Appendix A
Notice of Preparation and Comments

Notice of Preparation

Notice of Preparation

To: State Clearinghouse
1400 Tenth Street
Sacramento, CA 95814

From: Monterey One Water
5 Harris Court, Building D
Monterey, CA 93940

Subject: Notice of Preparation of a Draft Environmental Impact Report

Monterey One Water will be the Lead Agency and will prepare an environmental impact report for the project identified below. We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval for the project.

The project description, location, and the potential environmental effects are contained in the attached materials. A copy of the Initial Study (☐ is ☒ is not) attached.

Due to the time limits mandated by State law, your response must be sent at the earliest possible date but not later than 30 days after receipt of this notice.

Please send your response to Rachel Gaudoin at the address shown above. We will need the name for a contact person in your agency.

Project Title: Expanded Pure Water Monterey Project

Project Applicant, if any: Monterey One Water

Date May 14, 2019

Signature RGaudoin

Title PUBLIC OUTREACH COORDINATOR

Telephone 831-645-4623

Reference: California Code of Regulations, Title 14, (CEQA Guidelines) Sections 15082(a), 15103, 15375.

Notice of Preparation of a Supplemental Environmental Impact Report and Public Scoping Meeting Notice

To: California Office of Planning and Research; Responsible and Trustee Agencies; County Clerks; and Other Interested Parties

Subject: Notice of Preparation of a Supplemental Environmental Impact Report and Public Scoping Meeting Notice

Project: Expanded Pure Water Monterey Groundwater Replenishment Project

Lead Agency: Monterey One Water

Date: May 15, 2019

This Notice of Preparation (NOP) has been prepared to notify agencies and interested parties that Monterey One Water (M1W), formerly Monterey Regional Water Pollution Control Agency, as the Lead Agency is beginning preparation of a Supplemental Environmental Impact Report (EIR) pursuant to the California Environmental Quality Act (CEQA) for the proposed expansion of the Pure Water Monterey Groundwater Replenishment Project (Expanded PWM/GWR Project). M1W, in conjunction with the Monterey Peninsula Water Management District (MPWMD), is proposing an expansion of the capacity of the PWM/GWR Project which is currently under construction. The PWM/GWR Project's Advanced Water Purification Facility would be expanded from the current 5 million gallons per day (mgd) plant to up to a 7.6 mgd maximum capacity plant to enable an increase in groundwater replenishment from 4 mgd to up to 7.6 mgd. The proposed Expanded PWM/GWR Project also includes associated conveyance, injection and extraction facilities, as described below.

The proposed Expanded PWM/GWR Project would reduce discharges of secondary effluent to Monterey Bay and would replenish the Seaside Groundwater Basin with approximately 2,250 AFY of additional purified recycled water. Combined with the existing PWM/GWR Project yield this expansion would result in a total water supply yield of approximately 5,750 AFY to replace existing water supplies for California American Water Company's (CalAm) Monterey District service area and enable CalAm to comply with the State Board's Cease and Desist Order (Orders 95-10, 2016-0016) as amended. At this time, the Expanded PWM/GWR Project is considered a "back-up plan" to the Monterey Peninsula Water Supply Project (MPWSP), CalAm's planned 6.4 mgd desalination project. The Expanded PWM/GWR Project would be implemented in the event that the MPWSP encounters obstacles that prevent timely, feasible implementation.

This Notice of Preparation (NOP) includes a brief description of the Expanded PWM/GWR Project and the environmental topics to be addressed in the Supplemental EIR. The proposed expansion would constitute a change to the previously approved PWM/GWR Project. Therefore, the Supplemental EIR will evaluate whether any new or substantially more severe impacts on the environment would result from the project changes, compared to the environmental impacts disclosed in the previously certified PWM/GWR Project EIR and Addenda. The Supplemental EIR also will incorporate the applicable mitigation measures that were identified in the previously certified EIR and Addenda.

M1W is soliciting comments from all interested persons, responsible and trustee agencies and organizations as to the scope and content of the Supplemental EIR and the environmental information to be analyzed in connection with the proposed Expanded PWR/GWR Project. The Final EIR for the PWM/GWR Project was certified in October 2015. Addenda to that EIR were approved in June 2016 (Addendum No. 1), February 2017 (Addendum No. 2), and October 2017 (Addendum No. 3). The Final EIR and Addenda to the EIR can be found at the following link http://purewatermonterey.org/reports-docs/.

In accordance with CEQA, agencies and the public are requested to review the description of the Expanded PWM/GWR Project provided in this NOP and provide comments on environmental issues related to the commenting agencies' statutory responsibilities. The Supplemental EIR will be used by M1W, MPWMD and other Responsible Agencies when considering approval of the Expanded PWM/GWR Project.

Location: The Expanded PWM/GWR Project would be located within northern Monterey County and would include facilities located within the City of Seaside and portions of the unincorporated Monterey County, as shown in Figures 2 and 3. The Expanded PWM/GWR Project would increase the amount of purified recycled water available to replenish the Seaside Groundwater Basin, replacing existing water supplies for CalAm's Monterey District service area and enabling CalAm to comply with the State Board's Cease and Desist Order as amended. The NOP is available at http://www.purewatermonterey.org and at M1W's offices, located at 5 Harris Court, Building D Monterey, CA 93940.

Comments on the NOP must be received by M1W no later than 30 days after publication of this NOP. The NOP has been made available for public review on May 15, 2019.

Comments on this NOP must be received no later than **June 14, 2019** at 5 PM**.** Please send your comments, including a return address, contact name, and email to this address:

Mail: Monterey One Water
Attn: Rachel Gaudoin
5 Harris Court, Building D, Monterey, CA 93940

Email: purewatermontereyinfo@my1water.org

Public Scoping Meeting: A public meeting will be held to receive public comments and suggestions on the scope of the Supplemental EIR. The scoping meeting will be open to the public on the following date in the following location:

Wednesday, June 5, 2019 at 5:30 p.m.
Oldemeyer Center: Blackhorse Meeting Room
986 Hilby Avenue, Seaside, CA 93955

Expanded Pure Water Monterey Groundwater Replenishment Project

Notice of Preparation

Introduction and Background

Monterey One Water (M1W, formerly the Monterey Regional Water Pollution Control Agency or MRWPCA), in partnership with the Monterey Peninsula Water Management District (MPWMD), is proposing an expanded Pure Water Monterey Groundwater Replenishment Project (Expanded PWM/GWR Project) to create a reliable source of water supply to replace existing water supply sources for the Monterey Peninsula in northern Monterey County. **Figure 1** below shows M1W's existing infrastructure and service area. The Expanded PWM/GWR Project would increase the amount of purified recycled water produced by the PWM/GWR Project that is currently under construction.

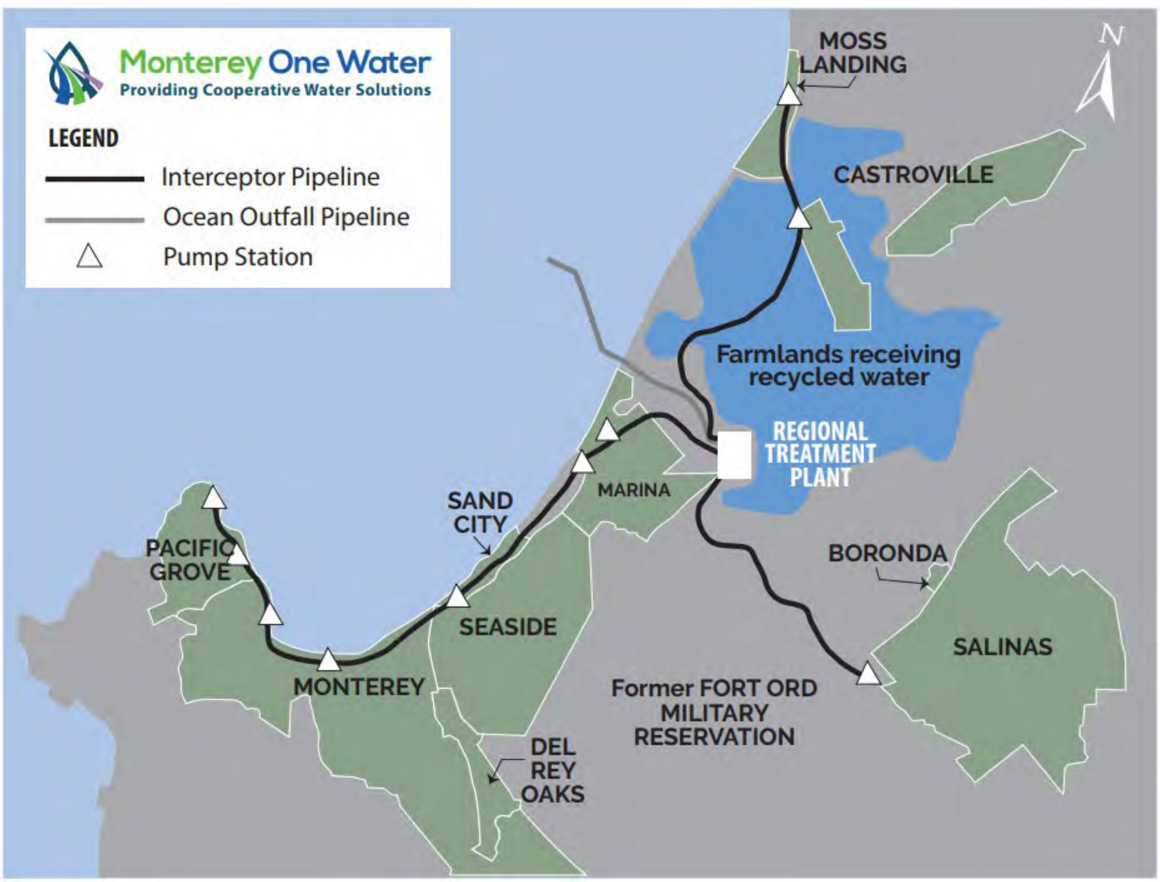

Figure 1. M1W Service Area

As approved, the PWM/GWR Project will create a reliable source of water supply by taking highly-treated water from the Advanced Water Purification Facility (AWPF)[1] and recharging the Seaside Groundwater Basin with the treated water using a series of shallow and deep injection wells. Once injected into the Seaside Groundwater Basin, treated water will mix with the groundwater present in the aquifers and be stored for future extraction and use. The primary purpose of the approved PWM/GWR Project is to provide 3,500 acre-feet per year (AFY) of high quality replacement water to California American Water Company (CalAm) for delivery to its customers in the Monterey District service area; thereby enabling CalAm to reduce its diversions from the Carmel River system by this same amount[2]. CalAm is under a state order to secure replacement water supplies by December 2021.[3] (Please refer to discussion below for a full description of the approved PWM/GWR Project). **Figure 2** shows the approved PWM/GWR Project facility locations.

The Expanded PWM/GWR Project would increase the AWPF peak capacity from the current 5 million gallons per day (mgd) to 7.6 mgd and increase recharge of the Seaside Groundwater Basin with high quality purified water by an additional 2,250 AFY (for a total PWM/GWR Project yield of 5,750 AFY). At this time, the Expanded PWM/GWR Project is considered a "back-up plan" to the MPWSP, CalAm's planned 6.4 mgd desalination project. The Expanded PWM/GWR Project would be implemented in the event that the MPWSP encounters obstacles that prevent its timely, feasible implementation. The Expanded PWM/GWR Project would include the following new or modified M1W facilities:

- improvements to the existing PWM/GWR Project AWPF (adding equipment, pipelines, and storage within the existing plant site);
- up to 2 miles of new purified water conveyance pipelines;
- one new injection well at a new eastern wellfield area and associated infrastructure;
- relocation of one approved injection well site and associated infrastructure to the eastern wellfield area; and
- relocation of previously approved monitoring well sites to the area between a new eastern injection well area and extraction wells along General Jim Moore Boulevard.

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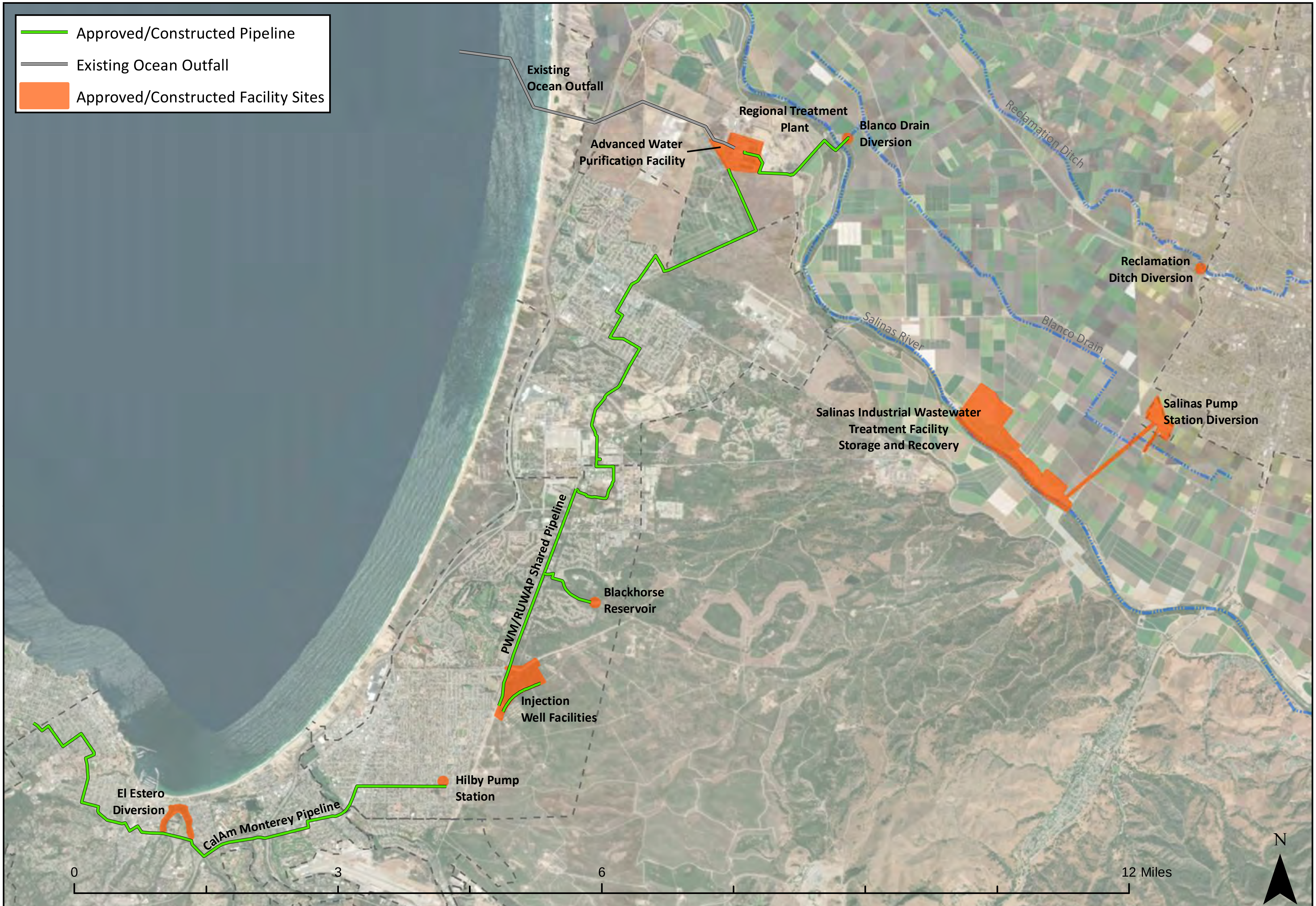
[1] Also referred to as the Advanced Water Treatment Facility (AWTF).

[2] The approved PWM/GWR Project also includes a drought reserve component to support crop irrigation during dry years. Under this component, an extra 200 AFY of advanced treated water will be injected in the Seaside Groundwater Basin during normal and wet years, up to a total of 1,000 AF, to create a "banked reserve." During drought years, M1W will reduce the amount of water injected into the Seaside Groundwater Basin in order to increase production of recycled water for crop irrigation. CalAm will be able to extract the banked water in the Seaside Groundwater Basin to make up the difference to its supplies, such that its extractions and deliveries will not fall below 3,500 AFY.

[3] The State Water Resources Control Board's Cease and Desist Order 95-10 required the reduction of CalAm pumping from the Carmel River; Order 2016-16 extended the time period for withdrawals above legal limits from the Carmel River through 2021.



Partners for Pure Water Solutions
Monterey One Water
Monterey Peninsula Water Management District
Prepared by Denise Duffy and Associates

Approved Pure Water Monterey Project Overview Map

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May 2019

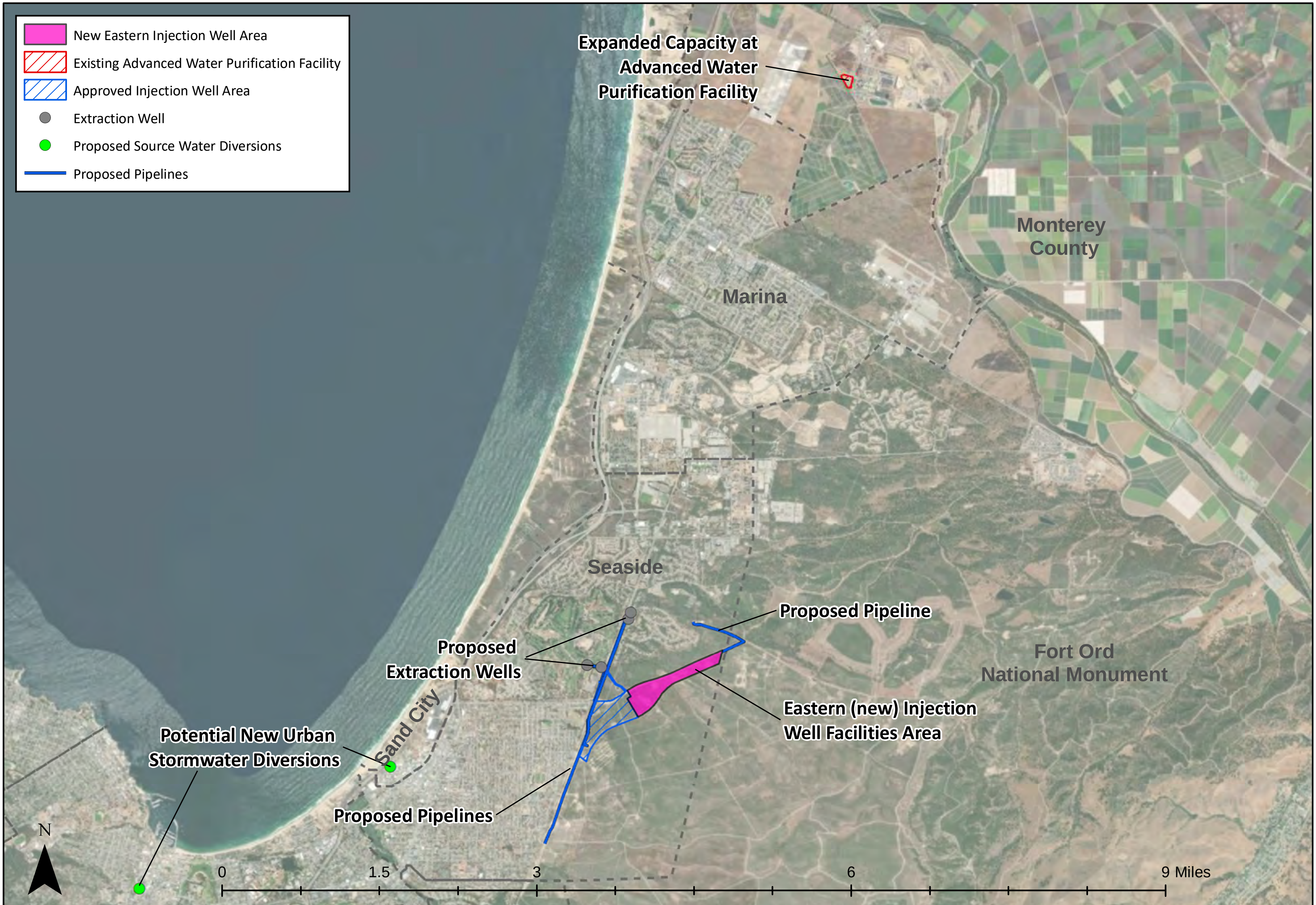
In order for CalAm to pump additional groundwater injected by the Expanded PWM/GWR Project into the Seaside Groundwater Basin and deliver it to meet its system demands, the following CalAm potable water system improvements would be required:

- two (2) new extraction wells, plus two (2) new extraction wells for system redundancy and associated infrastructure;
- wellhead disinfection (chlorination) treatment systems at the existing Paralta Well and two new extraction wells; and
- potable and raw water pipelines along General Jim Moore Boulevard and at the Seaside Middle School site.

In addition, one or more future urban storm water to sanitary sewer diversions (such as planned sanitary sewer diversion projects in Seaside and Monterey) may provide additional source water for the Expanded PWM/GWR Project. The locations of the above-described facilities are shown on **Figure 3.** These additional source waters are not necessary to achieve the Expanded PWM/GWR Project's recycled water yield objective of an additional 2,250 AFY of replacement supplies, nor would these additional source waters increase the Expanded PWM/GWR Project yield above 2,250 AFY. Rather, these additional source waters, if they come to fruition, would provide greater supply reliability for the Expanded PWM/GWR Project.

Monterey One Water

M1W was established in 1979 under a Joint Powers Authority agreement between the City of Monterey, the City of Pacific Grove and the Seaside County Sanitation District. M1W currently operates the regional wastewater treatment plant, including a water recycling facility (collectively, known as the Regional Treatment Plant or RTP), a non-potable water distribution system known as the Castroville Seawater Intrusion Project (CSIP), sewage collection pipelines, and wastewater pump stations. M1W's RTP is located two miles north of the City of Marina, on the south side of the Salinas River, and has a permitted capacity to treat 29.6 mgd of wastewater effluent. At the RTP, water is treated to meet Title 22 California Code of Regulations (CCR) Standards (tertiary filtration and disinfection) for unrestricted agricultural irrigation use, and the remainder is treated to meet secondary effluent water quality standards and the California Ocean Plan in M1W's National Pollutant Discharge Elimination System (NPDES) permit for ocean discharge. Commencing in 2019 with the startup and operation of the PWM/GWR Project, a portion of secondary effluent flows will be treated to Title 17 and Title 22 CCR at the AWPF for groundwater replenishment of the Seaside Groundwater Basin (Please refer to the below discussion for more detail on the PWM/GWR Project under construction).



Partners for Pure Water Solutions

Monterey One Water

Monterey Peninsula Water Management District

Prepared by Denise Duffy and Associates

Expanded Pure Water Monterey Project Overview Map

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May 2019

Seaside Groundwater Basin

The Seaside Groundwater Basin underlies an approximately 19- square-mile area underlying the Cities of Seaside, Sand City, and Del Rey Oaks, California State University Monterey Bay to the north, and open space overlying the former Fort Ord from the City of Seaside Boundary east to approximately Laguna Seca raceway, adjacent to Monterey Bay. A steep decline in groundwater elevation since 1995 in the northern coastal portion of the basin, where most of the groundwater production occurs, has coincided with increased extraction in that area after the State Water Resources Control Board required CalAm to reduce its Carmel River diversions, and instead maximize its pumping in the Seaside Groundwater Basin. Historical and persistent low groundwater elevations caused by pumping have led to concerns that seawater intrusion may threaten the Seaside Groundwater Basin's groundwater resources. In 2006, an adjudication process (CalAm v. City of Seaside et al., Case No. M66343) led to the issuance of a court decision that created the Seaside Groundwater Basin Watermaster (Watermaster). The Watermaster consists of nine representatives, one representative from each: CalAm, City of Seaside, Sand City, City of Monterey, City of Del Rey Oaks, MPWMD and Monterey County Water Resources Agency, and two representatives from landowner groups. The Watermaster has evaluated water levels in the basin and has determined that while seawater intrusion does not appear to be occurring at present, current water levels are lower than those required to protect against seawater intrusion. Water levels were found to be below sea level in both the Paso Robles (the shallower aquifer) and the Santa Margarita aquifers of the Seaside Groundwater Basin in 2012; therefore, it is recognized that recharge into both aquifers would be beneficial for protection against seawater intrusion.

State Orders to Reduce Carmel River Diversions

The 255-square-mile Carmel River Basin is bounded by the Santa Lucia Mountains to the south and the Sierra del Salinas to the north. The Carmel Valley aquifer, which underlies the alluvial portion of the Carmel River downstream of San Clemente Dam, is about six square-miles and is approximately 16 miles long. In the summer and fall, the alluvial aquifer is drawn down by CalAm and private pumpers. Historically, this combined pumping has resulted in dewatering of the lower six miles of the river for several months in most years and up to nine miles in dry and critically dry years.

In 1995, the State Water Resources Control Board issued Order No. WR 95-10, which found that CalAm was diverting more water from the Carmel River Basin than it was legally entitled to divert. The State Water Resources Control Board ordered CalAm, instead, to maximize diversions (to the extent feasible) from the Seaside Groundwater Basin and endeavor to secure a legal replacement supply. In addition, a subsequent Cease and Desist Order (SWRCB Order No. 2009-0060) issued in 2009 required CalAm to secure replacement water supplies for its Monterey District service area and reduce its Carmel River diversions to 3,376 AFY by the 2016-17 timeframe. In July 2016, the State Water Resources Control Board issued Order 2016-0016, amending the Cease and Desist Order by extending the time period for unauthorized withdrawals from the Carmel River through December 31, 2021.

CalAm, working with local agencies, has proposed construction and operation of a CalAm owned and operated desalination project (known as the Monterey Peninsula Water Supply Project or MPWSP)[4] to provide a part of the replacement water needed to comply with the Cease and Desist Order as amended and the Seaside Groundwater Basin Adjudication, in conjunction with the PWM/GWR Project. The California Public Utilities Commission, as the CEQA lead agency for the MPWSP, published the Final EIR/EIS in March 2018, and approved the MPWSP in September 2018.

Approved PWM/GWR Project Facilities and CEQA Documentation

Previously Approved Pure Water Monterey Groundwater Replenishment Project

On October 8, 2015, the Board of Directors of M1W approved the PWM/GWR Project as modified by the Alternative Monterey Pipeline and the Regional Urban Water Augmentation Project[5] (RUWAP) alignment for the product water conveyance system and certified the Final EIR (PWM/GWR EIR) (State Clearinghouse No. 2013051094). The stated primary objective of the PWM/GWR Project was to replenish the Seaside Groundwater Basin with 3,500 AFY of purified recycled water to replace a portion of CalAm's water supply as required by State Water Resources Control Board orders. The originally approved PWM/GWR Project included a 4 mgd capacity AWPF for treatment and production of purified recycled water that will be conveyed for injection into the Seaside Groundwater Basin using a series of shallow and deep injection wells. The injected water will then mix with the existing groundwater and be stored for urban use by CalAm, thus enabling a reduction in Carmel River system diversions by the same amount. CalAm will recover the groundwater at existing wells (indirect potable reuse). PWM/GWR Project product water conveyance facilities include ten miles of pipeline from the AWPF to injection wells in the Seaside Groundwater Basin.

Previously Approved Pure Water Monterey Groundwater Replenishment Project Expansion

On October 30, 2017, the Board of Directors of M1W approved modifications to the PWM/GWR Project to increase the operational capacity (peak or maximum product water flowrate) of the approved AWPF from 4.0 mgd to 5.0 mgd. This expanded capacity is achieved by using redundancies in the AWPF design and the purpose of the expansion is to enable delivery of 600 AFY of purified recycled water to Marina Coast Water District (MCWD) for urban landscape irrigation by MCWD customers. The additional recycled water delivery is a component of the approved RUWAP, an urban recycled water project developed by MCWD. The source water for the capacity expansion is entirely from contractual rights to the return of its municipal wastewater in addition to a portion of M1W's summer water allocation per the Amended and Restated Water Recycling Agreement. In April 2016 (amended in October 2017), M1W Board of Directors approved joint (shared) use of product water storage and conveyance facilities,

[4] CalAm submitted Application A.12-04-019 (*Application of CAW for Approval of the Monterey Peninsula Water Supply Project*) to the California Public Utilities Commission.

[5] The RUWAP is a recycled water project developed by MCWD in cooperation with M1W. RUWAP was originally developed to help MCWD meet the overall needs of its service area, delivering tertiary-treated and disinfected recycled water produced at the existing Salinas Valley Reclamation Plant ("SVRP") to urban users in the MCWD service area and former Fort Ord.

including Blackhorse Reservoir, with MCWD for the RUWAP and the PWM/GWR Projects (PWM/GWR EIR Addendum No. 3)[6].

Previously Approved PWM/GWR Project Overview

Figure 2 includes a map of the previously approved PWM/GWR Project. The previously approved PWM/GWR Project components identified above include[7]:

Source Water Diversion and Storage Sites

These facilities include source water diversion, conveyance, and storage facilities at Blanco Drain, Reclamation Ditch, the Salinas Pump Station, Salinas Industrial Wastewater Treatment Facility (SIWTF) and associated conveyance system. The PWM/GWR project also includes diversion structures and pipelines that have not been funded or constructed, including at the western edge of Lake El Estero and at Tembladero Slough.[8] The approved and funded facilities under construction will enable new source waters to be diverted into the existing municipal wastewater collection system and to the RTP to supplement the existing incoming wastewater flows.

Treatment Facilities at the Regional Treatment Plant

These include the AWPF and pump station facilities at the RTP that provide treatment and production of purified recycled water. The AWPF will include a state-of-the-art treatment system that uses multiple membrane barriers to purify the water, product water stabilization to prevent pipe corrosion due to water purity, a pump station, and a brine and wastewater mixing facility. The water treated by the AWPF will meet or exceed federal and state drinking water standards, including those set forth in Titles 17 and 22. The approved PWM/GWR Project also includes modifications to the Salinas Valley Reclamation Plant to improve delivery of recycled water to agricultural users, although this component has not been funded.

Product Water Conveyance

These facilities include the Product Water Conveyance Pipeline and Blackhorse Reservoir shared by the PWM/GWR and RUWAP projects and appurtenant facilities to transport the purified recycled water from the AWPF to the Seaside Groundwater Basin for injection.

Injection Well Facilities

The injection facilities include new wells (eight in total, four in the shallow and four in the deep aquifers), back-flush facilities, pipelines, electricity/power distribution facilities, and electrical/motor control buildings.

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[6] Note: the combined RUWAP-PWM conveyance system, also termed the Shared Product Water Conveyance Facilities, was also approved by MCWD in March 2016 (RUWAP Addendum No. 3).

[7] Source: Resolution October 2015, Monterey Regional Water Pollution Control Agency Board (now M1W) as modified by October 2017 Approvals (including Addendum No 3 to the PWM EIR and Addendum No. 3 to the RUWAP EIR).

[8] The Tembladero Slough diversion is no longer being pursued as part of the PWM/GWR Project due conditions imposed by the State Water Resources Control Board in water rights permits for the Blanco Drain and the Reclamation Ditch source water diversions.

CalAm Distribution System

CalAm distribution facilities necessary for water delivery from the Seaside Groundwater Basin and CalAm water distribution system improvements (Monterey Pipeline and Hilby Pump Station) to deliver the extracted groundwater to CalAm customers.

As approved, the PWM/GWR Project will provide the following benefits when it is fully operational:

Replenishment of the Seaside Groundwater Basin

The PWM/GWR Project will replenish the Seaside Groundwater Basin with 3,500 AFY of purified recycled water to replace a portion of CalAm's water supply as required by state orders, including State Regional Water Resources Control Board (State Water Board) Order WR 2009-0060, as amended by Order WR 2016-0016. This will enable CalAm to reduce its diversions from the Carmel River system by up to 3,500 AFY by injecting the same amount of purified recycled water into the Seaside Groundwater Basin. The PWM/GWR Project also includes a drought reserve program that provides a total of 200 AFY (up to 1,000 AF total) of water to the Seaside Groundwater Basin.[9]

Additional Recycled Water for Agricultural Irrigation in Northern Salinas Valley

The approved PWM/GWR Project included diverting and using additional new source waters and improving the existing water recycling facility at the RTP (the Salinas Valley Reclamation Plant) to produce additional recycled water for use in the CSIP's agricultural irrigation system. It is anticipated that in normal and wet years, thousands of acre-feet of additional recycled water supply could be created for agricultural irrigation purposes.

Existing Environmental Compliance and Permits

The PWM/GWR Project has undergone substantial environmental review and regulatory compliance. Key environmental review documents and permitting approvals include the following:

- The certified PWM/GWR Project EIR prepared to support project approvals and meet the requirements of the Clean Water State Revolving Fund loan program that is partially funded through the U.S. Environmental Protection Agency (certified October 8, 2015; available at: www.purewatermonterey.org) and Addenda by responsible agencies, and by M1W, the lead agency. Addendum No. 1 (2016) and Addendum No. 2 (2017) to the PWM/GWR EIR were approved by the MPWMD (related to the Monterey Pipeline and Hilby Pump Station) and Addendum No. 3 to the PWM/GWR EIR was approved by the M1W in October 2017 (related to Shared Conveyance Facilities and Increased Capacity at the AWPF).

[9] The Expanded PWM/GWR Project will not change either of the two groundwater banking programs (drought reserve and operational reserve) that are part of the approved PWM/GWR Project. The drought reserve would build a water storage account of up to 1,000 acre-feet (AF) of water in the Seaside Basin during normal and wet years. The extra recharge during normal and wet years would be offset by an increase in CSIP deliveries and a corresponding decrease in Seaside Groundwater Basin injection by up to 1,000 AFY during dry years, during which CalAm will continue to pump 3,500 AFY by using some of the drought reserve account. .

- Letter of concurrence from the State Historic Preservation Office completing the NHPA Section 106 process (April 19, 2016);
- U.S. Fish and Wildlife Service Biological Opinion for compliance with Endangered Species Act (ESA) Section 7 Consultation (December 20, 2016);
- Letter of concurrence from the National Oceanic and Atmospheric Administration National Marine Fisheries Service (December 5, 2016);
- Clean Water Section 404 Authorization to Fill Waters of the U.S. from the U.S. Army Corps of Engineers for the Blanco Drain and Reclamation Ditch Diversions (Source Waters components) (January 18, 2017);
- Clean Water Section 401 Water Quality Certification from the SWRCB for the Blanco Drain and Reclamation Ditch Diversions (March 30, 2017);
- California Fish and Game Code Section 1602 Lake and Streambed Alteration Agreement for the Blanco Drain and Reclamation Ditch Diversions (June 8, 2017);
- SWRCB Water Rights Permits 21376 and 21377 for the diversion of surface waters from Blanco Drain and Reclamation Ditch (March 17, 2017);
- Clean Water State Revolving Fund (CWSRF) CEQA findings and a Notice of Determination (January 2017);
- State Lands Commission, Land Lease Approval (April 2017);
- U.S. Bureau of Reclamation, Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) Pure Water Monterey Groundwater Replenishment Project (June 20, 2017);
- National Pollutant Discharge Elimination System Permit / Waste Discharge Requirements Reissuance for the Monterey One Water Regional Wastewater Treatment Plant and Advanced Water Purification Facility Discharge to the Pacific Ocean (December 6, 2018); and
- National Oceanic and Atmospheric Administration, Monterey Bay National Marine Sanctuary, EA and FONSI for the Authorization of the National Pollutant Discharge Elimination System Permit for the Monterey One Water Regional Wastewater Treatment Plant and Advanced Water Purification Facility (April 1, 2019).

In addition, private and local agency permits and approvals (including easements, right of entry agreements, land lease/sales, and encroachment permits), have been secured for the PWM/GWR Project. Entities include: CalAm, Cities of Seaside, Marina, Salinas; Fort Ord Reuse Authority; Marina Coast Water District; Monterey Bay Air Resources Board; Monterey County Health Department; Environmental Health Division; Monterey County Resource Management Agency; Monterey County Water Resources Agency; Monterey Peninsula Water Management

District;[10] Monterey Peninsula Airport District/Airport Land Use Commission; Monterey Regional Waste Management District; Pacific Gas and Electric; Seaside Groundwater Basin Watermaster; and local landowners.

Expanded PWM/GWR Project Description

Environmental documentation previously completed divided the PWM/GWR Project into the following components, as described in this document: Source Water Diversion and Storage Sites, Treatment Facilities at the Regional Treatment Plant, Product Water Conveyance, Injection Well Facilities, and CalAm Distribution System. To increase the amount of water available to CalAm under the Expanded PWM/GWR Project, several changes to these PWM/GWR Project Components would be required. See **Figure 3**. The following describes the proposed changes under this Expanded PWM/GWR Project:

Changes to Source Water Diversion and Storage Sites

No new source water diversion and storage sites are necessary to achieve the Expanded PWM/GWR Project's recycled water yield objective of an additional 2,250 AFY of replacement supplies. The Expanded PWM/GWR Project is designed to utilize existing M1W contractual rights to source waters and wastewaters.

However, one or more future urban storm water to sanitary sewer diversions (such as planned sanitary sewer diversion projects in Seaside and Monterey) may provide additional source water for the Expanded PWM/GWR Project. These additional source waters would not increase the Expanded PWM/GWR Project yield above 2,250 AFY. Rather, these additional source waters, if they come to fruition, would provide greater supply reliability for the Expanded PWM/GWR Project.

- The City of Seaside's proposed 90-inch Storm Water Diversion and Trash Capture Project would involve the installation and operation of a diversion structure on the 90-inch storm drain to divert dry weather and wet weather flows to hydrodynamic separators designed to remove sediment and debris from the water prior to diversion to the sanitary sewer. .
- Additional urban storm water to sanitary sewer diversion projects have been described in the Monterey Peninsula Water Recovery Study (see Appendix D of http://montereysea.org/stormwater-resource-plan/). The diversion project (the "diversion to sanitary sewer" portion) that was the top-ranked project from that study would be located near Hartnell Gulch.

Changes to Treatment Facilities at the Regional Treatment Plant

Modifications to the Advanced Water Purification Facility. The design and physical features of the AWPF currently under construction (the PWM/GWR Project as approved) allow operation of the AWPF at a peak capacity of 5.0 mgd. Expanding the AWPF to produce up to 7.6 mgd will require installation of additional treatment and pumping equipment, chemical storage, pipelines

[10] MPWMD approved the Hilby Pump Station and changes to the Monterey Pipeline through the required Water Distribution System permit, using the PWM/GWR EIR and Addenda No. 1 and 2.

and facility appurtenances within the 3.5-acre existing building area. The AWPF would be designed to produce a seasonal peak of 7.6 mgd.

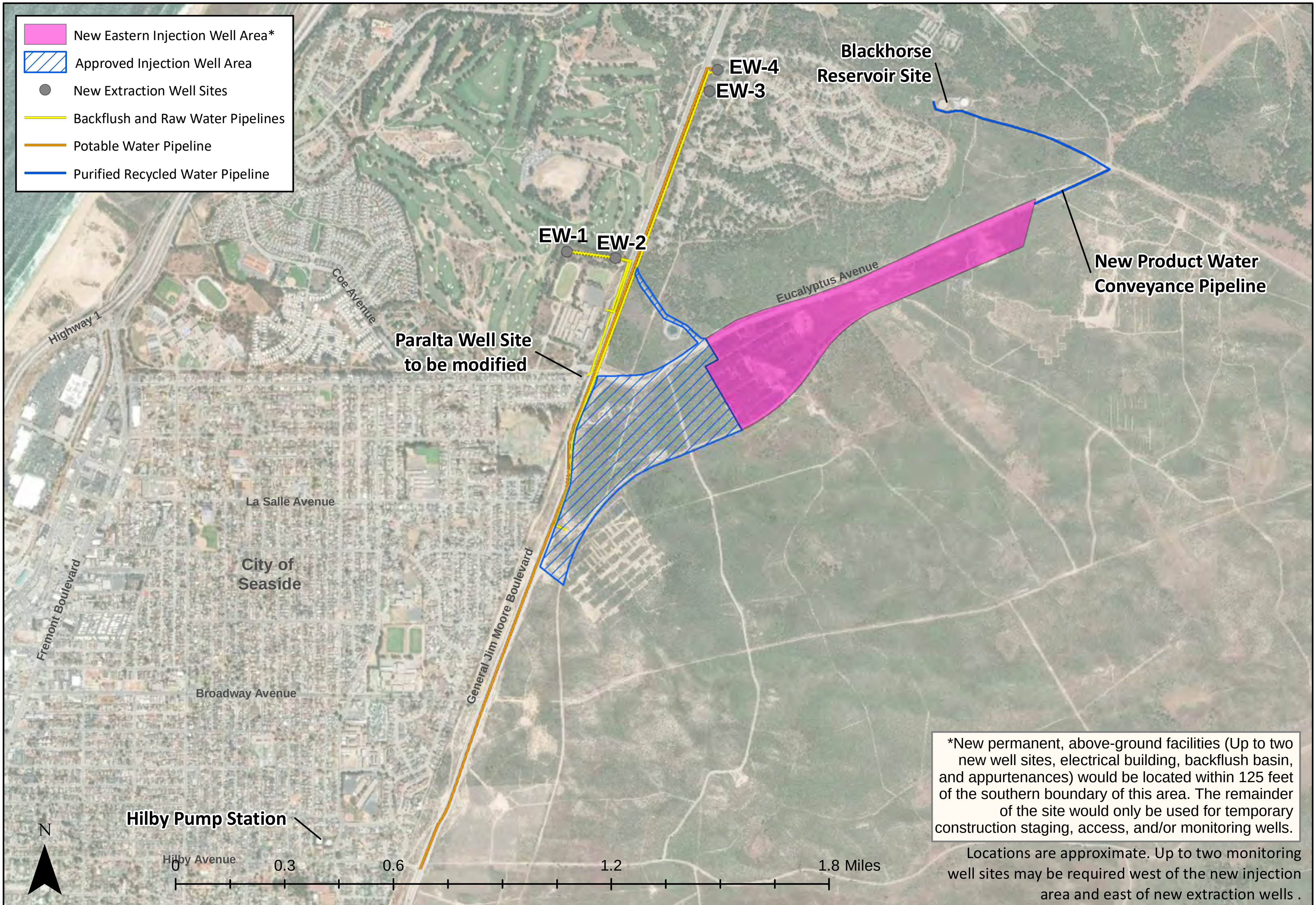
Changes to Product Water Conveyance
The Expanded PWM/GWR Project would require an additional Product Water Conveyance pipeline and, potentially, an additional booster pump station. To serve new injection well sites, the Expanded PWM/GWR Project would require the addition of up to 2 miles of 16-inch diameter pipeline and appurtenances. The pipeline would be located within existing unpaved and paved roads from the Marina Coast Water District's Blackhorse Reservoir to a new injection well site located in the area on the south side of Eucalyptus Road near the eastern boundary of the City of Seaside. See **Figure 4** for the location of this new purified recycled water pipeline that would carry water from the Blackhorse Reserve to the new eastern injection well facilities area.

In addition, a new booster pump station may be required to accommodate the additional water produced by the AWPF. Due to friction losses in the conveyance pipeline, the conveyance system may not have enough energy to enable adequate injection of purified recycled water at certain well sites (for example those at the highest elevations) without additional pumping. Therefore, a small booster pump station may be required to boost the flows to one or more potential injection well sites within the original injection well facilities area. If needed, this pump station would be within the boundaries of the previously approved injection well facilities construction areas.

Changes to Injection Well Facilities
Modifications to Injection Well Facilities. The approved PWM/GWR Project includes subsurface groundwater recharge facilities, including shallow (or vadose zone) and deep injection wells located within the Seaside Groundwater Basin in the area shown on **Figure 2**, the Approved Injection Well Facilities Area. The existing vadose zone wells inject water into the unsaturated soils overlying the uppermost aquifer (the unconfined Paso Robles Aquifer), and the deeper wells inject into the confined Santa Margarita Aquifer. Final project design and project permitting have resulted in minor modifications to the layout of the Injection Well Facilities site and have provided information to the team to refine the locations of the remaining two (2) deep wells originally planned. The PWM/GWR Project EIR evaluated four clusters of injection well facilities, each with one deep injection well and one shallow injection well. For an Expanded PWM/GWR Project, M1W would construct the remaining two (2) of the four (4) planned deep injection wells. However, for the Expanded PWM/GWR Project one of those planned deep injection well sites would be relocated farther to the northeast to the new Eastern Injection Well Area, and one additional new deep injection well would be constructed in the new Eastern Injection Well Area. No new vadose zone wells are proposed compared to the approved PWM/GWR Project that included four (4) new vadose zone wells. With the expansion, the total number of injection wells (8) will be no more than with the Approved PWM/GWR Project.[11] Each well would be equipped with associated backwash pumps and appurtenances. Under the approved PWM/GWR Project,

[11] The Approved PWM/GWR Project included analysis of eight (8) total injection wells: four (4) shallow and four (4) deep. The Expanded PWM/GWR Project may require eight (8) total injection wells with up to five (5) deep injection wells and up to three (3) shallow injection wells.

monitoring wells were proposed to be installed between the new deep injection well site and nearest downgradient extraction well. Although the locations of these monitoring wells are not shown on **Figure 3** and **Figure 4**, they would be located in the area between General Jim Moore Boulevard and the eastern injection wellfield area shown. This location would be different from the location for the monitoring wells under the approved PWM/GWR Project. A new electrical building and percolation basin for backwash water disposal (percolation into the vadose zone) would be included at a central location within the eastern Injection Well Facilities Area. The Expanded PWM/GWR Project would potentially include increasing the capacity of the approved percolation basin.



Partners for Pure Water Solutions

Monterey One Water

Monterey Peninsula Water Management District

Prepared by Denise Duffy and Associates

Expanded Pure Water Monterey Project
Injection and Extraction Facilities Map

4

May 2019

Changes to CalAm Distribution System

Extraction Wells. For CalAm to utilize the additional purified recycled water produced by the Expanded PWM/GWR Project, additional potable water extraction wells, wellhead treatment and pipelines would be required.[12] See **Figure 4** for proposed locations of the new CalAm facilities. To reliably meet the proposed yield of the Expanded PWM/GWR Project, CalAm would construct and operate two (2) new extraction wells, plus two additional extraction wells to provide system redundancy/back-up. Collectively these new extraction wells are identified as Extraction Wells 1 through 4. Extraction Wells 1 and 2 would be located just north of Seaside Middle School. The Blackhorse Golf Course is located to the north and west of Extraction Well sites 1 and 2. Extraction Wells 3 and 4 would be located just to the east of General Jim Moore Boulevard, near the southeast corner of the intersection of General Jim Moore Boulevard and Ardennes Circle on U.S. Army-owned property in the Fitch Park neighborhood of the Ord Military Community. Extraction Wells 3 and 4 would be designed consistent with the Aquifer Storage and Recover (ASR) Wells 5 and 6 as analyzed in previous environmental documentation prepared for the MPWSP; however, these wells would only include the capability to extract and treat groundwater, and would not include any above-ground facilities needed to enable injection. Extraction Wells 3 and 4 would be constructed to provide additional system extraction redundancy only. Each extraction well would include a well pump and motor, chlorination dosing equipment, and associated electrical equipment, which would be contained on an approximately 100 square foot concrete pad. CalAm may elect to install emergency generators at one or more extraction well sites, depending upon their need for system reliability. No new extraction wells were proposed or approved as part of the PWM/GWR Project, thus these extraction wells were not included in the construction areas of the PWM/GWR Project approved on October 8, 2015.

Potable and Raw Water Pipelines. In addition, for the Expanded PWM/GWR Project CalAm would construct and operate new potable and raw water pipelines to convey the water from the new extraction wells to treatment facilities (including new wellhead chlorination system at the existing CalAm Paralta Well) and to the existing CalAm distribution system. An up to 36-inch pipeline that would be up to approximately 2 ½ miles in length would be installed in the General Jim Moore Boulevard right of way. The pipeline would begin at Extraction Well 4 (the northern most extraction well) and connect to the existing ASR pipe network at ASR Wells 1 and 2 (Santa Margarita site). From that point, water would be distributed to CalAm customers throughout the region. This new potable water pipeline was not included in the approved PWM/GWR Project.

Potential Environmental Impacts

M1W, as the CEQA Lead Agency, proposes to prepare a focused Supplemental EIR to support the approval of changes to the PWM/GWR Project. The Supplemental EIR on the Expanded PWM/GWR Project will evaluate potential environmental effects associated with construction, operation, and maintenance activities. When M1W decides whether to approve the changes to the project, the M1W Board must consider the previous EIR as revised by the Supplemental EIR.

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[12] The approved PWM/GWR Project assumed extraction would occur using existing potable wells, disinfection treatment processes, and distribution systems (after the injected water meets regulatory-required residence time with groundwater in the Seaside Basin).

Therefore, the M1W Board will ultimately consider the Supplemental EIR in combination with the previous PWM/GWR EIR, which was certified in October 2015, and the adopted Addenda (refer to Approved PWM/GWR Project Facilities and CEQA Documentation, above).

The Supplemental EIR is intended to serve as a supplement to the previously adopted 2015 Final EIR, impacts and conditions presented in the previous EIR will serve as the primary base of comparison for the analysis. Elements of the prior analysis that are unchanged will not be repeated in the Supplemental EIR.

The Supplemental EIR for the Expanded PWM/GWR Project will assess the following issues of potential environmental effects focusing only on the revised project components as discussed above:

Aesthetics Resources

Expanded project facilities would predominantly be underground or located on existing water and wastewater facility sites. Those facilities that are not located on existing water and wastewater facility sites would be designed to visually blend into the environment through use of vegetative screening and/or appropriate materials and colors. The Supplemental EIR will evaluate visual/aesthetic impacts related to the Expanded PWM/GWR Project's limited above-ground facilities, including visual character, scenic vistas, and new sources of light and glare.

Agricultural and Forest Resources

There are no agricultural for forest resources within the Expanded PWM/GWR Project sites where components would be constructed. The evaluation of agricultural and forest resources as addressed in the 2015 Final EIR will not be updated in the Supplemental EIR.

Air Quality and Greenhouse Gas Emissions

The project site is located within the Monterey Bay Air Resources District (formerly the Monterey Bay Unified Air Pollution Control District). Construction of the expanded facilities would generate emissions from construction equipment exhaust, earth movement, construction workers' commutes, and material hauling. Operation of pump stations, wells, and treatment facilities would require use of electricity, which would generate greenhouse gas emissions. The Supplemental EIR will evaluate construction- and operation-related emissions of criteria air pollutants and greenhouse gas emissions from these expanded facilities and expanded operations.

Biological Resources

The Supplemental EIR will evaluate potential impacts of the expanded project facilities on terrestrial special-status animal and plant species, sensitive habitats, mature native trees, and migratory birds that may occur in the Expanded PWM/GWR Project area. The Supplemental EIR will also address potential impacts to marine resources from the expanded project and compliance with the California Ocean Plan water quality objectives.

Cultural Resources

Construction of new expanded facilities both above and below-ground could encounter previously unknown archaeological or paleontological resources during ground disturbance and excavation. The Supplemental EIR will assess if there are any potential effects of the Expanded PWM/GWR Project on cultural resources, including archaeological, paleontological, and Native American resources, and Tribal cultural resources.

Geology, Soils, and Seismicity

Construction and operation of the Expanded PWM/GWR Project will occur in a seismically active region. The Supplemental EIR will focus on new or expanded areas of ground-disturbing activities, soils and seismic hazards, and potential for soil erosion from the expanded facilities.

Hazards and Hazardous Materials

Construction of the Expanded PWM/GWR Project facilities would require excavation of the existing ground surface, which could uncover contaminated soils or hazardous substances that pose a substantial hazard to human health or the environment. The Supplemental EIR will focus evaluation on the potential for hazardous materials to be encountered during construction of the expanded facilities. The analysis will also consider the proper handling, storage, and use of hazardous chemicals that may be used during construction and operation of the expanded facilities.

Hydrology and Water Quality

Through the use of groundwater modeling and hydrogeologic analyses, the Supplemental EIR will evaluate changes in local groundwater quality, storage, and levels within the groundwater basins as a whole and their subbasins, as appropriate. The Supplemental EIR will describe the recharge, storage, and recovery capacities of the Seaside Groundwater Basin and describe potential impacts of recharge and extraction activities at the Expanded PWM/GWR Project locations. Potential effects on the seawater/freshwater interface (i.e., seawater intrusion) will also be evaluated. The Expanded PWM/GWR Project would be designed to comply with California Department of Public Health and Regional Water Quality Control Board standards and requirements to protect public health and water quality.

Construction and operation of the Expanded PWM/GWR Project could affect surface water quality and hydrologic systems/processes in the construction areas. Potential impacts to be evaluated include alteration of drainage patterns and increase in stormwater flows due to increase in the amount of impervious surfaces, and degradation of surface water quality as a result of erosion and sedimentation, hazardous materials release during construction, and construction dewatering discharges. The Expanded PWM/GWR Project would be designed to comply with standard construction and operational requirements, the California Ocean Plan, and permits under the National Pollutant Discharge Elimination System and Waste Discharge Requirements.

Land Use Planning

Implementation of the Expanded PWM/GWR Project includes construction and operation of new facilities and water supply infrastructure within the same planning jurisdictions as evaluated in the PWM/GWR EIR. The Supplemental EIR will focus on the proposed expanded facilities and determinations of consistency with established plans, policies, and regulations, as well as compatibility with the existing and future land use patterns in the area, including adjacent land uses. Because most conveyance facilities will be underground, and because the proposed treatment facilities would be located at the existing AWPF site at the M1W Regional Treatment Plant, significant effects on land use patterns are not anticipated.

Mineral Resources

The PWM/GWR EIR addressed local mineral resources; the evaluation of these resources as addressed in the 2015 Final EIR will not need to be updated in the Supplemental EIR.

Noise and Vibration

Implementation of the Expanded PWM/GWR Project would require construction and operation of expanded facilities that would potentially generate additional noise and vibration. The Supplemental EIR will focus on the potential noise sources and evaluate the proximity of sensitive receptors to the Expanded PWM/GWR Project components to assess whether the facilities would comply with local noise policies and ordinances.

Population and Housing

Implementation of the Expanded PWM/GWR Project would enhance the reliability of the water supply within the Monterey Peninsula area. The project would provide replacement water rather than new water to serve growth. The Supplemental EIR will identify current population and employment projections and identify local planning jurisdictions with the authority to approve growth and mitigate secondary effects of growth.

Public Services and Recreation

Implementation of the Expanded PWM/GWR Project would be unlikely to affect demand for public services, or to require new or expanded facilities for public service providers. The 2015 EIR previously assessed the potential for impacts on police and fire protection services, schools, parks and recreational facilities. This evaluation will not need to be updated in the Supplemental EIR.

Water Supply and Wastewater Systems

Implementation of the Expanded PWM/GWR Project would enhance the reliability of the water supply within the Monterey Peninsula area. The Supplemental EIR will address the Expanded PWM/GWR Project’s effect on water supplies. Implementation of the Expanded PWM/GWR Project is not expected to have a new adverse impact related to wastewater treatment facilities.

Transportation and Traffic

The Supplemental EIR will generally describe the types of construction activities that would be generated by the Expanded PWM/GWR Project focusing on temporary increases in traffic volumes along local and regional roadways from construction of expanded facilities.

Utilities, Service Systems, and Energy

Implementation of the Expanded PWM/GWR Project would result in increased use of pump stations, extraction wells, conveyance and treatment facilities, which would increase the amount of electricity use required locally to achieve regional water supply goals. The Supplemental EIR will evaluate energy consumption from the expanded facilities and compare the proposed energy use with energy demands in the 2015 EIR.

Cumulative and Growth Inducing Impacts

The Supplemental EIR also will evaluate potential growth-inducing impacts that could result from implementation of the Expanded PWM/GWR Project. The Supplemental EIR will address whether the Expanded PWM/GWR Project would have impacts that are individually limited, but cumulatively considerable when combined with the impacts of other past, present and reasonably foreseeable future projects (i.e., cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects).

Public Comment Letters

Appendix A- Summary of Written Comments Received on the Notice of Preparation Note: See attached comment letters		
Date	Commenter	Summary of Comment
6/14/2019	Department of the Army	Acknowledges that portions of the Project are proposed on Army owned Property, and the proposed project is a contingency plan to the proposed MPWSP and CalAm's desalination project.
6/13/2019	California State University, Monterey Bay	Requests that the SEIR analyze and include all appropriate mitigations for hydrology, water quality impacts, pipeline operations, and pipeline capacity/health and safety
6/14/2019	City of Seaside	The City of Seaside requests that the SEIR consider the following: • Placement of well injection facilities should be limited to 125-foot buffer zone parallel to the BLM lands to the east and development opportunity lands within the City of Seaside lands to the west. • Transfer of lands belonging to FORA to City of Seaside. • Pure One Water shall coordinate with City of Seaside for the relocation or modification of monitor wells that may be located within areas of future development. • Pure One Water shall coordinate with the City of Seaside Public Works Department on compliance with the ordinance policies related to digging and excavation activity • Pure One Water shall be required to adhere to best management practices to place dirt removal tracking devices at entrances to the public right-of-way. • All new driveways shall receive an encroachment permit from the City of Seaside Public Works Department. • Notify the City Manager of Seaside of all meetings/hearings
6/15/2019	Fort Ord Community Advisory Group (FOCAG)	Expresses concern about the location of the proposed project and proposed injection wells due to findings of lead, antimony and copper.
6/14/2019	Monterey County – Resource Management Agency	RMA-Public Works - no comments. The Monterey County Agricultural Commissioner's office requests for the following questions to be addressed in the SEIR: 1. What is the risk to pipes breaking and causing flooding in the neighboring agricultural land?

		2. What processes will be put in place to prevent flooding from a broken pipe?
6/7/2019	Monterey County Water Resources Agency	MCWRA recommends that a thorough water balance analysis occur to support the project recommendations for expansion of the PWM facilities and a water quality analysis of the agricultural wash water as a new water source.
6/15/2019	Seaside Basin Watermaster	Hydrometrics, LLC performed groundwater modeling for the Watermaster showing that injection of water nearer the coast provides greater benefit to the Seaside Basin. Therefore, the Watermaster requests that installation of injection wells for the Project nearer the coast be evaluated and given serious consideration within the scope of the environmental document.
5/23/2019	California Department of Transportation (Caltrans)	Supports local development that is consistent with State planning priorities intended to promote equity, strengthen the economy, protect the environment and promote public health. Reminds that any work completed in the State's right-of-way will require an encroachment permit from Caltrans; requests early consultation for any proposed underground alignments that will ultimately encroach the State right-of-way.
6/12/2019	Native American Heritage Commission	Requests compliance with Assembly Bill 52(AB 52), Senate Bill 18 (SB 18) and any other applicable laws for tribal consultation.
5/29/2019	State Water Resources Control Board	Requests a copy of the SEIR and notice of hearings or meetings regarding environmental review for the Project. Additionally, SWRCB requests environmental documentation and review, included in the environmental application package for Clean Water State Revolving Fund.
5/23-6/8-2019	Various Monterey Peninsula Residents	Concerned that recycled agriculture water may be harmful to human life; requests proof that the Project is environmentally and economically superior to CalAm's Desal Project.
7/2/2019	California Coastal Commission	Project components that would be located within the Coastal Zone will require a Coastal Development Permit (CDP) and would be subject to policies in the certified Local Coastal Programs (LCPs) of each local jurisdiction and/or Chapter 3 of the California Coastal Act. Given the different jurisdictional boundaries, Commission staff suggests that the Cities of Seaside and Monterey, and Monterey County, consider requesting a consolidated CDP process pursuant to Coastal Act Section 30601.3. Further, the project will trigger federal consistency requirements and therefore the Commission would be responsible for reviewing the project for federal consistency purposes, including potentially components both in and outside of the Coastal Zone. In addition: • The supplemental EIR should analyses for the potential of changes in ocean discharge, as well as address potential impacts to marine resources as

	necessary, and should include a consistence analysis with the Ocean Plan. • The supplemental EIR should use the most recent available information regarding sea level rise projections to evaluate potential effects on all project components. • The supplemental EIR should provide a project-specific assessment of the latest sea level rise projections and coastal erosion rates, and the way in which these and other coastal hazards interact in relation to the potential of inundation or saltwater intrusion of the Seaside Groundwater Basin. • Analyses for a public infrastructure project should cover a period of 50-75 years, with sea level rise and coastal hazards analyses covering a 100-year period.

Summary of Public Comments during the Scoping Meeting (June 5, 2019)	
Commenter	**Summary of Comment**
George Riley	Asked about comparative timing, environmental impacts and costs of the desalination project compared to the Proposed Expansion. Presented speaker's understanding of the cost of the project and noted it is a backup to CalAm's MPWSP desalination project.
Susan Schiavone,	Expressed support and opinion of the project; noted the Proposed Expansion conforms with the new guidelines from the State Water Resources Control Board (SWRCB) promoting recycled water.
Peter Mounteer	Asked if the EIR should address the development of this project in relation to the timeline with the desal plant. Asked "at what point do you decide to go forward with this and not the desal plant?" Asked about the water purchase agreement. Asked if these proposed modifications go forward and the desal plant moves forward, how is the water purchase agreement impacted and who buys that water when the desal plant gets built. Asked how much water this makes available in the future if we do move forward.
Unidentified Speaker	Asked about whether the project would occur within land under the jurisdiction of the Bureau of Land Management and in areas that have not been disturbed. Asked for the Supplemental EIR to evaluate biological mitigation.
Jan Shriner	Asked whether the Supplemental EIR will evaluate energy consumption from the expanded facilities and compare the proposed energy use with energy demands in the 2015 PWM/GWR EIR. Also asked if the document would include an evaluation of the carbon footprint/carbon emissions of the expansion. Asked if the analysis would compare impacts of carbon emissions against the MPWSP. Commenter also expressed agreement with comment on SWRCB conformance noted above.
Melodie Chrislock	Asked if the source water for the expansion is secure.
Unidentified Speaker	Asked if winter storage is needed.

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS, US ARMY GARRISON, PRESIDIO OF MONTEREY
1759 LEWIS ROAD, SUITE 210
MONTEREY, CA 93944-3223

Office of the Garrison Commander

JUN 1 4 2019

Monterey One Water
Attn: Rachel Gaudoin
5 Harris Court, Building D
Monterey, CA 93940

Dear Ms. Gaudoin,

The United States Army (Army) appreciates the opportunity to submit comments on the Notice of Preparation (NOP) for Monterey One Water's (M1W's) Expanded Pure Water Monterey Groundwater Replenishment Project (Expanded PWM/GWR Project) Supplemental Environmental Impact Report (SEIR).

The proposed project would reduce discharges of secondary effluent to the Monterey Bay and replenish the Seaside Groundwater Basin with approximately 2,250 AFY of additional purified recycled water. Portions of the Expanded PWM/GWR Project are proposed on Army owed property. These elements include Extraction Wells 3 and 4 located within the Fitch Park neighborhood of the Ord Military Community, plus backflush/raw water and potable water pipelines along General Jim Moore Boulevard. The Army understands the Expanded PWM/GWR Project is a "back-up or contingency plan" to the proposed Monterey Peninsula Water Supply Project (MPWSP), CalAm's planned 6.4 million gallons per day desalination project.

Please consider our comments when developing the scope of work for this SEIR. The POC for this letter is Ms. Joelle Lobo at 831-242-7829 or joelle.l.lobo.civ@mail.mil.

Sincerely,

Gregory J. Ford
Colonel, US Army
Commanding

1. *Changes to Source Water Diversion and Storage Sites; page 13:*

The Army is currently studying environmentally beneficial alternatives to manage and reduce the volume of stormwater being discharged into the Monterey Bay. One opportunity involves the Army owned stormwater outfall that currently discharges onto the beach at Fort Ord Dunes State Park. This option could potentially provide for the reuse of stormwater as a source for the Expanded PWM/GWR Project and therefore should be considered in this SEIR.

2. *Changes to the CalAm Distribution System, page 17:*

The Expanded PWM/GWR Project proposes to install extraction wells and water pipelines on Army owned property. The proposed use of Army property requires coordination and approval via compliance with the National Environmental Policy Act (NEPA) and issuance of a real estate outgrant for access to the land.

Although Aquifer Storage and Recover (ASR) Wells were analyzed in previous environmental documentation prepared for the Monterey Peninsula Water Supply Project (MPWSP), the Expanded PWM/GWR Project proposed wells and pipeline require separate review pursuant to NEPA of 1969, 42 United States Code (U.S.C.) Section 4321 et seq.; the Council on Environmental Quality regulations for implementing NEPA, 40 Code of Federal Regulations (CFR) Parts 1500–1508; and Environmental Analysis of Army Actions, 32 CFR 651 (March 2002). Recommend that if multiple Federal agencies are involved the Expanded PWM/GWR Project undergo a consolidated review under NEPA.

DEPARTMENT OF TRANSPORTATION
CALTRANS DISTRICT 5
50 HIGUERA STREET
SAN LUIS OBISPO, CA 93401-5415
PHONE (805) 549-3101
FAX (805) 549-3329
TTY 711
www.dot.ca.gov/dist05/

Making Conservation a California Way of Life.

May 23, 2019

MON-Var
SCH#2013051094

Rachel Gaudoin
Monterey One Water
5 Harris Court, Building D
Monterey, CA 93940

Dear Ms. Gaudoin:

COMMENTS FOR THE NOTICE OF PREPARATION (NOP) – EXPANDED PURE WATER MONTEREY GROUNDWATER REPLENISHMENT PLAN, MONTEREY COUNTY, CA

The California Department of Transportation (Caltrans), District 5, Development Review, has reviewed the Expanded Pure Water Monterey Groundwater Replenishment Plan which will expand the Pure Water Monterey Ground Water Project. Caltrans offers the following comments in response to the NOP:

1. Caltrans supports local development that is consistent with State planning priorities intended to promote equity, strengthen the economy, protect the environment, and promote public health and safety. We accomplish this by working with local jurisdictions to achieve a shared vision of how the transportation system should and can accommodate interregional and local travel and development. Projects that support smart growth principles which include improvements to pedestrian, bicycle, and transit infrastructure (or other key Transportation Demand Strategies) are supported by Caltrans and are consistent with our mission, vision, and goals.

2. Please be aware that if any work is completed in the State's right-of-way it will require an encroachment permit from Caltrans and must be done to our engineering and environmental standards, and at no cost to the State. The conditions of approval and the requirements for the encroachment permit are issued at the sole discretion of the Permits Office, and nothing in this letter shall be implied as limiting those future conditioned and requirements. For more information regarding the encroachment permit process, please visit our Encroachment Permit Website at: http://www.dot.ca.gov/trafficops/ep/index.html.

3. Caltrans requests early consultation for any proposed underground alignments that will ultimately encroach on State right-of-way. We want to concur with conceptual plans prior to applying for an encroachment permit.

Thank you for the opportunity to review and comment on the proposed project. If you have any questions, or need further clarification on items discussed above, please contact me at (805) 549-3157 or email christopher.bjornstad@dot.ca.gov.

Sincerely,

Chris Bjornstad

Chris Bjornstad
Transportation Planner
District 5 Development Review

NATIVE AMERICAN HERITAGE COMMISSION
Cultural and Environmental Department
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691 Phone (916) 373-3710
Email: nahc@nahc.ca.gov
Website: http://www.nahc.ca.gov
Twitter: @CA_NAHC

Received

JUN 12 2019

Monterey One Water
Administration

June 7, 2019

Rachel Gaudoin
Monterey One Water
5 Harris Court, Building D
Monterey, CA 93940

RE: SCH# 2013051094 Expanded Pure Water Monterey Groundwater Replenishment Project, Monterey County

Dear Ms. Gaudoin:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §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. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, §15064.5 (b) (CEQA Guidelines §15064.5 (b)). 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. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 5064 subd.(a)(1) (CEQA Guidelines §15064 (a)(1)). 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 within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that 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. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements.** 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 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with 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. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

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

AB 52

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

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: 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, to be accomplished by at least one written notice that includes:
    a. A brief description of the project.
    b. The lead agency contact information.
    c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).
    d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: 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. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1(b)).
    a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: 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. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: 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.
    d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: 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 §6254 (r) and §6254.10. Any information submitted by a California Native 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. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: 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 §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: 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. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §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 §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: 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 §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:
   a. Avoidance and preservation of the resources in place, including, but not limited to:
      I. Planning and construction to avoid the resources and protect the cultural and natural context.
      II. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
   b. 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:
      i. Protecting the cultural character and integrity of the resource.
      ii. Protecting the traditional use of the resource.
      iii. Protecting the confidentiality of the resource.
   c. 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.
   d. Protecting the resource. (Pub. Resource Code §21084.3 (b)).
   e. 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. (Civ. Code §815.3 (c)).
   f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: 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 §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §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.
   c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments 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. (Gov. Code §65352.3). 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

Some of SB 18's provisions include:

1. 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.** (Gov. Code §65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, 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 §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
   a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
   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. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. 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:
   a. If part or all of the APE has been previously surveyed for cultural resources.
   b. If any known cultural resources have already been recorded on or adjacent to the APE.
   c. If the probability is low, moderate, or high that cultural resources are located in the APE.
   d. If a survey is required to determine whether previously unrecorded cultural resources are present.

2. 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.
   a. 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.
   b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:
    a. 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.
    b. A Native American Tribal Consultation 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.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.
    a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). 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.
    b. 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.
    c. 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 §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be 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.

If you have any questions or need additional information, please contact me at my email address: Gayle.Totton@nahc.ca.gov.

Sincerely,

Nancy Gonzalez

for
Gayle Totton
Associate Governmental Program Analyst

cc: State Clearinghouse

MAY 2 9 2019

State Water Resources Control Board

Rachel Gaudoin
Monterey One Water
5 Harris Court, Building D
Monterey, CA 93940

Dear Ms. Gaudoin:

NOTICE OF PREPARATION (NOP) FOR MONTEREY ONE WATER (MOW); EXPANDED PURE WATER MONTEREY GROUNDWATER REPLENISHMENT (PROJECT); MONTEREY COUNTY; STATE CLEARINGHOUSE NO. 2013051094

We understand that MOW may be pursuing Clean Water State Revolving Fund (CWSRF) financing for this Project (CWSRF No. C-06-8432-110). As a funding agency and a state agency with jurisdiction by law to preserve, enhance, and restore the quality of California's water resources, the State Water Resources Control Board (State Water Board) is providing the following information on the preparation of the California Environmental Quality Act (CEQA) for the Project.

The State Water Board, Division of Financial Assistance, is responsible for administering the CWSRF Program. The primary purpose for the CWSRF Program is to implement the Clean Water Act and various state laws by providing financial assistance for wastewater treatment facilities necessary to prevent water pollution, recycle water, correct nonpoint source and storm drainage pollution problems, provide for estuary enhancement, and thereby protect and promote health, safety and welfare of the inhabitants of the state. The CWSRF Program provides low-interest funding equal to one-half of the most recent State General Obligation Bond Rates with a 30-year term. Applications are accepted and processed continuously. Please refer to the State Water Board's CWSRF website at:
www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/index.shtml.

The CWSRF Program is partially funded by the United States Environmental Protection Agency and requires additional "CEQA-Plus" environmental documentation and review. An enclosure is included that further explain the CWSRF Program environmental review process and the additional federal requirements. For the complete environmental application package please visit: http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/srf_forms.shtml. The State Water Board is required to consult directly with agencies responsible for implementing federal environmental laws and regulations. Any environmental issues raised by federal agencies or their representatives will need to be resolved prior to State Water Board approval of a CWSRF financing commitment for the proposed Project. For further information on the CWSRF Program, please contact Brian Cary at (916) 449-5624.

It is important to note that prior to a CWSRF financing commitment, projects are subject to provisions of the Federal Endangered Species Act (ESA), and must obtain Section 7 clearance from the United States Department of the Interior, Fish and Wildlife Service (USFWS), and/or the United States Department of Commerce National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) for any potential effects to special-status species.

Please be advised that the State Water Board will consult with the USFWS, and/or the NMFS regarding all federal special-status species that the Project has the potential to impact if the Project is to be financed by the CWSRF Program. MOW will need to identify whether the Project will involve any direct effects from construction activities, or indirect effects such as growth inducement, that may affect federally listed threatened, endangered, or candidate species that are known, or have a potential to occur in the Project site, in the surrounding areas, or in the service area, and to identify applicable conservation measures to reduce such effects.

In addition, CWSRF projects must comply with federal laws pertaining to cultural resources, specifically Section 106 of the National Historic Preservation Act (Section 106). The State Water Board has responsibility for ensuring compliance with Section 106 and the State Water Board must consult directly with the California State Historic Preservation Officer (SHPO). SHPO consultation is initiated when sufficient information is provided by the CWSRF applicant. MOW must retain a consultant that meets the Secretary of the Interior's Professional Qualifications Standards (http://www.nps.gov/history/local-law/arch_stnds_9.htm) to prepare a Section 106 compliance report.

Note that MOW will need to identify the Area of Potential Effects (APE), including construction and staging areas, and the depth of any excavation. The APE is three-dimensional and includes all areas that may be affected by the Project. The APE includes the surface area and extends below ground to the depth of any Project excavations. The records search request should extend to a ½-mile beyond project APE. The appropriate area varies for different projects but should be drawn large enough to provide information on what types of sites may exist in the vicinity.

Other federal environmental requirements pertinent to the Project under the CWSRF Program include the following (for a complete list of all environmental requirements please visit: http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/docs/forms/application_environmental_package.pdf):

A. An alternative analysis discussing environmental impacts of the project in either the CEQA document (Environmental Impact Report) or in a separate report.

B. A public hearing more meeting for adoption/certification of all projects except for those having little or no environmental impact.

C. Compliance with the Federal Clean Air Act: (a) Provide air quality studies that may have been done for the Project; and (b) if the Project is in a nonattainment area or attainment area subject to a maintenance plan; (i) provide a summary of the estimated emissions (in tons per year) that are expected from both the construction and operation of the Project for each federal criteria pollutant in a nonattainment or maintenance area, and indicate if the nonattainment designation is moderate, serious, or severe (if applicable); (ii) if emissions are above the federal de minimis levels, but the Project is sized to meet only the needs of current population projections that are used in the approved State Implementation Plan for air quality, quantitatively indicate how the proposed capacity increase was calculated using population projections.

D. Compliance with the Coastal Zone Management Act: Identify whether the Project is within a coastal zone and the status of any coordination with the California Coastal Commission.

E. Protection of Wetlands: Identify any portion of the proposed Project area that should be evaluated for wetlands or United States waters delineation by the United States Army Corps of Engineers (USACE), or requires a permit from the USACE, and identify the status of coordination with the USACE.

F. Compliance with the Farmland Protection Policy Act: Identify whether the Project will result in the conversion of farmland. State the status of farmland (Prime, Unique, or Local and Statewide Importance) in the Project area and determine if this area is under a Williamson Act Contract.

G. Compliance with the Migratory Bird Treaty Act: List any birds protected under this act that may be impacted by the Project and identify conservation measures to minimize impacts.

H. Compliance with the Flood Plain Management Act: Identify whether or not the Project is in a Flood Management Zone and include a copy of the Federal Emergency Management Agency flood zone maps for the area.

I. Compliance with the Wild and Scenic Rivers Act: Identify whether or not any Wild and Scenic Rivers would be potentially impacted by the Project and include conservation measures to minimize such impacts.

Following the preparation of the draft CEQA document for the Project, please provide us a copy of the document to review if MOW is considering CWSRF financing. In addition, we would appreciate notices of any hearings or meetings held regarding environmental review for the Project.

Thank you for the providing us a copy of your NOP, and the consideration of the CWSRF for the financing of MOW's Project. If you have any questions or concerns, please feel free to contact me at (916) 341-5686 or by email at Tessa.lenz@waterboards.ca.gov or contact Brian Cary at (916) 449-5624, or by email at Brian.Cary@waterboards.ca.gov.

Sincerely,

Tessa Lenz

Tessa Lenz
Environmental Scientist

Enclosure (1):

1. Clean Water State Revolving Fund Environmental Review Requirements

cc: State Clearinghouse
(Re: SCH# 2013051094)
P.O. Box 3044
Sacramento, CA 95812-3044

Governor's Office of Planning & Research

MAY 29 2019

STATE CLEARINGHOUSE

ENVIRONMENTAL REVIEW REQUIREMENTS

All applicants for SRF financing must thoroughly analyze the environmental consequences of their project. Applicants must comply with the California Environmental Quality Act (CEQA) and federal cross-cutting authorities as part of the SRF environmental review requirements. All SRF environmental requirements must be met prior to the start of construction activities.

CEQA

The environmental review process used to determine compliance with appropriate state and federal environmental regulations begins with successful completion of CEQA.

Typically, the applicant is the CEQA Lead Agency and must prepare and circulate an environmental document before approving a project. Only a public agency, such as a local, regional, or state government may serve as the Lead Agency under CEQA. If a project will be completed by a non-governmental organization, Lead Agency responsibility goes to the first public agency providing discretionary approval for the project. In these instances, the State Water Board may serve as Lead Agency on behalf of the applicant.

Usually, the State Water Board is a CEQA Responsible Agency, making its own independent findings using information submitted by the Lead Agency prior to approving funding for a project.

The applicant must provide the final, project-specific environmental document, associated reports, and other supporting materials demonstrating compliance with CEQA as part of the application's Environmental Package.

FEDERAL CROSS-CUTTING AUTHORITIES

In addition to completing CEQA, the applicant must conduct the necessary studies and analyses and prepare documentation demonstrating that the proposed project is in compliance with the federal cross-cutting environmental authorities. As the USEPA designated, "non-federal" state agency representative responsible for consultation with appropriate federal agencies, the State Water Board staff will review materials for compliance with relevant cross-cutters. Staff may require additional studies or documentation to fulfill this obligation. The principal federal authorities that need addressing in the application are:

- Archaeological & Historic Preservation Act
- Clean Air Act
- Coastal Barriers Resources Act
- Coastal Zone Management Act
- Endangered Species Act
- Environmental Justice Executive Order
- Farmland Protection Policy Act
- Fish & Wildlife Conservation Act
- Flood Plain Management
- Magnuson-Stevens Fishery Conservation & Management Act
- Migratory Bird Treaty Act
- National Historic Preservation Act
- Protection of Wetlands
- Rivers & Harbors Act
- Safe Drinking Water Act, Sole Source Aquifer Protection
- Wild & Scenic Rivers Act

Material in this brochure highlights key SRF environmental requirements

OUR SRF PROGRAMS

The State Water Resources Control Board (State Water Board) administers the Clean Water and Drinking Water State Revolving Fund (SRF) Programs to support a wide range of infrastructure projects. The SRF Programs represent a powerful partnership between the State and the United States Environmental Protection Agency (USEPA), who provides partial Program funding. The applicant will need to complete the Environmental Package, which compiles and transmits the necessary environmental documents and supporting information for State Water Board staff to review to determine compliance with state and federal environmental laws and regulations. SRF funds are available for planning and design, as well as construction activities.

QUESTIONS

The consultation process can be lengthy, especially if the project is expected to affect biological or cultural resources. Please contact your State Water Board Project Manager and/or Environmental Section staff early in the planning process to discuss what environmental information may be needed for your project.

WEBSITE

https://www.waterboards.ca.gov/water_issues/programs/grants_loans/environmental_requirements.html

October 2018-TAGraphics

CLEAN WATER & DRINKING WATER STATE REVOLVING FUND

ENVIRONMENTAL REVIEW REQUIREMENTS

STATE OF CALIFORNIA
Water Resources Control Board
Division of Financial Assistance

FEDERAL CROSS-CUTTING AUTHORITIES THAT USUALLY REQUIRE ADDITIONAL STUDIES

Clean Air Act (CAA)

CAA requires federally funded projects to meet the General Conformity requirements and applies in areas where National Ambient Air Quality Standards are not met or in areas that are subject to a maintenance plan.

If project emissions are below the federal "de minimis" levels, then a General Conformity determination is not required.

If project emissions are above the federal "de minimis" levels, then a General Conformity determination must be made.

An air quality modeling analysis may be needed regardless of the attainment status for the following constituents:

- Ozone;
- Carbon monoxide;
- Nitrous oxide;
- Sulfur dioxide;
- Lead; and
- Particulate matter (PM2.5 and PM10).

