782	0.0	0.7014;
331	101.2	0.0	27.63	35.19	3550.9	18.87	0.791	0.0	0.7019;
332	101.3	0.0	27.66	35.17	3512.0	19.08	0.800	0.0	0.7026;
333	101.3	0.0	27.69	35.15	3472.2	19.30	0.810	0.0	0.7033;
334	101.4	0.0	27.73	35.12	3431.4	19.53	0.820	0.0	0.7042;
335	101.4	0.0	27.77	35.10	3389.5	19.77	0.830	0.0	0.7053;
336	101.4	0.0	27.82	35.08	3346.6	20.02	0.841	0.0	0.7065;
337	101.5	0.0	27.87	35.06	3302.4	20.29	0.852	0.0	0.7080;
338	101.6	0.0	27.94	35.04	3257.0	20.57	0.863	0.0	0.7096;
339	101.6	0.0	28.01	35.01	3210.3	20.87	0.874	0.0	0.7115;
340	101.7	0.0	28.09	34.99	3162.2	21.19	0.886	0.0	0.7136;
341	101.7	0.0	28.19	34.96	3112.7	21.53	0.898	0.0	0.7160;
342	101.8	0.0	28.30	34.94	3061.6	21.88	0.911	0.0	0.7187;
343	101.9	0.0	28.42	34.91	3008.9	22.27	0.924	0.0	0.7218;
344	102.0	0.0	28.55	34.88	2954.5	22.68	0.938	0.0	0.7253;
345	102.0	0.0	28.71	34.85	2898.4	23.12	0.952	0.0	0.7292;
346	102.1	0.0	28.87	34.82	2841.6	23.58	0.966	0.0	0.7334;
347	102.2	0.0	29.05	34.79	2785.8	24.05	0.980	0.0	0.7378;
348	102.3	0.0	29.23	34.77	2731.1	24.53	0.994	0.0	0.7425;
349	102.4	0.0	29.43	34.74	2677.5	25.02	1.007	0.0	0.7474;
350	102.5	0.0	29.63	34.71	2624.9	25.52	1.020	0.0	0.7526;
351	102.6	0.0	29.85	34.68	2573.4	26.04	1.033	0.0	0.7581;
352	102.7	0.0	30.07	34.66	2522.9	26.56	1.046	0.0	0.7638;
353	102.7	0.0	30.30	34.63	2473.4	27.09	1.059	0.0	0.7697;
354	102.8	0.0	30.54	34.61	2424.9	27.63	1.071	0.0	0.7758;
355	102.9	0.0	30.79	34.58	2377.3	28.18	1.084	0.0	0.7822;
356	103.0	0.0	31.05	34.56	2330.6	28.75	1.096	0.0	0.7887;
357	103.1	0.0	31.32	34.54	2284.9	29.32	1.108	0.0	0.7955;
358	103.2	0.0	31.59	34.51	2240.1	29.91	1.120	0.0	0.8024;
359	103.3	0.0	31.87	34.49	2196.1	30.51	1.131	0.0	0.8096;
360	103.4	0.0	32.16	34.47	2153.0	31.12	1.143	0.0	0.8169;
361	103.5	0.0	32.46	34.45	2110.8	31.74	1.154	0.0	0.8244;
362	103.6	0.0	32.76	34.43	2069.3	32.38	1.166	0.0	0.8320;
363	103.7	0.0	33.07	34.41	2028.7	33.03	1.177	0.0	0.8399;
364	103.8	0.0	33.38	34.38	1988.9	33.69	1.188	0.0	0.8479;
365	103.9	0.0	33.70	34.36	1949.9	34.36	1.199	0.0	0.8561;
366	104.0	0.0	34.03	34.35	1911.6	35.05	1.210	0.0	0.8645;
367	104.1	0.0	34.37	34.33	1874.1	35.75	1.221	0.0	0.8730;
368	104.2	0.0	34.71	34.31	1837.4	36.47	1.231	0.0	0.8817;
369	104.3	0.0	35.06	34.29	1801.3	37.20	1.242	0.0	0.8905;
370	104.5	0.0	35.42	34.27	1766.0	37.94	1.252	0.0	0.8996; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 0.3817
Lmz(m): 0.3817
forced entrain 1 0.0 -1.357 0.900 0.0978
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632
;
2:07:00 PM. amb fills: 4

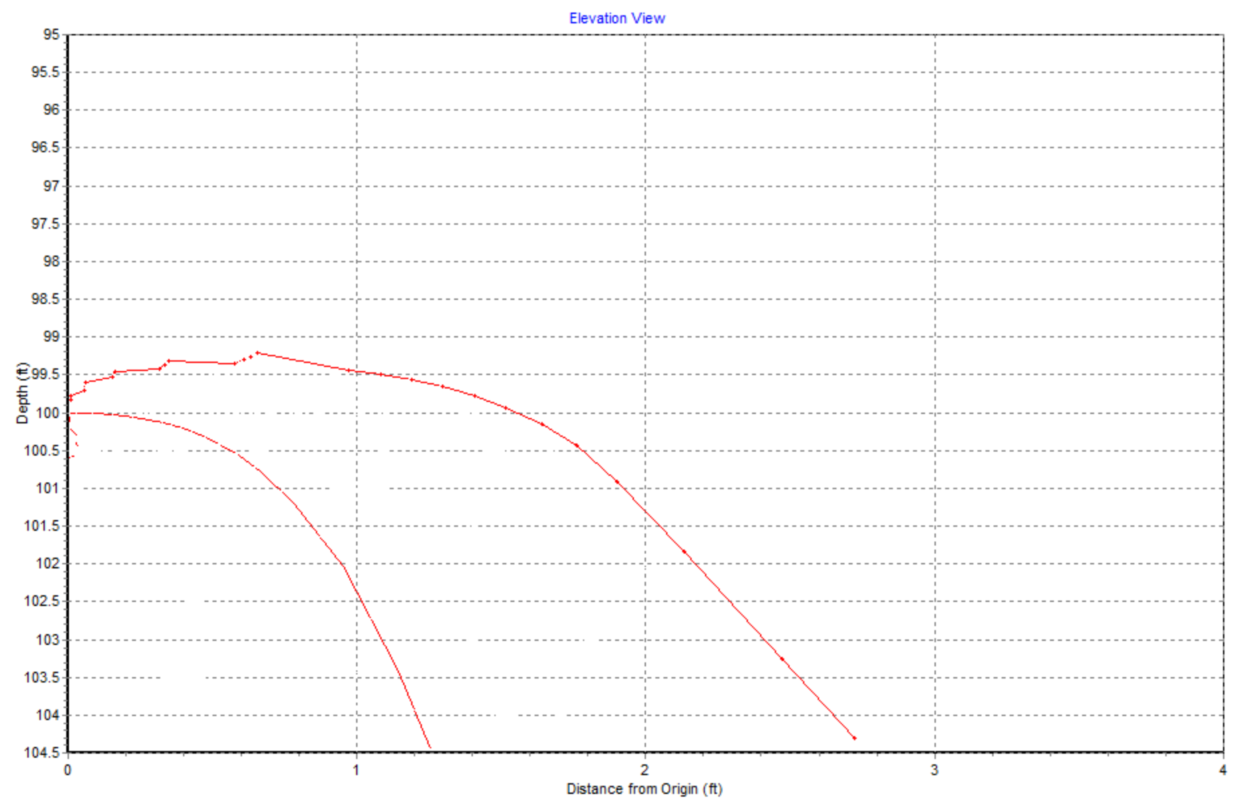

Figure C.5.1: Plumes 18b solution of discharge plume trajectories for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 99.3 ft. at Xa = 0.800 ft from the point of discharge. The centerline of the plume is at an average distance of Xb = 1.252 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

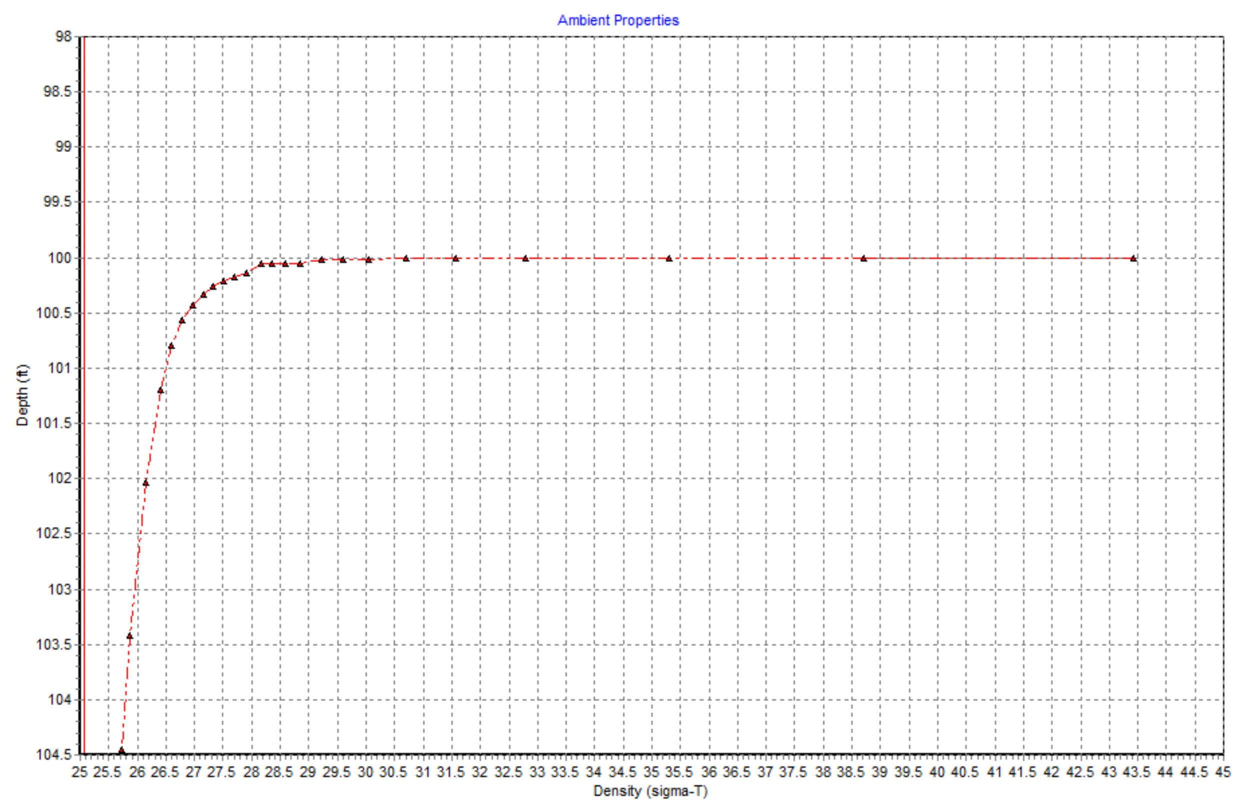

Figure C.5.2: Plumes 18b solution of vertical density profile for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

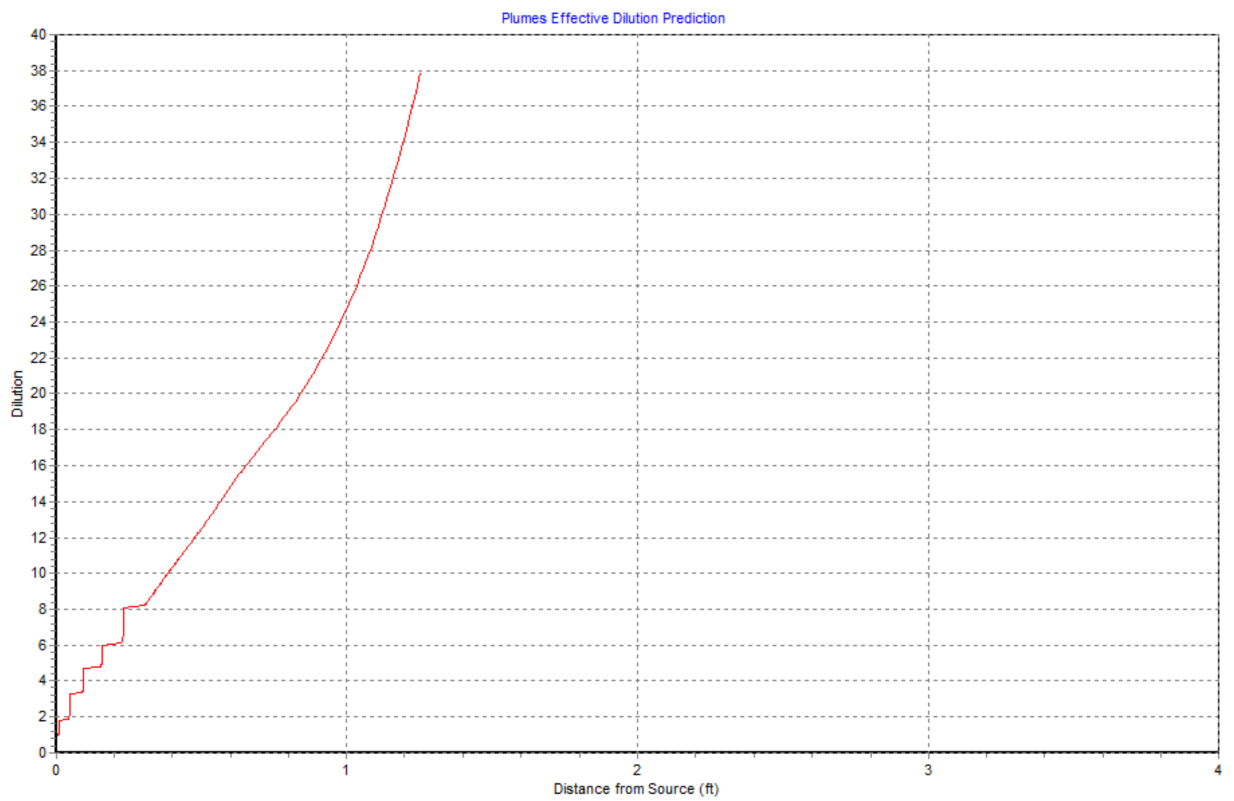

Figure C.5.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Effective dilution is S_a = 12.09 at the maximum rise of the plume at Xa = 6.038 ft. from the point of discharge. As the plume begins to impact the bottom, the plume centerline is at a distance of Xb = 10.14 ft from the point of discharge, where the effective dilution reaches S_a = 21.26.

C.6: Plumes 18b Results for SJCOO discharges of 0 mgd Wastewater and 3 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW0mgd_b3mgd_D-1"
memo
SJCOO discharging 0 mgd wastewater and 3 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 2:23:04 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW0mgd_b3mgd_D-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	3.0000	67.000	20.660	67000.0

Simulation:
Froude No: -1.678; Strat No:-1.57E-4; Spcg No: 14.39; k: 22307.6; eff den (sigmaT) 49.48870; eff vel 0.223(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (ft)	y-posn (ft)	Iso dia (m)
0	100.0	1.000E-5	3.050	67.00	67000.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.055	66.89	66769.4	1.003	0.00219	0.0	0.0776;
2	100.0	0.0	3.092	66.23	65430.1	1.024	0.00299	0.0	0.07853;
3	100.0	0.0	3.154	65.59	64118.2	1.045	0.0033	0.0	0.08011;
4	100.0	0.0	3.218	64.95	62833.3	1.066	0.00342	0.0	0.08173;
5	100.0	0.0	3.283	64.33	61574.6	1.088	0.00347	0.0	0.08339;
6	100.0	0.0	3.349	63.73	60341.7	1.110	0.00349	0.0	0.08507;
7	100.0	0.0	3.417	63.13	59133.9	1.133	0.00349	0.0	0.08679;
8	100.0	0.0	3.486	62.55	57950.9	1.156	0.0035	0.0	0.08855;
9	100.0	0.0	3.557	61.98	56791.9	1.180	0.0035	0.0	0.09034;
10	100.0	0.0	3.628	61.41	55656.6	1.204	0.0035	0.0	0.09216;
11	100.0	0.0	3.702	60.86	54544.3	1.228	0.0035	0.0	0.09402;
12	100.0	0.0	3.776	60.33	53454.7	1.253	0.0035	0.0	0.09592;
13	100.0	0.0	3.853	59.80	52387.3	1.279	0.0035	0.0	0.09786;
14	100.0	0.0	3.930	59.28	51341.6	1.305	0.0035	0.0	0.09983;
15	100.0	0.0	4.010	58.77	50317.1	1.332	0.0035	0.0	0.1018;
16	100.0	0.0	4.091	58.27	49313.3	1.359	0.0205	0.0	0.1039;
17	100.0	0.0	4.153	58.00	48774.2	1.374	0.0231	0.0	0.1055;
18	100.0	0.0	4.217	57.52	47801.7	1.402	0.024	0.0	0.1071;
19	100.0	0.0	4.302	57.05	46849.0	1.430	0.0244	0.0	0.1093;
20	100.0	0.0	4.389	56.58	45915.5	1.459	0.0246	0.0	0.1115;
21	100.0	0.0	4.477	56.13	45000.9	1.489	0.0246	0.0	0.1137;
22	100.0	0.0	4.567	55.68	44104.9	1.519	0.0246	0.0	0.1160;
23	100.0	0.0	4.659	55.24	43226.9	1.550	0.0246	0.0	0.1183;
24	100.0	0.0	4.753	54.81	42366.6	1.581	0.0246	0.0	0.1207;
25	100.0	0.0	4.849	54.39	41523.7	1.614	0.0246	0.0	0.1232;
26	100.0	0.0	4.947	53.98	40697.9	1.646	0.0246	0.0	0.1256;
27	100.0	0.0	5.046	53.58	39888.6	1.680	0.0246	0.0	0.1282;
28	100.0	0.0	5.148	53.18	39095.7	1.714	0.0246	0.0	0.1308;
29	100.0	0.0	5.250	52.80	38341.3	1.747	0.0246	0.0	0.1334; begin overlap;
30	100.0	0.0	5.351	52.44	37623.1	1.781	0.0246	0.0	0.1359;
31	100.0	0.0	5.445	52.14	37022.9	1.810	0.0246	0.0	0.1383;
32	100.0	0.0	5.544	51.78	36287.6	1.846	0.0472	0.0	0.1408;
33	100.0	0.0	5.601	51.68	36098.3	1.856	0.0491	0.0	0.1423;
34	100.0	0.0	5.662	51.38	35493.1	1.888	0.0499	0.0	0.1438;
35	100.0	0.0	5.756	51.09	34913.6	1.919	0.0501	0.0	0.1462;
36	100.0	0.0	5.849	50.81	34361.7	1.950	0.0503	0.0	0.1486;
37	100.0	0.0	5.941	50.55	33835.4	1.980	0.0503	0.0	0.1509;
38	100.0	0.0	6.031	50.29	33332.8	2.010	0.0503	0.0	0.1532;
39	100.0	0.0	6.120	50.05	32852.2	2.039	0.0503	0.0	0.1555;
40	100.0	0.0	6.208	49.82	32392.0	2.068	0.0503	0.0	0.1577;
41	100.0	0.0	6.295	49.60	31950.9	2.097	0.0503	0.0	0.1599;
42	100.0	0.0	6.380	49.39	31527.5	2.125	0.0503	0.0	0.1620;
43	100.0	0.0	6.464	49.18	31120.7	2.153	0.0503	0.0	0.1642;
44	100.0	0.0	6.547	48.99	30729.4	2.180	0.0503	0.0	0.1663;
45	100.0	0.0	6.629	48.80	30353.0	2.207	0.0503	0.0	0.1684;
46	100.0	0.0	6.710	48.61	29980.9	2.235	0.0503	0.0	0.1704;
47	100.0	0.0	6.796	48.41	29586.9	2.265	0.0503	0.0	0.1726;
48	100.0	0.0	6.910	48.12	29000.8	2.310	0.0776	0.0	0.1755;
49	100.0	0.0	6.940	48.08	28933.6	2.316	0.0792	0.0	0.1763;

50	100.0	0.0	6.985	47.92	28604.9	2.342	0.0798	0.0	0.1774;
51	100.0	0.0	7.062	47.76	28285.2	2.369	0.0801	0.0	0.1794;
52	100.0	0.0	7.140	47.60	27975.7	2.395	0.0802	0.0	0.1814;
53	100.0	0.0	7.218	47.45	27676.2	2.421	0.0802	0.0	0.1833;
54	100.0	0.0	7.295	47.30	27386.1	2.446	0.0802	0.0	0.1853;
55	100.0	0.0	7.371	47.16	27105.0	2.472	0.0802	0.0	0.1872;
56	100.0	0.0	7.446	47.02	26832.5	2.497	0.0802	0.0	0.1891;
57	100.0	0.0	7.520	46.89	26568.1	2.522	0.0802	0.0	0.1910;
58	100.0	0.0	7.594	46.76	26311.5	2.546	0.0802	0.0	0.1929;
59	100.0	0.0	7.667	46.63	26062.1	2.571	0.0802	0.0	0.1947;
60	100.0	0.0	7.739	46.51	25819.9	2.595	0.0802	0.0	0.1966;
61	100.0	0.0	7.811	46.39	25584.2	2.619	0.0802	0.0	0.1984;
62	100.0	0.0	7.882	46.28	25353.0	2.643	0.0802	0.0	0.2002;
63	100.0	0.0	7.953	46.16	25127.0	2.666	0.0802	0.0	0.2020;
64	100.0	0.0	8.069	45.91	24630.0	2.720	0.111	0.0	0.2050;
65	100.0	0.0	8.039	45.89	24595.0	2.724	0.112	0.0	0.2042;
66	100.0	0.0	8.076	45.78	24370.2	2.749	0.113	0.0	0.2051;
67	100.0	0.0	8.147	45.67	24149.9	2.774	0.113	0.0	0.2069;
68	100.0	0.0	8.219	45.56	23935.1	2.799	0.113	0.0	0.2088;
69	100.0	0.0	8.291	45.45	23725.9	2.824	0.113	0.0	0.2106;
70	100.0	0.0	8.363	45.35	23522.0	2.848	0.113	0.0	0.2124;
71	100.0	0.0	8.435	45.25	23323.3	2.873	0.113	0.0	0.2142;
72	100.0	0.0	8.506	45.15	23129.6	2.897	0.113	0.0	0.2160;
73	100.0	0.0	8.576	45.06	22940.7	2.921	0.113	0.0	0.2178;
74	100.0	0.0	8.646	44.96	22756.3	2.944	0.113	0.0	0.2196;
75	100.0	0.0	8.715	44.87	22576.4	2.968	0.113	0.0	0.2214;
76	100.0	0.0	8.784	44.78	22400.7	2.991	0.113	0.0	0.2231;
77	100.0	0.0	8.852	44.70	22229.0	3.014	0.113	0.0	0.2248;
78	100.0	0.0	8.919	44.61	22061.3	3.037	0.113	0.0	0.2265;
79	100.0	0.0	8.987	44.53	21894.6	3.060	0.113	0.0	0.2283;
80	100.0	0.0	9.050	44.46	21753.6	3.080	0.113	0.0	0.2299;
81	100.0	0.0	9.097	44.41	21667.9	3.092	0.113	0.0	0.2311;
82	100.0	0.0	9.206	44.20	21239.8	3.154	0.145	0.0	0.2338;
83	100.0	0.0	9.076	44.19	21217.9	3.158	0.147	0.0	0.2305;
84	100.0	0.0	9.107	44.10	21044.5	3.184	0.147	0.0	0.2313;
85	100.0	0.0	9.177	44.01	20873.7	3.210	0.148	0.0	0.2331;
86	100.0	0.0	9.249	43.93	20706.6	3.236	0.148	0.0	0.2349;
87	100.0	0.0	9.321	43.84	20543.3	3.261	0.148	0.0	0.2368;
88	100.0	0.0	9.394	43.76	20383.7	3.287	0.148	0.0	0.2386;
89	100.0	0.0	9.467	43.68	20227.8	3.312	0.148	0.0	0.2405;
90	100.0	0.0	9.539	43.61	20075.4	3.337	0.148	0.0	0.2423;
91	100.0	0.0	9.610	43.53	19926.4	3.362	0.148	0.0	0.2441;
92	100.0	0.0	9.681	43.46	19780.7	3.387	0.148	0.0	0.2459;
93	100.0	0.0	9.752	43.39	19638.2	3.412	0.148	0.0	0.2477;
94	100.0	0.0	9.822	43.32	19498.7	3.436	0.148	0.0	0.2495;
95	100.0	0.0	9.891	43.25	19362.2	3.460	0.148	0.0	0.2512;
96	100.0	0.0	9.960	43.18	19228.5	3.484	0.148	0.0	0.2530;
97	100.0	0.0	10.03	43.11	19097.7	3.508	0.148	0.0	0.2547;
98	100.0	0.0	10.10	43.05	18970.7	3.532	0.148	0.0	0.2564;
99	100.0	0.0	10.16	42.99	18850.8	3.554	0.148	0.0	0.2581;
100	100.0	0.0	10.22	42.93	18738.9	3.575	0.148	0.0	0.2597;
101	100.0	0.0	10.28	42.89	18656.2	3.591	0.148	0.0	0.2610;
102	100.1	0.0	10.40	42.70	18288.0	3.664	0.181	0.0	0.2642;
103	100.1	0.0	10.13	42.69	18272.3	3.667	0.183	0.0	0.2573;
104	100.1	0.0	10.16	42.62	18126.7	3.696	0.183	0.0	0.2581;
105	100.1	0.0	10.23	42.55	17982.9	3.726	0.184	0.0	0.2599;

106	100.1	0.0	10.31	42.48	17841.9	3.755	0.184	0.0	0.2619;
107	100.1	0.0	10.39	42.41	17703.8	3.784	0.184	0.0	0.2639;
108	100.1	0.0	10.47	42.34	17568.8	3.814	0.184	0.0	0.2659;
109	100.1	0.0	10.55	42.27	17436.7	3.842	0.184	0.0	0.2679;
110	100.1	0.0	10.62	42.20	17307.5	3.871	0.184	0.0	0.2699;
111	100.1	0.0	10.70	42.14	17181.1	3.900	0.184	0.0	0.2718;
112	100.1	0.0	10.78	42.08	17057.5	3.928	0.184	0.0	0.2738;
113	100.1	0.0	10.86	42.02	16936.5	3.956	0.184	0.0	0.2758;
114	100.1	0.0	10.93	41.96	16818.1	3.984	0.184	0.0	0.2777;
115	100.1	0.0	11.01	41.90	16702.1	4.011	0.184	0.0	0.2797;
116	100.1	0.0	11.09	41.84	16588.5	4.039	0.184	0.0	0.2816;
117	100.1	0.0	11.16	41.78	16477.2	4.066	0.184	0.0	0.2835;
118	100.1	0.0	11.24	41.73	16368.1	4.093	0.184	0.0	0.2854;
119	100.1	0.0	11.31	41.67	16261.2	4.120	0.184	0.0	0.2873;
120	100.1	0.0	11.38	41.62	16156.2	4.147	0.184	0.0	0.2891;
121	100.1	0.0	11.46	41.57	16053.4	4.174	0.184	0.0	0.2910;
122	100.1	0.0	11.53	41.52	15952.6	4.200	0.184	0.0	0.2928;
123	100.1	0.0	11.60	41.47	15855.9	4.226	0.184	0.0	0.2947;
124	100.1	0.0	11.67	41.42	15755.6	4.252	0.184	0.0	0.2965;
125	100.1	0.0	11.75	41.36	15649.0	4.281	0.184	0.0	0.2984;
126	100.1	0.0	11.91	41.20	15340.5	4.368	0.218	0.0	0.3024;
127	100.1	0.0	11.44	41.20	15328.8	4.371	0.220	0.0	0.2906;
128	100.1	0.0	11.47	41.14	15203.5	4.407	0.221	0.0	0.2913;
129	100.1	0.0	11.55	41.07	15079.3	4.443	0.221	0.0	0.2933;
130	100.1	0.0	11.63	41.01	14957.2	4.479	0.222	0.0	0.2954;
131	100.1	0.0	11.72	40.95	14837.5	4.516	0.222	0.0	0.2976;
132	100.1	0.0	11.81	40.89	14720.2	4.552	0.222	0.0	0.2999;
133	100.1	0.0	11.90	40.83	14605.3	4.587	0.222	0.0	0.3021;
134	100.1	0.0	11.99	40.77	14493.0	4.623	0.222	0.0	0.3044;
135	100.1	0.0	12.08	40.72	14383.0	4.658	0.222	0.0	0.3067;
136	100.1	0.0	12.17	40.66	14275.5	4.693	0.222	0.0	0.3090;
137	100.1	0.0	12.26	40.61	14170.3	4.728	0.222	0.0	0.3113;
138	100.1	0.0	12.35	40.56	14067.3	4.763	0.223	0.0	0.3136;
139	100.1	0.0	12.43	40.51	13966.6	4.797	0.223	0.0	0.3158;
140	100.1	0.0	12.52	40.46	13868.0	4.831	0.223	0.0	0.3181;
141	100.1	0.0	12.61	40.41	13771.4	4.865	0.223	0.0	0.3203;
142	100.1	0.0	12.70	40.36	13676.8	4.899	0.223	0.0	0.3225;
143	100.1	0.0	12.79	40.31	13584.2	4.932	0.223	0.0	0.3247;
144	100.1	0.0	12.87	40.27	13493.4	4.965	0.223	0.0	0.3269;
145	100.1	0.0	12.96	40.22	13404.4	4.998	0.223	0.0	0.3291;
146	100.1	0.0	13.04	40.18	13317.2	5.031	0.223	0.0	0.3313;
147	100.1	0.0	13.13	40.13	13231.6	5.064	0.223	0.0	0.3334;
148	100.1	0.0	13.21	40.09	13147.7	5.096	0.223	0.0	0.3356;
149	100.1	0.0	13.29	40.05	13065.4	5.128	0.223	0.0	0.3377;
150	100.1	0.0	13.38	40.01	12984.6	5.160	0.223	0.0	0.3398;
151	100.1	0.0	13.46	39.97	12905.3	5.192	0.223	0.0	0.3419;
152	100.1	0.0	13.54	39.93	12827.5	5.223	0.223	0.0	0.3440;
153	100.1	0.0	13.62	39.89	12751.0	5.254	0.223	0.0	0.3460;
154	100.1	0.0	13.70	39.85	12676.0	5.286	0.223	0.0	0.3481;
155	100.1	0.0	13.79	39.81	12602.2	5.317	0.223	0.0	0.3501;
156	100.1	0.0	13.87	39.77	12529.6	5.347	0.223	0.0	0.3522;
157	100.1	0.0	13.95	39.74	12458.4	5.378	0.223	0.0	0.3542;
158	100.1	0.0	14.02	39.70	12388.7	5.408	0.223	0.0	0.3562;
159	100.1	0.0	14.10	39.67	12318.2	5.439	0.223	0.0	0.3582;
160	100.1	0.0	14.18	39.63	12249.7	5.470	0.223	0.0	0.3602;
161	100.1	0.0	14.27	39.59	12174.1	5.503	0.223	0.0	0.3624;

162	100.1	0.0	14.38	39.53	12056.1	5.557	0.223	0.0	0.3653;
163	100.1	0.0	14.49	39.50	11990.5	5.588	0.223	0.0	0.3680;
164	100.1	0.0	14.56	39.47	11938.4	5.612	0.223	0.0	0.3698;
165	100.1	0.0	14.61	39.46	11903.6	5.629	0.223	0.0	0.3712;
166	100.1	0.0	14.78	39.34	11669.2	5.742	0.259	0.0	0.3754;
167	100.1	0.0	13.88	39.33	11662.2	5.745	0.261	0.0	0.3525;
168	100.1	0.0	13.90	39.28	11565.7	5.793	0.262	0.0	0.3531;
169	100.1	0.0	13.99	39.23	11469.7	5.841	0.263	0.0	0.3553;
170	100.1	0.0	14.07	39.19	11374.5	5.890	0.264	0.0	0.3575;
171	100.1	0.0	14.16	39.14	11280.4	5.940	0.265	0.0	0.3597;
172	100.1	0.0	14.25	39.09	11187.3	5.989	0.266	0.0	0.3620;
173	100.1	0.0	14.35	39.04	11095.3	6.039	0.266	0.0	0.3644;
174	100.1	0.0	14.44	39.00	11004.5	6.088	0.267	0.0	0.3668;
175	100.1	0.0	14.53	38.95	10914.9	6.138	0.268	0.0	0.3692;
176	100.2	0.0	14.63	38.91	10826.5	6.189	0.269	0.0	0.3716;
177	100.2	0.0	14.73	38.86	10739.2	6.239	0.269	0.0	0.3740;
178	100.2	0.0	14.82	38.82	10653.1	6.289	0.270	0.0	0.3765;
179	100.2	0.0	14.92	38.77	10568.1	6.340	0.271	0.0	0.3789;
180	100.2	0.0	15.01	38.73	10484.2	6.391	0.272	0.0	0.3814;
181	100.2	0.0	15.11	38.69	10401.5	6.441	0.272	0.0	0.3838;
182	100.2	0.0	15.21	38.65	10319.8	6.492	0.273	0.0	0.3863;
183	100.2	0.0	15.30	38.61	10239.2	6.544	0.274	0.0	0.3887;
184	100.2	0.0	15.40	38.57	10159.5	6.595	0.275	0.0	0.3911;
185	100.2	0.0	15.49	38.53	10080.8	6.646	0.275	0.0	0.3935;
186	100.2	0.0	15.59	38.49	10003.0	6.698	0.276	0.0	0.3959;
187	100.2	0.0	15.68	38.45	9926.0	6.750	0.277	0.0	0.3982;
188	100.2	0.0	15.77	38.41	9849.8	6.802	0.278	0.0	0.4006;
189	100.2	0.0	15.86	38.37	9774.4	6.855	0.279	0.0	0.4029;
190	100.2	0.0	15.95	38.33	9699.6	6.907	0.280	0.0	0.4051;
191	100.2	0.0	16.04	38.29	9625.4	6.961	0.281	0.0	0.4073;
192	100.2	0.0	16.12	38.26	9551.7	7.014	0.282	0.0	0.4095;
193	100.2	0.0	16.20	38.22	9478.4	7.069	0.283	0.0	0.4116;
194	100.2	0.0	16.28	38.18	9405.5	7.124	0.284	0.0	0.4136;
195	100.2	0.0	16.36	38.14	9332.7	7.179	0.286	0.0	0.4155;
196	100.2	0.0	16.43	38.11	9263.3	7.233	0.287	0.0	0.4173;
197	100.2	0.0	16.49	38.08	9197.6	7.285	0.289	0.0	0.4189;
198	100.2	0.0	16.55	38.04	9132.4	7.337	0.290	0.0	0.4203;
199	100.2	0.0	16.61	38.01	9067.8	7.389	0.292	0.0	0.4218;
200	100.2	0.0	16.66	37.98	9003.7	7.441	0.293	0.0	0.4232;
201	100.2	0.0	16.72	37.94	8940.2	7.494	0.295	0.0	0.4246;
202	100.2	0.0	16.77	37.91	8877.2	7.547	0.297	0.0	0.4260;
203	100.2	0.0	16.83	37.88	8814.7	7.601	0.298	0.0	0.4274;
204	100.2	0.0	16.88	37.85	8752.7	7.655	0.300	0.0	0.4288;
205	100.2	0.0	16.94	37.82	8691.1	7.709	0.301	0.0	0.4302;
206	100.2	0.0	16.99	37.79	8630.0	7.764	0.303	0.0	0.4315;
207	100.2	0.0	17.04	37.75	8569.3	7.819	0.305	0.0	0.4328;
208	100.2	0.0	17.09	37.72	8509.0	7.874	0.306	0.0	0.4341;
209	100.2	0.0	17.14	37.69	8449.1	7.930	0.308	0.0	0.4354;
210	100.2	0.0	17.19	37.66	8389.5	7.986	0.310	0.0	0.4367;
211	100.2	0.0	17.24	37.63	8330.4	8.043	0.311	0.0	0.4380;
212	100.2	0.0	17.29	37.60	8271.6	8.100	0.313	0.0	0.4393;
213	100.2	0.0	17.34	37.57	8213.1	8.158	0.315	0.0	0.4405;
214	100.2	0.0	17.39	37.54	8154.9	8.216	0.317	0.0	0.4418;
215	100.2	0.0	17.44	37.51	8097.0	8.275	0.318	0.0	0.4430;
216	100.2	0.0	17.49	37.48	8039.5	8.334	0.320	0.0	0.4442;
217	100.2	0.0	17.54	37.45	7982.1	8.394	0.322	0.0	0.4454;

218	100.2	0.0	17.58	37.42	7925.1	8.454	0.324	0.0	0.4466;
219	100.2	0.0	17.63	37.40	7868.2	8.515	0.326	0.0	0.4478;
220	100.2	0.0	17.67	37.37	7811.6	8.577	0.328	0.0	0.4489;
221	100.2	0.0	17.72	37.34	7755.2	8.639	0.329	0.0	0.4501;
222	100.3	0.0	17.77	37.31	7699.0	8.702	0.331	0.0	0.4512;
223	100.3	0.0	17.81	37.28	7642.9	8.766	0.333	0.0	0.4524;
224	100.3	0.0	17.86	37.25	7587.0	8.831	0.335	0.0	0.4535;
225	100.3	0.0	17.90	37.22	7531.3	8.896	0.337	0.0	0.4546;
226	100.3	0.0	17.94	37.20	7475.6	8.962	0.339	0.0	0.4558;
227	100.3	0.0	17.99	37.17	7420.1	9.030	0.341	0.0	0.4569;
228	100.3	0.0	18.03	37.14	7364.6	9.098	0.343	0.0	0.4580;
229	100.3	0.0	18.07	37.11	7309.2	9.167	0.345	0.0	0.4591;
230	100.3	0.0	18.12	37.08	7253.8	9.237	0.348	0.0	0.4602;
231	100.3	0.0	18.16	37.05	7198.5	9.308	0.350	0.0	0.4613;
232	100.3	0.0	18.20	37.03	7143.2	9.380	0.352	0.0	0.4624;
233	100.3	0.0	18.25	37.00	7087.8	9.453	0.354	0.0	0.4635;
234	100.3	0.0	18.29	36.97	7032.4	9.527	0.356	0.0	0.4646;
235	100.3	0.0	18.33	36.94	6977.0	9.603	0.359	0.0	0.4657;
236	100.3	0.0	18.38	36.91	6921.4	9.680	0.361	0.0	0.4668;
237	100.3	0.0	18.42	36.88	6865.8	9.759	0.363	0.0	0.4679;
238	100.3	0.0	18.46	36.85	6810.0	9.838	0.366	0.0	0.4690;
239	100.3	0.0	18.51	36.83	6754.1	9.920	0.368	0.0	0.4701;
240	100.3	0.0	18.55	36.80	6698.0	10.00	0.370	0.0	0.4712;
241	100.3	0.0	18.60	36.77	6641.6	10.09	0.373	0.0	0.4724;
242	100.3	0.0	18.64	36.74	6585.1	10.17	0.375	0.0	0.4735;
243	100.4	0.0	18.69	36.71	6528.2	10.26	0.378	0.0	0.4747;
244	100.4	0.0	18.74	36.68	6471.0	10.35	0.380	0.0	0.4759;
245	100.4	0.0	18.78	36.65	6413.5	10.45	0.383	0.0	0.4771;
246	100.4	0.0	18.83	36.62	6355.6	10.54	0.386	0.0	0.4783;
247	100.4	0.0	18.88	36.59	6297.4	10.64	0.389	0.0	0.4796;
248	100.4	0.0	18.93	36.56	6240.4	10.74	0.391	0.0	0.4808; end overlap;
249	100.4	0.0	18.97	36.53	6184.4	10.83	0.394	0.0	0.4819;
250	100.4	0.0	19.02	36.51	6129.4	10.93	0.397	0.0	0.4830;
251	100.4	0.0	19.05	36.48	6075.3	11.03	0.400	0.0	0.4840;
252	100.4	0.0	19.09	36.45	6022.1	11.13	0.403	0.0	0.4848;
253	100.4	0.0	19.12	36.43	5969.8	11.22	0.406	0.0	0.4857;
254	100.4	0.0	19.15	36.40	5918.2	11.32	0.409	0.0	0.4864;
255	100.5	0.0	19.17	36.37	5867.2	11.42	0.412	0.0	0.4870;
256	100.5	0.0	19.20	36.35	5816.9	11.52	0.415	0.0	0.4876;
257	100.5	0.0	19.22	36.32	5767.2	11.62	0.419	0.0	0.4881;
258	100.5	0.0	19.23	36.30	5718.0	11.72	0.422	0.0	0.4885;
259	100.5	0.0	19.25	36.27	5669.2	11.82	0.425	0.0	0.4889;
260	100.5	0.0	19.26	36.25	5620.8	11.92	0.429	0.0	0.4892;
261	100.5	0.0	19.27	36.22	5572.7	12.02	0.433	0.0	0.4894;
262	100.5	0.0	19.28	36.20	5524.8	12.13	0.436	0.0	0.4896;
263	100.5	0.0	19.28	36.17	5477.0	12.23	0.440	0.0	0.4897;
264	100.6	0.0	19.28	36.15	5429.4	12.34	0.444	0.0	0.4898;
265	100.6	0.0	19.29	36.12	5381.8	12.45	0.448	0.0	0.4899;
266	100.6	0.0	19.29	36.10	5334.1	12.56	0.452	0.0	0.4899;
267	100.6	0.0	19.29	36.08	5286.2	12.67	0.456	0.0	0.4899;
268	100.6	0.0	19.28	36.05	5238.1	12.79	0.461	0.0	0.4898;
269	100.6	0.0	19.28	36.03	5189.7	12.91	0.465	0.0	0.4897;
270	100.7	0.0	19.28	36.00	5140.9	13.03	0.470	0.0	0.4897;
271	100.7	0.0	19.27	35.98	5091.5	13.16	0.474	0.0	0.4896;
272	100.7	0.0	19.27	35.95	5041.6	13.29	0.479	0.0	0.4895;
273	100.7	0.0	19.27	35.92	4990.9	13.42	0.484	0.0	0.4894;

274	100.7	0.0	19.27	35.90	4939.4	13.56	0.489	0.0	0.4894;
275	100.8	0.0	19.27	35.87	4886.9	13.71	0.495	0.0	0.4893;
276	100.8	0.0	19.27	35.84	4833.4	13.86	0.500	0.0	0.4894;
277	100.8	0.0	19.27	35.82	4778.8	14.02	0.506	0.0	0.4895;
278	100.9	0.0	19.28	35.79	4722.8	14.19	0.512	0.0	0.4896;
279	100.9	0.0	19.28	35.76	4665.4	14.36	0.518	0.0	0.4898;
280	100.9	0.0	19.30	35.73	4606.4	14.54	0.524	0.0	0.4902;
281	100.9	0.0	19.31	35.70	4545.7	14.74	0.530	0.0	0.4906;
282	101.0	0.0	19.34	35.66	4483.2	14.94	0.537	0.0	0.4912;
283	101.0	0.0	19.37	35.63	4418.7	15.16	0.544	0.0	0.4919;
284	101.1	0.0	19.40	35.60	4352.0	15.40	0.551	0.0	0.4928;
285	101.1	0.0	19.44	35.56	4283.0	15.64	0.559	0.0	0.4939;
286	101.2	0.0	19.50	35.52	4211.5	15.91	0.566	0.0	0.4952;
287	101.2	0.0	19.56	35.49	4137.4	16.19	0.574	0.0	0.4968;
288	101.3	0.0	19.63	35.45	4060.6	16.50	0.583	0.0	0.4987;
289	101.3	0.0	19.72	35.41	3980.8	16.83	0.592	0.0	0.5008;
290	101.4	0.0	19.81	35.37	3902.7	17.17	0.600	0.0	0.5031;
291	101.4	0.0	19.90	35.33	3826.0	17.51	0.608	0.0	0.5056;
292	101.5	0.0	20.01	35.29	3750.9	17.86	0.617	0.0	0.5083;
293	101.6	0.0	20.13	35.25	3677.3	18.22	0.625	0.0	0.5112;
294	101.6	0.0	20.25	35.21	3605.1	18.58	0.633	0.0	0.5143;
295	101.7	0.0	20.38	35.18	3534.3	18.96	0.640	0.0	0.5177;
296	101.7	0.0	20.52	35.14	3464.9	19.34	0.648	0.0	0.5212;
297	101.8	0.0	20.66	35.11	3396.9	19.72	0.655	0.0	0.5249;
298	101.9	0.0	20.82	35.07	3330.2	20.12	0.663	0.0	0.5287;
299	101.9	0.0	20.97	35.04	3264.8	20.52	0.670	0.0	0.5328;
300	102.0	0.0	21.14	35.01	3200.7	20.93	0.677	0.0	0.5369;
301	102.1	0.0	21.31	34.97	3137.9	21.35	0.684	0.0	0.5413;
302	102.1	0.0	21.49	34.94	3076.3	21.78	0.691	0.0	0.5457;
303	102.2	0.0	21.67	34.91	3015.9	22.22	0.698	0.0	0.5503;
304	102.2	0.0	21.85	34.88	2956.7	22.66	0.705	0.0	0.5551;
305	102.3	0.0	22.05	34.85	2898.7	23.11	0.712	0.0	0.5600;
306	102.4	0.0	22.24	34.82	2841.8	23.58	0.718	0.0	0.5650;
307	102.5	0.0	22.44	34.79	2786.0	24.05	0.725	0.0	0.5701;
308	102.5	0.0	22.65	34.77	2731.3	24.53	0.731	0.0	0.5754;
309	102.6	0.0	22.86	34.74	2677.7	25.02	0.738	0.0	0.5807;
310	102.7	0.0	23.08	34.71	2625.2	25.52	0.744	0.0	0.5862;
311	102.7	0.0	23.30	34.68	2573.6	26.03	0.750	0.0	0.5919;
312	102.8	0.0	23.53	34.66	2523.1	26.55	0.757	0.0	0.5976;
313	102.9	0.0	23.76	34.63	2473.6	27.09	0.763	0.0	0.6034;
314	102.9	0.0	23.99	34.61	2425.1	27.63	0.769	0.0	0.6094;
315	103.0	0.0	24.23	34.58	2377.5	28.18	0.775	0.0	0.6155;
316	103.1	0.0	24.48	34.56	2330.8	28.75	0.781	0.0	0.6217;
317	103.2	0.0	24.73	34.54	2285.1	29.32	0.787	0.0	0.6280;
318	103.3	0.0	24.98	34.51	2240.2	29.91	0.793	0.0	0.6345;
319	103.3	0.0	25.24	34.49	2196.3	30.51	0.799	0.0	0.6410;
320	103.4	0.0	25.50	34.47	2153.2	31.12	0.805	0.0	0.6476;
321	103.5	0.0	25.76	34.45	2110.9	31.74	0.810	0.0	0.6544;
322	103.6	0.0	26.04	34.43	2069.5	32.37	0.816	0.0	0.6613;
323	103.6	0.0	26.31	34.41	2028.9	33.02	0.822	0.0	0.6683;
324	103.7	0.0	26.59	34.38	1989.1	33.68	0.827	0.0	0.6754;
325	103.8	0.0	26.87	34.36	1950.1	34.36	0.833	0.0	0.6826;
326	103.9	0.0	27.16	34.35	1911.8	35.05	0.838	0.0	0.6899;
327	104.0	0.0	27.46	34.33	1874.3	35.75	0.844	0.0	0.6974;
328	104.1	0.0	27.75	34.31	1837.5	36.46	0.849	0.0	0.7049;
329	104.2	0.0	28.06	34.29	1801.4	37.19	0.855	0.0	0.7126;

330	104.2	0.0	28.36	34.27	1766.1	37.94	0.860	0.0	0.7204;
331	104.3	0.0	28.67	34.25	1731.5	38.70	0.866	0.0	0.7283;
332	104.4	0.0	28.99	34.24	1697.5	39.47	0.871	0.0	0.7363;
333	104.5	0.0	29.31	34.22	1664.2	40.26	0.876	0.0	0.7444; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 0.2671
Lmz(m): 0.2671
forced entrain 1 0.0 -1.375 0.744 0.0595
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632
;
2:23:05 PM. amb fills: 4

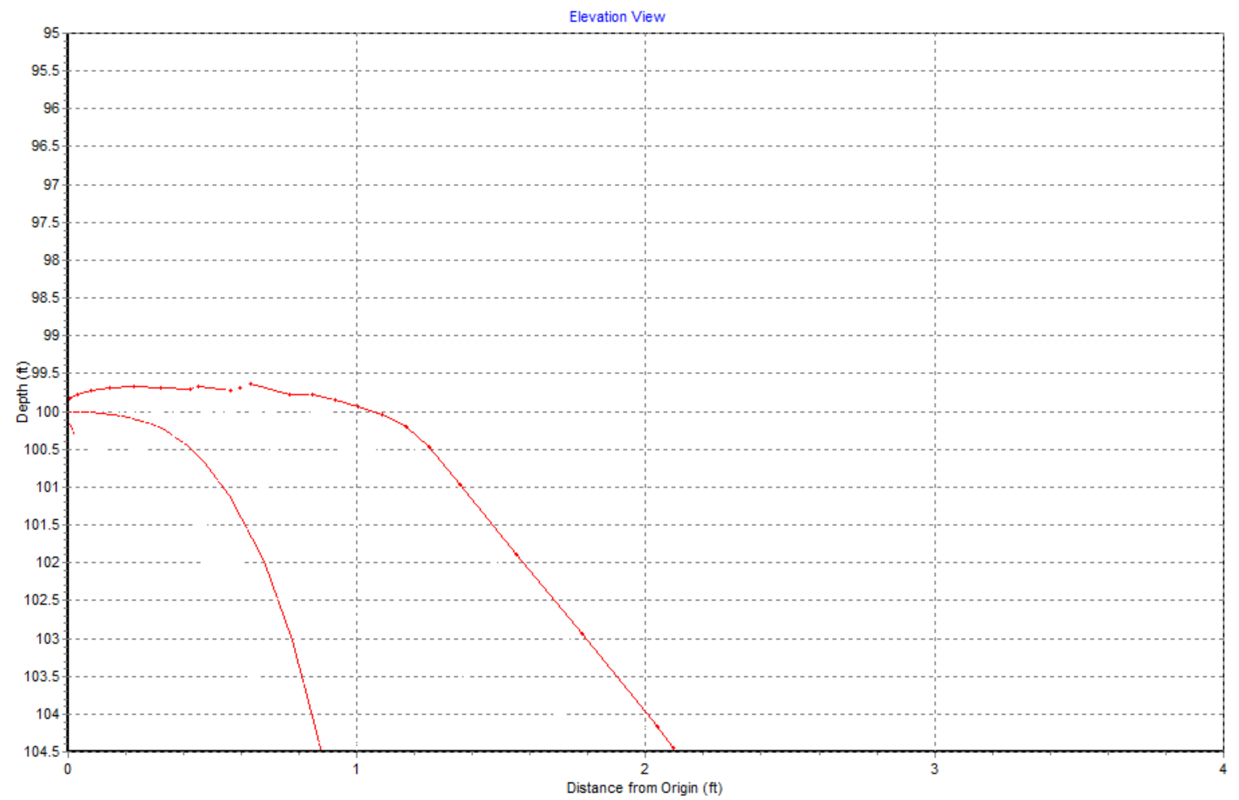

Figure C.6.1: Plumes 18b solution of discharge plume trajectories for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 3 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 99.8 ft. at Xa = 0.750 ft from the point of discharge. The centerline of the plume is at an average distance of Xb = 0.876 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

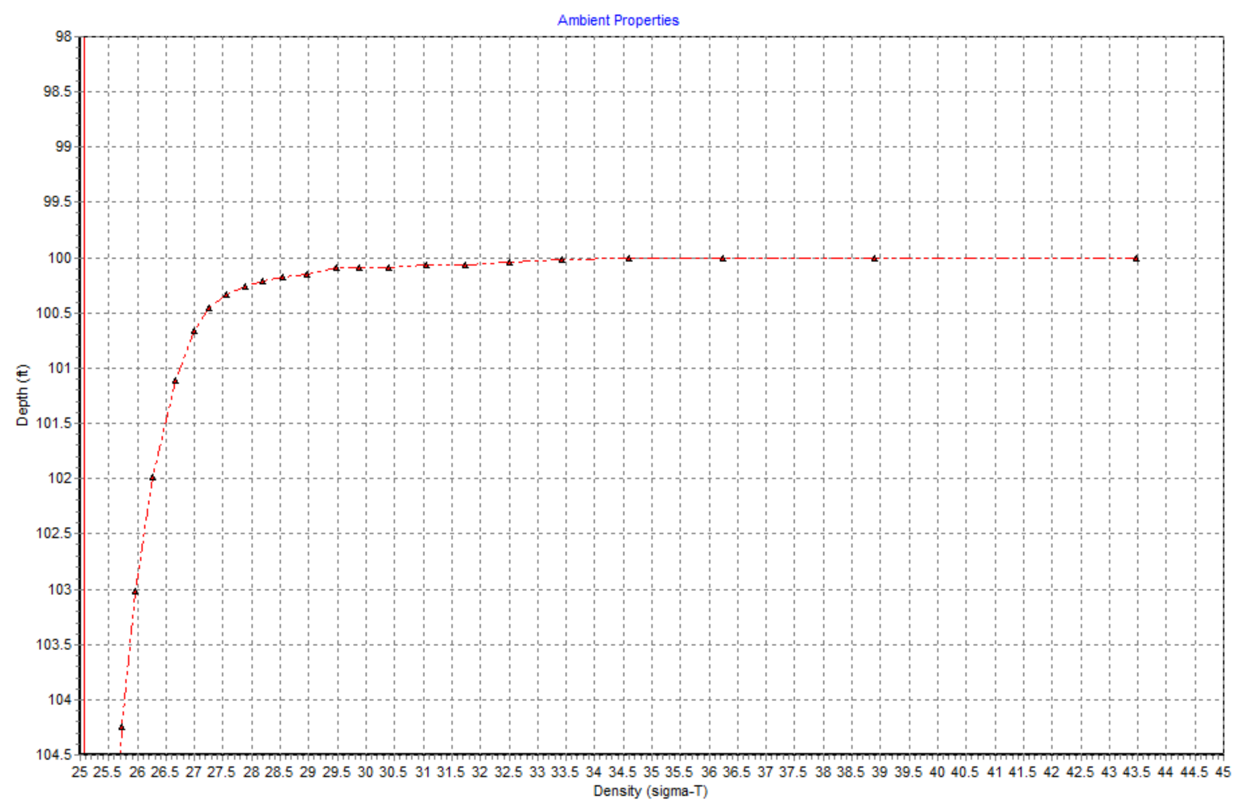

Figure C.6.2: Plumes 18b solution of vertical density profile for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 3 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

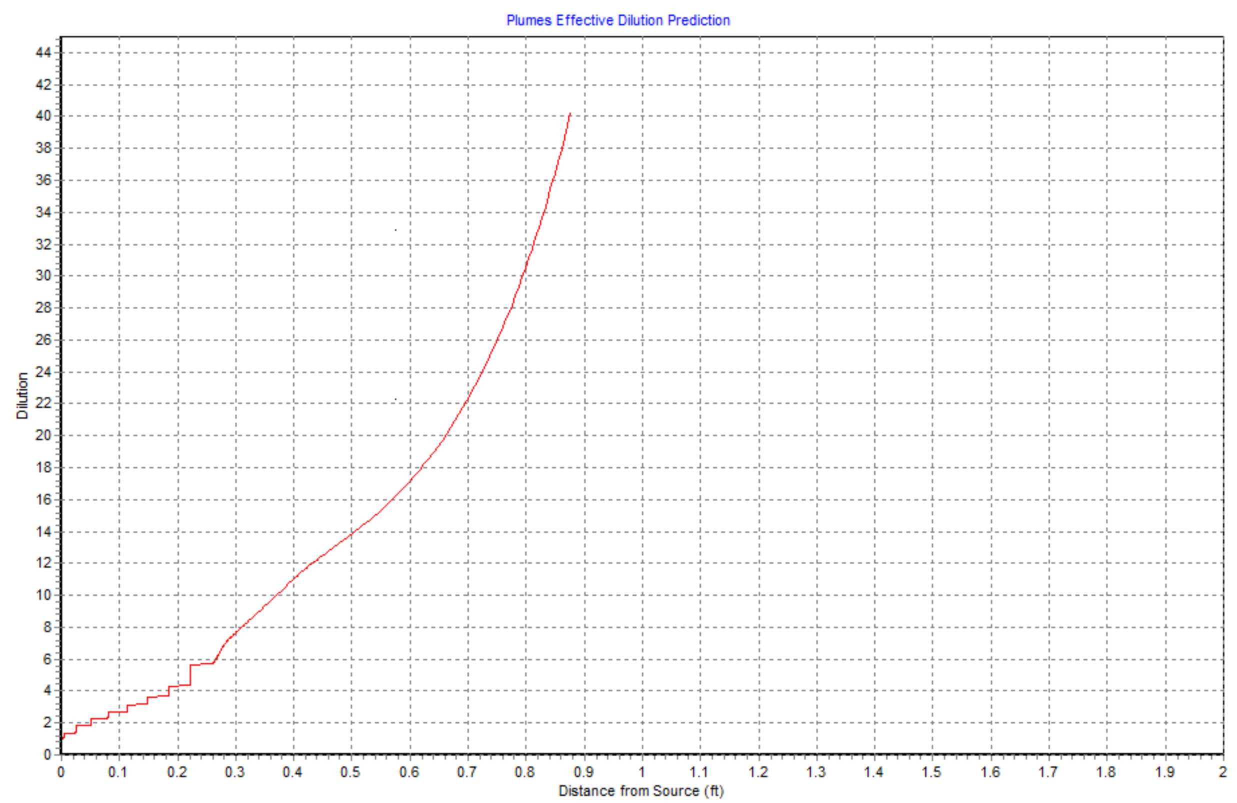

Figure C.6.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 0 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 3 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Effective dilution is S_a = 26.03 at the maximum rise of the plume at Xa = 0.750 ft. from the point of discharge. As the plume begins to impact the bottom, the plume centerline is at a distance of Xb = 0.876 ft from the point of discharge, where the effective dilution reaches S_a = 40.26.

C.7: Plumes 18b Results for SJCOO discharges of 0.35 mgd Wastewater and 5 mgd Brine:

Contents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WW0.35mgd_b5mgd_D-1"
memo
SJCOO discharging 0.35 mgd wastewater and 5 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 2:50:38 PM
Case 1; ambient file C:\Plumes18\SJCOO_WW0.35mgd_b5mgd_D-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)
3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	5.3500	62.630	20.660	62630.0

Simulation:
Froude No: -3.226; Strat No:-1.84E-4; Spcg No: 14.39; k: 39781.8; eff den (sigmaT) 46.00388; eff vel 0.398(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (ft)	y-posn (ft)	Iso dia (m)
0	100.0	1.000E-5	3.050	62.63	62630.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.059	62.45	62246.6	1.006	0.00389	0.0	0.07771;
2	100.0	0.0	3.100	61.88	61002.2	1.027	0.00642	0.0	0.07873;
3	100.0	0.0	3.162	61.32	59783.1	1.048	0.0082	0.0	0.08032;
4	100.0	0.0	3.226	60.78	58588.9	1.069	0.0095	0.0	0.08195;
5	100.0	0.0	3.291	60.24	57418.9	1.091	0.0105	0.0	0.0836;
6	100.0	0.0	3.358	59.71	56272.7	1.113	0.0112	0.0	0.08529;
7	100.0	0.0	3.426	59.20	55149.8	1.136	0.0118	0.0	0.08701;
8	100.0	0.0	3.495	58.69	54049.7	1.159	0.0123	0.0	0.08876;
9	100.0	0.0	3.565	58.19	52971.8	1.182	0.0126	0.0	0.09055;
10	100.0	0.0	3.637	57.71	51915.9	1.206	0.0129	0.0	0.09238;
11	100.0	0.0	3.710	57.23	50881.3	1.231	0.0131	0.0	0.09424;
12	100.0	0.0	3.785	56.76	49867.6	1.256	0.0133	0.0	0.09614;
13	100.0	0.0	3.861	56.30	48874.4	1.281	0.0134	0.0	0.09808;
14	100.0	0.0	3.939	55.85	47901.3	1.307	0.0136	0.0	0.1001;
15	100.0	0.0	4.019	55.41	46947.9	1.334	0.0136	0.0	0.1021;
16	100.0	0.0	4.100	54.98	46013.7	1.361	0.0137	0.0	0.1041;
17	100.0	0.0	4.182	54.55	45098.4	1.389	0.0138	0.0	0.1062;
18	100.0	0.0	4.267	54.14	44201.5	1.417	0.0138	0.0	0.1084;
19	100.0	0.0	4.353	53.73	43322.7	1.446	0.0139	0.0	0.1106;
20	100.0	0.0	4.440	53.33	42461.6	1.475	0.0139	0.0	0.1128;
21	100.0	0.0	4.530	52.94	41617.8	1.505	0.0139	0.0	0.1151;
22	100.0	0.0	4.621	52.56	40791.0	1.535	0.0139	0.0	0.1174;
23	100.0	0.0	4.714	52.18	39980.9	1.566	0.0139	0.0	0.1197;
24	100.0	0.0	4.809	51.81	39187.0	1.598	0.014	0.0	0.1221;
25	100.0	0.0	4.905	51.45	38409.1	1.631	0.014	0.0	0.1246;
26	100.0	0.0	5.004	51.10	37646.8	1.664	0.014	0.0	0.1271;
27	100.0	0.0	5.105	50.75	36899.8	1.697	0.014	0.0	0.1297;
28	100.0	0.0	5.208	50.41	36167.8	1.732	0.014	0.0	0.1323;
29	100.0	0.0	5.312	50.07	35450.5	1.767	0.014	0.0	0.1349;
30	100.0	0.0	5.419	49.74	34747.5	1.802	0.014	0.0	0.1376;
31	100.0	0.0	5.528	49.42	34058.7	1.839	0.014	0.0	0.1404;
32	100.0	0.0	5.639	49.11	33383.6	1.876	0.014	0.0	0.1432;
33	100.0	0.0	5.753	48.80	32722.1	1.914	0.014	0.0	0.1461;
34	100.0	0.0	5.868	48.50	32073.8	1.953	0.014	0.0	0.1491;
35	100.0	0.0	5.986	48.20	31438.5	1.992	0.014	0.0	0.1521;
36	100.0	0.0	6.107	47.91	30815.9	2.032	0.014	0.0	0.1551;
37	100.0	0.0	6.230	47.62	30205.7	2.073	0.014	0.0	0.1582;
38	100.0	0.0	6.355	47.34	29607.7	2.115	0.014	0.0	0.1614;
39	100.0	0.0	6.482	47.07	29021.7	2.158	0.014	0.0	0.1647;
40	100.0	0.0	6.613	46.80	28447.4	2.202	0.014	0.0	0.1680;
41	100.0	0.0	6.746	46.54	27884.5	2.246	0.014	0.0	0.1713;
42	100.0	0.0	6.881	46.28	27332.9	2.291	0.014	0.0	0.1748;
43	100.0	0.0	7.019	46.03	26792.3	2.338	0.014	0.0	0.1783;
44	100.0	0.0	7.160	45.78	26262.4	2.385	0.014	0.0	0.1819;
45	100.0	0.0	7.304	45.53	25743.2	2.433	0.014	0.0	0.1855;
46	100.0	0.0	7.451	45.30	25234.2	2.482	0.014	0.0	0.1893;
47	100.0	0.0	7.600	45.06	24735.5	2.532	0.014	0.0	0.1931;
48	100.0	0.0	7.753	44.83	24246.6	2.583	0.014	0.0	0.1969;

49	100.0	0.0	7.909	44.61	23767.5	2.635	0.014	0.0	0.2009;
50	100.0	0.0	8.068	44.39	23297.9	2.688	0.014	0.0	0.2049;
51	100.0	0.0	8.229	44.17	22837.7	2.742	0.014	0.0	0.2090;
52	100.0	0.0	8.395	43.96	22386.6	2.798	0.014	0.0	0.2132;
53	100.0	0.0	8.563	43.75	21944.5	2.854	0.014	0.0	0.2175;
54	100.0	0.0	8.729	43.56	21542.8	2.907	0.014	0.0	0.2217; begin overlap;
55	100.0	0.0	8.865	43.44	21273.9	2.944	0.014	0.0	0.2252;
56	100.0	0.0	9.009	43.24	20853.9	3.003	0.0509	0.0	0.2288;
57	100.0	0.0	9.118	43.19	20743.5	3.019	0.0552	0.0	0.2316; end overlap;
58	100.0	0.0	9.233	42.99	20334.1	3.080	0.0584	0.0	0.2345;
59	100.0	0.0	9.417	42.81	19932.8	3.142	0.0607	0.0	0.2392;
60	100.0	0.0	9.605	42.62	19539.4	3.205	0.0625	0.0	0.2440;
61	100.0	0.0	9.797	42.44	19153.9	3.270	0.0638	0.0	0.2489;
62	100.0	0.0	9.993	42.26	18778.5	3.335	0.0649	0.0	0.2538; begin overlap;
63	100.0	0.0	10.19	42.10	18424.5	3.399	0.0657	0.0	0.2588;
64	100.0	0.0	10.38	41.94	18090.0	3.462	0.0663	0.0	0.2636;
65	100.0	0.0	10.57	41.79	17773.2	3.524	0.0668	0.0	0.2684;
66	100.0	0.0	10.75	41.65	17472.7	3.584	0.0671	0.0	0.2731;
67	100.0	0.0	10.93	41.51	17187.1	3.644	0.0674	0.0	0.2777;
68	100.0	0.0	11.11	41.38	16915.2	3.703	0.0677	0.0	0.2822;
69	100.0	0.0	11.28	41.26	16656.0	3.760	0.0679	0.0	0.2866;
70	100.0	0.0	11.46	41.14	16408.4	3.817	0.068	0.0	0.2910;
71	100.0	0.0	11.63	41.03	16171.7	3.873	0.0681	0.0	0.2953;
72	100.0	0.0	11.79	40.93	15945.1	3.928	0.0682	0.0	0.2996;
73	100.0	0.0	11.96	40.82	15727.8	3.982	0.0683	0.0	0.3037;
74	100.0	0.0	12.12	40.73	15519.2	4.036	0.0683	0.0	0.3079;
75	100.0	0.0	12.28	40.63	15318.8	4.088	0.0684	0.0	0.3119;
76	100.0	0.0	12.44	40.54	15126.1	4.141	0.0684	0.0	0.3160;
77	100.0	0.0	12.60	40.45	14940.5	4.192	0.0685	0.0	0.3199;
78	100.0	0.0	12.75	40.37	14761.7	4.243	0.0685	0.0	0.3238;
79	100.0	0.0	12.90	40.29	14589.2	4.293	0.0685	0.0	0.3277;
80	100.0	0.0	13.05	40.21	14422.6	4.342	0.0685	0.0	0.3315;
81	100.0	0.0	13.20	40.13	14261.7	4.391	0.0685	0.0	0.3353;
82	100.0	0.0	13.35	40.06	14106.1	4.440	0.0685	0.0	0.3390;
83	100.0	0.0	13.49	39.99	13955.5	4.488	0.0685	0.0	0.3427;
84	100.0	0.0	13.64	39.92	13809.7	4.535	0.0685	0.0	0.3464;
85	100.0	0.0	13.78	39.85	13668.4	4.582	0.0685	0.0	0.3500;
86	100.0	0.0	13.92	39.79	13531.4	4.628	0.0686	0.0	0.3536;
87	100.0	0.0	14.06	39.72	13398.5	4.674	0.0686	0.0	0.3571;
88	100.0	0.0	14.20	39.66	13269.4	4.720	0.0686	0.0	0.3606;
89	100.0	0.0	14.33	39.60	13144.1	4.765	0.0686	0.0	0.3641;
90	100.0	0.0	14.47	39.55	13022.2	4.809	0.0686	0.0	0.3675;
91	100.0	0.0	14.60	39.49	12903.7	4.854	0.0686	0.0	0.3709;
92	100.0	0.0	14.73	39.44	12788.4	4.897	0.0686	0.0	0.3743;
93	100.0	0.0	14.87	39.38	12676.2	4.941	0.0686	0.0	0.3776;
94	100.0	0.0	15.00	39.33	12566.9	4.984	0.0686	0.0	0.3809;
95	100.0	0.0	15.13	39.28	12460.3	5.026	0.0686	0.0	0.3842;
96	100.0	0.0	15.25	39.23	12356.5	5.069	0.0686	0.0	0.3874;
97	100.0	0.0	15.38	39.18	12255.2	5.110	0.0686	0.0	0.3907;
98	100.0	0.0	15.51	39.14	12156.4	5.152	0.0686	0.0	0.3938;
99	100.0	0.0	15.63	39.09	12060.0	5.193	0.0686	0.0	0.3970;
100	100.0	0.0	15.75	39.05	11965.9	5.234	0.0686	0.0	0.4002;
101	100.0	0.0	15.88	39.00	11873.9	5.275	0.0686	0.0	0.4033;
102	100.0	0.0	16.00	38.96	11784.0	5.315	0.0686	0.0	0.4064;
103	100.0	0.0	16.12	38.92	11696.0	5.355	0.0686	0.0	0.4094;
104	100.0	0.0	16.24	38.88	11610.1	5.394	0.0686	0.0	0.4125;

105	100.0	0.0	16.36	38.84	11525.2	5.434	0.0686	0.0	0.4155;
106	100.0	0.0	16.48	38.80	11443.4	5.473	0.0686	0.0	0.4185;
107	100.0	0.0	16.60	38.76	11362.1	5.512	0.0686	0.0	0.4215;
108	100.0	0.0	16.72	38.72	11277.9	5.553	0.0686	0.0	0.4246;
109	100.0	0.0	16.84	38.68	11194.4	5.595	0.0686	0.0	0.4278;
110	100.0	0.0	16.96	38.65	11119.8	5.632	0.0686	0.0	0.4308;
111	100.0	0.0	17.07	38.61	11048.7	5.669	0.0686	0.0	0.4336;
112	100.0	0.0	17.19	38.58	10972.9	5.708	0.0686	0.0	0.4365;
113	100.0	0.0	17.29	38.55	10910.6	5.740	0.0686	0.0	0.4393;
114	100.0	0.0	17.38	38.53	10867.6	5.763	0.0686	0.0	0.4414;
115	100.0	0.0	17.43	38.52	10846.7	5.774	0.0686	0.0	0.4427;
116	100.0	0.0	17.62	38.42	10633.2	5.890	0.138	0.0	0.4475;
117	100.0	0.0	17.60	38.41	10628.2	5.893	0.141	0.0	0.4470;
118	100.0	0.0	17.65	38.38	10558.5	5.932	0.143	0.0	0.4484;
119	100.0	0.0	17.76	38.35	10489.8	5.971	0.144	0.0	0.4511;
120	100.0	0.0	17.87	38.32	10422.2	6.009	0.145	0.0	0.4539;
121	100.0	0.0	17.98	38.28	10355.7	6.048	0.146	0.0	0.4566;
122	100.0	0.0	18.09	38.25	10290.4	6.086	0.147	0.0	0.4594;
123	100.0	0.0	18.20	38.22	10226.2	6.124	0.148	0.0	0.4622;
124	100.0	0.0	18.31	38.19	10163.0	6.163	0.148	0.0	0.4650;
125	100.0	0.0	18.42	38.16	10101.0	6.200	0.149	0.0	0.4678;
126	100.0	0.0	18.53	38.13	10040.1	6.238	0.149	0.0	0.4706;
127	100.0	0.0	18.64	38.11	9980.1	6.275	0.150	0.0	0.4734;
128	100.0	0.0	18.75	38.08	9921.3	6.313	0.150	0.0	0.4761;
129	100.0	0.0	18.85	38.05	9863.4	6.350	0.150	0.0	0.4789;
130	100.0	0.0	18.96	38.02	9806.5	6.387	0.150	0.0	0.4817;
131	100.0	0.0	19.07	38.00	9750.5	6.423	0.151	0.0	0.4844;
132	100.0	0.0	19.18	37.97	9695.5	6.460	0.151	0.0	0.4872;
133	100.0	0.0	19.29	37.95	9641.4	6.496	0.151	0.0	0.4899;
134	100.0	0.0	19.39	37.92	9588.1	6.532	0.151	0.0	0.4926;
135	100.0	0.0	19.50	37.90	9535.8	6.568	0.151	0.0	0.4953;
136	100.0	0.0	19.61	37.87	9484.3	6.604	0.151	0.0	0.4980;
137	100.0	0.0	19.71	37.85	9433.6	6.639	0.151	0.0	0.5007;
138	100.0	0.0	19.82	37.82	9383.7	6.674	0.151	0.0	0.5033;
139	100.0	0.0	19.92	37.80	9334.6	6.709	0.151	0.0	0.5060;
140	100.0	0.0	20.02	37.78	9286.2	6.744	0.151	0.0	0.5086;
141	100.0	0.0	20.13	37.75	9238.6	6.779	0.151	0.0	0.5112;
142	100.0	0.0	20.23	37.73	9191.7	6.814	0.151	0.0	0.5138;
143	100.0	0.0	20.33	37.71	9145.5	6.848	0.151	0.0	0.5164;
144	100.0	0.0	20.43	37.69	9100.1	6.882	0.151	0.0	0.5190;
145	100.0	0.0	20.54	37.67	9055.2	6.916	0.151	0.0	0.5216;
146	100.0	0.0	20.64	37.65	9011.1	6.950	0.151	0.0	0.5242;
147	100.0	0.0	20.74	37.63	8967.6	6.984	0.151	0.0	0.5267;
148	100.0	0.0	20.84	37.61	8924.7	7.018	0.151	0.0	0.5293;
149	100.0	0.0	20.94	37.59	8882.4	7.051	0.151	0.0	0.5318;
150	100.0	0.0	21.04	37.57	8840.7	7.084	0.151	0.0	0.5343;
151	100.0	0.0	21.13	37.55	8799.6	7.117	0.151	0.0	0.5368;
152	100.0	0.0	21.23	37.53	8759.1	7.150	0.151	0.0	0.5393;
153	100.0	0.0	21.33	37.51	8719.1	7.183	0.151	0.0	0.5418;
154	100.0	0.0	21.43	37.49	8679.7	7.216	0.151	0.0	0.5442;
155	100.0	0.0	21.52	37.47	8640.8	7.248	0.151	0.0	0.5467;
156	100.0	0.0	21.62	37.45	8602.4	7.280	0.151	0.0	0.5491;
157	100.0	0.0	21.72	37.44	8564.6	7.313	0.151	0.0	0.5516;
158	100.0	0.0	21.81	37.42	8527.2	7.345	0.151	0.0	0.5540;
159	100.0	0.0	21.91	37.40	8490.3	7.377	0.151	0.0	0.5564;
160	100.0	0.0	22.00	37.38	8453.9	7.408	0.151	0.0	0.5588;

161	100.0	0.0	22.09	37.37	8418.0	7.440	0.151	0.0	0.5612;
162	100.0	0.0	22.19	37.35	8382.5	7.472	0.151	0.0	0.5636;
163	100.0	0.0	22.28	37.33	8347.5	7.503	0.151	0.0	0.5660;
164	100.0	0.0	22.37	37.32	8312.9	7.534	0.151	0.0	0.5683;
165	100.0	0.0	22.47	37.30	8278.7	7.565	0.151	0.0	0.5707;
166	100.0	0.0	22.56	37.28	8245.0	7.596	0.151	0.0	0.5730;
167	100.0	0.0	22.65	37.27	8211.6	7.627	0.151	0.0	0.5754;
168	100.0	0.0	22.74	37.25	8178.7	7.658	0.151	0.0	0.5777;
169	100.0	0.0	22.83	37.24	8146.1	7.688	0.151	0.0	0.5800;
170	100.0	0.0	22.92	37.22	8114.0	7.719	0.151	0.0	0.5823;
171	100.0	0.0	23.02	37.21	8082.2	7.749	0.151	0.0	0.5846;
172	100.0	0.0	23.11	37.19	8050.8	7.779	0.151	0.0	0.5869;
173	100.0	0.0	23.19	37.18	8019.7	7.809	0.151	0.0	0.5892;
174	100.0	0.0	23.28	37.16	7989.1	7.839	0.151	0.0	0.5914;
175	100.0	0.0	23.37	37.15	7958.7	7.869	0.151	0.0	0.5937;
176	100.0	0.0	23.46	37.13	7928.7	7.899	0.151	0.0	0.5959;
177	100.0	0.0	23.55	37.12	7899.1	7.929	0.151	0.0	0.5982;
178	100.0	0.0	23.64	37.11	7869.8	7.958	0.151	0.0	0.6004;
179	100.0	0.0	23.73	37.09	7840.7	7.988	0.151	0.0	0.6026;
180	100.0	0.0	23.81	37.08	7811.9	8.017	0.151	0.0	0.6049;
181	100.0	0.0	23.90	37.07	7783.5	8.047	0.151	0.0	0.6071;
182	100.0	0.0	23.99	37.05	7755.6	8.075	0.151	0.0	0.6093;
183	100.0	0.0	24.07	37.04	7727.6	8.105	0.151	0.0	0.6115;
184	100.0	0.0	24.16	37.03	7699.9	8.134	0.151	0.0	0.6137;
185	100.0	0.0	24.24	37.01	7674.2	8.161	0.151	0.0	0.6158;
186	100.0	0.0	24.33	37.00	7644.5	8.193	0.151	0.0	0.6180;
187	100.0	0.0	24.42	36.99	7617.1	8.222	0.151	0.0	0.6203;
188	100.0	0.0	24.51	36.97	7591.5	8.250	0.151	0.0	0.6225;
189	100.0	0.0	24.59	36.96	7568.6	8.275	0.151	0.0	0.6245;
190	100.0	0.0	24.66	36.95	7547.0	8.299	0.151	0.0	0.6263;
191	100.0	0.0	24.72	36.94	7528.2	8.319	0.151	0.0	0.6280;
192	100.0	0.0	24.77	36.94	7516.7	8.332	0.151	0.0	0.6293;
193	100.1	0.0	25.04	36.87	7369.0	8.499	0.243	0.0	0.6360;
194	100.1	0.0	24.05	36.87	7367.6	8.501	0.244	0.0	0.6108;
195	100.1	0.0	24.08	36.85	7333.7	8.540	0.246	0.0	0.6115;
196	100.1	0.0	24.16	36.84	7299.9	8.580	0.248	0.0	0.6136;
197	100.1	0.0	24.24	36.82	7266.2	8.619	0.250	0.0	0.6156;
198	100.1	0.0	24.32	36.80	7232.7	8.659	0.252	0.0	0.6177;
199	100.1	0.0	24.40	36.79	7199.4	8.699	0.254	0.0	0.6197;
200	100.1	0.0	24.48	36.77	7166.2	8.740	0.256	0.0	0.6217;
201	100.1	0.0	24.55	36.76	7134.2	8.779	0.258	0.0	0.6236;
202	100.1	0.0	24.62	36.74	7102.5	8.818	0.260	0.0	0.6255;
203	100.1	0.0	24.70	36.73	7071.0	8.857	0.262	0.0	0.6273;
204	100.1	0.0	24.77	36.71	7039.8	8.897	0.264	0.0	0.6291;
205	100.1	0.0	24.84	36.70	7008.9	8.936	0.266	0.0	0.6309;
206	100.1	0.0	24.91	36.68	6978.2	8.975	0.268	0.0	0.6327;
207	100.1	0.0	24.98	36.67	6947.8	9.014	0.270	0.0	0.6345;
208	100.1	0.0	25.05	36.65	6917.6	9.054	0.272	0.0	0.6363;
209	100.1	0.0	25.12	36.64	6887.7	9.093	0.274	0.0	0.6380;
210	100.1	0.0	25.19	36.63	6858.0	9.132	0.276	0.0	0.6397;
211	100.1	0.0	25.25	36.61	6828.5	9.172	0.278	0.0	0.6414;
212	100.1	0.0	25.32	36.60	6799.2	9.211	0.280	0.0	0.6431;
213	100.1	0.0	25.39	36.58	6770.2	9.251	0.282	0.0	0.6448;
214	100.1	0.0	25.45	36.57	6741.3	9.290	0.284	0.0	0.6465;
215	100.1	0.0	25.52	36.56	6712.7	9.330	0.287	0.0	0.6481;
216	100.1	0.0	25.58	36.54	6684.3	9.370	0.289	0.0	0.6498;

217	100.1	0.0	25.64	36.53	6656.1	9.409	0.291	0.0	0.6514;
218	100.1	0.0	25.71	36.52	6628.1	9.449	0.293	0.0	0.6530;
219	100.1	0.0	25.77	36.50	6600.2	9.489	0.295	0.0	0.6546;
220	100.1	0.0	25.83	36.49	6572.6	9.529	0.297	0.0	0.6561;
221	100.1	0.0	25.89	36.48	6545.1	9.569	0.299	0.0	0.6577;
222	100.1	0.0	25.95	36.46	6517.8	9.609	0.301	0.0	0.6592;
223	100.1	0.0	26.01	36.45	6490.7	9.649	0.303	0.0	0.6608;
224	100.1	0.0	26.07	36.44	6463.8	9.689	0.305	0.0	0.6623;
225	100.1	0.0	26.13	36.43	6437.0	9.730	0.308	0.0	0.6638;
226	100.1	0.0	26.19	36.41	6410.4	9.770	0.310	0.0	0.6652;
227	100.1	0.0	26.25	36.40	6383.9	9.811	0.312	0.0	0.6667;
228	100.1	0.0	26.31	36.39	6357.6	9.851	0.314	0.0	0.6682;
229	100.1	0.0	26.36	36.38	6331.5	9.892	0.316	0.0	0.6696;
230	100.1	0.0	26.42	36.36	6305.5	9.933	0.318	0.0	0.6710;
231	100.1	0.0	26.47	36.35	6279.7	9.973	0.321	0.0	0.6724;
232	100.1	0.0	26.53	36.34	6254.0	10.01	0.323	0.0	0.6738;
233	100.1	0.0	26.58	36.33	6228.4	10.06	0.325	0.0	0.6752;
234	100.1	0.0	26.63	36.31	6203.0	10.10	0.327	0.0	0.6765;
235	100.1	0.0	26.69	36.30	6177.7	10.14	0.329	0.0	0.6779;
236	100.1	0.0	26.74	36.29	6152.5	10.18	0.332	0.0	0.6792;
237	100.1	0.0	26.79	36.28	6127.5	10.22	0.334	0.0	0.6805;
238	100.1	0.0	26.84	36.27	6102.6	10.26	0.336	0.0	0.6818;
239	100.1	0.0	26.89	36.26	6077.8	10.30	0.338	0.0	0.6831;
240	100.1	0.0	26.94	36.24	6053.1	10.35	0.341	0.0	0.6844;
241	100.1	0.0	26.99	36.23	6028.5	10.39	0.343	0.0	0.6856;
242	100.1	0.0	27.04	36.22	6004.1	10.43	0.345	0.0	0.6869;
243	100.1	0.0	27.09	36.21	5979.8	10.47	0.348	0.0	0.6881;
244	100.2	0.0	27.14	36.20	5955.5	10.52	0.350	0.0	0.6893;
245	100.2	0.0	27.19	36.19	5931.4	10.56	0.352	0.0	0.6905;
246	100.2	0.0	27.23	36.17	5907.4	10.60	0.355	0.0	0.6917;
247	100.2	0.0	27.28	36.16	5883.5	10.65	0.357	0.0	0.6929;
248	100.2	0.0	27.32	36.15	5859.6	10.69	0.359	0.0	0.6940;
249	100.2	0.0	27.37	36.14	5835.9	10.73	0.362	0.0	0.6952;
250	100.2	0.0	27.41	36.13	5812.2	10.78	0.364	0.0	0.6963;
251	100.2	0.0	27.46	36.12	5788.7	10.82	0.367	0.0	0.6974;
252	100.2	0.0	27.50	36.11	5765.2	10.86	0.369	0.0	0.6985;
253	100.2	0.0	27.54	36.10	5741.8	10.91	0.371	0.0	0.6996;
254	100.2	0.0	27.59	36.08	5718.5	10.95	0.374	0.0	0.7007;
255	100.2	0.0	27.63	36.07	5695.2	11.00	0.376	0.0	0.7017;
256	100.2	0.0	27.67	36.06	5672.1	11.04	0.379	0.0	0.7028;
257	100.2	0.0	27.71	36.05	5649.0	11.09	0.381	0.0	0.7038;
258	100.2	0.0	27.75	36.04	5625.9	11.13	0.384	0.0	0.7048;
259	100.2	0.0	27.79	36.03	5603.0	11.18	0.386	0.0	0.7058;
260	100.2	0.0	27.83	36.02	5580.1	11.22	0.389	0.0	0.7068;
261	100.2	0.0	27.87	36.01	5557.2	11.27	0.391	0.0	0.7078;
262	100.2	0.0	27.90	36.00	5534.4	11.32	0.394	0.0	0.7088;
263	100.2	0.0	27.94	35.99	5511.7	11.36	0.397	0.0	0.7097;
264	100.2	0.0	27.98	35.98	5489.0	11.41	0.399	0.0	0.7107;
265	100.2	0.0	28.02	35.97	5466.4	11.46	0.402	0.0	0.7116;
266	100.2	0.0	28.05	35.95	5443.8	11.50	0.405	0.0	0.7125;
267	100.2	0.0	28.09	35.94	5421.3	11.55	0.407	0.0	0.7134;
268	100.2	0.0	28.12	35.93	5398.8	11.60	0.410	0.0	0.7143;
269	100.2	0.0	28.16	35.92	5376.3	11.65	0.413	0.0	0.7152;
270	100.2	0.0	28.19	35.91	5353.9	11.70	0.415	0.0	0.7160;
271	100.2	0.0	28.22	35.90	5331.5	11.75	0.418	0.0	0.7169;
272	100.2	0.0	28.26	35.89	5309.1	11.80	0.421	0.0	0.7177;

273	100.2	0.0	28.29	35.88	5286.8	11.85	0.424	0.0	0.7186;
274	100.2	0.0	28.32	35.87	5264.5	11.90	0.427	0.0	0.7194;
275	100.2	0.0	28.35	35.86	5242.2	11.95	0.429	0.0	0.7202;
276	100.2	0.0	28.39	35.85	5219.9	12.00	0.432	0.0	0.7210;
277	100.2	0.0	28.42	35.84	5197.6	12.05	0.435	0.0	0.7218;
278	100.3	0.0	28.45	35.83	5175.4	12.10	0.438	0.0	0.7225;
279	100.3	0.0	28.48	35.82	5153.1	12.15	0.441	0.0	0.7233;
280	100.3	0.0	28.51	35.81	5130.9	12.21	0.444	0.0	0.7241;
281	100.3	0.0	28.54	35.80	5108.6	12.26	0.447	0.0	0.7248;
282	100.3	0.0	28.56	35.78	5086.4	12.31	0.450	0.0	0.7255;
283	100.3	0.0	28.59	35.77	5064.1	12.37	0.453	0.0	0.7263;
284	100.3	0.0	28.62	35.76	5041.9	12.42	0.456	0.0	0.7270;
285	100.3	0.0	28.65	35.75	5019.6	12.48	0.459	0.0	0.7277;
286	100.3	0.0	28.68	35.74	4997.3	12.53	0.462	0.0	0.7284;
287	100.3	0.0	28.70	35.73	4975.0	12.59	0.466	0.0	0.7290;
288	100.3	0.0	28.73	35.72	4952.7	12.65	0.469	0.0	0.7297;
289	100.3	0.0	28.76	35.71	4930.3	12.70	0.472	0.0	0.7304;
290	100.3	0.0	28.78	35.70	4907.9	12.76	0.475	0.0	0.7311;
291	100.3	0.0	28.81	35.69	4885.5	12.82	0.479	0.0	0.7317;
292	100.3	0.0	28.83	35.68	4863.0	12.88	0.482	0.0	0.7324;
293	100.3	0.0	28.86	35.67	4840.4	12.94	0.485	0.0	0.7330;
294	100.3	0.0	28.88	35.66	4817.9	13.00	0.489	0.0	0.7336;
295	100.3	0.0	28.91	35.65	4795.2	13.06	0.492	0.0	0.7343;
296	100.3	0.0	28.93	35.64	4772.5	13.12	0.496	0.0	0.7349;
297	100.3	0.0	28.96	35.62	4749.7	13.19	0.499	0.0	0.7355;
298	100.3	0.0	28.98	35.61	4726.9	13.25	0.503	0.0	0.7362;
299	100.4	0.0	29.01	35.60	4704.0	13.31	0.506	0.0	0.7368;
300	100.4	0.0	29.03	35.59	4681.0	13.38	0.510	0.0	0.7374;
301	100.4	0.0	29.06	35.58	4657.9	13.45	0.513	0.0	0.7380;
302	100.4	0.0	29.08	35.57	4634.7	13.51	0.517	0.0	0.7386;
303	100.4	0.0	29.10	35.56	4611.4	13.58	0.521	0.0	0.7392;
304	100.4	0.0	29.13	35.55	4588.0	13.65	0.525	0.0	0.7399;
305	100.4	0.0	29.15	35.54	4564.4	13.72	0.529	0.0	0.7405;
306	100.4	0.0	29.18	35.53	4540.8	13.79	0.532	0.0	0.7411;
307	100.4	0.0	29.20	35.51	4517.0	13.87	0.536	0.0	0.7418;
308	100.4	0.0	29.23	35.50	4493.0	13.94	0.540	0.0	0.7424;
309	100.4	0.0	29.25	35.49	4469.0	14.01	0.544	0.0	0.7431;
310	100.4	0.0	29.28	35.48	4444.7	14.09	0.548	0.0	0.7437;
311	100.4	0.0	29.31	35.47	4420.3	14.17	0.553	0.0	0.7444;
312	100.4	0.0	29.33	35.46	4395.7	14.25	0.557	0.0	0.7451;
313	100.5	0.0	29.36	35.44	4370.9	14.33	0.561	0.0	0.7458;
314	100.5	0.0	29.39	35.43	4345.9	14.41	0.565	0.0	0.7465;
315	100.5	0.0	29.42	35.42	4320.7	14.50	0.570	0.0	0.7472;
316	100.5	0.0	29.45	35.41	4295.3	14.58	0.574	0.0	0.7480;
317	100.5	0.0	29.48	35.40	4269.6	14.67	0.579	0.0	0.7487;
318	100.5	0.0	29.51	35.38	4243.7	14.76	0.583	0.0	0.7496;
319	100.5	0.0	29.54	35.37	4217.5	14.85	0.588	0.0	0.7504;
320	100.5	0.0	29.58	35.36	4191.1	14.94	0.592	0.0	0.7512;
321	100.5	0.0	29.61	35.35	4164.3	15.04	0.597	0.0	0.7521;
322	100.5	0.0	29.65	35.33	4137.3	15.14	0.602	0.0	0.7531;
323	100.5	0.0	29.69	35.32	4109.9	15.24	0.607	0.0	0.7541;
324	100.6	0.0	29.73	35.31	4082.2	15.34	0.612	0.0	0.7551;
325	100.6	0.0	29.77	35.29	4054.1	15.45	0.617	0.0	0.7561;
326	100.6	0.0	29.81	35.28	4026.2	15.56	0.622	0.0	0.7572;
327	100.6	0.0	29.85	35.27	3998.5	15.66	0.627	0.0	0.7582; end overlap;
328	100.6	0.0	29.89	35.25	3971.2	15.77	0.632	0.0	0.7592;

329	100.6	0.0	29.92	35.24	3944.1	15.88	0.638	0.0	0.7601;
330	100.6	0.0	29.96	35.23	3917.2	15.99	0.643	0.0	0.7609;
331	100.6	0.0	29.98	35.22	3890.5	16.10	0.649	0.0	0.7616;
332	100.7	0.0	30.01	35.20	3864.0	16.21	0.654	0.0	0.7623;
333	100.7	0.0	30.04	35.19	3837.7	16.32	0.660	0.0	0.7629;
334	100.7	0.0	30.06	35.18	3811.5	16.43	0.666	0.0	0.7635;
335	100.7	0.0	30.08	35.17	3785.5	16.54	0.671	0.0	0.7640;
336	100.7	0.0	30.09	35.15	3759.6	16.66	0.677	0.0	0.7644;
337	100.7	0.0	30.11	35.14	3733.7	16.77	0.684	0.0	0.7648;
338	100.8	0.0	30.12	35.13	3707.9	16.89	0.690	0.0	0.7652;
339	100.8	0.0	30.14	35.12	3682.1	17.01	0.696	0.0	0.7655;
340	100.8	0.0	30.15	35.10	3656.4	17.13	0.703	0.0	0.7657;
341	100.8	0.0	30.16	35.09	3630.6	17.25	0.709	0.0	0.7660;
342	100.8	0.0	30.16	35.08	3604.8	17.37	0.716	0.0	0.7662;
343	100.8	0.0	30.17	35.07	3578.9	17.50	0.723	0.0	0.7663;
344	100.9	0.0	30.18	35.06	3552.9	17.63	0.730	0.0	0.7665;
345	100.9	0.0	30.18	35.04	3526.8	17.76	0.737	0.0	0.7666;
346	100.9	0.0	30.19	35.03	3500.5	17.89	0.744	0.0	0.7667;
347	100.9	0.0	30.19	35.02	3474.1	18.03	0.752	0.0	0.7668;
348	101.0	0.0	30.19	35.01	3447.4	18.17	0.760	0.0	0.7669;
349	101.0	0.0	30.20	34.99	3420.5	18.31	0.767	0.0	0.7670;
350	101.0	0.0	30.20	34.98	3393.3	18.46	0.775	0.0	0.7671;
351	101.0	0.0	30.21	34.97	3365.8	18.61	0.784	0.0	0.7672;
352	101.1	0.0	30.21	34.95	3337.9	18.76	0.792	0.0	0.7674;
353	101.1	0.0	30.22	34.94	3309.7	18.92	0.801	0.0	0.7675;
354	101.1	0.0	30.23	34.93	3281.0	19.09	0.809	0.0	0.7678;
355	101.2	0.0	30.24	34.91	3251.9	19.26	0.818	0.0	0.7680;
356	101.2	0.0	30.25	34.90	3222.3	19.44	0.828	0.0	0.7683;
357	101.2	0.0	30.27	34.88	3192.1	19.62	0.837	0.0	0.7687;
358	101.3	0.0	30.28	34.87	3161.4	19.81	0.847	0.0	0.7692;
359	101.3	0.0	30.31	34.85	3130.0	20.01	0.857	0.0	0.7698;
360	101.3	0.0	30.33	34.84	3098.0	20.22	0.867	0.0	0.7704;
361	101.4	0.0	30.36	34.82	3065.2	20.43	0.878	0.0	0.7712;
362	101.4	0.0	30.40	34.81	3031.7	20.66	0.889	0.0	0.7721;
363	101.5	0.0	30.44	34.79	2997.4	20.89	0.900	0.0	0.7731;
364	101.5	0.0	30.49	34.77	2962.2	21.14	0.911	0.0	0.7743;
365	101.6	0.0	30.54	34.76	2926.1	21.40	0.923	0.0	0.7757;
366	101.6	0.0	30.60	34.74	2889.0	21.68	0.935	0.0	0.7773;
367	101.7	0.0	30.67	34.72	2850.9	21.97	0.947	0.0	0.7791;
368	101.8	0.0	30.75	34.70	2811.8	22.27	0.960	0.0	0.7811;
369	101.8	0.0	30.84	34.68	2771.6	22.60	0.974	0.0	0.7835;
370	101.9	0.0	30.95	34.66	2730.2	22.94	0.987	0.0	0.7861;
371	102.0	0.0	31.06	34.64	2687.5	23.30	1.001	0.0	0.7890;
372	102.0	0.0	31.19	34.62	2643.6	23.69	1.016	0.0	0.7922;
373	102.1	0.0	31.33	34.60	2598.4	24.10	1.031	0.0	0.7959;
374	102.2	0.0	31.49	34.58	2551.9	24.54	1.046	0.0	0.7999;
375	102.3	0.0	31.67	34.56	2503.9	25.01	1.062	0.0	0.8045;
376	102.4	0.0	31.87	34.53	2454.8	25.51	1.079	0.0	0.8094;
377	102.5	0.0	32.07	34.51	2406.6	26.02	1.095	0.0	0.8146;
378	102.6	0.0	32.28	34.49	2359.4	26.54	1.111	0.0	0.8200;
379	102.7	0.0	32.51	34.47	2313.1	27.08	1.126	0.0	0.8257;
380	102.8	0.0	32.74	34.44	2267.7	27.62	1.141	0.0	0.8317;
381	102.9	0.0	32.99	34.42	2223.2	28.17	1.156	0.0	0.8379;
382	103.0	0.0	33.24	34.40	2179.6	28.73	1.171	0.0	0.8444;
383	103.1	0.0	33.51	34.38	2136.8	29.31	1.186	0.0	0.8511;
384	103.2	0.0	33.78	34.36	2094.9	29.90	1.200	0.0	0.8580;

385	103.3	0.0	34.06	34.34	2053.8	30.49	1.215	0.0	0.8652;
386	103.4	0.0	34.36	34.32	2013.5	31.11	1.229	0.0	0.8726;
387	103.5	0.0	34.65	34.30	1974.0	31.73	1.243	0.0	0.8802;
388	103.6	0.0	34.96	34.29	1935.3	32.36	1.256	0.0	0.8881;
389	103.7	0.0	35.28	34.27	1897.3	33.01	1.270	0.0	0.8961;
390	103.8	0.0	35.60	34.25	1860.1	33.67	1.283	0.0	0.9043;
391	103.9	0.0	35.93	34.23	1823.6	34.34	1.297	0.0	0.9127;
392	104.0	0.0	36.27	34.22	1787.8	35.03	1.310	0.0	0.9213;
393	104.1	0.0	36.62	34.20	1752.7	35.73	1.323	0.0	0.9301;
394	104.3	0.0	36.97	34.18	1718.3	36.45	1.335	0.0	0.9391;
395	104.4	0.0	37.33	34.17	1684.6	37.18	1.348	0.0	0.9483; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 0.4109
Lmz(m): 0.4109
forced entrain 1 0.0 -1.333 0.948 0.113
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632
;
2:50:38 PM. amb fills: 4

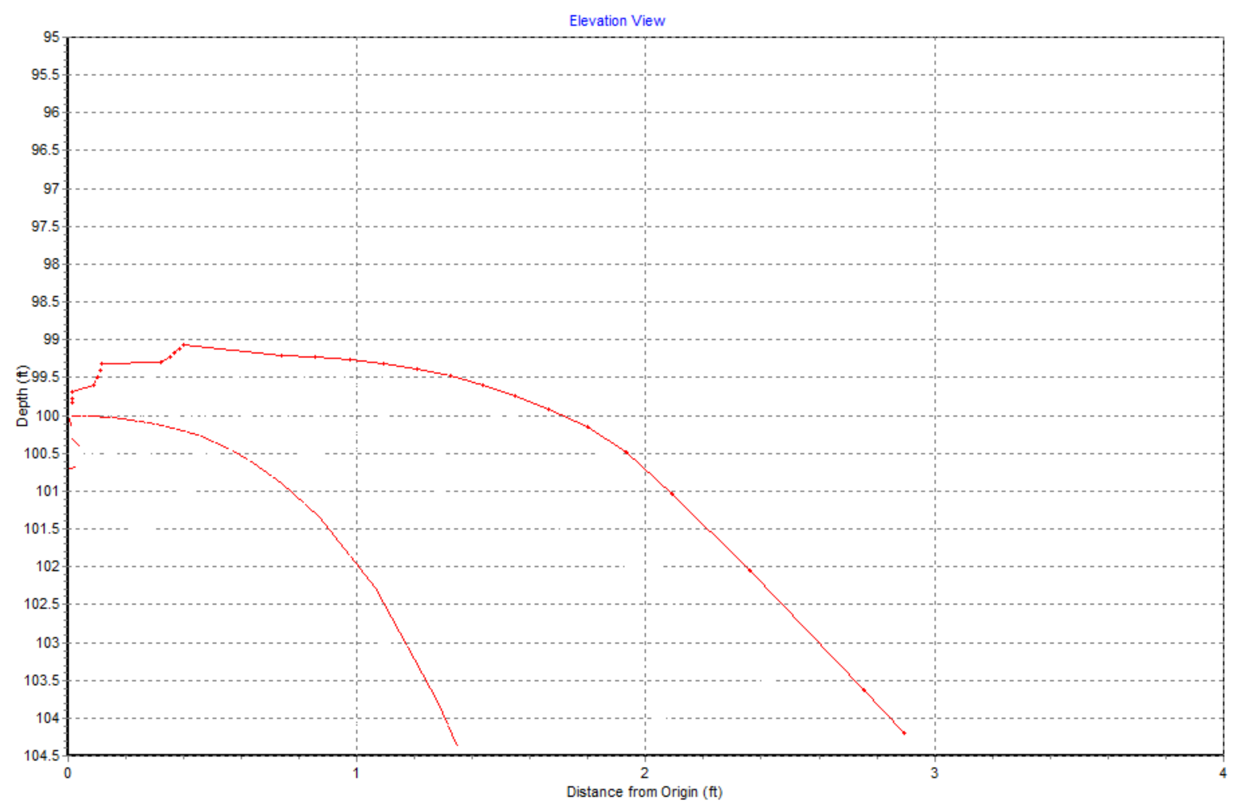

Figure C.7.1: Plumes 18b solution of discharge plume trajectories for discharges of 0.35 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt., and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 99.1 ft. at Xa = 0.462 ft from the point of discharge. The centerline of the plume is at an average distance of Xb = 1.348 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

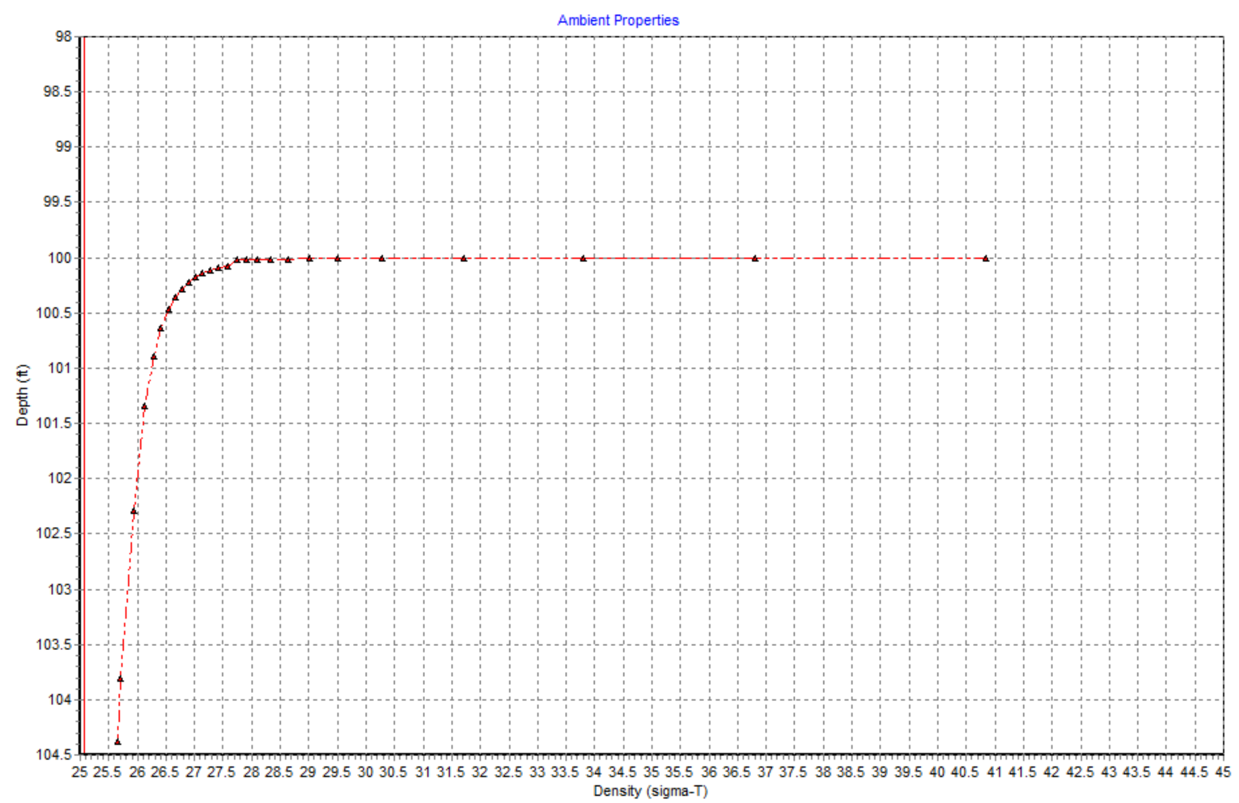

Figure C.7.2: Plumes 18b solution of vertical density profile for discharges of 0.35 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

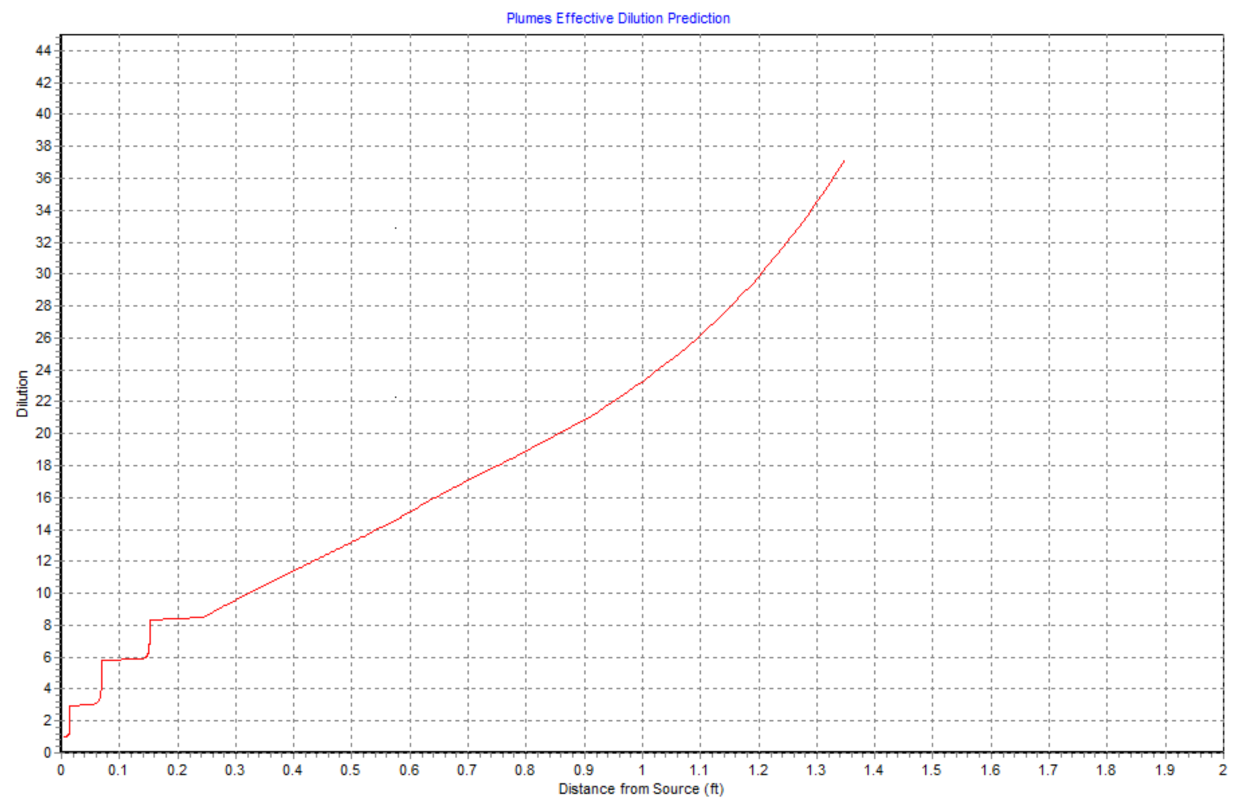

Figure C.7.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 0.35 mgd of SOCWA wastewater at average annual TDS = 1.25 ppt. and 5 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Effective dilution is S_a = 12.53 at the maximum rise of the plume at Xa = 0.462 ft. from the point of discharge. As the plume begins to impact the bottom, the plume centerline is at a distance of Xb = 1.348 ft from the point of discharge, where the effective dilution reaches S_a = 37.18.

C.8: Plumes 18b Results for SJCOO discharges of 1.8 mgd Well Water and 3 mgd Brine:

ontents of the memo box (may not be current and must be updated manually)
Project "C:\Plumes18\SJCOO_WellW1.8mgd_b3mgd_D-1"
memo
SJCOO discharging 1.8 mgd well water and 3 mgd brine

Model configuration items checked:
Channel width (m) 100
Start case for graphs 1
Max detailed graphs 10 (limits plots that can overflow memory)
Elevation Projection Plane (deg) 0
Shore vector (m,deg) not checked
Bacteria model : Mancini (1978) coliform model
PDS sfc. model heat transfer : Medium
Equation of State : S, T
Similarity Profile : Default profile (k=2.0, ...)
Diffuser port contraction coefficient 1
Light absorption coefficient 0.16
Farfield increment (m) 200
UM3 aspiration coefficient 0.1
Output file: text output tab
Output each ?? steps 1
Maximum dilution reported 1000
Text output format : Standard
Max vertical reversals : to max rise or fall

/ UM3. 1/14/2019 3:07:41 PM
Case 1; ambient file C:\Plumes18\SJCOO_WellW1.8mgd_b3mgd_D-1.001.db; Diffuser table record 1: ----------------------------------

Ambient Table:

Depth	Amb-cur	Amb-dir	Amb-sal	Amb-tem	Amb-pol	Decay	Far-spd	Far-dir	Disprsn	Density
m	m/s	deg	psu	C	kg/kg	s-1	m/s	deg	m0.67/s2	sigma-T
0.0	0.0	0.0	33.38	19.97	0.0	0.0	0.0	0.0	0.0003	23.55719
2.000	0.0	0.0	33.39	19.87	0.0	0.0	0.0	0.0	0.0003	23.59288
4.000	0.0	0.0	33.40	19.81	0.0	0.0	0.0	0.0	0.0003	23.61484
7.000	0.0	0.0	33.41	19.64	0.0	0.0	0.0	0.0	0.0003	23.67096
10.00	0.0	0.0	33.40	17.76	0.0	0.0	0.0	0.0	0.0003	24.12888
12.00	0.0	0.0	33.38	17.34	0.0	0.0	0.0	0.0	0.0003	24.21549
14.00	0.0	0.0	33.38	16.73	0.0	0.0	0.0	0.0	0.0003	24.35932
16.00	0.0	0.0	33.38	15.17	0.0	0.0	0.0	0.0	0.0003	24.71340
18.00	0.0	0.0	33.37	14.37	0.0	0.0	0.0	0.0	0.0003	24.87044
20.00	0.0	0.0	33.35	14.18	0.0	0.0	0.0	0.0	0.0003	24.89660
22.00	0.0	0.0	33.33	13.83	0.0	0.0	0.0	0.0	0.0003	24.95172
24.00	0.0	0.0	33.32	13.75	0.0	0.0	0.0	0.0	0.0003	24.96707
26.00	0.0	0.0	33.36	13.42	0.0	0.0	0.0	0.0	0.0003	25.06459
31.85	0.0	0.0	33.36	13.39	0.0	0.0	0.0	0.0	0.0003	25.07201

Diffuser table:

P-dia	Ver angl	H-Angle	SourceX	SourceY	Ports	MZ-dis	Isoplth	P-depth	Ttl-flo	Eff-sal	Temp	Polutnt
(in)	(deg)	(deg)	(ft)	(ft)	()	(ft)	(concent)	(ft)	(MGD)	(psu)	(C)	(ppm)

3.0500	0.0	0.0	0.0	0.0	125.00	1000.0	0.0	100.00	4.8000	54.440	20.660	54440.0

Simulation:
Froude No: -3.468; Strat No:-2.65E-4; Spcg No: 14.39; k: 35692.1; eff den (sigmaT) 39.56029; eff vel 0.357(m/s);
Current is very small, flow regime may be transient.

Step	Depth (ft)	Amb-cur (m/s)	P-dia (in)	Eff-sal (psu)	Polutnt (ppm)	Dilutn ()	x-posn (ft)	y-posn (ft)	Iso dia (m)
0	100.0	1.000E-5	3.050	54.44	54440.0	1.000	0.0	0.0	0.07747;
1	100.0	0.0	3.058	54.33	54140.8	1.006	0.00349	0.0	0.07768;
2	100.0	0.0	3.098	53.91	53065.0	1.026	0.00632	0.0	0.07868;
3	100.0	0.0	3.160	53.51	52010.8	1.047	0.00871	0.0	0.08027;
4	100.0	0.0	3.224	53.12	50977.8	1.068	0.0108	0.0	0.08188;
5	100.0	0.0	3.289	52.73	49965.6	1.090	0.0127	0.0	0.08353;
6	100.0	0.0	3.355	52.35	48973.7	1.112	0.0144	0.0	0.08521;
7	100.0	0.0	3.422	51.98	48001.7	1.134	0.0159	0.0	0.08692;
8	100.0	0.0	3.491	51.61	47049.3	1.157	0.0174	0.0	0.08867;
9	100.0	0.0	3.561	51.25	46115.9	1.181	0.0187	0.0	0.09046;
10	100.0	0.0	3.633	50.90	45201.3	1.204	0.020	0.0	0.09228;
11	100.0	0.0	3.706	50.56	44305.0	1.229	0.0212	0.0	0.09413;
12	100.0	0.0	3.781	50.22	43426.7	1.254	0.0224	0.0	0.09603;
13	100.0	0.0	3.857	49.89	42565.9	1.279	0.0235	0.0	0.09796;
14	100.0	0.0	3.934	49.57	41722.4	1.305	0.0246	0.0	0.09993;
15	100.0	0.0	4.013	49.25	40895.8	1.331	0.0256	0.0	0.1019;
16	100.0	0.0	4.094	48.94	40085.7	1.358	0.0266	0.0	0.1040;
17	100.0	0.0	4.176	48.63	39291.8	1.386	0.0276	0.0	0.1061;
18	100.0	0.0	4.260	48.33	38513.8	1.414	0.0285	0.0	0.1082;
19	100.0	0.0	4.346	48.04	37751.3	1.442	0.0294	0.0	0.1104;
20	100.0	0.0	4.433	47.75	37004.1	1.471	0.0303	0.0	0.1126;
21	100.0	0.0	4.522	47.47	36271.7	1.501	0.0312	0.0	0.1149;
22	100.0	0.0	4.613	47.19	35554.0	1.531	0.032	0.0	0.1172;
23	100.0	0.0	4.706	46.92	34850.7	1.562	0.0329	0.0	0.1195;
24	100.0	0.0	4.800	46.66	34161.3	1.594	0.0337	0.0	0.1219;
25	100.0	0.0	4.897	46.40	33485.7	1.626	0.0345	0.0	0.1244;
26	100.0	0.0	4.995	46.14	32823.6	1.659	0.0353	0.0	0.1269;
27	100.0	0.0	5.095	45.89	32174.7	1.692	0.036	0.0	0.1294;
28	100.0	0.0	5.198	45.64	31538.7	1.726	0.0368	0.0	0.1320;
29	100.0	0.0	5.302	45.40	30915.3	1.761	0.0375	0.0	0.1347;
30	100.0	0.0	5.408	45.17	30304.4	1.796	0.0383	0.0	0.1374;
31	100.0	0.0	5.517	44.94	29705.6	1.833	0.039	0.0	0.1401;
32	100.0	0.0	5.628	44.71	29118.8	1.870	0.0397	0.0	0.1429;
33	100.0	0.0	5.741	44.49	28543.6	1.907	0.0404	0.0	0.1458;
34	100.0	0.0	5.856	44.27	27979.9	1.946	0.0411	0.0	0.1487;
35	100.0	0.0	5.973	44.05	27427.4	1.985	0.0418	0.0	0.1517;
36	100.0	0.0	6.093	43.85	26885.8	2.025	0.0425	0.0	0.1548;
37	100.0	0.0	6.215	43.64	26355.1	2.066	0.0432	0.0	0.1579;
38	100.0	0.0	6.340	43.44	25834.8	2.107	0.0438	0.0	0.1610;
39	100.0	0.0	6.467	43.24	25324.9	2.150	0.0445	0.0	0.1643;
40	100.0	0.0	6.597	43.05	24825.2	2.193	0.0452	0.0	0.1676;
41	100.0	0.0	6.729	42.86	24335.3	2.237	0.0458	0.0	0.1709;
42	100.0	0.0	6.864	42.67	23855.2	2.282	0.0464	0.0	0.1744;
43	100.0	0.0	7.002	42.49	23384.6	2.328	0.0471	0.0	0.1779;
44	100.0	0.0	7.143	42.31	22923.4	2.375	0.0477	0.0	0.1814;
45	100.0	0.0	7.286	42.13	22471.2	2.423	0.0483	0.0	0.1851;
46	100.0	0.0	7.432	41.96	22028.1	2.471	0.0489	0.0	0.1888;
47	100.0	0.0	7.581	41.79	21593.7	2.521	0.0496	0.0	0.1926;

48	100.0	0.0	7.733	41.63	21168.0	2.572	0.0502	0.0	0.1964;	
49	100.0	0.0	7.888	41.47	20750.7	2.624	0.0508	0.0	0.2004;	
50	100.0	0.0	8.046	41.31	20341.7	2.676	0.0514	0.0	0.2044;	
51	100.0	0.0	8.207	41.15	19940.7	2.730	0.052	0.0	0.2085;	
52	100.0	0.0	8.372	41.00	19547.7	2.785	0.0525	0.0	0.2126;	
53	100.0	0.0	8.540	40.85	19162.5	2.841	0.0531	0.0	0.2169;	
54	100.0	0.0	8.711	40.70	18784.9	2.898	0.0537	0.0	0.2213;	
55	100.0	0.0	8.885	40.56	18414.8	2.956	0.0543	0.0	0.2257;	
56	100.0	0.0	9.063	40.42	18052.1	3.016	0.0548	0.0	0.2302;	
57	100.0	0.0	9.245	40.28	17696.4	3.076	0.0554	0.0	0.2348;	
58	100.0	0.0	9.430	40.14	17347.9	3.138	0.056	0.0	0.2395;	
59	100.0	0.0	9.619	40.01	17006.2	3.201	0.0565	0.0	0.2443;	
60	100.0	0.0	9.812	39.88	16671.3	3.265	0.0571	0.0	0.2492;	
61	100.0	0.0	10.01	39.75	16343.0	3.331	0.0576	0.0	0.2542;	
62	100.0	0.0	10.21	39.63	16021.2	3.398	0.0582	0.0	0.2593;	
63	100.0	0.0	10.41	39.50	15705.8	3.466	0.0587	0.0	0.2645;	
64	100.0	0.0	10.62	39.38	15396.6	3.536	0.0592	0.0	0.2698;	
65	100.0	0.0	10.83	39.27	15103.8	3.604	0.0598	0.0	0.2751;	begin overlap;
66	100.0	0.0	11.04	39.16	14827.3	3.672	0.0603	0.0	0.2803;	
67	100.0	0.0	11.24	39.06	14565.6	3.738	0.0608	0.0	0.2855;	
68	100.0	0.0	11.44	38.96	14317.5	3.802	0.0614	0.0	0.2905;	
69	100.0	0.0	11.63	38.87	14081.8	3.866	0.0619	0.0	0.2954;	
70	100.0	0.0	11.82	38.78	13857.6	3.929	0.0624	0.0	0.3003;	
71	100.0	0.0	12.01	38.70	13643.8	3.990	0.0629	0.0	0.3050;	
72	100.0	0.0	12.19	38.62	13439.7	4.051	0.0635	0.0	0.3097;	
73	100.0	0.0	12.38	38.55	13244.6	4.110	0.064	0.0	0.3143;	
74	100.0	0.0	12.55	38.47	13057.9	4.169	0.0645	0.0	0.3189;	
75	100.0	0.0	12.73	38.40	12878.9	4.227	0.065	0.0	0.3234;	
76	100.0	0.0	12.91	38.34	12707.1	4.284	0.0655	0.0	0.3278;	
77	100.0	0.0	13.08	38.27	12542.1	4.341	0.0661	0.0	0.3322;	
78	100.0	0.0	13.25	38.21	12383.4	4.396	0.0666	0.0	0.3365;	
79	100.0	0.0	13.41	38.15	12230.7	4.451	0.0671	0.0	0.3407;	
80	100.0	0.0	13.58	38.09	12083.5	4.505	0.0676	0.0	0.3449;	
81	100.0	0.0	13.74	38.04	11941.5	4.559	0.0681	0.0	0.3490;	
82	100.0	0.0	13.90	37.98	11804.4	4.612	0.0687	0.0	0.3531;	
83	100.0	0.0	14.06	37.93	11672.0	4.664	0.0692	0.0	0.3572;	
84	100.0	0.0	14.22	37.88	11544.0	4.716	0.0697	0.0	0.3611;	
85	100.0	0.0	14.37	37.83	11420.1	4.767	0.0702	0.0	0.3651;	
86	100.0	0.0	14.53	37.79	11300.1	4.818	0.0708	0.0	0.3690;	
87	100.0	0.0	14.68	37.74	11183.9	4.868	0.0713	0.0	0.3729;	
88	100.0	0.0	14.83	37.70	11071.2	4.917	0.0718	0.0	0.3767;	
89	100.0	0.0	14.98	37.65	10961.8	4.966	0.0724	0.0	0.3805;	
90	100.0	0.0	15.13	37.61	10855.7	5.015	0.0729	0.0	0.3842;	
91	100.0	0.0	15.27	37.57	10752.5	5.063	0.0734	0.0	0.3879;	
92	100.0	0.0	15.42	37.53	10652.3	5.111	0.074	0.0	0.3916;	
93	100.0	0.0	15.56	37.50	10554.8	5.158	0.0745	0.0	0.3952;	
94	100.0	0.0	15.70	37.46	10460.0	5.205	0.0751	0.0	0.3988;	
95	100.0	0.0	15.84	37.42	10367.6	5.251	0.0756	0.0	0.4024;	
96	100.0	0.0	15.98	37.39	10277.7	5.297	0.0762	0.0	0.4059;	
97	100.0	0.0	16.12	37.35	10190.1	5.342	0.0767	0.0	0.4094;	
98	100.0	0.0	16.26	37.32	10104.7	5.388	0.0773	0.0	0.4129;	
99	100.0	0.0	16.39	37.29	10021.3	5.432	0.0778	0.0	0.4164;	
100	100.0	0.0	16.53	37.26	9940.1	5.477	0.0784	0.0	0.4198;	
101	100.0	0.0	16.66	37.22	9860.7	5.521	0.079	0.0	0.4232;	
102	100.0	0.0	16.79	37.19	9783.2	5.565	0.0795	0.0	0.4265;	
103	100.0	0.0	16.92	37.16	9707.6	5.608	0.0801	0.0	0.4298;	

104	100.0	0.0	17.05	37.14	9633.6	5.651	0.0807	0.0	0.4332;
105	100.0	0.0	17.18	37.11	9561.3	5.694	0.0813	0.0	0.4364;
106	100.0	0.0	17.31	37.08	9490.6	5.736	0.0819	0.0	0.4397;
107	100.0	0.0	17.44	37.05	9421.4	5.778	0.0825	0.0	0.4429;
108	100.0	0.0	17.56	37.03	9353.7	5.820	0.0831	0.0	0.4461;
109	100.0	0.0	17.69	37.00	9287.5	5.862	0.0837	0.0	0.4493;
110	100.0	0.0	17.81	36.98	9222.6	5.903	0.0843	0.0	0.4525;
111	100.0	0.0	17.94	36.95	9159.1	5.944	0.0849	0.0	0.4556;
112	100.0	0.0	18.06	36.93	9096.8	5.985	0.0855	0.0	0.4587;
113	100.0	0.0	18.18	36.90	9035.8	6.025	0.0861	0.0	0.4618;
114	100.0	0.0	18.30	36.88	8976.0	6.065	0.0867	0.0	0.4649;
115	100.0	0.0	18.42	36.86	8917.3	6.105	0.0874	0.0	0.4679;
116	100.0	0.0	18.54	36.83	8859.8	6.145	0.088	0.0	0.4710;
117	100.0	0.0	18.66	36.81	8803.3	6.184	0.0886	0.0	0.4740;
118	100.0	0.0	18.78	36.79	8747.9	6.223	0.0893	0.0	0.4770;
119	100.0	0.0	18.90	36.77	8693.5	6.262	0.0899	0.0	0.4799;
120	100.0	0.0	19.01	36.75	8640.1	6.301	0.0906	0.0	0.4829;
121	100.0	0.0	19.13	36.73	8587.7	6.339	0.0913	0.0	0.4858;
122	100.0	0.0	19.24	36.71	8536.2	6.378	0.092	0.0	0.4887;
123	100.0	0.0	19.36	36.69	8485.6	6.416	0.0926	0.0	0.4916;
124	100.0	0.0	19.47	36.67	8435.8	6.453	0.0933	0.0	0.4945;
125	100.0	0.0	19.58	36.65	8386.9	6.491	0.094	0.0	0.4974;
126	100.0	0.0	19.69	36.63	8338.9	6.528	0.0947	0.0	0.5002;
127	100.0	0.0	19.81	36.61	8291.6	6.566	0.0954	0.0	0.5031;
128	100.0	0.0	19.92	36.59	8245.1	6.603	0.0962	0.0	0.5059;
129	100.0	0.0	20.03	36.58	8199.4	6.640	0.0969	0.0	0.5087;
130	100.0	0.0	20.14	36.56	8154.4	6.676	0.0976	0.0	0.5114;
131	100.0	0.0	20.24	36.54	8110.1	6.713	0.0984	0.0	0.5142;
132	100.0	0.0	20.35	36.52	8066.4	6.749	0.0991	0.0	0.5170;
133	100.0	0.0	20.46	36.51	8023.5	6.785	0.0999	0.0	0.5197;
134	100.0	0.0	20.57	36.49	7981.2	6.821	0.101	0.0	0.5224;
135	100.0	0.0	20.67	36.47	7939.6	6.857	0.101	0.0	0.5251;
136	100.0	0.0	20.78	36.46	7898.6	6.892	0.102	0.0	0.5278;
137	100.0	0.0	20.88	36.44	7858.2	6.928	0.103	0.0	0.5305;
138	100.0	0.0	20.99	36.43	7818.3	6.963	0.104	0.0	0.5331;
139	100.0	0.0	21.09	36.41	7779.1	6.998	0.105	0.0	0.5358;
140	100.0	0.0	21.20	36.40	7740.4	7.033	0.106	0.0	0.5384;
141	100.0	0.0	21.30	36.38	7702.2	7.068	0.106	0.0	0.5410;
142	100.0	0.0	21.40	36.37	7664.6	7.103	0.107	0.0	0.5436;
143	100.0	0.0	21.50	36.35	7627.5	7.137	0.108	0.0	0.5462;
144	100.0	0.0	21.60	36.34	7590.9	7.172	0.109	0.0	0.5488;
145	100.0	0.0	21.71	36.32	7554.8	7.206	0.110	0.0	0.5513;
146	100.0	0.0	21.81	36.31	7519.2	7.240	0.111	0.0	0.5539;
147	100.0	0.0	21.91	36.30	7484.0	7.274	0.112	0.0	0.5564;
148	100.0	0.0	22.00	36.28	7449.3	7.308	0.113	0.0	0.5589;
149	100.0	0.0	22.10	36.27	7415.0	7.342	0.114	0.0	0.5614;
150	100.0	0.0	22.20	36.26	7381.2	7.376	0.115	0.0	0.5639;
151	100.0	0.0	22.30	36.24	7347.8	7.409	0.116	0.0	0.5664;
152	100.0	0.0	22.39	36.23	7314.8	7.442	0.117	0.0	0.5688;
153	100.0	0.0	22.49	36.22	7282.2	7.476	0.118	0.0	0.5713;
154	100.0	0.0	22.59	36.20	7250.0	7.509	0.119	0.0	0.5737;
155	100.0	0.0	22.68	36.19	7218.1	7.542	0.120	0.0	0.5761;
156	100.0	0.0	22.78	36.18	7186.7	7.575	0.121	0.0	0.5785;
157	100.0	0.0	22.87	36.17	7155.6	7.608	0.123	0.0	0.5809;
158	100.0	0.0	22.97	36.16	7124.9	7.641	0.124	0.0	0.5833;
159	100.0	0.0	23.06	36.14	7094.5	7.674	0.125	0.0	0.5857;

160	100.0	0.0	23.15	36.13	7064.4	7.706	0.126	0.0	0.5880;
161	100.0	0.0	23.24	36.12	7034.7	7.739	0.127	0.0	0.5904;
162	100.0	0.0	23.33	36.11	7005.3	7.771	0.129	0.0	0.5927;
163	100.0	0.0	23.42	36.10	6976.1	7.804	0.130	0.0	0.5950;
164	100.0	0.0	23.51	36.09	6947.3	7.836	0.132	0.0	0.5973;
165	100.0	0.0	23.60	36.07	6918.8	7.868	0.133	0.0	0.5995;
166	100.0	0.0	23.69	36.06	6890.6	7.901	0.134	0.0	0.6018;
167	100.0	0.0	23.78	36.05	6862.6	7.933	0.136	0.0	0.6040;
168	100.0	0.0	23.87	36.04	6835.0	7.965	0.138	0.0	0.6063;
169	100.0	0.0	23.96	36.03	6807.5	7.997	0.139	0.0	0.6085;
170	100.0	0.0	24.04	36.02	6780.4	8.029	0.141	0.0	0.6107;
171	100.0	0.0	24.13	36.01	6753.4	8.061	0.143	0.0	0.6128;
172	100.0	0.0	24.21	36.00	6726.7	8.093	0.144	0.0	0.6150;
173	100.0	0.0	24.29	35.99	6700.3	8.125	0.146	0.0	0.6171;
174	100.0	0.0	24.38	35.98	6674.1	8.157	0.148	0.0	0.6192;
175	100.0	0.0	24.46	35.97	6649.1	8.188	0.150	0.0	0.6212;
176	100.0	0.0	24.53	35.96	6624.4	8.218	0.152	0.0	0.6232;
177	100.0	0.0	24.61	35.95	6599.9	8.249	0.154	0.0	0.6251;
178	100.0	0.0	24.69	35.94	6575.5	8.279	0.156	0.0	0.6271;
179	100.0	0.0	24.76	35.93	6551.5	8.310	0.158	0.0	0.6290;
180	100.0	0.0	24.84	35.92	6527.6	8.340	0.160	0.0	0.6309;
181	100.0	0.0	24.91	35.91	6503.9	8.370	0.162	0.0	0.6328;
182	100.0	0.0	24.99	35.90	6480.5	8.401	0.164	0.0	0.6346;
183	100.0	0.0	25.06	35.89	6457.2	8.431	0.165	0.0	0.6365;
184	100.0	0.0	25.13	35.89	6434.2	8.461	0.167	0.0	0.6384;
185	100.0	0.0	25.20	35.88	6411.3	8.491	0.169	0.0	0.6402;
186	100.0	0.0	25.28	35.87	6388.7	8.521	0.171	0.0	0.6420;
187	100.0	0.0	25.35	35.86	6366.2	8.551	0.173	0.0	0.6438;
188	100.0	0.0	25.42	35.85	6343.9	8.581	0.175	0.0	0.6456;
189	100.0	0.0	25.49	35.84	6321.8	8.611	0.177	0.0	0.6474;
190	100.0	0.0	25.56	35.83	6299.9	8.641	0.179	0.0	0.6491;
191	100.0	0.0	25.62	35.82	6278.1	8.671	0.181	0.0	0.6509;
192	100.0	0.0	25.69	35.82	6256.6	8.701	0.183	0.0	0.6526;
193	100.0	0.0	25.76	35.81	6235.1	8.731	0.185	0.0	0.6543;
194	100.0	0.0	25.83	35.80	6213.9	8.761	0.186	0.0	0.6560;
195	100.0	0.0	25.89	35.79	6192.8	8.791	0.188	0.0	0.6577;
196	100.0	0.0	25.96	35.78	6171.9	8.821	0.190	0.0	0.6594;
197	100.0	0.0	26.03	35.77	6151.1	8.850	0.192	0.0	0.6610;
198	100.0	0.0	26.09	35.77	6130.5	8.880	0.194	0.0	0.6627;
199	100.0	0.0	26.15	35.76	6110.0	8.910	0.196	0.0	0.6643;
200	100.0	0.0	26.22	35.75	6089.7	8.940	0.198	0.0	0.6659;
201	100.0	0.0	26.28	35.74	6069.5	8.969	0.200	0.0	0.6675;
202	100.0	0.0	26.34	35.73	6049.4	8.999	0.202	0.0	0.6691;
203	100.0	0.0	26.41	35.73	6029.5	9.029	0.204	0.0	0.6707;
204	100.0	0.0	26.47	35.72	6009.7	9.059	0.205	0.0	0.6723;
205	100.0	0.0	26.53	35.71	5990.1	9.088	0.207	0.0	0.6738;
206	100.0	0.0	26.59	35.70	5970.6	9.118	0.209	0.0	0.6754;
207	100.0	0.0	26.65	35.70	5951.2	9.148	0.211	0.0	0.6769;
208	100.0	0.0	26.71	35.69	5932.0	9.177	0.213	0.0	0.6784;
209	100.0	0.0	26.77	35.68	5912.8	9.207	0.215	0.0	0.6799;
210	100.0	0.0	26.83	35.67	5893.8	9.237	0.217	0.0	0.6814;
211	100.0	0.0	26.88	35.67	5874.9	9.267	0.219	0.0	0.6828;
212	100.0	0.0	26.94	35.66	5856.1	9.296	0.221	0.0	0.6843;
213	100.0	0.0	27.00	35.65	5837.5	9.326	0.223	0.0	0.6857;
214	100.0	0.0	27.05	35.64	5818.9	9.356	0.225	0.0	0.6872;
215	100.0	0.0	27.11	35.64	5800.5	9.385	0.226	0.0	0.6886;

216	100.0	0.0	27.16	35.63	5782.2	9.415	0.228	0.0	0.6900;
217	100.0	0.0	27.22	35.62	5763.9	9.445	0.230	0.0	0.6914;
218	100.0	0.0	27.27	35.62	5745.8	9.475	0.232	0.0	0.6927;
219	100.0	0.0	27.33	35.61	5727.8	9.505	0.234	0.0	0.6941;
220	100.0	0.0	27.38	35.60	5709.9	9.534	0.236	0.0	0.6955;
221	100.0	0.0	27.43	35.59	5692.1	9.564	0.238	0.0	0.6968;
222	100.0	0.0	27.48	35.59	5674.3	9.594	0.240	0.0	0.6981;
223	100.0	0.0	27.54	35.58	5656.7	9.624	0.242	0.0	0.6994;
224	100.0	0.0	27.59	35.57	5639.2	9.654	0.244	0.0	0.7007;
225	100.0	0.0	27.64	35.57	5621.7	9.684	0.246	0.0	0.7020;
226	100.0	0.0	27.69	35.56	5604.4	9.714	0.248	0.0	0.7033;
227	100.1	0.0	27.74	35.55	5587.1	9.744	0.250	0.0	0.7045;
228	100.1	0.0	27.79	35.55	5569.9	9.774	0.252	0.0	0.7058;
229	100.1	0.0	27.83	35.54	5552.8	9.804	0.254	0.0	0.7070;
230	100.1	0.0	27.88	35.53	5535.8	9.834	0.256	0.0	0.7082;
231	100.1	0.0	27.93	35.53	5518.9	9.864	0.258	0.0	0.7094;
232	100.1	0.0	27.98	35.52	5502.0	9.895	0.260	0.0	0.7106;
233	100.1	0.0	28.02	35.51	5485.3	9.925	0.262	0.0	0.7118;
234	100.1	0.0	28.07	35.51	5468.6	9.955	0.264	0.0	0.7129;
235	100.1	0.0	28.11	35.50	5451.9	9.985	0.266	0.0	0.7141;
236	100.1	0.0	28.16	35.49	5435.4	10.02	0.268	0.0	0.7152;
237	100.1	0.0	28.20	35.49	5418.9	10.05	0.270	0.0	0.7164;
238	100.1	0.0	28.25	35.48	5402.5	10.08	0.272	0.0	0.7175;
239	100.1	0.0	28.29	35.47	5386.1	10.11	0.274	0.0	0.7186;
240	100.1	0.0	28.33	35.47	5369.9	10.14	0.276	0.0	0.7197;
241	100.1	0.0	28.38	35.46	5353.7	10.17	0.278	0.0	0.7207;
242	100.1	0.0	28.42	35.46	5337.5	10.20	0.280	0.0	0.7218;
243	100.1	0.0	28.46	35.45	5321.4	10.23	0.282	0.0	0.7229;
244	100.1	0.0	28.50	35.44	5305.4	10.26	0.284	0.0	0.7239;
245	100.1	0.0	28.54	35.44	5289.4	10.29	0.286	0.0	0.7249;
246	100.1	0.0	28.58	35.43	5273.5	10.32	0.288	0.0	0.7259;
247	100.1	0.0	28.62	35.42	5257.7	10.35	0.290	0.0	0.7269;
248	100.1	0.0	28.66	35.42	5241.9	10.39	0.292	0.0	0.7279;
249	100.1	0.0	28.70	35.41	5226.2	10.42	0.294	0.0	0.7289;
250	100.1	0.0	28.73	35.41	5210.5	10.45	0.296	0.0	0.7298;
251	100.1	0.0	28.77	35.40	5194.9	10.48	0.299	0.0	0.7308;
252	100.1	0.0	28.81	35.39	5179.3	10.51	0.301	0.0	0.7317;
253	100.1	0.0	28.84	35.39	5163.8	10.54	0.303	0.0	0.7326;
254	100.1	0.0	28.88	35.38	5148.3	10.57	0.305	0.0	0.7336;
255	100.1	0.0	28.92	35.38	5132.9	10.61	0.307	0.0	0.7345;
256	100.1	0.0	28.95	35.37	5117.5	10.64	0.309	0.0	0.7353;
257	100.1	0.0	28.98	35.36	5102.2	10.67	0.311	0.0	0.7362;
258	100.1	0.0	29.02	35.36	5086.9	10.70	0.313	0.0	0.7371;
259	100.1	0.0	29.05	35.35	5071.6	10.73	0.316	0.0	0.7379;
260	100.1	0.0	29.08	35.35	5056.4	10.77	0.318	0.0	0.7387;
261	100.1	0.0	29.12	35.34	5041.2	10.80	0.320	0.0	0.7396;
262	100.1	0.0	29.15	35.33	5026.1	10.83	0.322	0.0	0.7404;
263	100.1	0.0	29.18	35.33	5011.0	10.86	0.324	0.0	0.7412;
264	100.1	0.0	29.21	35.32	4995.9	10.90	0.327	0.0	0.7420;
265	100.1	0.0	29.24	35.32	4980.9	10.93	0.329	0.0	0.7427;
266	100.1	0.0	29.27	35.31	4965.9	10.96	0.331	0.0	0.7435;
267	100.1	0.0	29.30	35.30	4951.0	11.00	0.333	0.0	0.7442;
268	100.1	0.0	29.33	35.30	4936.1	11.03	0.336	0.0	0.7450;
269	100.1	0.0	29.36	35.29	4921.2	11.06	0.338	0.0	0.7457;
270	100.1	0.0	29.39	35.29	4906.3	11.10	0.340	0.0	0.7464;
271	100.1	0.0	29.41	35.28	4891.5	11.13	0.343	0.0	0.7471;

272	100.1	0.0	29.44	35.28	4876.6	11.16	0.345	0.0	0.7478;
273	100.1	0.0	29.47	35.27	4861.9	11.20	0.347	0.0	0.7485;
274	100.1	0.0	29.49	35.26	4847.1	11.23	0.350	0.0	0.7491;
275	100.1	0.0	29.52	35.26	4832.4	11.27	0.352	0.0	0.7498;
276	100.1	0.0	29.54	35.25	4817.6	11.30	0.354	0.0	0.7504;
277	100.1	0.0	29.57	35.25	4802.9	11.33	0.357	0.0	0.7510;
278	100.1	0.0	29.59	35.24	4788.3	11.37	0.359	0.0	0.7516;
279	100.1	0.0	29.62	35.24	4773.6	11.40	0.362	0.0	0.7522;
280	100.1	0.0	29.64	35.23	4759.0	11.44	0.364	0.0	0.7528;
281	100.1	0.0	29.66	35.22	4744.3	11.47	0.366	0.0	0.7534;
282	100.1	0.0	29.68	35.22	4729.7	11.51	0.369	0.0	0.7540;
283	100.1	0.0	29.71	35.21	4715.1	11.55	0.371	0.0	0.7545;
284	100.1	0.0	29.73	35.21	4700.5	11.58	0.374	0.0	0.7551;
285	100.1	0.0	29.75	35.20	4685.9	11.62	0.376	0.0	0.7556;
286	100.1	0.0	29.77	35.20	4671.4	11.65	0.379	0.0	0.7561;
287	100.2	0.0	29.79	35.19	4656.8	11.69	0.381	0.0	0.7566;
288	100.2	0.0	29.81	35.18	4642.3	11.73	0.384	0.0	0.7571;
289	100.2	0.0	29.83	35.18	4627.7	11.76	0.387	0.0	0.7576;
290	100.2	0.0	29.84	35.17	4613.2	11.80	0.389	0.0	0.7580;
291	100.2	0.0	29.86	35.17	4598.6	11.84	0.392	0.0	0.7585;
292	100.2	0.0	29.88	35.16	4584.1	11.88	0.394	0.0	0.7589;
293	100.2	0.0	29.90	35.16	4569.5	11.91	0.397	0.0	0.7594;
294	100.2	0.0	29.91	35.15	4555.0	11.95	0.400	0.0	0.7598;
295	100.2	0.0	29.93	35.14	4540.4	11.99	0.402	0.0	0.7602;
296	100.2	0.0	29.95	35.14	4525.9	12.03	0.405	0.0	0.7606;
297	100.2	0.0	29.96	35.13	4511.3	12.07	0.408	0.0	0.7610;
298	100.2	0.0	29.98	35.13	4496.7	12.11	0.411	0.0	0.7614;
299	100.2	0.0	29.99	35.12	4482.2	12.15	0.413	0.0	0.7618;
300	100.2	0.0	30.00	35.12	4467.6	12.19	0.416	0.0	0.7621;
301	100.2	0.0	30.02	35.11	4453.0	12.23	0.419	0.0	0.7625;
302	100.2	0.0	30.03	35.10	4438.3	12.27	0.422	0.0	0.7628;
303	100.2	0.0	30.04	35.10	4423.7	12.31	0.425	0.0	0.7631;
304	100.2	0.0	30.06	35.09	4409.0	12.35	0.428	0.0	0.7634;
305	100.2	0.0	30.07	35.09	4394.3	12.39	0.430	0.0	0.7637;
306	100.2	0.0	30.08	35.08	4379.6	12.43	0.433	0.0	0.7640;
307	100.2	0.0	30.09	35.07	4364.9	12.47	0.436	0.0	0.7643;
308	100.2	0.0	30.10	35.07	4350.2	12.51	0.439	0.0	0.7646;
309	100.2	0.0	30.11	35.06	4335.4	12.56	0.442	0.0	0.7649;
310	100.2	0.0	30.12	35.06	4320.6	12.60	0.445	0.0	0.7651;
311	100.2	0.0	30.13	35.05	4305.7	12.64	0.448	0.0	0.7654;
312	100.2	0.0	30.14	35.05	4290.8	12.69	0.451	0.0	0.7656;
313	100.2	0.0	30.15	35.04	4275.9	12.73	0.455	0.0	0.7659;
314	100.2	0.0	30.16	35.03	4261.0	12.78	0.458	0.0	0.7661;
315	100.2	0.0	30.17	35.03	4246.0	12.82	0.461	0.0	0.7663;
316	100.2	0.0	30.18	35.02	4230.9	12.87	0.464	0.0	0.7665;
317	100.3	0.0	30.19	35.02	4215.8	12.91	0.467	0.0	0.7667;
318	100.3	0.0	30.19	35.01	4200.7	12.96	0.471	0.0	0.7669;
319	100.3	0.0	30.20	35.00	4185.5	13.01	0.474	0.0	0.7671;
320	100.3	0.0	30.21	35.00	4170.2	13.05	0.477	0.0	0.7673;
321	100.3	0.0	30.21	34.99	4154.9	13.10	0.481	0.0	0.7675;
322	100.3	0.0	30.22	34.99	4139.5	13.15	0.484	0.0	0.7676;
323	100.3	0.0	30.23	34.98	4124.1	13.20	0.487	0.0	0.7678;
324	100.3	0.0	30.23	34.97	4108.5	13.25	0.491	0.0	0.7679;
325	100.3	0.0	30.24	34.97	4092.9	13.30	0.494	0.0	0.7681;
326	100.3	0.0	30.25	34.96	4077.3	13.35	0.498	0.0	0.7683;
327	100.3	0.0	30.25	34.96	4061.5	13.40	0.502	0.0	0.7684;

328	100.3	0.0	30.26	34.95	4045.7	13.46	0.505	0.0	0.7686;
329	100.3	0.0	30.26	34.94	4029.8	13.51	0.509	0.0	0.7687;
330	100.3	0.0	30.27	34.94	4013.8	13.56	0.513	0.0	0.7688;
331	100.3	0.0	30.28	34.93	3997.7	13.62	0.516	0.0	0.7690;
332	100.3	0.0	30.28	34.92	3981.4	13.67	0.520	0.0	0.7691;
333	100.3	0.0	30.29	34.92	3965.1	13.73	0.524	0.0	0.7693;
334	100.3	0.0	30.29	34.91	3948.7	13.79	0.528	0.0	0.7694;
335	100.3	0.0	30.30	34.91	3932.1	13.84	0.532	0.0	0.7696;
336	100.4	0.0	30.30	34.90	3915.5	13.90	0.536	0.0	0.7697;
337	100.4	0.0	30.31	34.89	3898.7	13.96	0.540	0.0	0.7699;
338	100.4	0.0	30.32	34.89	3881.7	14.02	0.544	0.0	0.7700;
339	100.4	0.0	30.32	34.88	3864.6	14.09	0.548	0.0	0.7702;
340	100.4	0.0	30.33	34.87	3847.4	14.15	0.552	0.0	0.7704;
341	100.4	0.0	30.34	34.87	3830.0	14.21	0.556	0.0	0.7706;
342	100.4	0.0	30.35	34.86	3812.4	14.28	0.560	0.0	0.7708;
343	100.4	0.0	30.35	34.85	3794.7	14.35	0.565	0.0	0.7710;
344	100.4	0.0	30.36	34.84	3776.8	14.41	0.569	0.0	0.7712;
345	100.4	0.0	30.37	34.84	3758.7	14.48	0.574	0.0	0.7715;
346	100.4	0.0	30.38	34.83	3740.4	14.55	0.578	0.0	0.7717;
347	100.4	0.0	30.39	34.82	3721.9	14.63	0.583	0.0	0.7720;
348	100.4	0.0	30.41	34.82	3703.2	14.70	0.587	0.0	0.7723;
349	100.5	0.0	30.42	34.81	3684.3	14.78	0.592	0.0	0.7726;
350	100.5	0.0	30.43	34.80	3665.1	14.85	0.597	0.0	0.7730;
351	100.5	0.0	30.45	34.79	3645.7	14.93	0.601	0.0	0.7734;
352	100.5	0.0	30.46	34.79	3626.0	15.01	0.606	0.0	0.7738;
353	100.5	0.0	30.48	34.78	3606.1	15.10	0.611	0.0	0.7742;
354	100.5	0.0	30.50	34.77	3585.9	15.18	0.616	0.0	0.7747;
355	100.5	0.0	30.52	34.76	3565.3	15.27	0.621	0.0	0.7752;
356	100.5	0.0	30.54	34.75	3544.5	15.36	0.627	0.0	0.7758;
357	100.5	0.0	30.57	34.75	3523.3	15.45	0.632	0.0	0.7764;
358	100.6	0.0	30.59	34.74	3501.8	15.55	0.637	0.0	0.7771;
359	100.6	0.0	30.62	34.73	3480.2	15.64	0.642	0.0	0.7778;
360	100.6	0.0	30.65	34.72	3458.7	15.74	0.648	0.0	0.7785; end overlap;
361	100.6	0.0	30.67	34.71	3437.4	15.84	0.653	0.0	0.7791;
362	100.6	0.0	30.69	34.70	3416.2	15.94	0.659	0.0	0.7796;
363	100.6	0.0	30.71	34.70	3395.1	16.03	0.665	0.0	0.7802;
364	100.6	0.0	30.73	34.69	3374.1	16.13	0.671	0.0	0.7806;
365	100.6	0.0	30.75	34.68	3353.3	16.23	0.677	0.0	0.7810;
366	100.7	0.0	30.76	34.67	3332.5	16.34	0.683	0.0	0.7814;
367	100.7	0.0	30.78	34.66	3311.7	16.44	0.689	0.0	0.7817;
368	100.7	0.0	30.79	34.65	3291.0	16.54	0.695	0.0	0.7820;
369	100.7	0.0	30.80	34.65	3270.3	16.65	0.701	0.0	0.7822;
370	100.7	0.0	30.80	34.64	3249.6	16.75	0.708	0.0	0.7824;
371	100.7	0.0	30.81	34.63	3228.9	16.86	0.714	0.0	0.7826;
372	100.8	0.0	30.81	34.62	3208.2	16.97	0.721	0.0	0.7827;
373	100.8	0.0	30.82	34.61	3187.4	17.08	0.728	0.0	0.7828;
374	100.8	0.0	30.82	34.61	3166.6	17.19	0.735	0.0	0.7829;
375	100.8	0.0	30.82	34.60	3145.7	17.31	0.742	0.0	0.7829;
376	100.8	0.0	30.82	34.59	3124.7	17.42	0.749	0.0	0.7829;
377	100.8	0.0	30.83	34.58	3103.6	17.54	0.756	0.0	0.7830;
378	100.9	0.0	30.83	34.57	3082.3	17.66	0.764	0.0	0.7830;
379	100.9	0.0	30.83	34.56	3060.9	17.79	0.771	0.0	0.7830;
380	100.9	0.0	30.83	34.56	3039.2	17.91	0.779	0.0	0.7830;
381	100.9	0.0	30.83	34.55	3017.4	18.04	0.787	0.0	0.7830;
382	101.0	0.0	30.83	34.54	2995.3	18.17	0.795	0.0	0.7830;
383	101.0	0.0	30.83	34.53	2973.0	18.31	0.804	0.0	0.7831;

384	101.0	0.0	30.83	34.52	2950.4	18.45	0.812	0.0	0.7831;
385	101.0	0.0	30.84	34.51	2927.5	18.60	0.821	0.0	0.7832;
386	101.1	0.0	30.84	34.50	2904.3	18.74	0.830	0.0	0.7833;
387	101.1	0.0	30.85	34.49	2880.6	18.90	0.839	0.0	0.7835;
388	101.1	0.0	30.86	34.48	2856.6	19.06	0.848	0.0	0.7837;
389	101.2	0.0	30.87	34.47	2832.2	19.22	0.858	0.0	0.7840;
390	101.2	0.0	30.88	34.46	2807.4	19.39	0.868	0.0	0.7843;
391	101.2	0.0	30.90	34.45	2782.0	19.57	0.878	0.0	0.7848;
392	101.3	0.0	30.92	34.44	2756.2	19.75	0.888	0.0	0.7853;
393	101.3	0.0	30.94	34.43	2729.8	19.94	0.899	0.0	0.7859;
394	101.4	0.0	30.97	34.42	2702.8	20.14	0.909	0.0	0.7866;
395	101.4	0.0	31.00	34.41	2675.2	20.35	0.920	0.0	0.7874;
396	101.4	0.0	31.04	34.40	2646.9	20.57	0.932	0.0	0.7884;
397	101.5	0.0	31.08	34.39	2618.0	20.79	0.944	0.0	0.7895;
398	101.5	0.0	31.13	34.38	2588.4	21.03	0.956	0.0	0.7907;
399	101.6	0.0	31.19	34.37	2558.0	21.28	0.968	0.0	0.7922;
400	101.6	0.0	31.25	34.35	2526.8	21.54	0.981	0.0	0.7938;
401	101.7	0.0	31.33	34.34	2494.8	21.82	0.994	0.0	0.7957;
402	101.8	0.0	31.41	34.33	2461.9	22.11	1.007	0.0	0.7978;
403	101.8	0.0	31.50	34.32	2428.2	22.42	1.021	0.0	0.8001;
404	101.9	0.0	31.60	34.30	2393.4	22.75	1.035	0.0	0.8027;
405	102.0	0.0	31.72	34.29	2357.7	23.09	1.049	0.0	0.8056;
406	102.0	0.0	31.84	34.27	2321.0	23.46	1.064	0.0	0.8089;
407	102.1	0.0	31.99	34.26	2283.3	23.84	1.080	0.0	0.8125;
408	102.2	0.0	32.14	34.24	2244.5	24.26	1.096	0.0	0.8165;
409	102.3	0.0	32.32	34.23	2204.5	24.69	1.112	0.0	0.8209;
410	102.4	0.0	32.51	34.21	2163.4	25.16	1.129	0.0	0.8257;
411	102.5	0.0	32.72	34.20	2121.2	25.66	1.147	0.0	0.8311;
412	102.6	0.0	32.94	34.18	2079.6	26.18	1.164	0.0	0.8367;
413	102.7	0.0	33.17	34.16	2038.8	26.70	1.181	0.0	0.8425;
414	102.8	0.0	33.41	34.15	1998.8	27.24	1.198	0.0	0.8486;
415	102.9	0.0	33.66	34.13	1959.6	27.78	1.214	0.0	0.8549;
416	103.0	0.0	33.92	34.12	1921.1	28.34	1.230	0.0	0.8615;
417	103.1	0.0	34.19	34.10	1883.5	28.90	1.246	0.0	0.8684;
418	103.2	0.0	34.47	34.09	1846.5	29.48	1.262	0.0	0.8755;
419	103.3	0.0	34.76	34.07	1810.3	30.07	1.277	0.0	0.8828;
420	103.4	0.0	35.05	34.06	1774.8	30.67	1.293	0.0	0.8904;
421	103.5	0.0	35.36	34.05	1740.0	31.29	1.308	0.0	0.8982;
422	103.6	0.0	35.68	34.03	1705.8	31.91	1.323	0.0	0.9061;
423	103.7	0.0	36.00	34.02	1672.4	32.55	1.338	0.0	0.9143;
424	103.8	0.0	36.33	34.01	1639.6	33.20	1.352	0.0	0.9227;
425	104.0	0.0	36.67	33.99	1607.4	33.87	1.367	0.0	0.9313;
426	104.1	0.0	37.01	33.98	1575.9	34.55	1.381	0.0	0.9401;
427	104.2	0.0	37.37	33.97	1544.9	35.24	1.395	0.0	0.9491;
428	104.3	0.0	37.73	33.96	1514.6	35.94	1.409	0.0	0.9583;
429	104.4	0.0	38.10	33.95	1484.9	36.66	1.423	0.0	0.9677; bottom hit;

Horiz plane projections in effluent direction: radius(m): 0.0; CL(m): 0.4337
Lmz(m): 0.4337
forced entrain 1 0.0 -1.345 0.968 0.120
Rate sec-1 0.0 dy-1 0.0 kt: 0.0 Amb Sal 33.3632
;
3:07:41 PM. amb fills: 4

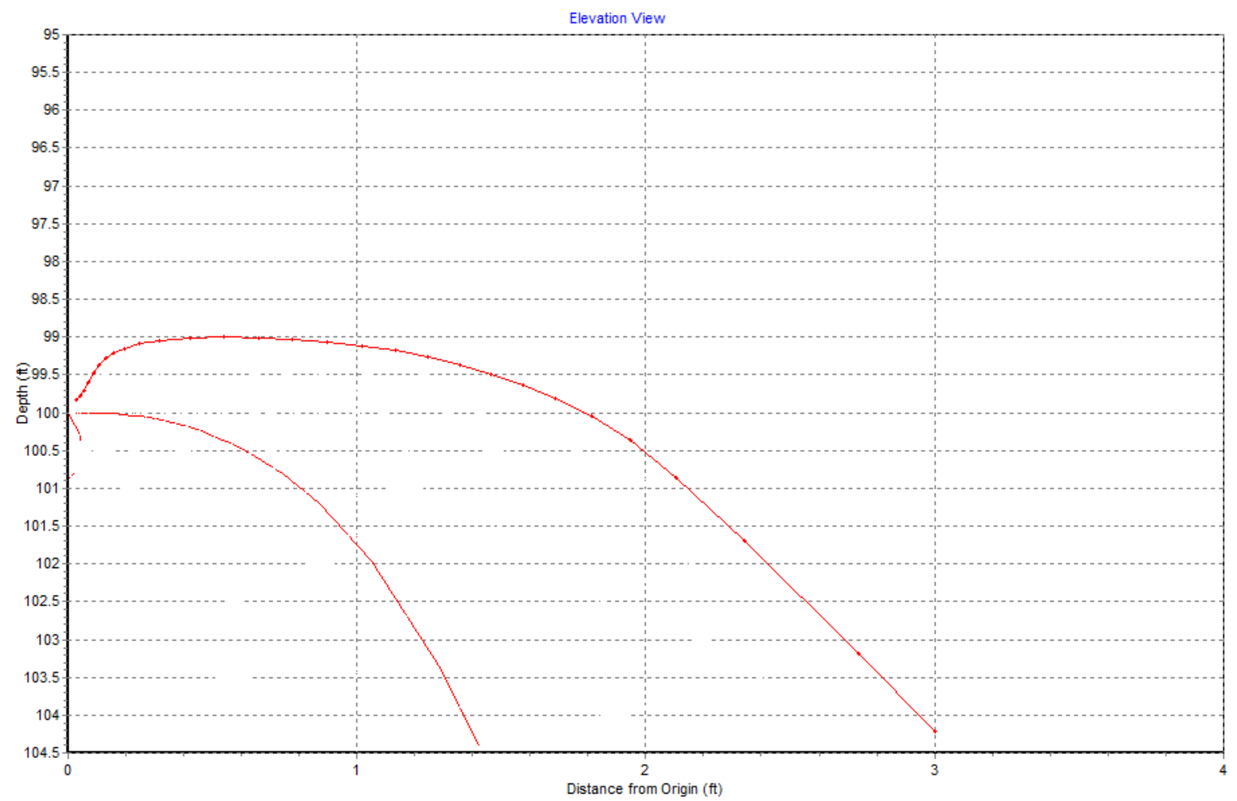

Figure C.8.1: Plumes 18b solution of discharge plume trajectories for discharges of 1.8 mgd of Doheny and Capistrano Beach well water average annual TDS = 33.5 ppt., and 3 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Depth of maximum rise of the plume is Z = 99.0 ft. at Xa = 0.735 ft from the point of discharge. The centerline of the plume is at an average distance of Xb = 1.423 ft from the point of discharge as the plume begins to impact the bottom at a depth of Z = 104.5 ft.

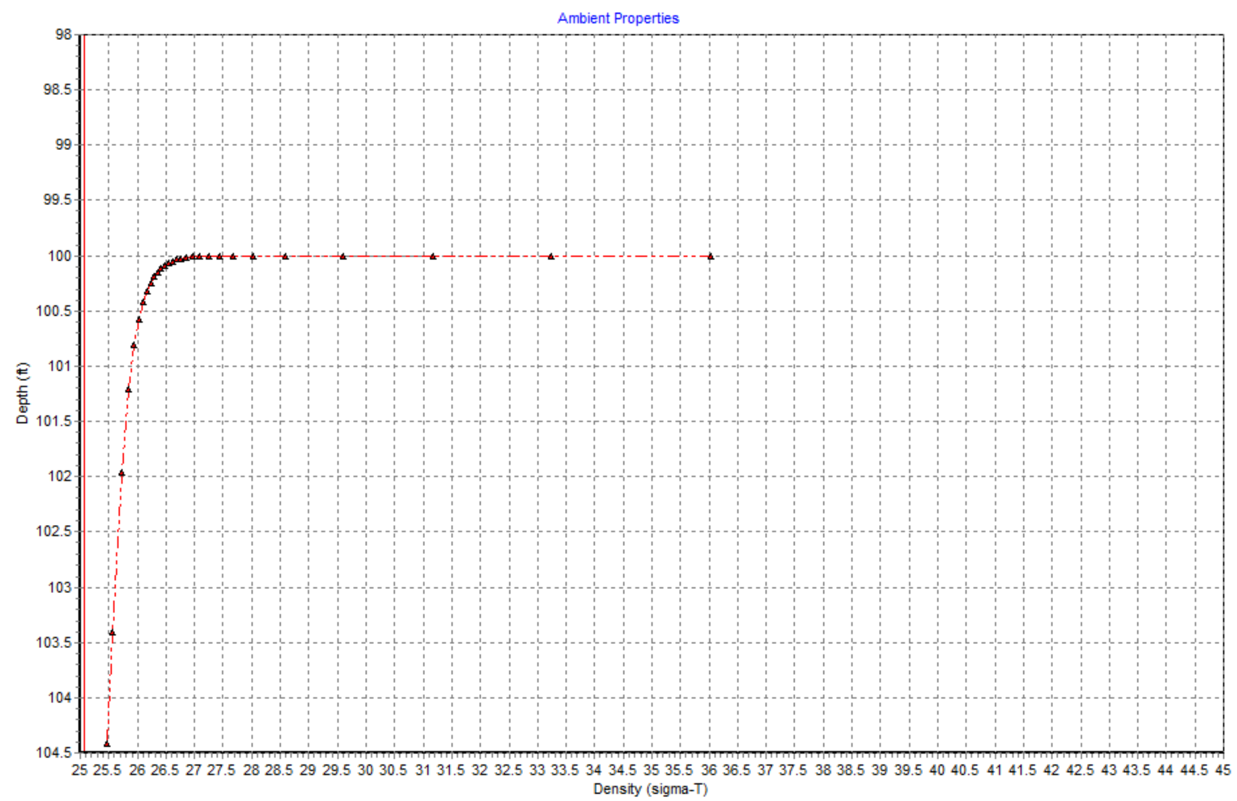

Figure C.8.2: Plumes 18b solution of vertical density profile for discharges of 1.8 mgd of Doheny and Capistrano Beach well water average annual TDS = 33.5 ppt. and 3 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Discharge effluent density shown as black triangles. Ambient water mass density profile shown as solid red line.

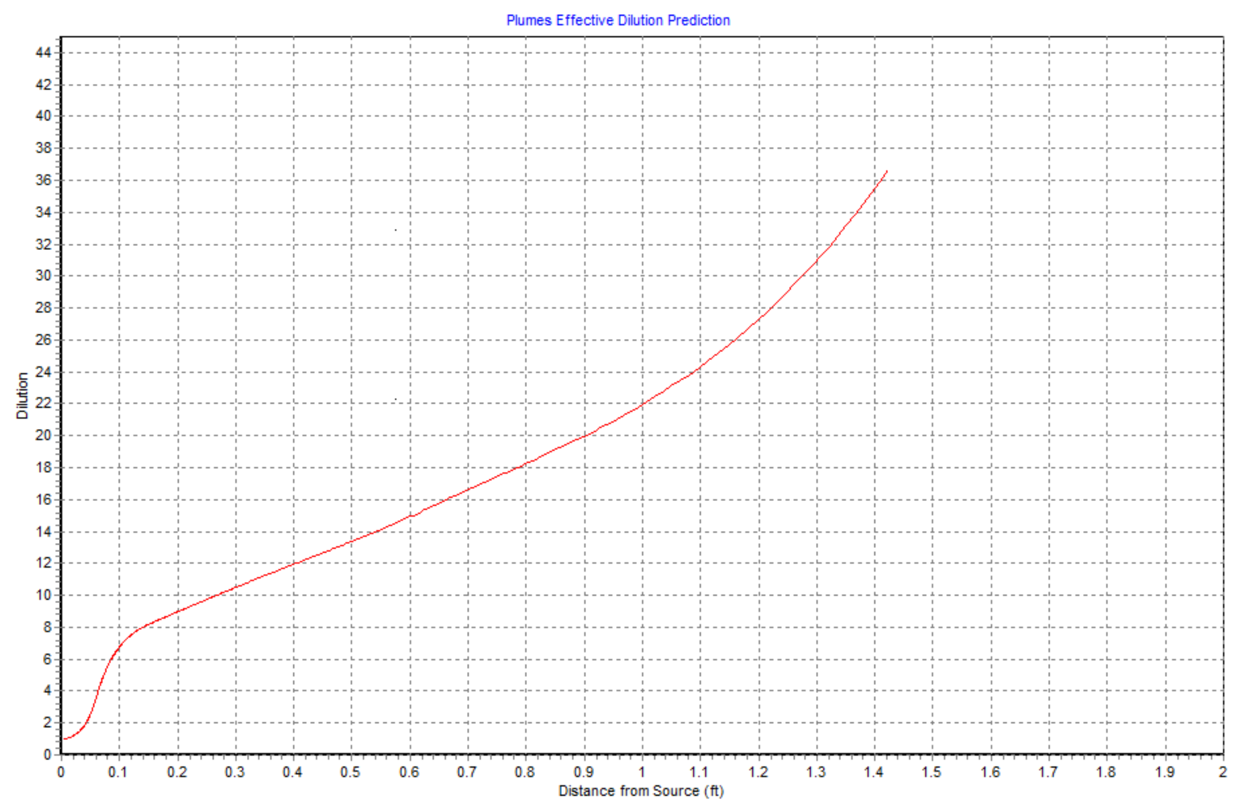

Figure C.8.3: Plumes 18b solution of effective (bulk average) dilution as a function of vertical distance from the point of discharge for discharges of 0.35 mgd of 1.8 mgd of Doheny and Capistrano Beach well water average annual TDS = 33.5 ppt and 3 mgd of brine from the Doheny Desalination Project with a brine salinity of 67 ppt. Effective dilution is S_a = 17.19 at the maximum rise of the plume at Xa = 0.735 ft. from the point of discharge. As the plume begins to impact the bottom, the plume centerline is at a distance of Xb = 1.423 ft from the point of discharge, where the effective dilution reaches S_a = 36.66.