Commonly, applicants use the California Emissions Estimator Model (CalEEMod) to approximate project related emissions. This model can be downloaded from www.caleemod.com. A user's guide and Frequently Asked Questions document are available at this site as well. Applicants also may want to discuss project impacts with the local air district.

Endangered Species Act (ESA)

ESA, Section 7, requires an assessment of the direct and indirect effects of the project on federally listed species and critical habitat. A biological resources assessment report is required and must include, but is not limited to:

- Recent species and critical habitat lists generated from the US Fish and Wildlife Service's Information for Planning and Consultation online database;
- A recent species list from the National Marine Fisheries Service, if appropriate;
- A recent search of the California Department of Fish and Wildlife's Natural Diversity Database, including appropriate species observation information and maps;
- A field survey performed by a qualified biologist;
- An evaluation (usually presented in table form) of the project's potential to affect federally listed species;
- Special surveys, as appropriate;
- Maps delineating the project area and species occurrence;
- Identification of measures to minimize, and/or avoid impacts; and
- A recommendation on an ESA determination (i.e., "no effect," "may affect, but not likely to adversely affect," or "may affect and is likely to adversely affect").

The State Water Board staff will conduct an independent review of these materials to determine the potential effect of the project on the federally listed species and will make a recommendation to USEPA on how to proceed under ESA, Section 7.

National Historic Preservation Act (NHPA)

NHPA, Section 106, requires an analysis of the effects of the project (or undertaking) on "historic properties." Historic properties (i.e., prehistoric or historic districts, sites, buildings, structures, or objects 50 years or older) are properties that are included in or eligible for inclusion in the National Register of Historic Places. A historic properties identification report (HPIR) must be prepared in accordance with Section 106 requirements by a qualified professional meeting the Secretary of the Interior's Standards in archaeology or history.

Specific requirements of the HPIR include, but are not limited to:

- The project description and a clearly defined area of potential effects (APE), specifying length, width, and depth of excavation, with a labeled map;
- A recent Information Center records search extending to half-mile beyond the project APE;
- Background research (e.g., old USGS maps, ethnographic records, historical records, etc.);
- Documentation of outreach to the Native American Heritage Commission, appropriate Tribes, historical societies, and interested parties;
- Detailed description of survey methods and findings; and
- Identification and evaluation of cultural resources within the APE.

Cultural resources reports prepared for CEQA may be used, but often require more information.

KEY PROCEDURAL REQUIREMENTS

Environmental Alternatives Analysis

SRF regulations require that an explanation of the alternatives considered for the project and the rationale for selection of the chosen project alternative be prepared and that it assess the environmental impacts of each alternative. Known as the environmental alternative analysis, this information can be included in the project engineering report, the CEQA document, or a technical memorandum. The environmental alternative analysis must include the following:

- Range of feasible alternatives, including a "no project/no action" alternative;
- Comparative analysis among the alternatives that discusses direct, indirect, and cumulative, beneficial and adverse environmental impacts on the existing and future environment, as well as sensitive environmental issues; and
- Appropriate mitigation measures to address impacts.

Public Participation

SRF regulations also require adequate opportunity for the public, responsible agencies, and trustee state agencies under CEQA to review and comment on the project. All projects, except those with little to no environmental impacts (namely, CEQA exempt projects), must hold a public hearing or meeting to approve the CEQA document(s). The CEQA process includes public noticing opportunities, but other public meetings may be needed to meet the federal requirements. The applicant will be asked to provide the date(s) of when such meeting(s) were held for the project as part of the environmental review.

Campus Planning and Development
100 Campus Center
Mountain Hall A, Bldg. 84
Seaside, CA 93955-8001
831-582-3709
831-582-3545 fax
csumb.edu

June 13, 2019

Monterey One Water
ATTN: Rachel Gaudoin
5 Harris Ct., Bldg. D
Monterey, CA 93940

Re: Expanded Pure Water Monterey Groundwater Replenishment Project Notice of Supplemental Environmental Impact Report Preparation

Dear Ms Gaudoin:

California State University, Monterey Bay (CSUMB) has reviewed the Notice of Preparation (NOP) of an Expanded Pure Water Monterey Groundwater Replenishment Project Notice of Supplemental Environmental Impact Report Preparation (SEIR). As you may know, the Pure Water Monterey groundwater replenishment pipeline transits through the CSUMB campus and, for that reason, CSUMB would be uniquely impacted by the proposed project. The University is particularly interested that the SEIR analyze those potential environmental impacts specific to the campus and that it include all appropriate mitigation. In that regard, we offer the following comments for your consideration and request that these issues specific to CSUMB be addressed in the SEIR, in addition to those issues already included in the NOP.

1. **Hydrology and Water Quality, Pipeline Operations** – CSUMB requests that the SEIR address hydrology, water quality impacts and pipeline operational impacts of the capacity expansion on CSUMB's exclusive right to adjust the energy content of all waters passing through the existing pipeline. In this regard, CSUMB will continue to work with MCWD and M1W on developing and studying this aspect of the pipeline.

2. **Pipeline Capacity/Health and Safety** – CSUMB requests that the SEIR address the capacity of the existing pipeline to carry greater flow rates than those identified in the currently approved EIR. This is particularly important because a section of this pipeline installed in the heart of the campus by MCWD in 2007 is of significantly smaller diameter than the pipeline upstream and downstream which was installed in 2018. Our understanding is that the smaller section of pipeline is already a bottleneck and potentially subject to large pressure fluctuations at the current planned flow rates. The SEIR should analyze the potential effects associated with the higher flow rates and analyze the effects of a pipeline rupture on campus students, faculty, and staff, as well as campus physical assets, and identify the appropriate mitigations measures.

CSUMB looks forward to working with MCWD and M1W on the above issues and reviewing the SEIR when it is released for public review. Regular consultation with University officials regarding M1W project is highly desirable. Please contact me if you have any questions or would like to discuss these comments in detail.

Sincerely,

Anya Spear

Anya Spear, Associate Director of Campus Planning
California State University, Monterey Bay
(831) 582-5098

Community Development Department
440 Harcourt Avenue
Seaside, CA 93955
www.ci.seaside.ca.us
Telephone 831-899-6727
Fax 831-718-8594

June 14, 2019

Mail: Monterey One Water
Attn: Rachel Gaudoin
5 Harris Court, Building D, Monterey, CA 93940

RE: Comment Letter on Notice of Preparation (NOP)

The City of Seaside Planning Division is providing the following comments on the NOP for the expansion of the groundwater replenishment project:

1. The placement of all well injection facilities and other above-ground apparatus associated with the project should be limited to the 125-foot buffer zone that exists parallel to the Bureau of Land Management lands to the east and development opportunity lands within the City of Seaside lands to the west. Pipelines crossing lands in Monterey County into the City of Seaside shall adhere to this standard as well.

2. Upon the transfer of lands under the ownership of the Fort Ord Reuse Authority upon which the ground replenishment facilities and pipelines are located to the City of Seaside, Pure One Water shall establish easements with the City of Seaside for the continued use the property which are being used to inject/extract water, that are being used as access routes to service/maintain the groundwater facilities and that are being used for pipelines.

3. Pure One Water shall coordinate with the City of Seaside for the relocation and/or modification of monitor wells that may be located within areas of future development within the City of Seaside.

4. Pure One Water shall coordinate with the City of Seaside Public Works Department on compliance with the Ordinance Ordnance policies related to digging and excavation activity with the expanded land area for the Groundwater Replenishment Project.

5. Pure One Water shall be required to adhere to best management practices to place dirt removal tracking devices at entrances to the public right-of-way.

6. All new driveways constructed shall receive an encroachment permit from the City of Seaside Public Works Department and shall comply with City Engineering Standards.

7. The City Manager of the City of Seaside shall be notified of all meetings/hearings held to consider any allocation of water that may become available to any jurisdiction from the expanded groundwater replenishment project.

If you have any questions or comments on the comments being provided by the City of Seaside, you can contact Gloria Stearns, Community development Director at (831) 899-6830 (gstearns@ci.seasode.ca.us).

Sincerely

Rick Medina
Senior Planner

Rachel Gaudoin

From: Michael Weaver <michaelrweaver@mac.com>
Sent: Saturday, June 15, 2019 4:07 PM
To: Pure Water Monterey Info
Subject: Comments re: Expanded Pure Water Monterey Groundwater Replenishment Project
Attachments: FINAL known and suspected Munitions and Pesticide.pdf

Fort Ord Community Advisory Group
Email: focagemail@yahoo.com

"The Fort Ord Community Advisory Group (FOCAG) is a public interest group formed to review, comment, and advise on the remediation (cleanup) of the Fort Old Army Base Superfund Site, to ensure that human health, safety, and the environment are protected to the greatest extent possible." - Mission Statement

To: Monterey One Water

Attn: Rachel Gaudoin

5 Harris Court, Building D, Monterey, CA 93940

Dear Ms. Gaudoin,

Former Fort Ord's Site 39 was one of the largest Army infantry training ranges in the United States and was used for decades. Former Fort Ord was also home to CDEC, Combat Development Experimentation Command

Munitions chemicals tested for at Fort Ord have primarily been for lead, antimony, and copper.

The research for the attachment (below) was completed by a FOCAG member.
The second to the last page shows an overlay, Site 39 is atop the Seaside aquifer.

The FOCAG has great concerns both about the location of your project and the proposed injection wells. Please do consider our comments.
If for some reason the atacjment will not open, please call and it can be faxed to you.

Thank you very much.

Respectfully,

Mike Weaver
Co- Chair
FOCAG
831-484-6659

Attachment

Fort Ord known and suspected Munitions and Pesticide Chemicals used in Training Areas

How can the extent of contamination in training areas be known if the cleanup program is not looking for all the potential chemicals?

Table 1: List of munitions chemicals compiled from 1994 Site 39 Remedial Investigation
Note: very few are being looked for in training areas.

Table 2: List of munitions chemicals compiled from 2003 Sampling and Analysis Plan
Note: very few are being looked for in training areas.

Table 3: List of munitions chemicals Military Explosives (Chemistry) 30 September 1984
Note: many of these munitions chemicals are not included in Tables 1 & 2

Table 4: List of munitions chemicals found in practice and pyrotechnic munitions
Note: many of these munitions chemicals are not included in Tables 1 & 2

Table 5: List of 23 pyrotechnic chemicals also used as Pesticides
Note: may explain why some training areas appear to be devoid of life
(very few bugs, birds, ground squirrels, etc.)

Table 6: List of 48 pesticides used at Fort Ord
Note: none of these chemicals have been looked for in training areas.

Table 7: Munitions Chemicals looked for in transferred training areas FORA ESCA RP parcels
Note: in training areas, very few and in some sites **no** munitions chemicals have been looked for. **No** pesticide chemicals have been looked for.

Map 1: Pesticide sampling locations
Note: This map generated from Fort Ord RI/FS 1995, VOL II - Remedial Investigation, Basewide Background Soil Investigation 1995; BW-1283E
This is **the only specific sampling for pesticides in training areas** known

Map 2: Site 39; Seaside Groundwater Basin
Note: This aquifer is the potable water supply for much of the Monterey Peninsula

Map 3: Historical Areas (HA) Sites
Note: Fort Ord training areas

FOCAG cleanup comment letters can be viewed in the Fort Ord Administrative Record by going to FortOrdCleanup.com

Table 1: Munitions Chemicals identified by the Fort Ord Superfund cleanup; 1994 RI/FS BW-1283K Tables

Phenol
Bis(2-chloroethyl) ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl alcohol
1,2-Dichlorobenzene
2-Methylphenol
4-Methylphenol
n-Nitrosodipropylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic acid
Bis(2-chloroethox)methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
2-Methlnaphthalene
Hexachorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
Dimethl phthalate
Acenaphthylene
2,6-Dinitrotoluene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
Diethyl phthalate
4-Chlorophenyl phenylether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methyl phenol
n-Nitrosodiphenylamine
4-Bromophenylphenylether
Hexachlorobenzene

Pentachlorophenol
Phenanthrene
Anthracene
Di-n-butlphthalate
Fluoranthene
Pyrene
Butylbenzylphthalate
3,3-Dichlorobenzidine
Benzo(a)anthracene
Chrysene
Bis(2-ethlhexyl)phthalate
Di-n-octyIphthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(l,2,3-cd)pyrene
Dibenzo(a,h)antkracene
Benzo(ghi)perylene
Bis(2-chloroisopropyl)ether
TPH-Diesel
TPH-Extractable Unknown Hydrocarbon
TPH-Gasoline
TPH-Purgeable Unknown Hydrocarbon
Benzene
Ethylbenzene
Toluene
Xylenes
HMX
RDX
1,3,5-Trinitrobenzene
1,3-Dinitrobenzene
Tetryl
Nitrobenzene
2,4,6-Trinitrotoluene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
o-NitroToluene
m-NitroToluene
p-ilitrotoluene
2-Amino-dinitrotoluene
4-Amino-dinitrotoluene
Nitroalvcerin
Picri;-hcid
Nitroguanidine
PETN

Table 2: Munitions Chemicals identified by the Superfund cleanup: 2003 Sampling and Analysis Plan, Revision 0; Fort Ord, California; BW-2214D

Gasoline (C -C)	8006-61-9
4-Bromofluorobenzene	460-00-4
Diesel (C -C)	68334-30-5
Motor Oil (C -C)	ADR-02-001
ortho-terphenyl	84-15-1
Acetone	67-64-1
Benzene	71-43-2
Bromobenzene	108-86-1
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform	75-25-2
Bromomethane	74-83-9
2-Butanone	78-93-3
n-Butylbenzene	104-51-8
sec-Butylbenzene	135-98-8
tert-Butylbenzene	98-06-6
Carbon disulfide	75-15-0
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
2-Chloroethyl vinyl ether	110-75-8
Chloroform	67-66-3
Chloromethane	74-87-3
2-Chlorotoluene	95-49-8
4-Chlorotoluene	106-43-4
Dibromochloromethane	124-48-1
1,2-Dibromo-3-chloropropane	96-12-8
1,2-Dibromoethane	106-93-4
Dibromomethane	74-95-3
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
Dichlorodifluoromethane	75-71-8
1,1-Dichloroethane	75-34-3
1,2-Dichloroethane	107-06-2
1,1-Dichloroethene	75-35-4
cis-1,2-Dichloroethene	156-59-2
trans-1,2-Dichloroethene	156-60-5
1,2-Dichloropropane	78-87-5
1,3-Dichloropropane	142-28-9
2,2-Dichloropropane	594-20-7
1,1-Dichloropropene	563-58-6
cis-1,3-Dichloropropene	10061-01-5
trans-1,3-Dichloropropene	10061-02-6
Ethylbenzene	100-41-4

Hexachlorobutadiene	87-68-3
2-Hexanone	591-78-6
Isopropylbenzene	98-82-8
p-Isopropyltoluene	99-87-6
Methyl tert-butyl ether	1634-04-4
Methylene chloride	75-09-2
4-Methyl-2-pentanone	108-10-1
n-Propylbenzene	103-65-1
Styrene	100-42-5
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	79-34-5
Tetrachloroethene	127-18-4
Toluene	108-88-3 75-125
1,2,3-Trichlorobenzene	87-61-6
1,2,4-Trichlorobenzene	120-82-1
1,1,1-Trichloroethane	71-55-6
1,1,2-Trichloroethane	79-00-5
Trichloroethene	79-01-6
Trichlorofluoromethane	75-69-4
1,2,3-Trichloropropane	96-18-4
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	08-67-8
Vinyl acetate	108-05-4
Vinyl chloride	75-01-4
m,p-Xylene	1330-20-7
o-Xylene	95-47-6
4-Bromofluorobenzene	1868-53-7
Dibromofluoromethane	460-00-4
1,2-Dichloroethane-d4	17060-07-0
Toluene-d8	2037-26-5
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzoic acid	65-85-0
Benzo[a]anthracene	56-55-3
Benzo[b]fluoranthene	205-99-2
Benzo[k]fluoranthene	207-08-9
Benzo[g,h,i]perylene	191-24-2
Benzo[a]pyrene	50-32-8
Benzyl alcohol	100-51-6
Bis(2-chloroethoxy)methane	111-91-1
Bis(2-chloroethyl)ether	111-44-4
Bis(2-chloroisopropyl)ether	108-60-1
Bis(2-ethylhexyl)phthalate	117-81-7
4-Bromophenyl phenyl ether	101-55-3
Butylbenzylphthalate	85-68-7
Carbazole	86-74-8

4-Chloroaniline	106-47-8
4-Chloro-3-methylphenol	35421-08-0
2-Chloronaphthalene	91-58-7
2-Chlorophenol	95-57-8
4-Chlorophenyl phenyl ether	7005-72-3
Chrysene	218-01-9
Dibenzo(a,h)anthracene	53-70-3
3,3'-Dichlorobenzidine	91-94-1
Dibenzofuran	132-64-9
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
2,4-Dichlorophenol	120-83-2
Diethylphthalate	84-66-2
2,4-Dimethylphenol	105-67-9
Dimethyl phthalate	131-11-3
Di-n-butylphthalate	84-74-3
4,6-Dinitro-2-methylphenol	534-52-1
2,4-Dinitrophenol	51-28-5
2,4-Dinitrotoluene	121-14-2
2,6-Dinitrotoluene	606-20-2
Di-n-octyl phthalate	117-84-0
Fluoroanthene	206-44-0
Fluorene	86-73-7
Hexachlorobenzene	118-74-1
Hexachlorobutadiene	87-68-3
Hexachlorocyclopentadiene	77-47-4
Hexachloroethane	67-72-1
Indeno(1,2,3-cd)pyrene	193-39-5
Isophorone	78-59-1
2-Methylnaphthalene	91-57-6
2-Methylphenol	95-48-7
3-Methylphenol	108-39-4
4-Methylphenol	106-44-5
Naphthalene	91-20-3
2-Nitroaniline	88-74-4
3-Nitroaniline	99-09-2
4-Nitroaniline	100-01-6
Nitrobenzene	98-95-3
2-Nitrophenol	88-75-5
4-Nitrophenol	100-02-7
N-Nitroso-di-n-butylamine	924-16-3
N-Nitrosodiethenolamine	1116-54-7
N-Nitrosodiphenylamine	86-30-6
N-Nitroso-di-n-propylamine	621-64-7
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Phenol	108-95-2

Pyrene	129-00-0
Pyridine	110-86-1
1,2,4-Trichlorobenzene	120-82-1
2,4,5-Trichlorophenol	95-95-4
2,4,6-Trichlorophenol	88-06-2
2,4,6-Tribromophenol	118-79-6
2-Fluorobiphenyl	321-60-8
2-Fluorophenol	367-12-4
Nitrobenzene-d5	20810-28-0
Phenol-d6	4165-62-2
Terphenyl-d14	98904-43-9
HMX	2691-41-0
sym-Trinitrobenzene	99-35-4
RDX	121-82-4
1,3-Dinitrobenzene	99-65-0
Nitrobenzene	98-95-3
2,4,6-Trinitrotoluene	118-96-7
Tetryl	479-45-8
2,4-Dinitrotoluene	121-14-2
2,6-Dinitrotoluene	606-20-2
2-Am-DNT	35572-78-2
4-Am-DNT	1946-51-0
2-Nitrotoluene	88-72-2
3-Nitrotoluene	99-08-1
4-Nitrotoluene	99-99-0
Nitroglycerin	55-63-0
1,4-Dinitrobenzene	100-25-4
Aluminum	7429-90-5
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Beryllium	7440-41-7
Cadmium	7440-43-9
Calcium	7440-70-2
Chromium	7440-47-3
Cobalt	7440-48-4
Copper	7440-50-8
Iron	7439-89-6
Lead	7439-92-1
Magnesium	7439-95-4
Manganese	7439-96-5
Molybdenum	7439-98-7
Nickel	7440-02-0
Potassium	7440-09-7
Selenium	7782-49-2
Silver	7440-22-4
Sodium	7440-23-5
Strontium	7440-24-6

Thallium	1314-32-5
Titanium	7440-32-6
Vanadium	7440-62-2
Zinc	7440-66-6
Mercury	7439-97-6
Perchlorate	14797-73-0

Table 3. Munitions Chemical Compositions

Explosives, Propellants, Pyrotechnics

Military Explosives (Chemistry) 30 September 1984

Explosives

Chapters 7 & 8

Lead Azide: Pb(N3)2, is a salt of hydrazoic acid, HN3. The compound is white, has a nitrogen content of 28.86 percent and a molecular weight of 291.26. At the melting point, 245°C to 250°C, decomposition into lead and nitrogen gas occurs. The pure compound has two crystal modifications: an orthorhombic form and a monoclinic form. The orthorhombic form, which is also called the alpha form, has a density of 4.68 grams per cubic centimeter and unit cell dimensions of a = 11.31 Angstroms, b = 16.25 Angstroms, and c = 6.63 Angstroms. The monoclinic form, which is also called the beta form, has a density of 4.87 grams per cubic centimeter and unit cell dimensions of a = 18.49 Angstroms, b = 8.84 Angstroms, and c =5.12 Angstroms. The compound is usually prepared as colorless, needlelike crystals.

Other Lead Azide Types:

Dextrinated Lead Azide (DLA)
Service Lead Azide (SLA)
Colloidal Lead Azide (CLA)
Polyvinylalcohol Lead Azide (PVA-LA)
RD-1333 lead azide
Dextrinated Colloidal Lead Azide (DCLA)

Mercury Fulminate Hg(ONC)2, is a salt of fulminic or paracyanic acid. The acid undergoes polymerization very rapidly in both aqueous and ethereal solutions, and so cannot be isolated. The structure of fulminic acid, and thus the salts of this acid, is undetermined. Mercury fulminate has an oxygen balance to CO2 of-17 percent, an oxygen balance to CO of -5.5 percent, a nitrogen content of 9.85 percent, and a molecular weight of 284.65. When mercury fulminate is crystallized from water, a hydrate, Hg(ON: C).1/2 H20, is formed that has a nitrogen content of 9.55 percent and a molecular weight of 293.64. The anhydrous form, which is crystallized from alcohol, is white when pure but normal manufacturing yields a gray product of only 98 to 99 percent purity. The crystals formed are octahedral but are usually truncated. Only the smaller crystals are fully developed. The crystal density is 4.43 grams per cubic centimeter.

Diazodinitrophenol (DDNP) This explosive is also known as 4,5-dinitrobenzene-2-diazo-1-oxide, dinol, diazol and may be referred to as DADNP. The compound is a greenish yellow to brown solid with tabular crystals. DDNP has a crystal density of 1.63 to 1.65 grams per cubic centimeter at 25°C and a molecular weight of 210.108. DDNP is not dead pressed even at a pressure of 896,350 kilopascals (130,000 pounds per square inch).

Lead Styphnate Two forms of lead styphnate are used as primary explosives: basic and normal. Basic lead styphnate has a nitrogen content of six percent and a molecular weight of 705.53.

The compound has two crystal forms: yellow needles with a density of 3.878 grams per cubic centimeter and red prisms with a density of 4.059 grams per cubic centimeter. The apparent density is 1.4 to 1.6 grams per cubic centimeter. Normal lead styphnate has a nitrogen content of nine percent and the monohydrate has a molecular weight of 468.38.

Tetracene is also known as guanyldiazoguanyl tetrazene and 4-guanyl-1 -(nitrosoaminoguanyl)-1tetrazene. The compound is a colorless to pale yellow, fluffy material with needle crystals, an oxygen balance to CO_2 of-57.6 percent, an oxygen balance to CO of-43 percent, a nitrogen content of 74.4 percent, and a molecular weight of 188.15. Tetracene forms a hydrate with three molecules of water. The melting point of the pure compound is between 140°C and 160°C accompanied by decomposition and explosion. The apparent density is only 0.45 grams per cubic centimeter. When compressed at 20,685 kilopascals (3,000 pounds per square inch), the density is 1.05 grams per cubic centimeter. The crystal density is 1.7 grams per cubic centimeter. The compound can be easily dead pressed. Tetracene is practically insoluble in water and ethanol and so can be stored wet with water or a mixture of water and ethanol. The compound is also insoluble in ether, benzene, acetone, carbon tetrachloride, and ethylene dichloride. Tetracene is soluble in dilute nitric acid or strong hydrochloric acid. In a solution with hydrochloric acid, the hydrochloride is precipitated by the addition of ether. Tetracene may then be recovered by treatment with sodium acetate or ammonium hydroxide. The heat of formation is 270 calories per gram and the heat of detonation is 658

Potassium Dinitrobenzofuroxane (KDNBF) is a red crystalline solid with a nitrogen content of 21.21 percent and molecular weight of 264.20. The oxygen balance of the compound to CO_2, H_2O, and K_2O is -42.4 percent. The anhydrous salt has a density of 2.21 grams per cubic centimeter and a melting point, with explosive decomposition, of 210°C. KDNBF is soluble to the extent of 0.245 grams per 100 grams of water at 30°C. Between the temperatures of 50C to 50°C the specific heat is 0.217 calories per gram per degree centigrade. KDNBF is used in primary compositions.

Lead Mononitroresorcinate (LMNR) has a nitrogen content of 3.89 percent, an NO_2 content of 12.77 percent, a lead content of 57.51 percent, and a molecular weight of 360.30. The compound forms microscopic reddish brown crystals. LMNR has slow burning properties and a low combustion temperature. The compound is used in electric detonators with DLA as the spot charge to initiate a PETN base charge, as an upper charge, and as an ingredient in primary compositions.

Primary Compositions are mixtures of primary explosives, fuels, oxidizers, and other ingredients used to initiate detonation in high explosive charges or ignite propellants and pyrotechnics. The ingredients and the portions of the ingredients for individual priming compositions are determined empirically from the use the composition is intended for. Fuels commonly used in priming compositions are lead thiocynate, antimony sulfide, and calcium silicide. The last two also serve to sensitize the composition to friction or percussion. Oxidizing agents include potassium chlorate and barium nitrate. Other ingredients include primary explosives and binders. The major determining factor in ingredient selection is the impetus which is to detonate the priming composition. The types of impetus commonly used are percussion and electrical.

Percussion Priming Compositions FA959, FA982, FA956, Compounds:

Normal lead styphnate
Tetracene
Barium nitrate
Antimony sulfide
Powdered zirconium
Lead dioxide
PETN
Aluminum
Gum Arabic

Stab Detonator Priming Compositions NOL130, PA101, NOL 60, Compounds:

Lead azide
Basic lead styphnate
Tetracene
Barium nitrate
Antimony sulfide
Powdered aluminum

Electric Priming Compositions I, II, III, IV, V, VI, Compounds:

Potassium chlorate
Lead mononitroresorcinate
Nitrocellulose
Lead thiocynate
DDNP
Charcoal
Nitrostarch
Titanium
Aluminum

Aliphatic Nitrate Esters compounds in this class are prepared by O-type nitration in which a nitro group is attached to an oxygen atom of the compound being nitrated.

1,2,4-Butanetriol Trinitrate (BTN) This explosive is also known as a, b, g-trihydroxybutane trinitrate and is sometimes referred to as BTTN. The compound is a light yellow liquid with a density of 1.520 at 20°C, a molecular weight of 241, a melting point of -27°C, an oxygen balance to CO2 of 17 percent, and a refractive index of 1.4738 at 20°C. The liquid has a viscosity of 62 centipoises at 20°C. 1,2,4- Butanetriol trinitrate is slightly soluble in water, miscible with alcohol, ether, acetone, and a solution of 2 parts ether and 1 part alcohol. BTN has a heat of formation of 368 calories per gram, a heat of combustion of 2,167 calories per gram, and a heat of detonation of 1,458 calories per gram. This compound is a good gelatinizer for nitrocellulose and can be used as a substitute for nitroglycerin in double-base propellants. Heat, vacuum stability, and volatility tests indicate more stability than nitroglycerin. Impact sensitivity is about the same as for nitroglycerin. Brisance, as measured by the sand test, is about the same: 49 grams crushed versus 51.5 grams for nitroglycerin or 47 grams for TNT. The five second explosion temperature is 230°C versus 220°C for nitroglycerin. BTN can be manufactured by the nitration of 1,2,4-butanetriol with a mixture of nitric and sulfuric acids.

Diethyleneglycol Dinitrate (DEGN) This explosive is also known as dinitrodiglycol or 2,2'-oxybisethanol dinitrate and is sometimes referred to as DEGDN. The compound is a clear, colorless, odorless liquid with a nitrogen content of 14.29 percent, a theoretical maximum density of 1.39 grams per cubic centimeter, an oxygen balance to C02 of-41 percent, and a molecular weight of 196. DEGN boils between 160° and 161°C and can, upon cooling, form a stable solid with a melting point of 2°C or remain liquid to a freezing point of -11.2° to 11.40°C. Other characteristics of the liquid are: refractive index at 20°C with sodium light, 1.450; viscosity at 20°C, 8.1 centipoises; vapor pressure at 20°C, 0.0036 torr; vapor pressure at 25°C, 0.00593 torr; vapor pressure at 600C, 0.130 torr; specific gravity, 1.385. At 60°C DEGN has a volatility of 0.19 milligrams per square centimeter per hour. At constant pressure, the heat of combustion is 2,792 calories per gram. The heat of formation is-99.4 kilogram calories per mole. The heat of detonation is 1,161 calories per gram. DEGN is readily soluble in ether, acetone, chloroform, benzene, nitrobenzene, toluene, nitroglycerin, and glacial acetic acid but is insoluble in ethanol, carbon tetrachloride, and carbon disulfide. Solubility in water at 25°C and 60°C is 0.40 and 0.46 gram per 100 grams, respectively. DEGN's chemical reactivity is similar to nitroglycerin's, but is less subject to hydrolysis and is not readily saponified by alcoholic sodium hydroxide. DEGN can be used as an explosive and can be used in propellants as a colloiding agent for nitrocellulose. Propellants based on DEGN and nitrocellulose develop relatively low temperatures and cause relatively little erosion of guns, but are unduly volatile.

Nitrocellulose (NC) or cellulose nitrate is a mixture of nitrates obtained by nitrating cellulose. Cellulose is a long chain polymer of anhydroglucose units (C5H10O5). The number of anhydroglucose units or degree of polymerization (DP) is variable. Cellulose used for preparation of military grades of nitrocellulose have a DP of approximately 1,000 to 1,500. Cellulose threads possess micellar structure and consist of numerous rod-like crystallites oriented with their long axis parallel to the thread axis, thus forming a fiber. Almost pure cellulose is found in the pith of certain plants, in absorbent cotton, and in some filter papers. Pure cellulose is most readily obtained from cotton by treating with a dilute acid or base solution then thoroughly washing with water. At the present time most of the cellulose for nitrocellulose preparation is obtained from coniferous wood, which is 50 to 60 percent cellulose. Another source is straw, which is 30 to 40 percent cellulose. The nitration of cellulose involves replacement of the hydrogen in the three hydroxyl (OH) groups in the anhydroglucose units with NO2 groups. A representative formula for the nitrated cellulose may be written as C6H7(OH)*x* (ONO2) *y* where *x*+ *y*=3. The mononitrate, *x* =2 and *y* =1, has a nitrogen content of 6.76 percent; the dinitrate, *x*=1 and *y* =2, has a nitrogen content of 11.11 percent; the trinitrate, *x* =0 and *y* =3, has a nitrogen content of 14.14 percent. As a practical matter, however, any desired degree of nitration up to 14.14 percent may be obtained by adjusting the composition of the mixed acid used for nitration, the acid to cellulose ratio, the time of nitration, or the temperature of nitration. In nitrocellulose with less than 14.14 percent nitrogen, the NO2 groups are distributed randomly along the entire length of the cellulose polymer, so *x* and *y* should be regarded as average values over the entire length of the chain. The nitrogen content determines the chemical and physical properties of any particular nitrocellulose. The five grades of nitrocellulose listed below are recognized and used.

Other Nitrocellulose Types:

Pyroxylin or collodion,
Pyrocellulose
Guncotton
High nitrogen nitrocellulose
Blended nitrocellulose

Nitroglycerin (NG), glycerol trinitrate, or 1,2,3-propanetriol trinitrate, is a clear, colorless, odorless, oily liquid with a theoretical maximum density of 1.596 grams per cubic centimeter. Nitroglycerin has a sweet, burning taste and a molecular weight of 227.1. Nitroglycerin is soluble in one liter of water to the extent of only 0.173, 0.191, 0.228, and 0.246 gram at 20°, 30°, 50° and 60°C, respectively and is essentially nonhygroscopic when exposed to atmospheric humidity.

Nitrostarch (NS) is a mixture of nitrates obtained by nitrating starch. The general formula for starch is C6H10O5. The structure of starch is the same as for nitrocellulose, with the exception that the polymer chains are spiral rather than straight. The starch molecule consists of approximately 1,000 anhydroglucose units. The nitration of starch involves replacement of the hydrogen in the three hydroxyl (OH) groups in the anhydroglucose units with NO2 groups. A representative formula for the nitrated starch may be written as C6H7(OH) *x* (ONO2)*y* where *x* +*y* =3. The NO2 groups are distributed randomly along the entire length of the starch molecule, so *x* and *y* should be regarded as averages over the entire length of the chain. The following empirical formula can be employed to obtain *y* as a function of the nitrogen content *N*: *y*=162N/(1400-45*N*)

Pentaerythritol Tetranitrate (PETN) is also known as 2,2-bis [(nitrooxy) methyl]-1,3-propanediol dinitrate; penthrite; or nitropenta and may be referred to as TEN. The compound is a white solid with a molecular weight of 316.2. PETN has two polymorphs: one with a tetragonal crystalline structure and the other with an orthorhombic crystalline structure. The phase change between the two polymorphs occurs at 130°C. The tetragonal crystals have a density of 1.778 grams per cubic centimeter and the orthorhombic crystals have a density of 1.716 grams per cubic centimeter. Normal manufacturing yields tetragonal crystals. The unit cell dimensions of the tetragonal crystals are a=9.38 Angstroms, b=9.38 Angstroms, and c =6.71 Angstroms. The dimensions for the orthorhombic crystals are a=13.29 Angstroms, b = 13.49 Angstroms, c = 6.83 Angstroms. There are two molecules per cell in the tetragonal form and four molecules per cell in the orthorhombic form. The interatomic distances have been determined as 1.50 Angstroms for the C-C bonds, 1.37 Angstroms for the C-O bonds, 1.36 Angstroms for O-N bonds, and 1.27 Angstroms for N-O bonds. PETN melts at 141.3°C. The boiling point is 160°C under a pressure of 2 torr; 180°C under a pressure of 50 torr. Under atmospheric pressure at temperatures above 21 0°C, PETN decomposes rapidly and in some cases detonates. The vapor pressure of solid PETN can be found by the empirical equation: $\log p = 16.73 - 7750/T$. PETN is more sensitive to initiation than nitrocellulose, RDX, or tetryl, as judged by the sand test. This is shown, also, by the fact that PETN with 35 percent of water present can be detonated by a No. 6 electric blasting cap, whereas RDX fails to explode if more than 14 percent of water is present. PETN is one of the most sensitive of the standardized military explosives.

Triethylene Glycoldinitrate (TEGN) This explosive is also referred to as TEGDN. The compound is a light yellow, oily liquid with a nitrogen content of 11.67 percent, a molecular weight of 240.20, and an oxygen balance to CO2 of -66.6 percent. The melting point of the solid is - 19°C. Other characteristics of the liquid are: refractive index, 1.4540; viscosity at 20°C, 13.2 centipoises; vapor pressure at 25°C, less than 0.001 torr; volatility at 60°C, 40 milligrams per square centimeter per hour; and density, 1.335 grams per cubic centimeter. At constant pressure, TEGN's heat of combustion is 3428 calories per gram, heat of explosion is 725 kilocalories per kilogram, and heat of formation is -603.7 kilocalories per kilogram. TEGN is very soluble in acetone, ether, and a solution of 2 parts ether and 1 part ethanol. TEGN is soluble in carbon disulfide and slowly soluble in water. The primary use of TEGN is as a gelatinizing agent for nitrocellulose in propellants, but TEGN can also be used as a component in a liquid explosive, a plasticizer in the fabrication of flexible explosive sheets, and as a plasticizer in pytrotechnic flares.

1,1,1 Trimethylolethane Trinitrate (TMETN) This explosive is also known as metriol trinitrate and is sometimes referred to as MTN. The compound is a slightly turbid, viscous oil with a nitrogen content of 16.41 percent and a molecular weight of 255.15. TMETN has a melting point of -3°C and an apparent boiling point of 182°C, but this is merely the temperature at which decomposition becomes vigorous enough to resemble boiling. Other properties of the liquid are a density of 1.47 grams per cubic centimeter at 22°C and a refractive index of 1.4752 at 25°C. TMETN is practically insoluble in water. Less than 0.015 grams dissolved per 100 grams of water at up to 60°C. TMETN is soluble in alcohol and many other organic solvents. At 60°C TMETN's volatility is 24 milligrams per square centimeter. The heat of formation is 422 calories per gram at constant volume and 446 calories per gram at constant pressure. The heat of combustion is 2,642 calories per gram at constant volume with the water being liquid. In an acid bath, TMETN is hydrolyzed to the extent of 0.018 percent in 10 days at 220°C and 0.115 percent in 5 days at 60°C. TMETN can be used as a flash and erosion reducing additive in propellants and an ingredient of commercial explosives. TMETN alone does not gelatinize nitrocellulose unless the temperature is raised to 100°C, which would be dangerous. But if mixed with only 8 percent of metriol triacetate, gelatinization takes place at 80°C. When TMETN is mixed with nitroglycerin, the mechanical properties of double-base cast propellants are improved. Combinations with triethylene glycol dinitrate are used as plasticizers for nitrocellulose.

Cyclotetramethylenetetranitramine (HMX) is also known as: octahydro-1,3,5,7-tetranitro-1 ,3,5,7-tetrazocine; 1,3,5,7-tetranitro-1 ,3,5,7-tetrazacyclooctane; cyclotetramethylene tetranitramine; or octogen. HMX is a white, crystalline solid with a nitrogen content of 37.84 percent, a theoretical maximum density of 1.905 grams per cubic centimeter, a nominal density of 1.89 grams per cubic centimeter, a melting point of 285°C, and a molecular weight of 296.17. There are four polymorphs of HMX: an alpha, beta, gamma, and delta form. Each polymorph has a range of stability and there are differences among them in physical properties such as density, solubility, and refractive index. The most common polymorph is the beta form. The term HMX without an alpha, gamma or delta qualifier refers to the beta form throughout the rest of this text. The crystalline structure of beta HMX is monoclinic with a density of 1.903 grams per cubic centimeter. The unit cell dimensions are a=6.54 Angstroms, b=11.05 Angstroms, and c=8.70 Angstroms. Beta HMX is stable to about 102°C to 104.5°C, when the crystalline structure is converted to the alpha form. The crystals of the alpha form are orthorhombic with a density of 1.82 grams per cubic centimeter. The unit cell dimensions are a=15.14 Angstroms, b =23.89 Angstroms, c = 5.91 Angstroms. At approximately 160°C to 164°C the meta stable gamma form exists. The crystals of the gamma form are monoclinic with a density of 1.76 grams per cubic centimeter. The unit cell dimensions are a=10.95 Angstroms, b =7.93 Angstroms, and c = 14.61 Angstroms. Above the 160°C to 164°C range to the melting point, the delta form exists. The crystals of the delta form are hexagonal with a density of 1.80 grams per cubic centimeter. The unit cell dimensions are a=7.71 Angstroms and b=32.55 Angstroms. The polymorphs may also be prepared by precipitation from solution under various conditions. The beta form is precipitated from a solution of HMX in acetic acid, acetone, nitric acid, or nitrometrane with very slow cooling. The alpha form is precipitated from the same solution with more rapid cooling and the gamma form is precipitated with even more rapid cooling. The delta form is crystallized from solution such as acetic acid orbetachloroethyl phosphate, in which HMX is only slightly soluble. Very rapid chilling of the solution is required.

Cyclotrimethylenetrinitramine (RDX) This explosive is also known as: hexahydro-1,3,5-trinitro-1,3,5-triazine; 1,3,5-trinitro1,3,5-triazacyclohexane; cyclotrimethylene trinitramine; hexogen; cyclonite; or 1,3,5-trinitrotrimethylene-triamine.The compound is a white solid with a density of 1.806 grams per cubic centimeter, a nitrogen content of 37.84 percent, and a molecular weight of 222.13. RDX has orthorhombic crystals with a wide variety of habits; from needles when precipitated from HNO3, to plates when precipitated from acetic acid, to a massive form when precipitated from nitroethane or acetone. The unit cell dimensions are a=13.18 Angstroms, b = 1 1.57 Angstroms, and c = 10.71 Angstroms, and there are eight molecules per cell unit. On the Moh's scale RDX has a scratch hardness of 2.5. Other properties of pure RDX include a specific heat as shown in table 8-15 and a heat of combustion at constant pressure of 2,307.2 calories per gram. The heat of formation value is + 14.71 kilocalories per mole. RDX has an extremely low volatility. Pure RDX is used in press loaded projectiles but not in cast loaded projectiles because of extensive decomposition at the melting point. Cast loading is accomplished by blending RDX with a relatively low melting point substance. Compositions in which the RDX particles are coated with wax are called Composition A, in mixtures with TNT, Composition B, and blends with a nonexplosive plasticizer, Composition C. Straight RDX is used as a base charge in detonators and in some blasting caps, and as an oxidizer in specialized gun propellant.

Ethylenediamine Dinitrate (EDDN) This explosive is also designated EDD or EDAD. The compound is composed of white crystals with a specific gravity of 1.595 at 25/40, a nitrogen content of 30.10 percent, an oxygen balance to C02 of-25.8 percent, a melting point of 185° to 187°C, and a molecular weight of 186.13. The compound is soluble in water, but insoluble in alcohol or ether. EDDN has a heat of combustion of 374.7 kilocalories per mole at constant pressure, a heat of formation of 156.1 kilocalories per mole, and a heat of explosion of 127.9 to 159.3 kilocalories per mole. Eutectics are formed with ammonium nitrate, but EDDN is immiscible with molten TNT. An aqueous solution of EDDN is distinctly acidic. EDDN has been used to a limited extent as a bursting charge pressed in shells and as a cast charge in eutectic mixtures with ammonium nitrate. Mixtures with wax were used in boosters during World War II by the Germans.

Ethylenedinitramine (Haleite) This compound is also known as N’ N'-dinitroethylene diamine; ethylene dinitramine; or 1,2-dinitrodiaminoethane, and is sometimes designated EDNA. The name Haleite is in recognition of the development of this compound as a military explosive by the late Dr. G. C. Hale of Picatinny Arsenal. The compound is white with an orthorhombic crystal structure, a nitrogen content of 37.33 percent, anoxygen balance to CO2 of-32 percent, an oxygen balance to CO of-10.5 percent, and a molecular weight of 150.10. The density of the crystals vary from 1.66 to 1.77 depending on the solvent from which the crystallization took place.

Nitroguanidine (NQ) This explosive is also known as picrite or guanylnitramine. The compound has a nitrogen content of 53.84 percent, an oxygen balance to CO2 of -30.8 percent, a theoretical maximum density of 1.81 grams per cubic centimeter, a nominal density of 1.55 to 1.75 grams per cubic centimeter, and a molecular weight of 104.1. The melting point of nitroguanidine varies somewhat with the rate of heating. The pure material melts with decomposition at 232°C, but values from 220°C to 250°C are obtainable with various heating rates. At least two crystalline forms exist for nitroguanidine; alpha and beta.

2, 4,6Trinitrophenylmethylnitramine (Tetryl) This explosive is also known as: 2,4,6tetranitro-N-methyl aniline; N-methyl-N,2,4,6tetranitro-benzenamine; 2,4,6-trinitrophenylmethylnitramine; tetranitromethylamulene; or picrylmethylnitramine and is sometimes referred to as pyronite, tetrylit, tetralite, tetralita, or CE. The compound is colorless when freshly prepared and highly purified, but rapidly acquires a yellow color when exposed to light. Tetryl has a nitrogen content of 24.4 percent, an oxygen balance to CO2 of-47 percent, a nominal density of 1.71 grams per cubic centimeter with a theoretical maximum density of 1.73 grams per cubic centimeter, and a molecular weight of 287.15. The melting point of the pure substance is 129.45°C and of the technical grade, 129°C.

Nitroaromatics. Compounds in this class are prepared by C-type nitration in which a nitrogroup is attached to a carbon atom of the compound being nitrated.

Ammonium Picrate This explosive is also known as ammonium 2,4,6-trinitrophenolate, explosive D, and Dunnite. The compound has a nitrogen content of 22.77 percent, an oxygen balance to C02 of- 52 percent, a maximum crystal density of 1.717 grams per cubic centimeter, a nominal density of 1.63 grams per cubic centimeter, a melting point with decomposition
of about 280°C and a molecular weight of 246. Ammonium picrate exists in a stable form as yellow,
monoclinic crystals and a meta stable form as red, orthorhombic crystals. The unit cell dimensions are a =13.45 Angstroms, b

1,3-Diamino-2,4,6-Trinitrobenzene (DA TB) This explosive is also known as 2,4,6trinitro-1,3-diaminobenzene; 2,4,6-trinitro-7,3benzenediamine trinitro-m-phenylenediamine; or 2,4,6-trinitro-1 ,3-diaminobenzol and may be referred to as DATNB. The compound is a yellow, crystalline solid with a nitrogen content of 28.81 percent, a melting point of 2860C to 301°C with decomposition, and a molecular weight of 243.14.

1,3,5Triamino-2, 4,6Trinitrobenzene (TA TB) This explosive is also known as 2,4,6trinitro-1,3,5-benzenetriamine and may be referred to as TATNB. TATB has a nitrogen content of 32.56 percent, an oxygen balance to C02 of -55.78 percent, and a molecular weight of 258.18. TATB is yellow but exposure to sunlight or ultraviolet light causes a green coloration which, with prolonged exposure, turns brown. The compound has a theoretical maximum density of 1.937 grams per cubic centimeter and a nominal density of 1.88 grams per cubic centimeter. An instantaneous hot bar decomposition temperature of 450°C to 451 °C was reported with rapid thermal decomposition above 320°C. The structure of the crystalline lattice of TATB contains many unusual features. Some of these are the extremely long C-C bonds in the benzene ring, the very short C-N bonds, amino bonds, and the six furcated hydrogen bonds. Evidence of a strong intermolecular interaction, hydrogen bonds, in TATB is indicated by the lack of an observable melting point and very low solubility. The intermolecular network results in a graphite-like lattice structure with the resulting properties of lubricity and intercalaction.

2,4,6-Trinitrotoluene (TNT) This explosive is also known as trotyl, tolit, triton, tritol, trilite, and 1-methyl-2,4,6-trinitrobenzene. TNT has been the most widely used military explosive from World War I to the present time. The advantages of TNT include low cost, safety in handling, fairly high explosive power, good chemical and thermal stability, favorable physical properties, compatibility with other explosives, a low melting point favorable for melt casting operations, and moderate toxicity. There are six possible ring nitrated TNT isomers. The alpha isomer, which is the one of military interest is symmetrical and will be referred to as TNT. The other five meta isomers will be identified by the Greek letters beta through eta excluding zeta. TNT is a yellow, crystalline compound with a nitrogen content of 18.5 percent, an oxygen balance to CO2 of-73.9 percent, a molecular weight of 227.13, and a melting point of 80°C to 81°C. TNT shows no deterioration after 20 years storage in a magazine.

Impurities Present in TNT

2,4,5-Trinitrotoluene
2,3,4-Trinitrotoluene
2,3,6-Trinitrotoluene
2,3,5-Trinitrotoluene
3,4,5-Trinitrotoluene
2,6-Dinitrotoluene
2,4-Dinitrotoluene
2,3-Dinitrotoluene
2,5-Dinitrotoluene
3,4-Dinitrotoluene
3,5-Dinitrotoluene
1,3-Dinitrobenzene
1,3,5-Trinitrobenzene
2,4,6-Trinitrobenzyl alcohol
2,4,6-Trinitrobenzaldehyde
2,4,6-Trinitrobenzoic acid
Alpha-nitrato-2,4,6-trinitrotoluene
Tetranitromethane
2,2'-Dicarboxy-3,3',5,5'-tetranitroazoxybenzene (white compound)
2,2',4,4',6,6'-Hexanitrobibenzyl (HNBB)
3-Methyl-2',4,4',6,6'-pentanitrodiphenylmethane(MPDM)
3,3',5,5'-Tetranitroazoxybenzene

Compositions are explosives in which two or more explosive compounds are mixed to produce an explosive with more suitable characteristics for a particular application. Generally, the characteristics of the composition are intermediate between the characteristics of the individual explosive ingredients. For example, the addition of TNT to RDX reduces brisance somewhat but considerably improves sensitivity. The composition explosives are categorized by the number of ingredients contained in the mixture.

Binary Mixtures

Amatols are binary mixtures of ammonium nitrate and TNT. The percentages of ammonium nitrate and TNT are reflected in the nomenclature for each mixture, for example, 80/20 amatol consists of 80 percent ammonium nitrate and 20 percent TNT. Ammonium nitrate is insoluble in TNT. The chemical and physical properties of the constituents determine the properties of the amatol. The mixture begins to melt at TNT's melting point but the ammonium nitrate, which has a higher melting point, remains solid.

Composition A explosives consist of a series of formulations of RDX and a desensitizer. Compositions A and A2 contain the same percentages of materials as composition A3 but the type of wax used and the granulation requirements for the RDX are different. Composition A contains beeswax, while composition A2 contains a synthetic wax. Compositions A and A2 are no longer used. All of the composition A explosives are press loaded. The density of composition A3 is 1.47 and 1.65 grams per cubic centimeter when pressed to 20,685 kilopascals (3,000 pounds per square inch) and 82,740 kilopascals (12,000pounds per square inch), respectively.

Composition B type explosives are mixtures of RDX and TNT. Composition B refers to mixtures of approximately 60 percent RDX and 40 percent TNT. Other portions of RDX and TNT are called cyclotols.

Composition C During World War II, the British used a plastic demolition explosive that could be shaped by hand and had great shattering power. As standardized by the United States, this explosive was designated as composition C and contained 88.3 percent RDX and 11.7 percent of a nonexplosive oily plasticizer. Included in the plasticizer was 0.6 percent lecithin, which helped to prevent the formation of large crystals of RDX which would increase the sensitivity of the composition.

Ednatols are mixtures of halite (ethylene dinitramine) and TNT. The most used haleite/TNT portions are 60/40, 55/45, and 50/50. Ednatols are yellowish, uniform blends with a melting point of 80°C. The eutectic temperature is about 80°C. In an extrudation test at 65°C there was no extrudate. Ednatols are considered satisfactory for bursting charges in ammunition. All of the following data in the discussion of the properties of ednatol refer to the 55/45 mixture. 55/45 Ednatol has an oxygen balance to carbon dioxide of -51 percent and to carbon monoxide of - 17 percent. The density of the cast explosive is 1.62 grams per cubic centimeter, which is four percent greater than that of cast TNT or haleite pressed under 206,850 kilopascals (30,000 pounds per square inch).

LX-14 is an explosive which consists of 95.5 percent HMX and 4.5 percent estane 5702-F1. The mixture is a white solid with violet spots. LX-14 has a theoretical maximum density of 1.849 grams per cubic centimeter, a nominal density of 1.83 grams per cubic centimeter, and a melting point of greater than 270°C, with decomposition. The heat of formation is 1.50 kilocalories per mole. The calculated heats of detonation are 1.58 kilocalories per gram with liquid water and 1.43 kilocalories per gram with gaseous water. At a density of 1.835 grams per cubic centimeter the detonation velocity is 8,830 meters per second.

Octols are mixtures of HMX and TNT. Octol is used as an oil well formation agent and in fragmentation and shaped charges. In fragmentation tests using a 105 millimeter M1 shell, 15 percent more fragments are produced and the average velocity of the fragments is 100 meters per second faster than with a similar shell loaded with composition B. This improvement is attributed to both the higher rate of detonation of octol and the greater density of octol which permits a greater weight of explosive in the same volume.

Pentolite are castable explosive mixtures containing PETN and TNT. The most commonly used blend consists of 50/50 PETN/TNT. Other blends such as 75/25, 40/60, 30/70, and 10/90 have been occasionally employed but the 50/50 blend is superior in the characteristics of sensitivity to initiation, brisance, and suitability for melt loading. 87 percent TNT and 13 percent PETN form a eutectic with a freezing point of 76.7°C. Cast 50/50 pentolite, therefore, consists of 42.2 percent PETN, and 57.8 percent of the eutectic mixture.

Picratol is a mixture of 52 percent ammonium picrate and 48 percent TNT. Molten TNT has little or no solvent action on ammonium picrate, and consequently, cast picratol consists essentially of a physical mixture of crystals of the two explosives. The density of cast picratol is 1.61 to 1.63. This permit’s a weight of charge almost equal to that

Tetrytols are light yellow to buff mixtures of TNT and tetryl. As is the case for tetryl, tetrytols are no longer used by the United States but are still being used by other nations including various NATO allies. Tetrytols resemble tetryl more closely than they resemble TNT. They are more powerful but less sensitive than TNT. Tetrytols can be cast into munitions, which is an advantage over press loading. Table 8-73 compares the physical characteristics of various detritus compositions.

Ternary Mixtures

Amatex 20 The mixture has a nominal density of 1.61 grams per cubic centimeter and is used as a filler in ammunition items.

Amatex 20 consists of:

RDX	40 percent
TNT	40 percent
Ammonium nitrate	20 percent

Ammonal

Ammonals are mixtures containing, as principle ingredients, ammonium nitrate and powdered aluminum incorporated with high explosives such as TNT, DNT, and RDX. Powdered carbon was also used in earlier ammonals. In the ammonals that do not contain carbon, the mixture of ammonium nitrate and high explosive detonates developing a very high temperature which causes volatilization of the aluminum powder. In general, ammonals are fairly insensitive and stable mixtures but are hygroscopic due to the presence of ammonium nitrate. In the presence of moisture, ammonals react with the same metals as amatols: copper, bronze, lead, and copper plated steel.

(HTA-3) are mixtures of HMX, TNT, and aluminum

Minol-2 are mixtures of TNT, ammonium nitrate, and aluminum.

Torpex is a silvery white solid when cast. The composition of torpex is 41.6 percent RDX, 39.7 percent TNT, 18.0 percent aluminum powder, and 0.7 percent wax.

Quanternary Mixtures

Depth bomb explosive (DBX) is the only explosive covered under quanternary mixtures. DBX consists of:

TNT	40 percent
RDX	21 percent
Ammonium nitrate	21 percent
Aluminum	18 percent

Industrial Explosives

Dynamites Military operations frequently necessitate excavation, demolition, and cratering operations for which the standard high explosives are unsuited. Recourse is made to commercial and special compositions. Commercial blasting explosives, with the exception of black powder, are referred to as dynamites although in some cases they contain no nitroglycerin.

Ammonium nitrate fuel oil explosives (ANFO) When ammonium nitrate is mixed with approximately 5.6 percent of a combustible material such as fuel oil, the heat liberated on detonation is increased by almost three-fold.

Propellants

CHAPTER 9
UNITED STATES PROPELLANTS

Introduction Selection of a propellant for an application is made on the basis of the requirements of that specific application. In general, guns are designed to meet specified performance standards and withstand a specific pressure in the barrel. With a knowledge of the properties of the constituents normally used for propellants, the propellant designer creates a formulation to satisfy the performance standards and limitations of the gun. When ignited, the propellant produces large quantities of hot, gaseous products. Complete combustion or deflagration of the propellant occurs in milliseconds in guns and the pressure produced accelerates the projectile down the barrel.

Single-base propellants M1, M6, M10, and IMR.

Double-base gun propellants M2, M5, M8 and M18.

Triple-base gun propellants contain nitroguanidine as additional energizer which increases the energy content of the formulation without raising the flame temperature.

Composite propellants, used in solid fuel rockets, contain a polymer binder, a fuel, and an oxidizer.

Ball Propellants

Propellants Compounds: M1, M2, M5, M6, M8, M10, M31, M30, IMR, M18

Nitrocellulose (NC)
Nitrogen
Nitroglycerin
Barium nitrate
Potassium nitrate
Potassium sulfate
Lead carbonate
Nitroguanidine
Dinitrotoluene
Dibutylphthalate
Diethylphthalate
Diphenylamine
Ethyl centralite
Graphite
Cryolite
Ethyl alcohol (residual)

Diphenylamine, $(C_6H_5)_2NH$, is an ammonia derivative in which two of the hydrogens have been replaced by phenyl groups. Each phenyl ring has three hydrogens which can be replaced with nitro groups. Therefore, DPA can be

nitrated to the hexanitrate by absorbing the nitrogen oxides produced during the decomposition of nitrocellulose. DPA is nitrated relatively easily and the reaction is not exothermic. During the decomposition of nitrocellulose, DPA nitrates to the following compounds in succession.

N-nitrosodiphenylamine
2-nitrodiphenylamine
4-nitrodiphenylamine
N-nitroso-2-nitrodiphenylamine
N-nitroso-4-nitrodiphenylamine
4,4', 2,4', 2,2', and 2,4-dinitrodiphenylamines
N-nitroso-4, 4'-dinitrodiphenylamine
N-nitroso-2, 4'-dinitrodiphenylamine
2, 4, 4' and 2, 2', 4-trinitrodiphenylamines
2,2', 4,4'-tetranitrodiphenylamine
2,2', 4,4', 6-pentanitrodiphenylamine
Hexanitrodiphenylamine

The propellant does not start to become unstable until most of the diphenylamine has been converted to hexanitrodiphenylamines. A very accurate test to measure the remaining safe storage life in a propellant lot is to analyze the distribution profile of the nitro DPAs. Only about one percent DPA can be added to a propellant because its nitrated products change the ballistic properties.

Centralite I (which is also called ethyl centralite or symmetrical diethyldiphenylurea), $OC[N-(C_2H_5)(C_6H_5)]_2$, was developed in Germany for use in double base propellants. The compound acts as a stabilizer, gelatinizer, and waterproofing agent. Unlike diphenylamine, centralite can be used in relatively large proportions and some propellant compositions contain as much as eight percent of this material. Like diphenylamine, centralite is nitrated by the products of nitrocellulose decomposition. The following compounds are formed successively, as many as four being present simultaneously, as deterioration of the powder proceeds.

4-nitrocentralite
4,4' dinitrocentralite
N-nitroso-N-ethylaniline
N-nitroso-N-ethyl-4-nitraniline
2,4, dinitro-N-ethyl-aniline

Centralite II (which is also called methyl centralite or symmetrical dimethyl diphenylurea), $OC[N(CH_3)(C_6H_5)]_2$, also has been used as a stabilizer but is not considered to be as effective as the ethyl analogue

Three akardites, or acardites, are used to stabilize propellants. Akardite II is often used in DEGN containing propellants.

Pyrotechnic Devices

Military Explosives (Chemistry) 30 September 1984

CHAPTER 10
UNITED STATES PYROTECHNICS

Pyrotechnics are used to send signals, to illuminate areas of interest, to simulate other weapons during training, and as ignition elements for certain weapons.(1)

All pyrotechnic compositions contain oxidizers and fuels. Additional ingredients present in most compositions include binding agents, retardants, and waterproofing agents. Ingredients such as smoke dyes and color intensifiers are present in the appropriate types of compositions.

Oxidizers: are substances in which anoxidizing agent is liberated at the high temperatures of the chemical reaction involved.

Fuels: include finely powdered aluminum, magnesium, metal hydrides, red phosphorus, sulfur, charcoal, boron, silicon, and suicides. The most frequently used are powdered aluminum and magnesium.

Binding agents: include resins, waxes, plastics, and oils. These materials make the finely divided particles adhere to each other when compressed into pyrotechnic items.

Retardants are materials that are used to reduce the burning rate of the fuel-oxidizing agent mixture, with a minimum effect on the color intensity of the composition.

Waterproofing agents are necessary in many pyrotechnic compositions because of the susceptibility of metallic magnesium to reaction with moisture, the reactivity of metallic aluminum with certain compounds in the presence of moisture, and the hygroscopicity of nitrates and peroxides.

Color intensifiers:

hexachloroethane (C2CI6)
hexachlorobenzene (C6CI6)
polyvinyl chloride
dechlorane (C1oCI12).

Smoke dyes are azo and anthraquinone dyes. These dyes provide the color in smokes used for signaling, marking, and spotting.

Flares and Signals The illumination provided by a flare is produced by both the thermal radiation from the product oxide particles and the spectral emission from excited metals.

Infrared Flare Formulas:

Silicon
KNO3
CsNO3
RbNO3
Hexamethylene
tetramine
Epoxy resin

Red-Green Flare System:

Barium nitrate
Strontium nitrate 13
Potassium perchlorate
Magnesium
Dechlorane
Polyvinyl acetate resin

Signal flares are smaller and faster burning than illuminating flares. Various metals are added these compositions to control the color of the flame.

Colored and White Smoke The pyrotechnic generation of smoke is almost exclusively a military device for screening and signaling. Screening smokes are generally white because black smokes are rarely sufficiently dense. Signal smokes, on the other hand, are colored so as to assure contrast and be distinct in the presence of clouds and ordinary smoke.

Venturi thermal generator type. The smoke producing material and the pyrotechnic fuel block required to volatilize the smoke material are in separate compartments. The smoke producing material is atomized and vaporized in the venturi nozzle by the hot gases formed by the burning of the fuel block.

Burning type. Burning type smoke compositions are intimate mixtures of chemicals. Smoke is produced from these mixtures by either of two methods. In the first method, a product of combustion forms the smoke or the product reacts with constituents of the atmosphere to form a smoke. In the second method, the heat of combustion of the pyrotechnic serves to volatilize a component of the mixture which then condenses to form the smoke. White phosphorus, either in bulk or in solution, is one example of the burning type of smoke generator.

Explosive dissemination type. The smoke producing material is pulverized or atomized and then vaporized, or a pregound solid is dispersed by the explosion of a bursting charge. The explosive dissemination smoke generator may contain metallic chlorides which upon dispersal, hydrolyze in air. Examples are titanium, silicon, and stannic tetrachloride.

Smoke Agent Mixtures:

White phosphorus
Sulfur trioxide

FS agent
HC mixture
FM agent
Crude oil

The preferred method of dispersing colored smokes involves the vaporization and condensation of a colored organic volatile dye. These dyes are mixed to the extent of about 50 percent with a fuel such as lactose (20 percent) and an oxidizer (30 percent) for which potassium chlorate is preferred.

Tracers and Fumers The principal small arms application of military pyrotechnics is in tracer munitions where they serve as incendiaries, spotters, and as fire control. Two types of tracers are used. The difference between the two types is the method of tracking. The more frequently used tracer uses the light produced by the burning tracer composition for tracking. Smoke tracers leave a trail of colored smoke for tracking. Red is the flame color most often employed in tracers.

Igniter and Tracer Compositions

Strontium peroxide
Magnesium
1-136 Igniter
Calcium resinate
Barium peroxide
Zinc stearate
Toluidine red (identifier)
Strontium nitrate
Strontium oxalate
Potassium perchlorate
Polyvinyl chloride

Incendiaries Two types of incendiaries are commonly used. The traditional type is a bomb containing a flammable material. These materials include thermite (a mixture of aluminum and rust), phosphorus, and napalm. In addition, the case of the bomb may be constructed of a material such as magnesium that will burn at a high temperature once ignited.Depleted uranium is used extensively in pyrotechnics which have armor piercing capabilities.

Depleted uranium deficient in the more radioactive isotope U235, is the waste product of the uranium enrichment process. The depleted uranium is formed into projectiles that can penetrate armor because of their high density and mechanical properties. The impact of the projectile causes the uranium to form many pyrophoric fragments which can ignite fuel and munition items.

Pyrophoric Metals

U	Uranium
Th	Thorium
Zr	Zirconium
Hf	Hafnium

Ce Cerium
La Lanthanum
Pr Praseodymium
Nd Neodymium
Sm Samarium
Y Yttrium
Ti Titanium

Delays and Fuses Delay compositions are mixtures of oxidants and powdered metals which produce very little gas during combustion.

Photoflash Compositions Photoflash compositions are the single most hazardous class of pyrotechnic mixtures. The particle size of the ingredients is so small that burning resembles an explosion. The various photoflash devices are similar, differing principally in size and the amount of delay.

Colored smokes:

Yellow: Auramine hydrochloride
Green: 1,4-Di-p-toluidinoanthraquinone with auramine hydrochloride
Red: 1-Methylanthraquinone
Blue: Not suitable for signaling because of excessive light scatter.

Currently used dyes:

Orange: 1-(4-Phenylazo)-2-naphthol
Yellow: N, N-Dimethyl-p-phenylazoaniline
Blue: 1,4-Diamylaminoanthraqdinone

Black Powders Used in Pyrotechnics

Potassium nitrate
Sodium nitrate
Charcoal
Coal (semibituminous)
Sulfur

Ignition Mixtures Components

Aluminum (powdered)
Ammonium dichromate
Asphaltum
Barium chromate
Barium peroxide
Boron (amorphous)
Calcium resinate
Charcoal
Diatomaceous earth (See also superfloss)
Fe203 (Red)
Fe304 (Black)
Potassium nitrate
Potassium perchlorate

Laminac
Magnesium (powdered)
Sodium nitrate
Nitrocellulose
Parlon (chlorinated rubber)
Pb02 -
Pb304
Sr peroxide
Sugar
Superfloss
Titanium
Toluidine red toner
Vegetable oil
Vistanex (polyisobutylene)
Zinc Stearate
Zirconium

Table 4. Pyrotechnic Munitions Chemicals

Chemicals found in practice and pyrotechnic munitions [1 2]

Aluminum	Copper powder	Potassium chromate
Ammonium chloride	Chlorinated rubber (Parlon)	Potassium chlorate
Ammonium perchlorate	Cupric oxide	Polyvinyl acetate
Amorphous boron	Cuprous chloride	Polyvinylchloride (PVC)
Antimony sulfide	Calcium silicide	Perchlorate
Antimony metal powder	Cellulose-nitrate-plastic	Potassium dichromate
Anthracene	Dichloromethane	Potassium perchlorate
Asphaltum	Gilsonite	Resin (laminac)
Barium nitrate	Graphite	Red phosphorous
Barium chromate	Hexachlorobenzene	Selenium
Barium chlorate	Hexachloroethane (HC)	Sodium oxalate
Barium peroxide	Iron oxide	Sodium bicarbonate
Barium sulfate	Infusorial earth	Stearic acid
Bismuth tetroxide	Lead dioxide	Strontium nitrate
Butyl rubber	Lithium peroxide	Strontium carbonate
Calcium resinate	Lithium perchlorate	Strontium nitrate
Calcium fluoride	Magnesium	Strontium peroxide
Carbon tetrachloride	Magnese dioxide	Shellac
Calcium metal	Mercurous chloride	Tellurium
Cobalt naphthenate	Polyisobutylene (vistanex)	Titanium
Copper carbonate	Potassium iodate	Tungsten
Zirconium hydride	Zinc stearate	White phosphorous
Polychlorotrifluoroethylene	Manganese	Magnesium aluminum
Lead monoxide	Lead chromate	Diatomaceous Earth
Saltpeter	Cupric Oxide	Charcoal
Calcium Resinate	Sulphur	Calcium Phosphide
Red Gum	Barium Oxalate	Adhesive, Dextrin
Dextrin	Ammonium Nitrate	Orange Shellac
Auramine Hydrochloride	Stearin	Arsenic Disulphide

Dyes

1-(2-Methoxyphenylazo)-2-Napthol Sudan Red G	4-Dimethylamino Azobenzene
1, 4 Dimethylamino Anthraquinone Fast Blue B	1, 4 Diphenyl Toluidino Anthraquinone
2-(4-Dimethylamino Phenylazo) Napthalene	1-Amino Anthraquinone Fast Red A1
Indanthrene Dye Golden Yellow GKAC	4-Methylamino Anthraquinone

[1] Book: Military Pyrotechnics, 1919; Henry B. Faber; Dean of Pyrotechnic Schools Ordnance Department U.S. Army

[2] Book: Military and Civilian Pyrotechnics, 1968; Dr. Herbert Ellern

Table 5. 23 Pyrotechnic munitions chemicals also used as Pesticides

Chemical		CAS	Pesticide/Biocide/Repellant
Arsenic sulfide	12344-68-2	12612-21-4	Herbicide, Insecticide, Rodenticide
Ammonium Nitrate		6484-52-2	Microbiocide, Rodenticide
Ammonium Chloride		12125-02-9	Algaecide, Microbiocide
Anthracene		120-12-7	Herbicide, Insecticide, Rodenticide
Barium nitrate		10022-31-8	Repellant
Calcium phosphide		1305-99-3	Rodenticide
Carbon tetrachloride		56-23-5	Fumigant,
Cobalt naphthenate		61789-51-3	Fungicide, Insecticide
Copper powder		7440-50-8	Fungicide,
Copper carbonate		12069-69-1	Algaecide, Fungicide, Insecticide
Cupric oxide		1317-38-0	Fungicide, Insecticide
Cuprous chloride		7758-89-6	Fungicide
Dichloromethane		75-09-2	Dog and Cat Repellant
Diatomaceous Earth		61790-53-2	Insecticide, Molluscicide
Iron oxide		1309-37-1	Herbicide
Potassium chlorate		3811-04-9	Defoliant, Herbicide, Microbiocide
Saltpeter		7757-79-1	Microbiocide, Rodenticide
Sodium bicarbonate		144-55-8	Fungicide
Sodium oxalate		62-76-0	Microbiocide
Sulphur		7704-34-9	Fungicide, Insecticide
Stearic acid		57-11-4	Adjuvant
Naphthalene (smoke dye)		91-20-3	Insecticide, insect repellant
Anthraquinone (smoke dye) (found in 4 smoke dye formulas)		84-65-1	Bird Repellant

Note: May explain why training areas are devoid of a robust insect and bird population.

Pesticide Use Information Source:
Pesticide Action Network North America: www.pesticideinfo.org/Search_Chemicals.jsp

Table 6. Pesticides known to have been used at Fort Ord

(potentially used in all training areas)

48 Pesticides known as used at Fort Ord

Calcium Cyanide Gas	Mercury	DDT
DDD	DDE	2,4-D
Malathion	Chlordane	Dieldrin
Warfarin	Diazinon	Baygon
Altosid SR-10	Tordon 101	Hyvar X
Sevin (Carbyrl Dust)	1080	Diphacinone
Chlorophacinone	Zinc Phosphide	Endrin
Heptachlor Epoxide	Gamma-BHC	Derzan-T
Derzvan	Methyl Bromide	Cyntroid 3-EC
Pyrethrum	Permaguard	Ficam W
Gophercide	Diphacin	Weed-Rhap LY-4P
Monuron	Ded-Weed Silvex LV	Simazine
Aertex	Paraquat CL	Betasan
Trexsan	Amino Triazole	Amitrol-T
Diquat	Tok-E-25	Surflan
Enide	Metalde HTDE	Arochlor 1254
Banvel		

Note: Pesticides where applied to training areas for decades. Pesticides were applied by air and ground to manage pests (rodents, insects, fungi, and vegetation) the extent of which is unknown.

Former Fort Ord Pesticide Use; Research Documents:

Available at Fort Ord Administrative Record ; http://fortordcleanup.com/adminrec/arsearch.asp
enter record number, example: BW-0013

1) Fort Ord Installation Assessment 1983; BW-0013, pesticide types and uses
2) Fort Ord Base Closure Preliminary Assessment1990; BW-2427, pesticide types and uses
3) Fort Ord Literature review and Base Inventory Report Vol I, 1991; RI/FS BW-0136
4) Fort Ord Basewide Background Soil Investigation draft 1992; BW-0289
5) Fort Ord Basewide Background Soil Investigation draft final 1993; BW-0352
6) Fort Ord Basewide Background Soil Investigation final 1995; BW-1283E Basewide RI/FS
7) Fort Ord 2003 Burn ATSDR Health Consultation; OE-0522

Table 7. Munitions Chemicals looked for in training areas transferred to the Fort Ord Reuse Authority (FORA) for development

All these development parcels are known training areas

Historical Area (HA) Training Areas and total chemicals looked for:

HA-161,CSUMB Booby Traps, Mines, Projectiles, Pyrotechnics - Development

TPH-Diesel	TPH-Motor Oil	Bis(2-ethylhexyl)phthalate
TPH-Gasoline	Di-n-butyl phthalate	Di-n-octylphthalate
Antimony	Copper	Lead
Cadmium		

HA-175, OE-45 Tactical Training Area - Development

No Sampling Required

HA-103, OE-13B Mortar Range / Parker Flats portion - MST/Horse Park Development

No Sampling Required: based on off-site sampling results

HA-110, DRO.1 Site 39 Multi-use Training/Impact Area - Del Rey Oaks Development

No Sampling Required: based on off-site sampling results

HA-111, DRO.2 Site 39 Multi-use Training/Impact Area - Del Rey Oaks Development

No Sampling Required: based on off-site sampling results

HA-112, SEA.1 Site 39 Multi-use Training/Impact Area - Seaside Development

No Sampling Required: based on "no stressed vegetation or impacts to soil"

HA-112, SEA.2 Site 39 Multi-use Training/Impact Area - Seaside Development

No Sampling Required: based on "no stressed vegetation or impacts to soil"

HA-112, SEA.3 Site 39 Multi-use Training/Impact Area - Seaside Development

No Sampling Required: based on "no stressed vegetation or impacts to soil"

HA-112, SEA.4 Site 39 Multi-use Training/Impact Area - Seaside Development

No Sampling Required: based on "no stressed vegetation or impacts to soil"

HA-116, MOCO1 Site 39 Multi-use Training/Impact Area - Monterey Co Development

No Sampling Required: based on "no MEC was identified during sampling"

HA-117, MOCO2 Site 39 Multi-use Training/Impact Area - Monterey Co Development

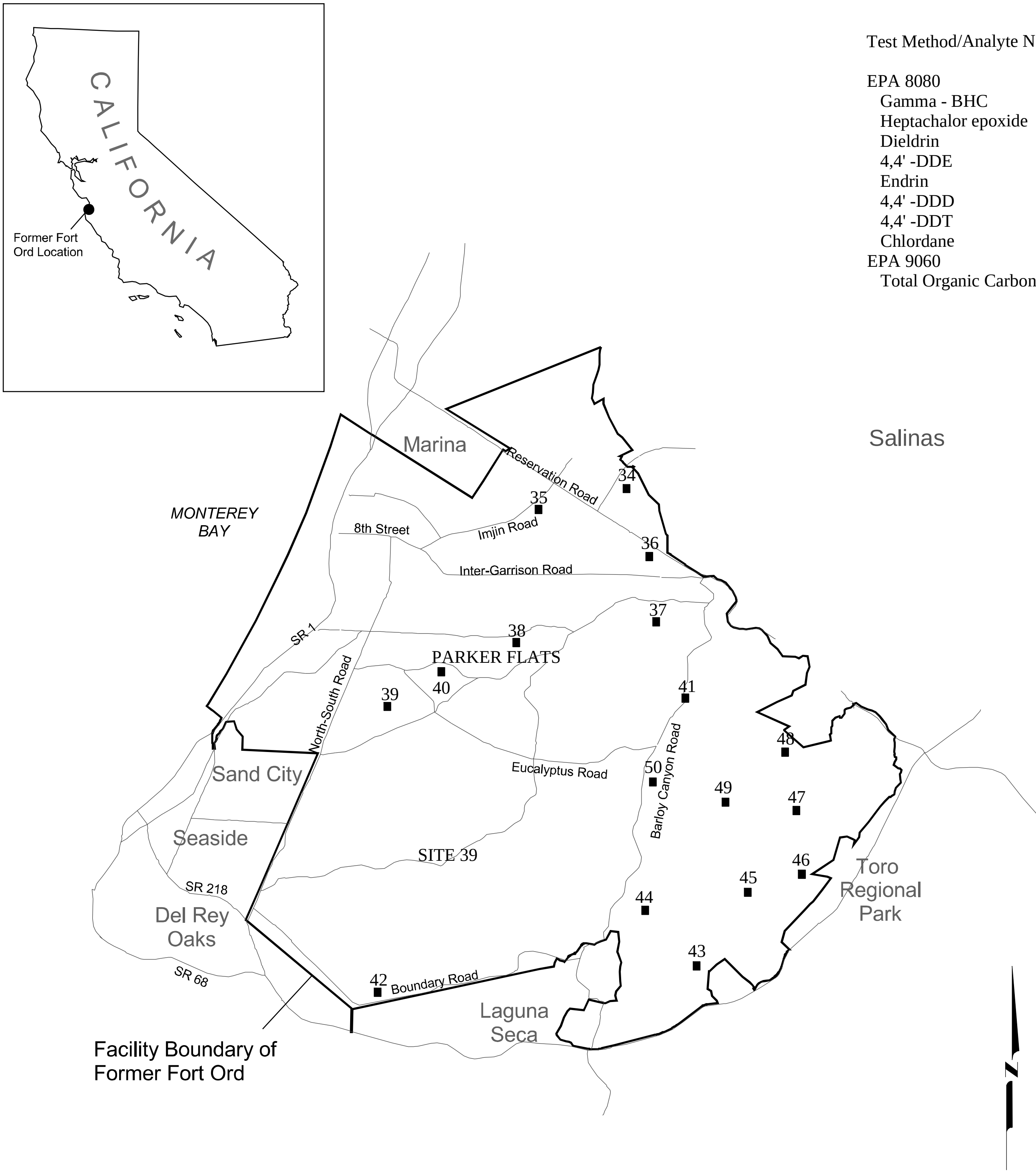
Antimony	Copper	Lead

HA-118, Site 39 Site 39 Impact Area - Habitat Management Area

2,4,6-Trinitrotoluene	2-Amino-trinitrotoluene	4-Amino-dinitrotoluene
HMX	RDX	1,3,5-Trinitrobenzene
Tetryl		

Note: Pyrotechnics were used day and night, over a 77 year period. Pyrotechnics were used for all types of troops training including non-live fire, live-fire, bivouac, and maneuvers activities.

Compiled from Fort Ord documents AR BW-2300J, Basewide Range Assessment Reports Final 2009



Test Method/Analyte Name

EPA 8080
Gamma - BHC
Heptachalor epoxide
Dieldrin
4,4' -DDE
Endrin
4,4' -DDD
4,4' -DDT
Chlordane
EPA 9060
Total Organic Carbon

■ Approximate On Base Soil Sample Locations

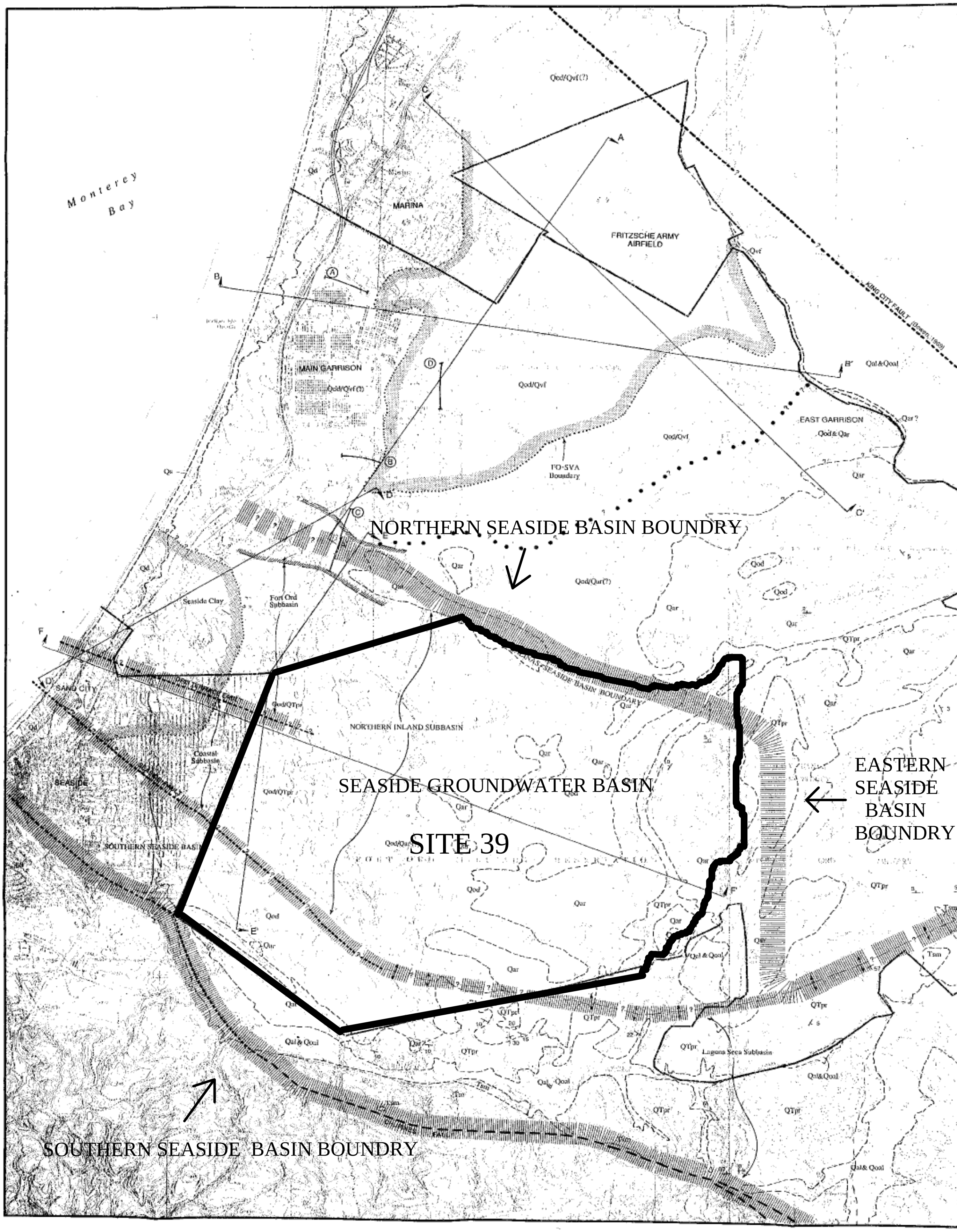
Note: Map generated from Fort Ord cleanup documents

10000 0 10000 Feet

Pesticide Sampling
Fort Ord RI/FS 1995, Vol II - Remedial Investigation
Basewide Background Soil Investigation
BW-1283E

SEASIDE GROUNDWATER BASIN / SITE 39 IMPACT AREA

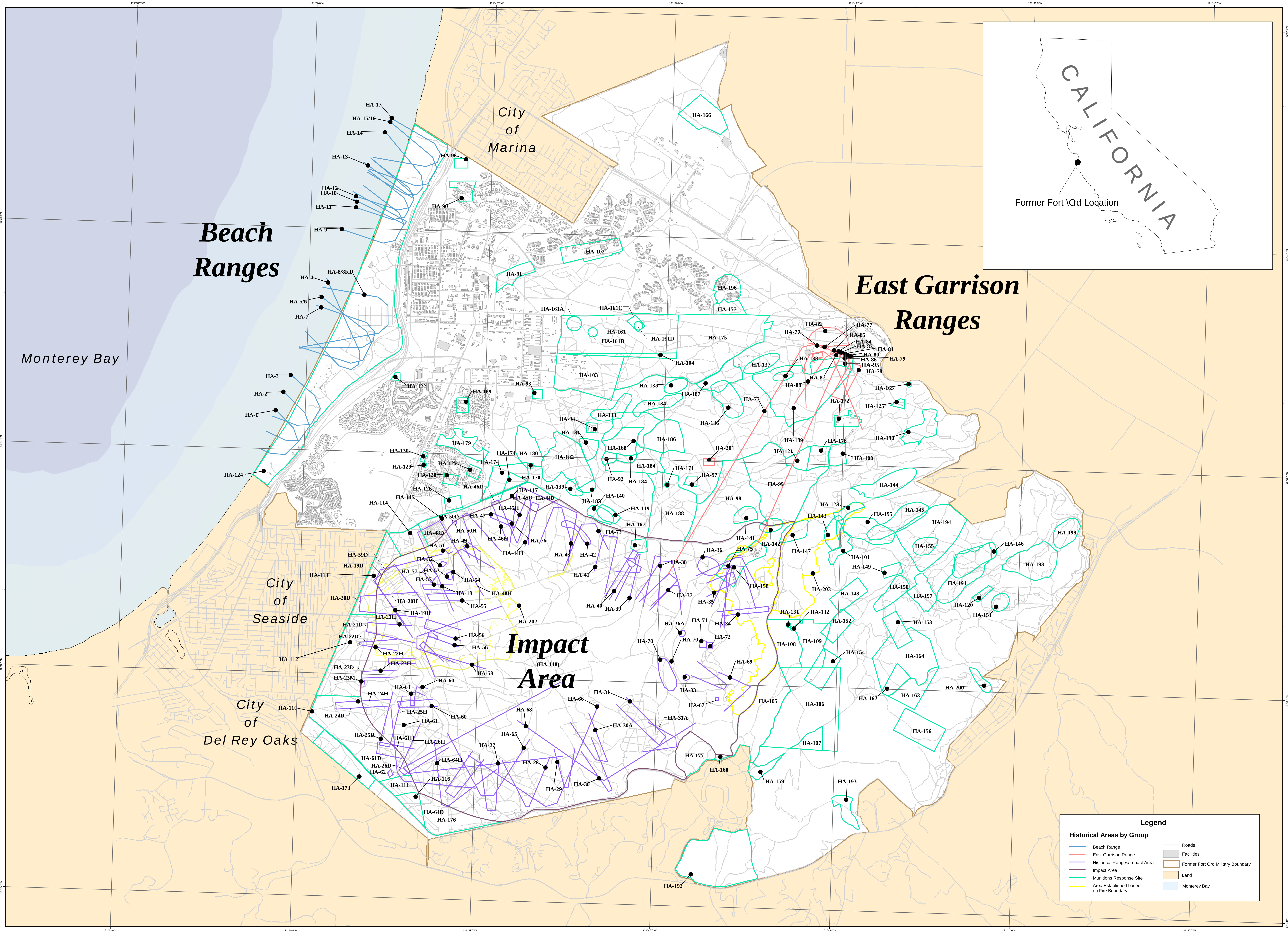
Basewide Hydrogeologic Characterization
BW-0608 PLATE 3



SITE 39 BOUNDRY (8000 Acres, one of the countries largest munitions training areas.)

SEASIDE GROUNDWATER BASIN BOUNDRY (Supplies City of Seaside drinking water.)

Where did all the munitions chemicals go? What chemicals where looked for? What where the actual chemical detection levels?



NO.	DATE	REVISIONS	BY	CHK

DESIGNED:
DRAWN: JCF
APPROVED: BF
DATE: 11/2006

PROJECT NO: 4087040806 02A
SCALE: 1" = 1750'
CHECKED: WF
DATE: 11/2006

MACTEC

Historical Areas, Investigation Status

FORMER FORT ORD, CALIFORNIA

Historical Areas of the Former Fort Ord
Characterization of Historical Areas
by Group

PLATE 1.1
SHEET
REVISION NUMBER A
DATE

Fort_Ord_GIS - Plate_1_1_HA_categorization_by_group.mxd

MONTEREY COUNTY
RESOURCE MANAGEMENT AGENCY
Carl P. Holm, AICP, Director

LAND USE & COMMUNITY DEVELOPMENT | PUBLIC WORKS & FACILITIES | PARKS
1441 Schilling Place, South 2nd Floor (831)755-4800
Salinas, California 93901-4527 www.co.monterey.ca.us/rma

June 14, 2019

Rachel Gaudoin
Monterey One Water
Rachel@my1water.org

EMAIL LETTER

Subject: Monterey County RMA Comments on NOP for the Supplemental EIR for the Expansion of PWM/GWR

Dear Ms. Gaudoin,

Thank you for the opportunity to review the Notice of Preparation for the Supplemental EIR for the Expanded Pure Water Monterey Groundwater Replenishment Project (PWM GWR). Monterey County RMA has reviewed the NOP with our various agencies and has specific input from RMA-Public Works and from the Monterey County Agricultural Commissioner's office.

From the department of Public Works:

The RMA-Public Works (RMA-PW) has reviewed the Notice of Preparation of Supplemental EIR for the Pure Water Monterey Groundwater Replenishment project. With exception of the Marina Landfill location, none of the proposed facilities appear to affect County roadways. Therefore, RMA-PW has no additional comment.

Please see the attached memo from the Monterey County Agricultural Commissioner's office with their comments on the NOP.

All other Monterey County RMA agencies did not have comments on the NOP.

We look forward to reviewing the supplemental EIR when available.

Sincerely,

Cheryl Ku, Senior Planner
Monterey County Resource Management Agency
kuc@co.monterey.ca.us
(831) 796-6049

MONTEREY COUNTY

AGRICULTURAL COMMISSIONER/SEALER OF WEIGHTS & MEASURES
HENRY S. GONZALES, AGRICULTURAL COMMISSIONER/SEALER
1428 ABBOTT STREET - SALINAS, CALIFORNIA 93901
PHONE: (831) 759-7325 FAX: (831) 422-5003
WEBSITE: ag.co.monterey.ca.us

TO: Cheryl Ku

FROM: Shandy Carroll, Agricultural Resources and Policy Manager

DATE: 6/12/2019

SUBJECT: Comments on scope and content of Pure Water Monterey project supplemental EIR

Dear Ms. Ku,

Thank you for the opportunity to comment on the scope and content of the proposed Pure Water Monterey project supplemental EIR. Because the proposed expanded pipelines will run adjacent to agricultural land, we ask for the following question to be addressed by the supplemental EIR:

1. What is the risk to pipes breaking and causing flooding to neighboring agricultural land?
2. What processes will be put in place to prevent flooding from a broken pipe?

We look forward to reviewing the supplemental EIR when available.

MONTEREY COUNTY

WATER RESOURCES AGENCY

PO BOX 930
SALINAS, CA 93902
(831) 755-4860
FAX (831) 424-7935

SHAUNA LORANCE
INTERIM GENERAL MANAGER

STREET ADDRESS
1441 SCHILLING PLACE, NORTH BUILDING
SALINAS, CA 93901

June 7, 2019

Monterey One Water
ATTN: Rachel Gaudoin
5 Harris Ct., Bldg. D
Monterey, CA 93940
Email: purewatermontereyinfo@my1water.org

VIA ELECTRONIC MAIL

RE: Expanded Pure Water Monterey Groundwater Replenishment Project
Notice of Preparation of a Supplemental Environmental Impact Report

Dear Ms. Gaudoin:

The Monterey County Water Resources Agency (MCWRA) received the above-referenced Notice of Preparation dated May 15, 2019. Thank you for the opportunity to review and comment on the subject document. The MCWRA has worked closely with Monterey One Water on the development of the Pure Water Monterey Groundwater Replenishment Project. The project will provide additional recycled water to MCWRA's Castroville Seawater Intrusion Project (CSIP), providing irrigation water to agricultural lands in the coastal region. Our two agencies have memorialized the terms of this project in the Amended and Restated Water Recycling Agreement which covers existing source water facilities and usage as well as new source water facilities and usage. The MCWRA recognizes the need to reduce pumping of the Carmel River and supports the collaboration efforts between the agencies in finding additional sources of water.

In preparation of the Supplemental EIR, MCWRA recommends that a thorough water balance analysis occur to support the project recommendations for expansion of the PWM facilities. This analysis should be consistent with the Amended and Restated Water Recycling Agreement terms of water use priorities and allocations as well as other contractual rights to source water. The MCWRA's State Water Resources Control Board's Appropriative Water Rights for Blanco Drain and Reclamation Ditch that are being utilized for this project should also be included to ensure full compliance will all terms and conditions. MCWRA also recommends a water quality analysis of the agricultural wash water as a new source water, specifically what is included in the pre-treatment program and any necessary modifications to the existing secondary or tertiary treatment processes used in recycling the water.

As we are interested in continuing our collaboration efforts on all of our project, please include the MCWRA in any future meetings or hearings related to the project. The MCWRA looks forward to reviewing the Supplemental Environmental Impact Report. Please feel free to contact

Shaunna Murray of my staff with any questions at 831-755-4865 or MurraySL@co.monterey.ca.us. We look forward to continuing to work with you on this important project.

Sincerely,

Shauna Lorance
Interim General Manager

Seaside Basin Watermaster
P.O. Box 51502
Pacific Grove, CA 93950
(831) 641-0113

June 5, 2019

Monterey One Water
Attention: Rachel Gaudoin
5 Harris Court, Building D
Monterey, CA 93940

Subject: Notice of Preparation - Expanded Pure Water Monterey Groundwater Replenishment Project

Dear Ms. Gaudoin:

The Watermaster is the Court-appointed body responsible for ensuring that the Seaside Groundwater Basin is managed in accordance with the requirements set forth in the Seaside Basin Adjudication Order (Superior Court of the State of California in and for the County of Monterey, Case No. M66343). The Seaside Basin is the groundwater basin into which the proposed Project will inject advance treated wastewater for groundwater replenishment.

The Watermaster is submitting these comments regarding the Notice of Preparation.

Groundwater modeling was performed for the Watermaster by HydroMetrics LLC to determine the most effective location for injection wells to help bring groundwater levels up to what is referred to as "protective elevations." A protective elevation at a well location means that the groundwater level is high enough to prevent seawater intrusion from occurring in that location. This modeling work is described in the report titled "*Groundwater Modeling Results of Coastal Injection in the Seaside Basin,*" dated July 19, 2013. A copy of the report is attached.

These are some of the pertinent findings of that report:

1. All of the report's findings and conclusions are based on the assumption that California American Water's replenishment repayment program of forgoing 700 AFY of pumping for a period of 25 years is being carried out.
2. Coastal groundwater levels in the Santa Margarita aquifer reach protective groundwater level elevations one to ten years faster, and with less injected water, if injection is performed near the coast rather than inland at the General Jim Moore Boulevard ASR well locations.
3. Coastal groundwater levels in the Paso Robles aquifer reach protective water level elevations at similar times with injection at either the coastal or General Jim Moore Boulevard locations.
4. In order to achieve protective water level elevations in all six of the coastal wells for which protective water levels were developed, over a 25-year injection period only 850 AFY of injection is required using coastal injection wells compared to 1,000 AFY required at the General Jim Moore Boulevard ASR well locations.
5. Injection rates higher than those mentioned in item 4 above would shorten the time needed to achieve protective water level elevations.

6. After coastal protective water level elevations are achieved, injection of 850 AFY would need to be continued indefinitely at coastal injection wells in order to keep groundwater levels above protective water level elevations.

The report shows that injection of water nearer the coast, rather than inland in the vicinity of General Jim Moore Boulevard, provides greater benefit to the Seaside Basin. Therefore, the Watermaster requests that installation of injection wells for the Project nearer the coast be evaluated and given serious consideration within the scope of the environmental document.

If you have any questions regarding these comments, please contact our Technical Program Manager, Mr. Robert Jaques, at (831) 375-0517 or by his email at bobj83@comcast.net.

Sincerely,

Robt S. Jaques

Robert S. Jaques
Technical Program Manager

HydroMetrics WRI

519 17th Street, Suite 500
Oakland, CA 94612

TECHNICAL MEMORANDUM

To: Seaside Groundwater Basin Board of Directors

From: Georgina King and Derrik Williams

Date: July 19, 2013

Subject: Groundwater Modeling Results of Coastal Injection in the Seaside Basin

1.0 BACKGROUND AND MODELING OBJECTIVES

Recent modeling work in the Seaside Basin has focused on recharging the basin at inland injection locations to increase groundwater levels above protective elevations. The Seaside Groundwater Basin Board of Directors requested that injection at coastal locations be assessed to determine if there is an advantage over inland injection. Seven model scenarios were developed and run to evaluate injection locations and injection rates required to achieve protective groundwater elevations within specified time frames.

The seven simulations are intended to provide bounding estimates and general guidance regarding the impacts from coastal injection and inland injection. The simulations are not intended to represent any particular project. Results of these simulations could inform initial project discussions, but should not be used to support final project descriptions.

2.0 MODEL SCENARIOS

To determine whether coastal injection could achieve protective groundwater elevations more quickly than inland locations, and whether less imported water could be used to reach protective elevations, seven new model scenarios were developed.

The seven coastal injection model scenarios were compared with an inland injection scenario, referred to as Scenario 0. Scenario 0 is a previously modeled scenario that is described in the April 4, 2013 Technical Memorandum: Groundwater Modeling Results of Replenishment Repayment in the Seaside Basin (HydroMetrics WRI, 2013). This scenario represented inland injection using existing ASR wells.

Each of the seven model scenarios simulated injection at one of two potential coastal injection sites (Figure 1). The Seaside-Highlands Storm Water Pond site, is immediately north of Seaside High School and monitoring well PCA-E. This location was selected because it is adjacent to the pumping depression in the deep aquifer and access to this site is possible (Figure 1). The MRWPCA South location was presented by Bob Holden at the May 2013 Technical Advisory Committee meeting. The southernmost of the MRWPCA sites was selected as a potential injection site because it is closer to the deep aquifer pumping depression (Figure 1). The injection well for this location was placed at the southernmost portion of the site outlined on Figure 1. The two injection locations are approximately 2,000 feet apart.

Only one injection well was modeled in each scenario because the injection required could be achieved by one well, or at the most, two wells within the same model cell. The in-well flow dynamics were not modeled in these scenarios, and water pressures in the injection wells were not a point of concern for this exercise. The number of wells and injection rates must be further analyzed for any managed aquifer recharge project.

The baseline simulation used to compare the results from coastal and inland injection was the 25 year California American Water (Cal-Am) replenishment scenario that was modeled previously (HydroMetrics WRI, 2013). In the baseline simulation, Cal-Am pumps only 774 acre-feet per year (AFY) of its assumed natural safe yield of 1,474 AFY beginning in January 2017. The 700 acre-feet (AF) of natural safe yield not being pumped over the 25 year period is Cal-Am's replenishment repayment. Consistent with the previous modeling of Cal-Am's replenishment repayment plant, the reduced pumping is distributed among Cal Am wells relative to the amount each well pumps as a percentage of monthly pumping.

This baseline simulation was selected because it includes important operational changes that are planned to be implemented. For the scenarios, coastal injection was added to this baseline simulation. December 2016 was the starting date for the model to simulate injection. The start of replenishment repayment is January 2017, but the start date of injection is December 2016 because December is the starting month of each year's injection cycle. December 2016 was chosen to begin additional injection because it is the injection cycle start date that is closest to January, 2017.

Water was injected into the lowest model layer (layer 5) which represents the Santa Margarita aquifer. A summary of the model scenarios are provided in Table 1. Modeling results would generally be the same if the injection and other operational changes mentioned above were delayed; with the dates shown on the time scales in the figures and cited in the tables commensurately delayed. Some small differences would be expected from a delayed project based on the timing of simulated wet years and dry years.

Table 1: Summary of Model Scenarios

Scenario	Description
0	Inject 1,000 AFY for 25 years into existing ASR wells at inland location along General Jim Moore Blvd, from December through May (previously modeled as Scenario 3 in the April 4, 2013 Tech Memo, HydroMetrics WRI, 2013)
1	Inject 1,000 AFY for 25 years at the Seaside-Highlands Storm Water Pond location from December through May
2	Inject 1,000 AFY at the Seaside-Highlands Storm Water Pond location year round
3	Inject 1,000 AFY for 25 years at the southern-most MRWPCA coastal location from December through May
4	Iteratively simulate various injection rates at the Seaside-Highlands Storm Water Pond location until protective elevations in all six protective groundwater elevation monitoring wells are achieved within 25 years (by 2041). Injection occurs between December and May.
5	Iteratively simulate various injection rates at the Seaside-Highlands Storm Water Pond location until protective elevations in three deep protective groundwater elevation monitoring wells are achieved within five years (December, 2021). Injection occurs between December and May
6	After protective elevations are reached in Scenario 1, iteratively estimate the injection rate required to sustain groundwater levels in the three deep protective groundwater elevation monitoring wells above protective elevations
7	After protective elevations are reached in Scenario 5, iteratively estimate the injection rate required to sustain groundwater levels in the three deep protective groundwater elevation monitoring wells above protective elevations

AFY = acre-feet per year

3.0 MODEL RESULTS

Model results are analyzed through simulated well hydrographs, groundwater contour maps, and estimated outflows to the ocean. Hydrographs for each of the six protective groundwater elevation monitoring wells are provided on Figure 2 through Figure 4. The six protective groundwater elevation monitoring wells are the six wells in the annual Seawater Intrusion Analysis Reports that are analyzed for evidence of seawater intrusion. Each hydrograph includes the predicted groundwater elevations for each model scenario and the baseline simulation. These hydrographs are compared to the protective groundwater elevation established for each well. A discussion of the results for the model scenarios is presented in the sections below.

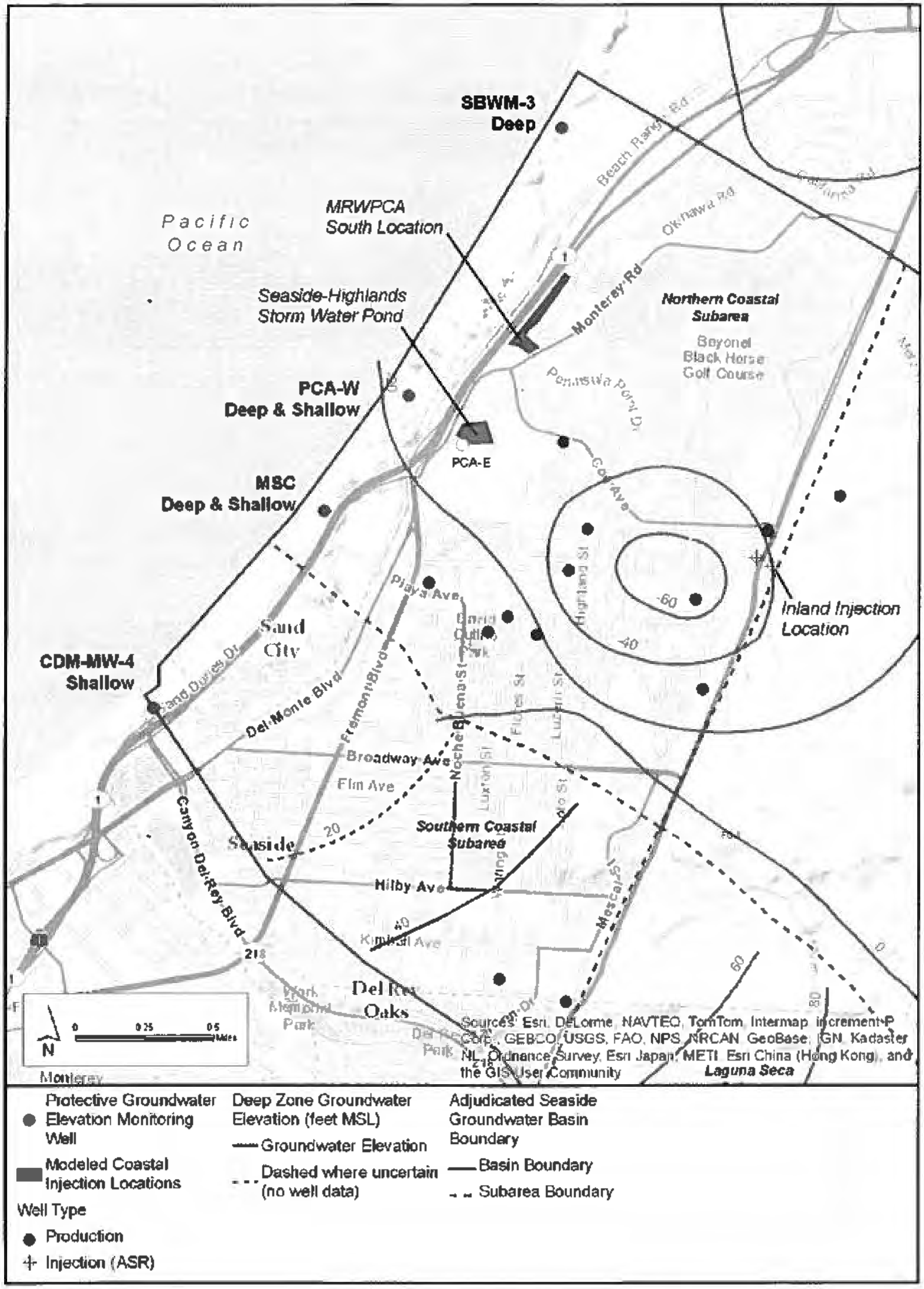


Figure 1: Modeled Injection Locations

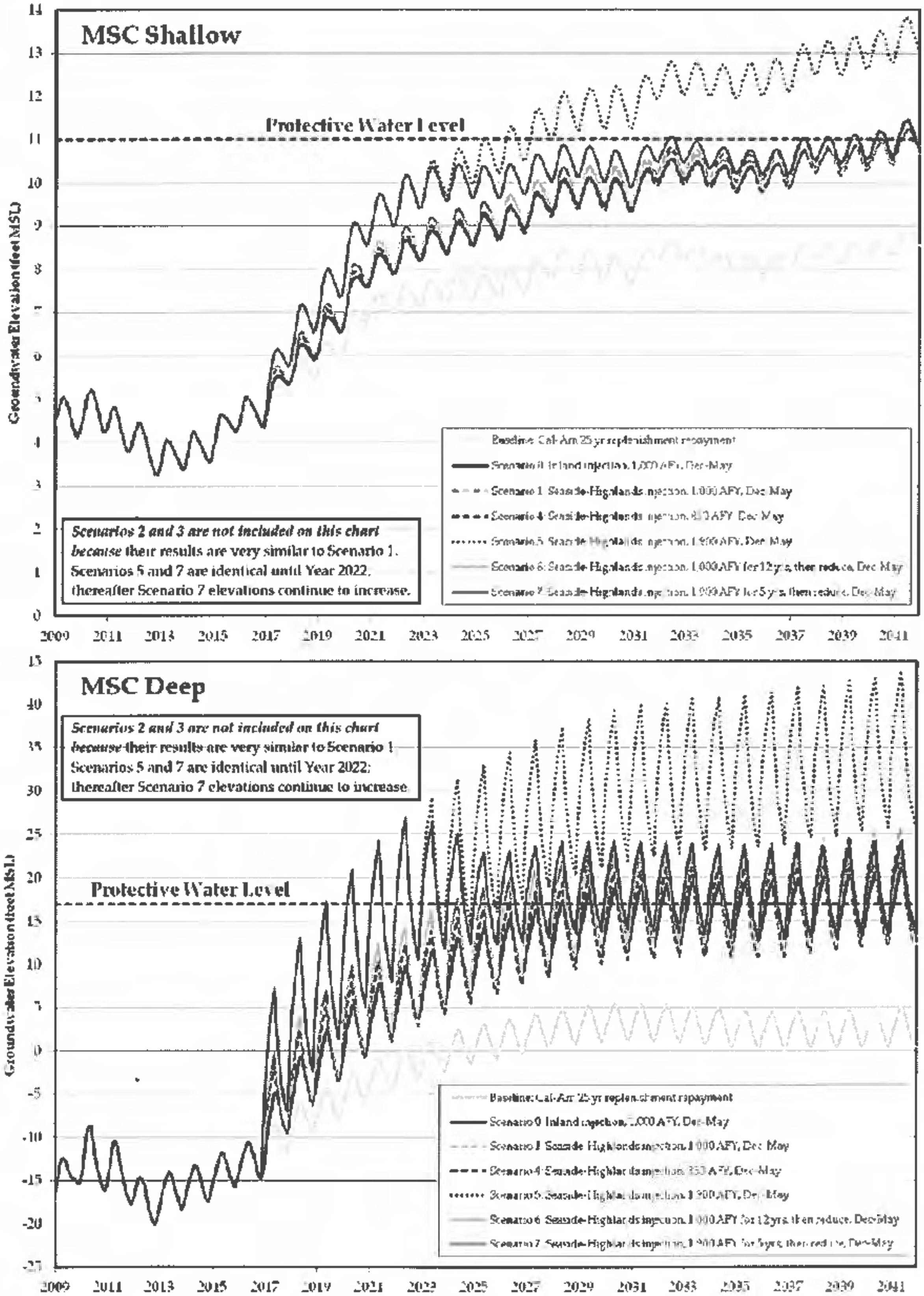


Figure 2: Predicted Groundwater Elevations and Protective Elevations for the MSC Wells

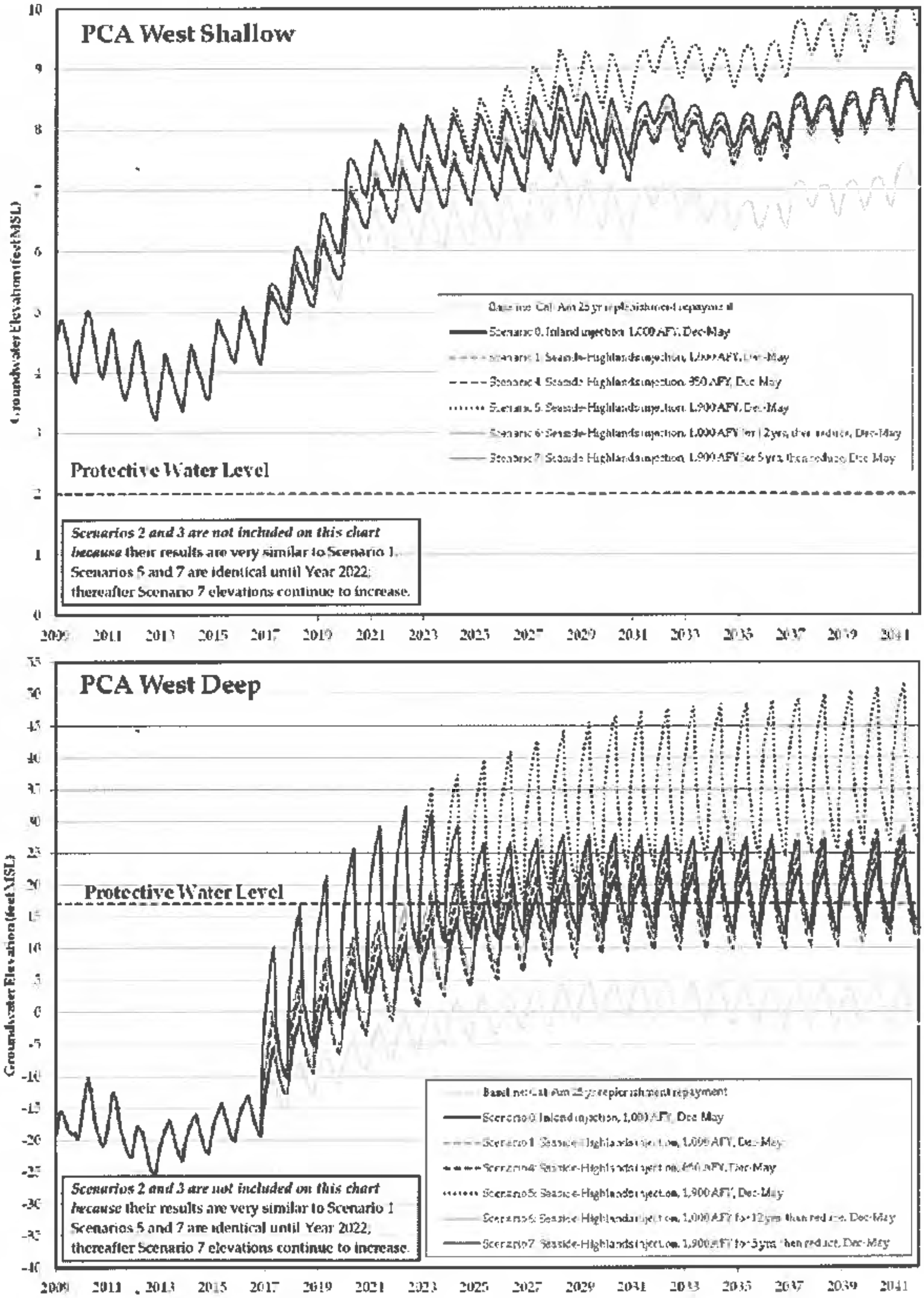


Figure 3: Predicted Groundwater Elevations and Protective Elevations for the PCA West Wells

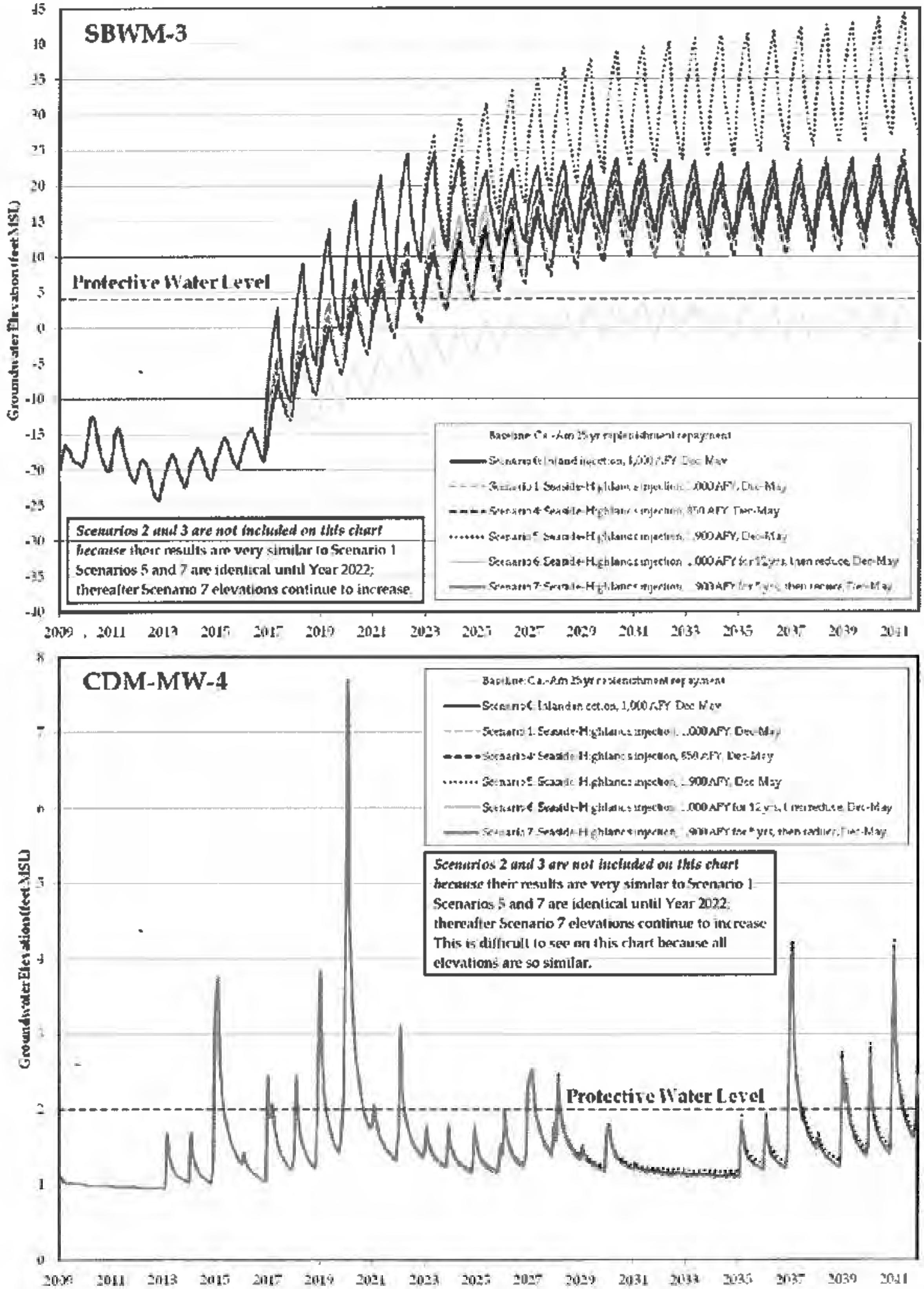


Figure 4: Predicted Groundwater Elevations and Protective Elevations for Sentinel Well 3 (SBWM-3) and CDM MW-4 Wells

3.1 SCENARIO 0: INLAND INJECTION OF 1,000 AFY

This model scenario was developed previously (HydroMetrics WRI, 2013). Injecting 1,000 AFY into existing ASR wells achieved protective elevations in all six protective groundwater elevation monitoring wells by 2041. Predicted groundwater contours in the deep Santa Margarita aquifer for Scenario 0 at the end of the last simulated water year (September 2041) are shown on Figure 5. September 2041 is not the end of the predictive model period, but has been selected as show groundwater elevations as it is the month where there is the biggest difference in groundwater elevations between Scenarios 0 and 1 due to it being the end of the dry, high production summer period.

3.2 SCENARIOS 1, 2, AND 3: COASTAL INJECTION OF 1,000 AFY

The results of Scenarios 1 through 3 are very similar, therefore their results are grouped together. The difference between the scenarios was in the injection location and injection schedule. Scenario 1 injects 1,000 AFY into one injection well at the Seaside-Highlands Storm Water Pond site from December through May each year, starting in December 2016. Scenario 2 is the same as Scenario 1, except it injects 1,000 AFY at a constant rate throughout the year rather than seasonally. Scenario 3 injects 1,000 AFY into one injection well at the MRPWCA South site from December through May each year, starting in December 2016.

Moving averages were calculated for the simulated groundwater elevations to remove seasonal trends and focus on long-term trends. A moving average is a way of smoothing data that are seasonally variable, such as the fluctuations seen in the protective groundwater elevation monitoring wells. Moving averages are calculated by selecting each data point individually, and replacing the selected data point with an average of all the data points surrounding the selected point. For our analysis, the moving average for each month was calculated by taking the groundwater level from that month, and averaging it with the all the groundwater levels from the six previous months and the next six months.

Moving average groundwater elevations at the protective groundwater elevation monitoring wells for all three scenarios were almost identical. This indicates that shifting the injection location northeast approximately 2,000 feet does not change the model results. Either site would be suitable for coastal injection. Likewise, the annual schedule of injection does not change average groundwater elevations.

Table 2, located at the back of this memorandum, shows the time it takes groundwater levels in each of the protective groundwater elevation monitoring wells to reach protective elevations, for each scenario. The three scenarios resulted in the three deep coastal monitoring wells – MSC Deep, PCA-West Deep, and Sentinel 3 wells – reaching protective groundwater elevations at the latest by April 2029, which depending on the well is between one to ten years faster than injecting at the existing inland ASR wells in Scenario 0 (Table 2). Although Scenario 0 only reaches protective elevations in 2041, groundwater elevations in the MSC Deep well are only approximately one foot below protective elevation when Scenarios 1, 2, and 3 reach protective elevations in April 2029.

The MSC Shallow well takes longer to reach protective elevations than the deep wells, although it achieves its protective elevation one year quicker than inland injection (Table 2)

Because in the modeled scenarios all injection was into the deeper Santa Margarita aquifer where the majority of the basin's pumping occurs. It takes additional time for the injected water to flow upward from the Santa Margarita aquifer into the overlying Paso Robles aquifer to allow the MSC Shallow well to reach protective elevations. Injection into the deep Santa Margarita aquifer is desirable as this is the main producing aquifer in the basin.

Predicted groundwater contours in the deep Santa Margarita aquifer for Scenario 1 at the end of the last simulated water year (September 2041) are shown on Figure 6. The difference between groundwater elevations for Scenario 1 (coastal injection) and Scenario 0 (inland injection) are shown on Figure 7. Model results from September 2041 were chosen rather than the end of the simulation (December 2041) because this is the month with the greatest groundwater elevation difference between Scenario 0 and Scenario 1. As expected, the coastal areas have higher groundwater elevations for Scenario 1 (coastal injection) than Scenario 0 (inland injection). Coastal injection results in an approximate 2.5 to 6.0 foot increase in groundwater levels along the coast compared to inland injection at the end of the last simulated water year (September 2041).

Groundwater outflow to the ocean and inflow from the ocean for Scenario 0 (inland injection) and Scenario 1 (coastal injection) is very similar (less than 18 AFY difference), as shown on Figure 8. This implies that coastal injection of 1,000 AFY does not lose much more water to the ocean than inland injection. The values plotted on the bar chart of Figure 8 are the difference between Scenario 1 and Scenario 0's annual net flows. Net flows are outflow less inflows. Although not apparent on this annual chart, but shown on the upper line chart, some months do have onshore flows but overall the annual flows are outflows to the ocean. For example in 2017, the annual net flow is an outflow of 8.2 AF (see bar chart) but on the upper line chart the months between June and December 2017 have onshore flows.

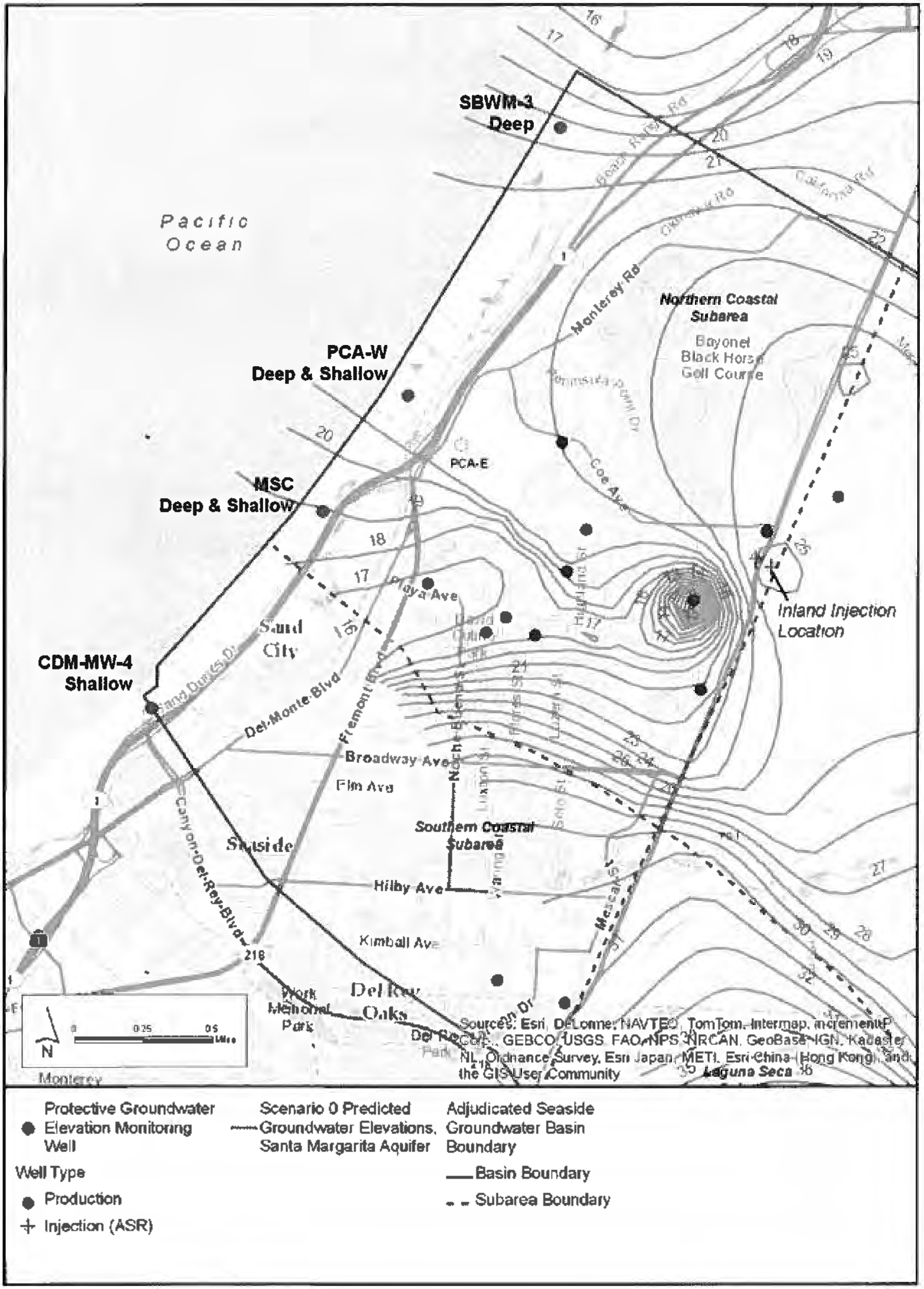


Figure 5: Scenario 0 Groundwater Elevation Contours, September 2041

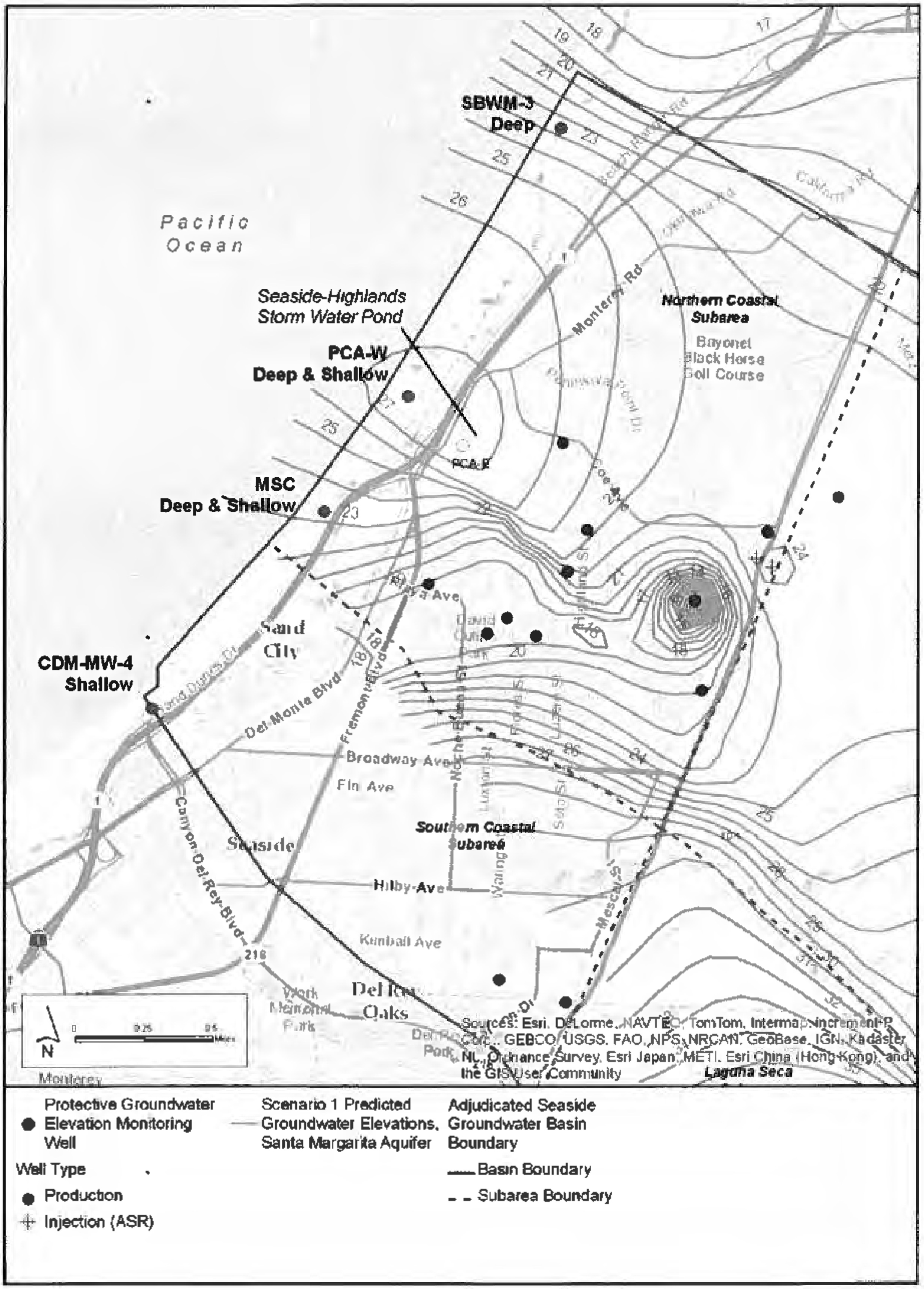


Figure 6: Scenario 1 Groundwater Elevation Contours, September 2041

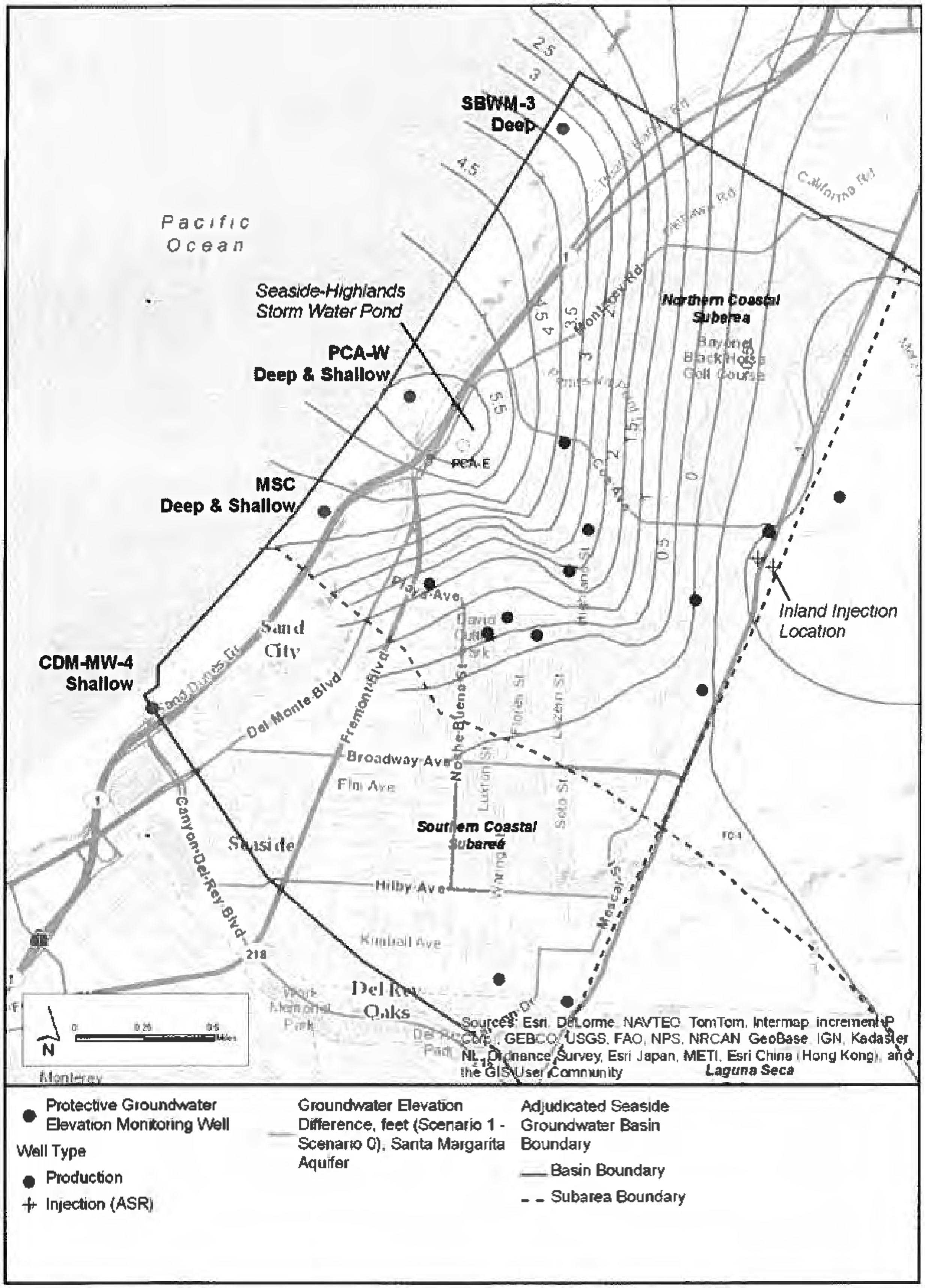


Figure 7: Scenario 1 and 0 Groundwater Elevation Difference, September 2041

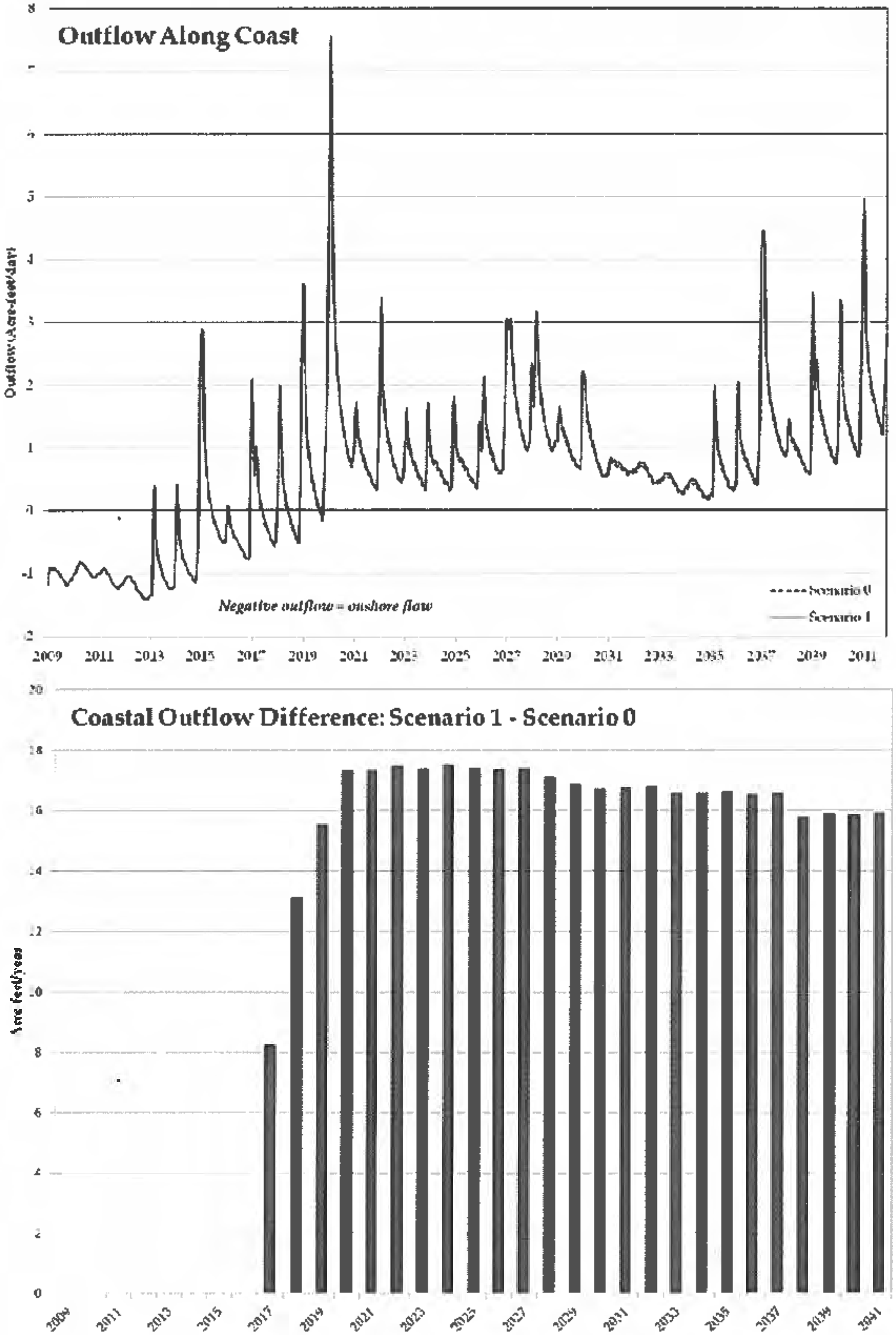


Figure 8: Outflow/Inflow Difference between Inland and Coastal Injection

3.3 SCENARIO 4: COASTAL INJECTION TO ACHIEVE PROTECTIVE ELEVATIONS BY 2041

Scenario 4 consisted of iteratively reducing the injection rates at the Seaside Highland Storm Water Pond site until protective groundwater elevations were achieved in all six protective groundwater elevation monitoring wells at the end of 2041. This simulation was conducted to demonstrate how much less water needs to be injected at the coast to achieve the same results as the inland injection simulation (Scenario 0). It was found that 850 AFY needs to be injected from December through May, starting in December 2016, to reach protective elevations in all six monitoring wells at the end of 2041. This is 150 AFY less than what is required at the inland location over the same period of time.

As subsequent scenarios show, 850 AFY would need to be injected at the coast to maintain groundwater levels above protective elevations. It is possible that continuing to inject 850 AFY after 2041 would result in groundwater levels remaining above protective elevations.

3.4 SCENARIO 5: COASTAL INJECTION TO ACHIEVE PROTECTIVE ELEVATIONS WITHIN FIVE YEARS

Scenario 5 consisted of iteratively increasing injection rates at the Seaside Highland Storm Water Pond location until protective groundwater elevations were achieved in the three deep protective groundwater elevation monitoring wells after five years of injection. It was found that 1,900 AFY needs to be injected from December through May, starting in December 2016, to reach protective elevations within five years. This is 900 AFY more than what is required to achieve protective elevations over a 25-year period at the same location (Scenario 1).

This scenario focused on the deep wells/aquifer because they are the most likely to be impacted by seawater intrusion as the pumping depression is most pronounced in this aquifer. Of the three shallow wells, the MSC Shallow well is the last to achieve protective elevations, which it does in December 2026 (Table 2).

3.5 SCENARIO 6: COASTAL INJECTION OF 1,000 AFY UNTIL DEEP PROTECTIVE ELEVATIONS ARE ACHIEVED AND THEN REDUCED INJECTION

To assess the amount of injection required to maintain protective groundwater elevations in the deep aquifer, a model run was developed that used Scenario 1's 1,000 AFY injection assumptions up until the point when all three deep protective groundwater elevation monitoring well groundwater levels reached protective elevations. This would occur in

April 2029 (Table 2). From May 2029 injection was iteratively reduced so that moving average groundwater levels always remained just above protective elevations for the remainder of the simulation. It was found that 900 AFY was required through November 2036, and thereafter 850 AFY was required to maintain protective water levels at the coast through the end of the simulation (2041).

This scenario focused on the deep wells/aquifer because they are the most likely to be impacted by seawater intrusion as the pumping depression is most pronounced in this aquifer. Of the three shallow wells, the MSC shallow well is the last to achieve protective elevations, which under this scenario is in August 2041 (Table 2).

3.6 SCENARIO 7: COASTAL INJECTION OF 1,900 AFY UNTIL DEEP PROTECTIVE ELEVATIONS ARE ACHIEVED IN FIVE YEARS AND THEN REDUCED INJECTION

To assess the amount of injection water that would be required to maintain protective groundwater elevations in the deep aquifer after protective groundwater elevations had been achieved in five years by injecting 1,900 AFY (Scenario 5), injection was iteratively reduced so that groundwater levels remained just above protective elevations for the remainder of the simulation. It was found that continued injection of 1,900 AFY in 2022, and then ramp downs to 1,565 AF for year 2023, 1,232 AF for year 2024, 900 AFY for years 2025 through 2028, and 850 AFY thereafter was required to keep moving average groundwater levels above protective elevations through to the end of the simulation (2041).

The volume injected in Scenario 7, from December 2016 through December 2041, is 5,050 AF more than Scenario 6. This equates to a 202 AFY difference over the 25 year injection period. Table 3 summarizes the injection volumes and amount of net outflow to the ocean (outflow – inflow) for all scenarios over the 25 year injection period.

TABLE 3: SCENARIO INJECTION VOLUME AND OCEAN OUTFLOW SUMMARY

Scenario	Years to Reach Protective Elevations	Injected Volume through 2041 (acre-feet)	Net Outflow to Ocean (acre-feet)
Scenario 0: Inland Injection ASR Wells, 1,000AFY, Dec-May	25	25,000	9,310
Scenario 1: Seaside-Highlands Coastal Injection, 1,000AFY, Dec-May	12	25,000	9,720
Scenario 2:MRWPCA South Coastal Injection, 1,000AFY, Dec-May	12	25,000	9,730

Scenario 3: Seaside-Highlands Coastal Injection, 1,000AFY, Year round	12	25,000	9,780
Scenario 4: Seaside-Highlands Coastal Injection, 850AFY, Dec-May	25	21,250	9,140
Scenario 5: Seaside-Highlands Coastal Injection, 1,900AFY, Dec-May	5	47,500	13,830
Scenario 6: Seaside-Highlands Coastal Injection, 1,000, AFY Ramping Down to 850AFY, Dec-May	12	23,600	9,550
Scenario 7: Seaside-Highlands Coastal Injection, 1,900AFY, Dec-May for Five Years, Ramping Down to 850 AFY, Dec-May	5	28,850	10,990

4.0 CONCLUSIONS

1. Injecting water at either the Seaside-Highlands Storm Water Pond location or the MRWPCA South location have similar responses, which suggests that either site would be equally suitable as a coastal injection location.

2. Average groundwater elevations in the protective groundwater elevation monitoring wells are similar regardless of whether coastal injection occurs seasonally (December through May) or year round (each month of the year).

3. Coastal groundwater levels reach protective elevations faster in response to coastal injection than in response to injection at existing inland ASR sites. Depending on the well, protective groundwater elevation monitoring wells in the deep Santa Margarita aquifer reach protective elevations one to ten years sooner in response to coastal injection compared to their response to inland injection. The shallow protective groundwater elevation monitoring wells reach protective elevations at similar times with both coastal and inland injection. The table summarizing protective elevation achievement is on page 11.

4. Approximately 850 AFY of coastal injection is needed to achieve results similar to injecting 1,000 AFY at the inland location over the 25 year injection period.

5. Protective elevations can be achieved within five years if 1,900 AFY is injected at the coastal location.

6. After protective groundwater elevations have been reached by injecting 1,000 AFY at the coast, 900 AFY for 7.5 years, and then 850 AFY is required to maintain groundwater levels above protective elevations.

7. After protective groundwater elevations have been reached after injecting 1,900 AFY at the coast for five years; injection rates can be ramped down to 850 AFY by year 2029 to maintain protective elevations.

5.0 REFERENCES

HydroMetrics WRI. 2013. Technical memorandum: groundwater modeling results of replenishment repayment in the Seaside Basin. Prepared for the Seaside Groundwater Basin Board of Directors. April 4, 2013.

Table 2: Summary of Protective Groundwater Elevation Achievement

Scenario	MSC Deep	MSC Shallow	PCAWest Deep	PCA-West Shallow	Sentinel3	CDM MW-4
Baseline: 25 Year Replenishment Repayment	Not attained	Not attained	Not attained	Jan 2009	Not attained	May 2015
Scenario 0: Inland Injection ASR Wells, 1,000AFY, Dec-May for 25 years	Jul 2039	Aug 2041	Nov 2032	Jan 2009	Mar 2022	May 2015
Scenarios 1 and 2: Coastal Injection, 1,000AFY, Dec-May Scenario 3: Coastal Injection, 1,000AFY, Year round for 25 years	Apr 2029	Dec 2040	Nov 2027	Jan 2009	Jun 2021	May 2015
Scenario 4: Coastal Injection, 850AFY, Dec-May for 25 years	Sep 2039	Sep 2041	Sep 2031	Jan 2009	Feb 2022	May 2015
Scenario 5: Coastal Injection, 1,900AFY, Dec-May for 25 years	Jan 2022	Dec 2026	May 2021	Jan 2009	Feb 2019	May 2015
Scenario 6: Coastal Injection, 1,000, AFY ramping down to 850 AFY, Dec May	Apr 2029	Aug 2041	Nov 2027	Jan 2009	Jun 2021	May 2015
Scenario 7: Coastal Injection, 1,900AFY, Dec-May for Five Years, Ramping Down to 850 AFY, Dec-May	Jan 2022	Feb 2041	May 2021	Jan 2009	Feb 2019	May 2015

Rachel Gaudoin

From: Whitney Carter <whitney601@yahoo.com>
Sent: Thursday, May 23, 2019 7:35 PM
To: Pure Water Monterey Info
Subject: Demand for Testing of Recycled AG Water Project.

Pure Water Management,

This email is written to express my concern with the safety of the recycled AG water project.

The project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins. This has never been attempted or done before anywhere in the world, and extensive adequate testing is needed to ensure the safety of this project.
It appears that the project and the water has not been adequately tested by trained professionals, who specializes in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body.
In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

I am writing this to demand a health science expert such as a toxicologist, micro-biologist, cancer discovery MD, pathologist et al is hired to give an opinion that the recycled toxic agriculture water is safe for potable purposes.

Thank you

Sent from Yahoo Mail for iPhone

Rachel Gaudoin

From: MWChrislock <mwchrislock@redshift.com>
Sent: Thursday, June 06, 2019 7:32 PM
To: Pure Water Monterey Info
Subject: Scoping Meeting Comment

Importance: High

Hi Rachel,

Here's my comment in writing:

Is the source water for the expansion secure and is there backup source water if needed?

Melodie Chrislock

Pure Water Monterey Expansion
Public Scoping Meeting
Wednesday, June 5, 2019
5:30 PM – 7:00 PM
Oldemeyer Center, Blackhorse Meeting Room
986 Hilby Avenue, Seaside

Rachel Gaudoin

From: Rachel Gaudoin
Sent: Monday, June 10, 2019 9:14 AM
To: Pure Water Monterey Info
Subject: FW: Another Scoping Meeting Comment

Importance: High

Rachel Gaudoin
Public Outreach Coordinator
Monterey One Water (formerly MRWPCA)
P:831-645-4623
www.MontereyOneWater.org

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Providing Cooperative Water Solutions

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- Sign up for our e-newsletter - "One Exchange"
- Follow our Facebook page for the latest news

From: MWChrislock <mwchrislock@redshift.com>
Sent: Thursday, June 06, 2019 7:35 PM
To: Rachel Gaudoin <rachel@my1water.org>
Subject: Another Scoping Meeting Comment
Importance: High

Rachel here's another comment in support:

The expansion of Pure Water Monterey looks like a much better environmental choice than Cal Am's desal. The water demand on the Peninsula is only 10,000 acre feet a year. The 2,250 acre-feet from the PWM expansion would give us more than enough water to restore flows in the Carmel River and meet the CDO by December 31, 2021. It would leave us about 1,500 acre-feet beyond what we need now, giving the Peninsula enough water for decades of new development.

Melodie Chrislock

Pure Water Monterey Expansion
Public Scoping Meeting

Wednesday, June 5, 2019

5:30 PM – 7:00 PM
Oldemeyer Center, Blackhorse Meeting Room
986 Hilby Avenue, Seaside

Rachel Gaudoin

From: Janis De Lay <katlarue1@icloud.com>
Sent: Saturday, May 25, 2019 9:49 AM
To: Pure Water Monterey Info
Cc: (My Husband) Mike De Lay; cgarfield@cityofpacificgrove.org; bpeake@cityofpacificgrove.org; huitt@comcast.net; rhuitt@cityofpacificgrove.org; nsmith@cityofpacificgrove.org; citymanager@cityofpacificgrove.org; cityclerk@cityofpacificgrove.org; atomlinson@cityofpacificgrove.org; jamelio@cityofpacificgrove.org; jmcadams@cityofpacificgrove.org; dave@laredolaw.net; heidi@laredolaw.net; moeammar@pacificgrove.org
Subject: recycled sewage and AG water as our drinking water.

This email is written to express my concern with the safety of the recycled AG water project.

I understand the State Department of Drinking Water created an addendum saying AG water was NOT to be used for direct drinking water, after our water project was approved. I understand the project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins. This has never been done before anywhere for good reason. There is no evidence that the toxins can be removed. People all over this peninsula spend a great deal of time and effort to purchase organic meat & produce, now you want us to wash not only our food but our bodies in the very chemicals we are paying $$ to avoid. We do not want to be the test group for your theory. If you insist on proceeding with this poisoning of the people of the Monterey Peninsula, you will be held accountable.

Many people are planning on demanding that health and safety experts be hired to test the safety of this water. That should have already been done. I do not want this water under any circumstances, water at the cost of health is not a choice. City councils, you are responsible for our well being, read your charters. Further, I foresee a huge financial loss to the peninsula when word of this debacle gets out to tourists, the peninsula’s primary source of income.

Wake up! Recycle the water back into the farms if you must. Use it to water plants and grass in parks, if you must. Don’t poison us in our very homes in your effort to get more water to Cal Am.

Janis De Lay
Pacific Grove, CA

Rachel Gaudoin

From: Wendy <wenpg@aol.com>
Sent: Thursday, May 23, 2019 12:37 PM
To: Pure Water Monterey Info
Subject: Demand for Testing of Recycled AG Water Project.

To Pure Water Management,
Re: Demand for Testing of Recycled AG Water Project.

This email is written to express my concern with the safety of the recycled AG water project.

The project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins. This has never been attempted or done before anywhere in the world, and extensive adequate testing is needed to ensure the safety of this project.
It appears that the project and the water has not been adequately tested by trained professionals, who specializes in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body.
In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

I am writing this to demand a health science expert such as a toxicologist, micro-biologist, cancer discovery MD, pathologist et al is hired to give an opinion that the recycled toxic agriculture water is safe for potable purposes.

Thank you,
Wendy Gregory

Rachel Gaudoin

From: Katya Kuska <katya_kuska@att.net>
Sent: Thursday, May 23, 2019 11:22 AM
To: Pure Water Monterey Info
Subject: Demand for testing

To Pure Water Management,
Re: Demand for Testing of Recycled AG Water Project.

This email is written to express my concern with the safety of the recycled AG water project.

The project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins. This has never been attempted or done before anywhere in the world, and extensive adequate testing is needed to ensure the safety of this project.
It appears that the project and the water has not been adequately tested by trained professionals, who specializes in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body.
In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

I am writing this to demand a health science expert such as a toxicologist, micro-biologist, cancer discovery MD, pathologist et al is hired to give an opinion that the recycled toxic agriculture water is safe for potable purposes.

Thank you,

Katya Kuska

Sent from my iPhone

Rachel Gaudoin

From: camilla Mitchell <koefoed@hotmail.com>
Sent: Thursday, May 23, 2019 8:40 AM
To: Pure Water Monterey Info
Subject: Request for testing of water

To Pure Water Management,

Re: Demand for Testing of Recycled AG Water Project.

This email is written to express my concern with the safety of the recycled AG water project.

The project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins.
This has never been attempted or done before anywhere in the world, and extensive adequate testing is needed to ensure the safety of this project.

It appears that the project and the water has not been adequately tested by trained professionals, who specializes in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body.
In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

I am writing this to demand a health science expert such as a toxicologist, micro-biologist, cancer discovery MD, pathologist et al is hired to give an opinion that the recycled toxic agriculture water is safe for potable purposes.

Thank you
Camilla Mitchell

Rachel Gaudoin

From: Sandy <skmoon@pacbell.net>
Sent: Thursday, May 23, 2019 6:33 PM
To: Pure Water Monterey Info
Cc: sandy m.
Subject: Please respond please don't make me sick

To Pure Water Management,
Re: Demand for Testing of Recycled AG Water Project.

This email is written to express my concern with the safety of the recycled AG water project.

The project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins. This has never been attempted or done before anywhere in the world, and extensive adequate testing is needed to ensure the safety of this project.
It appears that the project and the water has not been adequately tested by trained professionals, who specializes in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body.
In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

I am writing this to demand a health science expert such as a toxicologist, micro-biologist, cancer discovery MD, pathologist et al is hired to give an opinion that the recycled toxic agriculture water is safe for potable purposes.

Thank you
Sandy M

Rachel Gaudoin

From: Wendi Newman <wendi.newman7@gmail.com>
Sent: Thursday, May 23, 2019 6:52 PM
To: Pure Water Monterey Info
Subject: Demand for Testing of Recycled AG Water Project

To Pure Water Management,

This email is written to express my concern with the safety of the recycled AG water project.

The project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins. This has never been attempted or done before anywhere in the world, and extensive adequate testing is needed to ensure the safety of this project.

It appears that the project and the water has not been adequately tested by trained professionals, who specializes in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body.
In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

I am demanding a health science expert such as a toxicologist, micro-biologist, cancer discovery MD, pathologist et al is hired to give an opinion that the recycled toxic agriculture water is safe for potable purposes. You are going to need the public to support this project. To get that support you need to prove to us that the water has gone above and beyond normal minimal federal testing, and is free of agricultural chemicals, and publish the results. My neighbors and my family are angry and terrified of what will be coming out of the tap.

Sincerely,

Wendi Newman
Pacific Grove, CA 93950

Rachel Gaudoin

From: Patty Pai <pattypai@hotmail.com>
Sent: Thursday, May 23, 2019 8:58 AM
To: Pure Water Monterey Info
Subject: Demand for Testing of Recycled AG Water Project

To Pure Water Management,
Re: Demand for Testing of Recycled AG Water Project.

This email is written to express my concern with the safety of the recycled AG water project.

The project water will recycle(treat) agriculture waste water, including the most toxic sites, like Reclamation ditch and other 303d Basins. This has never been attempted or done before anywhere in the world, and extensive adequate testing is needed to ensure the safety of this project.
It appears that the project and the water has not been adequately tested by trained professionals, who specializes in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body.
In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

I am writing this to demand health science experts, such as a toxicologist, micro-biologist, cancer discovery MD, pathologist, et al, arehired to give an opinion that the recycled toxic agriculture water is safe for potable purposes.

Thank you,

Patty Pai
Pacific Grove, CA

Rachel Gaudoin

From: Michelle Raine <mor1951x@gmail.com>
Sent: Tuesday, May 28, 2019 2:24 PM
To: Pure Water Monterey Info
Cc: cgarfield@cityofpacificgrove.org; bpeake@cityofpacificgrove.org; huitt@comcast.net; rhuitt@cityofpacificgrove.org; nsmith@cityofpacificgrove.org; citymanager@cityofpacificgrove.org; cityclerk@cityofpacificgrove.org; atomlinson@cityofpacificgrove.org; jamelio@cityofpacificgrove.org; jmcadams@cityofpacificgrove.org; dave@laredolaw.net; heidi@laredolaw.net
Subject: Re: Demand for Testing of Recycled AG Water Project

To Pure Water Management,

This email is written to express our concern with the safety of the recycled AG water project. The project water will recycle (treat) agriculture waste water, including water from the most toxic sites like Reclamation ditch and other 303d Basins. This has never been attempted or done before anywhere in the world and extensive adequate testing is needed to ensure the safety of this project. I am informed that after our water project was approved, the State Department of Drinking Water created an addendum saying AG water was NOT to be used for direct drinking water.

It appears that the project and the use of this water has not been adequately tested by trained professionals who specialize in recycled water for human use safety, specifically addressing the toxicology and how this may have an impact on the human body. In the EIR for the original project, the health safety of this type of recycled water was never addressed. A sewage engineer gave an opinion that the project legally was entitled to a permit.

We are writing to demand health science experts such as a toxicologist, microbiologist, cancer discovery MD, and/or pathologists be employed to give an opinion after testing, that the recycled toxic agriculture water is safe for potable purposes. In light of the addendum by the State Department of Drinking Water that AG water not be used, We would like clarification of this issue, if you still intend to use AG water in your recycling program. We also would like to know the efficacy of the removal of drugs from the sewage water and if trace amounts remain, any adverse effects that the trace amounts may cause to humans in the drinking water. We also have an organic garden area and want to make sure that there are no trace amounts of pesticides in the water that we will using outdoors.

We would like a response to this letter prior to any delivery of recycled water to this residence.

Thank you

Michelle & James Raine

1310 Buena Vista Avenue

Pacific Grove, CA 93950

Rachel Gaudoin

From: George Riley <georgetriley@gmail.com>
Sent: Saturday, June 08, 2019 2:03 PM
To: Pure Water Monterey Info
Subject: NOP comment

The PWM/GWR EIR and Suppl were completed in 2016 and 2017.
Cal Am's desal FEIR was completed in 2018.
Since the 3500 project was designed to be part of the portfolio of supply, there probably were few references to Cal Am's desal, except as part of the package.
Now that the desal FEIR and the CPCN are final, they provide benchmarks for potential comparisons. Also the holes in the desal FEIR might be pointed out, since this later EIR can deal with more recent data and facts.
Compared the initial 3500 EIR, the additional 2250 is another animal altogether. It is a 'back-up', or alternative to Cal Am's desal.
Thus the EIR for the 2250 seems to require comparative data to desal, and all the angles that show the 2500 to be environmentally, and economically, superior. Can such a comparative analysis be included in the 2250 EIR? I think it should.
George T. Riley
Monterey CA

Margaret L. Thum
PO Box 991
Pebble Beach, CA 93953

June 14, 2019

VIA EMAIL (purewatermontereyinfo@my1water.org and rachel@my1water.org)

Monterey One Water
ATTN: Rachel Gaudion
5 Harris Ct., Bldg. D
Monterey, CA 93940

RE: Comments on NOP of Supplemental EIR – Due 5pm June 14, 2019

Dear Ms. Gaudion:

As a resident of the Monterey Peninsula, I am submitting the following comments on the NOP of Supplemental EIR ("EIR") for Proposed Expansion of GWR Project ("Project"). Monterey One Water, also known as the Monterey Regional Water Pollution Control Agency, is the lead agency ("MRWPCA" or "Monterey One Water"). Please note that I am not universally against recycling water; perhaps it can be useful for specific purposes not involving human consumption. However, I have significant concerns, including about the health and safety effects of the Project, because these issues have not been studied or addressed and will be made worse through the proposed expansion.

1. The Impact on Health should be Studied

The Project will combine hazardous water that is not safe for human consumption from different sources, including toxic, pesticide water from the Blanco drain and increased amounts of sewage water that will undoubtedly contain toxic matter, including pharmaceuticals, bacteria, viruses and other contaminants that have a deleterious effect on human health.

Studies have shown that recycled water technology is not yet sufficiently advanced to remove contaminants that will exist in the source waters and that can have a disastrous effect on the health of humans, wildlife and aquatic life.[1] That is, "most current wastewater treatment practices are inefficient in completely removing [pharmaceuticals]."[2] Another researcher has found that:

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[1] See https://www.ncbi.nlm.nih.gov/pubmed/29407709; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5352760/ (membrane bioreactor (MBR) systems are better than conventional systems for removing pathogens, but "they do not achieve total log removal.")

[2] See https://www.sciencedirect.com/science/article/pii/S1878535212002705#bb0145

> "Recycled wastewater presents a risk to human health and the environment due to contaminants of emerging concern (CECs) that are not removed even by high level water treatment processes, and can persist in the water for long periods of time, especially when used for agricultural irrigation. Residues of pesticides, pharmaceutical drugs, and other chemicals in irrigation water can end up on plant surfaces, be taken up by crops, or contaminate the soil, thus increasing human exposure risk and environmental contamination, as evidenced by a recent study conducted in Irvine, California."[3]

Furthermore, although water recycle facilities typically exclude hospital sewage for safety reasons, because viruses can slip through membranes and ELAP methods do not detect viable but undetectable viruses and real-time monitoring is insufficient, the Project does not exclude sewage from local hospitals.[4] (See also Attachment 1, a report titled "*Recycling water from sewage into drinking water: a "high level" health risk we should only take as a "last resort*" by Dr. Peter Collignon, Infectious Diseases Physician and Microbologist, Professor, School of Clinical Medicine, Australian National University).

The EIR should address how the Project will remove hazardous contaminants, pesticides, pharmaceuticals, pathogens and CECs to ensure the recycled water delivered to humans is safe for consumption. This should include a study of ways to prevent wastewater from local hospitals from being used for the Project in order to isolate dangerous viruses and other pathogens from being included in the source material that is used for the Project. And, the EIR should address the transformation contaminants into new contaminates that are created from trace levels of pollutants that get through the ATP.[5]

Furthermore, laboratory tests should be done by certified facilities outside the local area with expertise in testing for the various toxic materials that are known or foreseen to be in the source water and other water samples. ELAP labs do not have specialized equipment or expertise to conduct the necessary studies on sub-molecular levels of contaminants like PFAs and pesticides and viable, but not culturerable, viruses.[6]

If the studies indicate that the Project is unable to remove contaminants to a level that is safe for human consumption, the Project should be studied to see if there are any other beneficial uses for

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[3] See https://www.beyondpesticides.org/assets/media/documents/infoservices/pesticidesandyou/documents/WastewaterFall2014.pdf

[4] See https://www.ncbi.nlm.nih.gov/pubmed/29201017 (indicating hospital wastewaters derived from clinical specialty wards are hotspots for the spread of antimicrobial resistance (AMR). Assembled scaffolds of other mobile genetic elements were recovered in wastewater samples that aid the transfer of AMR).