APPENDIX 4.2.3

HYDROGEOLOGIC ANALYSES

APPENDIX 4.2.3.1

GROUNDWATER MODELING FOR FINAL EIR

Doheny Ocean Desalination Project

Hydrogeologic Analysis Related to Responses to Comments: Evaluate Project Impacts on San Juan Creek Surface Water Levels and Assessment of Project Impacts from Potential Upstream Bedrock "Barrier"

Prepared for: South Coast Water District / GHD

March 7, 2019

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THIS REPORT IS RENDERED TO GHD AND SOUTH COAST WATER DISTRICT AS OF THE DATE HEREOF, SOLELY FOR THEIR BENEFIT IN CONNECTION WITH ITS STATED PURPOSE AND MAY NOT BE RELIED ON BY ANY OTHER PERSON OR ENTITY OR BY THEM IN ANY OTHER CONTEXT. AS DATA IS UPDATED FROM TIME TO TIME, ANY RELIANCE ON THIS REPORT AT A FUTURE DATE SHOULD TAKE INTO ACCOUNT UPDATED DATA.

THIS DOCUMENT HAS BEEN CHECKED FOR COMPLETENESS, ACCURACY, AND CONSISTENCY BY THE FOLLOWING PROFESSIONALS:

____

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Principal
CHG No. 794

EIR DOHENY OCEAN DESALINATION PROJECT

HYDROGEOLOGIC ANALYSIS RELATED TO RESPONSES TO COMMENTS EVALUATE PROJECT IMPACTS ON SAN JUAN CREEK SURFACE WATER LEVELS AND ASSESSMENT OF PROJECT IMPACTS FROM POTENTIAL UPSTREAM BEDROCK "BARRIER"

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FIGURES

FIGURES (continued)

FIGURES (continued)

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EIR DOHENY OCEAN DESALINATION PROJECT

HYDROGEOLOGIC ANALYSIS RELATED TO RESPONSES TO COMMENTS EVALUATE PROJECT IMPACTS ON SAN JUAN CREEK SURFACE WATER LEVELS AND ASSESSMENT OF PROJECT IMPACTS FROM POTENTIAL UPSTREAM BEDROCK "BARRIER"

1.0 INTRODUCTION

The Doheny Ocean Desalination Project Draft Environmental Impact Report (DEIR) was issued on May 17, 2018. GEOSCIENCE Support Services, Inc. (GEOSCIENCE) reviewed the DEIR comments related to project impacts to groundwater and surface water provided to us by the project team, including those provided by the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA-NMFS, San Juan Basin Authority, and Santa Margarita Water District). In response to these comments, GEOSCIENCE has conducted additional analysis regarding the influence of slant well pumping on San Juan Creek lagoon, surface and groundwater levels in the shallow aquifer, and potential changes due to a suspected bedrock barrier. This technical memorandum summarizes the results of our analysis, as outlined in the approved scope of work from our proposal dated August 29, 2018 for GHD and South Coast Water District (SCWD).

2.0 EVALUATION OF PROJECT CHANGES ON SAN JUAN CREEK SURFACE FLOW

The San Juan Basin (SJB) Regional Groundwater Model was used to determine San Juan Creek discharges to the ocean under "No Project" (i.e., Baseline) and "Project" (i.e., pumping) conditions. Current pumping is assumed to continue into the future since the groundwater basin is currently managed by basin stakeholders to avoid over pumping. Under No Pumping conditions, current production from existing pumping wells are considered. Evaluating the surface outflow component under No Project and Project conditions allows for the quantification of the potential reduction in surface flow, in cubic feet per second (cfs).

2.1 San Juan Basin Regional Groundwater Model

The SJB Regional Groundwater Model was originally developed in 2013 to evaluate the basin yield and groundwater level response from existing and planned groundwater development. It was also utilized to determine potential Changes in groundwater levels and pumping interference from the installation of sheet piling along the San Juan Creek flood control channel, and assess changes associated with the Doheny Ocean Desalination Project (GEOSCIENCE, 2013). Later, the model was updated for the Doheny Ocean Desalination Project during work for the Foundational Actions Funding Program – Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling (GEOSCIENCE, 2015) to better understand 1) feedwater quality produced over time from a slant well system, 2) drawdown effects and environmental strategies along coastal reaches, and 3) the behavior of seawater flow and intrusion control in a multi-layered aquifer system. Following onshore and offshore geophysical surveys and the drilling of a borehole in 2017-2018 to better define the geometry of coastal paleochannels, the SJB Regional Model was further refined by incorporating the newer hydrogeological data.

The SJB Regional Model is a three (3) layered MODFLOW[1] model covering the lower and middle SJB area of approximately 47.5 square miles (30,400 acres), including an offshore area to incorporate infiltration from the ocean (see Figure 1). The model consists of a finite-difference grid with 1,012 rows in the north to south direction and 524 columns in the west to east direction, for a total of 530,288 cells per layer, or 1,590,864 cells total. Each model cell of the SJB Regional Model represents an area of 50 ft x 50 ft. The active model area represents unconsolidated and semi-consolidated fluvial deposits interbedded with numerous fine-grained silt and clay deposits. Inactive model areas and the base of the groundwater model represent surrounding and underlying consolidated geologic formations (i.e., bedrock).

The regional model was calibrated for the period from January 2004 to December 2014 for purposes of analyzing the impacts of full-scale pumping. This period was selected due to the importance of recent stresses (dry hydrologic period) on the basin for predicting future performance. The calibration was based on 2,435 groundwater level measurements from 36 target wells and measured streamflow from the San Juan Creek at La Novia gaging station and Trabuco Creek at San Juan Capistrano gaging station (see Figure 1).

2.2 Model-Calculated San Juan Creek Lagoon Elevations

The SJB Focused Model was developed and calibrated as part of the Foundational Actions Funding Program (GEOSCIENCE, 2015) to more accurately predict slant well pumped water quality over time, injection water flow/water quality/reactants, and ocean water intrusion. The finer cell size (resolution) used for the focused model was also important to understand seasonal coastal lagoon drawdown effects. Lagoon levels were calculated by the Focused Model, which employs the Lake Package to simulate the surface water-groundwater interaction.

Changes to San Juan Creek lagoon levels from Project operations were evaluated for the hydrologic period from January 1947 through December 2010 for the following scenarios:

- Baseline (i.e., no Project pumping)

[1] MODFLOW is a block-centered, finite-difference groundwater flow code developed by the United States Geologic Survey (USGS) (McDonald and Harbaugh, 1988) for the purpose of modeling both saturated and unsaturated groundwater flow.

- Scenario 1: Project pumping of 10 million gallons per day (MGD) from three slant wells
- Scenario 2: Project pumping of 10 MGD from seven slant wells at Capistrano Beach
- Scenario 3: Project pumping of 30 MGD from sixteen slant wells (20 MGD from slant well pods at Doheny and 10 MGD from pods at Capistrano Beach).

Due to the uncertainties remaining as to the hydrogeologic conditions at Capistrano Beach, a 30MGD with pumping from only a Doheny Beach wellfield was modeled as Scenario 4 also the current analysis does not consider Scenarios 2 for the cumulative changes.

- Scenario 4: Project pumping of 30 MGD from twelve slant wells at Doheny Beach

As presented in Table 4-3 of "Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data" Technical Memorandum, dated March 1, 2018, changes to lagoon water levels from Project pumping were reported as ranging from -0.14 to -0.26 ft under Scenario 1 conditions and -0.16 to -0.63 ft under Scenario 3 conditions for dry and wet hydrologic conditions. Scenario 4 conditions were not reported in Table 4-3 as Scenario 4 was modeled after the TM was issued (March 1, 2018). Under Scenario 4 conditions lagoon level changes will range from -0.15 to -0.74 ft. Groundwater levels in the shallow aquifer will range from -33.47 to -42.79 ft. To clarify the decreases in lagoon levels for dry and wet hydrologic conditions shown on Table 2-1 below summarize the model-calculated decreases and potential project impacts on lagoon surface levels. The "dry" and "wet" hydrologic cycle periods are determined when the cumulative departure from the mean is in a downward or upward trend (see Figure 2 and Section 2.6 of this memorandum).

Table 2-1. Change in Lagoon Surface Levels under Project Conditions

Hydrologic Cycle	Hydrologic Period	Change in Lagoon Level, ft		
		Scenario 1	Scenario 3	Scenario 4
Dry	1947-1976	-0.14	-0.16	-0.15
Wet	1978-1983	-0.26	-0.85	-0.86

It is important to note that the model-calculated decreases in San Juan Creek lagoon levels occur over the entire lagoon area of approximately 13.2 acres. The following section provides the model-calculated reduction in outflow that will occur as a result of Scenario 1, Scenario 3, and Scenario 4 pumping over the area influenced by Project pumping under dry and wet hydrologic conditions.

2.3 Model-Calculated San Juan Creek Outflow to the Ocean under No Project and Project Conditions

Surface flow in San Juan Creek was simulated in the 2016 SJB Regional Model using the Streamflow Routing Package (SFR Package) from MODLFOW, which accounts for the interaction between surface water and groundwater. This area is outside the Focused Model, so the Regional Model was used to evaluate changes in groundwater levels in this area. The SFR Package assigns recharge to stream cells that are sequentially numbered in the downstream direction. The downward leakage of streamflow, or streambed percolation, is calculated as a function of the hydraulic conductivity of the streambed, the wetted perimeter of the streambed, the length of the stream reach, the underlying groundwater head, stream stage, and streambed thickness. Model input for the routing package includes stream inflow, stream channel geometry, and streambed conductance (Niswonger and Prudic, 2006). Information on streamflow was available from observed measurements at the San Juan Creek at La Novia and Trabuco Creek at San Juan Capistrano gaging stations, which were also used for model calibration. These gaging stations are shown on Figure 1.

In order to evaluate the long-term outflow at the ocean, streamflow in San Juan Creek and surface outflow to the ocean was calculated by the SJB Regional Model for the hydrologic period from January 1947 through December 2010 for the same scenarios presented above. The model-calculated streamflow from San Juan Creek to the ocean is shown on Figures 3 through 6 under Baseline, Scenario 1, Scenario 3, and Scenario 4 conditions, respectively.

For baseline conditions, outflow at the ocean ranges from 15.91 cubic feet per second (cfs) under dry hydrologic conditions to 56.04 cfs under wet hydrologic conditions. Discharge under Scenario 1 Project pumping conditions ranges from 15.81 cfs under dry hydrologic conditions to 55.59 cfs under wet hydrologic conditions. Discharge under Scenario 3 ranges from 15.78 cfs under dry hydrologic conditions to 55.41 cfs under wet hydrologic conditions. Discharge under Scenario 4 ranges from 15.76 cfs under dry hydrologic conditions to 55.30 cfs under wet hydrologic conditions. The corresponding decrease in San Juan Creek streamflow under Project pumping conditions, as compared to baseline, is summarized in Table 2-2 below.

Table 2-2. Change in San Juan Creek Outflow to the Ocean under Project Conditions

Hydrologic Cycle	Hydrologic Period	Change in San Juan Creek Discharge, cfs		
		Scenario 1	Scenario 3	Scenario 4
Dry	1947-1976	-0.10	-0.13	-0.15
Wet	1978-1983	-0.45	-0.63	-0.74

The decreases in San Juan Creek streamflow from Project pumping correspond to approximately 0.6 to 0.8 percent of the baseline outflow under Scenario 1 conditions, 0.8 to 1.1 percent of the baseline outflow under Scenario 3 conditions, and 0.9 to 1.3 percent under Scenario 4 conditions.

2.4 Evaluation of Changes in Shallow Aquifer Groundwater Levels under Project Conditions

2.4.1 Groundwater Level Monitoring

Historical groundwater levels for the shallow aquifer in the vicinity of the San Juan Creek lagoon were collected both during and after the long-term slant well pumping test from transducers placed in District-owned nested monitoring wells MW-1 through MW-4 (12 total monitoring wells). MW-1 and MW-2, which are closest to the lagoon, are shown on Figure 2-1 (inset below).

Figure 2-1. Monitoring Well Locations in the Vicinity of the San Juan Creek Lagoon

During the initial field investigations conducted in 2005, boreholes B-2 and B-4 were completed as nested monitoring wells (MW-1 and MW-2, respectively). Each borehole contains three nested 2-inch PVC wells screened in the shallow, middle, or deep aquifer. A basic monitoring well construction diagram for

B-2/MW-1 and B-4/MW-2 is shown on the sketch below (inset Figure 2-2), which illustrates the general configuration of the nested monitoring wells in MW-1 and MW-2.

After the monitoring wells were constructed, they were developed and sampled. The depth to static groundwater level in each nested monitoring well was initially measured with an electronic sounder. Each nested monitoring well was later equipped with a pressure transducer to measure groundwater levels every 15 minutes. Transducer data were downloaded on a weekly basis during the long-term pumping test (June 2010 through April 2012) and on a monthly basis after the long-term pumping test to present. An on-site barometer was used to compensate the transducer data downloaded from each nested monitoring well. The compensated water level data were then converted to elevation (NAVD88) and plotted over time.

The nested well design allows for accurate water level data from each of the nearshore aquifers (shallow, middle, and deep). For example, the shallow screen in each nested monitoring well (MW-1S and MW-2S) provides water level data for the shallow aquifer, which is in direct hydraulic connection with San Juan Creek. Since the shallow aquifer is separated from the middle aquifer by an aquitard that is approximately 10 ft thick, water level measurements in the shallow aquifer are not influenced by the deeper systems. Therefore, water level data from MW-1S and MW-2S can be used to monitor and evaluate Project pumping impacts on the shallow aquifer. MW-2S was used to evaluate groundwater levels in the shallow aquifer under the lagoon due to its location in relation to both the Test Slant Well and the lagoon.

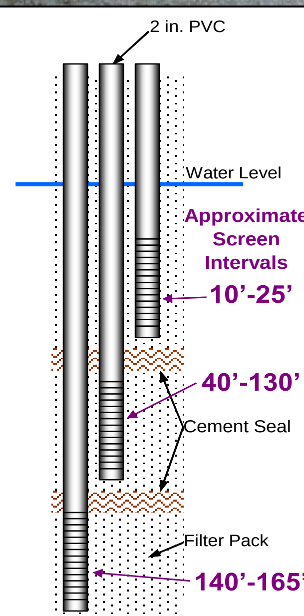


Figure 2-2. General Monitoring Well Construction

In addition, MW-2 is located at approximately the same location as one of the lagoon bottom profiles surveyed by the Chambers Group (2016) from Spring 2015 to Spring 2016 – providing a reference on the relative position of shallow aquifer water levels with respect to the lagoon bottom (see Figure 2-1). These profiles presented originally as Figure 2-14 of the Chambers Group report, are shown as attached Figure 7. The cross-sectional transects indicate most erosion taking place within the southwest corner of the lagoon where the sand berm is typically breached. Some accretion of sediment occurs on the eastern bank of the lagoon (see Chambers Group, 2016). An average bottom elevation of the lagoon was estimated to be approximately 4 ft NAVD88 from the Lagoon S cross-section (shown on Figure 2-1 as A-A').

2.5 Shallow Aquifer Groundwater Levels during Historical Hydrologic Cycles

Shallow aquifer groundwater levels from MW-2S are shown on Figure 8 from before the start of the long-term pumping test in June 2010, through present. The shallow aquifer groundwater levels are also shown in comparison to the average estimated lagoon bottom elevation of 4 ft NAVD88 and monthly precipitation from the Laguna Beach #2 precipitation gage. The water levels represent a combination of two sets of collected data from MW-2S that were combined to display shallow groundwater levels during the pumping test and post-pumping period. One dataset was collected and processed by GEOSCIENCE during slant well pumping test monitoring, and the other was collected and processed by South Coast Water District (SCWD) during post-pumping test monitoring.

As shown, groundwater levels in the shallow aquifer fluctuated above and below the average lagoon bottom elevation both during and after the long-term pumping test. Based on the observed fluctuations and local precipitation, changes in groundwater levels in MW-2S appear to correlate with periods of rainfall or no rainfall. At the start of the long-term pumping test, shallow aquifer water levels were near the elevation of the lagoon bottom. Just after the initiation of the test, water levels fall below the lagoon bottom elevation during the summer months. Water levels then rose above the lagoon bottom elevation in response to the increased precipitation that occurred from January 2011 through June 2011. Subsequently, water level in the shallow aquifer fell below the lagoon bottom elevation during the following dry season and continued to decline after the test slant well pump was shut off in April 2012 (2012 through 2014). Groundwater rose again following increased precipitation events in 2015 and 2016. However, despite the lower groundwater levels in the shallow aquifer during dry hydrologic conditions, review of aerial photos and land-based photos taken during monitoring events indicate surface water was still present in the lagoon during these times (Figure 9) which is likely due to low permeability of the materials (silt and clay) lining the lagoon bottom.

Based on the observed response of water levels to changes in precipitation, it appears that groundwater levels in the shallow aquifer in the vicinity of the San Juan Creek lagoon are primarily influenced by rainfall conditions.

2.6 Project Impacts during Wet, Dry, and Average Hydrologic Cycles

Figure 2 shows historical annual precipitation from 1928 through 2017, along with the calculated cumulative departure from the mean. The 70-year average precipitation is approximately 11.77 in/year during the period from 1928 through 2017. A downward slope on the cumulative departure curve indicates a less than average or “dry” conditions and upward slope shows periods during “wet” conditions. The long-term cumulative departure from the mean precipitation show that the study period during slant well pumping (June 2010 through April 2012) and post slant well pumping represented an overall dry hydrologic period which included the years 2005 - 2017.

A snapshot of the recent precipitation data, shown on Figure 2-3 (on the following page), suggests that the average precipitation over the past 13 years (which includes before and after test slant well pumping from 2005 – 2012) was only 6.84 in/year, which is nearly half of the long-term precipitation average of 11.77 in/year. The precipitation data shown on Figure 2-3 corresponds to the period for which groundwater level data was recorded, from 2005 to 2017, in the monitoring wells near the San Juan Creek lagoon.

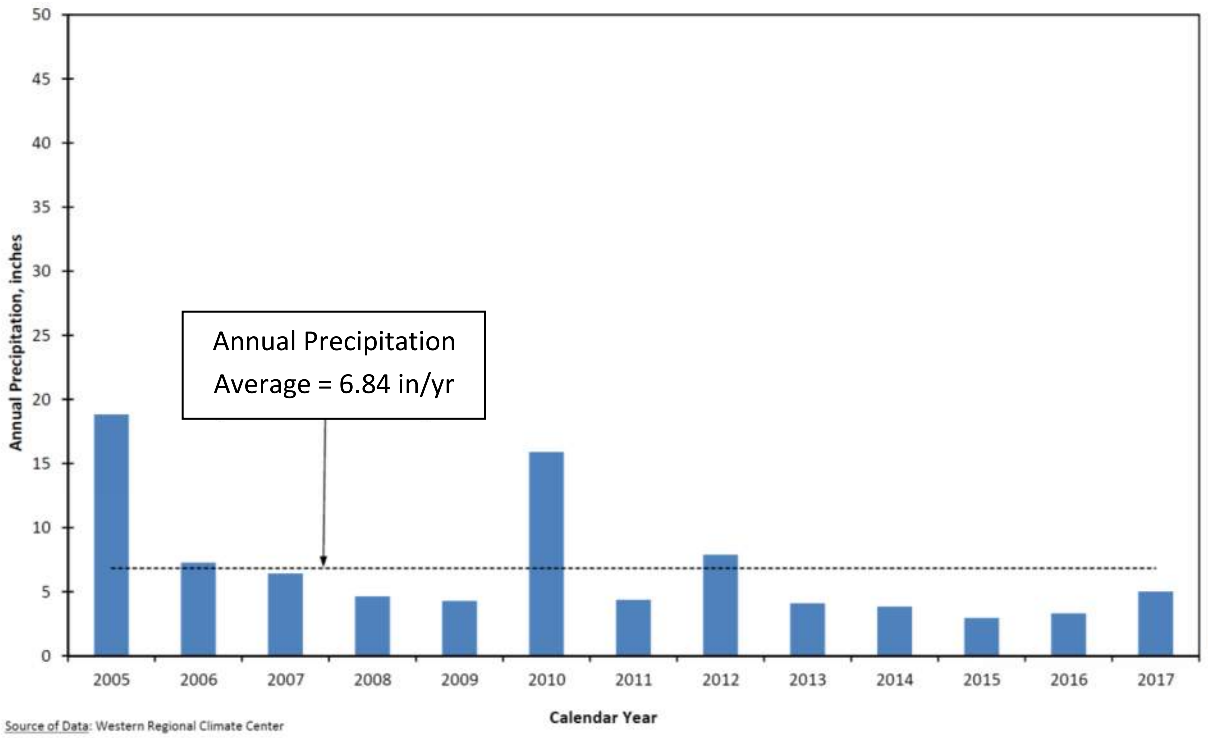


Figure 2-3. Annual Precipitation at Laguna Beach #2 Precipitation Gage (2005-2017)

Water levels in the shallow aquifer during the long-term pumping test and during the post-pumping period, which occurred during primarily dry hydrologic conditions (2005 to 2017), showed fluctuations that rose and fell above/below the average bottom elevation of the San Juan Creek lagoon. These fluctuations appear to be driven largely by local hydrologic cycles and precipitation patterns. However, even when shallow aquifer water levels fell below the lagoon bottom elevation in dry conditions, aerial imagery and field observations showed that water remained in the lagoon. When shallow groundwater levels are below the lagoon bottom, the water percolate from the lagoon in a "free fall" condition; that is, as water percolates into the subsurface it must percolate some distance before it reaches the water table. Therefore, the percolation rate is driven by the streambed hydraulic conductivity and not by depth to the groundwater elevation. As such, the degree of water level fluctuation expected under Project pumping conditions for the full-scale wellfield will not significantly affect surface outflow and lagoon levels as supported by the analyses reported in Table 2-1 and 2-2.

2.7 Changes in Annual Fish-Passage Days

2.7.1 San Juan Watershed Project

Environmental Science Associates (ESA) prepared a report entitled "San Juan Creek Fish Passage Assessment - Hydrologic Modeling Report (Three dam alternative)". The purpose of the analysis was to evaluate the impacts from the San Juan Watershed Project (SJWP) which will consist of the construction of three Rubber Dams on San Juan Creek between Stonehill Drive and just below the confluence of Trabuco Creek and San Juan Creek. ESA conducted an analysis with a surface water model using daily timesteps for hydrology between 1945 and 2014. ESA also used a hydraulic model of San Juan and Trabuco Creeks to identify flows at which average channel velocity and depths become barriers to adult upstream and downstream steelhead migration. The analysis assumed a minimum depth of 0.5 ft for swim-through cross-sections that do not require leaping. 7.9 feet/second was use for the average channel velocity parameter which is consistent with previous Trabuco Creek migration assessments (HDR, Inc., 2015).

ESA prepared a daily lagoon mouth closure model for the period 1945 to 2014. This model estimates when the mouth of San Juan Creek will open (from fluvial or wave overtopping) and close (from wave-caused beach buildup). Table 3 of the ESA analysis reports that the minimum flow to support a depth of 0.5 ft in the Reach 1 (between the ocean and halfway to Stonehill Drive) is 60 cfs. The same table reports that the minimum flow to support a depth of 0.5 ft in Reach 2 (Reach 1 to near Stonehill Drive is 70 cfs. Table 4 of the ESA report notes that the baseline modeled passage window for adult steelhead is 10.8 days for Reach 1 and 11.1 days for Reach 2. The SJWP will reduce the passage days to 9.7 for Reach 1 and 9.8 for Reach 2. However, the days for fish-passage for each reach must also consider conditions in all the other reaches. For Reaches 1 – 8 combined, the possible migration days from the ocean to Trabuco Creek above the dam pool for baseline and with project conditions is 8.7 days and 8.1 days, respectively. This is approximately an 8% reduction in passage days. The possible migration days from Reaches 1 – 9 combined, from the ocean to San Juan Creek above dam pool for baseline and with project is 9.1 days and 8.4 days, respectively This is also an 8% reduction in passage days.

2.7.2 Doheny Ocean Desalination Project

The impact to potential migration of steelhead is addressed using the data and methodology reported in the San Juan Creek Fish Passage Assessment (ESA, 2017). GEOSCIENCE used the model files from 2017 ESA report to assess the surface flow in Reaches 1 and 2 under the various conditions below:

- Baseline (no Project conditions),
- Baseline + Scenario 1 of the Doheny Ocean Desalination Project 10 MGD project,
- Baseline + Scenario 3 of the Doheny Ocean Desalination Project 20 MGD project,
- Baseline + Scenario 4 of the Doheny Ocean Desalination Project 30 MGD project,
- SJWP (conditions as reported in the 2017 ESA report),

- SJWP and Scenario 1 of the Doheny Ocean Desalination Project 10 MGD project,
- SJWP and Scenario 3 of the Doheny Ocean Desalination Project 20 MGD project, and
- SJWP and Scenario 4 of the Doheny Ocean Desalination Project 30 MGD project.

The surface outflow from the groundwater model was analyzed to determine the days that surface flow was equal to or exceeded 60 cfs in Reach 1 and 70 cfs in Reach 2 for all scenarios. The tables on the following pages summarizes surface flow in Reaches 1 and 2 under baseline conditions, Doheny Ocean Desalination Project conditions, SJWP conditions, and both project's cumulative conditions.

Table 2-3. Fish-Passage Days in Reaches 1 & 2 San Juan Creek

Scenario	Number of Days Daily Streamflow Exceeds 60 cfs[2]	Number of Days Daily Streamflow Exceeds 70 cfs[2]
	Reach 1	Reach 2
	Average for 1947-2014 (days/yr)	
Baseline	10.97	11.21
Scenario 1	10.76	11.13
Scenario 3	10.65	11.09
Scenario 4	10.63	11.04
SJWP	9.84	9.91
SJWP + Scenario 1	9.75	9.90
SJWP + Scenario 3	9.68	9.85
SJWP + Scenario 4	9.68	9.82

2 The ESA baseline numbers and baseline numbers generated for this analysis for Reaches 1 and 2 are slightly different because the ESA study considered all reaches (1 – 9) together in setting the baseline. This current study considers only the reaches affected by the Project (1 and 2).

Table 2-4. Reduction of Fish Passage Days from Baseline for the Doheny Ocean Desalination Project

Scenario	Reduced Number of Days Daily Streamflow Exceeds 60 cfs (Compared to Baseline)	Reduced Number of Days Daily Streamflow Exceeds 70 cfs (Compared to Baseline)
	Reach 1	Reach 2
	Average for 1947-2014 (days/yr)	
Scenario 1	0.21	0.08
Scenario 3	0.32	0.12
Scenario 4	0.34	0.17

Table 2-5. Reduction of Fish Passage Days with SJWP for the Doheny Ocean Desalination Project

Scenario	Reduced Number of Days Daily Streamflow Exceeds 60 cfs (Compared to SJWP)	Reduced Number of Days Daily Streamflow Exceeds 70 cfs (Compared to SJWP)
	Reach 1	Reach 2
	Average for 1947-2014 (days/yr)	
SJWP + Scenario 1	0.09	0.01
SJWP + Scenario 3	0.16	0.06
SJWP + Scenario 4	0.16	0.09

The results (Tables 2-3 through 2-5 above) show that the Doheny Ocean Desalination Project will reduce the potential fish-passage days from baseline in Reach 1 a maximum 0.34 days under Scenario 4 and 0.17 days in Reach 2 for the same Scenario. Table 2-5 shows the difference in fish passage days from that of the SJWP. For Reach 1 an additional 0.09 days for the 10 MGD project and 0.16 days for the 30 MGD project. For Reach 2 the difference in reduction in fish passage days form the SJWP ranges from 0.01 days for the 10 MGD project and 0.09 days for the 30 MGD project.

3.0 ASSESSMENT OF POTENTIAL IMPACTS FROM PROPOSED UPSTREAM BEDROCK BARRIER

During the hydrogeologic characterization of San Juan Creek, the elevation of bedrock beneath San Juan Creek was encountered in drill holes at a higher elevation than previously reported. The elevated bedrock area is below San Juan Creek in the area near Calle Jardin on the west and Naranja Road on the east. The existence of the elevated bedrock had been known historically as evidence by rising water at locations one to two miles from the coast (DWR, 1972). Historical gage data from the USGS surface water gage (11047350) at Stonehill Drive has shown additional flow in San Juan Creek with respect to upstream areas which has been attributed to rising water. As an example, Figure 3-1 below dated February 28, 2007 shows water rising to the surface in the area of elevated bedrock and infiltrating back into the aquifer downstream of Stonehill Drive. During very wet hydrologic seasons, rising water in San Juan Creek at this location can provide significant additional surface flow in San Juan Creek to the stream reaches downstream of Stonehill Drive.

Figure 3-1. Rising Water in San Juan Creek – Upstream of Stonehill Drive

An ancient landslide is mapped by the USGS (Tan, 1999) on the hillside east and north of San Juan Creek at Stonehill Drive and beneath the San Juan Creek. A geologic cross-section prepared by the USGS shows the landslide moved westward into San Juan Creek during a period when the base level of the creek was much lower due to lower sea level. However, the USGS mapping does not show the landslide extending to San Juan Creek. The landslide appears to have failed along bedding planes in the Capistrano Formation which would make it difficult to distinguish landslide deposits from the underlying in-place Capistrano

Formation in borings. Furthermore, with rising sea levels, San Juan Creek backfilled the valley with alluvial sediments effectively burying the elevated bedrock or landslide deposits.

The San Juan Basin Authority contracted WEI to perform an investigation to assess the extent of elevated bedrock and to determine whether elevation of the bedrock was sufficiently high to potentially act as a barrier to groundwater flow in the alluvial materials which compose the San Juan Basin aquifer. The investigation consisted of drilling sonic boreholes and collecting continuous core to accurately delineate the bedrock elevation, installing new monitoring wells at strategic locations to provide additional water level information, preparing geologic cross-sections to illustrate the distribution of bedrock, and conducting two pumping tests to assess whether the elevated bedrock would act as a barrier or boundary to pumping water levels. The results of the exploratory drilling and monitoring well installation completed as part of the "Bedrock Barrier Investigation" have validated the existence and better delineated the extent of elevated bedrock in the area. The cross-section below was prepared by WEI from the data collected during the barrier investigation. The results of the investigation show that elevated bedrock area is overlain by a minimum of 41 feet of alluvium in the cross-sectional area across San Juan Creek. Along this cross-section, the paleochannel is filled with aquifer material to depths ranging from 78 feet to 94 feet below ground surface. Therefore, the aquifer is continuous from upstream of the elevated bedrock area to the area downstream. The cross-section is located across the San Juan Creek along the alignment of Profile 2-2' shown on Figure 10.

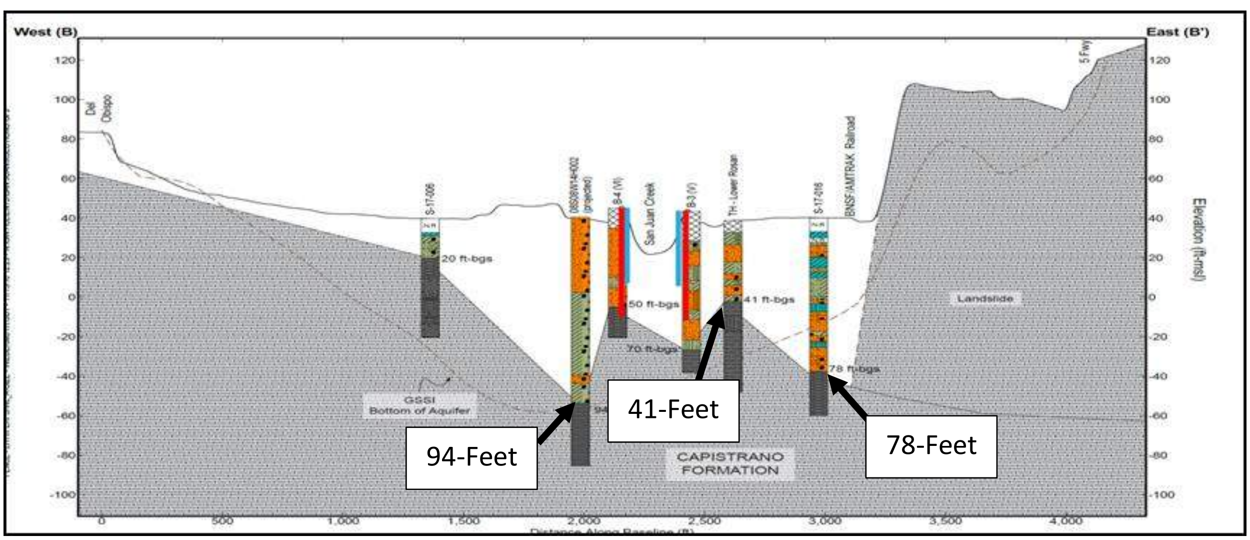


Figure 3-2. Cross-Section through the Elevated Bedrock Area - San Juan Creek near Calle Jardin and Naranja Road.

Pumping tests were conducted in wells located both upstream and downstream of the elevated bedrock area. Neither pumping test detected a barrier effect form the existence of elevated bedrock. It is likely that the pumping test, were not long enough, but more likely that the groundwater levels could not be lowered deep enough for the elevated bedrock to act as a barrier.

3.1 Assessment of Cumulative Impacts from the Potential Existence of Elevated Bedrock Beneath San Juan Creek

DEIR commenters have recommended an assessment of cumulative impacts from SJWP and Doheny Ocean Desalination Project due to a potential bedrock “barrier” located upstream of the slant well field located at Doheny Beach. To ensure that cumulative impacts from SJWP and Doheny Ocean Desalination Project were modeled correctly in combination, Wildermuth Environmental Inc., (WEI) provided the model files that they used to analyze groundwater changes for the SJWP EIR analysis. The cumulative impacts from the Doheny Ocean Desalination and SJW projects were evaluated using WEI model and model files. The model files provided by WEI included the results of Phase 1A and Phase 1C. For this analysis, GEOSCIENCE added the Doheny Ocean Desalination Project Scenarios 1, 3, and 4 operations to the WEI model. As stated, the WEI investigation has confirmed the existence of the elevated bedrock. However, the aquifer remains continuous over the elevated bedrock and as such groundwater is not isolated across the elevated bedrock. For the elevated bedrock area to act as a groundwater barrier, groundwater levels would have to be lowered below a depth of 94 feet to isolate groundwater upstream from groundwater downstream. Historical low groundwater levels have never been recorded below 35 feet above the elevated bedrock surface (See Figure 3-2), Never-the-less, impacts from the Doheny Ocean Desalination Project cumulative to those from the SJWP were assessed. The analysis was conducted using the WEI model output files which included SJWP Phase 1A (three rubber dams) and SJWP Phase 1C (three rubber dams and a new pumping well upstream of Stonehill Drive). GEOSCIENCE added the Doheny Ocean Desalination Project Scenarios 1, 3, and 4 to the SJWP to assess the cumulative impacts to groundwater levels beneath San Juan Creek along four cross-sectional profiles (see Figure 10). Profile 1 is near the SJBA Kinoshita Well. Profile 2 is through the elevated bedrock area. Profile 3 is through San Juan Creek at SCWD’s GRF well located south of Stonehill Drive and Profile 4 is located at the coast.

Figures 11 through 22 show the predicted groundwater levels with and without the SJWP for Scenario 1, 3, and 4 under high (1998) and low (2014) groundwater level conditions. With respect to the elevated bedrock area, under maximum pumping conditions and under historically low groundwater conditions, groundwater levels remain 22 feet above the top of the elevated bedrock and adjacent paleochannel areas contain aquifer materials that maintain a saturated thickness of 42 ft. Therefore, the elevated bedrock does not affect the cumulative groundwater level responses from the SJWP in combination with Doheny Ocean Desalination Project.

4.0 SUMMARY AND CONCLUSIONS

- Both the creek outflow and the shallow aquifer near the lagoon are affected primarily by hydrologic conditions (i.e., precipitation patterns).

- During periods of low precipitation (dry hydrologic conditions), water levels in the shallow aquifer generally fall below the average estimated lagoon bottom elevation – both during pumping conditions and in the absence of slant well pumping.

- Even during dry conditions when groundwater levels in the shallow aquifer fall below the lagoon bottom during No Project (no pumping) and Project (pumping) conditions, water is still present in the lagoon. In other words, when groundwater levels are below the bottom of the lagoon as they are seasonally, the lagoon water levels become independent of the surface flow or standing water in the lagoon. The relationship of water in the lagoon and slant well pumping can be described in terms of volumes diminish until the groundwater levels are below the bottom of the lagoon.

- When groundwater levels in the shallow aquifer fall below the lagoon/river bottom, surface water level in the lagoon is controlled by the hydraulic conductivity of the underlying sediments and is independent of groundwater levels (i.e., “free fall” conditions).

- During periods of high precipitation (wet hydrologic conditions) groundwater levels in the shallow aquifer generally rise above the lagoon bottom.

- Additional seepage from the lagoon and streambed upgradient of the lagoon occurs under Project pumping conditions. However, decreases in San Juan Creek streamflow from Project pumping correspond to approximately 0.6 to 0.8 percent of the baseline outflow under Scenario 1, 0.8 to 1.1 percent under Scenario 3, and 0.9 to 1.3 percent under Scenario 4 conditions.

- The total change to the annual fish passage days for the SJWP from baseline conditions are 1.1 to 1.3 for Reaches 1 and 2 respectively.

- The combined (SJWP and Doheny Ocean Desalination Projects) changes to annual fish-passage days through Reach 1 is 9.75 days for the 10 MGD project and 9.68 days for the 30 MGD project. from a baseline of 10.97 days. For Reach 2 the combined reduction in fish passage days ranges from 9.9 days for the 10 MGD project and 9.82 days for the 30 MGD project from a baseline of 11.21 days.

- Investigations have concluded the existence of an elevated bedrock surface upstream of Stonehill Drive that is overlain with a minimum of 41 ft and a maximum 94 ft of aquifer material. The top of the elevated bedrock is at about -20 ft above mean sea level (amsl)

- The elevated bedrock within San Juan Creek may represent a landslide deposited when sea level was lower.

- Historical groundwater levels in San Juan Creek have never been recorded lower than 35 ft. The pumping tests conducted during the “Bedrock Barrier Investigation” did detect the influence of the elevated bedrock.

- Under maximum pumping and historically low groundwater conditions, groundwater levels remain 22 feet above the top of the elevated bedrock. The deepest portion of the paleochannel present on both sides of the elevated bedrock also remains saturated with a thickness of 42 ft. Therefore, the elevated bedrock does not affect the cumulative groundwater level responses from both the SJWP and Doheny Ocean Desalination Projects under the maximum conditions.

- The Doheny Ocean Desalination Project will result in changes to annual fish-passage days from a baseline of 10.97 days to 10.76 (0.21 days) for the 10 MGD project and 10.63 days (0.34 days) for the 30 MGD project. In Reach 2 fish passage days will be reduced from a baseline of 11.21 days to 11.13 days ((0.08 days) for the 10 MGD project and 11.04 days (0.17 days) for the 30 MGD project.

5.0 REFERENCES

California Department of Water Resources (DWR), 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin No. 104-7.

Chambers Group (Chambers Group, Inc.), 2016. Lower San Juan Creek and Seasonal Coastal Lagoon Habitat Assessment – Orange County, California. Prepared for South Coast Water District and Municipal Water District of Orange County, dated July.

GEOSCIENCE (GEOSCIENCE Support Services, Inc.), 2013. Doheny Ocean Desalination Project – Phase 3 Extended Pumping and Pilot Plant Testing Vol. 3 San Juan Basin Regional Watershed and Groundwater Models. Prepared for the Municipal Water District of Orange County, dated November 8.

ESA, 2017. "San Juan Creek Fish Passage Assessment Hydrologic Modeling Report (Three dam Alternative), dated May 11, 2017.

GEOSCIENCE, 2015. Foundational Actions Funding Program – Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling for the Doheny Ocean Desalination Project Task 3 – Prediction of Coastal/Ocean Groundwater Flow and Water Quality. Prepared for South Coast Water District, dated November 6.

GEOSCIENCE, 2018. Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data. Prepared for South Coast Water District and GHD, dated March 1, 2018.

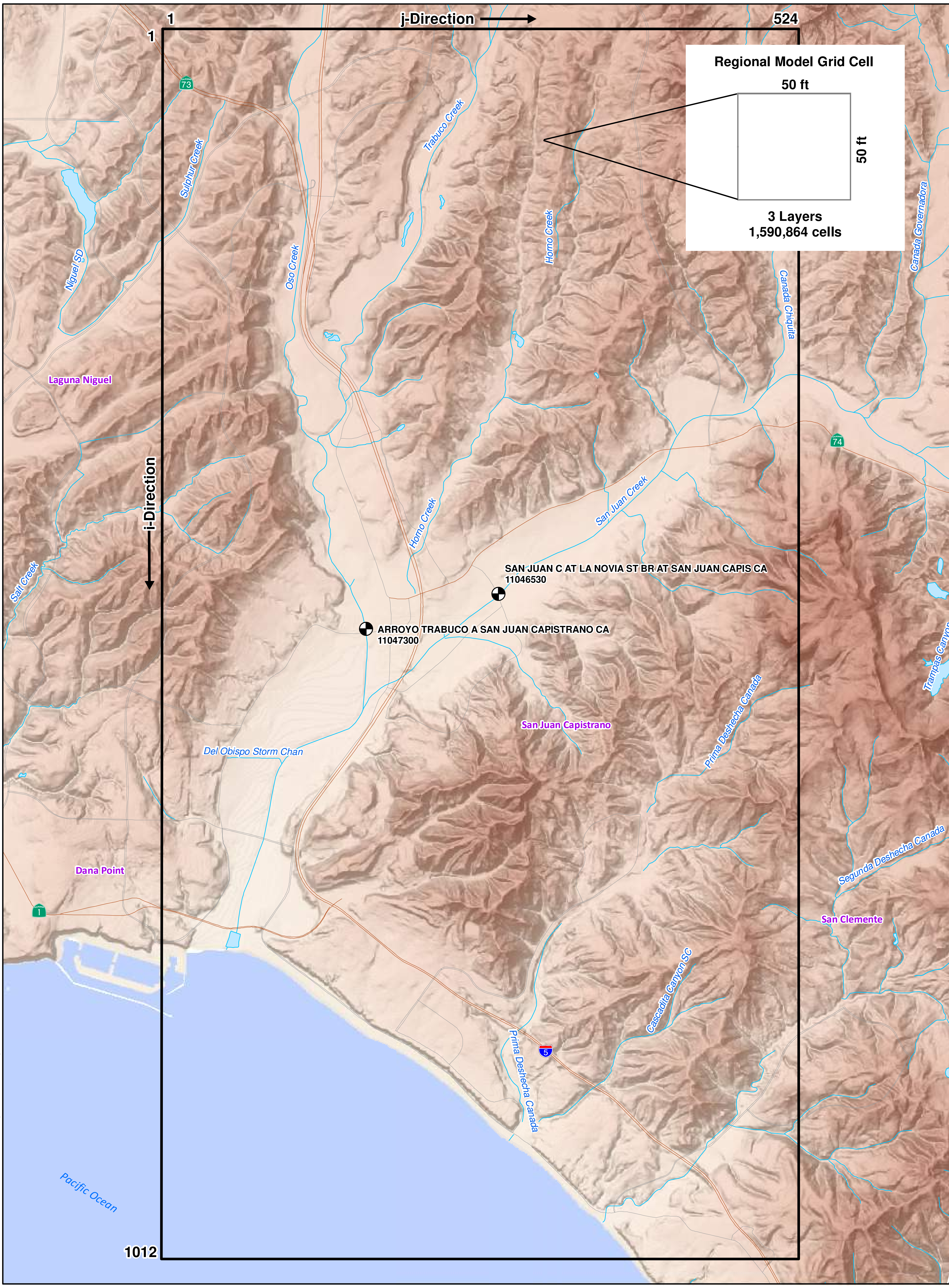
McDonald, M.G., and A.W. Harbaugh, 1988. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model: U.S. Geological Survey Techniques of Water-Resources Investigations Book 6, Chapter A1, 586 p.

Niswonger, R.G. and Prudic, D.E., 2006. Documentation of the Streamflow-Routing (SFR2) Package to Include Unsaturated Flow Beneath Streams – A Modification to SFR1. Chapter 13 of Section A, Ground Water, of Book 6, Modeling Techniques. U.S. Geological Survey Techniques and Methods 6-A13, Version 1.10, April 2006.

Tan, Siang S., 1999. Geologic Map of the Dana Point 7.5 Minute Quadrangle, Orange County, California, A Digital Database, version 1.0, California Geological Survey in cooperation with the United States Geological Survey.

WEI, 2018. "San Juan Watershed Project Phase 1 – Assessment of New Stormwater Recharge and Recovery, dated June 29, 2018.

WEI, 2019. "Summary of the Aquifer Testing Activities and Budgeting for the Bedrock Barrier Investigation" dated January 28, 2019.



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San Juan Basin Regional Groundwater Model Boundary

Gaging Station Name and Designation

SAN JUAN BASIN REGIONAL GROUNDWATER MODEL

19-Nov-18

Prepared by: DB. Map Projection: State Plane 1983, Zone VI.

NORTH

0 2,000 4,000 8,000 Feet

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

FIGURE 1

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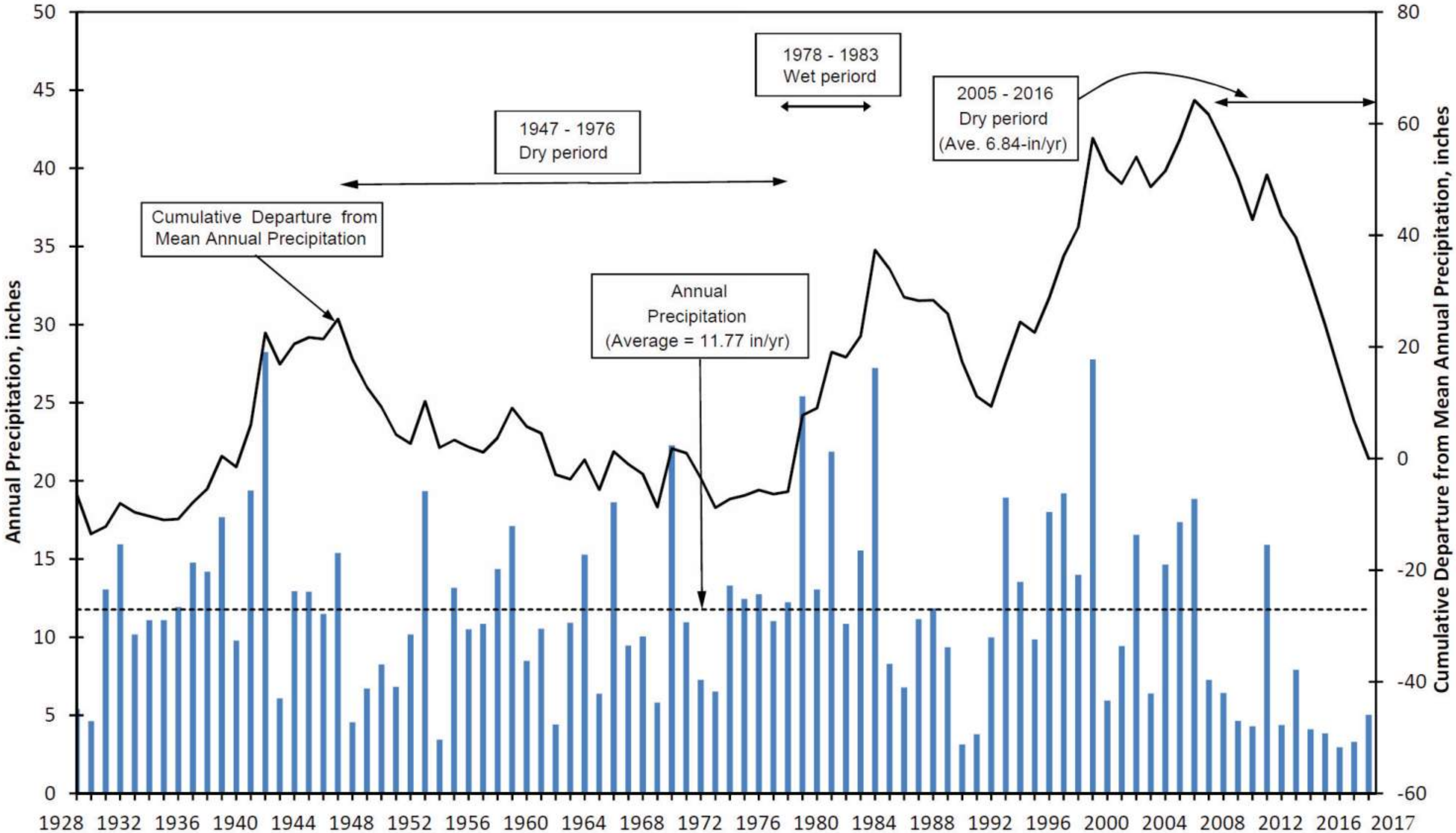
Annual Precipitation and Cumulative Departure from Mean Annual Precipitation
Laguna Beach #2, California
(1928-2017)



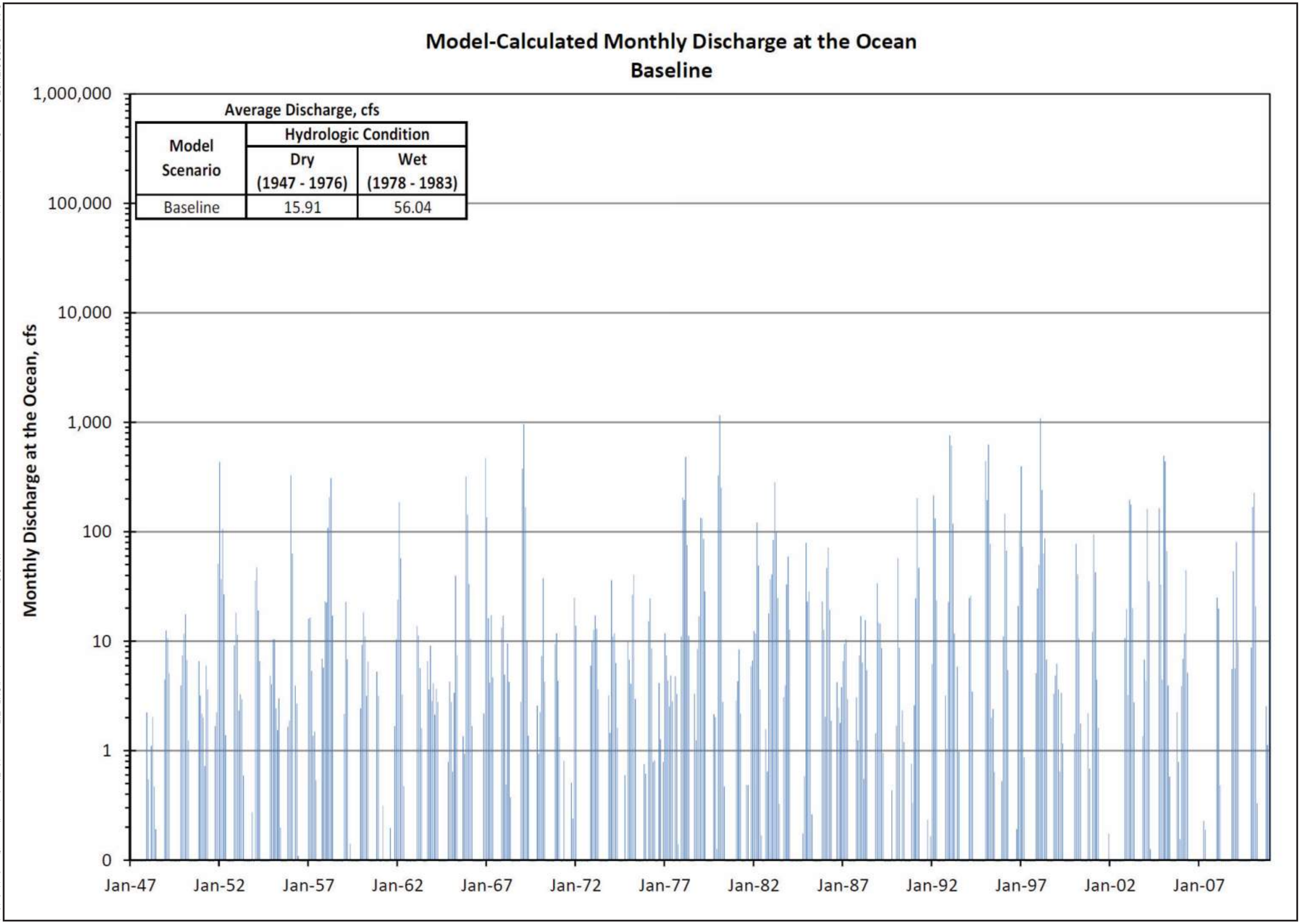
Source of Data: Western Regional Climate Center

7-Mar-19

SOUTH COAST WATER DISTRICT

FIGURE 2

GEOSCIENCE



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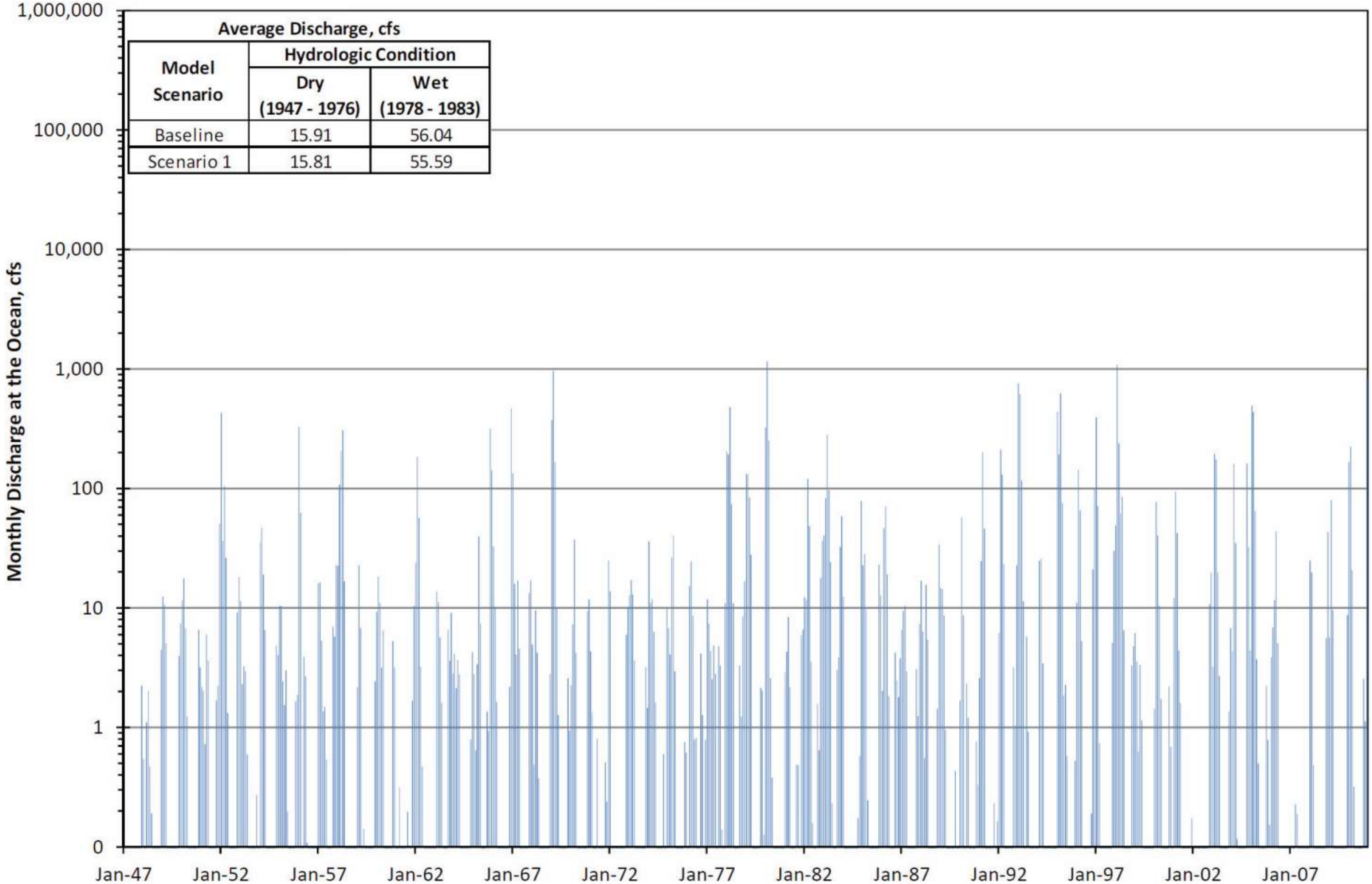
SOUTH COAST WATER DISTRICT

FIGURE 3

GEOSCIENCE

Model-Calculated Monthly Discharge at the Ocean
Scenario 1



Average Discharge, cfs

Model Scenario	Hydrologic Condition	
	Dry (1947 - 1976)	Wet (1978 - 1983)
Baseline	15.91	56.04
Scenario 1	15.81	55.59

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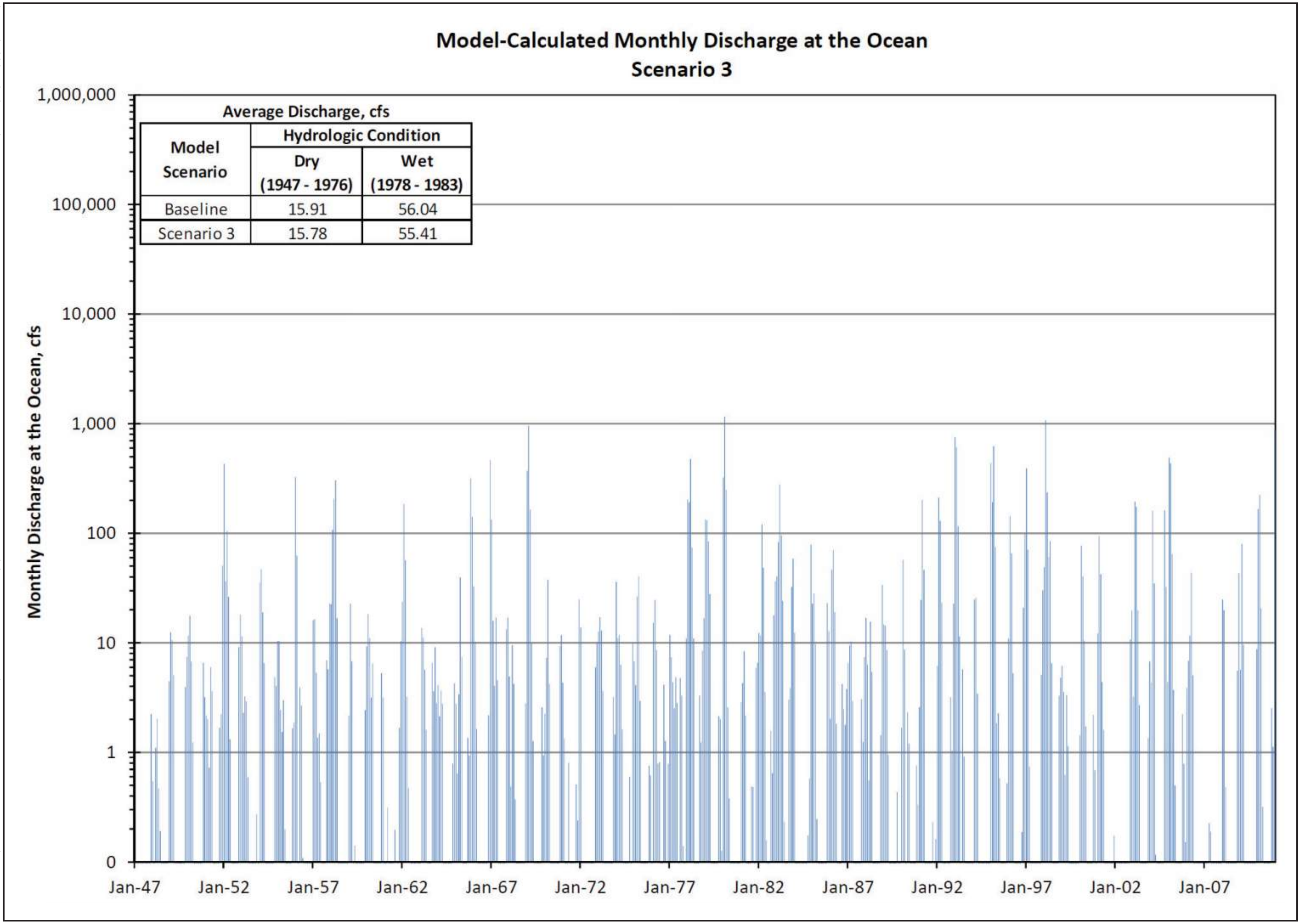

Model Scenario	Hydrologic Condition	
	Dry (1947 - 1976)	Wet (1978 - 1983)
Baseline	15.91	56.04
Scenario 3	15.78	55.41

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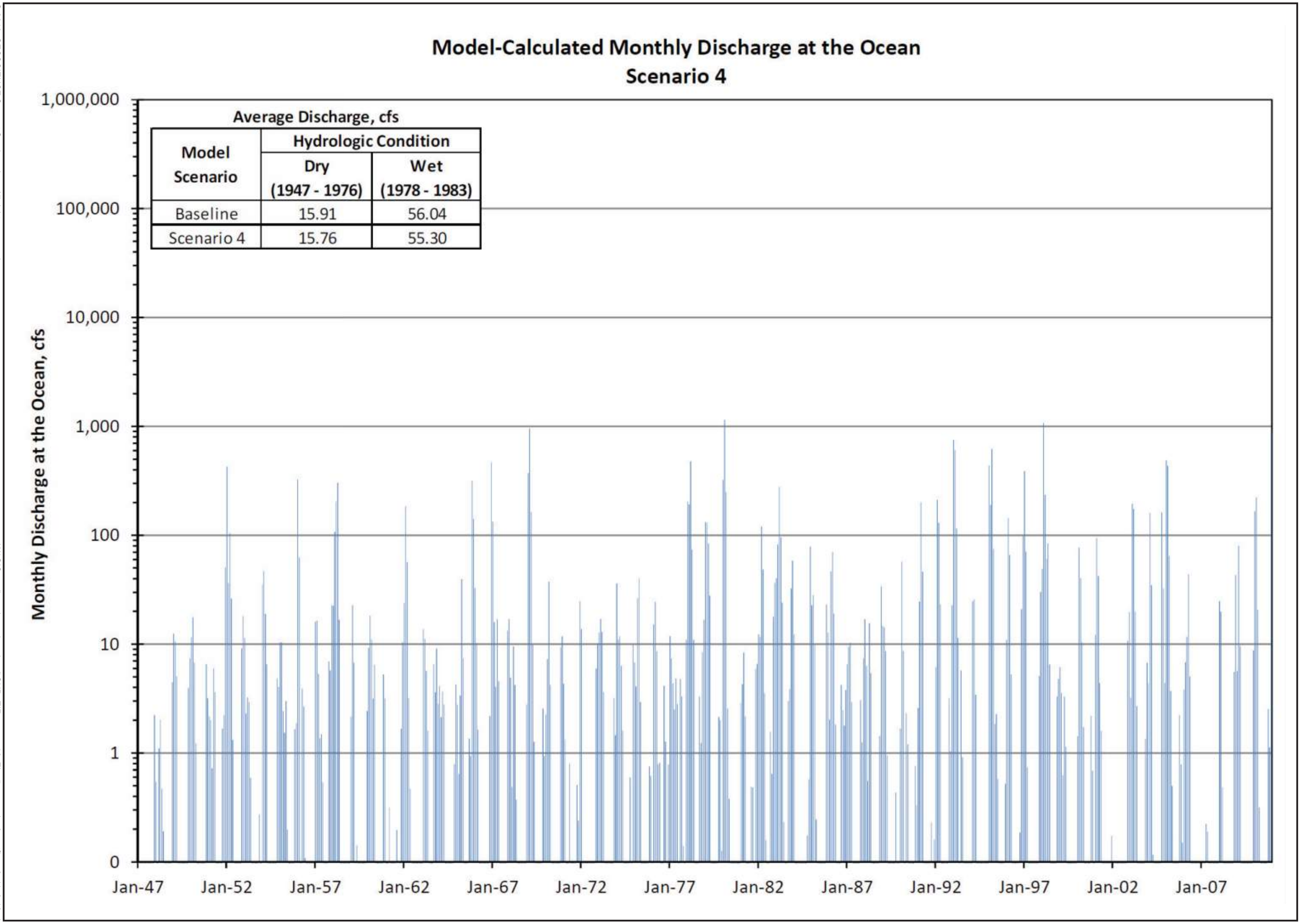

Model Scenario	Hydrologic Condition	
	Dry (1947 - 1976)	Wet (1978 - 1983)
Baseline	15.91	56.04
Scenario 4	15.76	55.30

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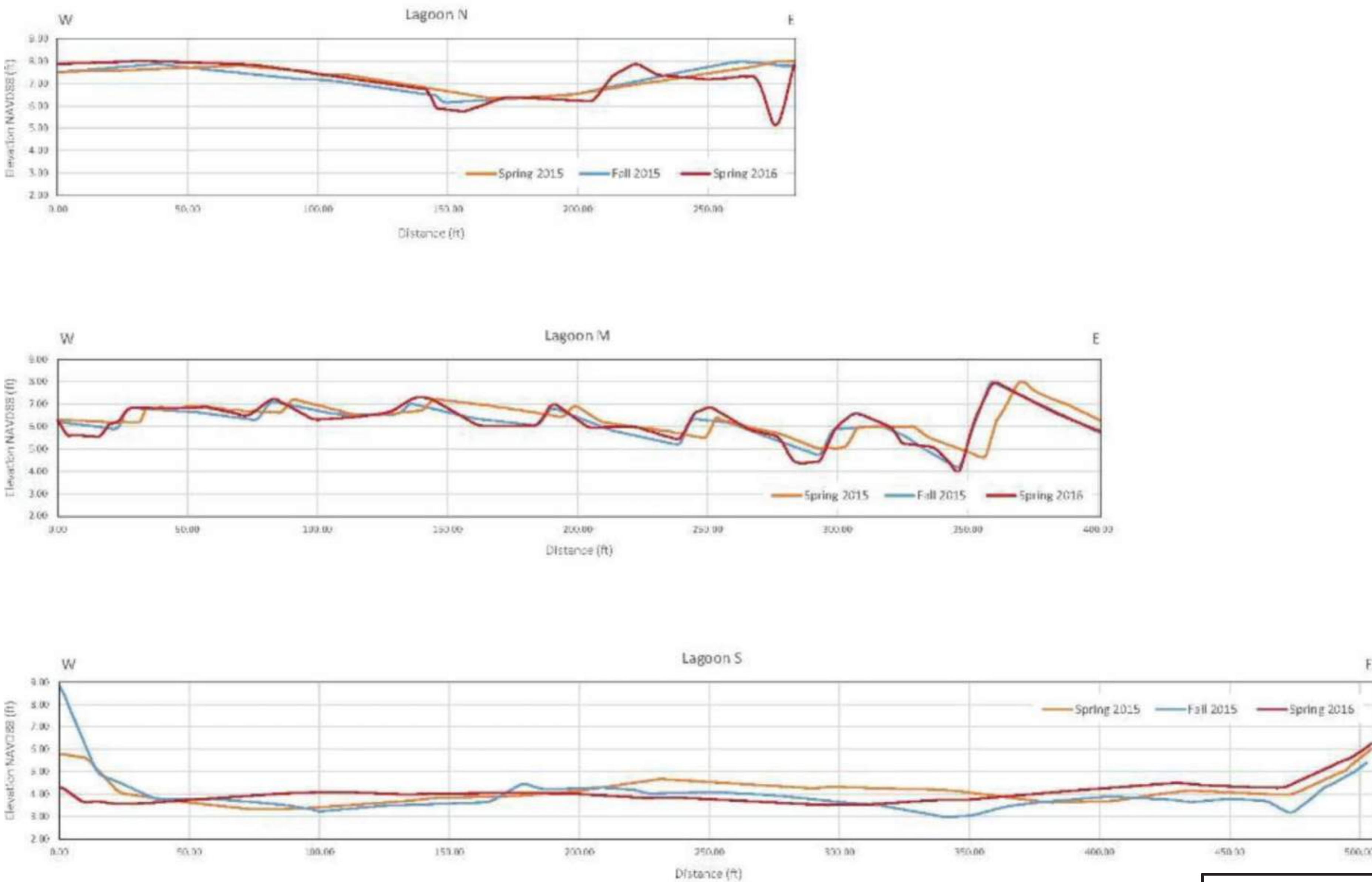
7-Mar-19

SOUTH COAST WATER DISTRICT

FIGURE 6

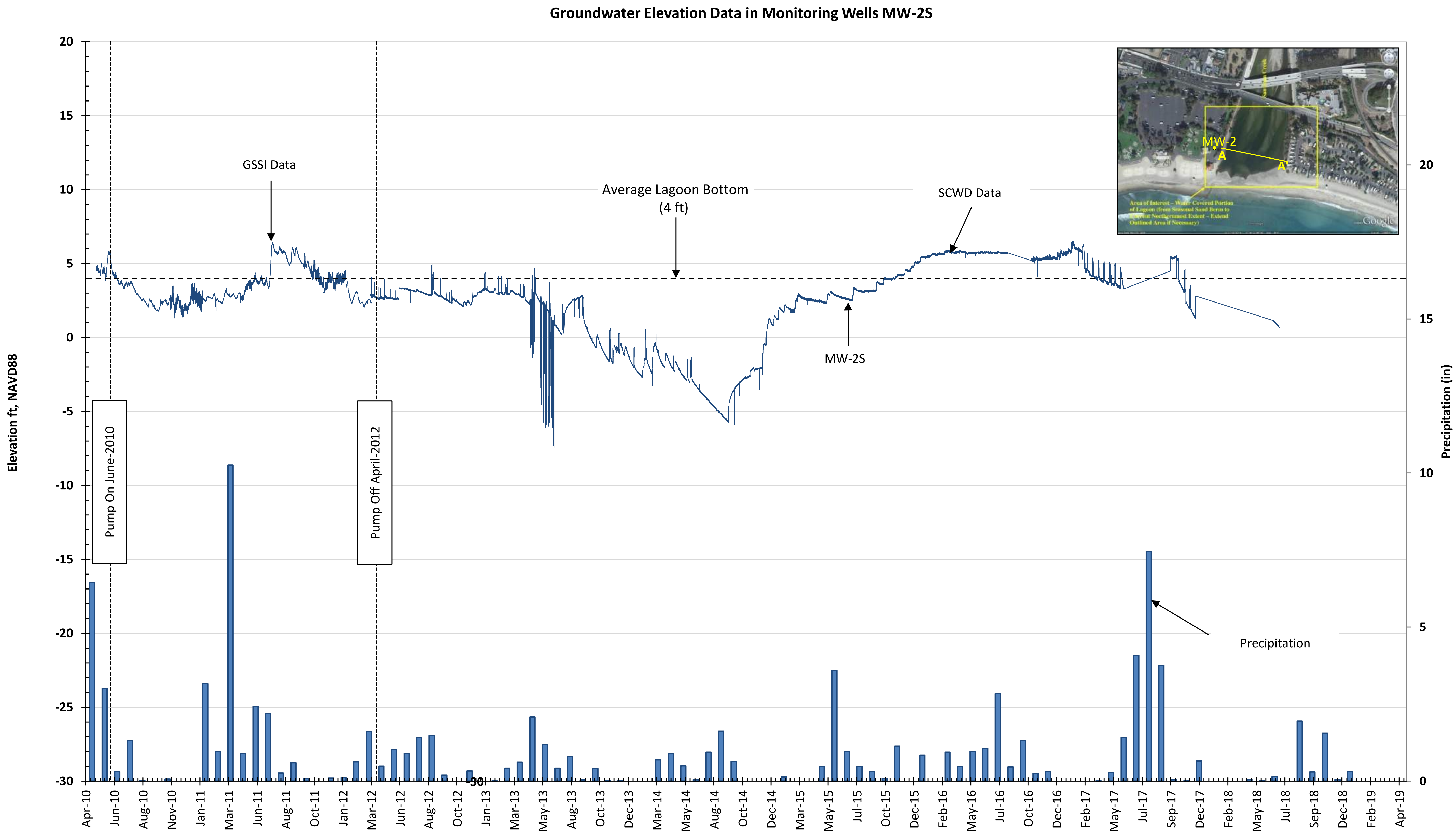
GEOSCIENCE



LAGOON BOTTOM PROFILES

SOURCE: FIGURE 2-14 OF CHAMBERS GROUP, 2016

7-Mar-19


Groundwater Elevation Data in Monitoring Wells MW-2S
Elevation ft, NAVD88
Precipitation (in)
GSSI Data
Average Lagoon Bottom
(4 ft)
SCWD Data
MW-2S
MW-2
A
A'
Pump On June-2010
Pump Off April-2012
Precipitation
20
15
10
5
0
-5
-10
-15
-20
-25
-30
Apr-10
Jun-10
Aug-10
Nov-10
Jan-11
Mar-11
Jun-11
Aug-11
Oct-11
Jan-12
Mar-12
Jun-12
Aug-12
Oct-12
Jan-13
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Dec-14
Mar-15
May-15
Jul-15
Oct-15
Dec-15
Feb-16
May-16
Jul-16
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Feb-17
May-17
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May-18
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Sep-18
Dec-18
Feb-19
Apr-19

Figure 8

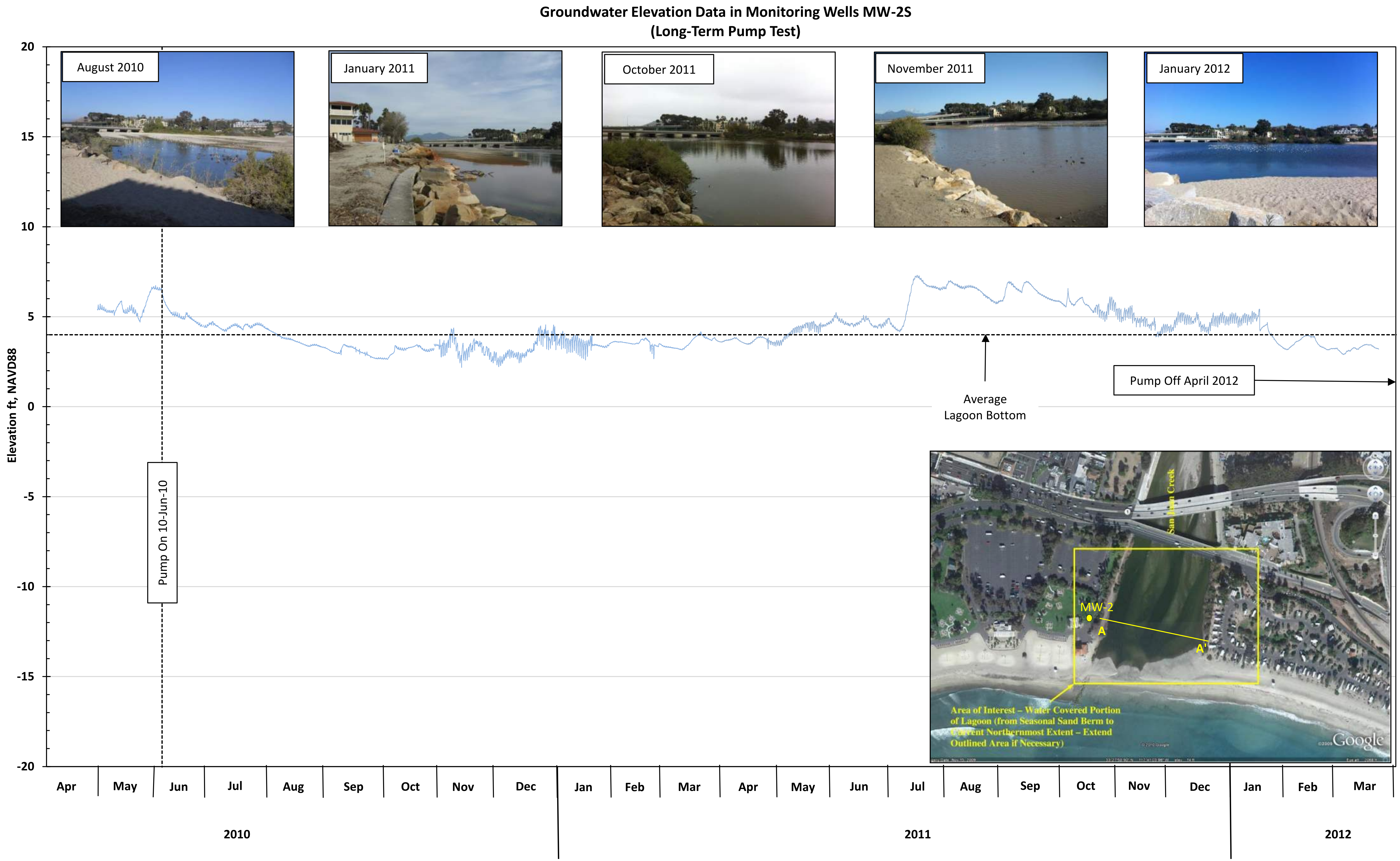
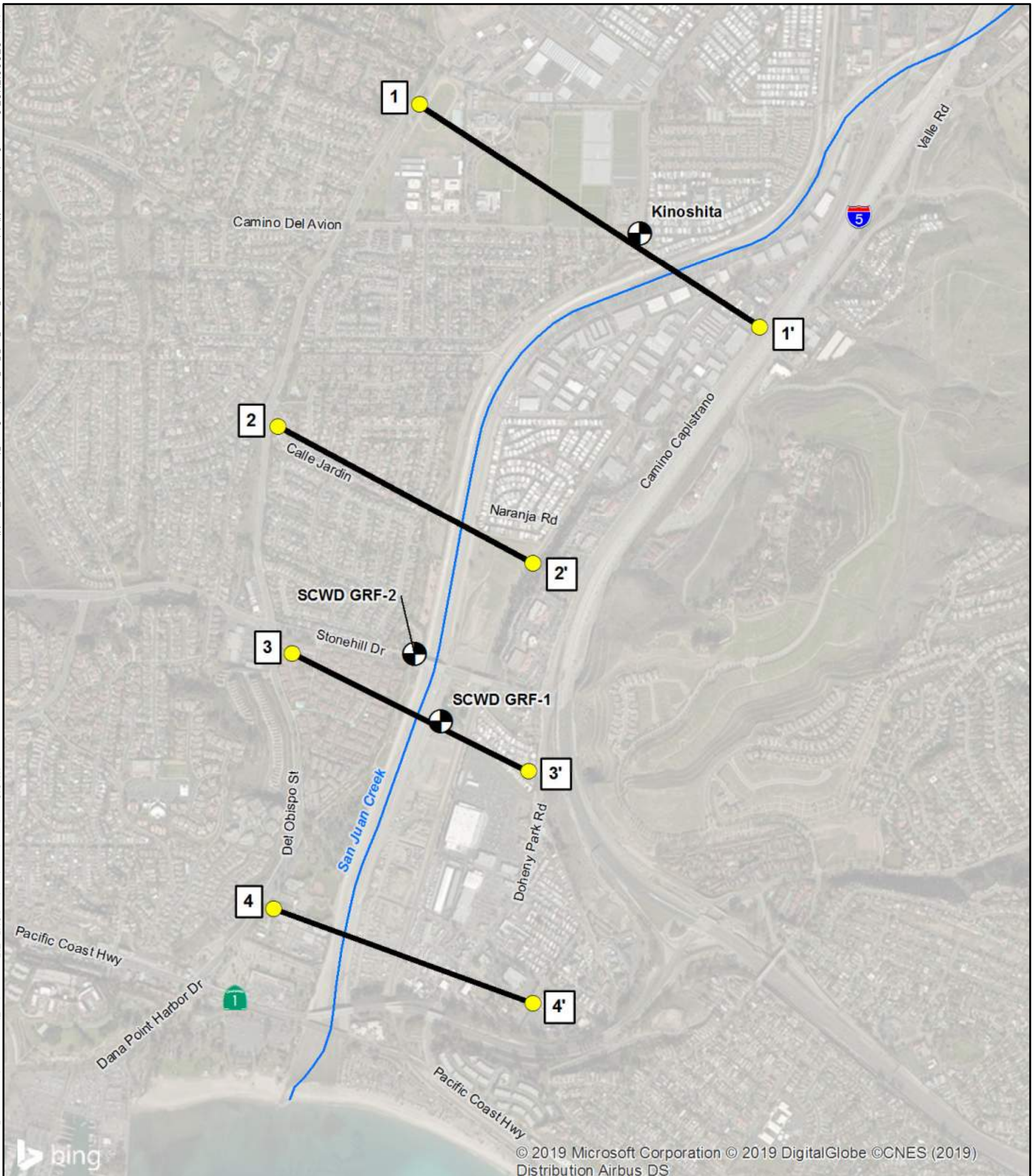

Groundwater Elevation Data in Monitoring Wells MW-2S
(Long-Term Pump Test)
August 2010
January 2011
October 2011
November 2011
January 2012
Elevation ft, NAVD88
20
15
10
5
0
-5
-10
-15
-20
Pump On 10-Jun-10
Average
Lagoon Bottom
Pump Off April 2012
San Juan Creek
MW-2
A
A'
Area of Interest – Water Covered Portion of Lagoon (from Seasonal Sand Berm to Current Northernmost Extent – Extend Outlined Area if Necessary)
Google
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
2010
2011
2012

Figure 9



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EXPLANATION

1 — 1' Profile Location

N

0 750 1,500

Feet

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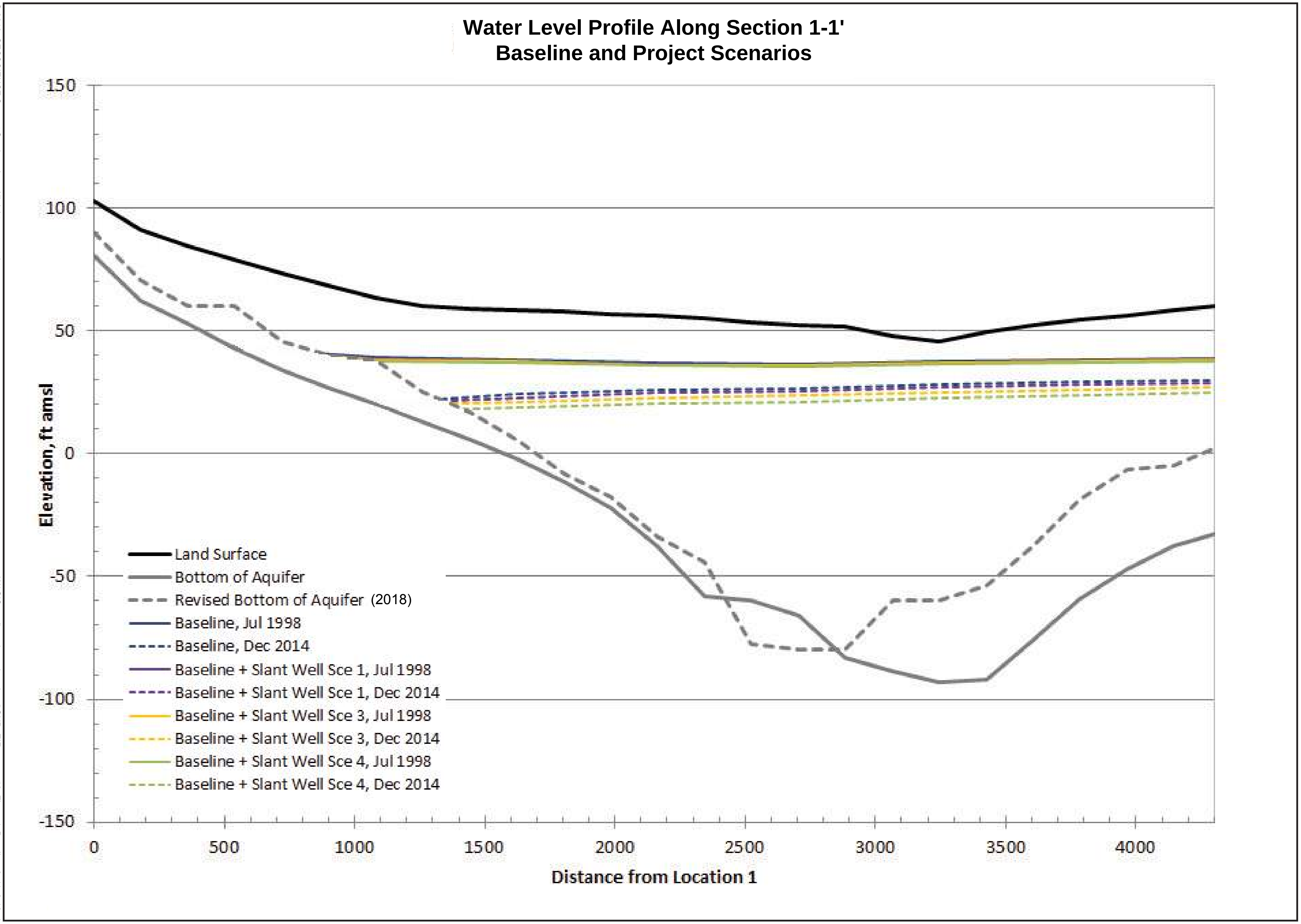
SAN JUAN CREEK PROFILE LOCATIONS



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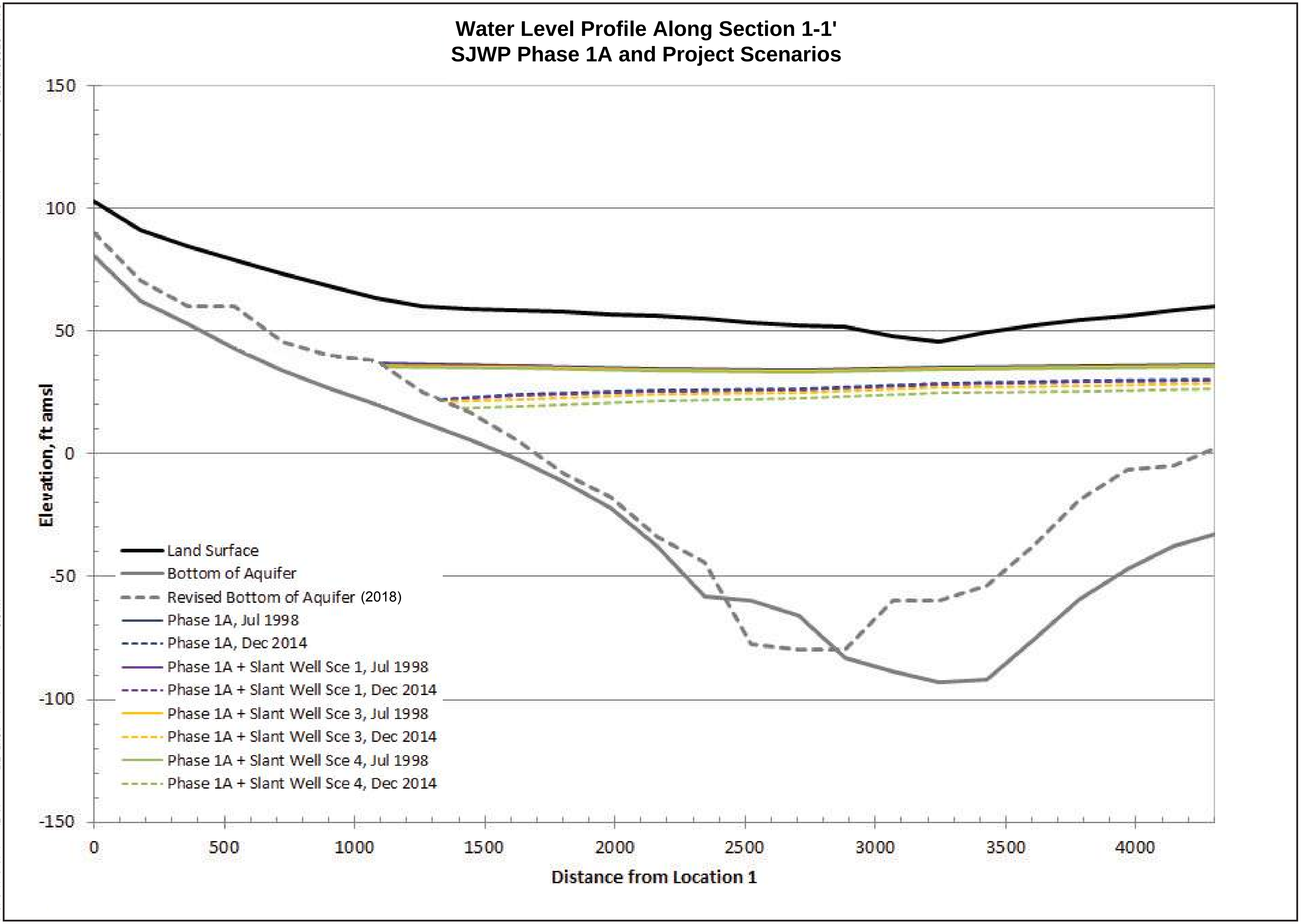
7-Mar-19

SOUTH COAST WATER DISTRICT

FIGURE 11

GEOSCIENCE



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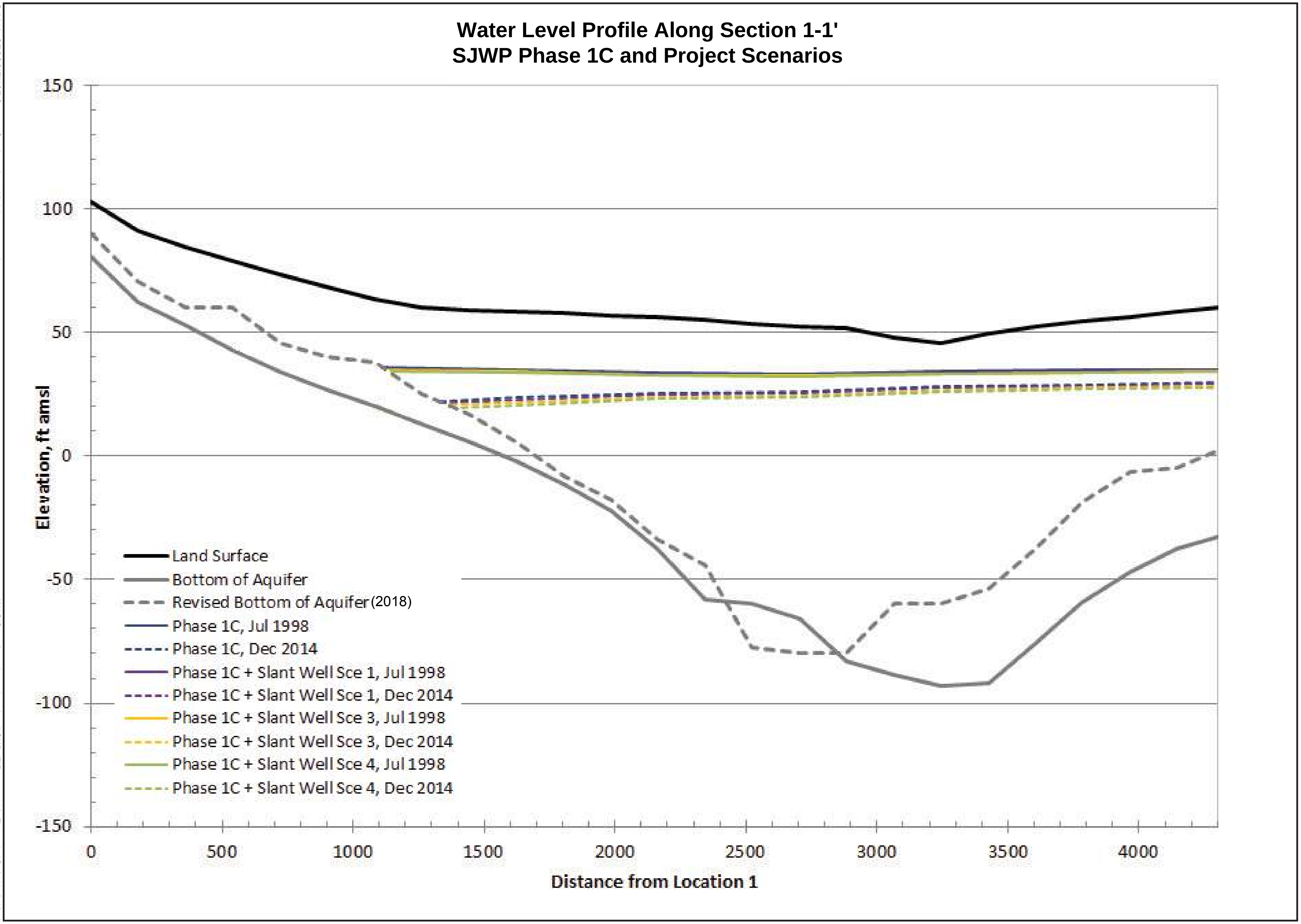
SOUTH COAST WATER DISTRICT

FIGURE 12

GEOSCIENCE



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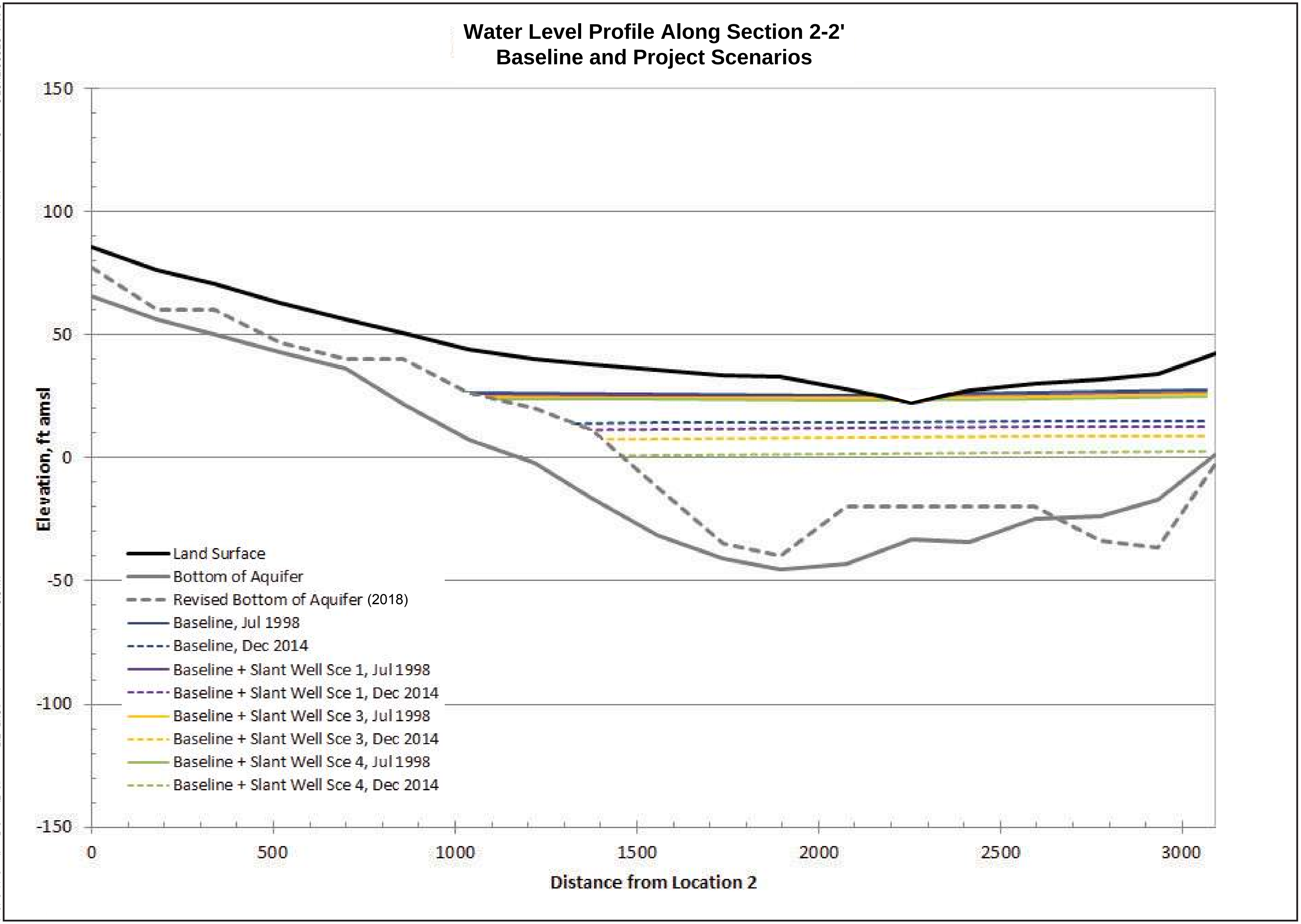
SOUTH COAST WATER DISTRICT

FIGURE 13

GEOSCIENCE



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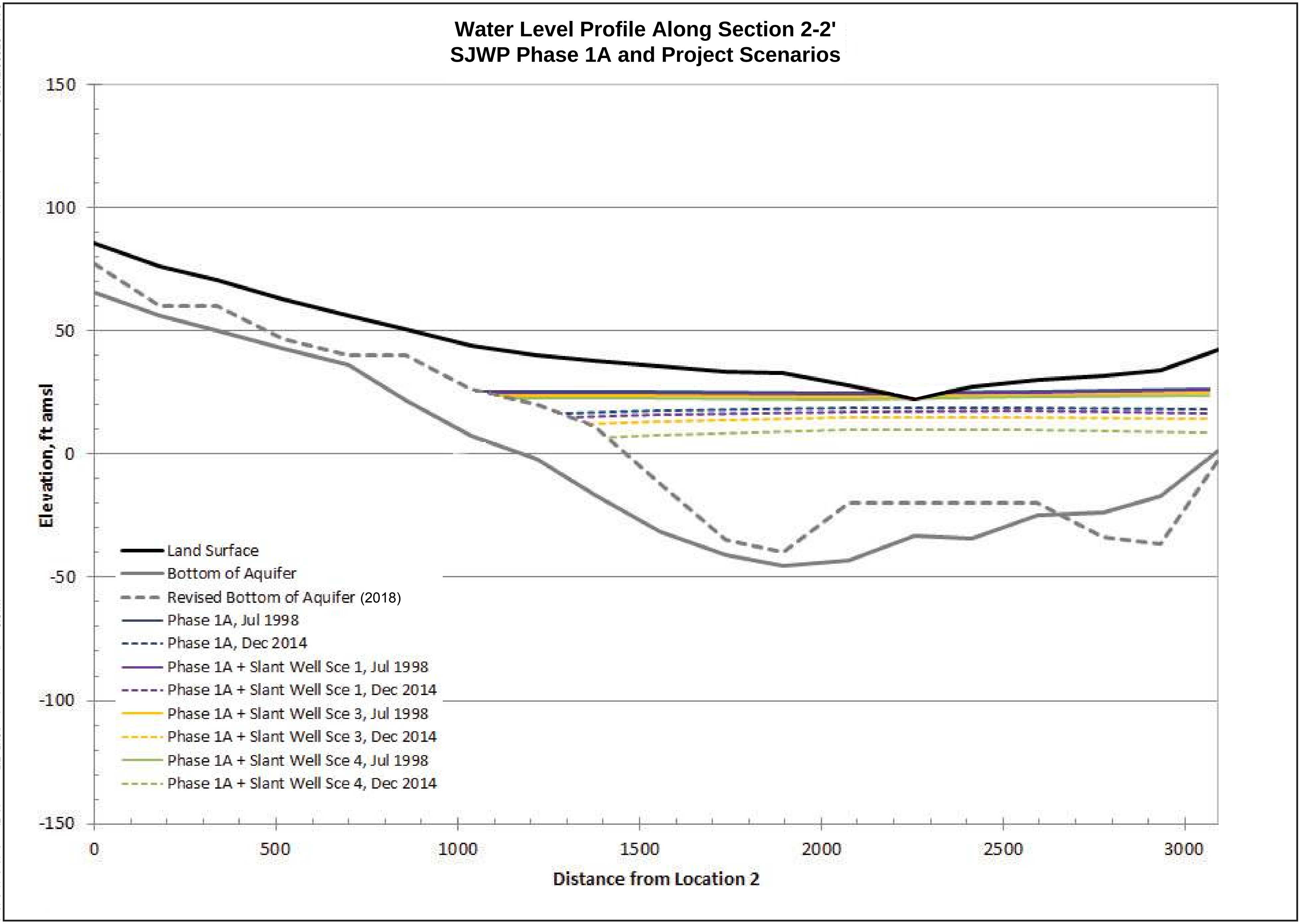
7-Mar-19

SOUTH COAST WATER DISTRICT

FIGURE 14

GEOSCIENCE



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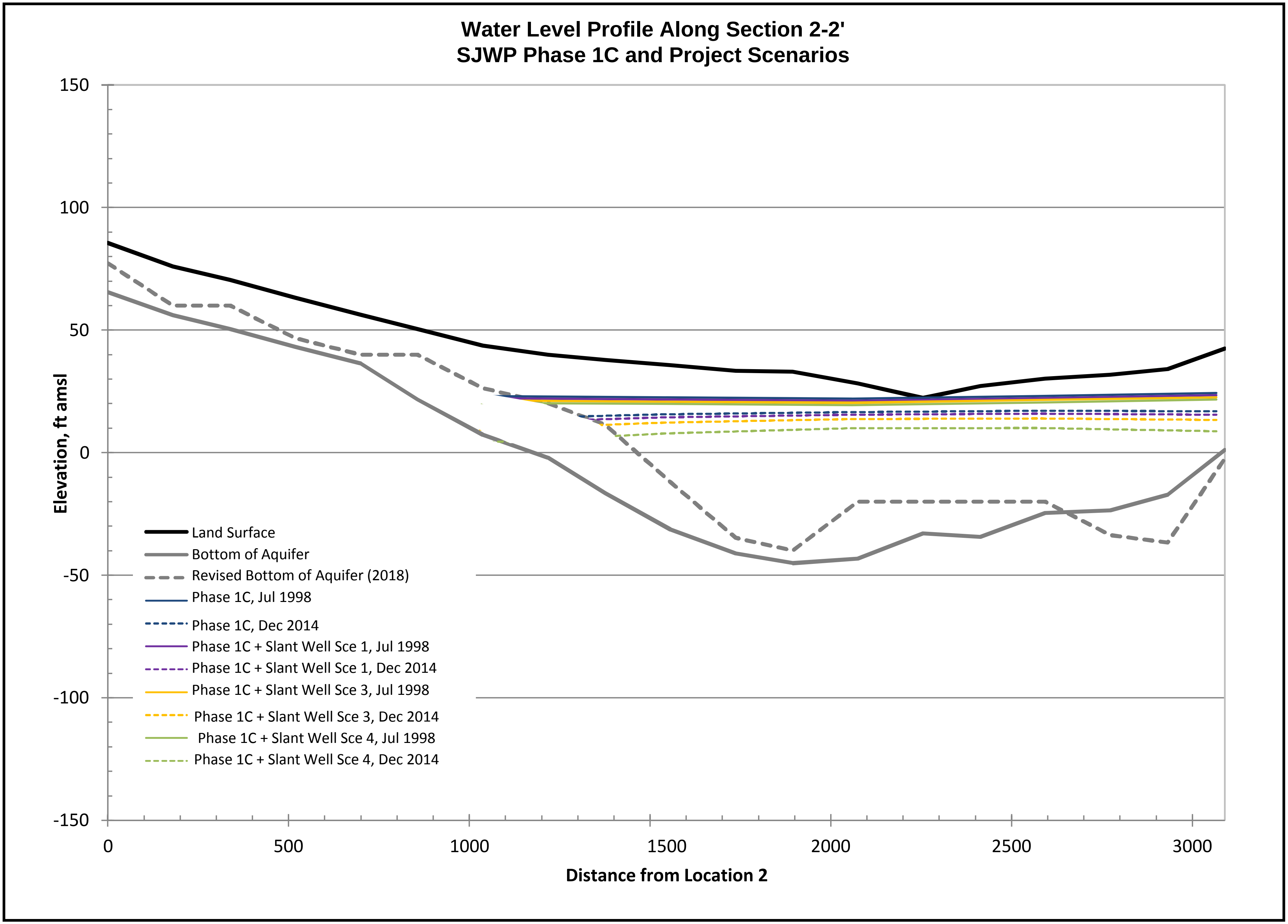
SOUTH COAST WATER DISTRICT

FIGURE 15

GEOSCIENCE



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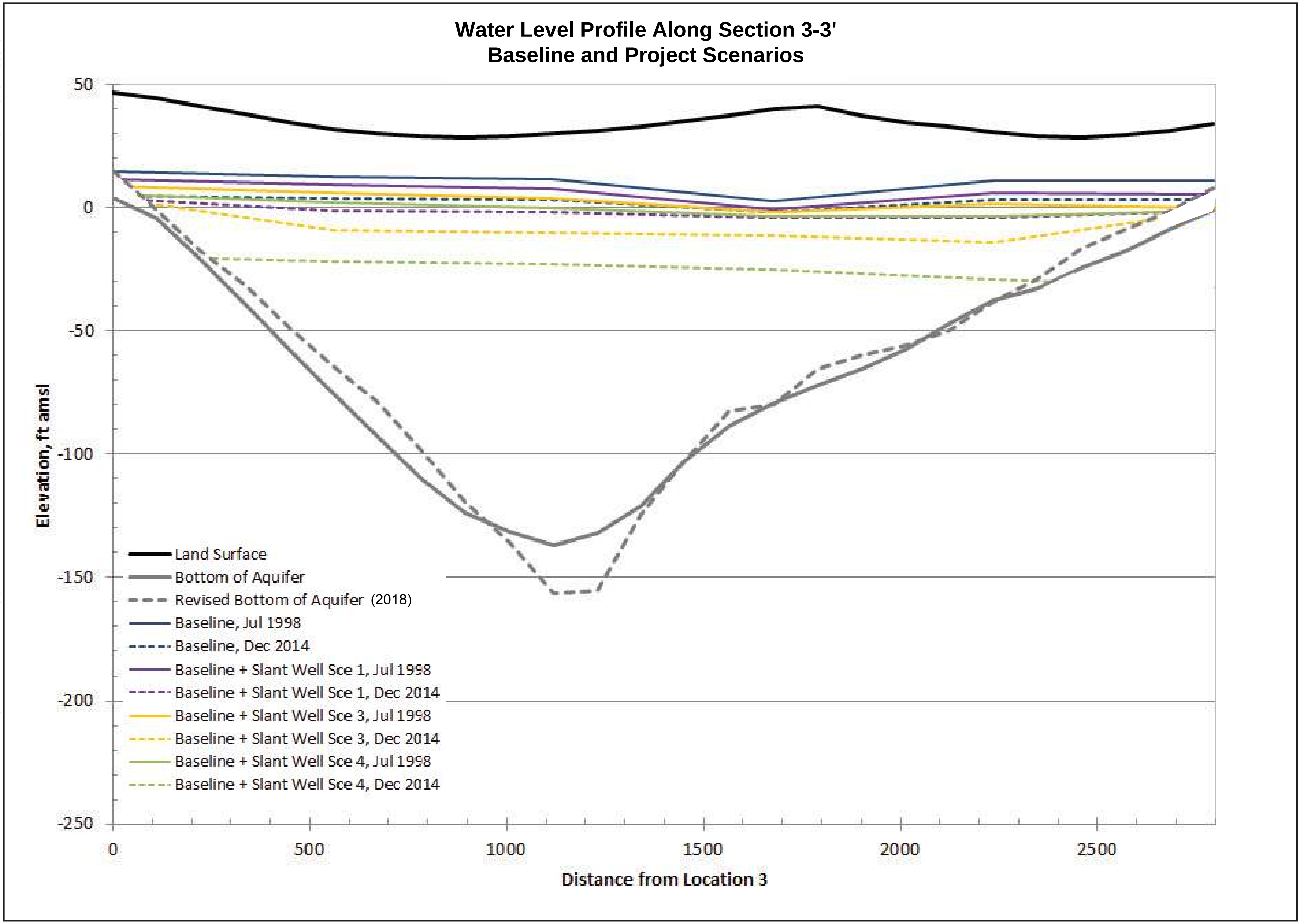
SOUTH COAST WATER DISTRICT

FIGURE 16

GEOSCIENCE



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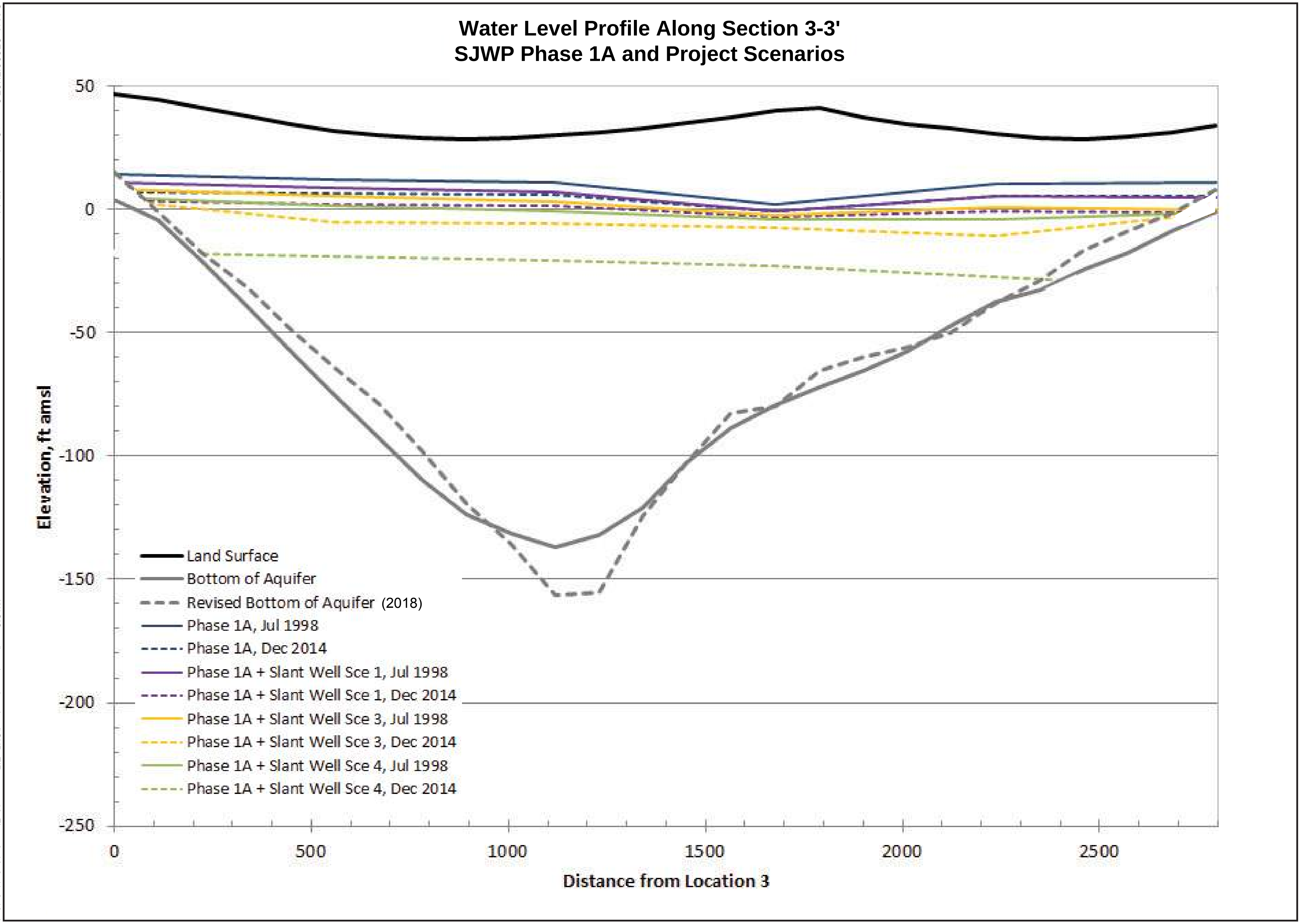
7-Mar-19

SOUTH COAST WATER DISTRICT

FIGURE 17

GEOSCIENCE



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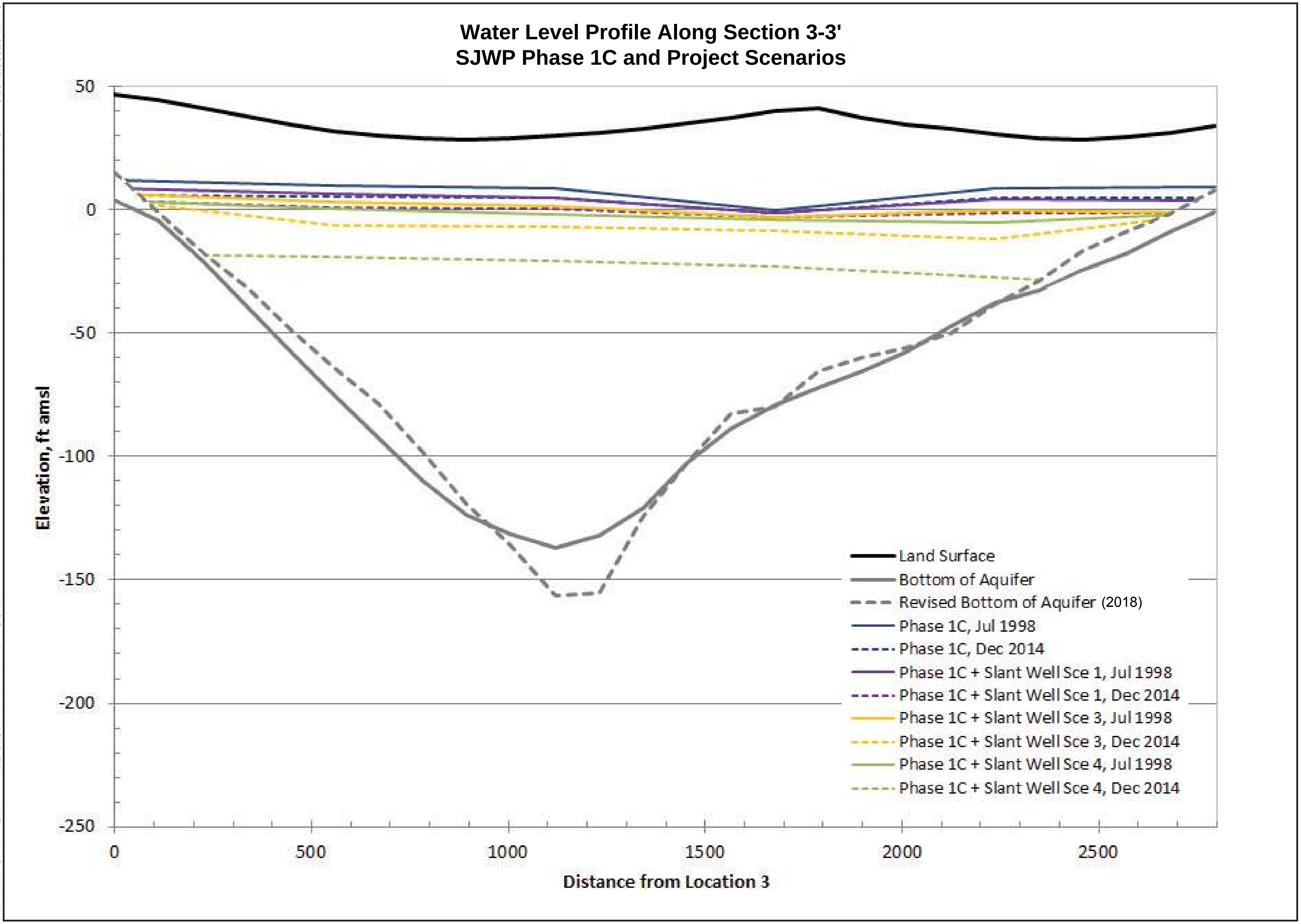
SOUTH COAST WATER DISTRICT

FIGURE 18

GEOSCIENCE



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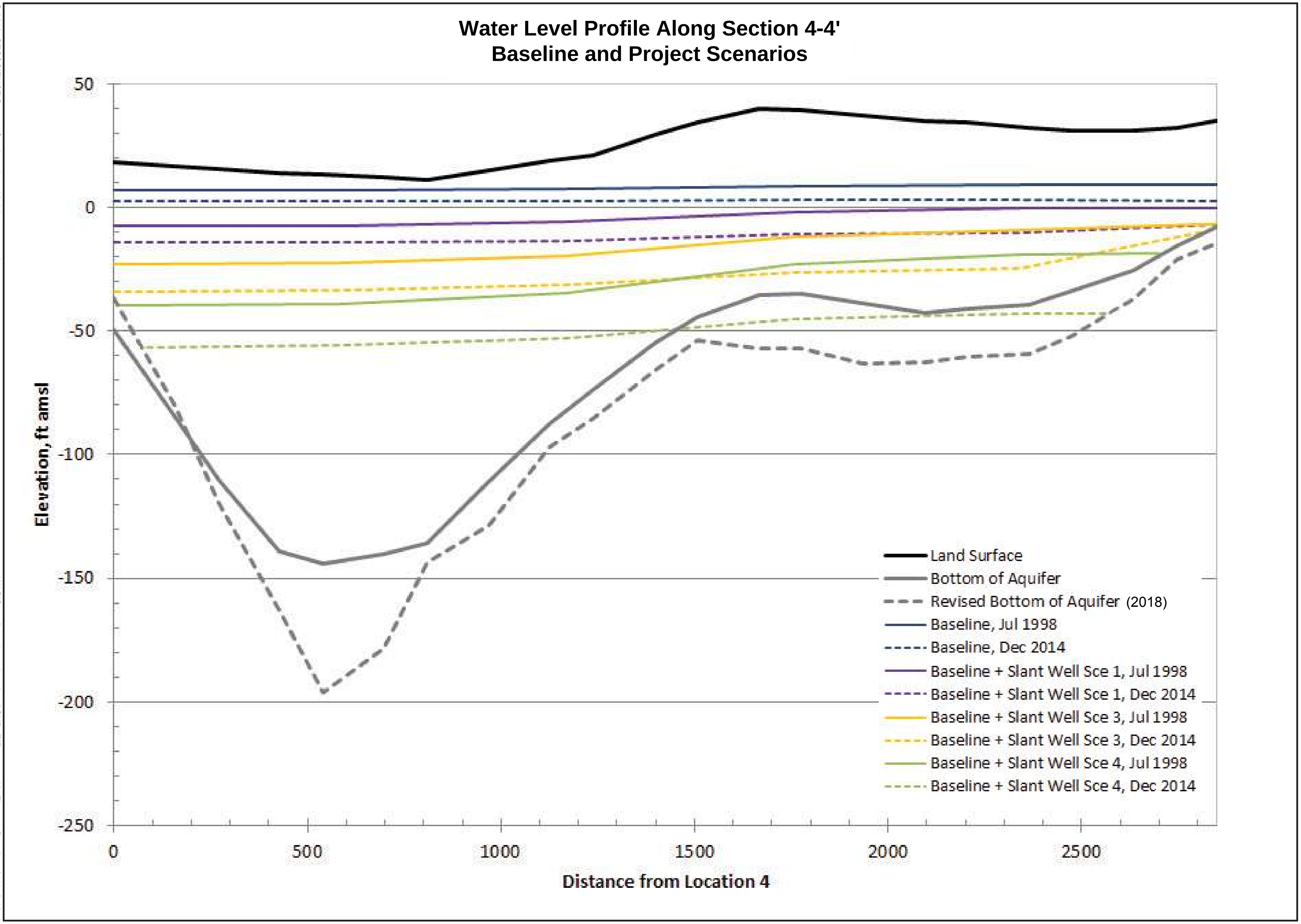
SOUTH COAST WATER DISTRICT

FIGURE 19

GEOSCIENCE



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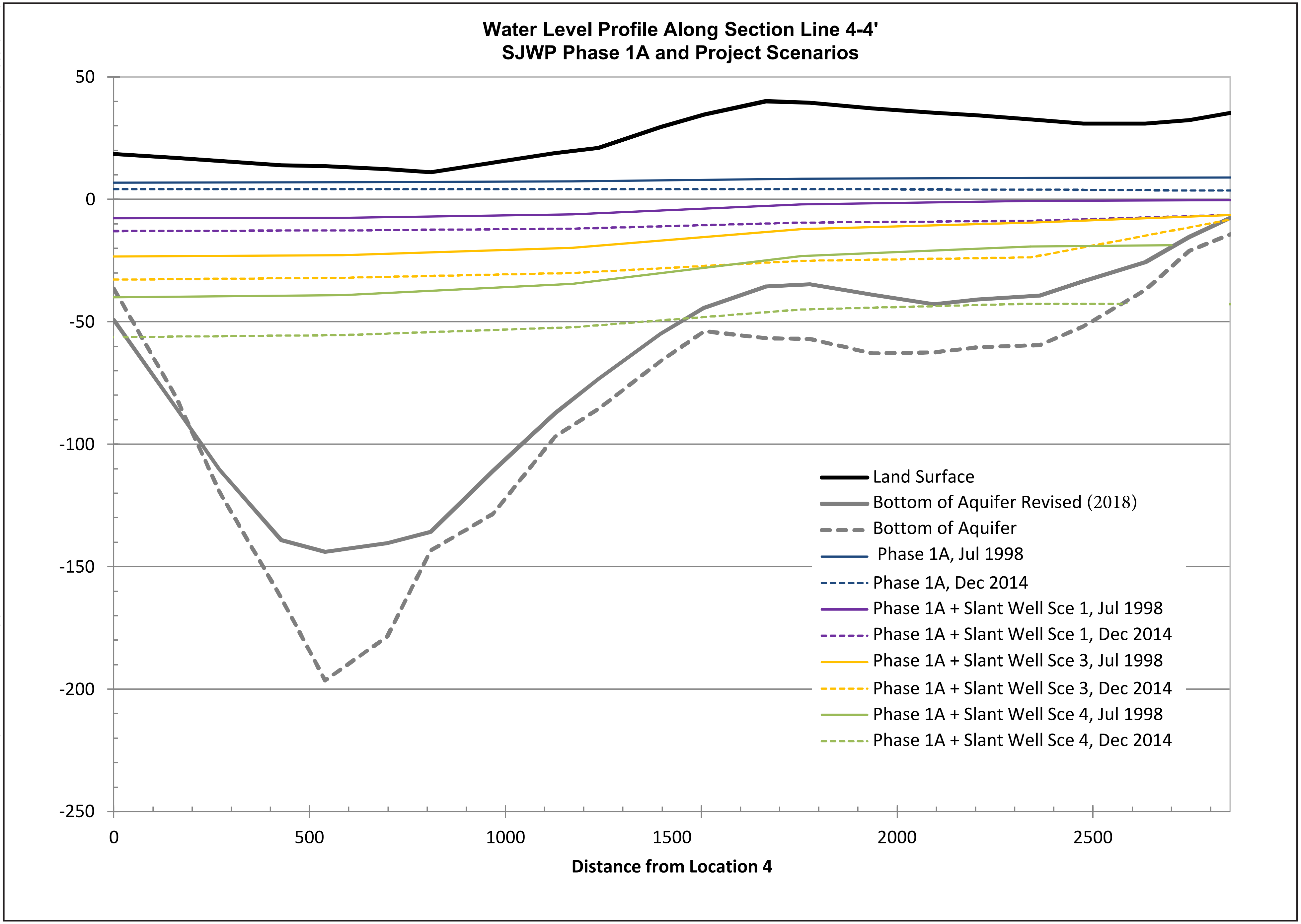
SOUTH COAST WATER DISTRICT

FIGURE 20

GEOSCIENCE



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SOUTH COAST WATER DISTRICT

FIGURE 21

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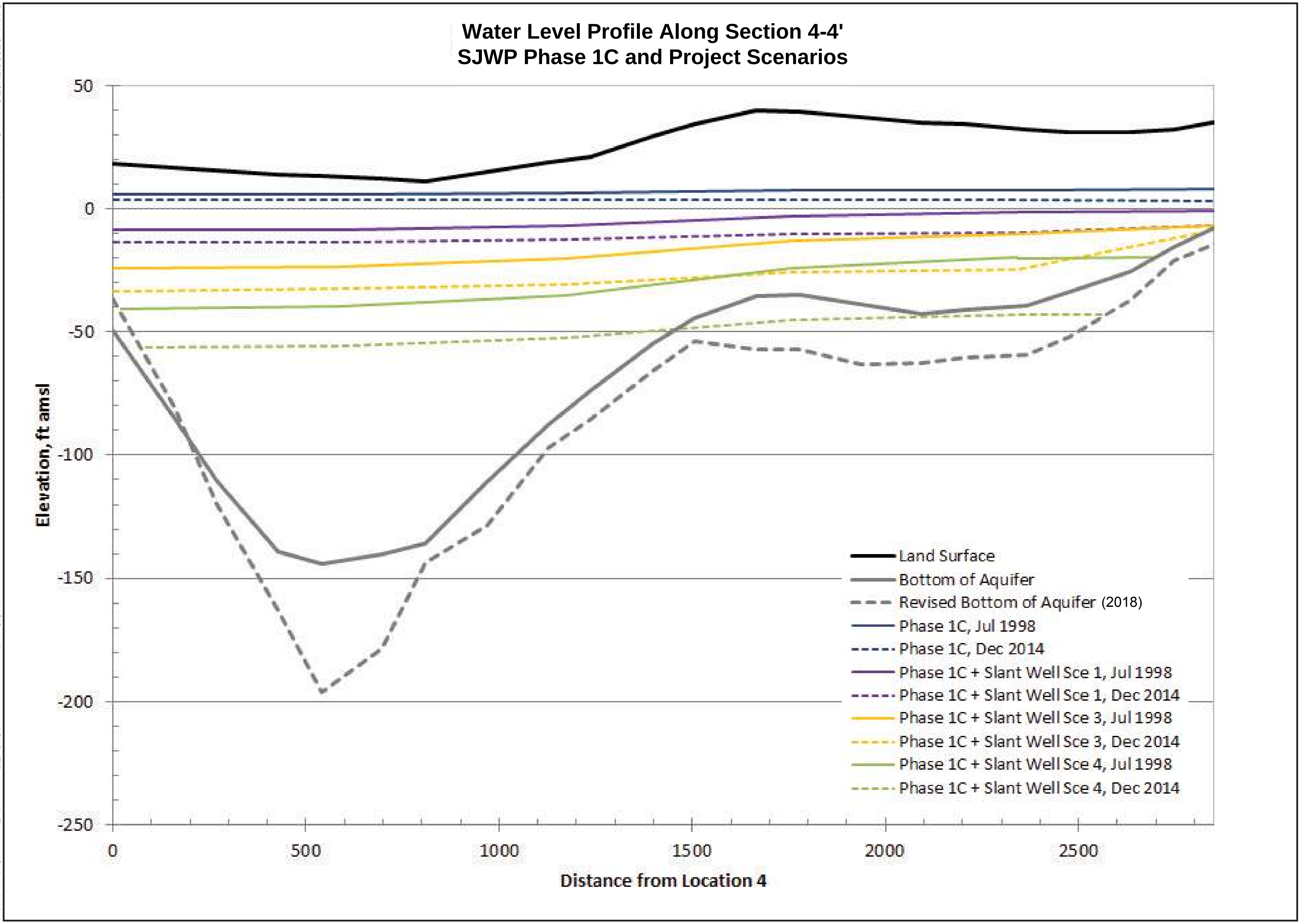

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7-Mar-19

SOUTH COAST WATER DISTRICT

FIGURE 22

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GEOSCIENCE Support Services, Inc. | P (909) 451-6650 | F (909) 451-6638

620 Arrow Highway, Suite 2000, La Verne, CA 91750 | Mailing: P.O. Box 220, Claremont, CA 91711

APPENDIX 4.2.3.2

SAN JUAN CREEK LAGOON TECHNICAL MEMO

Technical Memorandum

GEOSCIENCE

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To:	Mark Donovan, PE Principal Engineer GHD Engineering 175 Technology Dr. #200 Irvine, CA 92618
From:	Brian Villalobos, PG, CHG, CEG Principal Geohydrologist GEOSCIENCE Support Services, Inc.
Date:	November 19, 2018
Subject:	**EIR Doheny Ocean Desalination Project – Hydrogeologic Analysis Related to Responses to Comments – Task 1: Evaluate Project Impacts on San Juan Creek Surface Water Levels**

1.0 INTRODUCTION

The Doheny Ocean Desalination Project Draft Environmental Impact Report (DEIR) was issued on May 17, 2018. GEOSCIENCE Support Services, Inc. (GEOSCIENCE) reviewed the DEIR comments related to project impacts to groundwater and surface water provided to us by the project team, including those provided by the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA-NMFS). In response to these comments, GEOSCIENCE has conducted additional analysis regarding the influence of slant well pumping on San Juan Creek lagoon levels. This technical memorandum summarizes the results of Task 1: Evaluate Project Impacts on San Juan Creek Surface Water Levels, as outlined in the approved scope of work from our proposal dated August 29, 2018.

2.0 EVALUATION OF PROJECT IMPACTS ON SAN JUAN CREEK SURFACE FLOW

The San Juan Basin (SJB) Regional Groundwater Model was used to determine San Juan Creek discharges to the ocean under "No Project" (i.e., Baseline) and "Project" (i.e., pumping) conditions. Evaluating the surface outflow component under No Project and Project conditions allows for the quantification of the potential reduction in surface flow, in cubic feet per second (cfs), due to Project impacts. This quantification can be used for further biological evaluations of potential impacts, as requested by NOAA-NMFS.

2.1 San Juan Basin Regional Groundwater Model

The SJB Regional Groundwater Model was originally developed in 2013 to evaluate the basin yield and groundwater level response from existing and planned groundwater development, to determine potential impacts on groundwater levels and pumping interference from the installation of sheet piling along the San Juan Creek flood control channel, and to assess impacts associated with the Doheny Ocean Desalination Project (GEOSCIENCE, 2013). Later, the model was updated for the Doheny Desalination Project during work for the Foundational Actions Funding Program – Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling (GEOSCIENCE, 2015) to better understand 1) feedwater quality produced over time from a slant well system, 2) drawdown effects and environmental strategies along coastal reaches, and 3) the behavior of seawater flow and intrusion control in a multi-layered aquifer system. Following onshore and offshore geophysical surveys and the drilling of a borehole in 2017-2018 to better define the geometry of coastal paleochannels, the SJB Regional Model was further refined by incorporating the newer hydrogeological data.

The SJB Regional Model is a three (3) layered MODFLOW[1] model covering the lower and middle SJB area of approximately 47.5 square miles (30,400 acres), including an offshore area to incorporate infiltration from the ocean (see Figure 1). The model consists of a finite-difference grid with 1,012 rows in the north to south direction and 524 columns in the west to east direction, for a total of 530,288 cells per layer, or 1,590,864 cells total. Each model cell of the SJB Regional Model represents an area of 50 ft x 50 ft. The active model area represents unconsolidated and semi-consolidated fluvial deposits interbedded with numerous fine-grained silt and clay deposits. Inactive model areas and the base of the groundwater model represent surrounding and underlying consolidated geologic formations (i.e., bedrock).

The regional model was calibrated for the period from January 2004 to December 2014 for purposes of analyzing the impacts of full-scale pumping. This period was selected due to the importance of recent stresses (dry hydrologic period) on the basin for predicting future performance. The calibration was based on 2,435 groundwater level measurements from 36 target wells and measured streamflow from the San Juan Creek at La Novia gaging station and Trabuco Creek at San Juan Capistrano gaging station.

[1] MODFLOW is a block-centered, finite-difference groundwater flow code developed by the United States Geologic Survey (USGS) (McDonald and Harbaugh, 1988) for the purpose of modeling both saturated and unsaturated groundwater flow.

2.2 Model-Calculated San Juan Creek Lagoon Elevations

The SJB Focused Model was developed and calibrated as part of the Foundational Actions Funding Program (GEOSCIENCE, 2015) to more accurately predict slant well pumped water quality over time, injection water flow/water quality/reactants, and ocean water intrusion. The finer cell size (resolution) used for the focused model was also important to understand seasonal coastal lagoon drawdown effects. Lagoon levels were calculated by the Focused Model, which employs the Lake Package to simulate the surface water-groundwater interaction.

Project impacts were evaluated for the hydrologic period from January 1947 through December 2010 for the following scenarios:

- Baseline (i.e., no Project pumping)
- Scenario 1: Project pumping of 10 million gallons per day (MGD) from three slant wells
- Scenario 2: Project pumping of 10 MGD from seven slant wells at Capistrano Beach
- Scenario 3: Project pumping of 30 MGD from sixteen slant wells (20 MGD from slant well pods at Doheny and 10 MGD from pods at Capistrano Beach)

For the purposes of this evaluation, surface flows in San Juan Creek under baseline conditions (representing no Project pumping conditions) will be compared to Scenario 1 (representing low Project pumping conditions) and Scenario 3 (representing higher Project pumping conditions).

As presented in Table 4-3 of Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data Technical Memorandum, dated March 1, 2018, Project pumping impacts on the lagoon water levels were reported as ranging from -0.14 to -0.26 ft under Scenario 1 conditions and -0.16 to -0.85 ft under Scenario 3 conditions. To clarify decreases in lagoon levels for dry and wet hydrologic conditions, the table below summarizes the model-calculated decreases in lagoon levels.

Table 1. Project Impacts on Lagoon Surface Levels

Hydrologic Cycle	Hydrologic Period	Impact on Lagoon Levels, ft	
		Scenario 1	Scenario 3
Dry	1947-1976	-0.14	-0.16
Wet	1978-1983	-0.26	-0.85

It is important to note that the model-calculated decreases in San Juan Creek lagoon levels occur over the entire lagoon area of approximately 13.2 acres. The following section provides the model-calculated reduction in outflow that will occur as a result of Scenario 1 and Scenario 3 pumping over the area influenced by Project pumping under dry and wet hydrologic conditions.

2.3 Model-Calculated San Juan Creek Outflow to the Ocean under No Project and Project Conditions

Surface flow in San Juan Creek was simulated in the SJB Regional Model using the Streamflow Routing Package (SFR Package) from MODLFOW, which accounts for the interaction between surface water and groundwater. The SFR Package assigns recharge to stream cells that are sequentially numbered in the downstream direction. The downward leakage of streamflow, or streambed percolation, is calculated as a function of the hydraulic conductivity of the streambed, the wetted perimeter of the streambed, the length of the stream reach, the underlying groundwater head, stream stage, and streambed thickness. Model input for the routing package includes stream inflow, stream channel geometry, and streambed conductance (Niswonger and Prudic, 2006). Information on streamflow was available from observed measurements at the San Juan Creek at La Novia and Trabuco Creek at San Juan Capistrano gaging stations, which were also used for model calibration. These gaging stations are shown on Figure 1.

In order to evaluate the long-term outflow at the ocean, streamflow in San Juan Creek and surface outflow to the ocean was calculated by the SJB Regional Model for the hydrologic period from January 1947 through December 2010 for the same scenarios presented above. The model-calculated streamflow from San Juan Creek to the ocean is shown on Figures 2 through 4 under Baseline, Scenario 1, and Scenario 3 conditions, respectively.

For baseline conditions, outflow at the ocean ranges from 15.95 cubic feet per second (cfs) under dry hydrologic conditions to 56.04 cfs under wet hydrologic conditions. Discharge under Scenario 1 Project pumping conditions ranges from 15.86 cfs under dry hydrologic conditions to 55.59 cfs under wet hydrologic conditions. Discharge under Scenario 3 ranges from 15.83 cfs under dry hydrologic conditions to 55.41 cfs under wet hydrologic conditions. The corresponding decrease in San Juan Creek streamflow under Project pumping conditions, as compared to baseline, is summarized in the following table.

Table 2. Project Impacts on San Juan Creek Outflow to the Ocean

Hydrologic Cycle	Hydrologic Period	Impact on San Juan Creek Discharge, cfs	
		Scenario 1	Scenario 3
Dry	1947-1976	-0.09	-0.12
Wet	1978-1983	-0.45	-0.63

The decreases in San Juan Creek streamflow from Project pumping correspond to approximately 0.6 to 0.8 percent of the baseline outflow under Scenario 1 conditions and 0.8 to 1.1 percent of the baseline outflow under Scenario 3 conditions.

3.0 EVALUATION OF PROJECT IMPACTS ON SHALLOW AQUIFER GROUNDWATER LEVELS

3.1 Groundwater Level Monitoring

Historical groundwater levels for the shallow aquifer in the vicinity of the San Juan Creek lagoon were collected both during and after the long-term slant well pumping test from transducers placed in District-owned nested monitoring wells MW-1 through MW-4 (12 total monitoring wells). MW-1 and MW-2, which are closest to the lagoon, are shown on Figure 5 (inset below).

Figure 5. Monitoring Well Locations in the Vicinity of the San Juan Creek Lagoon

During the initial field investigations conducted in 2005, boreholes B-2 and B-4 were completed as nested monitoring wells (MW-1 and MW-2, respectively). Each borehole contains three nested 2-inch PVC wells screened in the shallow, middle, or deep aquifer. A basic monitoring well construction diagram for B-2/MW-1 and B-4/MW-2 is shown on the sketch below (inset Figure 6), which illustrates the general configuration of the nested monitoring wells in MW-1 and MW-2.

After the monitoring wells were constructed, they were developed and sampled. The depth to static groundwater level in each nested monitoring well was initially measured with an electronic sounder. Each nested monitoring well was later equipped with a pressure transducer to measure groundwater levels every 15 minutes. Transducer data were downloaded on a weekly basis during the long-term pumping test (June 2010 through April 2012) and on a monthly basis after the long-term pumping test to present. An on-site barometer was used to compensate the transducer data downloaded from each nested monitoring well. The compensated water level data were then converted to elevation (NAVD88) and plotted over time.

The nested well design allows for accurate water level data from each of the nearshore aquifers (shallow, middle, and deep). For example, the shallow screen in each nested monitoring well (MW-1S and MW-2S) provides water level data for the shallow aquifer, which is in direct hydraulic connection with San Juan Creek. Since the shallow aquifer is separated from the middle aquifer by an aquitard that is approximately 10 ft thick, water level measurements in the shallow aquifer are not influenced by the deeper systems. Therefore, water level data from MW-1S and MW-2S can be used to monitor and evaluate Project pumping impacts on the shallow aquifer. In particular, MW-2S was used to evaluate groundwater levels in the shallow aquifer under the lagoon due to its location in relation to both the Test Slant Well and the lagoon.

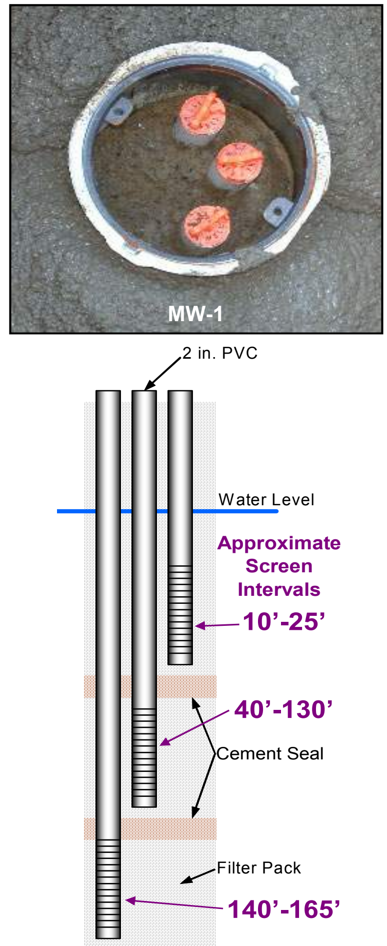


Figure 6. General Monitoring Well Construction

In addition, MW-2 is located at approximately the same location as one of the lagoon bottom profiles surveyed by the Chambers Group (2016) from Spring 2015 to Spring 2016 – providing a reference on the relative position of shallow aquifer water levels with respect to the lagoon bottom (see Figure 5). These profiles, presented originally as Figure 2-14 of the Chambers Group report, are shown as attached Figure 7. The cross-sectional transects indicate most erosion taking place within the southwest corner of the lagoon where the sand berm is typically breached. Some accretion of sediment occurs on the eastern bank of the lagoon (see Chambers Group, 2016). An average bottom elevation of the lagoon was estimated to be approximately 4 ft NAVD88 from the Lagoon S cross-section (shown on Figure 5 as A-A').

3.2 Shallow Aquifer Groundwater Levels during Historical Hydrologic Cycles

Shallow aquifer groundwater levels from MW-2S are shown on Figure 8 from just before the start of the long-term pumping test in June, 2010, through present. The shallow aquifer groundwater levels are also shown in comparison to the average estimated lagoon bottom elevation of 4 ft NAVD88 and monthly precipitation from the Laguna Beach #2 precipitation gage. The water levels represent a combination of two sets of collected data that were joined together to display shallow groundwater levels during the pumping test and post-pumping period. One dataset was collected and processed by GEOSCIENCE during slant pumping test monitoring, and the other was collected and processed by South Coast Water District (SCWD) during post-pumping test monitoring.

As shown, groundwater levels in the shallow aquifer fluctuated above and below the average lagoon bottom elevation both during and after the long-term pumping test. Based on the observed fluctuations and local precipitation, groundwater levels in MW-2S appear to correlate well with dry (below average) or wet (above average) hydrologic periods. At the start of the long-term pumping test, shallow aquifer water levels were hovering at the elevation of the lagoon bottom. Just after the initiation of the test, water levels fall below the lagoon bottom elevation. Water levels then rose above the lagoon bottom elevation in response to the increased precipitation that occurred from January 2011 through July 2011. Subsequently, water level in the shallow aquifer fell below the lagoon bottom elevation during the following dry years (2012 through 2015) and rose again following increased precipitation events in 2015 and 2016. However, despite the lower groundwater levels in the shallow aquifer during dry hydrologic conditions, review of aerial photos and land-based photos taken during monitoring events indicate surface water was still present in the lagoon during these times (Figure 9).

Based on the observed response of water levels to changes in precipitation, it appears that groundwater levels in the shallow aquifer in the vicinity of the San Juan Creek lagoon are heavily influenced by hydrologic conditions.

3.3 Project Impacts during Wet, Dry, and Average Hydrologic Cycles

Figure 10 shows historical annual precipitation from 1928 through 2017, along with the calculated cumulative departure from the mean. The 70-year average precipitation is approximately 11.77 in/year during the period from 1928 through 2017. A downward slope on the cumulative departure curve indicates a less than average or “dry” conditions and upward slope shows periods during “wet” conditions. The long-term cumulative departure from the mean precipitation show that the study period during slant well pumping (June 2010 through April 2012) and post slant well pumping represented an overall a dry hydrologic period.

A snapshot of the recent precipitation data, shown on Figure 11 (below), suggests that the average precipitation over the past 12 years is only 6.84 in/year, which is nearly half of the long-term precipitation average of 11.77 in/year. The precipitation data shown on Figure 11 corresponds to the period for which groundwater level data were recorded, from 2005 to 2017, in the monitoring wells near the San Juan Creek lagoon.

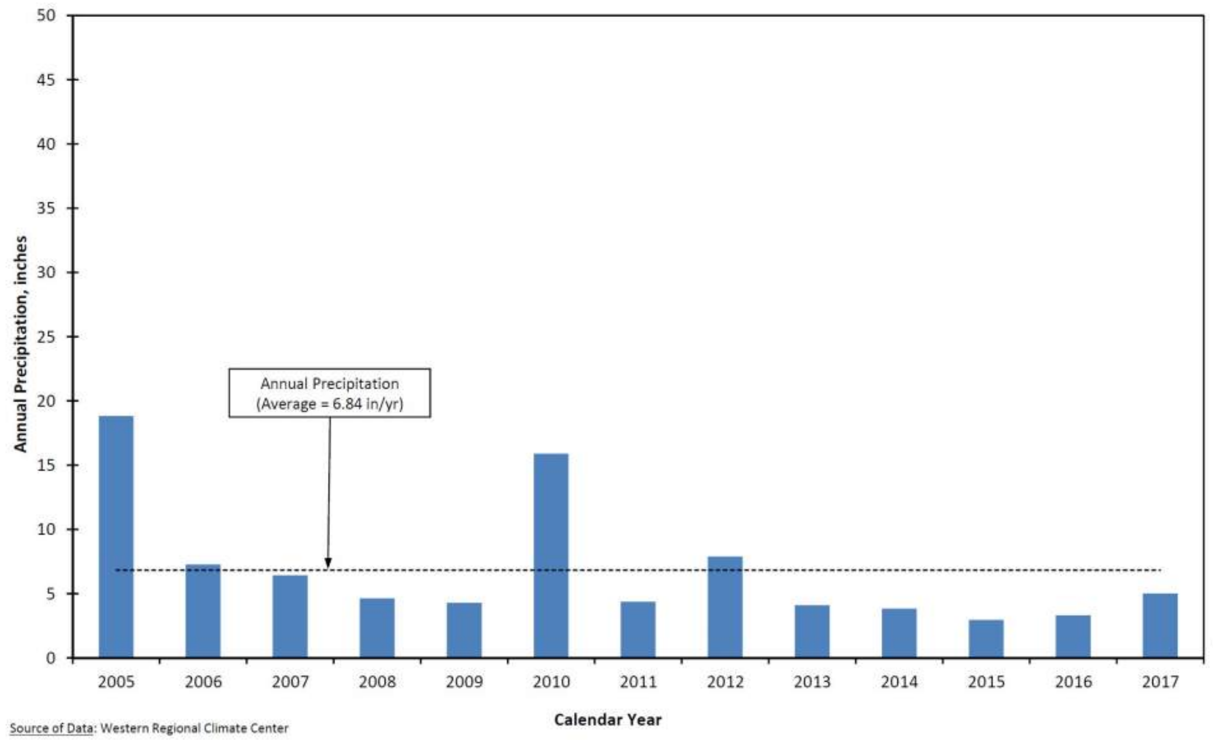


Figure 11. Annual Precipitation at Laguna Beach #2 Precipitation Gage (2005-2017)

Water levels in the shallow aquifer during the long-term pumping test and during the post-pumping period, which occurred during primarily dry hydrologic conditions (2005 to 2017), showed fluctuations that rose and fell above/below the average bottom elevation of the San Juan Creek lagoon. These fluctuations appear to be driven largely by local hydrologic cycles and precipitation patterns. However, even when shallow aquifer water levels fell below the lagoon bottom elevation in dry conditions, aerial imagery and field observations showed that water remained in the lagoon. During these conditions, the water percolated from the lagoon is in "free fall" conditions; that is, as water percolates into the subsurface it must percolate some distance before it reaches the water table. Therefore, the percolation rate is driven by the streambed hydraulic conductivity and not by depth to the groundwater elevation. As such, the degree of water level fluctuation expected under Project pumping conditions for the full scale wellfield will not significantly affect surface outflow and lagoon levels.

4.0 SUMMARY AND CONCLUSIONS

- Both the creek outflow and the shallow aquifer near the lagoon are highly affected by hydrologic conditions (i.e., precipitation patterns).

- During periods of low precipitation (dry hydrologic conditions), water levels in the shallow aquifer generally fall below the average estimated lagoon bottom elevation – both during pumping conditions and in the absence of slant well pumping .

- Even during dry conditions when groundwater levels in the shallow aquifer fall below the lagoon bottom during No Project (no pumping) and Project (pumping) conditions, water is still present in the lagoon.

- When groundwater levels in the shallow aquifer fall below the lagoon/river bottom, surface water level in the lagoon is controlled by the hydraulic conductivity of the underlying sediments and is independent of groundwater levels.

- During periods of high precipitation (wet hydrologic conditions) groundwater levels in the shallow aquifer generally rise above the lagoon bottom.

- Additional seepage from the lagoon and streambed upgradient of the lagoon occurs under Project pumping conditions. However, decreases in San Juan Creek streamflow from Project pumping correspond to approximately 0.6 to 0.8 percent of the baseline outflow under Scenario 1 conditions and 0.8 to 1.1 percent of the baseline outflow under Scenario 3 conditions.

5.0 REFERENCES

Chambers Group (Chambers Group, Inc.), 2016. Lower San Juan Creek and Seasonal Coastal Lagoon Habitat Assessment – Orange County, California. Prepared for South Coast Water District and Municipal Water District of Orange County, dated July.

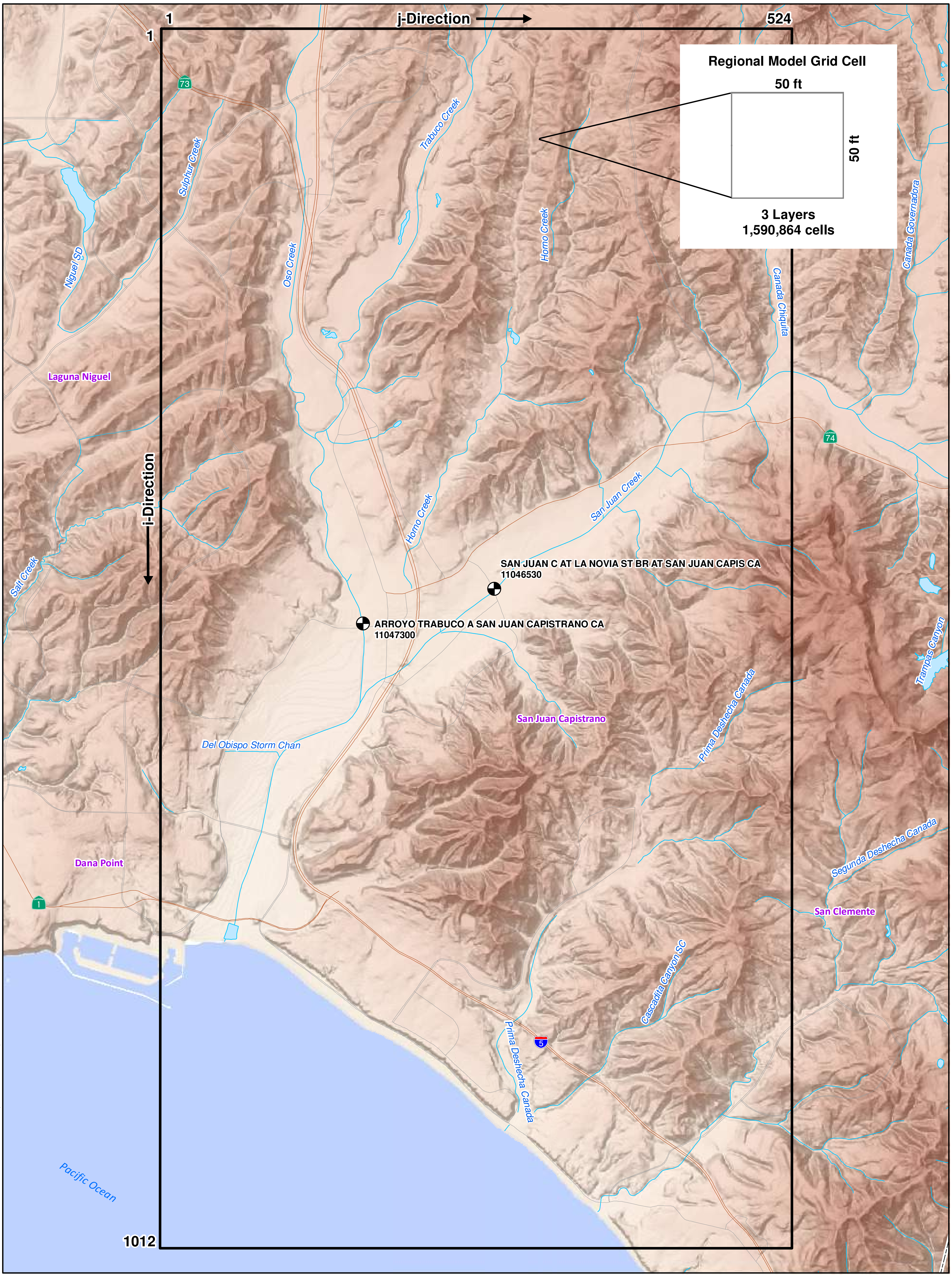
GEOSCIENCE (GEOSCIENCE Support Services, Inc.), 2013. Doheny Ocean Desalination Project – Phase 3 Extended Pumping and Pilot Plant Testing Vol. 3 San Juan Basin Regional Watershed and Groundwater Models. Prepared for the Municipal Water District of Orange County, dated November 8.

GEOSCIENCE, 2015. Foundational Actions Funding Program – Advancement of Slant Well Technology and Groundwater Flow and Solute Transport Modeling for the Doheny Desalination Project Task 3 – Prediction of Coastal/Ocean Groundwater Flow and Water Quality. Prepared for South Coast Water District, dated November 6.

GEOSCIENCE, 2018. Model Update and Refinement Using Results from Onshore and Offshore Geophysical Surveys and Exploratory Borehole Data. Prepared for South Coast Water District and GHD, dated March 1, 2018.

McDonald, M.G., and A.W. Harbaugh, 1988. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model: U.S. Geological Survey Techniques of Water-Resources Investigations Book 6, Chapter A1, 586 p.

Niswonger, R.G. and Prudic, D.E., 2006. Documentation of the Streamflow-Routing (SFR2) Package to Include Unsaturated Flow Beneath Streams – A Modification to SFR1. Chapter 13 of Section A, Ground Water, of Book 6, Modeling Techniques. U.S. Geological Survey Techniques and Methods 6-A13, Version 1.10, April 2006.



San Juan Basin Regional Groundwater Model Boundary

Gaging Station Name and Designation

SAN JUAN BASIN REGIONAL GROUNDWATER MODEL

19-Nov-18

Prepared by: DB. Map Projection: State Plane 1983, Zone VI.