[5] See https://undark.org/article/return-to-sender-california-water-recyling/

[6] See, e.g., comments by Sean Bothwell, California Coastkeeper Alliance, pp. 241-260, https://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/2018/121118_7_rtc_june_by_category.pdf

the treated water, e.g., for agricultural purposes. However, any such alternative purpose should also be studied and tested to ensure safety of the public and environment that will be impacted by the alternative use, e.g., that the recycled water is safe for farm workers.

2. The Impact of Contaminated Groundwater, including from PFOS and PFOAs should be Studied

The Project utilizes the Seaside Groundwater Basin ("Seaside Basin") that lies underneath Fort Ord, a former Army base established in 1917 and current Superfund site. The groundwater under Fort Ord has tested positive for perfluoroalkyl substances (PFAS), including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), that recently have been determined to increase the risk of cancer in humans at levels significantly lower than originally believed.[7] Moreover, PFOS and PFOA in the soil can contaminate groundwater in as quickly as a few years, and once in groundwater, the contamination migrates unencumbered throughout groundwater. In fact, the risk of ingesting PFOS and PFOAs is greater from drinking contaminated groundwater than from ingesting contaminated soil.[8]

The EIR should require analysis of the level of PFAs and other contaminates in the Seaside Basin and surrounding aquifers, and the hydrology of them to outline the possible migration path of PFAs to ensure they do not reach the groundwater that will be used as a drinking water source. The EIR should also require that any mitigation measures be revised should federal or state regulations be adopted in the future that require more stringent measures than currently known or available.

[7] See https://partner-mco-archive.s3.amazonaws.com/client_files/1524589484.pdf?_ga=2.158835187.890657880.1560489462-608159928.1560489462; https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=1117&tid=237; (The CDC's Agency for Toxic Substances and Registry ("ATSR") recently determined that the minimal risk level for some PFAs chemicals should be lowered significantly to less than 12 parts-per-trillion (ppt) from 70 ppt designated by the EPA in 2016); https://www.atsdr.cdc.gov/mrls/mrllist.asp;https://www.mlive.com/news/2018/05/politico_pfas_atsdr_epa_levels.html; https://www.njspotlight.com/stories/18/10/04/pfas-levels-at-nj-base-24-000-times-higher-than-proposed-federal-standard-study-says/ (PFOS and PFOAs were 264,300 ppt at Fort Dix in NJ, far above the 12 ppt deemed safe by the CDC)

[8] See https://www.sciencedirect.com/science/article/abs/pii/S0043135414006940; http://docs.fortordcleanup.com/ar_pdfs/ar-bw-2834/BW-2834.pdf (see pages 26-27 for the migration and changing levels of PFOS and POFAs in the Seaside Aquifer).

3. The Impact of seepage of Seaside Aquifer Ground Waters into Monterey Bay should be Studied

The quality of coastal water is directly impacted by the flow of groundwater to the ocean, and regions near active fault lines send greater amounts of groundwater to the ocean.[9]

Given the Seaside Aquifer's proximity to the ocean and the earthquake fault lines in the local area, there is a significant risk that any contaminated water that is injected into the Seaside Aquifer by the Project will seep to the Monterey Bay. The EIR should study this risk and also the impact to Monterey Bay as a result of any seepage of groundwater from the Seaside Aquifer into the Bay

Moreover, the Monterey Bay is polluted with microplastics to a far greater extent than originally thought.[10] The EIR should study the impact on the Monterey Bay from seepage of water from the Project, including the impact on the current microplastics pollution in the Bay, e.g., how will that seepage impact marine life.

4. The Impact of Hazards Resulting from Failed Operations, including from Earthquakes and Power Outages, and Spills should be Studied

Power outages are common in the local area, especially during the winter (after severe storms) and during the summer (due to blackouts caused by over use of the electrical grid). These are foreseeable events that could cause the Project to fail, potentially causing hazardous sewage to spill into the community and Monterey Bay, risking not only the environment but the health of residents in the local area. The EIR should study the impact of these events on the health and safety of the community and environment.

Moreover, MRWPCA has had a history of system failures that have resulted in large sewage spills on the Monterey Peninsula, including one in 2015 that released 220,000 untreated gallons of sewage in Pacific Grove[11] and another in 2018 that spilled millions of gallons of raw sewage into Monterey Bay over two days.[12] The EIR should study the events that led to these disasters and ensure that measures are in place to prevent similar future disasters resulting from the Project.

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[9] See http://www.millenniumpost.in/world/map-of-where-groundwater-merges-into-oceans-created-357020; see Attachment 2, an article titled "*Fresh Submarine Groundwater Discharge to the Near-Global Coast*," by Zhou, YaoQuan, 2019)

[10] See https://www.mbari.org/microplastics-water-column/

[11] See 2015-16 Monterey County Civil Grand Jury Report

[12] See http://www.montereycountyweekly.com/news/local_news/after-the-worst-sewage-spill-in-local-history-monterey-one/article_c9c12ff4-06d8-11e8-98b7-9bbb12939bcf.html (noting MRWPCA's (or Monterey One Water) failure caused the worst sewage spill in local history)

Respectfully,

Margaret Th

Margaret Thum

cc: File

May 23rd 2011

Recycling water from sewage into drinking water: a "high level" health risk we should only take as a "last resort".

Professor Peter Collignon AM
Infectious Diseases Physician and Microbiologist
Professor, School of Clinical Medicine, Australian National University.

PO Box 11, Woden. ACT. 2607. Australia.
fax 61 2 6281 0349, phone 61 2 6244 2105,
peter.collignon@act.gov.au (work email)

Declaration of interest statement

I do not have any contracts, consultancy arrangement or research grants from any companies that may derive major financial gains from building sewage recycling plants (eg engineering companies such as CH2M Hill, Veolia Water etc) nor from institutions that may be involved with the large sums of monies that will be needed to finance these types of projects (eg Macquarie Bank, Babcock and Brown, and/or water infrastructure funds).

In making this submission I am expressing my own opinions on a matter of the very important public interest and concern as a medical and public health expert in the field of microbiology and infectious disease. I am not making any adverse imputations on the possible motives of any party who may be seeking to promote the recycling of treated sewage into water for human use as drinking water. The statements made herein represent my own considered opinions and judgements and do not necessarily represent those of any employer of mine or of any other institution with which I may be, or may have been, affiliated.

Table of contents

Executive summary

Recycling water from sewage into drinking water was recently promoted by the Productivity Commission both in their draft report and particularly in the press statements - with headlines such as "National productivity commission recommends drinking of recycled waste water" (1).
I believe such public recommendations given by the commission are irresponsible.
It seems to be based on poor and misleading information presumably given to the commission by lobbyists and the very "rent seekers" the commission warns to be wary of in their April 2011 draft report.

While technically feasible, even if done with the currently optimal processes available (i.e. multiple barriers including reverse osmosis membrane), the community needs to be very wary. It should be a "last resort" option for many reasons, but especially because of the potential "catastrophic" public health implications if something in this complex and "very high risk" process goes wrong.

Even from just a monetary cost point of view, recycling water from sewage into drinking water is associated with very high initial capital costs and also high ongoing monetary and energy costs. The Commission correctly stressed that the inappropriateness of the extraordinary costs of desalination plants. However the plants that recycle water from sewage are the same as desalination plants and use the same technology (re RO membranes). Thus the capital cost will be almost identical. It is only the ongoing energy costs that are likely to be slightly lower (but these will still be substantial). The slightly lower energy costs are because the water source (sewage) has a lower salt concentration than sea water. However if appropriate microbiological testing and other additional steps that are needed are put into place because such a "High Risk" water source is now used, any likely potential savings from energy savings will likely be substantially negated.

From a health perspective these are "Very High Risk" proposals (2). They reverse 150 years of good public health policy – striving to keep sewage out of our drinking water supplies. When we need to recycle water from highly contaminated sources, it is much safer to use it via *separated pipelines* for industrial purposes (as do Singapore and Brisbane). Putting it into drinking water should be a "last resort". This was the conclusion of the most extensive scientific review on this issue in the US by their National Research Council (3). "It should be adopted only if other measures—including other water sources, *non-potable* reuse, and water conservation—have been evaluated and rejected as technically or economically infeasible." I agree with this conclusion from the National Research Council. I find it difficult to see how the Productivity Commission could come to any other conclusion if they had reviewed all the appropriate material that pertains to this issue.

Sewage contains very high concentrations of pathogens and drugs. Viruses (the most difficult pathogens to remove) can be in concentrations of more than 10^6 per litre - orders of magnitude higher than even the most polluted rivers. The technical and human performance standards required for recycling water from sewage into drinking water safely will need to be proportionately higher than current practice. This will be difficult to achieve as we have already skills shortages. Governments and water utilities also need to ensure that the system will work *all* the time (even a 99% satisfactory technical performance means there is a 1% failure rate and the population may be exposed to pathogens 3 days a year). Acceptance of even low failure is not an option.

Reverse Osmosis (RO) is the most effective way to remove the viruses and drugs from sewage. RO should remove virtually all viruses and drugs. Surprisingly, little in-use data are available to check this. These membranes seem to leak and/or perform less than expected. In Brisbane, RO only removed 92% of antibiotics (4). Recent safety reviews, including an Australian review (5) (but based on the previous study (3)), showed viruses were still detected post-treatment at 3 of 7 sites on some occasions. The calculated virus removal ranged from only 87% to >99.995% (log 1 to log 5). Even relatively very large non-viral agents, (e.g. a protozoan such as Giardia) were not always removed. This poor performance by some RO membranes in removing viruses and drugs has also been seen in some more recent studies. As pointed out in the Australian Guidelines for Water Recycling Augmentation of Drinking Water Supplies, we need however a consistent log 9.5 (or about 10 billion fold) reduction for Enteroviruses (2). This less than optimal performance was *when the system was not known to be malfunctioning* (e.g. induced leaking O rings or pinhole tears in membranes as an experiment). Modelling suggests that lowered performance might occur as often as 5 days per year (6).

Current surrogate testing (e.g. organic carbon, electrolytes) can only detect a 1% membrane leak (or bypass). This is only a log 2 reduction, well short of the log 9.5 reductions we need checked for virus removal and reasonable safety (2).

We should also take into account similar views when expressed by international water experts (as quoted in the Financial Times April 2007). Veolia's Mr Frerot says: "To my knowledge, there are only two places in the world where treated waste water is gradually mixed into tapwater: the town of Windhoek, in Namibia, and Singapore."

In Windhoek, that is because the river is more polluted than the waste water, he says. In Singapore, it is a political choice designed to reduce dependence on supplies from neighbouring Malaysia - and accounts for less than 1 per cent of water consumed.

Ultimately, says Mr Frerot, the most cost-effective solution to water shortages developing in many towns and cities must surely be to supply such treated waste water for use in industry and irrigation, in place of the tapwater used today. "That would halve the demand for natural water," he says. "That is what we should do, before talking about drinking waste water."

In conclusion we should only adopt recycling water from sewage into drinking water as a “last~~-r~~esort”.
It~~ is unlikely that in~~ Australian~~ cities that this type of~~ “recycling”~~ will ever need to be~~ adopted. Other measures—including using other water sources, *non-potable* reuse, more

dams, water conservation, and then trading of rural to city trading water rights — are all much less likely (if evaluated as alternatives to recycling water from sewage into drinking water), to be rejected as technically, environmentally or economically infeasible. Even if the community should ever find the need to do this type of "high risk" water recycling, we will also need *real time* tests to be developed to show we have adequate removal of all human pathogens such as viruses *all of the time*. With current testing methodology we are now more likely to *not know* at all or know *only after* processed but contaminated water from sewage is already recycled in our reservoirs.

References

1. Matt Johnston. National productivity commission recommends drinking of recycled waste water
Herald Sun. April 14, 2011

2. Australian Guidelines for Water Recycling Augmentation of Drinking Water Supplies. Environment Protection and Heritage Council, National Health and Medical Research Council and Natural Resource Management Ministerial Council. May 2008. Canberra. http://www.ephc.gov.au/sites/default/files/WQ_AGWR_GL__Augmentation_of_Drinking_Water_Supplies_Final_2008_05.pdf Accessed April 6th 2009

3. National Research Council (1998) Issues in Potable Reuse: The Viability of Augmenting Drinking Water Supplies with Reclaimed Water. National Academy Press, Washington, DC. http://www.nap.edu/openbook.php?isbn=0309064163 Accessed April 6 2009.

4. Watkinson AJ, Murby EJ, Costanzo SD. Removal of antibiotics in conventional and advanced wastewater treatment: implications for environmental discharge and wastewater recycling. Water Res. 2007;41:4164-76.

5. Khan S and Roser David. Risk Assessment and Health Effects Studies of Indirect Potable Reuse Schemes. Final Report. Centre for Water and Waste Technology School of Civil and Environmental Engineering. University of New South Wales. NSW, 2052, Australia. April 2007. http://www.lgaq.asn.au/lgaq/publications/Risk%20Assessment%20and%20Health%20Effects%20Studies%20-%20WSAA%20Version.pdf Accessed April 6 2009.

6. Roser D, Khan S, Davies C, Signor R, Petterson S and Ashbolt N. Screening Health Risk Assessment for the Use of Microfiltration-Reverse Osmosis Treated Tertiary Effluent for Replacement of Environmental Flows. Final Report. Centre for Water and Waste Technology School of Civil and Environmental Engineering University of NSW. October 2006.

Comments on errors and other corrections needed in Productivity Commission's draft report

The Commission has made some statements and recommendations in their draft report that I believe need to be modified or changed. These are addressed below.

Chapter 6 — Supply of water, wastewater and stormwater services
State and Territory Governments should adopt policy settings that allow the costs and benefits of all supply augmentation options to be considered using a real options (or adaptive management) approach.
Information on costs, risks and benefits to consumers of all augmentation options should be made publicly available and views of the community sought, especially regarding sensitive options like potable reuse.
Bans on particular augmentation options (those explicitly stated and those that are implied by government decisions) should be removed, including those on:
• *rural–urban trade (to allow water to be allocated to its highest value use)*
• *planned potable reuse (unplanned potable reuse occurs commonly without any apparent ill-effects).*

While I agree with most of the points above, the part of the last dot point that states statement "unplanned potable reuse occurs commonly without any apparent ill-effects" I believe is both wrong and dangerous. Millions of people (mainly children) die every year around the world because "*unplanned potable reuse occurs commonly".* Deaths occur not only in developing countries because of this *but also in developed countries*. In Canada, a Royal Commission was set up after deaths followed sewage leaks into water supplies.

Your statement is thus not only unbelievably wrong but dangerous. How can it have been made by anyone with a social conscience? It suggests the lowest common denominator re health and deaths is acceptable economic practice.

The recycling of wastewater and stormwater is increasing (section 2.3). Notwithstanding the river-based disposal of treated wastewater and reuse downstream (box 2.2), in Australia recycled wastewater and stormwater has been kept separate from the potable water supply, and instead has been used for non-potable purposes or discharged to the environment. (For a period of time in Orange recycled water was introduced into one of the town's dam (Orange City Council 2009b).) This however, is not the case in other countries. For example, Singapore recycles treated wastewater for potable and non-potable uses. Recycled water meets 30 per cent of Singapore's water demand (PUB 2010; 2011).

This statement is highly misleading. In Singapore the majority of recycled water is used for industry and not for potable use (close to 99% for non-potable use and the recycled water is piped to industry via a separate pipeline from the potable water supply).

Australia (it has occurred in Orange), there are places where there is unplanned potable consumption of untreated stormwater and treated wastewater. For example,

wastewater from upstream towns and cities that has been treated to a secondary or tertiary treatment level and undergoes natural treatment as it heads downstream. In many towns, stormwater enters the river system through drains.
Unplanned indirect potable reuse of treated wastewater has occurred in cities and towns that source drinking water from the Murrumbidgee and Murray Rivers.
Adelaide has long taken drinking water from the Murray River.
In recent years Canberra has sourced drinking water from the Murrumbidgee River and is in fact using its own stormwater.
Sources: ActewAGL (2011b); Alexander (2007); Costello (2006).

I will reiterate what I said earlier;
The statement or implication that "unplanned potable reuse occurs commonly without any apparent ill-effects" and is thus by implication is not a major issue, I believe is both wrong and dangerous if left as it is. Millions of people (mainly children) die every year around the world because "unplanned potable reuse occurs commonly".

Best practice for the last 150 years is to stop or significantly decrease "unplanned indirect potable use" of water source from sewage or stormwater. Why is the Commission trying to negate this fundamental health principle?

16 AUSTRALIA'S URBAN
WATER SECTOR
Energy costs
One of the largest operating costs for urban water utilities is energy. Energy is mainly used for the pumping and treatment of water. Pumping water from locations a significant distance away can significantly contribute to energy use. Moreover, moving from primary to secondary, or secondary to tertiary levels of treatment can double the energy intensity of the process (Kenway et al. 2008).
The proportion of energy used in different activities along the supply chain varies between cities (figure 2.2). In Adelaide, the majority of energy is used in the pumping of water, representing over 70 per cent of total energy used. Sydney also uses a high proportion of energy for pumping, at over 55 per cent. In contrast, water pumping in Brisbane only accounts for about 6 per cent of energy used, with treatment being the most energy intensive activity at just under 50 per cent. The reasons for these differences are likely explained by some of the cost drivers discussed earlier, especially the availability of sites to provide storage at higher altitudes than the point of consumption. In Melbourne and the Gold Coast wastewater treatment is the higher user of energy at about 50 per cent.

The water sector's energy costs are likely to rise in the future, due to a combination of increasing energy prices and desalination plants coming online, which are relatively energy intensive compared to other supply sources (Australian Academy of Technological Sciences and Engineering, sub. 34).

I have no problem accepting the argument on high energy costs, especially for pumping water uphill and for desalination plants. However why then does the Commission place sewage recycling in such a favourable light in so many places in the draft report?

The energy cost of any sewage recycling plants that puts water into the drinking water supply will involve both these factors in a very significant way compared to other means of water security (such as dams). Why are sewage recycling plants and their energy cots not mentioned as an example somewhere (i.e. the energy for RO membrane filtration and pumping cost of a sewage recycling plants) e.g. in this section?

Supply augmentation
There has been large investment in supply augmentation in recent years, ranging from households installing rainwater tanks and greywater systems to the construction of large desalination plants. The combined capital expenditure program of 30 of Australia's largest water utilities is approximately $30 billion over the period 2005-06 to 2011-12 (WSAA 2009). This section outlines some of the larger supply augmentation projects initiated by both government and water utilities themselves that have been completed in recent years, are currently underway, or will begin (or could begin) in coming years.

Desalination plants
Many jurisdictions have invested heavily in desalination plants in recent years. Desalination is a climate independent source of water, making it a more certain supply source than surfacewater and groundwater alternatives. Large desalination plants have been, or are being, built to service capital cities, and many desalination plants have been built to service private users, often in mining operations. Desalination plants have been built, or are currently being built, to service Sydney, Melbourne, south-east Queensland, Perth and Adelaide (table 2.4). The capacity and cost of the desalination plants vary greatly, with Perth and south-east Queensland constructing smaller desalination plants, between 45 and 50 GL, and costing between $387 million and $1.2 billion respectively, compared with Melbourne's desalination plant which has a capacity of 150 GL and the construction will cost an estimated $3.5 billion. It has been reported that the Melbourne plant is the largest desalination plant in the Southern Hemisphere (Miller and Schneiders 2010). The Adelaide desalination plant was originally designed to have a 50 GL capacity but will now be built to provide 100 GL of water. This plant was funded jointly by the Australian and South Australian Governments (Office for Water Security 2009; WSAA 2010b).

Dams
Augmenting supply through building new dams has become more difficult in recent years for a number of reasons, including:
• there are fewer options available with the best sites already used
• the opportunity cost of the land has increased
• dams are dependent on rainfall
• the community has changed its view on environmental impacts of dam, construction, such as the impact on native fauna and flora, and significant environmental ecosystems and processes

I note above that the recent cost for desalination capacity is about $200million per 10GL capacity. This relatively is a very expensive water source (dams are far more cost effective). The Commission correctly points this out and argues against some of this construction. However the cost of building a sewage recycling plant will be almost exactly the same as building a desalination plant. Why is there such inconsistency in not showing these costs for sewage recycling plants?

I also note from the Commissions figures and examples below that the cost of increased water security by increasing Dam capacity is between $10 to $30 million per extra 10Gl capacity (or about *one tenth* the costs of desalination and sewage recycling plants and *without the same ongoing high energy cost* for desalination and sewage recycling plants).

Table 2.4 **Large desalination plants**

Location	Project	Estimated cost of construction[a]	Capacity	Ability to increase capacity	Completion date
		$m	GL/annum	GL/annum	
Sydney	Kurnell	1 890	90	180	2010
Melbourne	Wonthaggi	3 500	150	Up to 200	2011
South-east Queensland	Tugun	1 200	49		2009
Perth	Kwinana	387	45		2006
	Binningup	955	50	100	2011
Adelaide	Port Stanvac	1 830	100		2011

[a] Costs were incurred in different years, making them not directly comparable.

Sources: Costa (2010); Gallop (2005); Hinchliffe (2010); Partnerships Victoria (2010); SA Water (2011c); Sydney Water Corporation (sub. 21); Water Corporation (ndb); WSAA (2010b).

Nevertheless, there are a number of dam-related projects currently underway. Significant projects include the upgrading of the Hinze Dam, which serves south-east Queensland, which will almost double its storage capacity from 161 GL to 310 GL (table 2.5). This upgrade is due to be completed in December 2010. An enlargement of Canberra's Cotter Dam is also underway, which will increase its capacity from 4 GL to 78 GL (WSAA 2010b). The project is expected to be completed in late 2011 (ACTEW 2010a).

Table 2.5 **Large dam projects**

Location	Project	Estimated cost[a]	Capacity	Completed
		$m	GL	
Canberra	Expansion of Cotter Dam	363	78[b]	2011
South-east Queensland	Upgrade of Hinze Dam	395	310[c]	2011
	Wyaralong Dam	348	103	2011
Melbourne	Tarago Reservoir reconnection and upgrade	97[d]	37.5	2009

[a] Costs were incurred in different years, making them not directly comparable. [b] Expansion from initial capacity of 4 GL. [c] Expansion from initial capacity of 161 GL. [d] Cost of the water treatment plant needed to reconnect the reservoir.

Sources: ACTEW (2010a); Melbourne Water (nda); QWI (nd); Seqwater (2009); WSAA (2010b).

Wastewater recycling

Australia's largest wastewater recycling project is the Western Corridor Recycled Water Scheme located in south-east Queensland. It comprises three advanced water treatment plants that treat wastewater to supply power stations and industry. It is expected to supply about 36 GL per year (table 2.6). Recycled water might also be used to replenish Wivenhoe Dam for indirect potable reuse when south-east Queensland's water storages fall below 40 per cent (increasing this trigger point would increase operating costs and the likelihood of dam spilling) (QWC 2010b).

One of Australia's largest residential water recycling schemes is the Rouse Hill Water Recycling Scheme in Sydney's north-west. Treated wastewater is distributed via a third pipe for toilet flushing, laundry washing and outdoor uses. Currently 19 000 homes are involved and eventually it will service 36 000 homes. The plant will treat about 4.7 GL of wastewater each year for use (Sydney Water 2010a).

Table 2.6 **Large water recycling projects**

Location	*Project*	*Estimated cost*[a]	*Supply/ Capacity*	*Completion*
		$m	GL	
Sydney	St Mary's Replacement Flows Project	250	18	2010
	Rouse Hill Water Recycling Scheme	60[b]	4.7	2008
	Rosehill-Camellia Recycled Water Scheme	100	4[c]	2011
Wollongong	Wollongong Water Recycling Plant	25	>7.3	2006
Melbourne	Eastern Treatment Plant – Tertiary Upgrade	380		2012
	West Werribee Recycled Water	114		2013
South-east Queensland	Western Corridor Recycled Water Project	2 600	36[d]	Completed
	Murrumba Downs Sewage Treatment Plant	197	11[e]	2010
Perth	Kwinana Recycled Water Scheme	28	6	2004
Adelaide	Glenelg to Adelaide Park Lands Recycled Water Project	76	5.5	2010

[a] Costs were incurred in different years, making them not directly comparable. [b] Cost of the upgrade only. [c] Can be expanded to 7 GL. [d] Expected supply for urban water use. Total capacity is expected to be greater. [e] Based on 4 ML per day.

Sources: GHD (2009); Glenelg to Adelaide Parklands Recycled Water Project (nd); QWC (2010b); Sydney Water (2006; 2009; 2010c; ndc; ndd); Unity Water (nd); Water Corporation (nda; 2008); WSAA (2008; 2009; 2010b)

I note the only example given above where technology used is stated as being potentially appropriate for potable water (Western Corridor recycled water project) that the cost is $2,600 million but *for only 36 GL of water capacity*. This appears to be a much higher costs per 10 GL of capacity than the even the desalination costs quoted elsewhere in the draft paper.

Public health

Access to clean water for drinking and washing, and reliable wastewater services are vital for public health. Indeed, the history of government involvement in urban water supply systems is very much tied up with public health concerns. Improvements in the standard of urban water and wastewater systems during the nineteenth and the first half of the twentieth century played a major role in reducing the prevalence of diseases such as typhoid and cholera in various countries (Barzilay, Weinberg and Eley 1999).

While gains in public health made in the distant past are often taken for granted in developed countries such as Australia, contributing to good public health outcomes remains an important objective for the urban water sector. Achieving this objective involves managing risks to public health, for example, the risk that people will get sick from ingesting water that contains microbial and chemical hazards. There is evidence that this risk is not always well managed in some regional areas (chapter 6).

Managing such risks efficiently does not usually involve eliminating all risks entirely. Consider a situation where there are large benefits available from developing a fit-for-purpose recycled water product for garden watering, toilet flushing and other uses. A risk eliminating approach might specify that the quality of such water needs to be comparable to that of potable water on the grounds that a small number of people may drink it. Such a requirement might make the project uneconomic, meaning that a large benefit is lost in order to eliminate what may have been a very small risk.

The above is true re never having zero risk. However we should continue to strive (as has been public health policy) to make the risk as close to zero as possible and lower the risk by using better and cleaner source waters when these sources are available. One will need a “risk eliminating approach” if any such water is recycled into drinking water however. However this is very expensive approach compared to most other water sources and also a much higher risk to public health as the sources’ water has such high concentrations of drugs and microbes.

Rent seeking

Where governments face different options for how to provide or regulate a service it is common that the vast majority of the community will be only slightly affected by the decision taken, while a small minority stand to gain or lose significantly.

Making an efficient decision requires that both diffuse and concentrated interests are taken into account, but the political process can err by giving undue weight to the latter.

The reason for this is that those strongly affected by a decision are most likely to be motivated to lobby for their preferred outcome, a practice known as rent seeking.

For example, while the vast majority of water users might benefit slightly from some urban water being purchased from irrigators, it may be that the strongest lobbying would come from a relatively small number of businesses in irrigation areas that would face significant costs.

I can only agree. Unfortunately the Commission seems to have been captured by rent seekers given their recommendations (without appropriate costing and caveats) on recycling water from sewage into drinking water.

Costs associated with ‘lost’ or delayed investment

Compliance costs and regulatory uncertainty have the effect of reducing the returns and riskiness associated with investments, thereby lowering their attractiveness.

Regulatory delays also potentially reduce investment, and can lead to sub-optimal investment strategies. For example, if there is a need for supply augmentation and the most attractive investment (from a cost–benefit viewpoint) is delayed by the regulatory process, the delay might lead to a less efficient investment taking place because it can be delivered in the truncated timeframe. This leads to an inefficient outcome, relative to the preferred investment, that can be considered a cost associated with regulatory delay.

Kerry McIlwraith, the chief financial officer of ACTEW, highlighted the impact of regulatory uncertainty on supply augmentation decisions:

So in a real options analysis once you introduce uncertainty what became apparent was that the dam would be chosen almost on every occasion because you had more possibility of [it proceeding] but the others just have been very difficult to get into place [due to the challenges associated with] getting interstate agreements, the environmental issues associated with each one and different environmental regulators. The Murrumbidgee–Googong pipeline had to go through New South Wales, the ACT and the Feds to get decisions and they had different views. We’ve managed to get two down and the third one we have an approval of sorts to proceed. But it’s the uncertainty of progressing those that makes it difficult. We’re still negotiating after some considerable period with Snowy Hydro about releasing the water in an amount that works for us as well. But to get that project to work we also need the pipeline so that we can pump the water, otherwise we wouldn’t be able to pump enough to make it a worthwhile proposition. (trans., pp. 83–84)1

I note from above that for just one important reason “Costs associated with ‘lost’ or delayed investment”, the dam option would have been chosen. It is also important to note however that there were many dam options looked at in the extensive ACTEW analyses that were done. Other than the Lower Cotter other localities for a new dam that were possible were the Tennent Dam, another dam on the Cotter

River but upstream plus others. *All the Dam options were much more economic compared to the sewage recycling option.*

The most expensive options available in monetary and energy costs were a desalination plant on the coast and then pumping the water to Canberra and a sewage recycling plant. Why did the Commission not quote or use any of these economic comparisons that ACTEW has already done? I can only presume that "rent seekers" prevented this from happening, presumably by being very selective in what information has been given to the commission.

It is important to subject proposed regulations to cost–benefit analysis (CBA). A CBA of a regulatory proposal involves systematically evaluating all of its impacts on the community and the economy, and not just the immediate or direct effects, financial effects or effects on one group. It should, to the maximum extent possible, value the gains and losses from a regulatory proposal in present day monetary terms, thereby enabling assessment of whether the benefits of the proposal exceed the costs. Such analyses should be made available to the public and it is highly preferable that the public be able to comment upon them prior to final decision making.

I can only agree. So why has this not been done in the draft report for recycling water from sewage into drinking water proposal? However the relative public health risks need also to be part of this type of analysis.

Analysis based on the limited information available to the Commission, suggests that it would have been considerably less costly (and more economically efficient) to obtain extra water through purchases from irrigators in the southern connected Murray-Darling Basin (box 6.3). The fact that a desalination plant was preferred suggests that there may have been an implicit government veto on the purchasing option, due to its political sensitivity.

If this is true for desalination plants (re other option being considerably less costly) then the same will hold for sewage recycling plants - as it is the same technology.

Prohibition on the planned potable use of recycled water
It is poss ble to treat stormwater and wastewater to a standard that makes it suitable for human consumption. Water that is recycled in this way can be piped into water supply dams or injected into aquifers that are used as a source of potable water. Where wastewater is used, recycling offers a source of water that is largely independent of rainfall. A major advantage of using recycled water for potable rather than non-potable use is that separate distr bution infrastructure is not required. Various countries, including the United States and Singapore, use recycled water as a source of drinking water in a planned way (ENTOX, TOXIKOS and the University of NSW 2008).

Many of the statements above are not true or else misleading. Sewage recycling is not completely independent of rainfall as a water source. When there is a drought the amount of water available from sewage significantly decreases (because the population adopts more water saving habits). While this recycled water can in theory be made suitable for human consumption, there is no testing currently used that can show it is consistently safe to use. Also in Singapore a separate pipeline is used to circulate the treated water. Further only a token amount is added to potable water supply in any case in Singapore (see appendix). Moreover why are there no costings given? In sections before this one, all the down sides of desalination plants are appropriately given, yet these sewage recycling plants are the same type of plants. Why this inconsistency from the Commission in its draft report. This perceived bias is somewhat disconcerting as it is coming from the Commission that should be above this.

There are many instances, in Australia and elsewhere, of wastewater being treated and discharged to a river system that supplies downstream communities with potable water. This practice is known as unplanned potable use of recycled water. For example, most of the ACT's wastewater is treated and discharged into the Molongolo River, which flows into the Murrumbidgee River which in turn flows into the Murray River. Along the way this water forms part of the water supply for many cities and towns, including Adelaide. The Commission is not aware of any major health concerns associated with this source of supply.

I will yet again reiterate what I said earlier:
The statement or implication that "unplanned potable reuse occurs commonly without any apparent ill-effects" and is thus by implication is not a major issue, I believe is both wrong and dangerous if left as it is. Millions of people (mainly children) die every year around the world because "unplanned potable reuse occurs commonly".

Deaths occur not only in developing countries because of this but also in developed countries. In Canada a Royal Commission was set up after the deaths following sewage leaks into water supplies. Your statement is thus not only unbelievable wrong but dangerous. How can it have been made by anyone with a social conscience? It suggests the lowest common denominator re health and deaths is acceptable economic practice.

Best practice for the last 150 years is to stop or significantly decrease "unplanned indirect potable use" of water source form sewage or stormwater. Why is the Commission trying to negate this fundamental health principle?

In contrast, more direct and planned use of recycled water for drinking is less common and remains contentious. Indeed, the NWC reports that New South Wales, Victoria and South Australia have policy bans that preclude the use of this option (NWC 2010b), despite these states utilising unplanned potable use of recycled water originally sourced from the ACT and elsewhere. In Queensland, three advanced water treatment plants have been built that have the capacity to supply south-east Queensland with drinking water, but a decision has been taken that they are only to be used for this purpose when dam levels fall below 40 per cent (Queensland Government nd).1 Recycling was also proposed for Toowoomba; however, government support for this project was withdrawn following community
opposition (box 6.4).
(1). The SEQ Water Grid Manager reported that there are significant savings on operating costs from not utilising this source when dam levels are higher (DERM,
Box 6.4 Toowoomba recycled water proposal
Toowoomba is located 127 kilometres west of Brisbane in the headwaters of the Darling River. It is one of Australia's largest inland cities, with a population of 95 000.
The population of the greater Toowoomba region is 135 000.

In the face of declining dam levels in the early 2000s, Toowoomba City Council began to assess various options for augmenting supply. These options included new dams, water produced from coal seam gas operations, groundwater and piping water from the Brisbane River system. For cost, environmental and reliability reasons, planned potable reuse of wastewater was identified as a preferred option. The environmental benefits related mainly to reduced nutrient and salt exports to the Darling River.
This option involved building an advanced water treatment plant (using reverse osmosis technology) to process more than 5000 megalitres of wastewater sourced from the city's wastewater treatment plant. Most of this water was to be piped to an existing dam to become part of the city's potable water supply, with some lower quality water being used for other purposes, including coal washing and irrigated agriculture.
The estimated cost of the project was $68 million and Council sought part-funding from the Australian Government's Water Smart Australia program in 2005.
There was fierce debate about this proposal in Toowoomba. People opposing the project ran a high-profile public campaign warning of possible public health risks, even though the plant was to produce water of a higher quality than the existing supply. This campaign reportedly extended to measures such as displaying babies' bottles with toilet paper in them.
According to the then mayor, the Australian Government took the unusual step of requiring that a poll be held to gauge the level of support for the project in Toowoomba before a decision on funding would be made. The poll was held in July 2006. The vote in favour of the project was 38 per cent, with 62 per cent opposed. In light of this result the project did not proceed.
Subsequently, a 38 kilometre pipeline was constructed to transport water from Wivenhoe Dam (Brisbane's main dam) to Cressbrook Dam near Toowoomba at a cost of $187 million.
Sources: Toowoomba City Council (2005); Diane Thorley, trans., pp. 419–31.

I note the disparaging way the opposition by those in Toowoomba who did not approve of putting water recycled from sewage into drinking water, is presented. I also note the cost of the ultimate solution (the pipeline) to the water problem was at a cost of $187million to be able to supply 18 Gl of water per year to Toowoomba and completed within 12 months. I agree this is expensive but it is still about half the cost of a desalination capacity (and thus a sewage recycling plant) of around $400million per 20GL capacity.

Thus the pipeline option seems to have more cost effective than the sewage recycling project (the estimated $68 million figures quoted seems unrealistically low given other data presented in the draft report that suggests $400 million for a 20 Gl sewage recycling plant is more likely). Again it suggests an evident bias by the Commission in their report. This bias needs to be addressed as Commission is supposed to be objective and impartial, especially on economic issues re data presentation.

"The project cost $187 million and was designed to initially supply 14,200 megalitres of water each year. The pipeline has the capacity to increase water supply to 18,000 megalitres per year catering for expected population growth and demand until 2051, should it be needed.

In November 2009, Toowoomba's dam levels were at under 9%. Without the construction of a pipeline, total dam depletion was predicted to occur by September 2010. Construction of the pipeline commenced in January 2009 and the pipeline became operational in January 2010, ensuring that Toowoomba and

surrounding communities did not run out of water."
(http://www.dip.qld.gov.au/projects/water/toowoomba-pipeline-project.html).

It could be argued that governments that impose policy bans on the potable use of recycled water are responding appropriately to the health and other concerns of the community. It would appear, however, that the weight of scientific evidence is that the risks of using recycled water for drinking purposes can be satisfactorily managed (NWC 2010b). Given this, the Commission is in agreement with the NWC that rather than impose outright policy bans:
… decisions on whether to use recycling for drinking purposes should objectively consider the risks, the costs and the benefits through a transparent and participatory process. (NWC 2010b, p. 1)

I don't agree. There is insufficient data to make this conclusion. Of the few studies available, these show that RO process in sewage recycling, despite the claims of proponents, does *not* consistently remove all drugs and pathogenic microbes.

Unwarranted preference given to water reuse and recycling for non-potable use
The Australian, State and Territory Governments give preference to supply augmentations that involve reusing or recycling water for non-potable uses by subsidising them or mandating their use. Although reuse and recycling options can provide benefits in addition to water supply, the Commission's view is that the preference given to these options is in most instances not justified by these additional benefits. Evidence and analysis of this issue are presented later in the section on integrated water cycle management, and this suggests that the costs to the community of unwarranted preference being given to water reuse and recycling for non-potable use are substantial.

If you are just interested in monetary issues and are happy to ignore Public Health and the potential for very large numbers of people to become ill and even die then your statement above is true. However I can only yet again reiterate that the best practice for the last 150 years is to stop or significantly limit the chance that any sources of water from sewage in entering the drinking water supply.

Scope for efficiency gains in pricing recycled water
The principles for pricing recycled wastewater and stormwater are no different from those for potable water. Essentially, the prices should reflect the cost of providing the water to users.

I think this is from an economic perspective a reasonable approach. Given that the capital and running costs of a sewage recycling plant are however so high ($200 million per 10 Gl capacity for construction alone), if this recommendation was followed it is hard to see how sewage recycling into drinking water would ever be economically viable in this country for if it were done properly and safety with appropriate real time testing for appropriate human pathogens (e.g. viruses) and drugs. It is thus hard to see why the Commission could have been recommending this as a viable economic option in its draft report or in press and media statements. The inconsistency compared to statements made by the

Commission on desalination plants is staggering (and that is before the Public Health issues are taken into account when the process should fail).

Submission

Introduction

One of the major advances in Public Health over the last 150 years has been to keep micro-organisms that are commonly found in the faeces of people and animals, out of our drinking water supplies. We are protected by treating drinking water (with chlorination, flocculation, etc) but also and just as important, in the protection of our catchment areas by minimising the entry into them of human and other waste (both treated and untreated).

Protecting the catchment is important because no disinfectant or sterilising system works instantaneously. They all rely on time to kill micro-organisms. Thus the more micro-organisms present in the water initially, the longer it takes to kill them. If there are large numbers of organisms present, then there is a bigger risk that all these micro-organisms may not be eradicated before the water is consumed by people.

The problem with proposals to recycle sewage into our drinking water supply is that this is a fundamental reversal of one of the basic principles that have helped keep our drinking water safe (i.e. keeping sewage out of our catchment area or from drinking water sources).

Sewage has the highest concentrations of pathogenic micro-organisms (e.g. viruses) and drugs compared to any other water source.

Membranes and reverse osmosis do not remove all drugs and salts

The equipment and membranes that will be involved with sewage recycling proposals (e.g. filtration, reverse osmosis, etc) are technologically very advanced systems. *Providing that they work*, they should be effective in protecting us from the large numbers of disease-caused by micro-organisms present in sewage including viruses (although in use verification data is very sparse).

Despite what is frequently claimed or implied by those promoting this technology for the recycling of sewage into drinking water, reverse osmosis (RO) does *not* remove all salts and nitrates from treated water (about 1 to 2% of salts and between 10 to 50% of nitrates are not removed). In Brisbane, reverse osmosis appeared to only remove about 92% of antibiotics from treated water derived from sewage (ie only about a one log reduction).

There is only very limited data available on how well reverse osmosis removes viruses, when used on large volumes of sewage. Direct testing for viruses is rarely or infrequently done, because of cost and technological problems. Thus other markers are used to assess performance (eg pressure, conductance changes, organic carbon etc.) which are in effect used ~~as~~ “surrogate” markers to assess virus and pathogen removal from water. However if we used salts or nitrates as surrogate markers for virus removal, then we would obviously be far from happy with the performance of RO to remove viruses. Some pilot studies and some operational tests from Singapore suggest that all viruses are removed by RO. However the data remains very limited (eg only about 20 tests for enteroviruses appear to have been documented in the Singapore expert report). Recent safety reviews, showed viruses were still detected post-treatment at 3 of 7 sites on some occasions. The calculated virus removal ranged from only 87% to >99.9 95% (log 1 to log 5).

Even if a system does remove all viruses when it is working normally, there always remains a risk, that something may go wrong on occasion (as is the case with any complicated engineering system). We need to remember that there have been numerous recent outbreaks of water-borne infections in the US, Canada and Europe that have resulted from both human failure and equipment failure involving much simpler water treatment processes (chlorination, filtration, flocculation, etc). This recycling process is an addition to any water system and hence an added risk.

I can only agree with the comments made in the recently released environmental discussion paper by the eWater Cooperative Research Centre:

“No treatment system anywhere in the world can be guaranteed to be absolutely failsafe 100% of the time. Consequently, equally important to the treatment system chosen must be the provisions made for detecting failure and ensuring that there is no break-through or leakage of incompletely treated water or wastes.”

It needs to be noted that when in Brisbane recently, fluoride was added to the water supply for the first time, the system malfunctioned and incorrect levels of fluoride were added to the water supply for a prolonged period of time (see appendix). This was supposedly via an automated state of the art and fool-proof system. It was also a system much less complex what what is proposed and needed for recycling water from sewage into the potable water supply.

It is also important to also note that in other countries where water from sewage has been recycled (which has been mainly for industrial use by separate pipelines in any case), that in general *all sewage from industrial areas, hospitals, abattoirs, pathology laboratories etc., are excluded from the recycling schemes*. This is because of fears that there may be larger quantities of unknown chemicals or other toxins in sewage from these types of sources in comparison to standard domestic sewage from residential areas. There concerns are based on worries that not all the toxins, chemicals etc from industrial areas may be removed by the sewage recycling processes and also that these chemicals may be more likely to damage the membranes using in reverse osmosis. Thus there is a perceived risk that sewage from these areas may increase the chance of a malfunction in the recycling process because of membrane failures. If we then recycle all the sewage from cities (as is currently suggested for many areas e.g. Canberra, Brisbane - because otherwise duplicate pipelines etc. need to be constructed), we will be participating in schemes that will thus incorporate some industrial waste-water as a source. This has not been done anywhere else in the world. We thus have no where else from which we judge efficacy and safety performance.

This is a “High Risk” proposal

If we do a Risk Assessment, this proposal is “high” risk, if one assesses it by the criteria set out in the risk matrix table from the Australian Drinking Water Guidelines – indeed it is probably “very high” risk. The reason for this “high” risk rating is that even though it should be rare that failures would occur with the system, the consequence of a failure, if it occurs in a large city such as Canberra or Brisbane, then tens of thousands of people, or more, could potentially be exposed to pathogens.

Pumping recycled water from sewage into drinking water is rarely done elsewhere in the world

It is frequently stated in the media by proponents and I note in the Commission’s paper that this is not a new proposal because frequently everywhere else in the world sewage is recycled into drinking water. I believe however, that those types of statements are either false or highly misleading and show what has been the undue influence of rent seekers and other lobbyists generating public misinformation.

The main example usually given is Singapore. However the water recycled in Singapore from sewage is used almost entirely for industry. The recycled water is very good quality water with a low salt content and it is offered at discount price. Thus it is very much in demand by high volume industry water users such as computer chip manufacturers. This recycled water is kept separated from their drinking water by the use of separate pipelines. By 2010, in Singapore, only a token 1% (or less) of their potable water is recycled from sewage (which is put back into their drinking water supply reservoirs).

Most recent proposals for recycling water from sewage, emphasise all the “non drinking” water purposes that this water will be used for, and it appears that they keep this recycled water away from their potable supplies as much as possible (eg information supplied by the large multi-national engineering company CH2M Hill which is involved with the recycling plant in city of Oxnard in California). In most other areas of the world where water is recycled from sewage “indirectly” into potable water supplies, it is usually done by replenishing aquifers and often because of the previous over-extraction of this underground water which has then resulted in the risk that salt water would enter the aquifer (eg Orange County and Oxnard). When recycled water is put into aquifers, there are usually also very long retention times before any recycled water is used. This means the many natural processes we have to help protect us against pathogens can still operate (eg major dilutions of the added water and prolonged storage or retention times). These natural processes result in viruses, bacteria etc dying off with time – often a 10 fold reduction in numbers every few weeks. In addition if water flows slowly through natural and shallow wetlands, UV light and other factors will usually kill human pathogens, and thus this wetland process is also protective. These types of additional safety barriers however will often not be present if something should go wrong. During any times of drought these additional barriers are likely to be significantly impaired.

Any recycled water from sewage will also need to be pumped uphill (as sewage plants are~~ always at the bottom of any city's water process)~~ via newly constructed separate pipelines. If not pumped via a separate pipeline, any recycled water be effectively going to be recycled directly into a potable water system (regarded by almost all in the water industry and elsewhere as unacceptable risk - as only done in Windhoek in Namibia).

It is not just my view that when it was proposed to recycle water from sewage in Canberra, this was something very radically different from accepted international health standards.   An article in the Financial Times (London) points out that this system proposed for Canberra has really not been done anywhere else in the world (see attachment) -

"Veolia's~~ Mr Frerot says: "~~To~~ my knowledge, there are only two places in the world~~ where treated waste water is gradually mixed into tapwater: the town of Windhoek, in Namibia, and Singapore."

In Windhoek, that is because the river is more polluted than the waste water, he says. In Singapore, it is a political choice designed to reduce dependence on supplies from neighbouring Malaysia - and accounts for less than 1 per cent of water consumed.

Ultimately, says Mr Frerot, the most cost-effective solution to water shortages developing in many towns and cities must surely be to supply such treated waste water for use in industry and irrigation, in place of the tapwater used today. "That would halve the demand for natural water," he says. "That is what we should do, before talking about drinking waste water."

This also means that there a few epidemiological studies that have been done elsewhere to access safety, are unlikely to be very useful for accessing the safety of this proposal for Canberra or Brisbane. Windhoek is probably the only comparable example for what was proposed for Canberra. Using a developing country in Africa for such analysis is problematic and not appropriate. There is thus a paucity of published data available that shows this proposal is safe.

I note this point is also made in the recently released Heath and public safety report form ACT government committee, "there have been relatively few systematic epidemiological studies of long-term health outcomes in communities supplied with drinking water supplemented by purified water."

There are other safer uses for recycled water rather than using it as drinking water

I am not arguing against using recycling water from sewage. I do however believe that one of the last places we should put this recycled water is into the *drinking* water. We should use it for other purposes such as industry, power stations, irrigation, etc. It is only if we then still have problems with a deficiency of water for drinking and household use that we then should consider recycling it into our potable water supply. There are places in the world where there are few alternatives but to recycle this type of water into potable water supplies. In general those are areas that have very poor average annual rainfalls (300 mm a year or less) and/or problems that have resulted after they have extracted too much water from aquifers: sea water would otherwise enter it and therefore leave them without any drinking water or with very badly compromised drinking water (eg Orange Country). None of those situations however is applicable to Canberra, Brisbane or other Australian capital cities. ACTEW's own Future Water Options Report stated that Canberra's average annual rainfall was sufficient for one million people.

A needless risk for the population; Canberra as an example

In Canberra generally, without water restrictions, about 65 GL/year (on average) of water is extracted from reservoirs. With Level 3 restrictions about 40 GL is taken from storage. In an average year, however more than 210 GL of water enters the current dam storage system from rain. Even during the recent record drought since 2001 to 2010, despite relatively mild water restrictions initially, the Canberra community managed to keep dams at reasonable levels (more than 50% of capacity). The exception was the year 2006 when there was very low rainfall and there were only about 25 GL inflows into storage. However at the beginning of 2006 (ie 5 years into the current prolonged drought) there was still storage levels at 68% of capacity. This had however dropped to about 35% by the end of 2006. We would only have serious problems if we have repeatedly, year on year, very low inflows. Such low inflows however would represent an over 80% reduction on our average inflows. Even in the worst case scenarios from CSIRO on climate change, there are only predictions of a possible 30% reduction in inflows over the long term. While such reductions would obviously be a problem, it would still mean that there would be more than enough water available to meet the needs for the Canberra community, as even a 30% reduction would mean on average that about 160 GL would still flow into our dams each year.

In Canberra water currently leaves storage for purposes of domestic and industry consumption (about 40 GL per year with level 3 restrictions). There is also a loose of about 10 GL a year through evaporation from storage and leakage. The local rivers also need to have water released from storage, with a minimum requirement of about 4 GL per year. This minimum usage adds up to a total requirement of about 54 GL per year of inflows into Canberra's dams with current usage patterns.

2006 was a very dry year with poor inflows into Canberra's dams. However despite this, in that year 17 GL was either released from or spilled over the dam wall of the Cotter and

Googong dams (12.7 GL and 4.3 GL respectively), despite inflows of only 25 GL. (Releases from these two dams are the only water that is "lost" from Canberra's storage system). The dams would have been quite adequate to supply Canberra's needs without water restrictions if much higher environmental flow requirements has not been imposed from 2000 on. In retrospect we also did not have enough reduction in environmental releases in place earlier enough in 2006, despite the poor rainfall and inflow being evident half way through the year.

Australia needs to learn from Canberra's mistakes in 2006. Dry years like 2006 are likely to occur again. In retrospect, we need to -

- ensure storage is adequate (as acknowledged by the ACT Government's Water Security Report;
- decrease our domestic use of water earlier (by water restrictions) when storage is in crisis; and
- better monitor and control the amount of water we released from these dams as river flows.

If these last two points were done better in the future, the ACT could have saved more than 20 GL of water a year during periods of drought in Canberra. This is the equivalent volume (or more) of the amounts of water likely to be recycled from the largest example of the prosed sewage-recycling plan for Canberra.

- Improved water storage capacity by a new Dam (such as the enlarged 78 Gl Cotter dam - now being built), will increase water security by a much larger amount per year than any of the previous potable water recycling from sewage proposals but at a much lower cost (money and energy) and with a much lower health risk to the population.

This is a very high energy proposal – it is not green or environmentally friendly

It is also important to remember that the sewage recycling plant proposal using reverse osmosis is really the same as a desalination plant. It therefore requires large amounts of energy (approximately 6,000 kilowatt/hours of electricity per ML of water produced). In Canberra it is estimated that will produce an extra 57,000 tonnes of extra CO_2 per year from plant operations. The recycled water proposal involved the water to be pumped over 13 km and uphill (it involves a 260 metre lift, firstly to the lower Cotter catchment and then again up to the Stromlo treatment plant). This pumping requires substantially energy requirements (more than the processing itself). These figures come from the recently released "Preliminary investigation of environmental issues discussion paper" which also points out that to be carbon neutral the process will require an additional 300,000 trees per year to be planted. To expend this energy with all its associated greenhouse gas emissions when this is not necessary in Canberra seems a very poor choice. Not only is this a very costly monetary exercise, the associated ever ongoing high-energy consumption will be contributing to the very problem blamed for changing our climate in the first place! It would be economically and environmentally irrational for the Productivity Commission endorse such an outcome.

There are also other environmental impacts arising from the necessity to get rid of wastewater (10% to 20% of water used) from the RO process itself and the high concentrations of brine, salts, microbes, drugs and other products this water will contain. The high concentration of pathogenic micro-organism in this water will require its own detailed risk assessment and risk management plans, especially for their safe disposal (and especially if transport of part of this material is planned). With desalination plants this "waste' material (mainly water with a high salt concentration) is usually put back into the sea. Disposing of the much more toxic "waste" material from a sewage recycling plant is a much more difficult and expensive task.

Procedures for testing micro-organisms are inadequate

In addition, the monitoring of this process will rely mainly on markers other than measuring micro-organisms to know whether the system may have malfunctioned (from an infection point of view this is known as using surrogate markers). There would be very little or no direct monitoring of most of the microbes that cause diseases if present in water. Previous testing such as Total coliform counts are recognised currently as being among the poorest testing markers for faecal contamination and water safety. E.coli counts are superior, but still have major limitations. While E. coli counts will be measured, there is not likely to be much in the way of human virus cultures or PCR testing etc, as the current technology for monitoring viruses that cause human disease (eg enterovirus) is expensive, slow, not yet standardised and not readily available. Unfortunately, while many faecal indicators are superior to *E. coli* and enterococci, these tests for the much smaller viruses (and the micro-organism thus most likely to get thru RO membranes) have not been developed to a point where there are methods readily available that are inexpensive and simple for routine use.

Currently and in the past, relatively speaking not much microbiological testing has been done in water (predominantly coliforms, E.coli and testing for Giardia and cryptosporidiosis). This is fine when your water supply is from a relative pristine source (eg in in Canberra where the main source of water for drinking in most years is the two dams on the upper parts of the Cotter River (Corin and Bendora), which have pristine catchment areas. If recycled water or water from other less pristine sources (e.g. Murrumbidgee River) are used then these are all much higher risk water sources. Thus I believe (and is implicit in the latest Australian drinking water guidelines) there will need to be substantial increases in both the frequency and types of testing being done. There will need to be additional testing for enterococcus, bacteriophages, spores of *C. perfringens* and if feasible *enteroviruses, norovirus* and *rotavirus*.

Spores of *C. perfringens* are very hardy and also largely of faecal origin. Thus if *C. perfringens* is present it is an indicator for viruses and parasitic protozoa that may also be present. Bacteriophages are viruses that infect bacteria and those that infect coliforms are known as coliphages, or more generally, phages. Phages have been proposed as microbial indicators as they behave more like the human enteric viruses which pose a health risk to water consumers if water has been contaminated with human faeces. Research results show that phages cannot be considered as reliable indicators, models or surrogates for enteric viruses in water. Enteric viruses have been detected in drinking water supplies despite tests that were negative for phages.

Need to explore many other water saving options

If we use Canberra as an example again, there are many other ways we could save the amounts of water being planned by this sewage-recycling proposal (even assuming it were necessary, as opposed to storage augmentation). If we use water from the current Molonglo sewage outflows for non-drinking water purposes (such as for irrigation, keeping Lake Burley Griffin filled, industry, sewer mining etc), then instead of needing to extract 50 GL of water from our dams, we may well only need to extract 40 GL or even less per year. Water tanks on houses, better use of grey water etc., (but in themselves higher cost options compared to dams) will also decrease the amounts of water we need to draw from our dams. If we look at other options rather than always seeming to include either desalination and/or sewage recycling (via similar plants), we will be recycling much more water, but in ways that should have little consequence for human health if something went wrong. And then we will also be able to better save our pristine and safer water (e.g. in Canberra with its Cotter catchment), for its best purpose, using it as a safe, inexpensive water supply. .

Risk management

Recycling water from sewage into drinking water is a "high risk" procedure because large numbers of people will be potentially exposed to a large variety of pathogens in the water, if the system malfunctions. The way to eliminate this risk is to avoid altogether recycling water from sewage into drinking water. Using Canberra an example there are many other ways of obtaining or saving 20 GL of water – all safer and less expensive than the sewage recycling proposal of a few year ago.

If however the sewage recycling into drinking water proposal were to go ahead, then the risk could be best minimised by only using the process at times of major shortages of water. Mr Michael Costello (Managing Director, ACTEW) in a letter he sent to me (see appendix) said "essential insurance which we hope …. will seldom, if ever, have to call upon." (see below)

> The balance of probability is that the extremely severe conditions of 2006 will not be repeated, and that there will be sufficient water to meet our needs without having to use recycled water. But what we have learned over the last few years is that for whatever reason we can no longer rely on the long-term averages. While it is unlikely, it is possible that we may face several more years in which river flows and inflows into our dams are at the extremely bad 2006 levels or worse. The consequences of this risk eventuating are so severe that even though it is a small risk we cannot afford not to take out insurance against it. And that is how we should see the recycled water project -- as essential insurance which we hope we will seldom, if ever, have to call upon.

I think his suggestion is a very sensible approach. If we proceed with the recycling plant then we can avoid exposing the population to any "risk" from recycled sewage being placed into drinking water if we don't use the plant. It is likely that for the vast majority of the time we will have adequate water storage, and thus the recycling plant will not be operating, as is pointed out by Mr Costello himself. And I believe it is also likely to be the case once we have a larger storage capacity in place, such as the enlarged Cotter Dam. Once Canberra has a larger Cotter Dam (by 2011 to 2012) and becomes wiser with how the water from dams is used, we should never find ourselves back in the situation of late 2006 and early 2007 re low total water storage levels. This then however implies that the expenditure on such a plant will be a "white elephant" and on economic ground should probably never proceed.

I understand the Productivity Commission has traditionally opposed "gold plating" or "white elephant" investments. Why the change in its outlook in its draft report that seems to recommend sewage recycling plants?

However I note that in both the draft health and environmental reports, and in the current future plans for Canberra that a pilot recycling facility is still being planned. Even the concrete footing for it has been laid at the Molonglo treatment works. This appears to be inconsistent with what Michael Costello has written previously and needs to be clarified, as this issue is very important in any strategy to minimise risks.

It is also important to note that in general any disinfectant and chemical sterilising agent works better at higher temperatures. Canberra has colder water than most other Australian cities. Therefore longer contact times will be needed to achieve the same level of removal of organisms (ie log reductions) as would be needed elsewhere. This is an added reason why it is very important to have organisms in concentrations as low as possible in any water that is being processed. Temperature has important implications for chlorination of water and other disinfection processes such as any planned UV therapy. I also note that lower temperatures mean the membranes do not work as well and at the very least need to be replaced more often. Given Canberra's cold water temperatures compared to other areas of Australia and Singapore, California etc, this is a significant factor that needs to be considered.

If the sewage recycling proposal were to go ahead, (notwithstanding its public health and economic irrationality), then we need to have as many safety barriers in place as possible and many of these should be “natural”. This means having very large dilution effects and long retention times before the water is used for drinking. This can only be done if the recycled water is in large reservoirs (eg the enlarged Cotter Dam or the Googong Dam). If the Googong Dam is used it should not go to that Dam via the reticulated water system. It is also preferable if by some means the recycled water could move very slowly (weeks or months) to the storage facility through some type of slow moving and shallow water system (eg wetlands) so that natural processes including UV light from the sun, as well as other factors, could help remove any pathogens and drugs that may be present, especially if a mishap occurs in the recycling plant.

Conclusion

There are many in the community who are greatly (and rightly) concerned about current proposals (such as suggested by the Commission) to recycle water from sewage into drinking water. I believe currently such proposal do not have enough safeguards for our population, nor have other options for recycling water, that does not involve recycling into drinking water, been adequately investigated and followed with appropriate community consultation.

Recycling water from sewage into drinking water is a “very high risk” procedure. It is an additional risk that the population does not need be exposed to, as in the vast majority of times we can store and access much safer and cheaper water for drinking purposes.

My belief remains that putting recycled water from sewage into drinking water should be one of the last options we should adopt to improve water security, as it is a retrograde step in terms of water quality, and potentially a retrograde step in terms of cost to the community. There are numerous other ways by which we could either save or find alternative sources for the proposed amount of water to be recycled into drinking water. Most are also safer, cheaper and more environmentally friendly. I thus cannot see why we should contemplate subjecting the population of Australia to this needles risk unless it is truly a “last resort” and then only after we have much better monitoring processes in place.

Appendices

Risk assessment Australian Drinking water standards

Table A4 *Qualitative measures of likelihood*

Level	Descriptor	Example description
A	Almost certain	Is expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Might occur or should occur at some time
D	Unlikely	Could occur at some time
E	Rare	May occur only in exceptional circumstances

Table A5 *Qualitative measures of consequence or impact*

Level	Descriptor	Example description
1	Insignificant	Insignificant impact, little disruption to normal operation, low increase in normal operation costs
2	Minor	Minor impact for small population, some manageable operation disruption, some increase in operating costs
3	Moderate	Minor impact for large population, significant modification to normal operation but manageable, operation costs increased, increased monitoring
4	Major	Major impact for small population, systems significantly compromised and abnormal operation if at all, high level of monitoring required
5	Catastrophic	Major impact for large population, complete failure of systems

Table A6 *Qualitative risk analysis matrix – level of risk*

Likelihood	Consequences				
	1. Insignificant	2. Minor	3. Moderate	4. Major	5. Catastrophic
A (almost certain)	Moderate	High	Very high	Very high	Very high
B (likely)	Moderate	High	High	Very high	Very high
C (possible)	Low	Moderate	High	Very high	Very high
D (unlikely)	Low	Low	Moderate	High	Very high
E (rare)	Low	Low	Moderate	High	High

Financial Times; Purified sewage is unpalatable

By Ross Tieman

Published: April 18 2007 03:00 | Last updated: April 18 2007 03:00.

http://www.ft.com/cms/s/352bc47a-ed4a-11db-9520-000b5df10621.html

In March this year, Jim Service, the chairman of water supply company Actew Corporation, and councillors from the Australian city of Canberra dutifully drank bottles of purified sewage water as they unveiled plans to recycle part of the city's wastewater into tapwater.

Within days, Professor Peter Collignon, director of infectious diseases and microbiology at the Canberra Hospital, wrote an open letter laying out his concerns about the health implications of the scheme.

What assurance could there be, he asked, that treatment would remove all disease-causing bacteria and viruses, as well as hormones and pharmaceutical compounds present in sewage?

It is a good question. As Antoine Frerot, chief executive of Paris-based global water champion Veolia Water, observes: "Louis Pasteur said 150 years ago that we drink 90 per cent of our illnesses. That is why water treatment was created."

Around the world, water companies and their equipment suppliers insist we have the technology to render sewage safe to drink - but they don't all guarantee they can pick up hormones or unexpected compounds. "This is an area in which we and others are doing a lot of research," says Roger Radke, chief executive of Warrendale, Pennsylvania-based Siemens Water Technologies.

Microfiltration through polymer membranes, followed by reverse osmosis through membranes can remove even viruses if a small enough pore size is specified, says Mr Radke, though to drink the water, you had better then pass it under ultra-violet light to be sure to kill microscopic parasites such as cryptosporidium and giardia.

But this adds expense. In reality, the level of treatment is dictated by standards that have been deemed necessary by regulators for the intended use. And when deployed, it typically comes at the back-end of the traditional waste-water treatment process.

In the case of Canberra, waste water would be treated in the conventional way with chemical and bacteriological processes to remove solids and create water of the quality that is typically released back into rivers around the world.

Actew says it is still investigating exactly which processes the water would then undergo before being pumped into the supply reservoir. It says it would expect to use a combination of micro-filtration and ultra-filtration to remove microscopic particles, contaminants and pathogens; reverse osmosis to remove salts, organic compounds and viruses; and ultra-violet disinfection/oxidation to additionally ensure any trace of organic material is destroyed. A final option is to let the water flow through an artificial marshland before joining the reservoir.

After that, the reservoir water would pass through an existing treatment plant before entering the tapwater distribution system.

Canberra, like many Australian towns, is short of water because of a drought that has proved longer, and more severe, than anyone forecast. Last year, residents of Toowoomba, Queensland, rejected proposals for a similar waste water-to-tapwater scheme in a referendum in which health concerns played a key role. The Canberra proposals could prove equally contentious.

Veolia's Mr Frerot says: "To my knowledge, there are only two places in the world where treated waste water is gradually mixed into tapwater: the town of Windhoek, in Namibia, and Singapore."

In Windhoek, that is because the river is more polluted than the waste water, he says. In Singapore, it is a political choice designed to reduce dependence on supplies from neighbouring Malaysia - and accounts for less than 1 per cent of water consumed.

Yet all around the world, city populations consume treated water drawn from rivers that receive treated wastewater from communities further upstream. Just as the citizens of Rouen, in France, drink the waste water of Parisians, the same is true in the River Thames in the UK, the Colorado in the US, and the Rhine in Germany and its neighbours. Without wastewater, these rivers would almost run dry.

Treatment prior to drinking is imperative: a 2003 study found the level of hormones in the River Seine sufficient to change the gender of some of its fish. And a study by the Netherlands government found that using Dutch rainwater even to flush toilets would pose a health risk.

If we are going to drink treated wastewater, says Mr Frerot, the best strategy, where geological conditions permit, is to reinject it into aquifers - as happens in Berlin and Adelaide. The soil acts as a natural filter, and the time-lag provides additional water for abstraction in periods of peak summer demand. Man is merely shortening the natural cycle.

Otherwise the most obvious and economically viable solution, he suggests, is to use treated waste water for industry and irrigation. Orange County, in California, adopted Siemens' micro-filtration and reverse osmosis to treat waste water a decade ago, initially reinjecting it into aquifers, and subsequently selling additional supplies to farmers and industry - which covers the cost of the additional treatment, says Mr Radke.

In Australia and elsewhere, some towns have a second distribution system for "reticulated" water used by householders for garden watering and washing cars.

Meantime, treated sewage water is widely used to supply industry, farms and golf courses, freeing up "natural" supplies for tapwater. Veolia alone has 100 such facilities in France, and others scattered from Honolulu to Durban in South Africa.

Dégremont, a Suez Environment subsidiary, cleans wastewater from Grasse, France's perfume capital, to bathing standards, says Dégremont chief operating officer Remi Lantier, providing water quality guarantees for fish farms downstream.

Pumping treated waste water into marshlands and reed beds, where sunlight and plants complete the purification, is an option too. But the outfall from even a small town would require a vast swamp to be effective.

The simplest solution for small communities, says Mr Radke, is to buy a Siemens skid-mounted modular unit - the size of a small car - for a few thousand, or tens of thousands of dollars, and turn waste water into irrigation quality water by passing it through membranes.

Dégremont's Mr Lantier says companies like his can produce ultra-pure water in which the only molecules are H20. He likens the safety issue to that in the nuclear industry, standards are that stringent.

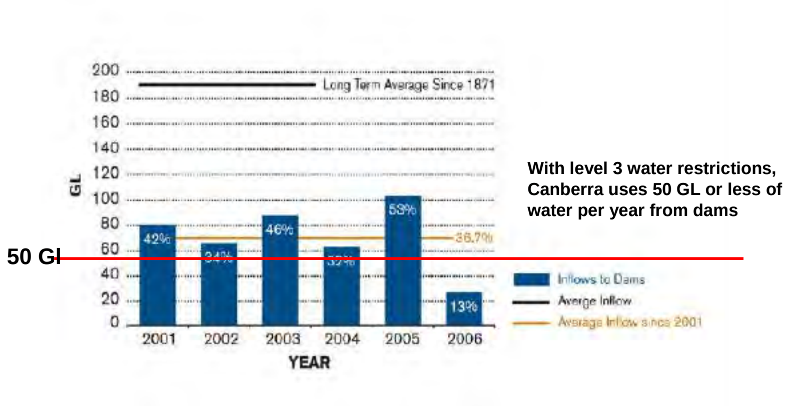
Globally, says Mr Lantier, only 45 per cent of the world's collected waste water is treated. The most urgent priority is to treat the 55 per cent released untreated. Of that treated, 20m m3 a day is recycled - about 2 per cent. He expects that proportion to triple in coming decades.

Ultimately, says Mr Frerot, the most cost-effective solution to water shortages developing in many towns and cities must surely be to supply such treated waste water for use in industry and irrigation, in place of the tapwater used today. "That would halve the demand for natural water," he says. "That is what we should do, before talking about drinking waste water."

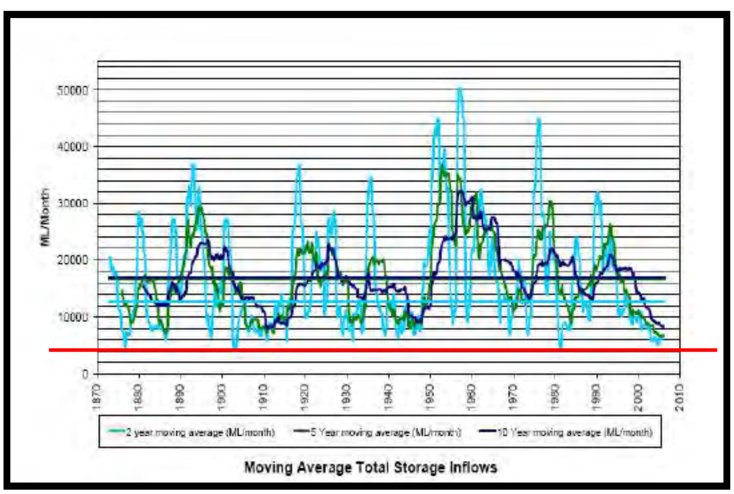
Inflows into Canberra's main dams (2001-2006)

Inflows to Corin, Bendora and Googong Dams (2001-2006)

ACTEW figures and graphs. Note however this excludes Cotter dam which receives about 25% of Cotter catchment area rainfall



Moving Average Inflows to Corin, Bendora and Googong Dams
red line is min requirement for Canberra with water restrictions
50 GL/Yr or 4,000 ML per month



Excess releases of water as river flows in 2006

These are the views of a forestry consultant (Chris Borough) from figures that were obtained from ACTEW re releases of water from our Dams in 2006 and also water consumption figures.

> Peter,
> As we now have all the statistics for 2006 it should be possible to be fairly objective.
>
> The Cotter dam has a capacity of 3.7 GL (see ACTEW website). The dam must be kept at 90% capacity to protect endangered fish needs. Thus the effective use that can be made of the 3.7 GL is substantially lower than the other storages
>
> The data supplied directly by ACTEW's engineers (updated for Dec 2006 - attached) clearly shows that legislation required 5.6 GL to flow from the Cotter Dam (a large amount and again should be reviewed in the analysis of Options) but in practice 12.7 GL was released or went over spillway. That is 7.1 GL was wasted. I can't see how the 2 GL claimed makes any sense in the light of the attached numbers. It could be that water was pumped from the Murrumbidgee (near the old pumping Station) back into the system after it was released from Cotter – this needs checking as they do have that capacity.
>
> With water restrictions in place we do use about 50 GL/a – well below the amount claimed in the newspaper ads. Our average use (average since 1996/7) for Winter has been 118 ML/d and for Summer 219 ML/d. A quick browse of the actual use figures published in Canberra Times shows numbers ranging from around 150 ML/d in mid summer to 100 ML/d in mid winter. Say 130 ML/d * 365 days is 47.45 GL – close enough to 50. The consumption for 2003/4 was 53 GL and 2004/5 51 GL (ACTEW website). If you add the 17 GL that was released from Googong and Cotter from both environmental flows and waste, the total usage figure does increase to >60 GL/a.
>
> Rather than spend millions of dollars on treating and adding 9 GL to an already overloaded Cotter Dam we could achieve the same result by not wasting the 7.1 GL from Cotter and the 1.8 GL from Googong (ie a total of 8.9 GL). I feel most Canberrans would prefer tougher usage restrictions to save the 0.1 GL required without all the inherent risks and massive capital and ongoing pumping/treatment costs of using treated water.
>
> The real issue for society is that energy cost will only go up as concerns about climate go up and fossil fuels run out. Why on earth would a "today" government commit to such a wild scheme that guarantees a commitment to use valuable fossil fuel ad infinitum from an almost non-existent gain?

Why not push for the enlarged Cotter Dam with less fuss over water levels for fish as the most logical way to go to avoid losses. Forget treatment of wastewater if we can avoid it. Use the treated wastewater as a substitute for useful things like ovals and parks.

Attached is ACTEW supplied table of water flows.

Chris Borough
Forest Science Consultancy Pty Ltd
PO Box 4378 Kingston
ACT 2604 AUSTRALIA
email: chrisborough@actewagl.net.au

Month	Corin (ML)		Bendora (ML)		Cotter (ML)		Googong (ML)	
	Required	Actual	Required	Actual	Required	Actual	Required	Actual
Jan-06	1362	6613	915	1675	465	2690	400	537
Feb-06	357	8074	923	1199	505	1484	228	323
Mar-06	83	6790	255	521	465	705	156	479
Apr-06	255	7518	854	914	535	742	62	279
May-06	241	7004	527	544	465	566	226	340
Jun-06	375	5848	1057	1102	535	676	300	362
Jul-06	770	4196	1265	1470	465	1218	400	602
Aug-06	2221	4465	2172	2135	465	1426	310	376
Sep-06	1478	4975	2321	2368	535	1548	379	608
Oct-06	414	7488	1055	1140	465	743	78	153
Nov-06	429	4735	507	739	450	705	13	128
Dec-06	176	2541	249	392	292	236	0	123
Sum (GL)	8.2	70.2	12.1	14.2	5.6	12.7	2.6	4.3
Excess (GL)				2.1		7.1		1.8

Jan-07	122	2669	610	865	184	281	57	149
Feb-07	210	1164	267	347	150	224	190	185

-----Original Message-----
From:
Sent: Thursday, 8 March 2007 3:42 PM
To:

Subject: Questions relating to data provided by Environment Australia

Dear Mr ,

Thankyou for your email of 15 January 2007, regarding environmental flow releases from ACT water supply dams.

ACTEW has a licence to abstract water from the Googong Reservoir and Corin, Bendora and Cotter Reservoirs for the purpose of water supply. The licence is regulated by the Environment Protection Authority. The Licence is guided by the *Environmental Flow Guidelines 2006* and stipulates minimum environmental flow requirements for Corin, Bendora, Cotter and Googong Reservoirs that ACTEW must meet. Under the Licence the environmental flows are categorised as baseflow, riffle maintenance flows and pool maintenance flows.

Please find the responses to your questions below.
1. Environmental flow release rates from Googong (and Cotter) have a minimum flow requirement, as opposed to Corin and Bendora, which have a target flow. ACTEW is in breach of the Licence if flows are under released. It is very difficult to exactly match minimum flow release requirements, due to the operational constraints such as time taken to close valves in large water mains. ACTEW err on the side of caution to ensure that Licence requirements are not breached.

In addition, a riffle maintenance flow was released during the month of March. This is a high flow for three consecutive days. To achieve the minimum flow and time span required, the release errs on the higher side. A riffle release is required every two months under the Licence to ensure environmental obligations are met. Further to this, the flow release is measured at a river gauge located some 8 kms downstream. During March, 18 mm of rain fell in the area between Googong dam and the river gauge, and the catchment runoff is included in the flow measured by the river gauge.

2. River gauging stations are checked for accuracy every month. Depending on the location and type of gauge, a correction to the preceding month of recorded flow can be adjusted +/- 6%. The data in the tables provided are flows that have been corrected, and so required and actual flows can appear worse after the fact. Although it is difficult to ensure total accuracy of gauging stations, ACTEW is working to improve the level of accuracy.

3. Please note that there was a data error related to the figures in question. The actual release figures for January 2006, for Bendora and Corin were mixed up, and need to be swapped around. This has since been corrected.

4. During March the flow release exceeded the minimum required amount, due to operational constraints associated with the mini hydro plant at Bendora dam.

5. Under the Licence ACTEW can release less environmental flow in the following month, if over-releases have occurred in the previous month. However, only 10% of the following months target can be carried over.

6. Two riffle maintenance flows were released during this time, which is a high flow release for three consecutive days. To achieve the minimum flow and time span required, the release errs on the higher side.

In addition as the ACT was in Permanent Water Conservation Measures during June-October, a larger base flow was required to be released daily under the Licence. When Stage 2 Water Restrictions or higher Restrictions are introduced, this amount reduces in an attempt to conserve the water supply for ACT.

If you have any further queries, please contact me and I can direct you to the appropriate person.

Regards,

ActewAGL House
Level 9, 221 Canberra ACT 2601
Phone: 02 6248 3174
Fax: 02 6248 3567

Singapore drinking water contains very little recycled water from sewage

This ~~is the text from an email I sent to~~ MLA's ~~on this matter~~.

I think that a few of you were surprised (and probably a bit sceptical) when I sent around a previous email stating that water from sewage was not recycled into the drinking water of Singapore to any significant extent. The common perception here in Australia seems to be that large amounts of water recycled from sewage are consumed in Singapore.

Since I sent my previous email I understand many of you have received emails, personal contacts or had material sent to you suggesting what I sent to you before and stated previously was incorrect on the Singapore water situation.

Below and attached are a number of different sources that allows you to independently check on the accuracy of my statements.

Hardly any (1% or likely less) of potable water in Singapore comes from recycled sewage (it seems to be mainly used by industry and is delivered by separate pipelines to drinking water and at a lower price). Thus looking at Singapore to establish any adverse health effects from this process in their population will be impossible as they hardly drink any of this type of recycled water.

Currently only 1% of Singapore potable water is recycled.
My sources for this are three different ones plus the Singapore water website
http://www.pub.gov.sg/NEWater_files/faq/index.html

How will NEWater be used?

A. We will continue to use NEWater for direct non-potable purpose by industries, commercial buildings, etc. As for Indirect Potable Use (IPU), 3 million gallons a day of NEWater, about 1% of the total volume of water consumed daily, has been blended with raw water in our reservoirs. The amount will be increased progressively to reach about 2.5% of the total volume of water-consumed daily by 2011.

The 2005 application form for NEWater that clearly shows there are two different pipelines and recycled water is kept separated from potable water (at least in 2005 it had said it is NOT for potable use).

"As NEWater is for non-potable use, customers will have to provide separate pipework for potable and non-potable water supply within their premises." http://www.scal.com.sg/index.cfm?GPID=263

The 2nd source is a Financial Times London article. "In Singapore, it is a political choice designed to reduce dependence on supplies from neighbouring Malaysia - and accounts for less than 1 per cent of water consumed."

The third source is a 2007 publication from a group at the Uni of Queensland (who I understand are in favour of recycling sewage water for drinking - but see their excellent summary of other places that use recycled water). They give Singapore as an example and say "small portion" into reservoir; page 30). This group also has figures and comments on the very high-energy costs of this reverse osmosis proposal (see page 19).

The Challenges of Water Recycling Technical and Environmental Horizons. January 2007. Compiled by Jeff Foley, Damien Batstone, Jurg Keller. Advanced Wastewater Management Centre. The University of Queensland, Brisbane QLD 4072. Australia
Publication available at http://www.awmc.uq.edu.au/awmc_wr_challenges.pdf

Extracts from "Indirect potable use and expansion of the Cotter Reservoir: Preliminary investigation of environmental issues Stage 1. Issues Discussion paper"

May 2007

Report compiled by:
Professor Gary Jones
Adjunct Assoc. Professor Mark Lintermans
Professor Richard Norris
Dr David Shorthouse
On behalf of eWater Cooperative Research Centre

Conceptual information about two options for recycling Canberra water has been provided by ACTEW. With both options (A and B), treated wastewater derived from tertiary treatment of sewage will progress from the existing Lower Molonglo Water Quality Control Centre (LMWQCC) to a proposed new on-site facility, for further treatment. The 'advanced' treated water will then be recycled into the lower Cotter catchment where it will enter the Cotter Reservoir, via a constructed wetland and probably a local stream.

Two other outputs of the new plant will be liquid and solid wastes, depending on the treatment option the plant uses. These wastes will either re-enter the LMWQCC with the incoming raw sewage, or, in the case of the reverse osmosis plant wastewater ('brine') from Option A, be piped to evaporation ponds north of Uriarra, for ultimate disposal elsewhere.

ACTEW also proposes also to enlarge the capacity of Cotter Reservoir from 4 GL to 78 GL (GL stands for gigalitre, 1 thousand million litres) to hold the treated water along with other catchment in-flows. Recycling of 25 ML each day is expected initially, rising to 50 ML per day once the new dam wall has been constructed (ML stands for megalitre, 1 million litres).

eWater notes that the technical information so far available on the treatment options is insufficient to carry out a detailed evaluation or proper environmental risk assessment.