NORTH

0 2,000 4,000 8,000 Feet

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

FIGURE 1

Model-Calculated Monthly Discharge at the Ocean
Baseline

Model Scenario	Average Discharge, (cfs) — Hydrologic Condition: Dry (1947 - 1976)	Wet (1978 - 1983)
Base	15.95	56.04

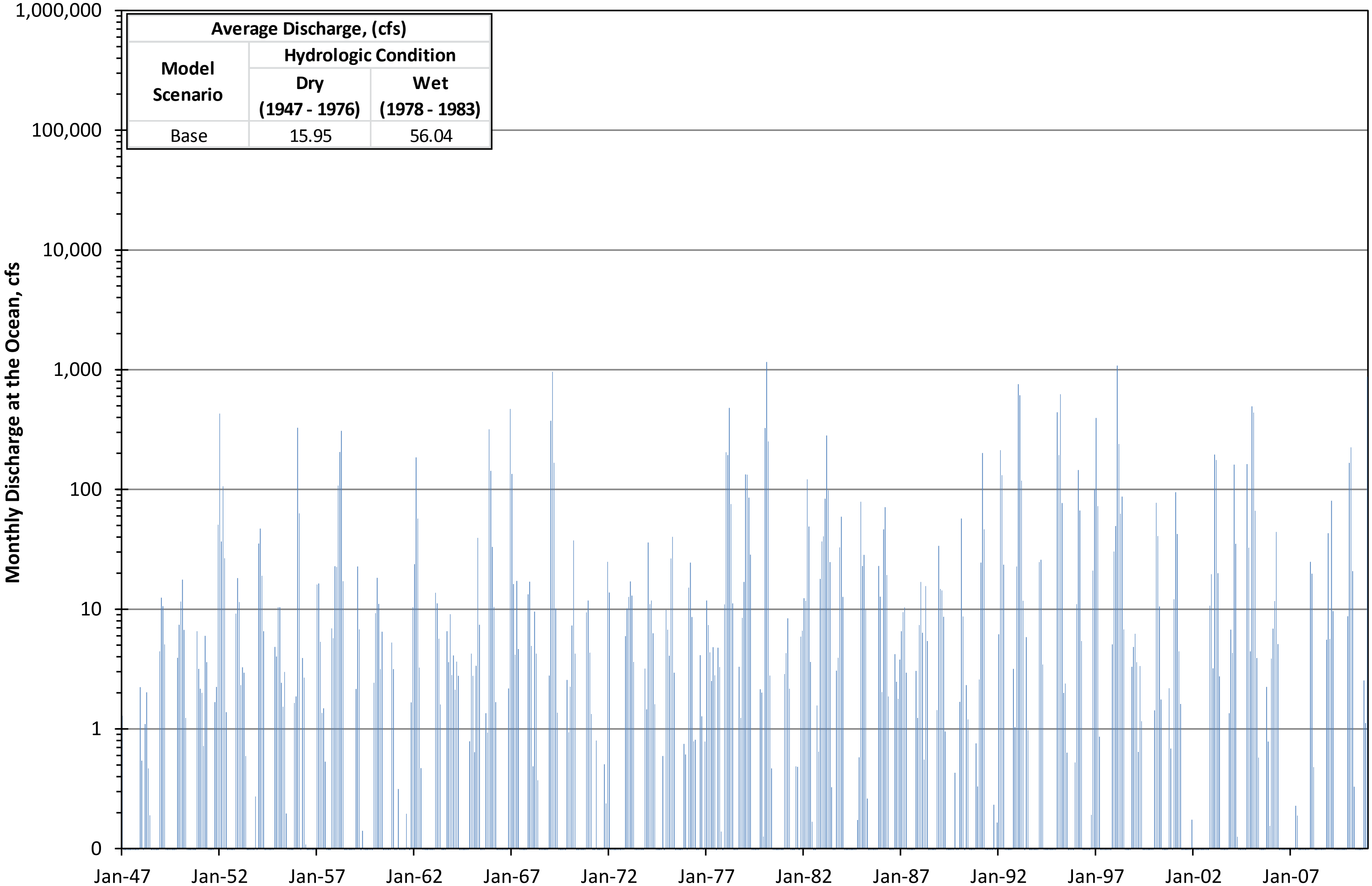
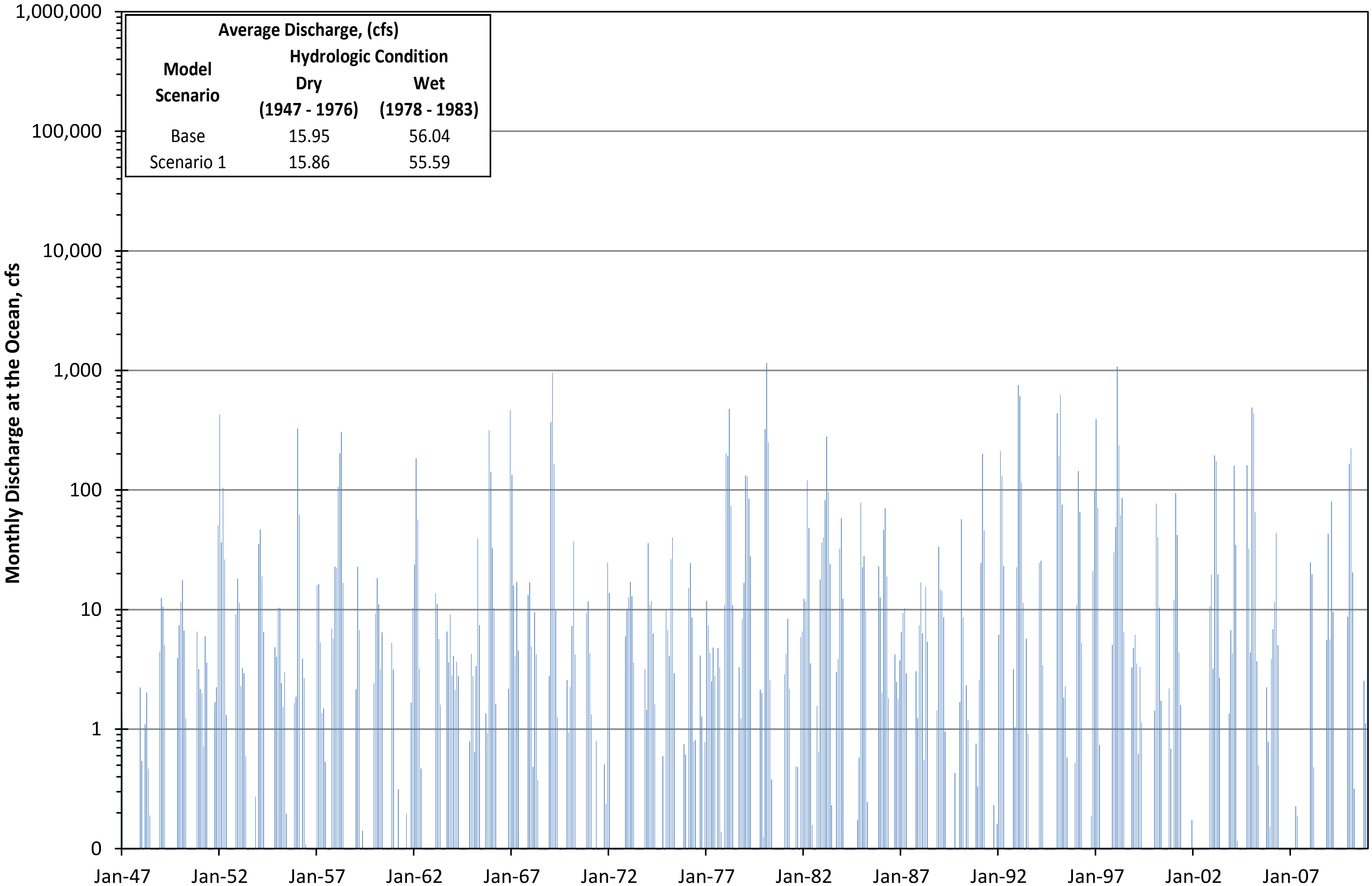


Figure 2

Model-Calculated Monthly Discharge at the Ocean
Scenario 1



Average Discharge, (cfs)		
Model Scenario	Hydrologic Condition	
	Dry (1947 - 1976)	Wet (1978 - 1983)
Base	15.95	56.04
Scenario 1	15.86	55.59

Figure 3

GHD/ South Coast Water District

EIR Doheny Ocean Desalination Project – Hydrogeologic Analysis Related to Responses to Comments

Task 1: Evaluate Project Impacts on San Juan Creek Surface Water Levels

Model-Calculated Monthly Discharge at the Ocean
Scenario 3

Average Discharge, (cfs)		
Model Scenario	Hydrologic Condition	
	Dry (1947 - 1976)	Wet (1978 - 1983)
Base	15.95	56.04
Scenario 3	15.83	55.41

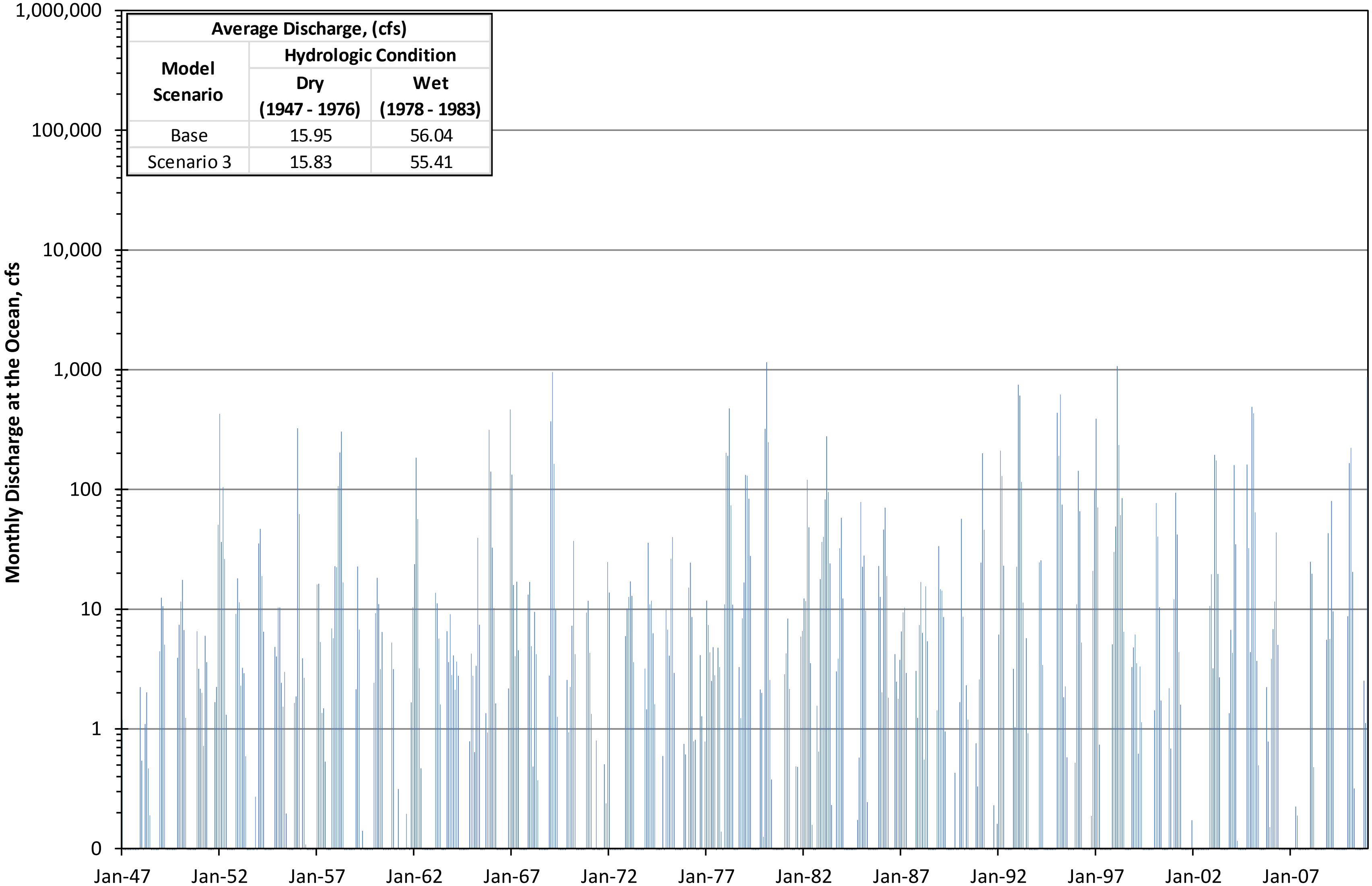
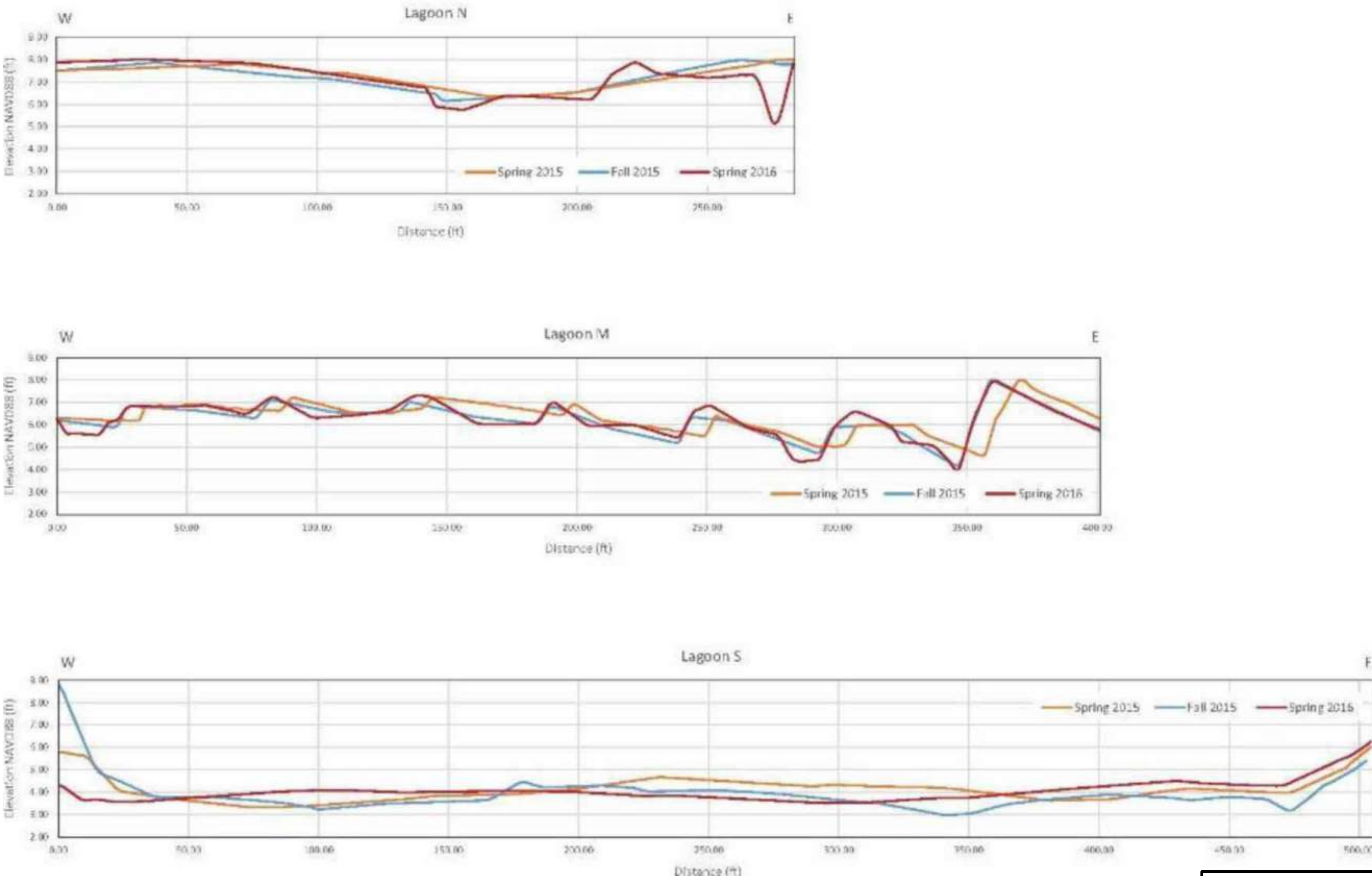


Figure 4



SOURCE: FIGURE 2-14 OF CHAMBERS GROUP, 2016

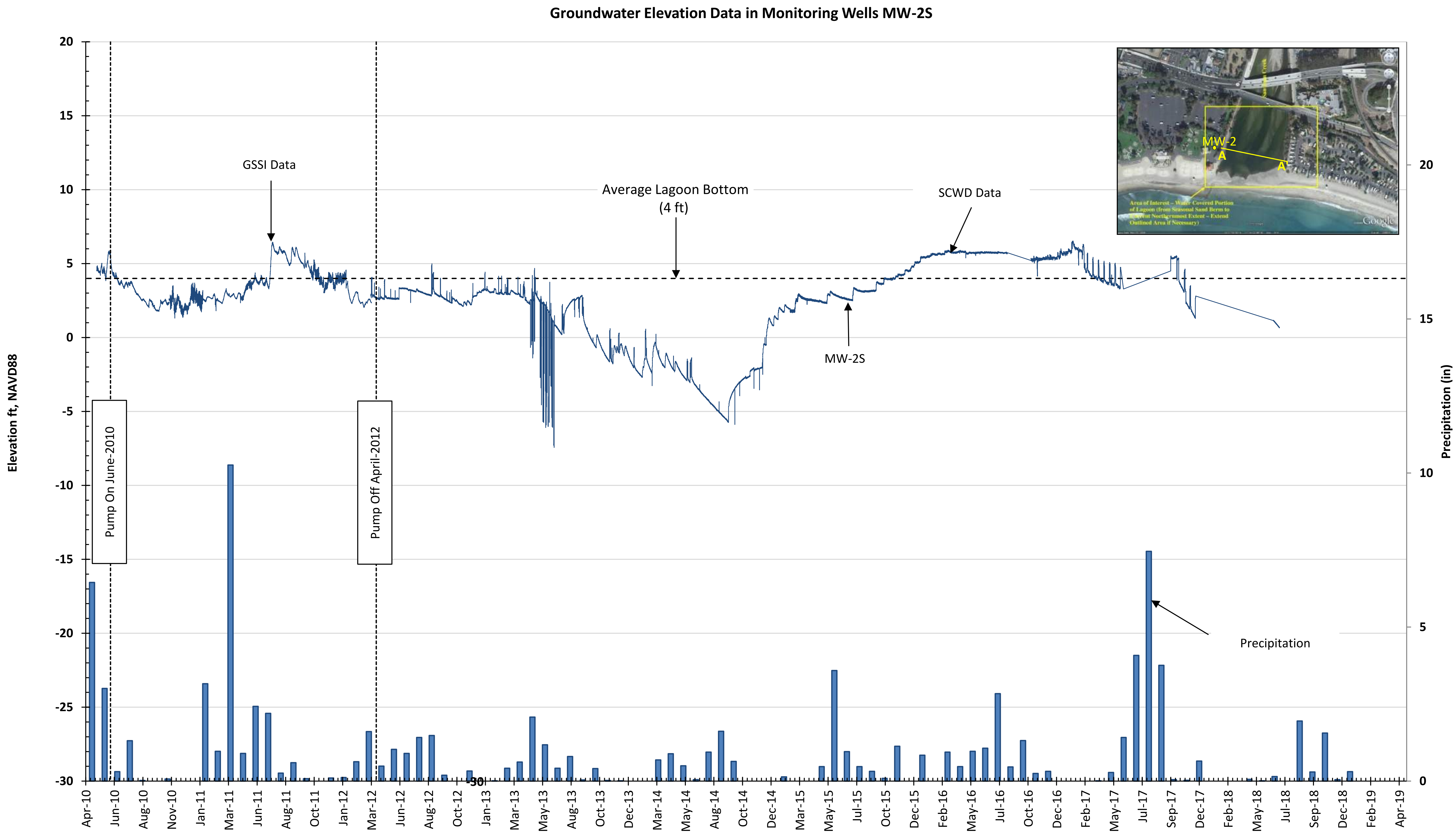
LAGOON BOTTOM PROFILES

SOUTH COAST WATER DISTRICT/GHD

FIGURE 7

EIR DOHENY OCEAN DESALINATION PROJECT – HYDROGEOLOGIC ANALYSIS RELATED TO RESPONSES TO COMMENTS
TASK 1: EVALUATE PROJECT IMPACTS ON SAN JUAN CREEK SURFACE WATER LEVELS

GEOSCIENCE


Groundwater Elevation Data in Monitoring Wells MW-2S
Elevation ft, NAVD88
Precipitation (in)
GSSI Data
Average Lagoon Bottom (4 ft)
SCWD Data
MW-2S
Precipitation
Pump On June-2010
Pump Off April-2012
MW-2
A
A'
20
15
10
5
0
-5
-10
-15
-20
-25
-30
Apr-10
Jun-10
Aug-10
Nov-10
Jan-11
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Apr-19

Figure 8

Groundwater Elevation Data in Monitoring Wells MW-2S
(Long-Term Pump Test)

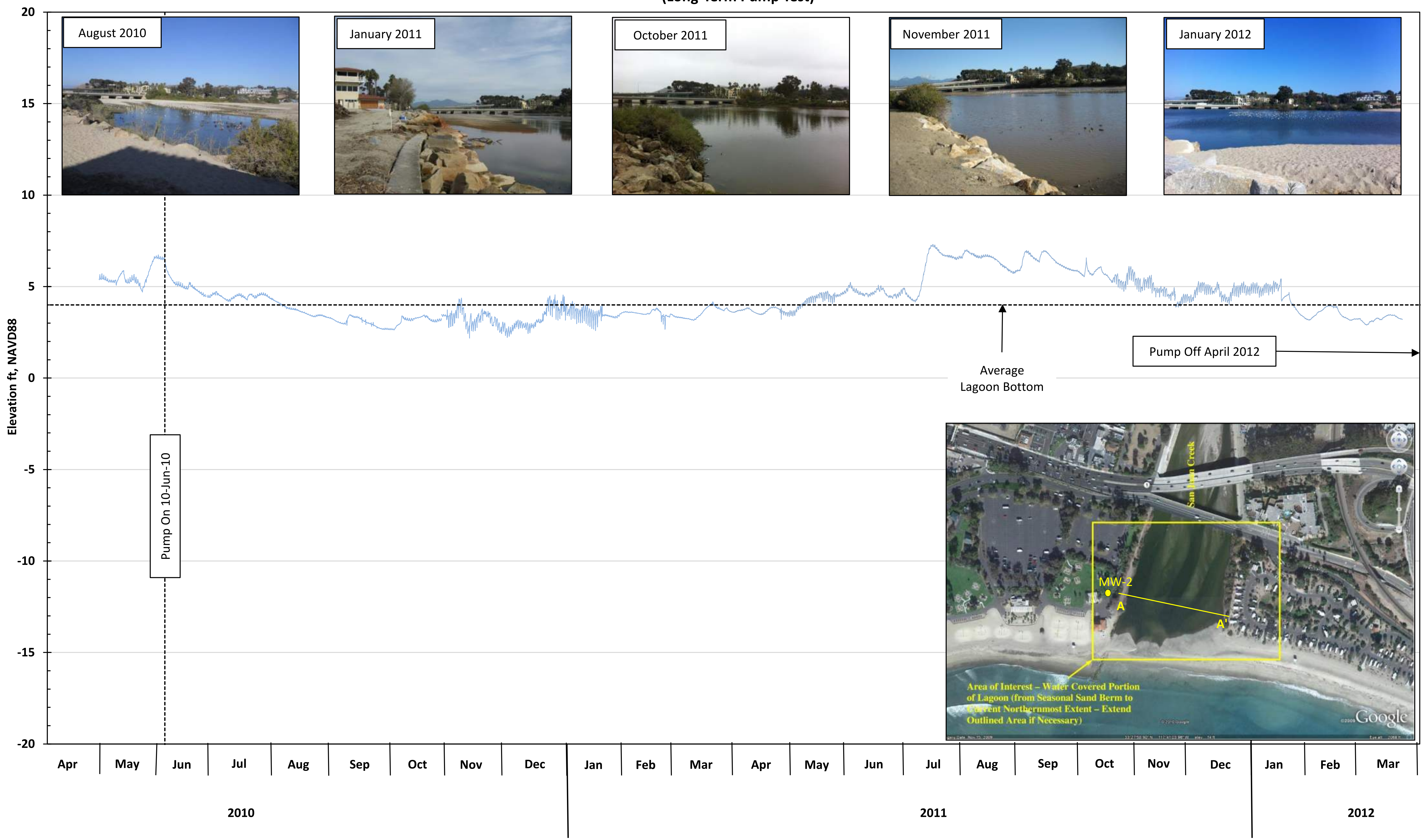
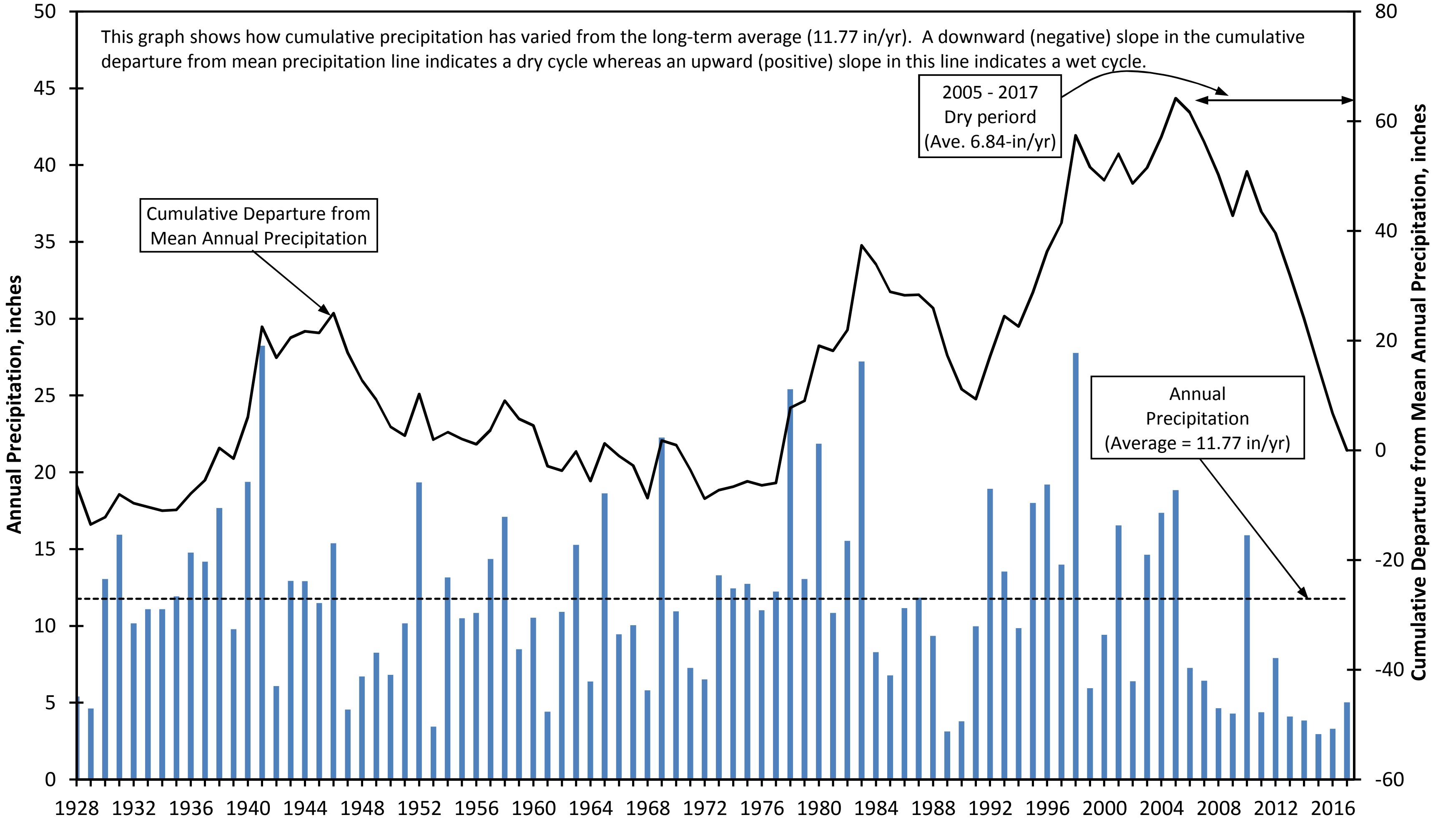


Figure 9

Annual Precipitation and Cumulative Departure from Mean Annual Precipitation
Laguna Beach #2, California
(1928-2017)



Source of Data: Western Regional Climate Center

Figure 10

APPENDIX 4.2.4

LOCAL HAZARD AND DRAINAGE CALCULATIONS FOR FINAL EIR

South Coast Water District

Doheny Desalination Project
Local Hazard Conditions and Drainage Study
January 2019

GHD Inc. | 320 Goddard Way Suite 200 Irvine CA 92618

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1. Introduction

1.1 Introduction

Imported water from northern California (State Water Project) and the Colorado River Aqueduct make up most of the water supply to south Orange County. With the continuous growth in California and the susceptibility of imported water to drought or other natural disaster, the availability and the reliability of water from imported sources is increasingly becoming a concern for local water providers. In response to the water supply challenge, South Coast Water District (SCWD) is in the planning stages to develop an ocean desalination facility in southern California. The proposed Doheny Desalination Plant, located in Dana Point along the east bank of San Juan Creek north of Highway 1, could supply up to 15 million gallons of local drinking water a day by desalinating seawater from the Pacific Ocean using reverse osmosis membrane treatment.

As a part of the Doheny Desalination Plant project development, SCWD has completed a wide range of studies and analyses to support the evaluation, planning, permitting and design processes. This report documents a Local Hazard Conditions and drainage study to assess the existing and future coastal and fluvial flood vulnerability at the project site, and to propose flood improvement options to protect the project site.

The Local Hazard Conditions and Drainage Study for the Doheny Desalination Project includes the following components:

- Coastal Analysis: A Local Hazard Conditions assessment evaluated the potential coastal flooding under the projected sea level rise scenarios. The assessment was conducted pursuant to the California Coastal Commission Sea Level Rise Policy Guidance, 2018.
- Fluvial Analysis: This analysis evaluated the hydraulic capacity of San Juan Creek, specifically the water surface elevations and levee/floodwall overtopping potential during 25-year and 100-year events, under existing and projected sea level rise scenarios. A hydrology analysis is prepared to define watersheds and to estimate stormwater flow to the project site. A hydraulic analysis is prepared to evaluate the capacity of the major stormwater conveyance system at the project site and the upstream watersheds. The analysis also included floodplain modelling to map flood inundation extent and depth. Based on the existing condition evaluation findings, the study evaluated four alternatives to assess its feasibility and relative performance to protect the project site from a 100-year flood, while not to increase flooding at the upstream watershed.

Section 2 of this report, as well as Appendix A and Appendix B documents the coastal analysis. Section 3 of the report documents the fluvial analysis. The analysis articulated the existing and future flood vulnerability due to the projected sea level rise, San Juan Creek overtopping, stormwater flow from the upstream watersheds, and the storm drain system capacity limitation. Improvement alternatives are evaluated, with a recommended site improvement concept to address potential project site flooding.

1.2 Existing Condition at the Project Site

The project site is located in Dana Point, California. As shown in Figure 1.1, the project site is adjacent to the Pacific Ocean, along the east bank of San Juan Creek between Highway 1 and Stonehill Drive. This section of San Juan Creek has been modified by the Flood Division of the Orange County Public Works, with flood improvements including a combination of concrete banks, levees, and floodwall.

Currently the project site is mostly leased to various tenants for outdoor storage. The site is relatively flat, with mostly dirt and gravel surfaces. Federal Emergency Management Agency (FEMA) Flood Insurance Rated Map (FIRM) shows the project site is located in flood Zone AO, with an average of one foot inundation depth under a 1% annual chance (100-Year) flood.

There are two major underground storm drain systems conveying runoff from the upper watershed to San Juan Creek through the project site. Owned by Orange County Flood Control District, the L01S02 system is a double concrete box culvert that runs parallel to the landside of the San Juan Creek levee before outfalling to San Juan Creek. The L01S02 system collects stormwater runoff from the upper watersheds, bounded by Stonehill Drive at the north and Highway 1 at the south, and extends to the east of Highway 5.

At the southern end of the project site, a 54-inch diameter (54”) Reinforced Concrete Pipe (RCP) runs in parallel with Highway 1. The pipe collects runoff from the project site and the watersheds east of the railroad tracks, and discharges to San Juan Creek. Local stormwater drainage within the project site is limited. A vegetated swale (South Drainage Swale) located at the northern end of the project site collects local runoff and discharges to the L01S02 system. The South Drainage Swale and the 54” RCP have gates to prevent backflow from San Juan Creek.

As a part of the study, a field survey was completed to verify the dimensions, locations, and elevations of the major storm drain system. The survey information is incorporated in the analysis to model the system hydraulic performance.

1.3 Study Assumptions

This study and the analysis is based on a range of assumptions to estimate the coastal and fluvial impacts to the project site. The following is a summary of the key assumptions in this study.

- The Doheny Desalination Plant will be in service in Year 2020. Hence, Year 2020 is defined as the existing condition in this study.
- The expected life of this project, for the purpose of the projected sea level rise estimate, is 50 years. Hence, the projected sea level rise planning horizon is in Year 2070.
- The flood protection design target for the plant is to provide 100-year (1% annual chance) flood protection.
- Under the no project condition, the levee and floodwall system along San Juan Creek, between Stonehill Drive and Highway 1, will not be improved in Year 2020.
- The watershed land use will not have significant change over the project life.

Section 2 and Section 3 discuss these and other study assumptions in detail.

2. Coastal Analysis

2.1 Introduction

This study was conducted pursuant to the California Coastal Commission Sea Level Rise Policy Guidance, 2018. The following is a summary of the Local Hazard Conditions assessment based on the process outlined in Appendix B of the Sea Level Rise Policy Guidance, and the sea level rise projections in Appendix G, Table G-11 (California Coastal Commission 2018).

The study was completed by Michael Baker International and presented in the September 2018 report titled Coastal Hazards Analysis for the Doheny Desalination Project by Scott A. Jenkins (Appendix B). Additional information on the historical shoreline evolution is provided in the GHD May 1, 2017 memo Doheny Desalination Plant Historical Shoreline Assessment (Appendix A). The mapping of flood impacts due to the modelled total water levels and tsunami events are provided in the summary below. Additional flood modelling available as part of The Coastal Storm Modeling System (CoSMoS) study prepared by the United States Geological Survey (USGS) is also presented for comparison. This includes predicted shoreline erosion due to sea level rise.

For this study, the project life expectancy was defined as 50 years. This was determined in consultation with the South Coast Water District (SCWD). The project life expectancy is an important design criterion to estimate the anticipated range of sea level rise. The guidance for project life expectancy ranges from 25 years for amenity structures, to 100 years for critical infrastructure. An additional prediction of water levels for a critical infrastructure planning horizon was also determined. Assuming the project will be constructed in Year 2020, the 50 year project life expectancy sets the project planning horizon to Year 2070. A critical infrastructure planning horizon of Year 2100 was used.

Section 2.2 provides a brief summary of the Local Hazard Conditions assessment findings. For additional detail refer to GHD May 1, 2017 memo Doheny Desalination Plant Historical Shoreline Assessment (Appendix A), and, Michael Baker International (2018) Coastal Hazards Analysis for the Doheny Desalination Project by Scott A. Jenkins (Appendix B).

2.2 Summary of Findings

2.2.1 Sea Level Rise Projection

Sea level rise projections were based on the water level province tabulation from NOAA tide gage stations with extended periods of record (California Coastal Commission 2018). The Doheny Desalination Project falls within the La Jolla tide gage water level province. Sea level rise projections are provided in Table G-11 in Appendix G of the California Coastal Commission 2018. Sea level rise projections for the lower and upper ranges are provided in Table 2.1.

Table 2.1 Sea Level Rise Projections

Planning Time Period (Year)		Best Fit Equation	
		Lower Range (feet)	Upper Range (feet)
50 year planning horizon (CCC, 2018)	2070	2.0	3.6
Critical Infrastructure Planning Horizon (CCC, 2018)	2100	3.6	7.1

2.2.2 Tidal Range and Future Inundation

Tidal datums were based on water level measurements from the Scripps Pier tide gage station, NOAA #9410230 for the 1983 – 2001 tidal epoch. Projected sea level rise for 2070 and 2100 were available from Table G-11 in Appendix G of California Coastal Commission 2018. Tidal datums and future datums based on lower and upper sea level rise projections are provided in Table 2.2.

Table 2.2 Tidal Datums at Scripps Pier NOAA Tide Gage Station 1983-2001 with Projected Sea Level Rise

Datum	Elevation (ft NAVD)	SLR 2070 lower range (ft NAVD)	SLR 2070 upper range (ft NAVD)	SLR 2100 lower range (ft NAVD)	SLR 2100 upper range (ft NAVD)
EHW (Extreme High Water)	7.47	9.47	11.07	11.07	14.57
MHHW (Mean Higher High Water)	5.13	7.13	8.73	8.73	12.23
MHW (Mean High Water)	4.41	6.41	8.01	8.01	11.51
MSL (Mean Sea Level)	2.54	4.54	6.14	6.14	9.64

2.2.3 Potential Still Water Level Changes from Surge, El Nino and Pacific Decadal Oscillation

Determining the Local Hazard Conditions following the California Coastal Commission Sea Level Rise Policy Guidance (2018) document includes determining potential still water level changes due to other processes in addition to sea level rise. These processes include surge, El Niño events, and the Pacific Decadal Oscillation (PDO).

Water level recurrence statistics were derived from the record of ocean water levels at the NOAA Scripps Pier tide gage. A stage frequency curve or hydroperiod function was developed from the 1924 to 2016 time series. The hydroperiod function presented in Appendix B includes the effects of El Nino, the Pacific Decadal Oscillation (PDO), and surge on the still water level.

2.2.4 Beach Erosion

An assessment of long term beach erosion was conducted using historical aerial photographs (Appendix A) and historical beach surveys (Appendix B) at Doheny State beach. Overall, Doheny State Beach appears to be in an equilibrium condition based on the historical aerial photographs used for the assessment. Sediment input from the San Juan Creek and potential beach nourishment projects in the past have maintained a relatively stable shoreline. A historical erosion rate could not be determined to apply to future adjustments due to sea level rise.

Michael Baker International (2018) utilized Bruun's Rule (as described in Appendix B) to account for erosion impacts of sea level rise. The Coastal Evolution Model included retreat of the shoreline based on Bruun's Rule. This assumes retreat of the shoreline with no change to the shape of the profile. Using this approach, the shoreline retreat will have no impact on the total runup elevations.

Unlike shoreline retreat due to Bruun's Rule, seasonal fluctuations in beach morphology do impact the total water level computation. All total water level estimates were based on both a typical accreted profile and typical eroded profile to account for the impacts to wave setup and wave runup (Appendix B).

Preliminary estimates of shoreline erosion due to sea level rise were available from The Coastal Storm Modeling System (CoSMoS) for the study area (Erikson et al., 2017). CoSMoS is a dynamic modeling approach that has been developed by the United States Geological Survey (USGS) to allow for more detailed predictions of coastal flooding due to both future sea level rise and storms integrated with long-term coastal evolution over large geographic areas. CoSMoS uses wind and pressure from global climate models to project coastal storms under changing climatic conditions during the 21st century.

CoSMoS 3.0 preliminary results were available for sea level rise scenarios of 0 m to 2 m at increments of 0.50 m and for 5 m for Southern California. Shoreline retreat for these scenarios is shown in Figure 2.1. Note that the shoreline was defined in CoSMoS 3.0 as the mean high water (MHW) which will occur seaward of the beach berm. It is also possible that the shoreline was defined during conditions when the beach was much wider. It is clear that the proposed plant is located far inland from the predicted eroded shoreline.

2.2.5 Waves, Wave Runup and Flooding Conditions

Future flooding levels were determined by Michael Baker International 2018, based on California Coastal Commission 2018. The Federal Emergency Management Agency (FEMA) standards for flooding frequency were followed by determining flood levels for the 100-year event. Extremal total water levels (TWL's) were based on the occurrence of extreme waves concurrent with extreme ocean water levels. Extremal total water levels are the sum of the total runup and the still water level. The total runup consists of wave setup, dynamic wave setup and wave runup. A joint probability analysis was used to determine the occurrence of extremal wave heights concurrent with extreme ocean water levels.

Extremal total water levels were determined for the low and high range sea level rise projections for 2100. Each wave and sea level scenario was modelled for both accreted and eroded beach profiles based on seasonal fluctuations at the site. Total water levels were always higher for the accreted beaches since they were steeper and caused greater wave setup and runup. The potential future flooding extent for the different scenarios are shown in Figure 2.2 based on topography generated from USACE 2014 LiDAR data. The figure shows total water levels for the accreted beach conditions for each event since these were higher water levels than the eroded beach condition. Note that the flood extent based on the extremal total water levels is a worst case approach since it includes wave runup. Wave runup is a short term process and therefore may not result in flooding to the full extent of the runup elevation. Also note that the mapping shows flooding for all areas below the given flood elevation even though there may not be a direct flow path to all locations. It can be seen that the extremal total water level for the low and high range sea level rise for 2100 may reach a very small portion at the very seaward tip of the project site where there is no proposed infrastructure. It also may flood along an existing South Drainage Swale due to backwater from the creek to the low grade area along the swale. The potential for flooded well heads and overtopping rates for each scenario are summarized in Table ES-1 in Appendix B.

Alternative flood extent predictions with sea level rise were available from CoSMoS 3.0 (Barnard et al., 2018). Flooding extents at the study site for the 0.5 m, 2 m and 5 m sea level rise scenarios for a 100-year storm event are presented in Figure 2.3. The flooding extents were much less than those based on the estimates of extremal total water levels provided by Michael Baker International (2018) because the CoSMoS flood elevations do not include wave runup.

2.2.6 Extreme Flooding Events Due to Tsunami

Tsunamic induced erosion, runup, and inundation were analyzed for the Doheny State Beach profiles for present and future sea levels, with low and high range sea level rise projections (Appendix B). The tsunami event scenario was based on a 2 m high solitary wave that could be anticipated for a catastrophic tsunami event from a major landside on the east side of San Clemente Island. The tsunami reaches 6 m in height due to shoaling, before breaking on the shoreline. The potential for flooded well heads and overtopping rates for each scenario are summarized in Table ES-2 in Appendix B. Flooding extents of the low and high range 2100 sea level projection scenarios are illustrated in Figure 2.4. Flood limits were very similar to the 100-year wave storm event for the 2100 low and high range sea level rise predictions (Figure 2.2). Flood levels were approximately 0.4 ft higher for the low range and high range sea level rise limits for a 100-year event. It can be seen that the tsunami for the 2100 low and high range sea level rise scenarios may reach a very small portion at the seaward tip of the property where there is no proposed infrastructure. Flooding also impacts the area around the existing South Drainage Swale due to backwater from the creek to the low grade area along the swale.

Additional tsunamic inundation predictions published on June 1, 2009 were created through a joint effort by the State of California Office of Emergency Services (Cal OES), the California Geologic Survey, the University of Southern California Tsunami Research Center, and NOAA. The map of the tsunami prediction for the study area is provided in Figure 2.5. While the mapping resolution is low, the flooding extent appears to be similar to that provided in Figure 2.4.

The assessment shows that the projected sea level rise scenarios considered in this study does not pose significant flood risk to the project site. The back water ponding shown along the South Drainage Swale can be mitigated by site design to regrade the low ground area along the swale.

3. Fluvial Analysis

3.1 Introduction

To quantify drainage and flooding conditions at the project site, a detail hydrologic and hydraulic analysis was performed. This analysis includes four primary components, as listed:

- San Juan Creek Hydraulic Analysis: This analysis was performed in order to estimate the water surface elevations in San Juan Creek during the design events, and to determine if the creek flow may overtop the levees;
- Watershed Analysis: This analysis was performed in order to quantify the flows entering the existing stormwater systems at the project site, from watersheds adjacent to and upstream from the project site;
- Floodplain Analysis: This analysis was performed to determine the available capacity of the existing stormwater system at the project site, and to determine floodplain inundation at and upstream of the project site under the existing condition; and
- Drainage Improvements: This analysis was performed to assess potential drainage improvement options for the project site.

Each of these analyses are discussed in further detail in this section. It should be noted that unless otherwise stated, all elevation data is reported in North American Vertical Datum of 1988 (NAVD 88).

3.2 San Juan Creek Hydraulic Analysis

3.2.1 Data Source

To analyze the hydraulics of San Juan Creek, GHD obtained a one-dimensional, steady-state hydraulic model of the creek, built in HEC-RAS hydraulic modelling software from Orange County. The model was originally constructed by PACE Engineering in the study Baseline Floodplain Hydraulics for San Juan Creek (PACE 2010). All elevations referenced in the model are in National Geodetic Vertical Datum of 1929 (NGVD 29).

In addition to the hydraulic model noted above, GHD also obtained San Juan Creek hydrograph information that was generated from the San Juan Creek Watershed Hydrology Study (PACE 2008). As will be noted in further detail in subsequent sections, the hydrographs obtained from the PACE analysis was for the 25-year and 100-year Expected Value storm events.

3.2.2 Boundary Condition at Pacific Ocean

As noted above, the tidal boundary condition at the Pacific Ocean could have backwater effect on the upstream water surface elevations along San Juan Creek. For this analysis, five separate tidal elevation scenarios were used to determine water surface profiles and its impacts due to the project sea level rise. The first tidal elevation scenario is the Mean Higher High Water (MHHW) elevation, which is typically applied in FEMA floodplain analysis. The other four tidal elevation scenarios are the Years 2070 and 2100 projected low and high sea level rise elevations. All five tidal elevation scenarios, based on the coastal analysis documented in Section 2 and Appendix B, are summarized in Table 3.1.

Table 3.1 Tidal Boundary Elevations Used in HEC-RAS Model

Pacific Ocean Tidal Boundary Condition	Tidal Elevation (NGVD 29)	Tidal Elevation (NAVD 88)
Mean Higher High Water (MHHW)	2.87	5.13
2070 Low Sea Level Rise Projection under MHHW	4.87	7.13
2070 High Sea Level Rise Projection under MHHW	6.47	8.73
2100 Low Sea Level Rise Projection under MHHW	6.47	8.73
2100 High Sea Level Rise Projection under MHHW	9.97	12.23

It should be noted that to be used in the HEC-RAS model, these elevations had to be converted from NAVD 88 to NGVD 29 vertical datum, which has the elevation difference of -2.26 ft.

3.2.3 Analysis Methods and Assumptions

To compute water surface profiles, and ultimately create a stage-flow time series for each of the existing outfalls along San Juan Creek, the steady state HEC-RAS model was run at increments of approximately every 3 hours using the hydrographs referenced in Section 3.1.1. Estimated creek flow in each time increment is input to the model, to estimate the creek water surface profiles under the three tidal elevation scenarios listed in Table 3.1.

The HEC-RAS model provided by Orange County covers approximately 5 miles of San Juan Creek upstream from the Pacific Ocean. To simplify the hydrograph inputs and the modelling analysis, the model was truncated at approximately 3,500 feet upstream from Stonehill Drive (Creek Station 8610). At this location, the hydrograph flows estimated at Node 146 in the San Juan Creek Watershed Hydrology Study (PACE 2008) were applied as flow input to the HEC-RAS model. A second flow input was applied further downstream at creek station 3955, which corresponds to Node 147 of the hydrology study (PACE 2008). The 25-year and the 100-year design flow are 26,116 cfs and 45,847 cfs, respectively. As a comparison, the 100-year design flow in FEMA Flood Insurance Study (FIS) is 42,000 cfs (FEMA 2009c).

3.2.4 Analysis Results

The HEC-RAS model was run using the 25-year and 100-year Expected Value hydrographs under Year 2070 scenarios. The creek hydraulic analysis based on these scenarios shows that the variations in downstream tidal elevation under the projected sea level rise conditions do not have an effect on the upstream creek water surface elevations. This appears to be due to the fact that the Highway 1 northbound and southbound bridges act as a significant creek flow constriction at the mouth of San Juan Creek. The backwater effects due to the bridges governs San Juan Creek hydraulics. In addition, in the HEC-RAS model, the channel flowline elevation at the mouth is 4.85 ft NGVD 29, which is above both the MHHW and Year 2070 low sea level rise tidal elevation projection.

The HEC RAS model also simulated the Year 2100 High MHHW Sea Level Rise projection for the 100-year storm event, to determine if it had any effect on the water surface elevation in San Juan creek upstream of the Highway 1 Bridge. Using the high sea level rise projection, the water surface elevation in the creek did change upstream of the bridge, however only during the receding limb of the streamflow hydrograph beginning at hour 30 of the simulation (note: the peak discharge in San Juan Creek occurs at hour 17.25). At this time, the flow in the stream is approximately 300 cfs, which is just a fraction of the flow that occurs at the peak of the storm (approximately 45,000 cfs for the peak of the 100-year storm). The change in water surface elevation only persists for about 500 feet upstream of the bridge, after that there is no effect that the boundary condition has on the water surface elevation at any point in time.

Therefore, it was determined that the various tidal elevations had no effect on the upstream creek water surface profile, and the subsequent results presented are valid under all five tidal elevation scenarios.

The maximum water surface profile for the 25-year storm event is shown in Figure 3.1, which occurs at approximately Hour 17.25 of the storm event. The peak of the 25-year flow is conveyed in the channel without overtopping the creek on either the left or right banks. The hydrograph used for the 25-year flow in San Juan Creek is shown in Figure 3.2. To compare the peak flow timing between the creek and the project site watershed, the hydrograph that was developed for the outfall of the Capistrano Beach Storm Drain (LO1SO2) is also shown in the plot. The development of the LO1SO2 hydrographs is discussed in further detail in Section 3.2.

The peak of the existing stormwater system adjacent to the project site occurs at approximately Hour 16.4 of the 24-hour design storm event. The peak flow in San Juan Creek occurs at Hour 17.25 of the 24-hour storm event, approximately 1-hour later.

The peak water surface profile for the 100-year storm event is shown in Figure 3.3. During the 100-year storm event, the peak creek flow overtops both channel banks for approximately 350 feet north of the Highway 1 northbound bridge, at the southern end of the project site. The hydrograph for the 100-year flow in San Juan Creek is shown in Figure 3.4. Similar to the 25-year storm event, the peak flow in San Juan Creek occurs approximately 1-hour after the peak of the Capistrano Beach Storm Drain.

3.2.5 Findings

The hydraulic analysis of the San Juan Creek Channel resulted in two key findings:

- The downstream tidal elevations modelled in this analysis do not have an effect on the upstream water surface profile.
- Based on the OCFCD HEC-RAS model, San Juan Creek overtops both the east and west banks during the 100-year expected value storm events. Adjacent to the project site, San Juan

Creek overtops the east bank floodwall at the upstream of Highway 1. The overtopping contributes to potential flooding at the project site.

3.3 Watershed Analysis

A watershed analysis was performed to estimate the flows entering the existing storm drain infrastructure at the project site. The purpose of this analysis is to determine if there is available capacity in the existing stormwater system, and to evaluate potential impacts to flooding as a result of stormwater runoff generated from the upstream watershed. The following sections describe the existing conditions around the project site, and the watershed analysis.

3.3.1 Existing Stormwater Infrastructure

In general, drainage in the project area and surrounding watersheds is conveyed from east to west, towards San Juan Creek. To provide stormwater relief for urban developments, railroad, and roadways located in the watershed, a system of large stormwater drainage conduits has been constructed as the primary drainage route for stormwater generated in the watershed. These drainage features are shown in Figure 3.5. Each of these components is discussed in further detail below. It should be noted that each of these main features described below is supported by a network of smaller stormwater pipes and drainage inlets to collect local runoff. However, this analysis only includes the major drainage features as listed to evaluate stormwater routing at the watershed scale, as well as drainage performance at the project site.

- **LO1**

  The San Juan Creek Channel. This creek acts as the primary receiving waters for runoff generated within the San Juan Creek watershed, including all stormwater generated at the project site.

- **LO1SO2**

  The Capistrano Beach Storm Drainage. This facility primarily collects stormwater generated east of the San Diego Freeway (I-5) and conveys flows west towards San Juan Creek. This facility also collects stormwater conveyed from facility LO1SO3, and both the northern and southern drainage swales (described below). Moving from east to west, this facility is composed of an 8-foot diameter (8') RCP pipe which connects to an 8' x 8' concrete box, a 7.5' x 12' railroad crossing, open concrete rectangular channel, then a double 11' x 11.5' box culvert and outfalls to San Juan Creek. The San Juan Creek outfall has no backflow prevention.

- **LO1SO3**

  LO1SO3 collects stormwater generated from the northern portion of the local watershed located within Stonehill Drive and the San Diego Freeway (I-5). It also collects runoff generated from the east side of the San Diego freeway though a box culvert, located at the upstream of the pipe terminus as shown in Figure 3.5. Moving from north to south, this facility is composed of a 6.5' RCP pipe, an 8' RCP pipe, a 6.5' x 13' concrete box railroad crossing, and an 8' RCP pipe that discharge to LO1SO2.

- **North Drainage Swale**

  This swale is located directly north of facility LO1SO2, and serves to drain the surrounding properties in the area. The outlet of the swale has a 3’ RCP culvert that connects to facility LO1SO2, with a flap gate to prevent backwater flow from San Juan Creek.

- **South Drainage Swale**

  This swale is located at the northern end of the project site, and drains runoff generated in areas both north and south of the swale. The eastern portion of the swale shown on Figure 3.5 is connected to a storm drain that extends eastwards toward the developments on the east side of the railroad track. The outlet of the swale is connected to a 4’ RCP pipe which connects with facility LO1SO2. The connection has a flap gate.

- **54” RCP Pipe**

  This pipe collects stormwater generated in the southern portion of the watershed bounded by the San Diego Freeway (I-5) and Highway 1. The pipe discharges to San Juan Creek upstream of Highway 1 bridges. The outfall has a flap gate.

3.3.2 Design Storm and Analysis Method

The following references establish the watershed analysis and design criteria, including design storms, for the project site:

- Orange County Hydrology Manual (1986);
- Orange County Hydrology Manual, Addendum No. 1 (1996); and
- Orange County Local Drainage Manual (1996).

From these documents, the following design storms criteria have been established, as shown in Table 3.2.

Table 3.2 Summary of Design Storms and Method

Criterion	Value	Source
Hydrology Method	Unit Hydrograph	Orange County Hydrology Manual
Design Storm for Pipes with Sumps or no Parallel Drainage Ways	25-year Expected Value	Orange County Local Drainage Manual
Design Storm for Habitable Structures	100-year Expected Value	Orange County Local Drainage Manual

Based on the Hydrology Manual (the manual), Addendum No. 1, the Expected Value hydrology was used in this analysis, as the focus of this analysis is to determine floodplain impacts and flood protection level of services.

The Orange County Hydrology Manual Unit Hydrograph method was used for contributing watershed hydrology analysis, since the total area contributing runoff to the local storm drain infrastructure is above 640 acres. The Unit Hydrograph method is based on developing an effective rainfall hyetograph, which accounts for initial and infiltration losses using the Curve Number method. The effective rainfall hyetograph is then transformed to a runoff hydrograph using the watershed Time of Concentration and S-Curves for the Orange County watersheds.

In addition to the Orange County Hydrology Method, the hydrologic model within PCSWMM, the hydraulic model used for this analysis, was used to develop runoff hydrographs. This was done to provide a second source of hydrologic analysis. To remain consistent with the Orange County Method, the hydrologic loss model used within PCWMM was the curve number method and the parameters developed for the Orange County Method were used in the PCSWMM model.

3.3.3 Watershed Descriptions

The initial step in the analysis was to estimate the runoff reaching the primary stormwater infrastructure. Watersheds were delineated using an iterative approach, which included checking surface elevation data from NOAA Coastal LiDAR, storm drain infrastructure maps from the Orange County Flood Control District (OCFCD), and the City of Dana Point Master Plan of Drainage (1998). Working east from the project site, a total of 18 watersheds were identified, which are shown in Figure 3.6. Watersheds 1A and 1B represent the project site watersheds.

3.3.4 Topography

Watersheds located within the area bound by Stonehill Drive, the San Diego Freeway, and Highway 1 (Watersheds 1A to 13) have typically mild average slopes, generally on the order of 5% to 40%. The main source of topographic relief in these watersheds is the fill prism or natural grades leading to the surrounding roadways. Elevations in this area range between 20’ and 150’. Watersheds located south and east of this area (Watersheds 14 to 17) have higher relief, with average slopes in these watersheds ranging from 50% to 90%. Elevations in these watersheds range between 150’ and 900’.

3.3.5 Soil Types

Soils information was collected from the NRCS Web Soil Server. Hydrologic Soils Groups in the watersheds range between groups B and D. All of the group B soils are located in the watersheds nearest San Juan Creek. At the east of the project site, the remainder of the watersheds are composed of group C and D soils, exhibit poor infiltration potential.

3.3.6 Existing Land Use

The three primary land use types in the watersheds shown in Figure 3.6 are residential, commercial, and open space. Watersheds 1A to 13 are primarily composed of residential and commercial use types. Watersheds 14 to 17 are primarily residential and open space use types.

3.3.7 Existing Condition Watersheds Summary

The physical characteristics of each watershed shown in Figure 3.6 are summarized in Table 3.3 below:

Table 3.3 Summary of Watershed

Watershed	Area (acres)	Average Slope (%)	Land Use Type(s)	Soil Type(s)
1A	9.7	11%	Commercial	B, C
1B	3.4	8%	Commercial	B, C
2	6.9	7%	Commercial	B, C
3	6.1	17%	Commercial	B, C
4	7.3	22%	Commercial	B, C
5	5.6	45%	Commercial	B, C
6	12.2	16%	Commercial	C
7	16	5%	Commercial	C
8	2	6%	Commercial	C
9	46.4	39%	Commercial/Open Space	C, D
10	16.5	26%	Commercial/Residential	C, D
11	30.3	11%	Commercial/Residential	C, D
12	13.1	6%	Commercial/Residential	C
13	16.2	54%	Commercial/Residential	C, D
14	29.9	56%	Residential/Open Space	C, D
15	765.5	90%	Residential/Open Space	C, D
16	108.9	57%	Residential/Open Space	C, D
17	46.6	88%	Residential/Open Space	C, D

3.3.8 Orange County Method Hydrologic Analysis

After the watersheds were delineated the Orange County Hydrology Method was used to develop the hydrologic parameters necessary to construct outflow hydrographs. The derivation of these parameters is presented below.

There are three primary steps in the Orange County Method: 1) Develop synthetic unit hydrograph; 2) Develop recurrence interval storm pattern; and 3) Develop runoff hydrograph. To ultimately produce the runoff hydrograph, the following parameters were derived. It should be noted that there are several steps in the manual where these parameters are used to develop intermediate information which leads to producing a runoff hydrograph. The following discussion is limited to the derivation of the base parameters, which are the components unique to this analysis.

3.3.9 Design Storm

To develop the 10-, 25-, and 100-year design storms, the Orange County Point Precipitation Data from Table B.2 of the hydrology manual was used to create logarithmic regression equations. Using these equations, precipitation depths were calculated for unit time periods of 5-minutes. These depths were then rearranged using the design storm distributions shown in Figures B-5a, b, and c of the hydrology manual. Due to the generally small size of the watersheds in this analysis, no depth area adjustments were performed to modify the design storms in this analysis.

3.3.10 Percent Impervious

Percent impervious was estimated by measuring the area of individual land use type in each watershed and multiplying each use area by a factor from the hydrology manual (Figure C-4). For this analysis, the recommended values for average conditions were assumed for each use type. Residential areas were assumed to have a density of 5 to 7 dwellings/acre, and open spaces were assumed to have no impervious cover. The resulting percent impervious cover for each watershed can be found in Table 3.4.

3.3.11 Curve Number

Composite curve numbers for antecedent moisture condition (AMC) II were generated for each watershed. This was done by using the total watershed area, and separating out the pervious from impervious area using the percent impervious values. As per the manual's recommendation, the impervious surfaces were assigned a curve number of 98. The remaining pervious area within a watershed was assigned a curve number based on the hydrologic soil group and the ground cover type. All open space areas in the watersheds was assigned values based on Open Brush cover, all residential areas were assigned values based on Turf cover, and all commercial areas were assigned values based on Commercial Landscaping cover. As per the manual recommendation, the quality of the cover was assumed to be 'good'. The resulting AMC II composite curve numbers for each watershed can be found in Table 3.4.

As per the manual, AMC II curve numbers are sufficient for watershed loss analysis for the 25-year storm event, however, AMC III curve number values are required for the 100-year event. To derive these values, the AMC II curve numbers were adjusted per the relationship presented in Table C.1 of the hydrology manual. The AMC II composite curve numbers can be found in Table 3.4.

3.3.12 Time of Concentration

As per the manual, the total time of concentration was calculated in two components. The first component is the sheet flow time, which was estimated using the nomograph from page D-4 of the manual. Flow lengths were measured in GIS from the most distant point in the watershed to the beginning of channelized flow, typically either gutter or pipe flow. The sheet flow lengths is limited to 1,000 feet. Elevation differences within each watershed were determined using contour surfaces generated using either NOAA Coastal LiDAR, or USGS elevation data.

The second component is the channelized flow time, which was calculated along the remaining length beginning at the end of sheet flow and ending at the watershed outlet. To be conservative, pipes and gutters for these components were assumed to be flowing full. The resulting total time of concentration for each watershed can be found in Table 3.4.

3.3.13 Lag Time

The lag time for each watershed was determined using the relationship from the manual, which states that the lag time should be equal to 80% of the watershed time of concentration. The lag time values for each watershed can be found in Table 3.4.

3.3.14 S-Curves

The watershed lag time was used to develop individual unit hydrographs based on locally produced S-Curves. These curves can be found in the hydrology manual, Figures E-3a, b, c, and d. For this analysis, a unit time period of 5-minutes was used to match the design storm patterns, and the Valley Developed S-curve (Figure E-3a) was used.

3.3.15 Orange County Watershed Hydrology Summary

The hydrologic parameters presented in the sections above are summarized in Table 3.4 below.

Table 3.4 Orange County Method Watershed Parameters

Watershed	Time of Concentration (min)	Lag Time (min)	Percent Impervious	Curve Number (AMC II)	Curve Number (AMC III)
1A	11.7	9.4	48%	81.3	94.5
1B	6.5	5.2	72%	89.7	97.9
2	7	5.6	64%	86.3	96.7
3	8	6.4	41%	78.4	93.0
4	24.3	19.5	32%	77.2	92.3
5	17.1	13.6	35%	79.0	93.3
6	10.2	8.2	85%	93.9	99.0
7	11.2	8.9	90%	95.1	99.2

Watershed	Time of Concentration (min)	Lag Time (min)	Percent Impervious	Curve Number (AMC II)	Curve Number (AMC III)
8	25.6	20.4	0%	75.0	90.9
9	17.6	14.1	65%	90.1	98.0
10	19.2	15.4	69%	90.5	98.2
11	8	6.4	90%	95.2	99.2
12	12.9	10.3	90%	95.1	99.2
13	9.5	7.6	52%	88.8	97.6
14	10.7	8.6	38%	85.9	96.6
15	30.5	24.4	26%	84.8	96.2
16	22	17.6	9%	82.4	95.1
17	14.1	11.3	58%	90.7	98.2

3.3.16 Proposed Development Watersheds

The hydrologic parameters for the developed conditions of Watersheds 1A and 1B were estimated using the same methodology as performed for the existing conditions watersheds above. To estimate these parameters, it was assumed that the entire Watersheds 1A and 1B would be converted to commercial use. The resulting parameters for the developed conditions of watersheds 1A and 1B are shown in Table 3.5.

Table 3.5 Hydrologic Parameters for Developed Project Site Watersheds

Watershed	Time of Concentration (min)	Lag Time (min)	Percent Impervious	Curve Number (AMC II)	Curve Number (AMC III)
1A – Developed	10.7	8.6	90%	95.5	99.3
1B - Developed	6.0	4.8	90%	96.3	99.4

3.3.17 Runoff Hydrograph Summary

The runoff hydrographs for each watershed were produced using the Orange County Hydrology Manual Method and the PCSWMM curve number hydrology method as noted above. Table 3.6 summarized the peak flow under 25-year and 100-year 24-hour storm events.

Table 3.6 Peak Flow Summary for Project Watersheds

Watershed	Peak Flow (cfs)	
	25-year Expected Value	100-year Expected Value
1A	12.2	16.4
1B	8.2	10.3
2	14.4	18.4
3	8.6	11.9
4	5.0	7.0
5	5.0	7.0
6	24.5	30.0
7	33.5	40.7
8	1.2	1.7
9	63.2	79.8
10	22.6	28.4
11	79.9	96.6
12	25.9	31.4
13	28.4	36.2
14	42.4	55.5
15	634.8	834.8
16	96.8	129.1
17	66.0	84.8
1A Developed	20.4	24.7
1B Developed	10.4	12.5

3.4 Floodplain Analysis

To perform the floodplain analysis, a coupled 1D/2D routing model was constructed in PCSWMM. The following sections describe how the model was constructed, and present the results of the existing conditions model results.

The hydraulic routing for the runoff generated in each watershed was modelled using PCSWMM software by CHI. PCSWMM is a coupled hydrologic/hydraulic model that uses the base EPA SWMM program as the hydrology and one-dimensional flow routing platform. In addition to the base SWMM code, PCSWMM includes a proprietary two-dimensional flow engine, which can simulate unsteady-state flow routing across a surface.

3.4.1 Existing Conditions Model Geometry

The geometric information, including conduit inverts, dimensions, and swale cross-sectional geometries, was based on the project topographic survey prepared by MNS Engineers and as-built information for the major drainage structures provided by Orange County. The survey data covered areas bound between Stonehill Drive to the north, the existing railroad to the east, San Juan Creek to the west, and Highway 1 to the south. The survey data collected did not include information which would require confined space entry into the storm drain infrastructure. For areas outside of the survey limit, including portions of the 54” RCP pipe, LO1SO2, and LO1SO3 located east of the railroad track, existing as built information for each component was used to obtain geometric information.

It should be noted that the vertical datum varied between the project survey and the as-built information. All elevation data was converted to NAVD 88 datum.

3.4.2 Manning’s Roughness

Table 3.7 listed the Manning’s roughness coefficients used in the hydraulics model.

Table 3.7 Manning’s Roughness Coefficients

Material	Value
Concrete Pipe	0.013
HDPE Pipe	0.011
Grassed Swales	0.035
Overland Flow Roughness[1]	0.05

[1]Used for 2D modelling surface.

3.4.3 Hydrologic Loading

The hydrographs generated using the Orange County Hydrology Manual Method and PCWMM were applied to receiving nodes in the hydraulic model. Table 3.8 below lists each watershed, which model junction the flows were applied to, and the receiving stormwater structure.

Table 3.8 Hydrograph Loading in PCSWMM Routing Model

Watershed	Model Node Applied	Receiving Infrastructure
1A	J13	54” RCP
1B	J20	South Drainage Swale
2	J19	South Drainage Swale
3	J24	North Drainage Swale
4	OF-4	San Juan Creek
5	OF-3	San Juan Creek

Watershed	Model Node Applied	Receiving Infrastructure
6	J15	54" RCP
7	J21	South Drainage Swale
8	J21	South Drainage Swale
9	J9	LO1SO2
10	J33	LO1SO3
11	J15	54" RCP
12	J10	LO1SO2
13	J11	LO1SO2
14	J15	54" RCP
15	J12	LO1SO2
16	J34	LO1SO3
17	J34	LO1SO3

3.4.4 Two-Dimensional Surface

A NOAA Coastal LiDAR digital elevation model was used as the base topographic surface data for two-dimensional modelling. The extents of the surface covered the San Juan Creek levee to the west, the San Diego Freeway to the east, Highway 1 to the south, and Stonehill Drive to the north. It should be noted that for this analysis, the model was constructed using LiDAR data, which does not include features such as buildings or other structures that would resist inundation.

3.4.5 Outfall Boundary Conditions

Outfall boundary conditions were determined using the San Juan Creek HEC-RAS analysis outlined in Section 3.1. Boundary conditions were produced for both the 25-year and 100-year storm events at five individual outfall locations. Table 3.9 below shows the time series that were developed for each model outfall, and the corresponding cross section from the HEC-RAS model that was used to determine the values.

Table 3.9 Model Outfall Boundary Conditions at San Juan Creek

HEC-RAS Model STA	1855	1502	4555	3955	3355	1855	1502	4555	3955	3355
Outfall	OF1	OF2	OF3	OF4	OF5	OF1	OF2	OF3	OF4	OF5
Hour	25-year Storm Outfall Water Surface Elevations (ft, NAVD 88)					100-year Storm Outfall Water Surface Elevations (ft, NAVD 88)				
0	9.6	8.4	19.4	16.3	14.3	13.1	12.4	23.5	21.3	19.0
1	10.7	9.8	20.8	17.9	15.8	13.1	12.4	23.5	21.2	18.9
3	12.4	11.7	22.9	20.3	18.1	14.1	13.4	24.6	22.6	20.2

HEC-RAS Model STA	1855	1502	4555	3955	3355	1855	1502	4555	3955	3355
Outfall	OF1	OF2	OF3	OF4	OF5	OF1	OF2	OF3	OF4	OF5
Hour	25-year Storm Outfall Water Surface Elevations (ft, NAVD 88)					100-year Storm Outfall Water Surface Elevations (ft, NAVD 88)				
6	13.6	12.8	24.0	21.8	19.5	15.0	14.2	25.6	23.6	21.2
9	13.9	13.2	24.4	22.3	19.9	15.5	14.6	26.1	24.2	21.8
12	14.5	13.7	25.0	23.0	20.6	16.3	15.3	26.9	25.1	22.6
15	17.0	15.9	27.6	26.0	23.4	20.4	19.3	31.0	29.7	27.1
17.25	19.0	18.0	29.6	28.2	25.6	26.1	27.2	33.2	32.2	29.4
18	19.0	17.9	29.6	28.2	25.6	25.9	27.0	32.9	31.9	29.2
21	16.6	15.6	27.2	25.5	23.0	18.7	17.7	29.3	27.9	25.3
24	14.1	13.3	24.6	22.5	20.1	15.5	14.6	26.0	24.2	21.8
27	12.4	11.6	22.7	20.2	18.1	12.8	12.1	23.1	20.8	18.6
30	10.4	9.3	20.3	17.3	15.2	10.7	9.6	20.6	17.7	15.6
33	10.0	8.8	19.7	16.8	14.6	10.5	9.4	20.4	17.4	15.3
36	9.9	8.7	19.6	16.7	14.5	10.1	8.9	19.8	16.9	14.7
39	9.9	8.7	19.6	16.6	14.5	9.9	8.8	19.7	16.7	14.5
42	9.8	8.7	19.6	16.6	14.5	9.9	8.7	19.6	16.6	14.5
45	9.8	8.6	19.6	16.6	14.4	9.8	8.7	19.6	16.6	14.5
48	9.8	8.6	19.5	16.5	14.4	9.8	8.6	19.6	16.6	14.4

3.4.6 Creek Overtopping

To model creek overtopping in the analysis, a boundary outfall condition was assigned in PCSWMM. This outfall condition was applied along the length of the floodwall that the hydraulic analysis in Section 3.1 indicated would overtop, which is about the final 350 feet of wall along the creek east bank, directly upstream of the Highway 1 northbound bridge. The outfall was modelled using the creek boundary condition developed for the 54” RCP pipe (model outfall 2), as most of the wall showing overtopping is located in this area.

To verify the creek overtopping flow rate at the floodwall that is estimated in the PCSWMM 2D model, we prepared a lateral weir model run at the floodwall in the San Juan Creek HEC-RAS model. When comparing the two analysis methods between PCSWMM and HEC-RAS, the estimated peak overtopping flows were within approximately 7% of one another at around 2,500 cfs.

3.4.7 Existing Conditions Results

Three existing condition model scenarios were simulated, the 25-year storm, the 100-year storm, and the 100-year storm without overtopping of San Juan Creek. As noted in Section 3.1, the hydraulic analysis of San Juan Creek determined that the creek does overtop near the southern area of the project site. However, to gain an understanding of how the floodplain near the site may change due to improvements of this floodwall, the 100-year storm was simulated assuming that the creek does not overtop.

Figure 3.7 shows the flood inundation for the existing condition 25-year storm event. During the 25-year event, flooding occurs at the eastern most model extent along the 54” RCP pipe, at the eastern side of the railroad tracks. This area represents a low point in the system, and can be seen in aerial imagery and from the LiDAR surface as a localized ponding area. Flooding in this case is caused primarily due to the boundary condition in San Juan Creek, which during high creek flow creates backwater to the pipe system. The estimated flood depth ranges up to one feet. During the 25-year event, no surcharging occurs in the South Swale or any features associated with LO1SO2.

Figure 3.8 shows the flood inundation for the existing condition 25-year storm event. During the 100-year event, the entire project site and much of the surrounding area is subject to flooding. As the storm progresses there are two primary contributing factors to flooding in the area. As the level of San Juan Creek begins to rise, the incoming flow from upstream watersheds begins to surcharge LO1SO2, the 54” RCP, and the South Swale. In addition the upstream flow, backflow from San Juan Creek through LO1SO2 begins to surcharge at the open channel sections and inundate the area. As the water level in San Juan Creek approaches its peak, the east bank floodwall at the north of Highway 1 overtops, which inundates additional areas in the project site and increase flood depths. Maximum flood depths at the project site during this storm range from one to six feet, and areas surrounding the project site are inundated around one to four feet.

Figure 3.9 shows the flood inundation for the existing conditions 100-year storm event, assuming no overtopping from San Juan Creek along the east bank floodwall. Under this scenario, flooding in the project site is due to a product of upstream stormwater surcharging and backflow from San Juan Creek through LO1SO2. When the creek does not overtop the floodwall, there is still flooding that occurs at the project site, but in less extent and depth. The depths of flooding range from approximately one feet to four feet.

3.4.8 Comparison to Previous Work

In addition to this study, there are a number of previous studies on flooding in the vicinity of the project area.

The FEMA FIS for the City of San Juan Capistrano shows similar floodplain boundaries to those shown in Figures 3.8 and 3.9. It should be noted that in the FEMA study, the flood zone was designated AO, overtopping from San Juan Creek was not a contributing factor. The FEMA floodplain delineation also references a portion of the flood zone which occurs due to surcharging at a stormwater manhole located at Sepulveda and Camino Capistrano. This result is not reproduced in this analysis, as this manhole is located outside the area of detailed study in the PCSWMM model.

Tetra Tech, Inc. completed a Floodway Compliance Technical Memo (2015) for the property known as Parking Lot B, which is located adjacent to the open channel portion of LO1SO2 on the north side. Using a one-dimensional WSPG model, the analysis estimated water surface elevation of 30.2’ at the open channel portion of LO1SO2, which when extrapolated across the property, it results in a flood depth range of 1.9 to 4.6 feet for the proposed lot grading. This analysis indicated a maximum water surface elevation of approximately 26 feet.

Tetra Tech 2016 assessed flooding at the South Orange County Wastewater Authority JB Latham Treatment Plant, which is located across San Juan Creek from the project site. The study also indicated backwater effect in San Juan Creek caused by the Highway 1 Bridge.

PACE completed a capacity analysis of San Juan Creek (PACE, 2010). This analysis was completed using the same HEC-RAS model that was used for the analysis presented in Section 3.1 of this report. The analysis demonstrated that the channel in the area of the project site has a bank full capacity of 19,000, indicating that flows higher than that would overtop the levee and flood the adjacent areas.

3.5 Drainage Improvements

To mitigate flooding at the project site, a set of site improvement options has been proposed that could be incorporated into the project design. The options are shown in Figure 3.10.

As shown in the figure, there are six main improvement options that have been developed for this site, they are:

- Regrade and raise the project site elevation;
- Add a stormwater detention basin to mitigate for post project runoff conditions;
- Abandon and relocate the existing drainage inlet (DI) near the outfall of the 54” RCP;
- Replace floodwall along San Juan Creek flood in section showing creek overtopping;
- Add a flap gate to prevent backflow from San Juan Creek entering LO1SO2; and
- Add a pump station to mitigate flooding originating from upstream watersheds.

Using these six improvement options, four separate alternatives have been developed which includes a subset of these improvement options. Each of the four alternatives was modelled in PCSWMM, and the results are discussed in further detail below. It should be noted that in each alternative section below, residual flooding that occurs after the implementation of the alternative is compared to a base case flooding scenario. The base case scenario is the 100-year flooding that is shown in Figure 3.8, which includes overtopping flows from San Juan Creek near the Highway 1 Bridge.

3.5.1 Alternative 1

Alternative 1 was formulated to be a standalone option that would mitigate flooding at the project site regardless of future flood improvements along San Juan Creek. This alternative includes re-grading the project site to 28.2 feet elevation, which is approximately 1 foot higher than the 100-year flood elevation with creek overtopping. Figure 3.10 shows the limits of grading for this alternative. This alternative also includes a detention basin to mitigate additional runoff generated from development of the project site. The detention basin was sized to be 0.5 acres and 3 feet deep. Lastly, this alternative includes the capping of the existing DI adjacent to the 54” RCP pipe outfall at San Juan Creek, and relocating the DI eastward in the project site. Otherwise, overtopping flow from the creek could enter the existing DI, backflow up the pipe and inundate areas east of the project site. See Figure 3.11 for the flood inundation map for this alternative, and Figure 3.12 for the change in flood elevations as compared to the base scenario.

Raising the ground elevation reduces both the extents and depth of flooding. As shown in Figure 3.12, the average flooding depth reduction in areas surrounding the project site is approximately one to four feet. Raising the ground elevation essentially acts as a flood barrier from the creek, which blocks overtopping flows from the creek to reach the project site and upstream watershed. Note that the proposed site regrade needs to include the area between the southern boundary of the project site property and the Highway 1 northbound bridge. Otherwise, the area between the southern edge of the project site and Highway 1 provides a flood path for overtopping creek flow to inundate upstream watershed area at the east of the project site.

3.5.2 Alternative 2

Alternative 2 includes floodwall improvements to eliminate San Juan Creek overtopping during a 100-year event. The proposed improvement for the floodwall includes approximately 500 feet of new concrete reinforced retaining wall set 1 foot above the 100-year flood elevation. This alternative also includes re-grading the project site to 26 feet elevation, which as discussed previously is approximately 1 foot higher than the 100-year flood elevation, without creek overtopping. The limits of grading for this alternative are the same as alternative 1. See Figure 3.13 for the flood inundation map for this alternative, and Figure 3.14 for the change in flood elevations as compared to the base scenario.

As shown, raising the ground elevation and improving the floodwall in this alternative reduces both the extents and depth of the flooding, similar to Alternative 1. As shown in Figure 3.14, the average flooding depth reduction in areas surrounding the project site is approximately one to four feet.

3.5.3 Alternative 3

Alternative 3 is the same as Alternative 2 except the addition of a new detention basin at the southern end of the project site. See Figure 3.15 for the flood inundation map for this alternative, and Figure 3.16 for the change in flood elevations as compared to the base scenario.

Raising the ground elevation and improving the levee for this alternative reduces both the extents and depth of the flooding, similar to Alternative 2. As shown in Figure 3.16, the average flooding depth reduction in areas surrounding the project site is approximately one to four feet. Adding the detention basin in this alternative results in a negligible reduction in flooding depths.

3.5.4 Alternative 4

Alternative 4 was formulated to work as an option that requires minimal site grading to mitigate flooding at the project site. This was achieved through a combination of alternatives to mitigate flooding from creek overtopping, creek backflow through LO1SO2, and upstream storm drain surcharging. This alternative includes installing a flap gate at LO1SO2 to cease backflow from San Juan Creek, floodwall improvements as presented in Alternatives 2 & 3, raising the site to a minimum elevation of 23.5 feet, and installing a pump station to mitigate flooding at the South Swale and LO1SO2. See Figure 3.17 for the flood inundation map for this alternative, and Figure 3.18 for the change in flood elevations as compared to the base scenario.

As shown, this alternative results in the greatest reduction in flooding over the project and urban area. Essentially, to make this alternative work to mitigate flooding originating from the South Swale and LO1SO2, the pump station must work to evacuate the peak three hours of the storm from these features. Some site grading in this area is still required, however, due to the flooding that originates from the 54” RCP, which as it surcharges flows north along the railroad tracks it would eventually inundate some of the area at the northeast corner of the project site.

3.5.5 Alternatives Summary and Planning Level Cost Estimates

Four flood improvement alternatives were formulated for the project site with the intent of eliminating flooding on the property during the 100-year expected value storm event. The work included in each alternative is summarized in Table 3.10. For this summary, preliminary earthwork fill quantities were generated from the model’s coastal LiDAR surface. These quantities are meant to be approximate and convey the relative magnitude of fill required for each alternative.

Table 3.10 Summary of Work for Each Improvement Alternative

Alternative	Improvements
1	• Raise project site to 28.2 feet (appx 67,000 CY fill volume) • Demolish existing DI and cap, install new DI • Install detention basin (0.5 acres, 3 feet deep)
2	• Raise project site to 26 feet (appx 27,000 CY fill volume) • Install 500 feet of new sheet pile floodwall along San Juan Creek levee
3	• Raise project site to 26 feet (appx 27,000 CY fill volume) • Install 500 feet of new sheet pile floodwall along San Juan Creek levee • Install detention basin (0.5 acres, 3 feet deep)
4	• Raise project site to 23.5 feet (appx 6,500 CY fill volume) • Install 500 feet of new sheet pile floodwall along San Juan Creek levee • Install detention basin (0.5 acres, 3 feet deep) • Install flap gate on LO1SO2 • Install a pump station and high flow bypass lines for LO1SO2 and South Swale

Planning level construction cost estimates were developed for each of the four alternative scenarios, as shown in Table 3.11. Detail cost estimate breakdowns for Alternatives 1, 2 and 3 are included in Appendix C.

Table 3.11 Summary of Work for Each Improvement Alternative

Alternative	Planning Level Cost Estimate
1	$2,312,000
2	$3,778,000
3	$3,961,000
4	$10,000,000+

The construction cost estimate for Alternative 4 is only an order-of-magnitude estimate, to illustrate the significant cost difference between Alternative 4 and the other alternatives. Should Alternative 4 be ultimately selected as the preferred flood improvement alternative for the project site, additional construction cost assessment is needed to fine tune the estimate.

Note that the cost estimates for Alternatives 2 and 3 included a construction cost estimate to construct 500 feet of sheet pile floodwall along San Juan Creek at the upstream of the Highway 1 bridges. It is deemed the minimum improvements necessary to alleviate the project site from 100-year flood. However, any floodwall improvements will need to be coordinated with Orange County, the owner of the floodwall and levee facilities. Orange County is working on a long range plan to potentially construct new sheet pile floodwall between Highway 1 and Stonehill Drive as a part of a regional flood improvement project. At 3,200 linear feet in length and a unit cost of $4,000 per linear foot for a new sheet pile wall, the total construction cost estimate would be around $12,800,000. The floodwall improvement estimate as included in Alternatives 2 and 3 may be considered as a starting point to assess a potential cost sharing for the regional flood improvement project, should the SCWD select either Alternatives 2 or 3 as the preferred alternative, and consider flood improvement partnership with Orange County.

3.6 Recommendations

In the alternative evaluation, it is found that Alternative 1 has a number of benefits and advantages over the other alternatives considered in the evaluation. The following listed the advantages of Alternative 1.

- It provides the same level of flood protection as Alternatives 2 & 3, yet lower residual flood risk since the flood protection mechanism is by elevation, not by floodwall;
- It reduces flooding in adjacent areas by blocking overtopping flows from San Juan Creek;
- It is the least costly alternative;
- It is a standalone option that works independent of the need to improve San Juan Creek, hence reduce the level of inter-agencies dependence and streamline inter-agencies collaboration;
- It has minimal long term maintenance, especially when compared to Alternative 4 which requires a major pump station facilities; and
- It is the simplest alternative to design and construct.

Since the premise of Alternative 1 is to build up the project site to be above the flood level, this option has the highest reliability, whereas Alternatives 2 and 3 depends on floodwall, and Alternative 4 depends on pump station, which all of these options have highest risk of failure. In addition, since Alternative 1 does not depend on San Juan Creek improvements, its project schedule does not need to be held depending upon the regional flood improvement project from Orange County. On the other hand, the proposed improvements in Alternative 1 will not preclude future improvement works on San Juan Creek.

As a refinement to the project recommendation, Alternative 1 is modified to exclude the proposed fill area at the south edge of the project site, adjacent to the Highway 1 northbound bridge along the Caltrans right of way. The modified Alternative 1, identified as Alternative 1a, is identical to Alternative 1, except the southern grading limit is shifted north to align with the South Coast Water District property boundary. The modification of the southern grading limit is to ensure the proposed grading does not encroach into the existing Caltrans right of way. See Figure 3.11a for the flood inundation map for this alternative, and Figure 3.12a for the change in flood elevations as compared to the base scenario.

As shown in Figure 3.12a, the average flooding depth reduction in areas surrounding the project site is approximately one to three feet. Raising the ground elevation essentially acts as a flood barrier from the creek, which blocks overtopping flows from the creek to reach the project site and upstream watershed. Note that since the proposed site regrade does not include the area between the southern boundary of the project site property and the Highway 1 northbound bridge, this area provides a flood path for overtopping creek flow to inundate upstream watershed area at the east of the project site. However, as shown in Figure 3.12a, it does not increase the level of flood inundation at the upstream watershed area at the east of the project site, as compare to the existing condition.

Same as Alternative 1, Alternative 1a does not depend on improvements at San Juan Creek nor the existing storm drain facilities. In addition, as shown in Table 3.12, the proposed project does not increase the peak flow at the existing storm drain facilities under the 100-year design storm.

Table 3.12 Peak Flow Summary at Storm Drain Facilities Creek Outfall

Storm Drain Facility	100-Year Storm	
	Pre-Project Peak Flow	Post-Project Peak Flow
54” Pipe	101 cfs	57 cfs
LO1SO2	1154 cfs	1150 cfs

Note that the reduced peak flow at the 54” pipe under post-project condition is due to the proposed detention basin attenuating the peak flow.

It is recommended that Alternative 1a as the preferred flood improvement alternative for the project site.

4. 500-Year Storm Sensitivity Analysis

4.1 Introduction

This section documents a sensitivity analysis to evaluate the flood inundation under a 500-year design storm event. The sensitivity analysis included a hydrology analysis for the watershed upstream of the project site contributing to the storm drain facility LO1SO2, a hydraulic analysis at San Juan Creek to estimate the water surface elevation of the creek channel and overtopping, and a watershed analysis to map the floodplain inundation.

4.2 Hydrology Analysis

The hydrology analysis is based on the same method as outlined in Section 3.3 for the design storms analysis. The only exception is the total rainfall depth for a 500-year design storm is not available in Orange County Hydrology Manual, so 500-year design storm data from NOAA Atlas 14 is used for the analysis. Table 4.1 lists the estimated peak flow from a 500-year storm in the project watersheds.

Table 4.1 500-Year Storm Peak Flow Summary for Project Watersheds

Watershed	Peak Flow (cfs)
	500-year Expected Value
1A	41.6
1B	20.8
2	40.4
3	31.7
4	25.9
5	19.8
6	57.0
7	73.8
8	5.2
9	179.8
10	74.9
11	172.2
12	59.7
13	79.1
14	131.87

Watershed	Peak Flow (cfs)
	500-year Expected Value
15	2048.1
16	354.5
17	194.8
1A Developed	62.4
1B Developed	31.2

The 500-year design flow for San Juan Creek is based on FEMA FIS for Orange County, California and Incorporated Areas (FEMA 2009c). Table 7 in the FIS listed the San Juan Creek 500-year design flow of 80,000 cfs, at the City of San Juan Capistrano corporate limits.

4.3 Hydraulic Analysis

The hydraulic analysis included San Juan Creek hydraulic analysis in HEC-RAS model to estimate the creek water surface elevation, and watershed hydraulic analysis in PCSWMM model to estimate the floodplain inundation.

In the San Juan Creek hydraulic analysis, the 80,000 cfs 500-year design flow is input to the upstream extent of the model at Stonehill Drive (River Station 5917 in the model).

During the existing conditions Q500 flood scenario San Juan Creek overtops the river left bank onto the project site. Overtopping begins at the upstream and middle portions of the project site where flood waters from the creek combine with excess flood volumes from the open portion of LO1SO2. From the northern portions of the site, flood waters then move south paralleling the creek, following the site’s natural grades. Flood waters eventually reach their highest concentration in the southwest portion of the project site, near where the existing grades are lowest adjacent to the flood wall and the Highway 1 roadway prism. At this location, even though the water surface elevation in the creek is higher than the floodwall, flood water from the site re-enters the creek or flows under the bridge given that floodplain water surface elevation at the project site is generally higher than the lower portions of the creek during the peak flooding hours.

Table 4.2 below shows the time series that were developed for each storm drain facility outfall, and the corresponding cross section from the HEC-RAS model that was used to determine the values.

Table 4.2 500-Year Storm Outfall Boundary Conditions at San Juan Creek

HEC-RAS Model STA	1855	1502	4555	3955	3355
Outfall	OF1	OF2	OF3	OF4	OF5
Hour	500-year Storm Outfall Water Surface Elevations (ft, NAVD 88)				
0	14.55	13.76	25.04	23.09	20.67
1	14.52	13.73	25.03	23.05	20.64
3	16.04	15.11	26.66	24.88	22.39
6	17.39	16.3	28.01	26.42	23.87
9	18.14	17.13	28.76	27.27	24.68
12	19.28	18.25	29.9	28.53	25.91
15	26.44	27.87	35.94	34.07	30.27
17.25	27.01	28.72	41.54	38.17	31.37
18	27.06	28.76	41.36	38.01	31.27
21	25.7	26.84	33.37	32.38	29.24
24	18.13	17.13	28.74	27.26	24.67
27	14.08	13.32	24.44	22.5	20.11
30	10.92	10.02	21.11	18.17	16.15
33	10.7	9.7	20.71	17.78	15.7
36	10.28	9.14	20.1	17.13	15
39	10.1	8.92	19.81	16.85	14.67
42	9.99	8.86	19.73	16.78	14.59
45	9.95	8.83	19.69	16.73	14.55
48	9.92	8.81	19.65	16.69	14.52

The water surface elevations in San Juan Creek and storm drain facility outfalls sets the downstream boundary condition for the watershed model in PCSWMM. The watershed model analyzed the routing of stormwater flow via surface runoff and storm drain facilities, and estimated inundation extent, depth, and duration in the floodplain. Figure 4.1 mapped the floodplain extent and depth at the project site and the adjacent watershed under the pre-project condition.

4.4 500-Year Storm Facility Protection

The hydraulic analysis showed the project site and the surrounding area has significant floodwater inundation under a 500-year storm event. Figure 4.1 shows that some area has over 3’ of flood depth under the pre-project condition. The maximum flood depth at the project site is at elevation 28.3’.

Under the post-project condition, the recommended alternative will raise the project site to 28.2’, to protect the project site from a 100-year flood plus 1’ of freeboard. As the post-project ground elevation at the project site is 28.2', the maximum 500-year flood elevation of 28.3' would likely results in minimal flooding at the project site.

As a sensitivity analysis, an improvement scenario is tested to provide the project site with 500-year flood protection with 1' of freeboard. Under this test condition, the recommended alternative would need to raise the project site to 29.3', with approximately 90,000 CY of fill material. Figure 4.2 shows the resultant floodplain with this test scenario. Figure 4.3 shows that with the improvements, the flood inundation depth at the vicinity of the project site will be reduced, since the fill at the project site created a barrier to block off overtopping flow from San Juan Creek to the floodplain in the watershed.

This analysis shows that under the recommended improvement to raise the site to elevation 28.2', the project site will likely have minimal inundation. Also considering the fact that the site improvement to provide 500-year flood protection with 1' freeboard will result in approximately 23,000 CY of additional fill, this study recommends the project to raise the project site to 28.2' to provide 100-year flood protection with 1' freeboard, as per the Alternative 1a outlined in Section 3.6. In addition, the project will identify and include flood proofing design at the critical facilities to minimize potential flood impacts and the resultant damage and system downtime.

5. References

California Coastal Commission. 2018. Sea-Level Rise Policy Guidance. Draft Science Update – October 2018.

County of Orange Environmental Management Agency. 1996. Orange County Local Drainage Manual. January 1996.

Erikson, L.H., Barnard, P.L., O'Neill, A.C., Vitousek, S., Limber, P., Foxgrover, A.C., Herdman, L.H., and Warrick, J.. 2017. CoSMoS 3.0 Phase 2 Southern California Bight: Summary of data and methods. U.S. Geological Survey. http://dx.doi.org/10.5066/F7T151Q4

Federal Emergency Management Agency (FEMA). 2009a. Flood Insurance Rated Map 06059C0506J. December 3, 2009.

Federal Emergency Management Agency (FEMA). 2009b. Flood Insurance Rated Map 06059C0508J. December 3, 2009.

Federal Emergency Management Agency (FEMA). 2009c. Flood Insurance Study for Orange County, California and Incorporated Areas. Volumes 1-3. Revised December, 2009.

National Research Council (NRC). 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Report by the Committee on Sea Level Rise in California, Oregon and Washington. National Academic Press, Washington, DC. 250 pp.

Orange County Environmental Management Agency. 1986. Orange County Hydrology Manual. October 1986.

Orange County Flood Control District. 2009. Base Map of Drainage Facilities. Sheet 75-& 78. August 2009.

Pacific Advanced Civil Engineering (PACE). 2010. Baseline Floodplain Hydraulics for San Juan Creek. Prepared for County of Orange. Updated April, 2010.

Pacific Advanced Civil Engineering (PACE). 2008. San Juan Creek Watershed Hydrology Study. August 2008.

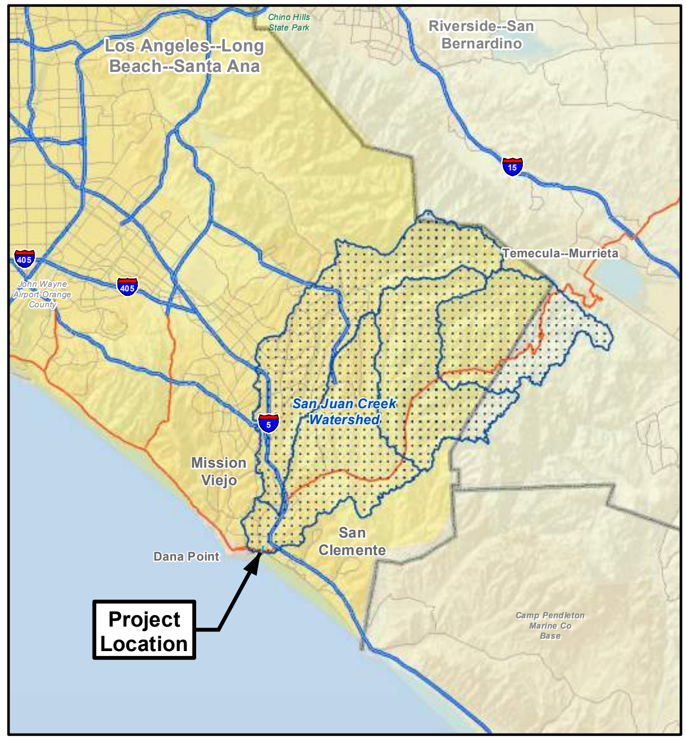
Tetra Tech. 2015. Floodway Compliance Technical Memorandum, San Juan Creek Property Site Improvements: Improvements for Boat & RV Parking Lot "B". June 2015.

Tetra Tech. 2016. San Juan Creek at SOCWA JB Latham Treatment Plant – Flooding and Storm Pump Evaluation. June 2016.

United States Army Corp of Engineers (USACE). 2016. 2014 USACE NCMP Topobathy Lidar DEM: California

Willdan Associates. 1998. City of Dana Point Master Plan of Drainage.

Figures



	Project Site		Freeway		Major Road
	San Juan Creek Watershed		Highway		Local Road
					Parks/Open Space

Paper Size 8.5" x 11" (ANSI A)
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Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California III FIPS 0403 Feet

N

South Coast Water District
Doheny Desalination Project - EIR

Job Number	11125157
Revision	A
Date	08 May 2017

Vicinity and Project Location

Figure 1.1

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_01_Vicinity_RevA.mxd

Data source: ESRI StreetMap/TeleAtlas; GHD GIS; Created by:jclark2

Paper Size ANSI A

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Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 11N

N

LEGEND

Site Location

2100 Shoreline - 0 m Sea Level Rise

2100 Shoreline - 0.5 m Sea Level Rise

2100 Shoreline - 1 m Sea Level Rise

2100 Shoreline - 1.5 m Sea Level Rise

2100 Shoreline - 2 m Sea Level Rise

2100 Shoreline - 5 m Sea Level Rise

Shoreline Data: U.S. Geological Survey, Pacific Coastal and Marine Science Center, 2015.

Doheny Desalination Project
Coastal Hazard Assessment

Job Number 11140040
Revision A
Date 04 May 2017

CosMos 3.0 Shoreline Retreat

Figure 2.1

6705 Millcreek Drive Unit 1 Mississauga ON L5N 5M4 Canada T 1 416 213 7121 F 1 905 890 8499 E mississauga@ghd.com W www.ghd.com

Data Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; Site Location: GHD, 2017; Shoreline Data: U.S. Geological Survey, Pacific Coastal and Marine Science Center, 2015.. Created by:rgalos

Paper Size ANSI A

0 100 200 300 400 500

Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 11N

N

LEGEND

Site Location

Extent of Assessment

Flooded Areas for Extremal Total Water Level

2100 Low Range Sea Level Rise (18.4 ft*)

2100 High Range Sea Level Rise (21.9 ft*)

*Source: Michael Baker International, 2018. Coastal Hazards Analysis for the Doheny Desalination Project. February 2018

Doheny Desalination Project
Coastal Hazard Assessment

Future Flooding 2100

Job Number	11140040
Revision	A
Date	30 Nov 2018

Figure 2.2

6705 Millcreek Drive Unit 1 Mississauga ON L5N 5M4 Canada T 1 416 213 7121 F 1 905 890 8499 E mississauga@ghd.com W www.ghd.com

Data Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; Site Location, and Extent of Assessment: GHD, 2017; Flooded Areas: GHD, 2018, based on U.S. Army Corps of Engineers (USACE) digital elevation model, 2016. Created by:aboone

Paper Size ANSI A

0 100 200 300 400 500

Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 11N

N

LEGEND

- Site Location
- CosMos Flood Limits - 0.5 m Sea Level Rise
- CosMos Flood Limits - 2.0 m Sea Level Rise
- CosMos Flood Limits - 5 m Sea Level Rise

Flood Data: Barnard, P.L., Erikson, L.H., Foxgrover, A.C., Limber, P.W., O'Neill, A.C., and Vitousek, S., 2018, Coastal Storm Modeling System (CoSMoS) for Southern California, v3.0, Phase 2 (ver. 1g, May 2018): U.S. Geological Survey data release, https://doi.org/10.5066/F7T151Q4.

Doheny Desalination Project
Coastal Hazard Assessment

Job Number	11140040
Revision	A
Date	30 Nov 2018

CosMos 3.0 Sea Level Rise

Figure 2.3

6705 Millcreek Drive Unit 1 Mississauga ON L5N 5M4 Canada T 1 416 213 7121 F 1 905 890 8499 E mississauga@ghd.com W www.ghd.com

Data Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; Site Location: GHD, 2017; Flood Data: U.S. Geological Survey, Pacific Coastal and Marine Science Center, 2018. Created by:aboone

Paper Size ANSI A

0 100 200 300 400 500

Feet

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 UTM Zone 11N

N

LEGEND

Site Location
Extent of Assessment

Flooded Areas for Extremal Total Water Level

2100 Low Range Sea Level Rise (18.82 ft*)
2100 High Range Sea Level Rise (22.31 ft*)

*Source: Michael Baker International, 2018. Coastal Hazards Analysis for the Doheny Desalination Project. February 2018

GHD

Doheny Desalination Project
Coastal Hazard Assessment

Job Number 11140040
Revision A
Date 30 Nov 2018

Tsunami Flooding 2100

Figure 2.4

6705 Millcreek Drive Unit 1 Mississauga ON L5N 5M4 Canada T 1 416 213 7121 F 1 905 890 8499 E mississauga@ghd.com W www.ghd.com

Data Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; Site Location, and Extent of Assessment: GHD, 2017; Flooded Areas: GHD, 2018, based on U.S. Army Corps of Engineers (USACE) digital elevation model, 2016. Created by:aboone

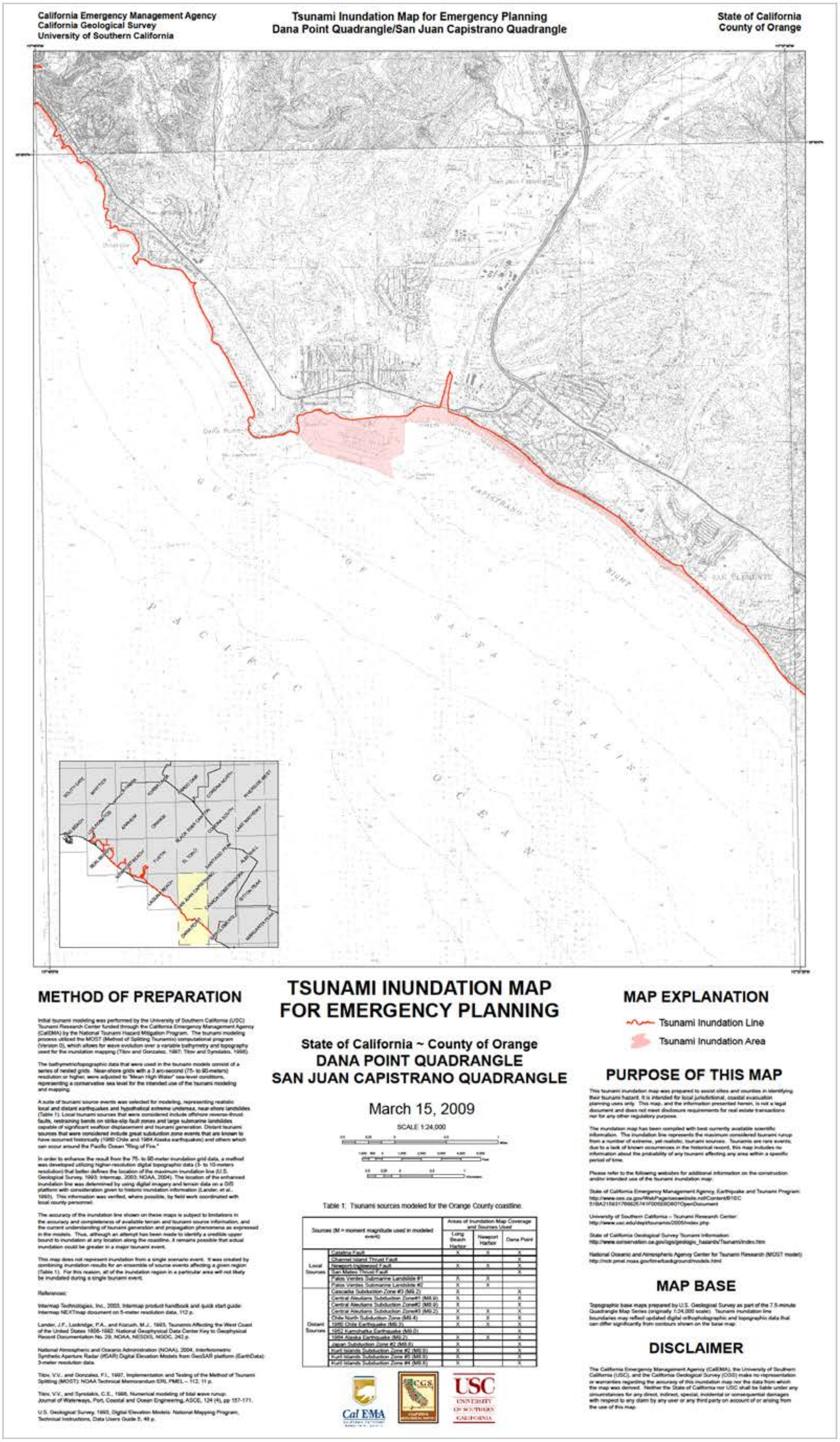


Figure 2.5 – Tsunami Inundation Map for Emergency Planning

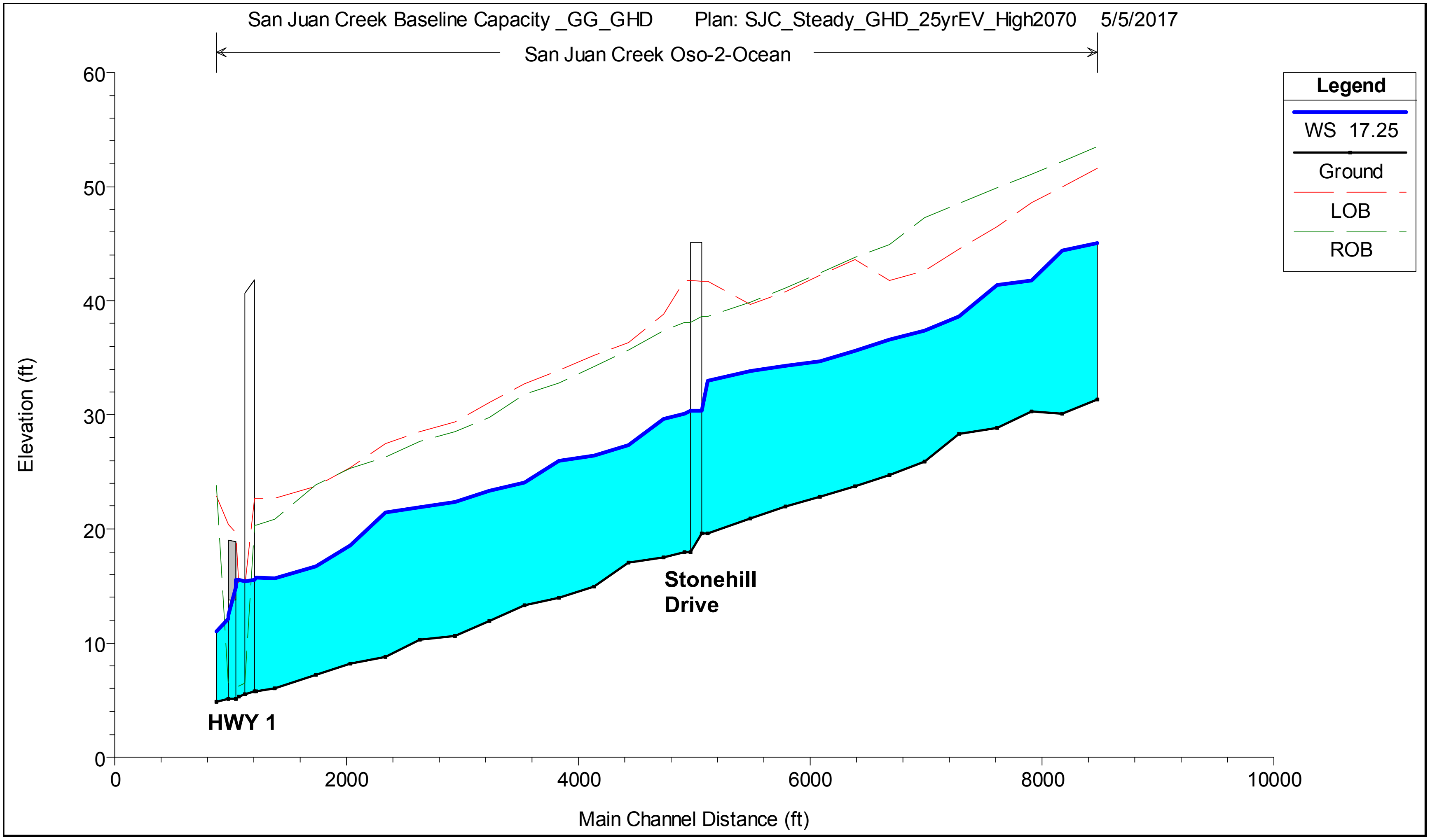


Figure 3.1 – San Juan Creek maximum water surface profile, 25-year event.

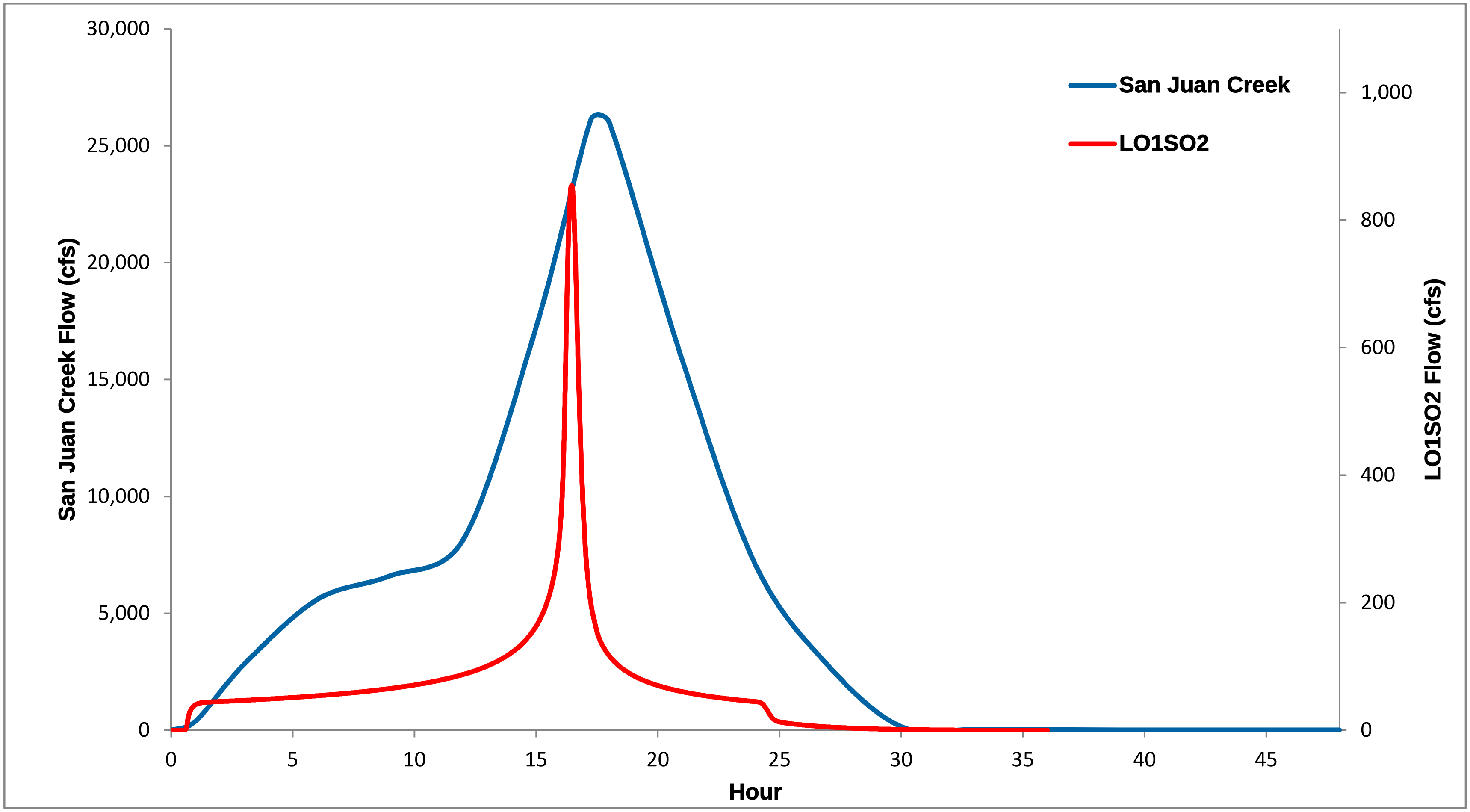


Figure 3.2 – San Juan Creek and LO1SO2 hydrograph comparison, 25-year event.

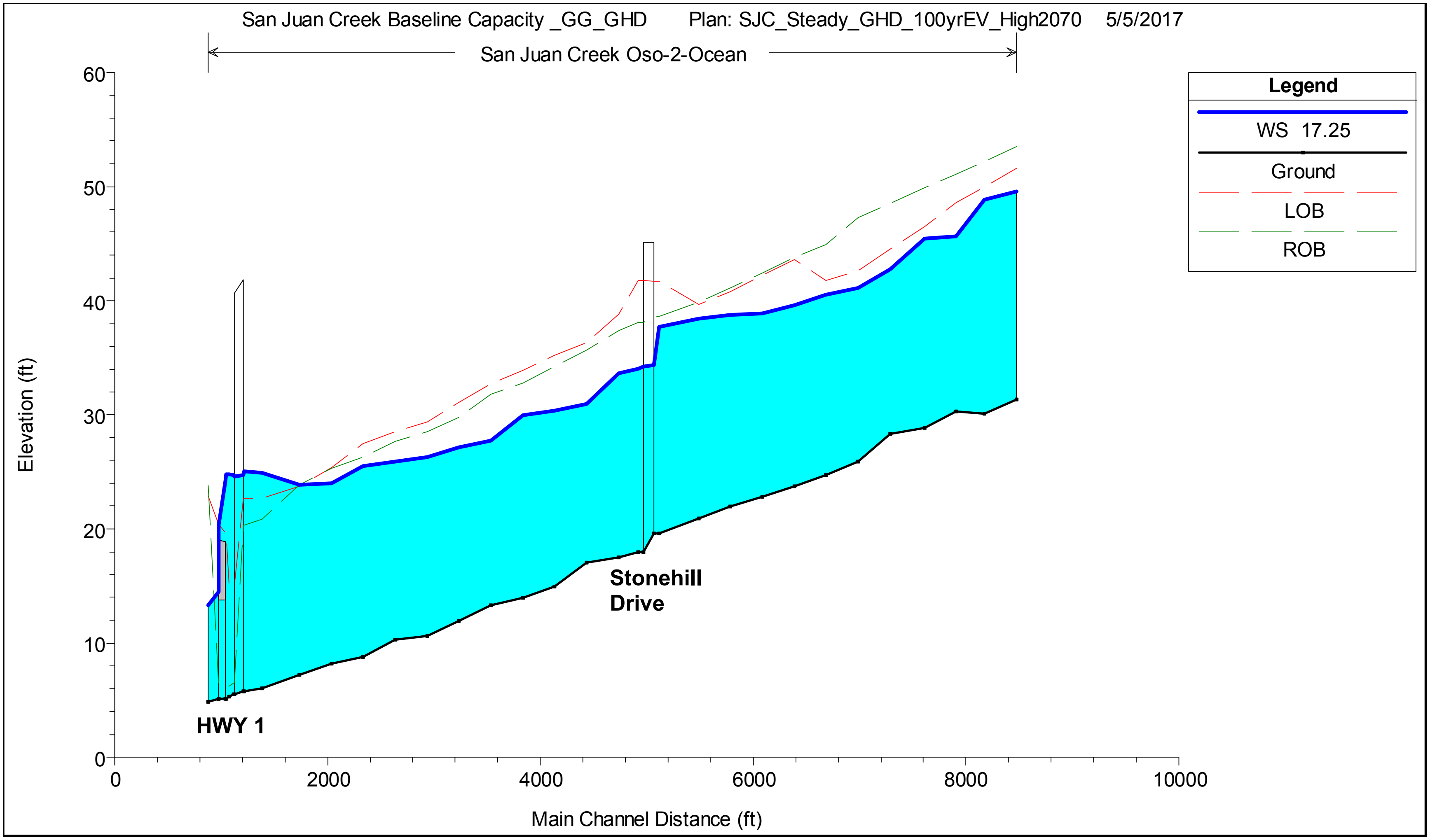


Figure 3.3 – San Juan Creek maximum water surface profile, 100-year event.

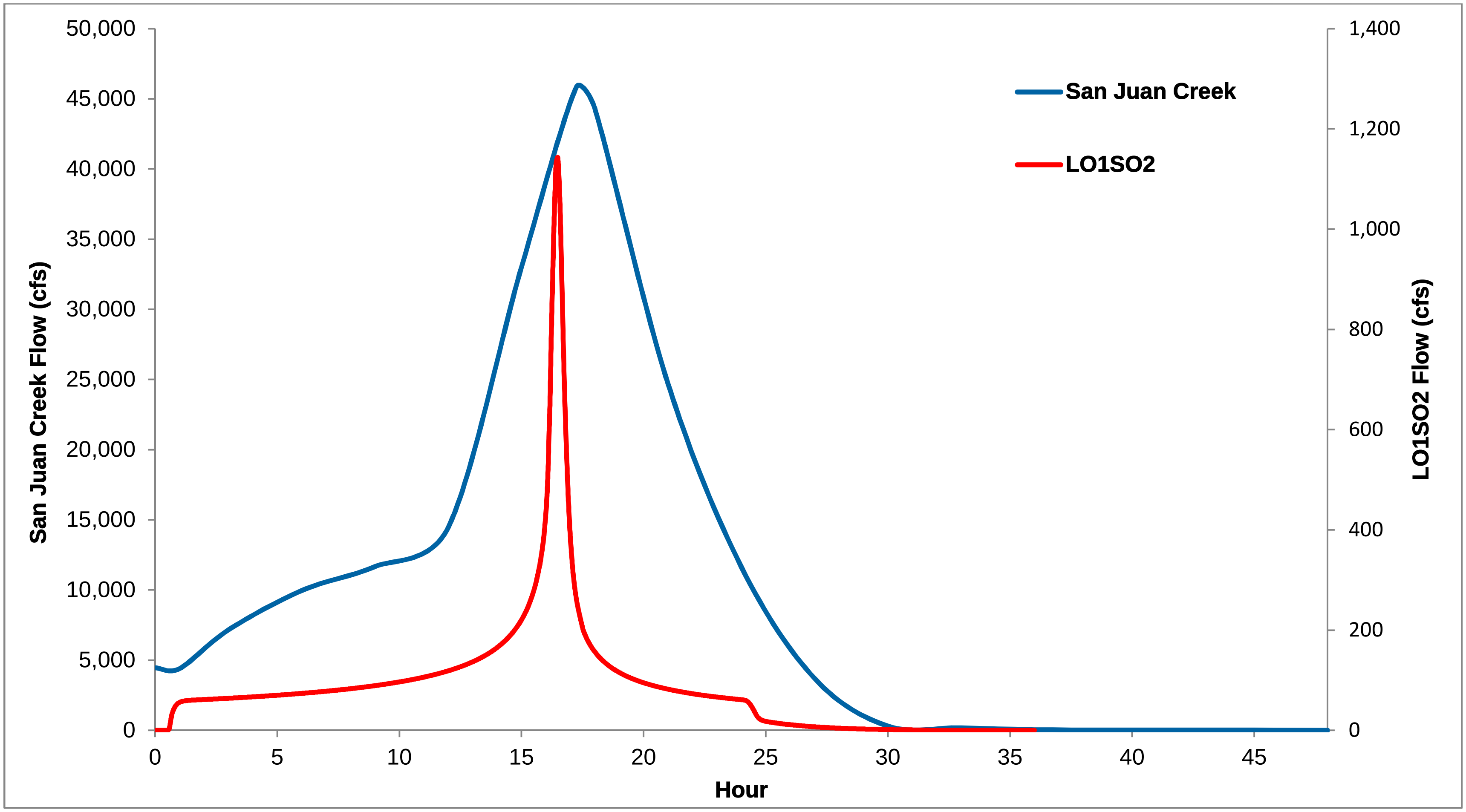
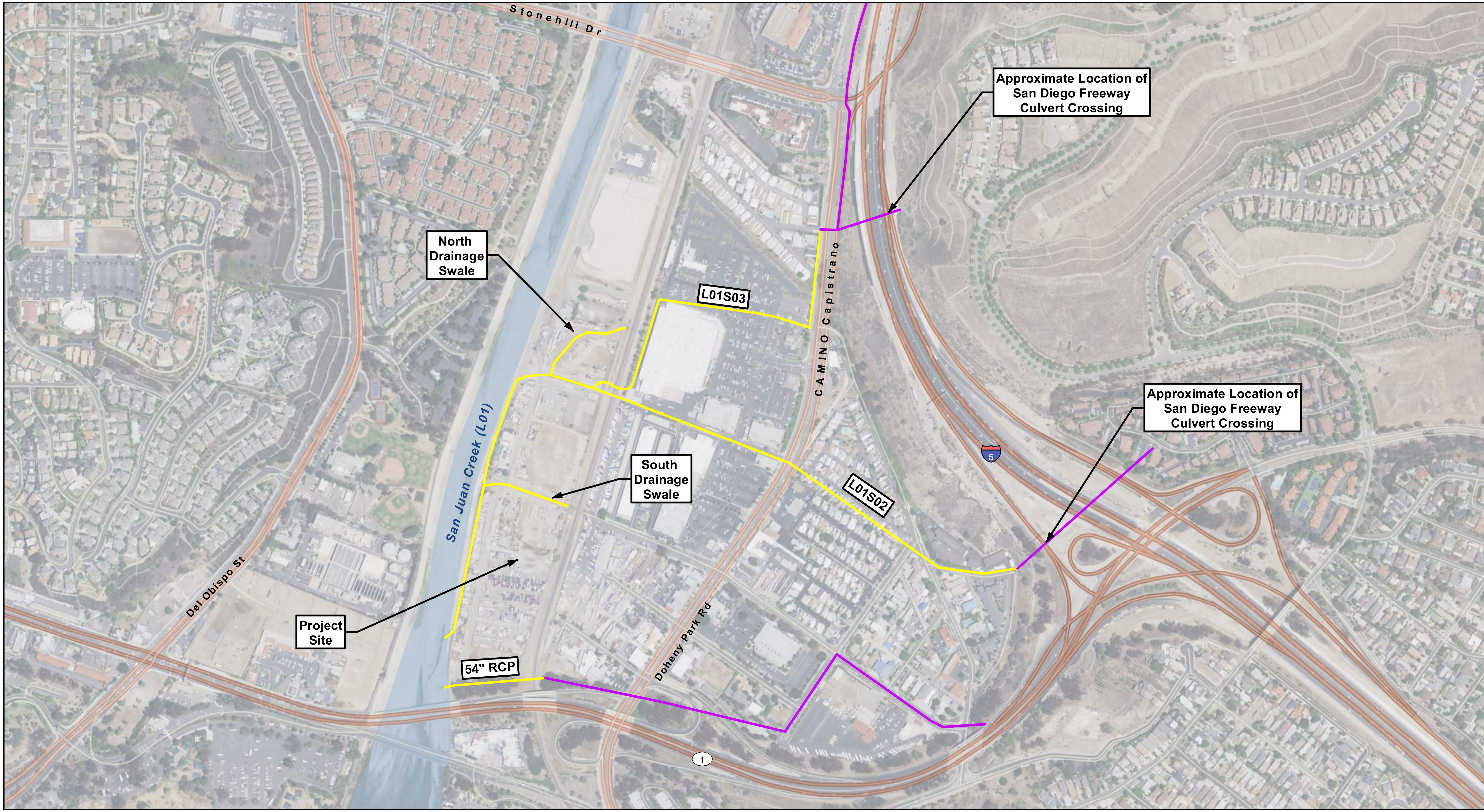


Figure 3.4 – San Juan Creek and LO1SO2 hydrograph comparison, 100-year event.



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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

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LEGEND

Storm Water Conduits (in model)

Storm Water Conduits (not in model)

South Coast Water District
Doheny Desalination Project Drainage Analysis

Job Number	11125157
Revision	A
Date	08 May 2017

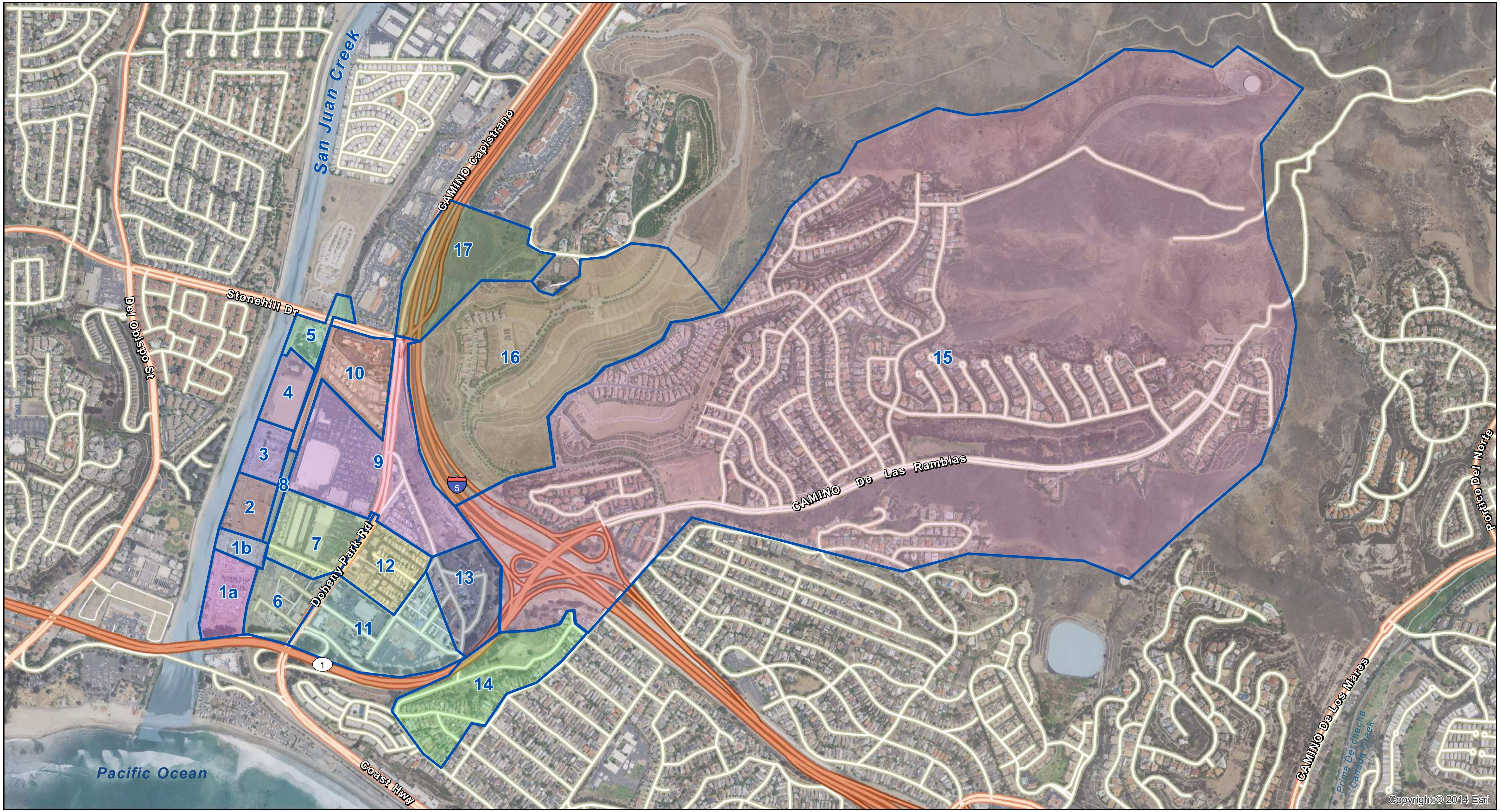
Existing Infrastructure Map

Figure 3.5

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_02_Existing_Infra_ANSIB.mxd

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: watershed delineation. Created by:jclark2

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com



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Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

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LEGEND

Doheny Watersheds

15 Watershed ID

South Coast Water District
Doheny Desalination Project Drainage Analysis

Job Number	11125157
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Date	08 May 2017

Doheny Watersheds Overview Map

Figure 3.6

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_01_Watersheds_ANSIB.mxd

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: watershed delineation, Version/Date. Created by:jclark2

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B
0 100 200 300
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 25-Year Event, Existing Condition

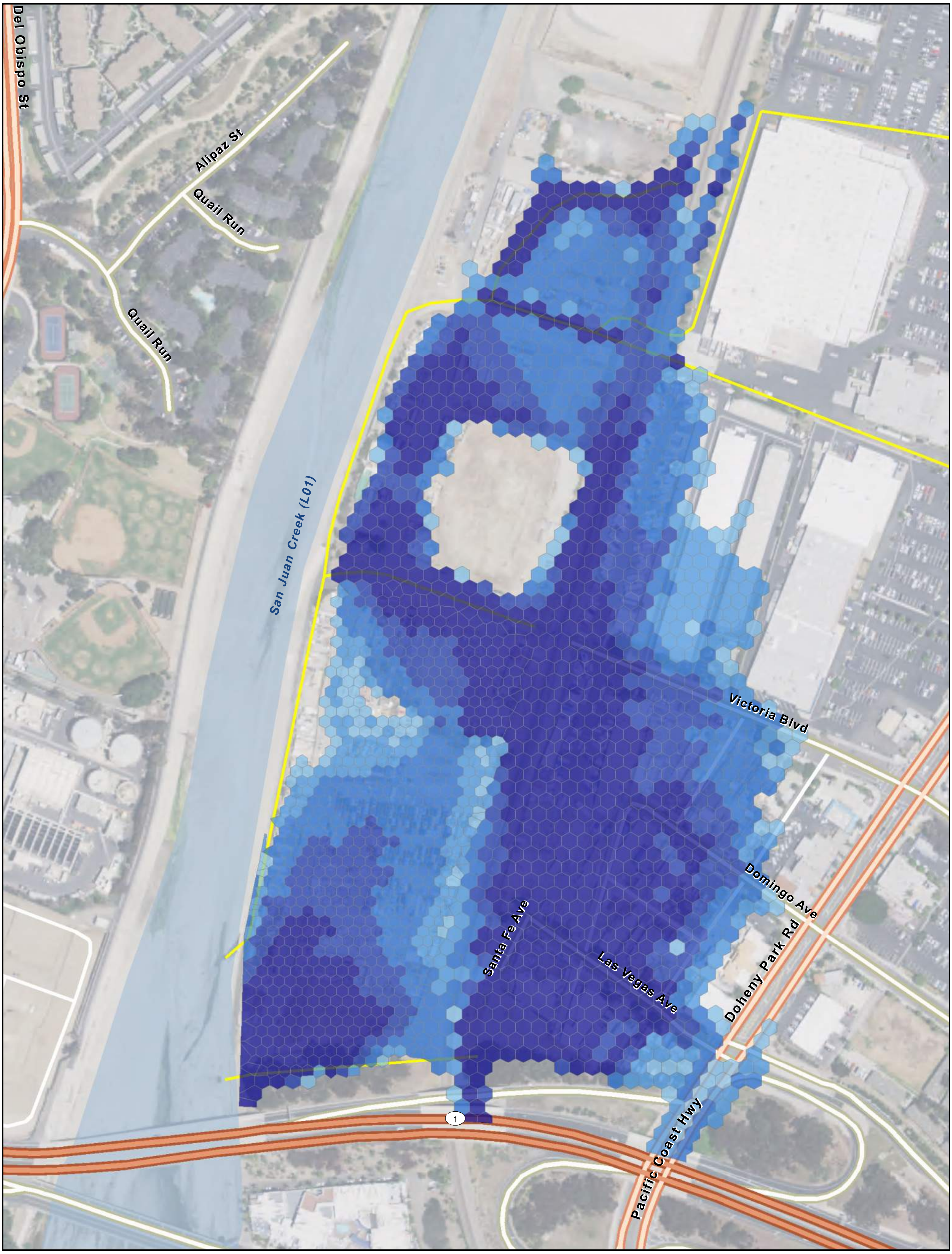
Job Number 11125157
Revision A
Date 09 May 2017

Figure 3.7

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 100-Year Event, Existing Condition

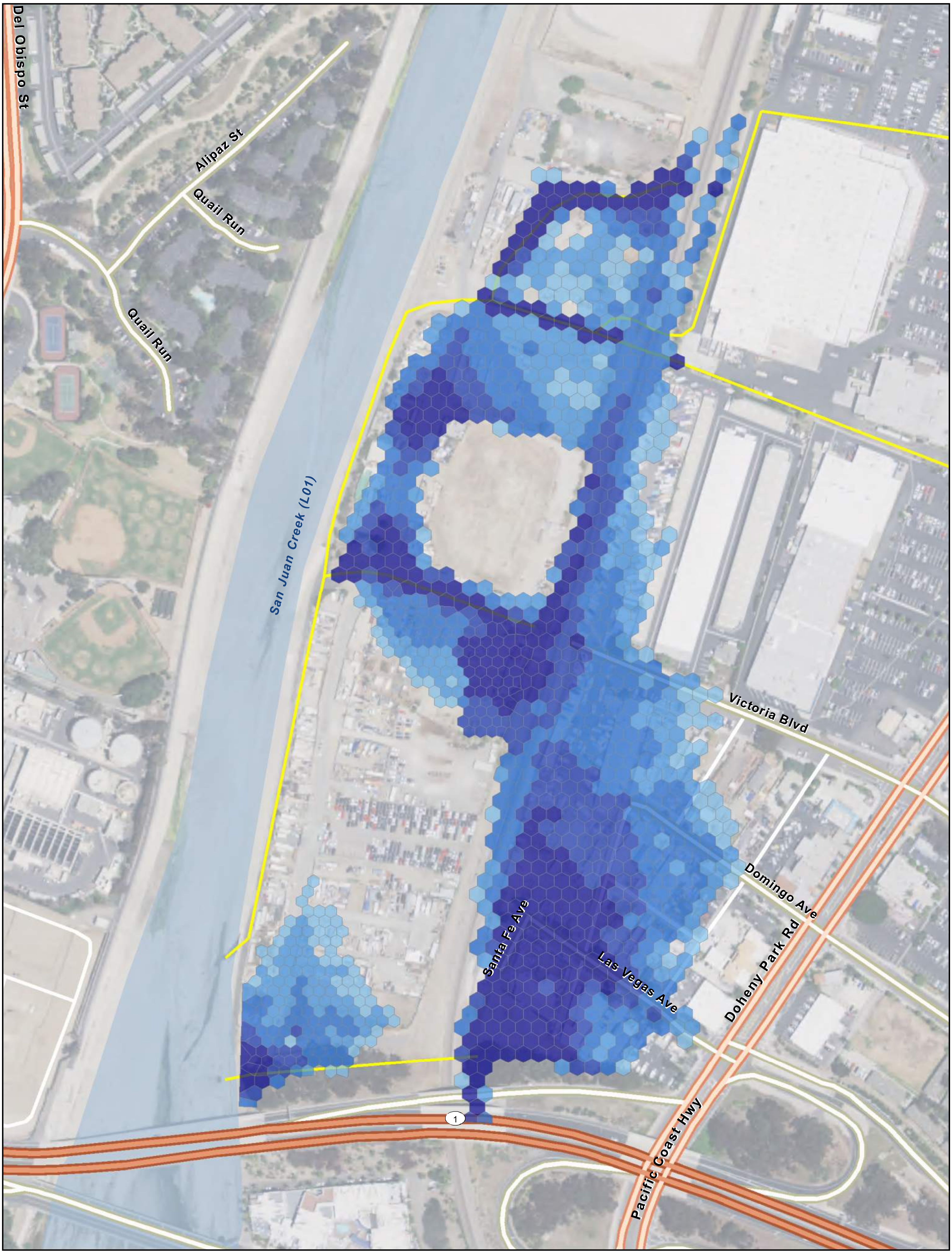
Job Number	11125157
Revision	A
Date	09 May 2017

Figure 3.8

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 100-Year Event, Existing Condition without San Juan Creek overtopping

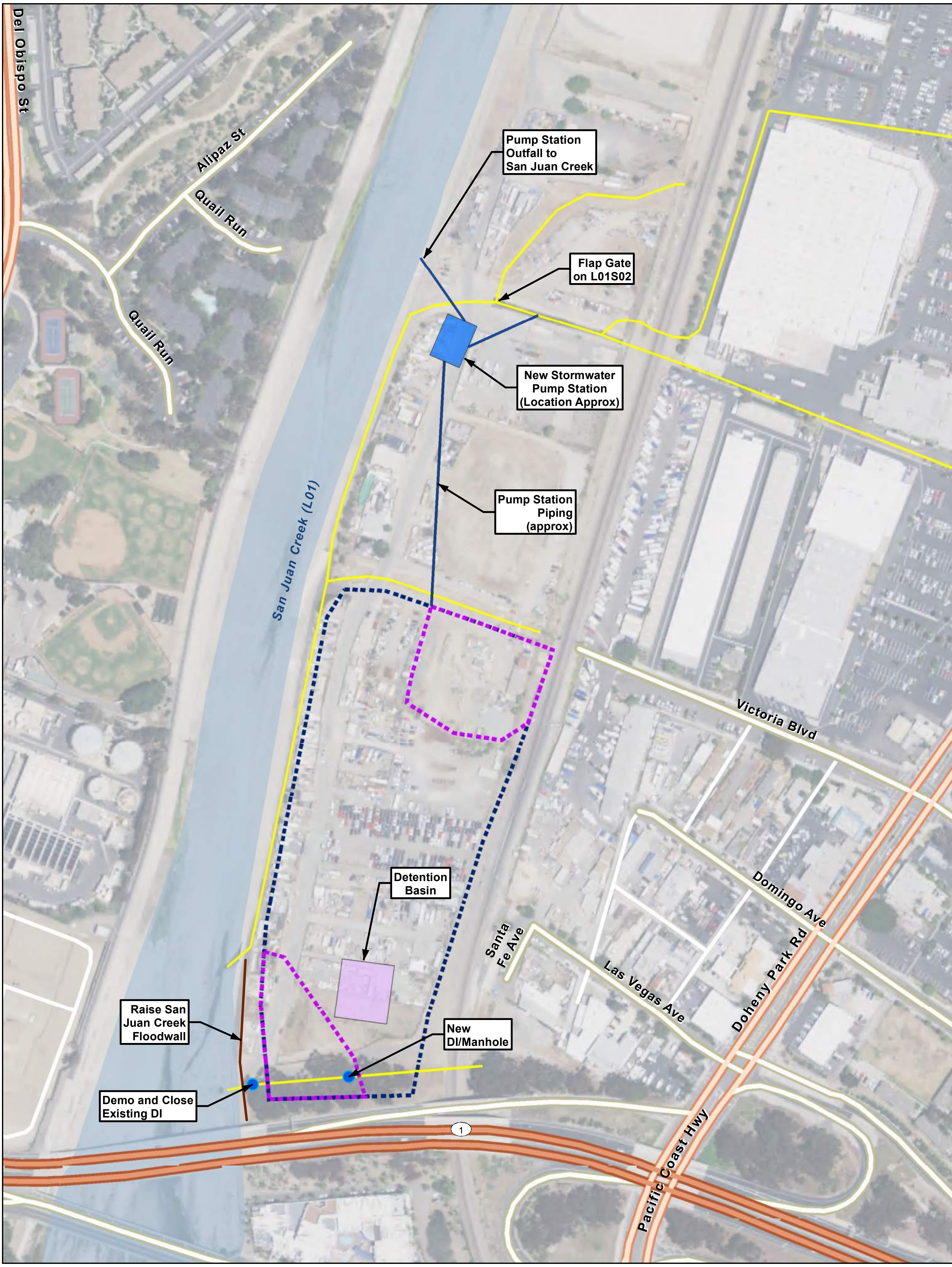
Job Number 11125157
Revision A
Date 09 May 2017

Figure 3.9

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)
Proposed Drainage Inlet
Proposed Floodwall
Proposed Pump Station Piping
Proposed Pump Station
Proposed Detention Basin
Approx. Limits of Grading, Alternative 4
Approx. Limits of Grading, Alternatives 1, 2, & 3

Paper Size ANSI B
0 100 200 300
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District
Doheny Desalination Project Drainage Analysis

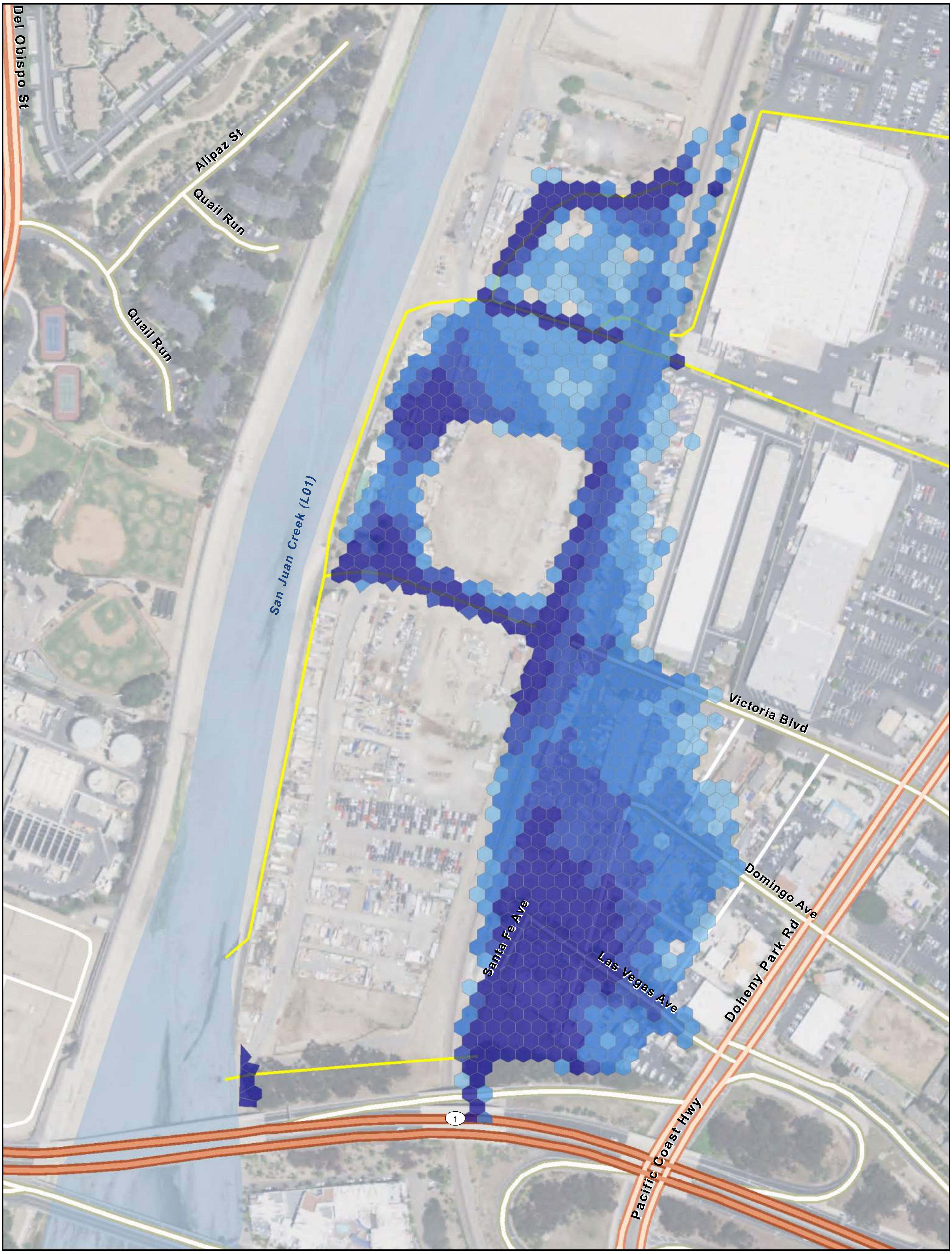
Job Number	11125157
Revision	A
Date	08 May 2017

Proposed Improvement Options Figure 3.10

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_0310_ProposedImprovementOptions_ANSIB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 100-Year Event, Future Condition, Alternative 1

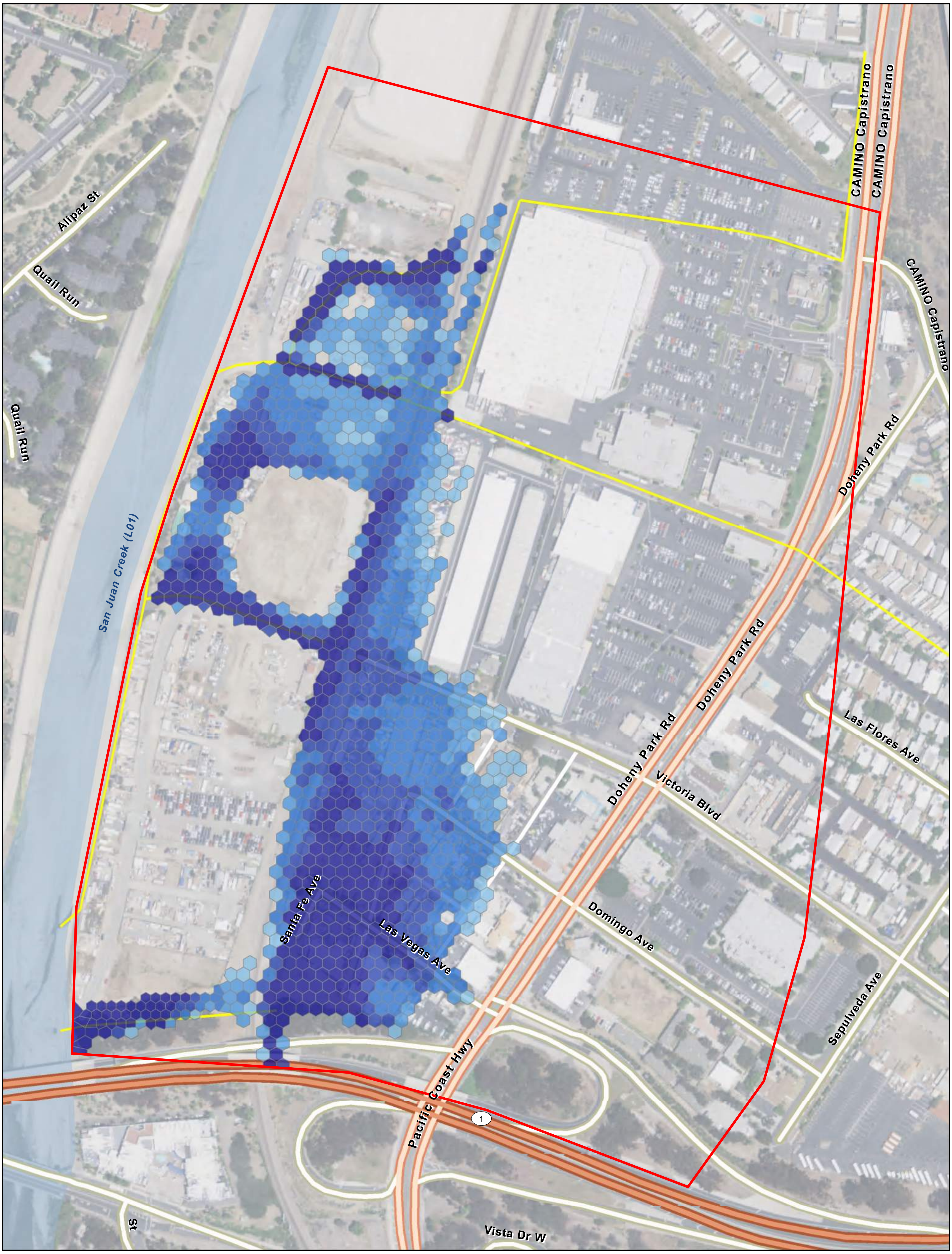
Job Number 11125157
Revision A
Date 09 May 2017

Figure 3.11

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Two-Dimensional Model Boundary

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District

Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 100-Year Event, Future Condition, Alternative 1a

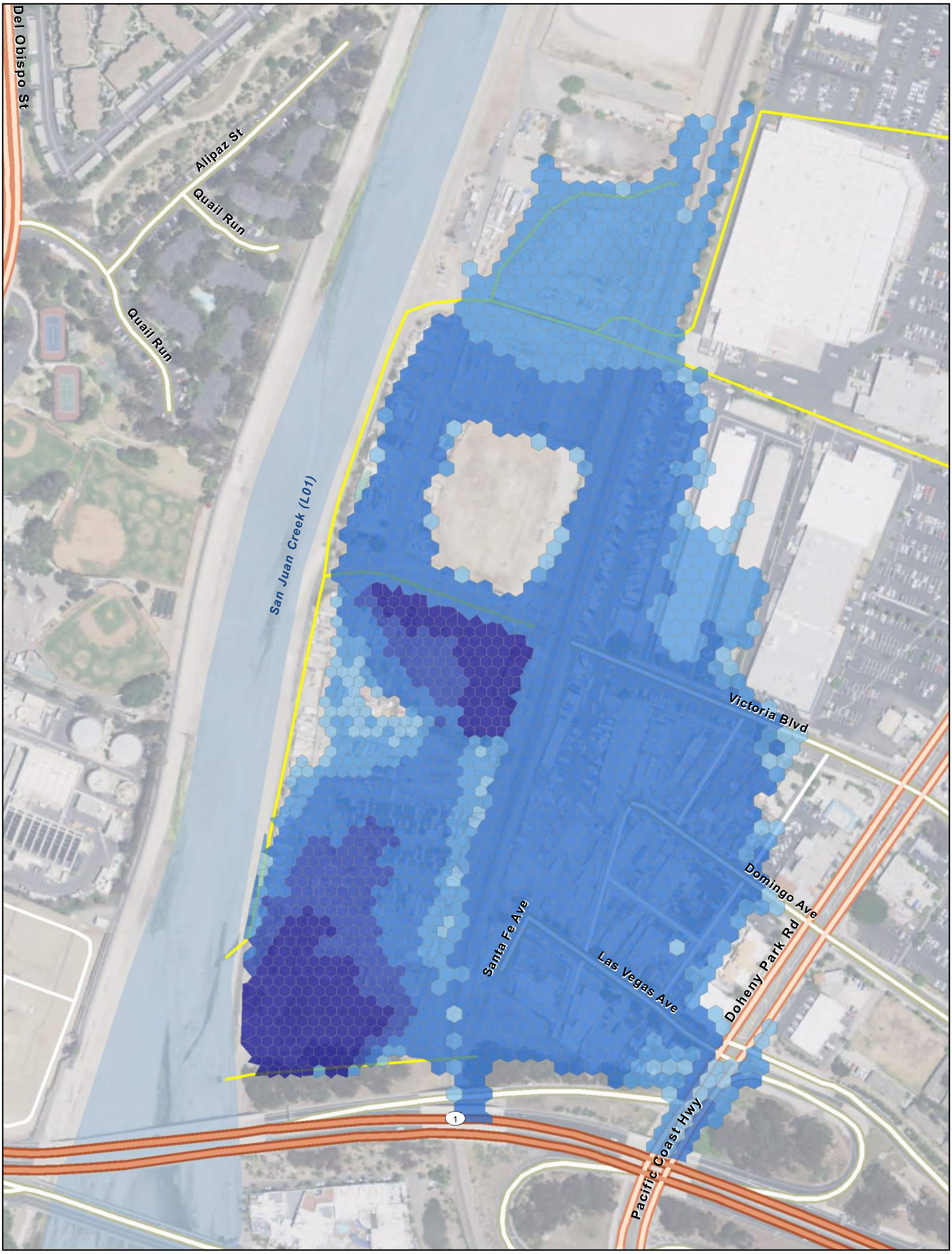
Job Number 11125157
Revision A
Date 12 Apr 2018

Figure 3.11a

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_0311a_FloodInundation.mxd

718 Third Street Eureka CA 95501 USA **T** 707 443 8326 **F** 707 444 8330 **E** eureka@ghd.com **W** www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Reduction in Maximum Flood Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B
0 100 200 300
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District
Doheny Desalination Project Drainage Analysis

Change in Flood Inundation, Existing Condition vs Alternative 1

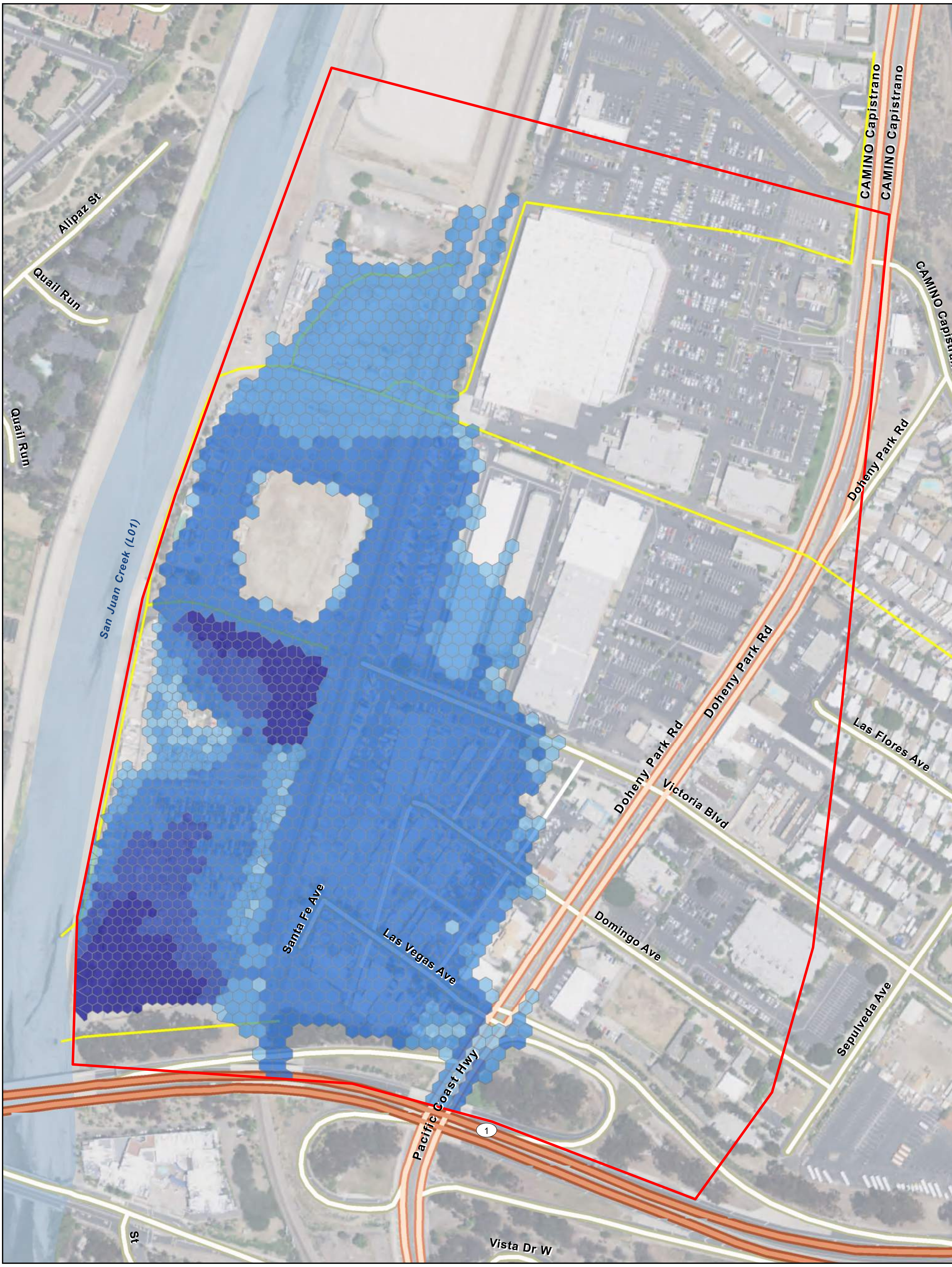
Job Number 11125157
Revision A
Date 09 May 2017

Figure 3.12

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Two-Dimensional Model Boundary

Reduction in Maximum Flood Depth

2-6"

6-12"

1-2'

2-3'

>3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District

Doheny Desalination Project Drainage Analysis

Change in Flood Inundation, Existing Condition vs Alternative 1a

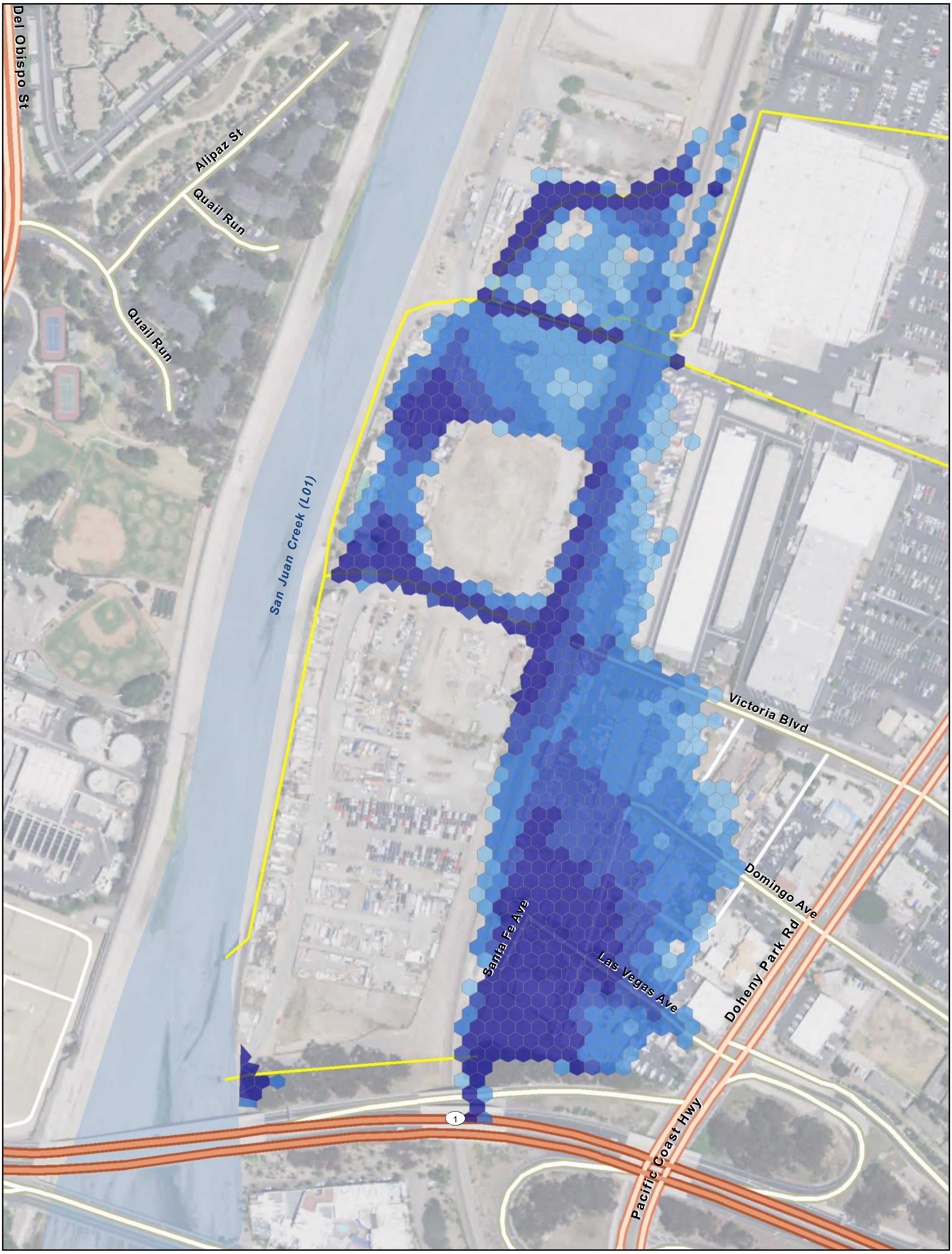
Job Number 11125157
Revision A
Date 12 Apr 2018

Figure 3.12a

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_0312a_FloodInundation.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 100-Year Event, Future Condition, Alternative 2

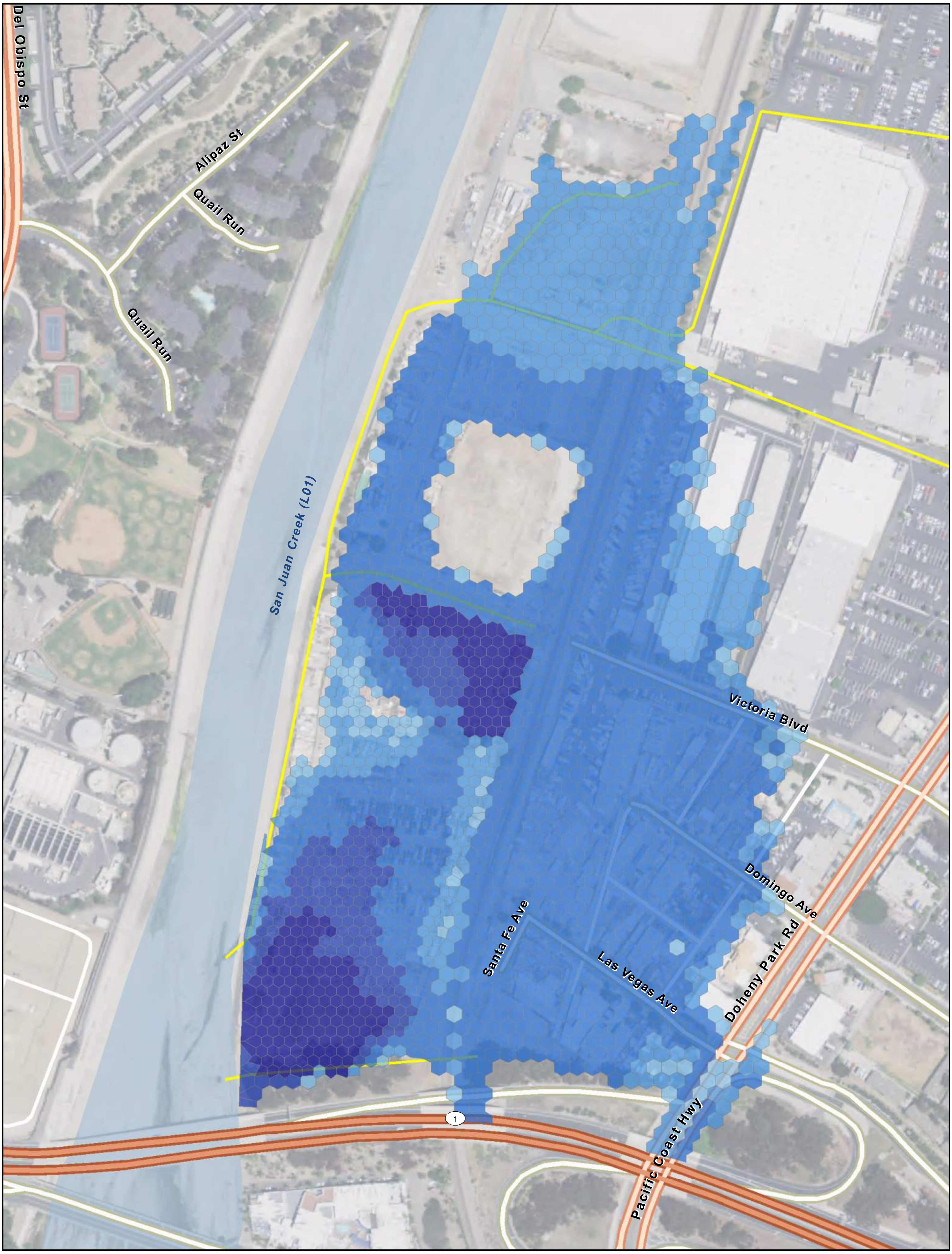
Job Number 11125157
Revision A
Date 09 May 2017

Figure 3.13

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA **T** 707 443 8326 **F** 707 444 8330 **E** eureka@ghd.com **W** www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Reduction in Maximum Flood Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Change in Flood Inundation, Existing Condition vs Alternative 2

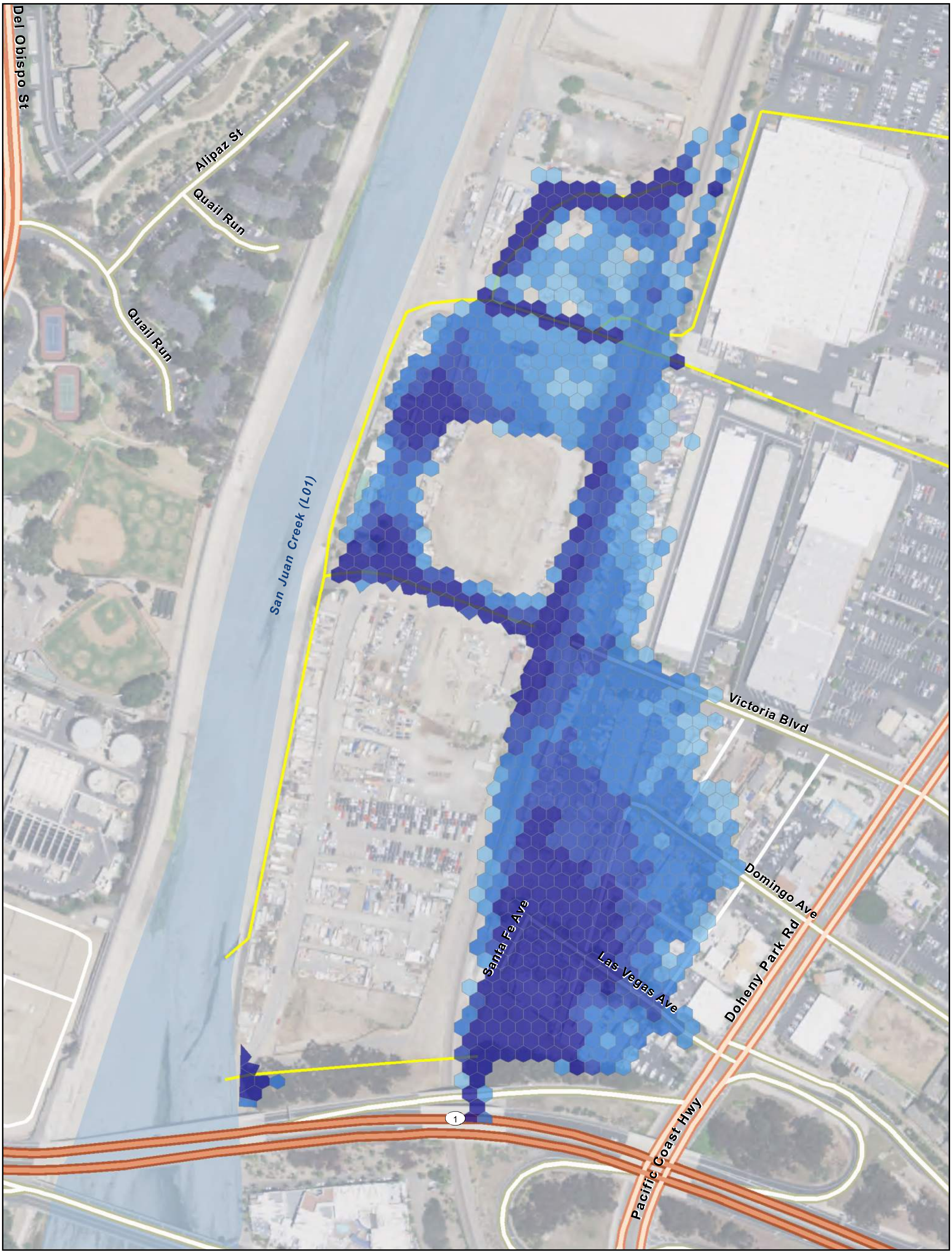
Job Number	11125157
Revision	A
Date	09 May 2017

Figure 3.14

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA **T** 707 443 8326 **F** 707 444 8330 **E** eureka@ghd.com **W** www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 100-Year Event, Future Condition, Alternative 3

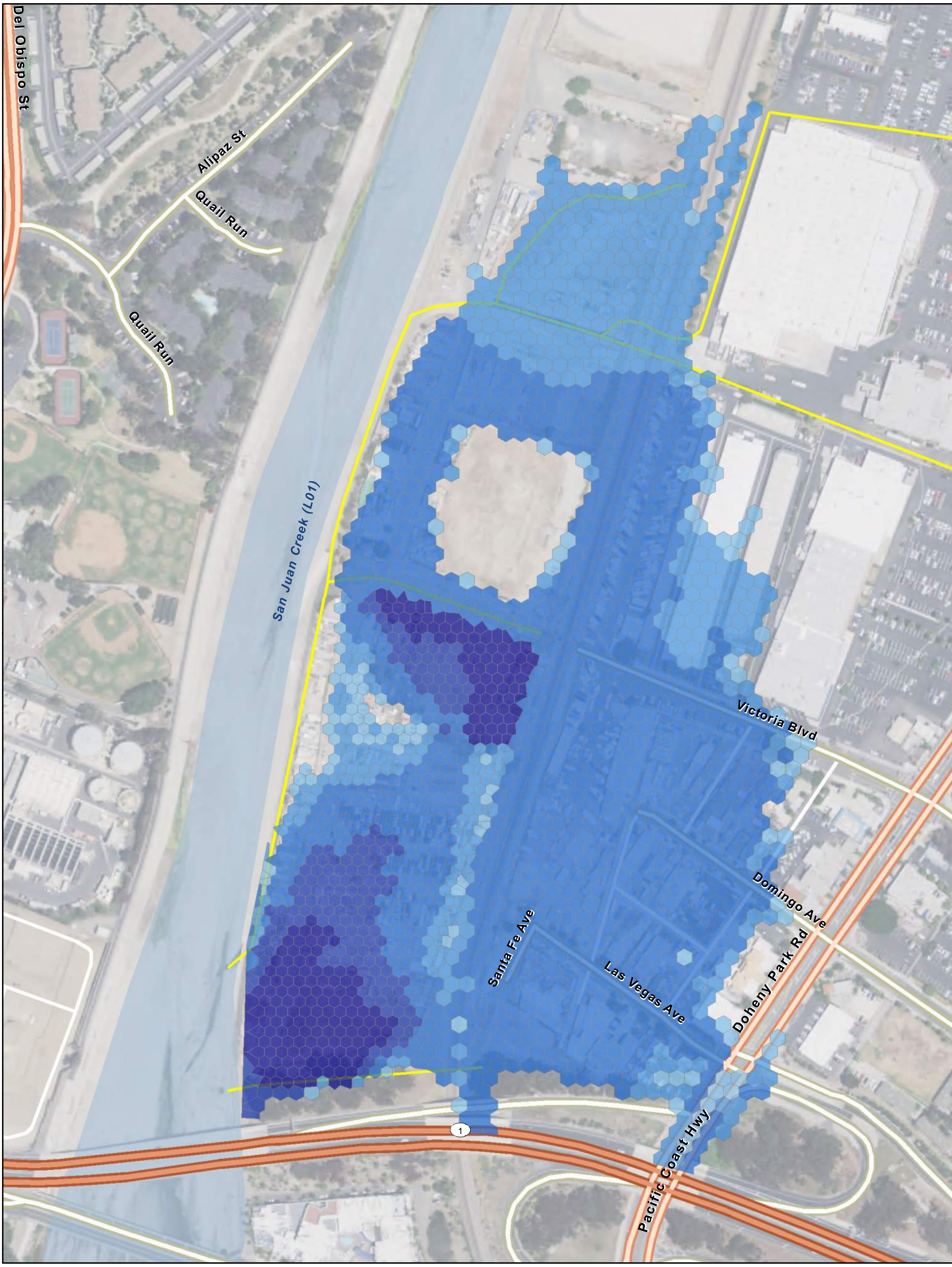
Job Number	11125157
Revision	A
Date	09 May 2017

Figure 3.15

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Reduction in Maximum Flood Depth

2-6" 6-12" 1-2' 2-3' >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District
Doheny Desalination Project Drainage Analysis

Change in Flood Inundation, Existing Condition vs Alternative 3

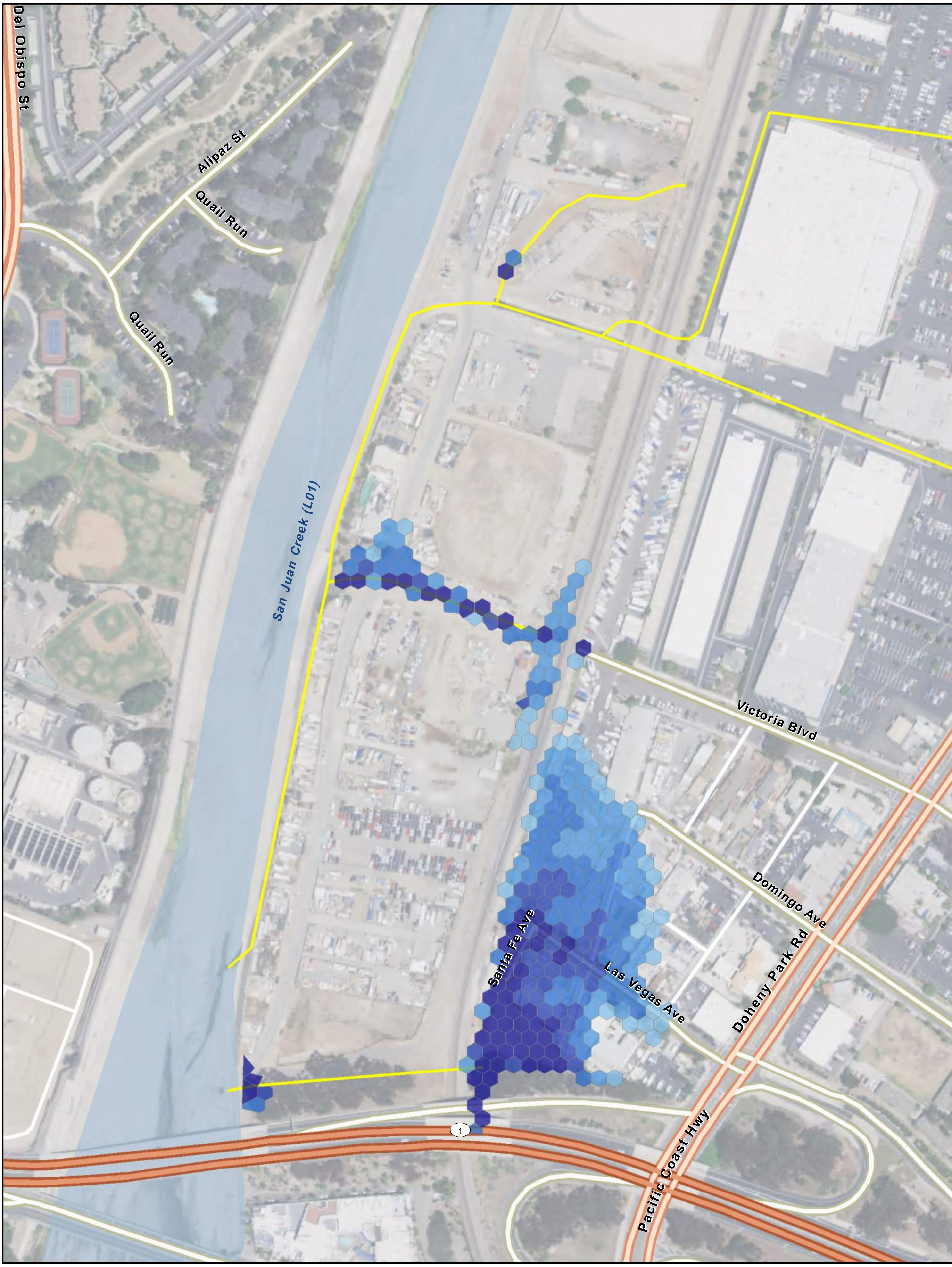
Job Number	11125157
Revision	A
Date	09 May 2017

Figure 3.16

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" 6-12" 1-2' 2-3' >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Job Number 11125157
Revision A
Date 09 May 2017

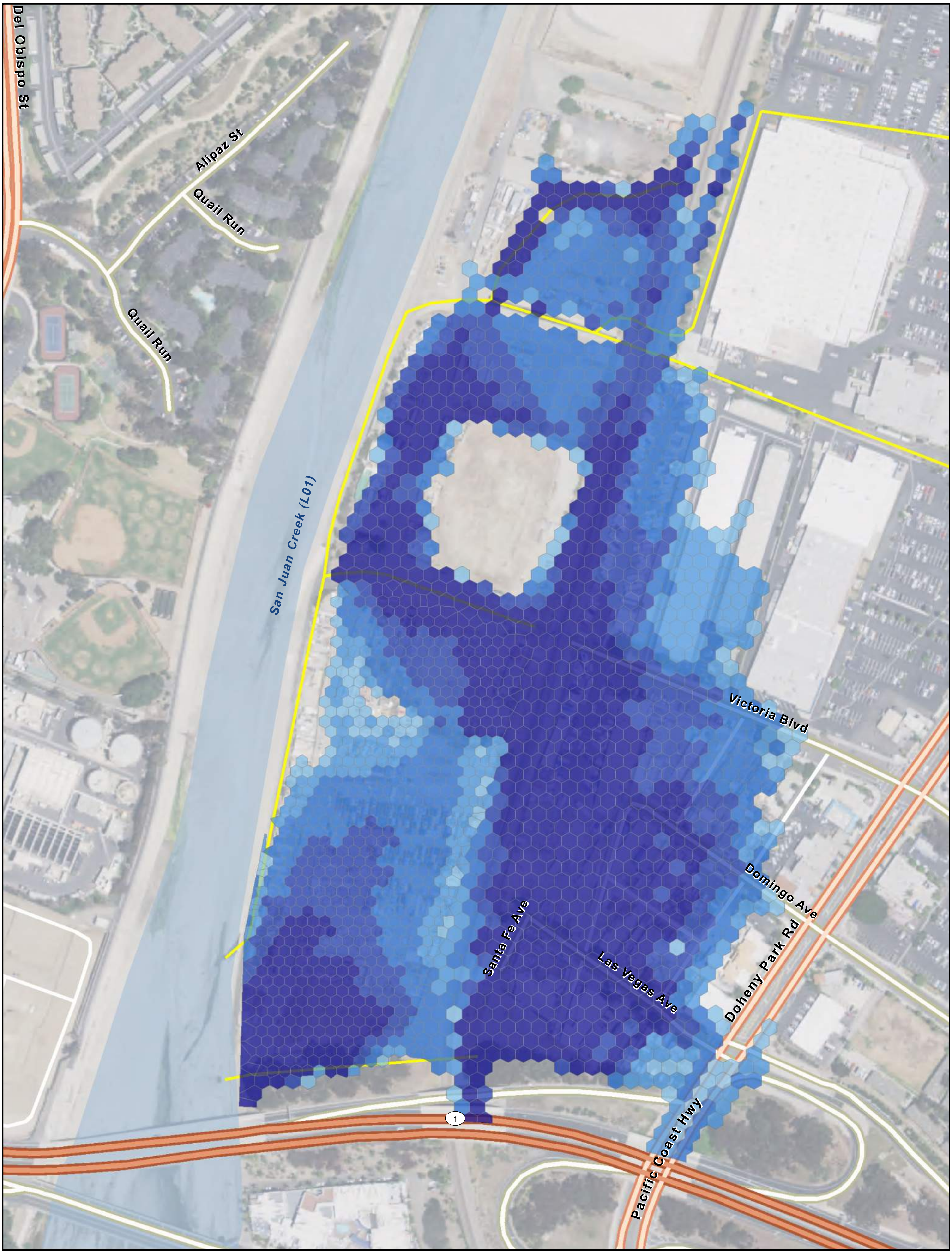
Flood Inundation Map, 100-Year Event, Future Condition, Alternative 4

Figure 3.17

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Reduction in Maximum Flood Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

South Coast Water District
Doheny Desalination Project Drainage Analysis

Change in Flood Inundation, Existing Condition vs Alternative 4

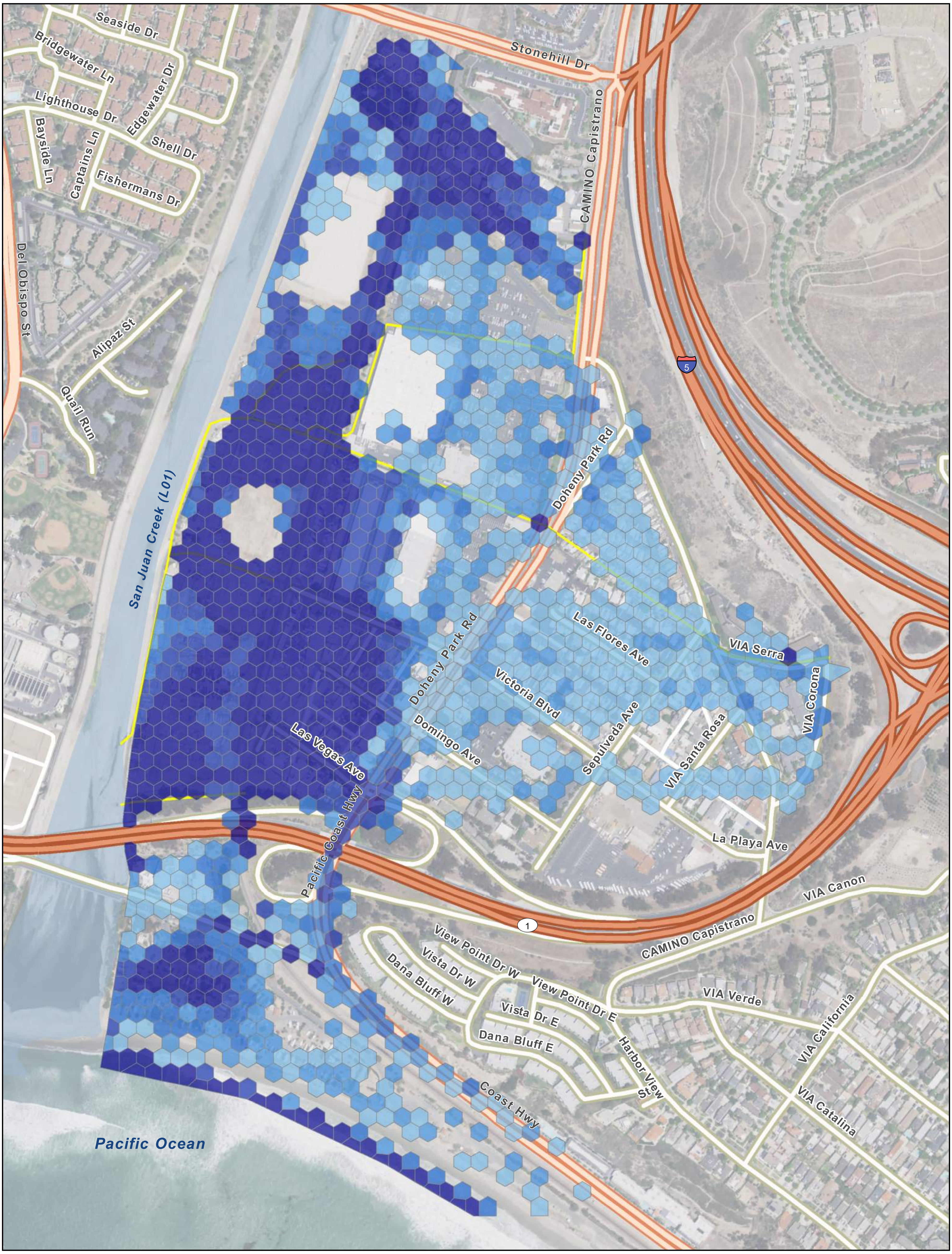
Job Number 11125157
Revision A
Date 09 May 2017

Figure 3.18

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_03_FloodInundation_MB.mxd

718 Third Street Eureka CA 95501 USA **T** 707 443 8326 **F** 707 444 8330 **E** eureka@ghd.com **W** www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:jclark2



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B
0 100 200 300
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 500-Year Event, Existing Condition

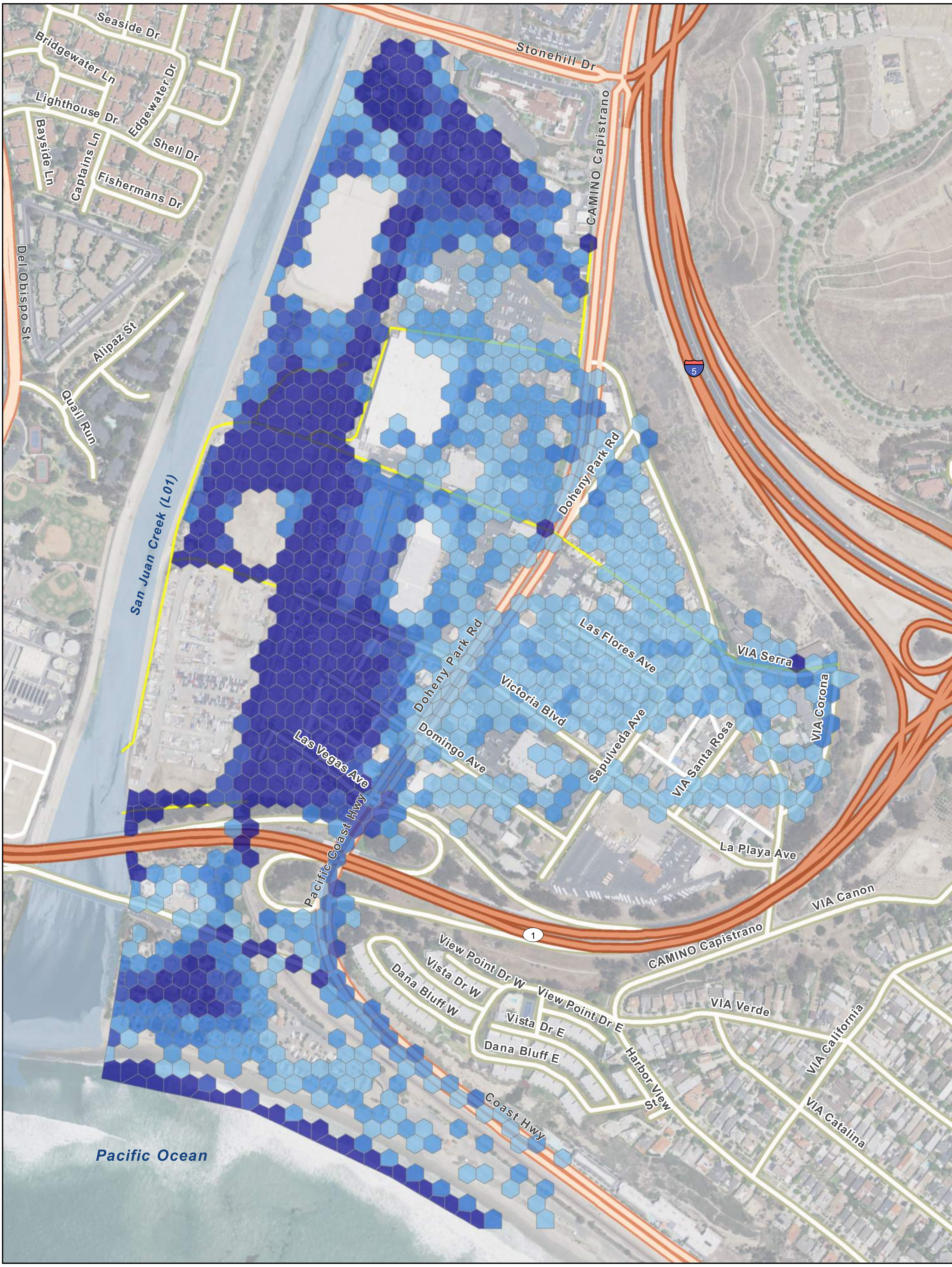
Job Number 11125157
Revision A
Date 16 Jan 2019

Figure 4.1

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_500_RevA.mxd

718 Third Street Eureka CA 95501 USA T 707 443 8326 F 707 444 8330 E eureka@ghd.com W www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:bnamsaly



Storm Water Conduits (in model)

Maximum Flooding Depth

2-6" | 6-12" | 1-2' | 2-3' | >3'

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District
Doheny Desalination Project Drainage Analysis

Flood Inundation Map, 500-Year Event, Future Condition

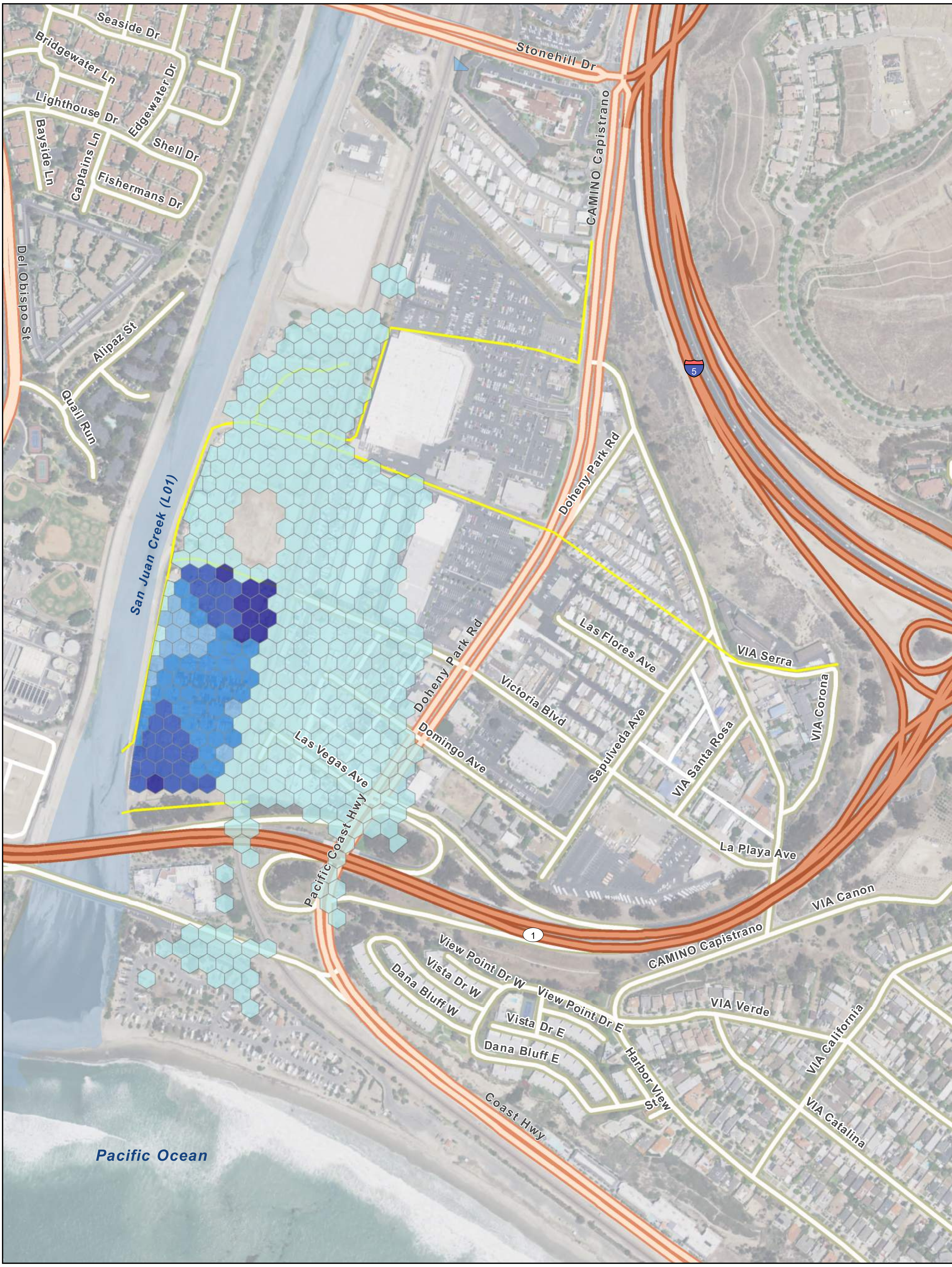
Job Number 11125157
Revision A
Date 16 Jan 2019

Figure 4.2

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_500_RevA.mxd

718 Third Street Eureka CA 95501 USA **T** 707 443 8326 **F** 707 444 8330 **E** eureka@ghd.com **W** www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:bnamsaly



Storm Water Conduits (in model)

Reduction in Maximum Flood Depth

2-6" | 6-12" | 1-2' | 2-3' | >3

Paper Size ANSI B

0 100 200 300

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane California VI FIPS 0406 Feet

N

GHD

South Coast Water District

Doheny Desalination Project Drainage Analysis

Change in Flood Inundation, 500-Year Event, Existing vs Future Condition

Job Number 11125157
Revision A
Date 16 Jan 2019

Figure 4.3

\\ghdnet\ghd\US\Irvine\Projects\111\11125157- SCWD TO #8B\08-GIS\Maps\Deliverables\380_11125157_500_RevA.mxd

718 Third Street Eureka CA 95501 USA **T** 707 443 8326 **F** 707 444 8330 **E** eureka@ghd.com **W** www.ghd.com

Data source: Aerial: NAIP, 2016; ESRI Street Map; GHD: elevation model. Created by:bnamsaly

Appendix A:

Historical Shoreline Assessment

To:	Mark Donovan, PE	Ref. No.:	11140040
From:	Jeffrey Doucette, Ph.D., P.Geo.(limited)	Tel:	19058144355
CC:	Raymond Wong, PhD, PE, LEED AP, CPESC		

Subject: **Doheny Desalinization Plant Historical Shoreline Assessment**

An historical aerial photographic assessment was conducted to complement the beach erosion assessment provided in the *Coastal Hazards Analysis for the Doheny Desalination Project* by Jenkins (2017). Jenkins (2017) reviewed historical beach surveys at Doheny State Beach from 2001 to 2007. He concluded that the beach was stable due to the relatively small seasonal variation in beach widths. The site was located at San Juan Creek which was a significant sediment source providing approximately 51,000 metric tons of beach grade sand to the site annually (Jenkins, 2017). This large sediment source allows the beach to maintain equilibrium profile adjustments through high El Nino and large seasonal cycles. Jenkins (2017) concluded that there was adequate sand cover to assume that the profile would shift according to Bruun's Rule due to sea level rise. This means that the profile will shift landward, however it will maintain its existing equilibrium shape. Runup elevation will therefore not be impacted by changes to the shoreline due to sea level rise.