Our preliminary evaluation of the international literature indicates that a well designed and well operating 'Option A' type system (micro/ultrafiltration + reverse osmosis + UV/peroxide oxidation) *has the potential* to remove all viral and bacterial contaminants and organic pollutants, and to reduce salts, nutrients and heavy metals to concentrations similar to, or lower than, that found in natural catchment run-off — this being the appropriate environmental benchmark for our analysis. Notwithstanding, one potential environmental issue noted is the comparatively weaker removal of the nutrient nitrate by reverse osmosis. This could, subject to other environmental factors, increase the risk of algal blooms and uncontrolled aquatic plant growth in Cotter Reservoir.

No treatment system anywhere in the world can be guaranteed to be absolutely failsafe 100% of the time. Consequently, equally important to the treatment system chosen must be the provisions made for detecting failure and ensuring that there is no break-through or leakage of incompletely treated water or wastes. The environmental concerns relating to system failure include:
- infection of fish and other biota by viral and other pathogens — something that could occur during even a single, short failure event;
- accidental land and water contamination because of pipe rupture — especially the treatedwater pipe crossing over or under the Murrumbidgee River;
- contamination of local land, streams and groundwaters due to constructed wetland 'overflow' or leakage; and
- shut-down of flow at critical ecological times — especially for wetlands and stream ecosystems that become established under an artificial flow regime.

Advanced water treatment is an energy-intensive process, especially where significant water pumping is required (as here). Preliminary estimates of the power requirements for the new treatment process are about 6000 kW (kilowatts). Assuming operations 24 hours a day, 365 days

per year, this translates to an estimated greenhouse gas emission rate of about 57,000 tonnes of carbon dioxide per year from plant operations.
The ‘Option B’ treatment train (using ozone–biologically activated carbon instead of reverse osmosis) would use a little less energy than Option A. However, there appear to be few other water treatment and environmental advantages of Option B over Option A.

In any treatment process, one of the biggest environmental risks lies with the handling and disposal of the concentrated waste stream. Issues that need to be further addressed are:

- contamination of birds and animals that will be attracted to the ‘brine’ ponds,
- groundwater contamination by the wastes,
- brine pond failure and run-off to adjacent streams,
- waste pipe eruption and discharge,
- waste management during prolonged wet periods,
- wind dispersal of dried waste accumulated on site,
- vehicular accident during transport of dried waste.

Water transfers to Cotter catchment

The proposed water-treatment wetlands will need to be sited where the soils, slope and drainage characteristics are capable of dealing with an inflow of 25–50 ML per day. Evaporation and loss through seepage need to be small to maximise the extra water the project aims to make available. The wetlands may be contaminated by pests carried on the wind or by birds, and bird excreta may also reduce water quality.

Water from the wetland is likely to be discharged into a nearby stream before reaching Cotter Reservoir. Subject to further analysis, it is reasonable to expect if water is discharged at rates approaching the proposed 25–50 ML/day that major ecological impacts on local streams will occur. There may be ways to mitigate such impacts to some extent, for example through the use of more than one stream. However, consideration should be given to direct piping and discharge of treated water to the Cotter Reservoir as a less environmentally impacting option.

Technical Report & Risk Assessment

The technical report will build on the Discussion paper through a consideration of potential responses or solutions to environmental issues. Issues to be considered are those included in the Discussion paper, and possibly additional issues identified during the community consultation process. For each issue the report will discuss:

- the likelihood that it will eventuate,
- the environmental consequences if it does eventuate,
- the potential for amelioration through management actions, siting or engineering solutions,
- proposed solutions to it.

As with the Discussion paper, some issues will be difficult to evaluate because we currently have insufficient understanding of the biological processes involved, and/or insufficient details of the proposed activities. For such issues eWater CRC will identify:

- the reasons for the uncertainty surrounding the issue,
- the additional investigations or information required to adequately assess the issue,
- the timing for full understanding of the issue.

The investigation of these issues will, by necessity, be a desk top study. It will be principally aimed at identifying those critical issues that have the potential to result in major environmental damage. These may include those for which the ACT Government has insufficient information to make an assessment, or those for which there are no apparent amelioration measures. The report will articulate the assumptions made in underpinning the assessment of issues.

New treatment process

(i) At a high level, ACTEW is considering two 'treatment trains’ as described below. Both treatment train options commence with tertiary treated sewage from the existing LMWQCC. The additional purification steps will be carried out in a new water purification plant to be built on the site of the existing LMWQCC.

Option A

Microfiltration/Ultrafiltration → Reverse Osmosis → UV/H_2O_2 oxidation → Wetland/Stream → Cotter Reservoir

Option B

+/– Microfiltration/Ultrafiltration → Ozone/BAC → UV/H_2O_2 oxidation → Wetland/Stream → Cotter Reservoir

BAC = Biologically activated carbon
UV/H_2O_2 = Ultraviolet light combined with hydrogen peroxide

The major difference between the two options is the omission of reverse osmosis in Option B, being replaced by ozone–biologically activated carbon treatment. Microfiltration/Ultrafiltration is also a sub-option within Option B. Option A will also include carbon dioxide stripping and pH adjustment before transfer of the treated water to the Cotter system.

(ii) Treated water will be pumped from the new purification plant at LMWQCC to a site approximately 13 km from the plant and through a height differential of approximately +260 m. ACTEW have advised that the treated water pumping regime currently being considered is a constant 25 ML/day for 365 days per year with the option to increase that to 50 ML/day if and when required (e.g. after completion of the Cotter Reservoir enlargement).

Microfiltration/Ultrafiltration (MF/UF), Reverse Osmosis (RO) and Ozone/BAC processes.
ACTEW proposes to return solid and liquid wastes from the MF/UF and Ozone/BAC processes (if chosen) to the raw sewage inlet treatment stream at LMWQCC.
However, the proposed RO Plant will generate a separate liquid waste or 'brine' stream — so called because it will contain significant quantities of dissolved salts as well as nutrients, organic compounds and virus particles not removed by ultrafiltration. The waste stream — about 10% of the total volume passing through the plant — will be transported by a separate pipeline to a site located to the north of the Uriarra Homestead and (former) Forestry settlement. There it will be dried through evaporation ponds (or mechanical means if required). The residual waste solids collected by this process will be disposed of by a method yet to be identified by ACTEW, but which may include trucking to land-fill sites outside the ACT.

Enlargement of Cotter Reservoir
An integral part of the project is the enlargement of Cotter Reservoir to allow treated water to be stored and returned as required to the normal potable treatment and supply system. This will be achieved by constructing a larger dam wall immediately downstream from the existing wall. The new wall will increase the maximum storage of Cotter Reservoir from its current volume of about 4 GL to 78 GL. Enlargement of the Cotter Reservoir to 78 GL would increase the total area inundated by about 260 ha.

Land proposed for possible wetland treatment sites was formerly managed as a pine plantation. Under current ACT Government proposals for restoration of this catchment the area is to be planted with native species and allowed to revert to a predominantly native vegetation type dominated by *Eucalyptus mannifera and E. macrorhyncha*, possibly reflecting its original pre-1750 woodland or forest vegetation. In 2007 the former plantation area is regenerating with some native vegetation, some dense pine wildlings and other weeds, particularly along the water-courses.

New treatment plant and water quality
An evaluation of potential environmental (and human health) risks must be predicated on the performance of the water treatment process being applied. From a technical perspective* there are a number of major issues requiring close attention and scrutiny with regard to the two treatment trains options:
1. the pathogen and contaminant removal efficiency of the new treatment plant under normal operating conditions;
2. the reliability of the entire process (treatment and waste management) and the provisions for timely detection of and response to system failure; and

3. the level of energy consumption and greenhouse gas emission.

In section 3.1, two treatment train options are summarised. Beneath these summary descriptions lies an enormous amount of treatment infrastructure and process detail that is yet to be finalised by ACTEW. The final built plant could be any one of a multiplicity of possible combinations of specific treatment technologies (type and brand) and operating processes (pressures, flow rates, backwash procedures, etc.).

We have necessarily assumed, within the range of possibilities under Options A and B, that the final treatment system selected by ACTEW will be the very best system available, based on all internationally available treatment & monitoring technologies and operating experiences.

In evaluating these systems, it is also pertinent to note that the feed water to the new treatment plant will have already undergone tertiary treatment at the LMWQCC. Water treated by these means has been discharged under licence to the Murrumbidgee River for many years. A range of contaminants and bacterial pathogens will have been significantly reduced in concentration through this tertiary treatment, before the feed water enters the new Water2WATER treatment system. *We also note that the technical information so far provided to eWater CRC, or available on the Internet from experiences elsewhere, is insufficient to carry out a proper risk assessment of the performance of either Option A or Option B. By necessity, this will be achieved during the Stage 2 analysis and reporting process.*

Treated water quality under normal operations
Option A
Our preliminary scan of the international literature indicates that a well designed and well operating 'Option A' type system (MF/UF+RO+UV/H2O2) *has the potential* to remove all viral and bacterial contaminants and organic pollutants, and to reduce salts, nutrients and heavy metals to concentrations similar to, or lower than, that found in natural catchment run-off.
This assumption will be further tested and evaluated through more detailed scientific review during preparation of the Stage 2 Technical Report (refer sec. 2.2). We consider the critical issues of system reliability and monitoring, which impinge on our preliminary assessment, in section 4.1.2 following.

Initial technical evaluations commissioned by ACTEW indicate the following operational performance (treated water quality) for the Option A configuration:

Water Quality Variable	Unit	Feed Water (average)	Treated Water (average)
Total dissolved solids	mg/L	490	<50
pH		7.7	7 – 7.5
Total Nitrogen	mg/L	15	2–3
Total Phosphorus	mg/L	0.2	<0.2
Total Organic Carbon	mg/L	4	<0.25
Viruses and Bacteria	No./100mL	-	Below detection
EDC	ng/L	-	Below detection
NDMA	ng/L		<10

EDC = endocrine-disrupting chemicals; NDMA = n-nitrosodimethylamine

We note with some caution that these figures are initial estimates of a handful of target contaminants provided by engineering consultants to ACTEW. And, the figures are averages — measures of typical performance — rather than the full operational performance range expected from best to worst case. For more detailed assessment of treatment plant performance, such information — and more, including real-world time series data from similar plants operating elsewhere in the world — is required.

One of the potentially important environmental issues noted here, and also in the international literature, is the comparatively poor removal of inorganic nitrogen compounds, especially nitrate and ammonia, by reverse osmosis — typically reported as only 50–90% removal (compared to 95–98%+ for other chemical contaminants).

It is intended that further 'natural' treatment will occur in the receiving wetlands to be constructed above Cotter Reservoir. While this may be true in principle (including the possibility of some denitrification — conversion of nitrate to nitrogen gas), it is also quite possible that the wetland will actually cause some deterioration in the quality of water entering Cotter Reservoir; for example, due to excreta from the bird and wildlife population that will be attracted to the wetlands.
Because the daily discharge rates proposed (25–50 ML/day) are high compared to natural flow rates in the stream(s) that may receive water from the wetlands, little or no 'in-stream' treatment of the water is likely, unless the design of the wetland system enables it to significantly retard discharge flows (which is unlikely).

Given the above, in on-going planning, consideration also should be given to direct discharge of water to Cotter Reservoir. This would also obviate concerns raised in section 4.4 about the hydrological impacts on Cotter catchment streams that may receive the treated water.

Treatment plant reliability and monitoring
Whatever the final built plant (Option A or B), no treatment system anywhere in the world can be guaranteed to be absolutely failsafe 100% of the time. Consequently, equally important to the treatment system chosen must be the provisions made for detecting failure and ensuring that there is no 'break-through' or leakage of incompletely treated water or wastes. System failure can be minor — performance moving outside approved operating range — or major — a complete failure of the system, with the risk, if not managed, of untreated or partially treated water being transferred into the Cotter catchment or Cotter Reservoir.
The environmental concerns relating to system failure include:
• infection of fish and other biota by viral and other pathogens — something that could occur during even a single, short 'failure event' (see sec. 4.3.2 for more details);
It will be imperative to ensure that the treatment system includes 'state of the art' real time monitoring at critical control points throughout the process all the way through to Cotter Reservoir. Linked to this must be the ability to, almost instantaneously, by-pass the treated water back to the normal LMWQCC treatment stream instead of into the Cotter catchment.
At the present time, we consider the issue of system-reliability, monitoring and response one of the biggest unknowns with the proposed Water2WATER treatment system.

Energy consumption and greenhouse gases
Advanced water treatment is an energy intensive process. Internationally, the major energy consuming and, consequently, greenhouse gas-emitting parts of the process tend to be reverse osmosis and pumping.

Estimates of energy consumption for the proposed process are in the order of:
• Dual membrane filtration (MF/UF) 400 kWhr/ML
• UV treatment 200 kWhr/ML
• Reverse Osmosis 800 kWhr/ML
• Pumping to discharge site 3000–5000 kWhr/ML (*estimate only).

A similar plant to that proposed under Option A operating in Singapore uses 700–900 kWhr/ML .
The contribution, if any, of pumping to that energy use is at present unknown.
Preliminary estimates by ACTEW's consulting engineers of the power requirements for the new treatment process are about 6000 kW (kilowatts).
Based on an estimated greenhouse gas emission rate of 1.08 kg CO2/kWhr, and assuming operations 24 hours a day, 365 days per year, this level of energy consumption translates to an estimated greenhouse gas-emission rate of about 57,000 tonnes of carbon dioxide per year from plant operations.

There may be opportunities to use heat generated from the plant itself, and other green energy sources to minimise or offset the net carbon dioxide emissions. New tree plantations may also be a possible source of carbon offsets. About 300,000 trees per year would need to be planted to offset the estimated carbon dioxide production rate.

Waste management

In any treatment process, wastewater or otherwise, one of the biggest environmental risks lies with the handling and disposal of the concentrated waste stream. With the proposed Water2WATER treatment process, solid and liquid wastes will be generated at the new LMWQCC site. The liquid waste concentrate from the reverse osmosis (RO) process will be pumped to the Uriarra area for evaporation in purpose-built ponds, and subsequent disposal of solids.

The RO liquid waste ('brine') will contain high concentrations of salts, chemical contaminants and some bacterial and viral pathogens (it is unclear from the information provide to the CRC whether the waste stream will be disinfected prior to pumping).

The volumes of RO liquid 'brine' waste will be quite high — estimated to be about 10–15% of the total volume of water passing through the new plant — about 3–4 ML/day initially and more than double that volume at full capacity.

We note that management of concentrated liquid wastes is a well understood and generally well managed process internationally (at least in wealthier countries). Nevertheless, there are many examples of failures around the world that have led to significant and even catastrophic environmental consequences. Consequently, the risks inherent in such waste disposal processes need to be properly evaluated and managed.

Water transfer to Cotter catchment

The water transfer raises at least three potential risks to the aquatic fauna of the lower Cotter catchment:

- introduction of alien fish species as either eggs, larvae or small juveniles,
- introduction of disease organisms,
- introduction of endocrine disruptors to Cotter Reservoir.

Pathogens

The major concern for the introduction of disease organisms relates to the potential spread of Epizootic Haematopoietic Necrosis Virus (EHNV). This virus, unique to Australia, was first isolated in 1985 on the alien Redfin Perch. It is characterised by sudden high mortalities of fish displaying damage to the renal haematopoietic tissue, liver, spleen and pancreas. The threatened Macquarie Perch found in the Cotter catchment is one of several species known to be extremely susceptible to the disease. EHNV was first recorded from the Canberra region in 1986 when an outbreak occurred in Blowering Reservoir near Tumut. Subsequent outbreaks have occurred in Lake Burrinjuck in late 1990, Lake Burley Griffin in 1991 and 1994, Lake Ginninderra in 1994 and Googong Reservoir, also in 1994.

The EHNV disease has not been recorded from the Cotter system.

It is probably reasonable to assume that the Water2WATER treatment process, if designed and operating effectively to eliminate any potential disease organisms relevant to human health, would also remove EHNV. Consequently, the likelihood of this virus being introduced into the Cotter system through discharge of treated water is considered to be low, assuming the Water2WATER treatment process does not fail (refer to sec. 4.1.2).

Nevertheless, an accidental introduction could lead to severe consequences for Cotter fish populations especially Macquarie Perch, and further investigation of issues surrounding EHNV (including the design of a monitoring system) will be necessary.

Endocrine disruptors

The addition of endocrine-disrupting chemicals to waterways is a threat only recently recognised in Australia. These chemicals either disrupt normal hormone function, or mimic hormones to give an unnatural response. One group of endocrine disruptors is the environmental oestrogens which can mimic the female hormone oestrogen. Major sources of environmental oestrogens are pesticides, detergents and prescription drugs such as antibiotics. In Europe and America there is growing evidence of the changed sex ratios or feminisation of many aquatic species, particularly fish, which have been exposed to environmental oestrogens. This can have severe impacts on the ability of the species to successfully reproduce. Little research has been conducted in Australia on this problem, but it represents a real threat to Australia’s streams, and further investigation is required. In principle, the reverse osmosis and advanced oxidation treatment that form part of the recycled water infrastructure for Option A should be effective in removing all such organic chemicals.

Nevertheless, there are sufficient uncertainties around system design and performance at the current time to warrant more detailed analysis of this issue for the Stage 2 technical report.

Wetland site impacts
The location proposed for discharge of the treated water is in an area of moderately steep slope with soils that are prone to erosion. With the information to hand it is not possible to assess how effectively the proposed wetlands will perform in terms of flow, potential for erosion, residence time, and vegetation growth.

Largely because of the previous land-use for this area there will be a need for detailed study of slope, soil and drainage characteristics on which to base the design of a system of wetlands suitable to receive the quantity of treated water (25–50 ML/day) expected for the project. There may be a need to consider alternative locations elsewhere in the lower Cotter catchment for wetland sites more suited to their role, flow requirements and restoration proposals in the catchment. Or indeed, alternative means of waste treatment and disposal.

As noted in section 4.1.1, the water-treatment value of the proposed wetlands appears marginal at best, and potentially detrimental. Of course, beyond these water-treatment issues, there are quite possibly incidental ecological benefits that would arise from the new wetlands, and some of these are briefly listed in section 5.2. Whatever the case, the pros and cons of the proposed wetlands should be carefully re-evaluated during on-going analysis and planning.

Stream impacts
Water from the wetland is likely to be discharged into a nearby stream before reaching Cotter Reservoir. Although the CRC has not yet had time to carry out proper hydrological modelling (it will do so during the stage 2 technical study), it is reasonable to expect if water is discharged at rates approaching the proposed 25–50 ML/day that major ecological impacts on local streams will occur. Scouring, incision and enlargement of the stream channel would be expected, with consequent loss of in-stream, and possibly riparian, plant and animal habitat, as well as major impacts on nutrient processing.

Fish in Cotter Reservoir are likely to perceive a wetland-stream discharge flow of 25–50 ML/day as a signal of the presence of a significant tributary, and attempt to migrate up this 'tributary'. If such flows were larger than the Cotter inflow during the spawning season of native fish (October–December), fish may attempt to spawn in the wetland discharge, a waste of scarce reproductive effort in threatened native fish.

There may be ways to mitigate such impacts to some extent, for example through the use of more than one stream. However, along with the issues raised in previous sections, this is another reason to carefully consider whether direct discharge of treated water to the Cotter Reservoir may be a better environmental option.

Environmental opportunities
This paper has highlighted many potential environmental risks of the Water2WATER project that must be further evaluated and carefully considered.

How many viruses may not be removed if there was just a small bypass of water though or around membranes.

See discussion on this website. Water Recycling in Australia

"An unemotional and rational discussion of the facts as best that they can be scientifically supported". The aim of this blog is to make information available to concerned or interested members of the community.

http://waterrecycling.blogspot.com/2007/05/risky-conversation-collignon-khan.html

PC comment. This website and its co-ordinator (Dr Stuart Khan from UNSW) are generally in favour of the recycling of water from sewage into drinking water. However from my perspective is has good discussions of most of the issues surrounding debates on this issue. It has many divergent views presented and includes good and relatively dispassionate discussions of scientific facts and other issues.

This is an extract of a discussion on how much water with viruses might escape via membrane or system leaks.

I was very interested in the discussion you and Mark had about math's. I share Marks' concerns and I think my math's came out similar to what I think Mark (and now you) are saying. My worry is what happens if 1% of the water does not go through the reverse osmosis membranes. That is different to 1% of the membrane failing. If 1% of the membrane failed, I presume large volumes of water would go through any rupture, as the high pressure in the system would drive the water that way. This presumably would be readily picked up by continuous pressure measurements etc. However it may only take very small leaks, tears etc to have 1% of the water volume go via some alternate pathways. I then don't see how any in-line measuring system will pick up such a small loss (eg pressure etc).

I thus agree with your comment that we need some type of regular measuring system developed that detects micro-organisms (especially viruses) rapidly and efficiently (presumably some type of viral molecular PCR testing– however even when we get over the practicalities of getting rapid results, PCR only picks up what you suspect is there. It won't pick up viruses etc that you don't have their genetic code included in the primers for your testing).

If 1% of water bypassed the RO system, then it likely means the numbers of viruses removed will be log 2 less than when the system had no leaks. This means that if there was say log 6 viruses per 100 litres of water (1 million viruses) in the original sample, then log 4 virus (10 thousand) would still be coming out the other end.

This is why I believe that you should not recycle water from sewage into our drinking water if there are other reasonable options to obtain water or decrease the amounts of water being taken from our potable water supplies (eg sewer mining for irrigation etc). If we have no choice but to recycle sewage for drinking water, then we firstly need to have some type of monitoring of viruses operating fairly regularly (I would think at least twice daily - but such systems do not seem to currently exist for everyday use). There also as you have said, needs to be multiple other barriers in place after the RO system, so that if something does go wrong you have added safety barriers in place. That is why I am so vocally against the current Canberra proposal - I do not think the proposal is needed plus it is not safe enough.

In Canberra~~, we have enough water from other sources. We thus don't have to take this~~ risk. However even if this proposal was to proceed, nearly all of the natural safety barriers that should be in place, will have been removed. People should note that in the recently released draft environmental report that the implications of membrane and system failure are commented on (more so than in the draft health report). In the environmental report, concerns are raised re the large volumes of water that will be put upstream of the very small Cotter dam. Because of these reasonable environmental concerns, I note that there is a proposal to consider putting the recycled water directly into the small Cotter reservoir (3.8 GL) instead of into artificial wetlands (which don't look to be able to work very well in the Canberra proposal anyway). This will mean that the ~~sewage recycling proposal is then really a "direct" potable recycling scheme, that the~~ recycled water will only have very short retention times and only relatively small dilution effects. Also there will be no slow exposure via shallow marshes, wetlands etc where UV light and other factors might have a protective and polishing effect on any viruses or other pathogens that might be in the water if a mishap with the equipment occurred. To go ahead with this proposal without finding better ways to test to ensure firstly that micro-organisms such as viruses may have slipped through (eg from small membrane ~~leaks etc as per your previous math's discussion) and then~~ also remove as many ~~natural safety barriers as possible, strikes me as leaving this as a "high risk"~~ proposal but without now any safety nets.

None ~~of the discussion about Canberra's water2water proposal I have seen so far, have~~ made me feel any happier about its overall merits and safety. I think short-cuts on health and safety look like they are going to be taken. Even if this proposal goes ahead, it in my view should not start until we have a much bigger dam available to capture the recycled water. This will allow a much bigger dilution effects and much longer retention times to be ~~available as natural protection barriers. A larger dam that can be kept "offline" for~~ periods will also allow us to presumably quarantine any recycled water until we know it is "safe" ~~by appropriate test results. Even without the bigger dam, we need some type of~~ accredited monitoring system for viruses to be readily available and in regular use so that if a failure in the system occurred, we firstly know about it and we then can then try as best we can to keep any contaminated water out of our drinking water supplies.

Peter Collignon

Extracts from "Intestinal illness through drinking water in Europe. December 2005"

A number of epidemiological tools have been used to investigate possible associations between drinking water and disease. Of these, randomised controlled trials (RCTs) represent the most robust methodological approach. Typically, households are randomly assigned to different water treatment groups.

Two studies conducted in Canada have looked prospectively at the incidence of gastrointestinal illness due to the consumption of drinking water from sewage contaminated surface waters meeting current (as defined at the time of study) water quality criteria [Payment *et al*., 1991, 1997]. In the first of these studies, people in households randomised to receive domestic reverse osmosis (RO) water filters were found to have a lower annual incidence of gastrointestinal illness (0.50 per person/year) in comparison to tap water drinkers (0.76, $p<0.01$); estimating that 35% of the gastrointestinal illness reported by tap water drinkers was water-related. In a successive, larger trial, it was estimated that tap water was accountable for between 14-40% of gastrointestinal illness.

Although both Canadian studies used randomisation, participants were not blinded to the type of water treatment received which can improve the validity of results. Hellard *et al*. [2001] conducted a double-blinded RCT in Melbourne, Australia. The drinking water in the study area was reported to be of high quality, derived from a highly protected source treated with chlorination only. Six hundred households received either real or sham RO water treatment units (WTUs). Over a period of 68 weeks participants completed a health diary reporting gastrointestinal illness symptoms. The study found 0.80 highly credible gastroenteritis (HCG) cases per person/year and the ratio of HCG episode rates for families with real vs sham WTUs was 0.99 (95% CI: 0.85, 1.15, p=0.85), indicating that the RO-filters did not significantly reduce the HCGI incidence.

In the US, Colford *et al*. [2005] conducted a triple blinded RCT cross-over intervention study. The drinking water in this study area was derived from a challenged source treated with conventional chlorination and filtration methods to conform to all current US regulatory standards. Participants received either a sham or real treatment device for six months before switching to the opposite device for a further six months. The active device contained a 1 μm absolute ceramic filter and used UV-light. A total of 2366 HCG episodes were recorded for the 1296 participants over a period of 12 months (1.83 cases/person/year). The relative rate estimate of HCG (sham vs real device) was 0.98 (95% CI: 0.86, 1.10), no reduction in gastrointestinal illness was detected following use of the real treatment device. Further studies from the Americas have shown an association between sporadic cases of illness and use of unfiltered municipal or non-municipal water [Birkhead and Vogt, 1989] and variation in drinking water turbidity [Morris *et al*. [1996], Schwartz *et al*. [2000]).

What is evident from outbreaks implicating public supplies is that harmful pathogens have the potential to reach a large body of consumers resulting in substantial economic and health-related costs, which is shown by the April 1993 *Cryptosporidium* outbreak in Milwaukee [Mackenzie *et al*. ,1994]. As a result of a **filtration failure** at a public water supply it was estimated that around 403,000 people suffered illness, 4,400 people were hospitalised and 100 people died, though these figures have been disputed by others [Hunter and Syed 2001]. The total cost of outbreak-associated illness in the Milwaukee outbreak was estimated to be US$96.2 million [Corso *et al*., 2003]. Furthermore, in a review of 25 studies on the economic burden associated with common water-related diseases [Bartram *et al*., 2002: 78], the cost of an outbreak reflected as a proportion of gross domestic product per person for 7 enteric outbreaks of waterborne disease ranged from 0.002 to 0.230. Whilst costs such as health care expenses, direct and indirect productivity loss, and bottled water purchase are incorporated into these estimates, the absence of macroeconomic costs (for example, reduced consumer confidence and tourism decline) means that the financial burden is underestimated.

Documented Public Water Supply Outbreaks

A total of 86 enteric disease outbreaks associated with EU public drinking water supplies for the years 1990 to 2004 were detected.

The majority of groundwater outbreaks occurred in Finland (31%) and the majority of surface water outbreaks occurred in England (44%). All outbreaks in Scotland and Northern Ireland involved surface water supplies, the majority of outbreaks in Finland (83%) and France (71%) involved groundwater supplies, and a large number of outbreaks in England involved surface water supplies (48%). Groundwater supply outbreaks reported a greater number of case s of illness (60%) than surface water supplies (32%). The country-specific trends for England, France, and Finland reported here tend to reflect the predominant source of supply utilised for drinking water (as reported by Bartram *et al.,* 2002: 87).

Of the 54 outbreaks where a pathogen could be isolated from cases and the source of the supply was known, 89% of surface water outbreaks were of protozoan origin compared to 46% of groundwater outbreaks (Table 3).

Table 3: Outbreaks by Pathogen Group and Source of Supply

Pathogen	Water Source		Total
	Groundwater Outbreaks	Surface Water Outbreaks	
Bacteria	7	2	9
Protozoa	12	25	37
Virus	7	1	8
Total	26	28	

Water quality testing was reported in 88% of outbreaks. Of 62 outbreaks reporting whether or not a pathogen was present in the drinking water, 45% found a positive result (Table 4).

The outbreaks listed above by no means constitute a definitive list of outbreaks in the EU. As previously noted, outbreak reports were required to meet criteria to avoid inclusion of duplicates, to be referable to the published literature and to allow data analysis, which will undoubtedly have led to an underestimation of the number of outbreaks identified.

The Canadian Council of Ministers of the Environment (CCME) multi-barrier approach to safe drinking water identifies three key elements (source water, drinking water treatment plant, and distribution system) to be managed in an integrated manner using tools such as water quality management and monitoring, legislation, and guidelines [Federal-Provincial-Territorial Committee on Drinking Water, 2002].

Sixty-one of the 86 outbreaks previously identified had sufficient information available regarding contributory failures to be utilised in the development of a generic outbreak fault tree (see Figure 1).

Failures occurring at the 'source' of the supply and during 'treatment' occurred with similar frequency and mean contributory scores. 'Distribution' system failures occurred less often but with higher mean contributory scores. Failures associated with the 'detection' of, and response to, microbial and non-microbial pathogens occurred the least often and had the lowest mean contributory score.

Looking in more detail at 'source' water failures, both 'livestock activity' and 'rainfall' base events often featured in outbreaks (41% and 44% of outbreaks respectively) which is consistent with the identified seasonality of month of outbreak onset. 'Sewage discharge into the water' or 'onto surrounding land' had higher mean contributory scores (18.4 and 21.8 respectively) than 'rainfall' (17.9) and 'livestock' (14.9), but relatively low frequency of below 10%. The low mean contributory scores for rainfall and livestock are likely due to the existence of further barriers (such as treatment and detection) between source water contaminated with surface water runoff and the consumer. Direct sewage contamination of the surrounding land or water may be intense thus compromising effectiveness of further barriers such as treatment. With regard to 'treatment' base events, 'chronic filtration failures' were the most frequently documented (38% of outbreaks), yet, 'temporary filtration failures' attained the highest mean contributory score of 58.8. Looking in more detail at 'source' water failures, both 'livestock activity' and 'rainfall' base events often featured in outbreaks (41% and 44% of outbreaks respectively) which is consistent with the identified seasonality of month of outbreak onset. 'Sewage discharge into the water' or 'onto surrounding land' had higher mean contributory scores (18.4 and 21.8 respectively) than 'rainfall' (17.9) and 'livestock' (14.9), but relatively low frequency of below 10%. The low mean contributory scores for rainfall and livestock are likely due to the existence of further barriers (such as treatment and detection) between source water contaminated with surface water runoff and the consumer. Direct sewage contamination of the surrounding land or water may be intense thus compromising effectiveness of further barriers such as treatment. With regard to 'treatment' base events, 'chronic filtration failures' were the most frequently documented (38% of outbreaks), yet, 'temporary filtration failures' attained the highest mean contributory score of 58.8.

Results have implications for the treatment of groundwater and surface water supplies and the monitoring of metrological, microbial, and non-microbial data. Although distribution system failures were considered to have the greatest contribution to surface water outbreaks, surface water supplies suffered most often from treatment failures. Of the treatment failures, chronic filtration failures occurred most often and temporary interruption to filtration was the most influential in causing such outbreaks. This is consistent with the finding that 89% of surface water outbreaks were associated with protozoa.

Published case studies of waterborne disease outbreaks--evidence of a recurrent threat. Hrudey SE, Hrudey EJ.

Water Environ. Res. 2007 Mar;79(3):233-45.

Environmental Health Sciences, 10-120 Clinical Sciences Building, School of Public Health, University of Alberta, Edmonton, Alberta T6G 2G3, Canada. steve.hrudey@ualberta.ca

Residents of affluent nations are remarkably lucky to have high-quality, safe drinking water supplies that most residents of modem cities enjoy, particularly when considered in contrast to the toll of death and misery that unsafe drinking water causes for most of the world's population. Some may presume that drinking-water disease outbreaks are a thing of the past, but complacency can easily arise. A review of drinking water outbreaks in developed countries over the past 3 decades reveals some of the reasons why drinking water outbreaks keep occurring when society clearly has the means to prevent them.

Prevention of future outbreaks does not demand perfection, only a commitment to learn from past mistakes and to act on what has been learned.

http://www.ncbi.nlm.nih.gov/sites/entrez

The role of wastewater treatment in protecting water supplies against emerging pathogens. Crockett CS.

Water Environ. Res. 2007 Mar;79(3):221-32.

Philadelphia Water Department, Office of Watersheds, 1101 Market Street, 4th Floor, Philadelphia, PA 19107, USA. Chris.Crockett@phila.gov

Traditionally, regulators, dischargers, and even water suppliers believed that wastewater discharge meeting the levels of 200 cfu/ 100 mL of fecal coliforms in wastewater effluent was sufficient to protect against downstream microbial effects. However, these beliefs are now being challenged by emerging pathogens that are resistant to standard water and wastewater treatment processes, exhibit extended survival periods in the environment, can adversely affect sensitive subpopulations, and require extremely low doses for human infection.

Based on this new information, it is estimated that discharges of emerging pathogens from conventional wastewater treatment plants as far as 160 km upstream and cumulative amounts of wastewater discharge ranging from 2 to 20 ML/d have the potential to reach a water supply intake in a viable state at significant concentrations that could exceed regulatory limits for drinking water supplies, increase endemic risk from drinking water, and/or require additional drinking water treatment. Wastewater dischargers may be able mitigate this potential effect and achieve upwards of 6 log combined removal and inactivation of emerging pathogens to mitigate drinking water effects by using alternative treatment processes, such as filtration or UV light disinfection, or optimizing these processes based on site-specific conditions.

Recycled sewage in our water supply; a needless human health hazard in Canberra

This is a revision of the opinion piece I had previously written and was published in the Canberra Times in March 2007.

It is proposed in Canberra we will recycle about 9 GL (9 billion litres) of waste-water and then pump this treated water back into our reservoirs. It will then be used as part of our domestic water supply, which includes drinking water.

One of our most significant public health improvements was removing sewage from water supplies. Human waste contains numerous viruses, bacteria, protozoans and other microbes that frequently cause disease if ingested. While our sewage will be treated so that it is “safe” to drink, the mechanisms being proposed for this all have potential problems with performance. Thus there is a strong possibility that at times we will contaminate our water supply with disease causing micro-organisms.

Worldwide there are localities where there is no alternative but to accept the risks associated with using recycled sewage. However, whenever possible when we can avoid placing treated sewage into drinking water this is hazard obviously desirable to avoid. In Canberra there is no reason to take this risk. The ACT has large volumes of unused water. Indeed ii is a very large net exporter of water to NSW (about 471 GL per year). We also currently have one of the best water supplies from a safety point of view in Australia (and probably worldwide). Currently no human sewage enters our drinking water in our catchments. We are also very fortunate (and unique) in that minimal domestic animal waste enters the water supply because few farms are in our catchments. Most of our current Canberra water is good enough to bottle!

A number of methods are purposed to make this recycled sewage “safe” but how many systems work perfectly all the time? If membrane technology is used, can we be sure that these membranes will be able to accommodate the planned 24 million litres of recycled water that they need to filter each day? How will we know when there are small tears in parts of the membranes or leaks around seals? Bacteria are very small and so the pore size of these membranes needs to be < 0.2 microns otherwise all bacteria will not be removed. However when the pore size is so small, these membranes can become fouled unless other means are found to prevent blockage by larger waste material. Even such small pore sizes will still not remove viruses, which are much smaller. These membranes will not remove drugs passed in urine and faeces that are not broken down (such as oestrogens).

A “reverse osmosis” process is also going to be used. But there is a lack of details available to Canberra residents to see how effective this system may be in removing viruses (and drugs). We know that salts and nitrates are not all removed by this process and also that some drugs pass through the membranes used in reverse osmosis. Ultraviolet light will also be used as an additional sterilising agent. However this is far from an ideal disinfectant. There are many issues such as time of exposure, susceptibly of different microbes etc, for it to work. How can we be sure that this can handle 24 million litres of waste-water per day?

Safety monitoring is planned, presumably by culturing the water and looking at coliform counts. If coliforms (eg *E. coli*) are present in the treated water this implies faecal contamination (and thus a failure of the system). However, this type of monitoring has problems. Around the world numerous outbreaks with water contaminated with viruses and Cryptosporidiosis, have occurred despite low or zero coliform counts. In addition these indicator bacteria take 1 or 2 days to grow and identify. There does not appear to be a plan for storing 2 or 3 days of recycled water in a temporary reservoir. The water will effectively be pumped directly back into small Cotter dam after treatment. This will mean that even when we detect a failure with our treatment system, there will be little we can do about it because the contaminated water will already be in the dam. How often will this coliform testing be done? -every half hour, hourly, daily or just weekly?

In Canberra we do not need to recycle our waste-water back into our drinking water supply. The current proposal is for initially 9 GL of water per year to be recycled into our dams. On average however about 120 GL per year has been released from our dams into the rivers as environmental flows (46 GL) and as spills (75 GL). Spills are when dams overflow – which has occurred frequently, even in droughts, with the Cotter dam because of is low storage capacity. This released water is relatively “pristine” from an infection point of view. Why not find ways to withhold 9 GL of this water? Is this not a better option than pumping 9 GL of very expensively treated waste-water upstream into our reservoirs when we cannot be assured it will always be free of harmful microbes?

In Feb 2006, the Chief Minister announced the start of a transfer scheme commencing in Dec 2006 of 12 GL per year from the Cotter reservoirs to the Googong Dam. “This Scheme takes water that would otherwise spill over our dam walls, and makes it available for consumption in the Canberra region”. This amount is larger than the proposed 9 GL volume of recycled water. Can’t more water from the Cotter dams be transferred if we still have a shortage of water in the Googong dam? On average large amounts of water “spills” per year from the Cotter river system and into the Murrumbidgee River. Surely the amount transferred from the Cotter system to the Googong dam could be increased to say 20 GL per year and avoid the costs and risks of recycling sewage into our water supply.

This current proposal to recycle sewage also does not seem to make environmental sense. Effectively this will be putting 9 GL less water into our waterways. This is because 9 GL of water will be pumped back into our reservoirs instead of being released into our rivers as occurs currently. We could remedy this by letting an extra 9 GL out of our dams and into the rivers. That however would effectively mean that there is no net increase in the water supply for human use. If we did that we will have spent maybe $150 million or more to process and pump water back into our dams, just to let the same amount of water out again! It makes neither environmental nor economic sense.

Nearly all of the water that is released from ACT Dams as environmental flows plus natural flows, move into the Murrumbidgee River where it is then captured in the Burrinjuck Dam (capacity 1,025 GL) near Yass. Nearly all the water in the Burrinjuck Dam is for irrigation purposes, when it is let out for downstream users. One of the major uses of this water is for rice cultivation. In 2001 (Australian Bureau of Statistics), 1,924 GL was used for rice production in NSW/ACT. There is no rice production in the ACT, which means all this water is being used further downstream in the Murrumbidgee river system. If the rice growers down river from Canberra decreased their water usage by just 1%, that would mean that there would be another 19 GL available for the rivers. This is more than double the amount that is proposed to be saved by recycling our waste-water in Canberra. It does not appear to make sense to spend huge amounts of money recycling waste water and putting this water back into our Canberra drinking water, when at the same time we are releasing “pristine” water from these same dams for environmental flows especially when this released water is effectively being used mainly for irrigation purposes downstream to produce water intensive crops such as rice.

In my view this proposal to recycle sewage should not proceed in Canberra. We have ample flows of much safer water that could be stored and used for human consumption. If we proceed we will be creating a human health hazard needlessly for our population at great financial cost and without any obvious benefits to our environment.

Prof Peter Collignon.
Infectious Diseases Physician and Microbiologist
Director Infectious Diseases Unit and Microbiology Department, The Canberra Hospital.
Professor, School of Clinical Medicine, Australian National University.

PO Box 11, Woden. ACT. 2607. Australia.
fax 61 2 6281 0349, phone 61 2 6244 2105,
peter.collignon@act.gov.au

These are my personal views and do not necessarily reflect the opinions of the organisations whom I work for or I am associated with. Many of the necsassry facts to have an informed public debate are surprising difficult to find (eg environmental flows per year etc). My sources for information and web site are given in the appendix.

Appendix

The current total water available in the ACT per year is 494 GL. Slightly more than half of this is reserved for environmental flows and just under half (222 GL) is available for human usage if needed. In the past the ACT has extracted 65 GL of water per year for human use but of this 35 GL is returned to the river system after processing. This means that there is a net usage of only 30 GL (of the 222 GL that is available for human use). In the last year (2006) our usage has dropped to 50 GL per year, which means that the ACT is only extracting 15 to 20 GL of water (this is the amount of water not returned to the river system).

The ACT is a net exporter of water to NSW. On overage 368 GL/year flows into the ACT from NSW, via the Murrumbidgee River. However, 839 GL flows out of the ACT, via the Murrumbidgee. This means that the ACT exports 471 GL of water per year to NSW.

Large amounts of water are released from our dams each year as Environmental flows. On average this is 46 GL/year plus there is another 75 GL/year that flows into the rivers as spills. Thus currently on average the ACT from its reservoirs is putting 120 GL/year of water into our rivers that could otherwise be stored in our dams (this is in comparison to the net annual human use of water in ACT of about 20 GL/year).

The ACT has storage capacity if all the dams are full of about 200 GL. Currently about 50 GL/year is being taken out of that storage for human use (with 35 GL returned to the rivers after processing). The average annual environmental plus spill flows is 120 GL of which 45 GL is "released". ~~Between 50 to 65 GL of water is extracted for domestic consumption each year. Total~~ about 100 GL. Thus it appears that our dams really only have about 2 years of storage capacity if full re the amounts on average that are currently released or used from the dams.

One of the major users of water in Australia is rice cultivation. In 2001 (Australian Bureau of Statistics), 1,924 GL was used for rice production in NSW/ACT. The net use of water for human use ~~per year in Canberra for our 350,000 people is 20GL. Thus one year's water use for the rice~~ production that occurs downstream from Canberra is equal to 100 years use of current net domestic water use in Canberra.

The ACT is currently suffering a major water inflow problem and an increase in evaporation. However, there have been worse droughts than is currently being experienced in the ACT including the late 1800s, 1914, 1944 and 1981-83.

References and Sources

This ~~source of information is reports from~~ ACTEW ~~2004 Report, plus "The Need to Increase ACT's Water~~ Storage 2004 http://www.actew.com.au/FutureWaterOptions/Documents/assessmentReport.pdf

ActewAGL ~~Water Facts and "Future Water Options for the ACT Region in the 21~~st Century, http://www.actew.com.au/futurewateroptions/Reports.aspx

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http://www.abs.gov.au/Ausstats/abs@ nsf/Previousproducts/4EB070C49861DA5DCA256F7200832FAE?opendocument

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Industrial waste needs to be excluded from any sewage

Discharge pretreatment

When recharging aquifers for human consumption it is important to develop efficient pretreatment programs for industrial discharges into the sewerage, so that effluents have relatively "controlled" characteristics. Although this is not part of recharge legislation, it is definitely an essential component. The presence of industrial discharges into the sewer system is a concern, because they carry compounds that are hard to determine and remove, and that have unpredictable and even unknown effects, so they must be segregated from the water before infiltration. Because there is reuse of treated wastewater for human consumption, regardless of whether it is intentional or unintentional, the discharge of toxic compounds must be regulated so that only domestic water is used.

http://www.who.int/water_sanitation_health/wastewater/wsh0308/en/index.html

Other cities use recycled water from sewage mainly for uses other than drinking water

CH2M Hill to design advanced water purification facility for city of Oxnard

OXNARD, CA, April 25, 2007 -- CH2M Hill, a global full-service engineering, construction, and operations firm based in Denver, has been chosen to manage the design of an advanced water purification facility (AWPF) for the City of Oxnard, CA. The facility will provide the city with reclaimed water that can be used for landscape and agricultural irrigation, industrial process water and groundwater recharge.

The APWF project is a part of the City of Oxnard's Groundwater Recovery Enhancement and Treatment (GREAT) program, whose focus is to use existing water resources more efficiently. A major component of the GREAT program is the use of recycled water for multiple beneficial uses including irrigation of edible food crops, landscape irrigation, injection into the groundwater basin that forms a barrier to seawater intrusion and other possible industrial uses.

The recycled water for reuse will be generated by the new AWPF. The source of the recycled water will be the existing city water pollution control facility which has a capacity of 32.5 million gallons per day. The AWPF will treat the secondary water from the city water pollution control facility using a multiple-barrier treatment train consisting of microfiltration/ultrafiltration, reverse osmosis and ultraviolet -light based advanced oxidation processes.

The project will be constructed in two phases, with capacity of the initial phase at 6.25 million gallons per day. The capacity during the build-out phase is expected to reach 25 million gallons per day.

The City of Oxnard has purchased a 4.65-acre parcel located east of Perkins Road and north of a railroad line owned by Ventura County Railroad Company. The City's water pollution control facility occupies land on the west side of Perkins Road. The feed water for the AWPF will be directed from the secondary effluent channel at the WPCF to an inlet structure at the AWPF site.

In addition to agricultural and landscape irrigation, water will be available for local industrial users and groundwater recharge. Farms in Pleasant Valley and along the Santa Clara River will be supplied with the AWPF high-quality water for agricultural irrigation. Additional water will be distributed across the City for landscape irrigation using the remodeled Redwood sewage trunk line.

Groundwater recharge will be conducted by injecting the water into the ground using injection wells along Hueneme Rd. east of the AWPF. The groundwater injection will protect the aquifer from seawater intrusion and provide credit to the City against penalties for over-pumping groundwater. All of the end users (agricultural irrigation, landscape irrigation, injection in the aquifer and industrial) will be served with the highest water quality of the AWPF, which meets the groundwater recharge criteria.

In addition to the key objective of producing purified water, the AWPF will be open to the public and have educational, visitor, and research functions. A portion of the site will contain a demonstration wetland. The wetland feature complete with vegetation. In addition, the wetland system will build upon results from previous pilot wetland studies conducted by CH2M HILL in 2003-2005. The use of this natural system will provide an opportunity for community education, further research and the potential to use such wetland biota for community wetlands restoration.

The initial phase is expected to be fully operational by the end of 2009.

With headquarters in Denver, CO, employee-owned CH2M Hill (www.ch2m.com) is a global leader in engineering, construction, and operations for public and private clients. With $4.5 billion in revenue, it's an industry- leading program management, construction management for fee, and design firm, as ranked by *Engineering News-Record* (2006). The firm's work is concentrated in the areas of transportation, water, energy, environment, communications, construction, and industrial facilities. The firm has long been recognized as a most-admired company and leading employer by business media and professional associations worldwide. CH2M Hill has over 19,000 employees in regional offices around the world.

http://ww.pennnet.com/Articles/Article_Display.cfm?Section=ONART&PUBLICATION_ID=41&ARTICLE_ID=290952&C=PROJE

About CH2M HILL

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Also see: "CH2M Hill to help lead five year research program on nutrient removal from wastewater"

Extracts taken from Australian drinking water standards

The greatest risks to consumers of drinking water are pathogenic microorganisms. Protection of water sources and treatment are of paramount importance and must never be compromised.

Waterborne pathogens can cause outbreaks of illness affecting a high proportion of the community and in extreme cases causing death. How much treatment is needed will depend on the level of protection of water supplies. Completely protected groundwater may not require treatment, but all other supplies will require continuous disinfection. If water supplies are not completely protected from human and livestock waste, filtration is likely to be required.

Disinfection is the single process that has had the greatest impact on drinking water safety. There is clear evidence that the common adoption of chlorination of drinking water supplies in the 20th century was responsible for a substantial decrease in infectious diseases. Disinfection will kill all bacterial pathogens and greatly reduce numbers of viral and most protozoan pathogens. Combined with protection of water sources from human and livestock waste, disinfection can ensure safe drinking water. In the absence of complete protection of source water, filtration is likely to be required to improve the removal of viruses and protozoa.

All waterborne disease outbreaks are avoidable. Pathogens can only cause disease and death in humans if water source protection, pathogen removal by disinfection or filtration, or integrity of distribution systems fail.

The drinking water system must have, and continuously maintain, robust multiple barriers appropriate to the level of potential contamination facing the raw water supply.

The multiple barrier approach is universally recognised as the foundation for ensuring safe drinking water. No single barrier is effective against all conceivable sources of contamination, is effective 100 per cent of the time or constantly functions at maximum efficiency. Robust barriers are those that can handle a relatively wide range of challenges with close to maximum performance and without suffering major failure.

Although it is important to maintain effective operation of all barriers, the advantage of multiple barriers is that short-term reductions in performance of one barrier may be compensated for by performance of other barriers. Prevention of contamination provides greater surety than removal of contaminants by treatment, so the most effective barrier is protection of source waters to the maximum degree practical. Knowing how many barriers are required to address the level of potential contamination in individual systems is important. This requires a thorough understanding of the nature of the challenges and the vulnerabilities of the barriers in place. In terms of reliability, there is no substitute for understanding a water supply system from catchment to consumer, how it works and its vulnerabilities to failure. Finally, a robust system must include mechanisms or fail-safes to accommodate inevitable human errors without allowing major failures to occur.

Any sudden or extreme change in water quality, flow or environmental conditions (e.g. extreme rainfall or flooding) should arouse suspicion that drinking water might become contaminated.

System operators must be able to respond quickly and effectively to adverse monitoring signals.

System operators must maintain a personal sense of responsibility and dedication to providing consumers with safe water, and should never ignore a consumer complaint about water quality.

Ensuring drinking water safety and quality requires the application of a considered risk management approach.

The process of keeping drinking water safe is one of risk management. This requires steering a sensible course between the extremes of failing to act when action is required and taking action when none is necessary. Lack of action can seriously compromise public health, whereas excessive caution can have significant social and economic consequences. Corrective action or system upgrades should be undertaken in a considered, measured and consultative manner. Failure to act when required (e.g. failing to shut down a system when disinfection is not working effectively) may lead to an outbreak of waterborne disease. Acting when not required (e.g. issuing a 'boil water' notice when that is not necessary) is usually less severe in the short term, but repeated occurrences waste resources and are likely to cause complacency in the long term, leading to failure to respond when it is truly necessary. Similarly, failing to install a treatment process when required could lead to waterborne disease; however, installing treatment processes that are not required could have a high financial cost and divert funds needed elsewhere.

Risk management is about taking a carefully considered course of action. As the obligation is to ensure safe water and protect public health, the balancing process must be tipped in favour of taking a precautionary approach.

Traditional preventive measures are incorporated as or within a number of barriers, including:

- catchment management and source water protection
- detention in protected reservoirs or storages
- extraction management
- coagulation, flocculation, sedimentation and filtration
- disinfection
- protection and maintenance of the distribution system.

The types of barriers required and the range of preventive measures employed will be different for each water supply and will generally be influenced by characteristics of the source water and surrounding catchment (see Box 3.2). Selection of appropriate barriers and preventive measures will be informed by hazard identification and risk assessment.

Box 3.2 *Examples of multiple barriers*

Large parts of Melbourne are supplied with high-quality source water from a highly protected catchment. Melbourne Water focuses much of its attention and resources on maintaining prevention of contamination at the source. The series of barriers for the majority of the water supply system include:

- protected forested catchments for harvesting of water with no human or livestock access
- large catchment reservoirs with long detention times
- additional detention time in seasonal storage systems
- disinfection of water before it enters the distribution system
- closed distribution systems.

In contrast, Adelaide is supplied with surface water derived from multi-use catchments and the Murray River where there is limited control over activities with potential impacts on water quality. As a result, the barriers applied are heavily weighted towards water treatment and downstream control to remove turbidity and microorganisms. Barriers include the use of multiple storage reservoirs, coagulation, flocculation, sedimentation, filtration and disinfection with long contact times before supply.

Provision of residual disinfectant through large parts of the distribution system is also an important barrier for both systems.

Catchment management and source water protection

Catchment management and source water protection provide the first barrier for the protection of water quality. Where catchment management is beyond the jurisdiction of drinking water suppliers, the planning and implementation of preventive measures will require a coordinated approach with relevant agencies such as planning authorities, catchment boards, environmental and water resources regulators, road authorities and emergency services.

Effective catchment management and source water protection include the following elements:

- developing and implementing a catchment management plan, which includes preventive measures to protect surface water and groundwater
- ensuring that planning regulations include the protection of water resources from potentially polluting activities and are enforced
- promoting awareness in the community of the impact of human activity on water quality.

Whether water is drawn from surface catchments or underground sources, it is important that the characteristics of the local catchment or aquifer are understood, and the scenarios that could lead to water pollution are identified and managed. The extent to which catchment pollution can be controlled is often limited in practical terms by competition for water and pressure for increased development in the catchment.

Effective catchment management has additional benefits. By decreasing contamination of source water, the amount of treatment and quantity of chemicals needed is reduced. This may lead to health benefits through reducing the production of treatment byproducts, and economic benefits through minimising operational costs.

In surface water catchments, preventive measures can include:

- selection of an appropriate source water (where alternatives exist)
- exclusion or limitations of uses (e.g. restrictions on human access and agriculture)
- protection of waterways (e.g. fencing out livestock, management of riparian zones)
- use of planning and environmental regulations to regulate potential water polluting developments (e.g. urban, agricultural, industrial, mining and forestry)
- use of industry codes of practice and best practice management
- regulation of community and on site wastewater treatment and disposal systems
- stormwater interception.

Detention in reservoirs or storages

Detention of water in reservoirs can reduce the number of faecal microorganisms through settling and inactivation, including solar (ultraviolet) disinfection. Most pathogenic microorganisms of faecal origin (enteric pathogens) do not survive indefinitely in the environment. Substantial die-off of enteric bacteria will occur over three to four weeks. Enteric viruses and protozoa will survive for longer periods (weeks to months).

Detention also allows suspended material to settle, which makes subsequent disinfection more effective and reduces the formation of disinfection byproducts.

Other preventive measures in reservoirs and storages include:

- reservoir mixing or destratification to reduce growths of cyanobacteria (taste, odour and toxin production)
- excluding or restricting human, domestic animal and livestock access
- diversion of local stormwater flows.

Extraction management

Where a number of water sources are available, there may be flexibility in the selection of water for treatment and supply. In such a situation it may be possible to avoid taking water from rivers and streams when water quality is poor (e.g. following heavy rainfall) in order to reduce risk and prevent problems in subsequent treatment processes.

Within a single water body, selective use of multiple extraction points can provide protection against localised contamination either horizontally or vertically through the water column (e.g. cyanobacterial blooms).

5.2 Microorganisms in drinking water

The microbial guidelines seek to ensure that drinking water is free of microorganisms that can cause disease. The provision of such a supply is of paramount importance to the health of a community.

The most common and widespread health risk associated with drinking water is contamination, either directly or indirectly, by human or animal excreta and the microorganisms contained in faeces. If the contamination is recent, and those contributing to the contamination include carriers of communicable enteric diseases (diseases of the gut), some of the microorganisms that cause these diseases may be present in the water. Drinking such contaminated water or using it in food preparation may cause new cases of infection. Those at greatest risk of infection are infants and young children, people whose immune system is suppressed, the sick, and the elderly.

Pathogenic (disease-causing) organisms of concern include bacteria, viruses and protozoa; the diseases they cause vary in severity from mild gastroenteritis to severe and sometimes fatal diarrhoea, dysentery, hepatitis, cholera or typhoid fever.

The supply of safe drinking water involves the use of multiple barriers to prevent the entry and transmission of pathogens. The effectiveness of these barriers should be monitored by a program based on operational characteristics and testing for microbial indicators

Urbanisation and industrialisation increased the pressure on water supplies and systems of waste disposal, and by the middle of the 19th century, Britain was affected by major epidemics of cholera and endemic typhoid. John Snow and William Budd provided incontrovertible evidence of the role of water in transmission of these two diseases. Snow's case rested very simply on a comparison of cholera incidence among the customers of three London water companies (Snow 1855): one supplied filtered water; the second moved the source of its supply to a cleaner area of the Thames; the third persisted in supplying polluted Thames water. Budd appreciated that the sewer was merely the continuation of the diseased gut (Budd 1856), and applied what are now classic epidemiological concepts to the investigation of water as a vehicle for spreading typhoid. As a result, filtration of river-derived water became a legal requirement in London in 1859, and the practice gradually spread through Europe. By 1917, Sir Alexander Houston could draw attention to the effectiveness of London's systems of water treatment and delivery in stopping the waterborne transmission of typhoid. He pointed out that in America an annual mortality rate from typhoid of 20 or more per 100 000 people was considered normal (e.g. the rate in Minneapolis was 58.7); however, in London the annual mortality from typhoid was 3.3 per 100 000 (Houston 1917).

Budd's relatively simple precautions against typhoid were remarkably successful (Budd 1856). A century later, Hornick's experiments on volunteers helped to explain this success by showing typhoid to be relatively difficult to catch (Hornick *et al* 1966): around 10^7 *Salmonella enterica* serovar Typhi caused disease in only 50 per cent of his volunteer subjects. Kehr and Butterfi eld (1943), however, showed that a small minority of the population (about 1.5 per cent) need to ingest only a single typhoid organism to contract typhoid; to protect such individuals, more elaborate precautions are needed.

5.4.3 VIRUSES

Viruses are among the smallest of all infectious agents. In essence they are molecules of nucleic acid that can enter cells and replicate in them. The virus particle consists of a genome, either ribonucleic acid (RNA) or deoxyribonucleic acid (DNA), surrounded by a protective protein shell, the capsid. Frequently this shell is itself enclosed within an envelope that contains both protein and lipid. Viruses replicate only inside specific host cells, and they are absolutely dependent on the host cell's synthetic and energy-yielding apparatus for producing new viral particles.

The viruses of most significance for drinking water are those that multiply in the human intestine and are excreted in large numbers in the faeces of infected individuals. Although they cannot multiply outside the tissues of infected hosts, some enteric viruses can survive in the environment and remain infective for long periods. Human enteric viruses occur in water largely as a result of contamination with sewage and human excreta. The numbers of viruses present and their species distribution will reflect the extent to which they are being carried by the population; however, the use of different analytical methods can also lead to wide variations in calculations of the numbers of viruses found in sewage. Sewage treatment may reduce numbers by a factor of 10 to 10 000, depending upon the nature and degree of treatment; however, even tertiary treatment of sewage will not eliminate all viruses. As sewage mixes with receiving water, viruses are carried downstream; the length of time they remain detectable depends on temperature, their degree of adsorption to particulate matter, penetration of sunlight into the water and other factors. Consequently, enteric viruses can be found at the intakes to water treatment plants if the water is polluted by sewage. However, proper treatment and disinfection should produce drinking water that is essentially virus free.

Recent methodological advances have revolutionised the diagnosis of viral diarrhoeal diseases, and waterborne outbreaks due to viruses have now been identified in both developed and developing countries all over the world, with many different strains of viruses isolated from raw and treated drinking water. Isolation of viruses from water indicates that a hazard exists, but it does not prove beyond doubt that water is a vehicle for transmission of disease.

Epidemiological proof of waterborne transmission of viral diseases is very difficult to establish, for a variety of reasons. Symptoms may not resemble those of typical waterborne diseases, and many of those infected will show no symptoms. Some infections, for example the hepatitis A virus, are difficult to trace to a source because of long incubation periods. Water is often only one of various routes of transmission, it is not always the major route, and adequately sensitive methods for detecting the infectious agent in water are often not available.

The occurrence of disease is also related to the relative level of immunity in the community. If, for example, the water supply has been repeatedly contaminated, the community may have become immune to some waterborne pathogens. Such a situation can be seen in some developing countries where the prevalence of pathogens is high and the standard of tap water is less than optimal. Visitors who drink the water frequently become ill, while the local community, especially adults, appear to suffer minimal morbidity. The immunity of the local population may, however, be acquired at the expense of the health of more susceptible individuals in that community, including children, the aged and people already in poor health.

Thus, a community consuming water with indicators of faecal pollution may show no discernible disease. Such a situation, however, is unstable. Apart from the risk to visitors, faecal pathogens affecting the locals may be introduced from, for instance, an immigrant or a seasonal outbreak of a disease such as cryptosporidiosis resulting from cattle in the catchment.

When illness occurs in a community, the route of infection needs to be confirmed by epidemiological investigation, even when the disease-causing organism is found in a suspect water supply.

Viruses

Adenovirus[a] Causes pharyngitis, conjunctivitis, gastroenteritis. Spread by inhalation, ingestion, direct contact. May contaminate water through sewage.
Enterovirus[a] May enter water via faecal contamination or sewage. Can cause gastroenteritis and other diseases, often
symptomless. Can probably be spread by drinking water.
Hepatitis viruses[a] A and E viruses can be spread in drinking water contaminated with faecal material or sewage effl uent.
Norwalk virus[a] Causes gastroenteritis, can be spread in drinking water, bathing, food (especially shellfi sh) contaminated
with sewage/faecal material.

Rotaviruses, pararotaviruses and reoviruses (Reoviridae) [a] Widespread in environment; can cause serious gastroenteritis in children, the elderly, and hospital patients. May enter water through faecal material/sewage contamination.

TREATMENT OF DRINKING WATER

Conventional water treatment should result in a water that is essentially virus-free, except where the intake water has a high virus load. This would occur where the intake water receives partially treated or untreated sewage. In such cases, other processes, such as some of the membrane technologies, may have to be used to ensure removal of the viruses.

DERIVATION OF GUIDELINE

The infectious dose for many viruses may be as low as one particle. Many tentative guidelines give figures of one particle per 1000 litres of water, but testing for viruses is difficult and results can be variable. Although no guideline value has been established, *E. coli* (or thermotolerant coliforms) is generally used as an indicator.

GUIDELINE

No guideline value has been set for enteroviruses in drinking water. If enteroviruses are specifically sought, they should not be detected. If detected, advice should be sought from the relevant health authority.

GENERAL DESCRIPTION

Enteroviruses have a worldwide distribution. Within temperate climates most major epidemics occur during the later summer months, whereas in the tropics, disease can occur throughout the year. The viruses shed in the faeces of infected individuals are spread by the faecal-oral route. They occur in water either through faecal contamination or by discharge of sewage effluents (Dahling 1989). While waterborne transmission is probable, it has not been proven. The part played by low-level transmission has also been suspected but not proven. There is a suggestion that small numbers of viruses present intermittently or continuously in drinking water cause symptomless infections, and that these are spread by person-to-person contact to cause outbreaks of disease that have no apparent connection with water.

The virus can also be spread on unwashed foods, particularly in areas where raw sewage is used as fertiliser, or it may be transmitted on the feet of vectors such as houseflies. Infants, with their faeces contained in diapers, also provide a major route of dissemination, particularly in day-care centres.

AUSTRALIAN SIGNIFICANCE

Enteroviruses have not been detected in Australian drinking water. This may be because of the difficulties associated with detection and the limited number of studies carried out in this country. They have been detected in drinking water in many other countries, both developed and developing.

Storage reservoirs and intakes

- Detention times
- Reservoir design:
  - size
  - materials
  - storage capacity
  - depth of storage
- Seasonal variations:
  - stratification
  - algal blooms
- Treatment efficiencies (microbial removal)
- Protection (e.g. covers, enclosures, access)
- Recreational or human activity
- Intake location and operation
- Bulk transport:
  - pipeline material
  - length
  - flow rate and changes in flow rate

– cleaning systems

Human and animal waste represent the largest sources of potential hazards in drinking water. Both can include high numbers of enteric pathogens and large amounts of nutrients.

Table A3 *Examples of hazardous events*
Catchments and groundwater systems
Rapid variations in raw water quality
Sewage and septic system discharges

Table A4 *Qualitative measures of likelihood*

Level	Descriptor	Example description
A	Almost certain	Is expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Might occur or should occur at some time
D	Unlikely	Could occur at some time
E	Rare	May occur only in exceptional circumstances

Table A5 *Qualitative measures of consequence or impact*

Level	Descriptor	Example description
1	Insignificant	Insignificant impact, little disruption to normal operation, low increase in normal operation costs
2	Minor	Minor impact for small population, some manageable operation disruption, some increase in operating costs
3	Moderate	Minor impact for large population, significant modification to normal operation but manageable, operation costs increased, increased monitoring
4	Major	Major impact for small population, systems significantly compromised and abnormal operation if at all, high level of monitoring required
5	Catastrophic	Major impact for large population, complete failure of systems

Table A6 *Qualitative risk analysis matrix – level of risk*

Likelihood	Consequences				
	1. Insignificant	2. Minor	3. Moderate	4. Major	5. Catastrophic
A (almost certain)	Moderate	High	Very high	Very high	Very high
B (likely)	Moderate	High	High	Very high	Very high
C (possible)	Low	Moderate	High	Very high	Very high
D (unlikely)	Low	Low	Moderate	High	Very high
E (rare)	Low	Low	Moderate	High	High

A6 Preventive measures and multiple barriers

The identification, evaluation and planning of preventive measures should always be based on system specific hazard identification and risk assessment. The level of protection used to control a hazard should be proportional to the associated risk.

The multiple barrier principle should be employed and preventive measures should be comprehensive from catchment to consumer. Wherever possible, the focus of these measures should be to prevent contamination in the catchment rather than to rely on downstream control. Box A1 provides further information on catchment management and source water protection.

Table A8 *Estimated removals of enteric pathogens using multiple barriers*

	Estimated reduction in	
	Watershed protection	**Reservoir detention**
Bacteria	0.5–1 log removal	~ 1 log removal per 10 days storage Retention for over 60 days will provide almost complete removal.
Viruses	Complete removal of human enteric viruses if human waste excluded.	1–2 log removal Long-term detention (1–6 months)
Giardia	0.5–1 log removal	1.5–2.5 log removal

Removal of antibiotics in conventional and advanced wastewater treatment:

Implications for environmental discharge and wastewater recycling.

Watkinson AJ, Murby EJ, Costanzo SD.
Water Res. 2007 May 22; [Epub ahead of print]

National Research Centre for Environmental Toxicology, 39 Kessels Road, Coopers Plains, Brisbane, Qld 4108, Australia; Cooperative Research Centre for Water Quality and Treatment, PMB 3, Salisbury, SA 5108, Australia.

Abstract;
Removal of 28 human and veterinary antibiotics was assessed in a conventional (activated sludge) and advanced (microfiltration/reverse osmosis) wastewater treatment plant (WWTP) in Brisbane, Australia. The dominant antibiotics detected in wastewater influents were cephalexin (med. 4.6mugL(-1), freq. 100%), ciprofloxacin (med. 3.8mugL(-1), freq. 100%), cefaclor (med. 0.5mugL(-1), freq. 100%), sulphamethoxazole (med. 0.36mugL(-1), freq. 100%) and trimethoprim (med. 0.34mugL(-1), freq. 100%).

Results indicated that both treatment plants significantly reduced antibiotic concentrations with an average removal rate from the liquid phase of 92%. However, antibiotics were still detected in both effluents from the low-to-mid ngL(-1) range. Antibiotics detected in effluent from the activated sludge WWTP included ciprofloxacin (med. 0.6mugL(-1), freq. 100%), sulphamethoxazole (med. 0.27mugL(-1), freq. 100%) lincomycin (med. 0.05mugL(-1), freq. 100%) and trimethoprim (med. 0.05mugL(-1), freq. 100%).

Antibiotics identified in microfiltration/reverse osmosis product water included naladixic acid (med. 0.045mugL(-1), freq. 100%), enrofloxacin (med. 0.01mugL(-1), freq. 100%), roxithromycin (med. 0.01mugL(-1), freq. 100%), norfloxacin (med. 0.005mugL(-1), freq. 100%), oleandomycin (med. 0.005mugL(-1), freq. 100%), trimethoprim (med. 0.005mugL(-1), freq. 100%), tylosin (med. 0.001mugL(-1), freq. 100%), and lincomycin (med. 0.001mugL(-1), freq. 66%).

Certain traditional parameters, including nitrate concentration, conductivity and turbidity of the effluent were assessed as predictors of total antibiotic concentration, however only conductivity demonstrated any correlation with total antibiotic concentration (p=0.018, r=0.7). There is currently a lack of information concerning the effects of these chemicals to critically assess potential risks for environmental discharge and water recycling.

PMID: 17524445 [Pubmed - as supplied by publisher]

Letter from Mr Michael Costello, Managing Director ACTEW

ACTEW
CORPORATION

3 April 2007

Professor Peter Collignon
PO Box 11
WODEN ACT 2617

Dear Professor Collignon

I refer to your email of 27 March 2007 to members of the ACT Legislative Assembly concerning the proposal to recycle water in the ACT. As ACTEW Corporation has carriage of this project, I am responding to the email and the context of your radio interview (29 March) directly to you.

I welcome your comments in this important public debate, and assure you that they will receive due consideration. I think it useful, however, to provide some contextual information in relation to your comments.

A key assumption in ACTEW's planning is the impact of climate change and climate variability on inflows into our dams. Based on the most pessimistic scenario in a report prepared for ACTEW by the CSIRO, inflows were assumed to have declined on average by 30% from the long term annual average. In fact inflows have declined by almost 65% on average over the last six years. In 2006, inflows declined by almost 90%, one of our worst year on record. Overall, total inflows of all rivers into ACT in 2006 were a mere 7% of the long-term average. So, it is not only the inflows into our dams that have declined, but all stream flows into the ACT have suffered. Statistics like this abound: whilst in the past we have had two individual years with such low inflows, this is undoubtedly the worst extended drought on record spanning 10 years. The rainfalls to the start of this year have been just as meagre as the one last year: considered as one the driest year on record. It is for these reasons that we are now examining water recycling as a new source of water. Recycling water from the Lower Molonglo Water Quality Control Centre (called Indirect Potable Use), and combining this with an enlarged Cotter dam will provide the long-term water security we need.

You have referred to the large volume of environmental flows released from our dams. ACT has a daisy chain of three dams on the Cotter river: Corin, Bendora and Cotter. All water released as environmental flows from Corin is captured and used from Bendora for town supply. Only water released from Cotter escapes down the river out of ACT, and these volumes are: 2004 (7.3GL); 2005 (8.5GL); 2006 (6.7GL). Releases from Googong have been: 2004 (1.5GL); 2005 (1.9 GL); 2006 (4.3GL). The slightly higher volumes you see for the Cotter dam are because this is a small dam, only 4GL capacity, and as such is prone to spill after a decent rainfall. This is one of the reasons why we are also committing to enlarge this dam to a new capacity of 78GL.

ACTEW Corporation Ltd.
ActewAGL House
Level 9, 221 London Circuit
GPO Box 366 Canberra ACT 2601

Tel. (02) 6248 3111
Fax. (02) 6248 3567

ABN 86 069 381 960

ACTEW is aware of the need for security through diversity. It is for these reasons that we have progressed with innovative, non-storage options over the last few years including the Cotter Googong Bulk Transfer and Murrumbidgee River abstraction. We have also been active in negotiating a reduced environmental flow regime during the drought. At the moment, we are releasing environmental flows from cotter dam at a rate of 5 megalitres a day or about 2 gigalitres a year. Unfortunately, our modelling is indicating that the severity of the drought is such that these measures are not sufficient, hence the recommendations to Government of new options to secure supply.

On the matter of using recycled water, ACTEW is committed to only proceeding with this scheme if the purified water is safe and meets Australian Drinking Water Guidelines (ADWG) – the same quality criteria that apply to our current town supply. ACTEW will be using the multiple barrier approach as advocated in the ADWG: tertiary treatment at LMWQCC, followed by advanced treatment using mature and proven processes before the water is released into the catchment. Here it will be subject to further environmental polishing and detention time before it is drawn for yet another treatment process at Mt Stromlo Water Treatment Plant that uses chlorination and will be using UV disinfection by next year. This will provide assurance that water at least meets the ADWG. The first stage of this will provide initially 9 gigalitres a year, progressing to 18-20 gigalitres capacity.

Whilst the exact configuration of the purification process is yet to be determined, process steps under consideration are: micro\ultra filtration with pore sizes below 0.1-0.01 μm, small enough to remove all bacteria and pathogens; reverse osmosis or advanced oxidation using UV\hydrogen peroxide, and UV\ozone disinfection. The consultants engaged by ACTEW are currently examining which process best suits our needs. The process train will have built in integrity tests and interlocks to assist in safe operations: such as turbidity traces, conductance and pressure measurements, etc which would detect any treatment malfunction and either shut down the treatment or divert the treated stream to the river. These types of precautionary measures have worked reliably in all our treatment plants and in other parts of the world.

As you state in your letter, the technology we are examining is in use all over the world. The assessment ACTEW is carrying out is to determine its suitability for ACT conditions, specifically the water from Lower Molonglo Water Quality Control Centre. I need to stress that if the outcome of our work, which will be subject to extensive scrutiny, is that is it is not safe, then we will not be recommending that it progresses.

The balance of probability is that the extremely severe conditions of 2006 will not be repeated, and that there will be sufficient water to meet our needs without having to use recycled water. But what we have learned over the last few years is that for whatever reason we can no longer rely on the long-term averages. While it is unlikely, it is possible that we may face several more years in which river flows and inflows into our dams are at the extremely bad 2006 levels or worse. The consequences of this risk eventuating are so severe that even though it is a small risk we cannot afford not to take out insurance against it. And that is how we should see the recycled water project – as essential insurance which we hope we will seldom, if ever, have to call upon.

The final decision rests with the ACT Government, who have committed to extensive community consultation program and also commissioned an Expert Reference Panel to advise on the health aspects of the proposed project.

I would be happy to discuss this further if required.

Yours sincerely

Michael Costello AO
Managing Director

National Water Quality Management Strategy
Guidelines for sewerage systems
Reclaimed Water

National Health and Medical Research Council
Agriculture and Resource Management Council of Australia and New Zealand
Australian and New Zealand Environment and Conservation Council

http://www.environment.gov.au/water/publications/quality/index.html

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4.1 Direct potable

This involves the treatment of wastewater to such an extent that it can be fed into a potable treatment or supply system. It is not possible at present to provide any guidelines for this practice.

4.2 Indirect potable

This involves the augmentation of groundwater and surface waters with reclaimed water. Water may then be extracted from these sources and subsequently treated for potable purposes. Ideally the water supply should be taken from the best quality sources available. Contamination of a water source should be prevented or controlled by the maintenance of the barriers. Where pristine sources are not available indirect potable water may be used. Reclaimed water used for augmentation should be of equal or better quality than the receiving water.

This practice of augmentation of surface waters using reclaimed water occurs in many parts of Australia. High dilution and extended storage of raw water normally takes place prior to abstraction and subsequent treatment to ensure that potable water meets NWQMS (1996) *Australian Drinking Water Guidelines* (Appendix 1). In the future this type of indirect potable reuse may in some cases be the best planning option for management of the water cycle particularly where water resources are limited.

Groundwater recharge and surface water augmentation using reclaimed water should be approved on a site specific basis by the health and environment protection authorities.

A minimum of secondary treatment is needed in order to provide a raw water quality for subsequent treatment to potable quality. Additional pathogen reduction by means of disinfection may be necessary for some indirect potable uses.

Hydrological and geological characteristics along with soil type determine the suitability of specific sites for recharge.

By providing a retention period of 12 months prior to groundwater abstraction for potable use, virus numbers are reduced through die-off and adsorption.

Nitrogen content of surface and groundwaters supplemented by reclaimed water should be closely monitored.

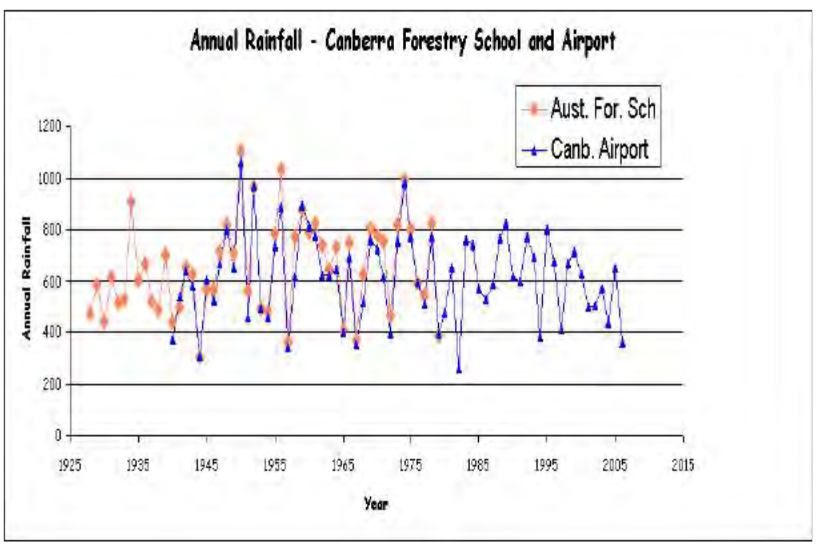
Total oxidised nitrogen levels should be less than 10 mg/L as N when diluted and abstracted for drinking purposes.

Long term Rainfall record in Canberra

Peter,

I chanced upon the rainfall data for Congwarra (1953 to 2004). These data show, of course, a higher rainfall than Canberra. The pattern clearly shown at Congwarra was that it was wetter in the 1950's through until about 1993 and then dropped, maybe from around 900 mm/a to 700 mm/a; quite a drop.

This stimulated me to locate the early Canberra records and they are best reflected in the two long-term stations at the Canberra Forestry School (Yarralumla) and the Canberra airport. In the period they overlap (1940 to 1979) there is amazingly close correlation; the Forestry School being sl. higher than the airport (Yarralumla is slightly wetter than airport). What is interesting to me is that the period 1928 to 1946 was dry with an average around 500 mm/a; this around the same as the current dry period (2001 – 2006). For CSIRO to claim in their report to ACTEW (Bates et al 2003) that their modelling has shown that run-off into the catchment has dropped by around 60% (rainfall closely matches catchment run-off) is simply not borne out by the data. I would interpret the current dry period to be similar to that of that late 1920's to the mid 1940's – like drought periods actually do occur in Australia. Fascinatingly 1942 was such a bad year down the South Coast of NSW that 100 of the 160 cows on "Haxtead" (near Central Tilba) died through lack of food/water.



Chris Borough
Forest Science Consultancy Pty Ltd
PO Box 4378 Kingston
ACT 2604 AUSTRALIA

National productivity commission recommends drinking of recycled waste water

- Matt Johnston
- From: *Herald Sun*
- April 14, 2011 12:00AM

The report recommends wide community consultation with the facts about the safety of recycling water / Herald Sun *Source:* Herald Sun

- Aussies could soon be drinking recycled water
- Commission recommends process be allowed
- "Give people choice... after they have information"

AUSTRALIANS could soon be drinking recycled waste water with a national productivity commission recommending the process be allowed.

A new report on Australia's urban water sector has also dubbed Victoria's desalination plant an efficiency dud, costing billions more than alternatives.

The productivity commission recommends scrapping water restrictions except for in "emergency" situations.

One way to get around water shortages while maintaining efficiency would be to allow used water to be pumped back into supplies, it says.

"Bans on particular augmentation options should be removed, including those on... planned potable re-use," the commission's draft report says.

It recommends wide community consultation where the facts about the safety of recycling water, and information about countries such as Singapore and the US where it already happens, be put on the table.

"A major advantage of using recycled water for potable (drinking) rather than non-potable use is that separate distribution infrastructure is not required," it said.

Presiding Commission Dr Wendy Craik said there was a strong case for reforming the sector and she said the cost of water restrictions on the community had been immense.

Lost community benefits because of stage 3a water restrictions in Melbourne cost about $150 million a year.

And choosing a massive desalination plant in Melbourne and Perth, rather than going with other options, costs communities up to $4.2billion over 20 years.

"Unless there is some kind of failure in the system you shouldn't have and shouldn't need water restrictions," Dr Craik said.

She said the commission recommended looking at water "contracts" instead, which would work in a similar way to internet contracts where you set a limit on your water use and pay more if you go over that limit.

Dr Craik said the point of putting recycled water back on the agenda was to consider all options and allow the community to choose.

"If a community says we would rather pay more for a desalination plant then fine," she said.

"Give people the choice... after they have all the information."

Relatively poor performance of Reverse Osmosis (RO) in the removal of Viruses from Drinking water

THE ENVIRONMENTAL TECHNOLOGY VERIFICATION
PROGRAM
U.S. Environmental Protection Agency NSF International
ETV Joint Verification Statement
TECHNOLOGY TYPE: POINT-OF-USE DRINKING WATER TREATMENT SYSTEM
APPLICATION: REMOVAL OF MICROBIAL CONTAMINANTS IN DRINKING WATER
PRODUCT NAME: WATTS PREMIER WP-4V VENDOR: WATTS PREMIER
ADDRESS: 1725 WEST WILLIAMS DR.
SUITE C-20 PHOENIX, AZ 85027
PHONE: 800-752-5582 INTERNET http://www.wattspremier.com
NSF International (NSF) manages the Drinking Water Systems (DWS) Center under the U.S. Environmental Protection Agency's (EPA) Environmental Technology Verification (ETV) Program. The DWS Center recently evaluated the performance of the Watts Premier WP-4V point-of-use (POU) reverse osmosis (RO) drinking water treatment system. NSF performed all of the testing activities and also authored the verification report and this verification statement. The verification report contains a comprehensive description of the test.
EPA created the ETV Program to facilitate the deployment of innovative or improved environmental

VERIFICATION OF PERFORMANCE As discussed above, the systems were first subjected to a TDS reduction test to verify that the RO membranes would perform as expected. The observed TDS reduction ranged from 89% to 96%. The certified TDS reduction for the WP-4V is 97%. reduction of B. diminuta ("normal" and kanamycin resistant B. diminuta combined) ranged from 1.3 to 6.4, with an average log The bacteria and virus log 10 reduction data is presented in Table VS-2. The log 10 reduction of 1.9. The challenge organisms were detected in the effluent samples for all test units but Unit 2 for the "normal" B. diminuta challenge. Since the Unit 2 effluent count for kanamycin resistant B. diminuta was 4.3 log 10 , and all other effluent samples had bacteria counts greater than 4 log (data not shown), it is possible that there was a sampling or analytical error associated with the Unit 2 "normal" B. diminuta sample. Therefore, that sample was not included in the mean log reduction calculation for the bacteria.

The virus challenge data showed similar performance. The log 10 reduction of the fr virus ranged from 1.4 to 3.6, with an overall mean of 2.5. The log reduction of MS2 ranged from 1.2 to 3.7, with an overall mean of 2.6. A visual comparison of the log reductions versus the challenge water pH shows the mean log 10 reductions decreasing with increasing pH. However, an examination of the 95% confidence intervals around the means (see verification report for data) shows that the decreases are not statistically significant. The minimum observed log reductions equal removal of 95% of *B. diminuta*, and 94% of the viruses.

Table VS-2. Bacteria and Virus Log Reduction Data

Target pH	Initial Measured pH	Final Measured pH	Challenge Organisms	Log_{10} Influent Challenge	Geometric Mean Log_{10} Reduction Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Mean
7.5 ± 0.5	7.6	7.8	*B. diminuta*	6.4	1.8	6.4*	1.3	1.5	1.6	1.5
7.5 ± 0.5	7.5	7.8	Kanamycin Resistant *B. diminuta*	7.2	1.4	2.9	2.6	2.6	3.1	2.4
6.0 ± 0.5	6.1	6.5	fr	3.9	1.8	3.1	3.6	3.4	3.0	2.9
			MS2	3.8	2.3	3.4	3.7	3.6	2.9	3.1
7.5 ± 0.5	7.5	7.7	fr	4.5	1.9	2.4	2.3	3.1	2.8	2.5
			MS2	4.2	1.7	2.4	2.4	3.4	3.2	2.5
9.0 ± 0.5	8.9	9.0	fr	5.0	1.4	2.3	2.1	2.3	2.6	2.1
			MS2	4.6	1.2	2.4	2.0	2.3	3.0	2.1
						Overall Means:			*B. diminuta*	1.9
									fr	2.5
									MS2	2.6

*Number not included in mean log reduction calculation.

INTEGRITY AND PERFORMANCE EVALUATION OF NEW GENERATION DESALTING MEMBRANES DURING MUNICIPAL WASTEWATER RECLAMATION

James DeCarolis*, Samer Adham, Manish Kumar, Bill Pearce, Larry Wasserman *MWH
ABSTRACT
301 N. Lake Ave Suite 600 Pasadena, CA 91101
Various RO membrane integrity monitoring methods are currently being evaluated during pilot testing at the North City Water Reclamation Plant (NCWRP) located in San Diego, CA. The main purpose of the testing is to assess both direct and indirect monitoring techniques currently available to measure the integrity and reliability of RO membranes during water reclamation. Specific methods being evaluated include vacuum hold testing, conductivity probing, online conductivity/sulfate monitoring and soluble dye testing. In addition, the testing program is designed to assess the integrity of new generation RO membranes being offered for water reuse applications. The specific membrane suppliers participating in this study include Koch, Saehan, Hydranautics and

Toray. Field evaluations are being conducted in three distinct phases. Phase I testing was conducted between August – April 2005. During this time period, the integrity of RO membranes from each of the participating suppliers was assessed using the various test methods during operation on tertiary wastewater from the NCWRP. Phase I pilot testing was performed using single stage RO systems operating at feed water recovery of 50%. Results from Phase I showed each of the methods tested correlated well to virus rejection but varied in sensitivity and ease of implementation. In addition, the degree of virus rejection observed from the membranes varied among suppliers. The purpose of Phase II testing, currently underway, is to assess the impact of staging on the sensitivity of each of the integrity monitoring techniques tested during Phase I. Accordingly, the RO membrane, which showed the highest level of rejection during Phase I testing, is currently being operated in a two-stage system at feed water recovery of 75%. Lastly during Phase III, the sensitivity of selected monitoring techniques to purposeful breaches in integrity will be evaluated.

MS2 Challenge Experiments

Challenge experiments were conducted on all RO membrane systems using MS2 bacteria phage. Results of the MS2 seeding experiments are presented in Figures 9 and 10. As shown, 6 samples of RO feed and 6 samples RO permeate (per RO membrane) were taken during each seeding experiment. Results indicate that RO membranes 1, 2, and 4 achieved LRV > 4, while the RO 3 only achieved LRV of 2-2.5. These results correlate well with both vacuum decay and sulfate monitoring data presented above.

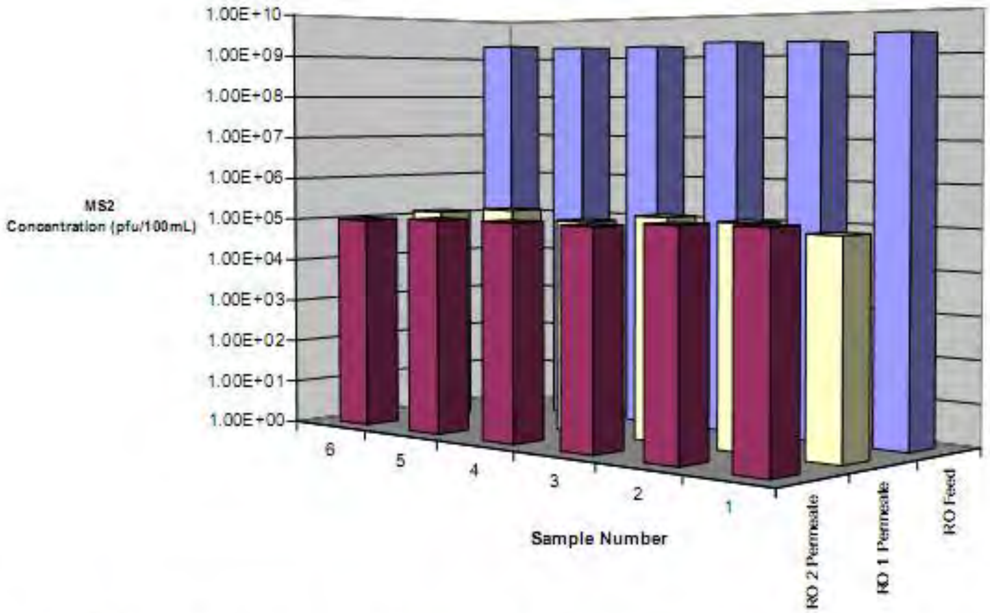


Figure 9: MS2 Phage Seeding Experiment Results (RO 1 and RO 2) Phase I

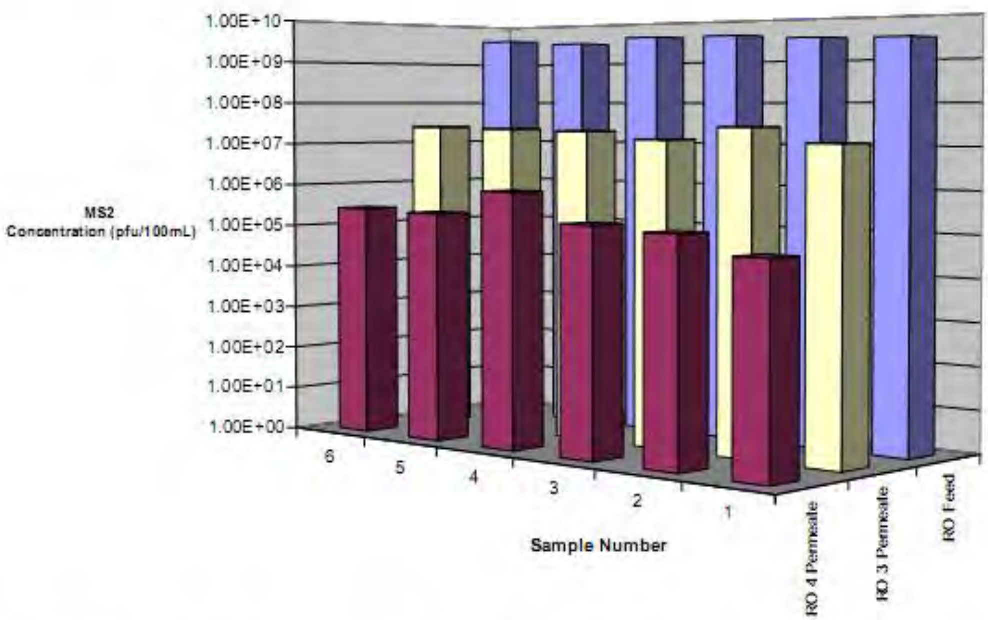


Figure 10: MS2 Phage Seeding Experiment Results (RO 3 and RO 4) Phase I

Numerous performance failures for virus removal and chemicals documented in Queensland report on "purified water"

Fluoride errors show system failures will likely not be rare if water from sewage is recycled into drinking water.

The recent failures to adequate control fluoride levels in Brisbane's drinking water highlights the dangers of recycling water from sewage. Human and/or technical errors allowed this to happen. Processing sewage for drinking water is much more complex than adding fluoride. It is very likely that periodic failures will also occur with sewage recycling. The numerous performance failures for virus removal and chemicals documented in a recently released Queensland report on "purified water" at Bundamba shows this may occur relatively frequently (Interim Water Quality Report. Feb 2009. Western Corridor Recycled Water Pty Ltd.
http://www.qwc.qld.gov.au/Interim+water+quality+report)

There were also long delays in finding there were failures with fluoride levels. Testing and timing is a major problem with recycling sewage. There are no appropriate real-time tests that can detect the most likely and dangerous pathogens that might leak through the system (viruses). Some real-time testing is done in the Qld sewage recycle plants (organic carbon, turbidly etc) but this will only detect a 100-fold reduction in performance of the system. Therefore these types of tests cannot demonstrate that we are achieving the 10-billion fold reduction in virus numbers needed to make this high risk water source, safe to drink.

Proponents repeatedly assure us that sewage purification systems will remove all chemicals and pathogens. Also there are so many additional processes and barriers that contaminated water will never reach reservoirs. If any faults occur then testing will detect these as they occur and thus stop that contaminated water reaching the system. The reported performance of the Qld sewage recycling system is not reassuring however. Both viruses and drugs were still detected in treated water (even after the final advanced oxidation step) that would have entered the reservoir. A previous Qld study had also showed that large percentages of antibiotics still remain in treated water even after the reverse osmosis step. While most of the chemicals and drugs detected in the latest study were below public health limits, it is disconcerting that a system that is marketed as removing all drugs and pathogens, can still detect many of these after its final purification step (advanced oxidation). However, not only does it appear that the process does not remove all viruses, chemicals and drugs, it adds some potentially dangerous chemicals. Because membranes foul, chemicals frequently need to be added and adjusted during the "purification" process. The Qld report shows resultant disinfection products (many classified as carcinogens) were found above safe levels on many occasions in the treated water.

From my infection perspective, the most important testing (virus testing) was poorly done. Over the 6 month study, only 3 tests each were done for the viruses of most concern (eg Enterovirus, rotavirus, norovirus etc). Also no details are given to show how sensitive and accurate these tests were in detecting these viruses or whether the system is capable of showing that we have always achieved the 10-billion fold reduction in viral numbers necessary to make water from sewage safe. More testing was done for viruses known as phages (as this is easier and cheaper to do). This testing was still relatively limited, as only 60 tests each were performed for the two types of phages monitored. Worryingly on two separate occasions with F RNA-bacteriophages, there were failures. The authors dismiss these results as most likely false positive tests, but without convincing arguments (they failed to take duplicate samples to validate these results later nor did they give details on what positive and negative controls they were running for viruses with each test run).

I don't think their positive viral culture results were false results as the report claims. It is of particular note that their positive virus results occurred at the same time they had unsafe and high bromate levels measured. I think the most likely explanation is that the reverse osmosis membrane leaked or was bypassed. This meant less bromide was removed from the source water and this was then converted to bromate by the final oxidation step. If and when bromide leaks thru the reverse osmosis step, then it is not a surprise if very small pathogens such as viruses may leak through as well.

It is of note that in international safety reports cited by proponents for this technology, only limited virus testing has been done in the water produced form sewage recycling plants. Only 7 sites are quoted in safety reports. Despite this small sampling, in the nearly half of these test sites, viruses such as enterovirus were still found on occasion in the final treatment water and often reductions in viral numbers of much less than 10 billion were achieved. Some even had large size pathogens such as Guardia detected after wastewater processing. Thus it seems that failures of these sewage recycling systems to remove all viruses may occur more frequently than proponents of this very energy expensive technology suggest.

Levels of bromodichloromethane (a product formed after increased disinfectant chemical use for membranes), were also raised above "safe" levels on a number of occasions in the final water product. This problem seems difficult to fix. The suggested solution in the report however is for Queensland Health to raise the levels defined as safe (to above Australian guidelines) so that "failures" no longer occur. This seems hardly the appropriate for chemical by-products produced during the sewage recycling process and which are carcinogens.

The current (and appropriate) position of the Queensland government is to only allow water from recycled sewage to be added to drinking water as a "last resort". The recycled water that is produced now is used appropriately for power stations and refineries. This means that now much less water is used from Brisbane's reservoirs than in the past. Given the recent performance failure with fluoride and with the sewage recycling, we need to re-examine the trigger for this "last resort" option. Currently it is when dam levels fall below 40%. This is too high. Only about 200 Gl per year is now used for domestic and other uses in Brisbane. Forty per cent represents about 700 Gl (or over 3 and a half years domestic supply). A more appropriate trigger is probably 20%, which is still about 2 years of domestic supply (even with no further rain).

If we recycle water from sewage into drinking water, because of the very high associated health risks, energy consumption and costs, it should only be used as a "last resort". When and if we do it, we need to also ensure we have adequate real-time testing in place that lets us know that all toxins, chemical, drugs and pathogens such as viruses are being removed to levels that will keep this treated water "safe" at all times. Available studies and the lack of appropriate real-time tests show that this currently cannot be consistently achieved.

Failures in Queensland to adequately monitor and control fluoride in drinking water

SEQWater puts too little fluoride in water supply

Article from:
By Craig Johnstone
May 19, 2009 12:00am

FIRST SEQWater overdosed southeast Queensland's water supply with fluoride, and now it has been discovered it is not putting enough in.

Still smarting from last week's embarrassing revelations that up to 20 times the allowable fluoride doses had been added to the water supply to about 4000 homes, State Government authorities have now admitted that too little is coming out of the tap.

SEQWater, the agency responsible for fluoridation, has revealed that all six water treatment plants adding fluoride to drinking supplies have failed to put enough of the chemical into the water.

The failure, blamed on a range of commissioning problems and equipment faults, potentially puts SEQWater in breach of health regulations governing fluoridation.

It is the latest mishap to have afflicted the controversial new system of distributing and supplying water around the region, after the Government's plans to introduce purified recycled water to the drinking reserves were also shelved by Premier Anna Bligh after dam levels began rising.

Queensland Health regulations dictate that average fluoride dosages must be 0.8 milligrams a litre but SEQWater's tests have shown that dosages for the first three months of this year have been as low as 0.04 mg/L.

SEQWater admitted to the dosage failure in a compulsory performance report it handed to Queensland Health last Friday – at the same time as it was battling the fall-out from the fluoride overdose at the North Pine treatment plant that affected about 400 homes and was not detected for two weeks.

The Bligh Government has committed $35 million to fluoridating the state's drinking water, about $10 million of which has gone to upgrading water treatment in southeast Queensland.

A spokesman for SEQWater said the low dosages were not surprising in the first few months of fluoridation and the start-up commissioning of the treatment plants. He said the minimum levels were recorded when the treatment plant being tested was "offline".

"From SEQWater's perspective this is absolutely to be expected," he said.

However, he admitted that he did not know for sure if the organisation had breached Queensland Health regulations, which stipulate that fluoride dosage should average within 0.1 of the optimum level of 0.8 mg/L.

Ms Bligh has ordered an investigation into the fluoride overdose incident.

Fluoride overdose a triple failure

Natasha Bita | May 16, 2009

Article from: The Australian

UP to three safeguard systems failed at the Brisbane water-treatment plant that released drinking water to residents with fluoride levels that were 20 times the legal limit.

The revelation came as the Queensland Government yesterday sent apology letters to the 4000 people in northern Brisbane whose water was dosed with 30 milligrams of fluoride per litre, rather than the 1.5mg/litre maximum, for three hours on May 2.

A member of the Queensland Government's Fluoridation Committee, toxicology expert Michael Moore, yesterday called for a review of fluoridation engineering to prevent a repeat bungle.

Mike Foster, a spokesman for Queensland government water authority Seqwater, yesterday admitted that up to three safeguard systems at the North Pine treatment plant had malfunctioned, allowing the fluoride overdose to occur.

The plant had been shut down for maintenance between April 27 and 30, but the dosing machinery continued to pour fluoride into the system.

When the plant came back online, a concentrated amount of fluoride flowed into the system and was not detected until another water company tested water in the pipeline, a process that took two weeks.

The Queensland Health Department's code of practice for water fluoridation warns of the need for back-up systems to prevent accidental overdoses. It specifically warns of the potential to overdose if the water supply is cut off but the fluoride continues to dose, as happened last month.

"All key components should be alarmed to alert the operator of a failure of the system," it says.

The fluoride overdose marks the second water crisis in six months to hit the Bligh Government, after it was forced to back down late last year on plans to add recycled effluent to southeast Queensland dams. The plan was deferred in the face of community and expert concerns about the safety of recycled water, but treated effluent will be added to dams when their levels fall to 40 per cent.

The overdose comes barely four months after Queensland became the last state or territory to introduce fluoride into drinking water.

Professor Moore, the chairman of Water Policy Research Australia, yesterday called for the safety aspects of fluoridation engineering to be re-examined.

"I'm a very firm believer in the benefits associated with fluoridation and this is the worst thing that could have happened," he said.

Professor Moore said the overdose was unlikely to have caused toxic effects.

Seqwater yesterday wrote to "sincerely apologise" to all affected residents in the suburbs of Warner and Brendale.

"It should not have happened and we are committed to ensuring it does not happen again," said the letter, co-signed by Seqwater chief executive Peter Borrows and Queensland Chief Health Officer Jeannette Young.

It says Queensland Health is confident the health hazards are "remote".

Fluoride overdoses can cause mottled teeth at concentrations above 1.5mg/litre and bone damage known as skeletal fluorosis at levels exceeding 4mg/litre, according to the Australian Drinking Water Guidelines.

"Fluoride is absorbed quickly following ingestion," the guidelines state. "It is not metabolised, but diffuses passively into all body compartments."

Fluoride injured 'won't be compensated'

Posted Fri May 15, 2009 7:37pm AEST

Brisbane residents who received water with elevated fluoride levels will not be able to take action, a lawyer says. (iStockphoto)

- Map: Brendale 4500

A Brisbane compensation lawyer says residents who received water with elevated fluoride levels will not be able to take action against the Queensland Government.

For three hours earlier this month some residents at Brendale and Warner, just north of Brisbane, were drinking water with a fluoride concentration 20 times higher than the recommended maximum limit.

An investigation is underway into an equipment malfunction.

Four thousand homes were affected and Premier Anna Bligh says they should receive an apology.

But lawyer Mark O'Connor says the Water Fluoridation Act prevents any legal action being taken against the Government over the bungle.

"The legislation makes it perfectly clear that there is no civil remedy for persons who drink fluoridated water, so regrettably if someone does have some illness that is caused by water fluoridation they don't have any civil remedy in Queensland," he said.

The Australian Medical Association says Brisbane residents could indeed suffer health problems from ingesting too much fluoride.

AMA Queensland president Dr Chris Davis says high levels can cause teeth pigmentation and brittleness of bones.

Meanwhile, water officials have begun distributing information to the public about the overdose.

Mike Foster from SEQ Water says up to 60 staff will be working this afternoon and tomorrow, running an information stand at the Strathpine shopping centre and making door-to-door visits in the affected suburbs of Brendale and Warner.

He says they will reassure people an investigation is underway, and the health risk was very low.

"Today's really just about the start of our process, the sort of mobilisation of our staff and some private contractors in to tomorrow, to ensure that every household and business in the Warner-Brendale areas actually do receive information about the North Pine fluoride incident," he said.

Water treatment error causes fluoride overload

Daniel Hurst
May 14, 2009

The State Government has ordered an investigation into a malfunction at the North Pine water treatment plant which resulted in 20 times the regulated level of fluoride being added to household water supplies north of Brisbane.
Premier Anna Bligh this afternoon appeared alongside Chief Health officer Jeannette Young and SEQWater spokesman Jim Pruss to assure the community there was an extremely minimal health risk as a result of the error, which occurred two weeks ago.
The water treatment plant had been shut down for maintenance but fluoride continued to be added to the system, resulting in a higher concentration of being added to the water supply when the treatment system returned to operation a short time later.
Ms Bligh said she had been advised up to 30 milligrams of fluoride per litre had been detected in a sample of water taken from the North Pine plant on April 29, well above the regulated maximum concentration of 1.5 milligrams per litre.
It is understood about 4000 households, including parts of Brendale and Warner, would potentially have received water to their pipes with elevated fluoride levels between 9am and 12pm on May 1.
Ms Young said any adverse health affects were "very unlikely".
She said someone who drank a large amount of water in the affected areas during the three-hour period may have experienced "very mild gastroenteritis", but she was not aware of any such cases in the past two weeks.
There would be no long-term health consequences, Ms Young said.
Ms Bligh defended not telling the public sooner, saying SEQWater was not aware of the problem until the results of the April 29 water sample came back on Tuesday.
The Premier, who continues to back the addition of fluoride to South-East Queensland water supplies, said she was personally informed of the result last night.
The malfunction, in which dosage units continued to add fluoride in the water treatment plant even though it was shut down for three days, was "completely unprecedented" in Australia, she said.
"I think it's important to understand this is an extremely unusual event," she told reporters in Brisbane.
Authorities have shut down the fluoride dosage units at the North Pine water treatment plant until an investigation is completed.
Mr Pruss said fluoride dosage units would be manually shut down at other SEQ plants whenever maintenance was required to prevent a repeat incident.

Premier Anna Bligh embarrassed by overdose of flouride in water supply

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Andrew Fraser | May 15, 2009
Article from: The Australian
QUEENSLAND Premier Anna Bligh has been severely embarrassed after 20 times the recommended maximum safe dose of fluoride was put into Brisbane's drinking water.

The incident occurred two weeks ago at North Pine Dam, on Brisbane's outskirts, where a treatment plant was shut down for general maintenance but fluoride kept being added automatically to the water.
Consequently, when the plant was turned back on, the water that contained an excessive amount of fluoride was put directly into the water supply of 4000 homes in the suburbs of Warner and Brendale, in Brisbane's north, between 9am and 12pm on May 1.
The concentration of fluoride in the water that flowed directly into households was 30-31mg per litre, while the regulated maximum is 1.5mg per litre.
The incident marks the second water problem for the Bligh Government, which was forced to back down late last year on plans to add recycled effluent to southeast Queensland dams. The plan was deferred in the face of community concerns about the safety of recycled water, but treated effluent will be added to dams when their levels fall to 40per cent.
While all other states have had fluoride in drinking water for years, the matter has always been more contentious in Queensland and fluoride was put into the drinking water in the state's southeast only at the start of this year.
Prolonged exposure to excessive fluoridation leads to gastroenteritis, but Queensland's Chief Health Officer, Jeanette Young, said that authorities did not receive any reports of widespread bouts of the disease at the time.
The error was discovered earlier this week when routine testing showed the high concentrations of fluoride.
Ms Bligh said she was "not happy" with what had happened. "This is unacceptable, and like a lot of Queenslanders, I've got a lot of questions about this," shesaid.
Ms Bligh said that despite fluoride being added to drinking water in various parts of Australia for nearly 50 years using this method, there had never been such an incident and she stressed that the matter would be "properly investigated".
She asked Mark Pascoe, chief executive of the Brisbane-based International Water Centre, to investigate the incident.
One priority of the investigation was establishing how the machinery that added the fluoride in the North Pine Dam treatment plant was not turned off automatically when the whole treatment plant was turned off.
Ms Bligh said the fluoride equipment was now being turned off manually in the other four treatment plants in southeast Queensland where fluoride was being added to the water.
Queenslanders for Safe Water convenor Merilyn Haines ran against Ms Bligh in her seat of South Brisbane to draw attention to the issue of fluoride being added to the water supply. She said yesterday that while she was not surprised by the accident, she was surprised by the way it had happened so soon after the introduction of fluoridation.
"That amount of fluoride is the equivalent of having 120 fluoride tablets in a litre of water, or 30 fluoride tablets in your standard glass," Ms Haines said.
"She's put people's lives at risk. Anyone who drank that water who was an asthmatic was at risk, as was anyone with a kidney disease."

Fluoride overload admission two weeks later

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May 14, 2009

Article from: Australian Associated Press

A QUEENSLAND water company has taken more than two weeks to tell the Government about a treatment plant malfunction that saw too much fluoride added to water supplies.

Premier Anna Bligh today said the malfunction occurred on May 1 but water service provider Seqwater only advised her Government and affected councils last night.

The Premier said she'd been advised there was an "extremely minimal health risk" from the malfunction, which came during a shutdown for scheduled maintenance.

The malfunction affected water supplies from North Pine Dam.

Ms Bligh said higher than usual levels of fluoride had passed through a pipeline servicing the Warner and Brendale areas north of Brisbane.

The flow lasted for three hours on the morning of May 1.

Ms Bligh has ordered an immediate investigation to determine how failsafe devices designed to prevent such an incident had malfunctioned.

Fluoride bungle not acceptable: Bligh

Posted Fri May 15, 2009 7:35am AEST

Updated Fri May 15, 2009 12:11pm AEST

The Government says test results took 12 days to identify the fluoride problem (ABC TV)

- Map: Brendale 4500
- Related Story: Malfunction blamed for fluoride overload

Queensland Premier Anna Bligh says residents should receive an apology over an excessive release of fluoride in drinking water supplies.

For three hours earlier this month some residents at Brendale and Warner, just north of Brisbane, were drinking water with a fluoride concentration 20 times higher than the recommended maximum limit.

The state Opposition says it should not have taken nearly two weeks for the Government to find out about the bungle.

Ms Bligh says Queensland Health and the Environment Department are preparing information for households.

"I think it should contain accurate and factual information about what happened, what they should be aware of, if they have any concerns and how they can find more information, and some form of apology about how this happened," she said.

"This is not acceptable. This is something Queenslanders should be able to rely on and in this case they haven't been able to."

The Government says test results took 12 days to identify the problem and Ms Bligh says she learned about it on Wednesday night.

She has ordered a full investigation.

Opposition Leader John Paul Langbroek says it is not good enough.

"It's more an issue of the management of the system and it is of concern that it took two weeks for the Government to be told about it and to release to the public," he said.
Mr Langbroek says the Government cannot afford to make mistakes on the purity of drinking water.
"The Government should be reassuring Queenslanders that they have got all the procedures in place, that fail-safe mechanisms are working properly and that this sort of thing is not repeated," he said.
The Australian Medical Association says Brisbane residents could suffer health problems from ingesting too much fluoride.
AMAQ president Doctor Chris Davis says high levels can cause teeth pigmentation and brittleness of bones.
"Queensland's chief health officer Doctor Janette Young has done an enormous amount of investigation of the households that were affected," he said.
"We have no reports that we're aware of [of] any symptoms that were reported anyway, which were increased salivation, nausea, vomiting and abdominal pain."

Geophysical Research Letters

RESEARCH LETTER
10.1029/2019GL082749

Key Points:
- Almost half of fresh submarine groundwater discharge (SGD) enters the ocean at wet equatorial regions
- High-relief, tectonically active margins have higher ratios of fresh SGD to river discharge
- Total annual volume of fresh SGD is ~489 km^3/year, or ~1% of river discharge

Supporting Information:
- Supporting Information S1

Correspondence to:
A. H. Sawyer,
sawyer.143@osu.edu

Citation:
Zhou, Y. Q., Sawyer, A. H., David, C. H., & Famiglietti, J. S. (2019). Fresh submarine groundwater discharge to the near-global coast. *Geophysical Research Letters*, *46*. https://doi.org/10.1029/2019GL082749

Received 8 MAR 2019
Accepted 15 APR 2019
Accepted article online 24 APR 2019

Fresh Submarine Groundwater Discharge to the Near-Global Coast

YaoQuan Zhou[1], Audrey H. Sawyer[1], Cédric H. David[2], and James S. Famiglietti[3]

[1]School of Earth Sciences, Ohio State University, Columbus, OH, USA, [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA, [3]Global Institute for Water Security, University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Abstract The flow of fresh groundwater to the ocean through the coast (fresh submarine groundwater discharge or fresh SGD) plays an important role in global biogeochemical cycles and coastal water quality. In addition to delivering dissolved elements from land to sea, fresh SGD forms a natural barrier against salinization of coastal aquifers. Here we estimate groundwater discharge rates through the near-global coast (60°N to 60°S) at high resolution using a water budget approach. We find that tropical coasts export more than 56% of all fresh SGD, while midlatitude arid regions export only 10%. Fresh SGD rates from tectonically active margins (coastlines along tectonic plate boundaries) are also significantly greater than passive margins, where most field studies have been focused. Active margins combine rapid uplift and weathering with high rates of fresh SGD and may therefore host exceptionally large groundwater-borne solute fluxes to the coast.

Plain Language Summary Fresh groundwater flows from land to sea through coastal rocks and sediment. While the amount of groundwater flow is small compared with rivers, it plays an important role in carrying dissolved chemicals like nutrients to sea, and it helps protect aquifers against salinization. We estimate groundwater flow through the near-global coast. Tropical regions have more groundwater flow, while dry midlatitudes have less. Dry midlatitude regions are therefore more vulnerable to salinization, which is problematic because these regions are also more likely to depend on groundwater to meet their water needs. Additionally, mountainous coastlines along tectonic plate boundaries have relatively large rates of groundwater discharge and may be associated with higher dissolved chemical fluxes to the coast.

1. Introduction

Rivers are the arteries of continents and are responsible for 90–99% of all fresh water that discharges to coasts (Church, 1996). The remaining 1–10% discharges directly from aquifers to coastal wetlands, beaches, and continental shelves (Burnett et al., 2003) in a process known as fresh submarine groundwater discharge (fresh SGD). In addition to fresh SGD that originates onshore, saline groundwater also circulates through the seabed at high rates. In total, the global rate of fresh and saline SGD may be as large as 300–400% of river discharge (Kwon et al., 2014). Radioisotope techniques such as radium isotopes (Moore, 2003) have made it possible to map the distributions of predominantly salty SGD at an unprecedented scale, while distributions of fresh (land-derived) SGD remain elusive. Direct measurements with seepage meters are time intensive and tend to vary over small spatial scales, posing a challenge for upscaling fresh SGD rates.

Fresh SGD is important because it can contain high concentrations of land-derived solutes. For example, fresh SGD from young volcanic rocks may deliver as much as 30% of the global silicate load from land to oceans (Rad et al., 2007). Fresh SGD also introduces nutrients to the coast from onshore fertilizer application. In some areas, nitrate loading from SGD exceeds both atmospheric and riverine sources (Swarzenski et al., 2001). An improved understanding of SGD rates can therefore help refine global biogeochemical budgets and manage coastal water resources.

Fresh SGD also buffers coastal aquifers against salinization. Fresh groundwater floats above denser saline groundwater, and the position of the freshwater-saltwater interface lies in a delicate balance (Michael et al., 2017). The flow of fresh groundwater toward the sea resists landward transport of salt and maintains a steep salinity front. When coastal communities extract groundwater, a portion of the extracted groundwater deducts from fresh SGD. If groundwater extraction reduces fresh SGD below a critical threshold, salinization occurs (Mazi et al., 2013). Aquifers with greater rates of recharge and fresh SGD can generally sustain more groundwater pumping. Thus, an improved understanding of coastal recharge and fresh SGD rates can help manage coastal aquifers.

Computer models have the potential to transform our understanding of fresh SGD, as the availability and quality of hydrologic and topographic data have improved. Fresh SGD rates were recently estimated at sub-kilometer resolution over data-rich regions using a water budget approach (Destouni et al., 2008; Sawyer et al., 2016; Zhou et al., 2018), but similar global estimates are lacking. We here estimate the flux of fresh SGD to the near-global coast at an unprecedented spatial resolution of 15 arc sec (approximately 500 m at the equator) and show that most fresh SGD is focused in equatorial regions. Additionally, the average rate of fresh SGD along tectonic plate boundaries (active margins) is approximately double the average rate along coastlines far from plate boundaries (passive margins).

2. Methods

We estimate fresh SGD using the water budget approach of Sawyer et al. (2016) and Zhou et al. (2018). Briefly, we define the aquifer control volume as the contributing area, or recharge zone, for fresh SGD. If patterns of groundwater flow are similar to overland flow, the recharge zones that contribute groundwater to the coast are the same as the wedge-shaped coastal catchments that lack streams and instead contribute runoff directly to the coast (Figure 1). This assumption is best for unconfined, thick, homogeneous aquifers in wet climates (Haitjema & Mitchell-Bruker, 2005) and may underestimate fresh SGD in areas with complex geology, especially in dry regions (Sawyer et al., 2016; Zhou et al., 2018). Assuming modest groundwater injection or withdrawal, the annual volume of fresh SGD (Q_{SGD}) for each coastal catchment is then the linear average annual net recharge rate (r), or recharge adjusted for evapotranspiration losses, integrated across the recharge area (A; m^2):

$$Q_{\mathrm{SGD}}\ (\mathrm{m}^3/\mathrm{year}) = r\ (\mathrm{m/year}) \times A\ (\mathrm{m}^2) \tag{1}$$

The fresh SGD flux (q_{SGD}) can also be defined as

$$q_{\mathrm{SGD}}\ (\mathrm{m}^2/\mathrm{year}) = r\ (\mathrm{m/year}) \times A\ (\mathrm{m}^2)/L\ (\mathrm{m}) \tag{2}$$

where L is the coastline length for the catchment.

To solve the water budget for coastal aquifers, we approximate the net recharge rate adjusted for evaporative losses (r in equation (1)) as the average infiltrating runoff from three land surface models (MOSAIC, NOAH, and VIC) obtained from NASA's Global Land Data Assimilation System (Rodell et al., 2004). All three land surface models solve a surface water budget to estimate the Earth's terrestrial water cycling. None of these models explicitly solves for lateral groundwater flow. Rather, they employ one-dimensional vertical water budgets and hence lack horizontal subsurface water transfers among modeled grid cells. Despite this simplification, the areal base flow contribution in these models is conceptually similar to net recharge (the recharge rate adjusted for evaporative loss), since it represents the flux of water from the soil compartment to deeper storage, which becomes discharge to drainage features. The development of land surface models started half a century ago (Manabe, 1969), and these models continue to benefit from new improvements and undergo detailed calibration and validation (Rodell et al., 2004; Xia, Mitchell, Ek, Cosgrove, et al., 2012; Xia, Mitchell, Ek, Sheffield, et al., 2012) to guarantee appropriate partitioning and closure of the terrestrial water budget.

Coastal recharge areas are delineated based on HydroSHEDS (Hydrological data and maps based on Shuttle Elevation Derivatives at multiple Scales), a high-resolution, near-global map of rivers and their catchments with coverage between 60°N and 60°S. The development of HydroSHEDS is primarily based on elevation data obtained from the NASA Shuttle Radar Topography Mission (Farr et al., 2007). Rivers that have upstream contributing areas greater than 8 km^2 are matched with the Global Lake and Wetland Database in ArcWorld to align with river networks. Smaller rivers are delineated solely from the elevation surface based on a flow direction and accumulation method (Tarboton, 1997) that involves a threshold in upstream number of grid cells. Because global topographic data sets are referenced to a spheroidal Earth, a difference in grid cell sizes at varying latitudes generates a discrepancy in the area (though not the number of grid cells)

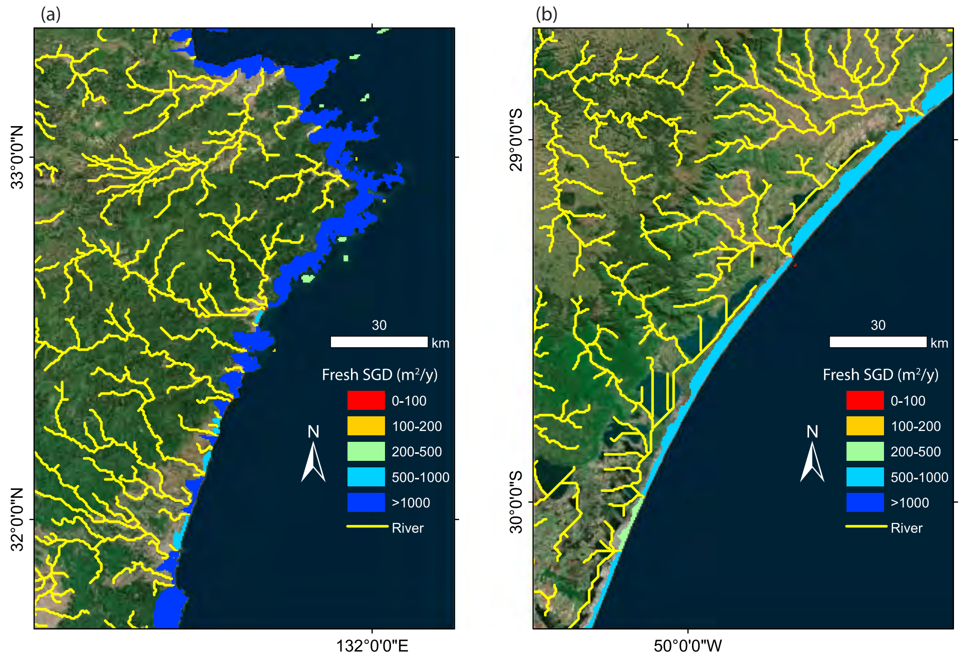

Figure 1. Example of fresh SGD rates and coastal catchment hydrography over tectonically (a) active and (b) passive margins with similar net recharge rates (approximately 0.16 m/year). SGD = submarine groundwater discharge.

of the smallest catchments that are home to a river reach. Such discrepancies have a potential to generate an underestimation of our fresh SGD calculation at high latitudes. However, in the absence of observed hydrographic data sets—which are only nascent at the continental scale (Allen & Pavelsky, 2015) and expected from future satellite missions (Alsdorf et al., 2007)—the correction of such discrepancy will remain a challenge.

Two components are needed from HydroSHEDS: the coastal catchment area and the coastline length. We first merge all catchments at the continental scale to define the coastline. Catchments in HydroSHEDS that do not contain streams are defined as "coastal" and extracted to yield coastal catchments (Figure 1). Fresh SGD is computed by multiplying catchment area by the annual net recharge rate at the catchment centroid (equation (1)). Fresh SGD estimates are sensitive to the choice of hydrographic data set (Destouni et al., 2008; Zhou et al., 2018), but HydroSHEDS is currently the only map product for delineating coastal catchments with near-global coverage. For comparison, the estimated average flux of fresh SGD for the United States Atlantic and Gulf Coast is 2.4 times less using HydroSHEDS than NHDPlus, another hydrographic data set that is only available within the United States (Zhou et al., 2018).

Wherever single values of Q_{SGD} or q_{SGD} are reported, they represent ensemble averages for the three recharge models (MOSAIC, NOAH, and VIC). Reported error is calculated as the standard deviation of estimates from MOSAIC, NOAH, and VIC, similar to the approach of Famiglietti et al. (2011) and Reager et al. (2016). This error only accounts for the uncertainty in net recharge, which directly influences fresh SGD (equation (1)). The challenge of accurately estimating recharge has been noted by Scanlon et al. (2002). Estimates from the individual recharge models generally agree to within a factor of 2 to 4, and median fresh SGD rates for the near-global coast are 72, 161, and 37 m^2/year for MOSAIC, NOAH, and VIC, respectively. These discrepancies may seem large, but they are reasonable, given that (1) fresh SGD rates vary by orders of magnitude and are lognormally distributed (Sawyer et al., 2016), and (2) SGD measurements from multiple methods at the same site can show similar or even larger discrepancies (Burnett et al., 2006).

Simplifying assumptions in the water budget calculation also contribute to uncertainties. Our estimates of fresh SGD are likely low under several conditions: (1) in layered unconfined-confined aquifer systems, where a fraction of fresh SGD originates from deeper confined aquifers with more distal recharge zones;

(2) in dry coastal regions which tend to receive groundwater import from upland basins (Schaller & Fan, 2009); (3) in karst, which represents 10% of the world's aquifers (Chen et al., 2017) and has complex patterns of recharge and conduit flow. Our estimates are likely high under other conditions: (1) in areas where groundwater discharges to unmapped tidal creeks or nearshore wetlands (this discharge is generally not considered “submarine” (Taniguchi et al., 2002), but is included with fresh SGD in the water budget method) and (2) in areas of intense groundwater extraction, which deducts from fresh SGD but can also enhance recharge. The combined error associated with our assumptions is difficult to quantify for the near-global coast. However, in a comparison of 10 sites from the continental United States (Bokuniewicz, 1980; Bokuniewicz et al., 2004; Hays & Ullman, 2007; Mulligan & Charette, 2006; Reay et al., 1992; Russoniello et al., 2013; Santos et al., 2009; Simmons, 1992; Uddameri et al., 2014; Zimmermann et al., 1985), our water budget analysis yields similar estimates of fresh SGD as seepage meter studies (Sawyer et al., 2016), other water budget calculations, and validated three-dimensional groundwater flow models (Befus et al., 2017; Zhou et al., 2018; supporting information Figure S1). Our estimates tend to be lower than field-based estimates, likely because of our conservative approach for delineating coastal recharge areas, which would tend to exclude groundwater imports from upland basins.

To assess regions where our estimates may be unrealistically high, we used Darcy's law to calculate the minimum head gradient that would be required to support the estimated fresh SGD rate in every coastal catchment and compared it with the available topographic gradient. We assumed a maximum bound on transmissivity of 1,000 m^2/day (hydraulic conductivity of 10 m/day and aquifer thickness of 100 m), which is below the maximum bound reported for coastal Bangladesh (Harvey, 2002), where our fresh SGD rates could easily be overestimated due to the intensity of groundwater extraction for irrigation. We found that the minimum required head gradient only exceeded the topographic gradient in 0.3% of coastal catchments (including parts of Bangladesh). Given these calculations and our comparisons with local field and modeling studies (supporting information Figure S1), we suggest that our estimated fluxes are within reason, and water budgets represent a practical, computationally efficient approach to estimating fresh SGD over large regions, especially in light of the paucity of hydraulic head data and information on aquifer properties to validate global groundwater models.

3. Results and Discussion

Integrated over the near-global coastline, the total annual volume of fresh SGD is 489 km^3/year $\pm$337 km^3/year, or 1.3% of river discharge (Dai & Trenberth, 2002), in line with previous estimates (Church, 1996; Zekster & Loaiciga, 1993). This estimate does not include the northern coastline of North America and Eurasia, which could contribute additional fresh SGD, particularly under a warming climate with thawing permafrost. Rates of fresh SGD are highly variable around the world (Figure 2). Averaged by continent, Asia has the largest average rate of fresh SGD, while Europe and Australia have the smallest (Table 1). Rates of fresh SGD are also low in dry regions of Central America, and Northern Africa (Figure 2). Most of the fresh SGD enters the ocean at wet equatorial and temperate regions (Figure 2, left). More than half the near-global flux of fresh SGD occurs within the tropics, and 41% occurs within 10° of the equator. The arid midlatitudes (23–40°) contribute only 10% of the world's fresh SGD (Figure 2, left). On average, the rate of fresh SGD per unit length of coast is 5 times less at arid midlatitudes than near the equator (Figure 3).

Near-global trends in fresh SGD largely coincide with climate, but the infiltration capacity of the land surface and coastal morphology also play a role (Figure 3). Soil properties and land use dictate the proportion of available water that can infiltrate and be transmitted as groundwater flow to the coast (Taylor et al., 2013; Figure 3). Average infiltration capacity (calculated as the ratio of infiltrating runoff to available water) is generally equal to or greater than 0.6 over most of the globe. This value is greater than infiltration capacities in many inland regions, likely due to the hydrogeologic properties of high-energy modern marine deposits along coastlines. The infiltration capacity declines at high temperate latitudes (45–60°), where 70% of the land is permafrost (Zhang et al., 1999). This decline reduces the average flux of fresh SGD to the ocean at high temperate latitudes (Figure 3).

Another factor that reduces the SGD flux at high latitudes is the shape of coastal catchments. Long, narrow valleys focus groundwater toward small segments of the coast, often at the heads of embayments.

10.1029/2019GL082749

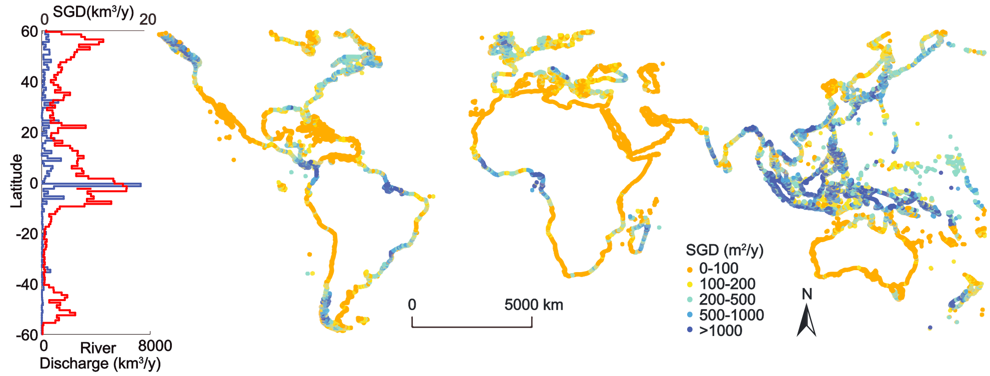

Figure 2. Map of fresh SGD rates along the near-global coastline. Uncertainty of fresh SGD is estimated to be 177.0 m^2/year. (left) Comparison of fresh SGD, blue (this study) and river discharge, red (Dai & Trenberth, 2002) by latitude. Note the different ranges of horizontal axes for river discharge and fresh SGD. SGD = submarine groundwater discharge.

Conversely, peninsulas or protrusions distribute groundwater to a long coastal segment (Figure 1). The drainage length, or average distance from any location in the coastal catchment to the shoreline, is generally smaller at high latitudes. The northern high latitudes are dominated by low-relief coastal plains along the Arctic coast (Bokuniewicz et al., 2003) and small islands along the Pacific coast that disperse groundwater. The southern high latitudes are dominated by numerous, small islands of Tierra del Fuego that also disperse groundwater. The average rate of fresh SGD is therefore greatest near the equator where drainage length, infiltration capacity, and available water are all maximized (Figure 3).

Within a given latitude, fresh SGD rates also tend to be greater along tectonically active margins (Figure 3). In fact, the near-global average fresh SGD rate in active margins is 2 times greater than passive margins. These differences are particularly driven by differences in available water. At atmospheric convergence zones near −60°, 0°, and 60° latitude, active margins tend to be wetter (Figure 3), likely due to orographic uplift and precipitation along mountainous coastal zones. Surprisingly, drainage lengths are not significantly different between active and passive coastal catchments when averaged by latitude (Figure 3). In general, high-relief active margins would be expected to have coastal catchments with longer drainage lengths separating steep river valleys (Figure 1), but average drainage lengths are only significantly longer near −20° latitude. These catchments almost exclusively drain the Andes Mountains of South America (Figure 2). Regardless of catchment geography, the higher relief of active margins would also tend to allow steeper hydraulic head gradients to develop near the coast, which could facilitate greater rates of fresh SGD compared to regions where topography limits recharge (Michael et al., 2013). It is interesting that our water budget analysis does not depend on an estimation of hydraulic head gradients (or even topographic gradients) but nevertheless predicts greater rates of fresh SGD in active margins.

Table 1
Fresh SGD Rate Averaged Over Each Continent

	SGD (m^2/year)				
Continent	VIC	NOAH	MOSAIC	Ensemble average	Coastline Length in 10^3km (percentage of total coast included)
Africa	41.9	267.3	98.6	135.9	68.1 (100%)
Asia	124.7	874.8	559.5	519.4	327.4 (79%)
Australia	47.2	229.2	102.0	126.1	91.2 (100%)
Europe	58.4	176.3	99.5	111.4	170.4 (70%)
North America	78.9	332.6	210.6	207.4	255.1 (80%)
South America	79.3	411.8	258.1	249.7	139.0 (100%)

Note. Uncertainty of fresh SGD is estimated to be 177.0 m^2/year. Due to limitations in data coverage at high latitudes, our analysis does not span the entire coastlines of Asia, Europe, and North America. We have approximated the percentage of analyzed coast for these three continents next to analyzed coastline length. SGD = submarine groundwater discharge.

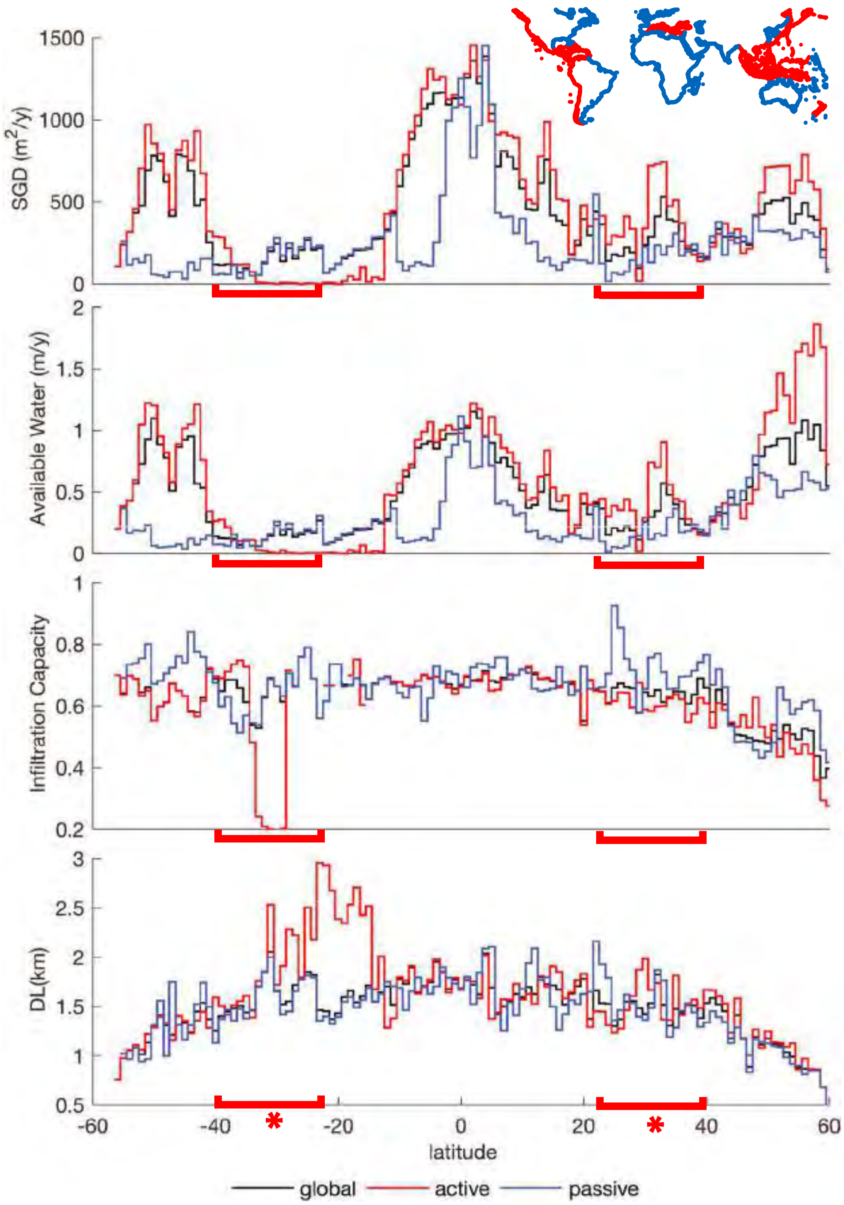

Figure 3. Climate, soil, and topography control fresh SGD trends across latitudes for active, passive, and global (all) margins. Available water is the sum of rainfall and snowmelt minus evapotranspiration and represents how wet or dry the climate is. Infiltration capacity is the fraction of available water that infiltrates and contributes to fresh SGD. Drainage (DL) is coastal catchment area divided by coastline length. Dry midlatitudes are highlighted with red marks. SGD = submarine groundwater discharge.

4. Implications for Water Management

Gaps in fresh SGD leave midlatitude coastal regions particularly vulnerable to salinization. These latitudes will suffer most from groundwater salinization because they also lack abundant surface water (Dai & Trenberth, 2002; Syed et al., 2009) and tend to use groundwater during dry years to address water shortages. The dry midlatitudes receive only 17% of global river discharge (Figure 2, left) and are expected to become drier in a changing climate (Held & Soden, 2006). Their coastlines are home to over 800 million people, or 36% of the world's coastal population. As densely populated, dry areas turn increasingly to groundwater, they risk salinization and deterioration of critical water resources. Some of these densely populated regions include cities like Shanghai and Los Angeles, which already face water management challenges. Shanghai has experienced intense water shortage and leans heavily on surrounding provinces for its water supply

(Zhao et al., 2016). Los Angeles is projected to have the greatest surface water deficit of all cities by 2050 (Flörke et al., 2018) and uses groundwater to stabilize its water insecurity. Even in wet climates with high recharge rates, densely populated megacities can place a strain on coastal aquifers. For example, Bangkok suffers from both land subsidence and salinization due to extensive groundwater pumping in recent decades (Phien-wej et al., 2006). Other vulnerable areas include small islands, which face substantial water security challenges under rising sea levels (Ferguson & Gleeson, 2012; Michael et al., 2013) and are isolated from external water supplies. Many small islands rely heavily on groundwater for domestic and agricultural uses.

Estimates of fresh SGD also reveal contamination threats to the ocean and the fisheries that coastal populations depend on. The ratio of river discharge to fresh SGD is particularly important (supporting information Figure S2), since rivers and groundwater carry contaminants at different concentration levels. Levels of nitrate in SGD can exceed rivers by orders of magnitude and contribute to harmful algal blooms (Slomp & Van Cappellen, 2004). Mercury contamination of fish habitats has also been linked with groundwater discharge more than river discharge in some regions (Black et al., 2009). The world's largest river deltas have some of the highest rates of river discharge that swamp the typical rates of fresh SGD. Meanwhile, mountainous coastal regions can have rates of fresh SGD that approach river discharge (supporting information Figure S2). Along the southwestern coast of South America, fresh SGD is 19% of river discharge on average. The high relief of this tectonically active margin favors fast groundwater flow toward the Pacific Ocean and truncates the drainage area of rivers that flow to the Pacific Ocean. Other areas with a relative abundance of fresh SGD include tectonically active settings such as the northwestern coast of North America, Philippine Sea, and East China Sea (supporting information Figure S2). Some of these regions are experiencing heavy population growth, urbanization, and agricultural developments. Because groundwater residence times in aquifers span decades, marine waters are vulnerable to delayed changes in chemical inputs from fresh SGD.

5. Conclusions

This study provides the first near-global and spatially distributed high-resolution estimate of fresh groundwater fluxes through the coast and can be used to inform new science on our coastal water resources. The near-global distribution of fresh SGD is highly influenced by climate, with concentrated outflows at wet equatorial and high latitudes and gaps at dry midlatitudes. Large population centers in these dry latitudes are vulnerable to aquifer salinization and must manage groundwater extraction carefully to avoid passing tipping points. Unfortunately, arid population centers are the very regions that depend most heavily on groundwater to meet their resource needs. Fresh SGD is also focused along tectonically active margins. The rapid uplift and weathering rates in these margins may be associated with high subterranean solute fluxes to the coast, but field measurements have focused heavily on passive margins along the Atlantic Ocean to date. More field studies, particularly in dry midlatitudes and wet active margins, are needed to assess the global distribution of fresh SGD rates and chemical fluxes.

Data Availability

Fresh SGD data (shape files for coastal catchments and rates of fresh SGD) have been shared publicly on Zenodo at the website (https://doi.org/10.5281/zenodo.2631971).

Acknowledgments
We thank the Editor and two anonymous reviewers for their recommendations that improved the manuscript. C. H. D. and J. S. F. were supported by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with NASA; including a grant from the SWOT Science Team.

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CALIFORNIA COASTAL COMMISSION

CENTRAL COAST DISTRICT OFFICE
725 FRONT STREET, SUITE 300
SANTA CRUZ, CA 95060
PHONE: (831) 427-4863
FAX: (831) 427-4877
WWW.COASTAL.CA.GOV

August 2, 2019

Rachel Gaudoin
Monterey One Water
5 Harris Court, Building D
Monterey, CA 93940

Subject: Expanded Pure Water Monterey Groundwater Replenishment Project NOP (State Clearinghouse Number 2013051094)

Dear Ms. Gaudoin:

Thank you for the opportunity to review and comment on the Notice of Preparation (NOP) for the Expanded Pure Water Monterey Groundwater Replenishment Project's (PWM/GWR's) supplemental Environmental Impact Report. The expanded project would increase the capacity of the approved PWM/GWR project, which is currently under construction, from 3,500 acre-feet per year (AFY) to 5,750 AFY by increasing the capacity of the project's Advanced Water Purification Facility and recharging the Seaside Groundwater Basin with the additional 2,250 AFY of purified recycled water. This increase in capacity would enable California American Water Company (Cal-Am) to cease or limit diversions from the Carmel River system, thereby complying with the State-mandated reduction of water diversion. We understand that the Expanded PWM/GWR Project is a "back-up plan" to Cal-Am's desalination project, known as the Monterey Peninsula Water Supply Project (MPWSP), and the Commission will review it as a possible alternative to the MPWSP.

Overall, we are supportive of the expanded project as it would curtail groundwater diversions from the Carmel River, reduce discharge of secondary effluent to Monterey Bay, replenish the Seaside Groundwater Basin with purified recycled water, and diversify Monterey County's water supply portfolio. The three components of the expanded project that could affect coastal resources are the additional source-water diversion projects, any changes to ocean discharge, and the potential for seawater intrusion of the Seaside Groundwater Basin. Project components that would be located within the Coastal Zone will require a Coastal Development Permit (CDP) and would be subject to policies in the certified Local Coastal Programs (LCPs) of each local jurisdiction and/or Chapter 3 of the California Coastal Act. Given the different jurisdictional boundaries, Commission staff suggests that the Cities of Seaside and Monterey, and Monterey County, consider requesting a consolidated CDP process pursuant to Coastal Act Section 30601.3. Further, the project will trigger federal consistency requirements and therefore the Commission would be responsible for reviewing the project for federal consistency purposes, including potentially components both in and outside of the Coastal Zone. With that in mind, please consider the following comments regarding the three project elements mentioned above:

Urban Stormwater Diversion Projects

Monterey One Water currently has all contractual rights to the source water and wastewater necessary to achieve the expanded project's recycled water yield objective of an additional 2,250 AFY. However, the expanded project includes additional water diversion projects to increase the number of water source sites, thereby providing greater supply reliability. The NOP mentions several planned urban-stormwater-to-sanitary-sewer diversion projects that are located in the City of Seaside and the City of Monterey and the majority of these projects appear to be located in the Coastal Zone. The CDP for each project would be subject to policies in the certified LCPs of each local jurisdiction and/or Chapter 3 of the California Coastal Act. Another option is to request a consolidated CDP process whereby the Commission would evaluate one consolidated CDP application under the Coastal Act. The Cities of Seaside and Monterey would also need to agree to such a consolidation process.

Saltwater Inundation

The approved PWM/GWR Project will replenish the Seaside Groundwater Basin with 3,500 AFY of purified recycled water by injecting the same amount of purified recycled water into the Seaside Groundwater Basin using four shallow and four deep injection wells. The shallow wells inject water into the uppermost aquifer (the unconfined Paso Robles Aquifer) and the deeper wells inject into the confined Santa Margarita Aquifer. As modified by the proposed expanded project, there would still be eight total injection wells but these would consist of three shallow injection wells and one additional deep injection well (for a total of five deep wells) in order to increase the amount of water available to Cal-Am. The expanded project may also include increasing the capacity of the approved percolation basin. This is a change in the pumping regime and the resulting increased demand on the Seaside Groundwater Basin has the potential to contribute to degradation of coastal aquifers or result in saltwater intrusion due to persistent and severe drought. Please review the effects of current in-basin pumping as well as any project effects from the projected pumping regime. In addition, locations potentially subject to inundation or saltwater intrusion could be exposed to increased risks from these coastal hazards with rising sea level and will require review for sea level rise effects. We understand the focused supplemental EIR for the expanded project will evaluate potential environmental effects to local groundwater quality, storage, and levels within the groundwater basins, as well as potential effects on the seawater/freshwater interface (i.e., saltwater intrusion). We recommend that these evaluations use the most recent available information about the likely effects of sea level rise and the most recent state guidance regarding sea level rise projections to evaluate potential effects on all project components over the lifetime of the proposed project (including up to 100 years for public infrastructure). We also note that expected sea level rise will be accompanied by an increased rate of coastal erosion and is expected to exacerbate related coastal hazards commensurately. We recommend the analyses in the supplemental EIR provide a project-specific assessment of the latest sea level rise projections and coastal erosion rates, and the way in which these and other coastal hazards interact in relation to the potential of inundation or saltwater intrusion of the Seaside Groundwater Basin.

Ocean Discharge
The expanded project has the potential to result in a change in quality and/or quantity of ocean discharge. We recommend the supplemental EIR provide analyses for the potential of changes in ocean discharge, as well as address potential impacts to marine resources as necessary. Please also confirm that the expanded project is in compliance with the California Ocean Plan water quality objectives and the National Pollutant Discharge Elimination System and Waste Discharge Requirements.

Note about Lifetime of Expanded Project
The NOP states that the projected timeline of the proposed project is 30 years. Please note that we typically recommend that analyses for a public infrastructure project cover a period of 50-75 years, with sea level rise and coastal hazards analyses covering a 100-year period.

In conclusion, thank you for the opportunity to review and comment on the NOP. Again, we are supportive of the expended project as it would curb ongoing impacts to the Carmel River, reduce discharge to Monterey Bay, and diversify Monterey County's water supply portfolio but we are also mindful of the potential adverse impacts to sensitive coastal resources and believe that addressing these issues early on will help facilitate the permitting process. We look forward to working through the above issues as you work through local and Commission permitting processes. Please do not hesitate to contact me at (831) 427-4863 if you have any questions or would like to further discuss these comments.

Sincerely,

Susan Craig FOR:

Alexandra McCoy
Coastal Planner
Central Coast District Office

Appendix B

Revised Source Water Rights Memorandum

PERKINSCOIE

October 3, 2019

TO: Bob Holden and Alison Imamura, M1W

FROM: Laura Zagar and Anne Beaumont

RE: ***Water Rights Analysis for Proposed Modifications to the Pure Water Monterey Groundwater Replenishment Project***

I. Introduction

The Pure Water Monterey Groundwater Replenishment Project (the PWM/GWR Project) consists of two components: the Pure Water Monterey Groundwater Replenishment improvements and operations that will develop high-quality replacement water for existing urban supplies, and a component that would increase flows for enhanced agricultural irrigation.

The approved PWM/GWR Project and the proposed modifications to expand the PWM/GWR Project would recycle and reuse water from a number of sources, including:

A. Municipal wastewater,
B. Industrial wastewater (agricultural wash water),
C. Urban stormwater runoff, and
D. Surface water diversions.

Below is a description of the Amended and Restated Water Recycling Agreement (the document that describes the framework for rights and associated responsibilities for these source waters), followed by an analysis of each water source, including the legal framework and current status of water rights for each source. A summary chart is included at the end.

II. Background and Status of the Amended and Restated Water Recycling Agreement

Monterey One Water (M1W) has entered into a number of relevant contracts, including contracts that assigned wastewater rights to Marina Coast Water District and Monterey County Water Resources Agency (Water Resources Agency). We understand M1W has entered into the following:

- The 1989 Annexation Agreement between M1W and the Marina Coast Water District provides the Marina Coast Water District with the right to obtain treated wastewater from M1W. The Marina Coast Water District has not exercised its recycled water rights but may do so in the future.

- The 1992 agreement between M1W and Water Resources Agency (including amendments) (1992 Agreement) provides for the construction and operation of the

Salinas Valley Reclamation Plant by M1W to provide water treated to a level adequate for agricultural irrigation for use by the Castroville Seawater Intrusion Project. In particular, Section 3.03 of the 1992 Agreement (Amendment 3) provides that M1W commits all of its incoming wastewater flows to the treatment plant from sources within the 2001 M1W service area, up to 29.6 million gallons per day, except for flows taken by the Marina Coast Water District under the Annexation Agreements, losses, flows not needed to meet the Water Resource Agency's authorized demand, and flows to which M1W is otherwise entitled under the agreement.

- In 1996, pursuant to another Annexation Agreement, the Marina Coast Water District received the right to tertiary-treated water from the Salinas Valley Reclamation Plant, in satisfaction of the 1989 agreement rights.

- In 2009, the Marina Coast Water District and M1W entered into a Memorandum of Understanding relating to the Regional Urban Water Augmentation Agreement (RUWAP MOU). In the RUWAP MOU, the M1W assigned a portion of its allotment from the Amendment 3 of the 1992 Agreement between M1W and Monterey County Water Resources Agency. M1W agreed to, among other things, provide 650 AFY of recycled waters during the months of May through August each year from M1W entitlements.[1] Marina Coast Water District agreed to commit 300 AFY of recycled water during the months of April through September from Marina Coast Water District's entitlements.

To address certain water rights, the stakeholder agencies entered into a Memorandum of Understanding (Source Waters MOU). The Source Waters MOU reaffirmed the Marina Coast Water District's and Water Resources Agency's recycled water entitlements and presented a proposal for collection of additional source waters to meet the PWM/GWR Project objectives.

The Source Waters MOU was not binding; rather, it was intended to provide a framework for negotiation of a definitive agreement that would establish the contractual rights and obligations of the parties. That definitive agreement between M1W and the Water Resources Agency, approved by the M1W Board in October 2016, is called the Amended and Restated Water Recycling Agreement (ARWRA). The ARWRA supersedes the Source Waters MOU.

A. *ARWRA Conditions and Amendment*

The ARWRA provides for new source waters from the Blanco Drain, Reclamation Ditch, and the City of Salinas (produce wash water) for the CSIP and the PWM/GWR Project. However, the

[1] Certain parties have disputed the validity of Amendment 3. If Amendment 3 were to be found invalid, the assignment of M1W's recycled waters to Marina Coast Water District in the RUWAP MOU may also be found to be invalid. For purposes of this analysis, however, it is assumed that Amendment 3 is valid and enforceable and that Marina Coast Water District has an existing right to 650 AFY during the summer months.

portions of the ARWRA applicable to the New Source Water Facilities do not become effective until the following six conditions in ARWRA Section 16.15 have been met:

1. Water Rights for the Blanco Drain and Reclamation Ditch are obtained from the California State Water Resources Control Board; and,
2. A fully executed, and California Public Utilities Commission approved, Water Purchase Agreement, between MRWPCA, MPWMD, and California-American Water; and,
3. Written findings are made by the Regional Water Quality Control Board that utilization of the Blanco Drain dry weather flows as New Source Water meets all treatment requirements for the aforesaid dry weather flows; and,
4. An independent third-party review of proposed capital and operating costs and preparation of an Engineer's Report is approved by the WRA Board of Directors and Board of Supervisors. The costs of the aforesaid third-party review shall be shared equally between WRA and M1W; and,
5. A successful assessment or Proposition 218 process for rates and charges related to the operation and maintenance of the New Source Water Facilities and proportional primary and secondary treatment charges; and,
6. Inclusion of Salinas Pond Water Return Facilities as New Source Water Facilities requires execution of a separate agreement between the Parties.

Due to delays in completing the cost-based Engineer's Report (condition 4 above) and changes in Water Resources Agency personnel, the conditions noted above have not yet been completed. Specifically, as of June 2019, conditions 1 and 2 had been satisfied; but conditions 3, 4, 5, and 6 have not been completed.

As a result, M1W and the Water Resources Agency developed an amendment to the ARWRA that will allow additional time to address the conditions precedent, delay required payments by the Water Resources Agency, and allow M1W to use the source waters for the PWM/GWR Project until such time as the conditions are met. The M1W Board approved the amendment in June 2019.

Under the amendment, therefore, M1W currently has the rights to use the new source waters from the Blanco Drain, Reclamation Ditch, and the City of Salinas (produce wash water) discussed in greater detail below until the conditions are met.

III. Source Waters

A. Municipal Wastewater Collection and Treatment System

1. *Brief Description of Project Use*

M1W collects municipal wastewater from communities in northern Monterey County and treats it at its Regional Wastewater Treatment Plant (Regional Treatment Plant). Most of the wastewater is recycled for crop irrigation at an onsite tertiary treatment plant called the Salinas Valley Reclamation Plant. The tertiary-treated wastewater is delivered to growers through a conveyance and irrigation system called the Castroville Seawater Intrusion Project (CSIP). The treated wastewater that is not recycled for crop irrigation, or used as influent to the AWPF, is discharged to the ocean through M1W's existing ocean outfall. The proposed modifications to the PWM/GWR Project enable more of the municipal wastewater to be recycled; thus, less municipal wastewater would be discharged through the ocean outfall.

2. *Legal Framework*

Unless otherwise provided by agreement, the owner of a wastewater treatment plant has the exclusive right to the treated wastewater it produces as against anyone who has supplied the water discharged into any part of its wastewater collection and/or treatment system, including a person using water under a service contract.[2] M1W therefore has the exclusive right to use municipal wastewater that is discharged into its collection system, except as that right has been varied by contractual arrangements.[3]

Here, as described above in Section II, M1W and the stakeholder agencies have entered into a number of relevant contracts, up to and including the ARWRA.

3. *Status of Water Rights*

As described in Section II above, the ARWRA is now in effect to address and resolve competing water rights of M1W, Marina Coast Water District, and the Water Resources Agency.

Separately, the ARWRA also provides the Water Resources Agency with rights to additional wastewater flows, since under the ARWRA, certain wastewater flows are to be evenly divided between M1W and the Water Resources Agency. Section 4.01(2) of the ARWRA states, "WRA shall be entitled to one-half of the volume of wastewater flows from areas outside of [M1W]'s 2001 Boundary provided; however, at the request of WRA, [M1W] passes the wastewater flows through the tertiary treatment facility or Pure Water Monterey Facilities." Because it is not applicable to the New Source Waters, this section is not subject to the ARWRA conditions described above and thus remains in effect, even if the conditions in ARWRA Section 16.15 have not been satisfied or completed.

Several flows that are treated at the Regional Treatment Plant are considered to be from areas outside of the 2001 M1W service area, and some of these flows are not metered (measured) with other influent to the Regional Treatment Plant at the headworks, as indicated. Thus, pursuant to

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2 Cal. Water Code § 1210.

3 California Water Code § 1211 requires the owner of a wastewater treatment plant to obtain approval of the State Board for a change in the point of discharge of treated wastewater when the proposed change would result in decreased flow in any portion of a watercourse. The proposed diversion of municipal wastewater from the Regional Treatment Plant from communities in northern Monterey County would not impact the flows in a watercourse; thus, approval from the State Board for this proposed diversion would not be needed.

the ARWRA section 4.01(2), rights to these wastewater flows would be evenly divided between M1W and the Water Resources Agency. They include the following:

- Backwash flows from the Salinas River Diversion Facility screening process (totaling up to approximately 200 AFY in the summer months (when the facility is operating and limited to April through September) [not metered as influent];
- Filter backwashing flows from the mixed media filters at the Salinas Valley Reclamation Plant (totaling approximately 2,000 AFY peaking in the summer months) [not metered as influent];
- AWPF filter backwash and clean in place flows (approximately 900 AFY distributed evenly throughout the year) [not metered as influent];
- Recycled Sumps #1 and #2 flows that convey wastewaters generated on-site and at the adjacent landfill (approximately 300 AFY) to the Regional Treatment Plant headworks [not metered as influent]; and
- Several areas in and around the City of Salinas and the community of Castroville (currently only the western annexation of the Boronda area constitute substantive flows totaling approximately 200 AFY distributed evenly throughout the year).

Total water rights to these wastewater flows at the Regional Treatment Plant available to M1W and the Water Resources Agency would range from approximately 1,700 to 1,900 AFY each,[4] depending upon flows of these waters, and particularly upon whether the Salinas River Diversion Facility is operating.

These flows are substantial, and use of these flows by M1W for meeting recycled water demands is *in addition to* M1W use of its wastewater rights and rights to new source waters from the Blanco Drain, Reclamation Ditch, and the City of Salinas (ag wash water and, potentially, storm water). Thus, even if the Water Resources Agency takes its share under the ARWRA, M1W would still have sufficient water rights from the Blanco Drain, Reclamation Ditch, and the City of Salinas (ag water and, potentially, storm water) for meeting new influent water flow needs for the PWM/GWR Project and proposed modifications.

B. Salinas Agricultural Wash Water System

1. *Brief Description of Project Use*

Water from the City of Salinas agricultural industries, 80% to 90% of which is water used for washing produce, is currently conveyed to ponds at the Salinas Industrial Wastewater Treatment Facility for treatment (aeration) and disposal by evaporation and percolation. The PWM/GWR

[4] This represents the total AFY available to each agency (M1W and the Water Resources Agency).

Project enables the agricultural wash water to be conveyed to the Regional Treatment Plant to be recycled. The PWM/GWR Project also includes improvements at the Salinas Industrial Wastewater Treatment Facility to allow storage of agricultural wash water and south Salinas stormwater in the winter and recovery of that water to the RTP for recycling and reuse in the spring, summer and fall.[5]

2. *Legal Framework*

The City of Salinas has the exclusive right to the treated wastewater it collects in its system and treats at the Salinas Industrial Wastewater Treatment Facility, unless modified in a contractual agreement.[6] Prior to making a change in the point of discharge of treated wastewater, the owner of a wastewater treatment plant shall obtain approval from the State Water Resources Control Board (State Water Board) for that change if the proposed change would result in decreased flow of any portion of a watercourse.[7]

3. *Status of Water Rights*

Since the City of Salinas would otherwise have exclusive right to its treated wastewater, M1W entered into a contract with the City of Salinas for the diversion and use of agricultural wash water. M1W entered into an agreement with the City of Salinas to utilize agricultural wash water (Salinas industrial wastewater) for recycling through the Salinas Valley Reclamation Plant for CSIP and for use by the PWM/GWR Project for groundwater replenishment in the Seaside Groundwater Basin.[8] If the conditions precedent in ARWRA section 16.15 are not met, section 16.16 states "WRA will retain the right to utilize the Agricultural Wash Water component from the City of Salinas." As discussed above, M1W currently has rights to use Agricultural Wash Water pursuant to Amendment No.1 to the ARWRA.

In addition, as the State Water Board clarified in its comments on the Draft EIR, its approval is needed for diversion of wastewater that is currently discharged into percolation ponds adjacent to the Salinas River, because such a diversion would reduce the flow of the Salinas River. The City of Salinas filed a Wastewater Change Petition with the State Water Board in October 2015, proposing a change in wastewater operation that would redirect wastewater treated at the Salinas Industrial Wastewater Treatment Facility to M1W's existing Regional Treatment Plant. In

5 The recovery of Salinas Industrial Wastewater Treatment Facility pond water to the Regional Treatment Plant is going to be enabled by the construction and operation of the Salinas Storm Water Phase 1B project that is grant-funded and currently under construction. The facilities are scheduled to be operational in early 2021. Rights and responsibilities for operational, maintenance, repair, and replacement costs of this new source water would be subject to a future agreement pursuant to the ARWRA section 16.15(6).

6 Cal. Water Code § 1210.

7 Cal. Water Code § 1211(a), (b).

8 Agreement for Conveyance and Treatment of Industrial Waste Water By and Between the City of Salinas and the Monterey Regional Water Pollution Control Agency (Oct. 27, 2015).

November 2015, the State Water Board issued its Order Approving Change in Place of Use, Purpose of Use, and Quantity of Discharge. Thus, this approval has been obtained.

C. Salinas Stormwater Collection System

1. *Brief Description of Project Use*

Stormwater from urban areas in southern portions of the City of Salinas is currently collected and released to the Salinas River through an outfall near Davis Road. The PWM/GWR Project includes improvements enabling Salinas Stormwater to be conveyed to the Salinas Industrial Wastewater Treatment Facility and to the Regional Treatment Plant to be recycled.

2. *Legal Framework*

To divert stormwater and dry weather flow from urban areas, agreements are needed between M1W and the relevant local agency that currently collects and conveys the flows in man-made facilities for discharge to surface waters. Stormwater runoff from urban areas through storm drain infrastructure (i.e., in the City of Salinas) does not become water of the state until it is discharged into a river or channel.

3. *Status of Water Rights*

M1W would need to obtain water rights from the applicable local agency, which here is the City of Salinas. We understand that there are currently no contractual arrangements or permits for diversion of stormwater or urban/agricultural runoff to the M1W wastewater collection and conveyance system. However, an agreement with the City of Salinas is being pursued by M1W. We understand that the City of Salinas has been working cooperatively with M1W, and agreement is reasonably likely. This demonstrates a reasonable likelihood that this source of water can be obtained.

D. Reclamation Ditch and Blanco Drain Surface Water Diversions

1. *Brief Description of Project Use*

The Reclamation Ditch is a network of excavated earthen channels used to drain natural, urban, and agricultural runoff and agricultural tile drainage. The PWM/GWR Project constructed infrastructure that enables water from the Reclamation Ditch watershed to be diverted from the Reclamation Ditch at Davis Road to be conveyed to the Regional Treatment Plant to be recycled.

The Blanco Drain collects water from approximately 6,400 acres of agricultural lands near Salinas. The PWM/GWR Project would include improvements that would enable water in the Blanco Drain to be diverted and conveyed to the Regional Treatment Plant to be recycled.[9]

2. *Legal Framework*

Water that enters surface streams and rivers is considered water of the state. A water rights permit is required to impound or divert waters of the state, except for certain riparian uses. Transfer of surface water flows out of known and defined channels for recycling would be a consumptive use that may come under the jurisdiction and regulation of the State Board.