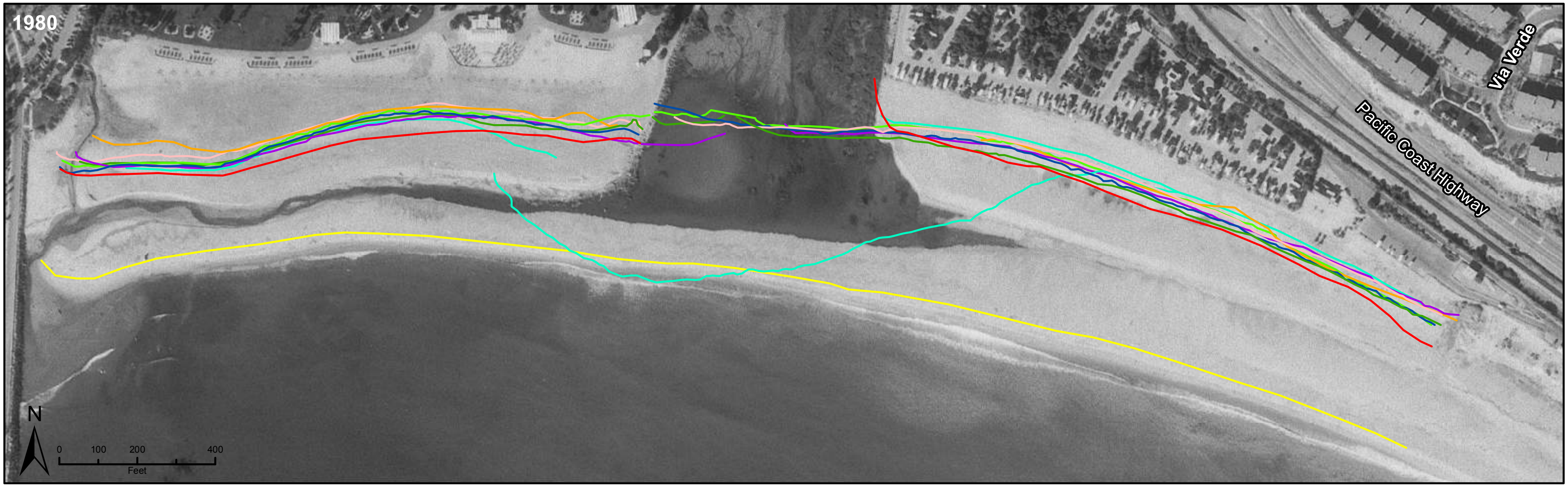
An historical aerial photographic assessment was conducted to confirm the observations that the beach width has been relatively stable by using older aerial photographs to determine if there has been any systematic shoreline change over time. The shoreline was traced in aerial photographs for 1975, 1980, 2004, and 2011 from the U.S. Geological Survey (USGS) and 2009, 2015, and 2016 from Google Earth Pro.

The shoreline was defined in each aerial photograph as the top of berm. Interpretation of the top of berm location within the aerial photographs was not exact given the difficulty in identifying this change in slope within the two-dimensional photographs. Generally changes in shading on the beach were used to determine the break in slope. Interpretation of the top of berm was spot checked using LIDAR data from NOAA from 2004 and 2014. All traces of the berm location were overlaid and shown in **Attachment A**.

Most of the traces of berm location fall within an approximately 60 m wide band over the approximate 180 m to 300 m wide subaerial beach. Notable exceptions were the location of the berm in 1980 and 2011. Two distinct berm locations were noted in 1980. One landward berm at a similar location to other years, and one berm much further seaward than any other years assessed. The seaward berm was likely due to a large flood event within San Juan Creek which discharged a large amount of sediment into the nearshore. This material was redistributed parallel to the shore by the incident waves. The landward berm was likely the location of the beach face before the large discharge event. A similar event was evident in 2011 where a large bar/delta feature was protruding from the shoreline. This feature would be redistributed parallel to the shoreline over time by the incident waves.

If we discount the seaward 1980 berm, the 1975 image had the widest beach and more recent images had narrower beaches. However there was no systematic trend in beach narrowing as the position of the berm moved both seaward and landward from year to year. Additional seasonal variability would be expected based on the typical California beach evolution between accretional summer profiles and erosional winter profiles. Other impacts to shoreline variability could be due to beach nourishment projects.

Overall Doheny State Beach generally appeared to be in an equilibrium condition based on the historical aerial photographs used on the assessment. Sediment input from the San Juan Creek and potential beach nourishment projects in the past have maintained a relatively stable shoreline. A historical erosion rate could not be determined to apply to future adjustments due to sea level rise. Application of the Bruun Rule as described in Jenkins (2017) is recommended to account for erosion impacts of sea level rise.



Legend

Historical Berm Locations

- 1975
- 1980 (Fore Berm)
- 1980 (Back Berm)
- 2004
- 2009
- 2010
- 2011
- 2015
- 2016

Berm Locations: GHD, 2016; Imagery: USGS, 1980 & Google Earth Pro, 2016.

Historical Shoreline Assessment

Doheny State Park,
California

ATTACHMENT A
DATE: MARCH 2017
PROJECT: 11140040
DRAWN BY: J.D., R.G.

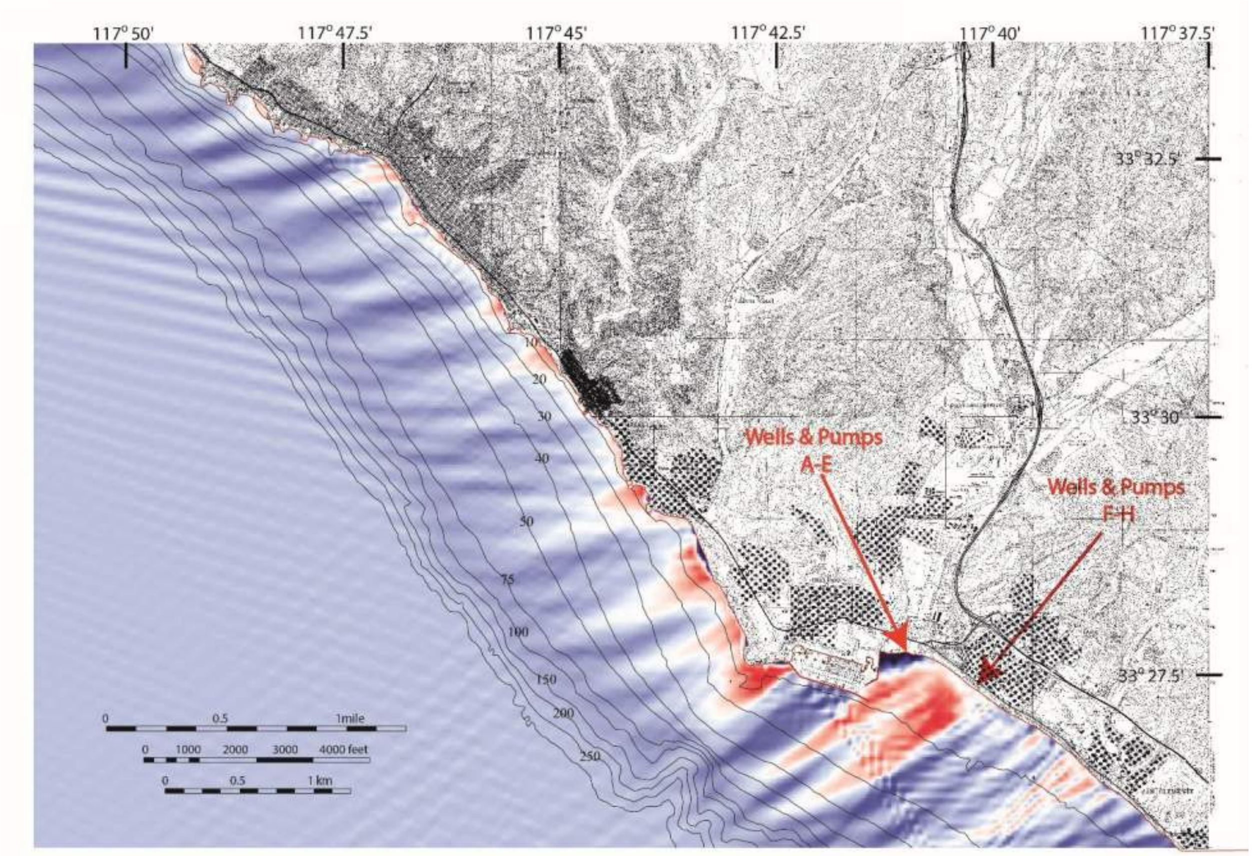
GHD

Appendix B:

Coastal Hazards Analysis

Coastal Hazards Analysis for the Doheny Desalination Project for the Final EIR

By Scott A. Jenkins, Ph.D.



Dana Point wave refraction for the 25 January 1983 storm
Wave height at offshore control point = 2.1 m, T=19.5 sec, from 246°.

Submitted by:
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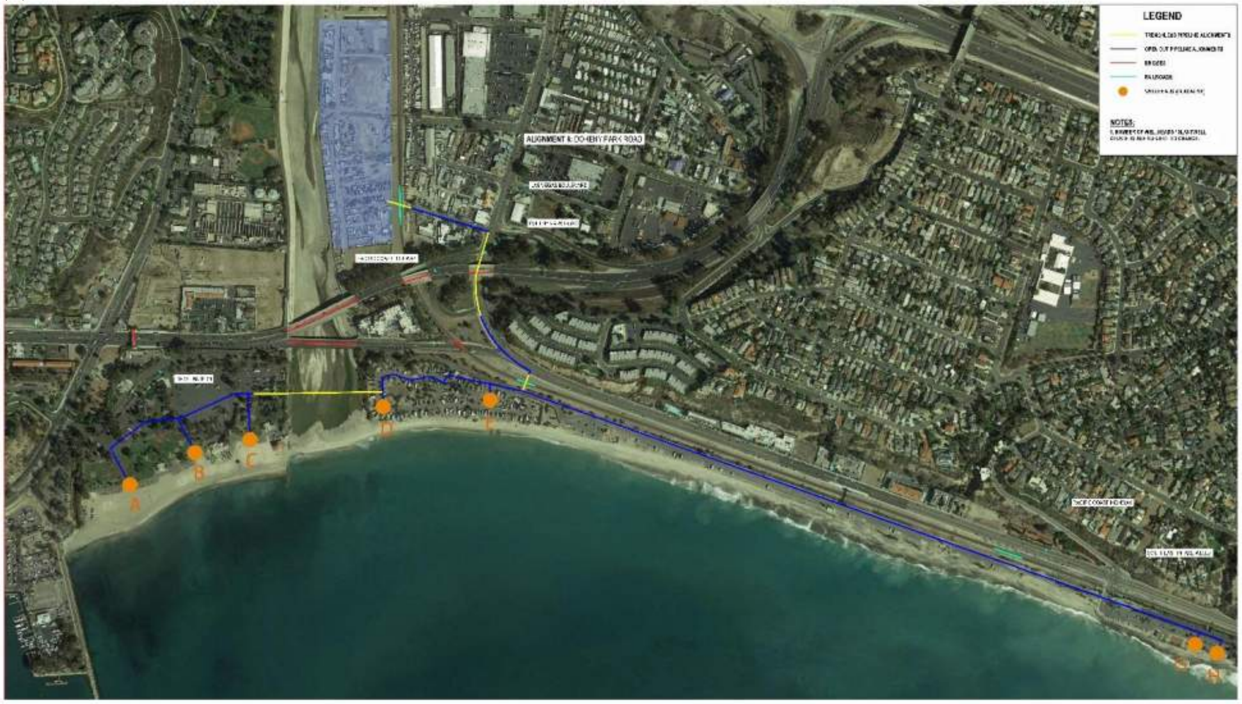
EXECUTIVE SUMMARY:

This 2019 study, prepared in response to comments for the Final EIR, provides further analysis to amplify the Coastal Hazards Analysis prepared in 2017 for the Draft EIR of the Doheny Desalination Project (DDP). That earlier work is being amplified herein in response to a revision of the *California Coastal Commission Sea Level Rise Policy Guidance* document that was originally released in August 2015, (CCC, 2015), but has been updated in July 2018 with new sea level rise projections. In addition, there have been minor adjustments in the locations of a number of the well heads and pump stations being proposed for the Doheny Desalination Project. The following study accounts for these intervening changes in policy guidance and minor modifications to the project description.

The primary analysis tool used in this study is the *Coastal Evolution Model* (CEM) developed at the Scripps Institution of Oceanography was used to evaluate Appendix-B requirements of the *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2015) for a sea level rise/coastal hazards analysis of the DDP. The Coastal Evolution Model is public domain and available from the University of California Digital Library at: http://repositories.cdlib.org/sio/techreport/58/. The Coastal Evolution Model employs algorithms consistent with the U.S. Army Corps of Engineers *Coastal Engineering Manual*, (USACE, 2006), but employs the latest generation equilibrium beach profile algorithms from Jenkins and Inman (2006) that provide 3-dimensional predictive and mapping capability of the wave run-up field, beach erosion and shoreline recession under the effects of wave climate variability, climate cycles and sea level rise. The CEM input files were populated with National Ocean Survey digital bathymetry in the offshore domain; beach profiles sediment grain size measurements by the U.S. Army Corps of Engineers, Coastal Environments and Coastal Frontiers; long-term wave data from the Coastal Data Information Program; long-term ocean water level measurements by the National Oceanic and Atmospheric Administration (NOAA); and stream flow and sediment flux for the San Juan Creek from the United States Geological Survey (USGS) and the Federal Emergency Management Agency (FEMA). Sea level rise projections used in this study were based on the *best fit equation* from Appendix-B of the *California Coastal Commission Sea Level Rise Policy Guidance* document for a 50 year project planning horizon (year 2070) and for a *critical infrastructure* planning horizon (year 2100). Critical project infrastructure subject to potential flooding by extreme event waves or tsunami concurrent with extreme ocean water levels and sea level rise are placed at two sites, namely Doheny State Beach and Capistrano Beach Park (cf. Figure ES-1a & b). At the Doheny Beach site, five potential locations are being evaluated for vaulted well heads with submersible pumps, including: ***Well Head A***, elevation 17 ft. NAVD, at 33°27'44.38"N, 117°41'16.32"W; ***Well Head B***, elevation 17 ft. NAVD, at 33°27'45.07"N, 117°41'10.30"W; ***Well Head C***, elevation 17 ft. NAVD at 33°27'45.12"N, 117°41'6.62"W; ***Well Head D***, at elevation 18 ft. NAVD at 33°27'44.48"N, 117°40'55.30"W; and ***Well Head E***, at elevation 18 ft. NAVD at 33°27'42.45"N, 117°40'47.33"W; (see Figure ES-1a). Two additional vaulted well heads with submersible pumps are being evaluated at the Capistrano Beach site (Figure ES-1b), which includes: ***Well Head G***, at elevation 18 ft. NAVD at 33°27'14.94"N, 117°39'59.91"W; and ***Well Head H***, at elevation 19 ft. NAVD at 33°27'13.17"N, 117°39'57.15"W.

This study is based on sea level rise projections appearing in Appendix-G, Table G-11, of the recently updated *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2018). This document provides no specific guidance on the redline frequency for flooding or inundation. In the absence of such guidance we have adopted FEMA standards for flooding

(a)



(b)

Figure ES-1: Critical shore-front infrastructure locations for the Doheny Desalination Project: a) Doheny State Beach site; and b) Capistrano Beach Park site frequency and set redline planning frequency at the 100 year event (1% probability of recurrence). The 100 year wave event was the two day storm of 17-18 January, 1988, which produced deep water significant wave heights off Doheny State Beach reaching 15.5 ft., approaching the beach from 270^0 with 14 second significant wave periods. An analysis of extremal total water levels, (TWL's), based on the occurrence of extreme waves concurrent with extreme ocean water levels at present and at year 2100 sea levels, is summarized in Table ES-1a for structures at the Doheny Beach site and Table ES-1 b for the Capistrano Beach site. Inspection of Table ES-1a & b reveals that all the beach front well sites for the Doheny Desalination Project (Figure ES-1) are safe from flooding or inundation at present sea levels by extreme event waves concurrent with extreme ocean water levels for event return periods between 1 yr. and 100 yr. However, once we admit to 2100 sea level rise projections, a number of the beach front facilities for the Doheny Desalination Project will suffer some flooding and overtopping to varying degrees.

For the low-range 2100 sea level projections, the three well sites on the north side of San Juan Creek (Well Heads A-C) and one of the wells at the Capistrano Beach site (Well Head G) will experience minor overtopping, even for a 1 year event if the beaches have been accreted by additional sands from water shed floods or still retain a built-out summer equilibrium beach profile, with overtopping rates of about Q'(1yr) = 0.038 cfs per lineal ft. of shoreline. However, if a 100-yr total water level event occurs during the low-range projection of 2100 sea levels, then all of the well sites will be overtopped to varying degrees if the beaches remain in an accreted condition with elevated berms and steep beach slopes. Under these beach conditions, overtopping rates will range from a high of Q'(100yr) = 0.094 cfs per lineal ft. of shoreline at Well Heads A- C, to a low of Q'(100yr) = 0.014 cfs/ft at Well Head H. Interestingly enough, none of the well heads would experience overtopping during a 100 year event when occurring during the low range 2100 sea levels if the beach were eroded, which would be the most likely condition during a 100-year event. Total water levels for eroded beach conditions are always less, because these beaches have flatter slopes and are more dissipative of wave set-up and run-up than the steeper accreted beaches.

For the high-range 2100 sea level projections, Table ES-1a indicates the 100 year total water level events at the Doheny Beach site reach *TWL*(100) = 21.9 ft. NAVD for the steeply sloping accreted beach conditions and *TWL*(100) = 20.2 ft. NAVD for the eroded beach conditions. At the Capistrano Beach site, shoaling wave heights are higher and total water levels for a 100 year event superimposed on the high range projections for 2100 sea levels produce total water levels reaching *TWL*(100) = 22.7 ft. NAVD for the steeply sloping accreted beach conditions and *TWL*(100) = 21.1 ft. NAVD for the eroded beach conditions. Consequently, all beach front well head vaults for the Doheny Desalination Project will be overtopped when extreme waves happen concurrently with extreme ocean water levels that are superimposed on the high range of 2100 sea levels. The lowest lying well heads (Well Heads A-C) would experience the highest overtopping rates, ranging from Q'(100yr) = 0.216 cfs/ft. to 0.331 cfs/ft. depending on the eroded or accreted condition of Doheny State Beach. According Table VI-5-6 in the Coastal Engineering Manual (USACE, 2006) overtopping rates of this order of magnitude are very dangerous for pedestrian and vehicle traffic, and may cause structural damage to adjacent buildings, but the well heads and pumps for the Doheny Desalination project will be protected by steel vault enclosures. The smallest overtopping rates during the 100-year event at the high range

Table ES-1a: Doheny Beach Extremal Total Water Level (*TWL) and Overtopping Rates (Q')

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
*$TWL(1)$ Present Sea Level (eroded/accreted)	8.7/10.5 ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry
*$Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = dry	15.8/17.6 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ Present Sea Level (eroded/accreted)	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry
**$Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach
**$Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.027 cfs/ft.	0.0/0.027 cfs/ft.
**$TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded
**$Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.149/0.263 cfs/ft.	0.149/0.263 cfs/ft.

*Evaluated for the 1-yr return period; ** Evaluated for the 100-yr return period

Table ES-1b: Capistrano Beach Extremal Total Water Level (TWL) and Overtopping Rates (Q')

	Well Head-G Elevation = 18 ft. NAVD	Well Head-H Elevation = 19 ft. NAVD
*$TWL(1)$ Present Sea Level (eroded/accreted)	9.7/11.5 ft. NAVD status = dry	9.7/11.5 ft. NAVD status = dry
*$Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	13.3/15.1 ft. NAVD status = dry	13.3/15.1 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	16.8/18.6 ft. NAVD status = flooded accreted beach	16.8/18.6 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.00 cfs/ft.
**$TWL(100)$ Present Sea Level (eroded/accreted)	14.0/15.6 ft. NAVD status = dry	14.0/15.6 ft. NAVD status = dry
**$Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	17.6/19.2 ft. NAVD status = flooded accreted beach	17.6/19.2 ft. NAVD status = flooded accreted beach
**$Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.081 cfs/ft.	0.0/0.014 cfs/ft.
**$TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	21.1/22.7 ft. NAVD status = flooded	21.1/22.7 ft. NAVD status = flooded
**$Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.209/0.318 cfs/ft.	0.142/0.250 cfs/ft.

*Evaluated for the 1-yr return period; ** Evaluated for the 100-yr return period

2100 sea level projections will occur at the highest located well head (Well Head H) at the Capistrano Beach site where overtopping rates will range from Q'(100yr) = 0.142 cfs/ft. to 0.250 cfs/ft. While these overtopping rates are still dangerous to pedestrian and vehicle traffic, they are easily managed by the steel vault enclosures of the well heads and pumps being placed at Capistrano Beach.

Tsunami induced erosion, runup, and inundation were analyzed for the Doheny and Capistrano Beaches and shore-side facilities associated with the Doheny Desalination Project for present and future sea levels according to low and high range sea level rise predictions. The analysis was based on numerical refraction/diffraction codes for a shoaling solitary wave. The tsunami event scenario is based on a 2m high solitary wave approaching Doheny Beach from 165 degrees true, as could be anticipated for a catastrophic tsunami event arising from a major landside on the east side of San Clemente Island. The local refraction/diffraction pattern from the solitary wave reveals the tsunami wave height begins to increase at 50 m of water depth due to shoaling, and reaches 6m of height before breaking along the shores of Doheny and Capistrano Beaches. Because the tsunami wave begins shoaling in much deeper water than typical storm-induced waves, it causes seabed scour and erosion to occur out to very deep-water depths. Therefore, all run-up and total water level solutions are based eroded beach profile conditions.

Tsunami TWL inundation calculations are summarized Table ES-2a for the Doheny Beach site, and Table ES-2b for the Capistrano Beach site. These tables indicate that all of the shore facilities of the Doheny Desalination Project are above tsunami inundation levels at present sea level. However, all of the well heads at both Doheny and Capistrano Beaches would suffer some degree of tsunami overtopping if concurrent with 2100 sea levels, and the overtopping rates could be quite severe, especially for the high 2100 sea level rise projections. At the low range of 2100 sea level projections, total water levels would reach *TWL* = 18.82 ft. NAVD at Doheny Beach and *TWL* = 18.83 ft. NAVD at Capistrano Beach. Well Heads A-C at Doheny Beach would experience the highest overtopping surges of Q' = 1.142 cfs/ft while Well Head G at Capistrano Beach would remain high and dry. However, if the tsunami occurred atop the high range sea level rise projections for year 2100, then total water levels would reach *TWL* = 22.31 ft. NAVD at Doheny Beach and *TWL* = 22.4 ft. NAVD at Capistrano Beach, sufficient to overtop all the well sites of the Doheny Desalination project. In this case the tsunami surge could produce very high, although short-lived, overtopping rates reaching a maximum of Q' = 5.691 cfs/ft at Well Heads A-C on Doheny Beach and a minimum of Q' = 2.916 cfs/ft at Well Head H on Capistrano Beach. Undoubtedly, the steel vault enclosures of the well heads can be designed to withstand these high surge rates, but particular attention should be given to the foundations of the vaults to assure those foundations have adequate depth to prevent undercutting by scour. These findings are consistent with the FEMA tsunami flood map which show that all of the Doheny Beach/San Juan Creek corridor extending several miles inland will be inundated by a shoaling tsunami solitary wave.

Table ES-2a: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Doheny Beach Site

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
TWL Present Sea Level	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry
Q' Present Sea Level	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.
TWL 2100 Sea Level Low Range Projection	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded
Q' 2100 Sea Level Low Range Projection	1.142 cfs/ft.	1.142 cfs/ft.	1.142 cfs/ft.	0.345 cfs/ft.	0.345 cfs/ft.
TWL @ 2100 Sea Level High Range Projection	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded
Q' 2100 Sea Level High Range Projection	5.691 cfs/ft.	5.691 cfs/ft.	5.691 cfs/ft.	4.162 cfs/ft.	4.162 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Doheny State Beach from 165 degrees true

Table ES-2b: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Capistrano Beach Site

	Well Head-G Elevation = 18 ft. NAVD eroded/accreted	Well Head-H Elevation = 19 ft. NAVD eroded/accreted
$*TWL$ Present Sea Level (eroded)	15.3 ft. NAVD status = dry	15.3 ft. NAVD status = dry
$*Q'$ Present Sea Level (eroded)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL$ 2100 Sea Level Low Range Projection (eroded)	18.83 ft. NAVD status = flooded	18.83 ft. NAVD status = dry
$*Q'$ 2100 Sea Level Low Range Projection (eroded)	0.352 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL$ 2100 Sea Level High Range Projection (eroded)	22.4 ft. NAVD status = flooded	22.4 ft. NAVD status = flooded
$*Q'$ 2100 Sea Level High Range Projection (eroded)	4.293 cfs/ft.	2.916 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Capistrano Beach from 165 degrees true

Coastal Hazards Analysis for the Doheny Desalination Project for the Final EIR

by Scott A. Jenkins, Ph.D.

1) Introduction: The source water for the Doheny Desalination Project will be drawn from an array of slant wells that extract pore water from marine sediments that were deposited in a paleo-channel cut by the San Juan Creek across the continental shelf during the previous low-stand of sea level (ca. 18,000 yr B.P.; Inman et al, 2003). With the subsequent rise in sea level during the Flandrian Transgression, the paleo-channel in-filled with fluvial sediments from the San Juan Creek and littoral sediments from the adjacent nearshore, (Jenkins and Wasyl, 2005), leaving only the expression of a modern sand delta at the mouth of the San Juan Creek (denoted by light brown contours in Figure 1). Thus a large formation of marine valley-fill sediments is available seaward of the mouth of the San Juan Creek to provide sub-bottom filtration of ocean source water harvested by slant wells. Desalination of this source water by reverse osmosis (RO) is expected to present several possible discharge scenarios for disposal of the concentrated seawater by-product (brine), depending upon the production rate and recovery ratio. The Doheny Desalination Project will blend brine with treated wastewater and will discharge the combined effluent through the San Juan Creek Ocean Outfall (SJCOO). The SJCOO extends seaward 10,334 ft. from the mouth of the San Juan Creek, (Figure 1), in a 1,488 ft. total length L-shaped linear diffuser with a 216 ft long shoreline-normal section and a right angle dog-leg with a 1,272 ft diffuser section employing 125 discharge ports. The diffuser= discharges at local depths of 95 ft MSL (29 m MSL), at a distance of roughly 4,415 ft (1,346 m) from the edge of the continental shelf.

The coastal hazards analysis evaluates potential impacts of combinations of extreme waves and ocean water levels on these structures at both present and future sea levels; and conversely, potential impacts of these structures on nearshore erosion, sediment transport and shoreline stability. The study includes assimilation of long-term wave climate data bases to evaluate inundation by extreme wave and tsunami run-up that may affect stability and operations of subsurface desalination plant intake structures, (slant wells), as well as supporting shore facilities. The essential requirements for this study, as stated in the California Coastal Commission guidance document for Coastal Development Permits Applications are: 1) quantify the magnitude and extent to which the subsurface intake and associated shore zone structures could be subject to sea level rise, erosion, wave attack or wave run-up due to wave refraction/diffraction over local nearshore and shelf bathymetry over a projected lifespan; 2) quantify the of the frequency of such events; and 3) evaluate the consequences of such events should they be determined significant, and pose remedial options for avoiding such consequences. In evaluating these potential hazards for this study, the study will also: 4) evaluate potential impacts to the adjacent shoreline due to sea level rise, erosion and wave diffraction and reflection from the subsurface intake structures. The latter requirement entails a sediment budget and transport analysis of both the near- and far-field of the study area.

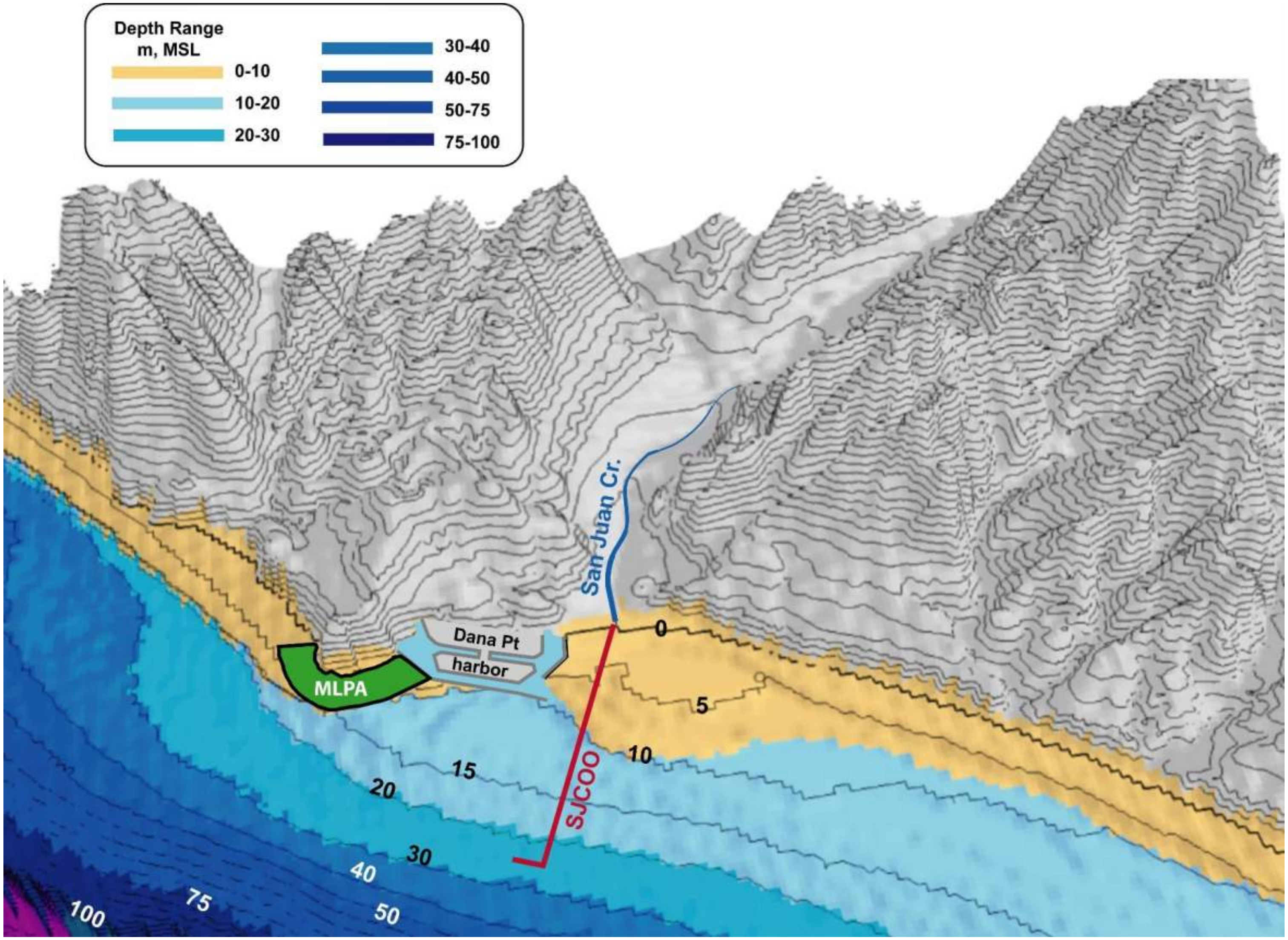


Figure 1.1: Project site map in GIS. Bathymetry contours in meters MSL. Data from GEODAS 3 arc-second database

2) Regulatory Requirements:

The *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2015) and CCC (2018) provides specific guidance on the analysis protocals of a sea level rise/coastal hazards analysis. These are:

Step 1 – Develop temporally- and spatially-appropriate sea level rise projections

Two methods are recommended for establishing a projection value for a specific year: 1) conduct a linear interpolation[100], or 2) use the "best fit" equations that are provided below. At this time, both are acceptable for Coastal Commission purposes

Step 2 – Determine tidal range and future inundation

This step requires the determination the future intersections of mean sea level or other tidal datums with the shoreline. Erosion must be accounted for in these determinations.

Step 3 – Determine still water changes from surge, El Niño events, and PDOs

Estimates of surge, El Niño, and PDO water elevation changes are to be developed primarily from historical records. There are no state-wide resources for this information,

Step 4 – Estimate beach, bluff, and dune change from erosion

There is no single specific accepted method for predicting future beach erosion. At a minimum, projects should assume that there will be inundation of dry beach and that the beach will continue to experience seasonal and inter-annual changes comparable to historical amounts. When there is a range of erosion rates from historical trends, the high rate should be used to project future erosion with rising sea level conditions (unless future erosion will encounter more resistant materials, in which case lower erosion rates may be used). For beaches that have had a relatively stable long-term width, it would be prudent to also consider the potential for greater variability or even erosion as a future condition.

Step 5 – Determine wave, storm wave, wave runup, and flooding conditions

Wave impacts to the coast, to coastal bluff erosion and inland development, should be analyzed under the conditions most likely to cause harm. Those conditions normally occur in winter when most of the sand has moved offshore leaving only a reduced dry sand beach to dissipate wave energy (this seasonal change in beach width is often referred to as short-term or seasonal erosion). On beaches that will experience long-term erosion, trends expected to occur over the entire expected life of the development should also be considered. Since water levels will increase over the life of the development due to rising sea level, the development should be examined for the amount of sea level rise (or a scenario of sea level rise conditions) that is likely to occur throughout the expected life of the development. Then, the wave impact analysis should examine the consequences of a 100-year design storm event using the combined water levels that are likely to occur with high water conditions and sea level rise, as well as a long-term and seasonally eroded beach.

Step 6 – Examine potential flooding from extreme events

Extreme events, by their very nature, are those beyond the normal events that are considered in most shoreline studies. Tsunami should be among the extreme events evaluated. Planning and project analysis need to consider and anticipate the consequences of these outlier events. Projections of potential flooding from extreme events are the principle outcome of Step-6.

3) Temporally- and Spatially-Appropriate Sea Level Rise Projections

This section adresses Step-1 of a sea level rise/coastal hazards analysis as outlined in Section 2. The *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2015) requires that coastal hazards analyses consider sea level rise impacts over the project lifetime. Precedence from antecedant desalination projects have typically used project lifspans of 50 years (SEIR, 2010). With a potential start date of 2020, a fifty year project life for the Doheney Desalination Project (DDP) would extend the sea level rise analysis out to 2070. However, the present analysis will use 2100 as the ultimate planning horizon for a critical infrastructure project.

Originally, CCC, (2015) permits either of two methods derived from the NRC report (NRC, 2012) for making sea level projections, 1) the *linear interpolation method*, and 2) the *best fit equation.* Sea level projection estimates using the “best-fit” equation are slightly less than estimations based on linear interpolation because the NRC’s sea level curves are concave upward (sea level rise is expected to accelerate over the 21st Century). In our previous study, we selected the best-fit equation method for the sea level rise projections used in this study. Since the Doheny Desalination Project is located well south of Cape Mendocino, the appropriate best fit equation for use in the DDP coastal hazards analysis is:

$$SLR = 0.0093t^2 + 0.7457t \quad \text{(upper-range projection)} \qquad (1)$$

$$SLR = 0.0038t^2 + 0.039t \quad \text{(lower-range projection)} \qquad (2)$$

Here, *SLR* is the sea level rise in centimeters (cm) and *t* is the time in years after the year 2000 baseline. Figure 3.1 plots the sea level rise projections from equations (1) & (2), which appear as the cyan colored curve in Figure 3.1 for the low-range projection; and the magenta colored curve for the high range projection. For the 2100 planning horizon, sea level rise was originally projected to range from 1.37 ft to 5.50 ft. However, in the updated sea level rise policy guidance document, (CCC, 2018), equations (1) and (2) were abandoned in favor of a water level province tabulation centered around NOAA tide gage stations having long periods of record. The Doheny Desalination Projects lies in the La Jolla tide gage water level province, for which sea level rise projections are listed in Table G-11 in Appendix-G of CCC (2018). These new projections are plotted in Figure 3.1 as the blue curve for the low range projections and the red curve for the high range projections. Clearly the clarified sea level rise curves in Figure 3.1 project significantly higher future sea levels, particularly for the low range estimates. For the 2100 planning horizon sea level rise is projected range from 3.6 ft to 7.1 ft. The low range projection represents a 17% probability that sea level rise exceeds these values; while the high range projection represents a 0.5% probability that sea level rise exceeds these values. These values will be used in the calculations of extreme total water levels (TWL’s) in the following sections.

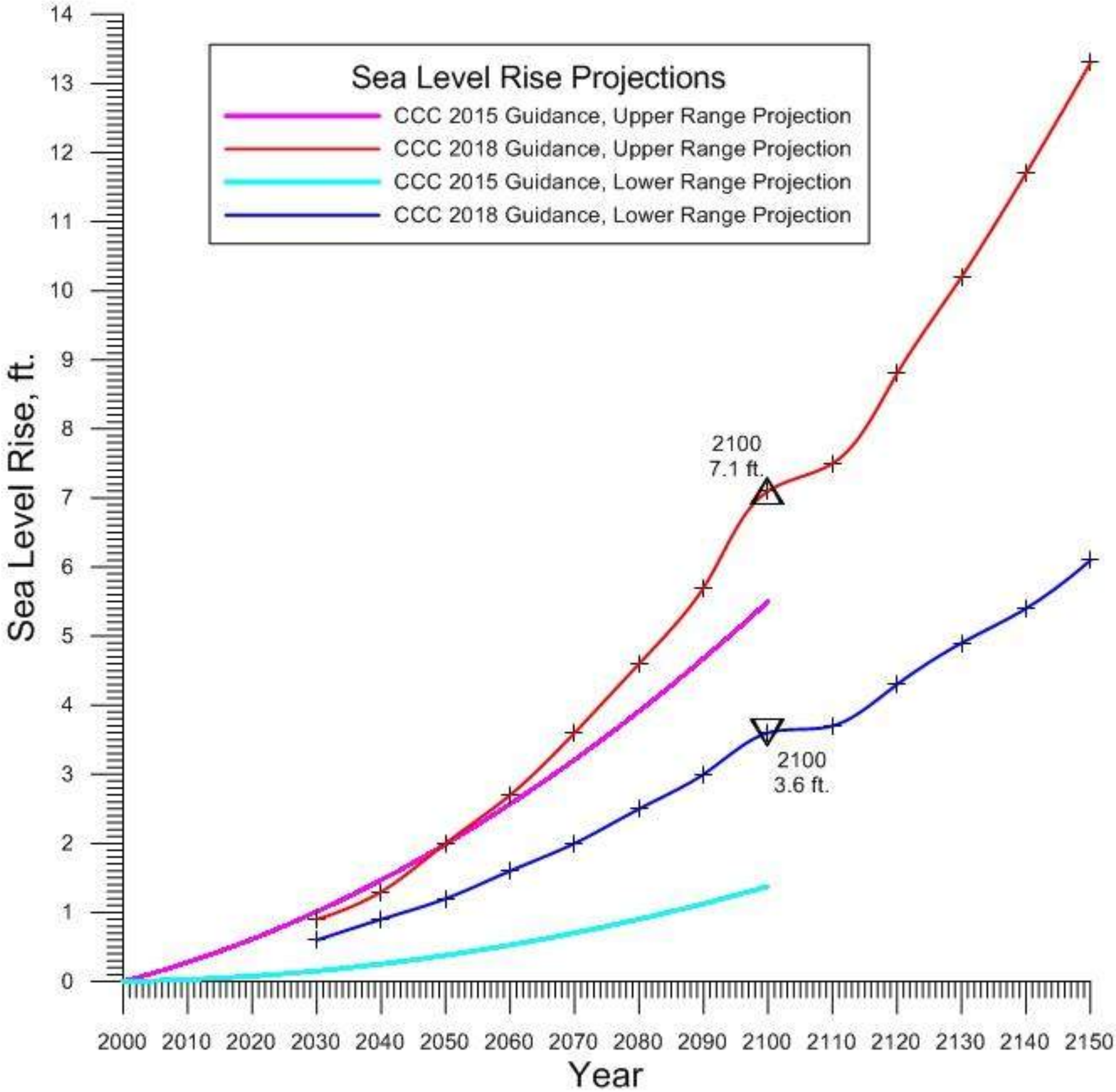


Figure 3.1: Range of sea level rise projections from the California Coastal Commission sea level rise guidance document, (CCC, 2018, Appendix-G). The 2100 planning horizon is indicated by symbols on the upper and lower range curves. Blue curve represents a 17% probability that sea level rise exceeds these values; red curve represents a 0.5% probability that sea level rise exceeds these values

4) Tidal range and Still Water Levels

This section adresses Steps-2 & 3 of a sea level rise/coastal hazards analysis as outlined in Section 2. This is accomplished by leveraging a long standing effort of NOAA who has deployed tide gages up and down the California coast (NOAA, 2016) to continuously monitor ocean and bay water levels, and who has periodically verified those water levels for multi-decadal periods referred to as "*tidal epochs*". NOAA has deployed continuously active tide gages along the California coast, which typically record water levels every 6 minutes, and those measurements account for all the combined astronomical, meteorological and climatic effects that have effected water levels in the coastal regions of California since the tide gages were installed. These effects include climate cycles such as El Niño /Southern Oscillation (ENSO) and the longer period Pacific Decadal Oscillation (PDO), as specifically cited for consideration in a coastal hazards analysis in CCC, (2015) and CCC (2018). The two closest NOAA tide gage stations to the Doheny Desalination Project site are at Newport (NOAA #9410580) and Scripps Pier in La Jolla (NOAA#9410230). The period of record for the Newport tide gage ends in 1994, and was not used as the basis for a water level province in Appendix-G of CCC (2018). Therefore we base our tidal range and static water level analysis on the Scripps Pier tide gage, whose period of record extends from 1924 until present, and its vertical datum elevations have also been verified by NOAA for the most recent tidal epoch 1983-2001. Those vertical datum elevations are listed in Table-1.

Water level recurrence statistics are derived from the record of ocean water levels at the NOAA Scripps Pier tide gage based on calculating a stage frequency curve called a "*hydroperiod function*". The hydroperiod function provides a continuous relationship between ocean water levels measured at 6 minute time intervals and the recurrence probability for each observed water level increment. The computations involves N_0 time steps in the NOAA water level files. Each time sep is at 6 minute intervals, over the period of record (1924-2016). Conditional if statements embedded in counting loops of the *hydro-pr_caltrans* software (developed for Caltrans coastal culvert design, cf. Jenkins and Taylor, 2016) calculate the number time steps, $N(\eta \leq Z_i)$, for which the ocean water level, η, was at least as high as a potential still-water elevation Z_i at or above mean sea level. The percent time that elevation Z_i is wet due to ocean inundation is calculated as:

$$\hat{E}_i = \frac{100\%}{\hat{N}_o} \sum N(\eta \geq Z_i) \qquad (3)$$

$$\text{where: } \hat{N}_0 = \sum_i N_i(\eta \geq MSL)$$

Time averaging Equation (3) over yearly increments and then ensemble averaging the yearly averages gives an *annualized hydroperiod function* $H_{i,j}$ that represents the annualized probability of ocean water levels reaching a still-water elevation Z_i

Table 4.1: Tidal Datums at Scripps Pier NOAA Tide Gage Station:
Elevations on Station Datum
Station: 9410230, La Jolla, CA
Status: Accepted (Oct 6 2011)
Units: Feet
T.M.: 120
Epoch: 1983-2001
Datum: STND

Datum	**Value**	**Description**
MHHW	9.69	Mean Higher-High Water
MHW	8.97	Mean High Water
MTL	7.12	Mean Tide Level
MSL	7.10	Mean Sea Level
DTL	7.03	Mean Diurnal Tide Level
MLW	5.27	Mean Low Water
MLLW	4.37	Mean Lower-Low Water
NAVD88	4.56	North American Vertical Datum of 1988
STND	0.00	Station Datum
GT	5.33	Great Diurnal Range
MN	3.69	Mean Range of Tide
DHQ	0.73	Mean Diurnal High Water Inequality
DLQ	0.91	Mean Diurnal Low Water Inequality
HWI	5.01	Greenwich High Water Interval (in hours)
LWI	11.07	Greenwich Low Water Interval (in hours)
Maximum	12.03	Highest Observed Water Level
Max Date & Time	01/11/2005 17:00	Highest Observed Water Level Date and Time
Minimum	1.50	Lowest Observed Water Level
Min Date & Time	12/17/1933 23:36	Lowest Observed Water Level Date and Time
HAT	11.51	Highest Astronomical Tide
HAT Date & Time	08/09/1987 03:54	HAT Date and Time
LAT	2.49	Lowest Astronomical Tide
LAT Date & Time	01/28/1987 22:48	LAT Date and Time

Tidal Datum Analysis Periods : 01/01/1983 - 12/31/2001

Tidal Datums:
EHW = 7.47 ft NAVD
HAT = 6.95 ft. NAVD
MHHW = 5.13 ft NAVD
MHW = 4.41 ft NAVD
MSL = 2.54 ft NAVD
MTL = 2.56 ft NAVD
MLLW = 0.00 ft. NAVD
ELW = -3.06 ft NAVD
NGVD 1929 = 2.35 ft. NAVD

$$P_{i,j} = \frac{1}{k} \sum_{j=1}^{j=k} \left[\frac{1}{\tau_j} \int_0^{\tau_j} \hat{E}_i \, dt \right] \tag{4}$$

Here τ_j is the length of tidal record in *year-j* and k is the number of years in the period of record of the tide gage. The annualized hydroperiod function of still-water level elevations at present sea level is plotted in Figure 4.1, based on the NOAA Scripps Pier ocean water level data (surrogate for the Doheny Desalination Project site). Inspection of Figure 4.1 indicates that recurrence probability for mean higher high water levels are *P*(MHHW) = 13% and *P*(MHW) = 28% for mean high water levels; while intuitively the recurrence probability for mean sea level is *P*(MSL) = 100%. The extreme high water level event is a less than 1% event at *P*(EHW) = 0.06%.

Table 1 reveals that the extreme high water level, (EHW = 7.47 ft. NAVD, occurring 1 November 2005) exceeds the highest astronomical tide, (HAT = 6.95 ft NAVD, occurring 9 August 1987). The largest exceedance of daily high water levels above the astronomic tides in the period of record of the NOAA #9410230 occurred during the 1997-98 El Niño on 13 November 1997, when the daily high water level was 1.47 ft above the astronomic tides (Figure 4.2). This discrepancy occurs as a result of climate cycle effects that warm the coastal ocean creating an increase in *steric* sea level due to thermal expansion of the water mass, which can persist for as long as 8-10 months. Climate cycles involve intense global modifications that are signaled by anomalies in the pressure fields between the tropical eastern Pacific Ocean and Australia/Malaysia known as the ***Southern Oscillation***. The intensity of the oscillation is often measured in terms of the ***Southern Oscillation Index (SOI)***, defined as the monthly mean sea level pressure anomaly in mb normalized by the standard deviation of the monthly means for the period 1951-1980 at Tahiti minus that at Darwin, Australia. The Southern Oscillation is in turn, modulated over multi-decadal periods by the ***Pacific Decadal Oscillation***, which results in alternating decades of strong and weak El Niño.

The long-term variability of the Pacific Decadal Oscillation (PDO) is shown in Figure 4.3 and the cumulative residual of the Southern Oscillation Index, between 1882 and 1996, is plotted in Figure 4.4, where cumulative residuals SOI_n are taken as the continued cumulative sum of departures of annual values of a time series SOI_j from their long-term mean values $\overline{SOI}$, such that :

$$SOI_n = \sum_{o}^{n} (SOI_i - \overline{SOI}) \tag{5}$$

Here n is the sequential value of a time series of n years. Southern Oscillation effects give rise to enhancements and protractions of the inter-annual seasonal cycles, and their two extremes are referred to as El Niño (SOI negative) and La Niña (SOI positive). Inspection of Figure 5a reveals a number of large positive oscillations in the SOI between 1944 and 1978 corresponding to La Niña dominated climate; and a series of very large negative oscillations occurring between 1978 and 1995 which correspond with El Niño dominated climate.

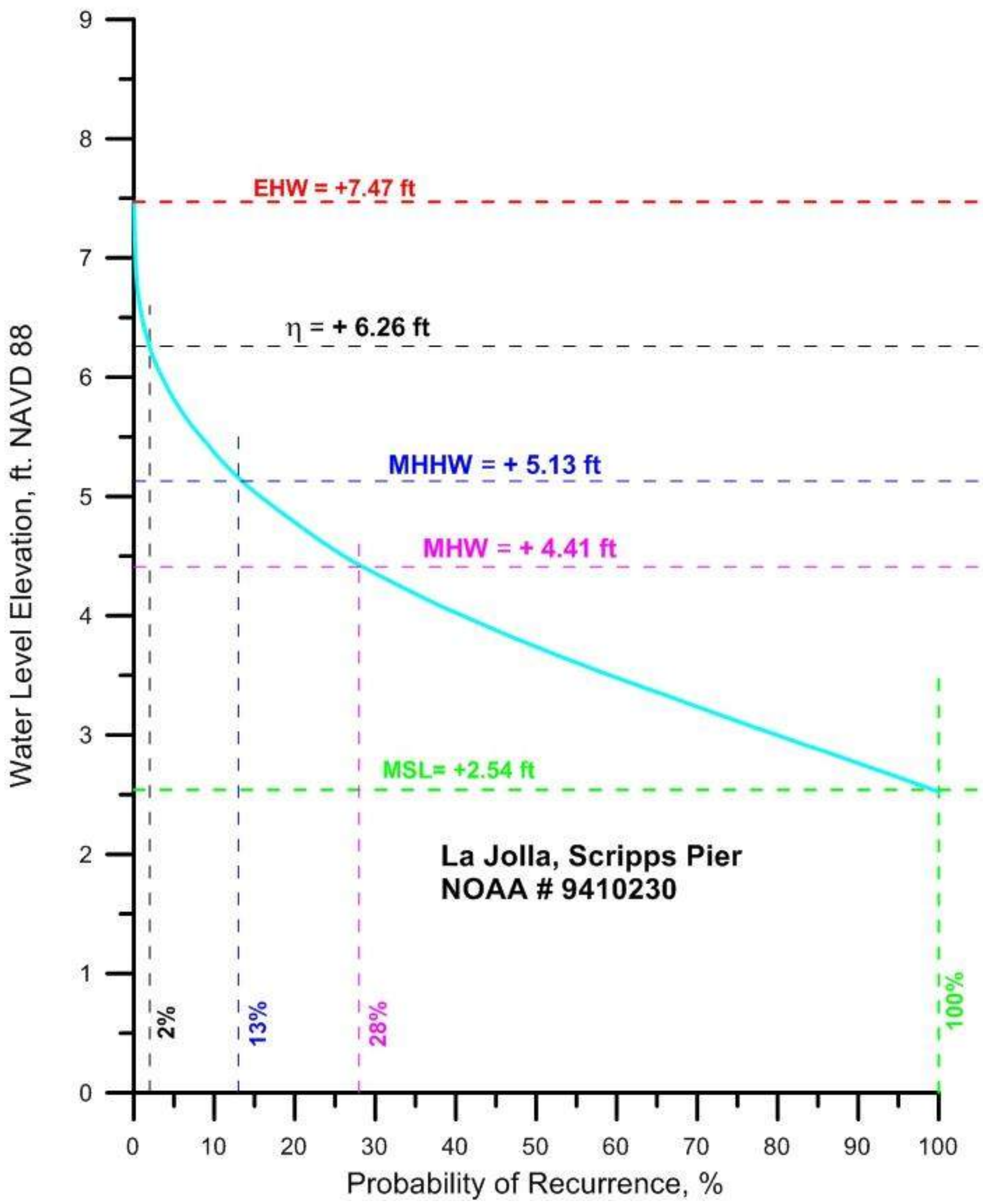


Figure 4.1: Hydroperiod function of still-water level elevations at present sea level, based on ocean water level measurements at the Scripps Pier tide gage station, NOAA #9410230, for the period of record 1924-2016. Tidal datums based on the 1983-2001 tidal epoch (latest datum analysis period).

Along the southern California coast, a period of mild-stable La Niña dominated pressure systems prevailed between 1944 and 1978. The average SOI for this period was +0.1,with strong La Niña events in 1950, (SOI = +1.4); 1955/56, (+1.2); 1970/71, (+1.0); 1973/74, (+1.0); and 1975/76 (+1.4). Winters were moderate with low rainfall, and winds were predominantly from the west-northwest. The principal wave energy was from Aleutian lows having storm tracks which usually did reach southern California. Summers were mild and dry with sea surface temperatures seldom exceeding 20^0C. The North Pacific High dominated the coastal transport by strengthening the California Current and promoting coastal upwelling of cold bottom water. The effect of these cool dry La Niña dominated climate periods was to promote negative anomalies in the steric sea level, augmented by depression of sea level by the inverse barometer effects of a strong North Pacific High.

The climate in southern California changed, beginning with the El Niño years of 1978/79 and extending at least until 1999. The average SOI for this period was -0.5, with the 1978/79 El Niño averaging -1.2, the 1982/83 El Niño averaging a record -1.7 and the 1993/94 El Niño recording a mean of -1.0. During these periods, the North Pacific High was weakened and transport of warm equatorial water masses into the Southern California Bight were promoted by topographically trapped Kelvin waves. The North Pacific High was weak and the prevailing north-westerly winter waves were replaced by high energy waves approaching from the west or southwest, while the previous southern hemisphere swell waves of summer were replaced by shorter period tropical storm waves during late summer months from the more immediate waters off Central America. These dynamics promoted positive sea level anomalies in steric sea level as a consequence of thermal expansion of the warm coastal ocean water mass, augmented by inverse barometer effects under strong frontal cyclones during winter.

These climate effects on the hydroperiod function are proportioned schematically in Figure 4.5. Basically, ocean water levels result from the astronomic tides oscillating around the steric sealevel, which itself varies slowly in response to seasonal warming and cooling of the coastal water mass, and longer term warming and cooling from ENSO and PDO. While the highest astronomic tides have reached HAT = +6.95 ft NAVD, astronomic tides typically do not exceed η = +6.0 ft NAVD during a typical spring-neap cycle. Seasonal warming of the coastal ocean can cause an increase in steric sea levels by as much as $\Delta\eta$ = +0.5 ft. As Figure 4.2 reveals, a strong El Niño event can create as much as $\Delta\eta$ =+1.47 ft. increase in steric sea level, but more typically El Niño events cause positive sea level anomalies on the order of $\Delta\eta$ =+1.47 ft. Because PDO re-enforces El Niño events during a multi-decadal warm wet climate period as occurred during the 1978-1998 epoch, just how much of these anomalies is due to PDO is uncertain, but generally it is believed that about 10% to 15% of an El Niño sea level anomaly is due to a positive PDO cycle. On the other hand, La Niña events depress steric sea levels and typically produce negative sea level anomalies on the order of $\Delta\eta$ = -0.6 ft.

Because the hydroperiod function in Figure 4.1 is based on multi decadal ocean water level measurements (1924-2016), it captures the combined effects of PDO, ENSO, and astronomic tides. It also captures the transient storm surge events. Storm surge is a wind-set-up phenomena, but because California is a collision coastline with a very narrow continental shelf, it does not develop the large storm surges of tens of feet that occur on the broad shelf environments of the Gulf and Atlantic coastlines during hurricanes. Storm surge on the California coast is primarily due to the inverse barometer effect, which causes the sea surface to bulge upwards under low pressure weather systems approaching the coastline, and typically lasts a few days during the passage of

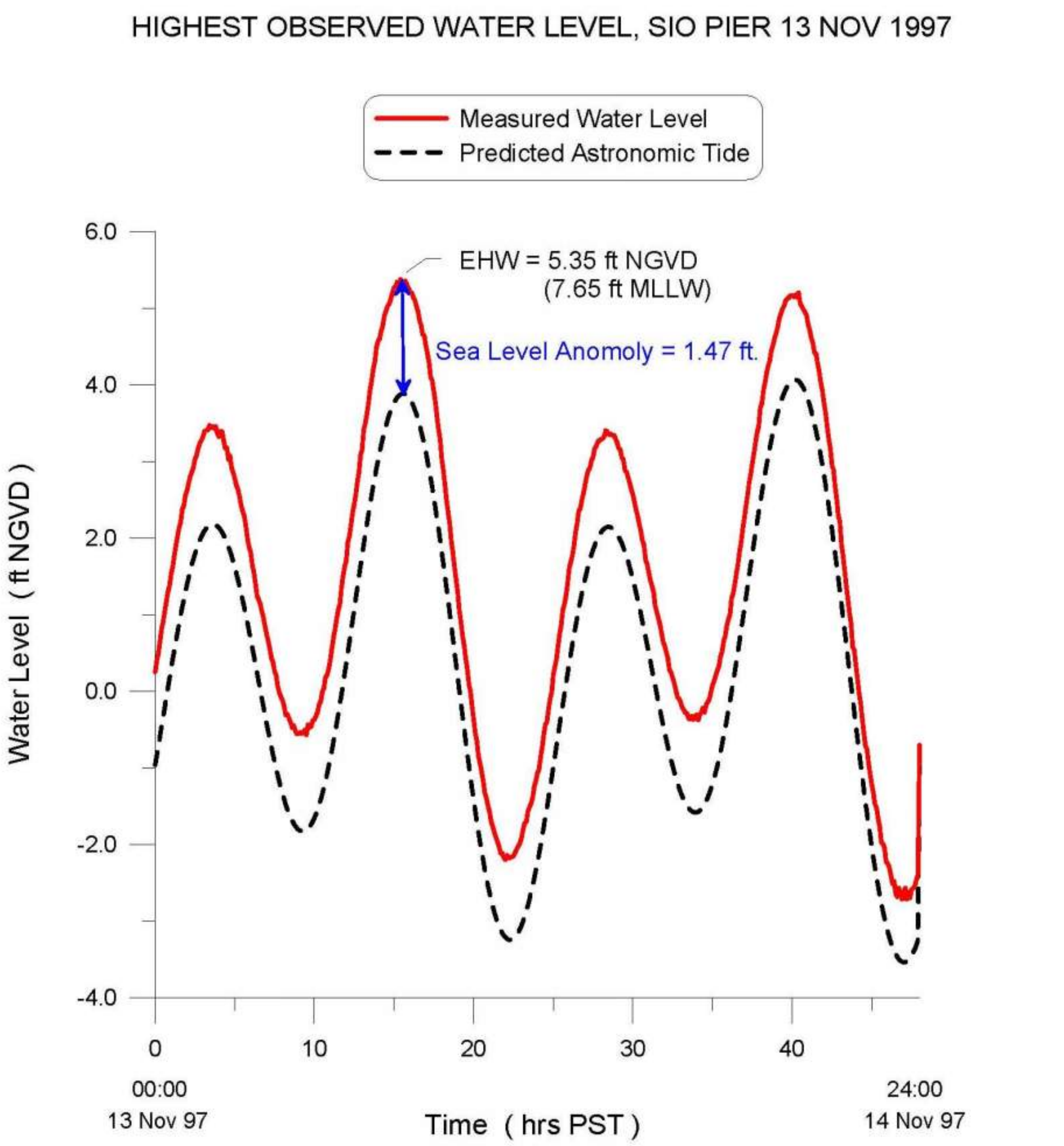


Figure 4.2: Comparison of measured ocean water level (red) at the Scripps Pier tide gage vs. predicted water level based on tidal constituents (black dashed) for the extreme high water event of 13 November 1997 (from Jenkins and Wasyl, 2005).

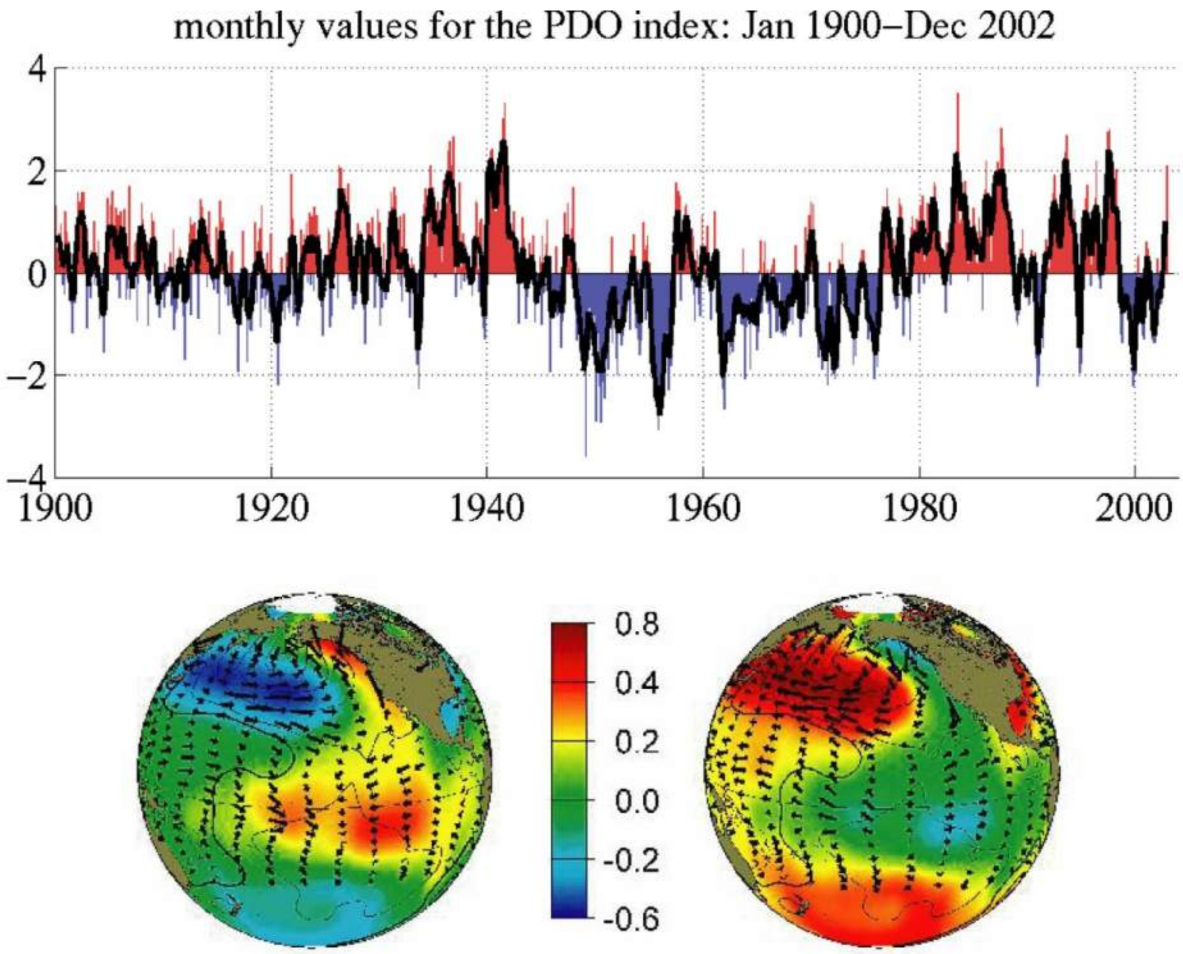


Figure 4.3. Typical wintertime Sea Surface Temperature (colors), Sea Level Pressure (contours) and surface wind stress (arrows) anomaly patterns during warm and cool phases of PDO.

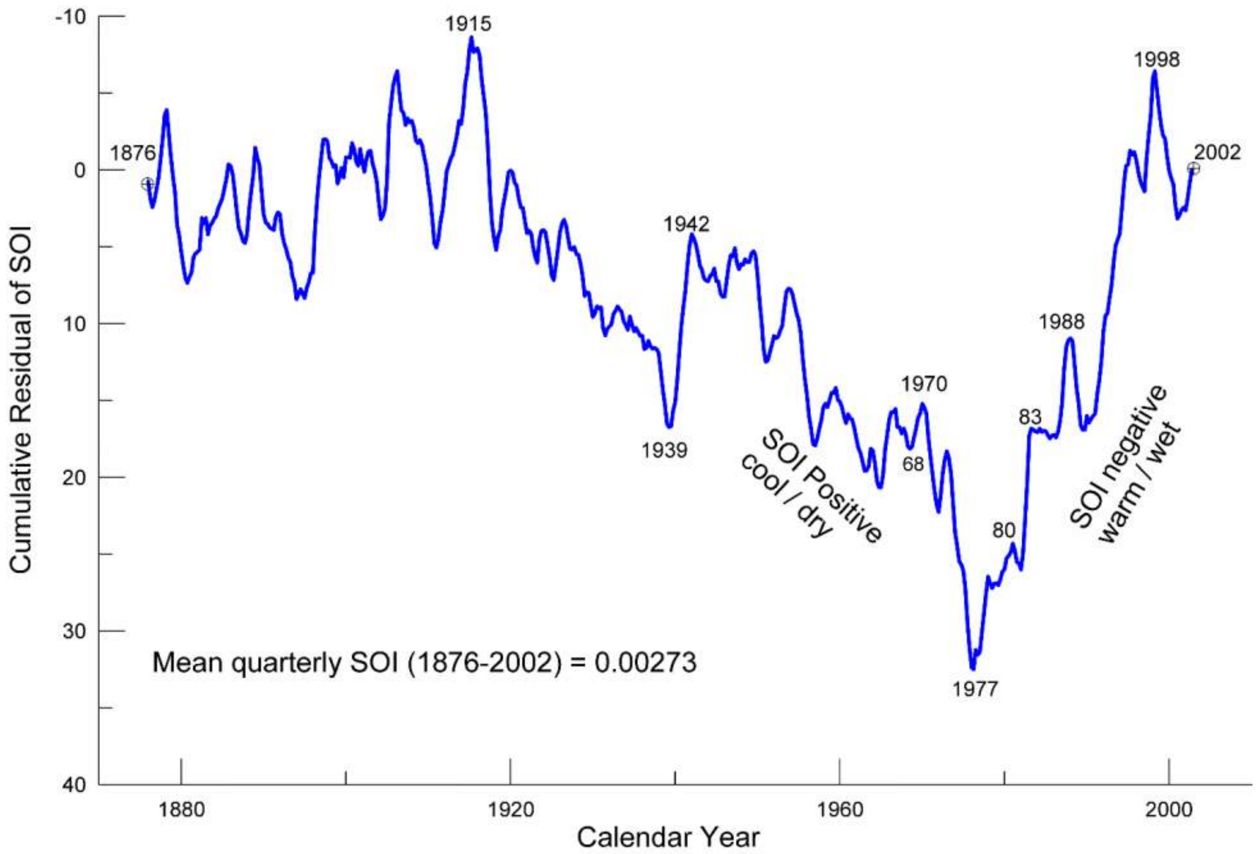


Figure 4.4. Cumulative residual of quarterly values of Southern Oscillation Index (SOI) [data from Australian Commonwealth Bureau of Meteorology].

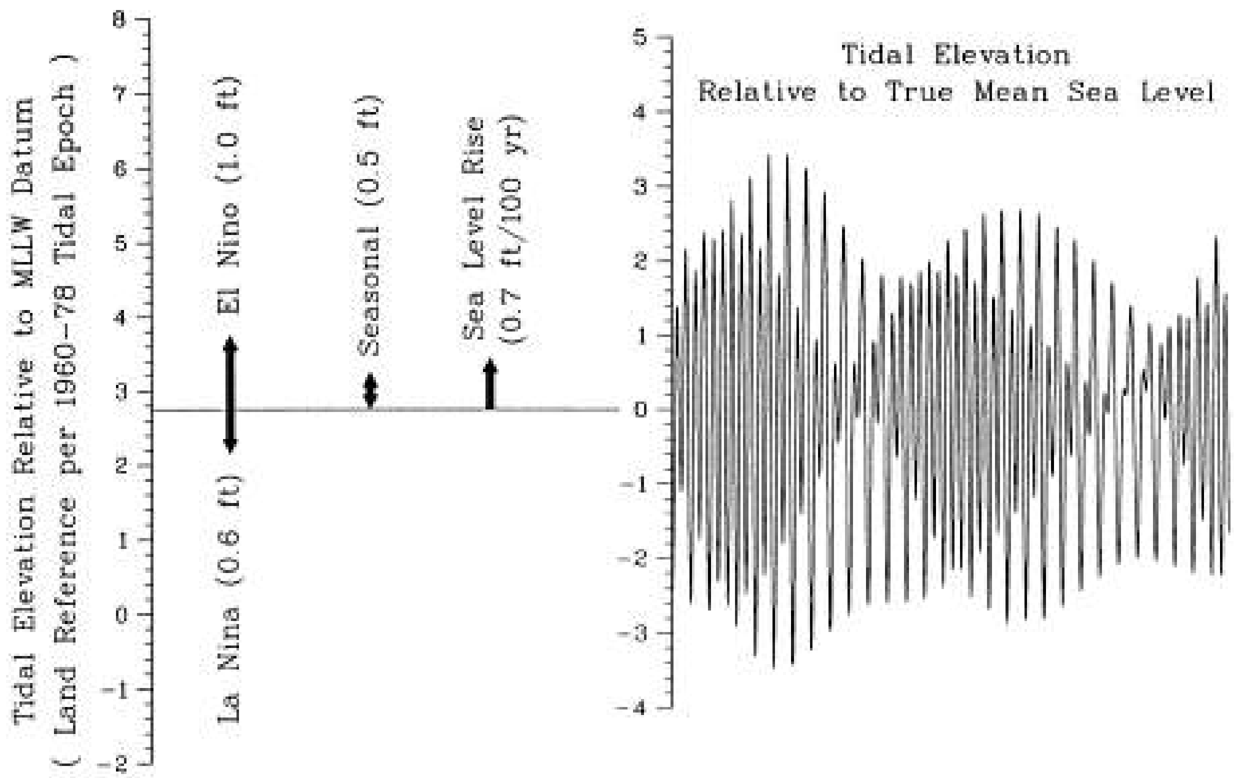


Figure 4.5 Schematic decomposition ocean water levels according to astronomic tides, and seasonal and ENSO/PDO cycle effects on steric sea levels.

winter cold fronts. The sea surface rises 1 cm for every millibar drop in atmospheric pressure. The atmospheric pressure during strong El Niño storms may drop to as low as 993 millibars, (as compared to 1,013 millibars standard atmospheric pressure); which equates to a 20 cm rise in ocean water level during the passage of the storm due to the inverse barometer effect. That short term rise is captured by the NOAA tide gage at the end of Scripps Pier, and is built into the hydroperiod function in Figure 4.1. But, because the Scripps Pier tide gages is located in a stilling well considerably seaward of the surf zone, the hydroperiod function derived from its water level measurements do not include dynamic effects from wave set-up or runup. Consequently the hydroperiod function maps the probabilities of still water levels at or above mean sea level.

Because both the Scripps Pier NOAA tide gage and the Doheny Desalination Project are sited in locations with narrow continental shelfs of only about 4.5 km in width, it is reasonable to assume that the local tidal dynamics will not be altered by higher future sea levels (ie, sea level rise will not cause any new resonance or damping effects of the astronomic tides across the continental shelf). It is not known how ENSO or PDO climate cycles might be altered by global warming and higher sealevels, but for now it is resonable to assume that the hydroperiod function of still water elevations at future sealevels can be obtained by linear superposition of the present hydroperiod function in Figure 4.1 and the sea level rise projections in Figure 3.1. By that approach, the hydroperiod function of still-water level elevations was obtained at 2100 sea level in Figure 4.6.

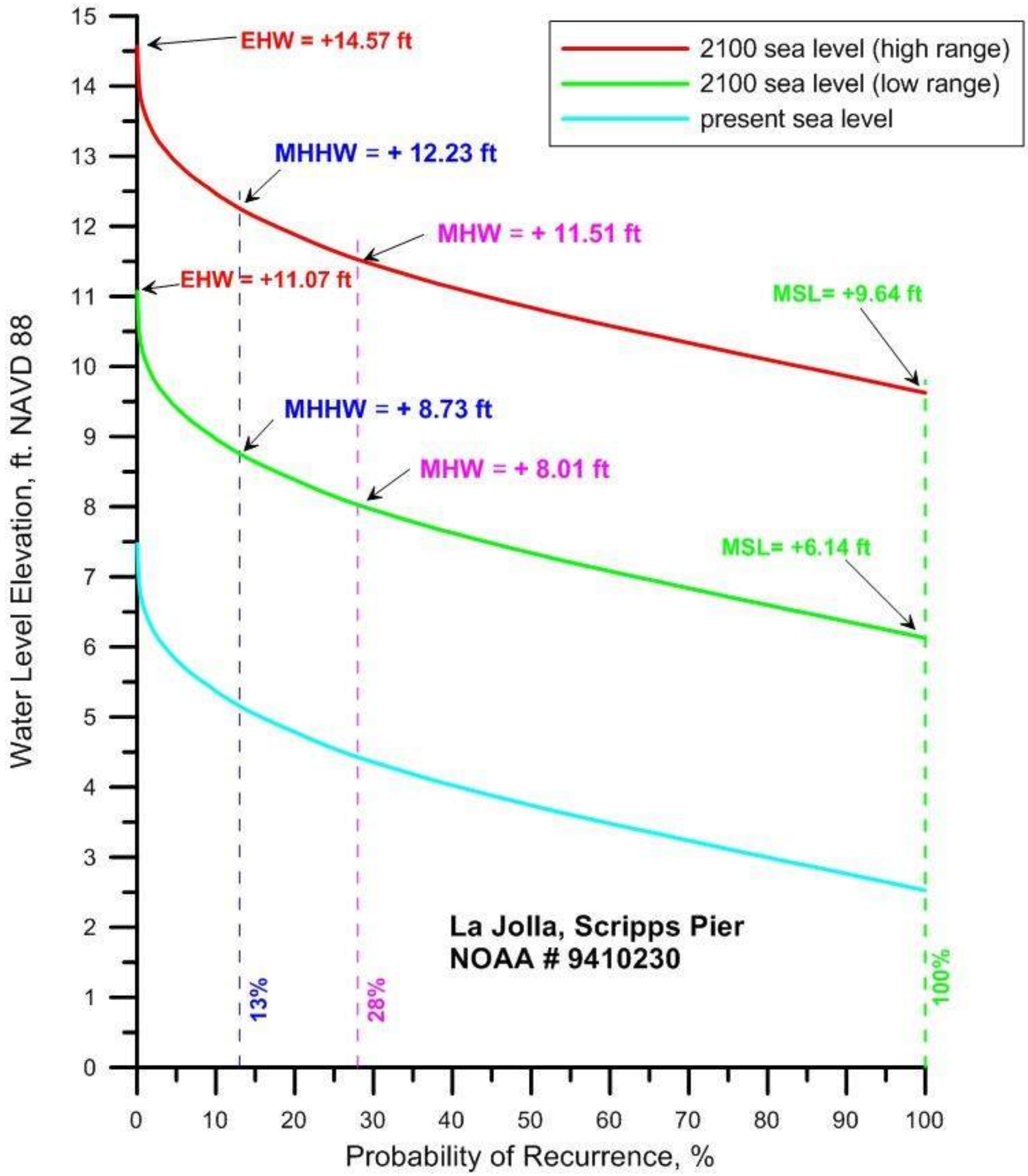


Figure 4.6: Hydroperiod function of still-water level elevations at 2100 sea level, based on ocean water level measurements at the Scripps Pier tide gage station, NOAA #9410230, for the period of record 1924-2016. Tidal datums based on the 1983-2001 tidal epoch (latest datum analysis period). Sea level rise component from Appendix-G, Table G-11 in CCC (2018)

At the year 2100 planning horizon for desalination projects, low range projections in Figure 4.6. indicate that mean sea level increases to MSL = +6.14 ft NAVD while extreme high water increases to EHW = +11.07 ft. NAVD, while mean higher high water increases to MHHW = + 8.73 ft. NAVD. At the high range 2100 projections, mean sea level increases to MSL = +9.64 ft. NAVD; extreme high water increases to an astonishing EHW = +14.57 ft. NAVD, and mean higher high water increases to MHHW = + 12.23 ft. NAVD. The still water elevations inferred at future sea levels from the linear superposition assumption are summarized in Table 4.2 below. It is interesting to note that under the updated policy guidance (CCC,2018) water levels for the high range sea level rise projections for 2070 are the same as water levels for the low range sea level rise projections for year 2100.

Table 4.2: Still Water elevations at present and future sea levels. Based on NOAA #941-0230 tide gage records and sea level rise from Appendix-G, Table G-11 in CCC (2018)

Tidal Datums	Present Sea Level (ft. NAVD 88)	2070 Sea Level Low Range Projection (ft. NAVD 88)	2070 Sea Level High Range Projection (ft. NAVD 88)	*2100 Sea Level Low Range Projection (ft. NAVD 88)	*2100 Sea Level High Range Projection (ft. NAVD 88)
Mean Sea Level (MSL)	2.54	4.54	6.14	6.14	9.64
Mean High Water (MHW)	4.41	6.41	8.01	8.01	11.51
Mean Higher-HighWater (MHHW)	5.13	7.13	8.73	8.73	12.23
Extreme High Water (EHW)	7.47	9.47	11.07	11.07	14.57

*Planning horizon for the Doheny Desalination Project.

5) Technical Approach for Erosion and Dynamic Water Level Analysis:

This section establishes the technical approach for evaluating Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2. The total run-up, R, is composed of three main components: Static wave setup, $\overline{\eta}$, Dynamic wave setup, η_{rms}; Incident wave run-up, R_{inc}. The total water level (TWL) is defined as the sum of the total run-up and the SWL, referenced to an established vertical datum.

5.1 Models: To quantitatively evaluate the problems of implementing subsurface intake technology at SJCOO, we invoke a numerical seabed stability analysis utilizing the *Coastal Evolution Model* (Figure 5.1) applied to the Oceanside Littoral Cell (Figure 5.2). The Coastal Evolution Model was commissioned by the Kavli Foundation to make forecast predictions of the effects of sea level rise on the coastline of California (Jenkins and Wasyl, 2005).

The Coastal Evolution Model (CEM) is a process-based numerical model. It consists of a Littoral Cell Model (LCM) and a Bedrock Cutting Model (BCM), both coupled and operating in varying time and space domains (Figure 5.1.) determined by sea level and the coastal boundaries of the littoral cell at that particular sea level and time. At any given sea level and time, the LCM accounts for erosion of uplands by rainfall and the transport of mobile sediment along the coast by waves and currents, while the BCM accounts for the cutting of bedrock by wave action in the absence of a sedimentary cover.

In both the LCM and BCM, the coastline of the Oceanside Littoral Cell (the region of coastline between Dana Point and Point La Jolla, Figure 5.2) is divided into a series of coupled control cells. Each control cell is a small coastal unit of uniform geometry where a balance is obtained between shoreline change and the inputs and outputs of mass and momentum. The model sequentially integrates over the control cells in a down-drift direction so that the shoreline response of each cell is dependent on the exchanges of mass and momentum between cells, giving continuity of coastal form in the down-drift direction. Although the overall computational domain of the littoral cell remains constant throughout time, there is a different coastline position at each time step in sea level. For each coastline position there exists a similar set of coupled control cells that respond to forcing by waves and current. Time and space scales used for wave forcing and shoreline response (applied at 6 hour intervals) and sea level change (applied annually) are very different. To accommodate these different scales, the model uses multiple nesting in space and time, providing small length scales inside large, and short time scales repeated inside of long time scales. The LCM (Figure 5.1, upper) has been used to predict the change in shoreline width and beach profile resulting from extreme wave run-up, sea level rise, erosion, accretion and longshore transport of sand by wave action, where sand source is from river runoff or from tidal exchange at lagoon and bay inlets (e.g., Jenkins and Inman, 1999). More recently it has been used to compute the sand level change (Farfield Effect) in the prediction of mine burial (Jenkins and Inman, 2002; Inman and Jenkins, 2002). Time-splitting logic and feedback loops for climate cycles and sea level change were added to the LCM together with long run time capability to give numerically stable long term predictions.

5.2: Computational Approach: The presently adopted procedure for wave run-up analysis for the design of coastal structures, (as set forth in the *U.S. Army Corps of Engineers Coastal Engineering Manual* (USACE, 2006), and its software counterpart, the *Automated Coastal Engineering System*, known as *ACES*), is based on the assumption of rigid boundaries. The Coastal Evolution Model described in Section 3.1 is utilized for this analysis and employs algorithms consistent with the U.S. Army Corps of Engineers Coastal Engineering Manual, but employs the

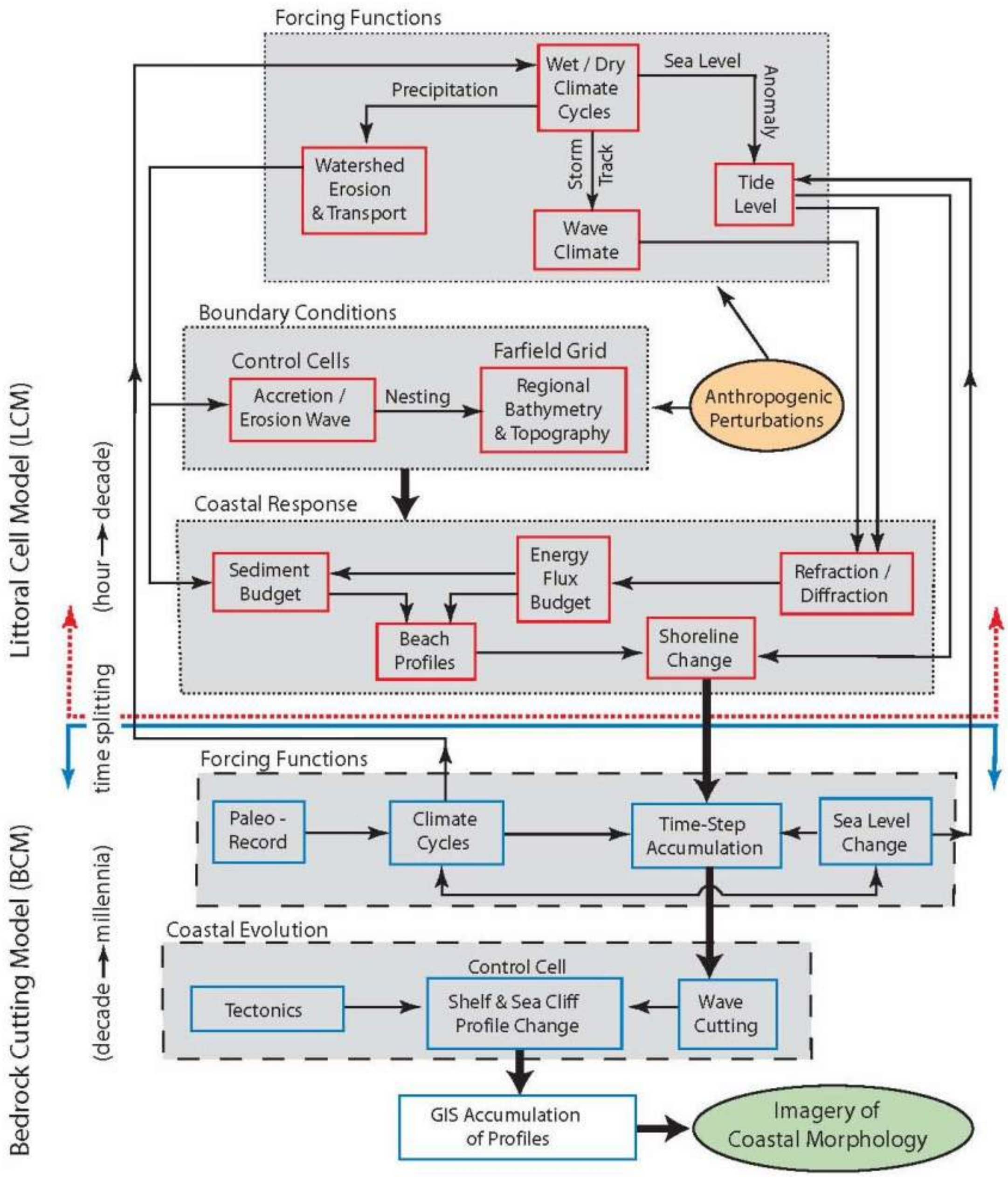


Figure 5.1: Architecture of the Coastal Evolution Model consisting of the Littoral Cell Model (above) and the Bedrock Cutting Model (below). Modules (shaded) are formed of coupled primitive process models. (Jenkins and Wasyl, 2005).

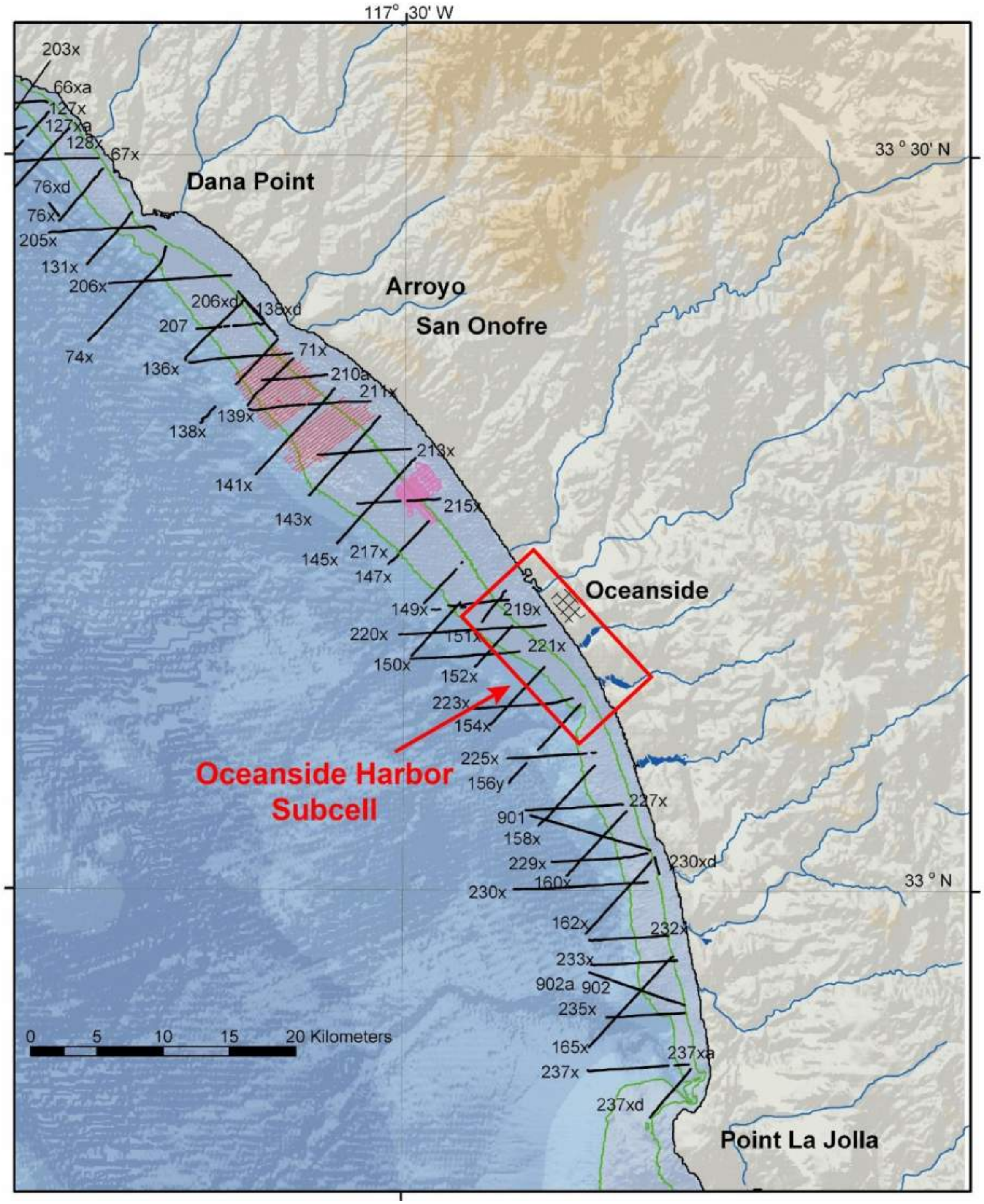


Figure 5.2: Oceanside Littoral Cell and Oceanside Harbor Sub-Cell. Composite bathymetry from NOS data base and equilibrium profiles after Jenkins and Inman (2006) for wave conditions of wet weather scenario. Depth contours shown in meters mean sea level. USGS cross-shelf survey tracks shown as numbered black line segments.

add-on features of latest generation equilibrium beach profile algorithms from Jenkins and Inman (2006) and supporting bathymetric data bases for the entire shore and continental shelf of California.

5.3) Wave Setup and Run-up: Wave setup is an increased elevation of the water level due to the effects of wave momentum being transferred to the surf zone. In wave systems composed of more than one wave component, as occurs in the Pacific Ocean, the setup oscillates and comprises a static and a dynamic component. Wave runup is the culmination of the wave breaking process, whereby the wave surges up the beach, bluff, or structure face along the shoreline. Overtopping occurs when the wave runup exceeds the profile crest elevation, which can result in flooding landward of the crest. Runup is a function of several key parameters. These include the wave height, H the wave period, T , the wave length, L , the profile slope, m , and the surf similarity parameter (Iribarren number), ξ defined as: $\xi = m / \sqrt{H/L}$. The total water level (TWL) is defined as the sum of the total runup and the SWL, referenced to an established vertical datum. The results for this study are referenced to the North American Vertical Datum of 1988 (NAVD88) vertical datum. The total runup, R , is composed of three main components: Static wave setup, $< \eta >$, Dynamic wave setup, η_{rms} ; Incident wave runup, R_{inc} .

Wave setup and runup are typically computed at hourly time steps from an historic record of wave monitoring, (see Section 6.0). Wave setup and runup are combined with still water level values (from hydroperiod functions, see Jenkins, 2015) to develop the TWL values. It should be noted that the increase in sea level for future scenarios should be added to each hourly SWL over the 32-year wave record (see Section 4.2) for the analysis of TWLs, with the 1-percent-annual-chance results derived statistically from the resultant 32 annual maxima as explained in Section 2.6.

Annual maxima TWLs are computed for each sea level rise (SLR) scenario, and a statistical Generalized Extreme Value (GEV) analysis is performed on these values to determine the 1-percent-annual-chance TWL for two example problems. The overtopping rate is calculated for instances where the TWL exceeded the engineered barrier crest and overtopping occurred. Each step used to evaluate hazards is described in detail in the following subsections.

Both static and dynamic components of wave setup were calculated using the Direct Integration Method (DIM) which uses a parameterized set of equations that consider wave and bathymetric characteristics, specifically the shape of the wave energy spectrum and the nearshore shorerise and bar-berm beach slope (m_{DIM}). The wave setup equations include factors for wave height (F_H and G_H), wave period (F_T and G_T), JONSWAP spectral narrowness factor (F_{Gamma} and G_{Gamma}), and nearshore slope (F_{Slope} and G_{Slope}).

Static wave setup is calculated as:

$$< \eta > = 4.0 F_H F_T F_{Gamma} F_{Slope} = 4.0 \left(\frac{H_0'}{26.2} \right)^{0.8} \left(\frac{T_P}{20.0} \right)^{0.4} \left(\frac{m_{DIM}}{0.01} \right)^{0.2} \qquad (6)$$

Dynamic wave setup is calculated as:

$$\eta_{rms} = 4.0\,G_H G_T G_{Gamma} G_{Slope} = 4.0\left(\frac{H_0'}{26.2}\right)^{0.8}\left(\frac{T_P}{20.0}\right)^{0.4}(Gamma)^{0.16}\left(\frac{m_{DIM}}{0.01}\right)^{0.2} \quad (7)$$

The wave parameters required as input for DIM are the deepwater equivalent significant wave height, in feet, (H'_0) and the spectral peak wave period (T_P), as well as a measure of the spectral shape (*Gamma*). The spectral peak parameter, *Gamma*, was computed via a polynomial fit between the spectral width parameter ν and *Gamma*, according to:

$$Gamma = 2047\nu^4 - 3083\nu^3 + 1782\nu^2 - 4769.9\nu + 507.1 \quad (8)$$

Values of are computed directly from the spectral moments ($\beta_0, \beta_1, \beta_2$) based on the Longuet-Higgins (1973) definition of the spectral narrowness:

$$\nu = \left[\frac{\beta_0\beta_2}{\beta_1} - 1\right]^{1/2} \quad (9)$$

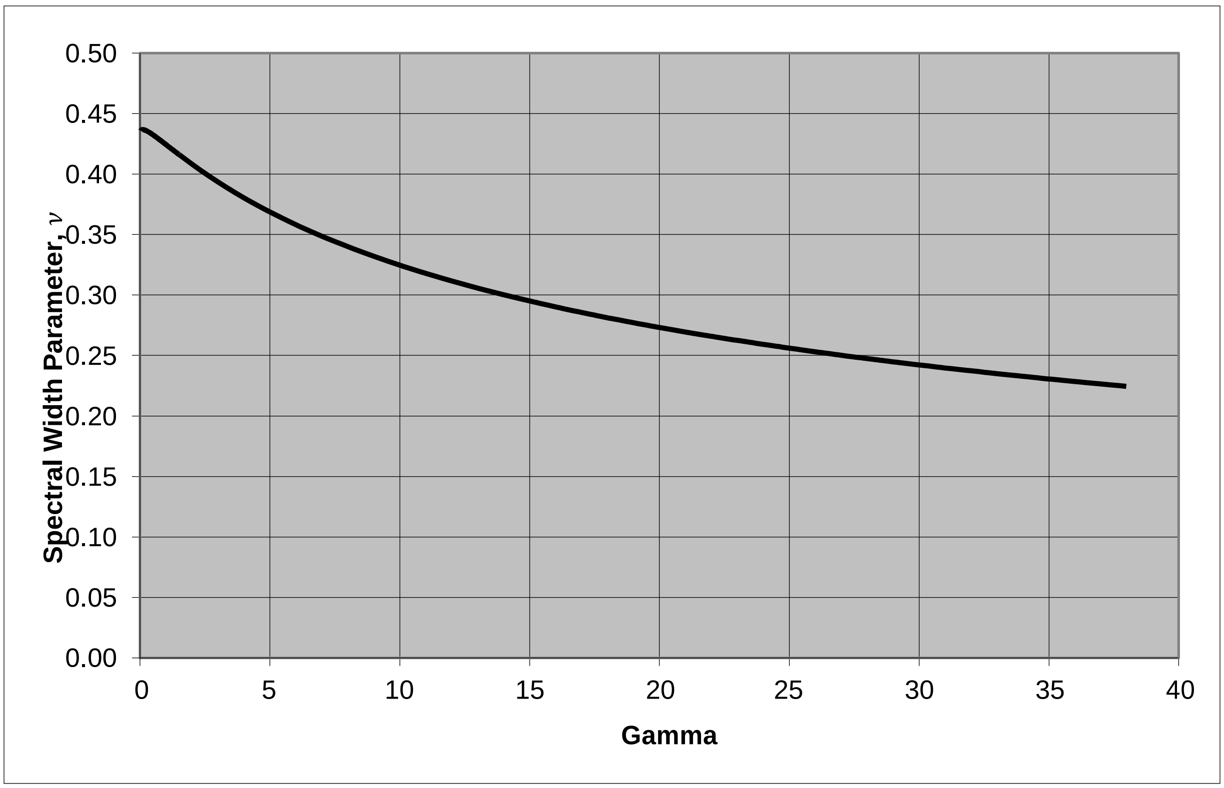


Figure 5.3 *Gamma* values are limited from 1 to 38, based on the range of wave data used (Section 4.4) to relate the spectral narrowness, ν , to the peak parameter, *Gamma*, as shown in Figure 3.3.

The deepwater equivalent significant wave height, H'_0, and the peak wave period, T_P, are provided as output from the CDIP wave monitoring data (CDIP, 2015) and are input directly into Equations 8 and 9. The nearshore slope, m_{DIM}, is taken from nearshore and beach surveys by Coastal Environments, et al., (2014) that were used to calibrate extreme event computations of profile slope using the elliptic cycloid algorithms of Jenkins and Inman (2006). The slope term, m_{DIM}. Used in the TWL computations is calculated from the average slope between the landward limit of wave runup and the location offshore where the water depth is two times the depth at which the deepwater significant wave height would be subject to depth-limited breaking (van der Meer, 2002). The landward limit of wave runup is calculated iteratively, with the initial approximation being the SWL.

5.4 Wave Runup: Wave runup was calculated using either the DIM or the Technical Advisory Working Group (TAW) method (van der Meer, 2002), depending upon the dynamic water level relative to the toe of the coastal structure and the shoreline (bar-berm) slope, m_{TAW}, calculated iteratively across the surf zone. The DIM is used to calculate runup for transects with natural, gently sloping (m_{DIM} < 0.125) profiles. For shorelines with shore protection structures and steeply sloping ($m_{TAW} \geq 0.125$) natural shorelines where the dynamic water level exceeds the toe of the structure, the TAW method was used to calculate runup. If the dynamic water level does not reach the toe of the structure or bluff face, the DIM is used. The total swash level, including wave setup and incident wave runup, is added to the *still water level* (SWL) to determine the *total water level*, (TWL), see Figure 5.4). Each of these methods is described in detail in the following subsections.

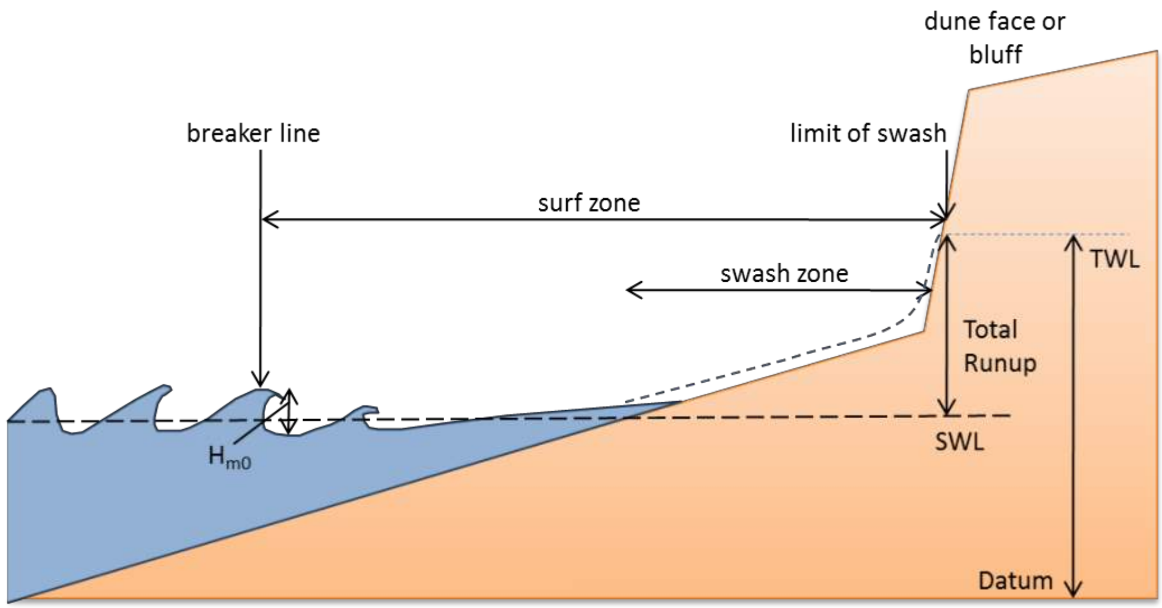


Figure 5.4: Conceptual Model Showing the Components of Wave Runup Associated with Incident Waves.

5.5 DIM Runup Calculations: Runup on gently sloping, natural shorelines, and beaches seaward of a structure or bluff toe, is calculated using the *direct integration method* (DIM). The runup calculation is based on the standard deviations of the oscillating wave setup and the incident wave runup components, and is a continuation of the DIM approach for wave setup. The dynamic setup η_{rms} is defined as the standard deviation of setup fluctuations, calculated from Equation 2. The standard deviation of the incident wave oscillations (wave runup), σ_2 on natural beaches is:

$$\sigma_2 = 0.3\xi_0 H'_0 \qquad (10)$$

Where, H'_0 is the deep water significant wave height, m_{DIM} is the nearshore (shorerise) bottom slope, $L_0 = gT_P^2 / 2\pi$ is the deep water wave length, and ξ_0 is the deep water Iribarren number:

$$\xi_0 = \frac{m_{DIM}}{\sqrt{H'_0 / L_0}}$$

The oscillating component of the total wave runup or *swash*, $\hat{\eta}_T$, is determined from the combination of the two standard deviations of the fluctuating components:

$$\hat{\eta}_T = 2.0\sqrt{\eta_{rms}^2 + \sigma^2} \qquad (11)$$

Combining the results from Equations 6 & 11 yields the total wave runup, which when superimposed with the SWL yields the total water level, TWL:

$$TWL = <\eta> + \hat{\eta}_T + SWL \qquad (12)$$

Where SWL is the still water level derived from the hydroperiod function given by Jenkins, (2015).

5.6 TAW Runup Calculations: Runup on barriers, including steep (m_{TAW} > 0.125) dune features, bluffs, and coastal armoring structures such as revetments, are calculated using the TAW method (van der Meer, 2002). Wave runup on barriers is a function of the geometry and roughness of the structure, as well as the height and steepness of the incident wave. The TAW method provides a mechanism for calculating wave runup with adjustments made through reduction factors to account for surface roughness and the effects associated with the angle of wave approach.

With the TAW methodology the wave setup component of the TWL is calculated at the toe of the structure, and wave setup landward of the toe of the structure is not included. Wave setup seaward of the toe of the structure is computed with the DIM, using the nearshore slope, m_{DIM} . Wave setup is not included for cases where waves would not have broken prior to reaching the toe of the structure.

The reference water level at the toe of the structure for runup calculations using the TAW method is defined as the 2-percent Dynamic Water Level (DWL2%). The dynamic water level is the sum of the measured SWL, the static wave setup, $\overline{\eta}$, and the dynamic wave setup, η_{rms}. Because DIM provides the static setup at the shoreline and not the barrier toe, and the magnitude of static wave setup varies significantly with depth across the surf zone, from a maximum at the shoreline to approximately zero seaward of the breaking point, a reduction to the static setup component is applied for cases where the barrier toe elevation is inundated by the SWL and the TAW method is used for computing wave runup. The dynamic setup, however, varies insignificantly across the surf zone and requires no adjustment.

This procedure involves computing the static wave setup at the shoreline and at the toe location to determine a static setup reduction factor to be applied to the static wave setup calculated using DIM. The wave setup at the shoreline and toe location and subsequent reduction factor are based on the root mean square of the breaking significant wave height $\left(H_b\right)_{rms}$, and the depth at the toe of the barrier relative to SWL, h. The $\left(H_b\right)_{rms}$ is determined using the deepwater equivalent significant wave height, H'_0, and the peak wave period, T_P , according to:

$$\left(H_b\right)_{rms} = 0.714 \left(\frac{\kappa}{g}\right)^{1/5} \left(\frac{H_0'^2 C_0}{2}\right)^{2/5} \tag{13}$$

Where κ is the breaker criterion equal to 0.78 and C_0 is the deepwater wave celerity, $C_0 = L_0 / T_P$. The static wave setup at the SWL shoreline is:

$$\overline{\eta}_0 = 0.189\left(H_b\right)_{rms} \tag{14}$$

And the static wave setup at the toe of the engineered barrier is:

$$\overline{\eta}(h) = 0.189\left(H_b\right)_{rms} - 0.186h \tag{15}$$

The static wave setup reduction factor, γ_η is then a ratio of the static wave setup at the toe to the static wave setup at the SWL shoreline, or:

$$\gamma_\eta = \frac{\overline{\eta}(h)}{\overline{\eta}_0} \tag{16}$$

This reduction factor is then applied to the DIM static wave setup to compute a depth-adjusted static wave setup at the toe of the engineered barrier,

$$\overline{\eta}' = \gamma_{\eta}\overline{\eta} \tag{17}$$

The 2-percent Dynamic Water Level ($DWL_{2\%}$) is thus calculated as:

$$DWL_{2\%} = \overline{\eta}' + 2\eta_{rms} + SWL \tag{18}$$

The next step is to compute the wave height at the toe of the barrier and the resultant wave runup on the barrier. Let H_{m0} represent the spectral significant wave height at the toe of the structure. If the $DWL_{2\%}$ depth at the structure toe is found to be too shallow to support the calculated wave height, the wave was assumed to be depth-limited and the incident wave height was calculated using a breaker index of 0.78, whence $H_{m0} = 0.78\ h_{toe}$. The average slope for use in the TAW methodology, m_{TAW}, is calculated iteratively across the surf zone between the still water line minus $1.5H_{m0}$ and the runup limit. The lower slope point must never be below the toe, however, even if SWL - $1.5H_{m0}$ falls below the toe (van der Meer, 2014). In these cases, the lower slope point is set at the toe. Since the runup limit is initially unknown, the still water level plus $1.5H_{m0}$ is chosen as a first estimate (Figure 5.5). If the runup limit exceeded the selected crest, the runup limit was set at the crest. The general formula of TAW for calculating the 2-percent wave runup on barriers is

$$R_{2\%} = 1.77H_{m0}\,\gamma_r\gamma_b\gamma_\beta\,\xi_{0m} \qquad \text{if: } 0.5 \le \gamma_\beta\,\xi_{0m} < 1.8$$

or:

$$R_{2\%} = H_{m0}\,\gamma_r\gamma_b\gamma_\beta\left(4.3 - \frac{1.6}{\sqrt{\xi_{0m}}}\right) \qquad \text{if: } 1.8 \le \gamma_\beta\,\xi_{0m} \tag{14}$$

Where, $R_{2\%} = 2\sigma_2$ is the wave runup height exceeded by 2 percent of the incoming waves; H_{m0} is the spectral significant wave height at the structure toe; γ_r is the influence coefficient for roughness element of slope; γ_b is the influence coefficient for a berm; γ_β is the influence coefficient for oblique wave attack; $\xi_{0m} = m_{TAW} / \left(H_{m0} / L_m\right)^{0.5}$ is the Iribarren number based on wave parameters at the toe of the structure. Influence factors for roughness, the presence of a berm, and oblique wave attack are selected according to Table D.4.5-3 in the Final Draft *Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States* (FEMA, 2005), hereafter referred to as the Pacific Guidelines. The roughness reduction factor is set to 1.0 for a smooth concrete seawall or sheet pile barrier.

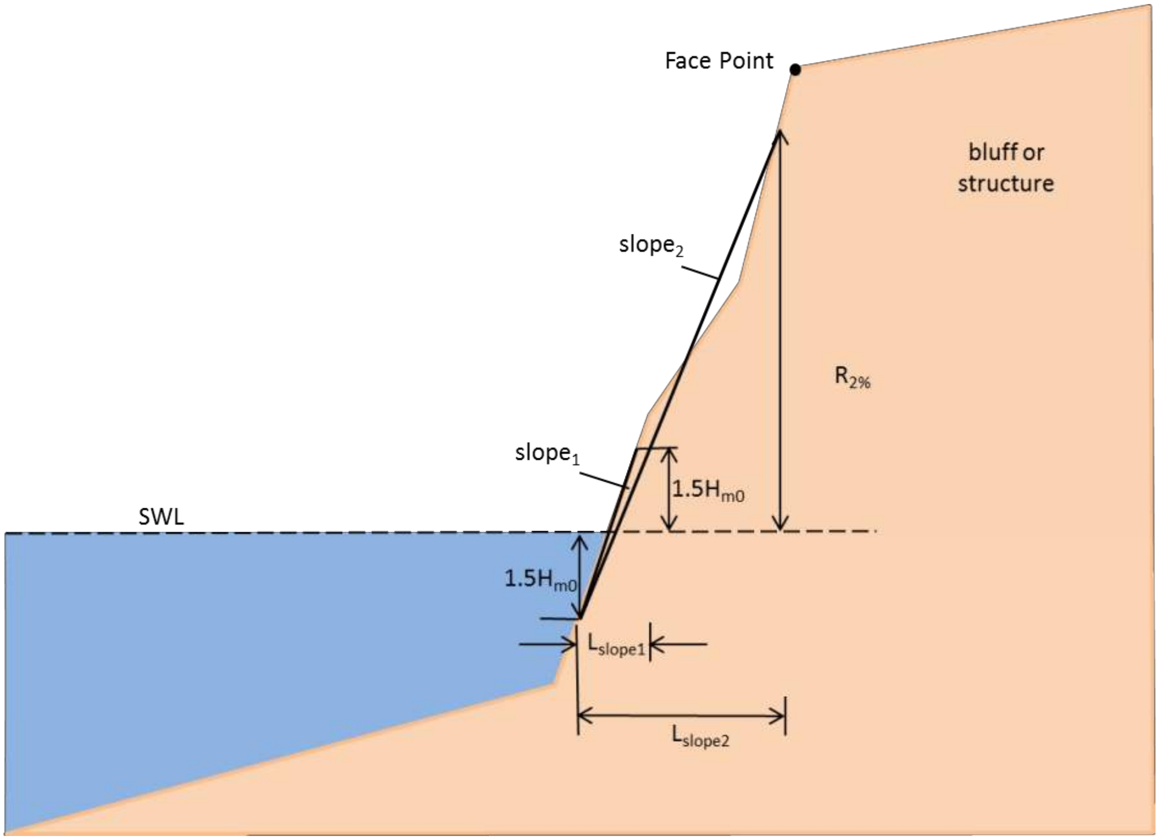


Figure 5.5: Determination of an Average Slope of Hard Back-Shore Formations (Bluff or Barriers) Based on an Iterative Approach, (Corrected from van der Meer, 2002)

The influence factor for oblique wave attack is calculated at each time step in the CDIP wave record (see Section 6). The spectral significant wave height H_{m0} is shoaled and refracted from a deep water point to the structure toe. The wave direction at the toe is compared to the transect orientation, perpendicular to the shoreline, to determine the angle of wave attack. For cases in which waves break seaward of the structure toe, the wave direction is taken from the point of breaking; i.e., where the incident wave height at the toe is depth-limited and calculated using a breaker index of 0.78, whence: $H_{m0} = 0.78\, h_{toe}$.

Incident wave runup, $R_{2\%} = 2\sigma_2$ is then statistically combined with the reduced dynamic wave setup as with the application of DIM, and added to SWL and static wave setup to yield the total water level, TWL, or:

$$TWL = SWL + \overline{\eta}' + 2.0\sqrt{\eta_{rms}^2 + \left(\frac{R_{2\%}}{2}\right)^2} \qquad (15)$$

For non-vertical structures with slopes greater than 1:1, the TAW manual after van der Meer (2002) suggests using the TAW method with an additional vertical wall reduction factor, γ_v, to account for runup on very steep (but not vertical) slopes. With steep slopes, the Iribarren number $\xi_{0m} = m_{TAW} / (H_{m0} / L_m)^{0.5}$ becomes large which means that the waves will not break. To keep the relationship between the type of breaking and the Iribarren number, the vertical wall must be schematized as a 1:1 slope. Therefore, the barrier slope was set to 1:1 for the Iribarren number calculation, and a vertical wall reduction factor for steep slopes was applied:

$$\gamma_v = 1.35 - 0.0078 \tan^{-1} m_{face} \tag{16}$$

where the face slope, m_{face} measured between the selected toe and face locations, is the angle of the actual slope in degrees (van der Meer, 2002). While this approach is based on work done for vertical walls atop dikes, sensitivity testing showed that it compared well with the TAW method and the Shore Protection Method (SPM) (USACE, 1984) for vertical walls as an intermediate approach to calculating runup on steep slopes. The use of this vertical wall reduction factor accounts for wave reflection expected on slopes greater than 45 degrees, and this approach generates results that fall between those for a 45- degree slope and those for a vertical wall.

Wave overtopping occurs when a potential runup elevation exceeds a structure's profile crest elevation. When wave runup is shown to exceed the barrier crest, the severity of wave overtopping is evaluated based on the mean overtopping rate, *q*. The required input parameters for computing the mean overtopping discharge are the wave height and freeboard, defined as the difference between the DWL2% and the structure crest. The 1-percent-annual- chance TWL available from the wave runup and extreme value analyses is a statistical value and is not associated with either a specific wave height or DWL2%. Therefore, the maximum wave height at the structure toe and the maximum and average DWL2% associated with the 32 annual maximum TWLs were chosen for use with the 1-percent TWL to estimate the 1-percent overtopping hazard.

Mean overtopping rates, *q*, were computed following Table VI-5-8 in the Coastal Engineering Manual (USACE, 2006) which presents an overtopping formula for impermeable and permeable barriers and structures according to:

$$Q' = a\, gH_s T_{om} \exp\left(-\frac{bR_c}{H_s \gamma_r} \sqrt{\frac{s_{om}}{2\pi}} \right) \tag{17}$$

Where H_s, is the significant wave height at the structure, R_c is the freeboard, γ_r is the influence factor for surface roughness, T_{om} is the wave period associated with the spectral peak in deep water, s_{om} is the wave steepness associated with the spectral peak in deep water, and a and b are empirical constants based on beach slope and berm width as determined from measured beach profiles plotted in Section 6.4. To conservatively maximize the overtopping potential, H_s and R_c are selected as the maximum wave height at the structure and the minimum freeboard between the highest DWL2% and the barrier crest elevation.

5.7) Beach Profile Calculations: A critical set of inputs to the wave setup, total runup and total water level (TWL) computations are the profile slope terms, m_{DIM} , m_{TAW} , and m_{face} . These are calculated from the beach and shore rise profiles during extremal wave events. Since there are only a limited set of beach profile measurements at Doheny State Beach, (and virtually none of these measurements have been performed during extremal wave events), the beach profile and its slope must be represented by model calculations that have been calibrated using the available set of beach profile measurements. Beach profile measurements at Doheny State Beach have been conducted by the US Army Corps of Engineers, USACOE (1991), Coastal Environments, (2014), and Coastal Frontiers (2014).

It is well known that beach and nearshore bottom profiles change seasonally in response to seasonal wave climate variations as shown in Figure 5.6, (cf: Inman et al, 1993; Jenkins and Inman 2006); and that seasonal transitions between summer and winter equilibrium states cause seasonal changes in the mean shoreline (Equation 7).

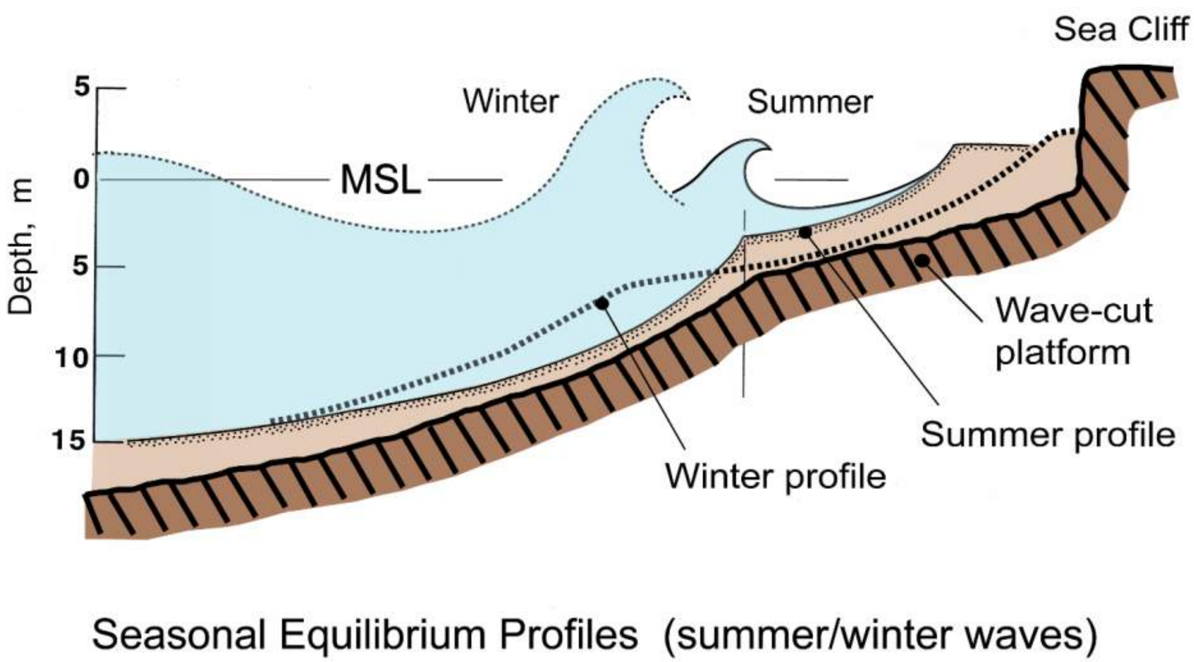


Figure 5.6: Schematic of summer and winter equilibrium beach profiles, from Inman, et al (1993).

Short period waves during summer (from the spin up of winds from the local North Pacific High) cause the inner bar-berm section of the beach profile to build up and steepen; while long period storm swells during winter from the Aleutian low cause the bar-berm profile to flatten, and transfer beach sand to the outer shore-rise profile. These changes between summer and winter equilibrium states are predicted from the long-term wave record (Section 6) applied to the well-tested elliptic cycloid solutions after Jenkins and Inman (2006). The elliptic cycloid represents the equilibrium beach profile with a curve that is traced out by following a point on the circumference of a rolling ellipse (Figure 5.7)

The elliptic cycloid solutions were developed for beach profiles by Jenkins and Inman, (2006) using equilibrium principles of thermodynamics applied to very simply representations of the nearshore fluid dynamics. Equilibrium beaches are posed as isothermal shorezone systems of constant volume that dissipate external work by incident waves into heat given up to the surroundings. By the maximum entropy production formulation of the second law of thermodynamics (the law of entropy increase), the shorezone system achieves equilibrium with profile shapes that maximize the rate of dissipative work performed by wave-induced shear stresses. Dissipative work is assigned to two different shear stress mechanisms prevailing in separate regions of the shorezone system, an outer solution referred to as the *shorerise* and a *bar-berm* inner solution (Figure 5.7a). The equilibrium shorerise solution extends from closure depth (zero profile change) to the breakpoint, and maximizes dissipation due to the rate of working by bottom friction. In contrast, the equilibrium bar-berm solution between the breakpoint and the berm crest maximizes dissipation due to work by internal stresses of a turbulent surf zone. Both shorerise and bar-berm equilibria were found to have an exact general solution belonging to the class of elliptic cycloids.

The elliptic cycloid solution is a curve allows all the significant features of the equilibrium profile to be characterized by the eccentricity and the size of one of the two ellipse axes. These two basic ellipse parameters are related herein to both process-based algorithms and to empirically based parameters for which an extensive literature already exists. The elliptic cycloid solutions reproduce realistic and validated wave height, period and grain size dependence and demonstrated generally good predictive skill in point-by-point comparisons with measured profiles (Jenkins and Inman, 2006 display).

To understand the formulation of the elliptic cycloid representation of the nearshore bottom profile and sensitivity to ocean conditions, we first review the nomenclature of the shorezone as shown schematically in Figure 5.7a. The seaward boundary of the shorezone is a vertical plane at the critical closure depth $\hat{h}_c$ (Figure 8a) corresponding to the maximum incident wave [e.g., *Kraus and Harikai*, 1983]. The landward boundary is a vertical plane at the berm crest (cross), a distance $\hat{X}_1$ from a bench mark. The cross-shore length of the system from the berm crest to closure depth is $\hat{X}_c$. The distance from the point of wave breaking to closure depth is $\hat{X}_{c2}$ such that $\hat{X}_c = \hat{X}_{c2} + \hat{X}_2$, where $\hat{X}_2$ is the distance from the berm crest to the origin of the shorerise profile near the wave breakpoint.

We consider equilibrium over time scales that are long compared with a tidal cycle and profiles that remain in the wave dominated regime where the relative tidal range (tidal range/H) < 3 [*Short*, 1999]. Under these conditions, the curvilinear solution to the bottom profile which satisfies the maximum entropy production formulation of the *Second Law of Thermodynamics* can be expressed in polar coordinates (r, θ) as:

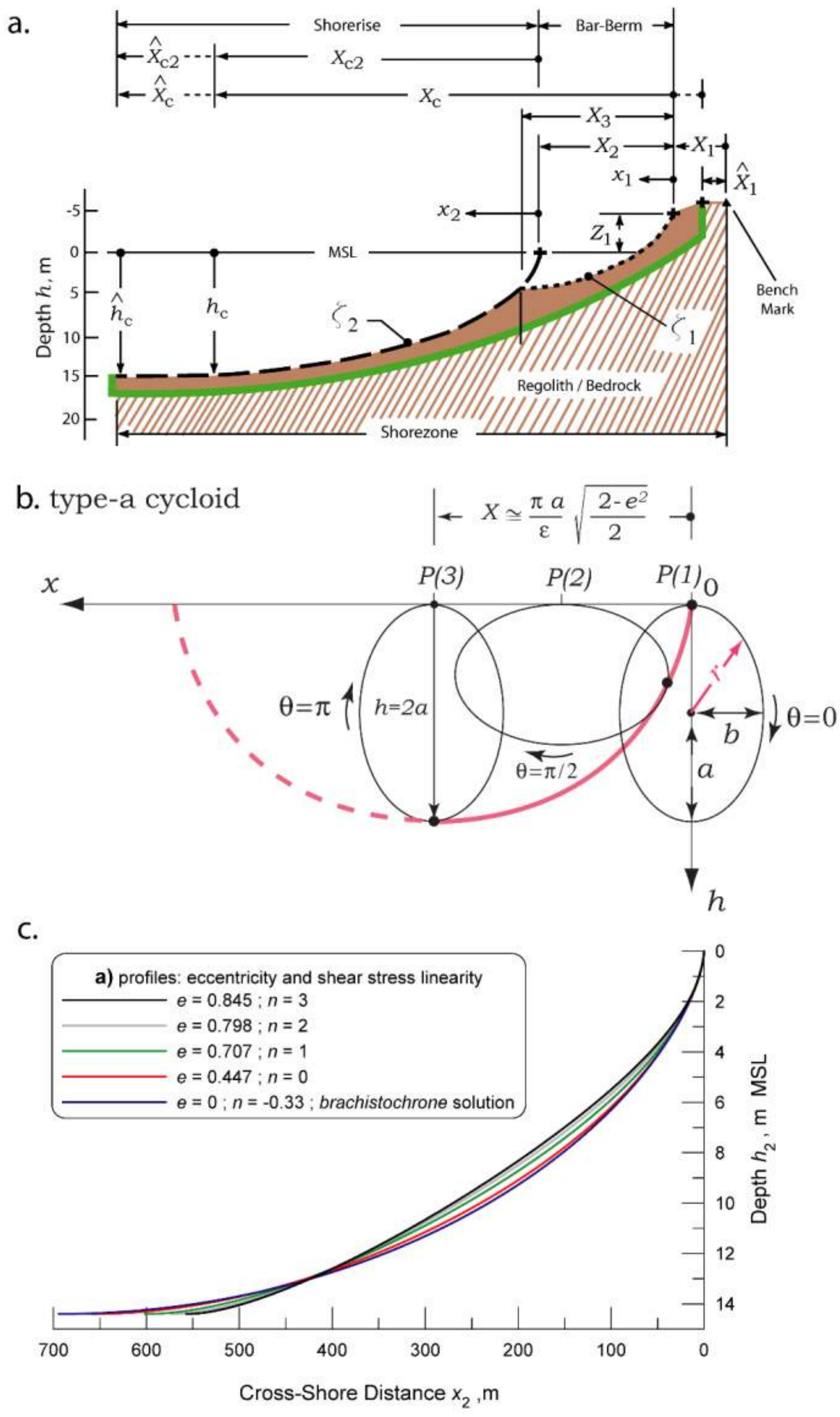


Figure 5.7. Equilibrium beach profile a) nomenclature, b) elliptic cycloid, c) Type-a cycloid solution.

$$x = x_2 = \frac{2r\, I_{\mathrm{e}}^{(k_{1,2})}}{\pi\, \varepsilon}\, (\theta - \sin\theta\,) \tag{18}$$

where r is the radius vector measured from the center of an ellipse whose semi-major and semi-minor axes are a, b and $I_{\mathrm{e}}^{(k)}$ is the elliptic integral of the first or second kind. This curve is what a point on the circumference of an ellipse would trace by rolling through some angle θ , (Figure 3.8b); hence the name elliptic cycloid. The polar equivalent of the type-a cycloid shown in Figure 3.8b has a radius vector whose magnitude is:

$$r \;= r_{\mathrm{a}} = \left[\frac{a^2\, b^2}{a^2 \sin^2\theta + b^2 \cos^2\theta}\right]^{1/2} = \frac{a\sqrt{1-e^2}}{\sqrt{\sin^2\theta + (1-e^2)\cos^2\theta}} \tag{19}$$

where e is the eccentricity of the ellipse given by $e = \sqrt{1-(b^2/a^2)}$. The polar form of the type-a cycloid in Figure 5.7b is based on the elliptic integral of the second kind that has an analytic approximation, $I_{\mathrm{e}}^{(2)} = (\pi/2)\sqrt{(2-e^2)/2}$, see *Hodgman* [1947]. The inverse of (18) for the type-a elliptic cycloid gives the companion solution in terms of local water depth, h, as:

$$h = h_2 = \frac{\pi\varepsilon\; x_2}{2I_e^{(k_{1,2})}}\left(\frac{1-\cos\theta}{\theta - \sin\theta}\right) = r\left(1-\cos\theta\;\right) \tag{20}$$

The depth of water at the seaward end of the profile ($\theta = \pi$) is $h = 2a$ in the case of the type-a cycloid. The length of the profile X is equal to the semi-circumference of the ellipse,

$$X \;= \frac{2aI_{\mathrm{e}}^{(2)}}{\varepsilon} \cong \frac{\pi\; a}{\varepsilon}\sqrt{\frac{2-e^2}{2}} \qquad \text{at} \quad \theta = \pi \quad \text{(type-a cycloid)} \tag{21}$$

With (21) the bottom slope can be solved as:

$$m = \frac{\sin\theta_b + e^2(\cos\theta_b - 1)\sin\theta_b\cos\theta_b}{1-\cos\theta_b + e^2(\sin\theta_b - \theta_b)\sin\theta_b\cos\theta_b} \tag{22}$$

$$\text{Where: } \theta_b = \arccos\left[1-2\left(\frac{H_0'}{\Lambda\gamma\, h_c}\right)^{\alpha}\right] \tag{23}$$

The shoaling factor assumed for these bar-berm solutions ($\Lambda =$ 0.81) was based on uniform shoaling of the incident wave conditions, while a mean value was chosen for gamma ($\gamma \;= 0.8$) from the data reported by *Raubenheimer et al.* [1996]. In equation (23) the term h_{c} is the *closure depth*, which represents the closest point to the shoreline where a stable seabed can be found, because it is the point beyond which all changes in the beach profiles cease. It is calculated from Jenkins and Inman (2006) by the following parametric relation:

$$h_c = \frac{K_e H_\infty}{\sinh k h_c}\left(\frac{D_o}{D_2}\right)^{\psi} \tag{24}$$

where K_e and ψ are non-dimensional empirical parameters, D_2 is the shorerise median grain size; and D_o is a reference grain size. With $K_e \sim 2.0, \psi \sim 0.33$ and $D_o \sim 100\mu\text{m}$, the empirical closure depths reported in *Inman et al.* [1993] are reproduced by Figure 5.8. From Figure 5.8 we find closure depth increases with increasing wave height and decreasing grain size, as shown in Figure 3.7. Because of the wave number dependence of (8), closure depth also increases with increasing wave period.

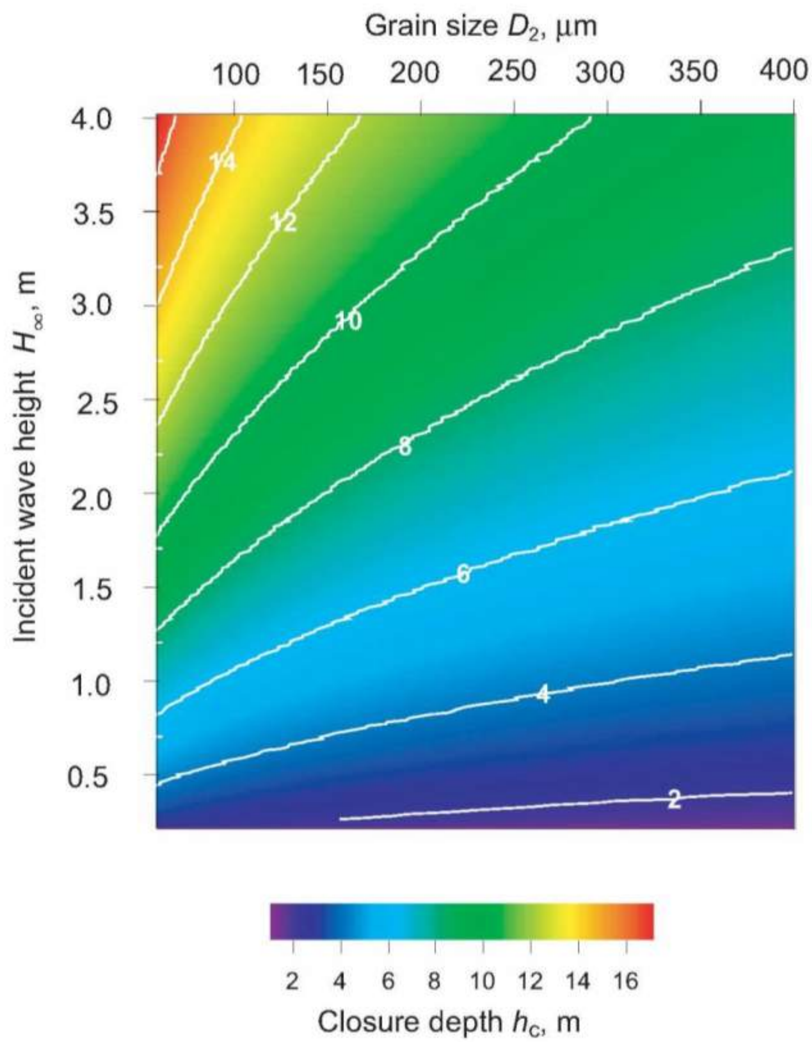


Figure 5.8: Closure depth contoured versus incident wave height and sediment grain size for waves of 15 second period, with $K_e \sim 2.0, \psi \sim 0.33$ and $D_o \sim 100\mu\text{m}$. D_2 is the shorerise median grain size; and D_o is a reference grain size.

6) Model Initialization:

This section develops the data bases necessary to evaluate Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2.

6.1) Bathymetry: Bathymetry provides a controlling influence on all of the coastal processes that affect dispersion and dilution. The bathymetry consists of two parts: 1) a stationary component in the offshore where depths are roughly invariant over time; and 2) a non-stationary component in the nearshore where depth variations do occur over time. The stationary bathymetry generally prevails at depths that exceed closure depth which is the depth at which net on/offshore transport vanishes. Closure depth is typically -12 m to -15 m MSL in the Oceanside Littoral Cell, (Inman et al. 1993). The stationary bathymetry was derived from the National Ocean Survey (NOS) digital database. Gridding is by latitude and longitude with a 1 x 1 arc second grid cell resolution yielding a computational domain of 30.9 km x 18.5 km. Grid cell dimensions along the x-axis (longitude) are 25.7 meters and 30.9 meters along the y-axis (latitude).

For the non-stationary bathymetry data inshore of closure depth (less than -15 m MSL) nearshore and beach surveys were conducted by the US Army Corps of Engineers in 1985, 1990, 1996, 2001 and have been compiled in USACE (2001). These nearshore and beach survey data were used to update the NOS database for contemporary nearshore and shoreline changes that have occurred following the most recent NOS surveys.

To perform both the required wave shoaling and transport computations in the farfield of the SJCOO outfall diffusers, a large-domain grid is required to compute the effects of island sheltering and regional scale refraction and circulation due to the shallow banks of the continental margin (Figure 6.1). A nearfield grid (Figure 6.2) in the immediate neighborhood of the diffuser is nested inside the farfield grid and is used to calculate the brine discharge dilution and dispersion.

6.2 Shore-side Structures: Wave runup, and overtopping were analyzed at the shore-side facilities associated with the Doheny Desalination Project assuming present conditions and two future scenarios including sea level rise. These facilities included: ***Well Head A***, elevation 17 ft.NAVD, at 33°27'44.38"N, 117°41'16.32"W; ***Well Head B***, elevation 17 ft. NAVD, at 33°27'45.07"N, 117°41'10.30"W; ***Well Head C***, elevation 17 ft. NAVD at 33°27'45.12"N, 117°41'6.62"W; ***Well Head D***, at elevation 18 ft. NAVD at 33°27'44.48"N, 117°40'55.30"W; and ***Well Head E***, at elevation 18 ft. NAVD at 33°27'42.45"N, 117°40'47.33"W; (see Figure 6.3a). Two additional vaulted well heads with submersible pumps will be placed at the Capistrano Beach site (Figure 6.3b), which includes: ***Well Head G***, at elevation 18 ft. NAVD at 33°27'14.94"N, 117°39'59.91"W; and ***Well Head H***, at elevation 19 ft. NAVD at 33°27'13.17"N, 117°39'57.15"W.

6.3) Wave Forcing: Waves in deep water generally do not cause significant mixing. But shoaling waves produces bottom currents (referred to as *bottom wind*), cause scrubbing action against intake and discharge structures that result in vertical mixing of the nearfield water mass, and cause longshore and rip current circulation as a result of along shore variation in shoaling wave heights due to refraction over shelf bathymetry.

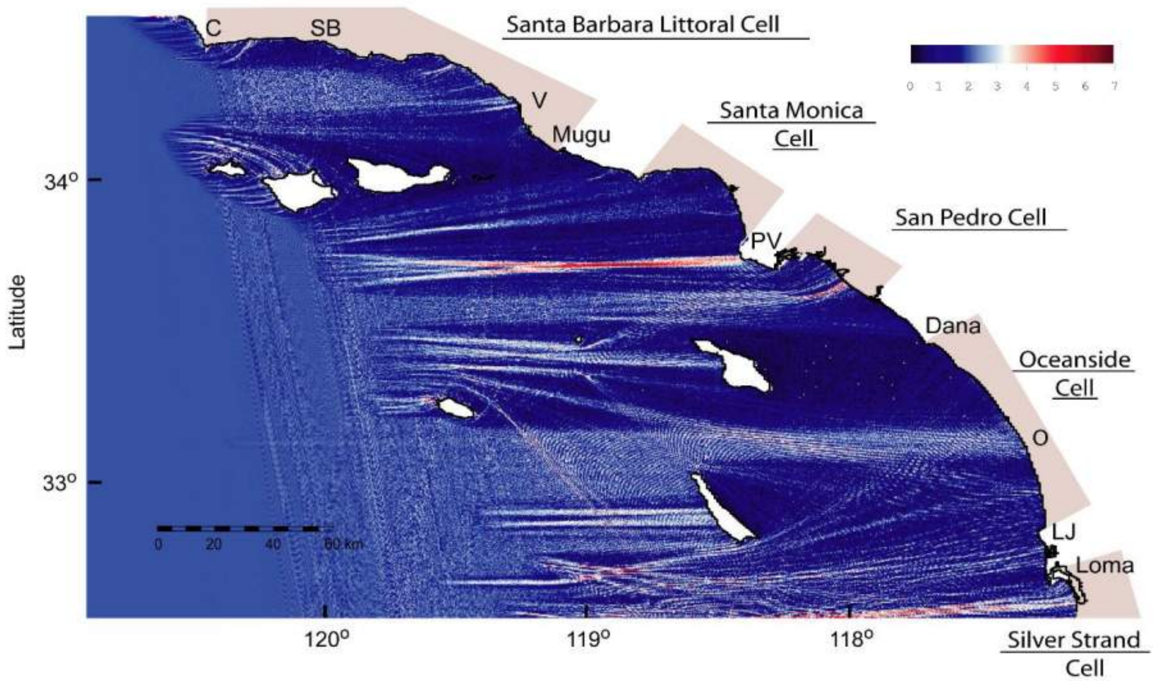
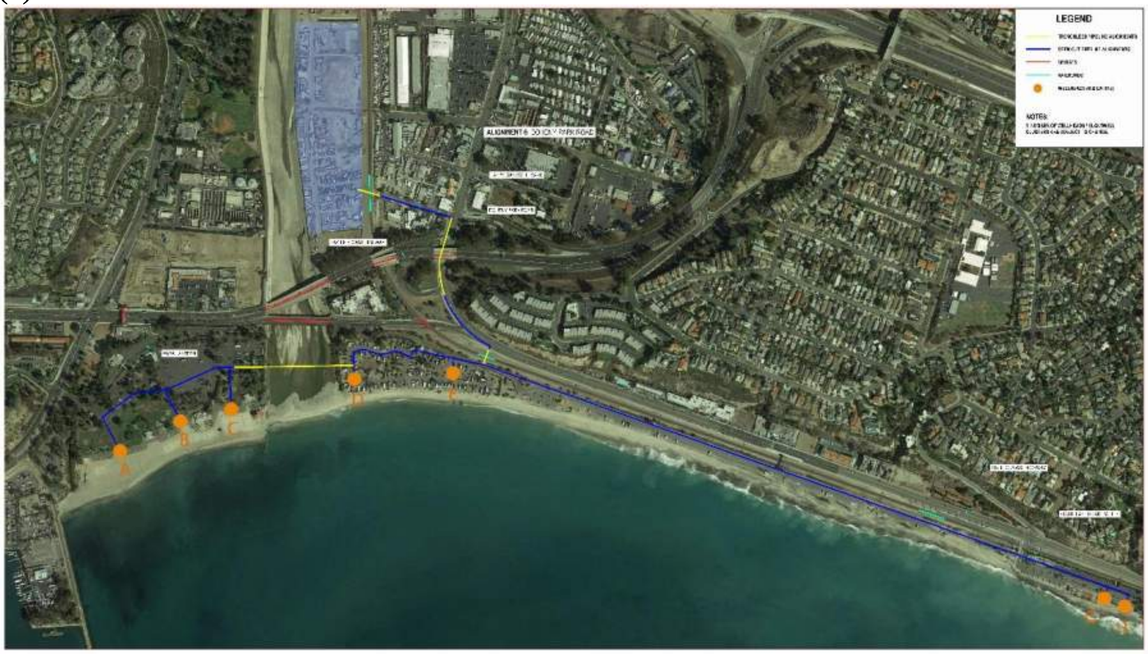


Figure 6.1: Far-field refraction/diffraction grid to simulate shoaling waves entering the Southern California Bight and Oceanside Littoral Cell. Results based on the 5 largest storms of the 1998 El Nino winter (from Jenkins and Wasyl, 2008b).

Figure 6.2: Near-field refraction/diffraction grid to simulate shoaling waves in the immediate neighborhood of Dana Point, SJCOO and Doheny Beach.

(a)



(b)

Figure 6.3: Critical shore-front infrastructure locations for the Doheny Desalination Project: a) Doheny Beach site; and b) Capistrano Beach site

Wave forcing to the Coastal Evolution Model (CEM) were derived from archival measurements of waves for the period 1980-2010, supplemented by wave burst measurements from the Acoustic Doppler Current Profiler (ADCP) measurements taken under the MBC *Applied Environmental Sciences* (MBC) marine environment studies. The archival wave records were obtained from the Oceanside, Dana Point, San Clemente, and Huntington Beach monitoring stations maintained by the Coastal Data Information Program, [CDIP, 2012, http://cdip.ucsd.edu]. To correct the archival data from widely spaced offshore monitoring sites to the nearshore of the SJCOO, raw data were entered into a refraction/diffraction numerical code, back-refracted out into deep water to remove local refraction and island sheltering effects, and subsequently forward refracted into the immediate neighborhood of the proposed Project. The backward and forward refractions of CDIP data were done using a numerical refraction-diffraction computer code called OCEANRDS. The primitive equations for this code are lengthy, but a listing of the codes for OCEANRDS are in Jenkins and Wasyl (2005).

An example of a reconstruction of the wave field throughout the Bight from the CDIP Oceanside buoy data is shown in Figures 6.1 for the 5 largest storms of the 1998 El Nino winter. Wave heights are contoured in meters according to the color bar scale and represent 6 hour averages, not an instantaneous snapshot of the sea surface elevation. Note how the sheltering effects of Catalina and San Clemente Islands have induced considerable variations in the neighborhood of the SJCOO and Dana Point Harbor. The wave height and direction parameters inside the Channel Islands are the values used as the deep water boundary conditions along the seaward face of the nearfield grid for the SJCOO Dana Point shoaling analysis.

Figure 6.4 gives the local forward refraction calculation into the nearfield domain of the SJCOO and the Doheny Desalination Project site (green box), due to the 100-year storm-wave event of 17-18 January 1998 after passing through the gaps in the continental margin and Channel Islands, (island sheltering effects, cf.Figure 6.1). Figure 6.4 gives extremal wave height variations along an 18.5 km section of coastline in the in the Dana Point region, including wave shoaling and reflection effects induced by the Dana Pt Harbor breakwater. Replication of the backward/forward refraction analysis on each of the 3 hour increments of the CDIP monitoring data produced continuous, unbroken records of the wave height, period and direction in the nearfield of the Doheny Desalination Project throughout the 1980-2010 period of record, as shown in Figure 6.5. The data in Figure 6.5 were supplemented by wave burst measurements from the Acoustic Doppler Current Profiler (ADCP) measurements taken at the SJCOO monitoring stations (MBC, 1998). Figure 6.6 gives the wave refraction/diffraction field in the SJCOO/Dana Pt. Harbor Littoral Sub-cell derived from these ADCP wave burst measurements. We find in Figures 6.4 & 6.6 that the refraction effects over local bathymetry create areas (indicated by red) where wave heights increase locally to 4 -5 m. In these areas, the shelf bathymetry has focused the incident wave energy and these regions of intensified wave energy are referred to as “bright spots”. The increased wave heights in these bright spots increases the wave run-up and induces local wave erosion. Conversely, the dark areas in Figures 6.4 & 6.6 (indicated by dark blue) where wave heights have been diminished are termed “shadows,” and represent areas of reduced run up and potential beach accretion For the January 1998 storm in Figure 6.6, the area around the SJCOO discharge site is indeed a bright spot in the local refraction pattern while the slant well sites for the Doheny Desalination Project are located in a shadow zone. Another wave shoaling phenomena at the slant well site is divergence of drift. Wave-driven longshore currents flow away from areas of high waves (away from bright spots) and converge on shadow regions. This convergence of the longshore current leads induces seaward flowing rip currents. Rip currents are advantages to shallow nearshore intake sites

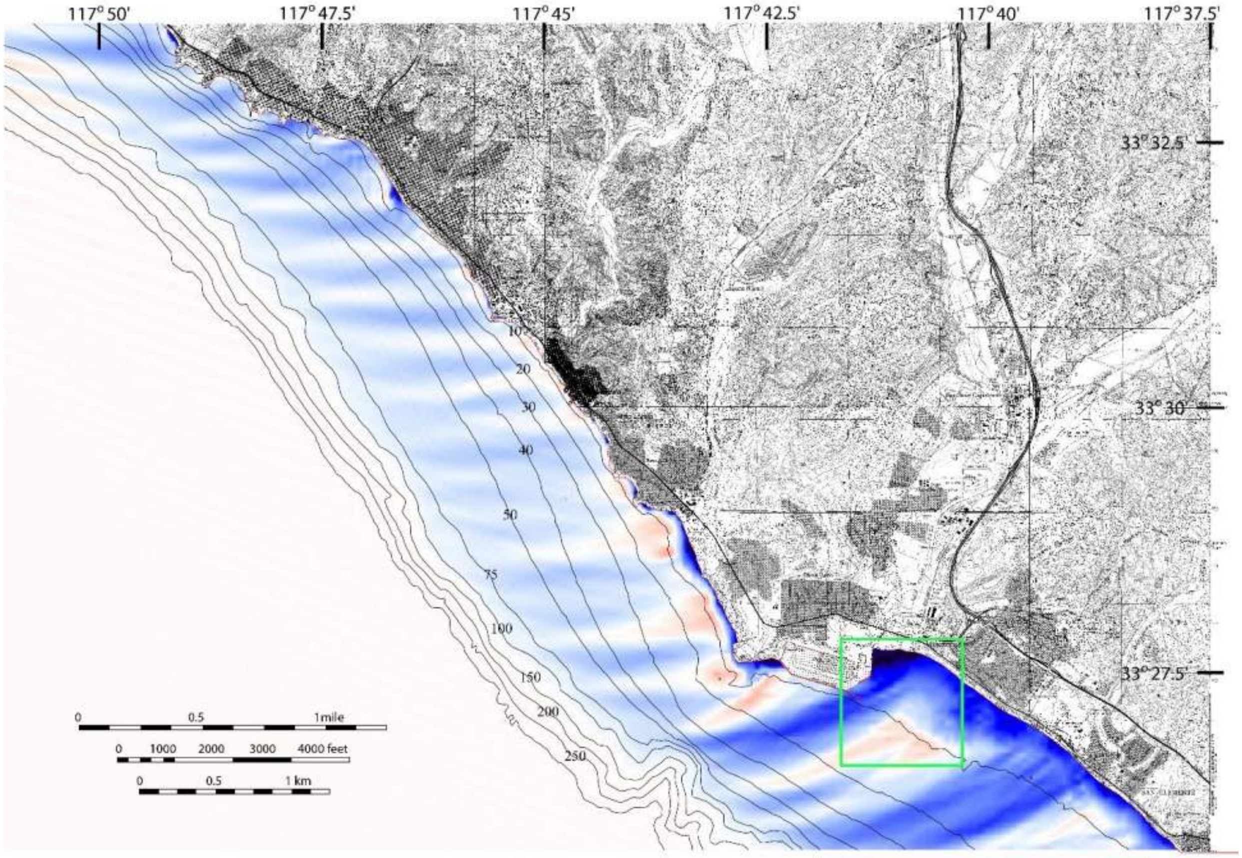


Figure 4. Maximum event wave refraction for period of record, 1980-2000 (18 January 1988). Wave height at offshore control point = 4.8 m, T=14 sec, from 270°.