Water rights permits from the State Board would be required for surface water diversions from the Reclamation Ditch and Blanco Drain. These source waters include agricultural return flow (overland flow and tile drainage), stormwater flow, and urban runoff. The State Board requires a completed CEQA document before issuing a permit.

In considering an application to appropriate water, the State Board considers a number of factors.[10] Specifically, the State Board considers "the relative benefit to be derived from (1) all beneficial uses of the water concerned including, but not limited to, use for domestic, irrigation, municipal, industrial, preservation and enhancement of fish and wildlife, recreational, mining and power purposes, and any uses specified to be protected in any relevant water quality control plan, and (2) the reuse or reclamation of the water sought to be appropriated, as proposed by the applicant. The State Board may subject such appropriations to such terms and conditions as in its judgment will best develop, conserve, and utilize in the public interest, the water sought to be appropriated."[11] The State Board is guided by the policy that domestic use is the highest use and irrigation is the next highest use of water.[12]

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9 M1W originally also planned to use source waters from the Tembladero Slough (to which the Reclamation Ditch is a tributary) and Lake El Estero. However, neither Tembladero Slough nor Lake El Estero is currently being pursued.

The Tembladero Slough diversion is no longer being pursued as a PWM/GWR Project source water due to a settlement agreement signed with California Department of Fish and Wildlife to resolve the water rights permit protest.

The City of Monterey actively manages the water level in Lake El Estero so that there is storage capacity for large storm events. Prior to a storm event, the lake level is lowered by pumping or gravity flow for discharge to Del Monte Beach. The PWM/GWR Project originally included improvements that would enable water that would otherwise be discharged to the beach to instead be conveyed to the Regional Treatment Plant to be recycled. Although Lake El Estero is not currently being pursued to be constructed, the City of Monterey and the M1W may choose in the future to pursue this project component; therefore, it is still included in the PWM/GWR Project as approved.

10 Cal. Water Code §§ 1250 et seq.

11 Cal. Water Code § 1257.

12 Cal. Water Code § 1254.

The Water Resources Agency submitted an application in April 2014 to the State Board to appropriate waters of the Blanco Drain and the Reclamation Ditch, as well as the Tembladero Slough.[13] Specifically, it applied to divert up to 25,000 acre-feet per year from each of the two water bodies at a combined rate of diversion of up to 100 cfs. On November 10, 2014, the State Water Resources Control Board sent a letter stating that staff had found the application was incomplete in several respects. In response, the Water Resources Agency submitted five separate applications on July 29, 2015, three of which are related to the PWM/GWR Project (Application Nos. 32263A, 32263B, 32263C).[14] At the request of the State Board, the Water Resources Agency submitted amended applications with minor changes on July 29, 2015.

3. *Status of Water Rights*

These water rights are secured. The State Board has approved the pending applications and issued two permits (Permit 21376 and Permit 21377) authorizing the Water Resources Agency to divert and use water from the Blanco Drain and the Reclamation Ditch, respectively. The ARWRA further addresses these water rights. Under the ARWRA amendment, as explained above, M1W currently has the rights to use the new source waters from the Blanco Drain, and the Reclamation Ditch, until the ARWRA conditions are met.

E. Summary Chart

Source of Water	**Status of Water Rights**
Municipal Wastewater Collection and Treatment System	**Secured**. The ARWRA is now in effect to address and resolve competing water rights of Marina Coast Water District and Monterey County Water Resources Agency. The ARWRA also provides that rights to additional wastewater flows—that are treated at the Regional Treatment Plant and are from areas outside of the 2001 M1W service area—are evenly divided between M1W and the Water Resources Agency.
Salinas Agricultural Wash Water System	**Secured**. A contract is in place between M1W and the City of Salinas assigning rights for diversion and use of the agricultural wash water to M1W. Under the ARWRA as amended, M1W currently has rights to use the

13 *See* footnote 9 above regarding the Tembladero Slough.

14 Regarding the Tembladero Slough application, see footnote 9. The remaining two applications related to the PWM/GWR Project were for the Blanco Drain and the Reclamation Ditch.

	new source waters from this source. In addition, the State Water Board has approved the diversion of the agricultural wash water away from the percolation ponds. Recovery of seasonally-stored agricultural wash water, mixed with storm water, from the City's system requires a contract between M1W and the City of Salinas.
Salinas Stormwater Collection System	**Pending**. A contract is needed between M1W and the City of Salinas for diversion of storm water, mixed with agricultural wash water, from the City's system.
Reclamation Ditch and Blanco Drain Diversions	**Secured**. The State Water Board has issued two permits authorizing the Water Resources Agency to divert and use water from the Blanco Drain and the Reclamation Ditch. Under the ARWRA as amended, M1W currently has the rights to use the new source waters from the Blanco Drain and Reclamation Ditch.

Appendix C

Agreement Between City of Salinas and MRWPCA

AGREEMENT FOR CONVEYANCE AND TREATMENT OF INDUSTRIAL WASTE WATER BY AND BETWEEN THE CITY OF SALINAS AND THE MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY

THIS AGREEMENT is made and entered into on October 27, 2015, by and between the **City of Salinas**, a California charter city and municipal corporation (hereinafter referred to as the "City"), and the **Monterey Regional Water Pollution Control Agency**, a California joint powers agency (hereinafter referred to as the "MRWPCA"), sometimes collectively referred to herein as the "Parties" and individually as "Party," as follows:

Recitals

A. The City owns and operates an Industrial Waste Water Collection and Conveyance System (the "IWCCS") that receives industrial waste water from approximately 25 processing and related businesses operating in the southeast corner of the City, and transports that water to the City's Industrial Waste Water Treatment Facility (the "IWTF") located at South Davis Road in the City and has the rights and access to and receives for treatment (by aeration) and disposal (by evaporation and percolation) approximately 4,000 acre feet/year of industrial waste water or also called agricultural wash water.

B. The MRWPCA has an existing need for source water for 1) to serve its Pure Water Monterey Groundwater Replenishment Project (the "GWR Project") and 2) to augment the existing Castroville Seawater Intrusion Project's ("CSIP") crop irrigation supply.

C. In July 2014 the Parties hereto, along with the Monterey County Water Resources Agency (the "MCWRA"), entered into a short-term Produce Wash Water Utilization Agreement (the "Utilization Agreement"), whereby industrial waste water from the IWTF was diverted, by means of a by-pass shunt to the MRWPCA's Regional Treatment Plant (the "RTP"), for treatment to provide additional water for treatment to the MRWPCA/MCWRA Salinas Valley Reclamation Project, to then be delivered as recycled water to the CSIP service area. That Utilization Agreement has been extended by the parties thereto for additional periods as deemed necessary and it is anticipated by the Parties that it will be extended into 2017.

D. In March 2015 the City and the MRWPCA entered into a further agreement, set forth and memorialized in mutual resolutions and minute actions of the governing bodies of each Party, to share the costs of design and construction of the permanent diversion facilities necessary to permit the redirection of the industrial waste water from the IWTF to the municipal waste water system for conveyance to the RTP. The permanent diversion facilities are as depicted and described in **Attachment A**, consisting of two pages, attached hereto and incorporated herein by this reference.

E. The purpose and intent of this Agreement, therefore, is for the Parties to set forth the terms and conditions by which they will continue the transfer, conveyance, treatment and use of the industrial waste water, utilizing the permanent diversion facilities, to the mutual benefit of the Parties and the communities served by the GWR Project and the CSIP.

F. This Agreement implements the Pure Water Monterey Groundwater Replenishment Project ("GWR") that the MRWPCA Board approved on October 8, 2015. The MRWPCA Board certified the Environmental Impact Report ("EIR") for the GWR Project as complete and in compliance with the California Environmental Quality Act ("CEQA"), and adopted the findings required by CEQA on October 8, 2015. This Agreement does not change the GWR Project and no change of circumstances or new information shows the GWR Project would result in new or substantially more severe environmental impacts such that major revisions to the certified EIR would be required. This Agreement is approved based on the EIR as certified.

Terms & Conditions

In consideration of the foregoing recitals, and the mutual promises, conditions and covenants made herein, the Parties agree to the following terms and conditions:

1. Source and Conveyance of Industrial Waste Water.

a. The City currently operates and maintains an industrial waste water, collection, conveyance and treatment system, the IWCCS, described in Recital A, above. For the term and any extended term of this Agreement, City agrees to continue to operate that system, or contract for operation of the system in a manner consistent with this agreement, and agrees unless otherwise directed by MRWPCA, to convey all industrial waste water collected in IWCCS to the permanent diversion facilities described in Recital D, to MRWPCA via its Salinas pump station and other facilities to the RTP for treatment and distribution for the uses described in Recital B, above.

b. For the term of this Agreement, City will provide MRWPCA access and rights to the industrial waste water in order for the MRWPCA to use the industrial waste water in a manner that is beneficial and consistent with the uses described in Recital B, above, and consistent with the Recitals and the terms and conditions listed in this Section.

c. For purposes of this Agreement, the point of transfer of industrial waste water described hereinabove from the City to the MRWPCA is the permanent shunt jointly installed by the Parties located ahead of the IWTF, as depicted in Attachment A.

d. As of the date of execution of this Agreement, City confirms that it is aware that approximately 25 wastewater producers deliver waste water to the City's industrial waste water system described hereinabove, the IWCCS, with those producers and amounts they delivered in the years noted and listed in **Attachment B**, consisting of two pages, attached hereto and incorporated herein by this reference. All waste water from all producers listed in Attachment B, and all waste water from producers added to the industrial waste water system subsequent to the execution of this Agreement, shall be directed and conveyed as provided by this Section 1.

e. Non-Compliant Discharge

(i) City agrees to cooperate with MRWPCA's Source Control division to ensure that all water quality characteristics are complied with.

(ii) Non-compliant waste water means water, delivered pursuant to this Section 1, that does not meet applicable legal standards or standards agreed to by the Parties by separate agreement, and that therefore is not suitable for delivery to MRWPCA.

(iii) City shall notify MRWPCA immediately upon City becoming aware of any non-compliant discharge. MRWPCA will then direct such rejected discharge to the IWTF.

(iv) Attached hereto as **Attachment C,** and incorporated herein by this reference is the Interruptible Rate Schedule, including Parties' agreed upon handling of non-compliant waste water. In case of conflict between **Attachment C** and the body of this agreement, provisions of the body of this agreement shall apply.

f. Disruption/Interruption of Service

(i) Disruption or interruption of service caused by but not limited to, acts of God, acts of war, or criminal acts of others, water shortages, fires, floods, earthquakes, epidemics, quarantine restrictions, strikes, or failure or breakdown of transmission or other facilities or similar occurrences may result in damages. Other reasons for disruption/interruption may include but are not limited to the flooding of the Salinas River, high flows at the pump station, industrial waste water not being needed at the regional treatment plant, a spill or toxic matter in the waste water. The harm thereby caused may delay or suspend delivery of the industrial waste water until such time as successful effort is made to restore service.

(ii) In the event of such disruption or interruption MRWPCA may close the permanent diversion facility to allow the industrial waste water to flow to the City's IWTF. MRWPCA will notify the appropriate City personnel within 24 hours regarding the reasons for diversion.

(iii) Interruption or disruption of service shall be according to the Interruptible Rate schedule set out in **Attachment C**, attached hereto and incorporated herein by this reference.

Lease for Operation and Maintenance of IWTF

g. (i) Upon execution of this Agreement, the parties will negotiate and endeavor in good faith to enter into an agreement whereby MRWPCA would assume responsibility for the operation and maintenance of the IWTF ponds starting in 2017. The annual lease payment shall be $300,000 a year, payable as negotiated, with an escalation factor to be negotiated as well.

(ii) The parties shall negotiate terms regarding the City's obligation to repair, maintain, reimburse or contract out in order to uphold their responsibility as the lessor of the Industrial Waste Treatment Facility Ponds to MRWPCA the Lessee. These items include but are not limited to rate of treatment which would include capital and reserve allocations, infrastructure improvements, water quality parameters, electricity, roads, costs associated with removal of sludge, etc.

(iii) As conditions of the lease agreement, the parties shall negotiate the level of MRWPCA's commitment to provide infrastructure improvements to the IWTF during the term of the lease to include MRWPCA consulting with the City regarding improvements required for the ponds to remain a productive and efficient means for treating, storing and reusing industrial waste water and which the infrastructure improvements are allocated. MRWPCA would employ a variety of options in order to meet the required infrastructure improvement figure. Options for securing the resources necessary to improve the pond infrastructure may include but are not limited to low interest loans, grants, public/private partnerships, in-kind labor by MRWPCA or other partner agencies.

2. Payment for Treatment.

a. City agrees to pay to MRWPCA all costs of treatment of the industrial waste water conveyed to MRPWCA and measured by meter pursuant to Section 1 above. As determined by a rate study prepared by MRWPCA and agreed to by City, the initial rate for treatment shall be $179.00/acre foot. If and as costs of treatment change, either as provided in the rate study or by other means, MRWPCA shall, by written notice given no later than 45 days prior to a rate change, notify City of such rate change, to include an explanation and accounting of the costs requiring a change. City shall, upon the effective date of a rate change, pay for costs at the new rate. MRWPCA shall make no more than one rate change in any twelve-month period, unless otherwise provided in the rate study. MRWPCA invoices for treatment costs shall be rendered monthly and paid by City within 45 days of receipt.

b. If City contests an invoice submitted under this Section, it shall give MRWPCA notice of the dispute at least 10 days prior to the day payment is due. To the extent MRWPCA finds City's contentions correct, it shall revise the statement accordingly and City shall make payment of the revised amount within 45 days of notice of the revised amount. If MRWPCA rejects City's contentions or where time is not available for review of the contentions prior to the due date, City shall make payment of the invoiced amount on or before the due date and make the contested part of such payment under protest and seek to recover the amount thereof from MRWPCA.

c. Upon the improvements to the IWTF system, industrial waste water or storm water that is stored at the IWTF site and returned to the Salinas Pump Station for the treatment and reuse at the Regional Treatment Plant (RTP), it is anticipated that the intended user of the water will pay for the cost of conveyance and treatment of water. The rates for treating this stored water will be in accordance to the Interruptible Rate table as calculated by the MRWPCA.

3. **Source Control Monitoring.** Source control monitoring of the City's industrial waste water processing facilities by MRWPCA shall continue pursuant to existing agreements between City and MRWPCA.

4. **Term.** The effective date of this Agreement is January 1, 2016. Unless earlier terminated or extended in writing by mutual agreement of the Parties, this Agreement shall remain in effect for a period of thirty (30) years from the effective date hereof. This Agreement shall be automatically extended for two successive five-year terms after the initial thirty (30) year term unless either Party gives written notice of termination no later than two years before the end of the initial term or later term as extended per this Section.

5. **Disputes.**

a. If any dispute under this Agreement arises, the Parties shall first meet and confer in an attempt to resolve the matter between themselves. Each Party shall make all reasonable efforts to provide to the other Party all the information in its possession that is relevant to the dispute, so that both Parties have ample information with which to reach a decision.

b. In the event a dispute involving the enforcement or interpretation of this Agreement is not resolved by the meet and confer process described in subsection a. of this Section, it must be submitted to non-binding mediation before suit is filed. Upon request by either Party, the Parties will within ten (10) days of submission to such arbitration, select a single mediator to mediate the dispute. If the Parties are unable to agree on a mediator within ten (10) days of the request to select, then either Party may ask the then presiding judge of the Monterey County Superior Court to select a mediator. If a dispute is not resolved within 45 days of selection, however selected, either Party may file suit specifically to enforce or interpret this Agreement and to seek any damages to which the Party may be entitled.

6. **Insurance/Self-Insurance.** Each Party is either insured or self-insured as to any requirements under this Agreement. No policies or bonds are required of either Party as to any provisions of this Agreement. The Parties are aware of and shall comply with the requirements of Section 3700 of the California Labor Code at their own cost and expense and, further, neither Party nor its insurer shall be entitled to recover from the other any costs, settlements, or expenses of Workers' Compensation claims arising out of this agreement.

7. **Indemnification and Hold Harmless.** Each Party hereto agrees that it shall indemnify, defend, and hold harmless the other Party, including Party's officers, agents and employees, from and against any and all claims, liabilities, and losses whatsoever occurring or resulting to any person, firm, corporation, or other entity for foreseeable consequential damage, property damage, injury, or death arising out of or connected a Party's negligence or non-performance of its obligations under this Agreement. The provisions of this Section 7 shall survive the expiration of the term or termination of this Agreement.

8. **Miscellaneous.**

    a. Each Party represents that it has read all terms set out herein and each fully understands and accepts all terms of this Agreement.

    b. The Parties acknowledge that each has reviewed this Agreement and that the usual rule of construction that ambiguities are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement

    c. This Agreement sets for the entire understanding of the Parties with respect to the subject matter hereof. Neither Party has made any statement or inducement for the other to enter into this Agreement, except as expressly set forth herein or incorporated herein by reference. The Parties agree that this Agreement shall not be altered, amended, modified, or otherwise changed except in writing by mutual consent of the Parties.

    d. This Agreement shall be governed by the laws of the State of California. Venue for any legal action relating to this Agreement is Monterey County.

    e. If any part of this Agreement is for any reason ruled unenforceable by a court of competent jurisdiction, the remainder shall remain in full force and effect unless the unenforceable part is a material consideration to a Party.

f. In the event of any claim, controversy or dispute that results in litigation or binding arbitration, the prevailing Party shall be entitled to recover from the losing party reasonable expenses, attorney fees, and costs.

g. Both parties shall cooperate fully to execute any and all documents, and to take any actions necessary and appropriate to give full force and effect to this Agreement, and which are not inconsistent with its terms.

h. The individuals whose signatures appear herein below represent, warrant and guarantee that they have the authority to execute this Agreement on behalf of the Party on whose behalf they purport to sign and execute.

i. It is expressly understood that this Agreement is intended by the Parties to be between two independent contractors and that no agency, employment, partnership, joint venture, or other relationship is established by this Agreement.

j. The Parties agree that neither Party shall be considered or deemed to have waived, released, or altered in any manner any or all rights which it would otherwise have pursuant to law with regard to any other matter not dealt with or affected by this Agreement.

9. **Counterparts.** This Agreement may be executed in two counterparts, each of which shall be deemed an original, but each of which shall be deemed to constitute one and same document.

10. **Notices.** All notices or other writings in this Agreement provided to be given or made or sent, or which may be given or made or sent, by one Party hereto or another, shall be deemed to have been fully given or made or sent with made in writing and deposited in the United States mail, registered, certified or first class, postage paid, and addressed as follows:

To MRWPCA: General Manager
Monterey Regional Water Pollution Control Agency
5 Harris Court, Building D
Monterey, CA 93940

To City of Salinas: City Manager
City of Salinas City Hall
200 Lincoln Ave.
Salinas, CA 93901

With a copy provided to the City & Agency's Attorney.

The address to which any notice or other writing may be given or made or sent to either Party may be changed upon written notice given by such Party as provided above.

IN WITNESS WHEREOF, the Monterey Regional Water Pollution Control Agency and the City of Salinas have entered into this Agreement as of the date first written above.

MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY

By Gloria De La Rosa

Its Board Chair

Approved as to Form: Robert R. Wellington
Robert Wellington, Legal Counsel

CITY OF SALINAS

By

Its Mayor

Approved as to Form:
Christopher Callihan, City Attorney

Appendix D
Groundwater Modeling Analysis Technical Memorandum

www.elmontgomery.com
1970 Broadway, Suite 225
Oakland, California 94612
510.903.0458

TECHNICAL MEMORANDUM

DATE:	November 1, 2019	PROJECT #: 91553.0202
TO:	Edwin Lin, Todd Groundwater	
FROM:	Pascual Benito and Derrik Williams	
PROJECT:	Pure Water Monterey	
SUBJECT:	Expanded PWM/GWR Project SEIR: Groundwater Modeling Analysis	

EXECUTIVE SUMMARY

Monterey One Water (M1W) is proposing to expand the currently approved Pure Water Monterey (PWM) groundwater replenishment project (approved PWM/GWR Project) to increase the capacity of the Advanced Water Purification Facility (AWPF) from 5 million gallons per day (MGD) peak production to 7.6 MGD. The expanded PWM/GWR Project will recharge the Seaside Groundwater Basin (Seaside Basin) with an average of 5,750 acre feet per year (AF/year) of high quality purified water for indirect potable reuse, and will deliver additional tertiary recycled water to the Salinas Valley for agricultural irrigation to replace existing water supply sources for the northern Monterey County region. The proposed modifications to the PWM/GWR Project are intended as a back-up to the California American Water Company (Cal-Am) Monterey Peninsula Water Supply Project (MPWSP). The proposed expansion would increase the amount of purified recycled water produced by the PWM/GWR Project, which is currently under construction. Proposed modifications include expansion of the AWPF capacity, relocating and adding additional injection well sites, and modifications to the Cal-Am conveyance system.

The calibrated groundwater flow model of the Seaside Basin (HydroMetrics WRI, 2009) was used to estimate impacts from the proposed project modifications in support of the impacts analysis for the Supplemental Environmental Impact Report (SEIR). A predictive model incorporating reasonable future hydrologic conditions and pumping demand was developed for this impacts analysis. The expanded PWM/GWR Project injection is assumed to begin in October 2020, eight years into the 33-year predictive model period.

The model simulates PWM injection, municipal pumping, and Aquifer Storage and Recovery (ASR) injection and extraction of treated Carmel River water. The amount of Carmel River water available for winter injection into the Seaside Basin was estimated by Monterey Peninsula Water Management District (MPWMD) staff (MPWMD, 2019). Cal-Am's future annual water demand was assumed to increase from 10,400 acre-feet (AF) at the start of the modified project to 11,325 AF at the end of the simulated 25-year project duration. It was also assumed that roughly two-thirds of the total Cal-Am demand would be satisfied by extraction of native groundwater, injected Carmel River water, and injected PWM water from the Seaside Basin. Extraction from the Carmel Valley, Cal-Am's Carmel River Table 13 diversion, and the Sand City Desalination plant would satisfy the remainder of the total Cal-Am demand. Monthly Seaside Basin pumping rates were set to meet monthly Cal-Am demand.

Model results show that the expanded PWM/GWR Project increases groundwater elevations in the Seaside Basin. Simulated groundwater elevations under the expanded PWM/GWR Project are, on average, higher than those under No-Project conditions at all simulated observation wells. The long-term coastal groundwater elevations under the expanded PWM/GWR Project are also higher than those under No-Project conditions, indicating that the expanded PWM/GWR Project is likely to reduce the potential for seawater intrusion. A water budget analysis of simulated inflows and outflows into the Seaside Basin shows that the expanded PWM/GWR Project increases groundwater storage by 400 AF/year compared to the No-Project conditions. It also reduces offshore inflows while increasing offshore outflows, decreasing the potential for seawater intrusion in the Seaside Basin.

Particle tracking was used to estimate the travel time of injected expanded PWM/GWR Project water from the point of injection/recharge to the closest point of extraction. Results predict that the shortest subsurface travel time of recharged PWM purified recycled water to reach an extraction well is 615 days for the expanded PWM/GWR Project; the majority of the subsurface travel times are longer than 5 years.

PROJECT DESCRIPTION

The expanded PWM/GWR Project will produce a reliable water supply by treating previously discharged secondary effluent with the AWPF and recharging the Seaside Basin with the purified recycled water using a series of shallow and deep injection wells. Once injected into the Seaside Groundwater Basin, treated water will mix with the groundwater in the aquifers, and be stored for future extraction and use. The approved PWM/ Project provides 3,500 AF/yr of supplies for Cal-Amto deliver to its customers in the Monterey District service area and allows Cal-Am to reduce its diversions from the Carmel River system.[1] Cal-Am is under a state order to secure replacement water supplies by December 2021.[2]

The proposed modifications would expand the AWPF peak capacity from 5 MGD to 7.6 MGD and increase recharge of purified recycled water in the Seaside Basin by 2,250 AF/yr (for a total average replenishment rate of 5,750 AF/yr). The proposed modifications are being developed as a back-up plan to the MPWSP, Cal-Am's planned 6.4-MGD desalination project. The proposed modifications would be implemented if the MPWSP encounters obstacles that prevent its timely, feasible implementation.

For Cal-Am to extract additional groundwater injected by the proposed modifications into the Seaside Basin, deliver it to meet its system demands at all times, and also provide system redundancy, the following Cal-Am potable water system improvements would be built and operated:

- Four new extraction wells and associated infrastructure; including two new extraction wells located at the Seaside Middle School (EW-1 and EW-2) and two new extraction wells located along General Jim Moore Boulevard[3] (EW-3 and EW-4) (see Figure 1); and,

- New conveyance facilities along General Jim Moore Boulevard and at the Seaside Middle School site.

The approved PWM/GWR Project includes four injection well sites; however, only two of the four approved well sites have been constructed based on final design of the approved PWM/GWR Project. The proposed modifications include an expansion of injection well facilities into an expanded area to the east. The expanded injection well area includes up to three well sites. The new well sites are numbered #5 through #7 and are shown on Figure 1. Under the proposed modifications, two of the four approved deep injection wells (DIWs) would be relocated into the expanded injection well area. Well Site #4 would be relocated to Well Site #7 in the expanded injection well area. Well Site #1 would be relocated to the expanded injection well area and renamed Well Site #5. In addition, one new DIW would be constructed and

---

[1] The approved PWM/GWR Project also includes a drought reserve component to support crop irrigation during dry years. Under this component, an extra 200 AF/yr of advanced treated water will be injected in the Seaside Groundwater Basin during normal and wet years, up to a total of 1,000 AF, to create a "banked reserve." During drought years, M1W will reduce the amount of water injected into the Seaside Groundwater Basin in order to increase production of recycled water for crop irrigation. Cal-Am will be able to extract the banked water in the Seaside Groundwater Basin to make up the difference to its supplies, such that its extractions and deliveries will not fall below 3,500 AF/yr.

[2] The State Water Resources Control Board's Cease and Desist Order 95-10 required the reduction of Cal-Am pumping from the Carmel River; Order 2016-16 extended the time period for withdrawals above legal limits from the Carmel River through 2021.

[3] The two new extraction wells located off General Jim Moore Boulevard are located at the same site as two of the aquifer storage and recovery (ASR) wells that were included in the MPWSP (ASR Wells 5 and 6).

operated at Well Site #6. No new vadose zone wells (VZWs) are proposed as part of the proposed modifications.

The proposed modifications to the PWM/GWR Project require increased well injection capacity to accommodate the additional 2,250 AF/yr of purified recycled water. Of the average 5,750 AF/year of purified recycled water injected into the Seaside Basin, 90% will be injected/recharged into the deeper confined Santa Margarita Aquifer, while 10% will be injected/recharged into the shallower unconfined Paso Robles Aquifer.[4]

[4] Annual injection volumes in the Seaside Basin up to 5,950 AF/year are projected to build an up to 1,000 AF drought reserve account for the Castroville Seawter Intrusion Project (CSIP), which can be withdrawn during drought periods.

Figure 1. Production wells and existing and proposed Modified PWM Injection Locations

MODEL BACKGROUND

The calibrated groundwater flow model of the Seaside Groundwater Basin (HydroMetrics, 2009)[5], the same model used to support the preparation of the approved PWM/GWR Project EIR (HydroMetrics, 2015), was used to evaluate potential changes to groundwater levels, changes to inflows and outflows to and from the Basin, and to estimate the underground retention time of injected purified recycled water from Project injection wells to nearby production wells in the Santa Margarita Aquifer and Paso Robles Aquifer. The model background and assumptions are repeated here for completeness.

The Seaside model is a regional groundwater flow model that was developed in 2009 for the Seaside Basin Watermaster. It covers an area larger than the adjudicated Seaside Groundwater Basin, extending east and north of the basin boundary into the Salinas Valley. The model was developed for the purpose of guiding basin management decisions such as:

- evaluating impacts from supplemental water projects
- determining storage efficiency of artificially recharged water
- re-estimating safe yield, and
- determining how much supplemental water is needed to reach protective groundwater elevations which would protect the basin from seawater intrusion

The three-dimensional numerical groundwater flow model was built using the U.S. Geological Survey's MODFLOW-2005 model code (Harbaugh, 2005). The model simulates five geologic layers: Aromas Red Sands, upper Paso Robles Aquifer, middle Paso Robles Aquifer, lower Paso Robles Aquifer, and Santa Margarita Sandstone/Purisima Formation. The model has been calibrated through history matching of water level data from January 1987 through December 2008. The model incorporates the time-dependent recharge calculated as part of the conceptual model and all of the pumping data. The model simulates the interaction of groundwater in the study area with the Pacific Ocean, as well as the interaction with the adjacent Salinas Groundwater Basin.

The model has been used extensively by the Seaside Basin Watermaster Technical Advisory Committee (TAC) to simulate groundwater response to potential future basin management activities and provide information on how to achieve protective groundwater elevations at the coast.

Minor modifications were made to the calibrated hydrogeologic parameters to incorporate data from aquifer tests conducted in the two existing Project DIWs (DIW-1 and DIW-2 located at Site #2 and Site #3), four MPMWD ASR wells, and an additional local drinking water well (Paralta).

[5] The original groundwater model report is available at the following URL: http://www.seasidebasinwatermaster.org/Other/Seaside_modeling_report_FINAL.pdf

A predictive model incorporating variable future hydrologic conditions was developed for this impact analysis. The groundwater model was calibrated through 2008; therefore, the predictive model begins in 2009. The predictive model simulates a 33-year period: from 2013 through 2045. Injection from the Pure Water Monterey project was assumed to start in October 2020 and was operating throughout the remaining 25 years of the simulation.

Updated Parameters Based on Aquifer Tests

The hydrogeological properties for the Santa Margarita Aquifer in the model were updated locally in the vicinity of the project to incorporate site specific data from aquifer pump tests conducted in project wells DIW-1 (located at DIW-SITE-2; Todd 2018) and DIW-2 (located at DIW-SITE-3; Todd, 2019), and in five nearby wells consisting of ASR-1 (Padre, 2002), ASR-2 (Pueblo, 2008), ASR-3 (Pueblo, 2012), ASR-4 (Pueblo, 2015), and the Paralta well (Fugro, 1997). The estimated aquifer properties for the seven wells are listed in Table 1, and their locations are shown in Figure 2. The aquifer thickness (b), estimated transmissivity (T), and storativity (S) values, were used to calculate and assign horizontal hydraulic conductivity (K = T/b) and specific storage (Ss = S/b) values to the cluster of model grid cells around each of the wells. The aquifer thickness was also used to adjust the model layer thickness at each location. Santa Margarita Aquifer parameters and layer thickness for all the model grid cells in a region within a 3,100-foot radius[6] (region shown in orange in Figure 2) of each of the wells were then re-interpolated based on the new data. The original model parameters outside the 3,100-foot interpolation buffer region remain unchanged. The interpolation region was clipped along the Ord Terrace Fault line as to not modify grid cell parameter values on the other side of the fault. This local change in aquifer parameters ensures smooth spatial variation between calibrated parameters and updated local parameters; calibrated parameters are unchanged outside of this area. The model was not recalibrated with updated parameters, though a comparison of calibration error statistics was evaluated and indicate no significant reduction or change to the calibration statistics at the regional model scale or the local basin subarea scale.

An effective porosity value of 24% was assigned to the Santa Margarita Aquifer based on actual porosity measurements of aquifer material collected during the installation of well ASR-2 (Pueblo, 2008). All other aquifer layers were assigned an effective porosity value of 20%.

[6] The radial distance of 3,100 feet was chosen based on the geometric mean of the estimated radius of influence from the short term aquifer tests at wells DIW-1 and DIW-2.

Table 1. Local Santa Margarita Aquifer Hydrogeologic Properties from Pumping Tests

Well	Aquifer Thickness b (ft)	Transmissivity T (ft^2/day)	Horizontal Hydraulic Conductivity K = T/b (ft/day)	Storativity S (ft/ft)	Specific Storage Ss = S/b (1/ft)	Data Source
DIW-1	280	21,878	78	9.29E-04	3.32E-06	(Todd, 2018)
DIW-2	170	14,188	83	2.57E-03	1.51E-05	(Todd, 2019)
ASR-1	220	13,946	63	-	1.66E-06*	(Padre, 2002)
ASR-2	230	18,803	82	3.83E-04	1.66E-06	(Pueblo, 2008)
ASR-3	240	15,861	66	2.00E-04	8.33E-07	(Pueblo, 2012)
ASR-4	240	13,139	55	-	8.33E-07**	(Pueblo, 2015)
Paralta	180	11,376	63	1.80E-03	1.00E-05	(Fugro, 1997)

*assumed same value as ASR-2
**assumed same value as ASR-3

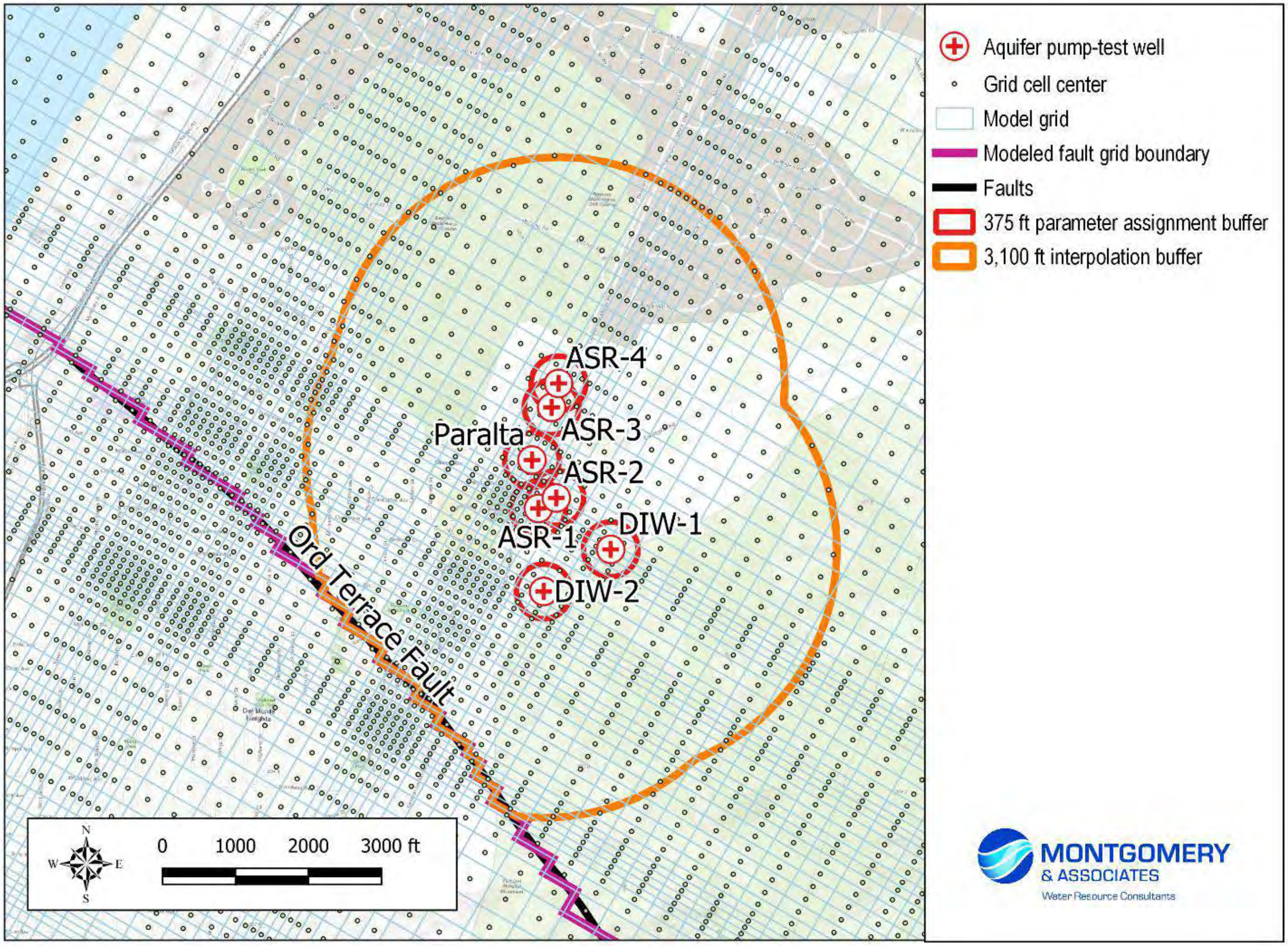

Figure 2. Model Santa Margarita Aquifer Parameter Update Region

Predicted Hydrology Assumptions

The Seaside Basin predictive model simulates a 33-year period (Hydrometrics WRI, 2009). The hydrology (rainfall and recharge) used to calibrate the groundwater model was applied to the predictive model. To extend the hydrology through the predictive period, the 1987 through 2008 hydrology data were used to simulate model year (MY) 1 through MY22, and the 1987 through 1997 hydrology data were then repeated for MY23 through MY33 (Figure 3). This is the approach that has been adopted for all predictive models of the Seaside Basin since 2009. By using this hydrology, even during the period from MY1 to present when actual hydrology is known, model runs can be compared to evaluate relative groundwater levels. The simulated hydrology includes both drought and non-drought periods, including a prolonged multi-year drought period.

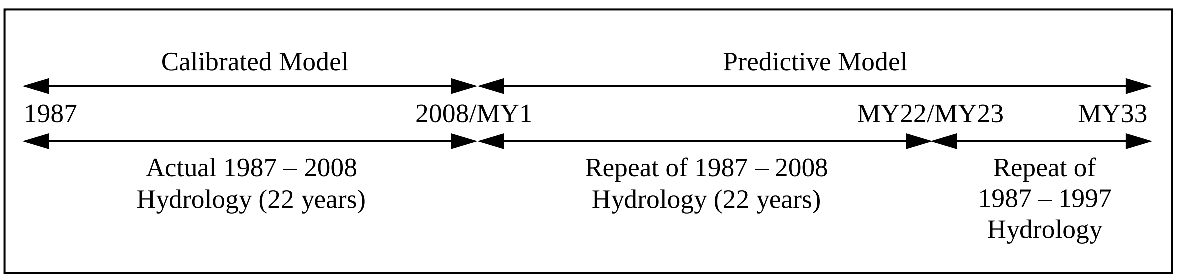

Figure 3. Repetition of Hydrology for Predictive Model

To be consistent with previous PWM simulations and allow for comparison between model runs, we assume that injection from the simulated expanded PWM/GWR Project starts in October MY8 and operation continues through the remaining 25 years of the simulation. In this simulation, MY8 is equivalent to future calendar year 2020; the 33-year simulated period spans years 2013-2045, with an 8 year period before the expanded PWM/GWR Project starts. We assume Cal-Am has met the cease-and-desist order (CDO) upon implementation of the PWM project expansion.

Predicted Carmel River Flow and Injection Assumptions

Monterey Peninsula Water Management District (MPWMD) estimated the amount of Carmel River water available for ASR injection for the predictive simulation based on historical streamflow records (MPWMD, 2019). Because the future simulated hydrology is based on the historical hydrology between 1987 and 2008, the future streamflows are expected to be the same as the historical streamflows. MPWMD staff compared historical daily streamflows between water year (WY) 1987 and WY 2008 with minimum streamflow requirements for each day. This allowed MPWMD to identify how many days in each month ASR water could be extracted from the Carmel River. Using a daily diversion rate of 20 acre-feet per day (AF/day), MPWMD calculated how many acre-feet of water from the Carmel River could be injected into the ASR system each month. The Carmel River water available for injection was divided between the ASR 1&2 Well Site and the ASR 3&4 Well Site according to the historic division of injection. The distribution of the estimated available monthly ASR injection volumes for the predictive simulation for both ASR wells is shown along with the simulated monthly extractions from the existing Cal-Am wells and proposed new extraction wells in Figure 8.

Expanded PWM/GWR Project Recharge Assumptions

Project water is recharged through four deep injection wells (DIWs) and two vadose zone wells (VZWs). The Project recharges variable volumes of water each year, with an average of 5,750 acre-feet recharged per year. Of this, 90% of the water is delivered to the Santa Margarita aquifer through the deep injection wells, and the remaining 10% is delivered to the Paso Robles aquifer through the vadose zone wells. The amount of water recharged each year depends on whether the predicted hydrology is in a drought or non-drought year, and on the rules for banking and delivering water to the Castroville Seawater Intrusion Project (CSIP) for irrigation use in the Salinas Valley. A monthly recharge schedule that includes an accounting and description of the CSIP banking and delivery program is shown on the 11 x 17-inch sized table at the end of this technical memorandum. The expanded PWM/GWR Project Scenario allocation of recharge between different well sites is shown below in Table 2.

Table 2. Allocation of Recharge to DIWs and VZWs for expanded PWM/GWR Project Scenario, Percent

	Deep Injection Wells					Vadose Zone Wells	
Percent of Total Recharge	90%					10%	
Well Site	DIW-SITE-2	DIW-SITE-3	DIW-SITE-5	DIW-SITE-6	DIW-SITE-7	VZW-SITE-2	VZW-SITE-3
Percent of Deep Recharge	15%	15%	25%	25%	20%	-	-
Percent of Vadose Zone Recharge	-	-	-	-	-	50%	50%
Percent of Total Recharge	13.5%	13.5%	22.5%	22.5%	18.0%	5%	5%

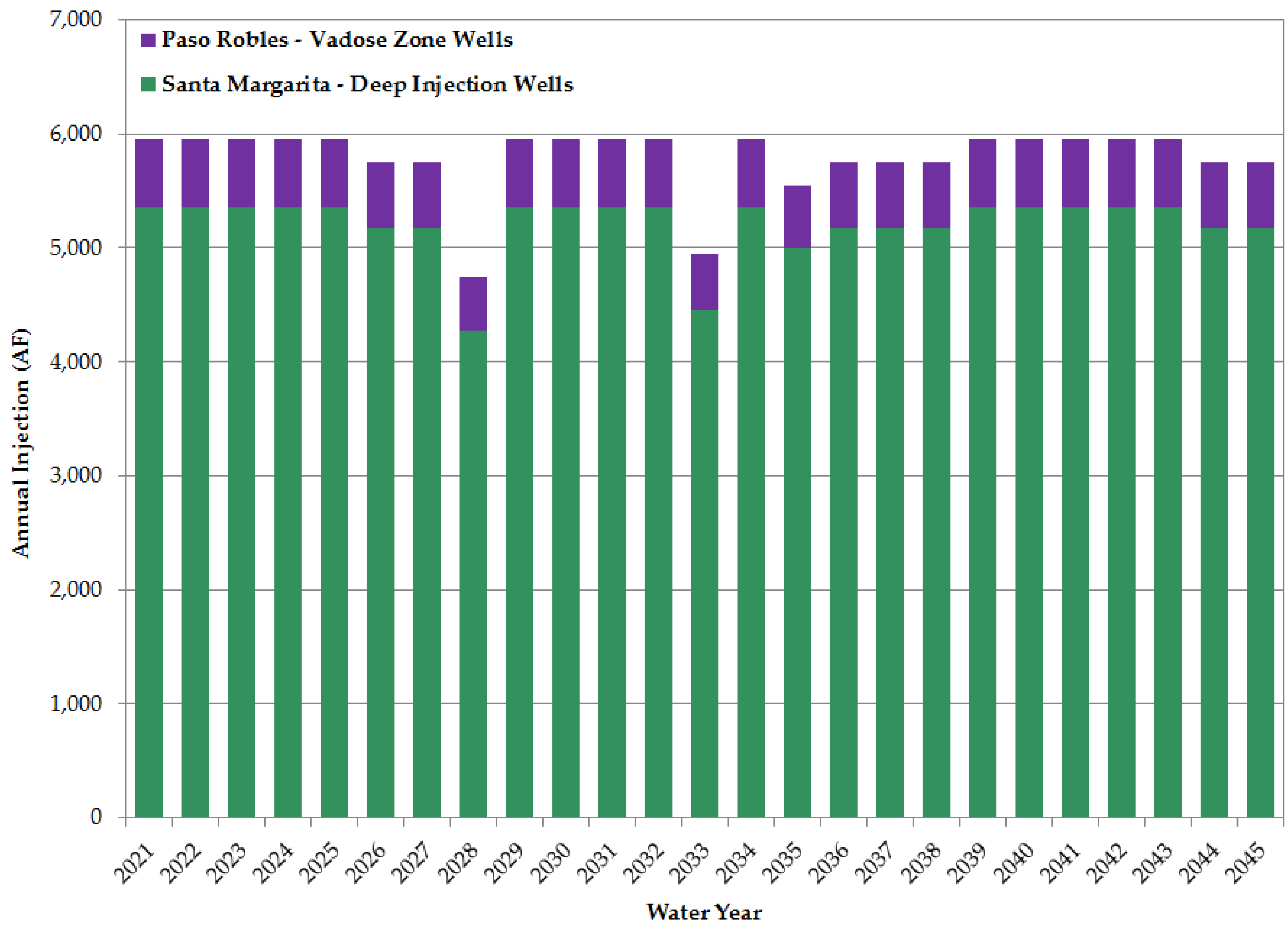

Figure 4: Expanded PWM/GWR Project Annual Recharge

Predicted Pumping Assumptions

HydroMetrics WRI made a number of assumptions about future pumping rates by various entities in the Seaside Basin for the original approved PWM/GWR Project EIR modeling (HydroMetrics, 2015). For the expanded PWM/GWR Project simulation, new Cal-Am pumping assumptions were developed based on predicted hydrology, water demands, pumping capacity, operational rules, and water availability. These assumptions were incorporated into a spreadsheet water supply/demand model developed by MPWMD (MPWMD, 2019), which was then used to assign Cal-Am pumping rate inputs for the groundwater model. Pumping assumptions for standard producers, alternative producers, and golf courses were consistent with assumptions developed for previous modeling efforts in the basin.

Model Year 1 through Model Year 3 Pumping

Actual historical pumping and injection data for all wells from January 2009 through December 2012 were used for the pumping input during MY1 through 3, consistent with previous simulations.

Municipal Pumping from Model Year 4 Onward

Predicted pumping by the City of Seaside and the City of Sand City follows the triennial reductions prescribed in the Amended Decision (California American Water v. City of Seaside et al., 2007). These pumping reductions are designed to reduce basin-wide pumping to the approximate safe yield of 3,000 acre-feet per year within eight years of implementation.

Cal-Am Pumping from Model Year 4 Onward

A number of assumptions were necessary to estimate Cal-Am's monthly pumping rates and pumping distribution. Cal-Am's predicted pumping constraints and demand are discussed below.

Cal-Am Pumping Constraints

- Predicted Cal-Am pumping comes from the five existing Cal–Am wells, two existing ASR sites, and four planned extraction wells. The five existing Cal-Am wells are Luzern #2, Ord Grove #2, Paralta, Playa #3, and Plumas #4. The two existing ASR well sites are ASR 1&2 and ASR 3&4. The planned extraction wells are EW-1, EW-2, EW3 and EW-4. These additional extraction wells are included in the expanded PWM/GWR Project because the total current capacity of the existing Cal-Am wells is not sufficient to meet predicted monthly demand.

- Data supplied by MPWMD indicate that the total pumping capacity of Cal-Am's existing non-ASR wells is 4,404 gallons per minute, or 19.46 AF/day.

- Based on information from MPWMD, we assume that only one ASR well extracts water from each ASR well pair site at a time. This means each ASR well site can produce 1,750 gallons per minute, or 7.7 AF/day. The total extraction capacity from ASR 1&2 and ASR 3&4 sites is 3,500 gallons per minute, or 15.4 AF/day. Each of the planned extraction wells is assumed to be able to produce 1,750 gallons per minute, or 7.7 AF/day. Although in practice, for the simulations it is assumed that only one well from each pair (EW-1&2 and EW-3&4) operates simultaneously, with the other well in the pair serving as a backup well. For these simulations, it was further assumed that the ASR-1&2 well pair does not extract water and only serves as an injection site This assumption is made possible because of the increased capacity from the additional proposed extraction wells.

- Injection of Carmel River water occurs only at sites ASR1&2 and ASR3&4, following the MPWMD schedule discussed in the Predicted Carmel River Flow and Injection section. These two sites are unavailable for extraction during injection months, and for the two months that follow injection. We make this assumption to allow disinfection byproducts formed during injection to degrade. Tests by MPWMD suggest that disinfection byproducts degrade within 45 to 60 days of injection in this basin.

- Extraction wells EW-3 and EW-4 are available for extraction while water is being injected at either site ASR-1&2 or ASR-3&4. This is possible due to the proposed modifications of Cal-Am's distribution system that will allow water to simultaneously flow from EW-3&4 to the main distribution system while Carmel River water is flowing to the ASR wells. Unlike with the ASR wells, well sites EW-3 and EW-4 can be pumped immediately after Carmel River injection ceases.

- For months when the ASR wells are not available, Cal-Am's pumping capacity (existing wells plus EW-1&2 and EW-3&4) is set to 34.86 AF/day. For months when the ASR sites are available for extraction, Cal-Am's pumping capacity is set to 42.56 AF/day (assumes only ASR-3&4 site extracts and that ASR-1&2 site does not extract).

Cal-Am Water Demand

The scenarios presented here are based on an annual demand that starts off at 10,400 acre-feet (AF) in October of MY8 (simulated year 2020) and increases linearly to 11,325 AF[7] through the end of MY33 (simulated year 2045). The monthly distribution of Cal-Am's annual deliveries, provided by MPWMD, was used to estimate future monthly demand, and are based on monthly averages of deliveries from 2007 to 2017. These values are summarized in Table 3.

Cal-Am's monthly groundwater pumping from the Seaside Basin is calculated by subtracting Cal-Am's Carmel River extractions for customer service, including Table 13 water rights[8], and

[7] MPWMD, "Supply and Demand for Water on the Monterey Peninsula," September 19, 2019.

[8] Cal-Am has legal rights to 3,376 AFA from the Carmel River comprised of 2,179 AF/yr from License 11866, 1,137 AF/yr of pre-1914 appropriative rights, and 60 AF/yr of riparian rights. Cal-Am received Permit 21330 from the State Water Board, referred to as Table 13 water rights for 1,488 AFA from the Carmel River. In addition, under the adjudication decision Cal-Am has rights to some additional water via a "Carryover Credit."

Sand City Desalination Plant supplies of 94 AF/year from the monthly demands shown in Table 3. MPWMD provided the monthly Table 13 diversion rates, which are based on projected hydrology and climate. Carmel Valley extractions for customer service and Sand City Desalination Plant flowrates are constant from year to year and are shown in Table 4.

Table 3: Cal-Am Estimated Monthly Demand

Month	Percent of Annual Delivery	Estimated Future Monthly Demand (AF) Model Year 8	Estimated Future Monthly Demand (AF) Model Year 33
October	9.1%	950	1,034
November	7.5%	778	847
December	6.7%	702	764
January	7.9%	819	892
February	6.8%	702	765
March	8.3%	863	940
April	8.2%	852	928
May	9.0%	933	1,017
June	8.9%	923	1,005
July	9.5%	983	1,071
August	9.5%	986	1,074
September	8.7%	907	988

Table 4: Cal-Am Carmel Valley Extraction and Sand City Desal Plant Supply, acre-feet

Month	Carmel Valley Extraction (AF)	Sand City Desal Supply (AF)
October	92	11
November	92	10
December	92	11
January	470	11
February	470	10
March	470	11
April	470	10
May	470	11
June	470	10
July	92	11
August	92	11
September	92	10

Assumptions behind these water sources are as follows:

- Cal-Am will produce only one million gallons per day from the Carmel River for customer service during summer months in order to preserve habitat flows while still maintaining minimum flows of 1 million gallons per day for operational and maintenance needs of their Begonia Iron Removal Plant

- The Sand City Desalination Plant supplies 125 AF/year to customers in the system at a constant daily rate.

- Additional water supplies are available from the Pacific Grove local water project when Sand City use of the desalination plant production increases.

Figure 5 shows how these water sources meet monthly Cal-Am demand. The purple line represents the total estimated monthly demand. The darkest blue area at the bottom of the graph represents the water supplied by the Sand City Desalination plant. The medium blue area in the middle of the graph represents water supplied from Carmel Valley for direct customer service. The light blue area represents Cal-Am's Table 13 diversion. Subtracting these three blue areas from the purple line yields the orange area, which is the remaining demand to be met by Seaside Basin pumping.

Water available for Cal-Am pumping

Cal-Am's future pumping from the Seaside Basin will be drawn from three pools of water, listed in the order in which they are applied to meet monthly demand:

- Native groundwater
- PWM project water recovery
- Carmel River ASR recovery

Figure 6 shows how Cal-Am's pumping is allocated to these three pools during the simulation. Pre-project values are consistent with previous model input (MY4 through MY7). On this figure, Cal-Am's annual Seaside Basin pumping needed to meet demand is shown by the dashed orange line. The area between the dashed orange line and the purple line represents the demand met by Table 13 water, direct service of Carmel River water, and Sand City Desal water. The amount of water pumped from each of the three pools is represented by the three colored areas under the dashed orange line. From future WY 2022 onward, the allotment from the three water pools is sufficient to supply the requisite pumping. This pool includes pumping for the SNG development from MY4 through 7, consistent with previous project models. The native groundwater pool is shown by the red area on Figure 6.

Cal-Am forgoes 700 AF of water from the native groundwater pool every year as a replenishment repayment once the CDO is met, which we assume occurs at the start of the project. Replenishment repayment is water Cal-Am must pay back to the Watermaster because Cal-Am has historically pumped more than their operating safe yield. We therefore assume that Cal-Am pumps only 774 AF/year of its assumed natural safe yield of 1,474 AF/year beginning in October 2020 (MY8). The 700 AF of natural safe yield not pumped over the 25-year period counts as in-lieu recharge, and is Cal-Am's replenishment repayment. Following demand projections from Cal-Am, we assume that native water is pumped at a constant daily rate in agreement with the annual water right. PWM project water is shown by the green area on Figure 6.

This water is projected to become available in WY2020 (MY8) and supply between 4,750 and 5,950 AF/year, in accordance with the climate-based projected injection schedule developed by M1W and Todd Groundwater (*PWM Expansion - Model Scenarios and Inj. Well Delivery*

Schedule 2019-08-01.xlsx). We assume zero PWM water in storage at the start of the Modified Project. PWM water in storage during the expanded PWM/GWR Project is shown by the green line on Figure 7.

Cal-Am's extraction of ASR water from the Carmel River is shown by the blue area on Figure 7. This water's availability is subject to climate conditions. Before Cal-Am has met the CDO (MY1 through MY7), the maximum allowed diversion rate of Carmel River water is 20 AF/day, and no ASR water can be stored from year to year. This is consistent with previous PWM models. Once Cal-Am meets the CDO (MY8), the maximum allowed diversion rate increases to 29 AF/day, and ASR water in storage is carried over from year to year. We assume that Cal-Am injects all of the water they are permitted to pump from the Carmel River on a monthly basis, and that ASR extraction is capped by ASR well capacity. The theoretical amount of ASR water in storage during the expanded PWM/GWR Project is shown by the blue area on Figure 7. The actual amount of ASR water stored during the project may be less than what is shown by the blue area on Figure 7 because some water may flow offshore or to adjoining basins.

During the first few months of the simulated Modified Project operation, in WY2020, there is not enough stored groundwater to allow Cal-Am to forgo its 700 acre-feet of replenishment repayment and meet all of its demands. To address this issue for 2020, we assume that Cal-Am will meet monthly demands by pumping excess native above its allotment. As ASR water in storage (Figure 7) increases later in WY2020, this credit against native groundwater is transferred to credit against the ASR water in storage, allowing Cal-Am to meet its native groundwater replenishment repayment for WY2020.

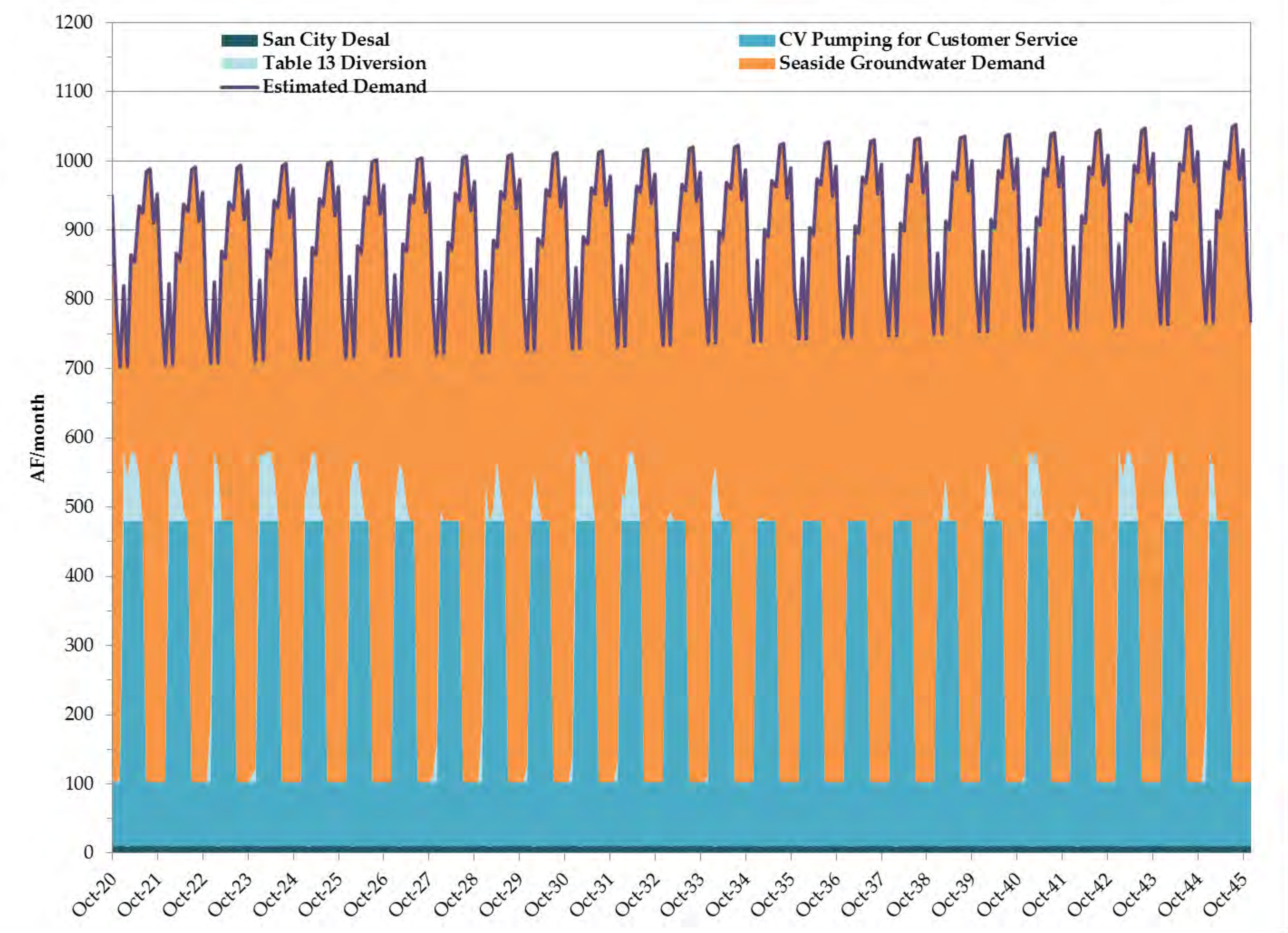

Figure 5: Monthly Demand, Non-Groundwater Sources, and Seaside Pumping Demand

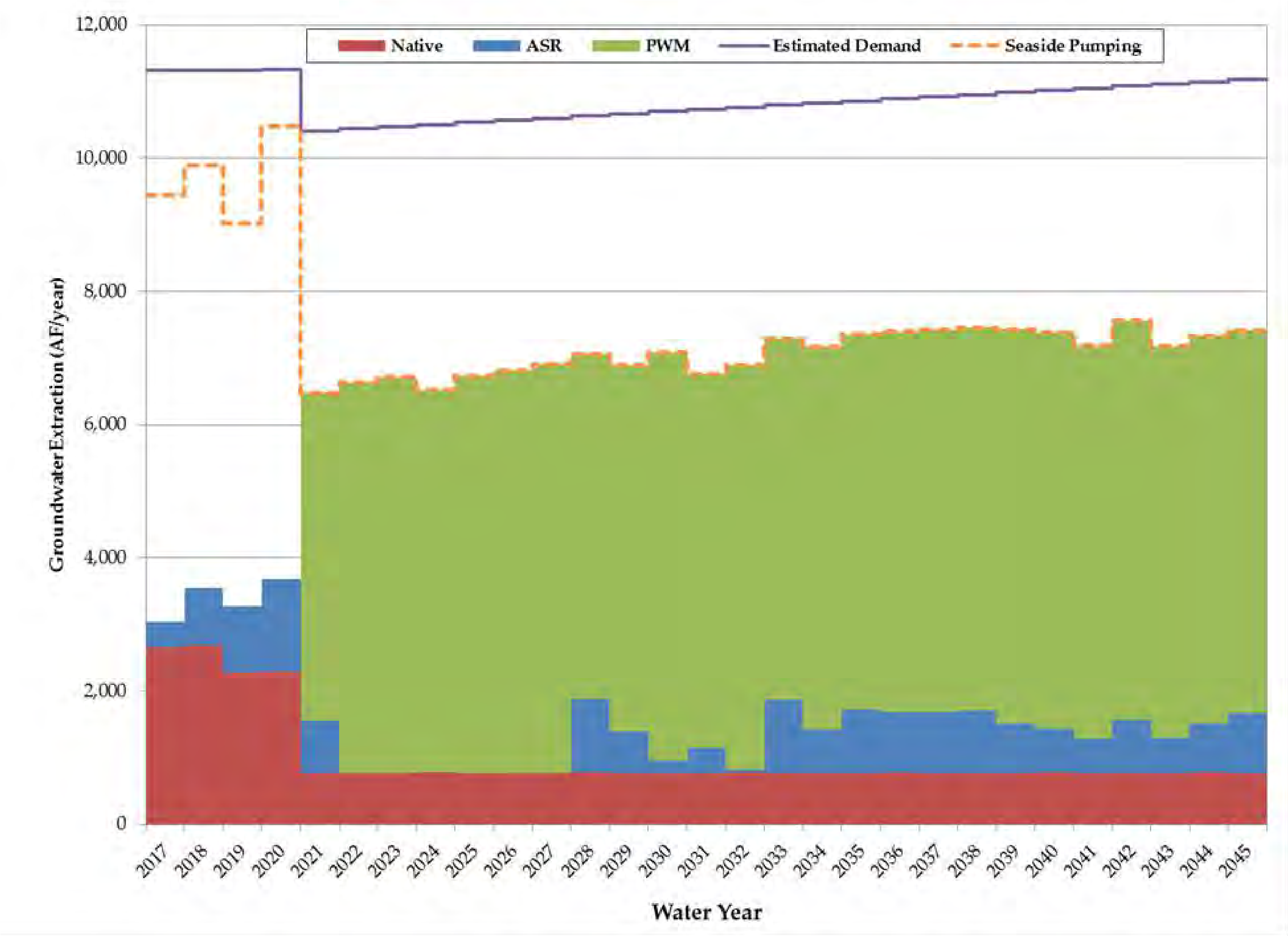

Figure 6: Annual Cal-Am Water Allocation by Water Right Source (expanded PWM/GWR Project)

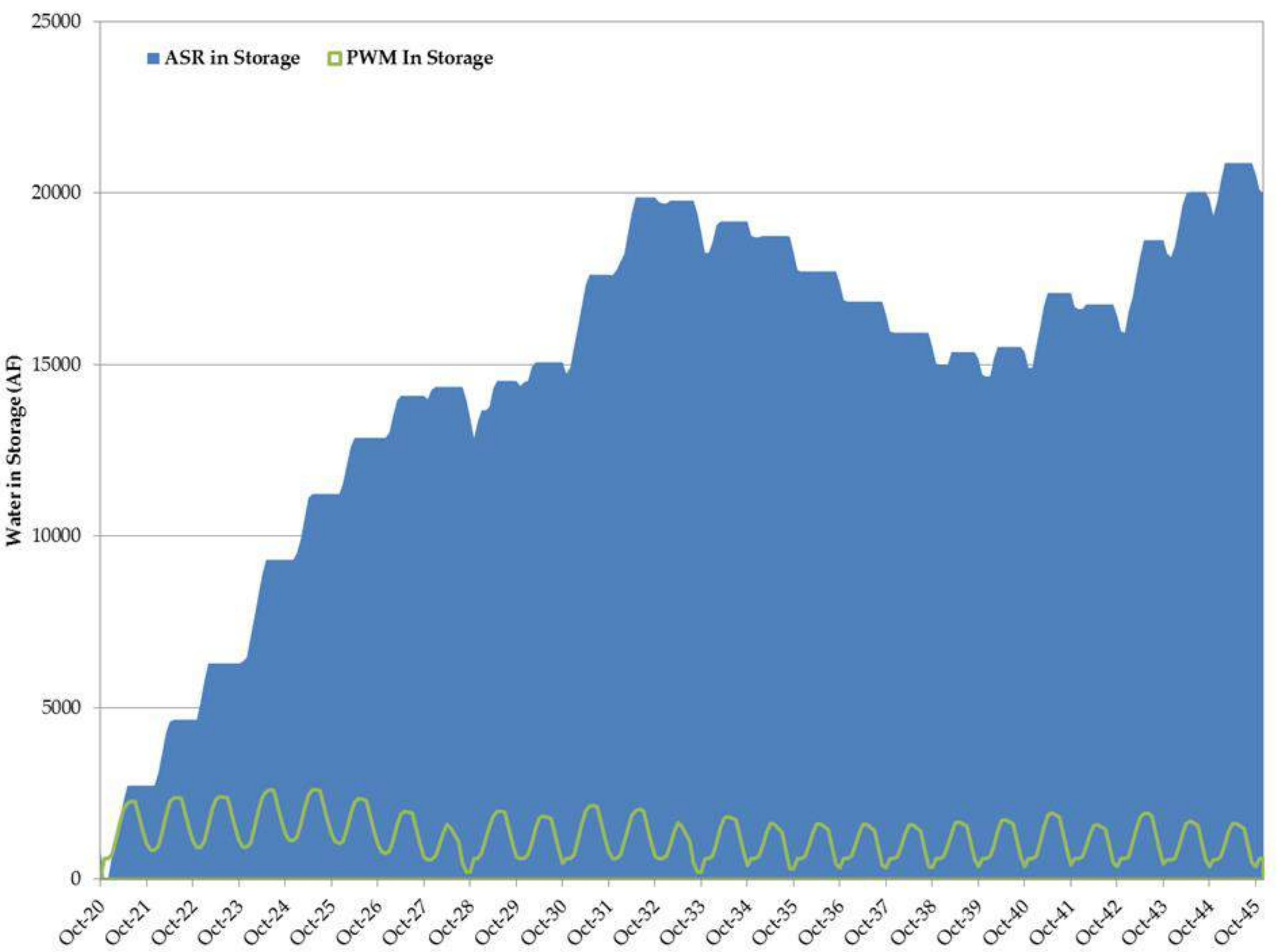

Figure 7: PWM and ASR Water in Storage

Pumping Allocation by Well

The following prioritization assignments were made with regard to allocating the extraction well capacity to meet the Cal-Am Seaside pumping demand:

- Ord Grove #2 (needs to always be pumping to keep system pressurized)

- When ASR Recovery is needed to meet Seaside pumping demand (e.g. Native Groundwater allowance plus PWM Recovery amount is insufficient) demand is met by assigning wells in the following order:
    - EW-1/EW-2 (single well pumping, second as backup)
    - EW-3/ EW-4 (single well pumping, second as backup)
    - ASR-3&4 (single well pumping, when not injecting or resting)

- At all other times when PWM and native groundwater are being extracted, the Seaside Basin pumping demand is met by assigning demand to the wells in following well order:
    - EW-1/EW-2 (single well pumping, second as backup)
    - EW-3/ EW-4 (single well pumping, second as backup)
    - ASR-3&4 (single well pumping, when not injecting or resting)
    - Paralta
    - Luzern
    - Playa 3
    - Plumas 4

Pumping in any month is first allocated to the Ord Grove #2 well up to its capacity. Demand is then allocated to the EW-1/EW-2 well up to its capacity, and so on. The ASR wells are considered unavailable for extraction if they are injecting water or have injected water at any time during the previous 3 months. The projected injection schedule is used to flag months during which the ASR wells would be unavailable. For these simulations, it was assumed that the ASR-1&2 site functions only as an injection well and is never used for extraction. This assumption is made possible by the increased well capacity from the additional proposed extraction wells.

During months when ASR wells are not available for pumping, the order of preference continues directly from the EW-1/2 and EW-3/4 well sites to Paralta, and so on. This generally occurs during early summer, when total pumping is high, and the ASR system has recently injected excess spring Carmel River flows.

Figure 8 shows monthly pumping by well. With Cal-Am's simulated demand, the total capacity of the first six wells listed above is sufficient for the requisite Seaside Basin pumping and the Playa 3 and Plumas 4 wells are not utilized at all.

When ASR water is being extracted, EW-1/2, EW-3/4 and ASR-3/4 wells are preferentially used to extract ASR water. If the ASR wells' capacity is inadequate to extract all ASR water, the remaining ASR water is allocated to the remaining wells as described above. If the ASR wells' capacity is greater than the ASR water allocated during a month, then the ASR wells remain available to extract native and PWM water up to their remaining capacity

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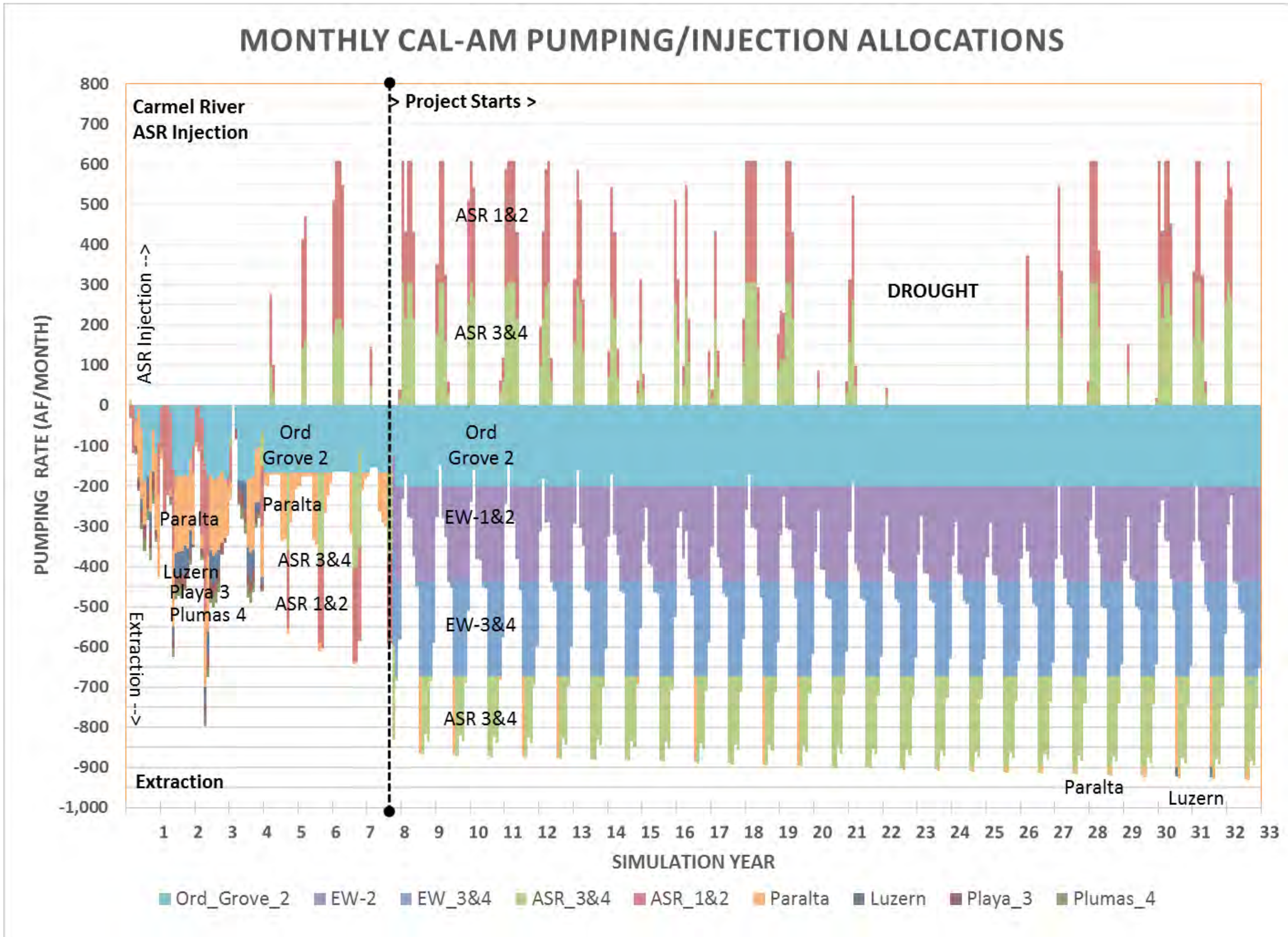

Figure 8. Monthly Pumping/Injection Totals by well

Golf Course Pumping from Model Year 4 Onwards

The simulation assumes that golf course pumping is based on the hydrologic year. For example, pumping in January 2015 was assumed to be the amount pumped in January 1993, because the simulated 2015 hydrology is based on 1993 hydrology. This ensures that the demand corresponds to the hydrology. If the amount pumped by a golf course pre-adjudication exceeded the golf course's adjudicated right, pumping was capped at the golf course's adjudicated amount.

Additional adjustments and assumptions were necessary for allocating future pumping at the two irrigation supply wells (named Seaside GC-Reservoir and GC-Coe) associated with the City of Seaside Bayonet and Blackhorse golf courses and which are downgradient of the PWM injection facilities and screened in the shallow aquifer. The simulated pumping could not be directly based on cycling the historical pumping values from the original model calibration period because of a number of changes that occurred in the operation and set up of the irrigation supply system, including:

- the installation of a second irrigation well (Seaside GC-Reservoir, in 1998),
- irrigation upgrades in 2007 that reduced irrigation demand by approximately 10% from historical amounts, and
- a 7-year period from 2009 to 2016 during which no pumping occurred because of an in-lieu replenishment program implemented by the City of Seaside, during which Marina Coast Water District provided water in-lieu of the City pumping from the Seaside Basin.

The following methodology was used to develop a pumping schedule for each well that represented the average pumping conditions at each well and also included seasonal patterns in irrigation demand. To characterize the seasonal irrigation demand, the monthly averages of pumping rates were calculated for historical periods when both of the Seaside Golf Course wells were operating, with pumping rates scaled by 90% for the period between 1999-2009 to account for the earlier lower irrigation efficiency and 100% for the 2016-2017 period. These projected monthly average extraction rates were then cycled uniformly for all model periods starting in 2016 (MY3), rather than basing demand based on the historical hydrology year. The average total demand used is 483 AF/yr from GC-Reservoir and GC-Coe combined. This is an update to the approach used in the original 2015 EIR modeling, which resulted in lower pumping rates and periods with only one of the two wells pumping. Additionally, previous simulations had the in-lieu replenishment end (and Seaside golf course pumping resume) in MY8, but this now occurs in MY3 to align with the simulated 2016 model year.

Predicted Alternative Producer and Private Pumping

Predicted alternative producer pumping was set at measured WY 2011 volumes from WY 2013 onwards. All other pumpers not covered by the Decision, including Cal Water Service and private wells, also pumped at WY 2011 volumes from WY 2013 onwards.

The simulation accounted for the following pumping exceptions:

- Water for SNG, which is an Alternative Producer, would be supplied from Cal-Am wells under an agreement with Cal-Am. When the SNG site is developed they will be supplied with water by Cal-Am, who will use SNG's water right of 149.7 acre-feet/year. Currently there is no production from the SNG well. Based on input from the property owner, Ed Ghandour, project construction was simulated as starting in 2013, and used 25 AF/yr of water. Water usage thereafter was estimated to be:
  - 2014 - 30 AF/yr
  - 2015 – 50 AF/yr
  - 2016 onwards – 70 AF/yr

NO-PROJECT SCENARIO

The No-Project scenario developed for the original 2015 PWM\GWR Project EIR analysis was also used as a No-Project scenario in the current analysis to show overall changes in groundwater conditions due to implementation of the expanded PWM/GWR Project. The No-Project scenario included all of the assumptions on future hydrology, future municipal pumping, and future alternative producer pumping discussed above, with the exception that the updates to pumping for the City of Seaside Golf Course wells described above were not included. Neither the approved nor expanded PWM\GWR Project injection was also included in the No-Project scenario. There are minor differences in the assumed ASR injection and extraction schedule between the No-Project scenario and the expanded PWM/GWR Project scenario due to updated information provided by MPWMD. The No-Project scenario did not assume that Cal-Am would meet the CDO; ASR water in storage was not carried over from year to year and does not accumulate over the course of the No-Project simulation. The pumping capacities of the existing Cal-Am wells were assumed to be lower under the No-Project scenario (consistent with the original pumping capacities used in the 2015 EIR analysis). The No-Project scenario did not include the updated modified Seaside Golf Course pumping rates, and instead uses the cycled historical values used in the 2015 EIR modeling. The No-Project scenario also did not include any of the approved or proposed PWM injection wells or the proposed additional extraction wells EW-1, EW-2, EW-3 and EW-4 or any of the other proposed modifications. The total annual amount of water pumped by Cal-Am is shown on Figure 9. The monthly pumping by well for the No-Project scenario is shown on Figure 10.