Figure 6.4: Forward wave refraction/diffraction for the 100-year storm-wave event of 17-18 January 1998. These local refraction results are used to provide the point-to-point initializations for the wave setup and runup inputs to the total water level problem. The nearfield domain of the SJCOO and the Doheny Desalination Project is designated by the green box.

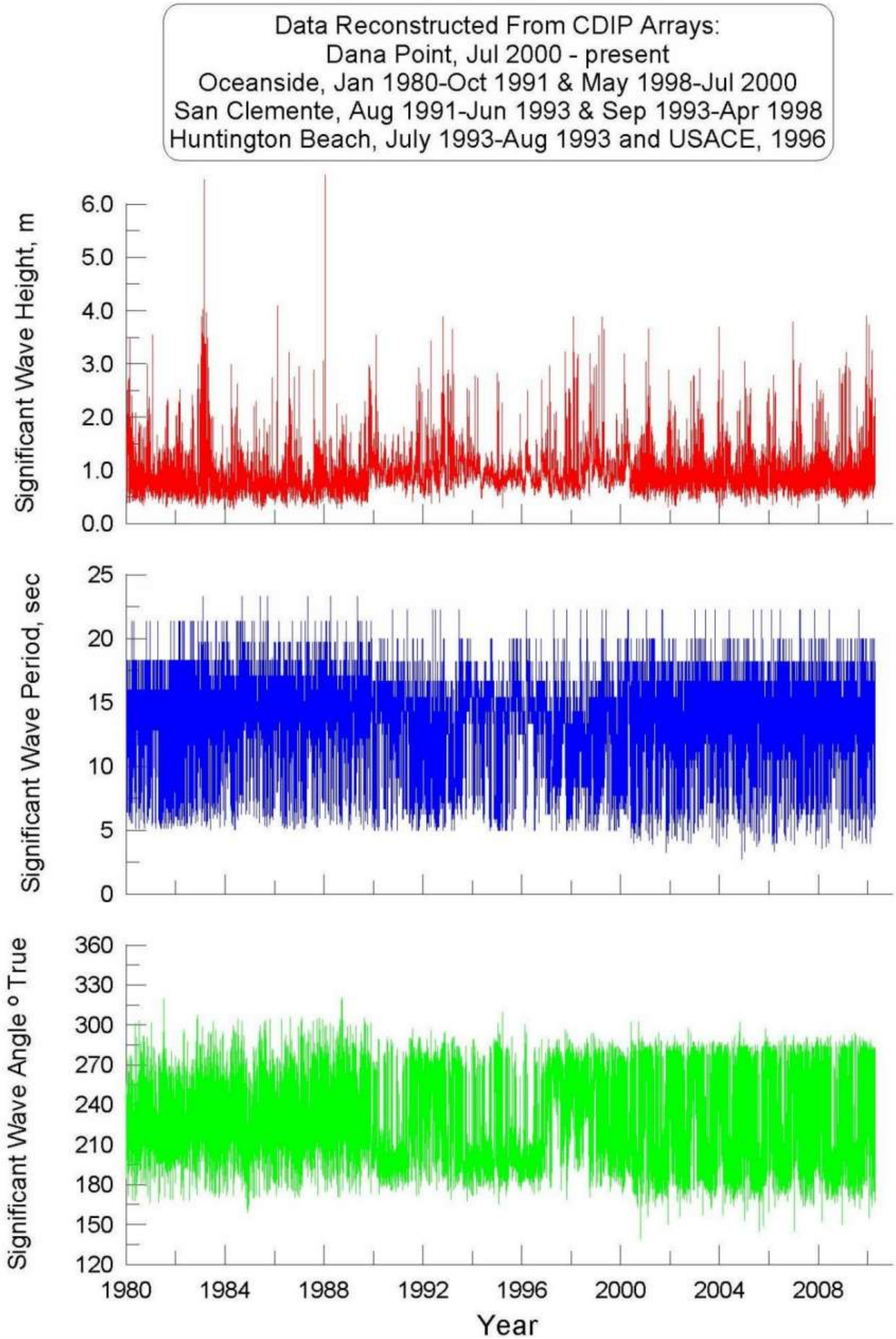


Figure 6.5: Archival wave forcing data 1980-2010 reconstructed for the SJCOO and Doheny Desalination Project modeling, from backward/forward refraction of regional CDIP wave monitoring data.

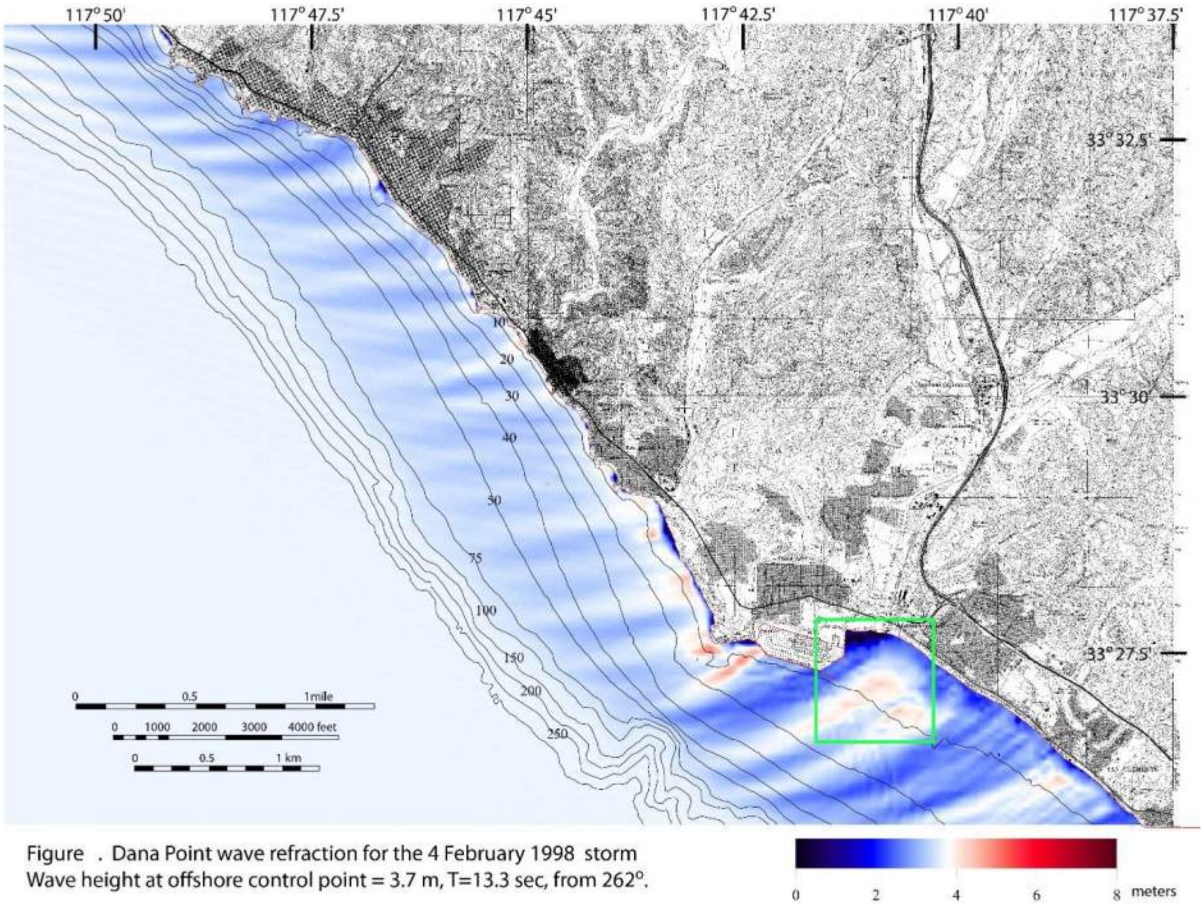


Figure 6.6: Wave refraction/diffraction field around the SJCOO site and the Doheny Desalination Project site derived from wave burst measurements from the Acoustic Doppler Current Profiler (ADCP) records taken under the MBC Applied Environmental Sciences (MBC) NPDES monitoring studies. Nearfield domain of the SJCOO and the Doheny Desalination Project site designated by green box.

because rip currents would advect storm water and urban run-off away from the shoreline and disperse it offshore in deeper water, thereby reducing potential for marine life impacts to nearshore and beach ecology. On the other hand, these same seaward flowing rip currents can also carry beach sand offshore, resulting in local beach erosion. Wave refraction/diffraction analyses of the 15 largest storm events in the 1980-2010 period of record are presented in Appendix-A. The 100 year event (1% event) was the two day storm of 17-18 January, 1988, and refraction/diffraction patterns for both days are also included in Appendix-A.

The composite 30-year wave record obtained from the CDIP archival data for 1980-2010 (Figure 6.5) was iteratively fit to Weibull (Type III) distributions with a range of *K-values* to find the best overall fit (highest correlation coefficient). A *K-value* of K = 1 was found to give an R-squared = 0.98, resulting in the extremal analysis curve shown in Figure 6.7. The red-line in Figure 6.5 is the Weibull Type III best fit and the crosses are the data points at the control point in 12 m water depth from Appendix-A refraction/diffraction analyses used to produce the best fit distribution. The Weibull Type III best fit projects a maximum significant wave height of $H_0' =$ 19.9 ft. with a probability of recurrence of 0.04% (return period = 2,500 yr); but such a wave has never been measured. The highest wave that was recovered from the refraction analysis in 12 m

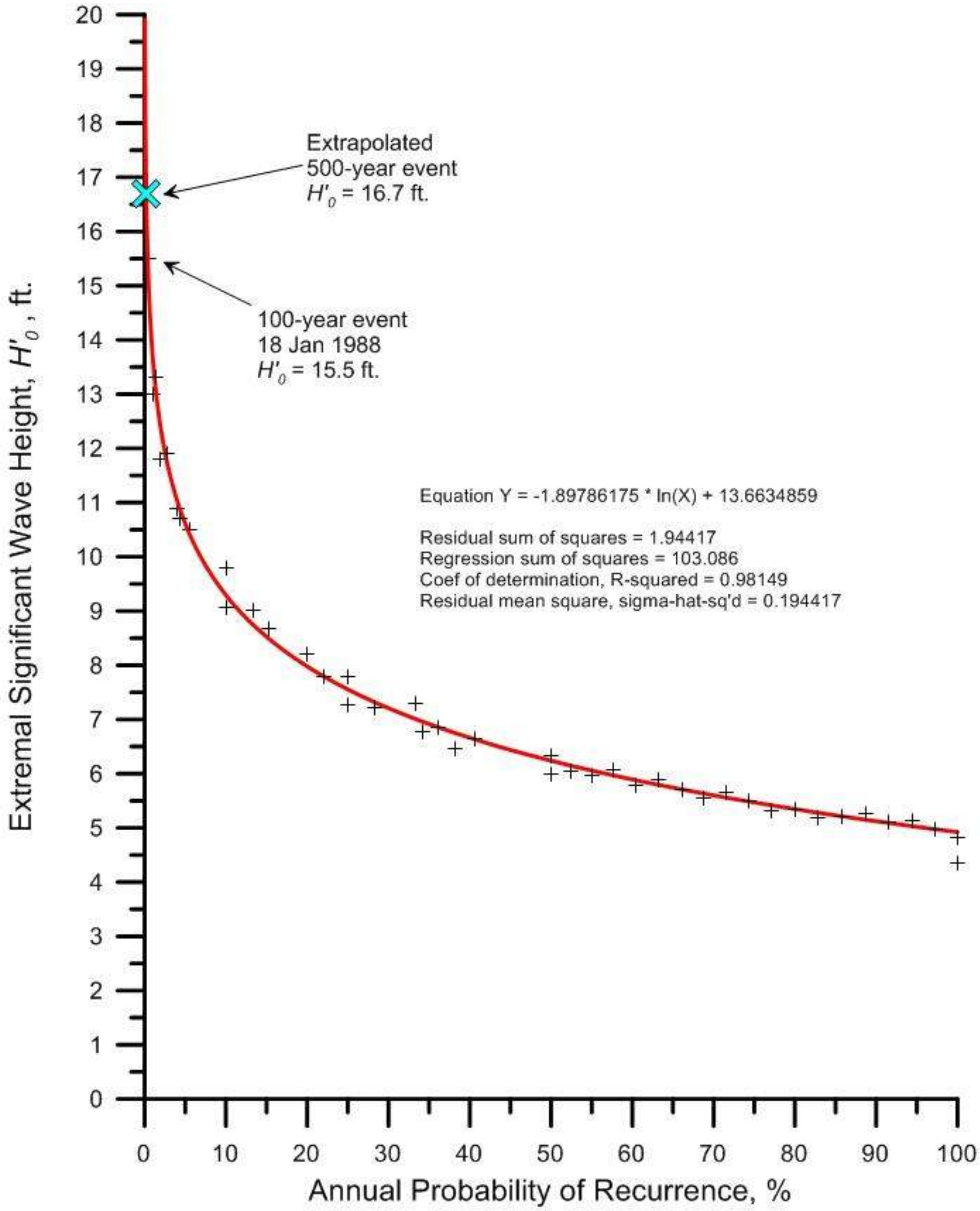


Figure 6.7 : Probability of recurrence of design wave heights based on Weibull extremal analysis of significant wave heights at Doheny & Capistrano Beaches. Analysisbased on Weibull Type III distribution applied to 12 m local water depth with K = 1.0. Recurrence Probability $P(H)$ = 100%/T, where T = return period

of water depth was due to the 18, January, 1988 storm (Figure 6.4) with a significant wave height H_0' = 15.5 ft. and a probability of recurrence of 1.0% (return period = 100 yr). The extremal analysis curve in Figure 6.7 will be the computational basis of the extreme value analysis of wave setup, total runup and total water level (TWL) in Section 7.

6.4) Beach Erosion: Another critical set of inputs to the wave setup, total runup and total water level (TWL) computations are the profile slope terms, m_{DIM} , m_{TAW} , and m_{face} . These are calculated from equations (22) – (24) using measured beach profiles to calibrate the empirical factors in these equations, which include the shoaling factor, Λ , and the non-dimensional empirical parameters: K_e and ψ . Beach profile measurements at Doheny State Beach have been conducted by the US Army Corps of Engineers, USACOE (1991), Coastal Environments, (2014), and Coastal Frontiers (2014). Plots of the beach profiles measured by the US Army Corps of Engineers, USACOE (1991) and Coastal Environments, (2014) are shown in Figures 6.8 & 6.9. Figure 6.8 shows the shore rise and bar berm sections of the beach profiles immediately west of Well Heads # 2 and #1; where profile ranges R4 & R5 bracket beach slope conditions in front of Well Head # 2, and range DB 1890 measured by the US Army Corps of Engineers give slope conditions in front of Well Head # 1 (cf. Figure 6.3). Figure 6.9 shows the shore rise and bar berm sections of the beach profiles immediately west of Well Heads # 2 and #3; where profile range R5 provides beach slope conditions in front of Well Head # 2, and range R7 gives slope conditions in front of Well Head # 3 (cf. Figure 6.3).

Figures 6.10 and 6.11 give seasonal profile changes at Doheny State Beach immediately west of Well Head #3 over a number of years between 2001 and 2007. Figure 6.10 provides a generalization of the winter profiles, indicating an average nearshore slope, m_{DIM} = 0.066, (proxy slope for an *eroded beach*). Figure 6.11 indicates that the average nearshore slope in summer steepens to m_{DIM} = 0.10, (proxy slope for an *accreted beach*). Using these values to calibrate the elliptic cycloidal slope algorithms in equations (22)-(24), the variation of beach slope with on/offshore position in response to the potential range of extremal wave height was calculated according to Figure 6.12. Generally, across the inner portion of the beach profile closest to the DDP well heads the beach slopes become flatter in winter and steeper in summer, while both types of seasonal profiles develop offshore bars offshore during higher extremal wave conditions. This response is consistent with the well- known response of sandy beaches to increasing levels of incident wave energy; whereby the exposed inner section of the beach profile (the bar-berm profile) erodes and flattens in slope during winter or periods of high waves, while outer submerged portion of the profile (the shore-rise profile) develops offshore sand bar formations. Review of the composite surveys in Figures 6.8-6.11 reveals that variations in the beach widths around the well heads between summer and winter profiles are on the order of 50 ft. to150 ft. These relatively small range of seasonal variation in beach width indicates that Doheny State Beach is stable, as a consequence of being located at a sediment source, i.e. the San Juan Creek. The San Juan Creek is the second largest source of sediment for the Oceanside Littoral Cell and provides an average of 51,000 metric tons of beach grade sand to Doheny State Beach annually (Figure 6.13). This supply of new sediment provides adequate sediment cover for the beach to establish and maintain equilibrium profile adjustments throughout the most high energy El Nino winter/summer seasonal cycles.

Variations in the beach widths and sediment cover with time are modeled in the LCM module of the Coastal Evolution Model (Figure 5.1) using time-stepped solutions to the sediment continuity equation (otherwise known as the *sediment budget*) applied to the boundary conditions of the coupled control cell mesh diagramed schematically in Figure 6.14. The sediment continuity equation is written (Jenkins, et al, 2007):

$$\frac{\partial q}{\partial t} = \frac{\partial}{\partial y}\left(\varepsilon \frac{\partial q}{\partial y}\right) - V_l \frac{\partial q}{\partial y} + J(t) - R(t) \qquad (25)$$

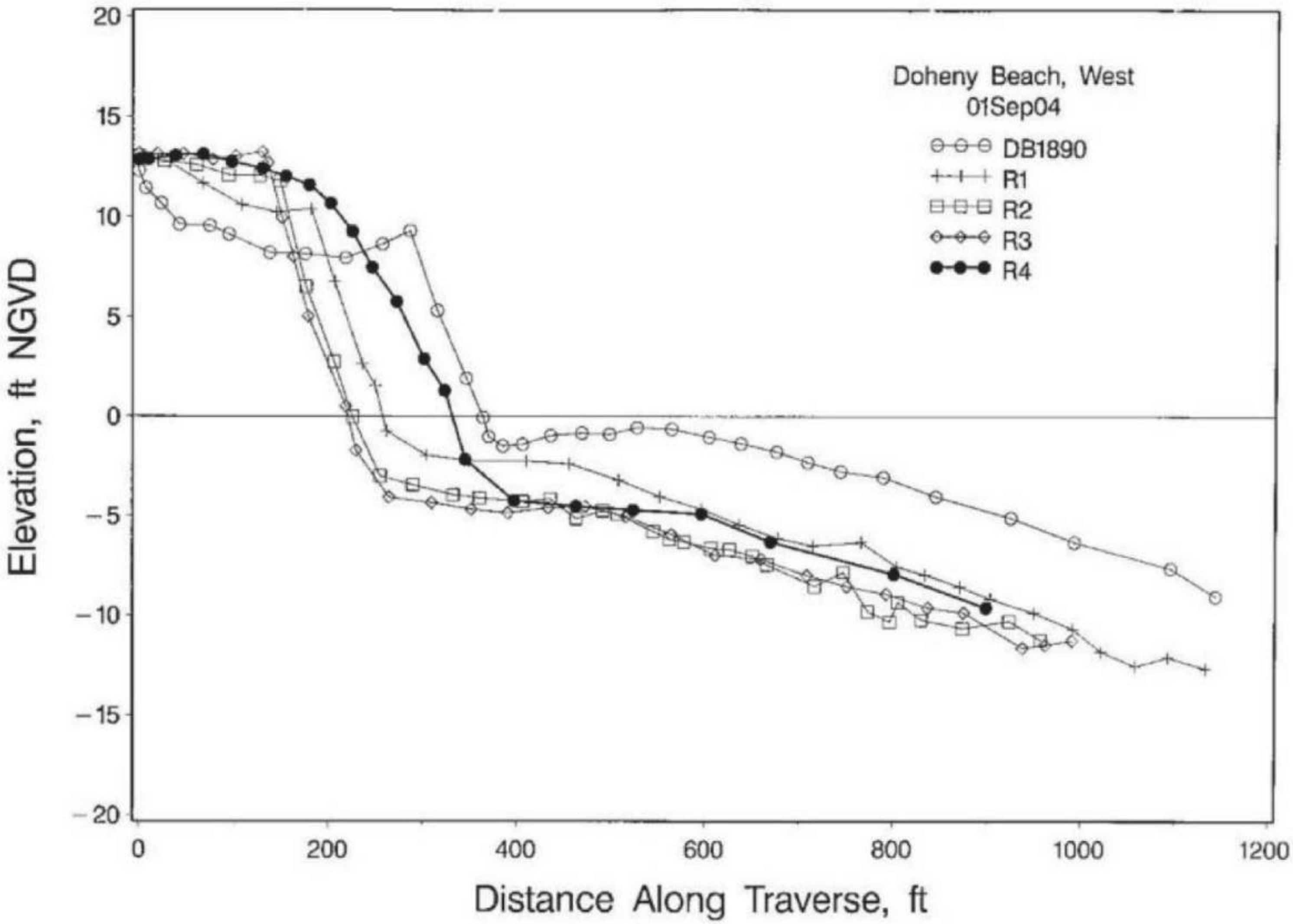


Figure 6.8: Beach profile surveys of Doheny Beach range lines adjacent to Well Heads A & B. Data from Coastal Environments, (2014).

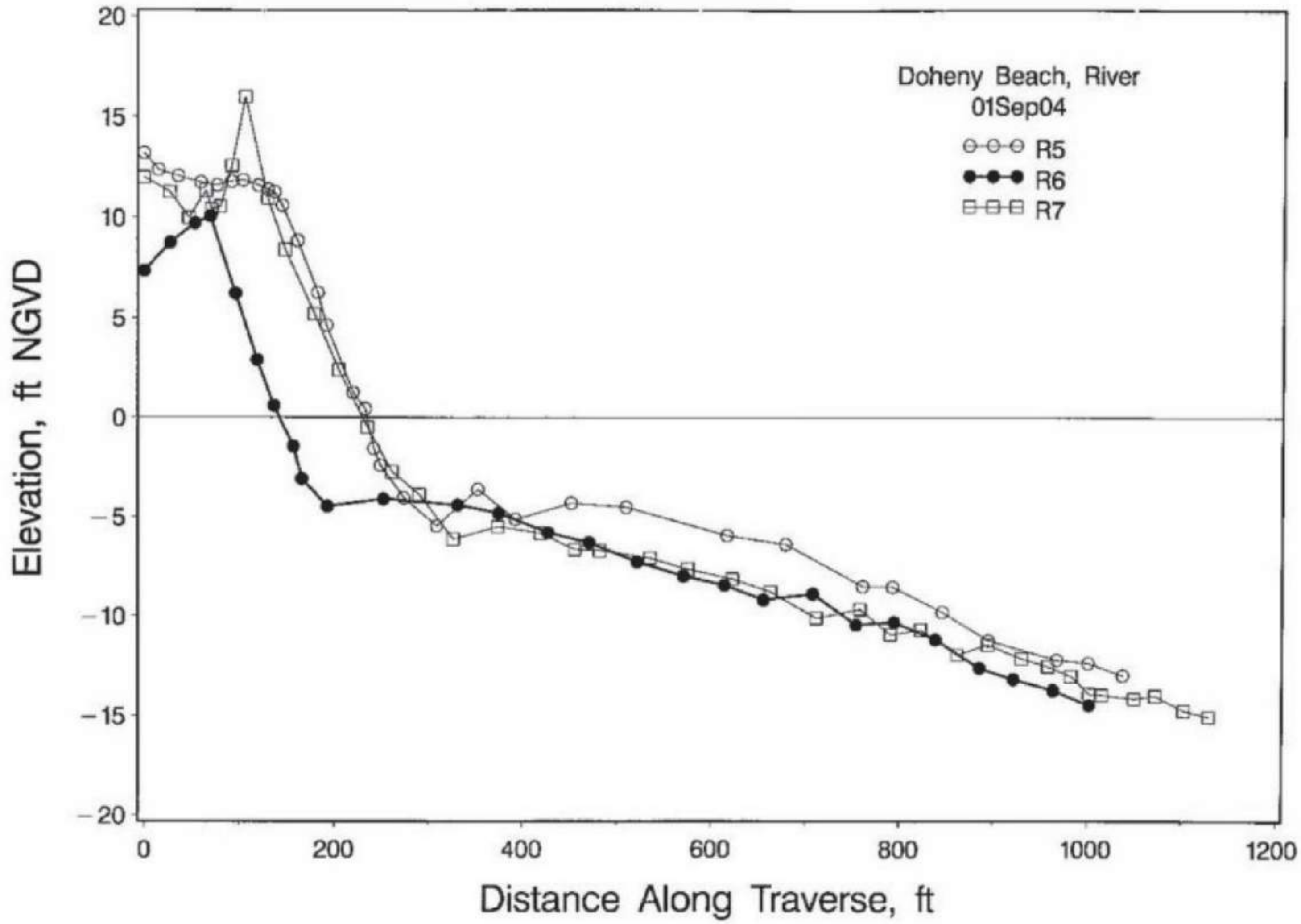


Figure 6.9: Beach profile surveys of Doheny Beach range lines adjacent to Well Heads C & D. Data from Coastal Environments, (2014).

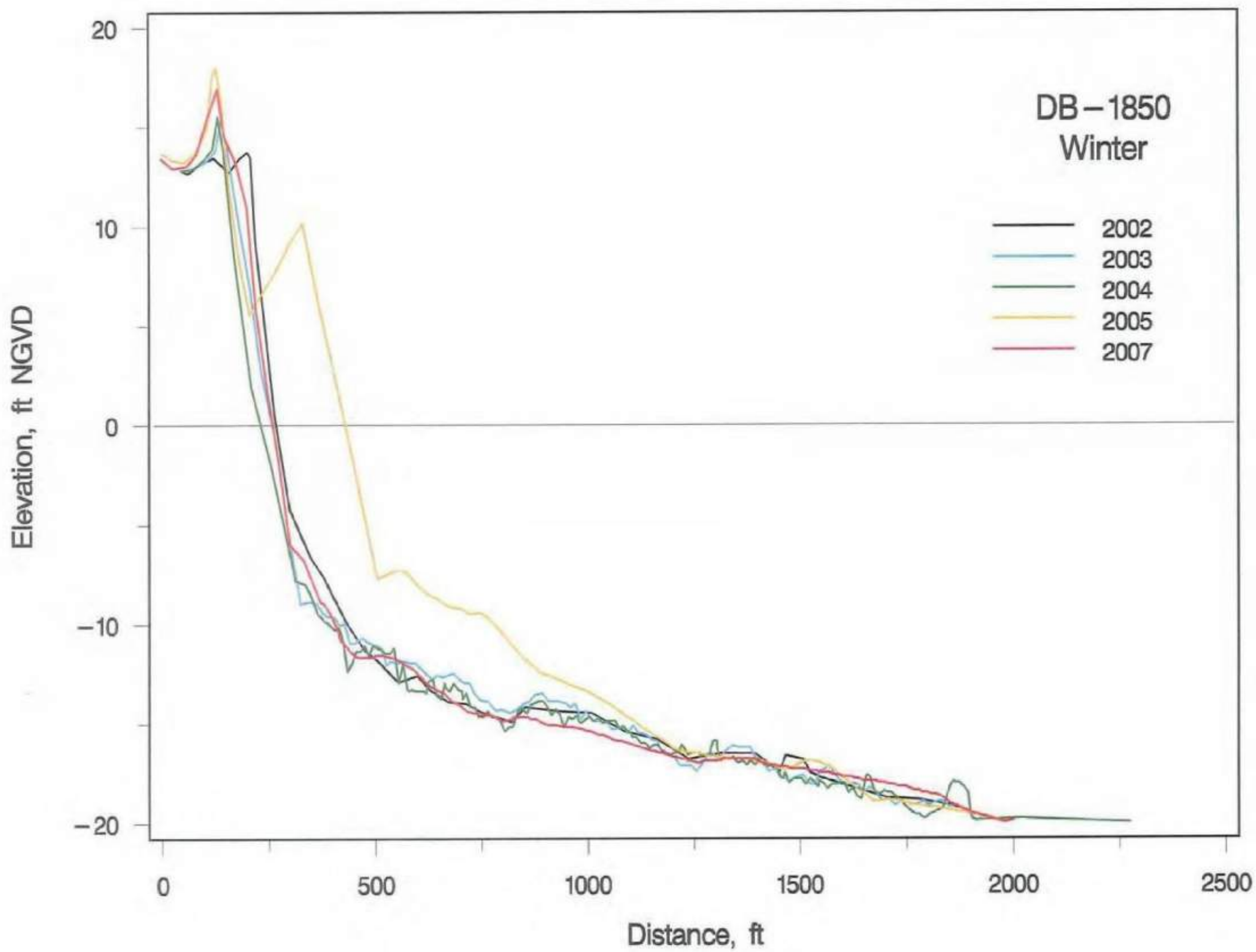


Figure 6.10: Winter beach profile surveys of Doheny Beach range lines adjacent to Well Heads D & E. Surveys due to the US Army Corps of Engineers. Data provided by Coastal Frontiers, (2014).

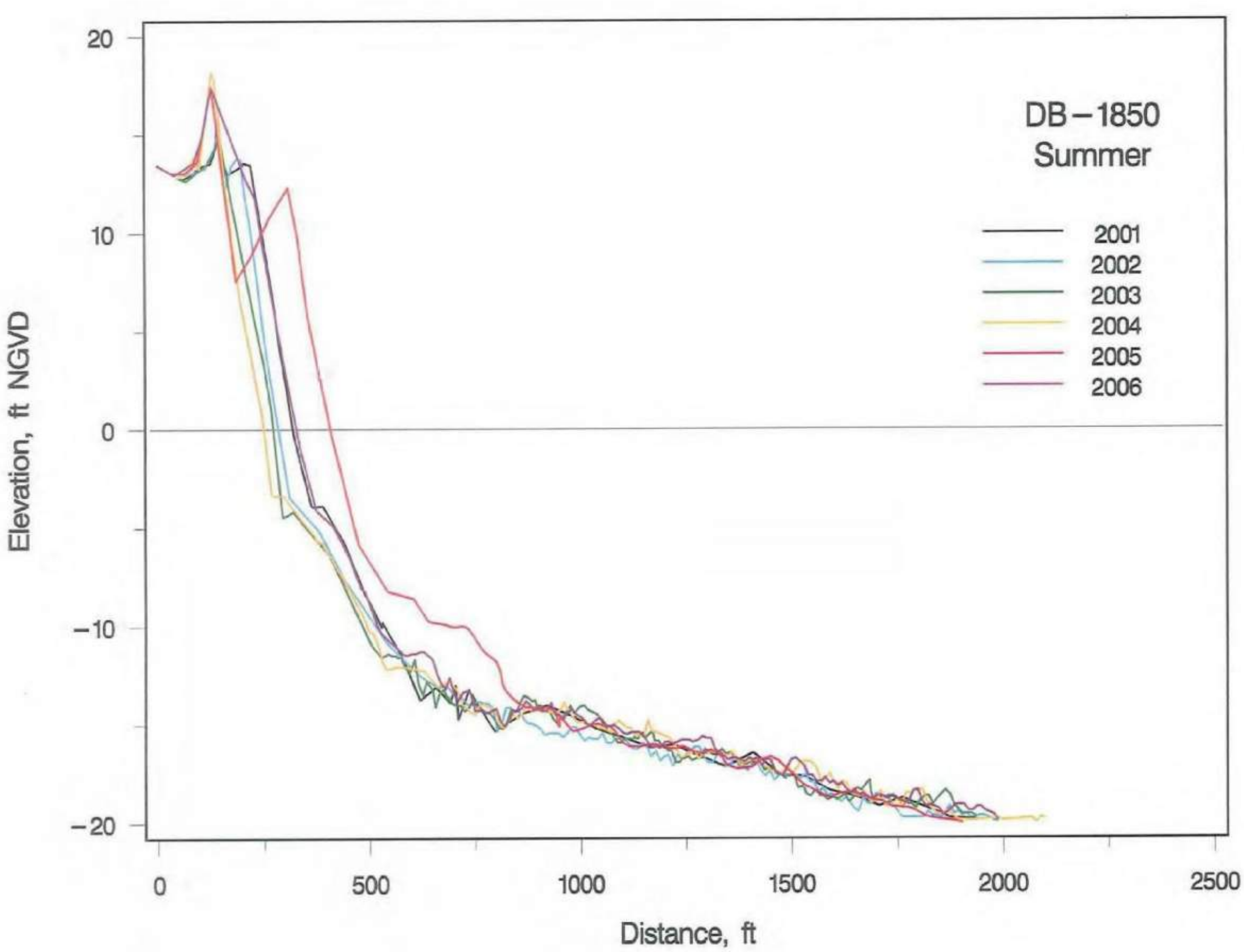
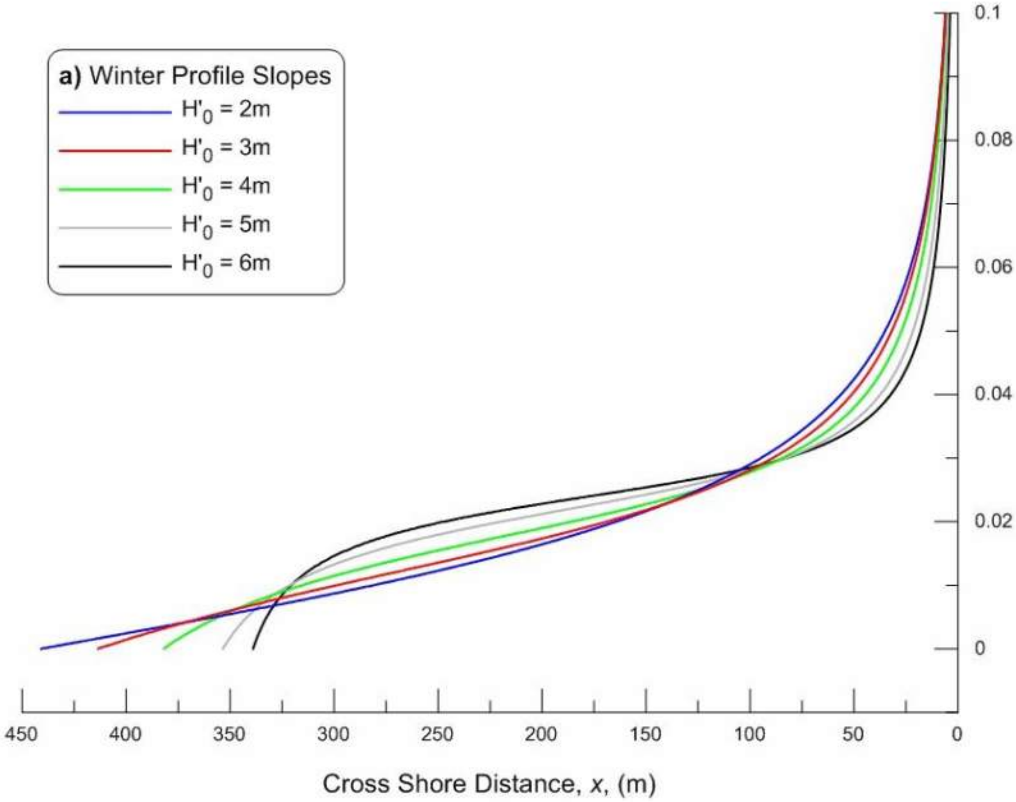


Figure 6.11: Summer beach profile surveys of Doheny Beach range lines adjacent to Well Heads D & E. Surveys due to the US Army Corps of Engineers. Data provided by Coastal Frontiers, (2014).



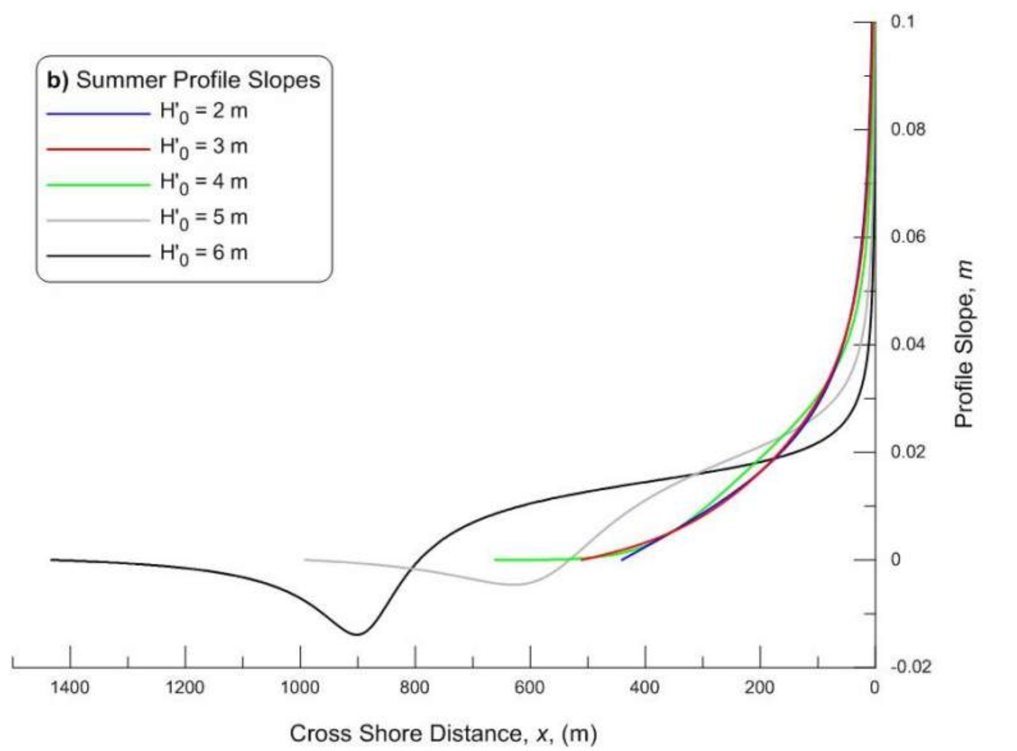


Figure 6.12. Family of elliptic cycloid slope solutions in the bar berm: a) type-a cycloids; b) type-b cycloids. Cycloids scaled for : H'_0 = 2 - 6 m; T = 15 sec; m_{DIM} = 0.06 (winter); m_{DIM} = 0.1 (summer); γ = 0.8; Γ = 0.76; Λ = 0.81

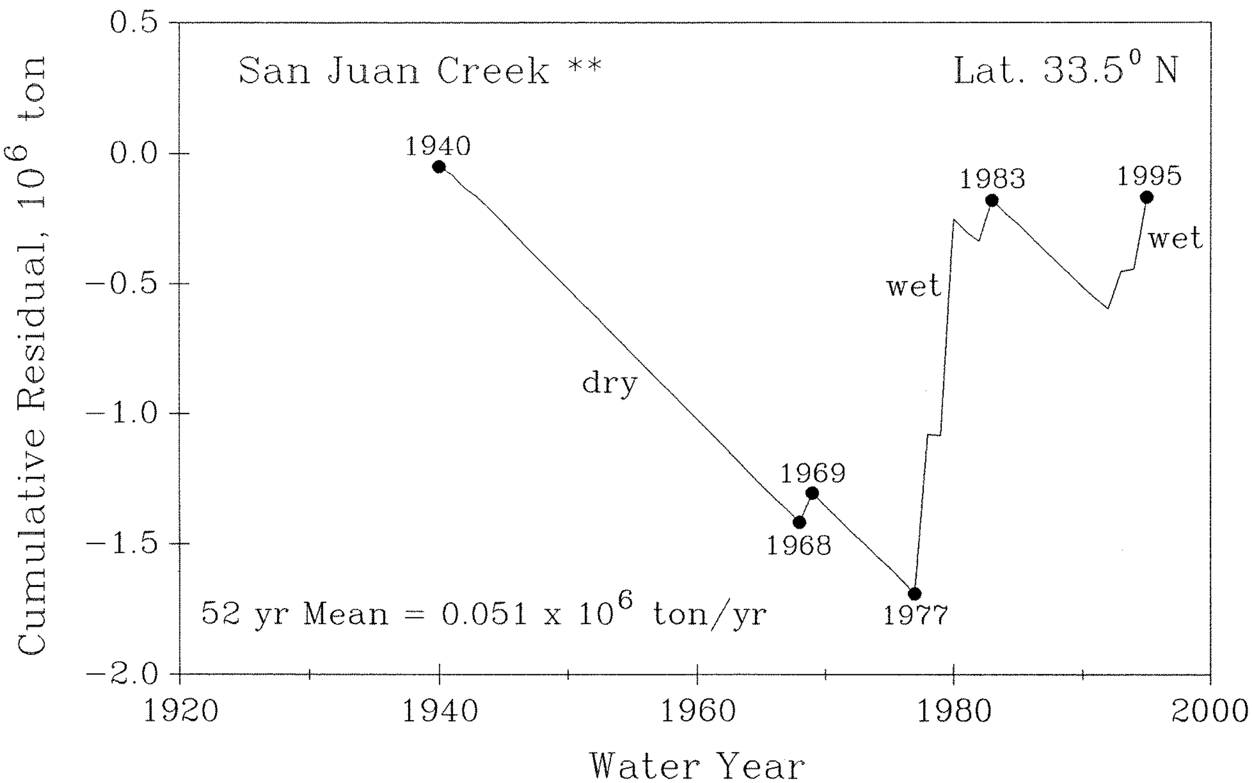


Figure 6.13. Cumulative residual time series of sediment flux for the San Juan Creek calculated using a 56-year mean (1940-1995), from Inman and Jenkins (1999).

In equation (25) q is the sediment volume per unit length of shoreline (m^3/m) and *dq/dt* is the sediment volume flux (m^3/m/day), ε is the mass diffusivity, V_l is the longshore current, *J(t)* is the flux of new sediment from the San Juan Creek, and *R(t)* is the flux of sediment lost to sinks , in this case, the scour holes near the mouth of the San Juan Creek following river floods. The first term in (1) is the surf diffusion term while the second is the advective term due to the longshore current. For any given control cell along Doheny State Beach, equation (25) may be discretized in terms of the rate of change of “beach volume”, Λ, in time increment Δt , given by:

$$\frac{d\Lambda}{dt} = J(t) + \frac{q_{in} + q_{out}}{\Delta t} \qquad (26)$$

Sediment is supplied to the control cells in Figure 6.14 by the sediment yield from the rivers and beach nourishment, $J(t)$ by the influx of sediment volume due to littoral drift from up-coast sources, q_{in} (beach-fill). Sediment is lost from the control cell due to the action of wave erosion

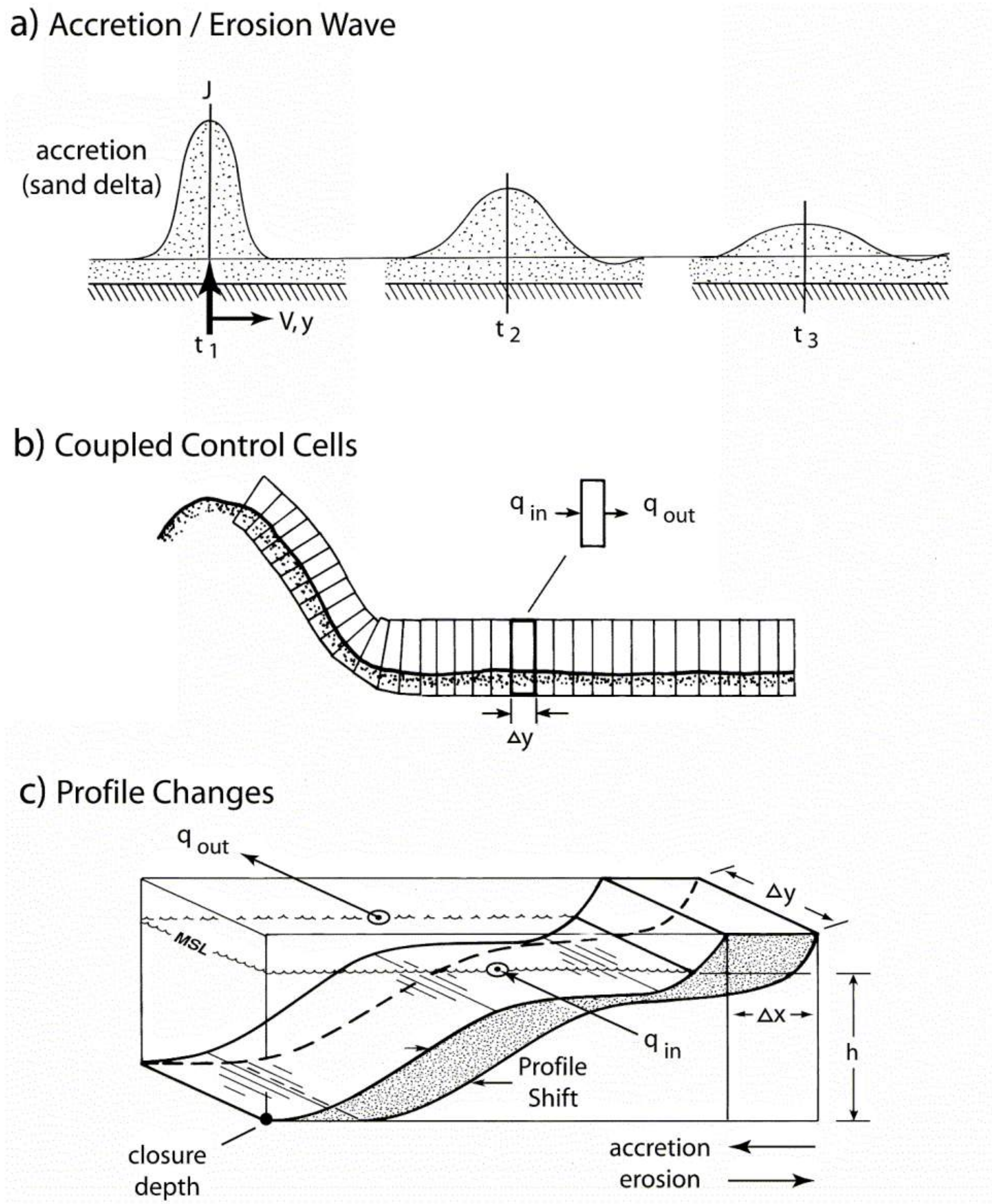


Figure 6.14: Computational approach for modeling changes in beach width and shoreline positon after Jenkins, et. al., (2007).

and expelled from the control cell by exiting littoral drift, q_{out}. Here fluxes into the control cell (*J(t)* and $q_{in} / \Delta t$) are positive and fluxes out of the control cell,
($q_{out} / \Delta t$), are negative.

The beach and nearshore sand volume change, *dq/dt*, is related to the change in shoreline position, *dX/dt*, according to:

$$\frac{dV}{dt} \cong \frac{d\Lambda}{dt} = \frac{dX}{dt} \cdot Z \cdot l \qquad (27)$$

where $$Z = Z_1 + h_c \qquad (28)$$

Here, Z is the height of the shoreline flux surface equal to the sum of the closure depth below mean sea level, h_c, (equation 24), and the height of the berm crest, Z_1, above mean sea level; and l is the length of the shoreline flux surface. Hence, beaches and the offshore bottom profile out to closure depth remain stable if a mass balance is maintained such that the flux terms on the right-hand side of equation (2) sum to zero; otherwise the shoreline will move during any time step increment as:

$$\Delta x(t) = \frac{1}{\Delta y(Z_1 + h_c)} \int \left(\frac{\partial}{\partial y}\left(\varepsilon \frac{\partial q}{\partial y} \right) - V \frac{\partial q}{\partial y} + J(t) \right) dt \qquad (29)$$

where ε is the mass diffusivity, *V* is the longshore drift , *J* is the flux of sediment from river sources, Δy is the alongshore length of the control cell, and Z_1 is the maximum run-up elevation from Hunt’s Formula. River sediment yield, *J*, from is calculated from streamflow, *Q*, based on the power law formulation of that river’s sediment rating curve after Inman and Jenkins, (1999), or

$$J = \xi\, Q^{\omega} \qquad (30)$$

where ξ, ω are empirically derived power law coefficients of the sediment rating curve from best fit (regression) analysis (Inman and Jenkins,1999). When San Juan Creek floods produce large episodic increases in *J*, a river delta is initially formed. Over time the delta will widen and reduce in amplitude under the influence of surf diffusion and advect (move) down-coast with the longshore drift, forming an accretion erosion wave (Figure 6.14a). The local sediment volume varies in response to the net change of the volume fluxes, between any given control cell and its neighbors, referred to as divergence of drift = q_{in} - q_{out} , see Figure 6.14b and 6.14c. The mass balance of the control cell responds to a non-zero divergence of drift with a compensating shift, Δx, in the position of the equilibrium profile (Jenkins and Inman, 2006). This is equivalent to a net change in the beach entropy of the equilibrium state. The divergence of drift is given by the continuity equation of volume flux, requiring that *dq/dt* is the net of advective and diffusive fluxes of sediment plus the influx of new sediment, *J*. The rate of change of volume flux through the control cell causes the equilibrium profile to shift in time according to (29), producing the net change in beach widths shown by the surveys in Figures 6.8 – 6.11. Changes in sea level also cause the shoreline to move (retreat) which are calculated in the LCM module of the Coastal Evolution Model using *Bruun's Rule*, (Bruun, 1962, 1983):

$$\Delta x = X_c \left(\frac{SLR}{h_c + Z_1} \right) \tag{31}$$

Where SLR is the increment of sea level rise, and X_c is the distance offshore to closure depth given by the elliptic cycloid formulation to the equilibrium profile (Jenkins and Inman, 2006) according to:

$$X_{c2} = \frac{h_c I_e^{(2)}}{\varepsilon} \cong \frac{\pi\, h_c}{2\varepsilon} \sqrt{\frac{2-e^2}{2}} \tag{32}$$

$$\text{With: } \varepsilon = \frac{\sigma}{N}\left(\frac{H_b}{\gamma\, g}\right)^{1/2} \cong \frac{\sigma^{4/5}}{2^{1/5} N}\left(\frac{H_0'}{g\gamma}\right)^{2/5}$$

Because Bruuns Rule merely produces a self-similar landward shift to profile in response to sea level rise (with no change to the shape of the profile or to the elliptic cycloid parameters); sea level rise does not effect the intrinsic slope parameters of the profile on which the total run-up elevation depends. This response is based on an assumption that the beach has adequate sand volume and sediment cover to execute the profile shift required under Bruun's Rule. This assumption appears to be well founded at Doheny State Beach due to the fact that it is continually re-nourished by the flux of new sediment from San Juan Creek, (*J* = 51,000 ton/yr)**.**

7.0 Wave Run-up and Overtopping Statistical Analysis:

This section uses the data bases described in Section 6 to evaluate Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2. We seek to quantify the probability of occurrences of *extremal total water levels* where the total water level (TWL) is the sum of the total run-up and the still water level (SWL). The total run-up, *R*, is a dynamic water level variation caused by wave shoaling and breaking, and is composed of three components: wave setup, $<\eta>$, dynamic wave setup, η_{rms} ; and incident wave run-up, R_{inc}. We will begin in Section 7.1 by setting the still water level equal to present or future mean sea level, which will allow us to isolate the total runup as an independent dynamic process whose probability is uniquely determined by the extremal wave height curve in Figure 6.7. We will then solve for *extremal total water levels* (TWL_{max}) by admitting to probability of occurrences of still water levels higher than mean sea level; which results in a joint probability analysis of occurrence of extremal wave heights concurrent with extreme ocean water levels.

7.1) Total Water Level Analysis for Constant Still Water Levels: Total water level is a multi-variant function determined by the combined effects of stationary processes (processes vary slowly in time) and dynamic processes (processes that vary rapidly with time). The still water level component of the total water level is a relatively stationary process when compared to the total run-up component, where the latter varies rapidly in time at the frequency of surface gravity waves. At lowest order approximation, we can solve for the probability of recurrence of potential total water levels by assuming the stationary processes are fixed in time. By that approach, we adopt a common practice in coastal engineering by setting the still water level at mean sea level and then solve for the potential total water levels as a conditional probability using Bayes' theorem:

$$P(TWL_{\max}) = P[R, Z_i] = P[R(H'_T] \bullet P_{i,j}(Z_i = MSL) \qquad (33)$$

Here, $P_{i,j'}(Z_i)$ is the annualized probability of ocean water levels reaching an elevation of Z_i feet NAVD 88 from equations (3) and (4), where $P_{i,j'}(Z_i = MSL)$ = 1, (cf. Figures 4.1, 4.6 & 4.7); $P[R(H'_T)]$ is the annualized probability of total run-up from the sum of equations (6) and (11) based on the probability of extremal wave heights with return frequency of once every T years, $P(H'_T) = 1/T$, (cf. Figure 6.7). The total run-up calculations using extremal wave heights are based on the direct integration method (DIM) from Section 5.5 because the beach slopes at Doheny State Beach for both eroded (winter) and summer (accreted) conditions are always than 12.5%. (Here beach slope, m_{DIM} , is taken as the average slope between the landward limit of wave run-up and the location offshore where the water depth is two times the depth at which the deep water significant wave height would be subject to depth-limited breaking, cf. Van der Meer, 2002). Figures 6.8 – 6.12 show generally that average nearshore beach slopes at Doheney State Beach range from $\overline{m}_{DIM}$ = 0.006 for eroded beach profiles, and steepen to $\overline{m}_{DIM}$ = 0.10 for accreted beach profiles. One advantage of the approach taken by equation (25) is that it allows us to separate the individual dynamic components to the total water level solutions.

Figures 7.1-7.3 give the annualized probability of recurrence of total run-up and its components of static wave setup, dynamic wave setup, and the total oscillatory swash component based on the extremal wave analysis curve in Figure 6.7 as applied to equations (6)- (12). For each component of total wave runup, there are two sets of curves, representing eroded and accreted conditions at Doheny and Capistrano State Beaches. In all cases, the maximum water elevations are greater for the accreted beach conditions than for the eroded beach conditions. This is due to the fact that eroded beaches have flatter slopes in the bar-berm section of the profile where waves are breaking and producing run-up. Flatter beach slopes are intrinsically more dissipative, resulting in less residual energy after breaking to produce runup. Inspection of Figure 7.3 indicates that maximum run-up is 15.4 ft. for the accreted beach conditions and 13.1 ft. for the eroded beach conditions, with a probability of recurrence of 0.04% (return period = 2,500 yr). But the maximum wave run-up is based on a statistical projection from the Weibull Type III best fit to the extremal wave results from refraction/diffraction analysis in Figure 6.7. The highest wave that was recovered from the refraction analysis in 12 m of water depth was due to the100-year storm of 18, January, 1988 (Figure 6.4) with a significant wave height H'_0 = 15.5 ft. and a probability of recurrence of 1.0%. The 1% runup up event in Figure 7.2 actually gives maximum total wave run-up of 11.88 ft. for the accreted beach conditions at Doheny Beach and 9.98 ft. for the eroded beach conditions. At Capistrano Beach, shoaling wave heights are greater and maximum total wave run-up is 12.73 ft. for the accreted beach conditions and 10.83 ft. for the eroded beach conditions

The annualized probability of recurrence of total water level is plotted in Figures 7.4 and 7.5 at Doheny and Capistrano Beaches, respectively, under the stationary hypothesis for still

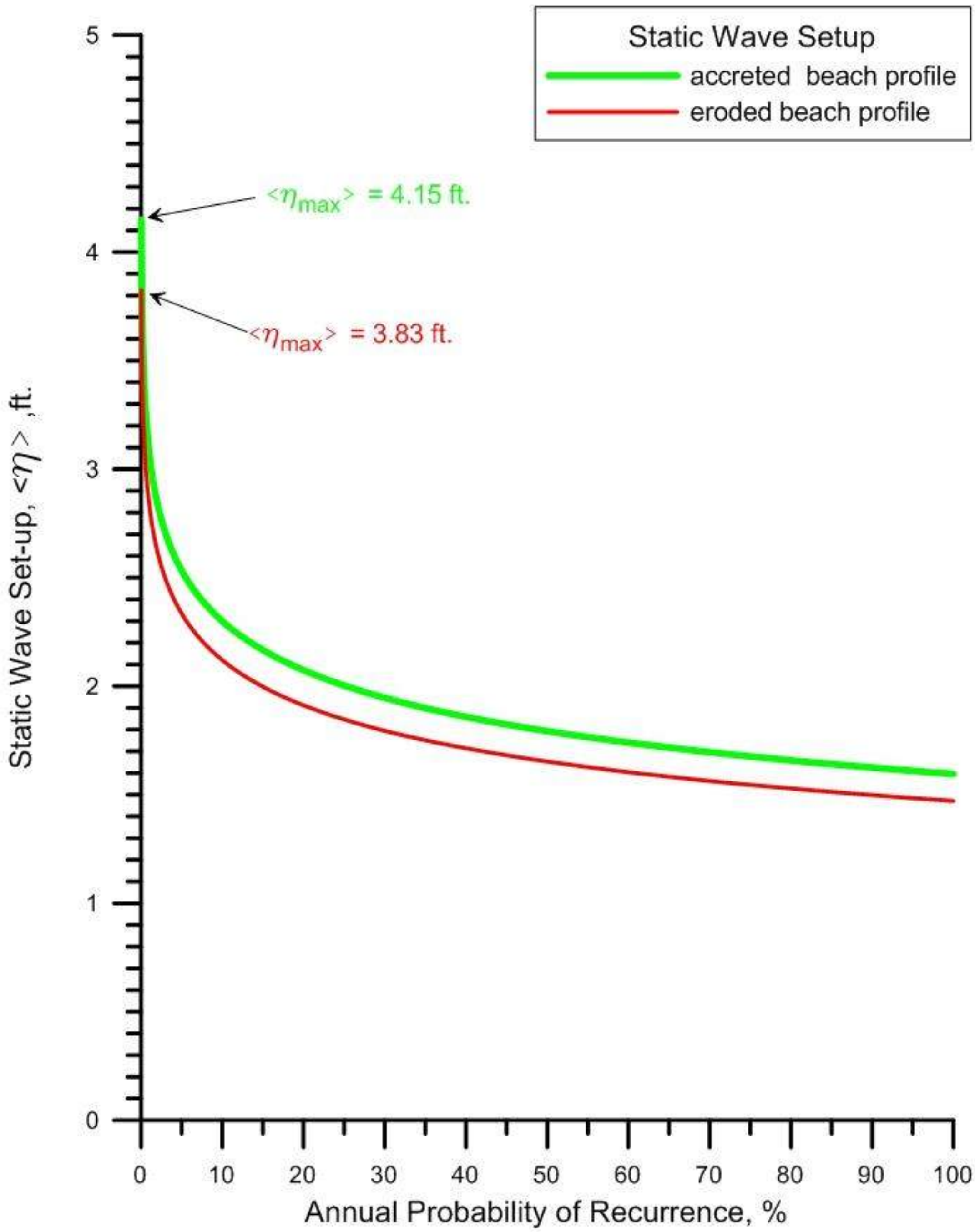


Figure 7.1: Probability of recurrence of static wave setup based on on extremal design wave heights from Weibull Type III distribution and beach profiles from Figures 6.8 - 6.11.

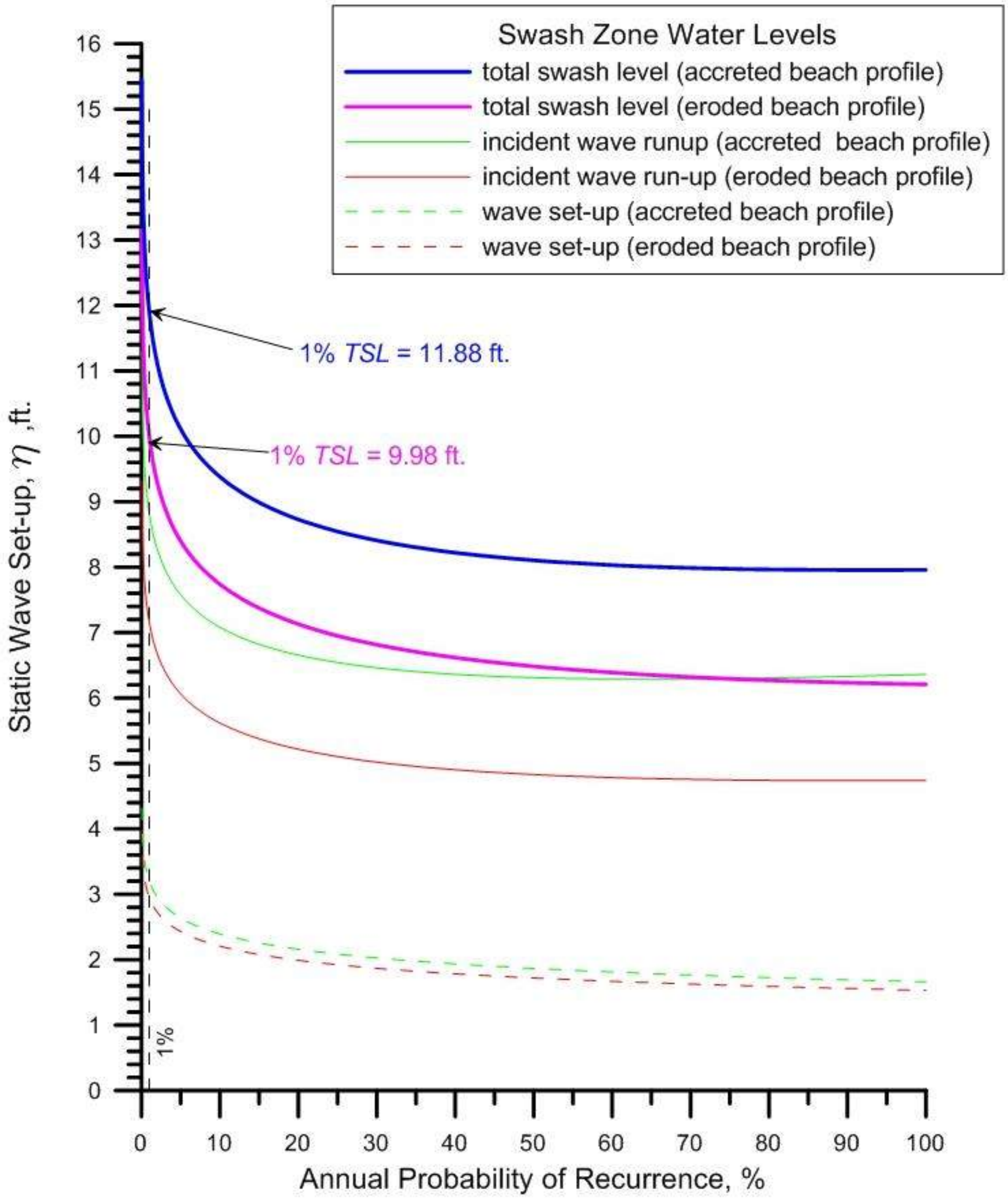


Figure 7.2 : Probability of recurrence of total swash level (*TSL*) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution

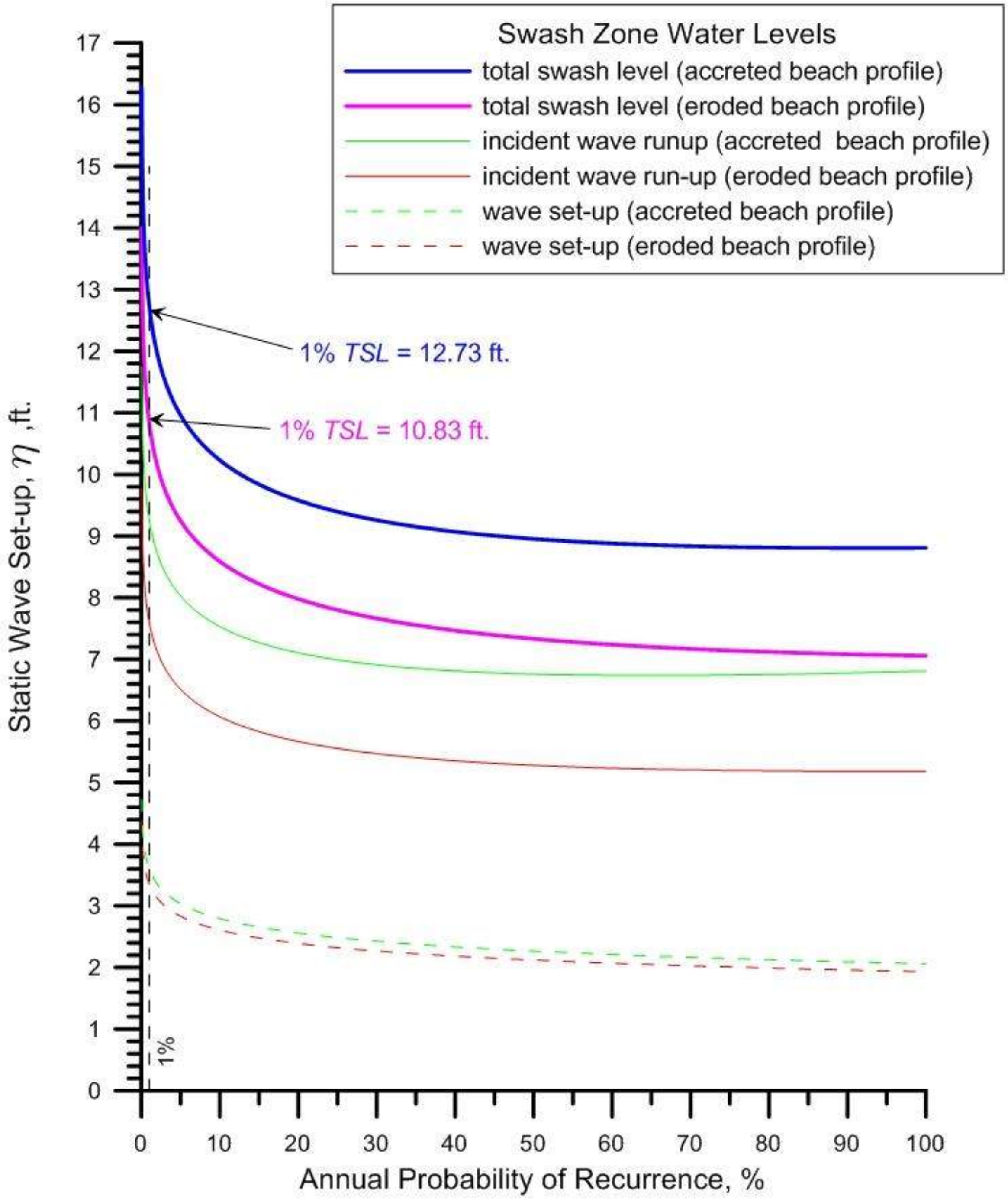


Figure 7.3 : Probability of recurrence of total swash level (*TSL*) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution

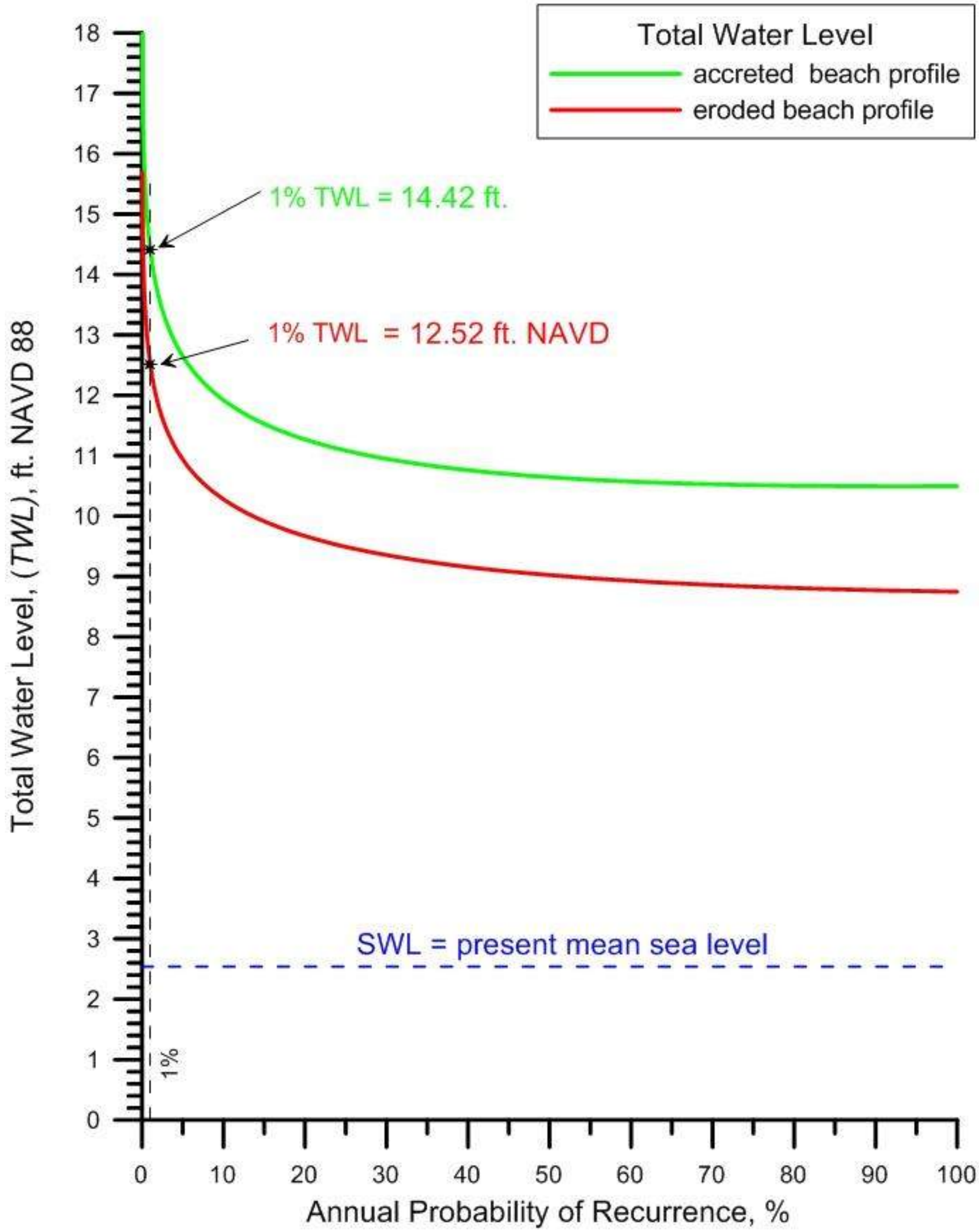


Figure 7.4: Annualized probability of recurrence of total water level at Doheny State Beach based on present sea level and extremal design wave heights from Weibull Type III distribution. SWL = MSL

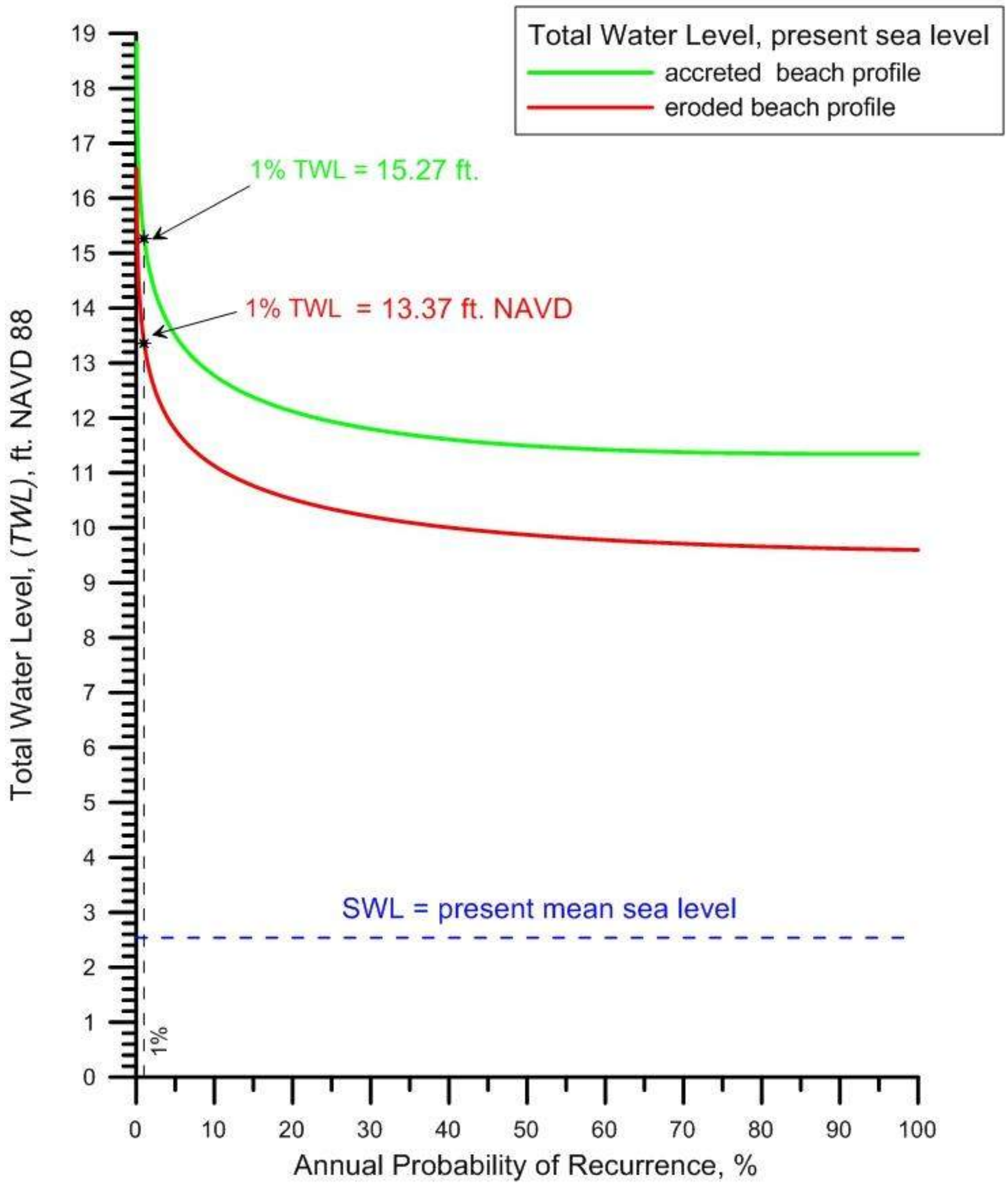


Figure 7.5 : Probability of recurrence of total water level at Capistrano State Beach for still water level at persent mean sea level based on extremal design wave heights from Weibull Type III distribution; SWL = MSL

water level according to equation (33). Under this assumption (where still water level is fixed at present mean sea level), the maximum total water level at Doheny Beach is TWL = 17.98 ft. NAVD for the accreted beach conditions and TWL = 15.69 ft. NAVD for the eroded beach conditions. At Capistrano Beach (Figure 7.5), the maximum total water level is TWL = 18.83 ft. NAVD for the accreted beach conditions and TWL = 16.54 ft. NAVD for the eroded beach conditions. (Total water levels are higher at Capistrano Beach because shoaling waves during the 100-year event are higher at that location, cf. Figure 6.4). The total water level achieved under accreted beach conditions at present sea level exceeds the elevations of well heads A, B, C and G, which are located at Z_i == 17 ft. NAVD and Z_i == 17 ft. NAVD, respectively; but the probability of this occurring is only 0.04% (return period = 2,500 yr). Appendix-B of the *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2015) provides no specific guidance on the redline frequency for flooding or inundation. In the absence of such guidance we will adopt Federal Emergency Management Agency (FEMA) standards for flooding frequency and set redline planning frequency at the 100 year event (1% probability of recurrence). Accordingly, Figures 7.4 & 7.5 have been annotated to highlight the 1% total water level events which indicate is TWL(1%) = 14.42 ft. NAVD for the accreted beach conditions and TWL(1%) = 12.52 ft. NAVD for the eroded beach conditions at Doheny Beach. At Capistrano Beach. The 1% probability (100-yr event) yields TWL(1%) = 15.27 ft. NAVD for the accreted beach conditions and TWL(1%) = 13.37 ft. NAVD for the eroded beach conditions.. Consequently we conclude that all the beach front facilities for the Doheny Desalination Project (Figure 6.3a & b) are safe from flooding or inundation by extreme event waves under the stationary hypothesis for still water level at present mean sea level.

We repeat the total water level analysis in Figures 7.6 and 7.7 for 2100 sea levels under the stationary hypothesis for still water level (where still water level is fixed at 2100 mean sea level for the low and high range projections). For the low-range 2100 sea level projections at Doheny Beach, (Figure 7.6), the 1% total water level events reach TWL(1%) = 18.02 ft. NAVD for the accreted beach conditions and TWL(1%) = 16.12 ft. NAVD for the eroded beach conditions; indicating that all the beach front facilities for the Doheny Desalination Project (Figure 6.3) are safe from flooding or inundation by extreme event waves if the beach is in an eroded winter condition. However, in the unlikely event that the 100 year storm occurs while the beach is still in a summer equilibrium condition (accreted beach), then Well Heads A-C will be overtopped by about 1 ft of excess runup, while Well Heads D and E would be partially wetted. At Capistrano Beach, the 1% total water level events at the low range projection for 2100 sea level, (Figure 7.7), reach TWL(1%) = 18.87 ft. NAVD for the accreted beach conditions and TWL(1%) = 16.97 ft. NAVD for the eroded beach conditions. While both well heads at Capistrano Beach would be safe from overtopping if Capistrano Beach were in an eroded winter state, Well Head G would be overtopped by about 0.87 ft. of runup if the beach remained in an accreted summer condition.

For the high-range 2100 sea level projections, (Figures 7.8 and 7.9) the 1% total water level events will overtop all of the well sites. At Doheny Beach, (Figure 7.8), the 1% total water level events reach TWL(1%) = 21.52 ft. NAVD for the accreted beach conditions and TWL(1%) = 19.62 ft. NAVD for the eroded beach conditions, exceeding the elevations of all well sites regardless of beach erosion or accretion. Similarly, at Capistrano Beach (Figure 7.9), the 1% total water level events reach TWL(1%) = 22.37 ft. NAVD for the accreted beach conditions and TWL(1%) = 20.47 ft. NAVD for the eroded beach conditions, again exceeding the elevations of all well sites regardless of beach erosion or accretion.

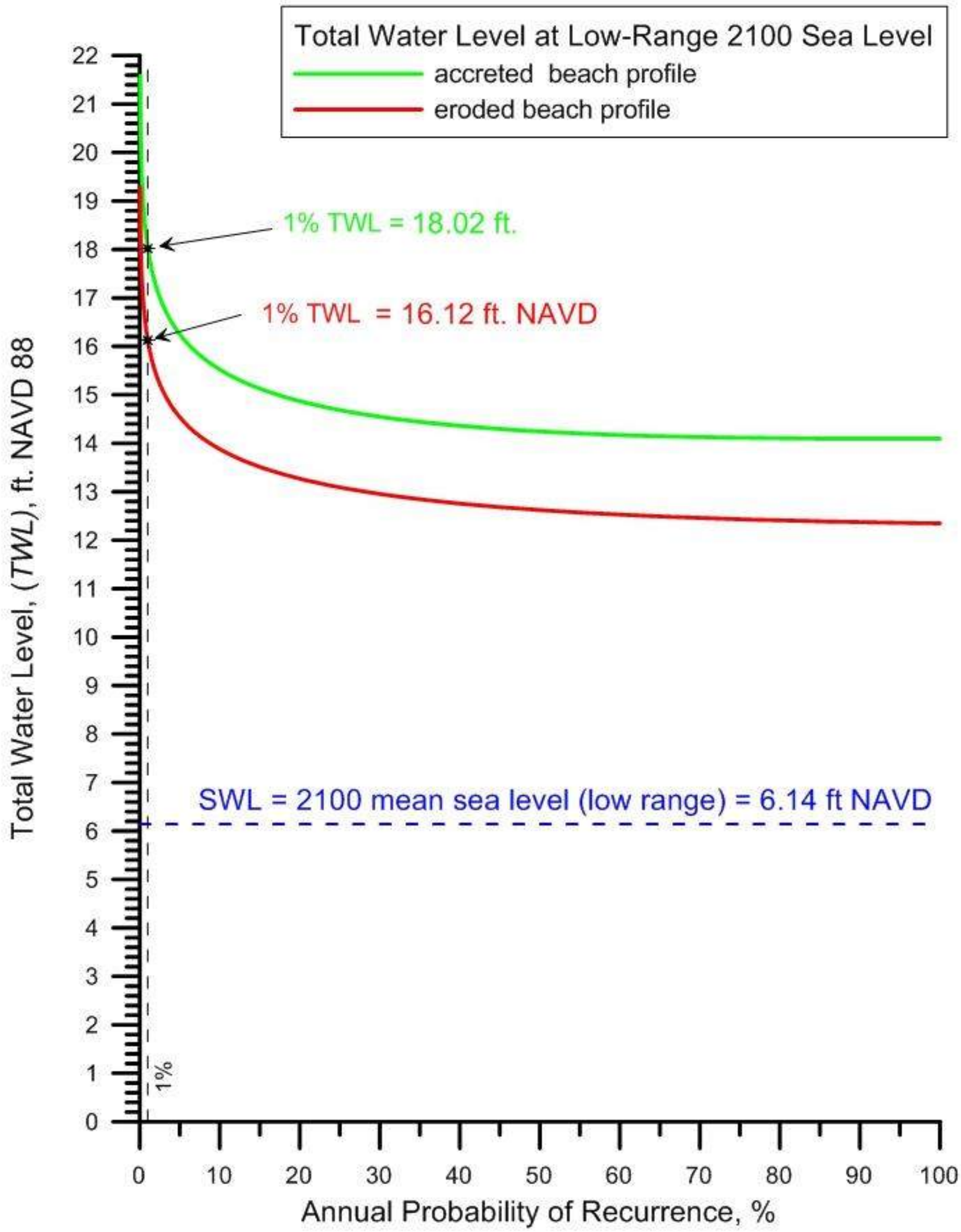


Figure 7.6: Annualized probability of recurrence of total water level at Doheny State Beach for still water level at 2100 (low range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

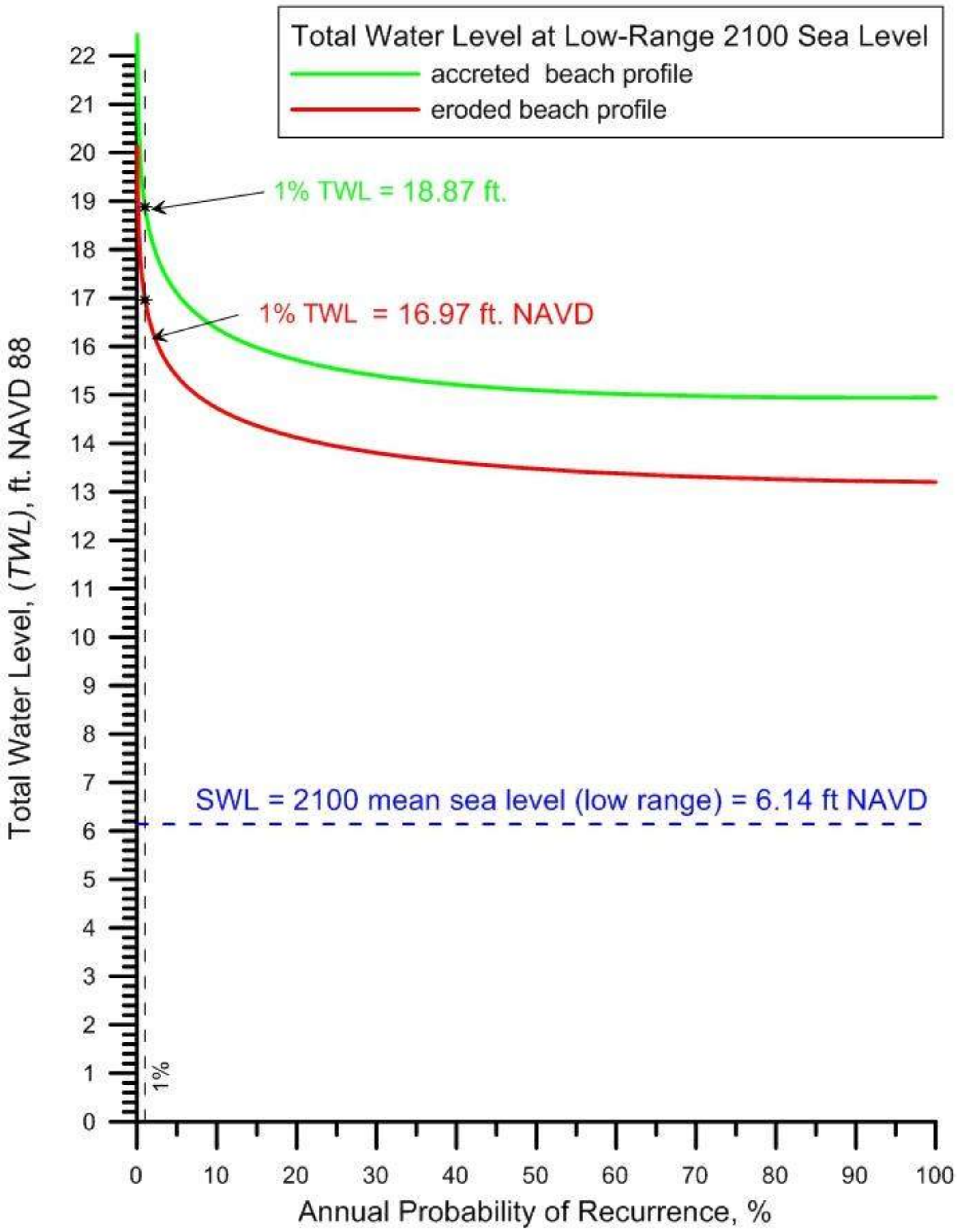


Figure 7.7: Annualized probability of recurrence of total water level at Capistrano State Beach for still water level at 2100 (low range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

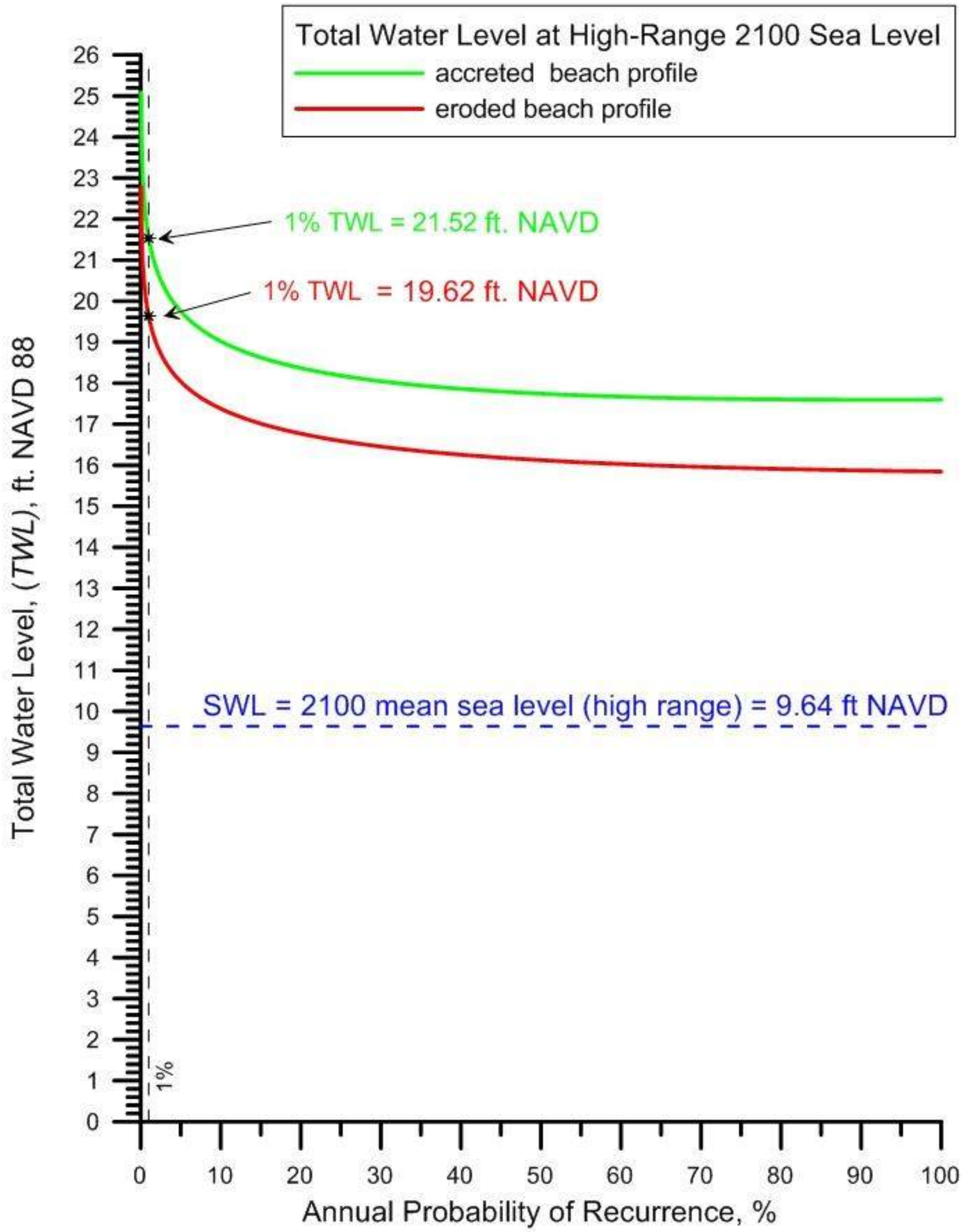


Figure 7.8: Annualized probability of recurrence of total water level at Doheny State Beach for still water level at 2100 (high range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

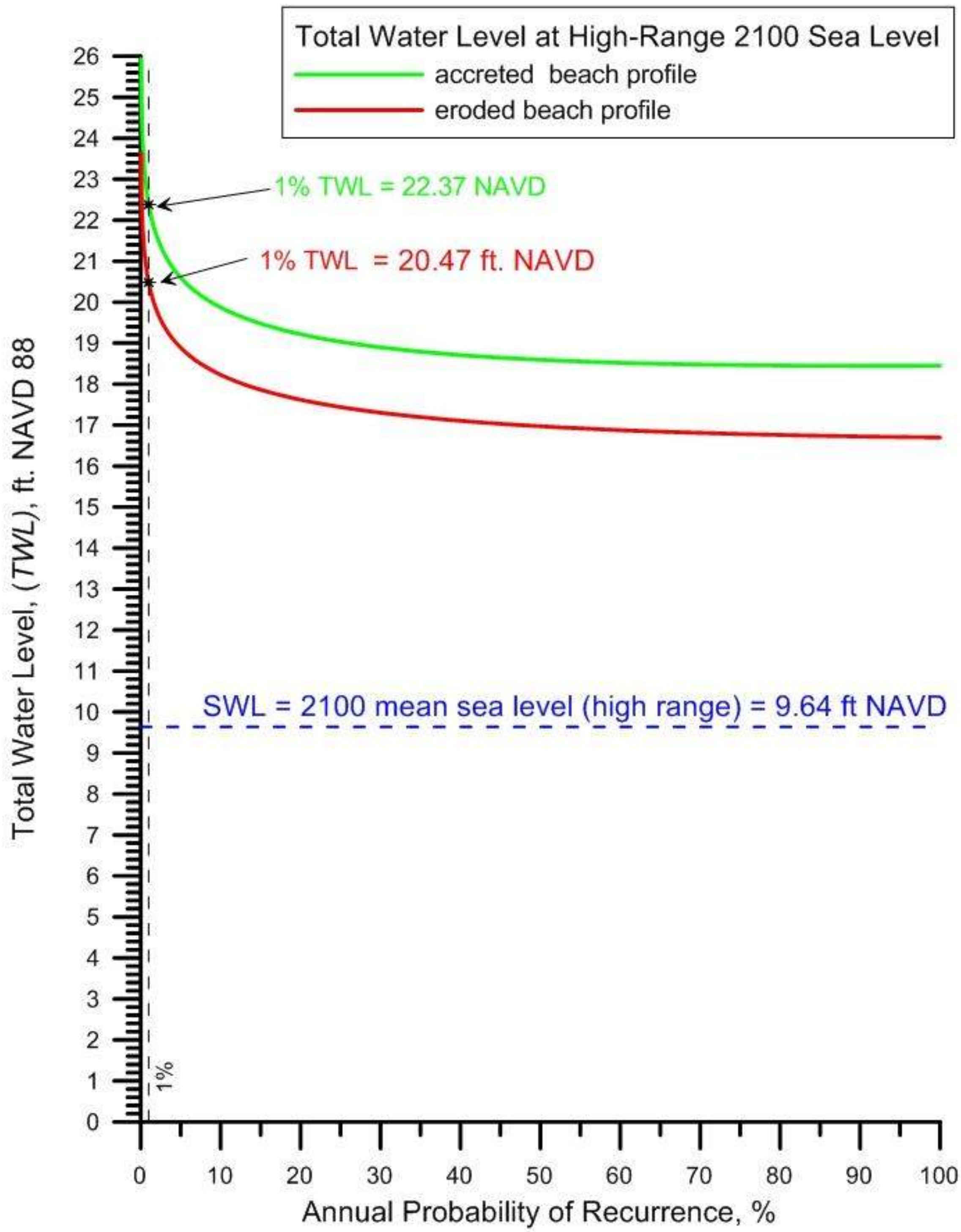


Figure 7.9: Annualized probability of recurrence of total water level at Capistrano State Beach for still water level at 2100 (high range) mean sea level, based on extremal design wave heights from Weibull Type III distribution. Sea level based on CCC (2018), Appendix-G, Table G-11

7.2) Total Water Level Analysis for Extremal Still Water Levels: In this section we relax the stationary hypothesis for still water level and allow it to vary according to the hydroperiod functions for present and future sea levels in Figures 4.1, 4.6, and 4.7. This will provide an analysis of total water levels due to extreme waves concurrent with extreme ocean water levels (extremal TWL's). The recurrence frequency (or return period) for these extremal TWL's is given by the joint probability of occurrence of extremal wave heights concurrent with extreme ocean water levels, or:

$$P(TWL_{\max}) = P[R, Z_i] = P[R(H_T'] \bullet P_{i,j}(Z_i) \qquad (34)$$

where H_T' is the extremal significant wave height with return period of T years, and $P_{i,j}(Z_i)$ is the annualized probability of ocean water levels η reaching an elevation of Z_i feet NAVD 88 at or above mean sea level, as derived from the annualized hydroperiod function, equations (3) and (4). The results for return periods $T_r = 1/P[R, Z_i]$ of extremal total water levels at present sea level are plotted in Figure 7.10 & 7.11 for Doheny and Capistrano Beaches, respectively, while those for 2100 sea levels are found in Figures 7.12 – 7.15. Comparing these results with the total water level results in Figures 7.4-7.9 (that were based on the stationary hypothesis for still water level) indicates that the joint probability analysis for extreme waves concurrent with extreme ocean water levels gives TWL's that are about 0.5 ft. higher for the 1% recurrence event (100 year return period). For example the extremal TWL's at present sea level at Doheny Beach in Figure 7.10 give the TWL(100) = 13.1 ft for eroded conditions and TWL(100) = 14.8 ft. for accreted conditions at present sea levels. On the other hand, when SWL is set at present mean sea level per Section 7.1, as shown in Figure 7.4, the 1% TWL = 12.5 ft for eroded conditions and 1% TWL = 14.4 ft. for accreted conditions at present sea levels. Therefore, we adopt the extremal still water formulation per equation (34) as the redline analysis method for assessing Steps-4 & 5 of a sea level rise/coastal hazards analysis as outlined in Section 2.

Inspection of Figures 7.10 & 7.11 indicates that all the beach front facilities for the Doheny Desalination Project (Figure 6.3) are safe from flooding or inundation by extreme event waves, even for event return periods as long as 500 yr, when extreme waves happen concurrently with extreme ocean water levels in an environment of present sea levels. However, once we admit to 2100 sea level rise projections, a number of the beach front facilities for the Doheny Desalination Project will suffer some flooding and overtopping to varying degrees. For the low-range 2100 sea level projections, (Figures 7.12 &7.13) the three well sites at Doheny Beach on the north side of San Juan Creek (Well Heads A-C) and one of the wells at the Capistrano Beach site (Well Head G) will experience minor overtopping, even for a 1 year event if the beaches have been accreted by additional sands from water shed floods or still retain a built-out summer equilibrium beach profile, with overtopping rates of about Q'(1yr) = 0.038 cfs per lineal ft. of shoreline, per equation (17). If a 100-yr total water level event occurs during the low-range projection of 2100 sea levels, then Figures 7.12 & 7.13 indicate that all of the well sites will be overtopped to varying degrees if the beaches remain in an accreted condition (i.e.,with elevated berms and steep beach slopes). Under these beach conditions, overtopping rates will range from a high of Q'(100yr) = 0.094 cfs per lineal ft. of shoreline at Well Heads A- C on Doheny Beach, to a low of Q'(100yr) = 0.014 cfs/ft at Well Head H on Capistrano Beach, while overtopping rates at Well Heads D & E would be Q'(100yr) = 0.027 cfs/ft at Doheny Beach and Q'(100yr) = 0.081 cfs/ft at Well Head G on Capistrano Beach. Interestingly enough, none of the well heads would experience overtopping during a 100 year event when occurring during the low range 2100 sea levels if the beach were eroded, which would be the most likely condition during a 100-

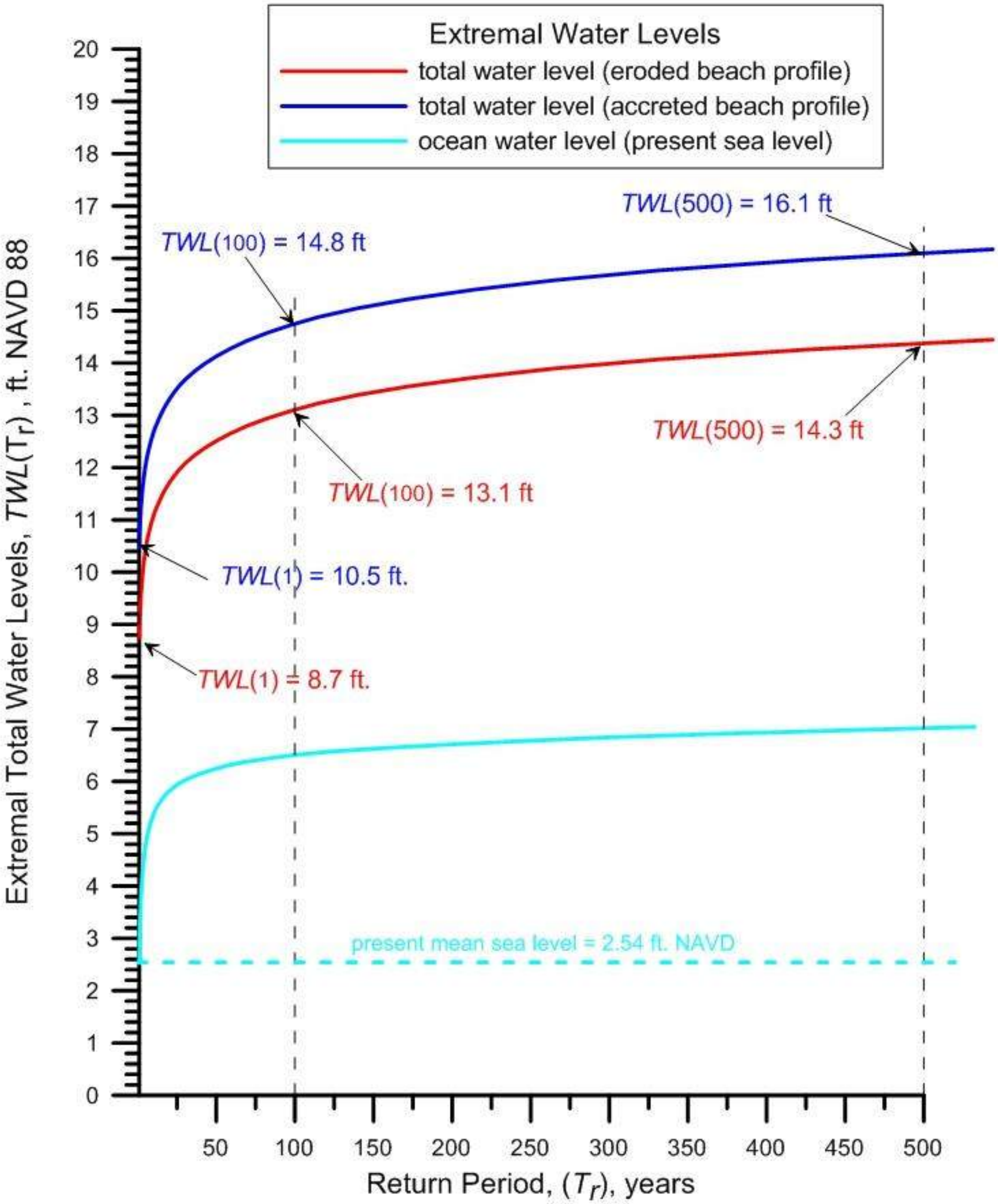


Figure 7.10: Return period of extremal total water level (TWL) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for present sea level, per NOAA tide gage #941-0230

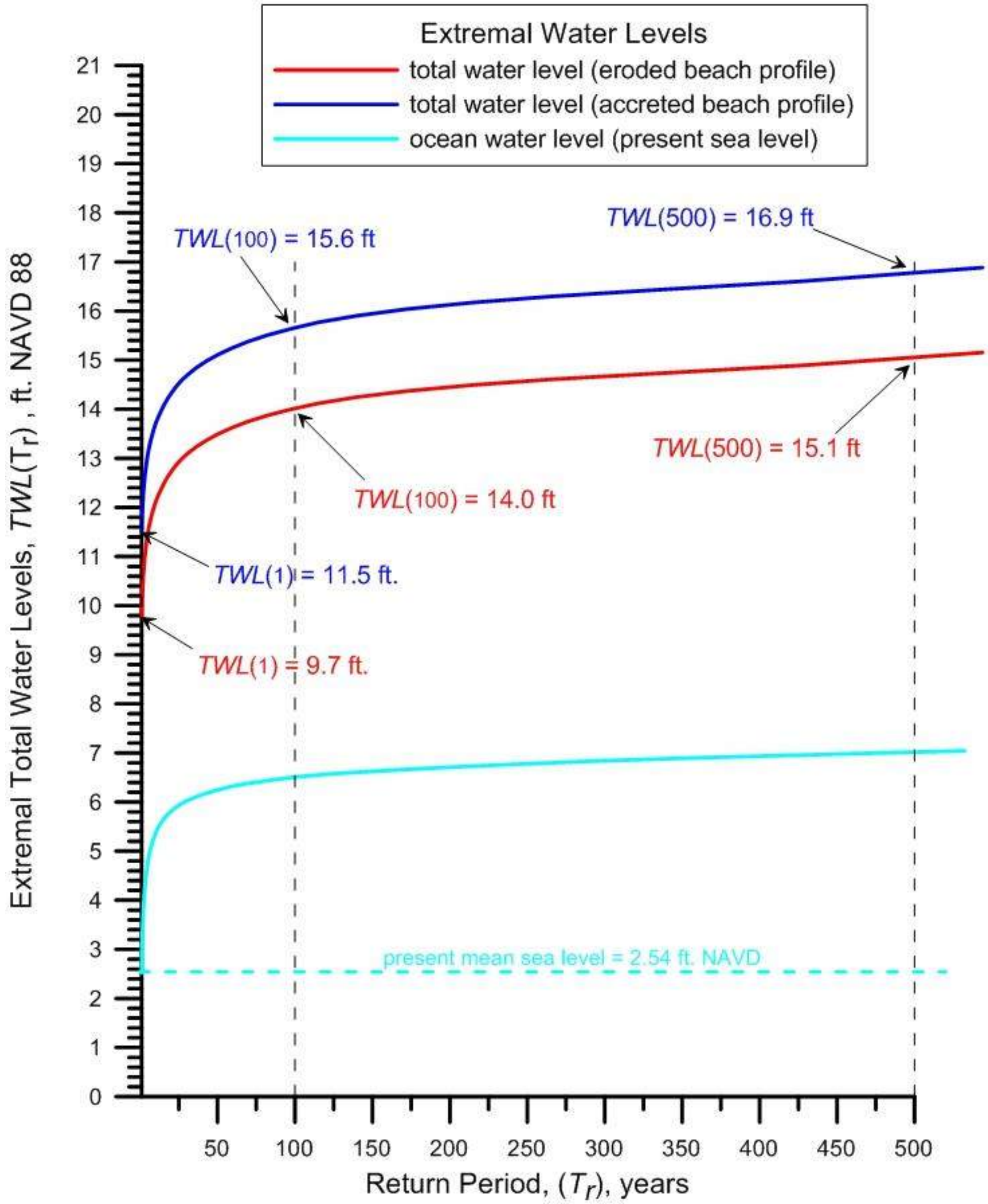


Figure 7.11: Return period of extremal total water level (TWL) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for present sea level, per NOAA tide gage #941-0230.

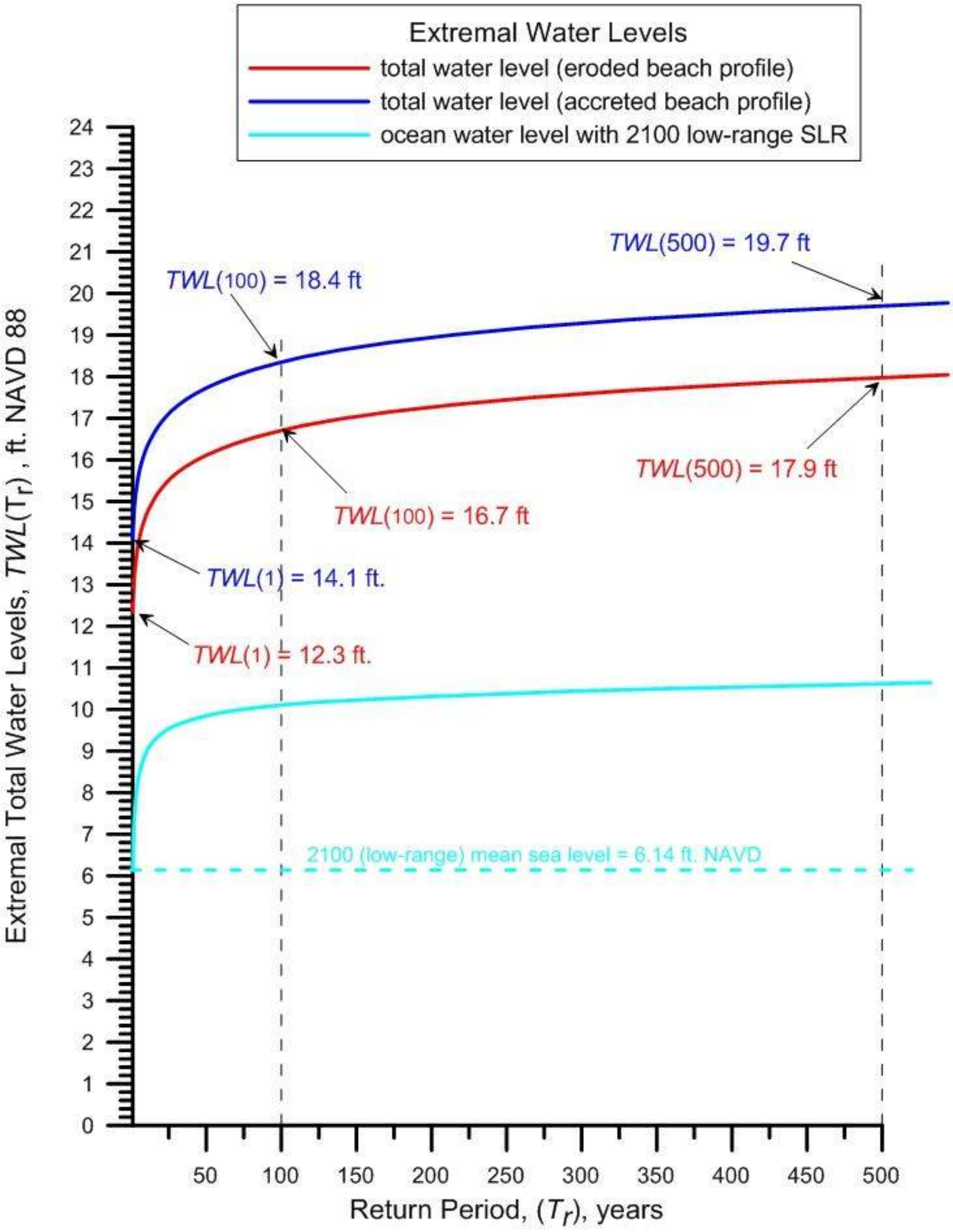


Figure 7.12: Return period of extremal total water level (TWL) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the low-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

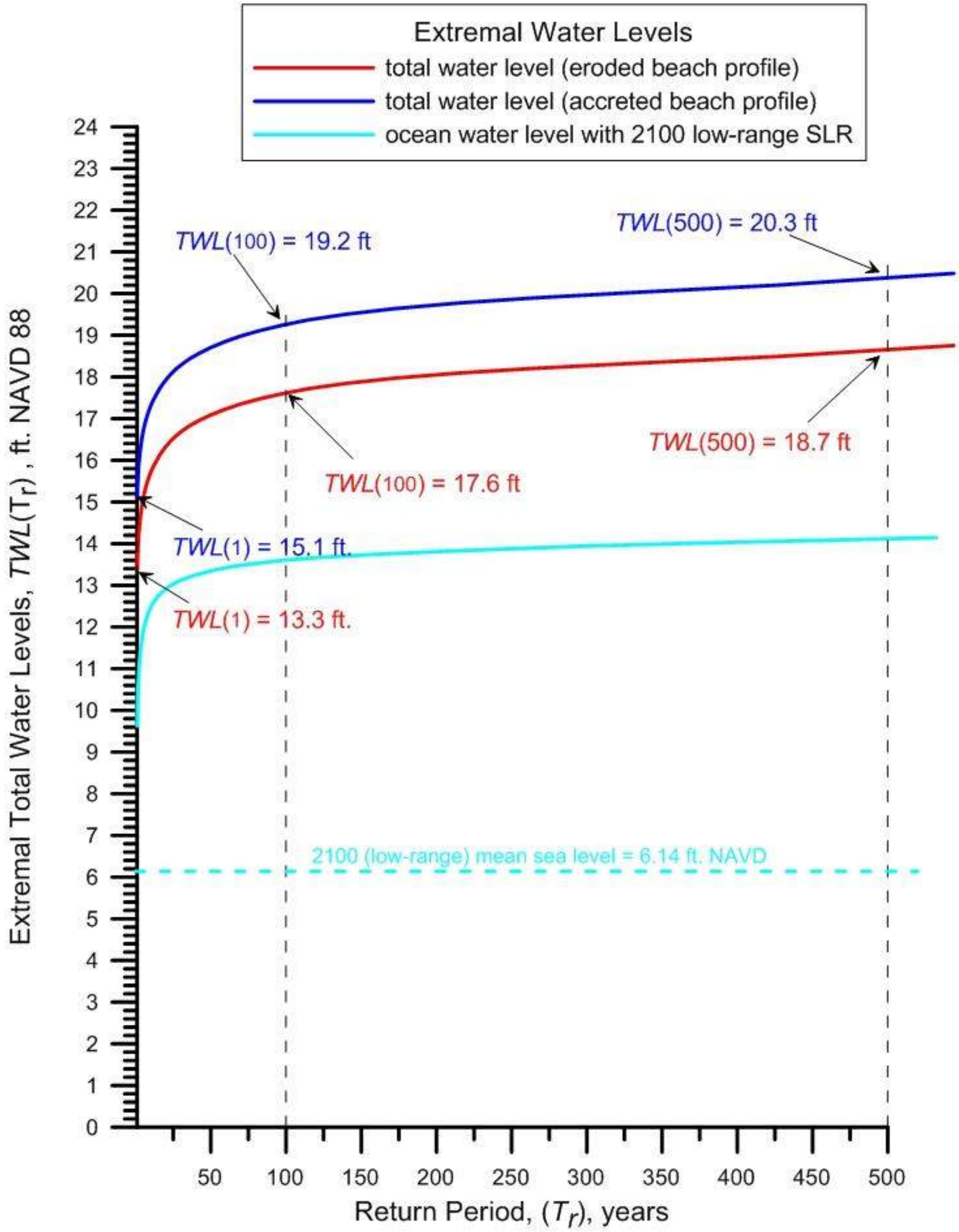


Figure 7.13: Return period of extremal total water level (TWL) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the low-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

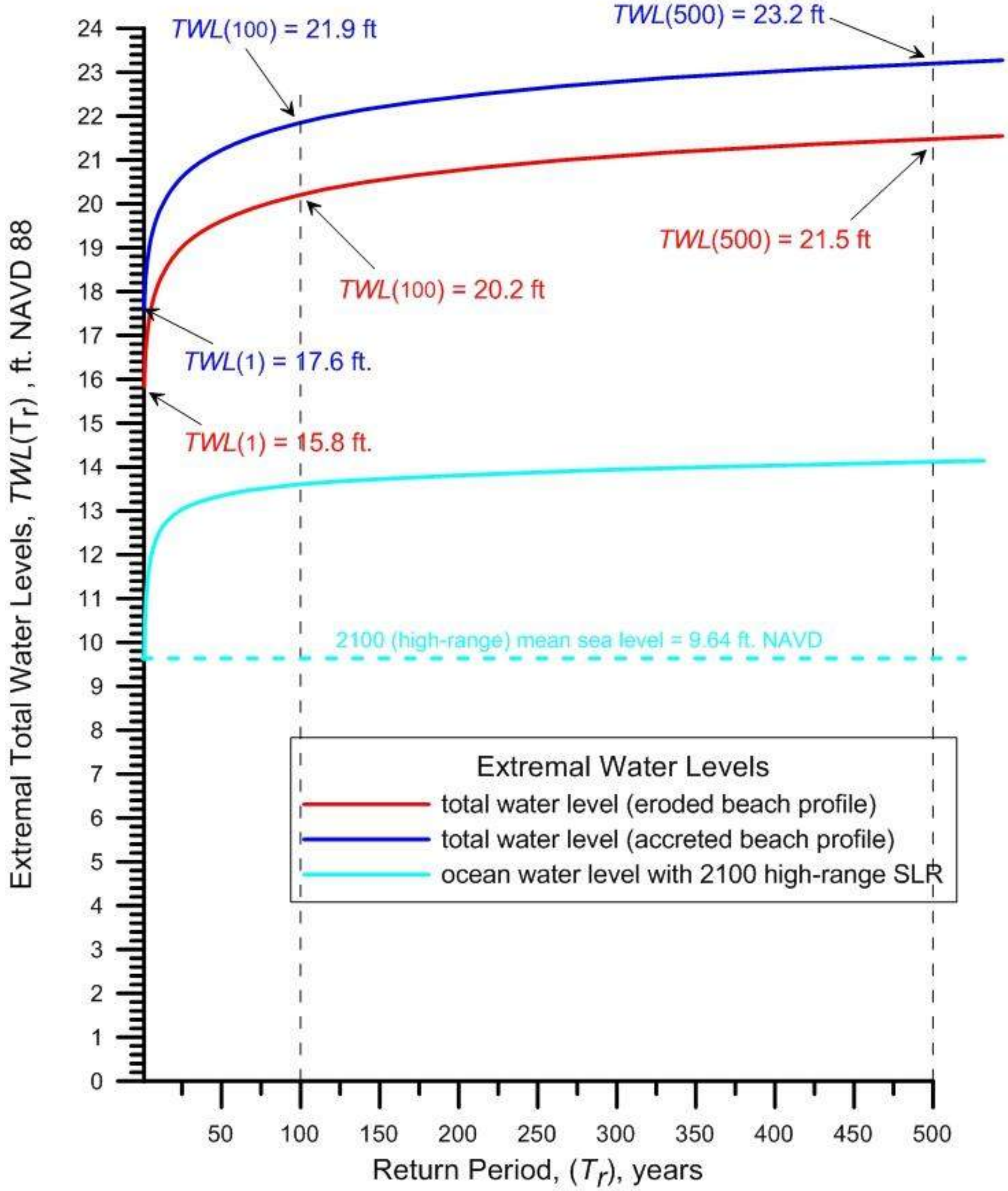


Figure 7.14: Return period of extremal total water level (TWL) at Doheny State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the high-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

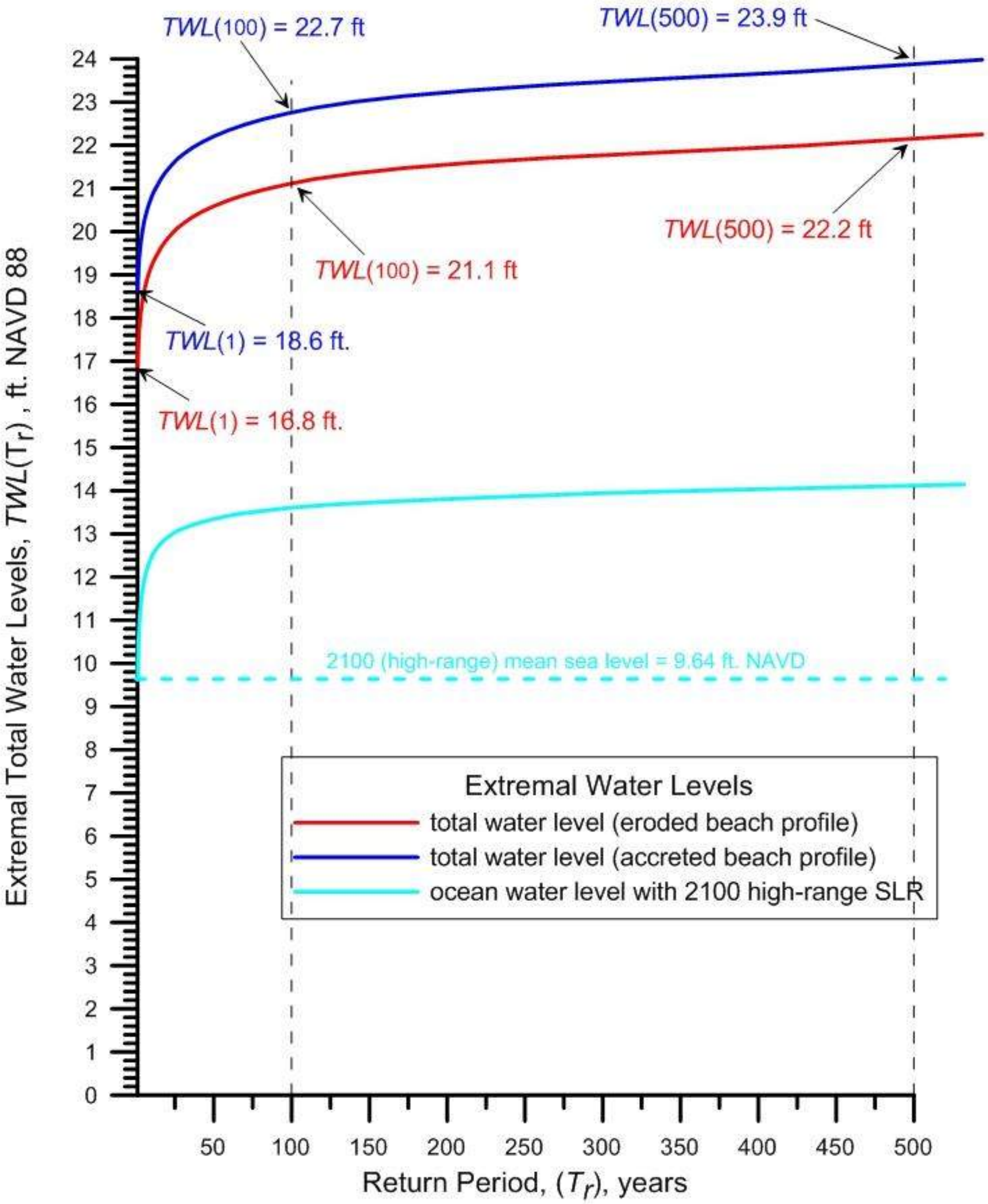


Figure 7.15: Return period of extremal total water level (TWL) at Capistrano State Beach based on extremal design wave heights from Weibull Type III distribution and still water levels set at extremal ocean water levels for the high-range 2100 sea level rise, per CCC (2018), Appendix-G, Table G-11

year event. Total water levels for eroded beach conditions are always less, because these beaches have flatter slopes and are more dissipative of wave set-up and run-up than the steeper accreted beaches.

For the high-range 2100 sea level projections at Doheny Beach (Figure 7.14), the 100 year total water level events reach $TWL(100)$ = 21.9 ft. NAVD for the accreted beach conditions and $TWL(100)$ = 20.2 ft. NAVD for the eroded beach conditions; while at Capistrano Beach, (Figure 7.15), $TWL(100)$ = 22.7 ft. NAVD for the accreted beach conditions and $TWL(100)$ = 21.1 ft. NAVD for the eroded beach conditions. Consequently all beach front facilities for the Doheny Desalination Project would be vulnerable to flooding by the 100-year event if it were occur during 2100 high range sea level projections. The lowest lying well heads (Well Heads A-C at Doheny Beach) would experience the highest overtopping rates, ranging from Q'(100yr) = 0.216 cfs/ft. to 0.331 cfs/ft. depending on the eroded or accreted condition of Doheny State Beach. According Table VI-5-6 in the Coastal Engineering Manual (USACE, 2006) overtopping rates of this order of magnitude are very dangerous for pedestrian and vehicle traffic, and may cause structural damage to adjacent buildings; but the well heads and pumps for the Doheny Desalination project will be protected by steel vault enclosures. The smallest overtopping rates during the 100-year event at the high range 2100 sea level projections will occur at the highest located well head (Well Head H) at the Capistrano Beach site where overtopping rates will range from Q' (100yr) = 0.142 cfs/ft. to 0.250 cfs/ft., with overtopping rates at Well Heads D & E on Doheny Beach ranging from Q'(100yr) = 0.149 cfs/ft to 0.263cfs/ft and Q'(100yr) = 0.209 cfs/ft to 0.318 cfs/ft at Well Head G on Capistrano Beach. While these overtopping rates are still dangerous to pedestrian and vehicle traffic, they are easily mitigated by the steel vault enclosures of the well heads and pumps being placed at Capistrano Beach. The results for total water levels and overtopping rates based on extremal still water levels analysis methods are summarized in Table 7.1 for the Doheny Beach well sites, and in Table 7.2 for the Capistrano Beach well sites.

Table 7.1:Doheny Beach Extremal Total Water Level (*TWL) and Overtopping Rates (Q')

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
*$TWL(1)$ Present Sea Level (eroded/accreted)	8.7/10.5 ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry	8.7/10.5ft. NAVD status = dry
*$Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry	12.3/14.1 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
*$TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = flooded accreted beach	15.8/17.6 ft. NAVD status = dry	15.8/17.6 ft. NAVD status = dry
*$Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.038 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ Present Sea Level (eroded/accreted)	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry	13.1/14.8 ft. NAVD status = dry
**$Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
**$TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach	16.7/18.4 ft. NAVD status = flooded accreted beach
**$Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.094 cfs/ft.	0.0/0.027 cfs/ft.	0.0/0.027 cfs/ft.
**$TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded	20.2/21.9 ft. NAVD status = flooded
**$Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.216/0.331 cfs/ft.	0.149/0.263 cfs/ft.	0.149/0.263 cfs/ft.

*Evaluated for the 1-yr return period; ** Evaluated for the 100-yr return period

Table 7.2: Capistrano Beach Extremal Total Water Level (*TWL*) and Overtopping Rates (Q')

	Well Head-G Elevation = 18 ft. NAVD	Well Head-H Elevation = 19 ft. NAVD
$*TWL(1)$ Present Sea Level (eroded/accreted)	9.7/11.5 ft. NAVD status = dry	9.7/11.5 ft. NAVD status = dry
$*Q'(1)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	13.3/15.1 ft. NAVD status = dry	13.3/15.1 ft. NAVD status = dry
$*Q'(1)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	16.8/18.6 ft. NAVD status = flooded accreted beach	16.8/18.6 ft. NAVD status = dry
$*Q'(1)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.0/0.038 cfs/ft.	0.0/0.00 cfs/ft.
$**TWL(100)$ Present Sea Level (eroded/accreted)	14.0/15.6 ft. NAVD status = dry	14.0/15.6 ft. NAVD status = dry
$**Q'(100)$ Present Sea Level (eroded/accreted)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$**TWL(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	17.6/19.2 ft. NAVD status = flooded accreted beach	17.6/19.2 ft. NAVD status = flooded accreted beach
$**Q'(100)$ 2100 Sea Level Low Range Projection (eroded/accreted)	0.0/0.081 cfs/ft.	0.0/0.014 cfs/ft.
$**TWL(100)$ @ 2100 Sea Level High Range Projection (eroded/accreted)	21.1/22.7 ft. NAVD status = flooded	21.1/22.7 ft. NAVD status = flooded
$**Q'(100)$ 2100 Sea Level High Range Projection (eroded/accreted)	0.209/0.318 cfs/ft.	0.142/0.250 cfs/ft.

*Evaluated for the 1-yr return period
** Evaluated for the 100-yr return period

8.0 Tsunami Run-up and Overtopping Analysis:

Tsunami induced erosion, runup, and inundation were analyzed for the Doheny State Beach bottom profiles (Figures 6.8- 6.12) and shore-side facilities associated with the Doheny Desalination Project for present and future sea levels according to low and high range sea level rise predictions as shown in Figure 3.1. Because of the uncertainty of the probability of occurrence of such a tsunami event, and the absense of specific guidance on the redline frequency for flooding considerations in the *California Coastal Commision Sea Level Rise Guidance Policy Guidance* document (CCC, 2018), we will carry forward the total water level analysis based on the stationary still water level hypothesis; whereby the still water level in the shoaling and runup equations is fixed at whatever mean sea level is for each sea level rise scenario.

The tsunami event scenario is based on a 2m high solitary wave approaching Doheny Beach from 165 degrees true, as could be anticipated for a catastrophic tsunami event arising from a major landside on the east side of San Clemente Island. The local refraction/diffraction pattern from the solitary wave is calculated in Figure 8.1 for present mean sea level. Inspection of Figure 8.1 reveals the tsunami wave height begins to increase at 50 m of water depth due to shoaling and reaches 6m of height before breaking along the shores of Doheny Beach. Because the tsunami wave begins shoaling in much deeper water than typical storm-induced waves, it causes seabed scour and erosion to occur out to very deep water depths. Therefore all run-up and total water level solutions are based eroded beach profile conditions. The critical mass thickness computed by the CEM in Figure 8.2 for this tsunami shoaling scenario reveals that seabed erosion occurs offshore to depths of -124 to -137 ft. MSL; and the volume of eroded sediment can be as high as 1,827 m^3 per meter of shoreline. Figure 8.2 also shows that a tsunami of this magnitude is capable of eroding as much as 4 ft to 6 ft of seabed offshore, to depths of -120 to -130 ft. MSL, and could erode as much as 12 ft . of beach sediment cover in a single tsunami wave breaking event.

Tsunami runup and TWL inundation calculations in Tables 8.1 & 8.2 also indicate that all of the shore facilities of the Doheny Desalination Project are above tsunami inundation levels at present sea level. However, all of the well heads at both Doheny and Capistrano Beaches would suffer some degree of tsunami overtopping if concurrent with 2100 sea levels, and the overtopping rates could be quite severe, especially for the high 210 sea level rise projections. At the low range of 2100 sea level projections, total water levels would reach *TWL* = 18.82 ft. NAVD at Doheny Beach and *TWL* = 18.83 ft. NAVD at Capistrano Beach. Well Heads A-C at Doheny Beach would experience the highest overtopping surges of Q' = 1.142 cfs/ft while Well Head G at Capistrano Beach would remain high and dry. However, if the tsunami occurred atop the high range sea level rise projections for year 2100, then total water levels would reach *TWL* = 22.31 ft. NAVD at Doheny Beach and *TWL* = 22.4 ft. NAVD at Capistrano Beach, sufficient to overtop all the well sites of the Doheny Desalination Project. In this case the tsunami surge could produce very high, although short-lived, overtopping rates reaching a maximum of Q' = 5.691 cfs/ft at Well Heads A-C on Doheny Beach and a minimum of Q' = 2.916 cfs/ft at Well Head H on Capistrano Beach. Undoubtedly, the steel vault enclosures of the well heads can be designed to withstand these high surge rates, but particular attention should be given to the foundations of the vaults to assure the foundations have adequate depth to prevent undercutting by scour. These findings are consistent with the FEMA tsunami flood map which show that all of the Doheny Beach/San Juan Creek corridor extending several miles inland will be inundated by a shoaling tsunami solitary wave.

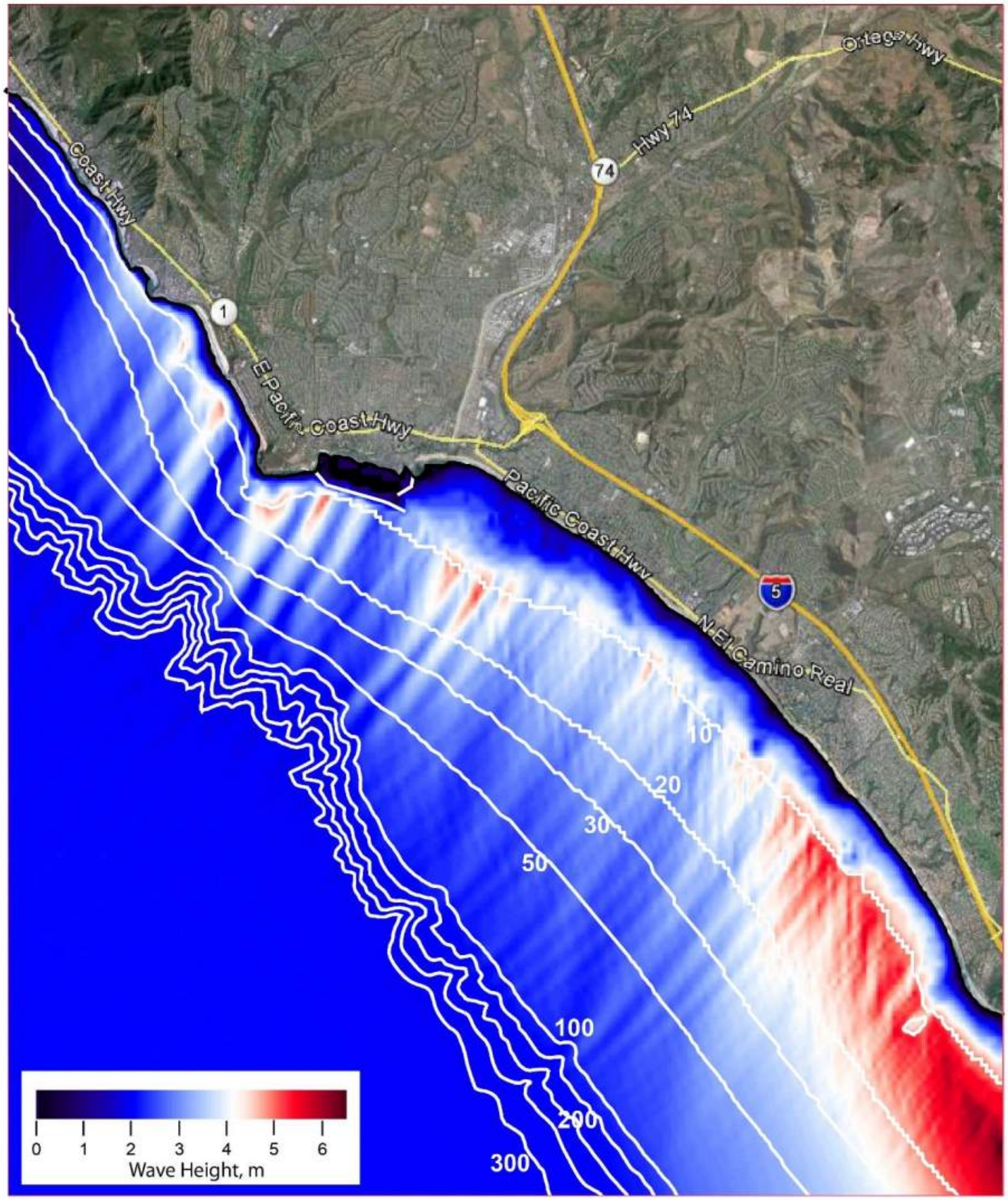


Figure 8.1: High resolution refraction/diffraction computation for a 2m high solitary tsunami wave approaching Doheny Beach from 165 degrees true.

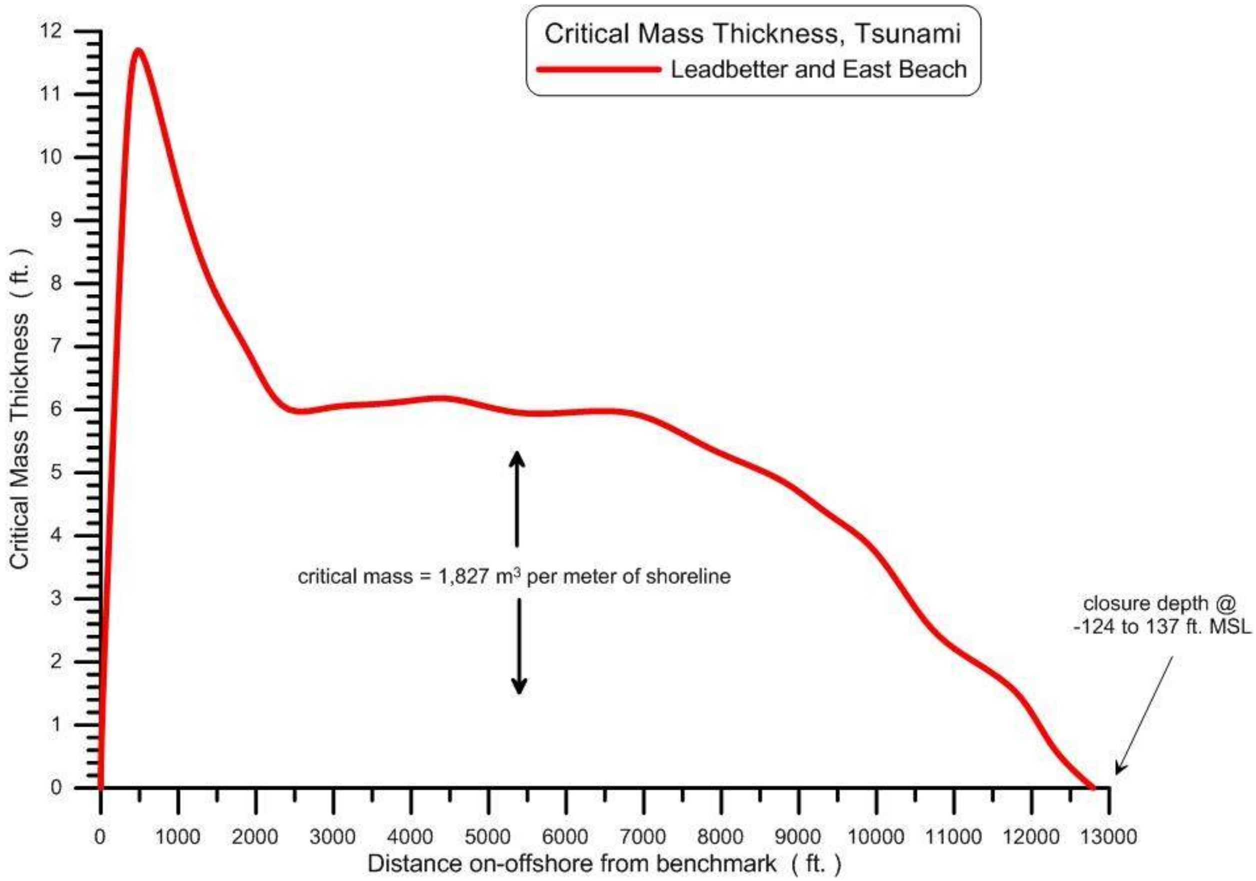


Figure 8.2: Thickness of critical mass envelope at historic survey ranges Doheny Beach, calculated by the calibrated CEM sediment budget based a 2m high solitary tsunami wave approaching Doheny Beach from 165 degrees true. Closure depth = -124 to -137 ft. MSL; critical mass volume = 1,827 m^3 per meter of shoreline.

Table 8.1: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Doheny Beach Site

	Well Head-A Elevation = 17 ft. NAVD	Well Head-B Elevation = 17 ft. NAVD	Well Head-C Elevation = 17 ft. NAVD	Well Head-D Elevation = 18 ft. NAVD	Well Head-E Elevation = 18 ft. NAVD
TWL Present Sea Level	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry	15.22 ft. NAVD status = dry
Q' Present Sea Level	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.	0.0 cfs/ft.
TWL 2100 Sea Level Low Range Projection	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded	18.82 ft. NAVD status = flooded
Q' 2100 Sea Level Low Range Projection	1.142 cfs/ft.	1.142 cfs/ft.	1.142 cfs/ft.	0.345 cfs/ft.	0.345 cfs/ft.
TWL @ 2100 Sea Level High Range Projection	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded	22.31 ft. NAVD status = flooded
Q' 2100 Sea Level High Range Projection	5.691 cfs/ft.	5.691 cfs/ft.	5.691 cfs/ft.	4.162 cfs/ft.	4.162 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Doheny State Beach from 165 degrees true

Table ES-2b: Tsunami Total Water Level (*TWL*) and Overtopping Rates (Q') Analysis at the Capistrano Beach Site

	Well Head-G Elevation = 18 ft. NAVD eroded/accreted	Well Head-H Elevation = 19 ft. NAVD eroded/accreted
$*TWL$ Present Sea Level (eroded)	15.3 ft. NAVD status = dry	15.3 ft. NAVD status = dry
$*Q'$ Present Sea Level (eroded)	0.0/0.0 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL$ 2100 Sea Level Low Range Projection (eroded)	18.83 ft. NAVD status = flooded	18.83 ft. NAVD status = dry
$*Q'$ 2100 Sea Level Low Range Projection (eroded)	0.352 cfs/ft.	0.0/0.0 cfs/ft.
$*TWL$ 2100 Sea Level High Range Projection (eroded)	22.4 ft. NAVD status = flooded	22.4 ft. NAVD status = flooded
$*Q'$ 2100 Sea Level High Range Projection (eroded)	4.293 cfs/ft.	2.916 cfs/ft.

*Evaluated for 2m high tsunami deep water wave height approaching Capistrano Beach from 165 degrees true.

9) Summary and Conclusions:

This 2019 study, prepared in response to comments for the Final EIR, provides further analysis to amplify the Coastal Hazards Analysis prepared in 2017 for the Draft EIR of the Doheny Desalination Project. That earlier work is being amplified herein in response to a revision of the *California Coastal Commission Sea Level Rise Policy Guidance* document that was originally released in August 2015, (CCC, 2015), but has been updated in July 2018 with new sea level rise projections. In addition, there have been minor adjustments in the locations of a number of the well heads and pump stations being proposed for the Doheny Desalination Project. The following study accounts for these intervening changes in policy guidance and minor modifications to the project description.

The primary analysis tool used in this study is the *Coastal Evolution Model* (CEM) developed at the Scripps Institution of Oceanography was used to evaluate Appendix-B requirements of the *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2015) for a sea level rise/coastal hazards analysis of the Doheny Desalination Project (DDP). The Coastal Evolution Model is public domain and available from the University of California Digital Library at: http://repositories.cdlib.org/sio/techreport/58/. The Coastal Evolution Model employs algorithms consistent with the U.S. Army Corps of Engineers *Coastal Engineering Manual*, (USACE, 2006), but employs the latest generation equilibrium beach profile algorithms from Jenkins and Inman (2006) that provide 3-dimensional predictive and mapping capability of the wave run-up field, beach erosion and shoreline recession under the effects of wave climate variability, climate cycles and sea level rise. The CEM input files were populated with National Ocean Survey digital bathymetry in the offshore domain; beach profiles sediment grain size measurements by the U.S. Army Corps of Engineers, Coastal Environments and Coastal Frontiers; long-term wave data from the Coastal Data Information Program; long-term ocean water level measurements by the National Oceanic and Atmospheric Administration; and stream flow and sediment flux for the San Juan Creek from the United States Geological Survey and the Federal Emergency Management Agency. Sea level rise projections used in this study were based on the *best fit equation* from Appendix-B of the *California Coastal Commission Sea Level Rise Policy Guidance* document for a 50 year project planning horizon (year 2070) and for a *critical infrastructure* planning horizon (year 2100). Critical project infrastructure subject to potential flooding by extreme event waves or tsunami concurrent with extreme ocean water levels and sea level rise are placed at two sites, namely Doheny State Beach and Capistrano State Beach. At the Doheny Beach site, five potential locations are being evaluated for vaulted well heads with submersible pumps, including : ***Well Head A***, elevation 17 ft. NAVD, at 33°27'44.38"N, 117°41'16.32"W; ***Well Head B***, elevation 17 ft. NAVD, at 33°27'45.07"N, 117°41'10.30"W; ***Well Head C***, elevation 17 ft. NAVD at 33°27'45.12"N, 117°41'6.62"W; ***Well Head D***, at elevation 18 ft. NAVD at 33°27'44.48"N, 117°40'55.30"W; and ***Well Head E***, at elevation 18 ft. NAVD at 33°27'42.45"N, 117°40'47.33"W. Two additional vaulted well heads with submersible pumps are being evaluated at the Capistrano Beach site, which includes: ***Well Head G***, at elevation 18 ft. NAVD at 33°27'14.94"N, 117°39'59.91"W; and ***Well Head H***, at elevation 19 ft. NAVD at 33°27'13.17"N, 117°39'57.15"W.

This study is based on sea level rise projections appearing in Appendix-G, Table G-11, of the recently updated *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC, 2018). This document provides no specific guidance on the redline frequency for flooding or inundation. In the absence of such guidance we have adopted Federal Emergency Management Agency standards for flooding frequency and set redline planning frequency at the 100 year event (1% probability of recurrence). The 100 year wave event was the two day storm of 17-18 January, 1988, which produced deep water significant wave heights off Doheny State Beach reaching 15.5 ft., approaching the beach from 270^0 with 14 second significant wave periods.

An analysis of extremal total water levels, (TWL's), based on the occurrence of extreme waves concurrent with extreme ocean water levels at present and at year 2100 sea levels, is summarized in Table 7.1 for structures at the Doheny Beach site and Table 7.2 for the Capistrano Beach site. Inspection of Table 7.1 & 7.2 reveals that all the beach front well sites for the Doheny Desalination Project are safe from flooding or inundation at present sea levels by extreme event waves concurrent with extreme ocean water levels for event return periods between 1 yr. and 100 yr. However, once we admit to 2100 sea level rise projections, a number of the beach front facilities for the Doheny Desalination Project will suffer some flooding and overtopping to varying degrees.

For the low-range 2100 sea level projections, the three well sites on the north side of San Juan Creek (Well Heads A-C) and one of the wells at the Capistrano Beach site (Well Head G) will experience minor overtopping, even for a 1 year event if the beaches have been accreted by additional sands from water shed floods or still retain a built-out summer equilibrium beach profile, with overtopping rates of about Q'(1yr) = 0.038 cfs per lineal ft. of shoreline. However, if a 100-yr total water level event occurs during the low-range projection of 2100 sea levels, then all of the well sites will be overtopped to varying degrees if the beaches remain in an accreted condition with elevated berms and steep beach slopes. Under these beach conditions, overtopping rates will range from a high of Q'(100yr) = 0.094 cfs per lineal ft. of shoreline at Well Heads A- C, to a low of Q'(100yr) = 0.014 cfs/ft at Well Head H. Interestingly enough, none of the well heads would experience overtopping during a 100 year event when occurring during the low range 2100 sea levels if the beach were eroded, which would be the most likely condition during a 100-year event. Total water levels for eroded beach conditions are always less, because these beaches have flatter slopes and are more dissipative of wave set-up and run-up than the steeper accreted beaches.

For the high-range 2100 sea level projections, Table 7.1 indicates the 100 year total water level events at the Doheny Beach site reach *TWL*(100) = 21.9 ft. NAVD for the steeply sloping accreted beach conditions and *TWL*(100) = 20.2 ft. NAVD for the eroded beach conditions. At the Capistrano Beach site, shoaling wave heights are higher and total water levels for a 100 year event superimposed on the high range projections for 2100 sea levels produce total water levels reaching *TWL*(100) = 22.7 ft. NAVD for the steeply sloping accreted beach conditions and *TWL*(100) = 21.1 ft. NAVD for the eroded beach conditions. Consequently, all beach front well heads for the Doheny Desalination Project will be overtopped and flooded when extreme waves happen concurrently with extreme ocean water levels that are superimposed on the high range of 2100 sea levels. The lowest lying well heads (Well Heads A-C) would experience the highest overtopping rates, ranging from Q'(100yr) = 0.216 cfs/ft. to 0.331 cfs/ft. depending on the eroded or accreted condition of Doheny State Beach. According Table VI-5-6 in the Coastal Engineering Manual (USACE, 2006) overtopping rates of this order of magnitude are very dangerous for pedestrian and vehicle traffic, and may cause structural damage to adjacent buildings, but the well heads and pumps for the Doheny Desalination project will be protected by steel vault enclosures. The smallest overtopping rates during the 100-year event at the high range2100 sea level projections will occur at the highest located well head (Well Head H) at the Capistrano Beach site where overtopping rates will range from Q'(100yr) = 0.142 cfs/ft. to 0.250 cfs/ft. While these overtopping rates are still dangerous to pedestrian and vehicle traffic, they are easily mitigated by the steel vault enclosures of the well heads and pumps being placed at Capistrano Beach.

Tsunami induced erosion, runup, and inundation were analyzed for the Doheny and Capistrano State Beaches and shore-side facilities associated with the Doheny Desalination Project for present and future sea levels according to low and high range sea level rise predictions. The analysis was based on numerical refraction/diffraction codes for a shoaling solitary wave. The tsunami event scenario is based on a 2m high solitary wave approaching Doheny Beach from 165 degrees true, as could be anticipated for a catastrophic tsunami event arising from a major landside on the east side of San Clemente Island. The local refraction/diffraction pattern from the solitary wave reveals the tsunami wave height begins to increase at 50 m of water depth due to shoaling, and reaches 6m of height before breaking along the shores of Doheny and Capistrano Beaches. Because the tsunami wave begins shoaling in much deeper water than typical storm-induced waves, it causes seabed scour and erosion to occur out to very deep-water depths. Therefore, all run-up and total water level solutions are based eroded beach profile conditions.

Tsunami TWL inundation calculations are summarized Table 8.1 for the Doheny Beach site, and Table 8.2 for the Capistrano Beach site. These tables indicate that all of the shore facilities of the Doheny Desalination Project are above tsunami inundation levels at present sea level. However, all of the well heads at both Doheny and Capistrano Beaches would suffer some degree of tsunami overtopping if concurrent with 2100 sea levels, and the overtopping rates could be quite severe, especially for the high 210 sea level rise projections. At the low range of 2100 sea level projections, total water levels would reach TWL = 18.82 ft. NAVD at Doheny Beach and TWL = 18.83 ft. NAVD at Capistrano Beach. Well Heads A-C at Doheny Beach would experience the highest overtopping surges of Q' = 1.142 cfs/ft while Well Head G at Capistrano Beach would remain high and dry. However, if the tsunami occurred atop the high range sea level rise projections for year 2100, then total water levels would reach TWL = 22.31 ft. NAVD at Doheny Beach and TWL = 22.4 ft. NAVD at Capistrano Beach, sufficient to overtop all the well sites of the Doheny Desalination project. In this case the tsunami surge could produce very high, although short-lived, overtopping rates reaching a maximum of Q' = 5.691 cfs/ft at Well Heads A-C on Doheny Beach and a minimum of Q' = 2.916 cfs/ft at Well Head H on Capistrano Beach. Undoubtedly, the steel vault enclosures of the well heads can be designed to withstand these high surge rates, but particular attention should be given to the foundations of the vaults to assure those foundations have adequate depth to prevent undercutting by scour. These findings are consistent with the FEMA tsunami flood map which show that all of the Doheny Beach/San Juan Creek corridor extending several miles inland will be inundated by a shoaling tsunami solitary wave.

10) References:

Bromirski, P., Miller, A., Flick, R., and G. Auad, 2011. "Dynamical suppression of sea level rise along the Pacific coast of North America," *Jour Geophysical Res.*, 116

Bruun, P.,1962, "Sea level rise as a cause of shore erosion," *Jour Waterways and Harbors Division*, ASCE, vol. 88, 116

Bruun, P., 1983, 'Review of conditions for use of the Bruuns Rule of erosion", *Coastal Eng.*, vol 7, p. 77-89.

CalCOFI, 2014, "California Cooperative Oceanic Fisheries Investigation", Southern California Coastal Ocean Observation System, SCOOS Data: http://www.calcofi.org/data/sccoos/sccoos-data.html

CCC, 2015, "*California Coastal Commision Sea Level Rise Policy Guidance",* adopted 12 August 2015, 254 pp.

CCC, 2018, "*California Coastal Commision Sea Level Rise Policy Guidance: Draft Science Update",* adopted July 2018, 305 pp.

CDIP, 1984-1988, "Coastal data information program, monthly reports," U. S. Army Corps of Engineers, California Department of Boating and Waterways, Monthly Summary Reports #97-#150.

CDIP, 1976-1995, "Coastal Data Information Program, Monthly Reports," U. S. Army Corps of Engineers, California Department of Boating and Waterways, SIO Reference Series, 76-20 through 95-20.

CDIP, 1993-1994, "Monthly Summary Report," SIO Reference Series (93-27) through (94-19).

CDIP, 2016, "Coastal Data Information Program" http://cdip.ucsd.edu/

Coastal Frontiers, 2014, "Doheny State Beach: Beach Profiles West of San Juan Creek", personal communications.

Coastal Environments,2014, "Updated Coastal Processes and Hydraulic/Hydrology Studies for Doheny State Beach, Technical Report," submitted to South Coast Water District, 164 pp.

Gacia, E., O. Invers, M. Manzaneera, E. Ballesteros and AJ. Romero. 2007. Impact of the brine from a desalination plant on a shallow seagrass (*Posidonia oceanic*) meadow. *Estuarine and Coastal Shelf Science* 72:579-590.

Graham, J. B., 2004, "Marine biological considerations related to the reverse osmosis desalination project at the Applied Energy Sources, Huntington Beach Generating Station," Appendix-S in REIR, 2005, 100 pp.

Jenkins, S. A. and J. Wasyl, 2005, "Coastal evolution model," Scripps Institution of Oceanography Tech Report No. 58, 179 pp + appendices. http://repositories.cdlib.org/sio/techreport/58/

Jenkins, S. A. and D. L. Inman, 2006, "Thermodynamic solutions for equilibrium beach profiles", *Jour. Geophys. Res.*, v.3, C02003, doi:10.1029/2005JC002899, 2006. 21pp.

National Research Council (NRC). 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Report by the Committee on Sea Level Rise in California, Oregon, and Washington. National Academies Press, Washington, DC. 250 pp. http://www.nap.edu/catalog/13389/sea-level-rise-for-the-coasts-of-california-oregon-and-washington.

NOAA, 2016, "Historic Water Levels - Station Selection," https://tidesandcurrents.noaa.gov/stations.html?type=Historic+Water+Levels http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=9410230%20La%20 Jolla,%20CA&type=Bench%20Mark%20Sheets

Raubenheimer, B., R. T. Guza, and S. Elgar (1996), Wave transformation across the inner surf zone, *J. Geophys. Res.*, *101*(11), 25589–25597.

RWQCB, 2014a, "ORDER NO. R9-2012-0012, NPDES NO. CA0107417 WASTE DISCHARGE REQUIREMENT FOR THE SOUTH ORANGE COUNTY WASTEWATER AUTHORITY, DISCHARGE TO THE PACIFIC OCEAN THROUGH THE SAN JUAN CREEK OCEAN OUTFALL," CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD SAN DIEGO REGION, 157 pp.

RWQCB, 2014b, "ORDER NO. R9-2012-0012, NPDES NO. CA0107417 WASTE DISCHARGE REQUIREMENT FOR THE SOUTH ORANGE COUNTY WASTEWATER AUTHORITY, DISCHARGE TO THE PACIFIC OCEAN THROUGH THE SAN JUAN CREEK OCEAN OUTFALL, APPENDIX-H DILUTION MODEL INFORMATION" CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD SAN DIEGO REGION, 8 pp.

SCCOOS, 2014, "Southern California Coastal Ocean Observation System", Current Data, SJCOO: http://www.sccoos.org/data/hfrnet/

SEIR, 2010, "Subsequent Environmental Impact Report Sea Water Desalination Project at Huntington Beach," #2001051092, City of Huntington Beach, prepared by Dudek Consulting, May, 2010, 9 sections + append.

SWRCB, 2015, Amendment to the Water Quality Control Plan For Ocean Waters of

California Addressing: “DESALINATION FACILITY INTAKES, BRINE DISCHARGES, AND THE INCORPORATION OF OTHER NON-SUBSTANTIVE CHANGES”, cf. Appendix-A: “Ocean Plan with the May 6, 2015 Final Desalination Amendment”, 1303 pp.

Star-CD, 1998 Manuals Version 3.1, *Computational Dynamics*. 1999.

U.S. Army Corps of Engineers, 1985, “Littoral zone sediments, San Diego Region, October 1983 – June 1984”, Coast of California Storm and Tidal Wave Study, CCSTWS 85-11.

U. S. Army, Corps of Engineers (USACE), 1991, “State of the Coast Report, San Diego Region,” Los Angeles District, CA: Coast of California Storm and Tidal Waves Study, Final Report 1.

U. S. Army, Corps of Engineers (USACE), 2006, “Coastal Engineering Manual,” Engineering Manual 1110-2-1100, U. S. Army, Corps of Engineers, Washington, DC, (in 6 volumes).

U.S. Department of Commerce National Ocean Service, 1986, “Tide tables 1986, high and low water predictions for west coast of North and South America”, 234 pp.

USGS, 1997, "USGS Digital Data Series DDS-37 at INTERNET URL," http://wwwrvares.er.usgs.gov/wgn96cd/wgn/wq/region18/hydrologic unit code.

Van der Meer, J.W., 2002. *Wave Run-up and Overtopping at Dikes.* Technical Report, Technical Advisory Committee for Water Retaining Structures (TAW), Delft, the Netherlands.

Appendix-A: Refraction/Diffraction Plots for Extreme Event Waves:

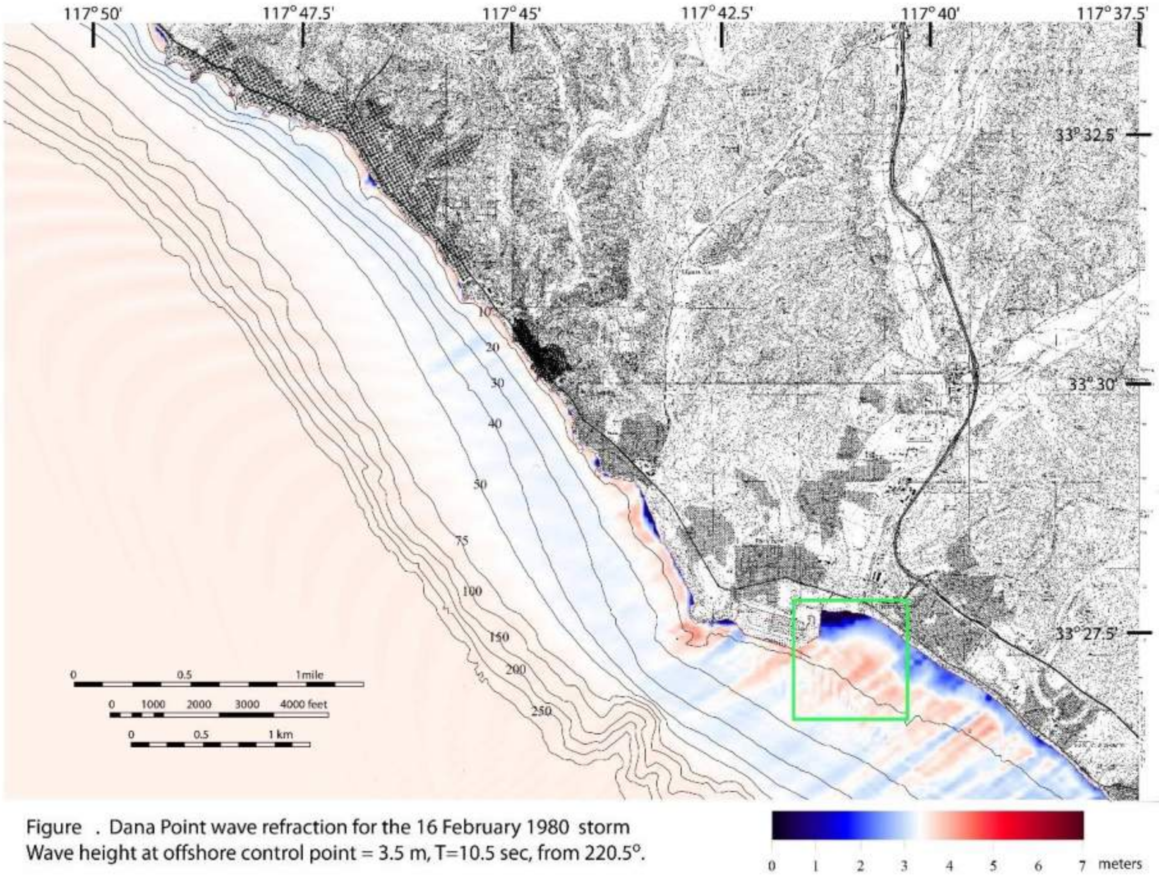


Figure . Dana Point wave refraction for the 16 February 1980 storm
Wave height at offshore control point = 3.5 m, T=10.5 sec, from 220.5°.

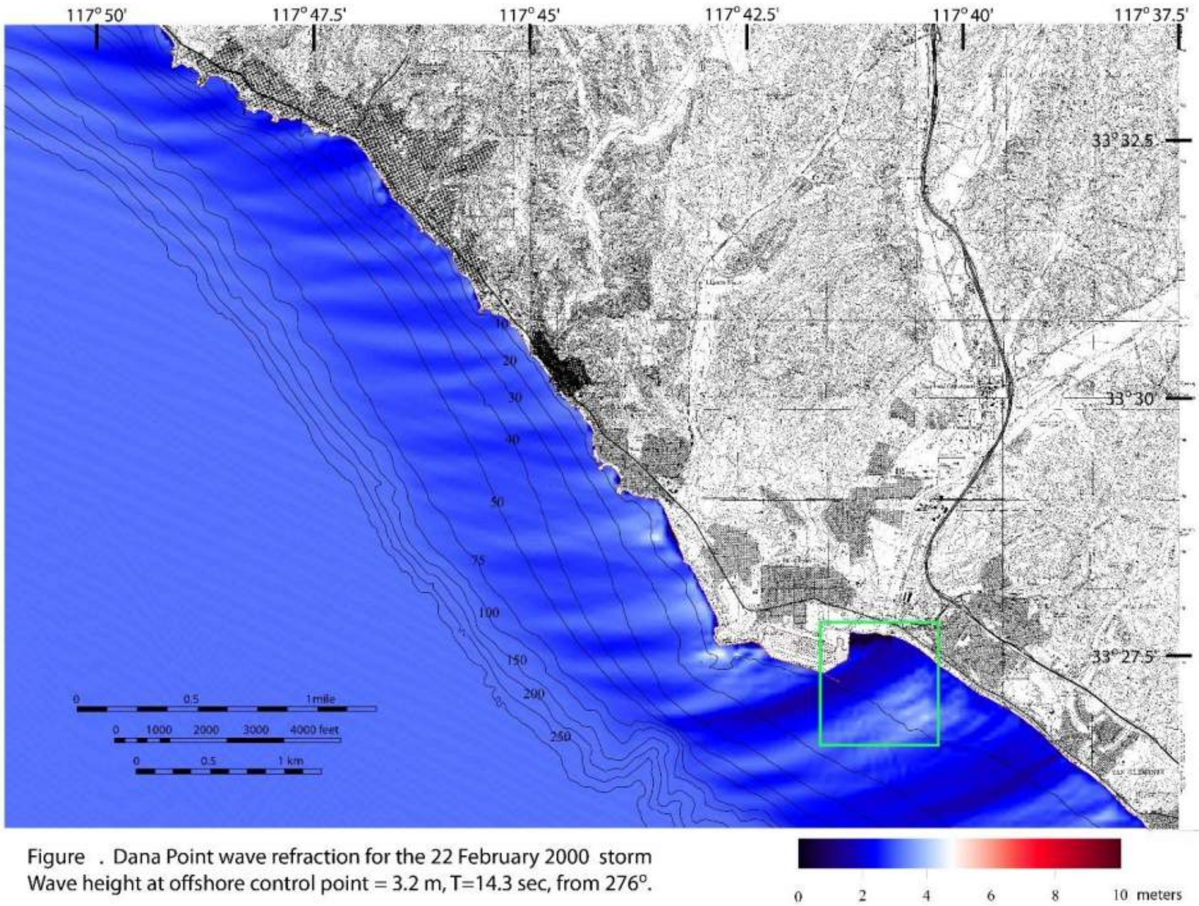


Figure . Dana Point wave refraction for the 22 February 2000 storm
Wave height at offshore control point = 3.2 m, T=14.3 sec, from 276°.

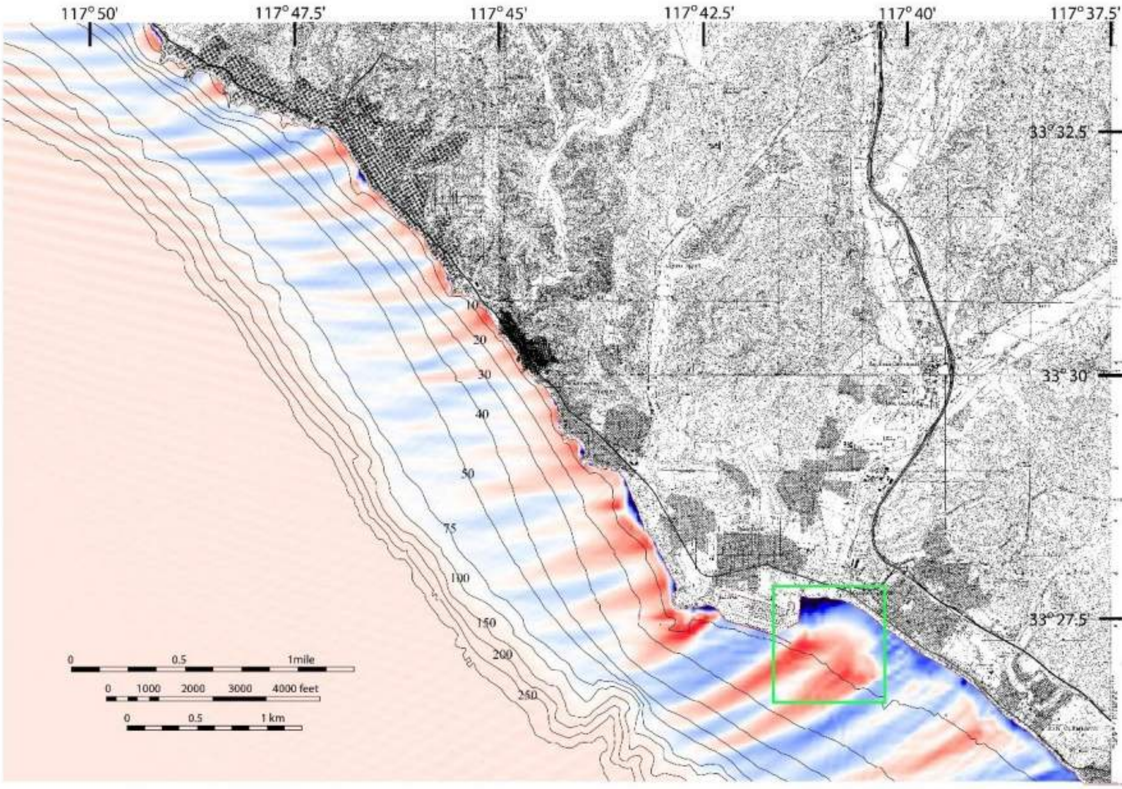
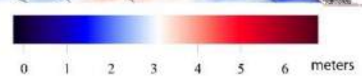


Figure . Dana Point wave refraction for the 28 January 1981 storm
Wave height at offshore control point = 3.5 m, T=15.5 sec, from 251.5°.



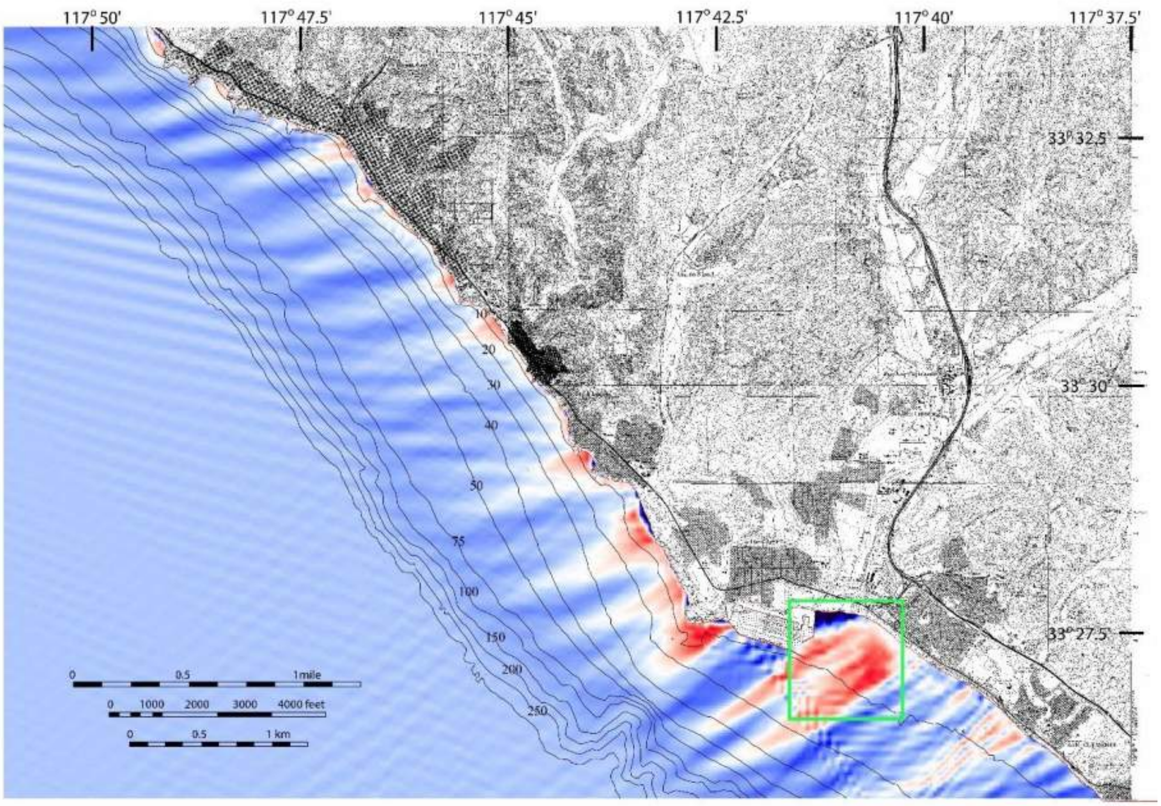


Figure . Dana Point wave refraction for the 25 January 1983 storm
Wave height at offshore control point = 2.1 m, T=19.5 sec, from 246°.

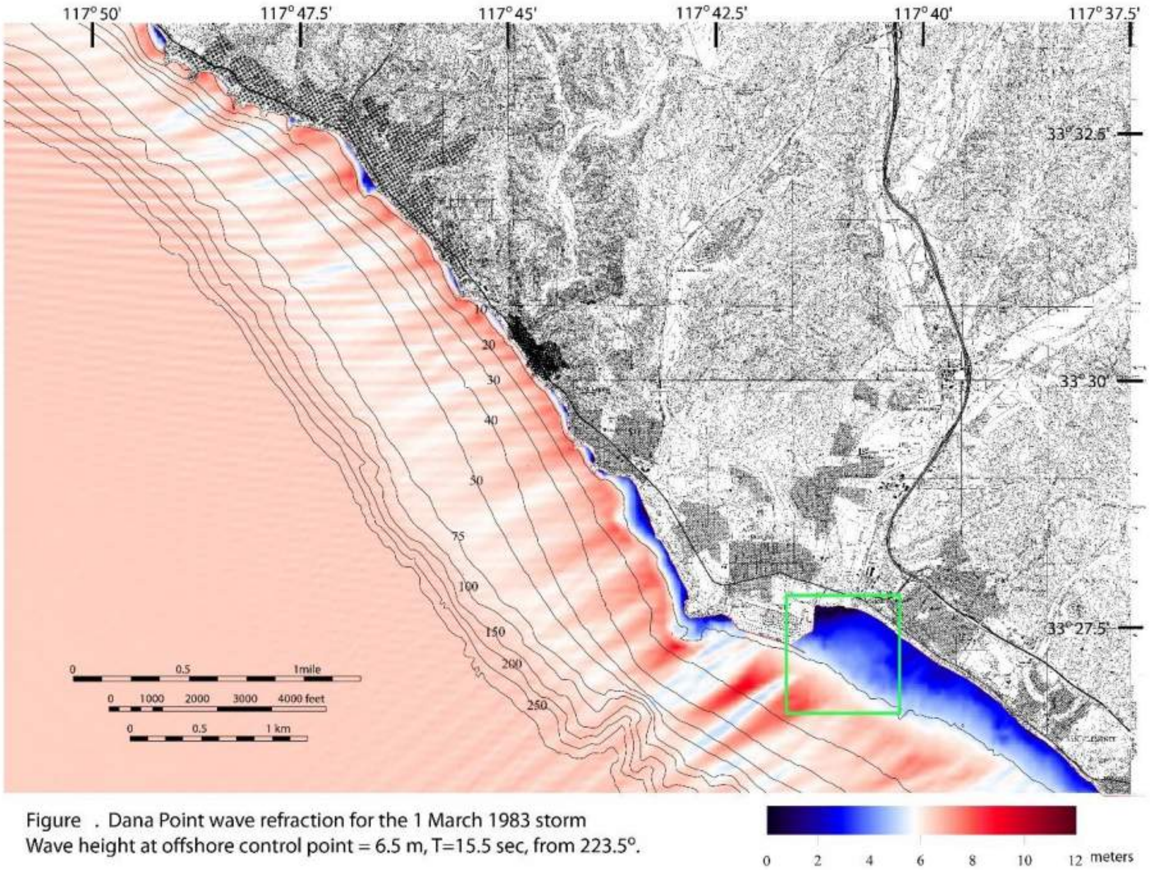


Figure . Dana Point wave refraction for the 1 March 1983 storm
Wave height at offshore control point = 6.5 m, T=15.5 sec, from 223.5°.

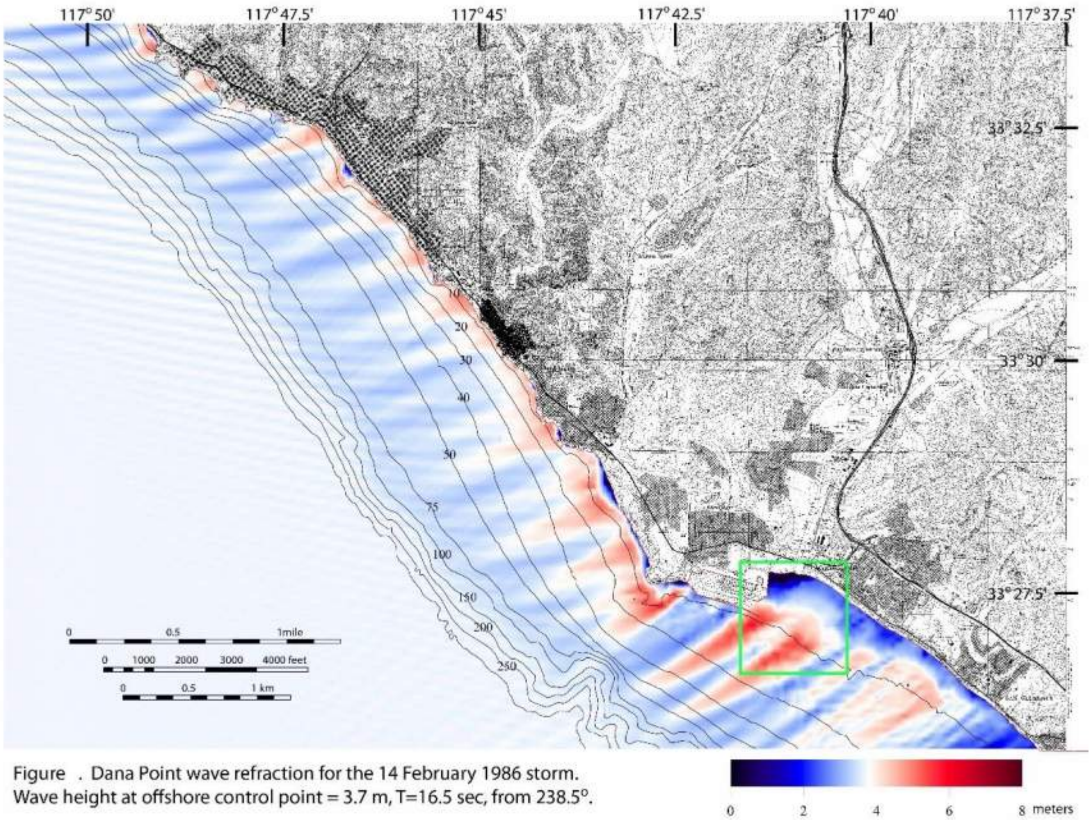


Figure . Dana Point wave refraction for the 14 February 1986 storm.
Wave height at offshore control point = 3.7 m, T=16.5 sec, from 238.5°.

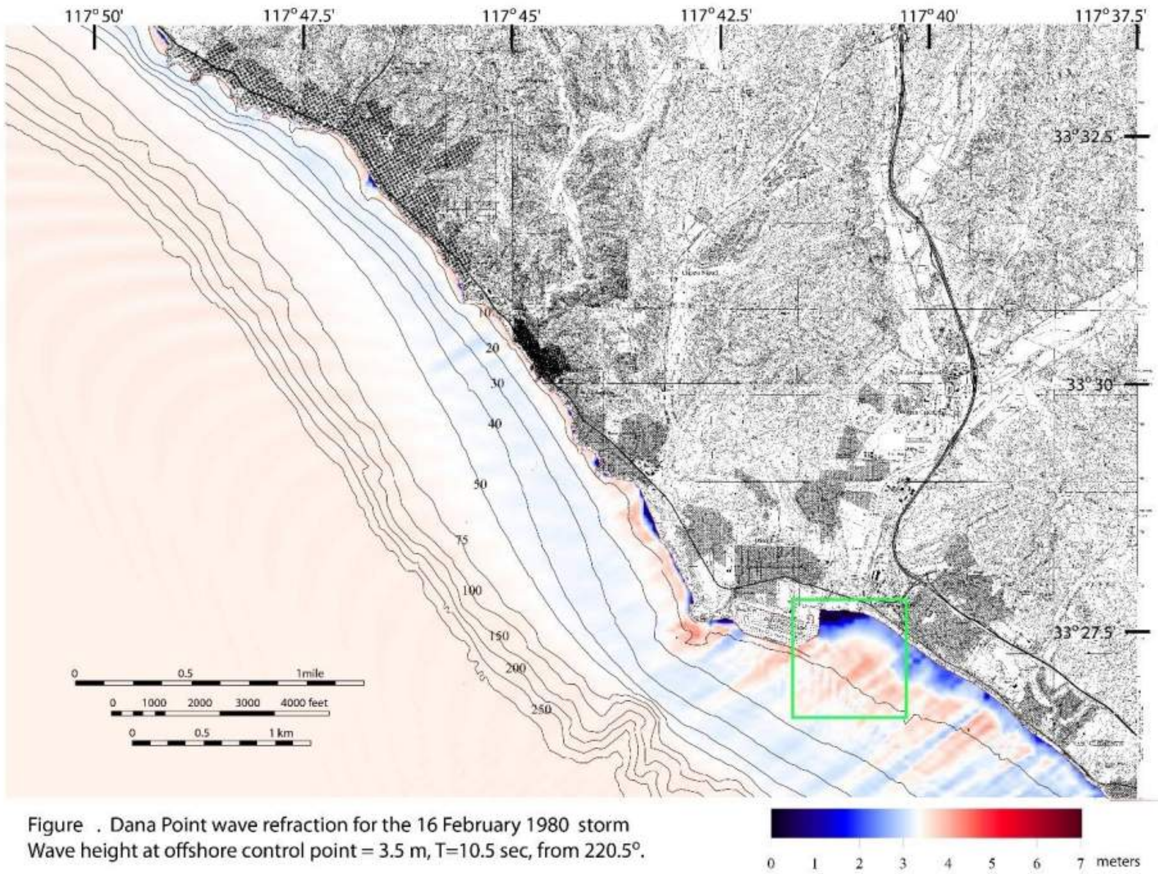


Figure . Dana Point wave refraction for the 16 February 1980 storm
Wave height at offshore control point = 3.5 m, T=10.5 sec, from 220.5°.

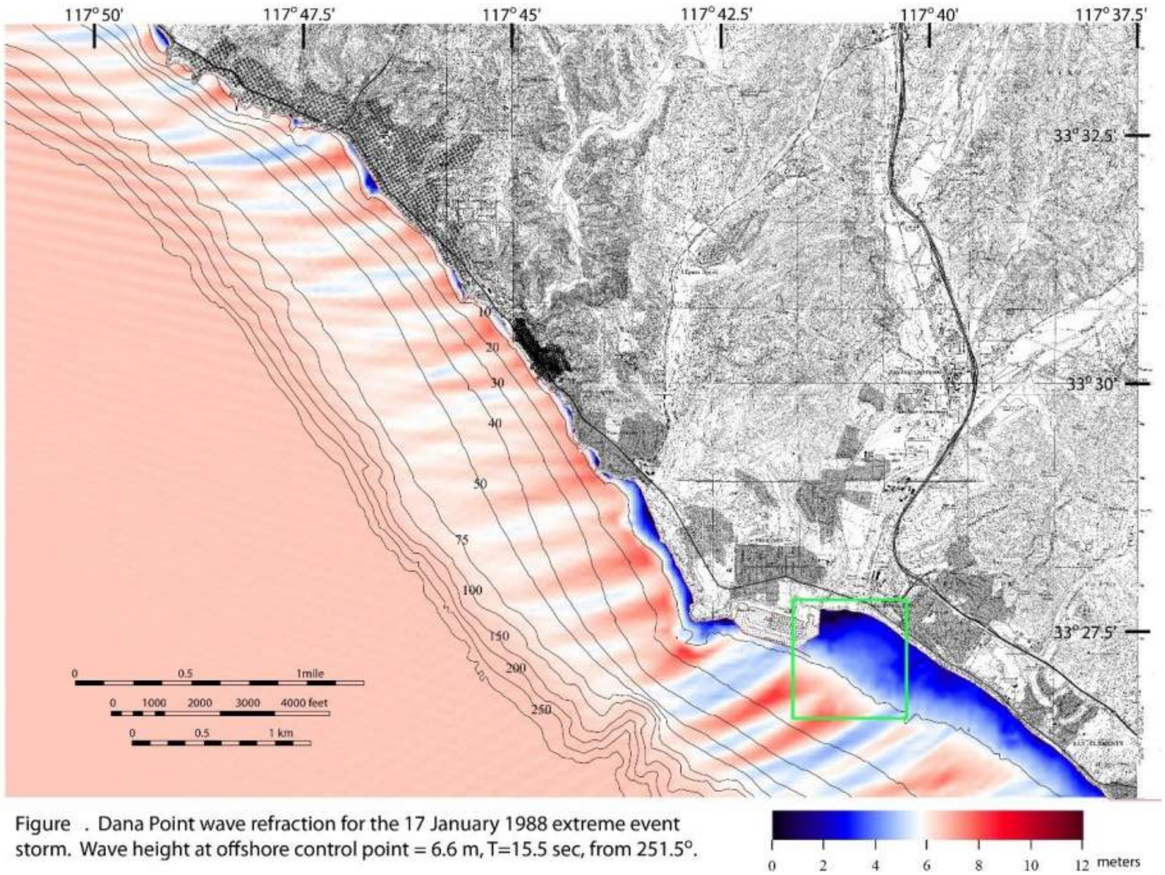


Figure . Dana Point wave refraction for the 17 January 1988 extreme event storm. Wave height at offshore control point = 6.6 m, T=15.5 sec, from 251.5°.

The 100 year (1%) Storm, Day-1

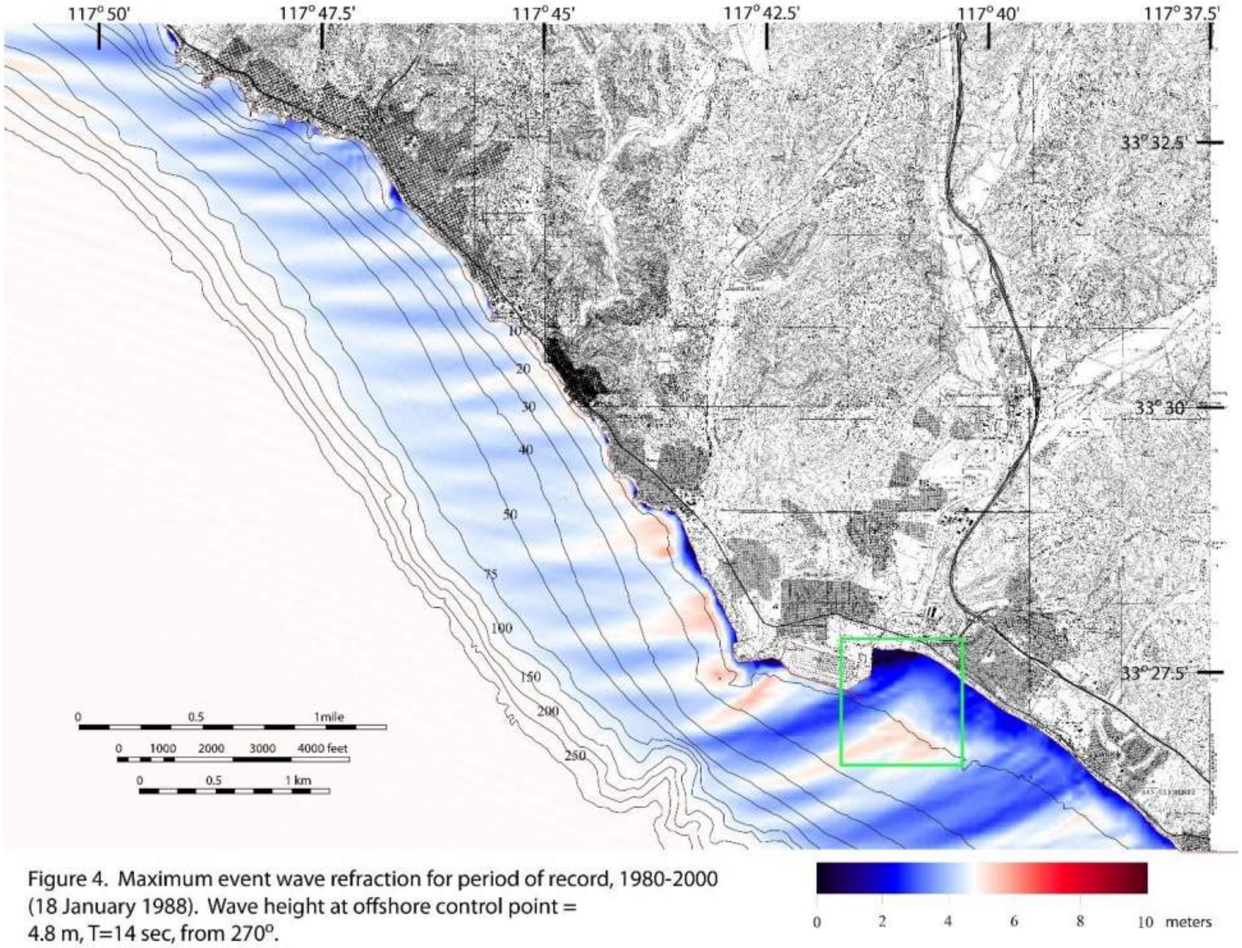


Figure 4. Maximum event wave refraction for period of record, 1980-2000 (18 January 1988). Wave height at offshore control point = 4.8 m, T=14 sec, from 270°.

The 100 year (1%) Storm, Day-2

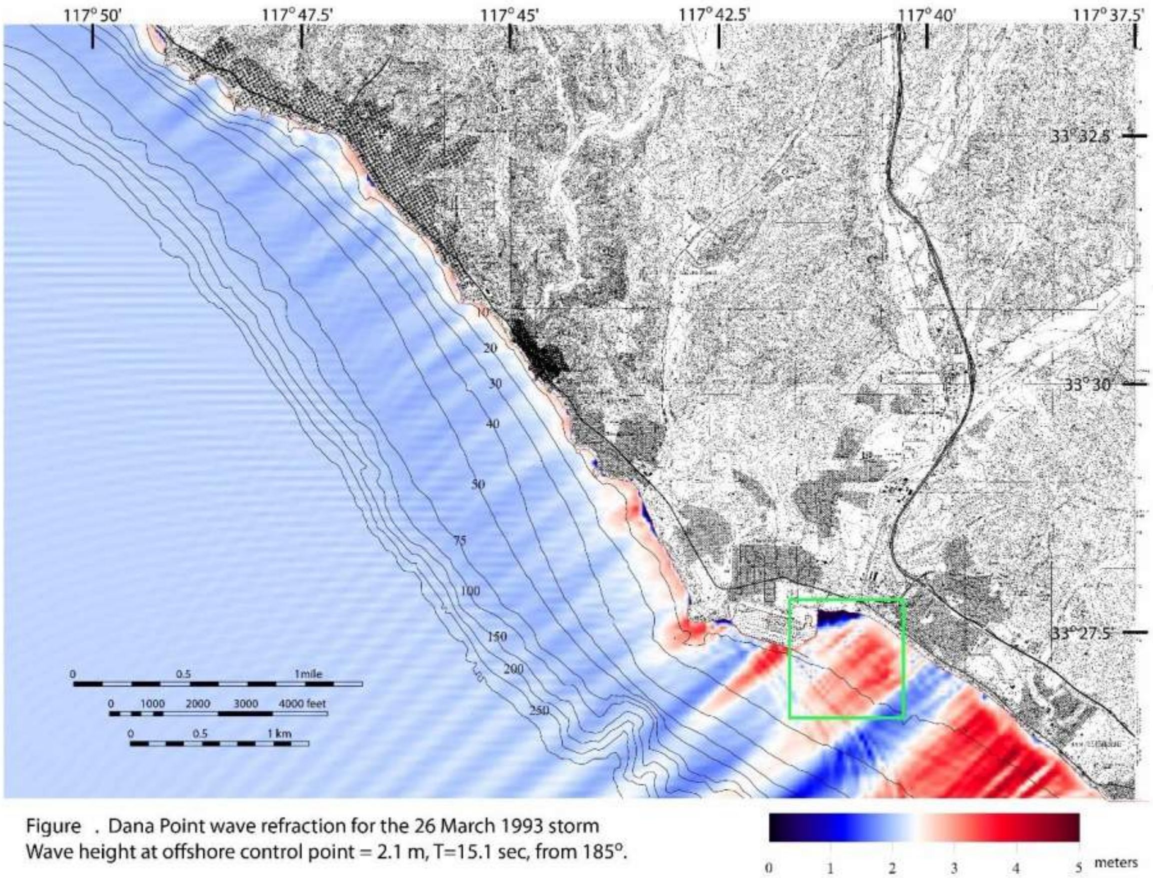


Figure . Dana Point wave refraction for the 26 March 1993 storm
Wave height at offshore control point = 2.1 m, T=15.1 sec, from 185°.

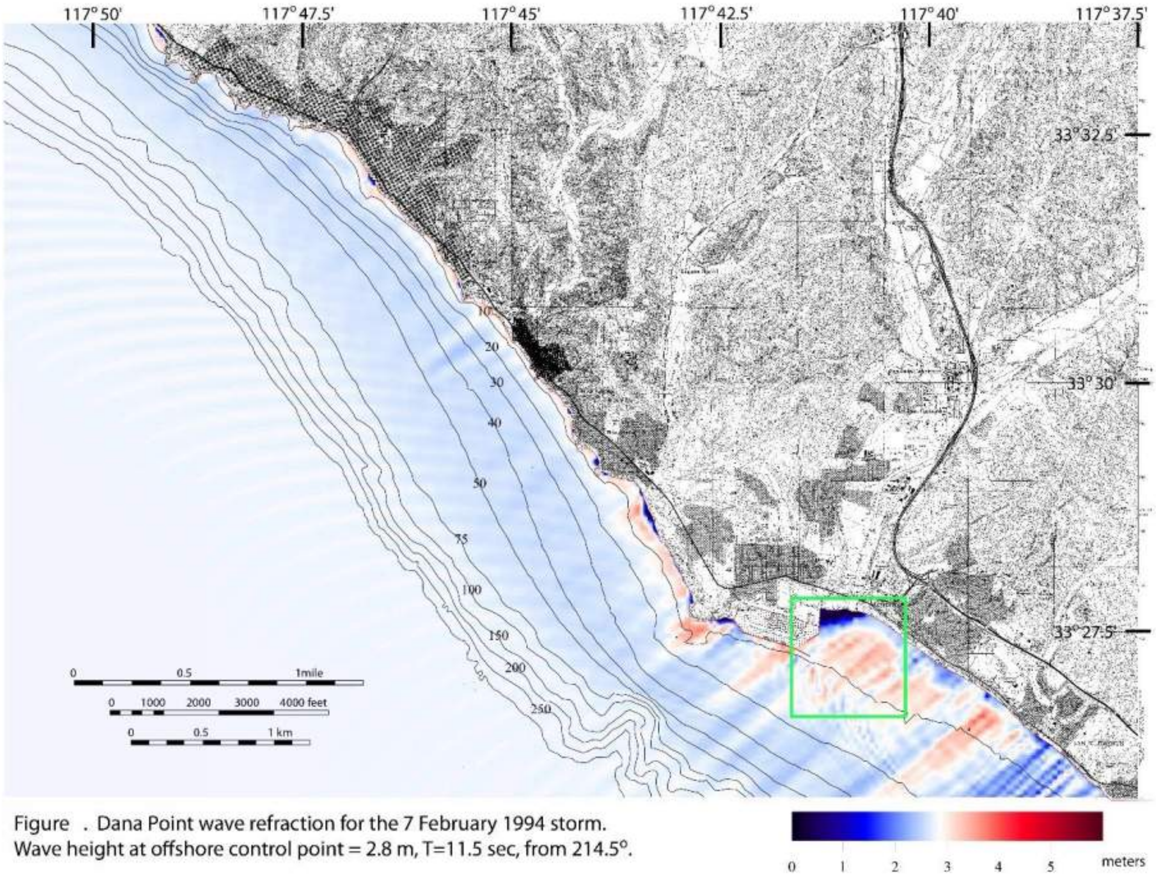


Figure . Dana Point wave refraction for the 7 February 1994 storm.
Wave height at offshore control point = 2.8 m, T=11.5 sec, from 214.5°.

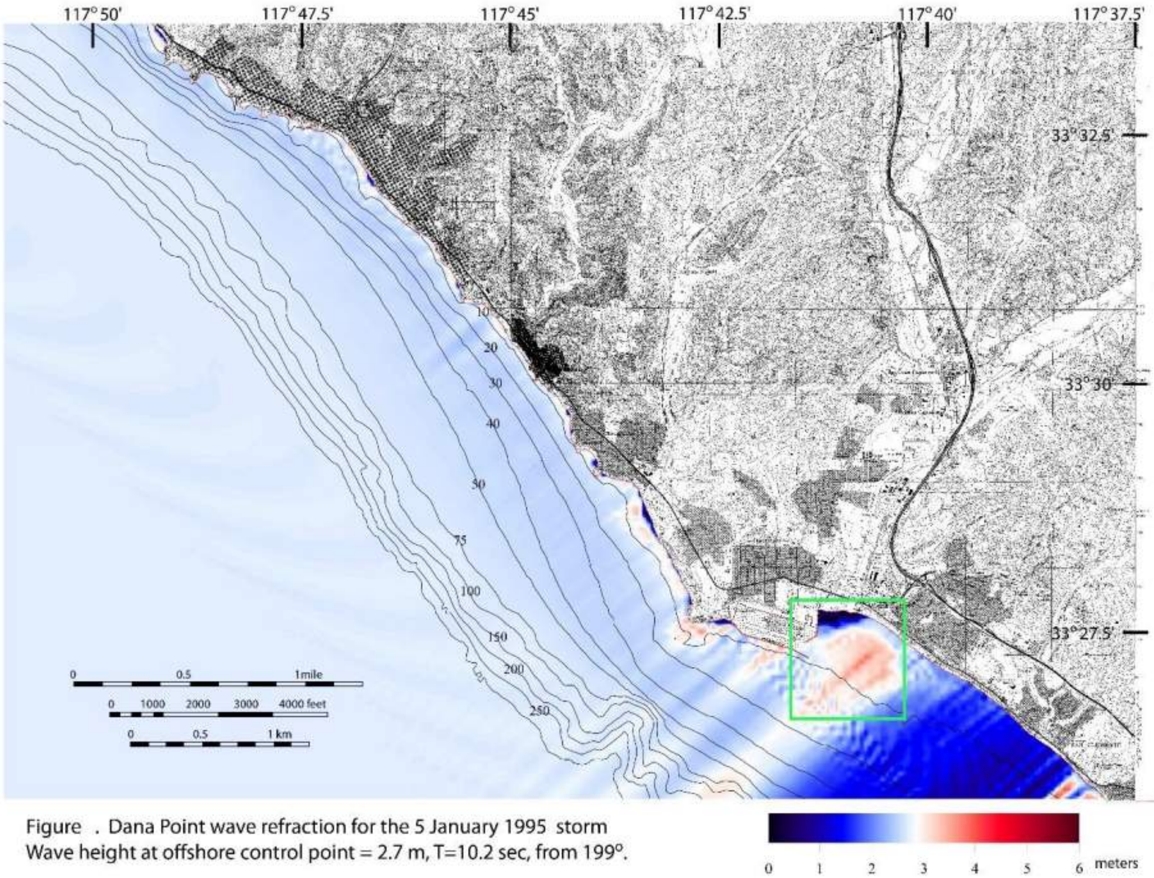


Figure . Dana Point wave refraction for the 5 January 1995 storm
Wave height at offshore control point = 2.7 m, T=10.2 sec, from 199°.

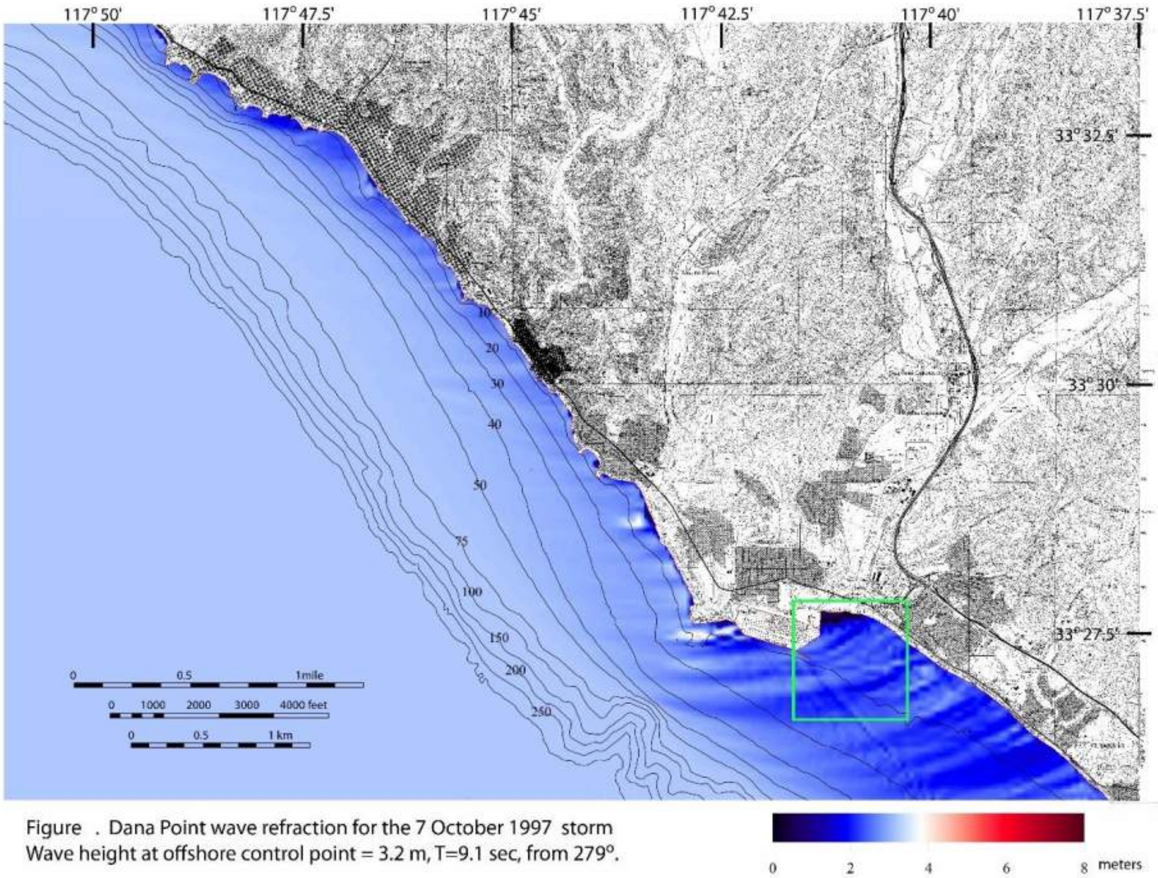


Figure . Dana Point wave refraction for the 7 October 1997 storm
Wave height at offshore control point = 3.2 m, T=9.1 sec, from 279°.

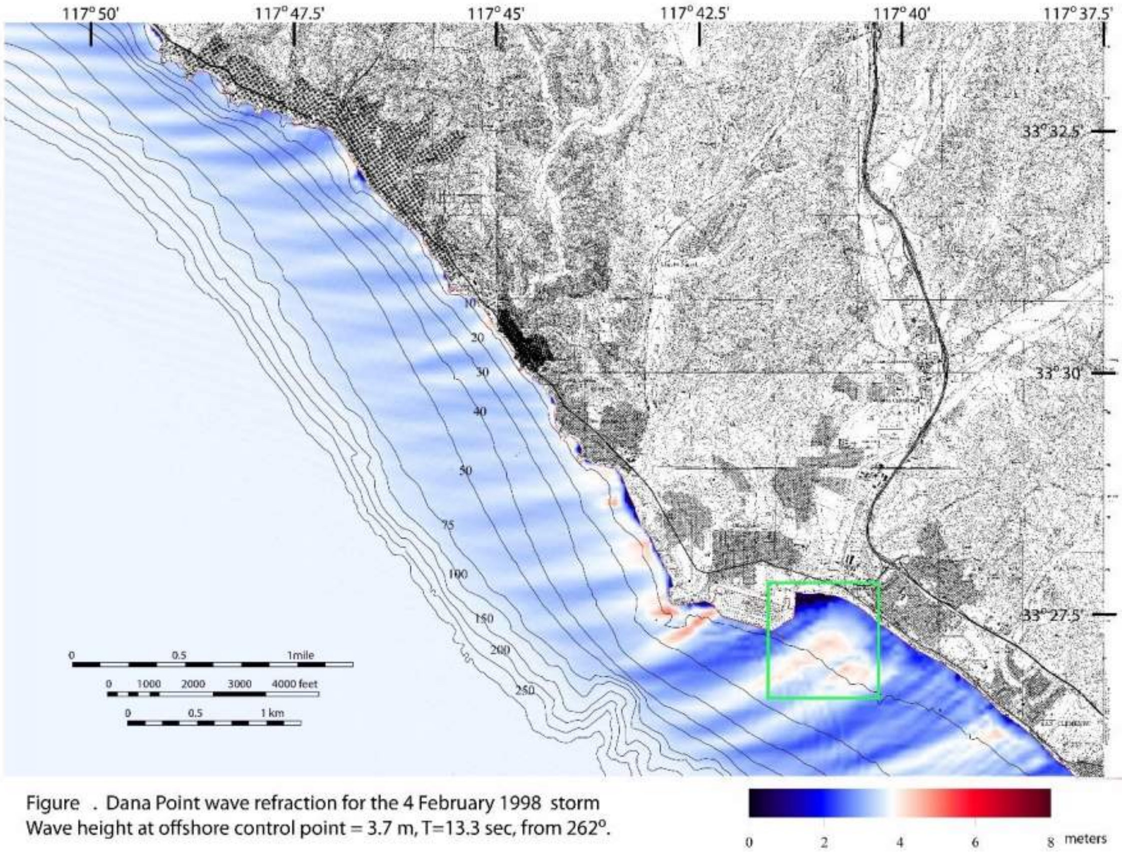


Figure . Dana Point wave refraction for the 4 February 1998 storm
Wave height at offshore control point = 3.7 m, T=13.3 sec, from 262°.

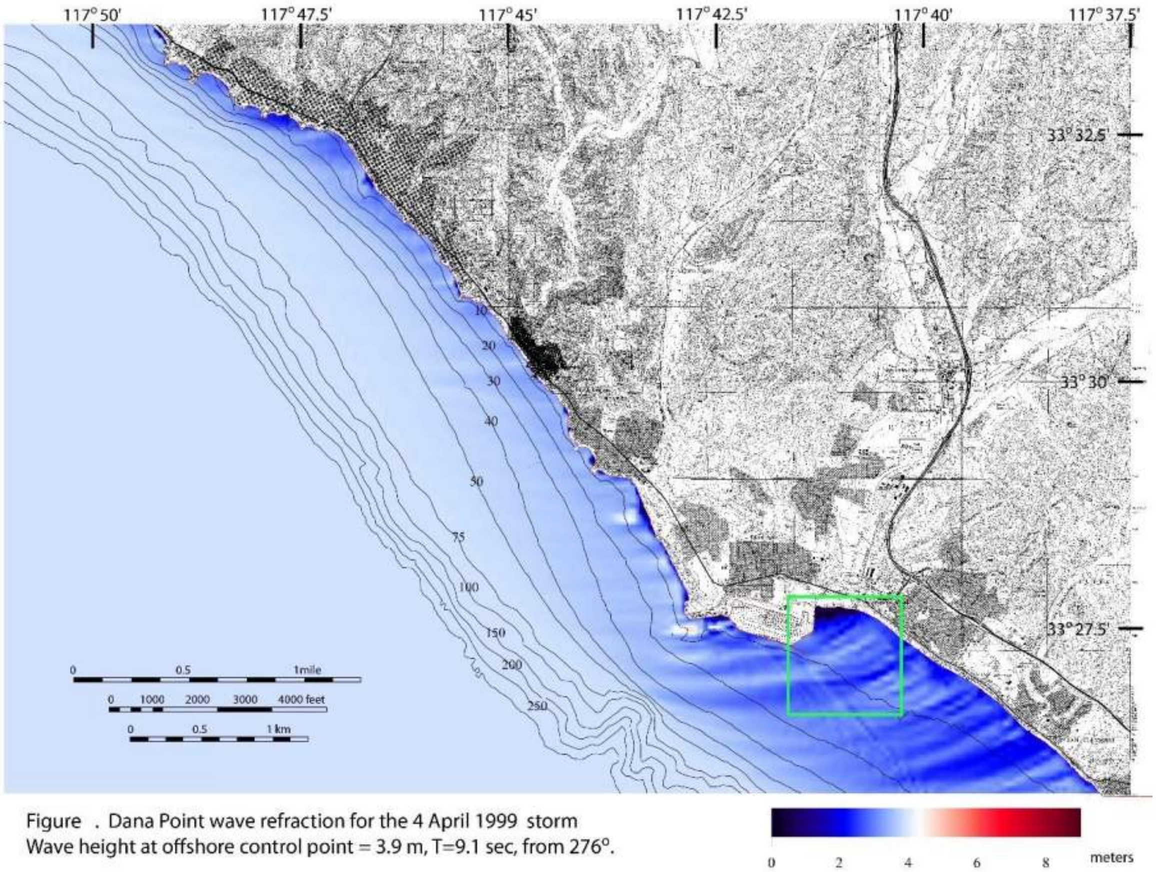


Figure . Dana Point wave refraction for the 4 April 1999 storm
Wave height at offshore control point = 3.9 m, T=9.1 sec, from 276°.

Appendix C:

Project Cost Estimates

Doheny Desalination Project Cost Estimates

Alternative 1

Item		Description	Unit	Quantity (GHD)	Unit Price	Item Total
A	**Mobilization & Demobilization**		LS	1	$161,900	$161,900
					Subtotal Construction Cost A	$161,900
B	**Site Improvements**					
	1	Clearing & Grubbing	LS	1	$20,000	$20,000
	2	Grading and Excavation	LS	1	$60,000	$60,000
	3	Earthwork (imported)	CY	63100	$25	$1,577,500
	4	Remove Existing Storm Drain Inlet	EA	1	$1,400	$1,400
	5	Cap Existing Manhole	EA	1	$1,200	$1,200
	6	Install Junction Structure (W6' x L6' x H20')	LS	1	$30,000	$30,000
	7	Shoring Equipment (6 weeks)	LS	1	$1,800	$1,800
	8	Miscellaneous Site Work	LS	1	$50,000	$50,000
					Subtotal Construction Cost B	$1,741,900
C	**Detention Basin**					
	1	Construct Stormwater Detention Basin (0.5 acres X 2' deep)	LS	1	$87,000	$87,000
	2	Miscellaneous Basin Work	LS	1	$20,000	$20,000
					Subtotal Construction Cost C	$107,000
					Subtotal Construction Cost (A+B+C)	$2,010,800
					15% Contingency	$301,620
					Total Construction Cost (A+B+C)	$2,312,420
		Grand Total				**$2,312,420**

Note:
1. Mobilization and demobilization is estimated to be 7% of construction cost.

Doheny Desalination Project Cost Estimates

Alternative 2

Item		Description	Unit	Quantity (GHD)	Unit Price	Item Total
A	**Mobilization & Demobilization**		LS	1	$264,500	$264,500
					Subtotal Construction Cost A	$264,500
B	**Site Improvements**					
	1	Clearing & Grubbing	LS	1	$20,000	$20,000
	2	Grading and Excavation	LS	1	$120,000	$120,000
	3	Earthwork (imported)	CY	27100	$25	$677,500
	4	Demolish Existing Channel Wall with Footing	LF	255	$600	$153,000
	6	Miscellaneous Site Work	LS	1	$50,000	$50,000
					Subtotal Construction Cost B	$1,020,500
C	**Sheet Pile Wall**					
	1	Furnish and Install Sheet Piles	LF	500	$4,000	$2,000,000
					Subtotal Construction Cost C	$2,000,000
					Subtotal Construction Cost (A+B+C)	$3,285,000
					15% Contingency	$492,750
					Total Construction Cost (A+B+C)	$3,777,750
		Grand Total				**$3,777,750**

Note:

1. Mobilization and demobilization is estimated to be 7% of construction cost.

Doheny Desalination Project Cost Estimates

Alternative 3

Item		Description	Unit	Quantity (GHD)	Unit Price	Item Total
A	**Mobilization & Demobilization**		LS	1	$277,500	$277,500
					Subtotal Construction Cost A	$277,500
B	**Site Improvements**					
	1	Clearing & Grubbing	LS	1	$20,000	$20,000
	2	Grading and Excavation	LS	1	$120,000	$120,000
	3	Earthwork (imported)	CY	27100	$25	$677,500
	4	Remove Existing Storm Drain Inlet	EA	1	$1,400	$1,400
	5	Cap Existing Manhole	EA	1	$1,200	$1,200
	6	Install Junction Structure (W6' x L6' x H20')	LS	1	$30,000	$30,000
	7	Shoring Equipment(6 weeks)	LS	1	$1,800	$1,800
	8	Demolish Existing Channel Wall with Footing	LF	255	$600	$153,000
	9	Gravel Bag Berm	LF	1050	$5	$5,250
	11	Miscellaneous Site Work	LS	1	$50,000	$50,000
					Subtotal Construction Cost B	$1,060,150
C	**Detention Basin**					
	1	Construct Stormwater Detention Basin (0.5 acres X 2' deep)	LS	1	$87,000	$87,000
	2	Miscellaneous Basin Work	LS	1	$20,000	$20,000
					Subtotal Construction Cost C	$107,000
D	**Sheet Pile Wall**					
	1	Furnish and Install Sheet Piles	LF	500	$4,000	$2,000,000
					Subtotal Construction Cost C	$2,000,000
					Subtotal Construction Cost (A+B+C+D)	$3,444,650
					15% Contingency	$516,698
					Total Construction Cost (A+B+C+D)	$3,961,348
		Grand Total				**$3,961,348**

Note:

1. Mobilization and demobilization is estimated to be 7% of construction cost.

APPENDIX 4.2.5

MARINE BIOLOGY TECHNICAL MEMOS

APPENDIX 4.2.5.1

DIFFUSER ENTRAINMENT MEMO FOR FINAL EIR

6 March 2019

Mark Donovan, PE
GHD
Desalination Program Manager
320 Goddard Way, Suite 200
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Re: Review of Plumes 18b Modeling Deleterious Diffuser Entrainment
Doheny Desalination Project

Hello Mark:

I reviewed the Plumes 18b report (Jenkins 2019) for the South Coast Water District Doheny Desalination Plant (DDP) and the following are my thoughts.

The results presented in Jenkins Table 3 (buoyant discharge scenarios) and Table 5 (non-buoyant discharge scenarios) include: depth of maximum plume rise, distance to maximum plume rise, volume of water with deleterious entrainment (entrainment mortality), the incremental change in the volume compared to baseline, diameter of the zone of initial dilution (ZID), and the incremental change in ZID diameter.

The buoyant discharge scenarios (Jenkins Table 3) all result in reduced entrainment mortality and smaller ZIDs. Therefore, Jenkins posits that "*no mitigation should be required for DDP (Doheny Desalination Plant) operational scenarios that result in buoyant combined discharges with SOCWA wastewater*."

Table 1. Modeling Summary (note both feet and meters are reported)

	Distance to maximum rise (ft)	Deleterious entrainment volume at maximum rise (mgd)	Incremental reduction in diffuser entrainment (mgd)	ZID diameter (m)	Incremental reduction in ZID diameter (m)
Buoyant scenarios	48.5–68.9	1,702–6,992	33–1,615	63–196	5–188
Non-buoyant scenarios	<1–20.1	67–729	N/A	N/A	N/A

The non-buoyant discharge scenarios (Jenkins Table 5) result in entrainment mortality volumes that range from 67 to 729 million gallons per day (mgd). These volumes "*are to be throughput to the ETM/APF (Empirical Transport Model/Area Production Foregone) calculus to compute the mitigation scaling for DDP diffuser turbulent impact*".

For simplicity, I'll refer to the "volume of deleterious entrainment" as "TM (turbulence mortality) volume". The volumes calculated above are high relative to the actual discharge volumes at the outfall. For example, the baseline discharge of 8 mgd of wastewater results in TM volume at maximum rise of 3,004 mgd, or 376 times the discharge rate. For comparison, when San Onofre Nuclear Generating Station was operational, each unit discharged approximately 1,200 mgd of cooling water (2,400 mgd total for Units 2 and 3).

If ETM/APF is the required approach, the required denominator for proportional entrainment is the source water volume. The APF estimates that we presented in the Draft EIR (Appendix 10.4.1) were based on an estimated source water with dimensions 2 km cross-shore, 25.9 km longshore, and 20 m deep. The longshore distance was based on a current speed of 6 cm/sec. The total source water volume was estimated at approximately 54,779 x 10^6 gallons.

The ETM/APF approach has been used for power plants and desalination facilities, and the focus has been fish eggs and larvae, and target meroplankton such as crabs, squid, and spiny lobster. We have not sampled plankton in the nearshore waters of Dana Point, but performed a year-long plankton study off San Onofre in 2006-7 (MBC 2007). The most abundant fish larvae during studies at San Onofre were Northern Anchovy (*Engraulis mordax*), unidentified anchovies (*Engraulidae*), Queenfish (*Seriphus politus*), and clinid kelpfish (*Gibbonsia* spp). The most abundant fish eggs were Engraulid eggs, unidentified fish eggs, and Sciaenid/Paralichthyid/Labrid eggs. The table below summarizes known egg sizes and hatching lengths for relevant taxa (from Moser 1996), and the percent contribution of each taxon to the egg/larval total in entrainment samples (MBC 2007).

Table 2. Sizes of fish eggs and larvae, and contribution to totals off San Onofre.

<table>
<tr><th>Species</th><th>Egg diameter (mm)</th><th>% contribution to egg total</th><th>Hatch length (mm)</th><th>% contribution to larvae total</th></tr>
<tr><td>Northern Anchovy</td><td>1.23–1.55*</td><td rowspan="2">42.8†</td><td>2.5–3.0</td><td>38.5</td></tr>
<tr><td>Deepbody Anchovy</td><td>0.6–0.9</td><td>1.5–2.5</td><td>20.3††</td></tr>
<tr><td>Queenfish</td><td>0.73–0.78</td><td>1.3‡</td><td>~1.6</td><td>5.9</td></tr>
<tr><td>Spotted Kelpfish</td><td></td><td></td><td>4.5</td><td>5.8‡‡</td></tr>
<tr><td>Giant Kelpfish</td><td>1.2–1.4</td><td></td><td>5.1–6.2</td><td>0.6</td></tr>
</table>

* Eggs of N. Anchovy are elongate. These are the lengths in the longest dimension.
† Engraulid eggs include N. Anchovy (*E. mordax*) and Deepbody Anchovy (*A. compressa*).
†† Engraulid larvae (unidentifiable to species).
‡ Sciaenid eggs (unidentifiable to species).
‡‡ *Gibbonsia* spp larvae (unidentifiable to species).

In the case of the DDP, it is assumed that TM is limited to organisms <1 mm in size, which would exclude fish larvae and some fish eggs.

This preliminary analysis uses the same assumptions described above, but depth is now considered to be 31 m (centered on the diffuser section). Because the focus is now on organisms <1 mm, we are now analyzing zooplankton instead of fish eggs and larvae (we assume phytoplankton are not of concern). Zooplankton are distributed throughout the water column and migrate vertically to various degrees (Mullin 1986). Zooplankton can be divided into microzooplankton (smaller than ~300 μm) and macrozooplankton (larger than ~300 μm). Microzooplankton feed on particulate organic sources, and consist of protozoans and juvenile stages of metazoan plankton, such as copepod nauplii and early copepodites (Dawson and Pieper 1993). Macrozooplankton include organisms such as gelatinous zooplankton, chaetognaths, copepods, cladocerans, and ostracods.

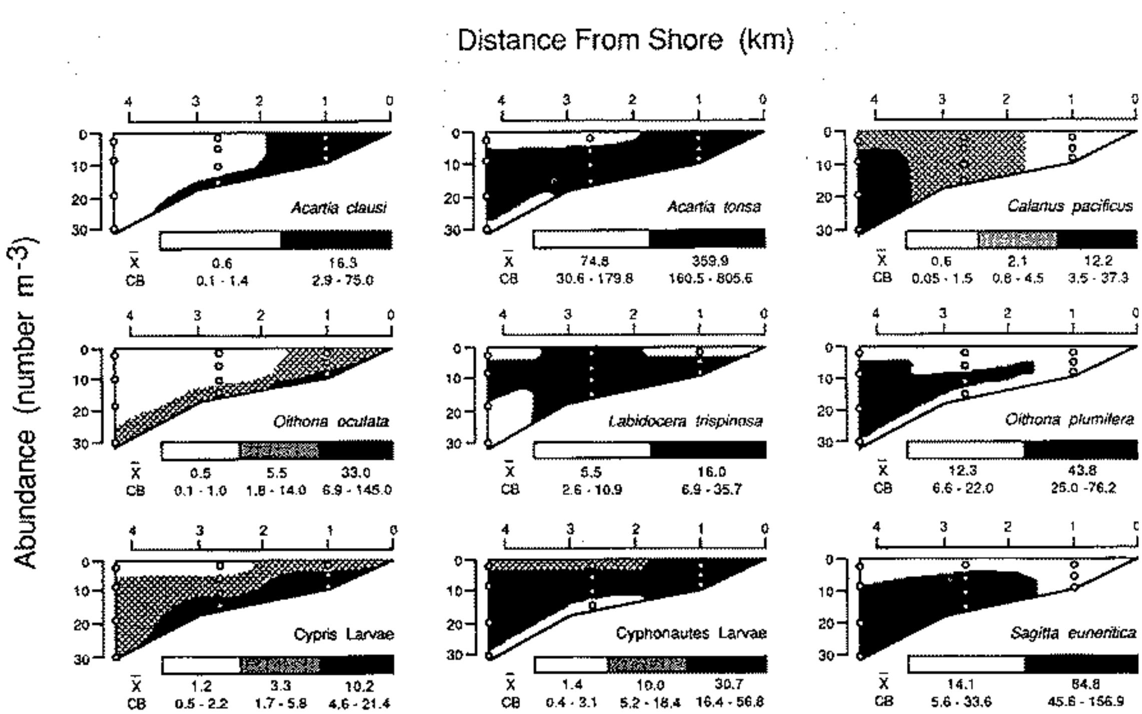

Figure 1. Mean cross-shore abundance profiles of nine zooplankton taxa off San Onofre, 1976 to 1980. From Barnett and Jahn (1987).

As mentioned earlier, the buoyant discharge scenarios all result in smaller TM volumes. The following estimates were calculated for the non-buoyant discharge scenarios, and are based on a source water volume of 87,235 x 10^6 gallons and a larval duration of one day. Note that these are not based on any empirical biological data, and we have no data to characterize spatial or temporal patterns of zooplankton abundance in the immediate project area. This data will ultimately be required for preparation of the Marine Life Mortality Report (per the Ocean Plan, III.M.2.e.1.a [Marine Life Mortality Report]).

Table 3. Probability of Mortality (P_M) and Area Production Foregone (APF) Estimates for DDP based on TM volumes from Jenkins (2019) and a larval duration of one day. The P_M and APF estimates were calculated using the TM volume at the bottom hit of the plume, which was larger than the maximum rise volume for both scenarios.

Non-buoyant Scenario	Wastewater + brine discharge rates (mgd)	TM volume (mgd) at maximum rise of plume	TM Volume (mgd) at bottom hit of plume	Probability of Mortality (P_M)	Area Production Foregone (acres)
1	0 + 3	78.09	120.78	0.00138	3.54
3	0 + 5	95.4	189.7	0.00217	5.57

Potential effects to zooplankton from entrainment in power plants and desalination facilities have not been analyzed in recent studies in southern California. The California Energy Commission published several reports that attempted to summarize standard collection and analysis methods for power plant entrainment studies. The report Assessing Power Plant Cooling Water Intake System Entrainment Impacts, Steinbeck et al (2007) determined:

"*Entrainment affects all types of planktonic organisms, but most studies do not assess holoplankton (phytoplankton and zooplankton that are planktonic for their entire life) because their broad geographic distributions and short generation times reduce the effects of entrainment on their populations. In contrast, the potential for localized effects on certain fish populations is much greater, especially for power plants located in riverine or estuarine areas where a large percentage of the local population may be at risk of entrainment (Barnthouse et al. 1988, Barnthouse 2000). Although the potential for similar effects exists for certain invertebrate meroplankton (for example, crab and clam larvae), taxonomy of early larval stages of many invertebrates is not sufficiently advanced to allow for assessments at the species level.*"

EPRI (2007) summarized analysis of plankton for the SWRCB as follows:

"*The entrainment performance standard for entrainment reduction in the EPA Rule focuses on addressing impacts to fish and shellfish rather than lower tropic levels such as phytoplankton and zooplankton. There are several reasons why there is a low potential for impacts to phytoplankton and zooplankton and why it made sense for EPA to focus on effects on fish and shellfish. EPA recognized the low vulnerability of phytoplankton and zooplankton in its 1977 draft §316(b) guidance (USEPA 1977). The reasons include the following*:

- *The extremely short generation times—on the order of a few hours to a few days for phytoplankton and a few days to a few weeks for zooplankton;*

- *Both phytoplankton and zooplankton have the capability to reproduce continually depending on environmental conditions; and*

- *The most abundant phytoplankton and zooplankton species along the California coast have populations that span the entire Pacific, or in some cases all of the world's oceans. For example, Acartia tonsa, one of the common copepod species found in the nearshore areas of California has a distribution that includes the Atlantic and Pacific coasts of North and South America and the Indian Ocean*."

From the CalAm Draft EIR (ESA 2017):

"*The minimum and maximum discharge velocities (7.4 ft/sec (2.26 m/sec) and 14.8 ft/sec (4.51 m/sec)) modeled across all scenarios for the proposed MPWSP (see Appendix D1) closely approximate the discharge velocities calculated by Foster. Foster (2013) concludes that, at these very small eddy scales: "Overall, the area of high shear impacted by the diffusers is relatively small and transit times through the region short. Thus, it seems reasonable to expect that, while the larvae that experience the highest shear will most likely experience lethal damage, the overall increase in mortality integrated over the larger area will be low.*"

When the environmental effects for San Onofre Nuclear Generating Station were being evaluated in the 1980s, the Marine Review Committee determined intake losses of zooplankton of about 1,350 metric tons per year were not a substantial adverse effect, so no mitigation was required (Ambrose et al. 1990). However, SCE was required to mitigate for losses to fish and kelp, and is prepared to double the size of the mitigation reef off San Clemente to achieve compliance with mitigation requirements (CSLC 2019).

The point of these references is to note that there has been little interest in analysis of potential effects to holoplankton in the last 30 years or so. For CalAm, they actually did a plankton survey in Monterey Bay, but ended up with the conclusion above that the effects would be minimal given the short duration and small area considered.

Please let me know if you would like any more information.

Respectfully,

MBC *Aquatic Sciences*

Shane Beck
President

Cc: K. Thomas (Kimley-Horn), D. Vilas (MBC)

References:

Ambrose, R.F., T.W. Anderson, B. Nelson, R. Stoughton, S.L. Swarbrick, and B.M. Williamson. 1990. Technical Report to the California Coastal Commision. H. Mitigation. Marine Review Committee, Inc. Feb. 1990.

Barnett, A.M. and A.E. Jahn. 1987. Pattern and persistence of a nearshore planktonic ecosystem off southern California. Cont. Shelf Res. 7:1-25.

California State Lands Commission. 2019. Final Subsequent Environmental Impact Report for the Construction and Management of an Artificial Reef in the Pacific Ocean near San Clemente, California (Wheeler North Reef Expansion Project). Prepared in coordination with Dudek. Jan. 2019.

Dawson, J.K. and R.E. Pieper. 1993. Zooplankton. Ch. 6 in: Dailey, M.D., D.J. Reish, and J.W. Anderson (eds.). Ecology of the Southern California Bight: A synthesis and interpretation. U.C. Press, Berkeley, Calif. 926 p.

Electric Power Research Institute (EPRI). 2007. Assessment of Cooling Water Intake Structure Impacts to California Coastal Fisheries. EPRI, Palo Alto, CA. 132 p.

ESA. 2017. Draft Environmental Impact Report/Statement: CalAm Monterey Peninsula Water Supply Project. Prepared for Calif. Public Util. Comm. and Monterey Bay Nat. Mar. Sanctuary. Jan. 2017.

MBC Applied Environmental Sciences. 2007. San Onofre Nuclear Generating Station, Clean Water Act Section 316(b) Impingement Mortality and Entrainment Characterization Study. Prepared for So. Calif. Edison. Dec. 11, 2007.

Moser, H.G. 1996. The Early Stages of Fishes in the California Current Region. Cal. Coop. Ocean. Fish. Invest. Atlas No. 33. Nat. Mar. Fish. Serv., Southwest Fish. Sci. Center, La Jolla, Calif.

Mullin, M. 1986. Spatial and temporal scales and patterns. Ch. 6 in: Eppley, R. W. (ed.). Plankton Dynamics of the Southern California Bight. Lecture Notes on Coastal and Estuarine Studies. Springer-Verlag, New York, N.Y.

Steinbeck, J., J. Hedgepeth, P. Raimondi, G. Caillier, and D. Mayer. 2007. Assessing power plant cooling water system entrainment impacts. CEC-700-2007-010. Prepared for the Calif. Energy Comm. 105 p. plus appendices.

APPENDIX 4.2.5.2

BRINE DISCHARGE MEMO FOR FINAL EIR

7 March 2019

Mark Donovan, PE
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Re: Review of Dense-Discharge Associated Impacts for the Doheny Desalination Project

Hello Mark:

This memo was prepared to review a range of impacts related to the discharge of dense (negatively buoyant) discharge scenarios presented in the Plumes 18b report (Jenkins 2019) prepared for the South Coast Water District Doheny Desalination Plant (DDP).

Based on Jenkins (2019) there are two separate impacts to the marine environment from the discharge of the dense plume: shear stress mortality as the plume is released from the diffuser ports, and the introduction of a sinking, concentrated brine into the marine environment. Shear stress impacts as a result of a dense discharge were reviewed in MBC Aquatic Sciences' (MBC's) memo *Review of Plumes 18b Modeling Deleterious Diffuser Entrainment Doheny Desalination Project* dated 6 March 2019 and will be discussed further later. This memo will determine the area of exposure of the benthic habitat to elevated salinity levels and later combine the two impacts to determine area of impacts as a starting point to evaluate appropriate mitigation.

The California Ocean Plan (SWRCB 2015) allows for an area of initial mixing of concentrated brine discharges as described below:

> *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.*

This area is defined as the Brine Mixing Zone (BMZ). For the Doheny Desalination Project the 328 feet (ft) regulatory limit of the BMZ is displayed in Figure 1. This figure illustrates the BMZ at 328 ft in all directions from the discharge pipe for the 1,488 ft of the pipeline on which diffuser ports are located. The area of the allowed BMZ for the project is 20.1 acres.

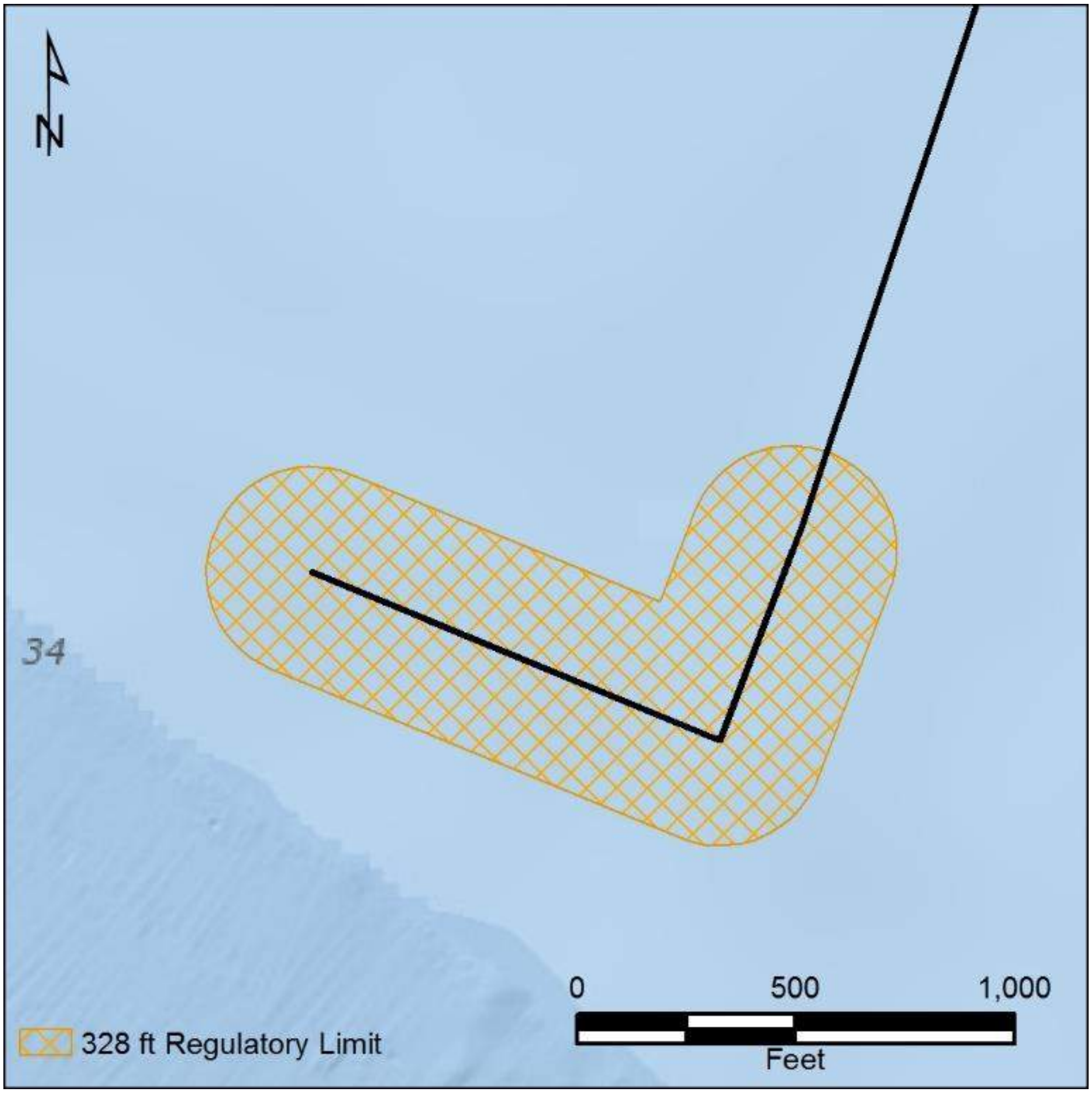

Figure 1. The 328 foot regulatory limit of the BMZ at the project location.

Jenkins (2019, Table 5) modeled eight brine mixing scenarios which would result in a dense plume. Of these, two scenarios, the discharge of 3 million gallons per day (MGD) and 5 MGD of 67 ppt brine with no wastewater dilution, have a remote chance of occurring in the future. Jenkins calculated the distance at which the 2 ppt above ambient salinity is met for the 3 MGD discharge is less than 0.6 ft from the discharge pipe, and for the 5 MGD discharge the limit is met less than 0.7 ft from the pipe (Figure 2). In a worst-case scenario, the discharge of 15 MGD of 67 ppt brine with no wastewater dilution, the salinity mixing meets the 2 ppt limit less than 2.5 ft from the discharge pipe.

Using GIS tools, MBC determined the area of exposure of the benthic habitat to salinities in excess of 2 ppt above ambient for both of the low-likelihood discharge scenarios and for the worst-case scenario (Table 1). To be conservative the area of the pipe was included in in the calculation of these exposure areas. For both low-likelihood dense discharge mixing

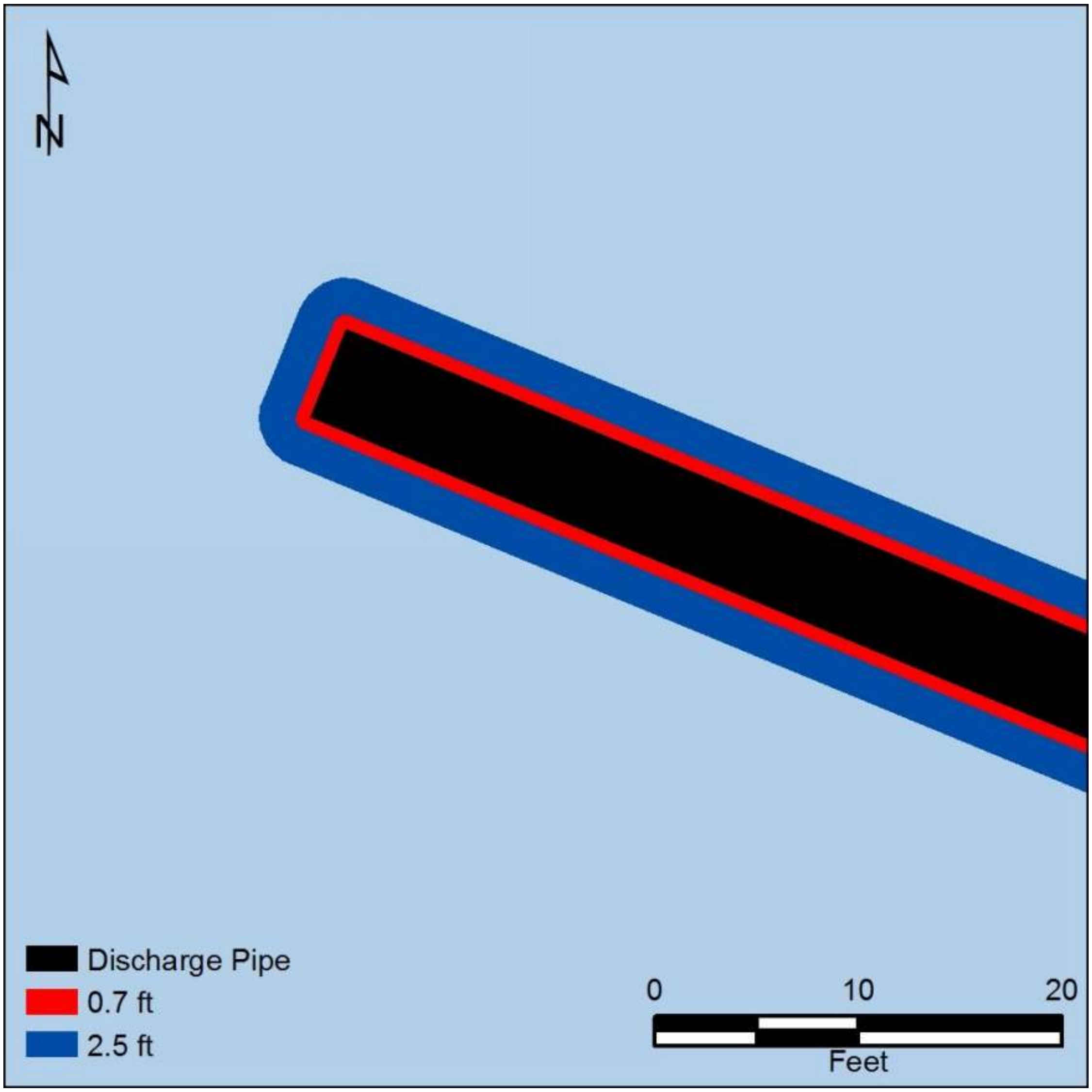

Figure 2. Distance from the discharge pipe for compliance with the 2 ppt regulatory mixing requirement. The red line at 0.7 ft from the pipe approximates the mixing zones for both of the low likelihood mixing scenarios of 3 and 5 MGD of 67 ppt brine with no dilution. The blue line at 2.5 ft from the pipe is the worst-case scenario of 15 MGD of 67 ppt brine with no dilution Note: The pipeline diameter is 4.75 ft.

scenarios the area of benthic exposure >2 ppt above ambient salinity is about 0.2 acres, 1% of the area allowed for this project by the Ocean Plan (SWRCB 2015). For the worst-case scenario the area is still less than one-third of an acre. These area totals are considered the BMZs for the respective scenarios.

Because of the relatively small area of the BMZ for both low-likelihood dense discharge mixing scenarios we will not further parse out detrimental impacts related to acute toxicity or osmotic stresses to benthic organisms that reside within the BMZ. Instead, in these cases we propose basing mitigation on the area of the entire BMZ. We do not suggest that this

Table 1. Area (acres) of benthic exposure >2 ppt above ambient salinity for the two low-likelihood discharge scenarios and for the worst-case scenario.

Dense Discharge Scenario (Jenkins 2019, Table 5)	Wastewater + brine discharge rates (MGD)	Horizontal distance (feet) to within 2 ppt of ambient salinity (Jenkins 2019, Table 5)	Area (acres) of benthic exposure >2 ppt above ambient salinity (BMZ)
1	0 + 3	0.566	0.1999
3	0 + 5	0.653	0.2058
6	0+15	2.466	0.3296

should be set as a precedent, and a case-by-case analysis is recommended, but for this model determining the areas of differential impacts within the BMZ would not substantially change the final mitigation requirements.

As mentioned above, benthic exposure (BMZ) is one of two impacts to the marine environment from the discharge of a dense plume identified by Jenkins (2019). The second impact is stress-related mortality to small, water-column organisms from mechanical mixing of the discharge into the receiving water. Impact areas for stress-related mortality associated with the two low-likelihood dense discharge mixing scenarios were evaluated by the Area of Production Foregone (APF) method in the MBC 6 March 2019 memo. The APF and BMZ area will be considered additive for purposes of determining an area for the basis of evaluating preliminary mitigation requirements. The full area of impact for the two low-likelihood dense discharge mixing scenarios are presented in Table 2. (The worst-case scenario is not further included.) Combined impact area for the 3 MGD discharge scenario is less than four acres and for the 5 MGD discharge scenario less than six acres.

The intent of this memo is to present a methodology and a result for the cumulative area of impact to the marine environment for the low-likelihood dense plume discharge scenarios. Should analysis of the low-likelihood dense plume discharge scenarios move forward, methodology for proposed mitigation for dense-discharge impacts will be presented in subsequent documents.

Table 2. Combined BMZ and APF impact areas (acres) for the determination of mitigation requirements for the two low-likelihood dense plume discharge scenarios.

Dense Discharge Scenario (Jenkins 2019, Table 5)	Wastewater + brine discharge rates (MGD)	Area (acres) of benthic exposure >2 ppt above ambient salinity (BMZ)	Area (acres) Production Foregone (APF)	Combined BMZ and APF area (acres)
1	0 + 3	0.20	3.54	3.74
3	0 + 5	0.21	5.57	5.78

Please let me know if you would like to discuss further.

Cordially,

MBC *Aquatic Sciences*

David Vilas
Senior Scientist

Cc: K. Thomas (Kimley-Horn), D.S. Beck (MBC)

References:

Jenkins, S. 2019. Plumes 18b Modeling Deleterious Diffuser Entrainment Doheny Desalination Project. Prepared for Mark Donovan, GHD, 15 January 2019.

MBC Aquatic Sciences (MBC). 2019. Review of Plumes 18b Modeling Deleterious Diffuser Entrainment Doheny Desalination Project. Memo to Mark Donovan, GHD, dated 6 March 2019.

State Water Resources Control Board (SWRCB). 2015. California Ocean Plan.

Attachment A: Comment Letter O1 Exhibits

- *Exhibit D – Water Well Standards*
- *Exhibit E – Water Well Standards*
- *Exhibit F – IDA Technical Paper (Dennis Williams, 2015)*
- *Exhibit G – Extended Pumping and Pilot Test (MWDOC, 2014)*
- *Exhibit H – CalEEMod User Manual (2017)*

EXHIBIT D

Water Well Standards

CHAPTER II. STANDARDS

Section 23. Requirements for Destroying Wells.

A. *Preliminary Work.* Before the well is destroyed, it shall be investigated to determine its condition, details of construction, and whether there are obstructions that will interfere with the process of filling and sealing. This may include the use of downhole television and photography for visual inspection of the well.

1. *Obstructions.* The well shall be cleaned, as needed, so that all undesirable materials, including obstructions to filling and sealing, debris, oil from oil-lubricated pumps, or pollutants and contaminants that could interfere with well destruction are removed for disposal.

   The enforcing agency shall be notified as soon as possible if pollutants and contaminants are known or suspected to be in a well to be destroyed. Well destruction operations may then proceed only at the approval of the enforcing agency.

   The enforcing agency should be contacted to determine requirements for proper disposal of materials removed from a well to be destroyed.

2. Where necessary, to ensure that sealing material fills not only the well casing but also any annular space or nearby voids within the zone(s) to be sealed, the casing should be perforated or otherwise punctured.

3. In some wells, it may be necessary or desirable to remove a part of the casing. However, in many instances this can be done only as the well is filled. For dug wells, as much of the lining as possible (or safe) should be removed prior to filling.

B. *Filling and Sealing Conditions.* Following are requirements to be observed when certain conditions are encountered:

1. *Wells situated in unconsolidated material in an unconfined groundwater zone.* In all cases the upper 20 feet of the well shall be sealed with suitable sealing material and the remainder of the well shall be filled with suitable fill, or sealing material. (See Figure 9A, of Bulletin 74- 81.)

2. *Well penetrating several aquifers or formations.* In all cases the upper 20 feet of the well shall be sealed with impervious material.

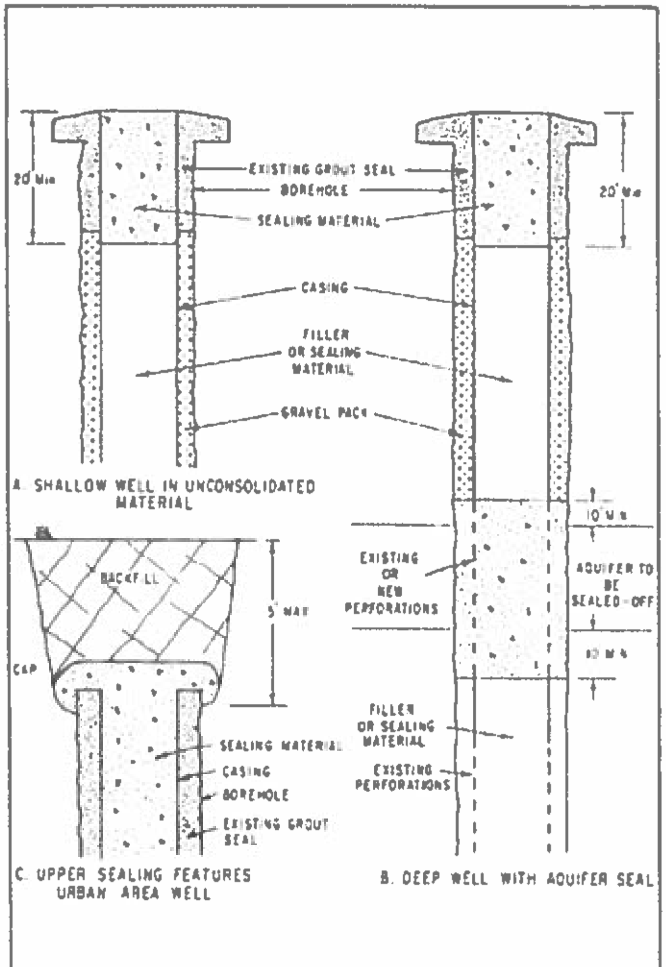

Figure 9. PROPERLY DESTROYED WELLS

In areas where the interchange of water between aquifers will result in a significant[Note 22] deterioration of the quality of water in one or more aquifers, or will result in a loss of artesian pressure, the well shall be filled and sealed so as to prevent such interchange. Sand or other suitable inorganic material may be placed opposite the producing aquifers and other formations where impervious sealing material is not required. To prevent the vertical movement of water from the producing formation, impervious material must be placed opposite confining formations above and below the producing formations for a distance of 10 feet or more. The formation producing the deleterious water shall be sealed by placing impervious material opposite the formation, and opposite the confining formations for a sufficient vertical distance (but no less than 10 feet) in both directions, or in the case of "bottom" waters, in the upward direction. (See Figure 9B.)

In locations where interchange is in no way detrimental, suitable inorganic material may be placed opposite the formations penetrated. When the boundaries of the various formations are unknown, alternate layers of impervious and pervious material shall be placed in the well.

3. *Well penetrating creviced or fractured rock.* If creviced or fractured rock formations are encountered just below the surface, the portions of the well opposite this formation shall be sealed with neat cement, sand-cement grout, or concrete. If these formations extend to considerable depth, alternate layers of coarse stone[Note 23] and cement grout or concrete may be used to fill the well. Fine grained material shall not be used as fill material for creviced or fractured rock formations.

4. *Well in noncreviced, consolidated formation.* The upper 20 feet of a well in a noncreviced, consolidated formation shall be filled with impervious

material. The remainder of the well may be filled with clay or other suitable inorganic material.

5. *Well penetrating specific aquifers, local conditions.* Under certain local conditions, the enforcing agency may require that specific aquifers or formations be sealed off during destruction of the well.

C. *Placement of Material.* The following requirements shall be observed in placing fill or sealing material in wells to be destroyed:

1. The well shall be filled with the appropriate material (as described in Subsection D of this section) from the bottom of the well up.

2. Where neat cement grout, sand-cement grout, or concrete is used, it shall be poured in one continuous operation.

3. Sealing material shall be placed in the interval or intervals to be sealed by methods that prevent free fall, dilution, and/or separation of aggregate from cementing materials.

4. Where the head (pressure) producing flow is great, special care and methods must be used to restrict the flow while placing the sealing material. In such cases, the casing must be perforated opposite the area to be sealed and the sealing material forced out under pressure into the surrounding formation.

5. In destroying gravel-packed wells, the casing shall be perforated or otherwise punctured opposite the area to be sealed. The sealing material shall then be placed within the casing, completely filling the portion adjacent to the area to be sealed and then forced out under pressure into the gravel envelope.

6. When pressure is applied to force sealing material into the annular space, the pressure shall be maintained for a length of time sufficient for the cementing mixture to set.

7. To assure that the well is filled and there has been no jamming or "bridging" of the material, verification shall be made that the volume of material placed in the well installation at least equals the volume of the empty hole.

D. *Materials.* Requirements for sealing and fill materials are as follows:

1. *Impervious Sealing Materials.* No material is completely impervious. However, sealing materials shall have such low permeability that the

volume of water passing through them is of small consequence.

Suitable impervious materials include neat cement, sand-cement grout, concrete, and bentonite clay, all of which are described in Section 9, Subsection D, "Sealing Material" of these standards; and well-proportioned mixes of silts, sands, and clays (or cement), and native soils that have a coefficient of permeability of less than 10 feet per year.[Note 24] Used drilling muds are not acceptable.

2. *Filler Material.* Many materials are suitable for use as a filler in destroying wells. These include clay, silt, sand, gravel, crushed stone, native soils, mixtures of the aforementioned types, and those described in the preceding paragraph. Material containing organic matter shall not be used.

E. *Additional Requirements for Wells in Urban Areas.*

In incorporated areas or unincorporated areas developed for multiple habitation, to make further use of the well site, the following additional requirements must be met (see Figure 9C):

1. A hole shall be excavated around the well casing to a depth of 5 feet below the ground surface and the well casing removed to the bottom of the excavation.

2. The sealing material used for the upper portion of the well shall be allowed to spill over into the excavation to form a cap.

3. After the well has been properly filled, including sufficient time for sealing material in the excavation to set, the excavation shall be filled with native soil.

F. *Temporary Cover.* During periods when no work is being done on the well, such as overnight or while waiting for sealing material to set, the well and surrounding excavation, if any, shall be covered. The cover shall be sufficiently strong and well enough anchored to prevent the introduction of foreign material into the well and to protect the public from a potentially hazardous situation.

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EXHIBIT E

Water Well Standards

CHAPTER II. STANDARDS

Part III. Destruction of Wells

Section 20. Purpose of Destruction.

A well that is no longer useful[Note 21] (including exploration and test holes) must be destroyed in order to: 1. Assure that the groundwater supply is protected and preserved for further use. 2. Eliminate the potential physical hazard.

Section 21. Definition of "Abandoned" Well.

A well is considered 'abandoned' or permanently inactive if it has not been used for one year, unless the owner demonstrates intention to use the well again. In accordance with Section 115700 of the California Health and safety Code, the well owner shall properly maintain an inactive well as evidence of intention for future use in such a way that the following requirements are met:

(1) The well shall not allow impairment of the quality of water within the well and groundwater encountered by the well.

(2) The top of the well or well casing shall be provided with a cover, that is secured by a lock or by other means to prevent its removal without the use of equipment or tools, to prevent unauthorized access, to prevent a safety hazard to humans and animals, and to prevent illegal disposal of wastes in the well. The cover shall be watertight where the top of the well casing or other surface openings to the well are below ground level, such as in a vault or below known levels of flooding. The cover shall be watertight if the well is inactive for more than five consecutive years. A pump or motor, angle drive, or other surface feature of a well, when in compliance with the above provisions, shall suffice as a cover.

(3) The well shall be marked so as to be easily visible and located, and labeled so as to be easily identified as a well.

(4) The area surrounding the well shall be kept clear of brush, debris, and waste materials.

If a pump has been temporarily removed for repair or replacement, the well shall not be considered 'abandoned' if the above conditions are met. The well shall be adequately covered to prevent injury to people and animals and to prevent the entrance of foreign material, surface water, pollutants, or contaminants into the well during the pump repair period.

Section 22. General Requirement.

All "abandoned" wells and exploration or test holes shall be destroyed. The objective of destruction is to restore as nearly as possible those subsurface conditions which existed before the well was constructed taking into account also changes, if any, which have occurred since the time of construction. (For example, an aquifer which may have produced good quality water at one time but which now produces water of inferior quality, such as a coastal aquifer that has been invaded by seawater.)

Destruction of a well shall consist of the complete filling of the well in accordance with the procedures described in Section 23 (following).

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EXHIBIT F

YIELD AND SUSTAINABILITY OF LARGE SCALE SLANT WELL FEEDWATER SUPPLIES FOR OCEAN WATER DESALINATION PLANTS

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Abstract:

There is no theoretical upper limit of the yield and sustainability of slant wells used as a source of feed water supply to ocean desalination plants. Research and field testing over the past nine years suggest that slant wells extracting water from subsea alluvial aquifers can provide a high yielding and long-lasting sustainable water supply when designed, constructed and maintained properly. Furthermore, the total yield is a function of scale and the reliability is guaranteed by the ocean source. Slant wells are angled wells completed in aquifers beneath the ocean floor and receive a high percentage of recharge from both vertical leakage (through the seabed) as well as horizontal flow from offshore aquifers. Natural filtration in the subsea permeable deposits results in low turbidity and reduction or elimination of seawater reverse osmosis (SWRO) pretreatment. Environmental advantages include lack of impacts to fish and marine life and no surface visibility. Maximum supply limitations are a function only of the permeability of near shore and offshore aquifers, the areal and vertical extent of these deposits, the availability of land, and potential adverse impacts. Slant wells are merely vertical wells drilled on an angle. As such, sustainability of flow is assured by the same routine maintenance programs developed over the past seven decades and routinely utilized in vertical wells. Using the dual-rotary method of construction and incorporating a telescopic design, 4 mgd slant wells can be constructed with angles ranging from a few degrees to a few tens of degrees and achieve lengths of 1,000 ft or more. Variable angles allow targeting production from specific aquifers and longer well screen lengths result in higher production than vertical wells. A slant well layout may be comprised of a single well or group of wells within the same wellhead area (i.e., pod). Multiple slant well arrays may be constructed and "linked" together until the cumulative total discharge rate meets the feed water supply demand. Interference between wells governs the number and spacing and geohydrologic considerations and land availability govern limitation on spatial extent. For example, for typical California coastal aquifers, a feed water supply of nine slant well pods with each pod containing three 4.32 mgd slant wells can yield approximately 117 mgd from a two mile reach of coastline. The Monterey Peninsula Water Supply Project has recently completed a 724 ft test slant well at an angle of 19 degrees below horizontal north of Monterey, CA. The well is currently undergoing long-term testing to develop well and aquifer parameters and potential impacts for the 24 mgd full scale project which will consist of ten slant wells including standby capability. Routine maintenance employing mechanical cleaning on the order of every three to five years provides a long-term sustainable feed water supply. The current misconceptions that slant wells yield only low amounts of supply and that they contribute to seawater intrusion is false. Experience gained has shown that the primary constraint to development of subsurface feed water supplies is permitting. This paper discusses research and experience on slant well and well field design and upward scalability for large SWRO desalination feed water requirements exceeding 200 mgd.

INTRODUCTION

1.1 Background

The number of subsurface intakes throughout the world is relatively small compared to open ocean intakes; averaging approximately 12 mgd per facility as compared to approximately 52 mgd per facility for open ocean intakes [1], [2]. Slant well feed water supplies for SWRO desalination plants is an emerging technology. Originating out of the necessity to explore subsea aquifers near Dana Point, CA, the first test slant well was constructed in 2006. Since then, a number of subsurface intakes for SWRO have been and are continuing to be evaluated along the California coast ranging in size from small systems (< 10 mgd) to very large systems (> 150 mgd). As of this writing, a 724 ft test slant well completed in March of 2015 near Monterey, California as part of the Monterey Peninsula Water Supply Project (MPWSP) is currently undergoing long-term test pumping.

Slant wells are simply vertical wells drilled on an angle and produce water from near shore and subsea aquifers. Drawing seawater from subsea and near shore aquifers provides natural filtration from suspended organic matter and sediment, particularly during storm surges and heavy precipitation. Slant wells receive recharge from vertical leakage through the sea floor (i.e., benthic zone) and horizontal flow from subsea and near shore aquifer systems. Field tests show that the engineered artificial filter pack surrounding the screened portion of the slant well intake results in very low turbidity (i.e., low SDI indices) which minimizes the need for RO pre-treatment. A slant well feed water supply typically consists of shallow angled wells[1] in a beach or near-coastal environment. The supply may consist of a single slant well, an array of wells or multiple arrays of wells grouped together into "pods"[2] extending beneath the ocean. As long as there are permeable subsea deposits, available land, and no undesirable impacts, there is no theoretical upper limit to the quantity of feed water which can be produced from slant wells. Environmentally sensitive, slant well systems are buried systems completed below the land surface eliminating both impingement and entrainment issues to marine life as well as undesirable aesthetic impacts (i.e., no visual impacts on the surface).

1.2 Subsurface Intakes - The Preferred Technology for SWRO Intakes in California

In a recent amendment to the Water Quality Control Plan for Ocean Waters of California (i.e., "Ocean Plan"), the California State Water Resources Control Board [3], recommended to "Establish subsurface intakes as the preferred technology for seawater intakes." In accordance with the Ocean Plan amendment, a number of desalination projects along the coast of California have evaluated or are in the process of evaluating the feasibility of subsurface intakes for feed water supply (see Figure 1).

Figure 1. Projects along the California coast which have considered or are evaluating the feasibility of subsurface intake systems

[1] For purposes of this paper, the word angled well and slant well both refer to a non vertical well and are used interchangeably.
[2] A slant well pod is the common wellhead area for multiple slant wells with each well in the pod having varying azimuth angles.

Currently, only ten small desalination facilities are in operation along the California coast with 15 more in the feasibility phase and with a cumulative fresh water output ranging from 260–367 mgd [3].

KNOWLEDGE GAINED FROM THE DOHENY AND MONTEREY TEST SLANT WELL PROJECTS

The Doheny Ocean Desalination Project[3] near Dana Point, California has been summarized extensively in previous documents [4], [5], [6], [7], [8], [9], [10]. A few years after construction of a test slant well in 2006, an approximate two year extended pumping test ensued from 2010-2012. Since then, improvements on the technology have been made and applied to the recently completed MPWSP test slant well north of Marina in Monterey County, California. The Doheny test slant well represents the first successful high capacity slant well completed with an artificial filter pack beneath the ocean floor. At 23 degrees below horizontal and a total lineal length[4] of 350 ft, it was the longest dual rotary-drilled artificially filter packed slant well until recently, when the Monterey test slant well was drilled to a total MD of 724 ft. Continuing work on both the Doheny and Monterey projects is still in progress which will include additional testing, predictive ground water modeling, and final design of the full scale projects.

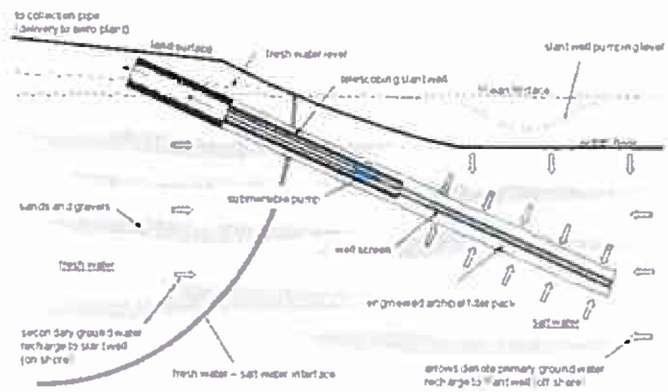

Figure 2. Telescoping Well Design

1.3 Telescoping Well Design

During the two year pilot testing, the Doheny test slant well produced approximately 3 mgd with relatively stable drawdowns. When it was constructed in 2006, it was test pumped at approximately 2,100 gpm[5] and displayed a well efficiency of 95%. During the extended pilot testing the well efficiency dropped from the original value of 95% in 2006 to 52% in 2012 [10].

Figure 3. Monterey Test Slant Well (19 degrees 724 ft)

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[3] Formerly the South Orange Coastal Ocean Desalination Project (SOCOD)

[4] In angled wells, the term lineal length or "Measured Depth" (MD) is used. MD is the length of the well bore as determined by a measuring stick as compared to true vertical depth (TVD) which is a straight vertical line from the surface to the bottom of the borehole (or anywhere along its length).

[5] The pump used for the two year extended pumping test was a high speed, high capacity pump (2480 rpm) producing 2,200 gpm.

This loss of well efficiency was expected due to the inability to fully develop the well during construction. Specifically, due to limited funding, the Doheny test slant well project was completed with a uniform 12-inch diameter casing and screen without a larger diameter pump house chamber. Consequently, the largest diameter submersible test pump that could be installed in the well was ten inches with a maximum discharge rate of 1,700 gpm. The standard industry practice is to develop a well at 1.5 times the design discharge rate, or approximately 3,200 gpm for a design discharge rate of 2,100 gpm. Figure 2 shows a typical telescoping well design and Figures 3 and 4 show the telescoping well design used in the Monterey test slant well north of the town of Marina in Monterey County, California.

1.4 Larger Pump House Casings

Due to the pump house casing limitation experienced at Dana Point and the inability to fully develop the well, the MPWSP test slant well included a larger diameter pump house casing. The Monterey test slant well has an 18 in. pump house casing which can accommodate placement of large development pumps with capacities over 3,000 gpm. Properly developed wells constructed using corrosion resistant materials such as 2507 Super Duplex Stainless Steel minimize well deterioration due to corrosion and biofouling. As such, these design improvements result in less frequent well rehabilitation with intervals estimated at between 3–5 yrs. Redevelopment will include the use of a high capacity air lift/swab assembly as part of the on-going maintenance process.

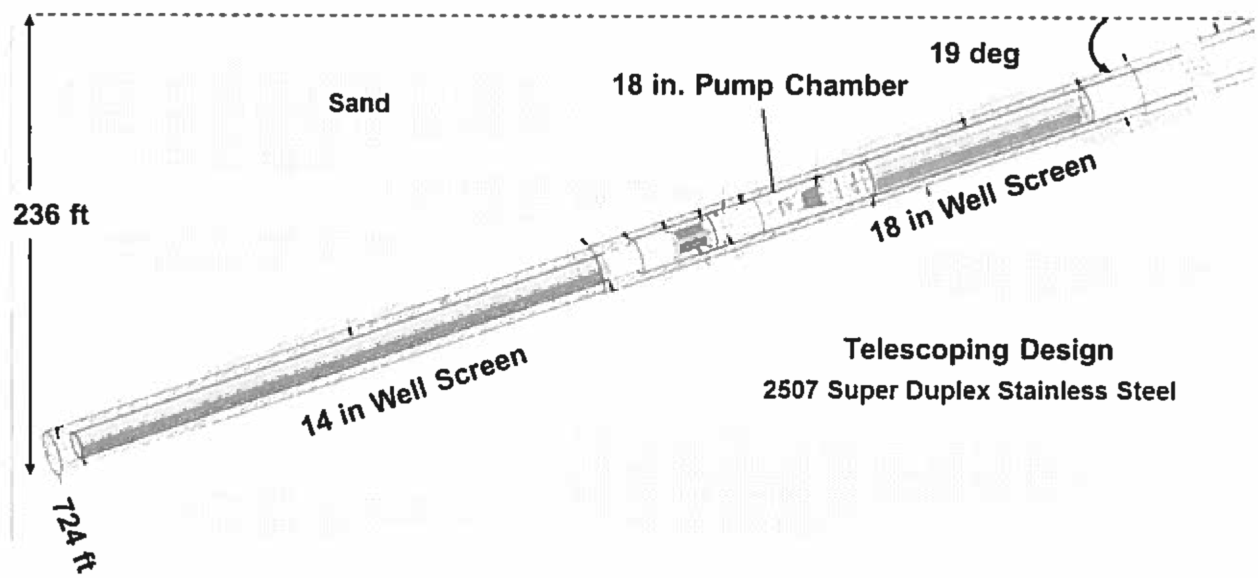

Figure 4. Telescoping design showing larger pump house casing used in the Monterey test slant well

1.5 Pumping Out Old Marine Ground Water

Geochemical tracers used to quantify water sources to the Doheny test slant well during an almost two year pumping test (2010-2012) were used to estimate slant well connectivity to the ocean and relevant amounts of water sources [8]. Testing found that old marine ground water is slightly acidic, anoxic, and enriched with dissolved iron and manganese. Dissolved iron and manganese concentrations increased in the pumped water to a peak of 11 milligrams per liter (mg/L) and decreased to 5 mg/L by the end of the test. It was estimated that the concentration of dissolved iron in the old marine ground water exceeds 41 mg/L. Test results support the increased capture of shallow, young marine ground water. Natural isotope data showed after one year of pumping, recharge to the slant well consisted of a mixture of brackish ground water (which showed a decreasing trend), ocean water (which showed an increasing trend), and old marine ground water which initially increased and then slightly decreased as it was being removed from the aquifer. This reflected the fresh/salt interface being induced to migrate toward the well. The geochemical data combined with a three-dimensional variable density flow and solute transport model predicted that the old marine ground water would be fully removed from the subsea aquifer within approximately one year at the full scale production rate of 30 mgd. Furthermore, upon reaching steady state conditions, (approximately one year), and after removal of the old marine ground water, the source of water to the feed water supply wells was predicted to consist of 95% "younger" ocean water (with very low levels of dissolved iron/manganese, ~ 2 μg/L), and 5% brackish ground water (~2 mg/L of dissolved iron/manganese), resulting in a blended concentration of approximately 0.10 mg/L. Results from the Doheny project suggest that the project may be constructed in two stages:

1- Initial Stage: Well field, conveyance and disposal system to pump out old marine ground water[6],
2- Final Stage: Construction of the project once the feed water quality is known.

Comparison of iron and manganese results from the Doheny test slant well and the current Monterey test slant well shows that the old marine water present in the Dana Point area is not found in the Monterey area. Iron and manganese concentrations from the MPWSP test slant well are very low suggesting that the subsea environment containing old marine ground water may not be present in coastal aquifers (such as Monterey), and may only be associated with subsea paleochannels such as in Dana Point.

SLANT WELL HYDRAULICS

1.6 Universal Drawdown Equation (UDE)

Development of an equation to calculate the drawdown distribution in the vicinity of angled wells was developed out of the necessity to understand water level distributions around slant wells without having to develop a distributed parameter ground water flow model. Conventional drawdown equations for vertical or horizontal wells are inadequate to properly describe the drawdown distribution in the vicinity of slant wells. Williams [11] used the principle of superposition combined with standard well hydraulics to develop universal drawdown equations (UDE) which calculate the drawdown distribution in the vicinity of angled production wells with inclination angles ranging from 0 degrees (horizontal wells), to 90 degrees (vertical wells). The method is computationally simple and, other than the normal assumptions for standard well equations, only requires that the calculated drawdown represent the drawdown which would be measured in a fully penetrating observation well. Solutions using the UDE

[6] During this phase, pilot plant testing would be undertaken to finalize feed water quality for treatment process design.

are developed for confined, unconfined and semi-confined (leaky) aquifers. Figures 5 and 6 below illustrate the variables used in the UDE and their notations.

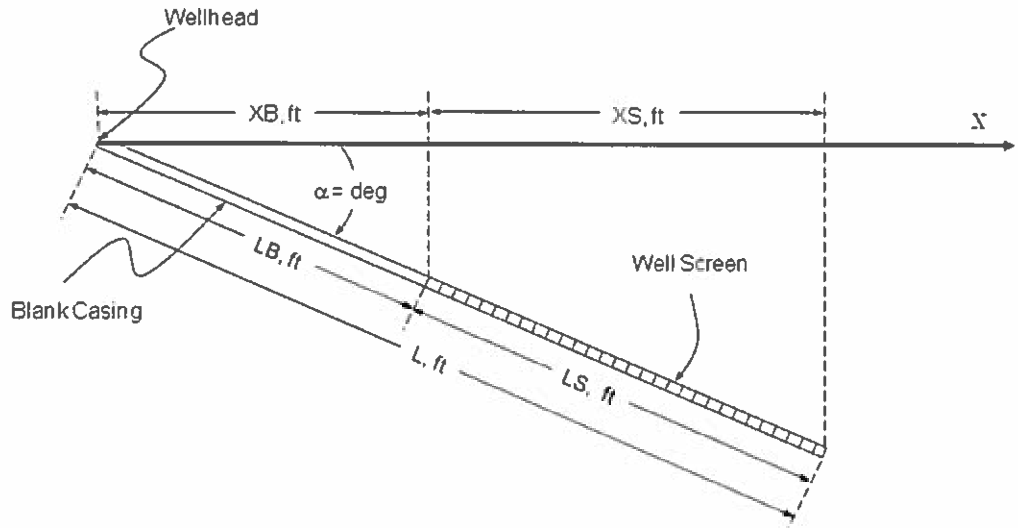

Figure 5. Cross section of an angled well showing notation used in the UDE

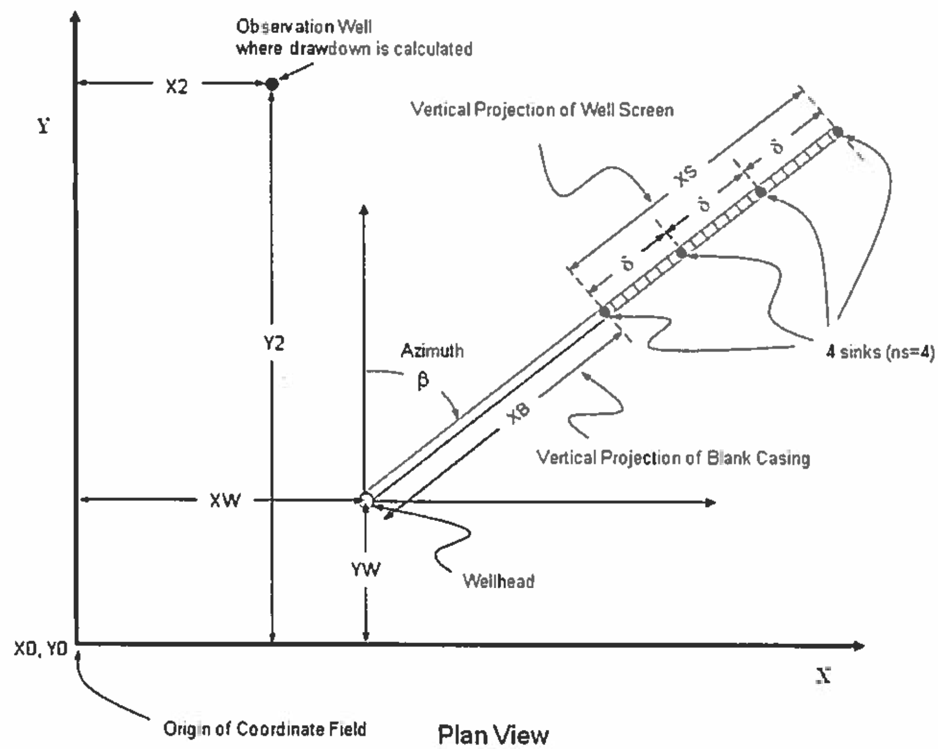

Figure 6. Plan view of angled well and notations used in the UDE

The following equation calculates the drawdown distribution around an angled well for a confined aquifer using Jacob's equation [11]:

$$s = (264\ Q/T)\ [\ \log (0.3Tt/S) - (2/ns) \log (RP_1 \times RP_2 \times RP_3 \times_{\dots} RP_{ns})\ ] \qquad (1)$$

where:

- s = drawdown, ft
- Q = well discharge rate, gpm
- T = aquifer transmissivity, gpd/ft
- S = aquifer storativity, fraction
- t = time since pumping started, days
- ns = number of sinks in the vertical projection of the well screen
- RP_i = horizontal distance from point where drawdown is desired to the "ith" sink, ft

1.7 Slant Wells Completed Beneath the Ocean

The drawdown solution in the vicinity of a slant well completed in subsea aquifers behaves exactly like a leaky artesian aquifer. The benthic zone (i.e., the zone of the sea floor and a few feet below), is generally a lower permeability zone than underlying subsea aquifers and behaves as a semi-pervious layer. This semi-pervious layer (i.e., leaky layer) has a vertical hydraulic conductivity of K' and a thickness of b' consistent with the leakance term of K'/b' as defined by Hantush [12]. Thus, the UDE concept of superposition may be applied to subsea leaky aquifers using the Hantush-Jacob leaky aquifer equation [13]. Figure 7 illustrates the concept of sea-floor leakage.

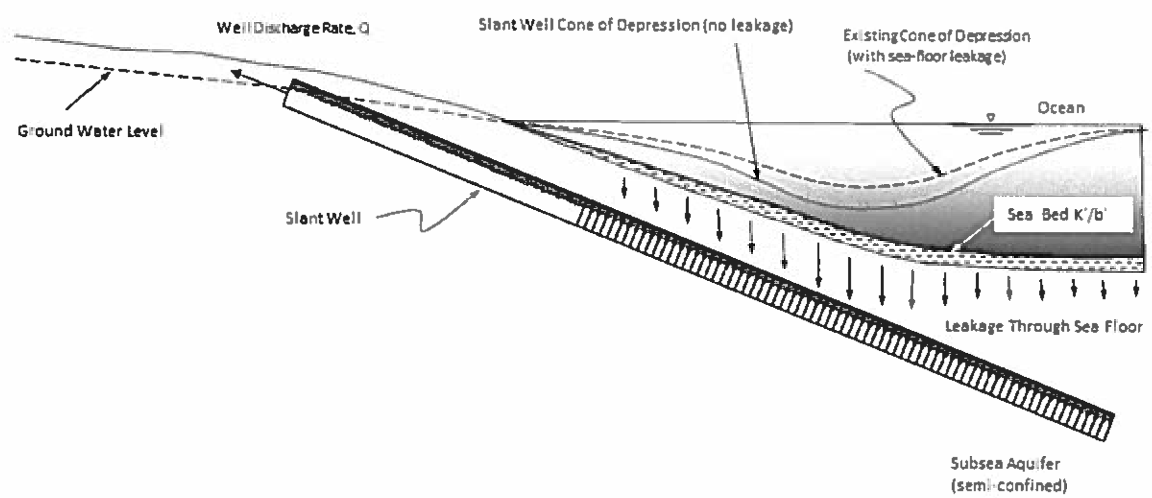

Figure 7. Induced infiltration to slant wells from vertical leakage through the sea floor

1.8 Slant Well and Vertical Well Production Comparison.

The cone of depression in the vicinity of production wells is a function of aquifer hydraulic properties, discharge rate, and time since the start of pumping. Vertical wells have a concentric cone of depression with the highest drawdown being in the vicinity of the well and declining outward. In angled wells, the cone of depression is ellipsoidal and the drawdown distribution "bowl "shaped centered around the vertical projection of the well screen. As such, for the same aquifers, slant wells produce more water than vertical wells for the drawdown available above the top of the well screen. Specifically, in slant wells, the formation loss (i.e., drawdown in the aquifer), is "spread out" over the vertical projection of the well screen length. In vertical wells, it is concentrated in a logarithmic cone centered on a point. Mathematical support for this statement can be seen by comparing the non-steady state equation in a confined aquifer for a vertical well (i.e., Jacob's equation), with that of an angled well (UDE-Jacob – see eq. 6 in [11] with ns=4). When the discharge rate is varied in both cases (vertical and slant), and limiting the maximum drawdown to the top of the well screen, slant wells have discharge rates approximately 1.5 to 2 times greater than vertical wells[7].

$$Q2 / Q1 = \log(B) / [\log(B) - 0.5 \log(XS^4 / 144)] \qquad (2)$$

where:

$Q1$	=	vertical well discharge rate, gpm
$Q2$	=	slant well discharge rate, gpm
B	=	$(0.3 \times T \times t) / S$, ft^2
T	=	transmissivity, gpd/ft
S	=	storativity
t	=	time, days
XS	=	vertical projection of slant well screen, $LS \times \cos(\alpha)$, ft
α	=	slant well angle, degrees below horizontal

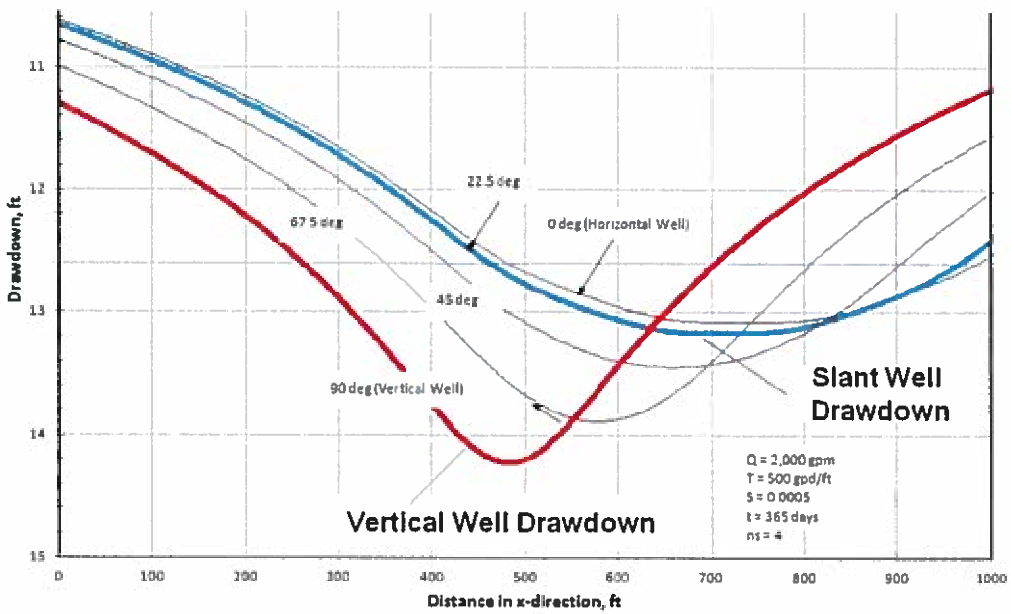

Figure 8. Vertical Well and Slant Well Drawdown Comparisons

1.9 Large-Scale Well Field Hydraulics (UDEM)

An extension of the principle of superposition used to calculate the drawdown distribution around nonvertical wells [11] is presented here to calculate the drawdown distribution around multiple slant

[7] Comparisons are for the same drawdowns and a typical range of aquifer parameters and slant well angles. Also, this comparison is for the laminar flow loss component of the total drawdown only.

wells. The UDEM stands for *Universal Drawdown Equation for Multiple Wells* and is merely a calculational algorithm used to develop regional drawdowns around multiple slant wells and slant well fields. The UDEM calculates the drawdown distribution in the vicinity of multiple slant wells by algebraically adding drawdown distributions from individual wells over a finite difference grid network. The UDEM is useful in the initial planning and layout of slant wells and well pod spacings as well as a first approximation to potential impacts to sensitive habitat and inland ground water resources. As the UDEM obeys the basic assumptions of the underlying equations, regional boundary conditions need to be included by further refinement using a formal three dimensional ground water flow and solute transport model.

1.9.1. Leaky Aquifer Approximation

As slant wells producing from subsea aquifers receive vertical leakage through the sea floor as well as lateral recharge, to properly simulate drawdown effects, the UDEM calculates drawdowns using the Hantush-Jacob leaky aquifer equation [13]. However, when calculating drawdowns for a large number of slant wells with multiple sinks over a large grid network, the calculation may be quite laborious and time consuming due to the approximation of the leaky aquifer well function. This was overcome by using a site specific relationship between the non leaky and leaky aquifer solutions. Specifically:

$$\Delta = a \times \exp(b \times r) \tag{3}$$

where:

Δ	= non leaky aquifer drawdown - leaky aquifer drawdown, ft
a, b	= constants from best fit equation
exp(x)	= the exponential function, also denoted as e^x
e	= base of the natural logarithm (e = 2.718)
r	= distance from pumping well (or sink), ft

For most problems of practical interest, the exponential relationship between Δ and r yields excellent correlation.

UPWARD SCALABILITY OF SLANT WELL FEEDWATER SUPPLIES

1.10 Siting, Permitting, Access and Maintenance

Large scale slant well feed water supplies need a number of permits including land acquisition and access which are dependent upon environmental and operational factors, which if not complied with, could prohibit the project altogether. For example, many of these projects are limited to a maximum percentage of slant well recharge derived from inland water supplies (i.e., basin water vs. ocean water recharge). If this percentage is exceeded, expensive mitigation or provision of supplemental supplies may be required, adding to the overall cost of the project. Other factors affecting wellhead placement may include setbacks due to coastal erosion, a 100-year flood event, sea level rise and proximity to sensitive habitat [14], [15], [16]. Each slant well location should also consider well construction footprints and access to the drilling site and equipment staging area (during construction and routine maintenance).

1.11 Environmental concerns

Environmental factors during construction and operation are primarily concerned with adverse impacts to the natural environment (e.g., sensitive ecological or environmental areas inhabited by a particular species of animal, plant, or other type of organism). In areas of sensitive vegetation, fish habitat or other wildlife, well drawdowns (i.e., ground water level changes), from pumping may restrict placement or hinder construction and maintenance. Other environmental impacts may include visual impacts of facilities during construction or after completion, such as unsightly facilities on the beach or in near shore areas where recreational or other high uses occur.

1.12 Common Wellhead Areas

To minimize unnecessary infrastructure in conveying feed water to the desalination plant site, multiple slant wells can be constructed in close proximity to one another (i.e., common wellhead area or slant well "pod"). The common wellhead areas also minimize disturbance and access during both construction and routine maintenance.

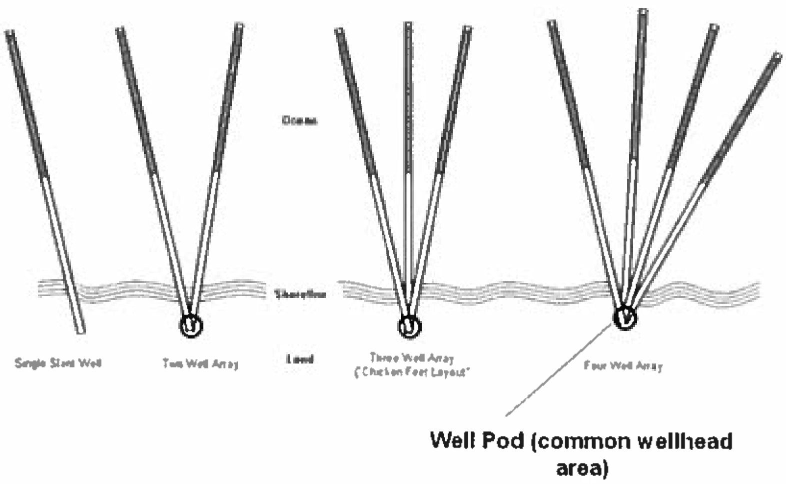

Figure 9. Multiple slant wells from common wellhead areas

1.13 Seawater Intrusion Control

Wells pumping at the coast or from subsea aquifers beneath the ocean floor do not contribute to seawater intrusion. On the contrary, slant wells help prevent seawater intrusion through creation of an extraction trough that intercepts seawater as shown on Figure 10. Modeling studies of full scale slant well projects in California (e.g., Dana Point, Monterey, Cambria, and San Diego) show that the slant well pumping trough acts as a seawater intrusion control mechanism.

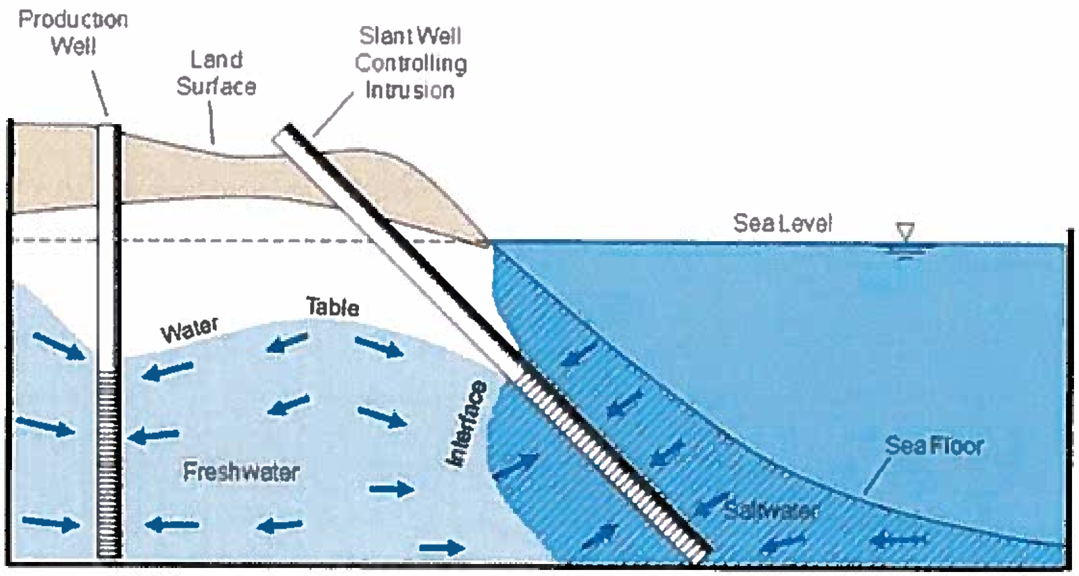

Figure 10. Slant Wells Intercepting Seawater Providing Seawater Intrusion Control

1.14 Large Scale Feed Water Supplies - 78 mgd, 117 mgd, and 233 mgd

For typical California coastal aquifers, a feed water supply of nine slant well pods with each pod containing three 4.32 mgd slant wells can yield approximately 117 mgd from a two mile reach of coastline.

The following interference drawdown plots were generated using the UDEM and field data from a site along the coast of California. The following parameters were used in the calculations:

Slant well length (L)	= 1,000 ft
Length of well screen (LS)	= 860 ft
Angle below horizontal α	= 15 degrees
Transmissivity (Kb)	= 246,000 gpd/ft
Storativity (S_s b)	= 0.045
Saturated thickness(b)	= 223 ft
Slant Well Discharge Rate (Q)	= 3,000 gpm
Time since start of pumping (t)	=365 days
Sea bed leakance (K'/b')	= 0.014/day
Number of sinks per slant well (ns)	= 4
Number of wells per pod	= 3

Figures 11, 12 and 13 illustrate the concept of modular addition of slant well pods to achieve a feed water production of 78 mgd, 117 mgd, and 233 mgd respectively.

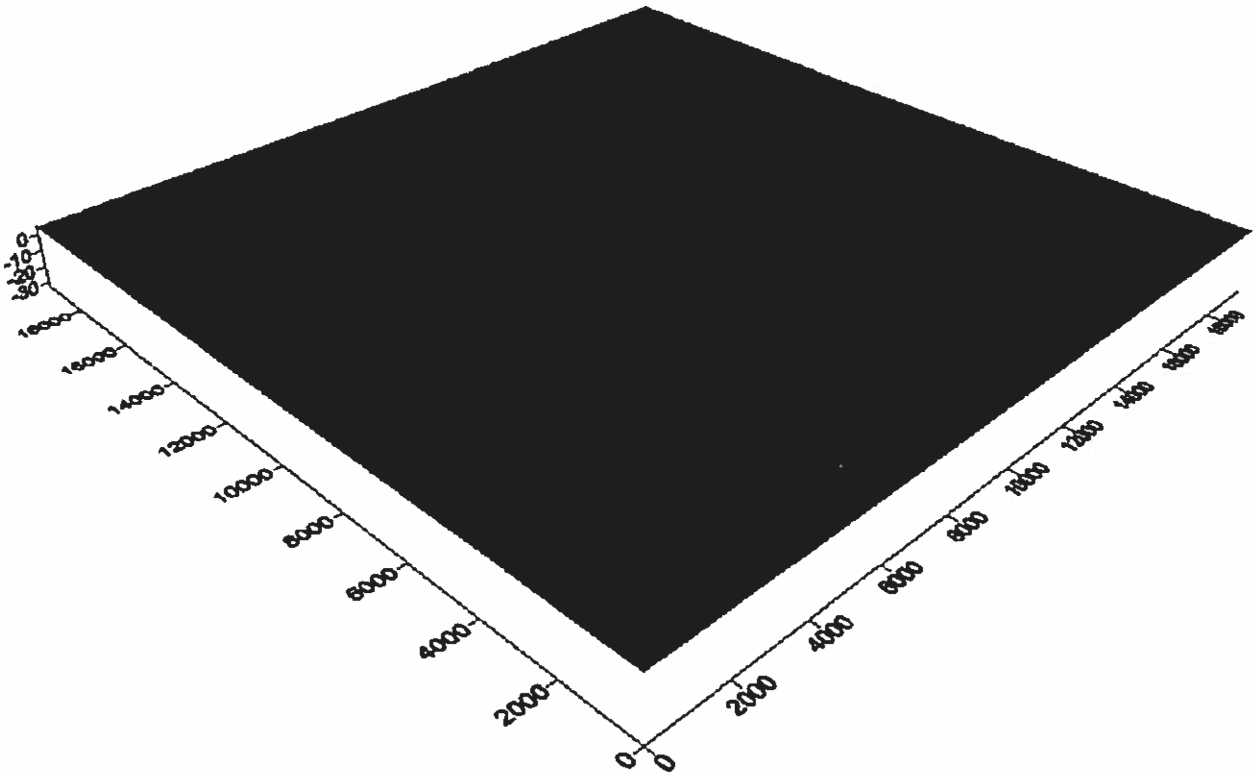

Figure 11. 78 mgd SWRO slant well feed water supply. Six slant well pods and 18 wells. Drawdown distribution in Subsea Aquifers, ft.

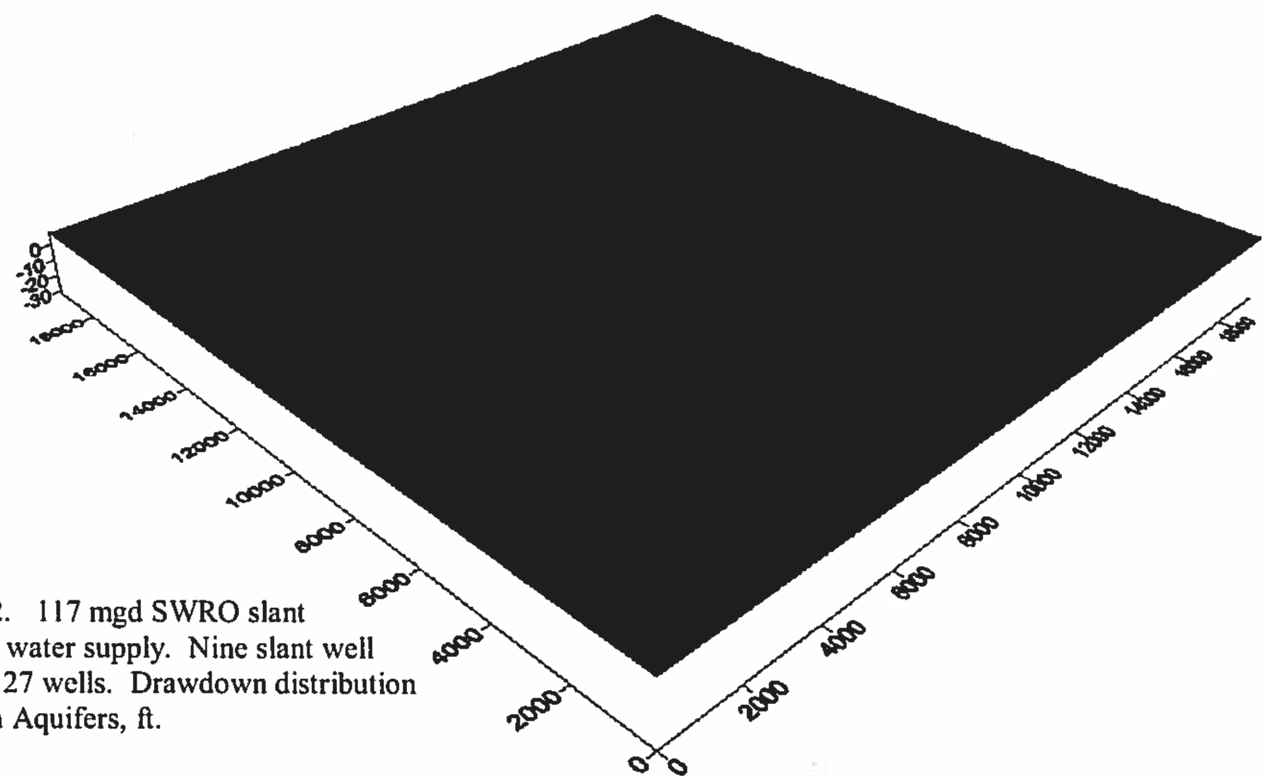

Figure 12. 117 mgd SWRO slant well feed water supply. Nine slant well pods and 27 wells. Drawdown distribution in Subsea Aquifers, ft.

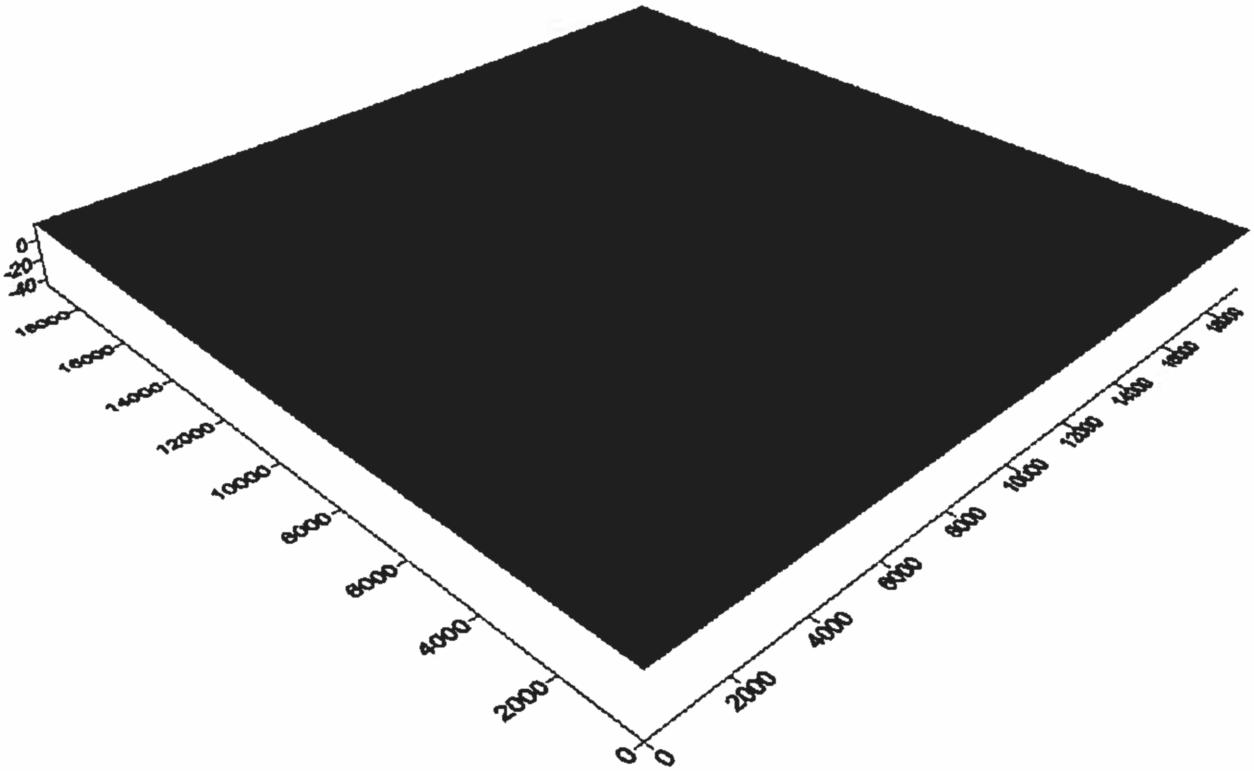

Figure 13. 233 mgd SWRO slant well feed water supply. Eighteen slant well pods and 54 wells. Drawdown distribution in Subsea Aquifers, ft.

SUSTAINABILITY OF SUPPLY

In order to maintain feed water production, planned rehabilitation of a slant well subsurface supply will periodically be necessary. All wells (vertical and angled), need redevelopment from time to time to maintain performance. This periodic redevelopment typically consists of mechanical and/or chemical redevelopment using the same "tried and true" methods developed in the water well industry for vertical wells over the past 70 yrs. As access to the wellhead area is required, provision must be made during siting to minimize disturbance during routine maintenance. This is especially important if the well is sited in an environmentally sensitive area, or in areas where recreation or other high uses exist (e.g., on a State Beach). The frequency between rehabilitation depends on both site-specific conditions and operational schedules. However, it is generally expected to range between approximately three to five years for properly constructed and developed slant wells with corrosion resistant casing and screen.

1.15 Maintaining Well Efficiency

In order to maintain feed water production, planned rehabilitation should be performed when the well efficiency shows an unacceptable decline. Well efficiency is defined as:

$$E = (BQ / s_w) \times 100 \tag{4}$$

where:

E	= well efficiency, %
B	= formation loss coefficient, ft/gpm
Q	= well discharge rate, gpm
s_w	= drawdown in the pumping well, ft

The formation loss coefficient and well efficiency can be calculated from variable rate pumping tests (i.e., step drawdown tests – [17] which is a straight-forward procedure involving at least three different discharge rates. Periodically, step drawdown testing can be performed, efficiency calculated and comparisons made against historical values.

As a general rule, when well efficiencies decline to 50% of the maximum value (at the design production rate), it is a good idea to take the well out of service, perform a video inspection and develop a rehabilitation plan. Based on limited data from the Doheny test slant well, it is expected that in wells properly designed, developed and consisting of corrosion resistant steels, the frequency between well rehabilitation would be on the order of three to five years. However, depending on other constituents in the ground water (e.g., iron and manganese), rehabilitation frequency may vary.

MONTEREY PENINSULA WATER SUPPLY PROJECT

Slant wells are drilled using the dual-rotary method of drilling with angles below horizontal typically ranging from 10 degrees to 30 degrees. A telescoping well design allows construction of slant wells up to 1,000 ft or more with an artificial filter pack and half moon screen pattern[8] typically yielding 3-4 mgd/well. In the Monterey area north of the town of Marina, a 724 ft long test slant well 19 degrees below horizontal has recently been constructed as the first phase of testing of the MPWSP. Prior to construction of the test slant well, a number of exploratory borings were made to define the near-shore aquifers. The test slant well is currently pumping 3 mgd and is being monitored daily for coastal and inland water level and salinity impacts. The full scale feed water supply of 24 mgd will be met using an array of ten slant wells including two for standby capability. Slant well angles can vary depending on site conditions to allow targeting specific aquifer thicknesses. In the case of the Monterey area, aquifers being tested include the shallow Dune Sand and the deeper 180-FTE aquifers. Field testing has validated theoretical analysis and show that shallow angled slant wells have higher discharge rates than vertical wells for the same aquifer thickness due to their increased aquifer efficiency (i.e., broader cones of depression than vertical wells). Data from the long term testing is being used to refine a three dimensional variable density ground water flow and solute transport model which is being used to predict coastal and inland impacts from the full scale project.

SUMMARY

- There is a current misconception that subsurface intakes using slant wells are limited to small scale facilities typically less than 3 mgd. Research and field testing over the past nine years

[8] The half moon screen pattern denotes perforation of only the lower portion of the well screen pipe. This allows for some settlement of the artificial filter pack over the crown of the pipe preventing fine-grained aquifer sands from coming into direct contact with the perforations.

have shown that in typical coastal aquifers in California, slant well feed water supplies can provide approximately 50 mgd of feed water supply per mile of coastline.

- Maximum yield of slant well intakes for SWRO feed water supplies is only limited by the availability of coastline and potential adverse impacts to riparian and onshore resources.

- With improved drilling technology and telescopic designs, slant well lengths can reach and exceed 1,000 ft with individual well yields of 4 mgd and greater.

- Since the first SWRO slant well was constructed off the coast of Dana Point, California in 2006, continuing research and field testing has led to larger scale systems currently in the planning and testing stage. A 724 ft test slant well is currently under long-term testing off the coast of Monterey as part of the first phase of the Monterey Peninsula Water Supply Project.

- Comparison of results from the Doheny test slant well pumping test and the current Monterey test slant well pumping shows that old marine water present in the Dana Point area is absent in the Monterey area. This suggests that widespread subsea coastal aquifers such as present in the Monterey area do not have the same conditions as subsea paleochannels.

- Permitting is the number one constraint to development of subsurface feed water supplies.

- Coastal erosion, 100-yr floods and sea level rise must be considered in the siting and layout of slant well feed water supply systems.

- The Dual Rotary drilling method is a proven technology for construction of artificially filter packed slant wells under the ocean.

- Telescoping slant well design allows for larger pump house casings, proper development and yields of 3-4 mgd per well.

- Slant wells completed in subsea aquifers typically produce over 95% of their supply from ocean water sources (vertical leakage through the sea floor) and lateral flow from subsea aquifers.

- Regular maintenance on the order of every three to five years may be necessary to maintain slant well feed water supply production. Well efficiency declines can be monitored from routine step drawdown testing.

- Slant well maintenance is not complex nor is it more difficult than that which is required for conventional vertical wells and typically includes mechanical and chemical rehabilitation.

- The drawdown distribution in the vicinity slant wells is the algebraic sum of drawdowns for a finite number of point sinks distributed along the vertical projection of the well screen.

- Simplified solutions for the drawdown distribution in the vicinity of slant wells and slant well fields can be developed using the UDEM.

- Variable density ground water flow and solute transport models can predict impacts from full-scale project pumping as well as provide estimates of the time to pump out old marine ground water found in paleochannels.

- Due to slant well geometry, slant wells produce 1.5 to 2 times as much flow as vertical wells for the same available drawdown.

- Silt density indices, one of the major design parameters in desalination feed water supply, are typically < 1 for properly designed and constructed slant wells.

- Coupon testing in a seawater environment show materials such as 2507 Super Duplex Stainless Steel provide long life and minimal corrosion for slant well casing and screens.

- Pumping troughs created by large scale slant well feed water intercept seawater providing seawater intrusion control.

REFERENCES

1. Missimer, T.M., N. Ghaffour, A.H.A. Dehwah, R. Rachman, R.G. Maliva, and G. Amy. 2013. Subsurface intakes for seawater reverse osmosis facilities: Capacity limitation, water quality improvement, and economics. *Desalination* 322 (2013) 37-51

2. GHD Desalination Portfolio, July 2012, http://www.ghd.com/PDF/Desalination_experience_document.pdf

3. California State Water Resources Control Board (2014). Amendment to the Water Quality Control Plan for Ocean Waters of California, Draft Staff Report, July 3, 2014

4. Williams, D.E., (2007). *Results of Drilling, Construction, Development and Testing of Dana Point Ocean Desalination Project Test Slant Well*, Published in the National Groundwater Association's Horizontal News Volume 10/Number 1 in the Summer 2007 Edition.

5. Williams, D.E. (2008). Horizontal well technology application in alluvial marine aquifers for ocean feed water supply and pretreatment. Prepared for State of California Department of Water Resources/Municipal Water District of Orange County.

6. Williams, D.E. (2011). Design and construction of slant and vertical wells for desalination intake. Proceeding, International Desalination Association World Congress on Desalination and Water Reuse, Perth, Australia.

7. Williams, D.E., R. Bell, and G. Filteau. 2012. Multiple Advantages of Slant Wells for Ocean Desalination Feed water Supply. Presentation for the NGWA Ground Water Summit, May 7, 2012.

8. Charette, M.A. 2012. Natural Isotope Tracer Study: Test Slant Well Phase 3 Extending Pumping Test – South Orange Coastal Ocean Desalination Project. Report prepared for the municipal Water District of Orange County by Coastal Groundwater Consulting, November 27, 2012.

9. GEOSCIENCE Support Services, Inc. 2007. Subsurface System Intake Feasibility Assessment – Task 4 Report. Prepared for Municipal Water District of Orange County, March 1, 2007.

10. GEOSCIENCE (2012). Aquifer Pumping Test Analysis and Evaluation of Specific Capacity and Well Efficiency Relationships SL-1 Test Slant Well Doheny Beach, Dana Point, California. Prepared for the Municipal Water District of Orange County. September 7, 2012.

11. Williams, D.E. (2013). Drawdown distribution in the vicinity of nonvertical wells. Ground water 51(5), 745-751.

12. Hantush, M. S. (1964). Hydraulics of wells. In: Chow, V.T. (ed.), *Advances in Hydroscience*. New York, Academic Press, 281-432.

13. Hantush, M.S., and C.E. Jacob, (1955), Non-steady radial flow in an infinite leaky aquifer, Transactions of the American Geophysical Union, 36, 95-100

14. California Coastal Committee (CCC) (2003). Establishing development setbacks from coastal bluffs, Memorandum W11.5.

15. California Ocean Protection Council (OPC) (2011). Resolution of the California Ocean Protection Council on sea-level rise.

16. California Ocean Protection Council (OPC) (2013). State of California sea-level rise guidance document.

17. Roscoe Moss, Co. (1990). *Handbook of ground water development, 2nd edition*. John Wiley & Sons, Hoboken, New Jersey.

EXHIBIT G

FINAL SUMMARY REPORT
DOHENY OCEAN DESALINATION PROJECT
PHASE 3 INVESTIGATION

Extended Pumping and Pilot Plant Test
Regional Watershed and Groundwater Modeling
Full Scale Project Conceptual Assessment

PREPARED BY

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

JANUARY 2014

Final Summary Report
Doheny Ocean Desalination Project
Phase 3 Investigation

Extended Pumping and Pilot Plant Test
Regional Watershed and Groundwater Modeling
Full Scale Project Conceptual Assessment

Prepared by

Municipal Water District of Orange County

January 2014

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GLOSSARY

AFY	acre-feet per year.
Alluvial/Alluvium	A geologic term describing beds of sand, gravel, silt, and clay deposited by flowing water through which groundwater can readily flow.
Aquifer	A geologic formation or group of formations which store, transmit, and yield significant quantities of water to wells and springs.
Anoxic	A common condition in older natural groundwater where the water is completely devoid of any dissolved oxygen.
ARB	California Air Resources Board
California Ocean Plan	The water quality control plan for the ocean that is established and periodically updated by the State Water Resources Control Board. The plan sets out the standards under which wastewater discharge permits are based upon.
dFe/dMn	Reduced, divalent iron and manganese occur in the dissolved form, primarily as hydroxides in anoxic waters.
D.O.	Dissolved oxygen
Drawdown	The change in hydraulic head or water level relative to a background condition.
Dual Rotary Drill Rig	A water well drilling rig that combines the ability to drill and construct an outer casing to protect the open hole without the use of drilling muds.
DWR	California Department of Water Resources
Evapotranspiration	The combined loss of water from a given area by evaporation from the land and transpiration from plants.
Fault	A fracture in the earth's crust, with displacement of one side of the fracture with respect to the other. Faults may be impervious to the flow of water due to the grinding of adjacent formation materials into very fine sediments.
Fe/Mn	Iron and manganese
gpm	gallons per minute
Groundwater	Water contained in interconnected pores located below the water table in an unconfined aquifer or located in a confined aquifer.
He/Tr	Helium and Tritium isotopes

LBCWD	Laguna Beach County Water District
MET	Metropolitan Water District of Southern California
MGD	million gallons per day
mg/l	milligrams per liter
MNWD	Moulton Niguel Water District
MWDOC	Municipal Water District of Orange County
Natural Isotope Tracer	Naturally occurring radioactive isotopes provide information about a groundwater's age, which refers to the last time the water was in contact with the atmosphere. They can be used to evaluate the sources of pumped groundwater over time.
NTU	nephelometric turbidity units, a measurement of turbidity and clarity of water.
O&M	Operation and maintenance
OTE	Operations, testing and evaluation
R & R	Repair and Rehabilitation
Ranney or Radial Well	A horizontal well built from a central large shaft with radial intakes horizontally pushed out into the formation, usually spaced equidistantly around the circumference of the shaft. These types of wells allow water to be drawn from the lower portion of river or stream channels to maintain yield during dry periods.
RO	Reverse Osmosis. A treatment process that uses high pressure to force water through very fine membranes.
SDCWA	San Diego County Water Authority
SDG&E	San Diego Gas & Electric
SCWD	South Coast Water District
SDI	Silt Density Index, a measure of the suspended solids in water commonly used to measure the clogging potential of feedwater to reverse osmosis membrane systems.
SJBA	San Juan Basin Authority
Slant Well	A water supply well-constructed at a relatively flat angle.

SOCOD	South Orange Coastal Ocean Desalination Project. Former name of the Doheny Ocean Desalination Project.
SOCWA	South Orange County Wastewater Authority
SWP	State Water Project
TDS	Total Dissolved Solids
UCI	University of California Irvine
UF	Ultra Filtration
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WHOI	Woods Hole Oceanographic Institute
µ	Micron

A. Project Information

1. Type: Ocean Desalination Feasibility Investigation
2. Title: Phase 3 Doheny Ocean Desalination Project – Extended Pumping and Pilot Plant Test, Regional Watershed and Groundwater Modeling, and Full Scale Project Conceptual Assessment
3. Start Date: January 11, 2008
4. End Date: December 31, 2013
5. Grant and Funding Information:
    a. California Department of Water Resources, Prop 50 Grant Agreement No. 4600007435 for $1,500,000.
    b. U.S. Environmental Protection Agency, STAG Grant Agreement No. XP-00T40501-0, for $848,000.
    c. U.S. Bureau of Reclamation, WaterSmart Grant R10AP35290 for $499,000
    d. Project Participants (South Coast Water District, City of San Clemente, City of San Juan Capistrano, Moulton Niguel Water District) Local Funding totaling $3,300,000.
6. Grantee and Managing Agency: Municipal Water District of Orange County
7. Contact: Mr. Karl W. Seckel, PE, Program Manager; Mr. Richard B. Bell, PE, Project Manager and Principal Engineer
8. Phase 3 Total Project Cost: $6,147,000.

B. Executive Summary

The Municipal Water District of Orange County (MWDOC) in partnership with five participating agencies, investigated the feasibility of slant wells to extract ocean water for the planned Doheny Ocean Desalination Project (aka Dana Point and South Orange Coastal Ocean Desalination (SOCOD) Project). The Phase 3 Extended Pumping and Pilot Plant Test, Regional Watershed and Groundwater Modeling and Full Scale Project Conceptual Assessment work were initiated in January 2008. The five participating agencies provided technical review and elected official decision-maker direction through a project governing committee structure. MWDOC provided overall project management, project development and permitting, technical support work, and staffed the committee.

Project Location and Development of the Doheny Ocean Desalination Project

The Phase 3 test facilities are located in Doheny State Beach in Dana Point, California. The test facilities consisted of the Test Slant Well, submersible pump, control vault, two monitoring wells, conveyance lines, the Mobile Test Facility, electrical service, and a temporary diffuser for discharge to the surf zone.

The full scale project would produce 15 MGD of drinking water (95% operational load factor = 15,961 AFY) and would be situated on a nearby 5-acre parcel being reserved for the project by South Coast Water District. The project site is crossed by the two regional imported supply pipelines and the adjacent San Juan Creek Ocean Outfall has sufficient brine disposal capacity. The major technical issue for the project was to determine the most cost-effective method to produce ocean water.

Figure 1A - Schematic of Test Slant Well

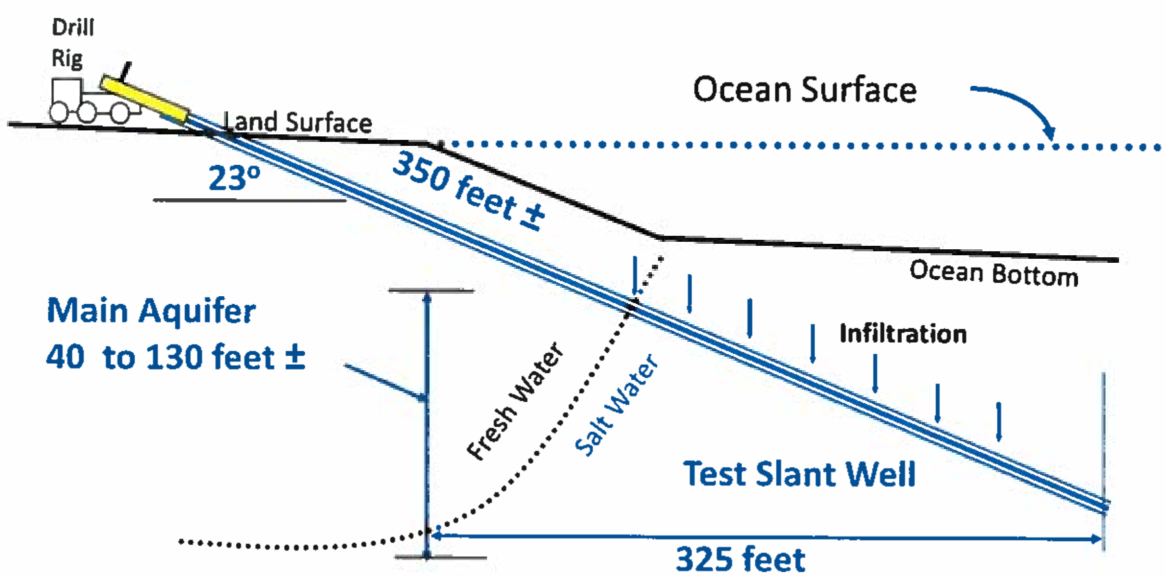


Figure 1B - Schematic of Doheny Desal Project Layout

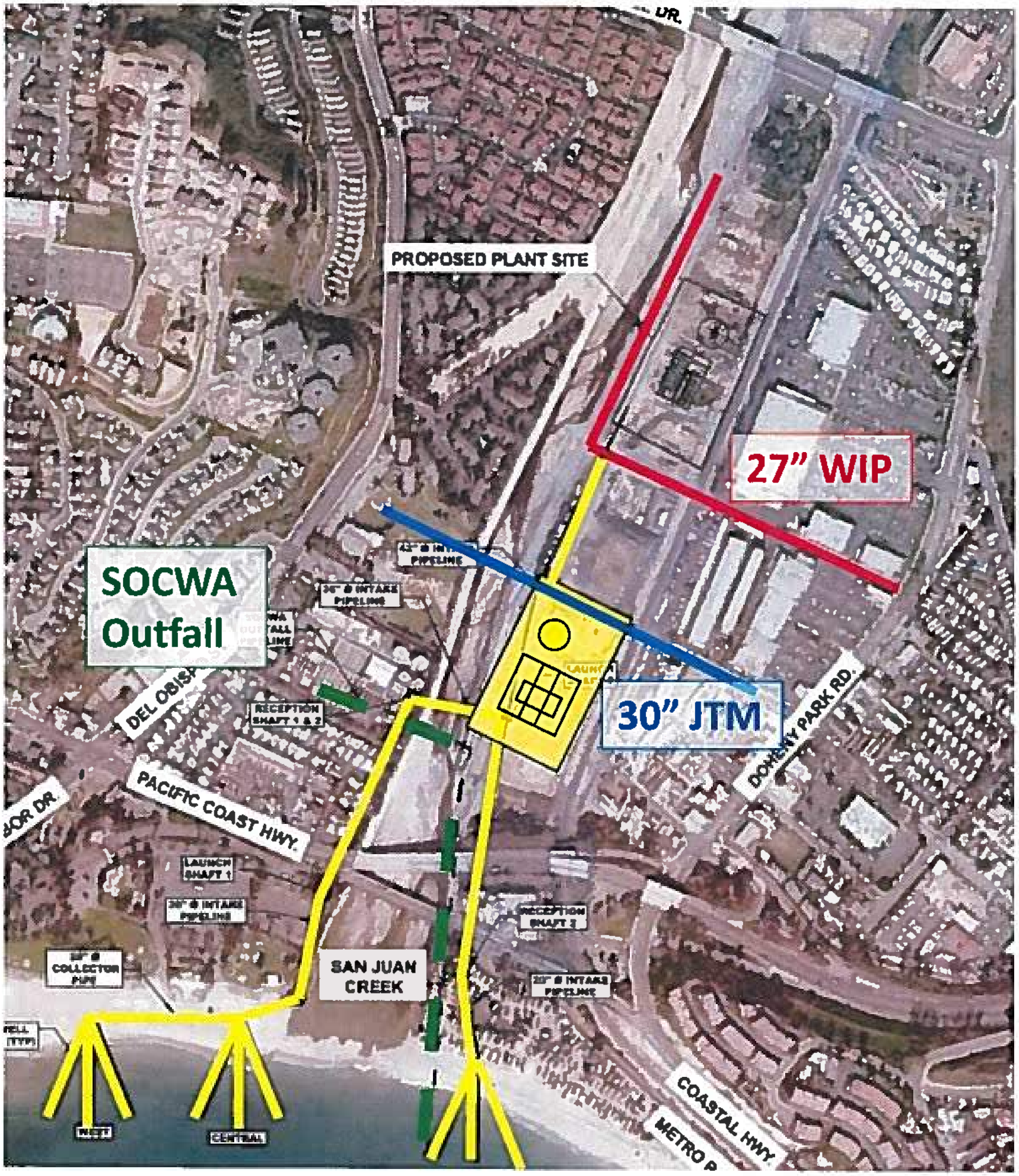


Figure 2 - Schematic of Test Facility

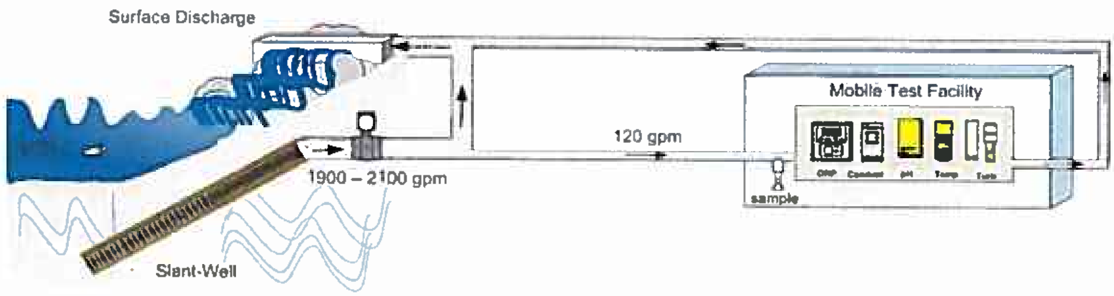
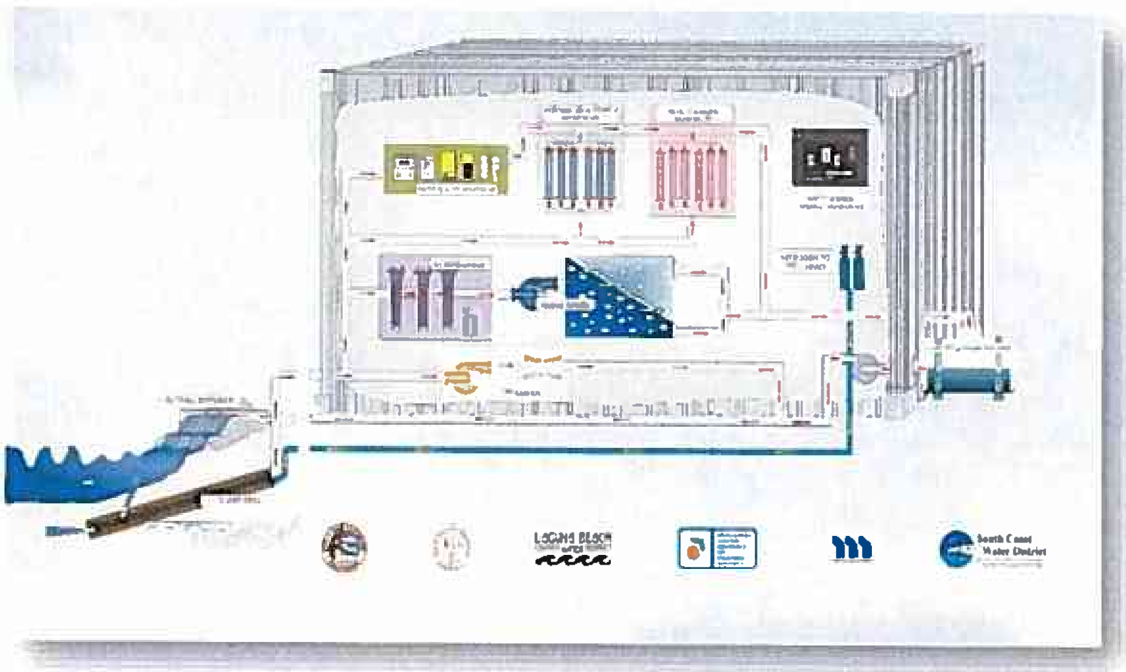


Figure 3 - Layout of Test Facilities

In 2003/04, MWDOC undertook preliminary studies to assess alternative approaches to produce ocean water in the vicinity where San Juan Creek discharges to the ocean in Dana Point. Options included a conventional open intake, a subsurface infiltration gallery, and various types of beach wells. A flat continental shelf in this location would require that a conventional open intake be situated about 7,000 feet offshore to provide sufficient depth for protection of the intake. Due to the

Figure 4 - Mobile Test Facility (MTF)



expected high cost and difficult permitting for an open intake system and based on early discussions with the California Coastal Commission staff, a decision was made to investigate the feasibility of constructing a subsurface intake system using a horizontal or angled well construction method. Infiltration galleries were deemed infeasible due to high costs, ocean floor impacts, clogging, decreasing yields and maintenance challenges. Radial wells (aka Ranney Wells) were deemed infeasible due to high costs, a long construction period that would exceed the 8-month off-season construction window allowed by State Parks, limitations on the ability to gravel pack the laterals, and the limitation to extend the laterals at significance distance out under the ocean.

To investigate the feasibility of a subsurface slant well intake, a phased hydrogeology and subsurface well technology investigation was undertaken. In 2004/05, four exploratory boreholes were drilled along the beach to a depth of 188 feet below the ground surface. The boreholes encountered highly permeable alluvium throughout their depth. In 2005/06, after a thorough review of several technologies it was determined that the most cost-effective approach for this location was the use of slant beach wells constructed with a dual rotary drill rig from the beach out under the ocean. A test slant well was deemed necessary to evaluate the aquifer response, water quality, and aquifer filtration. Groundwater modeling was also necessary to evaluate the impacts of the project draw on the groundwater basin associated with San Juan Creek and to determine the potential capacity of a slant beach wellfield.

In 2005/06 with grant funding support from the California Department of Water Resources, U.S. EPA and U.S. Bureau of Reclamation and MWDOC, a demonstration Test Slant Well was permitted, designed and constructed and a short-term aquifer pumping test was performed. Initial groundwater modeling indicated a full scale slant wellfield could produce about 30 million gallons per day at acceptable drawdowns to wells in the local vicinity. The results from this demonstration well were encouraging and it was then determined that an extended pumping and pilot plant test was necessary.

Phase 3 Extended Pumping and Pilot Plant Test – AN OVERVIEW

The extended pumping and pilot plant test required the installation of a submersible pump, vault with control valves, a diffuser for surf zone discharge of the pumped water, conveyance lines to and from a mobile test facility, and electrical service. MWDOC conducted the planning, environmental documentation and permitting with the assistance of consultants. The mobile test facility was designed by Dr. Mark Williams and the submersible pump was designed by Bayard Bosserman under contracts to MWDOC. The Mobile Test Facility was procured from Intuitech and the submersible pump was procured from INDAR. The remainder of the test facility infrastructure was designed by Carollo Engineers and awarded to and constructed by SCW Contractors. This work was conducted in 2008 to 2010.

Separation Processes (SPI) was the contractor selected for the extended pumping and pilot plant Operations, Testing and Evaluation (OTE) work. They were awarded the work through a competitive proposal/interview process that consisted of staff from the participating agencies and outside experts. The OTE work consisted of pumping the test slant well for a period over 21 months to evaluate the performance of the pump, well and aquifer and to determine water quality produced from the marine aquifer, filtration performance of the aquifer, and corrosion and microbial fouling potential. In addition, the work included iron/manganese pretreatment pilot tests.

The testing work found that the pump and aquifer performed exceptionally well. The well experienced some sand clogging that was due to insufficient well development which was a result of a decision to construct the test slant well with only a 12-inch internal diameter (to reduce costs) and to utilize a high speed submersible pump that would enable a shorter test duration at high pumping rates to adequately stress the aquifer. This problem should not occur in the full scale project as proper and full development would be provided and the well would be equipped with a lower speed production pump.

Over the extended test period, the salinity increased from 2,500 mg/l to over 17,000 mg/l, which was fairly close to what was predicted by the initial variable density groundwater model. It is estimated, that under constant pumping it would have eventually reached about 32,000 mg/l when fully connected with the ocean assuming 95% ocean water at 33,700 mg/l (average of analyses during Phase 3) and 5% brackish groundwater at 2,200 mg/l. The increase in salinity showed that ocean water was slowly being pulled into the well over the test period. A major and unexpected finding was the high level of dissolved iron and manganese contained in the pocket of old marine groundwater that lies under the ocean. This water was anoxic (devoid of oxygen) and slightly acidic, and was found to be about 7,500 years old. From the groundwater modeling work, it was estimated that under full production capacity, the old marine groundwater would be mostly pumped out and replaced by ocean water within a year or so. However, further work is needed to zero in on this time estimate.

The pump out of the old pocket of marine groundwater will likely significantly reduce or potentially eliminate the need for iron/manganese pretreatment. There is also some uncertainty whether the pumped water would remain anoxic under full scale production. In all other respects, the produced water showed a very low silt density index (average around 0.5 units) and turbidity (averaged around 0.1 NTU), indicating excellent filtration by the aquifer which eliminates the need for conventional pretreatment filtration and saves costs.

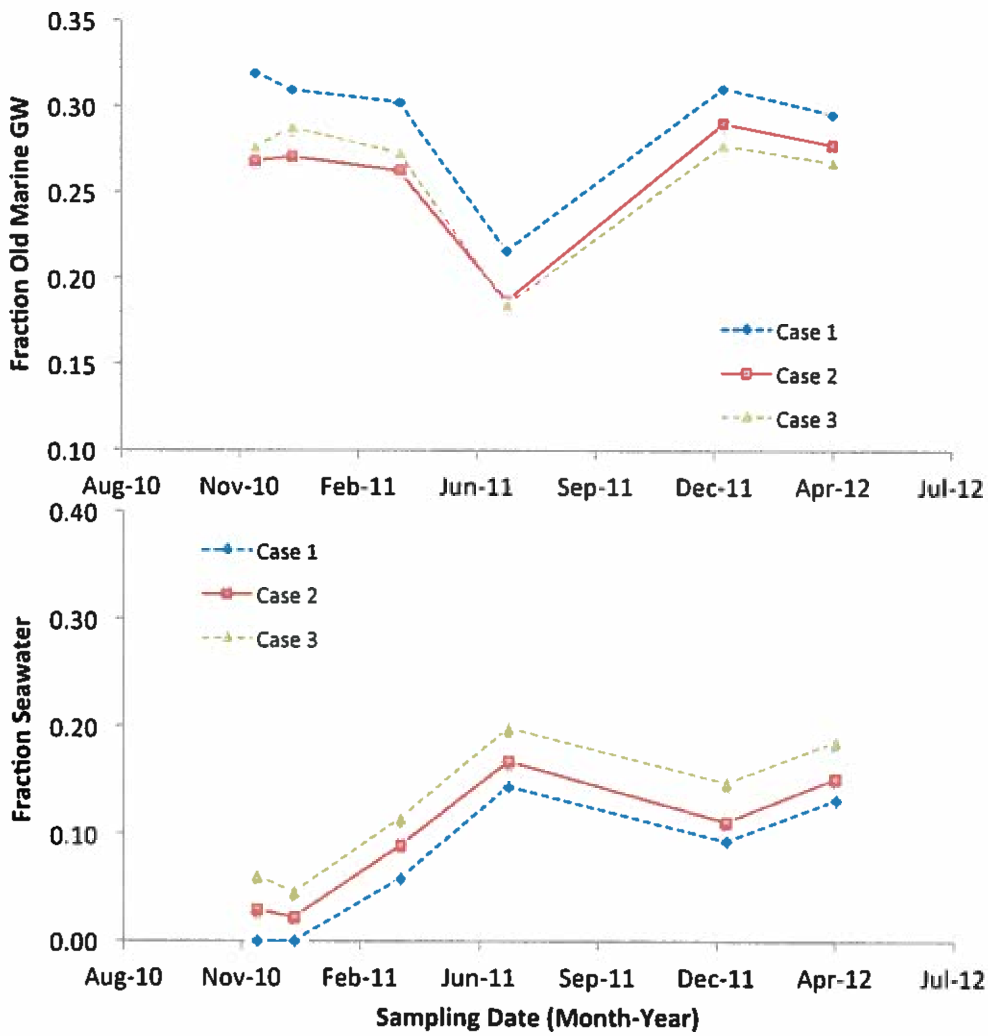
In addition, the produced water showed no presence of bacterial indicator organisms which were found to be present in high concentrations in the ocean and seasonal lagoon. Initial pump out of the brackish groundwater showed higher levels of TOC (Total Organic Carbon) which decreased with increasing production of marine groundwater and ocean water. During the initial period of pump out, a higher level of groundwater bacteria were observed which steadily decreased to extremely low levels. Biofilm growths by the end of the test were found to be less than 10 μ in thickness, a level of no concern for biofouling.

Pumped well water was run directly to the test RO units continuously for over four months. No fouling or performance deterioration was observed during the test or in the post-membrane autopsy as all the dissolved iron and manganese was easily removed as anoxic conditions were maintained throughout the test period.

A pilot plant study was conducted to test advanced iron/manganese removal pretreatment systems. The tested pretreatment processes were oxidized pressure filtration and pre-oxidized UF membrane filtration. Column tests were performed to determine the best media, oxidants, and dosages. Oxidation and sedimentation tests were also performed to evaluate approaches for use during well development to meet discharge requirements. The results showed that the oxidized advanced media filtration process provided higher levels and consistency of removal. A final decision on whether pretreatment would be required must wait until the initial period of pump out of the old pocket of marine groundwater is accomplished. It is recommended that prior to final design, that a final pilot plant test be conducted on the produced water after it has stabilized and the old pocket of marine groundwater has been pumped out.

To determine how much ocean water was being recharged into the aquifer and pumped, natural isotope testing and analyses were conducted throughout the test. This work utilized a multiple tracer approach to quantify the groundwater source captured by the slant well intake. Tracers included natural isotopes of radium, helium, tritium and radiocarbon. Three iterations of a mixing model that utilized the multiple tracer dataset were performed. The model runs suggested ocean water recharge capture was 14-20% by the end of the test with the remainder being a mixture of old marine and brackish groundwater. At the beginning of the test the capture was 0-6%. The 6% range in the model estimates can be narrowed by sampling of the old marine groundwater (see Figure 5).

Figure 5 - Natural Isotope Model - Slant Well Source Production



If the pumping test were to have continued, the old marine groundwater would have been most likely fully pumped out of the offshore formation and replaced by ocean water. Under steady state pumping conditions, there is a high probability that the pumped water would contain very low levels of dissolved iron/manganese. This would result from a combination of the infiltration and plug flow movement of the oxic and slightly alkaline ocean water into and through the aquifer that is reduced to either slightly oxic or anoxic groundwater as a result of microbial activity that consumes dissolved oxygen depending on the amount of available organic carbon. Furthermore, given the observed levels of dissolved Fe and Mn in the old marine groundwater, it is unlikely that their in-situ precipitation from any boundary mixing of oxygenated seawater recharge flows would have a measurable impact on the aquifer permeability at the expected Fe and Mn concentrations, especially under the plug flow conditions that would largely occur. Further, the accumulation of Fe (and Mn) oxides is likely present within the upper shallow aquifer where there is a likely redox boundary where iron precipitation would occur under groundwater ocean discharge conditions. With pumping, ocean water would flow down into the aquifer.

There are two likely locations for precipitation: (1) in the shallow zone of the terrestrial-marine groundwater interface before the water discharges into the ocean and (2) in the shallow sediments on the ocean side of the ocean water interface, where wave and tide driven pore water exchange drive high pH and oxygen rich groundwater into the aquifer. Altogether, under steady-state pumping conditions, this zone would likely contribute little iron to the ocean water that would infiltrate and move through the aquifer to the wellfield. The presence of organic carbon and aerobic bacteria in the shallow seafloor sediments utilizes the oxygen in the ocean water rendering it anoxic, as demonstrated over the extended pumping test. Further evaluation of the organic carbon content in the shallow sediments and sources should be evaluated to determine if the anoxic condition of the recharged ocean water would be maintained over the long run.

Initial Pump Out and Disposal of Old Marine Groundwater

The alluvial channel within the continental shelf offshore of San Juan Creek was submerged by the ocean following the end of the last ice age. Under current conditions, subsurface outflows from San Juan Creek discharge out under and up into the ocean within the area shoreward of the saltwater interface. On the ocean side of this interface, the ocean filled alluvium groundwater has remained isolated since its inundation about 7,500 years ago. We have termed this "older" ocean groundwater as "old marine groundwater".

Testing found that the old marine groundwater is slightly acidic, anoxic and enriched with reduced, divalent, dissolved iron and manganese. Dissolved iron and manganese concentrations increased by the end of the test to a peak of about 11 mg/l and 5 mg/l, respectively. Their concentrations in the old marine groundwater may range from 11 mg/l to as high as 30 mg/l, but the current range is inconclusive due to a lack of offshore aquifer water quality and microbial community conditions.

Water quality and isotope testing provided data to estimate the relative mix by source of the pumped groundwater over the test period. Based on the natural isotope data/model, the pumped water was first mostly brackish groundwater which then steadily decreased as ocean water steadily increased from zero to about 17%, and old marine groundwater. The fraction of old marine groundwater started out at zero, reached an apparent maximum of about 29% before decreasing and in time would have been fully replaced by replaced by recharged "young" ocean water. See Figure 6 for an illustration of how the change in source water would occur over time. Under the full production rate of 30 mgd ocean water recharge would be greatly accelerated from what was observed under the Phase 3 test of 3 mgd.

As illustrated, the source of water being pumped out will continually change in make up until it reaches a steady state condition. For the full scale project, initial modeling suggested that under steady state conditions the extracted well water would reach about 5% brackish groundwater and about 95% ocean water ("young" marine groundwater).

The Phase 3 test data is planned to be utilized in the calibration of a fine grid coastal groundwater flow, variable density, and geochemical model. The fine grid model will help to better predict pumped water quality over time and by source, to evaluate drawdown effects, and seawater intrusion and controls.

Under the full scale project, during the period of initial pumping when the pocket of old marine groundwater is being pumped out and replaced by "young" ocean water, there are two major questions:

(1) How long will it take to pump out the pocket of old marine groundwater?

(2) What is the best approach for handling the old marine groundwater?

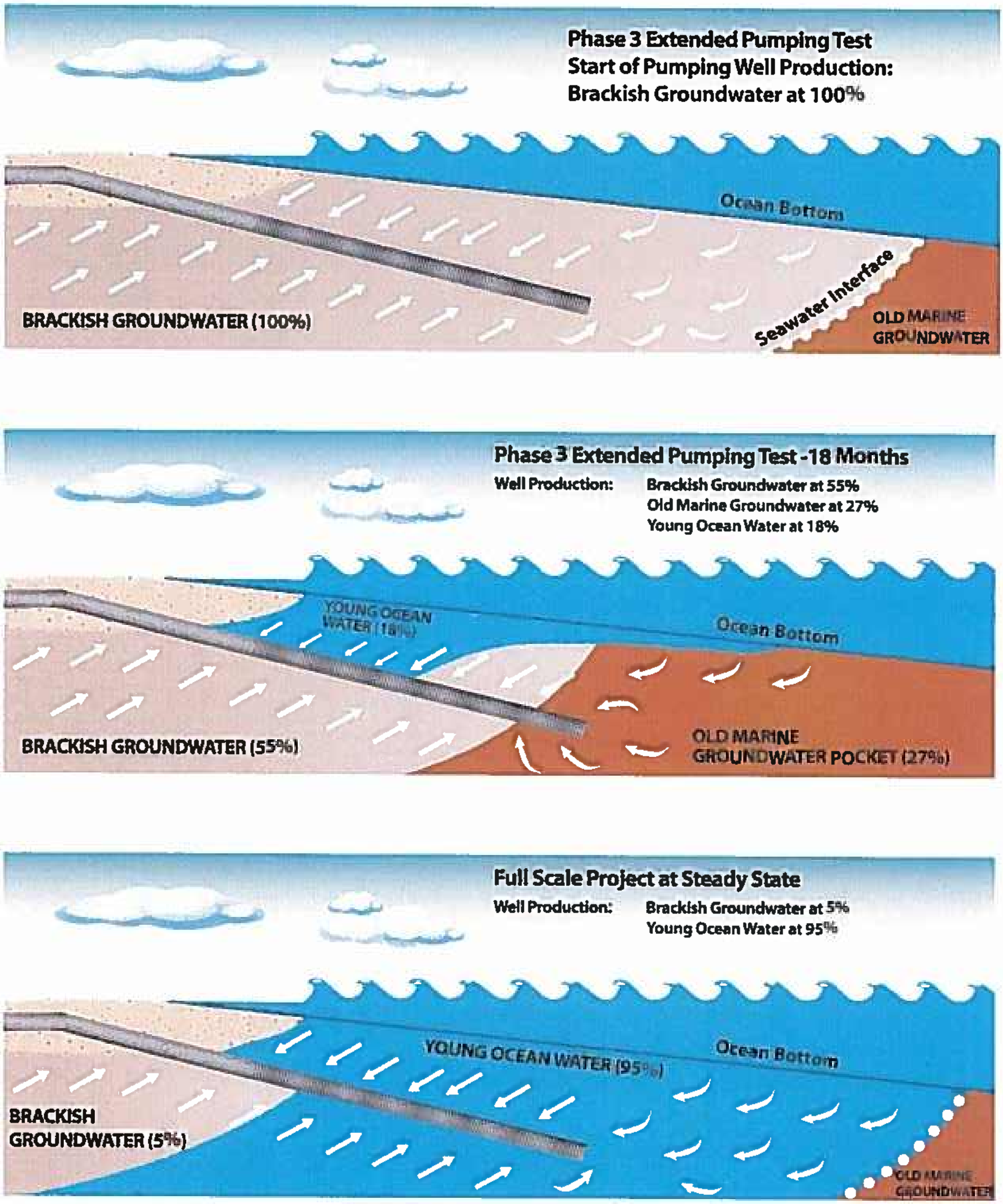
We see two basic approaches for construction of the full scale 30 mgd slant well intake capacity project: (1) include in the desalination plant an iron/manganese pretreatment unit (capital cost estimated at $50 million), or (2) pump out the old pocket of marine groundwater before completing the design and construction of the desalination plant, since it is expected that levels will drop significantly under steady state conditions to levels which will either significantly reduce or avoid the need for Fe/Mn removal.

In addressing the first approach, Arcadis (Malcolm Pirnie) assumed that the steady state iron concentration would remain constant at 6 mg/l and developed capital and O&M cost opinions for handling this amount of dissolved iron. This approach assumes a constant high level of iron/manganese throughout the project life. This is unlikely the case.

It should be noted that during the Phase 3 test, the iron concentration in the pumped water reached 11 mg/l and was fairly constant for several months. However, when considering the full scale project slant well intake production rate of 30 mgd, based on initial modeling, it would be expected that the old marine groundwater would be pumped out in about one year, reducing the concentration of iron/manganese in the feedwater to very low levels. As previously noted, the fine grid, variable density, geochemical model will aid in better understanding the old marine groundwater pump out time as well as aiding in understanding changes in water quality during the pump out period and what might be expected under steady state conditions.

For the second approach to be feasible, we need to better know how long it will take to pump out the old marine groundwater until it is fully replaced with "young" ocean water and reaches steady state conditions. During the Phase 3 test, the iron levels increased steadily and then stayed relatively constant after reaching about 10 mg/l after 8 months of pumping and then slightly increased to 11 mg/l near the end of the test; the increasing amount of "young" ocean water and the slightly decreasing fraction of old marine groundwater kept the iron concentrations relatively flat over the last year of the test. The isotope data showed a slightly decreasing fraction of old marine groundwater being pumped over the test, as the "young" ocean water recharged the marine aquifer area where brackish groundwater had discharged out under the ocean. The location of the seawater interface was previously estimated at about 1,100 feet offshore under 2005 wet hydrologic conditions and lower basin pumping. For comparison, it is worth noting that the estimated volume of the brackish water from the shoreline to the saltwater interface was about 1200 AF (at a specific yield of 10 percent) under 2005 conditions and over the Phase 3 test the pumped volume of brackish water was estimated at about 3,600 AF out of a total volume of 5,286 AF by a salinity model that used actual test data (see Figure 6).

Figure 6 - Illustration of Slant Well Source Water Production vs. Time



Modeling will be required to evaluate the change in fraction of source water reaching the full scale project wells as a function of pumping rate and duration. Based on the earlier Phase 2 modeling, it had been roughly estimated that the old marine groundwater could be fully pumped out within about a year or so at the much higher 30 mgd production rate. The fine grid model will improve this estimate. At steady state after pump out of the old marine groundwater, the wells were predicted to produce about 95% "young" ocean water and 5% brackish groundwater.

The blended concentration at steady state is expected to be low from the large dilution of the "young" ocean water component. The iron/manganese concentrations at steady state are largely dependent on the concentration of iron/manganese in the brackish groundwater reaching the wells and if there is any trace amount of old marine groundwater remaining. Ocean water in the vicinity of the project is fully oxidized and would be expected to have a very low level of iron/manganese (levels are higher near the shoreline and decrease offshore away from San Juan Creek). As the ocean water is recharged into the aquifer, it is anticipated that the ocean water will pick up some dissolved Fe. Under steady state conditions, the produced water is expected to have a dissolved iron concentration around 0.10 mg/l assuming brackish groundwater iron at 2.0 mg/l. At this low total iron concentration the RO membrane should not have a problem removing any oxidized portion of the dissolved iron/manganese in the produced water. However, some chemical conditioning may be required to minimize cleaning. If higher concentrations occur, higher oxidized media filtration rates than assumed by the Arcasdis cost estimate could be used to remove iron/manganese at much lower capital and O&M cost.

If an injection barrier is found to be necessary to reduce drawdown impacts, in time both the injected and slant wellfield produced water would likely be largely free of dissolved iron/manganese.

Further fine grid flow, variable density and geochemical modeling is necessary to provide a better estimate of the pump out time, to estimate produced water quality over time, and to estimate pumped water quality under typical or steady state conditions. Offshore hydrogeology borehole lithology and water quality data and geophysical surveys for alluvial channel structural data will be necessary to fine tune these estimates during the project design, but are expensive to obtain. With operational data, the best method of handling the old marine groundwater iron/manganese loads can then be determined.

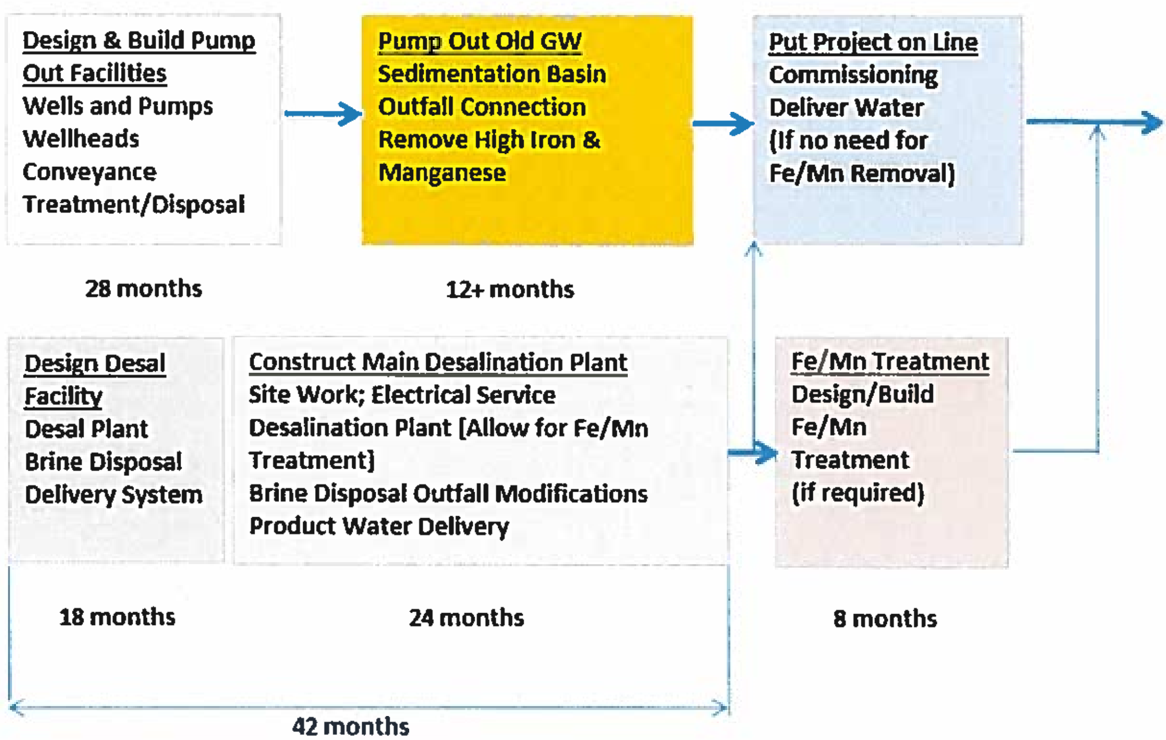
Assuming that the old marine groundwater can be pumped out in about a year or so under full scale production at 30 mgd, the second approach would be preferred. This approach would require that the project be constructed in two stages: (1) wellfield, conveyance and disposal system constructed and operated to pump out the old marine groundwater, complete pilot plant testing to finalize feedwater quality for treatment process design, and (2) complete construction of the remainder of the project. This may be necessary in any event due to the unknown steady state pumped water quality.

During the initial period of pump out of the old marine groundwater, it would be necessary to install a system to remove iron/manganese to levels that can meet discharge requirements through the SOCWA ocean outfall. The current NPDES permit does not have an iron/manganese numerical discharge limitation, but does have limits on settleable solids and turbidity, which would be impacted by the discharge of oxidized iron/manganese. This operation would require permitting through SOCWA and under its NPDES discharge permit.

To meet discharge requirements, iron/manganese will need to be reduced to acceptable levels in a cost-effective manner. During the Phase 3 iron/manganese pilot plant testing work, data were obtained on the effectiveness of oxidizing soluble iron/manganese followed by sedimentation to reduce the iron/manganese load. It was found that chlorine addition was necessary to provide effective oxidation followed by sedimentation at 15 minutes detention, which nearly fully removed all the iron and manganese. The cost for this short-term operation, for one year would include the costs for outfall use, slant well pumping energy, outfall O&M, ocean monitoring, and treatment equipment with chemicals and O&M. The cost for one year of operation is estimated around $4.5 Million. If a longer period is required, a second year is estimated to cost about $3.5 M. Compared to the cost of installing a full scale iron/manganese removal plant at $50 Million, the two stage approach is warranted.

Figure 7 "Full Scale Project Design and Construction Staged Implementation" illustrates the sequence for the major design and construction activities for the full scale project following the recommended approach to pump out the old marine groundwater prior to a decision on Fe/Mn treatment.

Figure 7 - Full Scale Project Design and Construction Staged Implementation



Regional Watershed and Groundwater Modeling

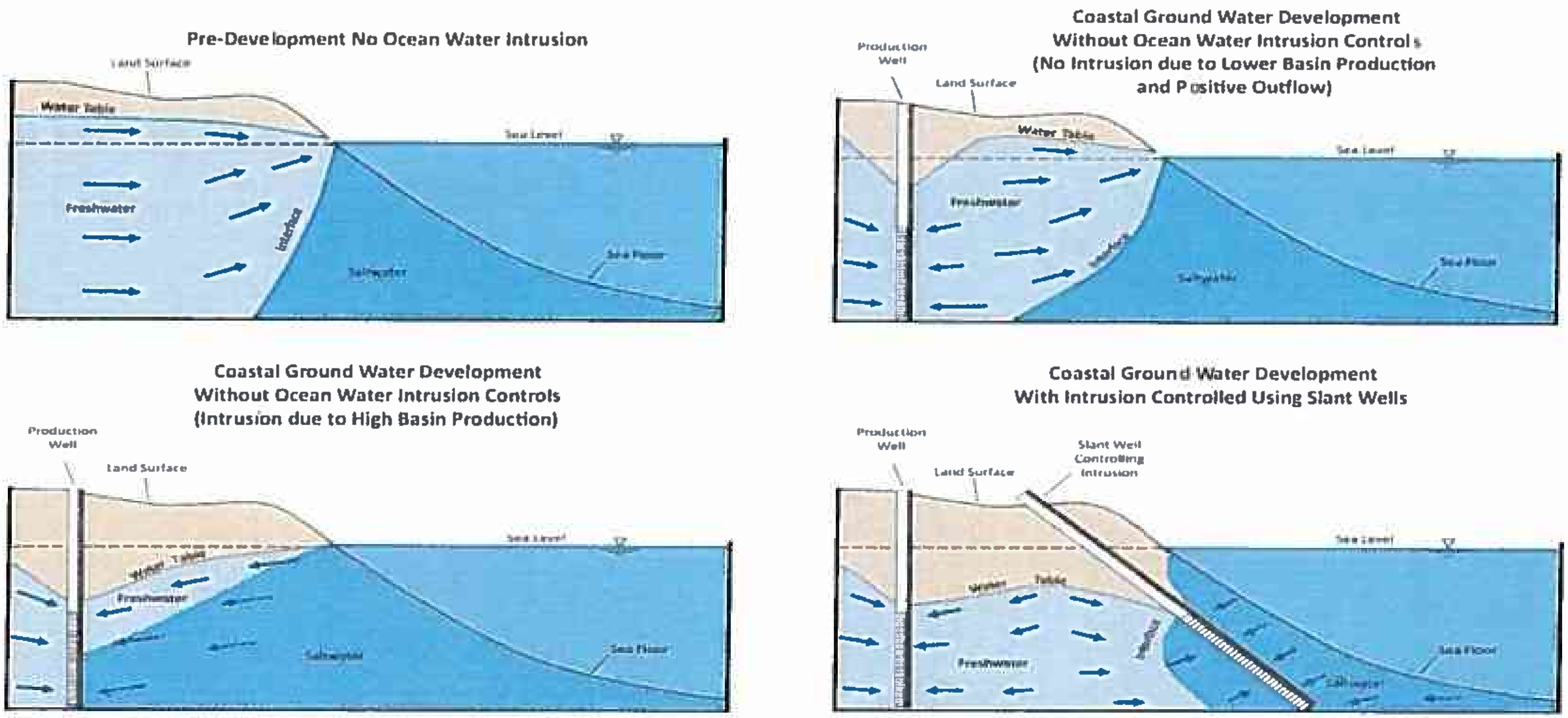
In this location, the paleo San Juan Creek alluvial channel extends out under the ocean within the continental shelf for about three miles. This paleo-channel offers a permeable connection to the ocean. The slant wells would tap into this alluvial structure to pull in filtered ocean water. Under steady state conditions, about 5% of the pumped water would be pulled in from the landward portion of the aquifer, which is brackish groundwater. Groundwater development of the Lower San Juan Basin has occurred over the last several years with the construction of two groundwater recovery desalter plants. To determine the Doheny Desal project impact on the basin and the desalter plant wells, it was necessary to develop analytical models to evaluate drawdown and groundwater take impacts on the basin.

To determine these impacts, a regional surface watershed and groundwater model was developed to determine the basin operable yield using a 64 year hydrology record (1947-2010) which included a 31 year dry period. The first tasks were to determine the basin operable yield without the ocean desalination project. This work which required nearly three years of effort, determined that the lower basin total storage capacity is about 46,000 acre-feet, about 12% less than previously estimated by DWR in 1972 and that the actual volume of water in storage in 2010 was about 30,000 af. The modeling also showed that basin yields over an extended dry and average periods would be about 8,040 AFY and 9,150 AFY, respectively, less than previously believed. Over the 64 year hydrology, it was found that basin storage levels would drop to about 25% of capacity during the long dry period and would refill relatively rapidly under average and wet periods. The model also indicated that seawater intrusion would occur over both dry and average conditions and would reach the SCWD wells in 9 to 12 years, assuming the higher production levels at the long-term sustainable yield levels, rendering them inoperable if additional desalination process treatment were not constructed. Accounting for the seawater intrusion would reduce the yields noted above by 300-400 AFY. Further work is necessary to refine these estimates.

As previously noted, about 5% of the 30 mgd slant well field production (about 1,660 AFY) would be basin brackish groundwater. In addition, the slant well field would provide seawater intrusion control through a coastal trough created from pumping. To mitigate the drawdown and take impacts on impacted producers, make-up water from the desalination project up to 1,660 AFY could be provided to them, less the amount that the basin would otherwise have to use to curtail production to avoid seawater intrusion impacts. Also, seawater intrusion control benefits that would be provided by the Doheny Desal Project should greatly reduce or fully avoid SJBA seawater intrusion control costs.

Future detailed coastal groundwater and geochemical modeling are required to fine tune drawdown impacts and to predict pumped water quality over time. This work will also evaluate physical mitigation using injection wells to create an artificial barrier by raising groundwater levels in the coastal area. This analysis will help to determine the least cost mitigation approach. Other work by the SJBA will investigate the ability to augment the groundwater supplies through stormwater conservation and recycled water and means to protect against seawater intrusion. The two monitoring wells constructed by MWDOC in Doheny State Beach should be maintained and used to monitor for seawater intrusion under upstream groundwater operations.

Figure 8 - Illustration of Seawater Intrusion and Extraction Control



Full Scale Project Conceptual Assessment

The full scale Doheny Desal Project will consist of five major components: (1) feedwater supply system, (2) power supply, (3) desalination plant, (4) brine disposal and (5) system integration. Following is a brief description of each major system component.

Feedwater Supply System. At this time, it is expected that 30 MGD of ocean water supply can be drawn from a slant beach well system consisting of nine wells constructed in three clusters of three wells each along the mouth of the paleo-channel of San Juan Creek along Doheny State Beach. The wells will be fully buried and will extend out under the ocean. Seven wells will be fully operational with two standby wells for operating flexibility and redundancy. The slant wells, wellhead vaults, submersible pumps, power supply, instrumentation cables, nitrogen feed lines, and conveyance pipelines will all be fully buried. Since the wells will be constructed on Doheny State Beach, the construction and maintenance periods are restricted to the off-peak recreational use season, September 15 to May 15.

The wells will be constructed from the beach upslope of the ordinary high water line near the back of the sandy beach, at a 23 degree angle from horizontal, fully penetrating the offshore paleo-channel alluvial deposits. The preferred construction method is Dual Rotary Drilling which avoids the need for drilling muds by advancing an outer pipe shield casing that also prevents cave ins. The well lengths will be approximately 520 feet, consisting of about 280' of 24-inch diameter blank pump housing and 240' of 12 to 16-inch diameter well screen. The long pump housing permits maximum drawdown and yield.

The wells will be constructed in arrays of three wells each with a single construction location and common well vault. The three vaults will be buried to a depth of about five feet below the beach. The vaults will contain the well headers, distribution pipeline, well spools for well cleaning, control valves, flow meters, check valves, isolation valves, nitrogen gas feed lines, and power and instrument cable connections. The nitrogen gas is required to prevent air being pulled into the well in order to minimize any potential oxidation of dissolved iron and manganese prior to the treatment processes.

Preliminary vault drawings are shown in Figure 9. Acoustical damping of the submersible pump noise to very low levels on the beach may be required.

Conveyance from the slant wells to the Desalination Plant site will be by pipeline/tunneling. Preliminary alternative alignments were identified in the Boyle Engineering Corporation Engineering Feasibility Study (March 2007). Two candidate alignments were recently laid out and costs estimated by Kiewit. A collection pipeline to each of the three well vaults will parallel the shoreline and then combine into a single line to cross under PCH and/or cross under San Juan Creek and then to the Desalination Plant. Excavation and microtunneling construction methods, with launch and reception shafts for construction under the beach, PCH and San Juan Creek will be required. The conveyance system will terminate at the Desalination Plant at the Feedwater Supply High Pressure Pumping Station. This pumping station must be in-line without a wet well to prevent air entrainment and oxidation of iron/manganese which is expected in the feedwater at low concentrations, at least during the initial start-up period.

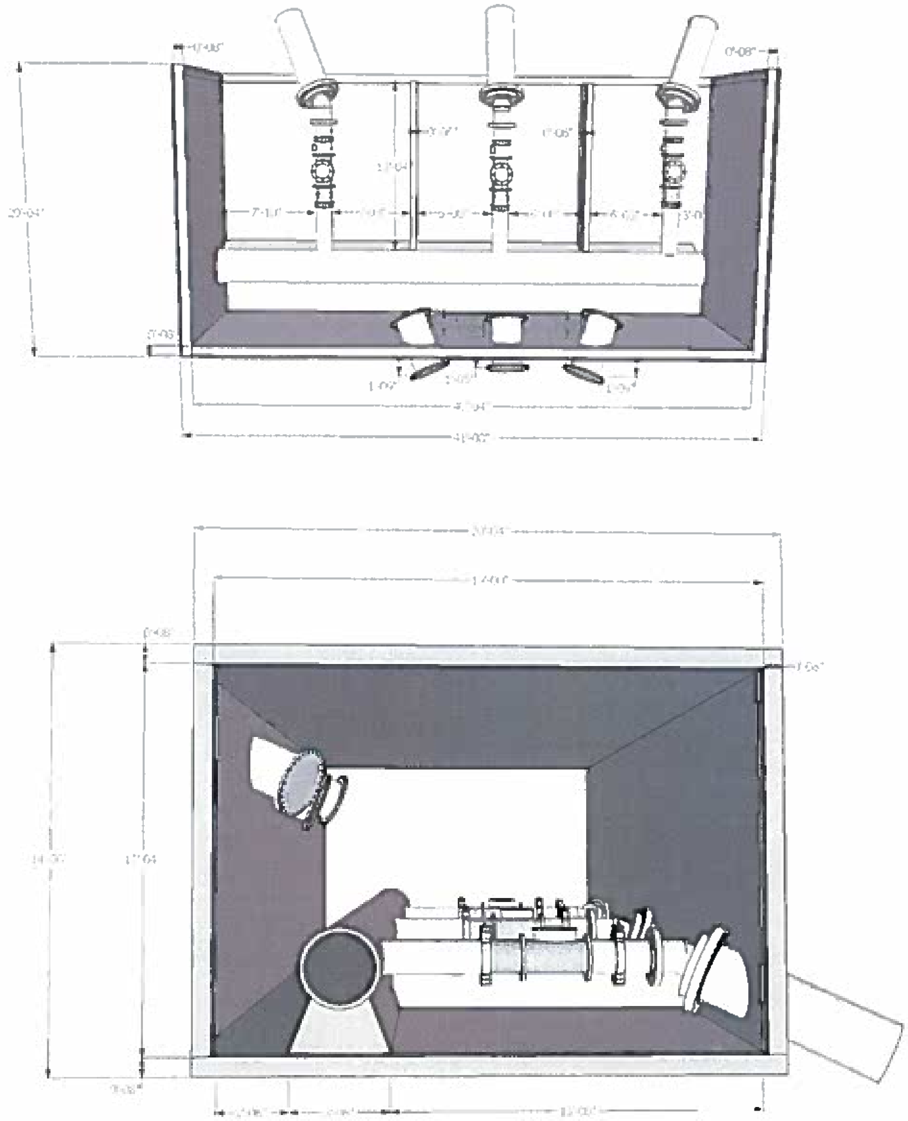


Figure 9 - Top and Side Views of Conceptual Wellhead Vault

Power Supply. Electrical service to the facility will be provided by San Diego Gas & Electric Company. SDG&E prepared an "Engineering Study for Electric Service at the Dana Point Ocean Desalination Plant" dated March 2007. An updated study will be required and is being discussed at this time. Based on an estimated load of 8.3 MW, one to two 12kV transmission circuit feeds would be extended to the plant site, with transformer, panels, cables and meter. About 1,000 feet in new trenches for 4-5" conduits would be required to extend existing feeds to the plant site. Additional facilities and equipment to step voltage down to 4kV or lower voltages would be the responsibility of the project and would be placed on the desalination plant site. The capital cost of these facilities is about $700,000 with the bulk of the power supply costs being built into the rates by SDG&E. The full options for power service will need to be evaluated. In addition, it may be possible to enter into a "demand shedding" agreement with SDG&E

for short-term "called" interruptions in the power supply to help them manage loads during peak demand periods. In exchange, a discount on the energy rate is provided. These options have not been fully explored at this time. Clearwell storage and/or reservoir storage would be used to maintain supplies during the few hours of "load shedding".

Renewable energy capabilities at the site and within the ocean are quite limited. Solar panels may be placed on the building roofs, but would only support minimal energy needs. Wave energy is considered infeasible in this location. Third party wheeling of renewable energy sources developed outside of the area is not available to water utilities at this time. Further, it would be expected that the costs for these types of renewable projects would be higher than what the electrical utility can develop. If the same requirements are placed on the project as incurred by the Poseidon Resources project, offset energy would be required to make the project carbon neutral with imported water deliveries. The cost of providing this mitigation is modest, estimated at about $50,000 per year.

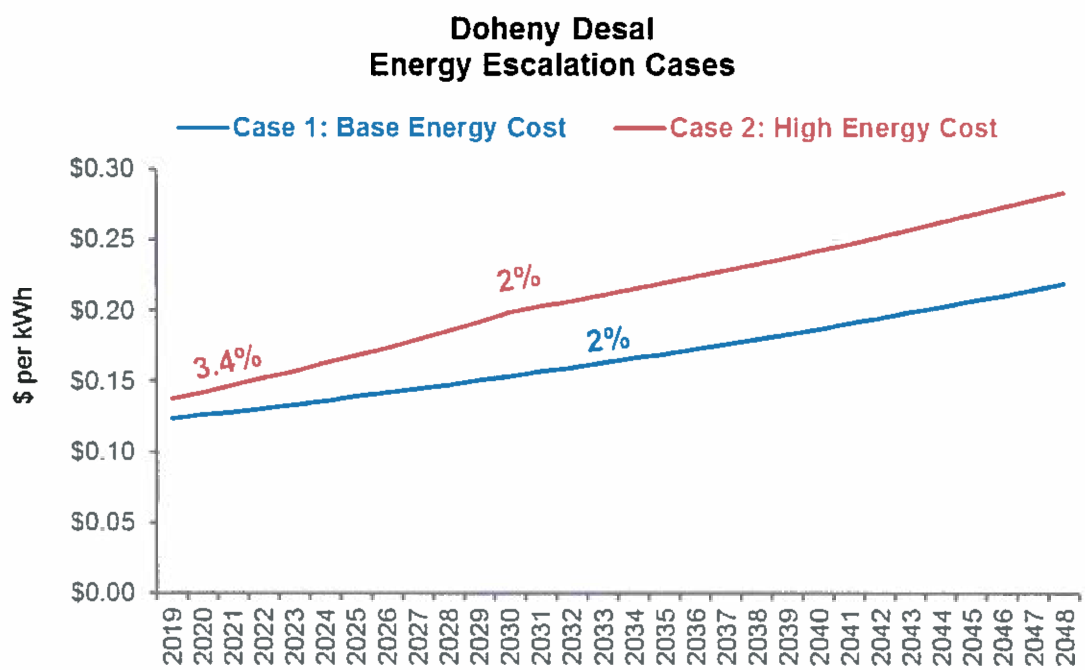
Projected Cost of Electricity for the Plant. Electricity charges are projected to bump up over the next 7 years and then level off due to several coincidental factors. There are three main causes for the bump up in rates: (1) California's mandate to achieve 33 percent renewable energy by 2020 which includes solar, wind and ocean generation, energy storage, and new transmission and distribution facilities, (2) phase out of once-through cooling systems and retirement of older inefficient generation facilities, and (3) closure of the San Onofre Nuclear Generation Station. Long-term estimates of electrical energy costs to supply the plant are difficult to make in California given the uncertainty in how far California will pursue renewable energy goals beyond the 2020 mandate, the effect of future increased distributed user generation and storage systems, long-term natural gas fuel prices, efficiency standards and usage, future population and economic growth drivers, and general inflation.

For the Doheny Desal economic analysis, two rate projection scenarios were evaluated. These rate projections were developed by SDCWA in July 2012 for their energy cost analysis for the Carlsbad Desalination Project and are considered applicable at this time. It should be recognized that actual energy prices will likely be higher or lower than the forecasts. It should be remembered that the Doheny Desal would be a base-loaded 24-7, 365 day per year operating facility. Recent changes by SDG&E in their cost of service have favored these types of facilities compared to typical residential customers, which has resulted in a lowering of the rates. The two cases analyzed are:

- Base Case 1 – Assumes significant RPS (renewable portfolio standard) and AB 32 implementation with electricity cost escalation at 2% annually through 2030 (5 successive 6% rate case increases from July 2012 – actual rate effective in July 2012 was 10.5¢ per kwhr) and then at 2% thereafter. The first bump up in rates occurred in late September 2013 when the AL-TOU rate increased from 10.54¢ to 11.54¢ per kwhr, a 9.5% increase in 15 months (7.6% annualized rate of increase).
- Higher Rate Scenario Case 2 – Assumes high RPS/AB 32 implementation with electricity costs escalation at 3.4% annually through 2030 (6 successive 10+% rate case increases from July 2012) and then reversion thereafter to 2%.

Figure 10 below shows a comparison of the two rate forecasts. Since energy costs account for about 30% of the project cost, the issue of future energy costs needs to be carefully tracked. Depending on future regulatory policy, renewable technology advancements, and shale gas production and natural gas prices, self-generation or investments in outside projects to deliver the energy to the site may be viable options, but competing with SDG&E at their cost of energy and based on the level of reliability they bring will be difficult.

Figure 10



Desalination Plant. The Desalination Plant site is a 5-acre parcel situated on the east side of San Juan Creek just north of PCH on land owned by South Coast Water District. This parcel is situated within the jurisdictional boundary of the California Coastal Commission under the category of "Appeal Jurisdiction". The parcel is currently rough graded to an elevation of approximately 22 feet msl. A geotechnical study is required to determine the design measures to reduce geotechnical hazards from either an earthquake, flood or tsunami. It is anticipated that the site will need to be raised to provide flood control protection with an allowance for sea level rise. 100 or 200 year storm flood protection and flow criteria will need to be determined for protection of the site. In addition, it is anticipated that the site will need to be excavated, compacted and stabilized to provide an adequate foundation for the facility structures.

The Desalination Plant will consist of the following main system components: (1) Electrical Service Sub-Station and Equipment, (2) High Pressure Feedwater Supply Pumping Station, (3) possible Pretreatment Facilities, (4) Reverse Osmosis Desalination Building and Equipment, (5) Post-Treatment Facility, (6) Concentrate Brine Holding Storage and Discharge Connection to the adjacent San Juan Creek Ocean Outfall, (7) a potable clearwell reservoir and (8) a booster pumping station. The site will also consist of roads, parking areas and other related storage, equipment, chemical storage and feed system, and related appurtenances. The structures will need to be constructed in an architecturally pleasing style fitting to the area and will be constructed to be energy efficient with possible solar roof panels and/or green roofs and other related "green" energy systems.

The plant will receive feedwater at 30 MGD. Due to the limitations on yield, it is recommended that a recovery rate of 50% be designed in order to yield 15 MGD of product water. Energy recovery pressure exchanger devices will be utilized to recover 95% of the energy in the high pressure brine stream.

Subject to regulatory and economic feasibility, the Doheny Desal project may be designed to recover the RO concentrate streams from the City of San Juan Capistrano and South Coast Water District groundwater recovery plants by using those flows as feedwater. It is estimated that both of these plants will be enlarged from their current combined 6 MGD capacity to 10 MGD in the future, producing about 2 MGD of brine at a concentration of approximately 10,000 mg/l. This could result in an increased Doheny Desal Project plant yield by up to 1 MGD. This approach appears promising as it would reduce costs to both the City of San Juan Capistrano and South Coast Water District and to the Doheny Desal Project. The feasibility of an integrated brine recovery plan should be evaluated.

Post-Treatment for the RO permeate will be required to stabilize the water so that it is not corrosive to the distribution system. The standard method is to add in lime to the permeate to produce a stabilized water. Some locations, such as Israel now also require the addition of magnesium to achieve a more balanced cation mix. One option that will be considered for regulatory and economic feasibility is to further condition the water with about 1 MGD of brackish water, potentially from one of the SCWD wells, treated for removal of dissolved iron and manganese, disinfected and blended back with the permeate. This will allow production of water that more closely resembles in quality imported water, including providing a more natural blend of cations (calcium, magnesium, potassium) and anions (carbonate, bicarbonate, chloride, sulfate). Additional stabilization with respect to calcium carbonate saturation will be required.

Product water quality criteria will be developed for the desalination system. Key considerations are the level of bromide and boron in the product water. A second pass system at a minimum of 40% capacity is being planned to lower bromide to acceptable levels that prevent accelerated decay of chloramine disinfection residuals in the finished water. Boron levels will also be reduced when achieving the bromide levels. This will provide a product water that is fully protective of ornamental landscape plants.

Brine Concentrate Disposal. The waste brine concentrate from the Reverse Osmosis unit process will be co-disposed with treated municipal wastewater in the adjacent San Juan Creek Ocean Outfall. Due to the diurnal flow pattern of the wastewater flows, a regulatory storage basin at the desalination plant will be required. The concentrate will have a concentration of approximately 66,000 mg/l and will be combined with wastewater having a concentration about 800 mg/l. The current average dry weather municipal wastewater flow in the outfall is 17 MGD. It is anticipated that this flow rate will decrease in the future with additional upstream recycling.

The SWRCB (State Water Resources Control Board) is in the process of amending its California Ocean Plan for Ocean Desalination Intakes and Brine Disposal. When the plan is amended it is anticipated that more stringent requirements for brine discharges will be required.

The ocean outfall diffusers may need to be modified to meet the new SWRCB Ocean Plan Amendment requirements. Modifications might include new diffusers, such as tidal or rosetta valves, or other diffuser devices to increase initial dilution to meet new regulatory requirements. The San Juan Creek Ocean Outfall has an estimated hydraulic capacity of 85 MGD. Plant operations and brine disposal will be ceased only during major storms when total wastewater and infiltration/inflow rates exceed the ability to discharge the brine. This is a rare event and only occurs during very wet years when the collection system trenches are saturated and when stormflows greater than an estimated 25 year intensity occur.

The existing outfall requires structural improvements at the ocean junction structure and at the surge chamber connection from the Latham Plant to the outfall where it joins with the Santa Margarita Water District land outfall on the east side of San Juan Creek. These improvements would be undertaken by South Orange County Wastewater Authority as they are needed for wastewater disposal. The brine concentrate line would connect to the surge chamber structure which is located adjacent to the project site. Flow and water quality monitoring will be required for the discharge. SOCWA approval is required. For project participants not discharging wastewater to the San Juan Creek Outfall, it will be necessary to acquire capacity in the system. The current San Juan Creek Ocean Outfall capacity and ownership are shown in the following Table 1. Cost allowances for the outfall capacity have not been included in the Project Cost Estimate because final capacity selection by agencies have not yet been made and nor has an engineering study been completed, which needs to be held off until the new SWRCB Ocean Plan Amendments are finalized.

Table 1 – SOCWA San Juan Creek Ocean Outfall – Agency Ownership

Agency	Ownership Percentage (%)	Capacity Ownership (mgd)	
		80 mgd	85 mgd
Moulton Niguel WD	15.51	12.42	13.18
San Clemente	16.62	13.30	14.13
San Juan Capistrano	11.08	8.86	9.42
Santa Margarita WD	44.32	35.46	37.67
South Coast WD	12.47	9.98	10.60
	100.00	80.00	85.00

Ref: SOCWA Hydraulic Capacity Evaluation, Carollo Engineers, June 2006

System Integration. The project water will be pumped into the Joint Transmission Pipeline and the Water Importation Pipeline. The hydraulic grade line is approximately 450 feet in both pipelines. Both pipelines cross near the Desalination Plant site on South Coast Water District property, requiring short pipelines to the two points for interconnection. Connections to Laguna Beach County Water District will require a small pump station addition at the existing SCWD/LBCWD interconnection station. Some additional provisions to assure maintenance of the disinfection residual at sag points may be required.

Conceptual Level Cost Opinion

Arcadis (Malcolm Pirnie) prepared a conceptual level cost opinion update for the project in 2011. The cost estimate was modified for the RO system cost, based on cost reviews provided by three firms.

Operation and Maintenance costs were estimated for labor, replacements and repairs, chemicals and feed systems, maintenance materials, and energy. These costs are shown in Table 2. Without energy, the O&M costs are estimated at about $5.8 million per year which is equal to $363/AF. Energy costs are estimated at $7.1 million per year which is equal to $446/AF. Total O&M, plus energy is estimated at $809/AF.

The overall adjusted project capital cost opinion was $152,800,000 (2012$) for the case without iron/manganese removal as shown on the following Table 3. The reviewers had more recent bid data and recommended reducing the RO system cost by 20% ($8 million). The costs include a 25% contingency ($22.6 million) and 15% for professional services ($18.8 million).

The unit cost of water from the project, in current dollars, assuming high iron and manganese removal is not required, is estimated at:

- $1,611 per AF without the MET subsidy of $250 per AF
- Capital at $588 per AF (includes contingency and professional services)
- O&M at $363 per AF
- Energy at $446 per AF
- Land Lease at $47 per AF
- GW Mitigation at $167 per AF for take of 1,660 AFY on average

- Accounting for the MET subsidy results in a cost of water of $1,361 per AF (2012 dollars)
- For comparison purposes, MET avoided water costs in 2013 (Tier 1 + Capacity Charge Readiness to Serve Charge) amounts to $953 per AF

More detailed cost information is shown in the subsequent cost and economic analysis section.

Areas of greatest cost uncertainty are: (1) electrical energy and (2) brine disposal. The projected rate of increase in electrical energy costs over the next decade is a major uncertainty due to a combination of factors: implementation of AB32 and renewable energy, elimination of coastal power plants once through cooling systems, and the shutdown of the San Onofre Nuclear Generation Station (SONGS). These costs will need to be closely followed and incorporated into the project economic analysis.

Brine disposal costs for purchase of capacity in the San Juan Creek Ocean Outfall for those needing new or additional capacity are not yet included in the costs. The costs to modify the outfall diffuser to allow meeting discharge requirements are unknown at this time and no estimates have been included. A placeholder for modifications to the outfall junction structure at $2 million has been included. The outfall costs may further increase if significant recycling depletes the wastewater discharge. Evaluation of new diffuser systems and the performance of the system under the forthcoming SWRCB brine disposal regulations will need to be undertaken to determine the cost for brine disposal. This work also will require brine dispersion modeling and possibly some marine biology assessments.

Table 2 - Full Scale Doheny Desal Project O&M Cost Opinion

Excluding Electrical Energy Malcolm Pirnie (2011)	
	No Pretreatment
Labor	$1,260,000
Replacements/Repairs (Includes RO membranes & other)	$1,937,000
Chemicals/Feed Systems	$1,300,000
Maintenance Materials	$750,000
Other	$550,000
Subtotal O&M	$5,797,000
O&M $/AF	$363
Energy	$7,112,900
Energy $/AF	$446
Total - $/AF	$809

Notes

1. Average Labor rate updated to $105,000/year (OCWD GWRS O&M labor cost plus benefits)
2. Malcolm Pirnie assumed 12 FTE no Pretreatment
3. Replace First Pass RO Membranes every 3 years and Second Pass every 5 years; plus includes all other equipment replacements.
4. Energy at 4,228 kwhr/af and 10.5¢/kwhr
5. O&M increases to $421 per AF if high iron and manganese treatment is required.

Table 3 - Doheny Ocean Desalination Project Capital Cost Opinion

South Orange Coastal Ocean Desalination Project Conventional Design-Bid-Build Project Cost Opinion (Oct 2011)				
Major Activity Cost Item	**Description/Sub-Activities**	**Estimated Schedule (Months)**	**Case 1 Fe/Mn Pretreatment**	**Case 2 No Pretreatment**
PRE-CONSTRUCTION PHASE				
Preliminary Engineering Work	Engineering Work and Support for Environmental and Permitting Work	24	$750,000	$750,000
CEQA/NEPA Work	Baseline Environmental Monitoring	12	$300,000	$300,000
	Prepare and Process EIR/EIS	18	$500,000	$500,000
Additional Studies & Investigations	Outfall Modeling & Modification Engineering	15	$250,000	$250,000
	San Juan Creek Property Geotechnical and Site Investigations	15	$100,000	$100,000
	Offshore Geophysical Investigation	12	$400,000	$400,000
	Offshore Hydrogeology/Downcoast Drilling/Testing Investigation	12	$3,600,000	$3,600,000
	Power Supply Plan	12	$100,000	$100,000
Permitting and Approvals	Agency Meetings (Parks, CDPH, RWQCB, ACOE, CCC, SLC etc) Permit Applications Supporting Technical Data/Analyses Permit Applications Preparation and Submittals Permit Processing and Approvals	24	$400,000	$400,000
JPA Formation, Legal/Financial Advisors	JPA Formation Legal and Financial Advisor	12	$300,000	$300,000
Design/Construction Team Selection	RFP Development and Design Engineer Selection	12	$300,000	$300,000
SUBTOTAL UP FRONT ACTIVITIES COST	Subtotal		$7,000,000	$7,000,000
	Contingency at 20%		$1,400,000	$1,400,000
	Total		**$8,400,000**	**$8,400,000**
DESIGN & CONSTRUCTION PHASE		30		
Design/Construction Project Costs	Intake and Raw Water Conveyance		$44,759,000	$44,759,000
	Pretreatment for Fe/Mn Removal		$43,300,000	$0
	RO Treatment		$53,534,000	$53,534,000
	Post Treatment		$15,636,000	$15,636,000
	Miscellaneous (Brine, SDGE, State Parks, Mitigation)		$11,648,000	$11,648,000
	Subtotal Construction Contractor Cost		**$168,877,000**	**$125,577,000**
	Base Construction Contractor Cost		$138,503,250	$102,991,000
	Contingency (25%) **(1)**		$30,373,750	$22,586,000
	Prof Services (Design & Construction Phases at 15%)		$25,331,550	$18,836,550
	Subtotal Contstruction Cost		**$194,208,550**	**$144,413,550**
Total Project Duration and Capital Cost		**70**	**$202,608,550**	**$152,813,550**

(1) Cost of pump-out and treatment of high iron and manganese laden water prior to start of operations estimated at $4.5 million, assumed part of contingency

Cost Comparison to Imported Water and Economic Analyses

Local projects that develop new sources of supply provide both source and system reliability benefits. In the case of ocean desalination, there is also a water quality benefit derived by production of desalinated water that has lower salts and hardness than the imported supply. Typically, when evaluating new projects, the cost of the new supply is first compared to the projected cost of MET water. The desalination supply will offset MET water purchases and in time these costs are projected to be less than imported water costs resulting in a net positive savings (benefit #1). In addition, ocean desalination improves system reliability (benefit #2), provides a drought proof supply (benefit #3) and provides improved water quality (benefit #4). The question is how to more accurately account for these benefits. Since the local agency drought benefit is reduced under the current approach taken in MET's Water Supply Allocation Plan and water quality benefits are derived by the end-user through longer water fixture life, the analysis conducted focused only on the direct supply and reliability benefits.

The unit costs were favorably compared to the projected costs of imported water, showing a possible cross over in about 10 years after start of operations. The investment cost was also favorably compared to the value of system reliability provided by the project when compared to alternative emergency reservoir costs and capabilities.

Cost of MET Water. MET has recently updated the projected cost of water to 2017. MET staff believes the near-term projection of rates is a reasonable estimate. Many factors that will result in upward pressure on MET rates have been reflected in these projections including a lower water sales assumption. The effect of a lower water sales assumption by MET is more conservative and, hence, is able to provide more flexibility for covering unexpected rate impacts in the future. Discussions with MET staff indicated that out-year projections beyond 2017 would best be covered by looking at a range of escalation factors from 3 percent on the low side to 6 percent on the high side.

The future cost of water from MET is sensitive to a number of variables, making it difficult to develop an accurate long-term projection. Following are potential factors that could impact rates into the future:

- Energy Costs – The impact of California's Global Warming and Solutions Act (AB 32) on electricity prices is not factored in and is unknown at this time. Higher energy rates are forecasted due to several factors: AB32 mandated requirement for a higher mix of renewable energy sources, replacements and expansions in the Statewide electrical transmission system, phase out of Once-Thru-Cooling coastal power plants, and the shutdown of the SCE SONGS Plant (San Onofre Nuclear Generation Station) and its replacement. MET and the State Water Project Contractors are also facing a particular nuance of the AB 32 legislation whereby the electricity they import from out-of-state for Colorado River Aqueduct and State Water Project pumping may be assessed by California Air Resources Board as an "energy generator" in the state. MET staff is in the process of negotiating a method to provide relief and at this time ARB has indicated that they may provide MET some allowances, but not to the SWP. The impact of this decision could impact MET costs on the order of several million dollars per year.

- Bay-Delta Conservation Plan (BDCP) – A portion of the future costs of the BDCP have been factored into the near-term forecasts with the remaining portion of the costs to be included in the escalation range. The most recent estimate of costs for the fix, assuming MET pays for about 25%, is the cost of water for capital amortization and O&M costs estimated around $200 per AF on the MET water rate. Depending on what actually occurs, the costs could likely be either higher or lower, but would probably tend to cluster towards a higher cost. These are factored in between now and 2026 when the project is expected to start-up. Inflation is not included in these costs.
- MET Rehabilitation and Repair (R&R) Costs of Infrastructure (PAYGO funding) – MET has over $6 billion of investments in the ground not including their share of the SWP. These assets require periodic R&R or replacement. MET's asset management analysis completed several years ago estimated that the R&R program can be achieved at an annual cost of $125 M per year. This program is funded annually through the Pay-As-You-Go (PAYGO) funding, which is still considered sufficient at this time. When inflation picks up, the spending over time will have to correspondingly increase to keep in step with the R&R and replacement needs.
- SWP R&R – It is widely reported that the SWP is not maintained in nearly as good a condition as the MET system. Currently, the SWP is limited by facility conditions to about 70% of the delivery capacity of the SWP and hydropower generation has been reduced because of the failure at the Oroville facilities. MET has included some additional costs of future requests for SWP R&R funding in their budget (higher than what the State is requesting). This may or may not be sufficient to cover the deficiencies in the SWP needs. The SWP contracts expire in 2035 and as the contracts are renewed, it is possible that the renewed contracts will allow for additional levels of R&R and replacement funding without rate increases when the original debt of the SWP is fully repaid. MET and DWR are currently looking at options for the SWP R&R needs.
- Treatment Costs – The full capital and O&M costs associated with the ozone retrofit project at all five of MET's treatment plants are fully captured in the near-term projected water rates.
- Pension/Health Costs – A portion of the (not all) MET pension costs are already built into the rate projections. Other Post Employment Benefits (OPEB) have about a $500 million unfunded liability. MET believes they can eliminate the exposure with an annual contribution of about $50 M per year over the next 10 years. This is not fully reflected in the near term water rates. The other possibility is that by setting a more conservative assumption on water sales, any excess revenue, should it occur, could be used to fund this liability.
- The most recent population projections for the MET service area show an increase of 7.5 million by 2060. This increase in population will require additional new water supply at an increased cost to the region. The share of these costs between MET and the retail suppliers is the subject of future decisions.
- MET staff is examining methods to increase their fixed revenue. One such method is to change the basis of future AV tax revenue so that the percentage of tax levy remains fixed into the future at the current level rather than having the tax levy transition to zero between now and 2035 as planned. The additional tax levy, if successful, would tend to hold rates down in the future because of the estimated $80 million or so in fixed revenue that would accrue each year.

Figures 11 and 12 provide a summary of historical and projected MET water rates. Note the stair step pattern seen in the historical chart. This pattern is caused by water sales, costs and reserve variations.

Figure 11 - MWD Water Rate History (1980-2012)

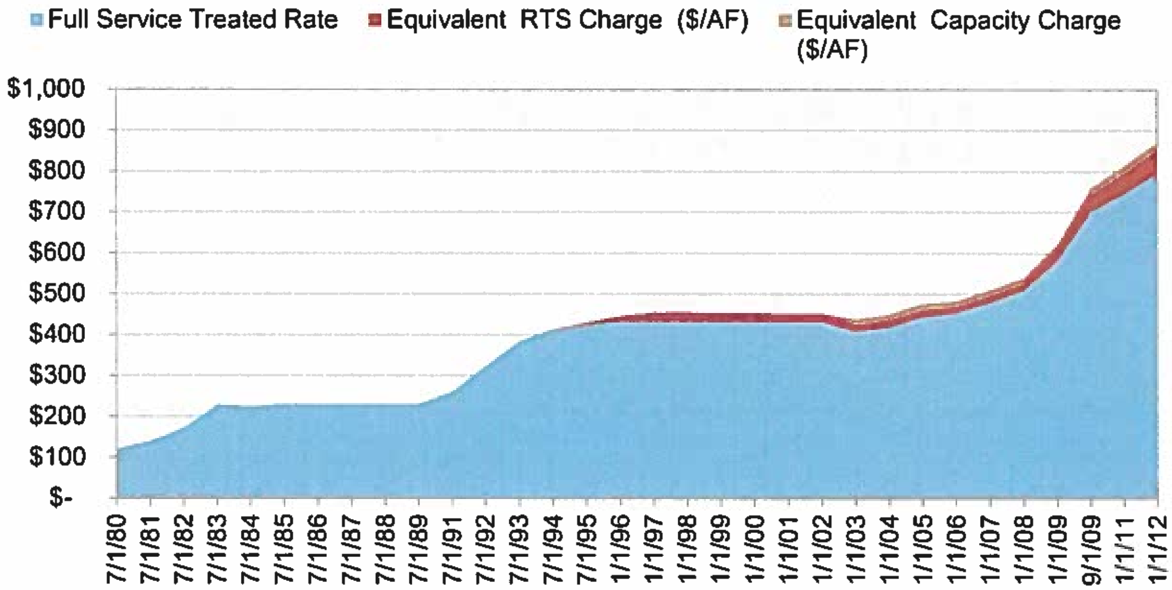
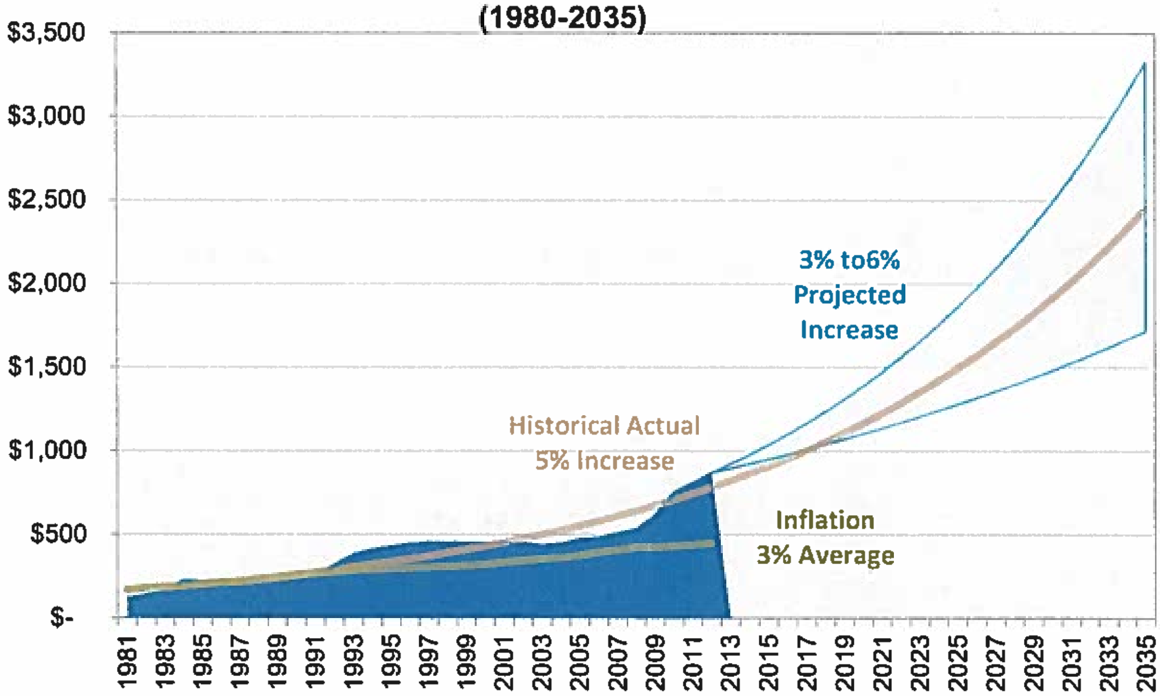


Figure 12 - Historical and Projected MWD Water Rates (1980-2035)



Discussions with MET staff indicate that outyear cost projection beyond 2017 ranging from an annual escalation of about 3% per year on the low side to about 6% per year on the high side can be expected. Discussions with various sources in the industry note more cost pressures pushing rates towards the higher side of this range although recent discussions with MET staff indicate the potential that MET costs will trend towards the lower side of the range over both the near and mid-term, depending on future inflation rates and other potential unexpected costs.

Sensitivity Modeling. A sensitivity analysis approach was utilized to set up an economic analysis which would allow various input assumptions to be tested to understand the effects on both the cost of water from the Doheny Desal Project and to evaluate the project cost cross over point with MET rates (the point in time when the project cost would be less than imported water costs). This allows an analysis of the potential net present value difference between Doheny Desal and MET water rate scenarios. Figure 9 presents the "base case" analysis. The model provides the ability to vary the following parameters:

- Cost and escalation assumptions for Doheny Desal, the level of contingency assumed and whether or not pre-treatment facilities for iron and manganese will be needed

- Energy consumption and cost information can be varied. Two periods of energy escalation were provided, 2012 to 2030 and then after 2030 to allow the rate assumptions to be tested

- General inflation rates

- Project financing assumptions including the bond interest rate and whether any grant funds will be provided

- For the economic analysis, the Present Value factor can be modified

- A place-holder for land costs and an escalation factor is provided

- The MET rates are hard coded into the analysis through 2017 and then an escalation rate is used for rates beyond 2017

- The calculation summary provides the capital and O&M cost breakdown

- The Net Present Value function calculates the difference between the project rate and the MET rate and provides a present value to 2012 dollars. The purpose of this calculation is to understand the amount of costs above the MET rates up to the point of cross over and then it also quantifies the amount of costs less than the MET rate after the cross over and summarizes the full 30-year Net Present Value (positive = savings).

- A Reliability Benefit is the last input function. This is a measure of the system reliability benefit for the project. There are good reasons for investing in a project, even if the initial cost of water from the project may be above the cost of MET water. These include the reliability provided by having a local production facility able to supply system needs during an outage of the imported system in the event of a major earthquake or other cause and through an extended drought, as the desalination supply is independent of hydrology. The project would provide a significant emergency supply, system reliability benefit to protect the area from an outage of the imported water system as well as a drought supply benefit.

Discussion of Economic Assumptions in Table 4. Nine different economic scenarios were run to test the sensitivity of the assumptions in the sensitivity model, and the results can be found in Table 4. The findings indicated that the Doheny Desal Project supply cost is generally competitive with projected imported water costs. When considering the system reliability benefit of avoided investment in other local projects, the project provides a substantial cost savings and economic value to the community. The cross over point and net present value savings is most sensitive to future MET rates escalation assumption, e.g. higher MET rates improve the project comparisons. The detailed presentations of the nine sensitivity cases are included in the Appendix. The nine scenario runs include the following assumptions:

- **Reliability Benefit.** A project benefit is the ability to continue providing water into the local system in the event of an outage of the import system. The ocean is analogous to an emergency reservoir. Santa Margarita WD recently constructed the Upper Chiquita Reservoir Project at a cost of $50 M. This facility can provide emergency water supply at 23 cfs for about 2 weeks. The Doheny Desal Project can supply 23 cfs continuously. For a one month outage, the desal project provides the same emergency supply as two Upper Chiquita Reservoirs. The cost of two reservoirs would be about $100 M, which is the equivalent emergency reliability benefit that would be provided by the Doheny Desal Project assuming a 30 day outage. The value increases with the length of outage. Taking this benefit into account by amortizing it at the same rate and period as the overall project results in lowering the "cost" line (shown below by a second "project cost line" by about $385 dollars per AF (amortized cost of $100M). Accounting for the second benefit does not truly lower the cost of the project, but it does help identify and account for the emergency supply value of the project and the avoided cost of new reliability projects.

- **Fe/Mn Treatment.** The basis for the iron/manganese pretreatment system cost estimate was the assumption that Fe/Mn concentrations would remain at 6 mg/l throughout the project life, resulting in a capital cost for the oxidized filtration system at $50 million. Based on our expert panel review, it is expected that the old marine groundwater which is high in Fe/Mn would be pumped out in about a year, leaving just the 5% contribution from the brackish groundwater which has Fe/Mn concentrations around 2 mg/l. Under this scenario, the steady state Fe/Mn concentration would be 0.10 mg/l, not 6 mg/l. At this low level, pretreatment is not likely necessary, or if it is the costs would be substantially below the $50 million estimate as much higher loading rates could be utilized in the oxidized media filters. Also, use of an injection barrier along the coast to mitigate the project's take of brackish groundwater would eliminate in about a year or so the Fe/Mn contribution from brackish groundwater, thus eliminating any need for Fe/Mn removal.

- **Energy Scenario.** For the base case, energy costs have been escalated at 2% per year and have been projected at that same rate based on studies by SDG&E and others before the shutdown of the SONGS and increase in renewable requirement to 33% by 2020. For the high energy rate escalation scenario, 3.4% was used out to 2030 and 2% thereafter, based on work done by SDCWA.
- **Project Financing.** Project financing was assumed at an interest rate of 4.5% (current municipal AA bond rates). It is likely the project could receive a low interest loan from the State Water Resources Control Board State Revolving Fund that would further reduce the interest rate (at one-half of the State's prior year's general obligation bond rates).

- **Additional Benefits.** The project would also provide seawater intrusion control and water quality benefits to the basin, avoiding the need for a dedicated seawater intrusion control barrier. The project supports optimum utilization of the San Juan Basin without the basin having to incur the cost for seawater intrusion control. The basin benefits have not been factored into the economic analysis. This benefit was NOT specifically addressed in this analysis and is likely better to be accounted for in any future mitigation discussions.

Figure 13 – Doheny Ocean Desalination Project Economic Analysis – Base Case

Doheny Ocean Desalination Project - Economic Analysis - DRAFT VERSION 1.8

Input

Capital Cost	
Fe/Mn Treatment?	No
Contingency of Const.	25%
Start of Construction	

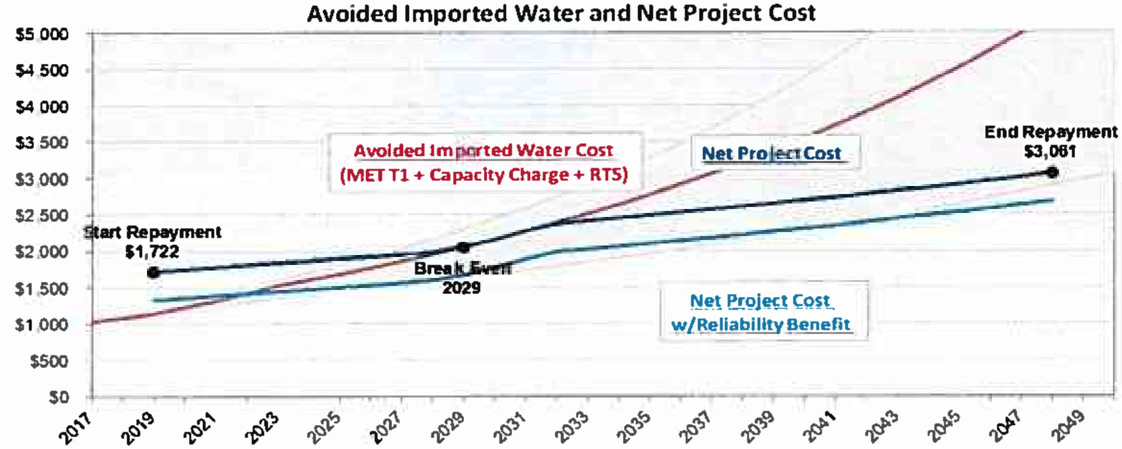
O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,228
Base Energy Rate ($/kWh)	$	0.105
Energy Escalation 2012 - 2030		2.0%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$	47
Lease Escalation Rate		2.5%
General Inflation Rate		
Current - 2020		2.5%
2021 - Future		2.5%

Project Financing	
Grant Amount	
Bond Repayment	Select →
Bond Interest Rate	4.50%
PV Discount Rate	4.00%

MET Avoided Costs	
Esc. Rate After 2017	5.0%
Melded Rate- % Tier 1	100%

Output

Avoided Imported Water and Net Project Cost



Project Capital Costs	
Capital Cost (2012)	$130,227,550
Grants	$0
Contingency	$22,586,000
Total Cost (2011)	$152,813,550
Total Cost Escalated to Midpt. of Const.	$181,647,290

Costs per AF	Current Year 2012	First Year 2019
Capital Cost	$588	$699
O&M	$363	$489
Energy	$446	$522
Annual Cost	$1,397	$1,709
Annual Cost w/ Land	$1,444	$1,767
Mitigation Costs	$167	$205
Total w/ MET Subsidy	$1,361	$1,722

Net Present Value	
Up to Break Even	($31,436,811)
Break Even to End	$72,613,733
Total Savings	$41,176,923

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Table 4 - Summary of Economic Analyses

Case	Description	Fe/Mn Treat.?	Energy Scenario	MET Esc.	Cross Over Year	30 Year PV Savings	With Reliability Added
1	Base Case – Expected w/ 4.5% Finance	No	Base	5%	2029	$41 M	$141 M
2	With Fe/Mn	Yes	Base	5%	2032	$-6 M	$94 M
3	High Electrical Costs	No	High	5%	2032	$7 M	$107 M
4	Expected with $15 M Grant	No	Base	5%	2028	$55M	$155 M
5	Low Interest Rate at 2.5%	No	Base	5%	2026	$72M	$172M
6	Base w/Low MET Costs	No	Base	3%	2046	$-7M	$93M
7	Fe/Mn with High Energy	Yes	High	5%	2035	$-10 M	$90 M
8	Fe/Mn with Low MET Costs	Yes	Base	3%	2048	$-10M	$90M
9	Low Interest & Low MET Costs	No	Base	3%	2040	$-5M	$95M

Cost Comparison to the Poseidon Resources Huntington Beach Project

Comparison of the cost of ocean desalination projects from location to location can be difficult, especially when comparing a public project to a private project. Typically, public financing offers cost advantages compared to private equity financing. Private projects can be crafted in a manner to take on additional responsibilities and risks when they are providing water to public entities. Site characteristics can also vary and result in cost differences from project to project.

For the Doheny Desal Project, there are several site and other factors that make the costs very competitive:

- For the size of the Doheny Desal Project, slant wells are less expensive than open intakes which also require pretreatment systems to remove sediments and organic materials. Slant wells provide highly filtered water via the natural filtration process provided by the marine aquifer, thus avoiding the cost of having to construct and operate conventional pretreatment strainers, filtration and solids handling/disposal facilities. It has been determined from the results of the extended pumping test that the use of a slant well intake system will avoid the need for conventional pretreatment costs estimated at $56 million in capital and about $1 million in O&M costs, thus reducing the costs compared to other sites by more than $300 per AF.

- Co-disposal with wastewater through an existing outfall with sufficient hydraulic capacity avoids construction of a new brine discharge line and should make compliance with brine discharge easier to meet.

- System integration is relatively simple as the regional pipelines cross the desalination plant site and the pumping lift is relatively moderate at 450 feet. The savings of this integration system when comparing to other locations can be over $100 per AF or more.

- Public financing costs are typically lower than private financing

For the Huntington Beach site:

- Quite a bit of work has been done at the site and the engineering and permitting for moving forward with a construction project is nearly complete.

- Initially, the project can use the existing intake and outfall system. Uncertainties exist with the need for potential regulatory driven future changes to the intake and outfall systems. Use of the open ocean intakes also requires investments for the pre-treatment of the water.

- System integration is more complex than at the Doheny site.

- The methodology for capital recovery is on an escalated basis at 2.5% per year and has the result of lowering the early year costs and increasing the later year cost. This is an appropriate technique for phasing the costs of the project with future escalation; however, it results in a "different" cost compared to equalized annual debt recovery. The approximate first year impact is a decrease of about $300 per AF. If Doheny Desal used the same technique, the first year cost would be about $180 per AF lower.

- The costs also include repayment of private equity at considerably higher interest rates than available to public financed projects, project development costs, profit, and franchise tax and related payments. However, Poseidon has also agreed to take on much of the construction and performance risks for providing potable drinking water that meets specific quality criteria at the purchased water price.

The Poseidon Huntington Beach project unit cost as of February 2013 is around $1,800 per AF, including all costs and assuming a contribution from MET of $250 per AF. The Doheny Desal Project cost, **assuming an escalation of debt repayment similar to the Huntington Beach Project at 2.5%**, is currently estimated around $1,200/AF including all costs and assuming a contribution from MET of $250 per AF. Most of the differential in costs between the two projects can be explained by the factors noted above with the exception that:

- Poseidon found that their early cost estimates were overly optimistic compared to what was finally agreed upon. We will not have a more detailed estimate for Doheny until additional work is completed

- The element of "risk" taken on by Poseidon is not able to be defined as a cost per AF value.

Conclusion and Recommendations

The project is awaiting decisions by the project participants, SJBA and MWDOC on the next activities for the Project. The only work scheduled at this time is the upcoming Foundational Action Plan work; each of the Phase 3 Participants are now considering what their interest and role will be in that work. Key remaining issues for the project include how best to mitigate the drawdown and take impacts from the project on the San Juan Basin, the produced water quality from the slant wellfield over time, energy costs, and project costs. The groundwater basin and project mitigation alternatives questions will be answered through the work to be undertaken through the MET Foundational Action Program proposed work. This work includes groundwater basin management planning and additional project groundwater modeling work that will be completed over the next year or two by both SJBA and several of the Doheny Desal partners. This work will be important in formulation of the final project concepts and configuration.

Over the past several years of work, a great deal of information on the basin and the project has been developed. Our understanding of the basin and the project interaction has evolved over these years but additional information, study and project development work remain necessary. With respect to the groundwater basin, the necessary work falls under the following areas:

- Complete project impact analysis using a more detailed coastal model
- Evaluate alternative project mitigation measures – providing make-up water from the project or injecting recycled water along the coast to mitigate the drawdown and take impacts of the project on the basin.

- Evaluate seawater intrusion control effectiveness with a more detailed, coastal model

- Evaluate any project impacts to the seasonal coastal lagoon water levels

- Coordinate and track work with the SJBA on its implementation of the Groundwater Management Plan Recommended Alternative No. 6 and opportunities for coordinated and/or joint facility development and use.

The work has resulted in a "lot of new news" and a better understanding of the relationship among these various parameters. At this time, both the work to be conducted by the SJBA and several of the Doheny Desal partners needs to occur to focus in on the final projects configuration.

At any time, the pre-design CEQA and permitting work could be started. The critical path items are the environmental baseline monitoring, offshore geotechnical work, and preliminary engineering for the ultimate project, or the schedule could include a waiting period to finish the work at hand. Discussions with the five Doheny Desal Participants regarding how they would like to move forward will be occurring over the next several months.

The Participants recommended staff develop a "watch" list of issues that could ultimately impact the cost and/or feasibility of the Project. The following Table 5 identifies issues to keep within our monitoring efforts as we move forward.

Table 5 Doheny Desal Cost Impact "Watch" List
These are issues that could impact the ultimate cost of water from the Doheny Desal Project and so should be reviewed from time to time for their status and impact to the project assessment:
1. Financing has been at record low levels.
2. Outside funding may be available from State or Federal sources, either via grants or legislative actions; the State Revolving Fund and anticipated Water Infrastructure Finance and Innovation Authority (WIFIA) funding and 2014 State Bond are examples.
3. Technology Improvements can lower the costs of desalination.
4. The bidding environment has been at record low levels; many companies are interested in getting involved in ocean desalination in the U.S. and California.
5. The cost of energy is difficult to predict in the State of California due to implementation of AB 32, related regulatory policies and programs, hydraulic fracking and natural gas prices, changes in solar energy technology and costs, etc.
6. Iron and manganese pretreatment may be necessary (the costs have been estimated) but at what level is uncertain at this time.
7. The State Water Resources Control Board Ocean Plan Amendment is pending and the cost implications are unknown. New regulations could impact brine discharge through the SOCWA outfall.
8. Other regulatory issues that might arise during permitting.
9. Future costs will be higher due to inflation but are uncertain on a real dollar basis with improvements in technology and increased competition.
10. Mitigation costs with the San Juan Groundwater Basin have to be negotiated – a placeholder has been included in the conceptual level cost opinion.
11. Fisheries issues (e.g., southern Steelhead) in San Juan Creek and the Seasonal Coastal Lagoon due to groundwater drawdown may need to be worked out.
12. Design/Build and Operate, and Design/Build/Operate delivery mechanisms could offer savings in life cycle project costs compared to the conventional Design, Bid, Build, Operate method.
13. As other projects in California get up and operating, relevant knowledge can be transferred to the project.
14. Drought supply shortages and an increasingly greater public recognition of the value of water may spur increased public and political support and willingness to pay for improved supply reliability.

C. Goals and Objectives

The three main goals for Phase 3 were:

- Conduct an extended pumping and pilot plant test to determine the performance of the well and aquifer, to determine water quality over time, and to determine the pretreatment effectiveness of the aquifer

- Evaluate the project impacts and mitigation approaches on the groundwater basin using a regional watershed and groundwater model by first estimating the basin yield and its performance without the project and then determine the effect on the basin with the project.

- Conduct a conceptual level assessment of the full scale project and its costs.

To support the overall goals of the Phase 3 work, 10 specific objectives were developed:

1. Obtain long-term well performance, salinity, and drawdown data and use in validating and refining the groundwater model that will be used in aiding in the design of the feedwater supply system and evaluating project impacts. Conduct natural isotope testing on the extracted water to quantify the sources of water pumped from the well over the extended test period.

2. Collect and analyze slant test well water quality to determine the character of groundwater produced over the extended pumping period. Assess how water quality may change over time as the well pulls in offshore marine groundwater and ocean water. Evaluate how potential changes in ocean water quality, such as red tides, may influence the produced well water. This information will also help to validate the existing SEAWAT groundwater model predictive capability and develop source water quality specification that can be used for project environmental review and permitting.

3. Conduct corrosion studies to determine appropriate materials for the wells, pumps, and system piping and valves.

4. Evaluate the effectiveness of using a nitrogen blanket in the test slant well headspace to minimize introduction of air into the well. This step is intended to control microbiological growth and oxidation/precipitation of dissolved iron and manganese in the produced well water and to facilitate evaluation of any oxygenated ocean water entry into the well over the test period.

5. Conduct studies to identify and measure the extent of microbiological growth over the extended pumping period on the well and selected materials, which are anticipated to result from both brackish and ocean water influences. Determine the speciation of natural organisms that may grow in the well/conveyance facilities and evaluate control approaches as necessary.

6. Evaluate the pretreatment effectiveness of the aquifer and well through the use of standardized testing procedures (e.g., silt density index (SDI), turbidity, pilot unit RO membrane performance); evaluate microbial, colloidal, and particulate fouling; and determine and test any additional pretreatment that may be necessary.

7. Conduct an extended "Under the Influence of Surface Water" study for determining if the well production is affected by San Juan Creek water quality, evaluate applicable California Department of Public Health (DPH) treatment requirements, and develop testing protocols with DPH review.

8. Test RO process performance using test slant well water initially without pretreatment then with the addition of pretreatment, if necessary.

9. Develop a regional watershed model to generate streamflows and a groundwater model to determine groundwater basin yield over an extended period of time including a dry period and to determine the impact of the project on the basin and mitigation approaches.

10. Conduct conceptual level assessment of the full scale project to develop an opinion of probable construction and O&M costs.

The Phase 3 investigation accomplished all of the above objectives.

D. Phase 3 Project Implementation

MWDOC was responsible for carrying out the implementation of the Phase 3 test project. This work included:

Environmental Documentation

A consultant was retained who prepared the project description and mitigated negative declaration for the Phase 3 facilities construction and their operation and maintenance, publication, processing and adoption. This work was done by Chambers Group, an environmental consulting firm.

Permitting and Approvals

This work included the preparation of information and special studies for the permit applications, the permitting process, including agency meetings, and execution of the permits. The following permits and approvals were required and issued: (1) California Department of Parks and Recreation (Right of Entry Permit), (2) State Lands Commission (amended lease), (3) California Regional Water Quality Control Board (NPDES Discharge Permit and a Water Quality 401 Certification), (4) California Department of Fish and Game (Streambed Alteration Agreement), (5) U.S. Army Corps of Engineers (404 Outfall Nationwide Permit), and (6) California Coastal Commission (Coastal Development Permit).

Design, Procurement and Construction of the Test Facilities

This work included consultant selection and design, procurement and construction of the test facilities. The test facilities were designed, procured, or constructed under the direction of MWDOC, who served as the project manager. This work included: (a) well inspection and redevelopment, (b) design and procurement of a submersible pump, (c) installation of the submersible pump, (d) design and procurement of a Mobile Test Facility, and (e) design and construction of appurtenant test facility infrastructure (placement of the Mobile Test Facility, pipelines, conduits, control and metering vault, outfall diffuser and electrical service).

These facilities were located entirely within Doheny State Beach. GEOSCIENCE/Boart Longyear provided the well work and Carollo Engineering provided the design and construction observation services for the test facility. Williams McCaran, Inc. designed the Mobile Test Facility, which was then procured by MWDOC. MWDOC procured this item due to its long-lead time in manufacturing and special features that were required for the Phase 3 extended pumping and pilot plant test. This also allowed MWDOC to control overall quality of the facility. MWDOC also solicited bids as part of this effort. Intuitech, a company specializing in assembling pilot water and wastewater process test equipment, manufactured the test facility. Prior to installation at Doheny State Beach, Intuitech performed shakedown testing using a freshwater supply to make sure that all process equipment, instrumentation, and electrical equipment was functioning properly. This work was observed by WMI to ensure all work was completed in compliance with the design.

Pilot Facilities Start-up and Operation

After installation and construction of the test facilities, SPI was selected to operate the test facility and to conduct the various testing work over the extended pumping test.

Remove/Destroy/Abandon Test Facilities and Restore Site

Participant funds are being reserved to eventually remove the test facilities and restore the project site. Currently, an agreement with State Parks allows the test facility to remain in place. Permits are also maintained. The temporary facilities that will eventually be removed are: (1) the mobile test facility (this is planned to be salvaged and moved to the full scale plant site for use during start up and for future testing work); (2) test slant well submersible pump, wellhead, discharge piping and outfall diffuser; (3) temporary electrical and instrument conduits run from the test facility to the wellheads and; (4) the meter and electrical conduit supply to the test facility. Additionally, the test horizontal/slant well and nested monitoring well MW1 located on the beach will be abandoned or destroyed if there is no future use for these facilities. MW1 is expected to be transferred to San Juan Basin Authority which will require a long-term use agreement with State Parks.

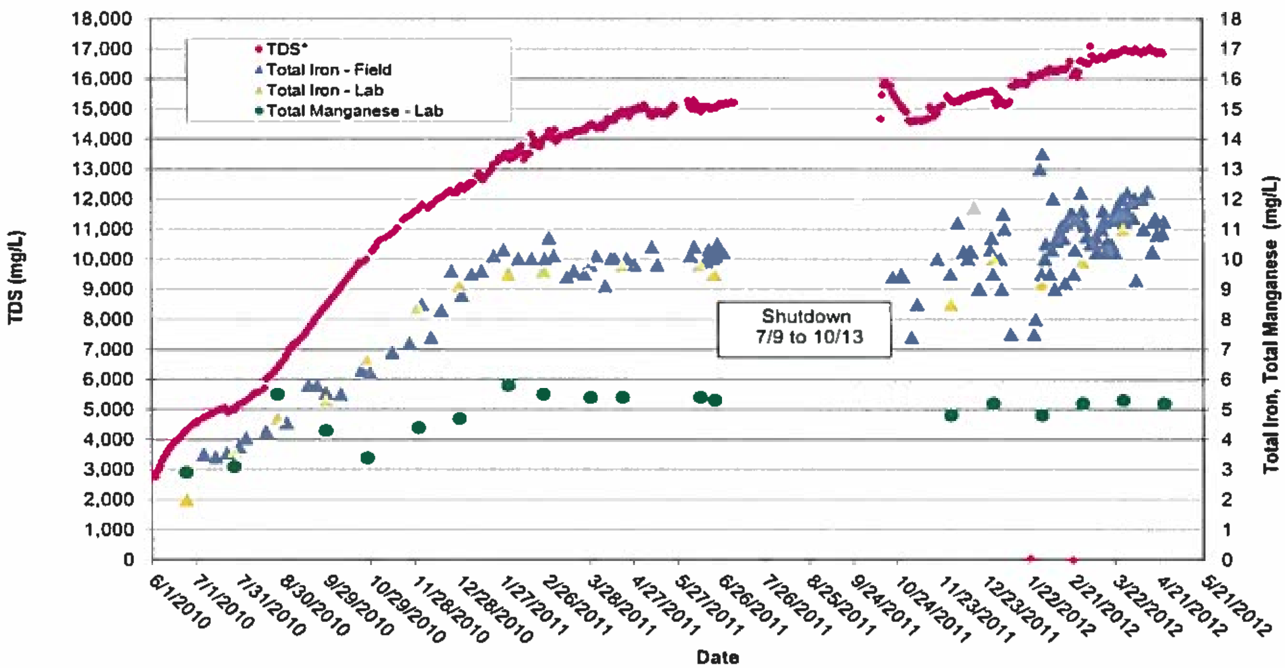
E. Project Results – What Was Learned

Following is a summary of results, findings and conclusions gained from the Phase 3 work.

Feedwater Supply

1. Construction and operation of slant wells along Doheny State Beach is feasible.
2. Old Marine groundwater was encountered and was found to be enriched with dissolved iron and manganese and remained anoxic (without oxygen) throughout the nearly two year extended pumping test. This test showed a continuing increase in salinity and of ocean water (from isotope data) being pulled into the well. See Figure 14.

Figure 14 - Slant Well TDS, Total Iron and Total Manganese



* Note: TDS calculated by 0.65 x Conductivity

3. We believe the pocket of old marine groundwater will be pumped out over time. Geochemical modeling or offshore geophysics and borings are required to more accurately estimate the time required to pump out the old water.
4. The Marine Aquifer provides excellent filtration as evidenced by nearly two years of pumping and testing data.

5. The natural isotope study provided excellent information on the rate of connection to the ocean and the data can be used to refine the coastal groundwater model calibration. The data clearly showed an increasing trend in the amount of ocean water being pumped (which is a good trend).
6. The corrosion study recommends 2507 Super Duplex Stainless Steel for the wells. This was the material used to construct the test submersible pump.
7. The microbial biofouling study showed very low levels of microbial biofilm growth.
8. The slant wellfield configuration is expected to consist of 3 clusters of 3 wells located along Doheny State Beach for a total of nine wells. Preliminary study indicates that the wells would be about 520 feet long at an angle of about 23 degrees. The actual wellfield configuration, well and wellhead design, and wellfield capacity needs to be determined. In the future, the offshore geophysics survey will be needed for both the coastal groundwater model update and wellfield configuration design work.
9. The slant wellfield can be permitted as a water supply. The subsurface intake is regarded favorably by the regulatory agencies based on verbal comments and staff reports by the Coastal Commission for other projects. Further, the State Water Board draft Ocean Desalination Policy is also supporting a slant well subsurface intake approach. Using a subsurface intake will save significant permitting time and costs. Drawdown impacts on the lagoon are expected to be minor. Environmental baseline monitoring is required to support the environmental impact report and permitting activities.
10. Based on work being conducted by West Basin MWD, an open ocean intake system may also be feasible with the use of wedge wire screens. However, conceptual work indicates that it will be a very expensive proposition to construct a "new intake" structure via tunneling if pursued at the Doheny site. Another potential option is to put the intake in the easterly basin in Dana Point Harbor, but limited depths and fueling operations would make this option problematical. This approach was not investigated.

Lower San Juan Basin Groundwater Yield and Integrated Operations

1. The 2007 preliminary groundwater model has been significantly improved through development of a basin wide surface water flow model and updated groundwater model for the Lower San Juan Basin completed in April 2013. This work was developed in close cooperation with San Juan Basin Authority (SJBA) and with their Groundwater Management Plan development work.

2. The groundwater model has been recently re-calibrated to a reasonable level of accuracy for planning purposes over the more recent period, 2004-2010, a period with higher groundwater pumping than under historical operations.

3. Groundwater production in the basin during the period 2004-2010 averaged 5,370 AF per year. Under this level of production, groundwater discharges to the ocean from rising water and subsurface outflow were estimated at 1,880 AFY. The near-term pumping by San Juan Capistrano and South Coast in the Lower San Juan Basin will increase over these historical levels which will

significantly reduce the rising water and subsurface outflow losses. Continued increased pumping can result in seawater intrusion.

4. Without the Doheny Desal Project, the 2013 modeling results indicate that net basin water supply on average came out to 9,150 afy and during a repeat of the 30-year dry period the supply would decrease to 8,040 afy. These values include ocean water intrusion, rising groundwater outflow to the ocean, subsurface outflow to the ocean and change in basin storage. Under this run, ocean water intrusion began to occur; the South Coast wells were turned off after nine years when the salinity reached 2,600 ppm. It is likely these basin yield values are over estimated by about 300-400 AFY as the modeled pumping amounts results in seawater intrusion. The breakdown of this analysis is shown below in Table 6:

Table 6 - Groundwater Modeling Production Analysis – Base Case (2i/2j)
Pumping Water Level Constraint with Salinity Constraint

	Groundwater Pumping Yield (afy)	
Producer	Dry	Average
City's GWRP Wells	5,808	6,690
City's Other Wells	823	942
Subtotal City	6,631	7,632
SCWD	559	664
Private Wells	850	850
Total	8,040 afy	9,146 afy

5. With the Doheny Desal Project intake production at 30 mgd, the groundwater modeling indicates that on average about 5% of the slant well production (1.5 mgd, 1,660 afy) will be San Juan Creek brackish groundwater. This estimate was made by averaging the Doheny Desal draw on the basin of 1,495 afy in dry periods and 1,820 afy in average periods, averaging about 1,660 afy.

6. The modeling indicates that South Coast Water District wells (the wells in the basin closest to the ocean) would be potentially impacted by a drop in groundwater elevation between 15' to 20' with slant wellfield production level at 30 mgd. The drawdown impacts to the City of San Juan Capistrano wells further up in the basin would be approximately 1 to 3 feet.

7. The 30 mgd slant wellfield production level will protect the SCWD wells and the lower basin (e.g., Latham WWTP) from ocean water intrusion.

8. The leaking underground storage tanks at the gasoline stations in the vicinity are in the process of being cleaned up and are not expected to impact the project start up. Continued coordination with the Orange County Heath Care Agency (OCHCA) and oversight is required.

9. Drawdown impacts to the San Juan Creek seasonal lagoon at the ocean interface will likely be small as the lagoon is underlain by a shallow highly permeable aquifer and an areal extensive clay layer. The seasonal lagoon receives ocean water recharge as well as streamflow from storms and urban runoff. A more detailed coastal groundwater model will be needed in the future to assess this impact as well as intrusion through the shallow aquifer.

Desalination Facility, Product Water Quality and System Integration

1. The desalination facility site (5 acres) is proposed to be located just north of PCH on existing South Coast Water District property. South Coast Water District has generally reserved the site for the project. Negotiations for use of the plant site will have to be completed. The current cost estimate has a placeholder lease cost for the site. The site will require geotechnical work to prepare the foundation for location of a new plant. The rough grade of the site will need to be raised to protect against flooding including an allowance for sea level rise.

2. Product water quality will be driven by the level to which bromide and boron need to be reduced. A bromide level of 0.3 mg/l will provide adequate protection for disinfection residual stability. This requires about a 40% second RO pass. This will also produce a boron level around 0.5 mg/l which will be protective for ornamental plants. Typical second pass RO configurations for plants range from 30% to 100%.

3. System integration is relatively low in cost, as both imported water pipelines cross near the Plant site. The water would be boosted out of a clearwell reservoir to a 450 foot hydraulic grade line to match with the imported water system (Joint Regional Water Supply System (JRWSS) and Water Importation Pipeline (WIP)). Additional pumping of about 110 feet would be required to supply the water to the Laguna Beach 400 zone from the SCWD 290 zone.

Brine Disposal

1. The San Juan Creek Ocean Outfall has adequate capacity to dispose 15 mgd of brine flow from the Doheny Desal Project. The outfall has a capacity of about 85 mgd and present day average daily dry weather flow is about 17.5 mgd; the current permitted capacity is 30 mgd. In the future the average daily dry weather flow will likely decrease with additional recycling and water use efficiency measures.

2. The brine disposal point of connection would be into the surge chamber junction, located adjacent to the Desalination Facility site.

3. A brine disposal study needs to be undertaken with South Orange County Wastewater Authority (SOCWA) to determine if any modifications are necessary to the outfall and its diffuser for compliance with SOCWA's National Pollution Discharge Elimination Standard (NPDES) permit. The study would need to evaluate ranges of blending with wastewater for co-disposal of 0% up to about 50%.

4. Non participants in the SOCWA outfall will have to acquire capacity from agencies with excess capacity.

5. The SWRCB is in the process of amending its California Ocean Plan which will include new regulations and standards for brine disposal. This amendment is expected to be completed either late this year or in early 2014.

Energy Supply and GHG Offsets

1. The project will have an electrical load of about 8.2 megawatts (MW). The project is estimated to consume 4,228 kilowatt-hours (kwhr) of electrical energy per acre-foot (AF) of produced water, including the pumping lift for system integration. For comparison purposes, imported water delivered to the area from the East Branch of the SWP through the Water Importation Pipeline uses a net of about 3,440 kwhr/af.

2. An electrical service study by SDG&E was completed in 2007; we are working with SDG&E to update this study. As of this time we don't have any response from SDG&E on the cost of the new work or time required to complete the update.

3. SDG&E is embarking on a $500 million reliability upgrade to their electrical distribution system in its Orange County service area.

4. The SDG&E reliability improvements include a new enlarged San Juan Capistrano substation. This should reduce the cost of running a 12 kV service to the Desalination Facility (the previous study ran the 12 kV line from the Laguna Niguel substation).

5. SDG&E has indicated that their worst case power outage would be for 12 hours. Based on this, no back-up power would be required for this short of an outage. This does not include any electrical reliability issues that have arisen with the recent SONGS plant closure.

6. SDG&E offers programs to shed load for electrical cost savings. The two main programs are their Critical Peak Pricing and Base Interruptible schedules. These will be further explored to reduce costs to the project.

7. A new law allows an agency, not a Joint Powers Authority (JPA), to build and wheel up to 3 MW of renewable energy through the PUC regulated agency grid. However, typically these costs are higher than grid energy from SDG&E.

8. SDG&E service environmental impacts could be covered under the Doheny Desal Project EIR.

9. SDG&E indicated that 2 years are required to design and construct their service facilities.

10. Energy costs will increase due to reliability improvements, expansion of the State's transmission and distribution system, meeting renewable energy targets of 33 percent by 2020, phase out of power plants using Once Thru Cooling (OTC) technology, impact of SONGS closure and replacement power, and general rate increases. However, natural gas fuel costs continue to stabilize the cost of energy from natural gas fired power plants. Predicting future energy costs with a reasonable degree of certainty is difficult at this time. Future decisions on SONGS replacement (assumed) and consumer liability by the PUC and SDG&E have not yet been made and no projections are available.

11. Greenhouse gas (GHG) offsets will likely be required by the State Lands Commission and Coastal Commission. Without any mitigation, the annual cost for GHG offsets is not expected to be significant, at about $50,000 per year at today's market rate.

Project Costs and Economics

1. Project capital cost is estimated at $153 million ($2012).

2. Capital and Project Unit Costs ($/AF) are lower than other desalination projects due to the attractive project location: slant wells avoid pretreatment costs compared to an open intake system, land is available near the coast, outfall capacity is available, system integration and pumping lift costs are very low, and SDGE is investing $500 million to improve electrical service reliability to the area (which should slightly reduce the electrical service cost to the Doheny Desal Project). Slant well intakes have unit costs per capacity similar to open intake systems, but can be built at lower capacities at much reduced capital cost than open intakes, which are best suited to large scale plants.

3. Estimated project unit costs (at this time) in 2012 dollars without grants or low interest loans are:

    - $1,611 per AF without the MET subsidy of $250 per AF
    - Capital at $588/AF (includes a 25% contingency and a 15% allowance for professional services)
    - O&M at $363/AF
    - Energy at $446/AF
    - Land at $47/AF
    - GW Mitigation at $167/AF for take of 1,660 afy on average
    - Total of all costs = $1,611 per AF.
    - Accounting for the MET subsidy results in a cost of water to the local agencies in 2012 dollars of $1361 per AF
    - For comparison purposes, MET avoided water costs in 2013 (Tier 1 + Capacity Charge + Readiness to Serve Charge) amounts to $953/AF.

4. Projected imported and desalination water costs cross about 8 to 10 years out (or further depending on the assumptions used) from which point on the desalination water costs would be

lower than imported water costs. Nine different economic scenarios were run to test the sensitivity of the assumptions. The most sensitive assumption was the out-year escalation of MET water rates (a higher MET escalation makes the Doheny Desal Project look more favorable and a lower escalation of MET rates is not favorable to the economics of the project).

5. One of the scenarios included higher energy cost escalation, which would increase the cost of the project. Current energy escalation costs are somewhat speculative. Future work should focus on refining the energy costs inputs to the project.

6. The system reliability benefit of the project has been estimated at about $100 Million when valued on the cost of storage at Upper Chiquita Reservoir Project. The project also provides benefits during droughts and helps prevent water shortages during emergency situations – these last two benefits have not been captured in the economic analysis.

F. Conclusions Regarding Slant Wells

Water supply wells when properly designed, constructed and developed can last for 75 years or more. There is no difference with Slant Wells as these will be built using tried and true water well technology along with the design and construction experience and innovations gained from the construction and operation of the Test Slant Well. We expect the Slant Wells to perform very well over the long- term and expect a useful life of 75 years.

Well Production Capacity

Based on the Test Slant Well pumping test at 2,100 gpm and recent groundwater modeling, we expect the full scale wells will be able to produce 3,000 gpm. Drawdowns, including well interference, will be approximately 90 feet vertically from mean sea level to the pumping water level in the well to produce the 30 mgd from seven pumping wells with two wells on rotational standby. The aquifer thickness is about 200 feet along the coastline, which is sufficient to allow the expected drawdowns and well yield. Should a problem occur during the summer when beach access is restricted there will be two standby wells that can then be turned on to continue uninterrupted production at the 30 mgd level. Drawdown impacts to wells in the San Juan groundwater basin will only be significant to the most nearby wells owned by South Coast Water District.

Well Design, Construction and Development

Design and construction of the full scale slant wells will need to be approached similarly to conventional water well design and drilling, but since the wells will be relatively flat in slope, additional care must be taken in gravel placement and well development. The design and construction will be aided through the experience gained in design and construction of the Test Slant Well. A key to the long-term success of the wells will be to provide thorough development work to assure minimum levels of sand clogging to the gravel pack. Sand clogging can occur over time in a well when it is not properly designed, constructed and/or developed. Causes include too large of well screen slot spacing, too large of gravel size in the gravel pack, gaps in the gravel pack, and most commonly, insufficient development of the well. The well screen and gravel pack size can be properly sized assuming the well designer has good technical capability and experience. Improper well development can occur due to insufficient swabbing, bailing and/or air lifting and due to insufficient development pumping rate and time.

For the full scale slant wells development, the development pumping rate needs to be around 1.5x the production rate with development pumping over a sufficient period of time to allow complete removal of entrainable fines from the near borehole formation. Assuming the full scale well capacity at 3,000 gpm, the development pumping rate should be specified at 4,500 gpm.

To assure adequate development pumping, procurement of high speed 4,500 rpm pump(s) in advance of the construction will be required. Well contractors typically do not stock submersible pumps of this capacity that would be able to fit into the well. Contractors often use suction development pumping, but this option will not be possible, as these pumps are limited to a suction or drawdown of 32 feet and a greater lift will be required. The designed drawdown will be approximately 45 feet below sea level (lower low water) and the wellhead floor elevation will be approximately minus 2 feet MSL, a differential of 43 feet, exceeding suction limits.

Another consideration in the construction of the nine wells is the ability to complete the work within the 8-month winter time window. This will likely require three well drilling crews working concurrently. The advantage of three wells drilled from a single site is the time and cost savings from moving the drill site. The well driller will need to possess well in advance of construction three large dual rotary drill rigs (DR-40) and trained crews. Sufficient lead time will need to be provided to acquire any additional rigs from the manufacturer.

Well and Pump Materials and Corrosion Protection

The Slant Wells will be constructed with Super Duplex 2507 Stainless Steel, an alloy which showed very little corrosion over the extended pumping test and which is considered suitable for achieving a long useful life for the well. Over the nearly two year extended pumping test, this alloy showed no corrosion. It is used in many ocean desalination projects worldwide. Super Duplex 2507 will not support biofouling iron bacteria that are common in carbon steel cased wells. It is considerably less costly than AL-6XN, another superior stainless steel used in ocean applications.

Long-Term Aquifer Performance

Over the nearly two-year extended pumping test, the step drawdown test indicated no observable change in aquifer losses. Aquifer loss can occur in certain types of aquifers that are susceptible to biochemical in-situ encrustation or precipitation, especially in limestone formations. For the alluvial aquifer system offshore of San Juan Creek this condition will not occur.

During the initial start up pumping period, the wells will pump out the old (age 7500 years) marine groundwater that is anoxic and enriched with dissolved iron and manganese. As the wells pump, the ocean water, which is oxic and has only trace levels of iron and manganese, will slowly recharge the aquifer and flow towards the well. No mixing will occur along the boundary of the marine groundwater and recharge front of ocean water, except for trace convective diffusion effects which will have no observable effect on aquifer permeability due to any minimal oxidation along the front as the masses in the boundary zone are insignificant.

The oxic ocean water will slowly become less oxic as microbial activity consumes the available organic carbon and dissolved oxygen as the recharging ocean water flows through the aquifer to the wells. Since the ocean water will have some dissolved oxygen over part of its flow course to the wells, this oxic condition will not cause any further dissolution of iron and manganese minerals that might remain in the sediments. Likely all of the iron and manganese mineral oxides in the original sediments were fully dissolved out of the formation since the time the ocean flooded these sediments, some 7,500 years ago ("old marine groundwater"). Over the extended pumping test, the well was pulling in about 20% ocean water, which became anoxic by the time it reached the well. This ocean recharge most likely entered the well near its upper screens that are only 50 feet below the ocean floor. Sufficient organic carbon was available to the naturally occurring aerobic bacteria in the seafloor sediments. The travel path to the remainder of the screens is longer and will allow for further uptake of any dissolved oxygen in the recharging water. The San Juan Creek and lagoon produce significant organic carbon loads which are swept out to the ocean by periodic storms. This condition is likely to indefinitely continue into the future.

Within the aquifer, where the ocean water groundwater flow and brackish groundwater flow boundary occurs, there will be a small mass reaction over time along this boundary due to slowly varying heads and tidal forces that will result in some convective diffusion along the boundary area which would cause some iron oxide precipitation within this brackish/ocean water flow boundary. However, the masses are quite small compared to the volume of the alluvium pore space that it would take a very long time to seal this flow boundary with iron oxy-hydroxide precipitates. The effect would be to reduce the amount of brackish groundwater that would enter the wells, which is a desirable outcome.

The project microbiologist, Dr. Sunny Jiang from UCI studied biofouling rates over the two year extended pumping test. Biofouling rates were found to be very low with biofilms less than 10 µm in thickness on the stainless steels. She does not expect much biofouling activity in the full scale wells.

Under the initial period of pump out, a large portion of the pumped water was brackish groundwater. This water has a much higher TOC than the old marine groundwater and ocean water. Initial levels of naturally occurring bacterial growths were fairly high but declined dramatically as the TOC levels dropped significantly as the ocean water was pulled into the well. It is uncertain what impact if any the project will have on the seasonal lagoon associated with San Juan Creek, as this area is underlain by an extensive 4-foot plastic clay layer that minimizes drawdown effects on water levels in the lagoon. The reverse condition is also true – the lagoon should have very little if any effect on the water quality produced from the slant wells.

Well Oxidation Control

The wells will be designed to be fed nitrogen gas into the headspace in the well above the pumping water level to prevent oxygen transfer into the water. This was used successfully over the Phase 3 extended pumping test and performed quite well.

Well and Pipeline Cleaning

If the ocean water that enters the wells contains some dissolved oxygen it will then mix with any anoxic brackish groundwater that has dissolved iron and manganese that enters the well. Once the mixing is initiated the oxidation reaction times are fairly rapid. If the DO levels are above about 1 ppm, this will lead to oxidation during the movement of water through the pipeline to the plant of dissolved iron and manganese. Under this condition, some accumulations of iron deposits along the walls in the upper well screen area, through the pump column, and along the conveyance pipeline can be anticipated. A mitigation design measure is to size the conveyance system to maintain high velocities around 8 to 9 fps, within a reasonable headloss, to help to scour and minimize iron deposition accumulations.

The submersible pumps will be serviced or replaced once every 5 to 10 years along with well inspection and any required maintenance. It may be necessary to acquire a dual rotary drill rig with angled set up to allow for less costly well maintenance, as the mobilization costs can be high as these rigs are often kept out of state as they are frequently used in the mining industry. In the future, the merits of this approach should be evaluated.

Phase 3 Final Reports

Separately published Project reports from Phase 3 are listed below in Table 7.

Table 7 - Phase 3 Final Reports

#	Title	Author	Issued
1.	Project Summary Report	MWDOC	Final Jan 2014
2.	Volume 1 – Phase 3 Project Development Report	MWDOC & Carollo Engineers	Final Sep 2013
3.	Volume 2 – Pilot Plant Operations, Testing, Evaluation Report	SPI	Final Aug 2013
4.	Volume 3 – Phase 3 San Juan Basin Regional Watershed and Groundwater Models Report	Geoscience	Final Nov 2013
5.	Pilot Testing of Slant Well Seawater Intakes and AWT Pretreatment Technologies for Control and Removal of Iron and Manganese	SPI	Final July 2013
6.	Expert Panel Workshop Report: Offshore Hydrogeology/Water Quality Investigation Scoping, Utilization of Slant Beach Intake Wells for Feedwater Supply	Dr. Susan Paulson, Flow Science and MWDOC	Final Oct 2012
7.	Final Report: Desalination Corrosion Study	Dr. Joseph King, Engineering Materials	Final May 2012
8.	Natural Isotope Tracer Study: Test Slant Well Phase 3 Extending Pumping Test	Matthew A. Charette, Ph.D. - Coastal Groundwater Consulting & WHOI	Final Nov 2012
9.	TECHNICAL MEMORANDUM: Aquifer Pumping Test Analysis and Evaluation of Specific Capacity and Well Efficiency Relationships, SL-1 Test Slant Well	Geoscience	Final Sept 2012
10.	Microbial Testing – Phase 3 Extended Pumping Study	Dr. Sunny Jiang, UCI	Final Nov 2012

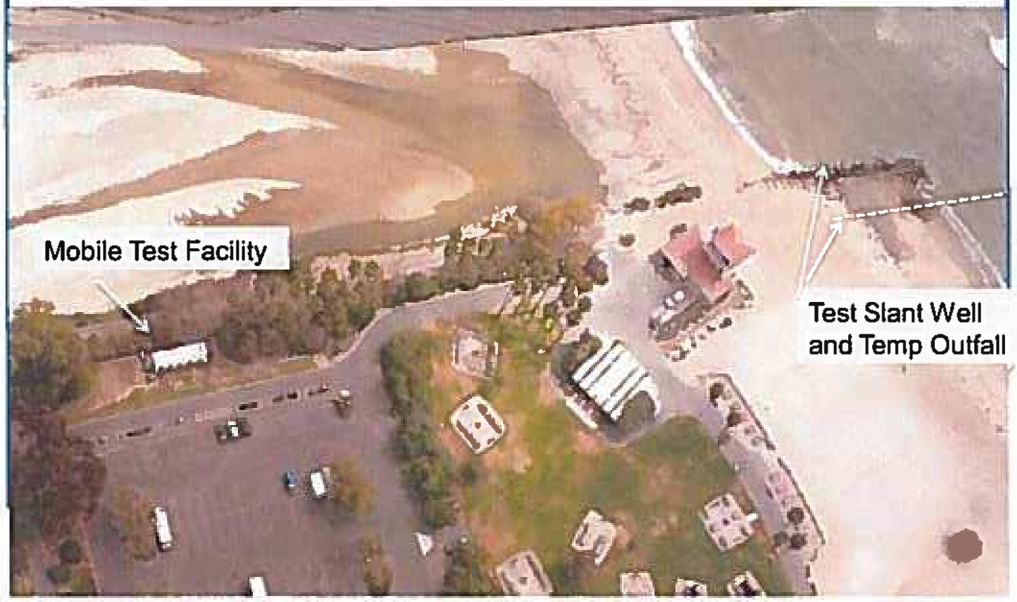
Appendix

Project Photographs

Groundwater Modeling Exhibits

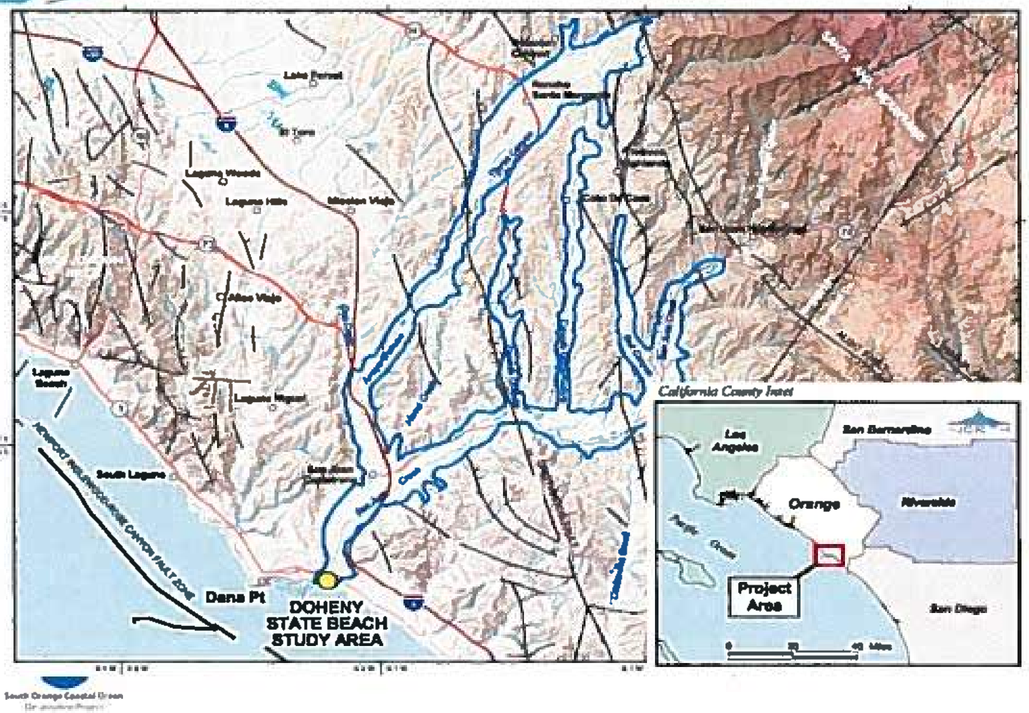
Project Economic Analyses Scenarios

View of Slant Well and Test Facility Site
Doheny State Beach

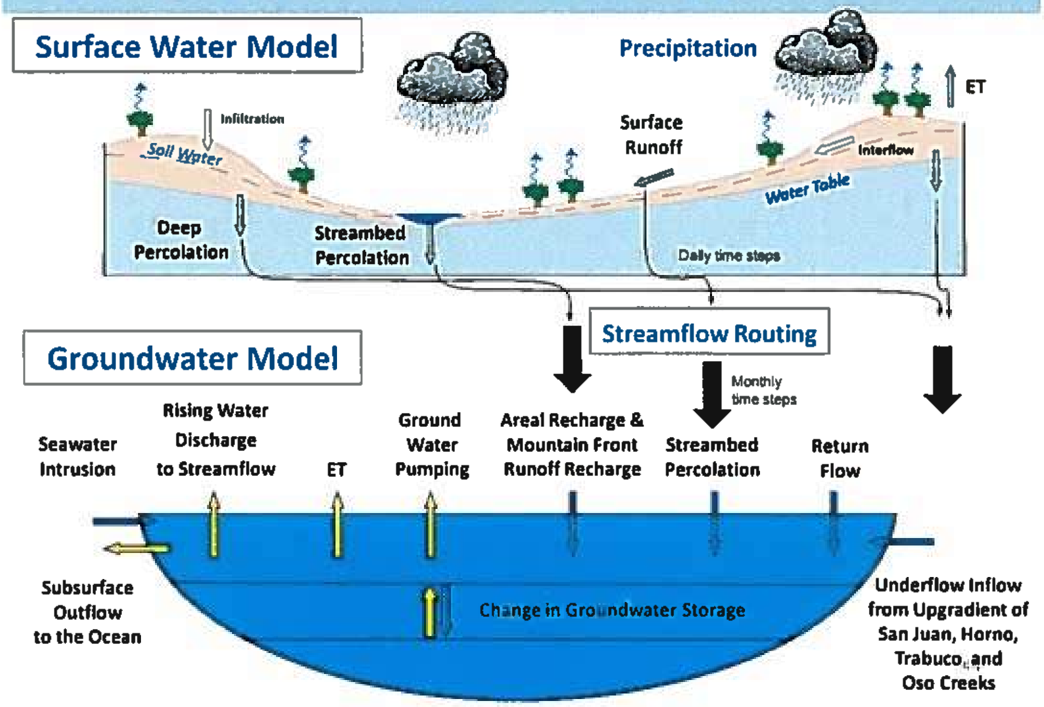


Mobile Test Facility

San Juan Groundwater Basin



Surface Water Model/Groundwater Model Interface



Project Economic Analyses Cases

Economic Analysis – Case 1 Base
No Fe/Mn Pre-treatment (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

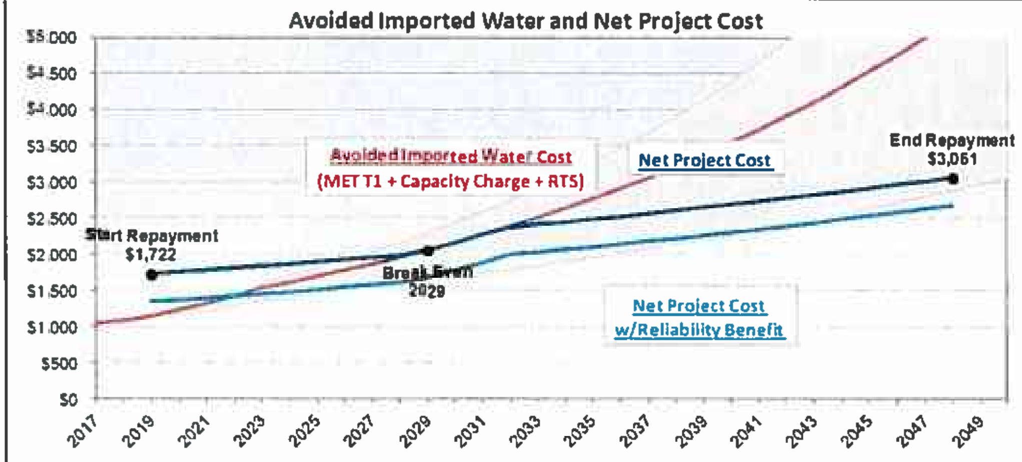
Capital Cost		
Fe/Mn Treatment?	No	
Contingency of Const	25%	
Start of Construction	2017	

O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,228
Base Energy Rate ($/kWh)	$	0.105
Energy Escalation 2012 - 2030		2.0%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$	47
Lease Escalation Rate		2.5%
General Inflation Rate		
Current - 2020		2.5%
2021 - Future		2.5%

Project Financing		
Grant Amount		$
Bond Repayment	Select →	
Bond Interest Rate	4.50%	
PV Discount Rate	4.00%	

MET Avoided Costs		
Esc. Rate After 2017	5.0%	
Melded Rate- % Tier 1	100%	

Output



Project Capital Costs	
Capital Cost (2012)	$130,227,550
Grants	$0
Contingency	$22,586,000
Total Cost (2011)	$152,813,550
Total Cost Escalated to Midpt. of Const.	$181,647,290

	Current Year	First Year
Costs per AF	2012	2019
Capital Cost	$588	$699
O&M	$363	$489
Energy	$446	$522
Annual Cost	$1,397	$1,709
Annual Cost w/ Land	$1,444	$1,767
Mitigation Costs	$167	$205
Total w/ MET Subsidy	$1,361	$1,722

Net Present Value	
Up to Break Even	($31,436,811)
Break Even to End	$72,613,733
Total Savings	$41,176,923

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 2
Base Case with Fe/Mn Pretreatment (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

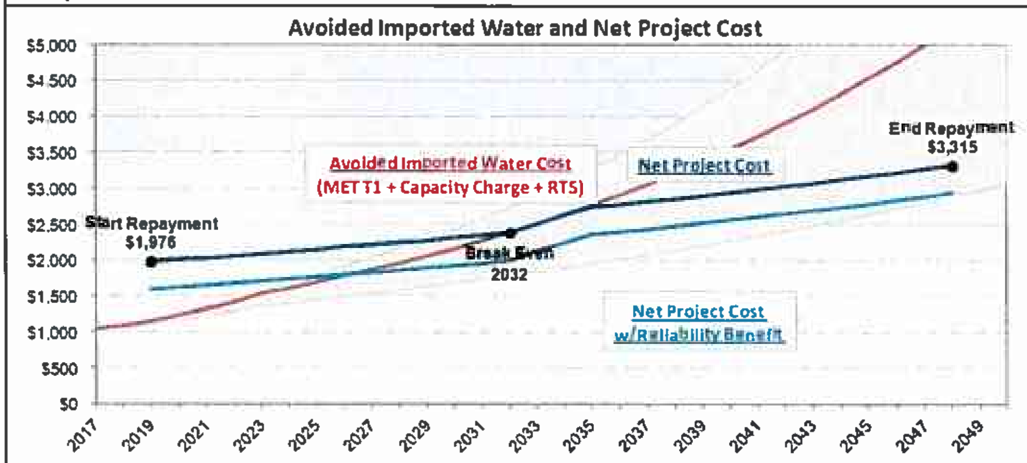
Capital Cost		
Fe/Mn Treatment?	Yes	
Contingency of Const	25%	
Start of Construction	2017	

O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,259
Base Energy Rate ($/kWh)	$	0.105
Energy Escalation 2012 - 2030		2.0%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$	47
Lease Escalation Rate		2.5%
General Inflation Rate		
Current - 2020		2.5%
2021 - Future		2.5%

Project Financing		
Grant Amount		$
Bond Repayment	Select →	
Bond Interest Rate	4.50%	
PV Discount Rate	4.00%	

MET Avoided Costs		
Esc. Rate After 2017	5.0%	
Melded Rate- % Tier 1	100%	

Output



Project Capital Costs	
Capital Cost (2012)	$172,234,800
Grants	$0
Contingency	$30,373,750
Total Cost (2011)	$202,608,550
Total Cost Escalated to Midpt. of Const.	$240,837,897

	Current Year	First Year
Costs per AF	2012	2019
Capital Cost	$779	$926
O&M	$421	$489
Energy	$446	$522
Annual Cost	$1,646	$1,937
Annual Cost w/ Land	$1,693	$1,994
Mitigation Costs	$196	$231
Total w/ MET Subsidy	$1,640	$1,976

Net Present Value	
Up to Break Even	($59,808,624)
Break Even to End	$53,308,026
Total Savings	($6,500,598)

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 3
No Fe/Mn; High Electrical (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

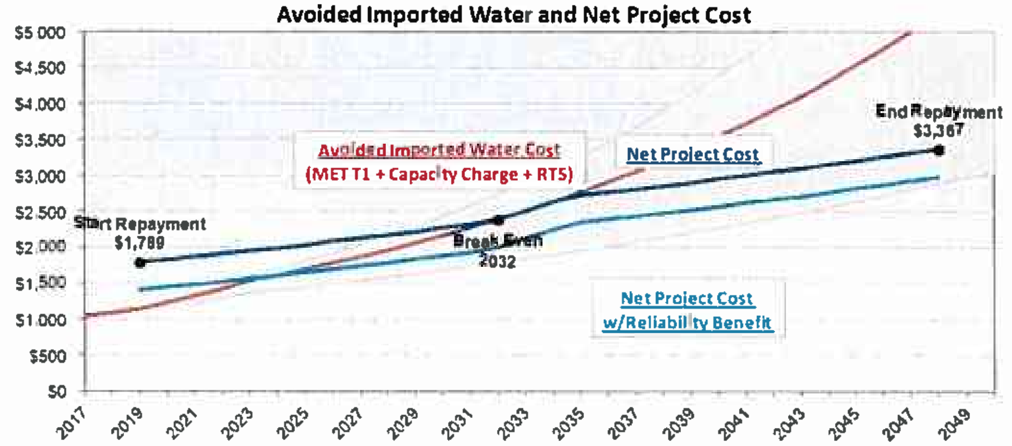
Capital Cost	
Fe/Mn Treatment?	No
Contingency of Const.	25%
Start of Construction	2017

O&M Costs	
Energy Costs	
Energy Usage (kWh)	4,228
Base Energy Rate ($/kWh)	$ 0.105
Energy Escalation 2012 - 2030	3.4%
Energy Escalation after 2030	2.0%
Land Cost	
Land Cost per AF (2011)	$ 47
Lease Escalation Rate	2.5%
General Inflation Rate	
Current - 2020	2.5%
2021 - Future	2.5%

Project Financing	
Grant Amount	$
Bond Repayment	Select → 30
Bond Interest Rate	4.50%
PV Discount Rate	4.00%

MET Avoided Costs	
Esc. Rate After 2017	5.0%
Melded Rate - % Tier 1	100%

Output



Project Capital Costs	
Capital Cost (2012)	$130,227,550
Grants	$0
Contingency	$22,586,000
Total Cost (2011)	$152,813,550
Total Cost Escalated to Midpt. of Const.	$181,647,290

	Current Year	First Year
Costs per AF	2012	2019
Capital Cost	$588	$699
O&M	$363	$489
Energy	$446	$582
Annual Cost	$1,397	$1,769
Annual Cost w/ Land	$1,444	$1,827
Mitigation Costs	$167	$212
Total w/ MET Subsidy	$1,361	$1,789

Net Present Value	
Up to Break Even	($45,288,833)
Break Even to End	$52,460,361
Total Savings	$7,171,528

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 4
Base Case with $15M Grant; No Fe/Mn (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

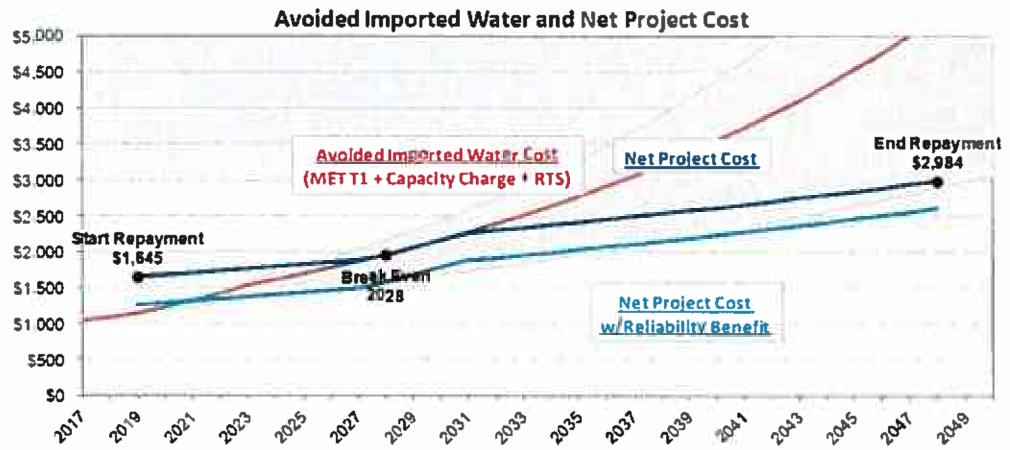
Capital Cost	
Fe/Mn Treatment?	No
Contingency of Const.	25%
Start of Construction	[illegible]

O&M Costs	
Energy Costs	
Energy Usage (kWh)	4,228
Base Energy Rate ($/kWh)	$ 0.105
Energy Escalation 2012 - 2030	2.0%
Energy Escalation after 2030	2.0%
Land Cost	
Land Cost per AF (2011)	$ 47
Lease Escalation Rate	2.5%
General Inflation Rate	
Current - 2020	2.5%
2021 - Future	2.5%

Project Financing	
Grant Amount	$ 15,000,000
Bond Repayment	Select → 30
Bond Interest Rate	4.50%
PV Discount Rate	4.00%

MET Avoided Costs	
Esc. Rate After 2017	5.0%
Melded Rate - % Tier 1	100%

Output



Project Capital Costs	
Capital Cost (2012)	$130,227,550
Grants	$15,000,000
Contingency	$22,586,000
Total Cost (2011)	$137,813,550
Total Cost Escalated to Midpt. of Const.	$163,817,004

	Current Year	First Year
Costs per AF	2012	2019
Capital Cost	$530	$630
O&M	$363	$489
Energy	$446	$522
Annual Cost	$1,339	$1,641
Annual Cost w/ Land	$1,386	$1,698
Mitigation Costs	$161	$197
Total w/ MET Subsidy	$1,297	$1,645

Net Present Value	
Up to Break Even	($24,278,982)
Break Even to End	$79,452,496
Total Savings	$55,173,514

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 5
Low Interest Rate; No Fe/Mn (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

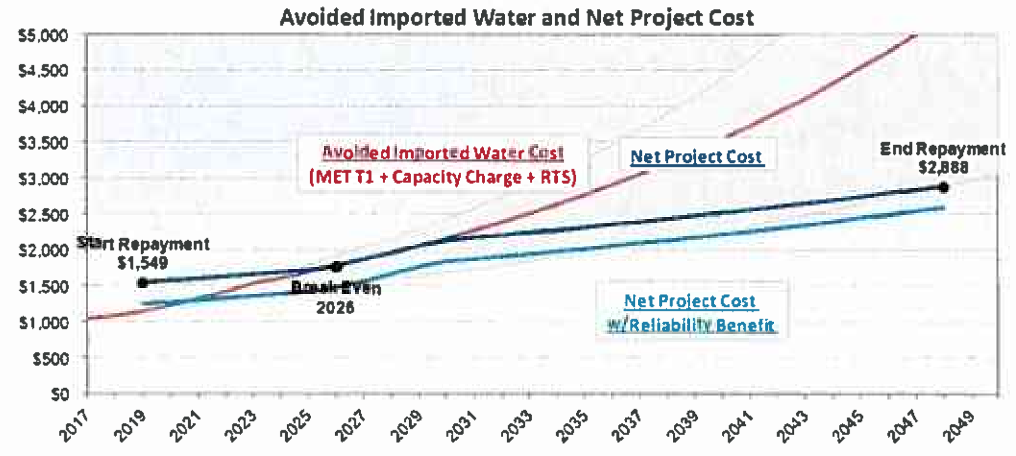
Capital Cost		
Fe/Mn Treatment?	No	
Contingency of Const.	25%	
Start of Construction		2017

O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,228
Base Energy Rate ($/kWh)		$ 0.105
Energy Escalation 2012 - 2030		2.0%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$ 47	
Lease Escalation Rate	2.5%	
General Inflation Rate		
Current - 2020	2.5%	
2021 - Future	2.5%	

Project Financing		
Grant Amount		$
Bond Repayment	Select →	30
Bond Interest Rate	2.50%	
PV Discount Rate	4.00%	

MET Avoided Costs		
Esc. Rate After 2017	5.0%	
Melded Rate- % Tier 1	100%	

Output



Project Capital Costs	
Capital Cost (2012)	$130,227,550
Grants	$0
Contingency	$22,586,000
Total Cost (2011)	$152,813,550
Total Cost Escalated to Midpt. of Const	$181,647,290

	Current Year	First Year
Costs Per AF	2012	2019
Capital Cost	$457	$544
O&M	$363	$489
Energy	$446	$522
Annual Cost	$1,266	$1,554
Annual Cost w/ Land	$1,313	$1,612
Mitigation Costs	$152	$187
Total w/ MET Subsidy	$1,216	$1,549

Net Present Value	
Up to Break Even	($16,445,195)
Break Even to End	$88,913,956
Total Savings	$72,468,761

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 6
Base with Low MET Escalation; No Fe/Mn (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

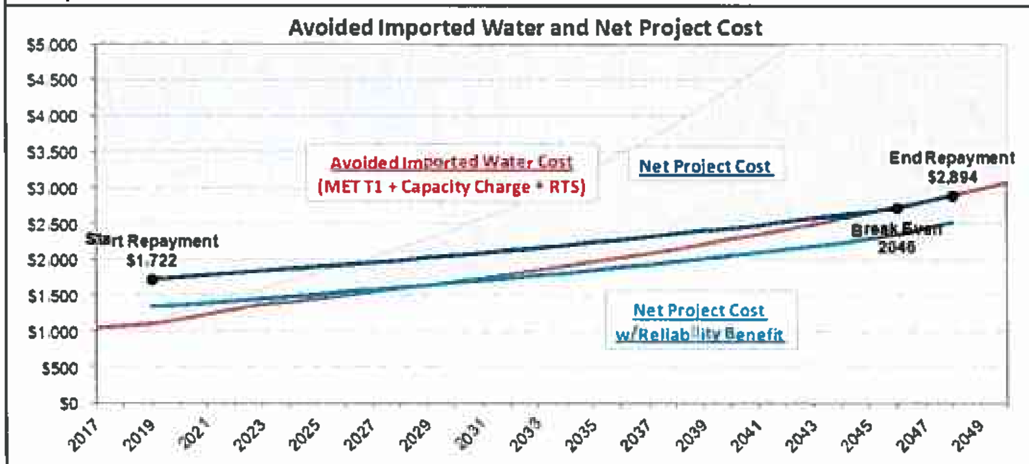
Capital Cost		
Fe/Mn Treatment?	No	
Contingency of Const.	25%	
Start of Construction		2017

O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,228
Base Energy Rate ($/kWh)		$ 0.105
Energy Escalation 2012 - 2030		2.0%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$ 47	
Lease Escalation Rate	2.5%	
General Inflation Rate		
Current - 2020	2.5%	
2021 - Future	2.5%	

Project Financing		
Grant Amount		$
Bond Repayment	Select →	30
Bond Interest Rate	4.50%	
PV Discount Rate	4.00%	

MET Avoided Costs		
Esc. Rate After 2017	3.0%	
Melded Rate- % Tier 1	100%	

Output



Project Capital Costs	
Capital Cost (2012)	$130,227,550
Grants	$0
Contingency	$22,586,000
Total Cost (2011)	$152,813,550
Total Cost Escalated to Midpt. of Const	$181,647,290

	Current Year	First Year
Costs Per AF	2012	2019
Capital Cost	$588	$699
O&M	$363	$489
Energy	$446	$522
Annual Cost	$1,397	$1,709
Annual Cost w/ Land	$1,444	$1,767
Mitigation Costs	$167	$205
Total w/ MET Subsidy	$1,361	$1,722

Net Present Value	
Up to Break Even	($72,772,358)
Break Even to End	$65,495,638
Total Savings	($7,276,720)

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 7
High Electrical & Fe/Mn Pre-Treatment (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

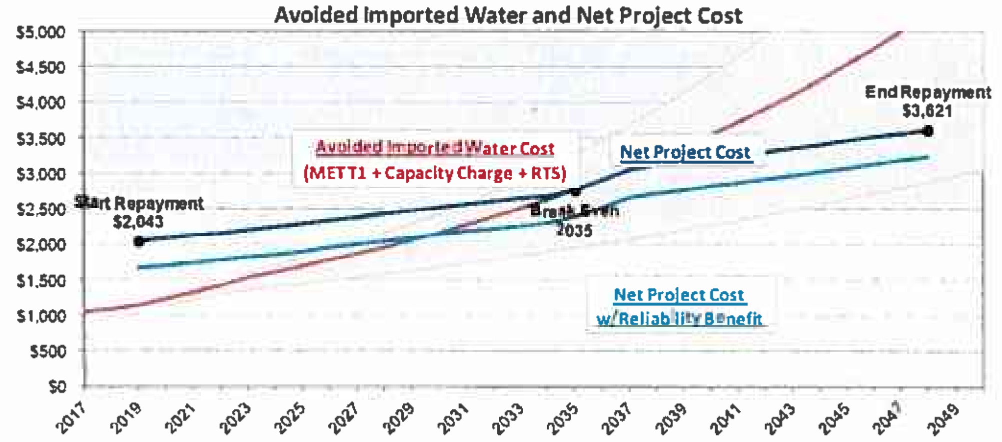
Capital Cost		
Fe/Mn Treatment?	Yes	
Contingency of Const.	25%	
Start of Construction		2017

O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,259
Base Energy Rate ($/kWh)		$ 0.105
Energy Escalation 2012 - 2030		3.4%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$ 47	
Lease Escalation Rate	2.5%	
General Inflation Rate		
Current - 2020	2.5%	
2021 - Future	2.5%	

Project Financing		
Grant Amount		$
Bond Repayment	Select →	30
Bond Interest Rate	4.50%	
PV Discount Rate	4.00%	

MET Avoided Costs	
Esc. Rate After 2017	5.0%
Melded Rate- % Tier 1	100%

Output



Project Capital Costs	
Capital Cost (2012)	$172,234,800
Grants	$0
Contingency	$30,373,750
Total Cost (2011)	$202,608,550
Total Cost Escalated to Midpt. of Const.	$240,837,897

Costs per AF	Current Year 2012	First Year 2019
Capital Cost	$779	$926
O&M	$421	$489
Energy	$446	$582
Annual Cost	$1,646	$1,997
Annual Cost w/ Land	$1,693	$2,054
Mitigation Costs	$196	$238
Total w/ MET Subsidy	$1,640	$2,043

Net Present Value	
Up to Break Even	($78,811,738)
Break Even to End	$68,285,103
Total Savings	($10,526,635)

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 8
Low MET Escalation with Fe/Mn Pre-Treatment (with MITIGATION costs)

Doheny Desalination Project - Economic Analysis - Draft Version 1.8

Input

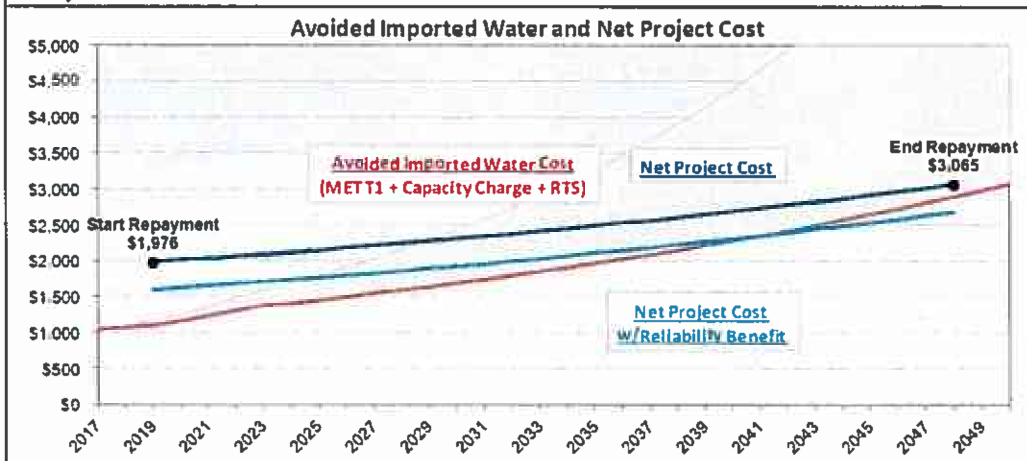
Capital Cost		
Fe/Mn Treatment?	Yes	
Contingency of Const.	25%	
Start of Construction		2017

O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,259
Base Energy Rate ($/kWh)		$ 0.105
Energy Escalation 2012 - 2030		2.0%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$ 47	
Lease Escalation Rate	2.5%	
General Inflation Rate		
Current - 2020	2.5%	
2021 - Future	2.5%	

Project Financing		
Grant Amount		$
Bond Repayment	Select →	30
Bond Interest Rate	4.50%	
PV Discount Rate	4.00%	

MET Avoided Costs	
Esc. Rate After 2017	3.0%
Melded Rate- % Tier 1	100%

Output



Project Capital Costs	
Capital Cost (2012)	$172,234,800
Grants	$0
Contingency	$30,373,750
Total Cost (2011)	$202,608,550
Total Cost Escalated to Midpt. of Const.	$240,837,897

Costs per AF	Current Year 2012	First Year 2019
Capital Cost	$779	$926
O&M	$421	$489
Energy	$446	$522
Annual Cost	$1,646	$1,937
Annual Cost w/ Land	$1,693	$1,994
Mitigation Costs	$196	$231
Total w/ MET Subsidy	$1,640	$1,976

Net Present Value	
Up to Break Even	($125,500,571)
Break Even to End	$115,260,666
Total Savings	($10,239,905)

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

Economic Analysis – Case 9
Low MET Escalation with Low Interest (with MITIGATION costs)

South Orange Coastal Desalination Project - Economic Analysis - DRAFT VERSION 1.8

Input

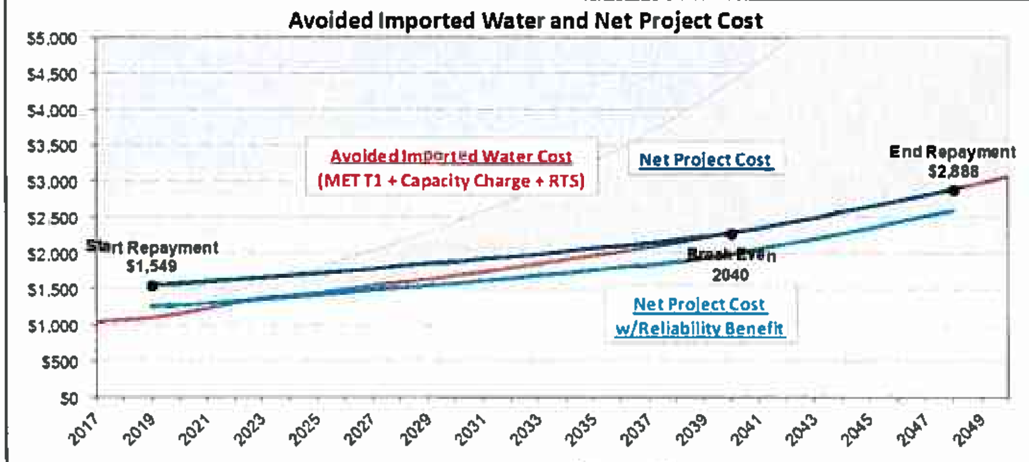
Capital Cost		
Fe/Mn Treatment?	No	
Contingency of Const.	25%	
Start of Construction		2017

O&M Costs		
Energy Costs		
Energy Usage (kWh)		4,228
Base Energy Rate ($/kWh)	$	0.105
Energy Escalation 2012 - 2030		2.0%
Energy Escalation after 2030		2.0%
Land Cost		
Land Cost per AF (2011)	$ 47	
Lease Escalation Rate	2.5%	
General Inflation Rate		
Current - 2020	2.5%	
2021 - Future	2.5%	

Project Financing		
Grant Amount		$
Bond Repayment	Select --	30
Bond Interest Rate	2.50%	
PV Discount Rate	4.00%	

MET Avoided Costs	
Esc. Rate After 2017	3.0%
Melded Rate- % Tier 1	100%

Output



Project Capital Costs	
Capital Cost (2012)	$130,227,550
Grants	$0
Contingency	$22,586,000
Total Cost (2011)	$152,813,550
Total Cost Escalated to Midpt. of Const.	$181,647,290

	Current Year	First Year
Costs per AF	2012	2019
Capital Cost	$457	$544
O&M	$363	$489
Energy	$446	$522
Annual Cost	$1,266	$1,554
Annual Cost w/ Land	$1,313	$1,612
Mitigation Costs	$152	$187
Total w/ MET Subsidy	$1,216	$1,549

Net Present Value	
Up to Break Even	($40,765,490)
Break Even to End	$35,505,320
Total Savings	($5,260,170)

Additional Reliability Benefit	
Storage Reservoir	$100,000,000

EXHIBIT H

California Emissions Estimator Model®

User's Guide

Version 2016.3.2

Prepared for:
California Air Pollution Control Officers Association (CAPCOA)

Prepared by:
BREEZE Software, A Division of Trinity Consultants
in collaboration with South Coast Air Quality Management District and
the California Air Districts

Date:
November 2017

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Table of Contents

List of Appendices

1 Introduction

This User's Guide (Guide) to the California Emission Estimator Model (CalEEMod)® is meant to give the user an introduction on how to use the program as well as to document the detailed calculations and default assumptions made in associated appendices. The purpose of CalEEMod is to provide a uniform platform for government agencies, land use planners, and environmental professionals to estimate potential emissions associated with both construction and operational use of land use projects. It is intended that these emission estimates are suitable for quantifying air quality and climate change impacts as part of the preparation of California Environmental Quality Act (CEQA) documents. In addition, individual districts may rely on the model's emission estimates to show compliance with local agency rules.

CalEEMod utilizes widely accepted methodologies for estimating emissions combined with default data that can be used when site-specific information is not available. Sources of these methodologies and default data include but are not limited to the United States Environmental Protection Agency (USEPA) AP-42 emission factors, California Air Resources Board (CARB) vehicle emission models, studies commissioned by California agencies such as the California Energy Commission (CEC) and CalRecycle. In addition, some local air districts provided customized values for their default data and existing regulation methodologies for use for projects located in their jurisdictions. When no customized information was provided and no regional differences were defined for local air districts, then state-wide default values were utilized. Since resource data and regulations are constantly changing, local agencies should be consulted to determine whether there are any circumstances when updated values should be used in place of the defaults currently incorporated into CalEEMod. A majority of CalEEMod's default data associated with locations and land use is derived from surveys of existing land uses. For any project that substantially deviates from the types and features included in the surveys, site-specific data that are supported by substantial evidence should be used, if available.

The model provides a number of opportunities for the user to change the defaults in the model; however, users are required to provide justification for all changes made to the default settings (e.g., reference more appropriate data sources) in the Remarks box provided at the bottom of the screen before the user will be able to proceed to the next screen. Further, the user should make every effort to ensure that correct data is entered, including the choice and percent reduction of mitigation most applicable to the land use project being evaluated.

1.1 Purpose of Model

CalEEMod provides a simple platform to calculate both construction emissions and operational emissions from a land use project. It can calculate both the daily maximum and annual average for criteria pollutants as well as annual greenhouse gas (GHG) emissions. The output from these calculations can be used in the preparation of quality and GHG analyses in CEQA documents such as Environmental Impact Reports (EIRs) and Negative Declarations. For projects located in the jurisdiction of San Luis Obispo APCD, the model can also calculate the sum of reactive organic gas (ROG) and nitrogen oxide (NO_x) emissions on a rolling quarterly basis. In addition, CalEEMod contains default values for estimating water and energy use which may be useful for preparing hydrology and energy analyses in other sections of a CEQA document. Specifically, the model can aid the user by conducting the following calculations:

- Short-term construction emissions associated with the demolition, site preparation, grading, building, coating, and paving from the following sources:
  - Off-road construction equipment;
  - On-road mobile equipment associated with workers, vendors, and hauling;
  - Fugitive dust associated with grading, demolition, truck loading, and on-road vehicles traveling along paved and unpaved roads. (Fugitive dust from windblown sources such as storage piles and inactive disturbed areas, as well as fugitive dust from off-road vehicle travel, are not quantified in CalEEMod, which is consistent with approaches taken in other comprehensive models.)
  - Architectural coating activities *(including the painting/striping of parking lots)* and paving (ROG).
- Operational emissions for fully built-out land use development from the following sources:
  - On-road mobile vehicle traffic generated by the land uses;
  - Fugitive dust associated with roads;
  - Architectural coating activities (ROG);
  - Off-road equipment (e.g., forklifts, cranes) used during operation;
  - Landscaping equipment;
  - Emergency generators, fire pumps, and process boilers;
  - Use of consumer products, parking lot degreasers, fertilizers/pesticides, and cleaning supplies (ROG);
  - Wood stoves and hearth usage;
  - Natural gas usage in the buildings;
  - Electricity usage in the buildings (GHG only);
  - Electricity usage from lighting in parking lots and lighting, ventilation and elevators in parking structures;
  - Water usage per land use (GHG only); and,
  - Solid waste disposal per land use (GHG only).
- One-time vegetation sequestration changes
  - Permanent vegetation land use changes
  - New tree plantings

- Mitigation adjustments to both short-term construction and operational emissions. Several of the mitigation measures described in CAPCOA's Quantifying Greenhouse Gas Mitigation Measures[1] have been incorporated into CalEEMod.

[1] Available at: http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf

2 Program Installation

The program is distributed and maintained by the California Air Pollution Control Officers Association[2]. The most recent version can be downloaded from www.caleemod.com.

2.1 Operating System Requirements

CalEEMod was programmed by Trinity using Microsoft SQL Compact Edition in conjunction with a Visual Basic Graphical User Interface (GUI). CalEEMod requires the following system requirements:

- Microsoft Windows 8 or 10 Operating System with Microsoft .NET Framework 3.5 (includes .NET 2.0 and 3.0)
- Microsoft Windows XP, Vista, or 7 Operating System with Microsoft .Net Framework 4 or higher
- Microsoft SQL Server Compact 3.5 SP2
- Microsoft Access Database Engine 2010 Redistributable, 32-bit
- 300 Mb hard drive space available

2.2 Installation Procedures

To install:

1. Ensure you have the required Microsoft .Net framework installed on your machine. Microsoft .NET Framework 3.5 is available for free from Microsoft at: https://www.microsoft.com/en-us/download/details.aspx?id=21. Microsoft .NET Framework 4.0 or higher is available free from Microsoft at: https://www.microsoft.com/en-us/download/details.aspx?id=17851. Once the file is downloaded, unzip the file anywhere on your computer and run the installation file (setup.exe) and follow the instructions on Microsoft's website to locate the appropriate .msi file.

2. To install Microsoft SQL Server Compact 3.5 SP2, go to https://www.microsoft.com/en-us/download/details.aspx?id=5783. For 32-bit computers, you will need to install SSCERuntime_x86-ENU.msi. For a 64-bit computer, you will need to install both the 32-bit and the 64-bit version of the SQL Server Compact 3.5 SP2 MSI files because the existing SQL Server Compact 3.5 applications may fail if only the 32-bit version of the .msi file is installed on the 64-bit computer.

3. To install 32-bit Microsoft Access Database Engine 2010 Redistributable, go to https://www.microsoft.com/en-us/download/details.aspx?id=13255&751be11f-ede8-5a0c-058c-2ee190a24fa6=True, click on Download, select "AccessDatabaseEngine.exe" (25.3 MB), and click on Next. Once this file is

downloaded, double click on "AccessDatabaseEngine.exe" file and follow the on-screen instructions to finish the installation.

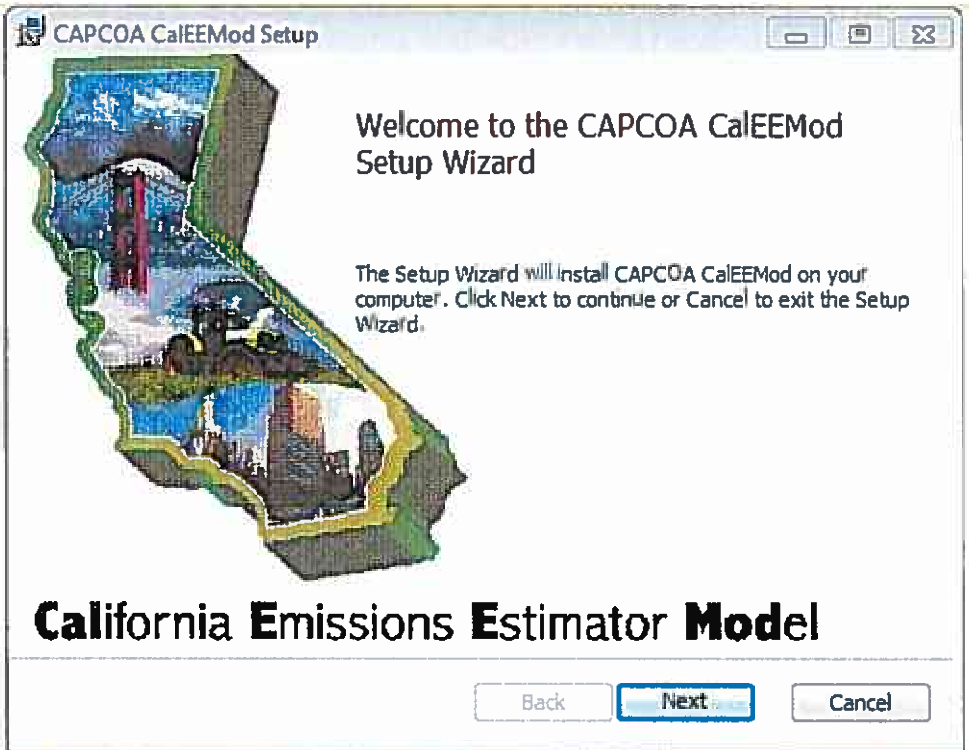
4. From www.CalEEMod.com, download the installation file (CalEEMod.WixSetup 2016.3.2.25.msi), click on the file and follow the instructions. Pages 6 through 8 show screen shots of the CalEEMod Windows Installer XML (WiX) Setup Wizard.

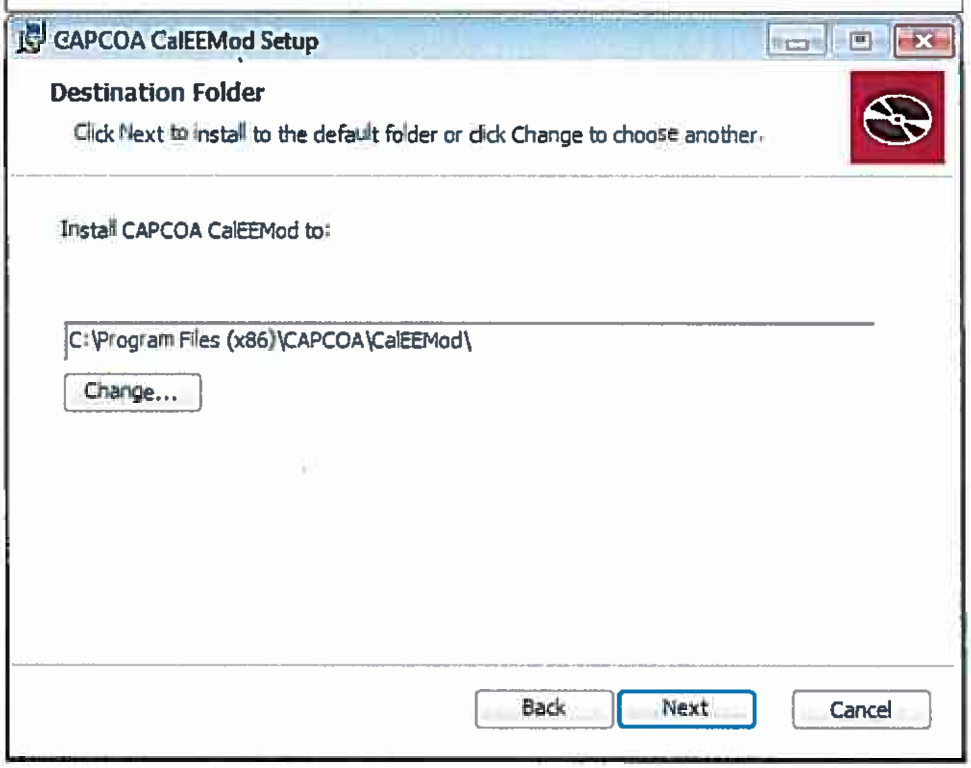
5. CalEEMod version 2016.3.2 can be installed side by side with version 2016.3.1 provided that each version is installed in different folders. For 32-bit computers, the default directory for CalEEMod version 2016.3.2 is C:\Program Files\CAPCOA\CalEEMod; for 64-bit computers, the default directory for CalEEMod version 2016.3.2 is C:\Program Files (x86)\CAPCOA\CalEEMod. If you want to run CalEEMod version 2016.3.2 side by side with CalEEMod version 2016.3.1 but CalEEMod version 2016.3.1 is already installed in C:\Program Files\CAPCOA\CalEEMod on a 32-bit computer or C:\Program Files (x86)\CAPCOA\CalEEMod on a 64-bit computer, click on Change to change the destination folder[3].

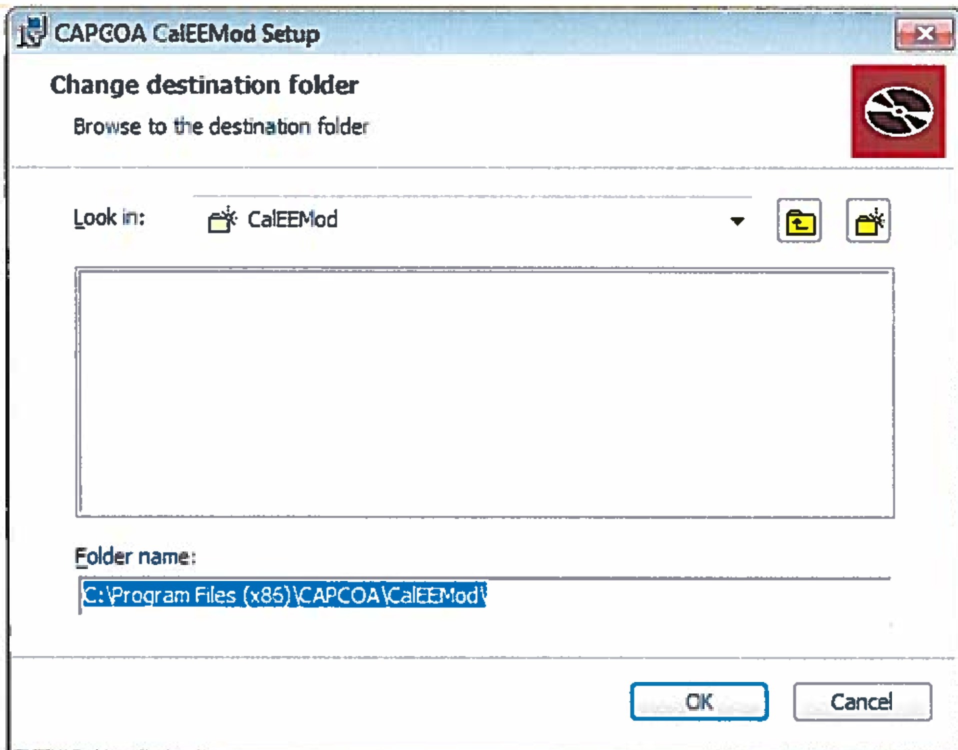
6. Click Next until the installation has completed, then click Finish to exit the installer.

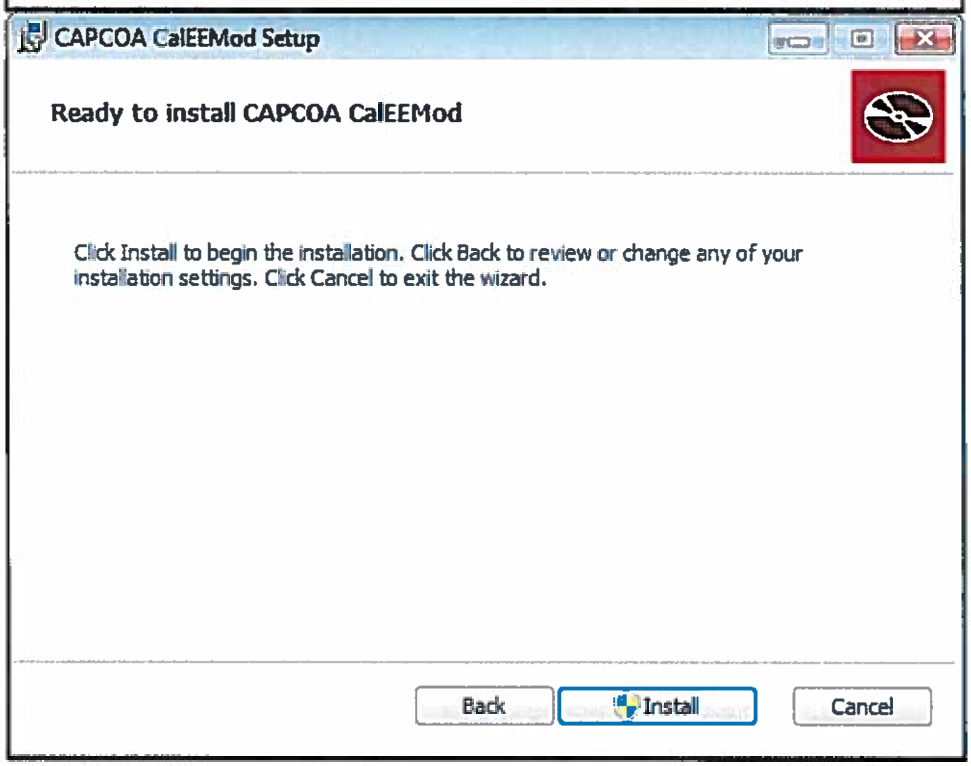
7. If you have any further trouble installing CalEEMod, verify that you have appropriate user privileges and that your computer meets the operating system requirements.

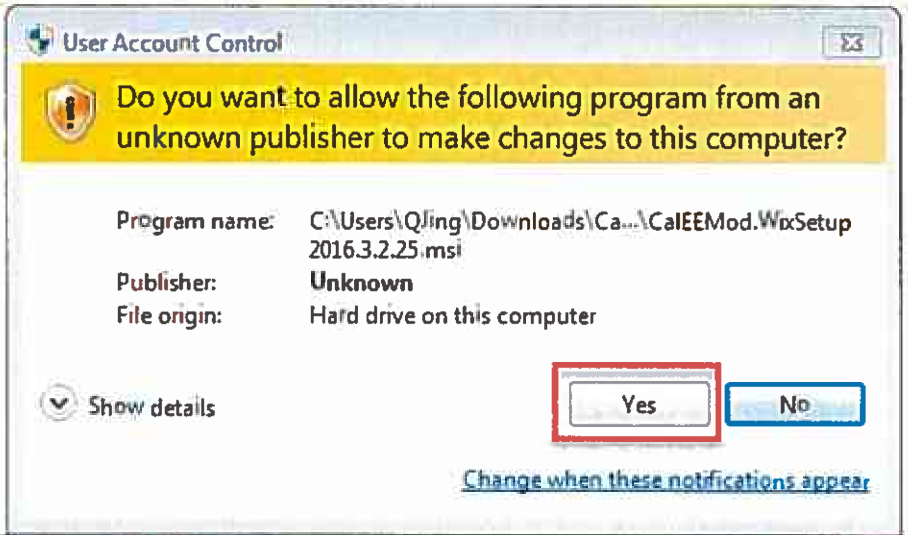
[3] If you use Windows Vista, 7, 8 or 10, file privileges may not allow access rights to some folders during program operations such as C:\Program Files\.

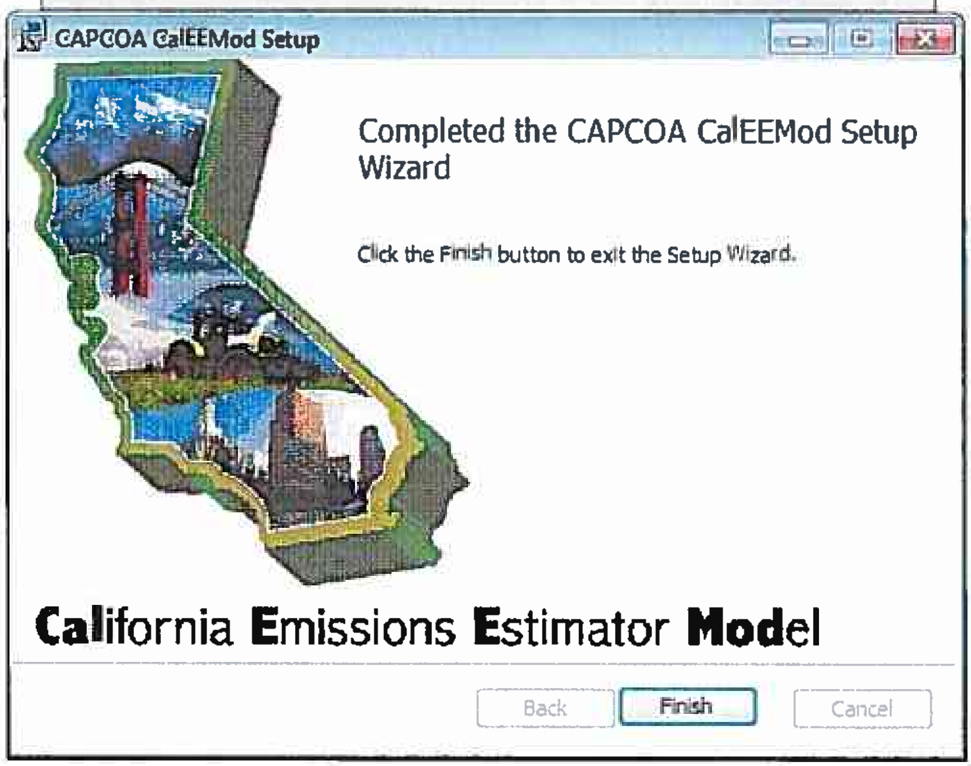

CAPCOA CalEEMod Setup
Welcome to the CAPCOA CalEEMod Setup Wizard
The Setup Wizard will install CAPCOA CalEEMod on your computer. Click Next to continue or Cancel to exit the Setup Wizard.
California Emissions Estimator Model
Back
Next
Cancel


CAPCOA CalEEMod Setup
Destination Folder
Click Next to install to the default folder or click Change to choose another.
Install CAPCOA CalEEMod to:
C:\Program Files (x86)\CAPCOA\CalEEMod\
Change...
Back
Next
Cancel


CAPCOA CalEEMod Setup
Change destination folder
Browse to the destination folder
Look in:
CalEEMod
Folder name:
C:\Program Files (x86)\CAPCOA\CalEEMod\
OK
Cancel

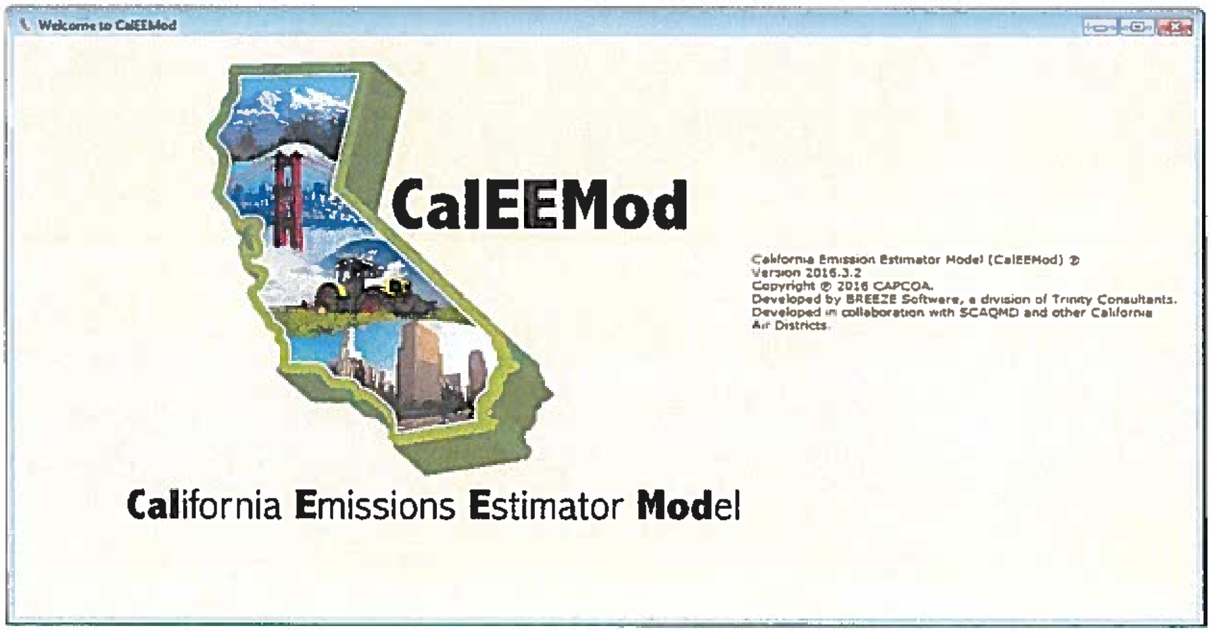

CAPCOA CalEEMod Setup
Ready to install CAPCOA CalEEMod
Click Install to begin the installation. Click Back to review or change any of your installation settings. Click Cancel to exit the wizard.
Back
Install
Cancel


User Account Control
Do you want to allow the following program from an unknown publisher to make changes to this computer?
Program name: C:\Users\QJing\Downloads\Ca...\CalEEMod.WixSetup 2016.3.2.25.msi
Publisher: Unknown
File origin: Hard drive on this computer
Show details
Yes
No
Change when these notifications appear


CAPCOA CalEEMod Setup
Completed the CAPCOA CalEEMod Setup Wizard
Click the Finish button to exit the Setup Wizard.
California Emissions Estimator Model
Back
Finish
Cancel

2.3 Starting CalEEMod

After the installation is complete, a CalEEMod short cut icon will be appear on the desktop and CalEEMod will appear in the list of Programs available from the Start Button. To start the model, select CalEEMod from the program files or double click on the CalEEMod short cut icon.



3 Using CalEEMod

3.1 Key Features

CalEEMod is comprised of a linear series of screens with each screen designed with an individual purpose to define features of the project such as project characteristics, construction schedule and equipment, operational activity, mitigation measures, etc. The user will need to input basic information about the project such as location, land use type (e.g., residential, commercial, retail, etc.) and project size and the model will populate later screens with pre-determined defaults. The user may override the defaults to input more accurate, project-specific information as appropriate.

The figure on page 11 identifies some key features of CalEEMod which are described below.

1. Menu Bar: A drop down menu bar is found on all screens. For example, the Home menu controls file features such as New Project, Open Project, Save Project, and Save As Project. The Help menu will link to appropriate information for the relevant screen from this User's Guide. All of the other menus will allow navigation between the screens in any order.

2. Screen Name: Identifies the name of the current screen.

3. Default Button: This button allows the user to restore the program defaults after the user has changed any default values on the screen. User-entered values will be highlighted in yellow to clearly indicate the defaults that have been changed. The user will be prompted to specify whether the default should be restored for the current or last cell on the screen or for the entire screen. The Import csv option will allow the user to load in a .csv file for a specific data grid. Clicking on the Undo button will allow the user to cancel or undo the previous action.

4. Remarks: This section is located at the bottom of each screen and it requires the user to enter comments regarding any defaults that have been replaced with user-defined values. The Remarks section is meant to assist project reviewers to determine or assess the justification for user-defined values entered.

5. Next Button: When the user clicks on this button, the next sequential screen will appear. As the user progresses through the model, later screens will also show a Previous button that will take the user to the previous screen.

6. Data Grid: This is a common box where values for the variables defined across the top are to be filled in with data. The number of rows will automatically be adjusted based on the number of rows of information required to define the information. On some data grids, the last row may have an asterisk (*) and once the user begins adding information to this row, a new row will be added at the end. To delete a row, select the desired row to delete, and hit the delete button on your keyboard. (Deleting information is generally allowed unless the data grid contains a fixed list such as the Pollutant selection list.) Scroll bars (both horizontal and vertical) may also occur on some data grids, as appropriate.

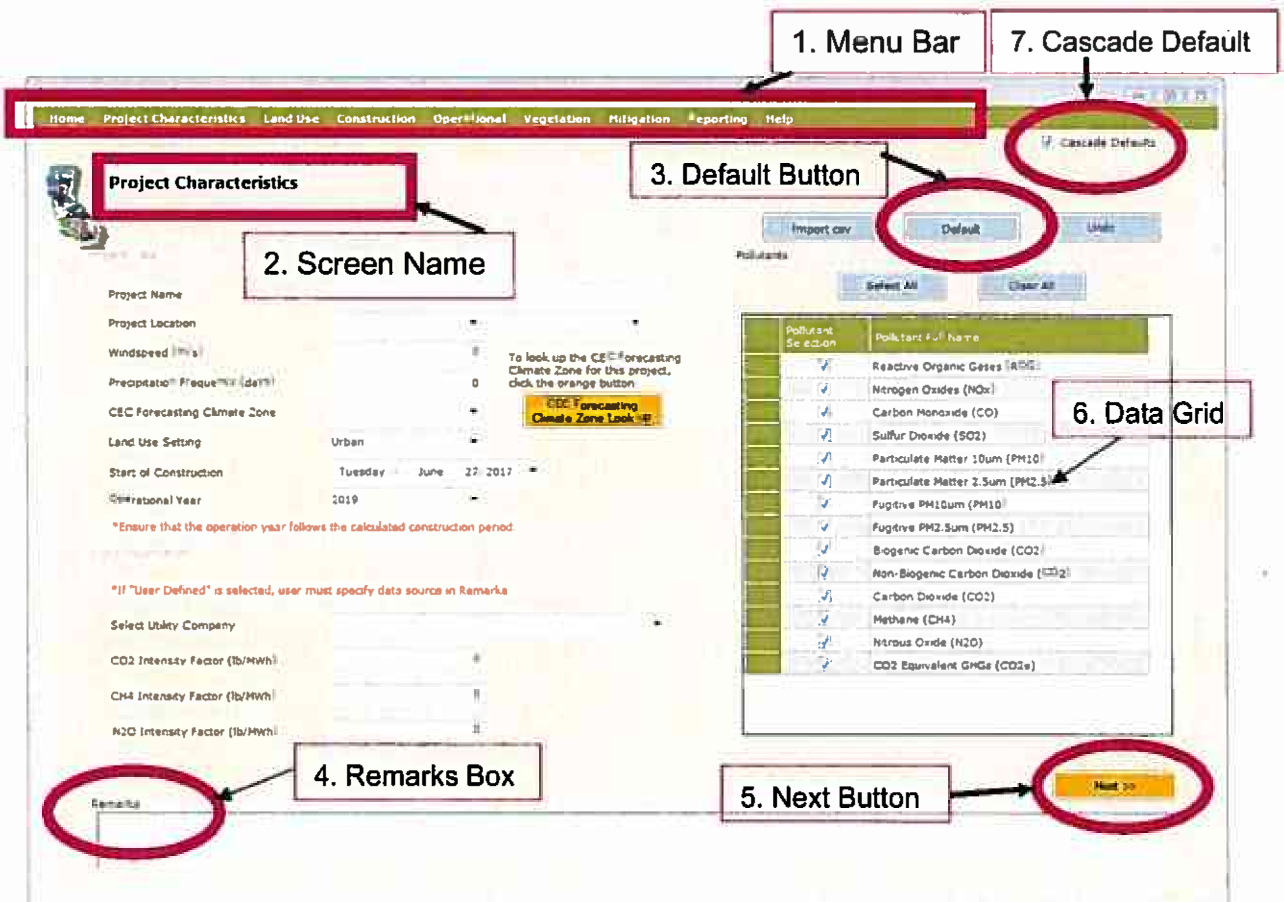
7. Cascade Defaults: CalEEMod has a feature that freezes the automatic downloading of the programmed defaults. Each input screen displays a box called Cascade Default which will be automatically checked to populate defaults in future screens. However, if user unchecks the Cascade Default box, no defaults will be populated in subsequent screens and the user will need to input project-specific data. Unless all the necessary input parameters required for a proper analysis are known, the user should run the model at least once with "Cascade Default" button checked to allow the defaults to be populated. Then, if the user would like to change the project's parameters (e.g., number of dwelling units, building square footage, etc.) without cascading new defaults in later screens, then the user should uncheck the Cascade Default box when in the Land Use screen. This feature may be helpful when the defaults are replaced with project-specific information (e.g., construction schedule, construction equipment, water use, energy use, etc.) and the user would like to evaluate different project scenarios with the same basic project information (e.g., land use type, location, etc.). In addition, by unchecking the Cascade Default box, the following will occur:

   - The defaults in *ALL* subsequent screens will be frozen.
   - Any changes that are made to screens that follow the Land Use screen (e.g., adding a new construction phase) will not cascade defaults relating to that change or add

new tabs (e.g., trips and VMT, dust material movement). Thus, the user will need to manually input project-specific information in order for the impacts to be calculated.

- If any changes to land use type (e.g., from single family housing to a hospital) are made, the subsequent screens will not reflect the new land use type causing some incorrect calculations (e.g., impacts from energy and water use) to be performed.

When changing or adding a land use type, the user should click on the Cascade Default button so the future screens will be populated with appropriate defaults and the correct calculations specific to the changed or added land use type will occur.



3.2 Home

The Home tab on the file menu bar that controls the file saving and opening features. The available options are:

- New Project
- Open Project
- Save
- Save As
- Exit

The user should select Open Project to open a project that has been previously created and saved or New Project to create a new project. Note that opening a previously saved project will remove any information that has been entered into the GUI unless it has been saved to a file. Save will save the currently loaded project database as a Microsoft Excel file and this file can be closed, and then re-opened later. Save As will allow the user to change the name of the saved project file. Exit will close CalEEMod. The Microsoft Excel file can be edited following the format of the save file to quickly make edits outside of the Graphical User Interface (GUI) but the user will still need to use the GUI in order to report the results. This can be most useful in making changes to construction lists. Data for individual tabs can be uploaded as a .csv file in various places in CalEEMod to minimize the data entry.

3.3 Defining a Project

In order to define a project, the user will need to enter information on both the Project Characteristics screen and the Land Use screen. After entering information on these two screens, CalEEMod will populate all of the other information required to calculate unmitigated construction (unless there is demolition, grading, or site preparation) and operation emissions using default data. If demolition, grading, and/or site preparation activities are part of the project, then the user will need to enter additional information on the appropriate construction screens, including but not limited to, the amount of material to be demolished and transported to or from the site. If site-specific information is not needed for the project, the user can skip this part and jump to the Mitigation screen and enter mitigation measures. After completing the Mitigation screen, the user can proceed to the Reporting screen to select the type of report to be generated for the project.

3.4 Altering Default Data

CalEEMod was designed with default assumptions supported by substantial evidence to the extent available at the time of programming. The functionality and content of CalEEMod is based on fully adopted methods and data. However, CalEEMod was also designed to allow the user to change the defaults to reflect site- or project-specific information, when available, provided that the information is supported by substantial evidence as required by CEQA. If the user chooses to modify any defaults, an explanation will be required in the Remarks box found at the bottom of the screen to justify and support the modification before the user will be able to proceed to the next screen. Modifications to defaults and the explanations are noted in the output report. Comments in the Remarks box are also included in the report and alert reviewers of modifications to the defaults. Comments are important because they show the user's justification for the modifications, which allows the reviewers the ability to determine whether or not the modifications are appropriate and sufficiently justified.

3.5 Mitigation

Common construction mitigation measures that impact the calculations in CalEEMod have been incorporated as options for the user to select. It is important to note that compliance with fugitive dust rules vary widely by district and include requirements to reduce dust. Even though the fugitive dust rules contain requirements that when implemented, have the effect of mitigating dust emissions, these requirements are not considered to be mitigation per se. For these reasons, requirements such as percentage adjustments to fugitive dust rules have not been incorporated into the unmitigated fugitive dust calculations.

Several mitigation measures from CAPCOA's Quantifying Greenhouse Mitigation Measures have been incorporated including combinations and caps when using multiple mitigation measures. CalEEMod was designed to include typical mitigation measures that are some of the more effective measures available to development projects. If mitigation measures are not available as options in CalEEMod, the user can alter the inputs in the program to adjust to account for mitigation measures that may be less common. This will require separate runs of CalEEMod files in order to properly account for unmitigated and mitigated scenarios. For more details regarding mitigation, see Subchapter 4.11.

3.6 Reporting

The Reporting tab allows the user to select the type of report (e.g., annual, winter or summer) to present the results of the calculations. The reports can be viewed on screen and then saved as either a Microsoft Excel file or a .pdf file. For more details regarding reporting, see Subchapter 4.11.

4 Detailed Program Screens

4.1 Project Characteristics

The Project Characteristics screen is starting point where the user enters the project name, project location, and selects utility provider, climate zone, and pollutants to be analyzed. The information entered on this screen will trigger project appropriate default data to populate subsequent screens. Any changes entered on this screen will override any previously entered user-defined data and the corresponding default data. The project name will appear in the reports. Each of the information categories on this screen are described in more detail below.

Project Location

To define the region where the project is located, the user is given the option to select Air District, Air Basin, County, or Statewide. The second drop down box will reveal a list of specific locations to the region selected. If the user selects County, It is important to note that there may be some counties that are shared by multiple Air Districts, Air Basins or District-specific sub-regions and the default values (e.g., on-road vehicle emissions, trip lengths, water supply and treatment electricity use, solid waste disposal rates, amount of paved roads, days of landscaping equipment use, architectural coating emissions, and hearth usage) may vary accordingly. Thus, if the user selects County, the user may also be prompted to select the sub-county area. If you are uncertain about what region to choose for your project location, consult your lead agency.

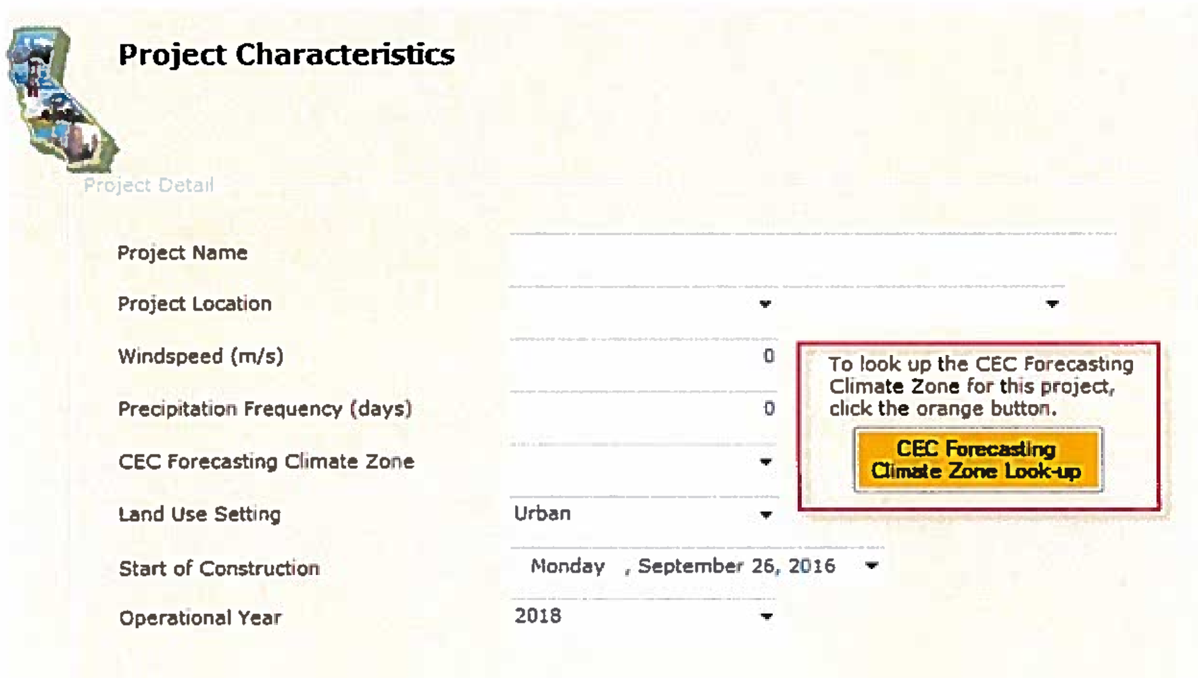
Wind Speed and Precipitation Frequency

Selection of project location will automatically fill in the default wind speed and precipitation frequency. The user can also choose to override this information and enter a different value. The wind speed, in meters per second (m/s), is used in the fugitive dust calculations. Precipitation frequency, e.g. the number of days per year with a precipitation amount measuring greater than 0.01 inches in one day, is used in the fugitive dust calculations.

Climate Zone

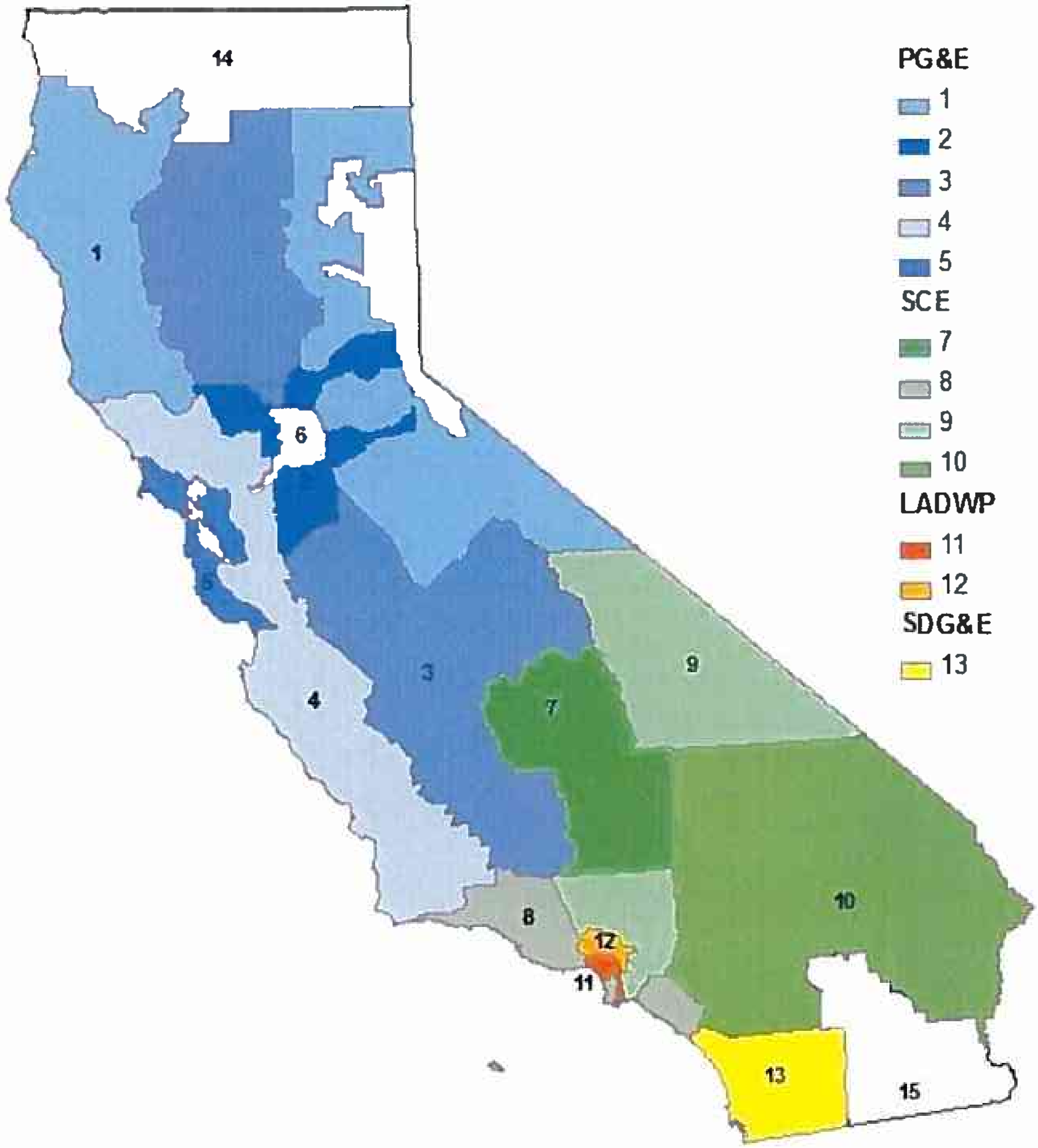
Selection of project location will restrict the climate zones available for the user to choose from based on the climate zones in the project location. The climate zones that have been programmed into CalEEMod are based on the California Energy Commission's (CEC) Forecasting Climate Zones, which are different from the Title 24 Building Climate Zones. The user should determine the correct climate zone by either referring to the figure below or by clicking on the orange button that says "CEC Climate Zone Forecasting Look-up" on the Project Characteristics screen. In addition, the user may also determine the climate zone by city or zip code from the look up tables in Appendix F.

CEC Forecasting Climate Zone Look-up Button



CalEEMod utilizes the Forecasting Climate Zones because the baseline data in the 2002 California Commercial End Use Survey (CEUS) and 2009 Residential Appliance Saturation Survey (RASS), upon which CalEEMod relies, are categorized in this manner. Further information on the calculation of building energy usage, including the application of data specific to the Forecasting Climate Zones, is contained in Appendix E.

CEC Forecasting Climate Zones[4, 5]



[4] Adapted from Figure ES-2 of CEC. 2010. Residential Appliance Saturation Survey. Available at: http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF

[5] White spaces represent areas served by other electric utilities not included in survey.

Land Use Setting

The Land Use Setting tab is where the user indicates whether the project is located in a rural or urban setting. The user should contact the local air district for the region where the project is located for guidance on the appropriate Land Use Setting to select.

Start of Construction

To indicate when construction of the project will begin, the user will need to insert a date in the Start of Construction field. The date when construction will start triggers a rolling calendar that starts with the construction start date and follows by various construction phases that will be populated with default date ranges in the Construction screen.

Operational Year

CalEEMod is currently designed to key off of one year to initiate the beginning of the full operation of the project. Thus, to indicate when the project will begin operation activities, the user will need to insert a year. CalEEMod will use this year to determine the appropriate emission factors to be used in all operational module calculations. CalEEMod can accommodate the following years for the initial operational year: 2000, 2005, 2010-2035, 2040, 2045, and 2050. To conduct a backcasting analysis by inserting an operational year that occurs in the past, the selection of years is limited to minimize the file size associated with vehicle emission factors. For a project that consists of multiple phases with operation activities occurring over multiple years, the user should run the model multiple times for the various input parameters for each operational year.

Utility Company

From the drop down list, the user will need to select the appropriate utility company that will serve the project location. . When a specific utility is selected, the intensity factors for CO_2, CH_4 and N_2O will be automatically populated with defaults applicable to the specified utility. However, if the utility for the project is not in the drop down list, the user may select User Defined and the user will need to manually enter the various intensity factors. In addition, the user will need to identify the utility in the Remarks section.

The intensity factors are used in various modules to calculate the GHG emissions associated with electricity use. The default values are based on CARB's Local Government Operations Protocol (LGO)[6] for CO_2, updated public utility protocols for CO_2, and E-Grid values for CH_4 and N_2O. Each default CO_2 intensity factor is based on the latest reporting year available for each utility. Appendix D, Table 1.2 provides the default CO_2 intensity factor and reporting year from which the factor was identified for each utility identified in the drop down list. As with other defaults in the model, if a new intensity factor is identified before the defaults in CalEEMod are updated, the user may override the default and provide justification for the change in the Remarks section at the bottom of the Project Characteristics screen.

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[6] Available at: http://www.arb.ca.gov/cc/protocols/localgov/localgov.htm

Pollutants

CalEEMod provides a list of pollutants with adjacent check boxes for the user to select. Upon starting a new project, all of the boxes are automatically checked and if the boxes remain checked, all pollutants will be quantified and identified in the reports. If user unchecks any of the boxes, the unchecked pollutants will be excluded from the calculations and the reports. Some of the pollutants may overlap other identified pollutants. For example, carbon dioxide (CO_2) is identified on its own, and it is separated into biogenic and non-biogenic categories. In addition, CO_2 Equivalent GHGs represents, all CO_2 emissions plus methane (CH_4) and nitrous oxide (N_2O) as adjusted by their corresponding Global Warming Potential (GWP) weighted value. The GWPs are based on the 2007 IPCC's Fourth Assessment Report (AR4)[7], and are consistent with 2014 CARB's Scoping Plan Update[8].

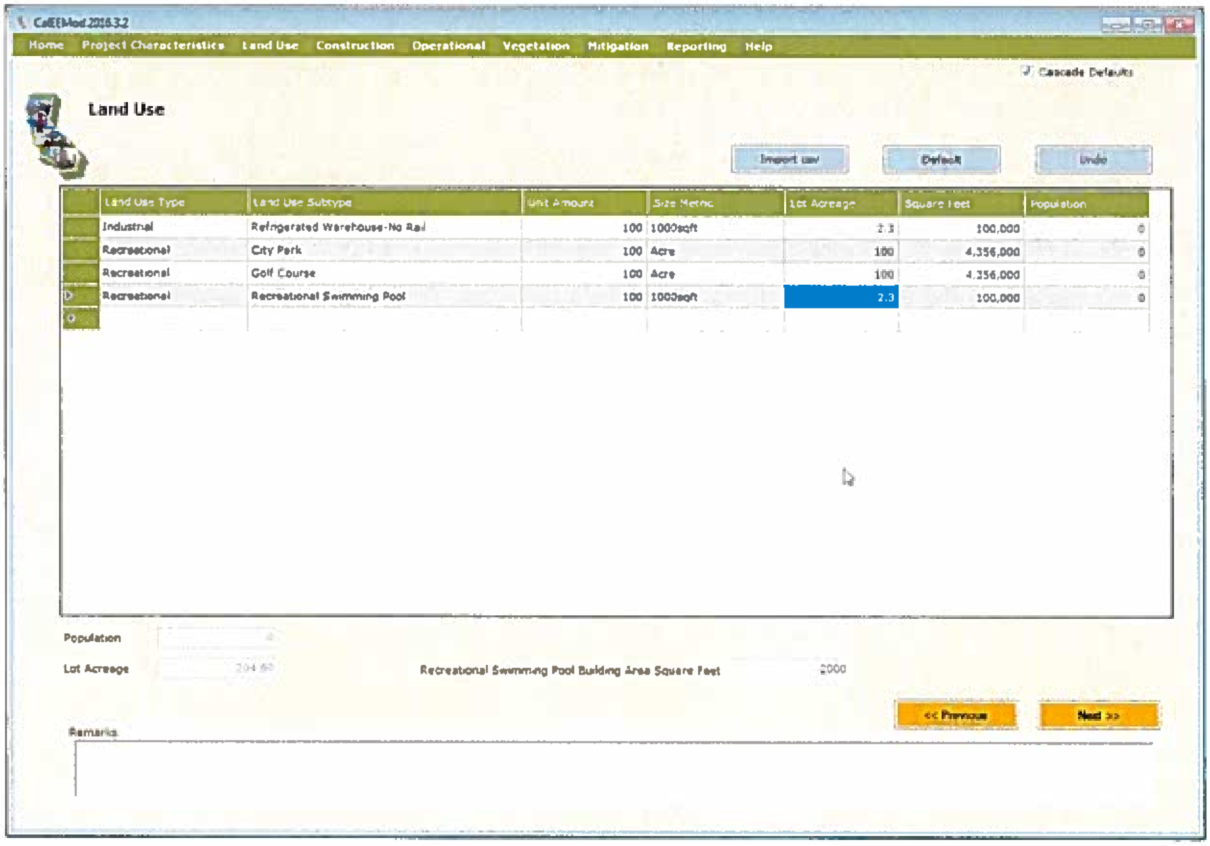
Remarks

As previously explained in Subchapter 3.4, if the user chooses to modify any defaults, the user will be required to provide an explanation or justification in the Remarks section for incorporating user defined (e.g., non-default) values before the user will be able to proceed to the next screen. Any remarks that are entered will be included in the reports and will assist a reviewer in understanding the reasons for a change in the default value (e.g., new trip rate based on a project-specific traffic study conducted by traffic engineers).

4.2 Land Use

The Land Use screen is where the user identifies the land use(s) that will occur at the project site. The data in the land use types and subtypes, unit amounts, size metric, lot acreage, square feet and population fields determine the default variables that are used in the calculations. It is important to note that for any project that includes a city park, golf course, or recreational swimming pool land use, the user will be prompted to enter the square footage of the buildings associated with these land uses (e.g., restrooms/changing rooms, pro-shop, etc.). By excluding the entire lot size for these three land use types, and instead only using the square footage of the buildings, the calculations for consumer product use will provide a more accurate representation of where these materials are actually used and avoid incorrectly attributing consumer products use to greenspaces and pool water. For more information on the calculations for consumer product use, see Subchapter 4.5, Section 4.5.2.

[7] Available at: https://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_full_report.pdf
[8] Available at: http://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm


CalEEMod 2016.3.2
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100
1000sqft
2.3
100,000
0
Recreational
City Park
100
Acre
100
4,356,000
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Recreational
Golf Course
100
Acre
100
4,356,000
0
Recreational
Recreational Swimming Pool
100
1000sqft
2.3
100,000
0
Population
Lot Acreage
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2000
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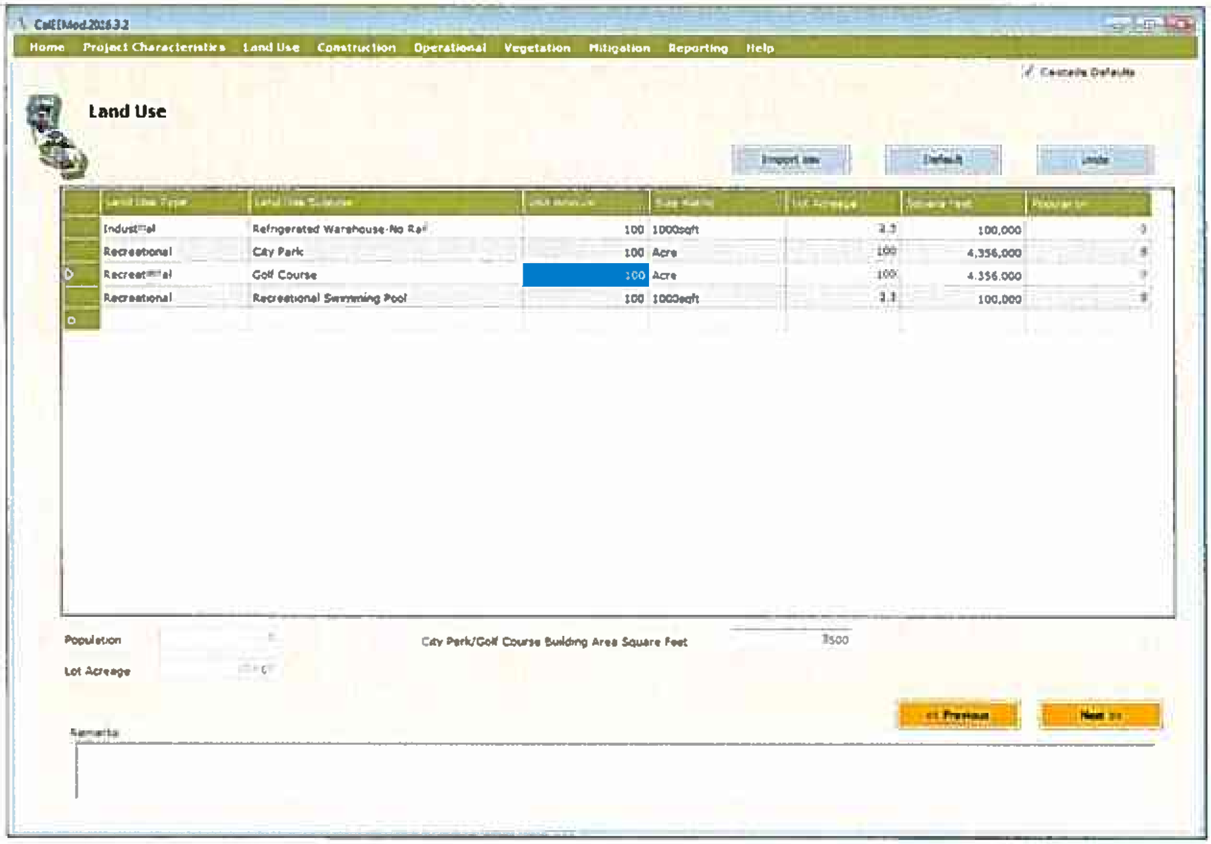
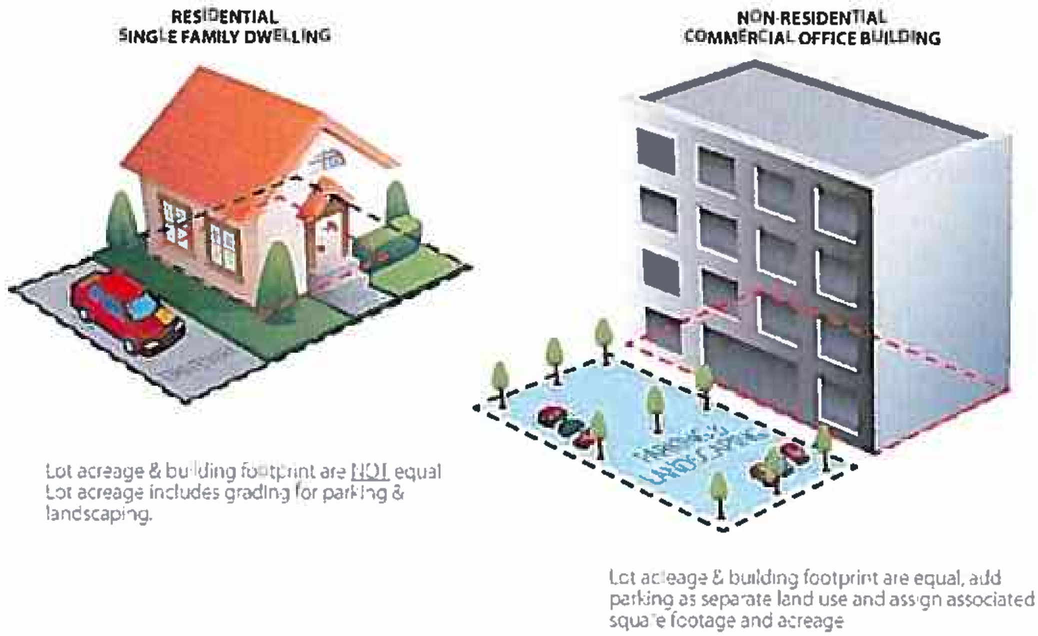


Land Use Type

The Land Use Type tab allows the user to select any of the following primary land use types from a drop down list: Commercial, Educational, Industrial, Parking, Recreational, Residential, and Retail. The 63 different land use types were chosen for inclusion in CalEEMod because each has an established trip rate critical for mobile source calculations.

CalEEMod specifically designates parking areas as a separate land use rather than as a part of an associated non-residential land use (e.g., commercial buildings, retail facilities, etc.). However, no separate parking land use for a driveway or garage needs to be identified for residential land uses because parking is already included in the calculation For more information on how CalEEMod treats parking based on the footprint and lot acreage of residential and non-residential land uses, please refer to the following figure. As depicted, the lot acreage of a residential land use includes the parking and building footprint. For non-residential land uses, the lot acreage is the same as the building footprint, so parking needs to be entered as a separate land use.

CalEEMod Default Lot Acreage for Res and Non Res Land Uses



For the parking land use subtype, two primary options are available: parking lot or parking structure (e.g., garage). There are four types of parking structures: 1) enclosed; 2) enclosed with an elevator; 3) unenclosed; and, 4) unenclosed with an elevator. The reason for these specific descriptions is so that the model properly accounts for energy impacts associated with ventilation and elevator operations.

For land use subtypes that are not listed (e.g., roads, underground parking, pipelines, etc.) or that do not accurately represent the project being analyzed, each land use subtype has a User Defined option that the user can select. If a User Defined land use subtype is selected, there is no default data (including size metric) that will automatically populate the data fields. Instead, the user will need to manually enter the unit amount, size metric, lot acreage, etc. If these fields are left blank, no emissions will be calculated for the User Defined land use subtype. Also, whatever size metric (e.g., per acre, per 1000 square foot, etc.) the user chooses for the User Defined land use subtype needs to be consistently applied to all subsequent default values (e.g., gallons of water used *per acre* or *per 1000 square foot*). An alternative approach to entering a User Defined land use subtype would be to choose a land use subtype that most closely fits the project and allow the model to populate the data fields with the defaults. Then, the user can go back through the model and modify the defaults with any known specific project information and enter the required Remarks to explain why the defaults are modified.

Land Use Subtype

63 land use subtypes have been included in CalEEMod and each has an established trip rate that is used for calculating mobile source emissions. By tabbing over to the next column in a row, the user can select a variety of land use subtypes. The user also has the option to select a User Defined land use subtype; however, as explained previously, there is no default data (including size metric) that will automatically populate the data fields. Instead, the user will need to manually enter the unit amount, size metric, lot acreage, etc. Land use subtypes are based primarily on the land use definitions used for (mobile source) trip generation rate information from the Institute of Transportation Engineers (ITE) 9th edition of the Trip Generation Manual. In some cases similar generalized land uses or surrogate data was mapped to some land use subtypes in order to generate the default data needed for various modules.

Table 1: Land Use Subtype Descriptions

Land Use Subtype	Description[1]	ITE Number
	RESIDENTIAL	
Apartments High Rise	High-rise apartments are units located in rental buildings that have more than 10 levels and most likely have one or more elevators.	222
Apartments Low Rise	Low-rise apartments are units located in rental buildings that have 1-2 levels.	221
Apartments Mid Rise	Mid-rise apartments in rental buildings that have between 3 and 10 levels.	223
Condo/Townhouse	These are ownership units that have at least one other owned unit within the same building structure.	230
Condo/Townhouse High Rise	These are ownership units that have three or more levels.	232
Congregate Care (Assisted Living)	These facilities are independent living developments that provide centralized amenities such as dining, housekeeping, transportation and organized social/recreational activities. Limited medical services may or may not be provided.	253
Mobile Home Park	Mobile home parks consist of manufactured homes that are sited and installed on permanent foundations and typically have community facilities such as recreation rooms, swimming pools and laundry facilities.	240
Retirement Community	These communities provide multiple elements of senior adult living. Housing options may include various combinations of senior adult housing, congregate care, assisted living, and skilled nursing care aimed at allowing the residents to live in one community as their medical needs change.	255
Single Family Housing	All single-family detached homes on individual lots typical of a suburban subdivision	210

Table 1: Land Use Subtype Descriptions

Land Use Subtype	Description[1]	ITE Number
	EDUCATIONAL	
Day-Care Center	A day care center is a facility where care for pre-school age children is provided, normally during the daytime hours. Day care facilities generally include classrooms, offices, eating areas and playgrounds.	565
Elementary School	Elementary schools typically serve students attending kindergarten through the fifth or sixth grade. They are usually centrally located in residential communities in order to facilitate student access and have no student drivers.	520
High School	High schools serve students who have completed middle or junior high school.	530
Junior College (2Yr)	This land use includes two-year junior, community, or technical colleges.	540
Junior High School	Junior High schools serve students who have completed elementary school and have not yet entered high school.	522
Library	A library is a facility that consists of shelved books; reading rooms or areas; and sometimes meeting rooms.	590
Place Of Worship	A church is a building in which public worship services are held. A church houses an assembly hall or sanctuary; it may also house meeting rooms, classrooms and occasionally dining catering or party facilities.	560
University/College (4Yr)	This land use includes four-year universities or colleges that may or may not offer graduate programs.	550
	RECREATIONAL	
Arena	Arenas are large indoor structures in which spectator events are held. These events vary from professional ice hockey and basketball to non-sporting events such as concerts, shows, or religious services. Arenas generally have large parking facilities, except when located in or around the downtown of a large city.	460
City Park	City parks are owned and operated by a city.	411
Fast Food Restaurant W/O Drive Thru	This land use includes fast-food restaurants without drive-through windows. Patrons generally order at a cash register and pay before they eat.	933
Fast Food Restaurant With Drive Thru	This category includes fast-food restaurants with drive-through windows.	934
Golf Course	Golf courses include 9, 18, 27 and 36 hole courses. Some sites may also have driving ranges and clubhouses with a pro shop, restaurant, lounge and banquet facilities.	430
Health Club	These are privately-owned facilities that primarily focus on individual fitness or training. Typically they provide exercise classes; weightlifting, fitness and gymnastics equipment; spas; locker rooms; and small restaurants or snack bars.	492

Table 1: Land Use Subtype Descriptions

Land Use Subtype	Description[1]	ITE Number
High Turnover (Sit Down Restaurant)	This land use consists of sit-down, full-service eating establishments with turnover rates of approximately one hour or less. This type of restaurant is usually moderately priced and frequently belongs to a restaurant chain.	932
Hotel	Hotels are places of lodging that provide sleeping accommodations and supporting facilities such as restaurants; cocktail lounges; meeting and banquet rooms or convention facilities; limited recreational facilities and other retail and service shops.	310
Motel	Motels are places of lodging that provide sleeping accommodations and often a restaurant. Motels generally offer free on-site parking and provide little or no meeting space and few supporting facilities.	320
Movie Theater (No Matinee)	Movie theaters consist of audience seating, single or multiple screens and auditoriums, a lobby and a refreshment stand. Movie theaters without matinees show movies on weekday evenings and weekends only; there are no weekday daytime showings.	443
Quality Restaurant	This land use consists of high quality, full-service eating establishments with typical turnover rates of at least one hour or longer. Quality restaurants generally do not serve breakfast, some do not serve lunch; all serve dinner. This type of restaurant usually requires reservations and is generally not part of a chain. Patrons commonly wait to be seated, are served by a waiter, order from menus and pay for meals after they eat.	931
Racquet Club	These are privately-owned facilities that primarily cater to racquet sports.	491
Recreational Swimming Pool	This is a typical recreational swimming pool that may be associated with community centers, parks, swim clubs, etc.	495
PARKING		
Enclosed Parking Structure	This is an enclosed parking structure that may be above or below ground. It is not covered in asphalt. This land use will require lighting and ventilation, and will be more than one floor with no elevator.	
Enclosed Parking with Elevator	This is an enclosed parking structure that may be above or below ground. It is not covered in asphalt. This land use will require lighting and ventilation, and will be more than one floor with an elevator.	
Other Asphalt Surfaces	This is an asphalt area not used as a parking lot (e.g., long driveway, basketball court, etc.)	
Other Non-Asphalt Surfaces	This is a non-asphalt area (e.g., equipment foundation, loading dock area, etc.).	
Parking Lot	This is a typical single surface parking lot typically covered with asphalt. This land use will require lighting.	
Unenclosed Parking Structure	This is an unenclosed parking structure that may be above or below ground. It is not covered in asphalt. This land use will require lighting but not ventilation. It will be more than one floor with no elevator.	
Unenclosed Parking with Elevator	This is an unenclosed parking structure that may be above or below ground. It is not covered in asphalt. This land use will require lighting but not ventilation. It will be more than one floor with an elevator.	

Table 1: Land Use Subtype Descriptions

Land Use Subtype	Description[1]	ITE Number
RETAIL		
Automobile Care Center	An automobile care center houses numerous businesses that provide automobile-related services, such as repair and servicing; stereo installation; and seat cover upholstering.	942
Convenience Market (24 Hour)	These markets sell convenience foods, newspapers, magazines and often beer and wine. They do not sell or dispense motor vehicle fuels (e.g., gasoline and diesel).	851
Convenience Market With Gas Pumps	These markets sell or dispense motor vehicle fuels (e.g., gasoline and diesel), convenience foods, newspapers, magazines and often beer and wine. This includes convenience markets with motor vehicle fueling dispensers where the primary business is the selling of convenience items, not the fueling of motor vehicles.	853
Discount Club	A discount club is a discount store or warehouse where shoppers pay a membership fee in order to take advantage of discounted prices on a wide variety of items such as food, clothing, tires and appliances. Many items are sold in large quantities or in bulk.	857
Electronic Superstore	These are free-standing facilities that specialize in the sale of electronic merchandise.	863
Free-Standing Discount Store	Discount stores offer centralized cashiering and sell products that are advertised at discount prices. These stores offer a variety of customer services and maintain long store hours seven days a week.	815
Free-Standing Discount Superstore	The discount superstore is similar to the free-standing discount stores with the addition that they also contain a full-service grocery department under the same roof that shares entrances and exits with the discount store area.	813
Gasoline/Service Station	This land use includes service stations where the primary business is the fueling of motor vehicles. They may also have ancillary facilities for servicing and repairing motor vehicles.	944
Hardware/Paint Store	These stores sell hardware and paint supplies and are generally free-standing buildings.	816
Home Improvement Superstore	These are free-standing facilities that specialize in the sale of home improvement merchandise.	862
Regional Shopping Center	A shopping center is an integrated group of commercial establishments that is planned, developed, owned and managed as a unit. A shopping center's composition is related to its market area in terms of size, location and type of store.	820
Strip Mall	Small strip shopping centers contain a variety of retail shops and specialize in quality apparel, hard goods and services such as real estate offices, dance studios, florists and small restaurants.	826

Table 1: Land Use Subtype Descriptions

Land Use Subtype	Description[1]	ITE Number
Supermarket	Supermarkets are free-standing retail stores selling a complete assortment of food: food preparation and wrapping materials; and household, cleaning items. Supermarkets may also contain the following products and services: ATMs, automobile supplies, bakeries, books and magazines, dry cleaning, floral arrangements, greeting cards, limited-service banks, photo centers, pharmacies and video rental areas.	850
	COMMERCIAL	
Bank (With Drive-Through)	Drive-in banks provide banking facilities for motorists who conduct financial transactions from their vehicles; many also serve patrons who walk into the building.	912
General Office Building	A general office building houses multiple tenants where affairs of businesses commercial or industrial organizations or professional persons or firms are conducted. If information is known about individual buildings, it is suggested that this land use be used instead of the more generic office park.	710
Government (Civic Center)	A group of government buildings that are interconnected by pedestrian walkways.	733
Government Office Building	This is an individual building containing either the entire function or simply one agency of a city, county, state, federal, or other governmental unit.	730
Hospital	A hospital is any institution where medical or surgical care and overnight accommodations are provided to non-ambulatory and ambulatory patients. However, it does not refer to medical clinics or nursing homes.	610
Medical Office Building	This is a facility that provides diagnoses and outpatient care on a routine basis but is unable to provide prolonged in-house medical and surgical care. One or more private physicians or dentists generally operate this type of facility.	720
Office Park	Office parks are usually suburban subdivisions or planned unit developments containing general office buildings and support services, such as banks, restaurants and service stations, arranged in a park-or campus-like atmosphere. This should be used if details on individual buildings are not available.	750
Pharmacy/Drugstore W/O Drive Thru	These are retail facilities that primarily sell prescription and non-prescription drugs. These facilities may also sell cosmetics, toiletries, medications, stationery, personal care products, limited food products and general merchandise. The drug stores in this category do not contain drive-through windows.	880

Table 1: Land Use Subtype Descriptions

Land Use Subtype	Description[1]	ITE Number
Pharmacy/Drugstore With Drive Thru	These are retail facilities that primarily sell prescription and non-prescription drugs. These facilities may also sell cosmetics, toiletries, medications, stationery, personal care products, limited food products and general merchandise. The drug stores in this category contain drive-through windows.	881
Research & Development	R&D centers are facilities devoted almost exclusively to R&D activities. The range of specific types of businesses contained in this land use category varies significantly. R&D centers may contain offices and light fabrication areas.	760
	INDUSTRIAL	
General Heavy Industry	Heavy industrial facilities usually have a high number of employees per industrial plant and are generally limited to the manufacturing of large items.	120
General Light Industry	Light industrial facilities are free-standing facilities devoted to a single use. The facilities have an emphasis on activities other than manufacturing and typically have minimal office space. Typical light industrial activities include printing, material testing and assembly of data processing equipment.	110
Industrial Park	Industrial parks contain a number of industrial or related facilities. They are characterized by a mix of manufacturing, service and warehouse facilities with a wide variation in the proportion of each type of use from one location to another. Many industrial parks contain highly diversified facilities.	130
Manufacturing	Manufacturing facilities are areas where the primary activity is the conversion of raw materials or parts into finished products. It generally also has office, warehouse, and R&D functions at the site.	140
Refrigerated Warehouse-No Rail	This is a warehouse that has refrigeration but no rail spur.	152
Refrigerated Warehouse-Rail	This is a warehouse that has refrigeration and a rail spur.	152
Unrefrigerated Warehouse-No Rail	This is a warehouse that does not have refrigeration and no rail spur.	152
Unrefrigerated Warehouse-Rail	This is a warehouse that does not have refrigeration but has a rail spur.	152

[1] Based on land use descriptions in Institute of Transportation Engineers (ITE) Trip Generation Manual, 9th Edition.

Unit Amount and Size Metric

By tabbing over to the Unit Amount and Size Metric columns, respectively, the user can enter the number of units (e.g., houses, apartments, etc.) and the corresponding size metric (e.g., per 1000 sq. ft., employees, students, etc.). This data combination will be used to populate the lot acreage, square feet and population columns on this screen. For example, a school land use allows the user to define its size by the number of students, building square footage, or number of employees. It is important to note that the square footage, which is used for calculating such impacts as architectural coatings and energy use, relates to the total building square footage and not the building footprint or lot acreage which is used for housing density as well as grading and site preparation calculations.

Lot Acreage

If actual lot acreage data is available, the user should override the default value. However, for a mixed use, multi-story building, the user should not override the square footage default value for each individual land use or the acreage default value assigned to the residential portion or the split between the non-residential land uses if there is no residential portion. The figure below provides an example of a mixed use project and instructions for applying the appropriate square footage and acreage.

Acreage is used to estimate housing density and assign construction default data (e.g., grading, site preparation, etc.). Table 2 contains housing density default data per land use in terms of dwelling units (DU) per acre. By using this data, CalEEMod can estimate the number of acres per dwelling unit (DU) for residential land use. For example, if the user enters 10 apartments in a low rise building, then the lot acreage will be 0.625 acre (10 DU divided by 16 acres/DU). According to the California Energy Commission's Residential Appliance Saturation Survey (RASS), the metric for low rise apartments is 1,000 square feet per DU (see Table 2.1). Similarly, using the same example, the building footprint will be 0.23 acre (10 DU x 1000 sq. ft./DU x 1 acre/43,560 sq. ft.). Thus, the total lot acreage includes the residential footprint plus driveway and landscaping/open space.

After the user has completed entering all of land uses for the project, CalEEMod will add the lot acreage values for each land use and the total will be reflected in the lot acreage text box located at the bottom of the screen. The value in the total lot acreage box cannot be modified by the user.

Example of Mixed Use Project in CalEEMod

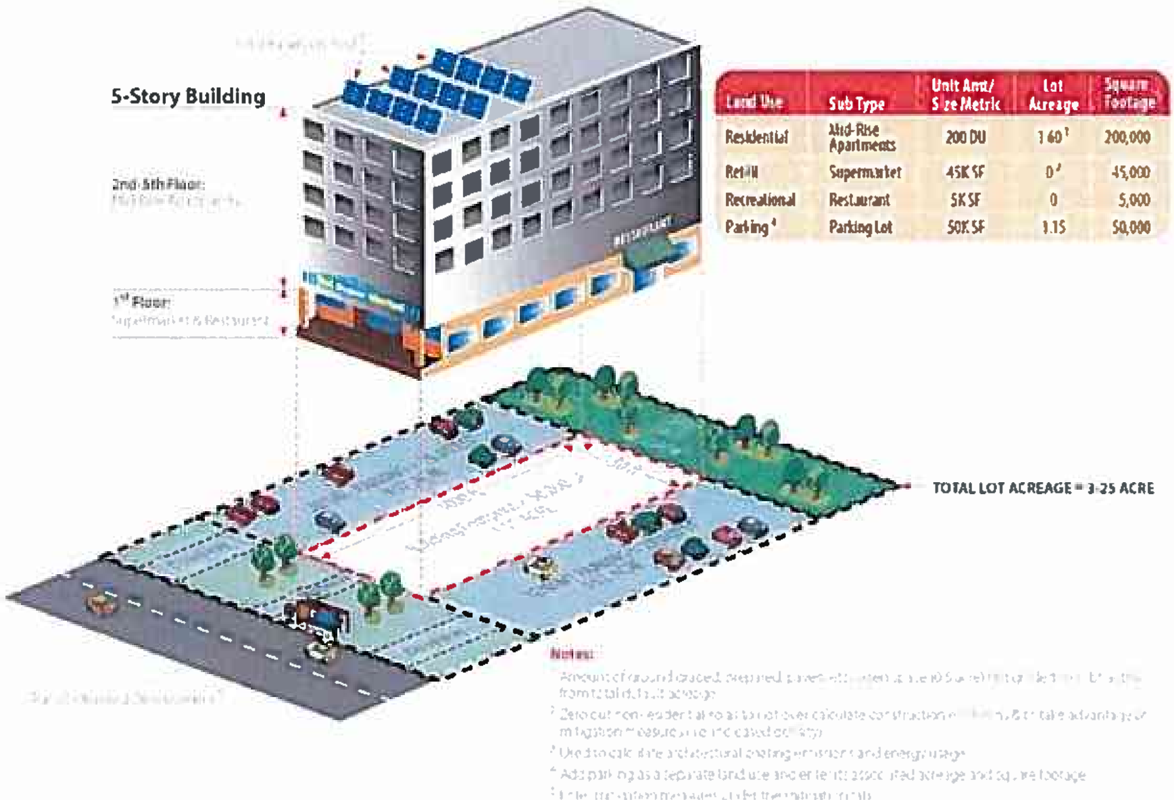


Table 2: Default Housing Density[1]

Land Use Subtype	Density (Dwelling Units/Acre)
Single Family Housing	3
Apartments low rise	16
Apartments mid rise	38
Apartments high rise	62
Condo/townhouse	16
Condo/townhouse high rise	64
Mobile Home Park	8
Retirement Community	5
Congregate care (Assisted Living)	16

[1] Based on the density assumed in ITE Trip Generation 8th Edition

Square Footage

If actual square footage of the total building or building footprint is known, the user should override the default value.

Population

After the completing the tabs for unit amount, size metric, lot acreage, and square footage, the population field will contain a default which represents an estimate of the population for each land use type and subtype selected by the user. If the actual population data is known, the user should override the default value.

After the user has completed entering all of land uses for the project, CalEEMod will add the population values for each land use and the total will be reflected in the population text box located at the bottom of the screen. The value in the total population box cannot be modified by the user.

City Park/Golf Course Building Area Square Feet (text box)

If the user selects a City Park and/or Golf Course land use, a text box will appear at the bottom of the screen that will prompt the user to enter the building square footage of all the buildings that will be located on the City Park and/or Golf Course property (e.g., restrooms/changing rooms, pro-shop, etc.). The user must input site-specific building square footage data because there are no default values for building footprints on these types of land uses. If the building square footage is left blank (e.g., zero square feet), a warning message will appear to remind the user to enter a value in this field.

Recreational Swimming Pool Building Area Square Feet (text box)

If the user selects a Recreational Swimming Pool land use, a text box will appear at the bottom of the screen that will prompt the user to enter the building square footage of all the buildings that will be located on the property (e.g., restrooms/changing rooms, pro-shop, etc.). The user must input site-specific building square footage data because there is no default value for the building footprint on this type of land use. If the building square footage is left blank (e.g., zero square feet), a warning message appear to remind the user to enter a value in this field.

4.3 Construction

After completing the Land Use screen and clicking on the Next button, the Construction screen will appear along with seven tabs/sub-screens that cover the following construction topic areas: Construction Phase; Off-Road Equipment; Dust from Material Movement; Demolition; Trips and VMT, On-Road Fugitive Dust, and Architectural Coatings. To move from one tab/subscreen to another, the user can use the Next and Previous buttons, or click on any of grey tabs. The construction tabs/sub-screens contain default information that was obtained from a survey of construction sites conducted by South Coast Air Quality Management District (SCAQMD). The construction survey data is grouped by construction phase and lot acreage and can be found in Appendix E1. The default construction equipment list and phase length data were determined to be the most appropriate for the size and types surveyed. In addition, some data in the survey was extrapolated to create default values for project sizes that were not in the survey. However, if the user has more detailed site-specific equipment and phase information, the user should override the default values.

4.3.1 Construction Phase

The Construction Phase tab is where the user can enter the type of each construction phase and the date range for each phase. . Default phases are based on the total lot acreage of the project. Depending on the project being modeled, not all phases may be necessary so the user may need to delete phases that are not applicable to the project. For example, not all projects require demolition. In addition, the user may need to add multiple phases of similar types for large projects with staged build out scenarios. It is important to note that if a project has demolition, grading, and site preparation phases, the user will need to provide additional project-specific data on the Demolition and Dust from Material Movement sub-screens.

Phase Name and Phase Type

The Phase Name and Phase Type fields will be automatically populated with the following default construction phases: Site Preparation; Demolition; Grading; Building Construction; Paving; and, Architectural Coating. The inclusion of any of these phases will define the types of calculations and default assumptions for on-road vehicle trips and fugitive emissions that occur in subsequent construction sub-screens. The definitions of the default phase types are as follows:

- *Demolition* involves removing buildings or structures.
- *Site Preparation* involves clearing vegetation (grubbing and tree/stump removal) and removing stones and other unwanted material or debris prior to grading.
- *Grading* involves the cut and fill of land to ensure that the proper base and slope is created for the foundation.
- *Building Construction* involves the construction of the foundation, structures and buildings.
- *Architectural Coating* involves the application of coatings to both the interior and exterior of buildings or structures, the painting of parking lot or parking garage striping, associated signage and curbs, and the painting of the walls or other components such as stair railings inside parking structures.
- *Paving* involves the laying of concrete or asphalt such as in parking lots, roads, driveways, or sidewalks.

Start Date and End Date

The user can enter with the aid of a calendar, the Start Date and End Dates for each construction phase. The default Start Date is the Start of Construction date defined on the Project Characteristics screen. The cells will be automatically populated with a default construction schedule starting with the Demolition phase, with subsequent phases starting the following day after the previous phase's end date. The user may change the defaults to alter the total days estimated for each phase. Because CARB's emission factors vary from year to year, when the user inserts the start and end dates for each construction phase, the model will select the correct emission factors for the year when each piece of off-road equipment will be utilized.

Days per Week

The user can select from a drop down box the number of days per week (either 5, 6, or 7 days) that construction will occur. Five days per week assumes that construction will occur from Monday through Friday, and six days per week assumes that construction will occur Monday through Saturday.

Total Days

The Total Days field is intended to indicate the number of days that it will take to complete a particular construction phase and this field is initially populated with default values. If the End Date or the Days per Week fields are changed, clicking the Total Days field will trigger a recalculation of the Total Days. If the Total Days field for any phase is changed, then once leaving this field, the program will automatically adjust the End Date based on the Start Date for that phase.

4.3.2 Off-Road Equipment

The Off-Road Equipment tab is for the user to select the type and quantity of off-road equipment needed for each construction phase and to define the daily usage schedule. Since equipment lists can be lengthy and vary widely for each construction phase, the user will need to first select the phase from Phase Name drop down list or by clicking on the Previous or Next buttons located next to the phase name, and then select the off-road equipment that will be used for each construction phase. The Off-Road Equipment screen calculates emissions based on the expected off-road equipment engine use for each piece of equipment listed over the duration of the phase length. It is important to note that fugitive emissions from off-road equipment are calculated elsewhere on other construction screens.

After the user enters the Equipment Type, Number of Units, and Hours per Day for each piece of equipment that will be used in any phase, The Horsepower and Load Factor fields will be automatically populated with the default average values from CARB's OFFROAD2011. If equipment-specific information is available, the user can override these default values. In some cases, CARB's OFFROAD2011 emission factors are not available for all years. Thus, if the user selects a construction year that does not have corresponding emission factors, CalEEMod has been programmed to substitute the emissions factors from nearest, lower end (e.g., oldest) year. For example, if construction will occur in year 2037 (a year which does not have emission factors), CalEEMod will substitute the emission factors from year 2035 instead. Since newer equipment tends to have less emissions than older equipment, by selecting emission factors from year 2035 (an older year), the calculations may result in a conservative, slight overestimate of emissions.

If the project requires the use of off-road equipment that is not specifically listed in the drop down list, the user can select from three generalized equipment categories to add customized equipment to the analysis: 1) Other Construction Equipment; 2) Other General Industrial Equipment; and, 3) Other Material Handling Equipment. In addition, the user may choose to select a surrogate equipment type which has a similar horsepower rating and load factor. To include water trucks and cement trucks in the analysis, the user needs to first determine if these trucks are off-road or on-road vehicles. If they are only driven off-road, then the user can select the Off-Highway Trucks category in the Off-Road Equipment screen. If the trucks are driven on-road, the user can account for the on-road emissions by entering this information as Additional Vendor Trips on the Trips and VMT screen (see Subchapter 4.3.5).

4.3.3 Dust from Material Movement

The Dust from Material Movement sub-screen is intended for calculating fugitive dust emissions associated with the Site Preparation and Grading phases (defaults) during construction. This sub-screen calculates the following three types of fugitive dust: 1) fugitive dust from dozers moving dirt; 2) fugitive dust from graders or scrapers leveling the land; and; 3) fugitive dust from loading or unloading dirt into haul trucks. These methods have been adapted from USEPA's AP-42 method for Western Coal Mining. Once the enters the amount of material imported and exported to the site, CalEEMod will estimate the number of hauling trips associated with from material transport activities. The user may define the units in terms of Ton of Debris or Cubic Yards. The user may also select whether the import/export of material is phased (e.g., a the same truck that arrives with material departs with another load of material to export in one round trip or two-one way trips. The calculations for non-phased material import/export trips assume that one truck arrives empty and departs full and a different truck arrives full for a total of two round trips (or four one-way trips). Thus, phasing material import and export trips reduces the number of haul trips.

The Total Acres Graded field represents the cumulative distance traversed on the property by the grading equipment, assuming a blade width of 12 feet. In order to properly grade a piece of land, multiple passes with grading equipment may be required. So even though the lot size is a fixed number of acres, the Total Acres Graded could be an order of magnitude higher than the footprint of the lot and is calculated based on the equipment list (including number of equipment), the number of days need to complete the grading and/or site preparation phase, and the maximum number of acres a given piece of equipment can traverse in an 8-hour workday. For more information regarding how Dust from Material Movement is calculated, including grading rates, see Appendix A, Subchapter 4.3.

4.3.4 Demolition

The Demolition sub-screen is intended for the user to enter the amount of material that is demolished, if a demolition phase is selected by the user as part of the construction project. The user can select the Size Metric to define the amount of demolished material that is expected to be generated during the demolition phase in terms of Ton of Debris or Building Square Footage. With this data, fugitive dust emissions generated during demolition are calculated. The calculation of fugitive dust emissions during demolition is derived from the methodology described in the report prepared for the USEPA by Midwest Research Institute, Gap Filling PM_{10} Emission Factors for Selected Open Area Dust Sources.

4.3.5 Trip and VMT

The Trip and VMT sub-screen is used to provide the number and length (in terms of vehicle miles traveled or VMT) of on-road vehicle trips for workers, vendors, and hauling for each construction phase. Depending on the land use type and subtype combined with the various construction phases, CalEEMod will populate the fields for Number of Trips, Trip Length, and Vehicle Class for worker, vendor and haul trips, respectively, with default values. The vehicle class descriptor HHDT, MHDT means that there is a 50/50 percent mix of heavy-heavy duty trucks and medium-heavy duty trucks. Similarly, the vehicle class descriptor LDA, LDT1, LDT2 means that there is a 50/25/25 percent mix of light duty autos, light duty truck class 1 and light duty truck class 2, respectively. The user may override the defaults and enter different weightings of vehicle fleet mixes. It is important to note that if the user selects a construction year that does not have corresponding EMFAC2014 emission factors for on-road vehicles, CalEEMod has been programmed to substitute the emissions factors from nearest, lower end (e.g., oldest) year. For example, if construction will occur in year 2037 (a year which does not have emission factors), CalEEMod will substitute the emission factors from year 2035 instead. Since newer equipment tends to have less emissions than older equipment, by selecting emission factors from year 2035 (an older year), the calculations may result in a conservative, slight overestimate of emissions.

CalEEMod quantifies the number of construction workers by multiplying 1.25 times the number of pieces of equipment for all phases (except Building Construction and Architectural Coating). For the Building Construction, the number of workers is derived from a study conducted by the Sacramento Metropolitan Air Quality Management District (SMAQMD) which determined the number of workers needed for various types of land uses and corresponding project size. This study and its analysis are included in Appendix E2. For the Architectural Coating phase, the number of workers is approximately 20% of the number of workers needed during the Building Construction phase.

The number of vendor trips during the Building Construction phase is also derived from a study conducted by the SMAQMD. The SMAQMD trip survey during construction counted cement and water trucks as vendor trips (instead of counting them as off-road vehicle trips) and these trip rates were incorporated into the calculations for the Building Construction phase. If the user deletes the Building Construction phase from the analysis, but the project will require water and/or cement trucks, then the user will need to account for these either as vendor trips under another construction phase or under the Off-Road equipment screen.

The default values for hauling trips are based on the assumption that a truck can haul 20 tons (or 16 cubic yards) of material per load. If one load of material is delivered, CalEEMod assumes that one haul truck importing material will also have a return trip with an empty truck (e.g., 2 one-way trips). Similarly, a haul truck needed to export material is assumed to have an arrival trip in an empty truck and a loaded departure truck (e.g., 2 one-way trips). Thus, each trip to import and export material is considered as two separate round trips (or 4 one-way trips). However, if the Phase box is checked, the same haul truck that imported the material will be assumed to be the same haul truck that export material resulting in one round trip (or 2 one-way trips).

4.3.6 On-Road Fugitive Dust

The On-Road Fugitive Dust sub-screen defines the variables that will be used to determine the fugitive dust emissions from on-road vehicles driving over paved and unpaved roads during construction. CalEEMod automatically populates the data fields based on the construction phase. The calculations use emission factors from USEPA's AP-42 for paved roads (January 2011 edition) and unpaved roads (November 2006 edition). Each data field is the same as those defined in the aforementioned AP-42 sections.

4.3.7 Architectural Coatings

The Architectural Coatings sub-screen is intended to calculate ROG emissions associated with painting the interior/exterior of residential and non-residential buildings as well as calculate emissions from parking lot painting or striping. The user may override any of the default interior and exterior surface areas estimated for residential and non-residential buildings. In addition, each of these surface types has a different emission factor indicating the ROG content of the paint in grams per liter (g/L). It is important to note that the parking area square footage is not included in the non-residential interior/exterior square footage when calculating emissions attributable to parking lot striping. See Appendix A, Subchapter 4.7 for the methodology of estimating surface areas to be coated from building square footage.

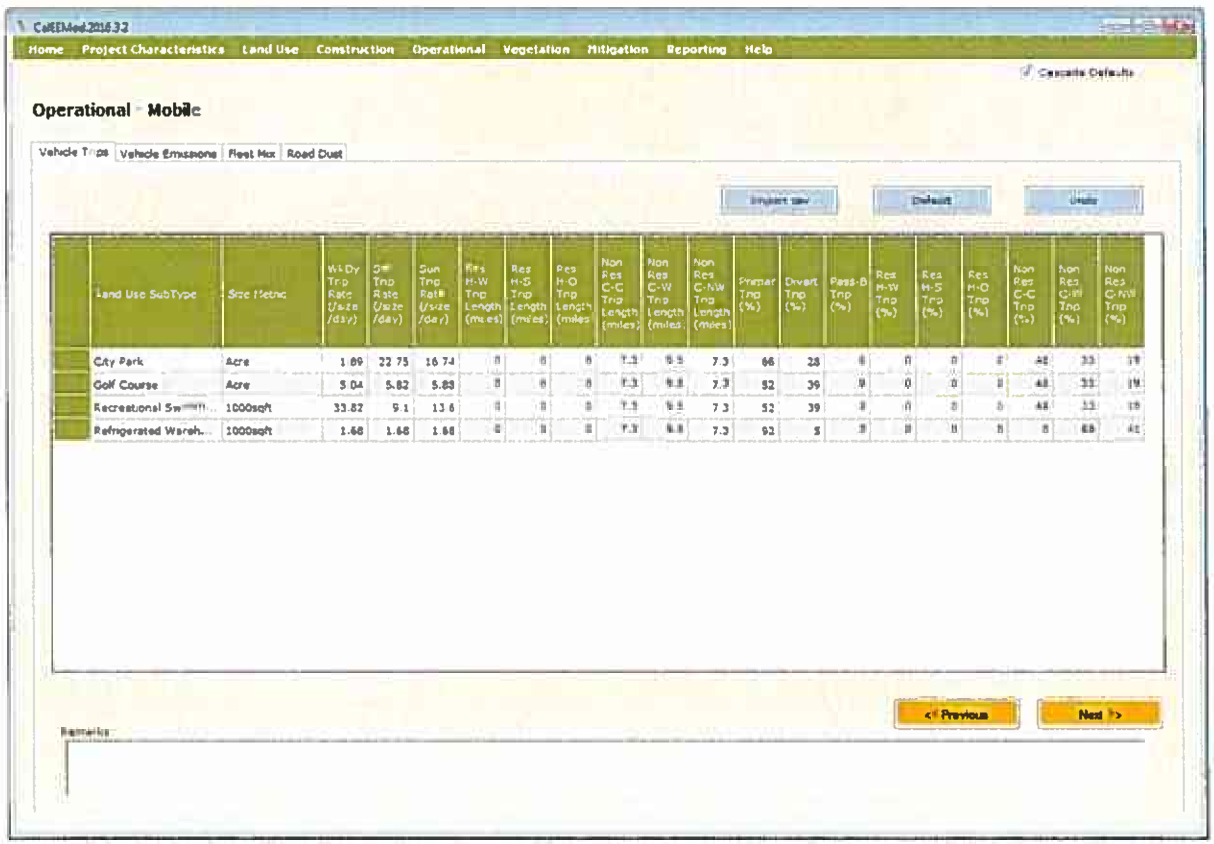
4.4 Operational Mobile

The operational mobile screen is made up of four sub-screens: Vehicle Trips, Vehicle Emissions, Fleet Mix and Road Dust. These screens are used in defining the information necessary to calculate the emissions associated with operational on-road vehicles.

4.4.1 Vehicle Trips

This sub-screen includes the trip rates, trip lengths, trip purpose, and trip type percentages for each land use subtype in the project. The user can edit any of this information by entering a new value in the appropriate cell. Trip rates are in terms of the size metric (thousand square footage or dwelling unit) defined on the land use screen and are listed for weekday, Saturday and Sunday if available. Trip lengths are for primary trips. Trip purposes are primary, diverted, and pass-by trips. Diverted trips are assumed to take a slightly different path than a primary trip and are assumed to be 25% of the primary trip lengths. Pass-by trips are assumed to be 0.1 miles in length and are a result of no diversion from the primary route. Residential trip types are defined as home-work (H-W), home-shop (H-S), and home-other (H-O). Non-residential trip types are defined as commercial –customer (C-C), commercial-work (C-W), and commercial-nonwork (C-NW) such as delivery trips. Appendix A includes the equations and methodology used to calculate motor vehicle emissions from the operation of a project.

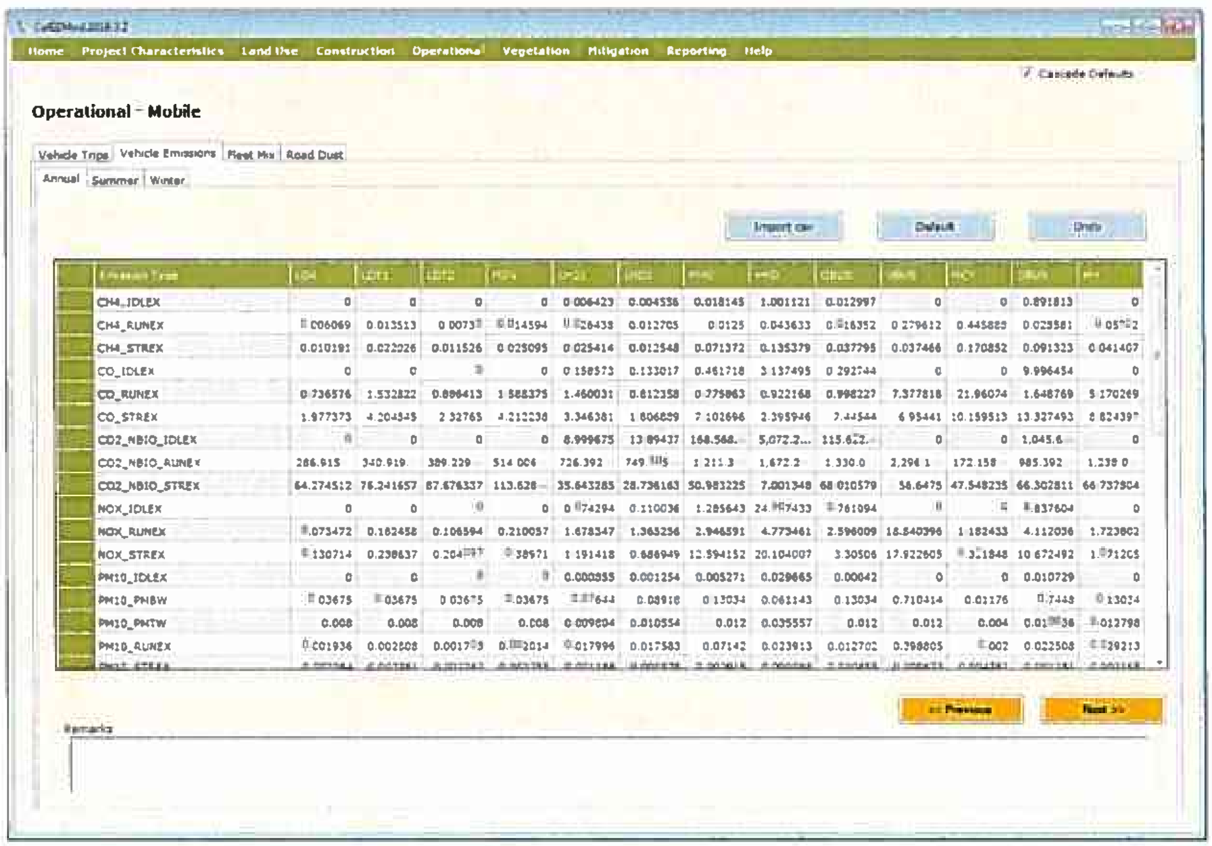
The trip rates are based on ITE 9th edition average trip rates for the respective land use categories.



4.4.2 Vehicle Emissions

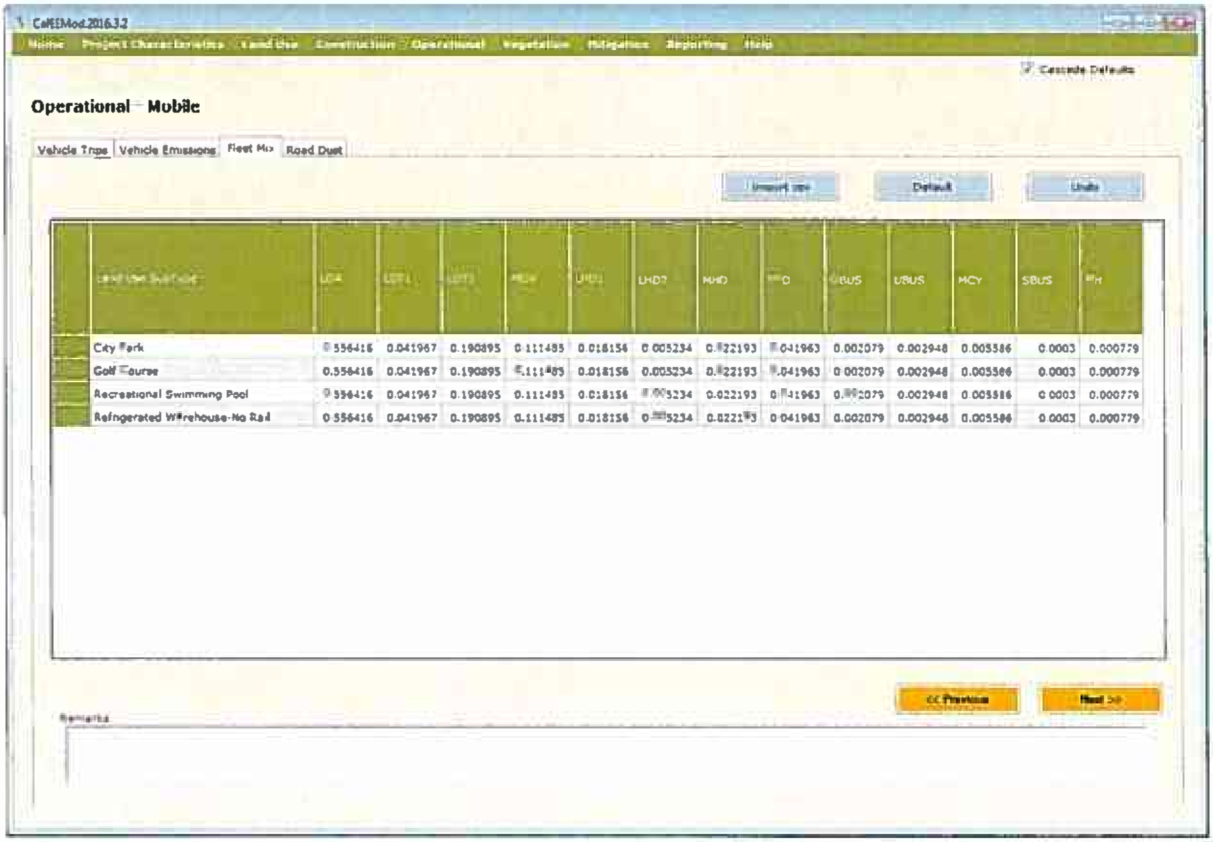
This sub-screen contains the detailed vehicle emission factors based on EMFAC2014. Appendix A includes the description of how these emission factors were derived from EMFAC2014. It is anticipated that most users will not edit data in this sub-screen. There are separate tabs for annual, summer, and winter emissions values. If the user wants to alter the breakdown of fuel types (catalytic, non-catalytic, and other) within a vehicle class, they will have to provide their own data. This will likely be an infrequent change due to CEQA enforceability requirements.

This screen along with the previous screen (Vehicle Trips) and next screen (Fleet Mix) will provide the data for the model to calculate the emissions associated with on-road motor vehicle use. The calculation does not include the fugitive dust emissions from travel over roads as these are associated with the next screen (Road Dust).



4.4.3 Fleet Mix

In CalEEMod Version 2016.3.1, the fleet mix was separated from the Vehicle Emissions screen and a new Fleet Mix screen was created so that users are able to change default fleet mix associated with different land use subtypes.



4.4.4 Road Dust

This sub-screen is used to change any of the default values that are used in the USEPA's AP-42 methods for calculating fugitive emissions from paved and unpaved roads. The defaults for the road dust (e.g., material silt content, material moisture content, and mean vehicle speed) are statewide averages, but the user has the ability to override the defaults if data specific to the project is known. Local jurisdictions can also provide guidance to users as to what default properly reflects known regional road dust parameters.

For the San Luis Obispo region, the user is recommended to provide the following unpaved road dust parameters overriding the statewide defaults if users choose to use USEPA's AP-42 methods:

9.3 for Material Silt Content (%) *(instead of 4.3 statewide default)*

0.1 for Material Moisture Content (%) *(instead of 0.5 statewide default)*

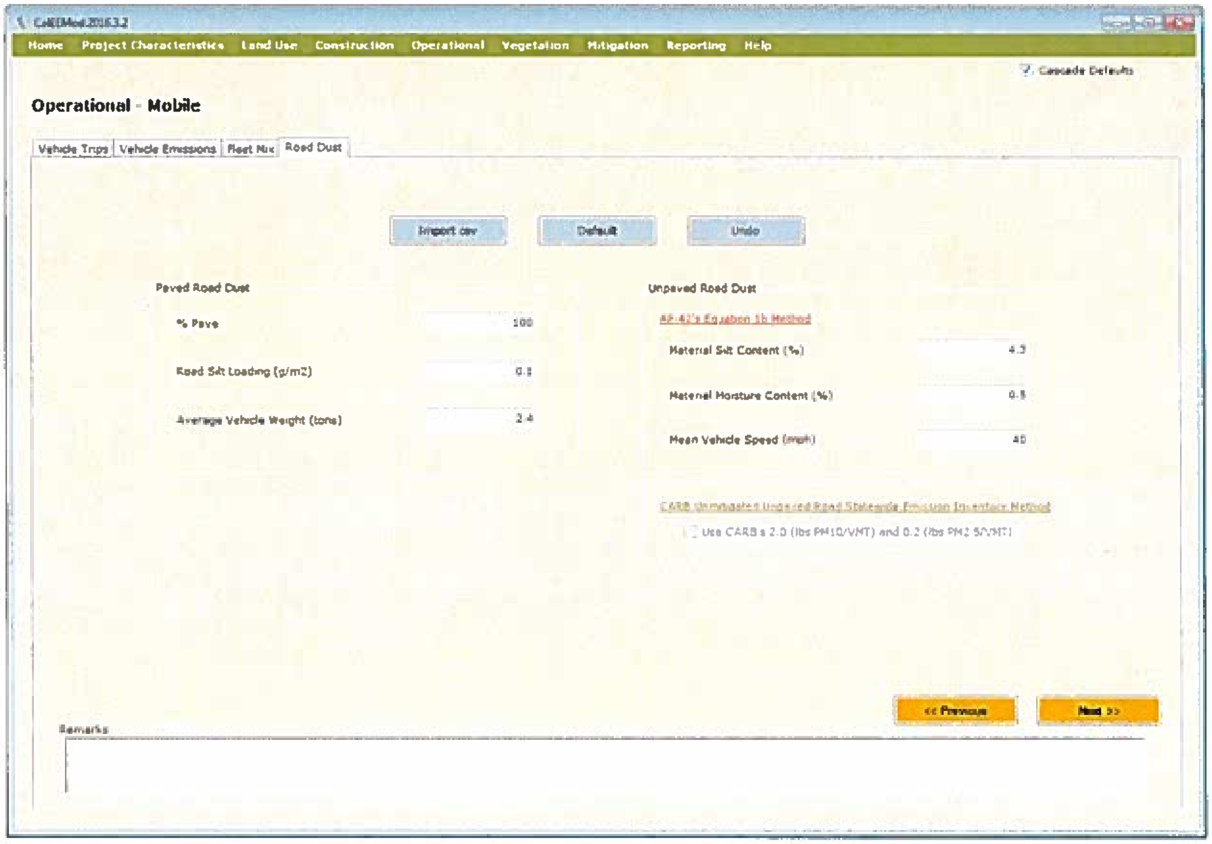
32.4 for Mean Vehicle Speed (mph) *(instead of 40 statewide default)*

In CalEEMod Version 2016.3.1, projects located in San Luis Obispo County APCD and Sacramento Metropolitan AQMD were provided an additional option for the user to select CARB's 2.0 lbs. PM_{10}/VMT[9] as the default unmitigated fugitive dust emission factor for unpaved roads during the operational phase. If this default is selected, an emission factor of 0.2 lbs. $PM_{2.5}$/VMT is also applied based on a 10% $PM_{2.5}$/ PM_{10} ratio[10, 11]. By checking the box, the program will use CARB's emission factor to override the calculated emission factor based on USEPA AP-42. Note: For project locations other than San Luis Obispo County APCD and Sacramento Metropolitan AQMD, CARB's 2.0 lbs. PM_{10}/VMT is not an option that the user can select.

9 Available at: http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-10.pdf

10 Available at: http://www3.epa.gov/ttnchie1/ap42/ch13/related/mri_final_fine_fraction_dust_report.pdf

11 Available at: http://www.arb.ca.gov/app/emsinv/emssumcat_query.php?F_YR=2015&F_DIV=-4&F_SEASON=A&SP=2009&F_AREA=CA#0

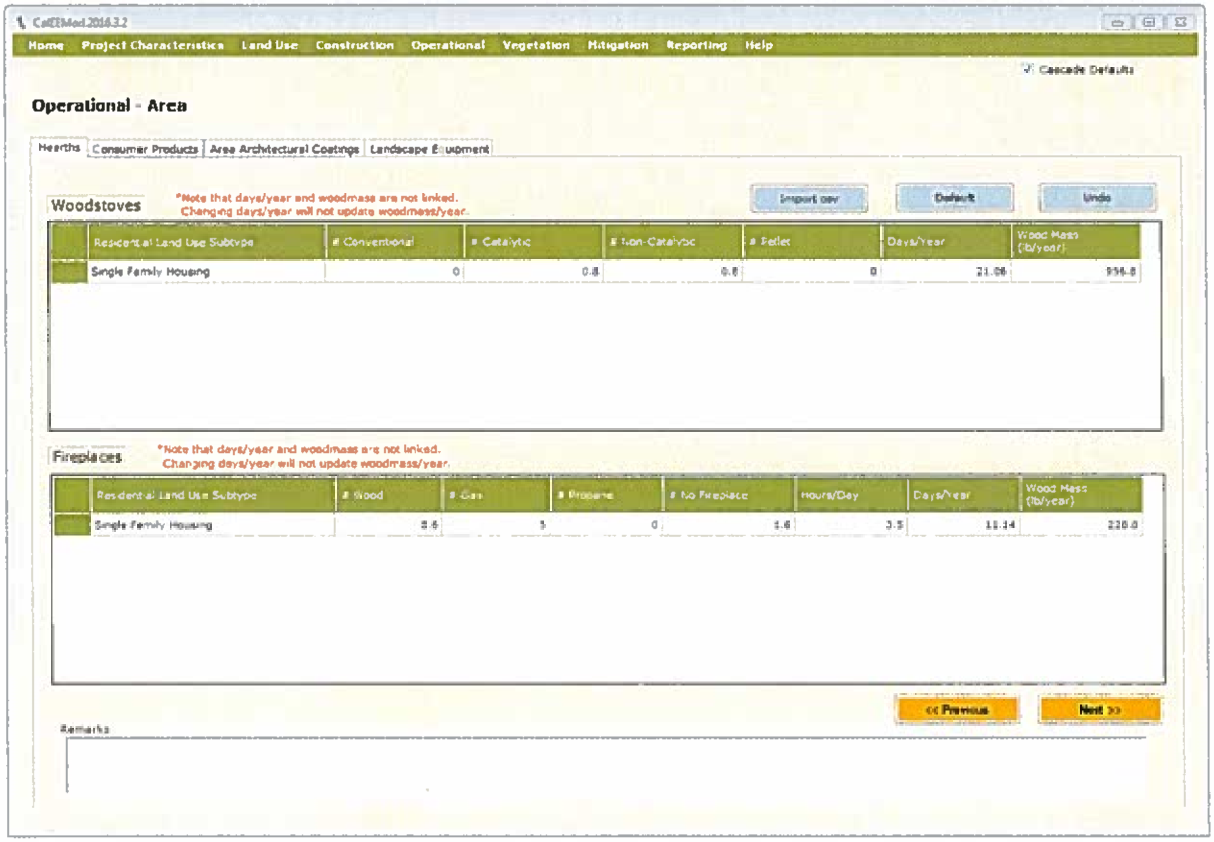


4.5 Area

The area source screen consists of four sub-screens: Hearths, Consumer Products, Area Architectural Coatings, and Landscaping Equipment. Natural gas emission variables from all uses except hearths are included in the energy use screen (described in Section 4.6).

4.5.1 Hearths and Woodstoves

This sub-screen allows the user to enter the number of woodstoves and hearths of various types as well as the usage of these devices. Woodstoves are separate from fireplaces since a home may have both and these devices may have different use patterns. The number of devices that is entered for each device type represents the total number of devices installed in the dwelling units for a particular land use. Appendix A contains the emissions calculation methodology and details of variables that the user cannot override. Some of these emissions may be classified as biogenic and are therefore reported as CO_2-Biogenic. For most locations a default percent of hearths and stoves was provided by air districts and is multiplied through. The number of devices was chosen to include in CalEEMod instead of a percentage to allow for incorporation of various air district rules regarding hearths and woodstoves in new residences without having specialized data entry screens. Commercial land uses by default do not have hearths or woodstoves in CalEEMod. These are included for those cases where they may occur such as in restaurants or hotels.



The San Joaquin Valley jurisdiction has a regulatory limit on the number of hearths depending upon the type and number of residential development. The regulatory limit is generated by CalEEMod but all the input parameters (e.g., unit density, etc.) are necessary to determine the value. Thus, the regulatory limit is disclosed during the reporting stage under the Default Value box in the report. The model, however, calculates emission impacts from the number of hearths inputted on the Area source screen (listed under the New Value column in the report). Therefore, if the user wants to calculate emissions from regulatory limit, the report needs to be run to determine the regulatory limit and the user needs to go back to the Area Source screen to input that value and re-run the report. If the user chooses to calculate emissions from a different number of hearths (e.g., a number of hearths less than the regulatory limit), then that number needs to be inputted on the Area Source screen to properly calculate emissions. Again, the report will provide the regulatory limit under the Default Value column and the user input value under New Value column.

4.5.2 Consumer Products

Consumer products are various solvents used in non-industrial applications which emit ROGs during their product use. These typically include cleaning supplies, kitchen aerosols, cosmetics and toiletries. SCAQMD has developed an emission factor based on the total of all building square footage for both residential and non-residential buildings. Details of how this emission factor was developed can be found in Appendix E. The user can change this emission factor if more relevant data is available. In CalEEMod Version 2016.3.1, ROG emissions from pesticides/fertilizers for City Parks and Golf Courses and ROG emissions from parking surface degreasers were separated from the general consumer products category. Also in CalEEMod Version 2016.3.1, the model also assumes that there would be no ROG emissions from the actual pool surface area for Recreational Swimming Pools because the chemicals used for maintaining pools are not considered to be ROGs. Details of how the ROG emission factors for pesticides/fertilizers and parking surface degreasers were determined can be found in Appendix E.

4.5.3 Area Architectural Coatings

This sub-screen has text boxes for the reapplication rate and coating ROG content for each building surface type and parking surface. The reapplication rate is the percentage of the total surface area that is repainted each year. A default of 10% is used, meaning that 10% of the surface area is repainted each year (i.e., all surface areas are repainted once every 10 years). Daily emissions divide the annual rate by 365 days per year. This is based on assumptions used by SCAQMD in their district rules regarding architectural coatings. Some districts provided details on their coating regulations that phase-in over time, which have been incorporated to the extent feasible, given the general classifications of paint (interior or exterior for residential and non-residential). Coating ROG content from state regulations are used for air districts that did not provide specific architectural coating information. Consult your local air district for suggested values that may be lower than the state regulations.

The ROG contents under the Operational Area Architectural Coatings screen (either CalEEMod defaults or site-specific values defined by users) become the default ROG contents for the Area Mitigation screen. The user may check the box under the Area Mitigation screen and specify a lower ROG content limit.

4.5.4 Landscape Equipment

This sub-screen has two text boxes to show the number of snow days or summer days. In addition, the defaults consider a realistic number of days which the landscaping equipment would be operated. For example, landscaping at commercial facilities typically do not take place during a weekend or during the summer at educational facilities that are not open. The number of days are applied to the appropriate landscape equipment types available in OFFROAD2011 using the average horsepower and load factors of the population mode. The derivation of emission factors used for each equipment type from OFFROAD2011 is described in Appendix A.

4.6 Energy Use

The energy use screen is used to gather the information necessary to estimate the emissions associated with building electricity and natural gas usage (non-hearth). The electricity energy use is in units of kilowatt hours (kWh) per size metric for each land use subtype. Natural gas use is in units of a thousand British Thermal Units (kBTU) per size metric for each land use subtype.

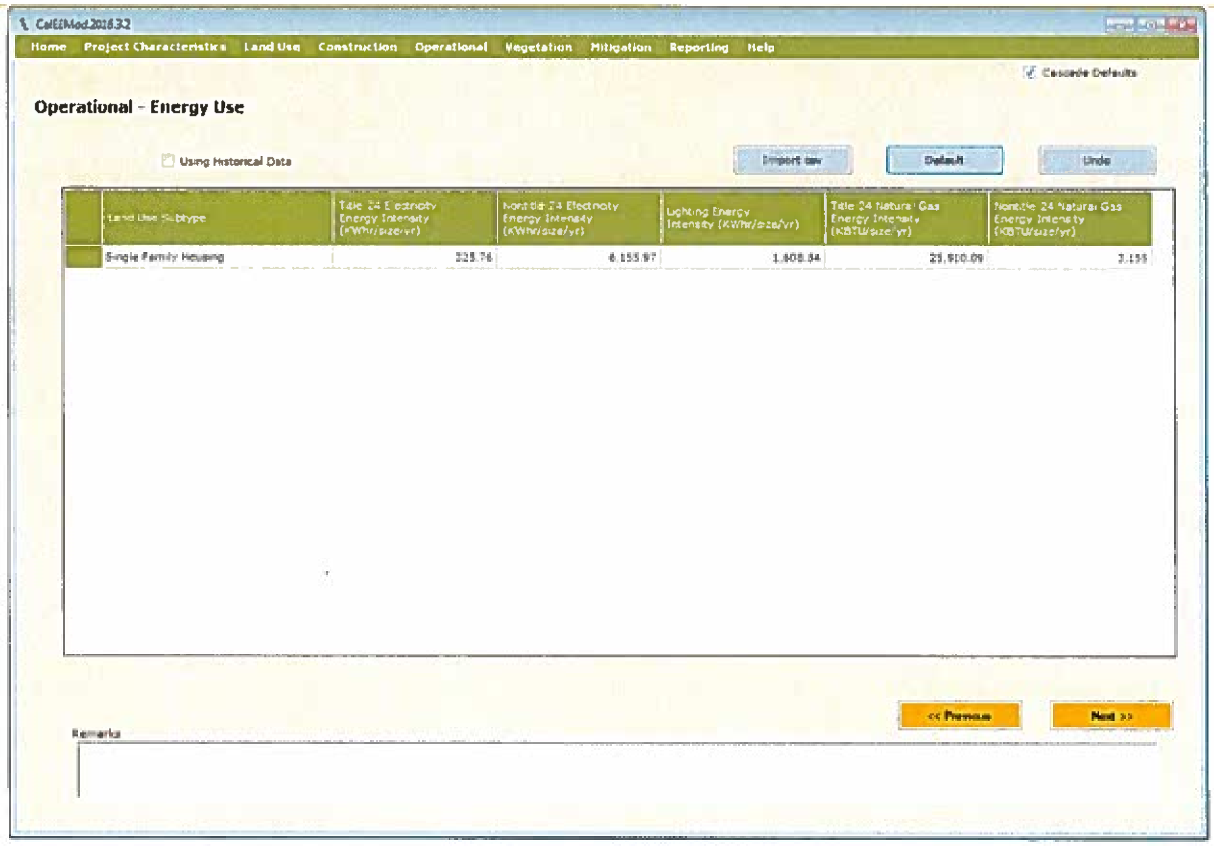
Title 24 of the California Code of Regulations, known as the California Building Standards Code or Title 24, contains energy conservation standards applicable to all residential and non-residential buildings throughout California. With CalEEMod, building electricity and natural gas use is divided into two categories: 1) end uses subject to Title 24 standards; and, 2) end uses not subject to Title 24 standards. The distinction is used when the mitigation measure for exceeding Title 24 standards (BE-1) is applied. Lighting is also a separate category in CalEEMod for which a separate mitigation measures (LUT-1) may be applied for using energy efficient lighting.

For electricity, Title 24 uses include the major building envelope systems covered by Part 6 (California Energy Code) of Title 24 such as space heating, space cooling, water heating, and ventilation. Non-Title 24 uses include all other end uses, such as appliances, electronics, and other miscellaneous plug-in uses. Because some lighting is not considered as part of the building envelope energy budget, and since a separate mitigation measure is applicable to this end use, CalEEMod makes lighting a separate category.

For natural gas, uses are likewise categorized as Title 24 or Non-Title 24, with Title 24 uses including building heating and hot water end uses. Non-Title 24 natural gas uses include cooking and appliances (including pool/spa heaters).

The baseline values are based on the CEC sponsored California Commercial End Use Survey (CEUS) and Residential Appliance Saturation Survey (RASS) studies[12]. For climate zones not included in these surveys, data from the closest climate zone was used as a surrogate. Since these studies are based on older buildings, adjustments have been made to account for changes due to Title 24 building codes as described in Appendix E. The user should select the use historical box if they only want an adjustment to the 2005 standards which were in effect when CARB developed its Scoping Plan 2020 No Action Taken predictions. After selecting the historical button, the user must also click the default button to load the historical default values.

[12] CEC. October 2010. Residential Appliance Saturation Survey. Available at: http://www.energy.ca.gov/appliances/rass
CEC. March 2006. Commercial End-Use Survey. Available at: http://www.energy.ca.gov/ceus/



4.7 Water and Wastewater Use

This screen estimates the land uses contribution of GHG emissions associated with supplying and treating water and wastewater. This screen is used to enter the amount of water in gallons used indoors and outdoors for each land use subtype[13]. The indoor water is also used to estimate the amount of wastewater. The electricity intensity factor for various phases of providing water is provided. Depending on the specific water supply used or treatment method used these numbers can vary over a wide range. Supplying water is bringing the water from its primary source such as the ground, river, or snowpack to the treatment plant. Distributing the water is bringing the water from the treatment plant to the end users. The electricity intensity

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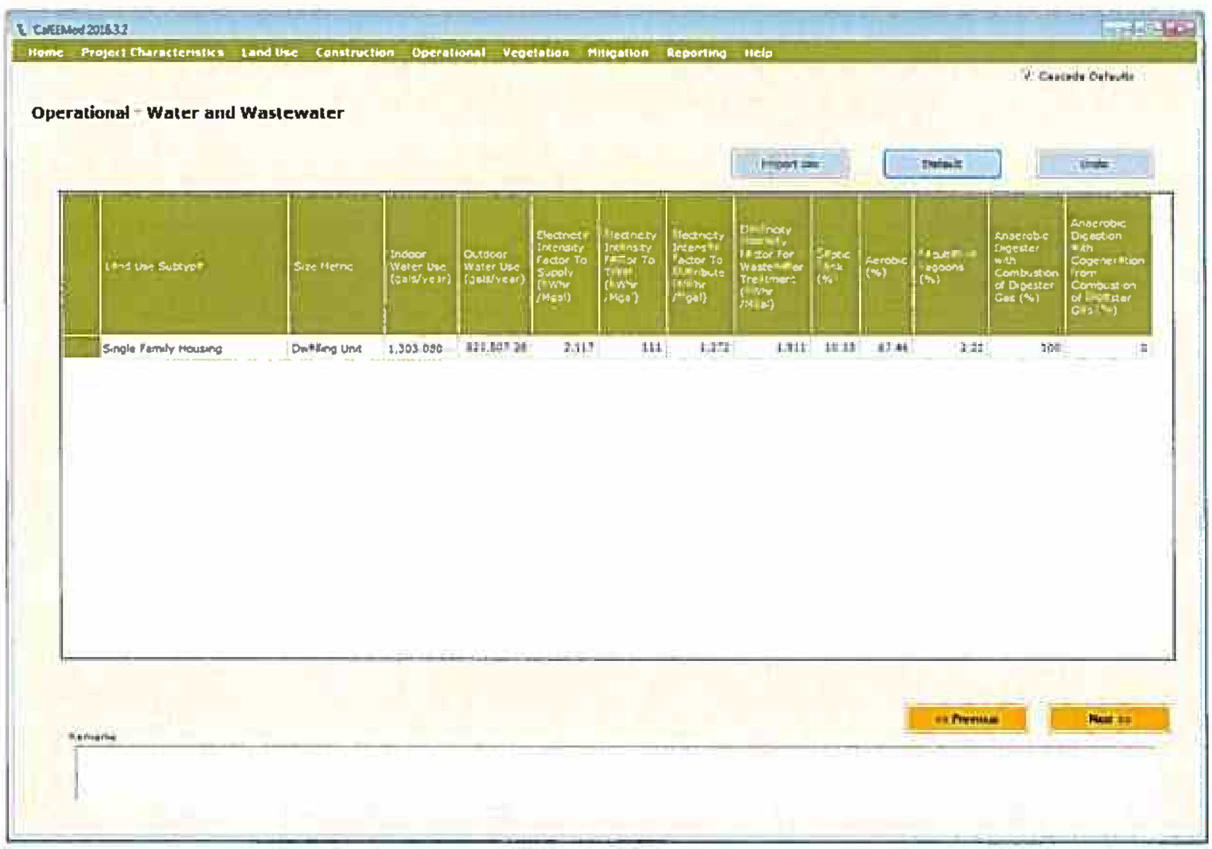
[13] Gleick, P.H.; Haasz, D.; Henges-Jeck, C.; Srinivasan, V.; Cushing, K.K.; Mann, A. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California. Published by the Pacific Institute for Studies in Development, Environment, and Security. Full report available at: http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf. Appendices available at: http://pacinst.org/publication/waste-not-want-not/

Dziegielewski; B.; Kiefer, J.C.; Optiz, E.M.; Porter, G.A.; Lantz, G.L.; DeOreo, W.B.; Mayer, P.W.; Nelson, J.O. 2000. Commercial and Institutional End Uses of Water. Published by the American Water Works Association Research Foundation.

Northern California Golf Association. Improving California Golf Course Water Efficiency. Available at: http://www.water.ca.gov/wateruseefficiency/docs/2004Apps/2004-079.pdf factors are multiplied by the utility GHG emissions intensity factors for the GHGs and are classified as indirect emissions. The default electricity intensity is from the CEC's 2006 Refining Estimates of Water-Related Energy Use in California using the average values for Northern and Southern California[14]. The location will automatically select the appropriate values if using these defaults. Since the electricity can vary greatly based on locations, the user should override these values if they have more specific information regarding their specific water supply and treatment.

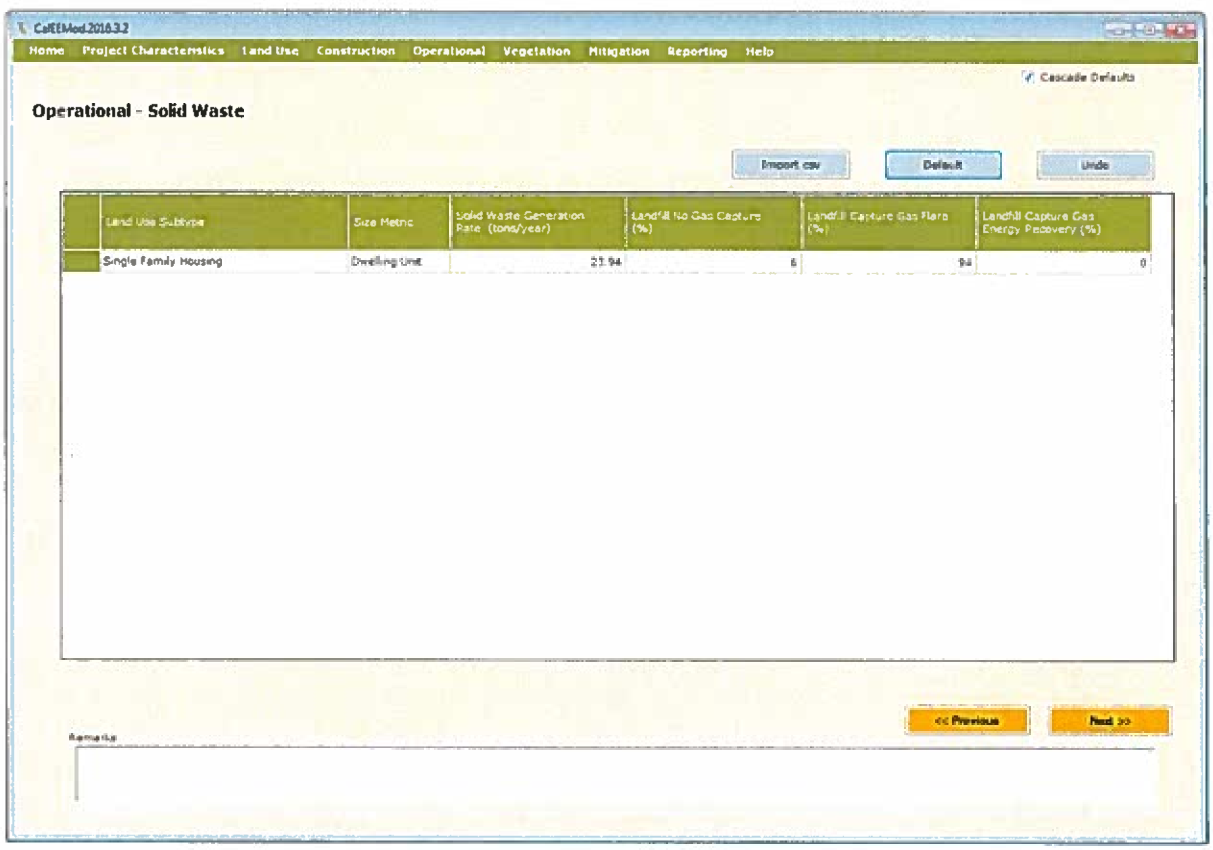
Wastewater may also have direct emissions of GHGs. These depend on the type of wastewater treatment system (e.g., septic, aerobic or lagoons) used and therefore the wastewater treatment type percentages are variables. In addition, the model calculates impacts if the solids are digested either through an anaerobic digester or with co-generation from combustion of digester gas. Each type has associated GHG emission factors. Some of these may be classified as biogenic. Not all of the biogenic emissions are accounted for since there are not adequate emissions factors at this time. Refer to Appendix A on how to properly change the defaults, if necessary, and the methodology used to calculate impacts from wastewater treatment.



[14] CEC-500-2006-118. Available at http://www.energy.ca.gov/2006publications/CEC-500-2006-118/CEC-500-2006-118.PDF.

4.8 Solid Waste

The solid waste screen determines the GHG emissions associated with disposal of solid waste into landfills. In order to estimate the eventual contribution of GHG emissions from solid waste disposed by a land use annually, the total amount of carbon dioxide and methane that would be evolved over the span of many years is calculated. This is based on the IPCC's methods for quantifying GHG emissions from solid waste using the degradable organic content of waste[15]. Waste disposal rates by land use and overall composition of municipal solid waste in California is primarily based on CalRecycle data. The amount of methane emitted depends on characteristics of the landfill, and therefore the default percentage is based on the types of landfills assumed by CARB in their GHG emissions inventories. Portions of these emissions are biogenic. The defaults for the gas capture (e.g., no capture, flaring, energy recovery) are statewide averages except for Santa Barbara APCD which has a 100% landfill capture gas flare. The user has the ability to override the defaults if the gas capture at the landfill to be used by the project is known. Local jurisdictions can also provide guidance to users as to what default properly reflects known regional solid waste gas capture.



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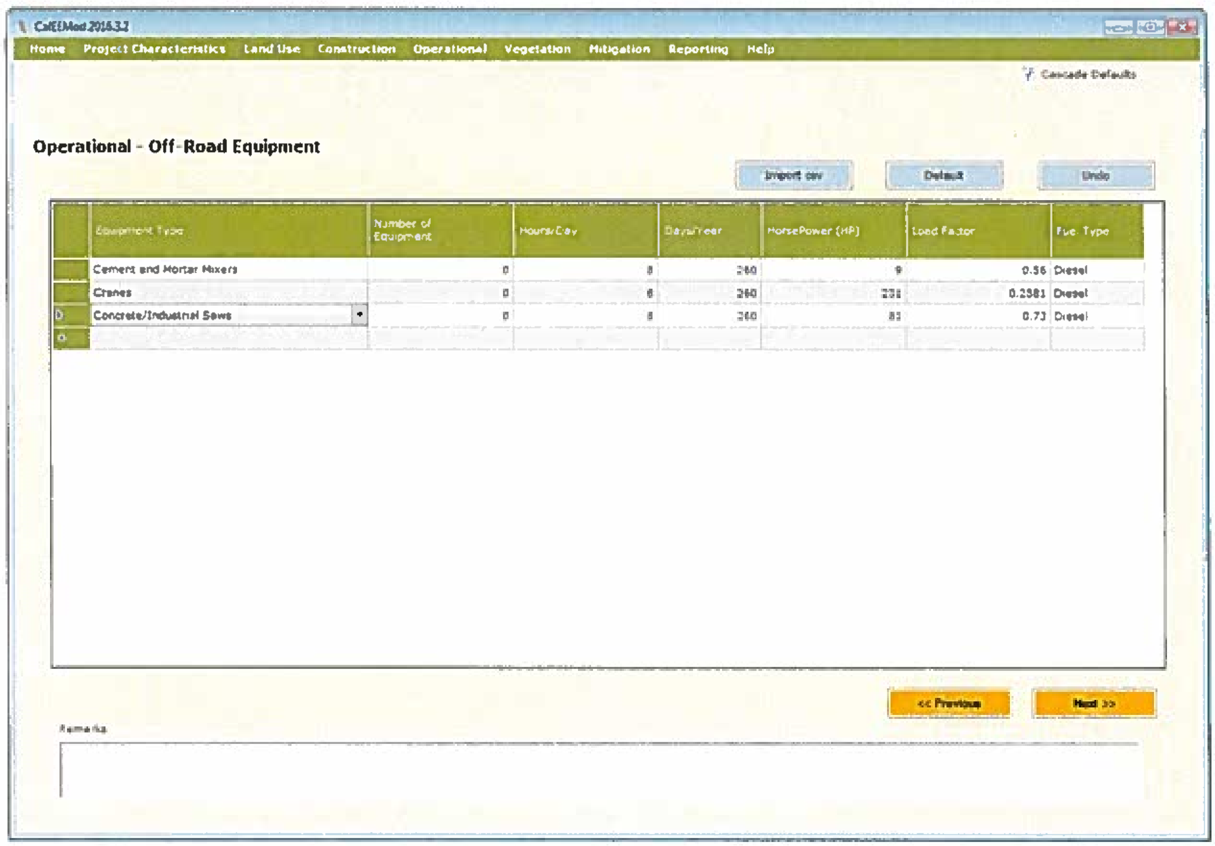
15 IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5 Waste. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

4.9 Off-Road Equipment

The Operational - Off-Road Equipment sub-screen allows the user to identify any off-road equipment used during operational activities (e.g., forklifts, cranes, loaders, generator sets, pumps, pressure washers, etc.) at the project site. Because such equipment cannot be assumed to be needed for a particular land use project, a user must provide the data in order for CalEEMod to calculate the resulting emissions from off-road equipment operation. A dropdown list of off-road equipment is provided for the user to identify each piece of equipment. The model requires the following specific information per equipment type. The user would need to provide the number of pieces for each equipment type. The model assumes an operation activity of 8 hours per day and 260 days per year, as well as the horsepower and load factor of the equipment type, but the user has the ability to override the default assumptions with project specific information. Finally, the model assumes diesel fuel, but a dropdown menu is provided to allow the user to choose bio-diesel, compressed natural gas (CNG) or electrical if known, to power the equipment.

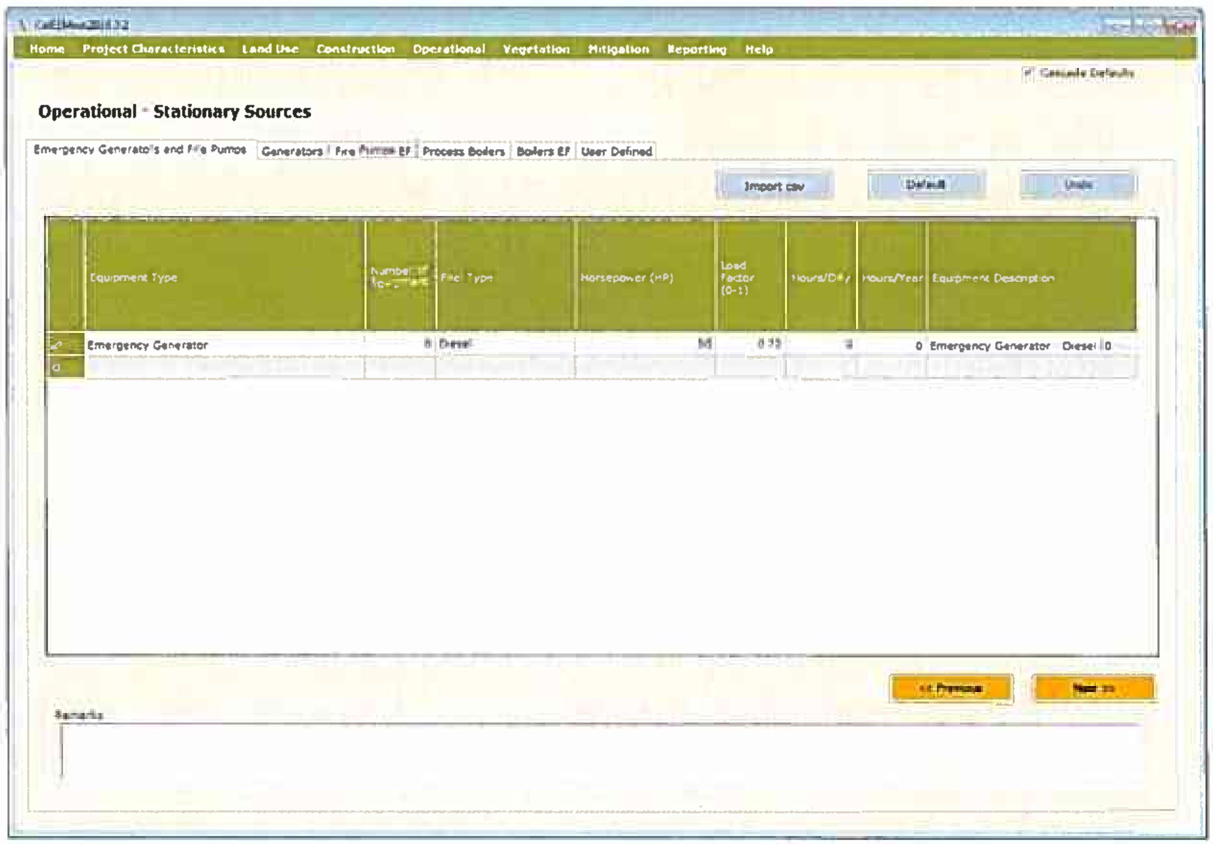


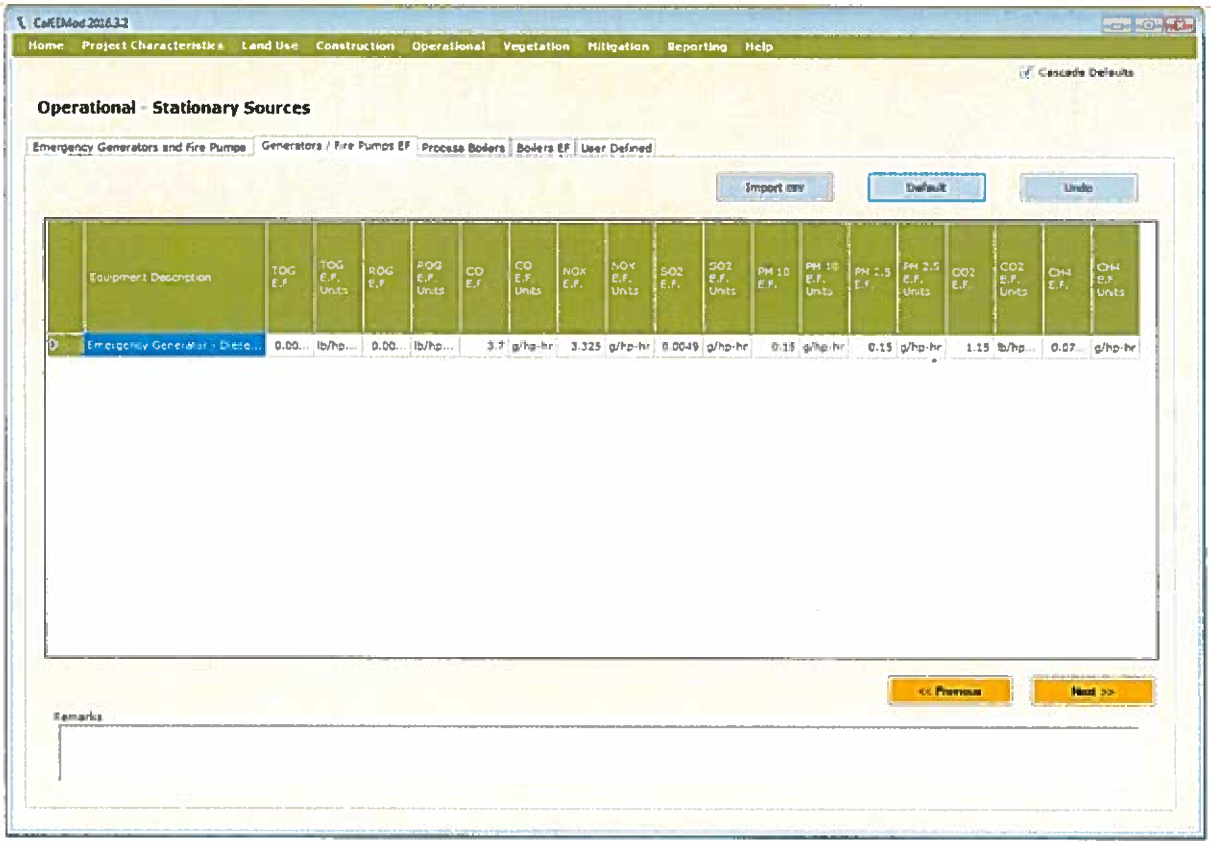
4.10 Stationary Sources

The Stationary Sources screen consists of five sub-screens: Emergency Generators and Fire Pumps and their default emission factors, Process Boilers and their default emission factors, and User Defined Sources. Consult with the local air district to determine if permitted stationary sources should be included in the project analysis using CalEEMod.

4.10.1 Emergency Generator and Fire Pumps and Default Emission Factors

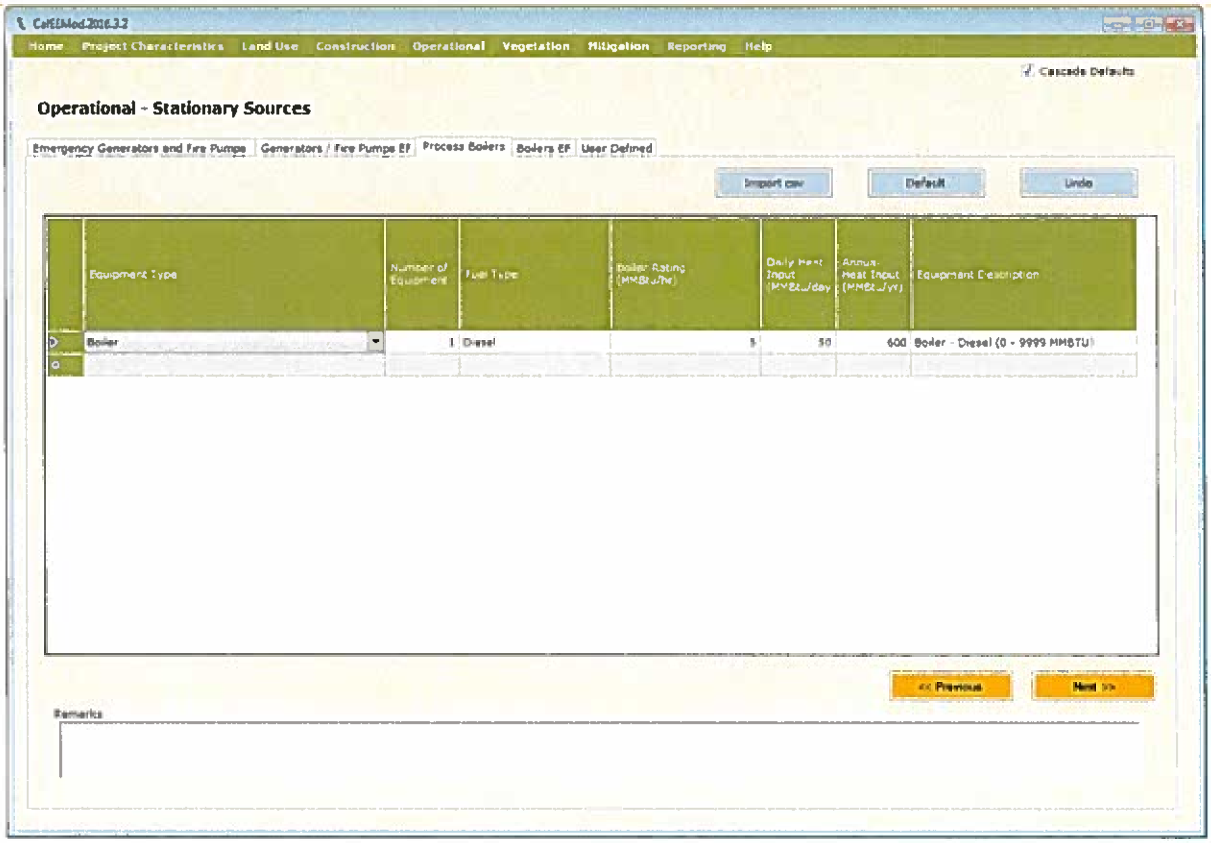
Two sub-screens allow the user to enter emergency power generators and diesel fueled fire pumps and to estimate emissions. This type of equipment operates only for maintenance and testing, or during emergency situations, such as power failures. To calculate emissions, the user must enter the engine rating (in horsepower), the anticipated maximum daily usage, and the anticipated maximum annual usage into the Emergency Generators and Fire Pumps sub-screen. The user may change the default load factor. The default emission factors for the equipment are shown on the separate Generators/Fire Pumps EF (emission factor) sub-screen. The user can replace the default emission factors, but needs to provide custom emission factors in the predefined units. See Appendix A for the sources of default emission factors and emission calculation methodology.





4.10.2 Process Boilers and Default Emission Factors

Two sub-screens allow the user to enter process boilers and to estimate emissions. Do not use this option for boilers providing space heating or building hot water, as these uses are included building energy use (See Subchapter 4.6). To calculate process boiler emissions, the user must enter the boiler rating (in million BTU/hr) and maximum anticipated daily and annual heat input in the Process Boilers sub-screen. The default emission factors for boilers are shown on the separate Boiler EF (emission factor) sub-screen. The user can replace the default emission factors, but needs to provide custom emission factors in the predefined units. See Appendix A for the sources of default emission factors and emission calculation methodology.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Daily Heat Input (MMBtu/day)
Annual Heat Input (MMBtu/yr)
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600
Boiler - Diesel (0 - 9999 MMBTU)
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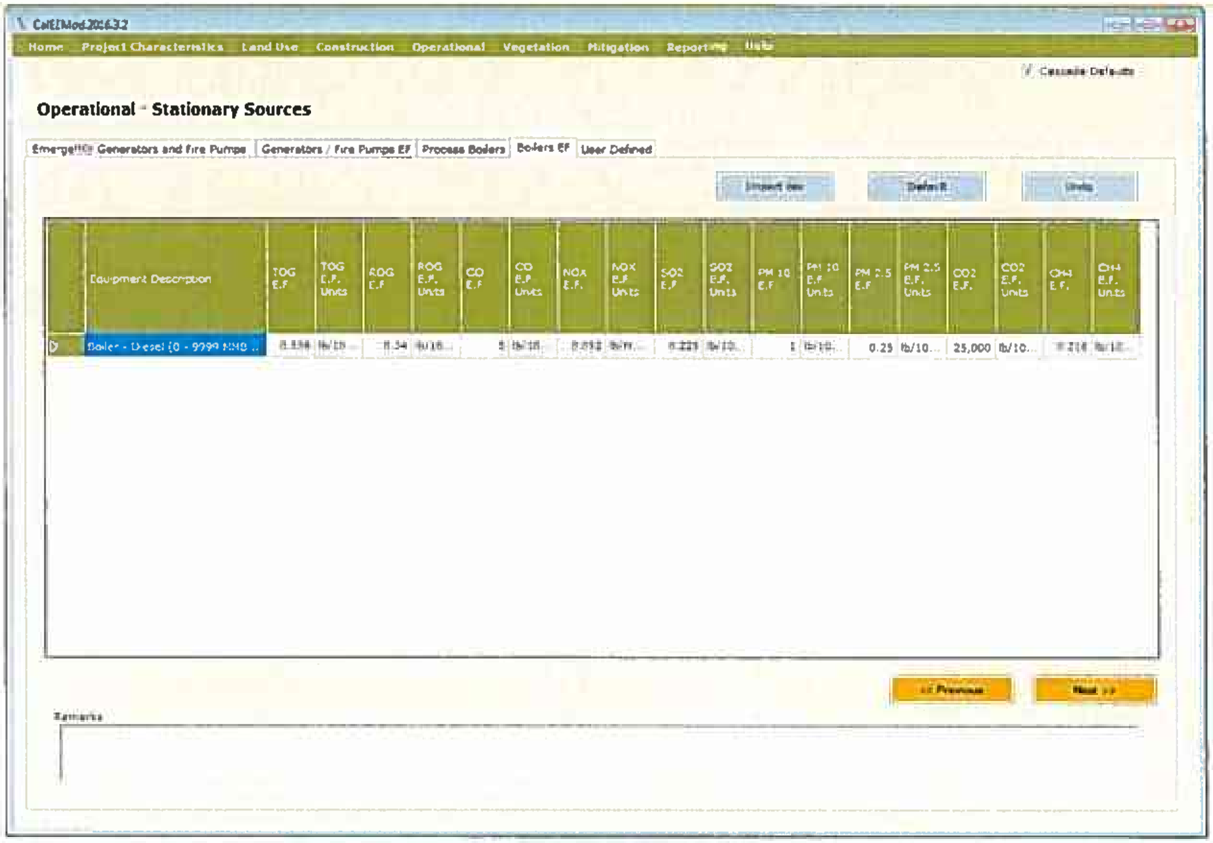
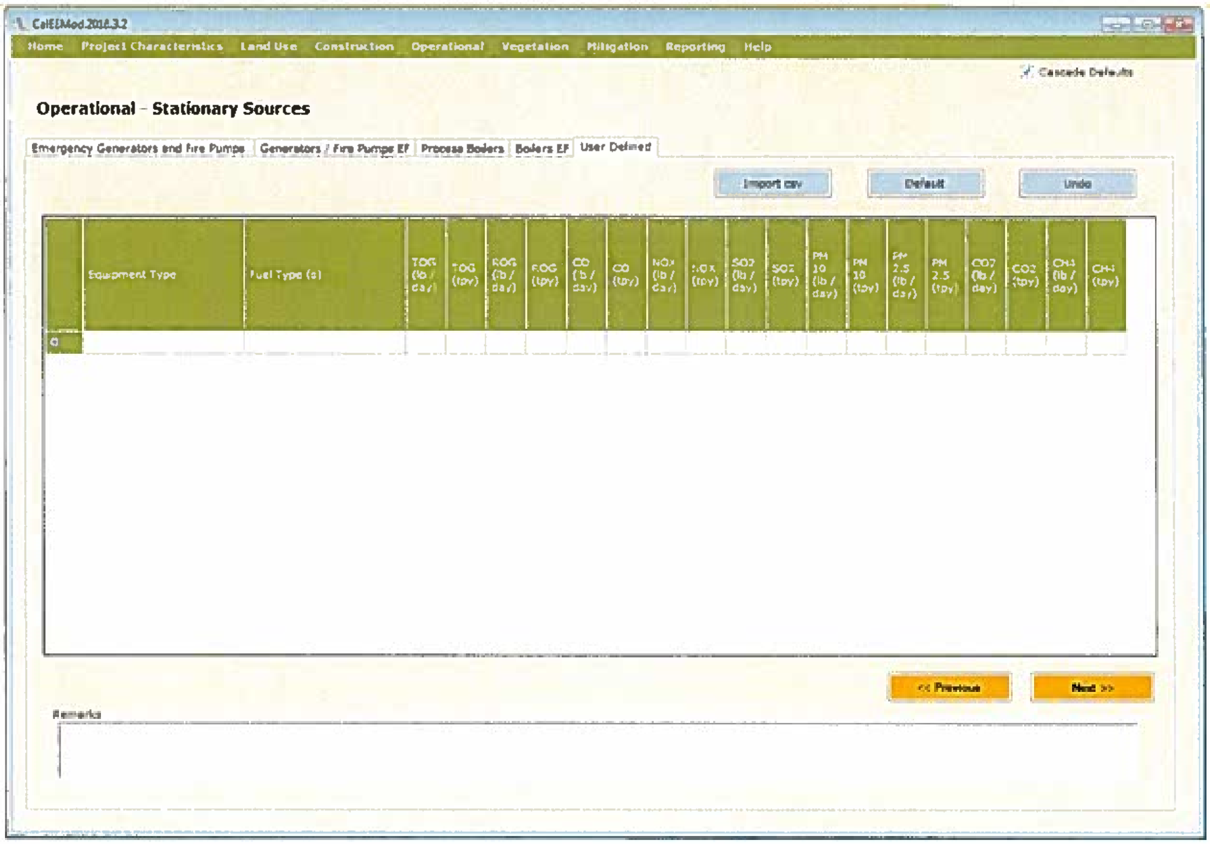


4.10.3 User Defined

An option for the user to define stationary sources other than emergency generators, fire pumps and process boiler has been included in the User Defined sub-screen. Emissions for this source would include any other miscellaneous sources that typically require permits to operate issued by an air district. Emissions may be manually entered here, either by transferring values from the permits to operate, or by calculating emissions outside of CalEEMod. Any emissions entered here will be transferred to the appropriate reports.



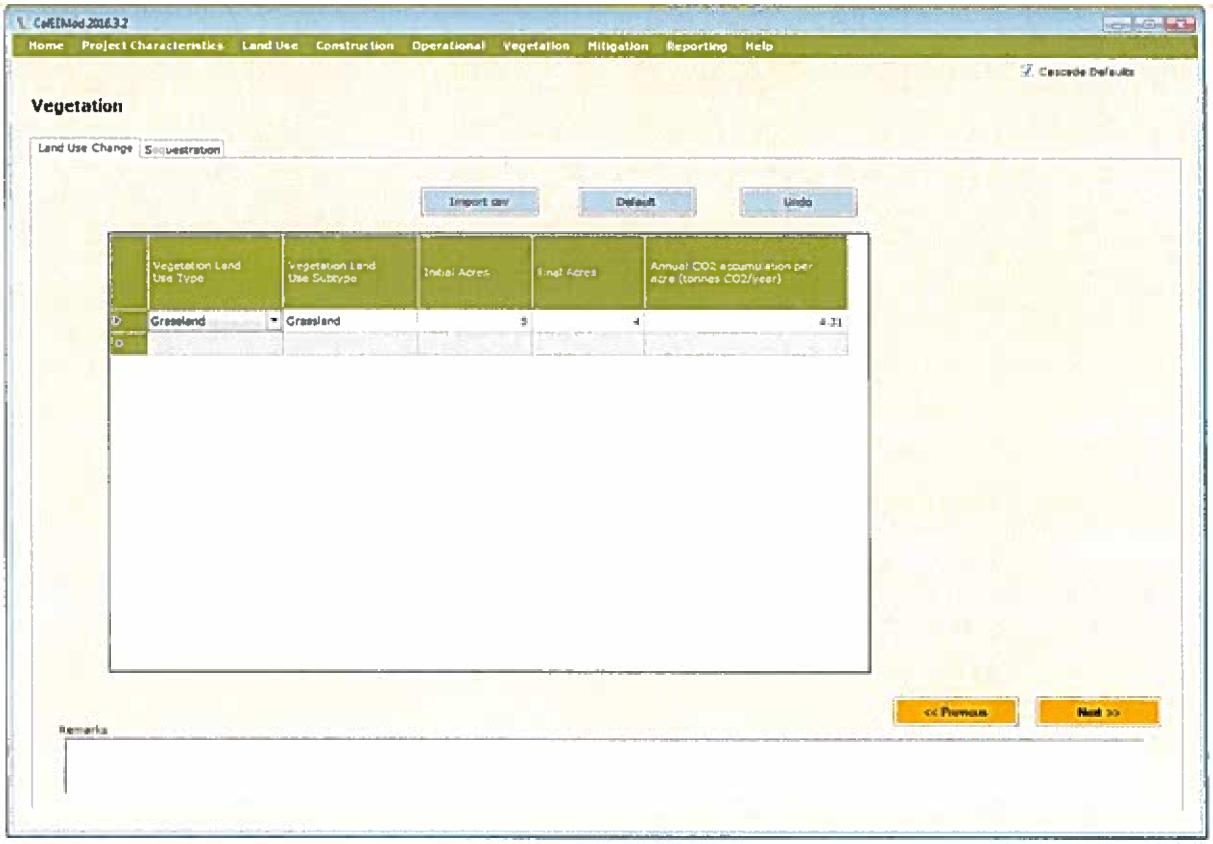
4.11 Vegetation

The vegetation screen is used to estimate the one-time change in carbon sequestration capacity due to a project. There are two sub-screens, Land Use Change and Sequestration. The methods used are based on IPCC[16].

4.11.1 Land Use Change

The Land Use Change sub-screen estimates GHG emissions due to a change in vegetation resulting from a change in land use type. The user enters the vegetation land use type, the initial and final acreage of the vegetation land use type, and the annual carbon dioxide equivalent accumulation per acre if the user chooses to override the default value. Settlement land use acreage is not considered since it is a net zero at steady state unless trees are added.

[16] IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html



4.11.2 Sequestration

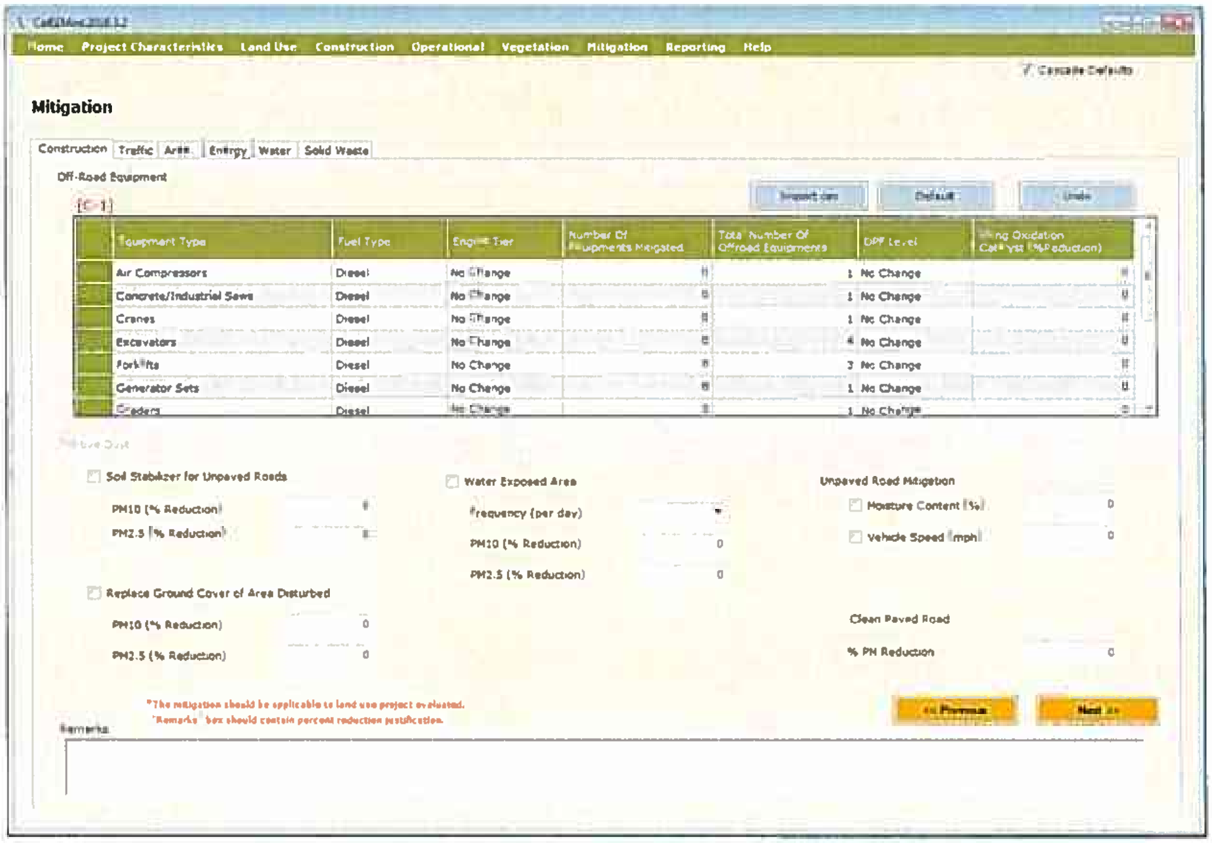
This sub-screen of Vegetation is used to estimate the GHG emissions associated with the sequestration of net new trees added to the project site. Consistent with IPCC recommendations a 20 year active growth period is assumed. The user enters the tree type or miscellaneous if it is not known, and the total number of trees. The user can override the default carbon sequestration rate.

4.12 Mitigation

The mitigation screen consists of six sub-screens that the user can indicate and supply the necessary information to estimate the emissions after mitigation measures have been implemented. The mitigation measures included in CalEEMod are largely based on the CAPCOA Quantifying Greenhouse Gas Mitigation Measures (http://www.capcoa.org/wp-content/uploads/downloads/2010/09/CAPCOA-Quantification-Report-9-14-Final.pdf) document. The CAPCOA measure numbers are provided next to the mitigation measures in CalEEMod to assist the user in understanding each measure by referencing back to the CAPCOA document. This User's Guide focuses on key aspects of the Mitigation sub-screens that users should pay particular attention.

4.12.1 Construction Mitigation

This sub-screen consists of a datagrid of off-road construction equipment to apply various mitigation measures and check boxes with supplemental information for fugitive dust emissions mitigation.



To apply mitigation to construction equipment, the user selects the equipment type, notes the number of equipment mitigated (of the total number of off-road equipment listed), and type of mitigation that applies. If substantial evidence supporting reductions was available at the time of development, options include fuel type (diesel, CNG, electric, hybrid, biodiesel), engine tier (typically select Tier 4), diesel particulate filter tiers (Tier 3 being the most effective), and use of oxidative catalysts. The program estimates how much if any increase or decrease in emissions to apply for each pollutant. Some mitigation measures have trade-offs in pollutant reductions and therefore may result in increases of some pollutants. The mitigation option to use alternative fuel for construction equipment is consistent with mitigation measure C-1 in the CAPCOA Quantifying GHG Mitigation document.

To apply mitigation to construction fugitive dust, the user selects the check box in front of the mitigation measure name, and enters in the appropriate information in the drop down or text boxes. Some fugitive dust mitigation required by some air districts do not appear here since the fugitive dust source they mitigate is not quantified by CalEEMod, in particular this includes fugitive dust generated by wind over land and storage piles. Since the fugitive dust source is not quantified it is not appropriate to apply the reduction.

For Unpaved Road Mitigation for construction fugitive dust, the maximum vehicle speed and the minimum moisture content for unpaved roads are entered. Defaults for these values are those entered on the On-Road Fugitive Dust screen. Mitigated emissions are calculated using the VMT from on-road vehicles traveling along unpaved roads, previously calculated from the percentages entered on the On-road Fugitive Dust Screen (e.g., % Pave Worker, % Pave Vendor or % Pave Hauling).

Users may check the boxes and provide a lower vehicle speed and a higher moisture content to conduct the mitigation calculation. If during a particular construction phase the user defined mitigated vehicle speed is higher than the unmitigated vehicle speed and/or the user defined mitigated moisture content is lower than the unmitigated moisture content, a warming message will be displayed. In this case, the unmitigated values will be used, resulting in no mitigation being calculated.

4.12.2 Traffic Mitigation

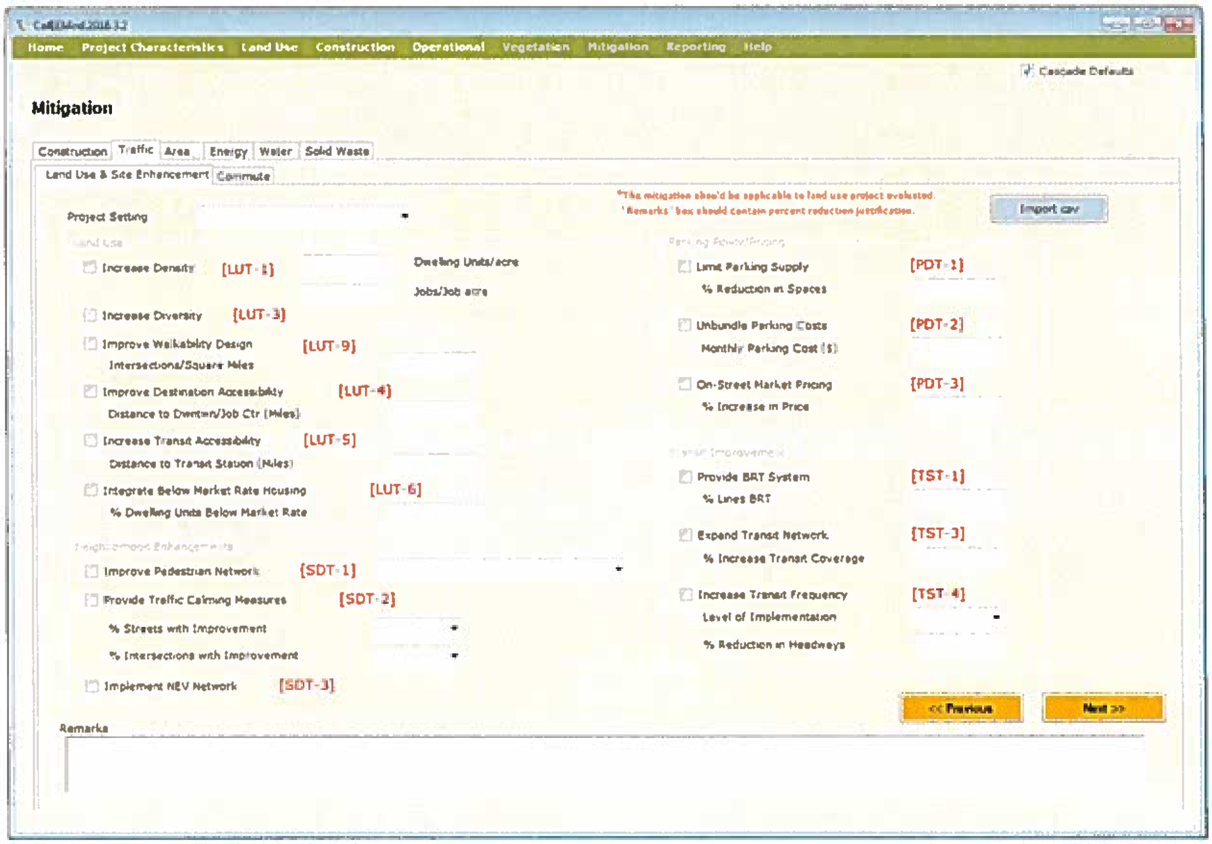
There are two traffic mitigation sub-screens that the user can select from, Land Use & Site Enhancement and Commute. First, the user must select the Project Setting as defined in the CAPCOA document (pp. 59-60).

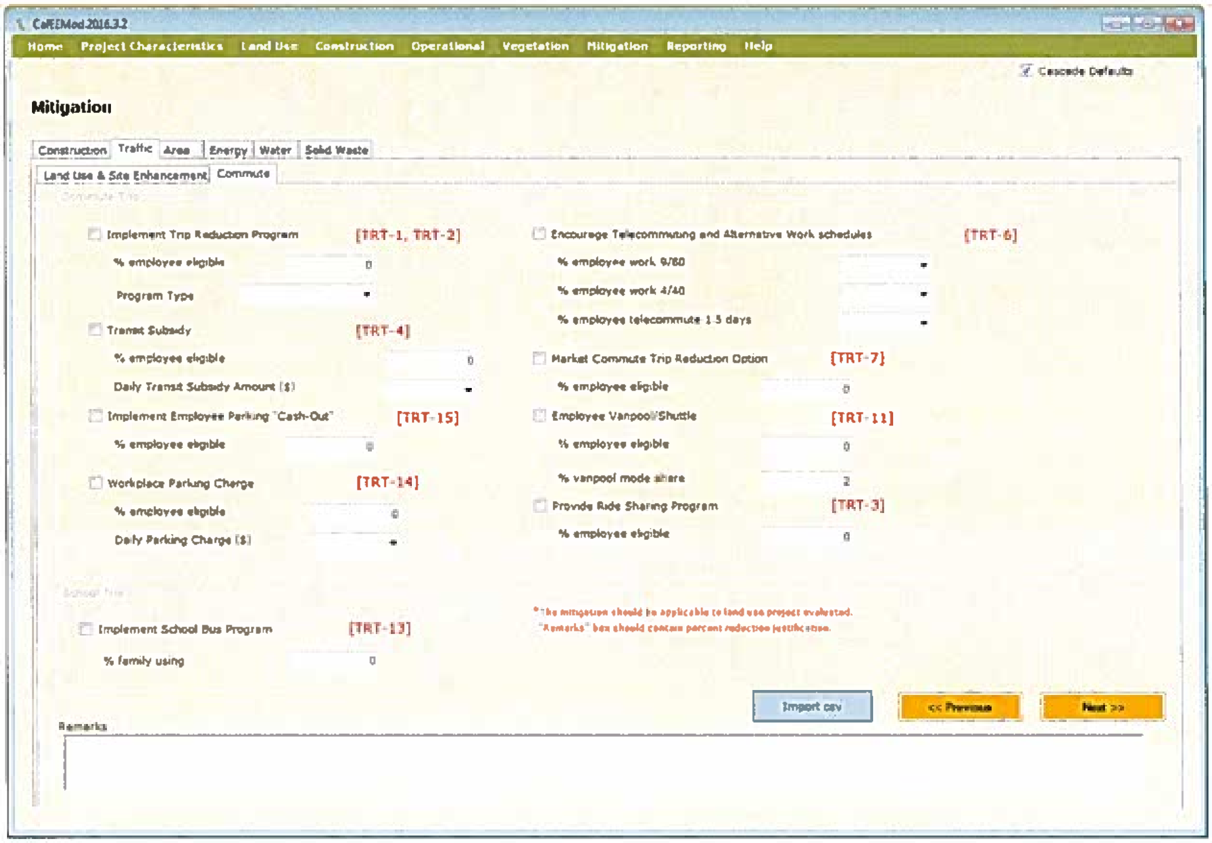
- Low Density Suburban: An area characterized by dispersed, low-density, single-use, automobile dependent land use patterns, usually outside of the central city (a suburb).
- Suburban Center: An area that serves the population of the suburb with office, retail and housing which is denser than the surrounding suburb.
- Urban: An area which is located within the central city with higher density of land uses than you would find in the suburbs. It may be characterized by multi-family housing and located near office and retail.
- Urban Center *(referred to as Compact Infill in the CAPCOA document)*: An area which is located within or contiguous with the central city. Examples may include redevelopment areas, abandoned sites, or underutilized older buildings/sites.

If the CAPCOA measure did not distinguish between Suburban Center and Low Density Suburban, values for Low Density Suburban were used. Similarly, if Urban Center and Urban values were not distinguished, Urban values were used.

The user checks the box next to each mitigation measure and fills in the appropriate information as required. The maximum reduction caps defined in the CAPCOA Quantifying GHG Mitigation document are integrated into these calculations. The CAPCOA traffic mitigation measure numbers included in CalEEMod are the following: LUT-1, LUT-3, LUT-9, LUT-4, LUT-5, LUT-6, SDT-1, SDT-2, SDT-3, PDT-1, PDT-2, PDT-3, TST-1, TST-3, TST-4, TRT-1, TRT-2, TRT-4,

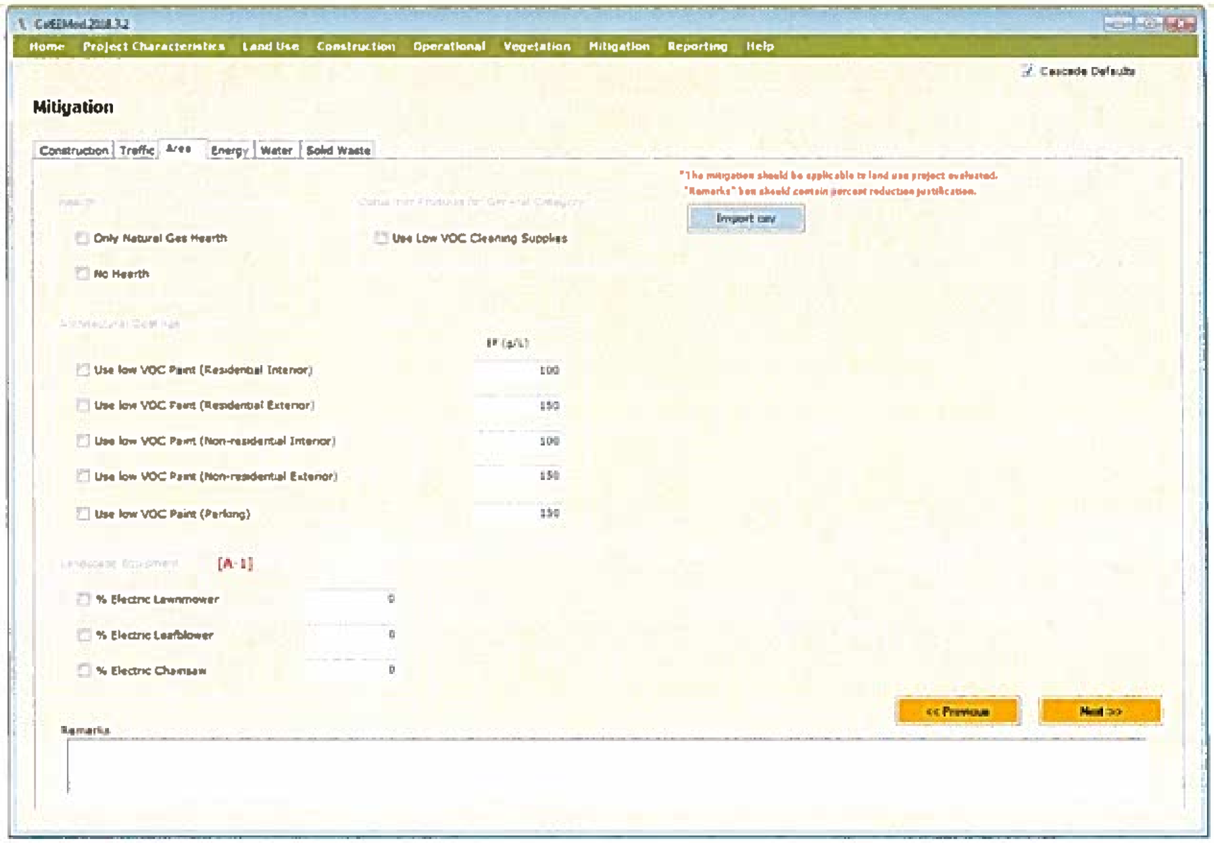
TRT-15, TRT-14, TRT-6, TRT-7, TRT-11,TRT-3, and TRT-13. The NEV network mitigation measure (SDT-3) assumes the low end of the CAPCOA recommendations.





4.12.3 Area Mitigation

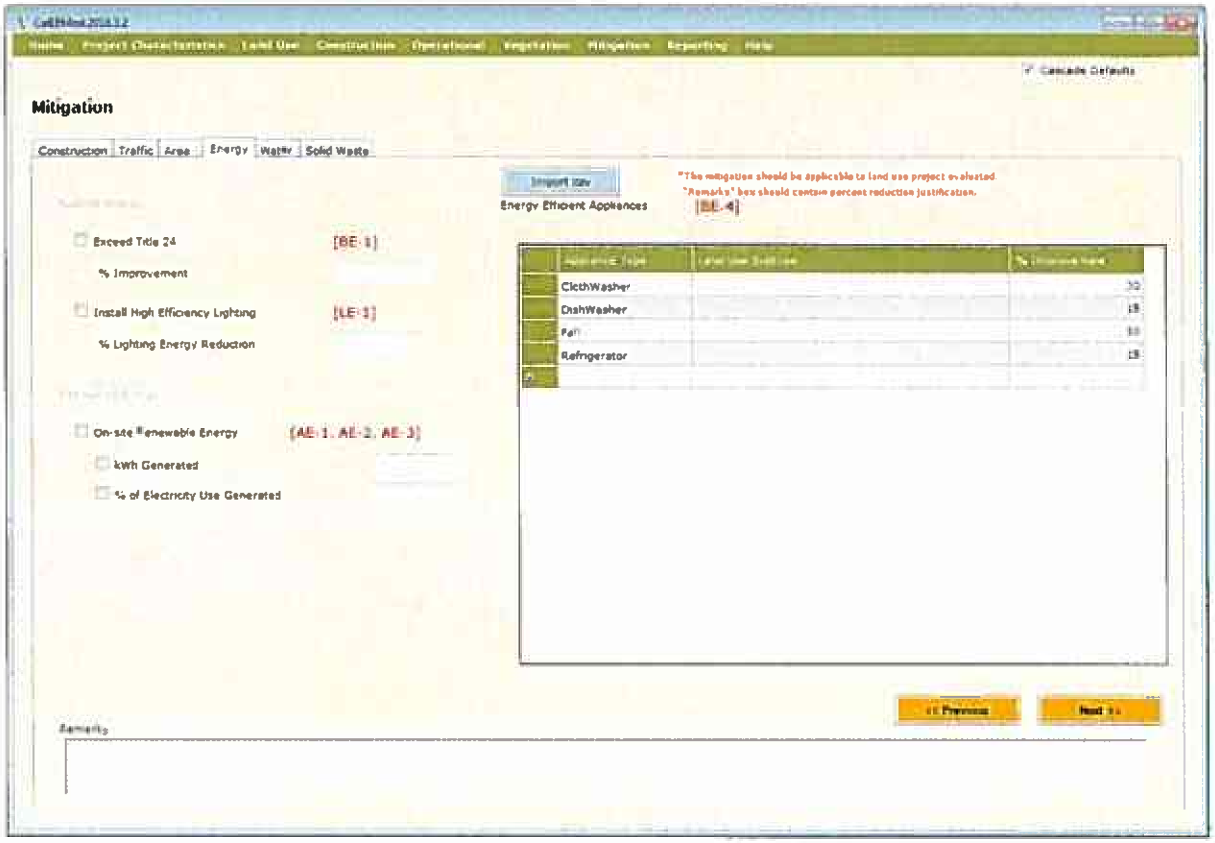
The user can select from a few area source mitigation measures on the Area sub-screen by checking the appropriate box and supplying any additional information in the text boxes. These measures include all natural gas hearths, no hearths, electric landscaping equipment use, reduced ROG coatings, and reduced general category consumer product ROG content. The area landscaping mitigation to prohibit gas powered landscape equipment is consistent with mitigation A-1 in the CAPCOA Quantifying GHG Mitigation document.



4.12.4 Energy Mitigation

The user selects energy mitigation measures on the Energy sub-screen by using the check boxes or the datagrid. These correspond to CAPCOA Mitigation Measures LE-1, BE-1, AE-1, AE-2, AE-3 and BE-4 as listed in the CAPCOA Quantifying GHG Mitigation document. The lighting is a percentage reduction in lighting as supplied by the user. The datagrid is used to enter the land use subtypes that will use energy efficient appliances. The percent improvement is the typical percent improvement above standard appliances according to the 2008 Energy Star Annual Report[17]. Alternative Energy has two methods to enter the amount of alternative energy. The first is the amount of kW-hr generated. The second is the percentage of the total electricity use by buildings that is generated. At this time alternative energy methods that are not carbon neutral are not quantified. To apply the amount of alternative energy only one of the two methods (kW-hr or percentage) needs to be entered for CalEEMod to calculate emission reductions.

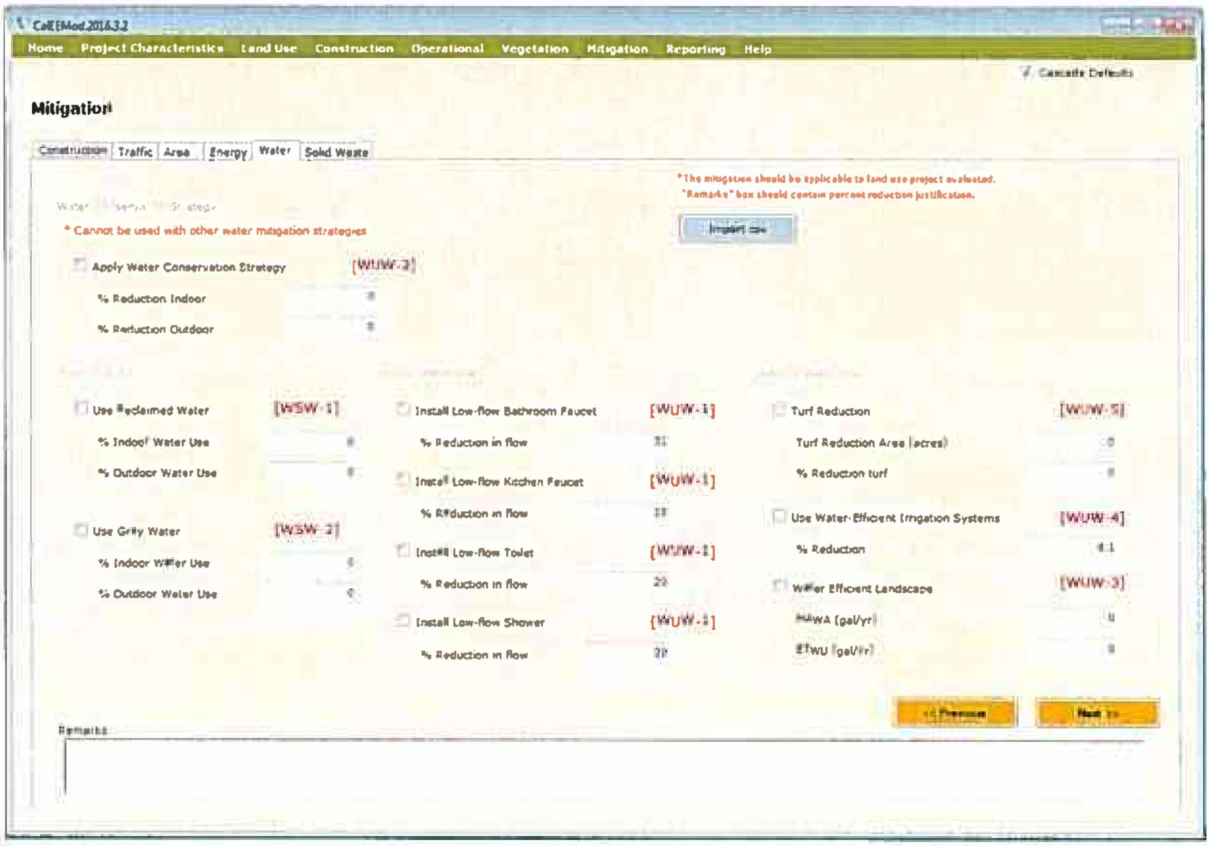
[17] Available at: https://www.energystar.gov/ia/partners/annualreports/annual_report_2008.pdf



4.12.5 Water Mitigation

On the Water sub-screen, water mitigation can either be estimated as the percent reduction based on a water conservation strategy or the other individual mitigation measures. The CAPCOA Quantifying GHG Mitigation document includes water supply and use measures WSW-1 & 2, and WUW-1 through 5.

For CAPCOA Mitigation Measure WSW- 3 (Use Locally Sourced Water Supply), using locally-sourced water or water from less energy-intensive sources reduces the electricity and indirect CO_2 emissions associated with water supply and transport because water from local or nearby groundwater basins, nearby surface water and gravity-dominated systems have smaller energy-intensity factors. This mitigation measure is not included in the Water mitigation sub-screen, therefore, to implement WSW-3, the user should alter the energy intensity values in water and run a separate CalEEMod run to accommodate these values.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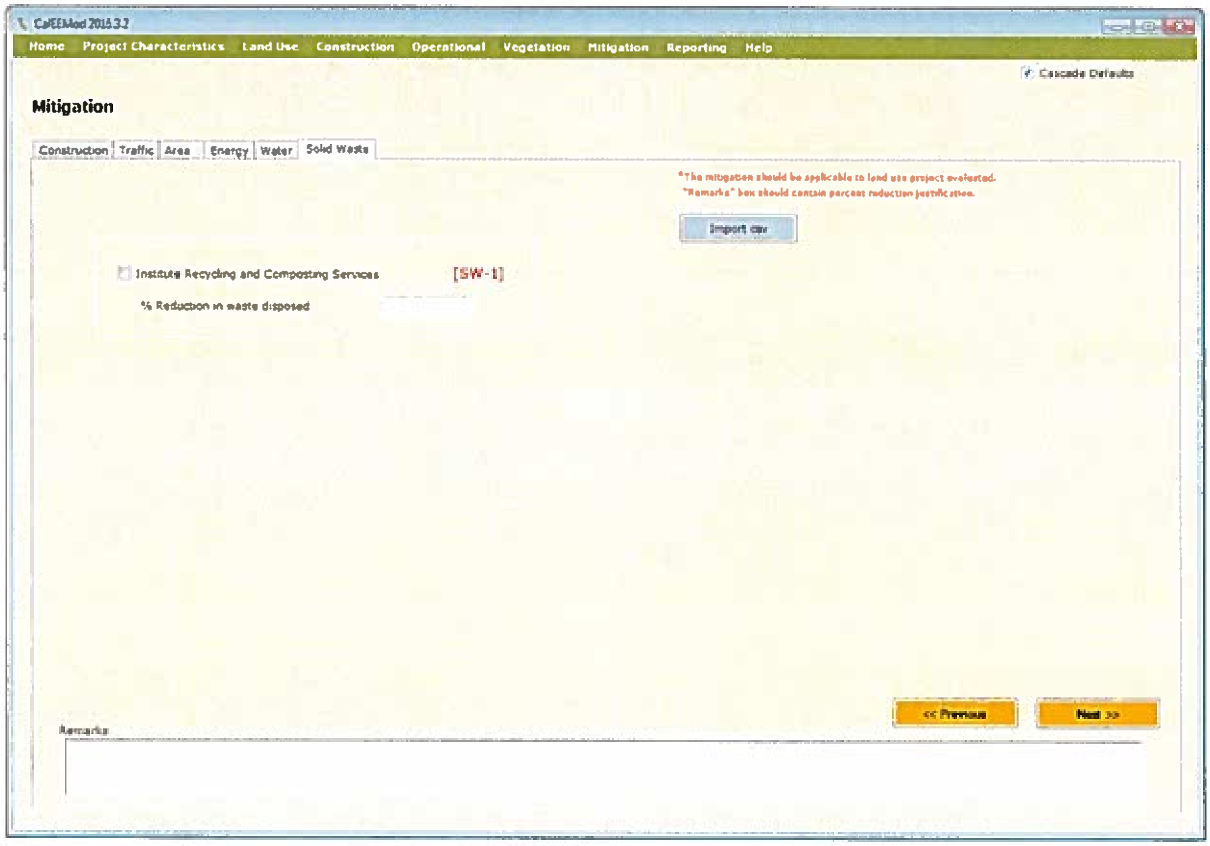
* Cannot be used with other water mitigation strategies
Apply Water Conservation Strategy
[WUW-2]
% Reduction Indoor
% Reduction Outdoor
Use Reclaimed Water
[WSW-1]
% Indoor Water Use
% Outdoor Water Use
Use Grey Water
[WSW-2]
Install Low-flow Bathroom Faucet
[WUW-1]
% Reduction in flow
Install Low-flow Kitchen Faucet
Install Low-flow Toilet
Install Low-flow Shower
Turf Reduction
[WUW-5]
Turf Reduction Area (acres)
% Reduction turf
Use Water-Efficient Irrigation Systems
[WUW-4]
% Reduction
Water Efficient Landscape
[WUW-3]
Remarks

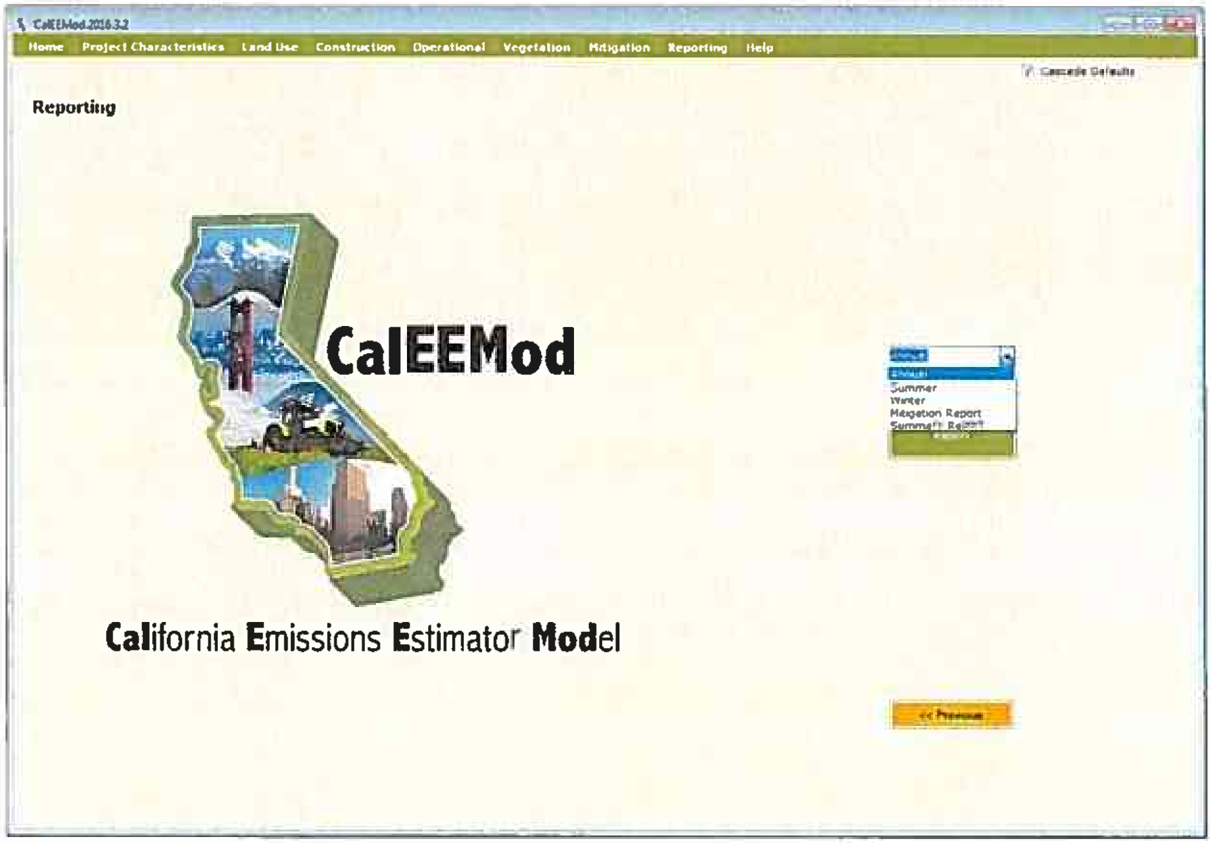
4.12.6 Solid Waste Mitigation

The user can calculate an emissions reduction for recycling waste. This mitigation measure corresponds to CAPCOA Mitigation Measure: SW-1.



4.13 Reporting

The user initiates final emission calculations by selecting the report and clicking on the Recalculate All Emissions and Run Report button. The available reports include: Annual, Summer (peak) Daily, Winter (peak) Daily, Mitigation and Summary of peak daily emissions and annual GHG emissions. A separate report viewer will appear on the screen. From this report viewer, the user can view the each selected report on-screen, print each report, save each report as either a Microsoft Excel .xls file, an Adobe Acrobat .pdf file, or in the case of the Mitigation report, a Microsoft Word .doc file. It is important to note that the data presented in the Excel file has already been calculated and the calculated results are placed in the grids as text. For this reason, the user cannot change an emission value presented in an Excel file and expect the report to calculate a revised value. These values, however, can be copied to new Excel spreadsheet for any further desired calculation with the data. If the user elects to generate a Summary report, the project needs to use only the CalEEMod defaults and there can be no remarks on any page.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