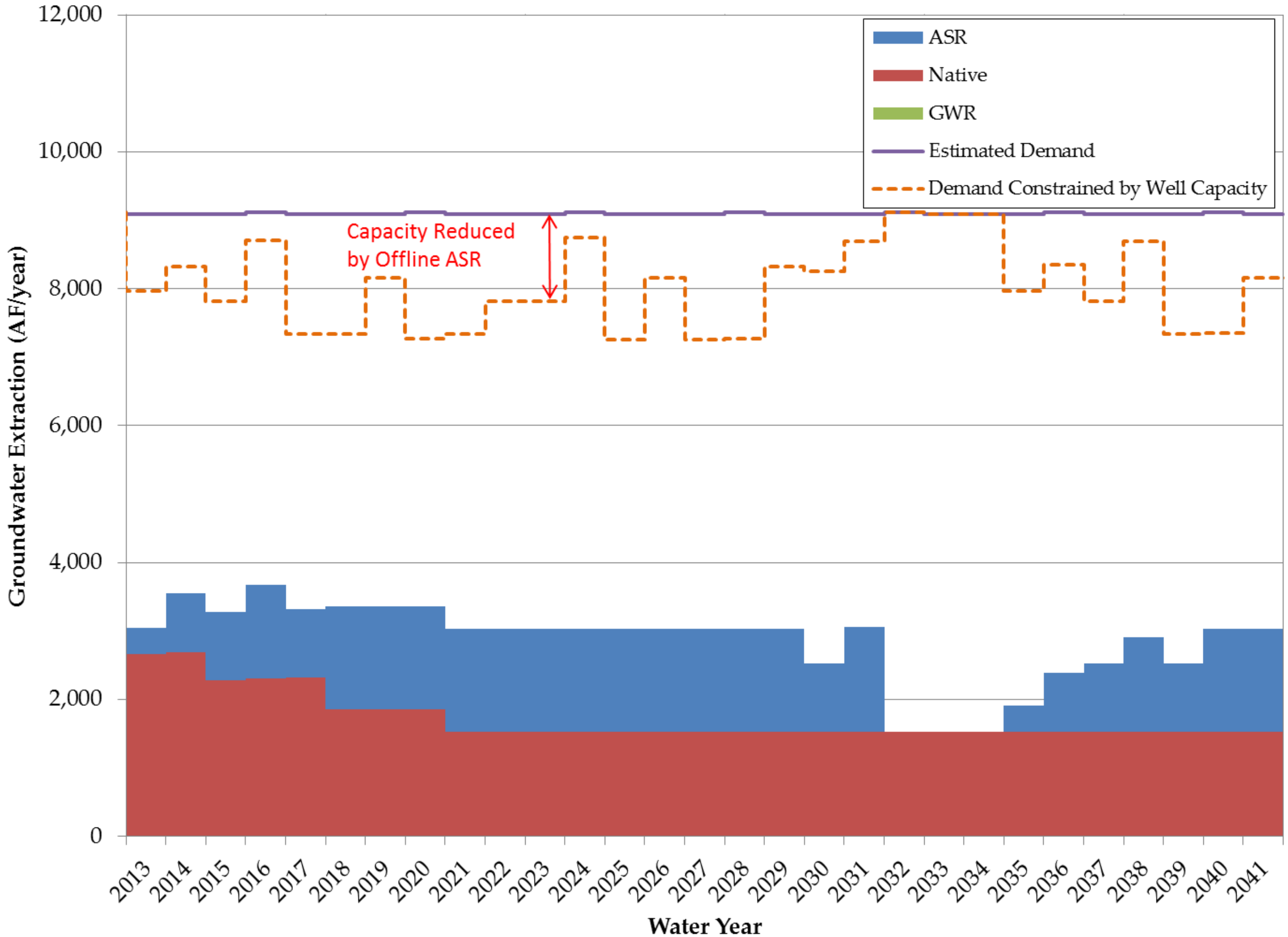

Figure 9. Annual Cal-Am Water Allocation by Water Right Source for No-Project Scenario

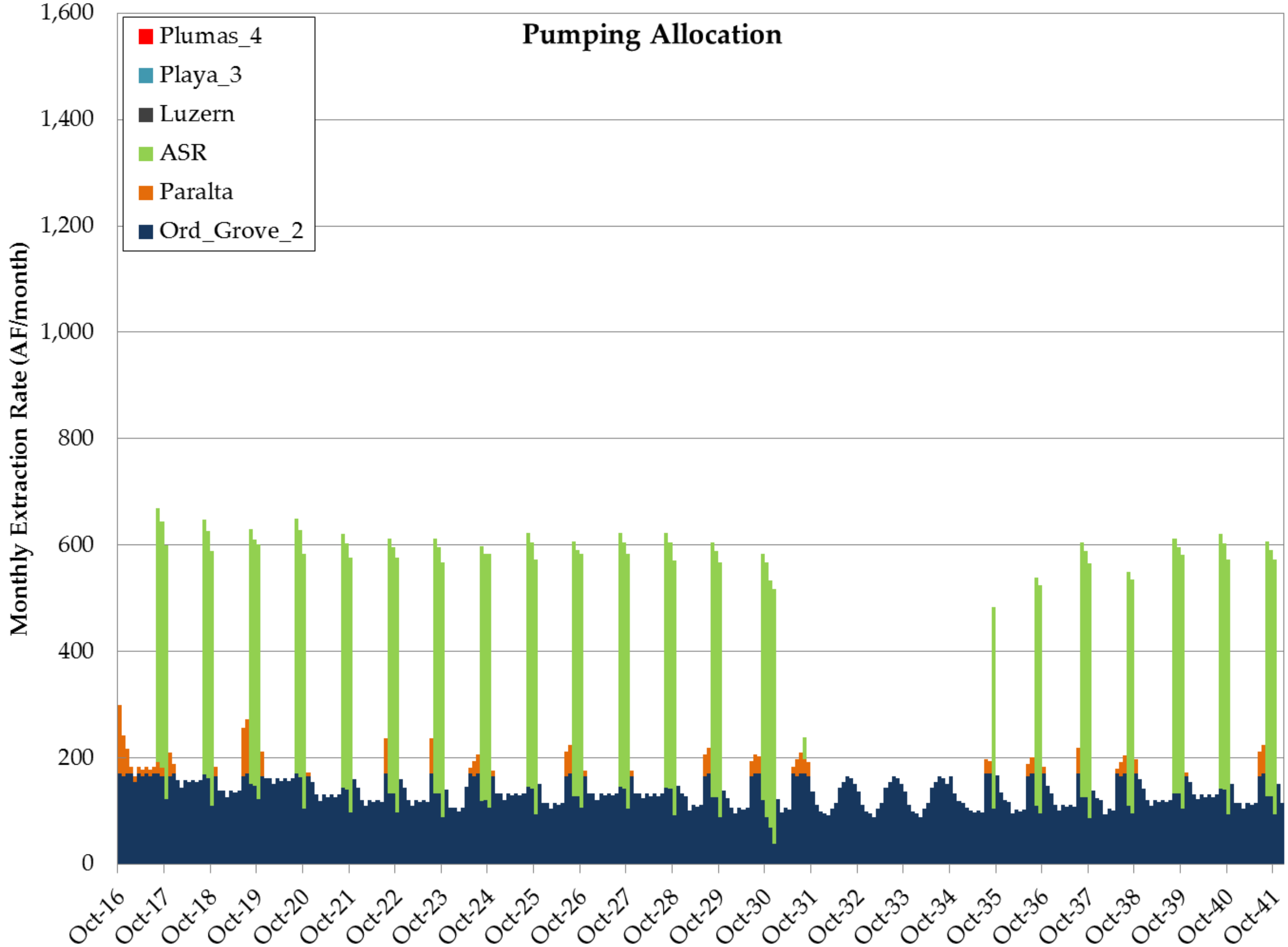

Figure 10. Monthly Pumping Totals by Well for No-Project Scenario

PARTICLE TRACKING APPROACH

Particle tracking was conducted to estimate the fate and transport of injected PWM Project purified recycled water for the expanded PWM/GWR Project. Particles were released uniformly from the seven PWM Project injection wells during the 25-year simulated project period corresponding to October 2020 through December 2045 (corresponding to MY7.8 to MY33). A set of 40 particles was released into the aquifer from each recharge well at the beginning of each month of simulated project operation. Every particle was tracked through the model until it terminated at an extraction well, or until the end of the simulation period in 2045. Introducing the particles continuously ensured that there were particles introduced and tracked during times when the travel times would be the fastest.

Particles were placed along the edges of each of the model grid cells that contained the injection and vadose wells; grid cell dimensions are shown below in Table 5. This strategy ensured that the particles are carried outward in all directions in the same manner that water would travel radially from a well. Placing many particles at the exact location of the well can produce the undesirable result of limited flowpaths taken by introduced particles. While the approach of placing particles around the edge of the model cell gives a more accurate picture of the dispersal pattern of the water from the injection wells, it also places some particles initially closer to the extraction wells than other particles, resulting in faster predicted travel times than would occur if the water were injected at the actual position of the wells within the grid cell.

Table 5. Dimensions of Model Grid Cells Containing Project Recharge Wells

Recharge Well	Model Grid Cell Dimensions		
	Side Length 1 (ft)	Side Length 2 (ft)	Area (ft^2)
DIW-SITE-2	100.0	375.0	37,500.0
DIW-SITE-3	150.0	281.5	42,225.0
DIW-SITE-5	400.0	500.0	200,000.0
DIW-SITE-6	400.0	500.0	200,000.0
DIW-SITE-7	400.0	500.0	200,000.0
VZW-SITE-2	100.0	250.0	25,000.0
VZW-SITE-3	225.0	281.5	63,337.5

A particle is “captured” by an extraction well when it reaches the edge of the model grid cell that contains the extraction well, not when it reaches the exact location of the extraction well. This also results in faster predicted travel times than if the particle was “captured” when it reached the actual well location. The results shown below should therefore be considered conservative modeled estimates as they do not include the additional travel time that would occur from the edge of the grid cell to the actual location of the extraction well. For VZWs, the particles are simulated as being released at the top of water table. Thus, simulated travel times are conservative, because they do not include the time for the recharged water to percolate through the vadose zone to the Paso Robles Aquifer. A brief analysis estimating the magnitude of the additional intra-cell and vertical vadose zone travel times is presented at the end of the results section.

Expanded PWM/GWR Project Scenario Model Results

An expanded PWM/GWR Project Scenario with a 90% and 10% split between deep injection wells and shallow vadose zone recharge wells was simulated and evaluated. Results are presented below which evaluate changes in groundwater elevations, water budget components, and residence time of injected water.

Groundwater Elevation Results

The impact of the expanded PWM/GWR Project on groundwater elevations was determined by comparing results with results from the No-Project baseline scenario. Simulated groundwater elevations from the expanded PWM/GWR Project Scenario and the No-Project Scenario were compared at the following eight wells:

- ASR 1&2
- City of Seaside #3
- Ord Grove #2
- Paralta
- Luzern
- PCA-West (Shallow)
- PCA-West (Deep
- Sentinel #3

Figure 11 shows the location of the wells used to analyze groundwater elevations in green, the Project Scenario injection wells in both violet and dark green, and the proposed new extraction wells in pink. These wells span the area between the expanded PWM/GWR Project Scenario injection wells and the coast. Several of the major recovery wells for the project water are also included in this set of wells.

Hydrographs for simulated groundwater elevations under the No-Project and expanded PWM/GWR Project scenario are shown on Figure 12 through Figure 19. The blue lines represent the simulated static groundwater elevation under the No-Project scenario and the green lines represent the simulated static groundwater elevation under the Modified Project scenario. The horizontal axis represents time in years since the start of the simulation. The start date of the injection project is shown as dotted light blue line. In general, the expanded PWM/GWR Project scenario hydrographs show long-term increases in average groundwater elevations relative to the No-Project hydrographs. Increased groundwater elevations are apparent within one year of the start of the expanded PWM/GWR Project, with the hydraulic head in the wells screened in the deeper confined Santa Margarita aquifer increasing the most quickly, and the water level rise in the wells screened in the unconfined shallow aquifers showing a more gradual increase.

The hydrographs for the wells closest to the ASR and PWM injection sites (ASR 1&2, City of Seaside #3, Ord Grove #2, and Paralta) show long-term groundwater elevation increases of between approximately 5 to 20 feet above the No-Project baseline. The amplitude of annual groundwater elevation fluctuations increases under the expanded PWM/GWR Project conditions, a result of both the higher injection and extraction rates. The expanded PWM/GWR Project groundwater levels in these wells show a decreasing trend during the simulated drought period that runs from MY20 through MY25, compared with a stable trend during the drought in the No-Project baseline. This downward trend reflects extraction of PWM water in storage during the simulated drought.

The expanded PWM/GWR Project scenario hydrographs also reveal increasing groundwater elevations farther to the west of the injection sites. At the Luzern well (Figure 14), screened in the shallower Paso Robles aquifer, groundwater elevations rise by between 5 and 10 feet above the No-Project baseline during the Project. At the PCA-West Shallow well (Figure 15), groundwater elevations rise by 1 to 2 feet. These wells are screened in the upper unconfined aquifer, so the effect of increased injection and extraction in the Santa Margarita Aquifer on annual variability is somewhat dampened.

Hydrometrics WRI (2009) previously developed protective groundwater elevations at four coastal monitoring wells, including the PCA-West wells, to help evaluate and manage the potential for seawater intrusion in the Seaside Basin. A comparison of the simulated PCA-West well hydrographs for the expanded PWM/GWR Project and No-Project scenarios relative to the protective groundwater elevations provides insight into the potential impacts of the expanded PWM/GWR Project on seawater intrusion potential in the Seaside Basin. As shown on Figure 15, the groundwater elevations at the PCA-West Shallow well are consistently above the protective elevation for the shallow aquifer both during the expanded PWM/GWR Project and also for the No-Project baseline and reach over five feet above the protective elevation by the end of the simulated expanded PWM/GWR Project. Figure 16 shows that groundwater elevations at the PCA-West Deep well are consistently below the protective elevation for the Santa Margarita Aquifer in both the No-Project baseline and the expanded PWM/GWR Project scenario. This indicates that there is a potential for seawater intrusion both with and without the expanded PWM/GWR Project at this location. However, the simulated water levels for the expanded PWM/GWR Project scenario levels are 5 to 10 feet higher in elevation than for the No-Project scenario. These hydrographs suggest that the expanded PWM/GWR Project decreases the potential for seawater intrusion at this location. The hydrographs for the Sentinel 3 monitoring well (Figure 19), located at the coast and screened in the deeper aquifer down gradient of the DIW-SITE-5 and DIW-SITE-6 injection sites, are similar to PCA-West Deep, where the No-Project baseline water levels are always below the protective elevation established for the well. The expanded PWM/GWR Project water levels are on average 5 to 10 feet above No-Project water levels and are above the protective elevation for periods of time, indicating that the expanded PWM/GWR Project decreases the potential for seawater intrusion at this location.

Figure 11. Locations of Selected Wells with Groundwater Elevation Comparisons

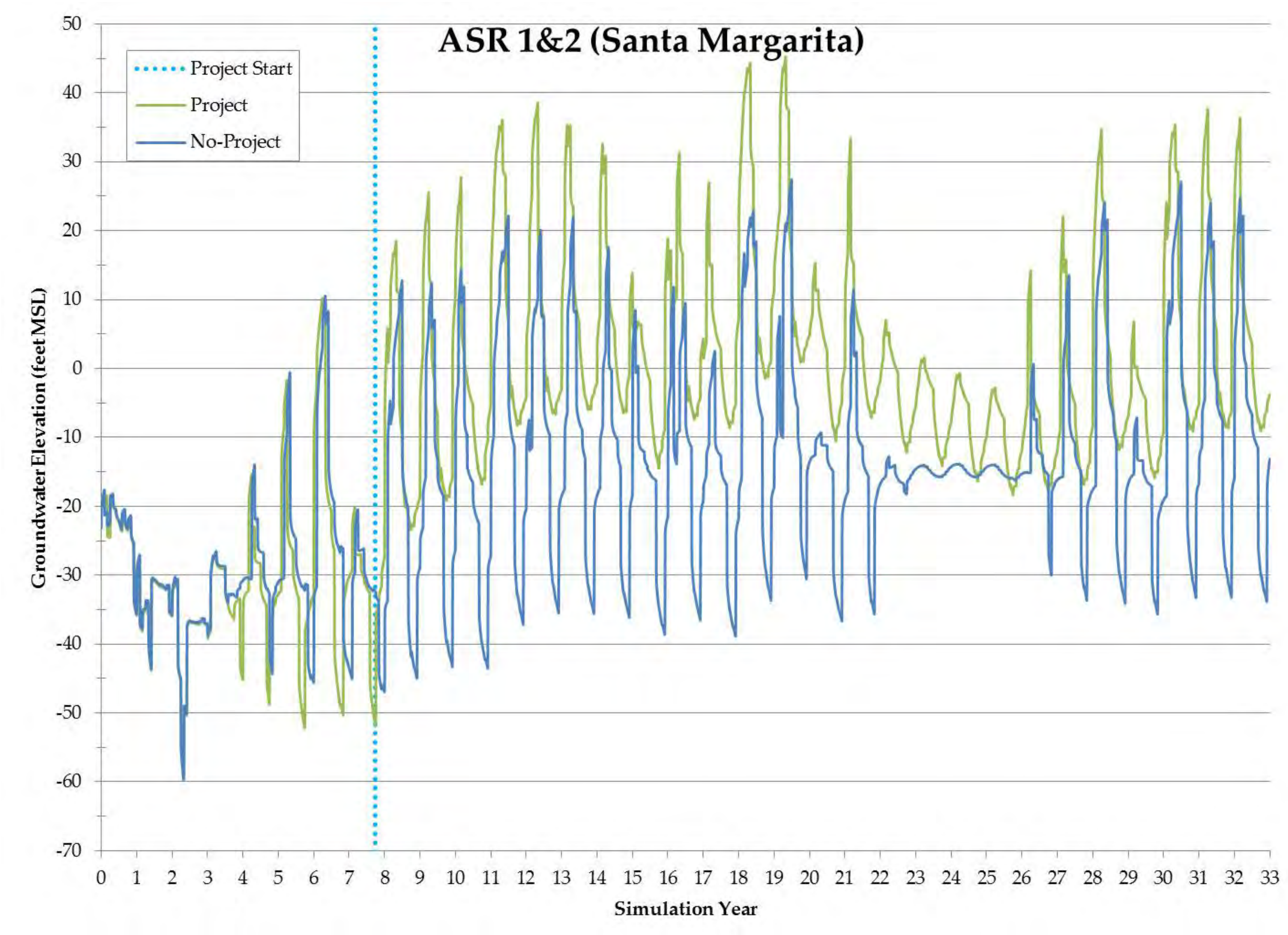

Figure 12. Predicted Static Groundwater Elevations at ASR 1&2 Wells

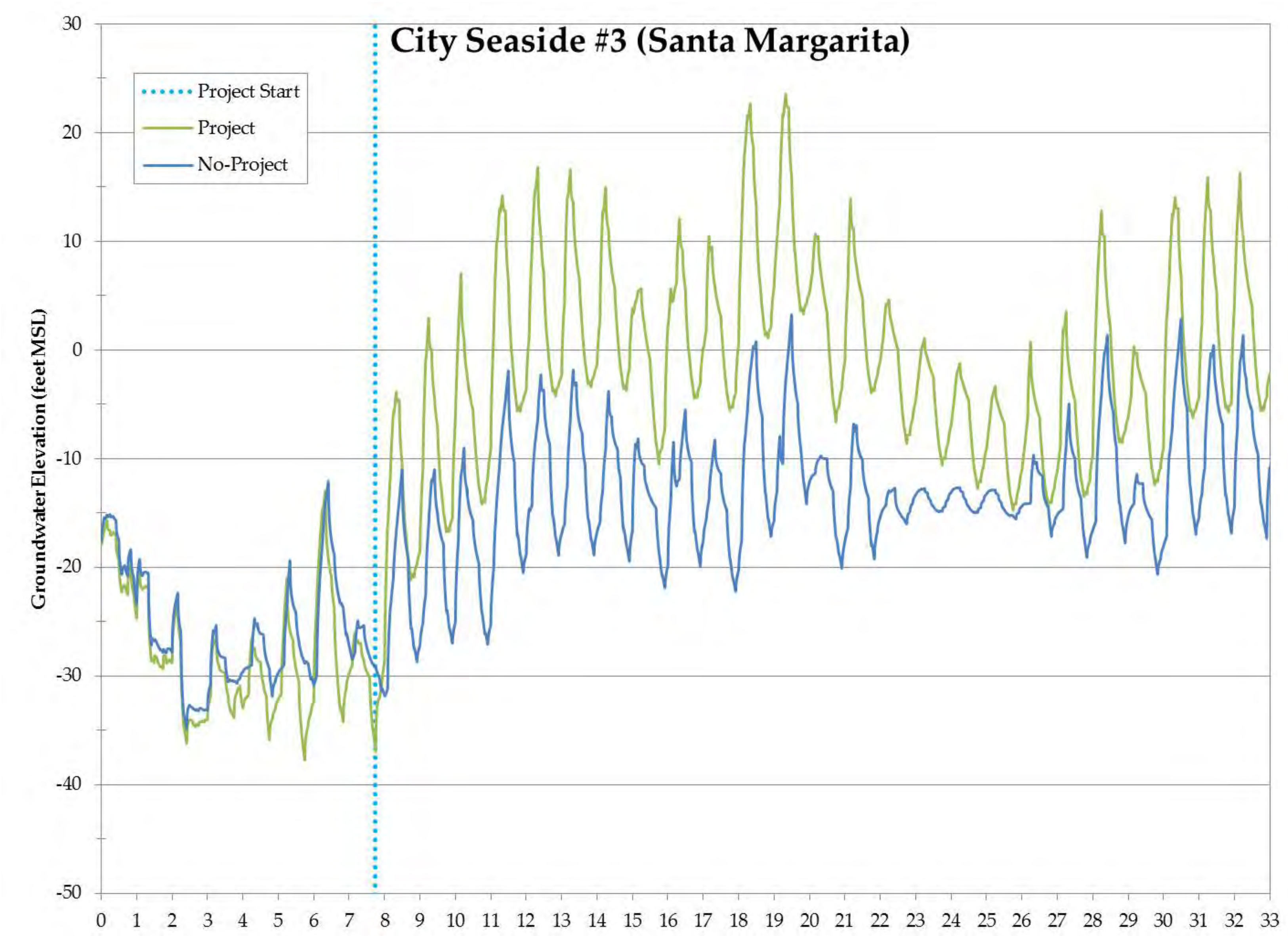

Figure 13. Predicted Static Groundwater Elevations at City of Seaside 3 Well

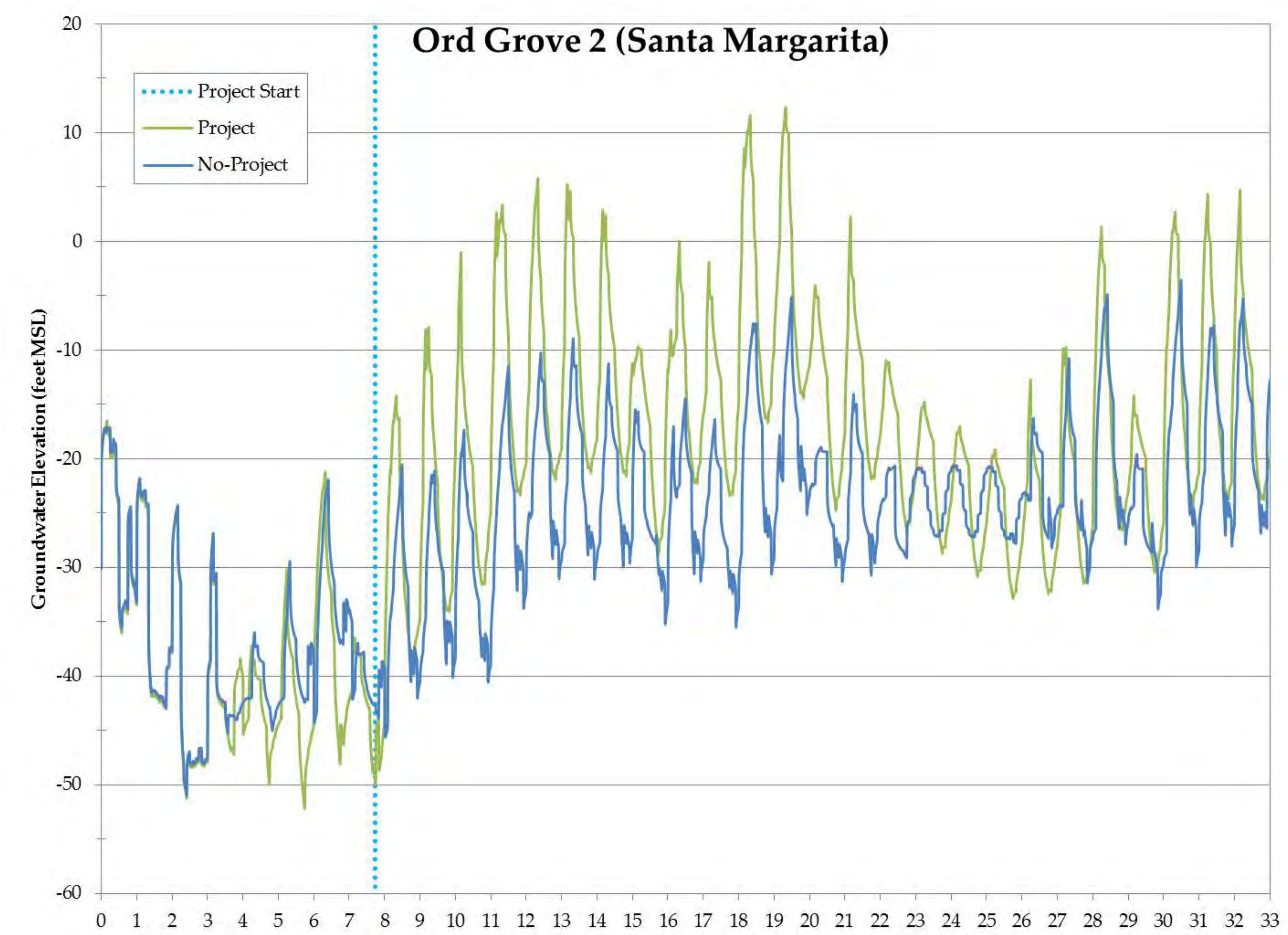

Figure 14. Predicted Static Groundwater Elevations at Ord Grove 2 Well

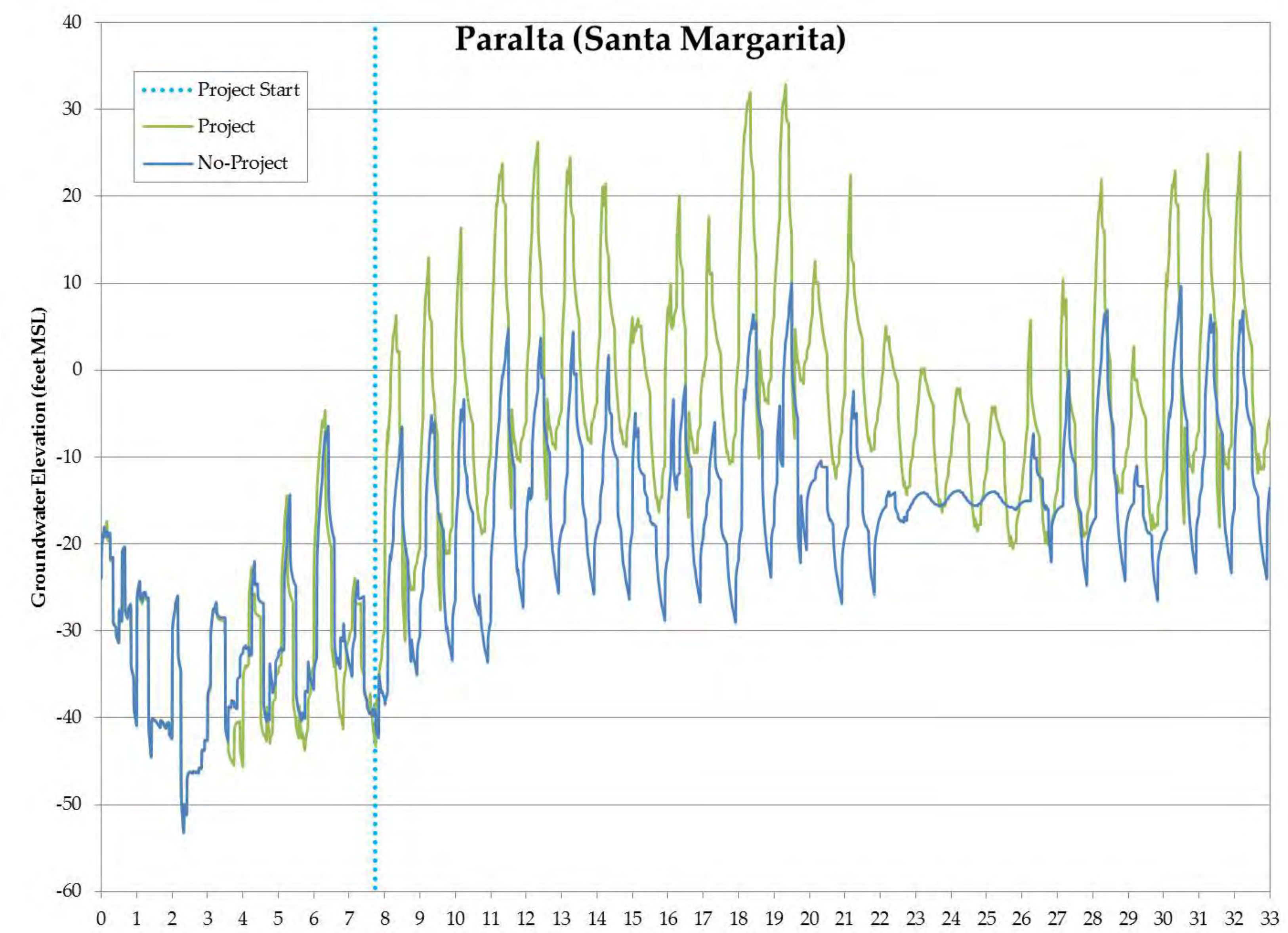

Figure 15. Predicted Static Groundwater Elevations at Paralta Well

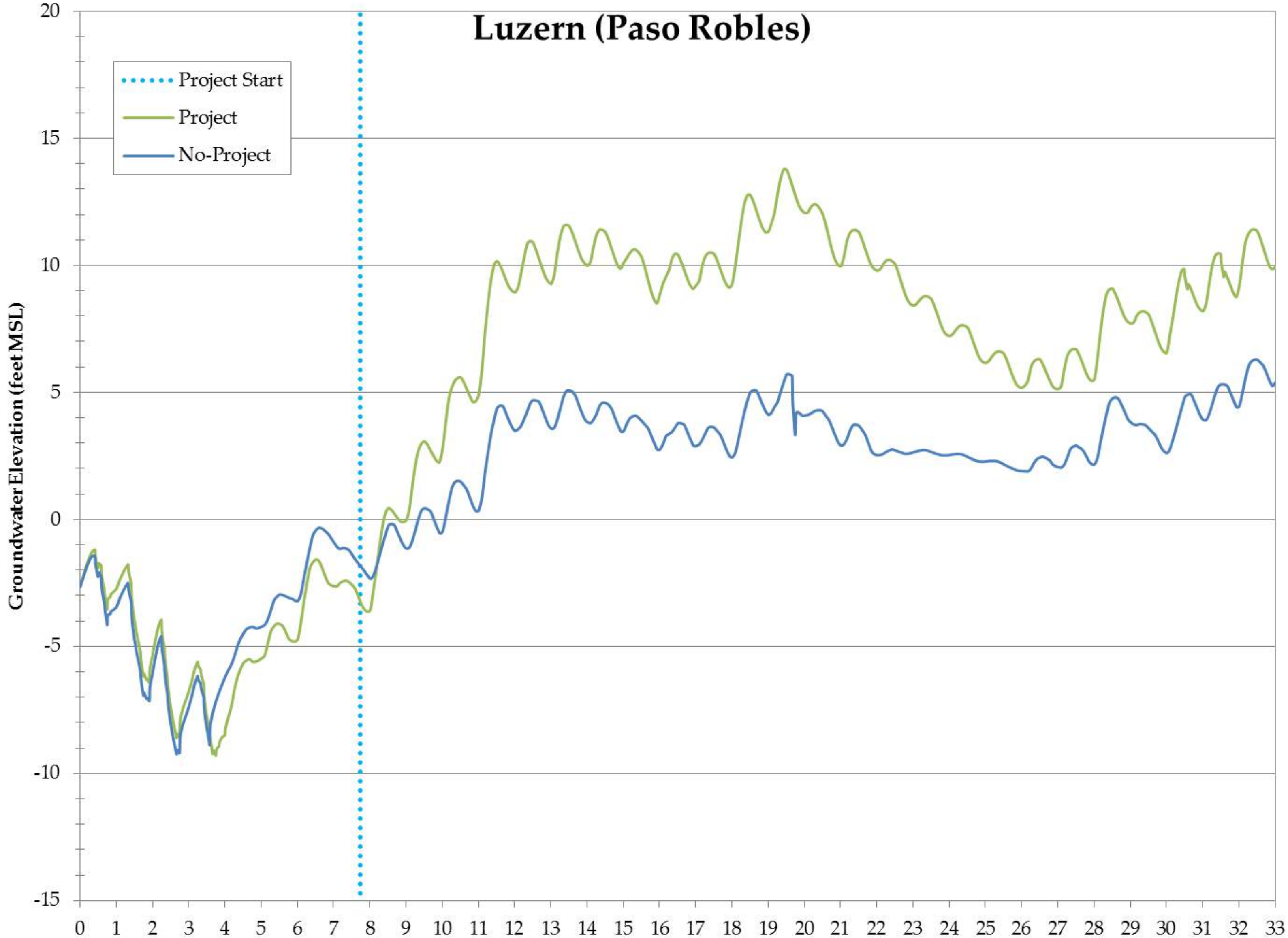

Figure 16. Predicted Static Groundwater Elevations at Luzern Well

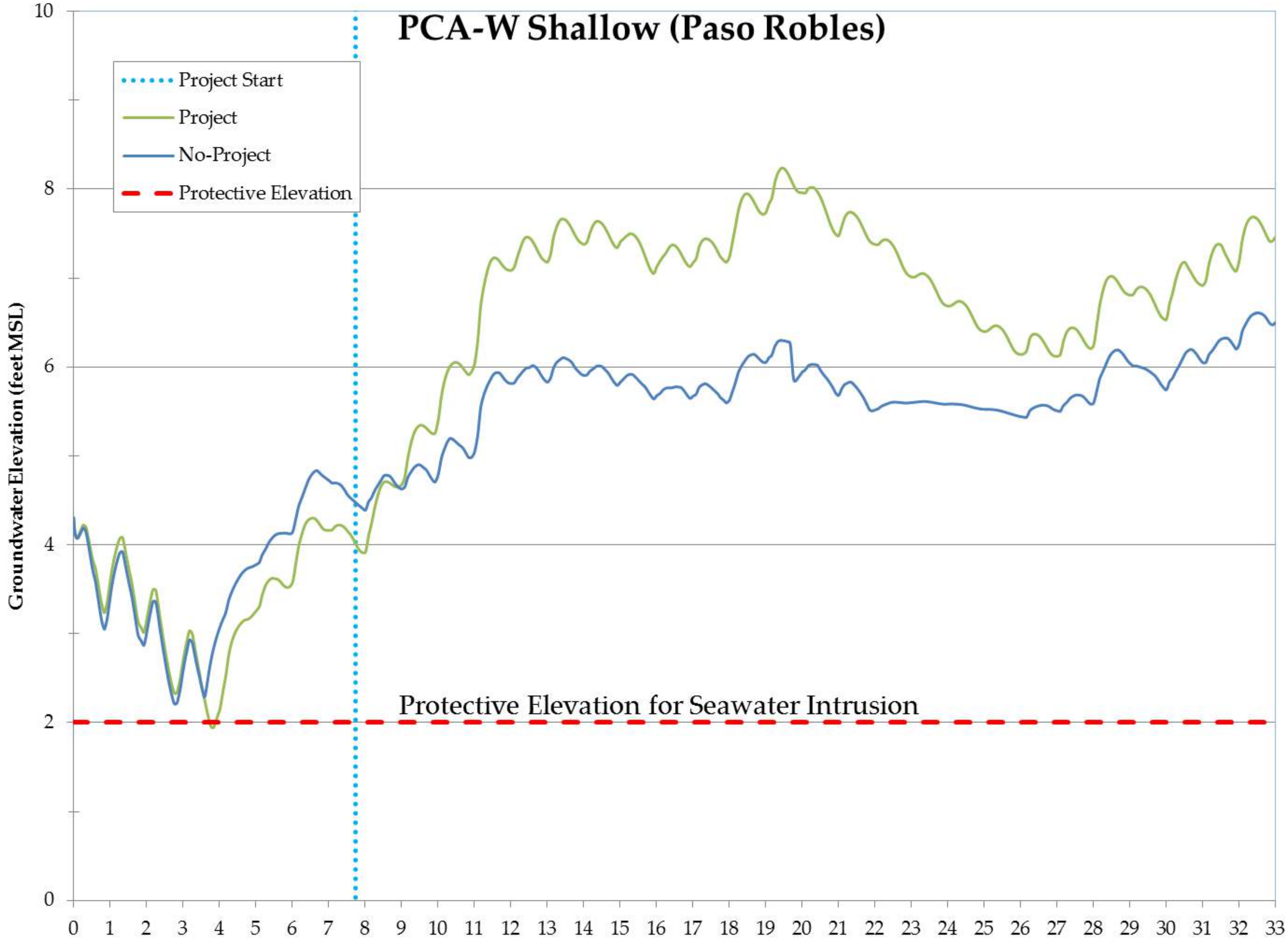

Figure 17. Predicted Static Groundwater Elevations at PCA-West Shallow Well

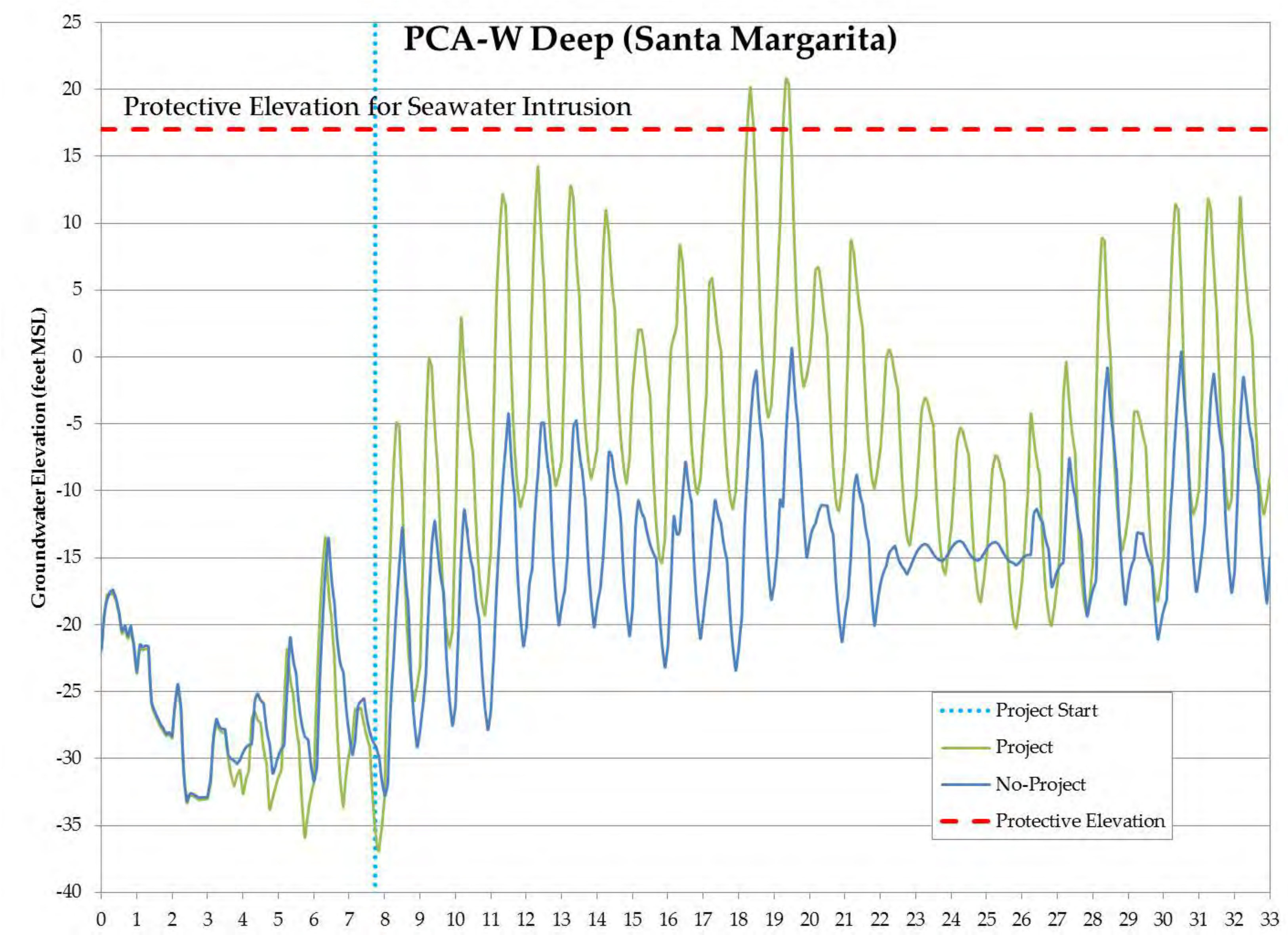

Figure 18. Predicted Static Groundwater Elevations at PCA-West Deep Well

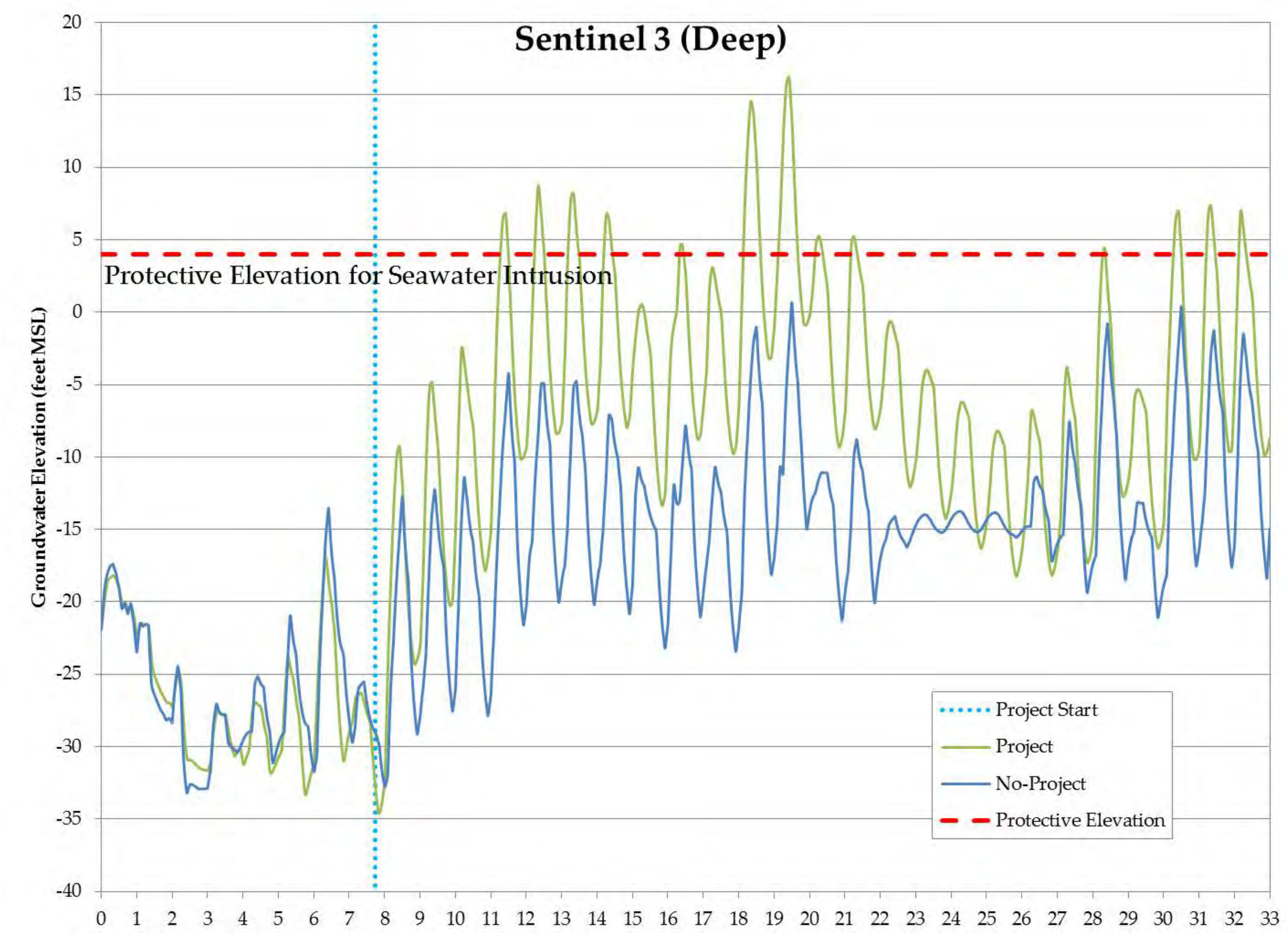

Figure 19. Predicted Static Groundwater Elevations at Sentinel 3 Well

Water Budget Results

Water budgets of simulated annual average groundwater inflows and outflows to the Seaside Basin were calculated for the No-Project Baseline scenario and the expanded PWM/GWR Project scenario and are summarized below in Table 6. The right-most column shows the net difference between the expanded PWM/GWR Project and the No-Project Baseline scenario. The net difference shows that compared to No-Project baseline scenario the expanded PWM/GWR Project results in a slight reduction of inflows from offshore areas, while outflows to the offshore area increase, both of which would serve to reduce the potential for seawater intrusion. Outflows into the adjacent Monterey Subbasin also increase, but on average the expanded PWM/GWR Project increases the amount of water being put into storage (inflow-outflow) in the Seaside Basin each year by 400 AF/yr.

Table 6. Simulated Average Annual Groundwater Budget for Water Years 2021 to 2045, units in AF/yr

Inflow/Outflow Source	No-Project Baseline Scenario	Expanded PWM/GWR Project Scenario	Net Difference (Expanded minus No-Project)
Inflows			
Shallow Aquifer Recharge[9] (precipitation, irrigation, system losses, recharge ponds, and PWM Vadose Zone Wells)	3,834	4,436	602
Deep Aquifer Injection wells[10] (ASR and PWM wells)	1,428	6,810	5,381
Groundwater inflow			
From Outside Basin (onshore)	1,167	1,518	351
From Offshore Area	255	197	-58
Total inflows	*6,684*	*12,961*	*6,277*
Outflows			
Extraction wells	3,391	8,287	4,896
Groundwater outflow			
To Outside Seaside Basin (onshore)	2,305	3,110	805
To Offshore Area	546	723	177
Total outflows	*6,243*	*12,120*	*5,878*
Storage Change (Inflows - Outflows)	*441*	*841*	*400*

[9] Shallow aquifer recharge for the No-Project scenario does not include any PWM/GWR Vadose Zone Well recharge, and only includes recharge from precipitation, irrigation, leakage from water conveyance systems, and municipal recharge ponds.
[10] Deep aquifer injection wells for the No-Project scenario only include the ASR wells

Particle Tracking Results

Figure 20 and Figure 21 show the flow paths taken by each particle (in a group of particles all released on the same date) from the initial injection locations. Each particle is either captured by an extraction well or is still in transit within the aquifer at the end of the simulation period. The position of each particle is color-coded based on travel time (in months). Figure 20 shows the paths originating from the five deep injection well (DIW) sites – DIW-SITE-2, DIW-SITE-3, DIW-SITE-5, DIW-SITE-6 and DIW-SITE-7 in the Santa Margarita Aquifer. Figure 21 shows the particle paths originating from the shallow aquifer VZWs at VZW-SITE-2 and VZW-SITE-3. The particle tracks shown on each figure display the fate of all particles that were released in the model period corresponding to nine years after the start of the project (simulated October 1, 2029). This date was selected because it is the release period resulting in the fastest simulated travel time (615 days, or 20.2 months, between DIW-SITE-3 and the Ord Grove 2 municipal supply well). The travel time color-coding illustrates that although the fastest particle travel path from the deep injection may reach Ord Grove 2 in under two years, the majority of particles don't arrive until after more than two years.

The particle path figures show that the northwestern-directed regional groundwater flow field dominates the migration of particles from the VZWs, with some influence from the two shallow City of Seaside Golf Course irrigation wells, while the local dynamics of the many deep injection and extraction wells dominate the migration pathways of the particles from the deep injection wells. As noted above, there are several particle paths that fluctuate towards and away from the ASR 1&2 well locations before the particles are captured. These fluctuations are the result of the injection and extraction pattern at the ASR wells. When the ASR wells are extracting, they pull particles towards the ASR wells. When the ASR wells are injecting, they push particles away. Figure 21 shows some particle path lines from the VZWs which appear to bifurcate and/or take very sharp turns. These occur at the locations where particles have moved downward from a shallow to deeper model layer and experience changes in the magnitude and direction of flow gradients due to different conditions (e.g. different extraction well screen depths and/or different hydraulic properties).

The extraction wells that capture particles released from any of the seven expanded PWM/GWR Project injection wells include Ord Grove 2, ASR 3&4, EW-2, EW-3&4, Paralta, and Luzern municipal supply wells, and the two City of Seaside Golf Course irrigation wells (Reservoir and Coe).

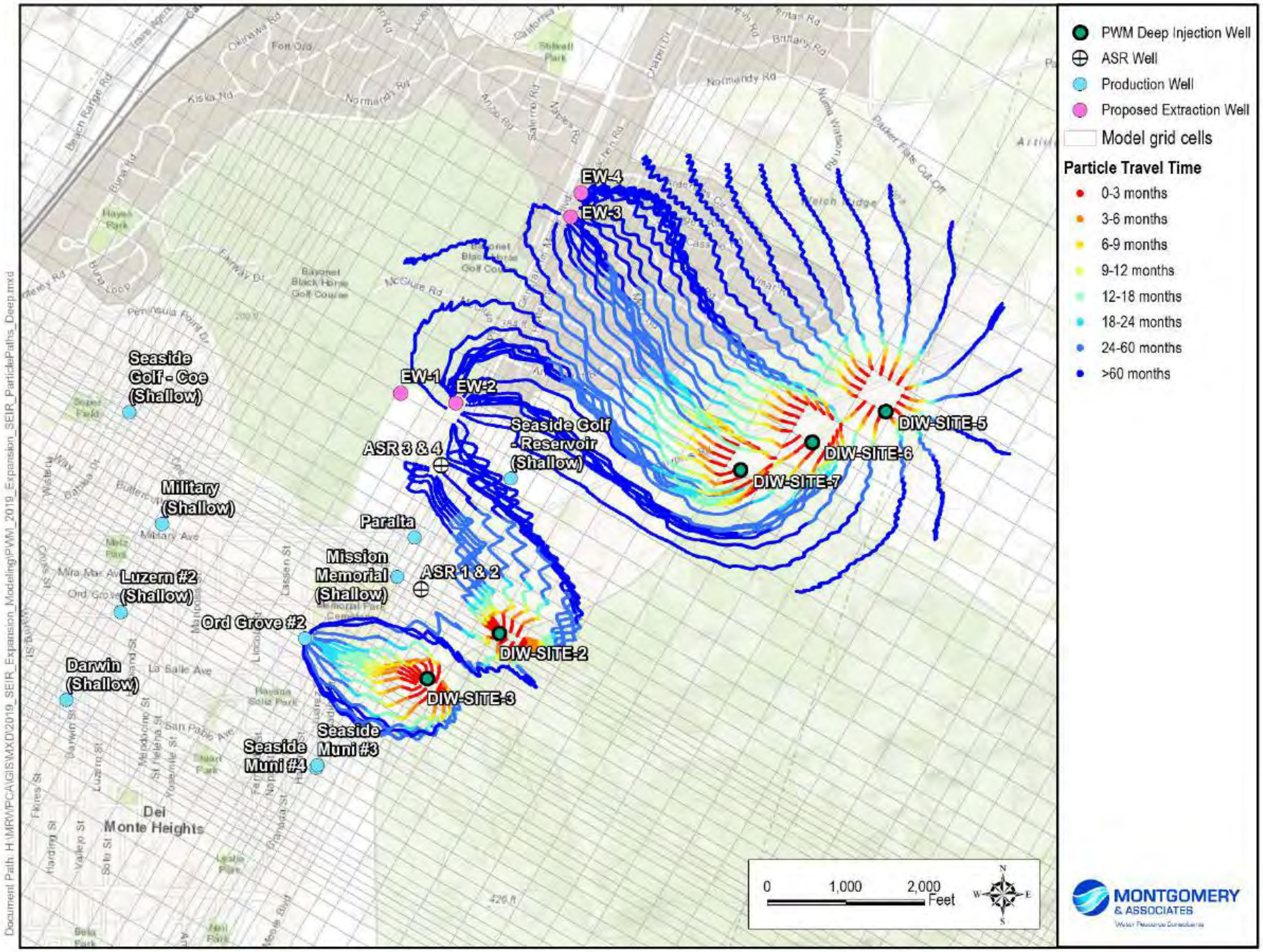

Figure 20. Particle Paths and Travel Times from Deep Injection Wells for Single Particle Release Time for expanded PWM/GWR Project Scenario

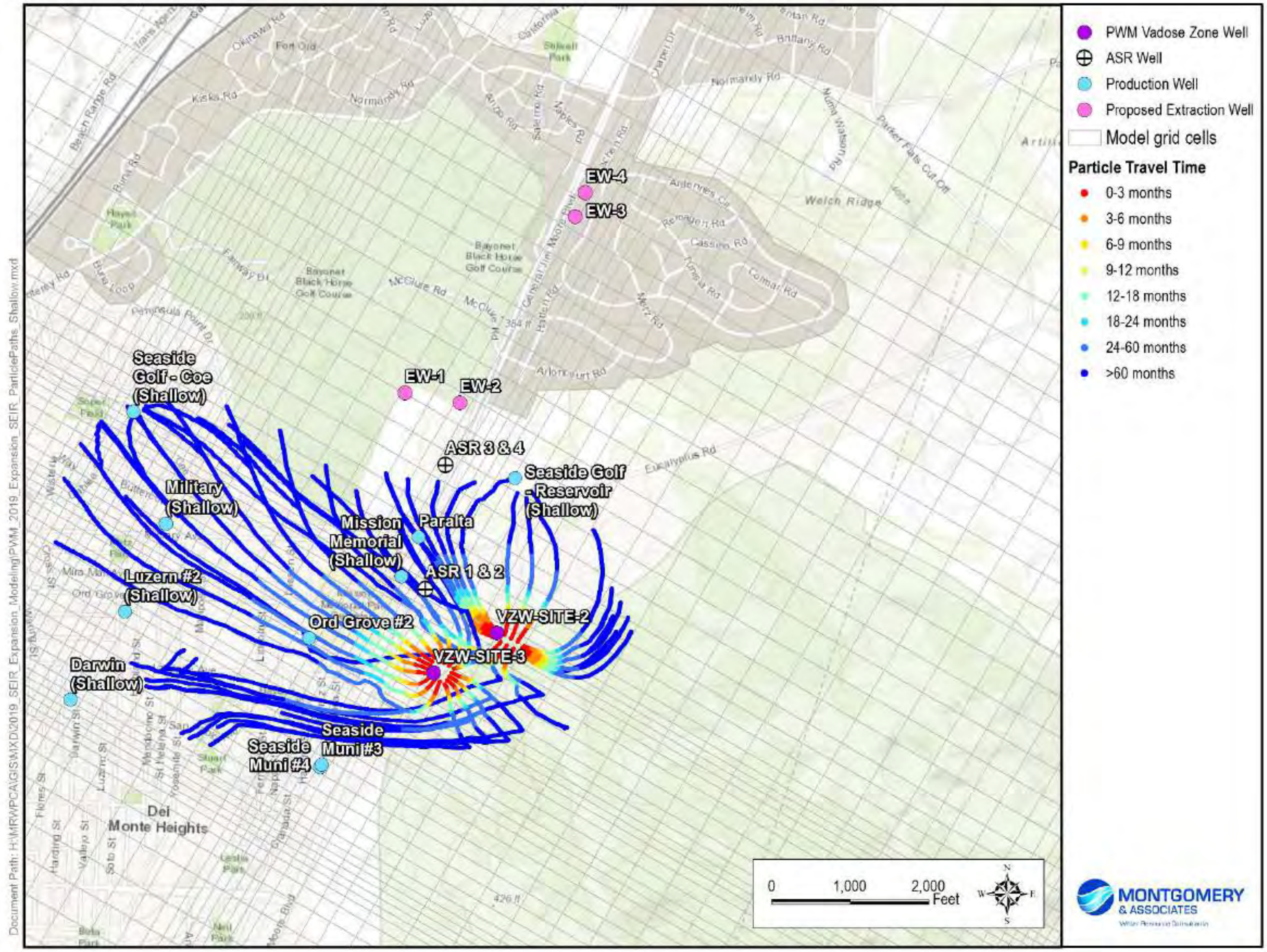

Figure 21. Particle Paths and Travel Times from Vadose Zone Wells for Single Particle Release Time for expanded PWM/GWR Project Scenario

Table 7 summarizes the percentage of total particles released at each recharge well that are captured by an extraction well over the 25-year project simulation period. The same total number of particles (12,120 particles) are released from each well over the entire 25-year period. For each injection well, the bottom row shows the percentage of particles released at that well captured by an extraction well during the simulation period. The percent captured values do not total up to 100% as many particles still remain in the aquifer at the end of the simulation. For each extraction well, the right-most column shows the percentage of particles released that were captured by that extraction well. As shown in the table, 43% of all the particles released are captured by an extraction well during the simulation period, with the remainder uncaptured and remaining in the aquifer. Ord Grove 2 captures roughly 14% of all the particles released, with 87% of those particles coming from DIW-SITE-3 and 13% coming from DIW-SITE-2. Because of its central location, particles released at DIW-SITE-2 are captured by four different extraction wells, with the largest percentage (40%) being captured by ASR 3&4. With the exception of DIW-SITE-5, which is the furthest from any extraction well, close to over 60% of particles released in deep injection wells are captured by extraction wells. The percentage of capture of particles released from the VZWs is quite small, with only between 5% to 16% of the particles released in the shallow wells being captured, overwhelmingly by the two Seaside Golf Course irrigation wells. The percent capture is a function of both the distance between the extraction and injection well pairs, the magnitude of pumping and injection at each well, and the pore water velocity between the wells. It is important to note that a large fraction of particles that were not captured during the simulation period are particles released closer to the end of the simulation period, but which would eventually be captured by extraction wells if the simulation period were extended. It is also important to note that the percentage of particles captured is not equivalent to the volume of purified water captured because each well is injecting at different volumetric rates.

Table 7. Percent of Particles Captured by Extraction Wells for the expanded PWM/GWR Project Scenario

Extraction Well	Aquifer	Recharge Well of Origin							Percent Capture of All Particles Released
		DIW-SITE-2	DIW-SITE-3	DIW-SITE-5	DIW-SITE-6	DIW-SITE-7	VZW-SITE-2	VZW-SITE-3	42.7%
Seaside Golf Course - Coe (irrigation)	Shallow	-	-	-	-	-	0.1%	4.4%	0.6%
Seaside Golf Course - Reservoir (irrigation)	Shallow	-	-	-	-	-	16.3%	-	2.3%
Luzern	Shallow	-	-	-	-	-	-	0.3%	0.04%
Paralta	Shallow	-	-	-	-	-	-	0.3%	0.04%
Paralta	Deep	5.0%	-	-	-	-	-	-	0.7%
Ord Grove 2	Deep	13.2%	87.3%	-	-	-	-	-	14.4%
ASR-3&4	Deep	39.6%	-	-	-	-	-	-	5.7%
EW-2	Deep	4.5%	-	4.2%	24.6%	35.2%	-	-	9.8%
EW-3&4	Deep	-	-	2.0%	39.0%	22.7%	-	-	9.1%
Percent Capture of Particles Released at Recharge Well		62%	87%	6%	64%	58%	16%	5%	

Note: - = no particle traveling between wells

Table 8 lists the fastest travel times between each recharge well and the nearest extraction wells. No value is shown if no particle travelled between the two wells.

Table 8. Fastest Travel Times between Recharge and Extraction Wells during the 25-Years of Simulated Project Recharge, in days, for expanded PWM/GWR Project Scenario

Extraction Well	Aquifer	Recharge Well of Origin						
		DIW-SITE-2	DIW-SITE-3	DIW-SITE-5	DIW-SITE-6	DIW-SITE-7	VZW-SITE-2	VZW-SITE-3
Seaside Golf Course - Coe (irrigation)	Shallow	-	-	-	-	-	8,243	5,716
Seaside Golf Course -Reservoir (irrigation)	Shallow	-	-	-	-	-	2,904	-
Luzern	Shallow	-	-	-	-	-	-	5,885
Paralta	Shallow	-	-	-	-	-	-	7,427
Paralta	Deep	1,313	-	-	-	-	-	-
Ord Grove 2	Deep	1,771	615	-	-	-	-	-
ASR-3&4	Deep	1,758	-	-	-	-	-	-
EW-2	Deep	3,173	-	4,475	2,405	1,895	-	-
EW-3&4	Deep	-	-	5,496	2,555	2,182	-	-

Note: - = no particle traveling between wells

The fastest particles are released from DIW-SITE-3 and captured at the Ord Grove 2 well after 615 days (20.2 months, or 1.7 years). The particles with the fastest travel time were released from DIW-SITE-3 in October of MY28, corresponding to simulated date of 10/1/2041, or twenty-one years into the recharge project. Travel times from deep injection well site DIW-SITE-2 are the next fastest; taking approximately 1,313 days (43.1 months, or 3.6 years) for the fastest particles to reach the Paralta well. The shortest travel times from the other deep injection wells are all greater than 4 years.

The fastest travel of particles released from the vadose zone wells are from VZW-SITE-2 which take 2,904 days (95.4 months, or 8.0 years) to reach the City of Seaside Golf Course – Reservoir irrigation well. The next fastest vadose zone travel time is 5,716 days (187.8 months, 15.6 years) from VZW-SITE-3 to City of Seaside Golf Course – Coe irrigation well. Other travel times from the vadose wells are all greater than 16 years.

Figure 22 shows plots of the fastest particle travel times between each of the project recharge wells and any extraction wells where particles are captured, as a function of the date of particle release. The horizontal axis represents the time at which groups of particles were released from the injection wells and the vertical axis represents the time it took for the fastest particle released at in that group to reach an extraction well. The left vertical axis shows the travel time in years, and the vertical axis on the right shows the travel time in months. Each dot represents the time travelled by the fastest particle in the group. The orange and yellow dots show travel times from the locations of the vadose zone injection wells at VZW-SITE2 and VZW-SITE-3, respectively. The other colors represent the fastest travel times from the five deep injection well sites.

For all the recharge wells, there are fluctuations in the minimum travel time taken by the released particles throughout the simulation period. There are both seasonal-scale fluctuations as pumping and injection rates rise and fall, and in some cases also longer scale trends. Travel times from deep injection wells are strongly influenced by the injection-extraction cycles of the ASR wells. For example, particles released at DIW-SITE-2 experience more influence from the ASR wells than travel times from well DIW-SITE-3 or DIW-SITE-7 because it is closer to the ASR well sites. Carmel River injection at ASR 1&2 cycles on and off seasonally, while ASR 3&4 both injects and extract water throughout the simulation period, thereby impacting groundwater gradients through which the DIW-SITE-2 particles move. These ASR wells sometimes draw particles in and sometimes repel them, creating greatly different trajectories depending on when a particle approaches the ASR wells. Generally speaking, deep injection wells whose particles are captured primarily by non-ASR wells show smaller variations in the fastest travel times (e.g. DIW-SITE-3 and DIW-SITE-7), compared to injection wells whose particles are captured by multiple wells (e.g. DIW-SITE-2). The impact of the simulated drought period, during which ASR injection of Carmel River water is largely absent, on travel times can be observed in the decreasing minimum travel times from wells DIW-SITE-6 and DIW-SITE-7 as particles traveling towards EW-2 are no longer repelled by ASR injection mounding.

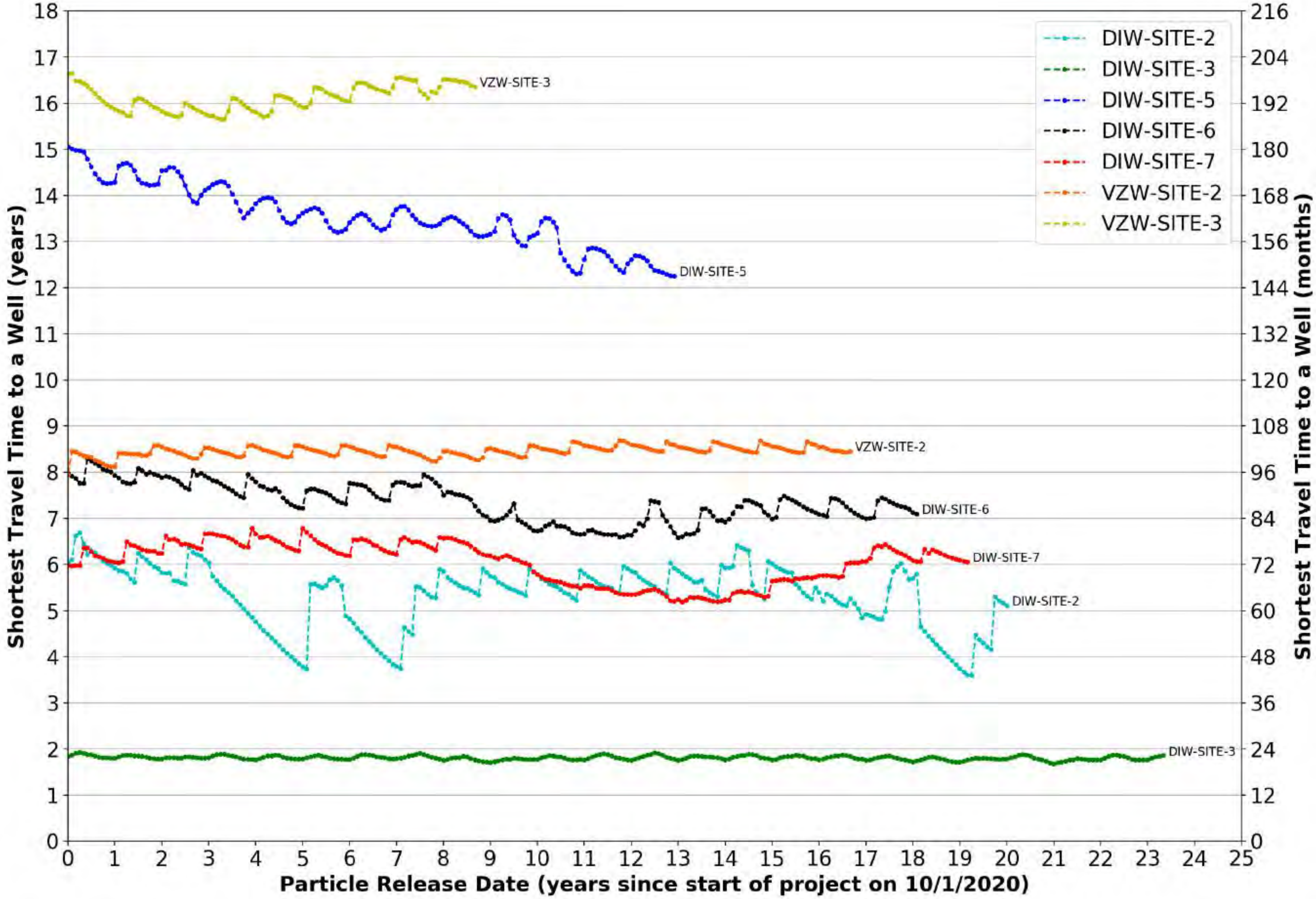

Figure 22. Fastest Travel Times between Recharge Wells and Extraction Wells versus Release Date for Project Scenario

The two vadose zone wells also display variations in minimum travel times throughout the simulation period. These particles are initially released at shallow depths, above the influence of the large-capacity injection and extraction wells. The dynamics of the shallow layers in the model are mostly influenced by fluctuations in natural recharge, by the vadose zone injection itself, and by the seasonal pumping of the City of Seaside Golf Course irrigation supply wells. Particles also move from shallower to deeper model layers where they experience different gradients and groundwater velocities depending on the extraction wells active in those layers.

We emphasize that the travel times shown in Table 8 are the shortest travel times observed in the simulation and do not necessarily represent a typical average particle travel time for the corresponding injection-extraction well pair. Histograms of the distribution of travel times from DIW-SITE-2 to ASR 3&4 and DIW-SITE-3 to Ord Grove 2 are presented on Figure 23 and illustrate that the particle travel times between injection-extraction well-pairs are described by a distribution of travel times. Statistics for these travel times are presented in Table 9. For DIW-SITE-2 to ASR 3&4 the median travel time (50th percentile) is 98.9 months, with an interquartile range (a measure of the spread) of 46.1 months. For DIW-SITE-3 to Ord Grove the median travel time is 28.5 months, with a smaller interquartile range of 22.3 months.

Table 9. Statistics for Travel Times from DIW-SITE-2 and DIW-SITE-3 to Ord Grove 2 for Project Scenario

Injection Extraction Well Pair	Percentile of travel times (Julian months)			
	25th	50th	75th	Interquartile Range
DIW-SITE-2 to ASR 3&4	78.0	98.9	124.1	46.1
DIW-SITE-3 to Ord Grove 2	23.1	28.5	45.5	22.3

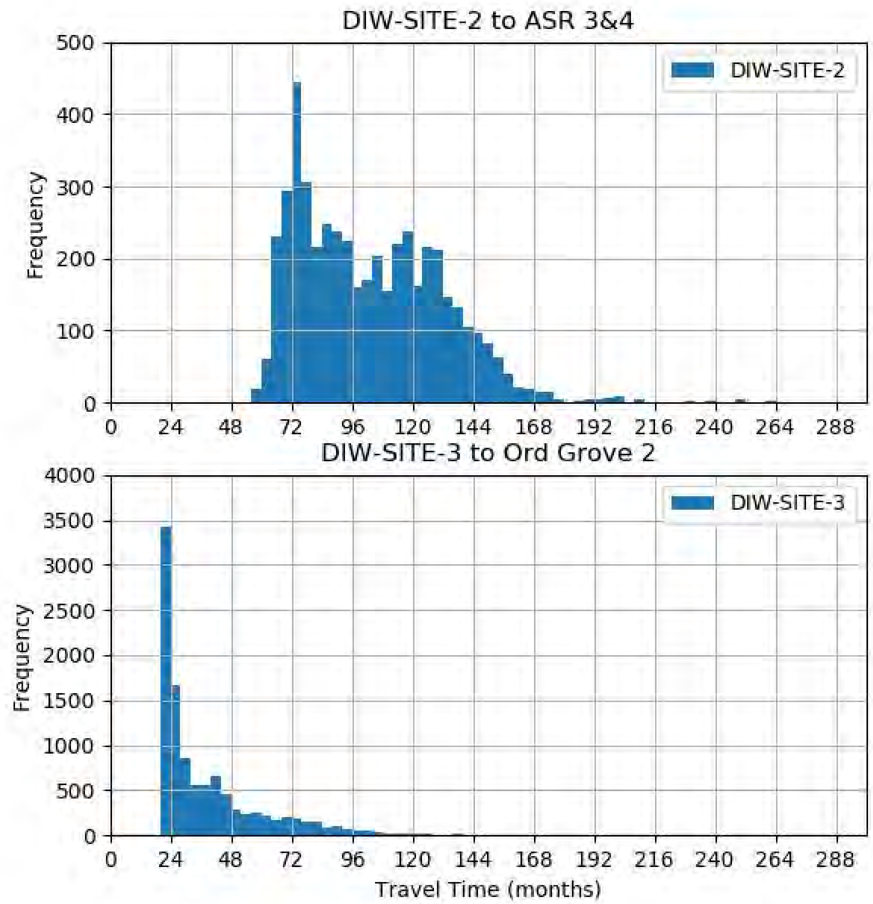

Figure 23. Histograms of travel times between DIW-SITE-3 and DIW-SITE-4 and Ord Grove 2 for the Project Scenario

As described earlier, the estimated travel times are conservative, because particles are released and captured at the edges of the model grid cells that contain the injection and extraction wells, rather than at the wells themselves. The intra-grid cell travel time that the particles would occur as particles moved the injection well to the edge of grid cell, and then from the edge of the extraction well grid cell to the well itself, are excluded. The magnitude of the intra-cell travel time depends on the injection/extraction rate at each well, and the distance from the edge of the cell to the actual location of the well within the grid cell. In order to provide an estimate for the magnitude of this additional intra-cell travel time, an analytic expression for the travel time to/from a pumping/injecting well operating at a constant flow rate (USEPA, 1987) was used. This intra-grid cell travel time is estimated to add somewhere on the order of 10 to 40 days of additional travel time depending on the size of the grid cell and the actual location of the wells relative to the grid cell edges. Similarly, for the vadose zone wells, the simulated recharge is modeled as being applied directly to the top of water table in the upper aquifer, and does not explicitly account for the vertical travel time that would occur through the vadose zone as the water percolates down to the water table. The general magnitude of this vertical travel time was conservatively estimated by using Darcy's Law to calculate the vertical travel time over the distance from 100 feet below ground surface down through each of the upper aquifer layers down to the top of the water table, utilizing the calibrated saturated vertical hydraulic conductivities for each layer and an assumption of a unit hydraulic gradient, and a porosity of 20%. For VZW-SITE-3 this vertical vadose travel time was estimated to be on the order of 245 days, and for VZW-SITE-4 on the order of 313 days.

It should be noted that the advective groundwater velocity which determines the travel time of particles from the recharge wells, is slower than the velocity of pressure propagation that occurs with the increase in pressure head (or hydraulic heads) that spreads out from the recharge wells. Thus, for a confined aquifer such as the Santa Margarita Aquifer, the hydraulic head increases associated with the project propagate outward into the

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Table 10. Planned Project Water Injection Schedule and CSIP Storage and Delivery Operation

Water Year	Simulated Historical Climate Water Year	Salinas Station Precip (% of Ave.)	Drought Year Criteria (<75% of Average)	Injection Delivery Schedule	Injection Volume (AF)	Annual Recycled Water to CSIP (AF)	Drought Reserve Change (AF)	Cumulative Drought Reserve (AF)	Injection Delivery Schedule (AFM) Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Total
2021	1995	131%		A	5,950	-	200	200	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2022	1996	95%		A	5,950	-	200	400	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2023	1997	123%		A	5,950	-	200	600	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2024	1998	240%		A	5,950	-	200	800	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2025	1999	98%		A	5,950	-	200	1,000	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2026	2000	114%		B	5,750	-	-	1,000	573	577	607	591	538	587	381	383	369	382	387	376	5,750
2027	2001	93%		B	5,750	-	-	1,000	573	577	607	591	538	587	381	383	369	382	387	376	5,750
2028	2002	74%	Drought	F	4,750	1,200	(1,000)	-	573	577	607	591	538	587	217	214	205	213	218	212	4,750
2029	2003	94%		A	5,950	-	200	200	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2030	2004	82%		A	5,950	-	200	400	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2031	2005	148%		A	5,950	-	200	600	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2032	2006	118%		A	5,950	-	200	800	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2033	2007	73%	Drought	C	4,950	1,000	(800)	-	607	610	641	625	569	621	217	214	205	213	218	212	4,950
2034	2008	79%		A	5,950	-	200	200	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2035	1987	60%	Drought	D	5,550	400	(200)	-	607	610	641	625	569	621	315	315	304	314	319	310	5,550
2036	1988	40%	Drought	E	5,750	200	-	-	607	610	641	625	569	621	348	349	337	348	353	343	5,750
2037	1989	63%	Drought	E	5,750	200	-	-	607	610	641	625	569	621	348	349	337	348	353	343	5,750
2038	1990	57%	Drought	E	5,750	200	-	-	607	610	641	625	569	621	348	349	337	348	353	343	5,750
2039	1991	88%		A	5,950	-	200	200	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2040	1992	90%		A	5,950	-	200	400	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2041	1993	140%		A	5,950	-	200	600	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2042	1994	83%		A	5,950	-	200	800	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2043	1995	131%		A	5,950	-	200	1,000	607	610	641	625	569	621	381	383	369	382	387	376	5,950
2044	1996	95%		B	5,750	-	-	1,000	573	577	607	591	538	587	381	383	369	382	387	376	5,750
2045	1997	123%		B	5,750	-	-	1,000	573	577	607	591	538	587	381	383	369	382	387	376	5,750
2046	1998	240%		A	5,950	-	200	800	607	610	641	625	569	621	381	383	369	382	387	376	5,950

Purified Water Delivery Schedule for Injection (AF)			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Total
before drought reserve complete	wet/normal year	A	607	610	641	625	569	621	381	383	369	382	387	376	5,950
after drought reserve complete	wet/normal year	B	573	577	607	591	538	587	381	383	369	382	387	376	5,750
before drought reserve complete	drought year (1,000 AF to CSIP)	C	607	610	641	625	569	621	217	214	205	213	218	212	4,950
before drought reserve complete	drought year (800 AF to CSIP)	NA	607	610	641	625	569	621	250	248	238	247	251	245	5,150
before drought reserve complete	drought year (600 AF to CSIP)	NA	607	610	641	625	569	621	282	281	271	280	285	278	5,350
before drought reserve complete	drought year (400 AF to CSIP)	D	607	610	641	625	569	621	315	315	304	314	319	310	5,550
before drought reserve complete	drought year (200 AF to CSIP)	E	607	610	641	625	569	621	348	349	337	348	353	343	5,750
after drought reserve complete	drought year (1,000 AF to CSIP)	F	573	577	607	591	538	587	217	214	205	213	218	212	4,750

Appendix E

Water Quality and Statutory Compliance Report

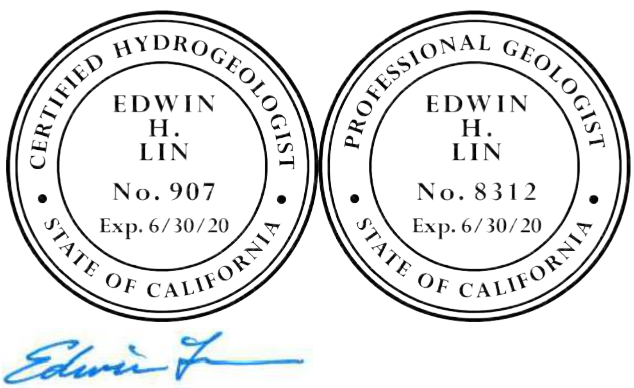
Water Quality Statutory and Regulatory Compliance Technical Report
For the Proposed Modifications to the
Pure Water Monterey Groundwater Replenishment Project

November 5, 2019

Revised report prepared by:
John D. Kenny, P.E. (Trussell Technologies, Inc.)
Elaine W. Howe, P.E. (NM), BCEE (Trussell Technologies, Inc.)
Edwin Lin, PG, CHg. (Todd Groundwater)
Denise H. Conners (Larry Walker Associates, Inc.)

SIGNATURE PAGE

John D. Kenny, P.E.
Supervising Engineer
Trussell Technologies, Inc.



Edwin Lin, PG, CHg
Principal Hydrogeologist
Todd Groundwater

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1. Executive Summary

Monterey One Water (M1W), previously Monterey Regional Water Pollution Control Agency (MRWPCA), is preparing a Supplemental Environmental Impact Report (EIR) in accordance with the provisions of the California Environmental Quality Act (CEQA) for the proposed expansion of the Pure Water Monterey Groundwater Replenishment Project (PWM/GWR Project or GWR Project). The GWR Project as approved was designed to produce 5 MGD of purified water, and construction is ongoing. The proposed facility expansion will have a maximum plant capacity of 7.6 MGD. The GWR Project will create a reliable source of water supply by collecting a variety of new source waters that will be combined with existing incoming raw wastewater flows for conveyance to and treatment at M1W's Regional Wastewater Treatment Plant (RTP). A portion of the RTP secondary effluent is treated to produce "disinfected tertiary recycled water" at the Salinas Valley Reclamation Plant (SVRP) and used for agricultural irrigation in northern Salinas Valley. The remainder of the RTP secondary effluent will be conveyed to the newly constructed advanced water purification facility (AWPF) for "full advanced treatment" and production of highly-purified recycled water (purified water). The purified water will be used to replenish the Seaside Groundwater Basin (Seaside Basin) by injecting the high quality water into a series of shallow and deep injection wells. Once injected into the Seaside Basin, the purified water will mix with the groundwater present in the aquifers and be stored for future extraction by existing potable water supply wells.

The primary purpose of the approved GWR Project is to provide 3,500 acre-feet per year (AFY) of high quality treated "replacement" water to California American Water Company (CalAm) for delivery to its customers—enabling CalAm to reduce its diversions from the Carmel River system by this same amount. The GWR Project expansion will increase the AWPF peak capacity from 5 MGD to 7.6 MGD, and increase recharge of the Seaside Groundwater Basin by an additional 2,250 AFY, for a total GWR Project yield of 5,750 AFY. CalAm is under a Cease and Desist Order issued by the State Water Resources Control Board to secure replacement water supplies and cease over-pumping of the Carmel River by December 2021.

The GWR Project will also result in additional tertiary recycled water supply for agricultural irrigation in northern Salinas Valley. Currently and prior to the 5 MGD AWPF startup, the only sources of supply for the SVRP were municipal wastewater, occasionally, industrial wastewater from the City of Salinas's separate system, and small amounts of urban dry weather runoff.[1] Municipal wastewater flows have declined in recent years due to aggressive water conservation efforts by the M1W member entities. By increasing the amount of source waters entering the existing wastewater collection system, additional tertiary recycled water can be provided for use in the Castroville Seawater Intrusion Project's (CSIP's) agricultural irrigation system. These additional source waters will provide 4,500 to 4,750 AFY of additional recycled water supply, in normal and wet years, for CSIP irrigation purposes. Some modifications would be made to the SVRP to optimize and enhance the delivery of recycled water to growers. The tertiary recycled water complies with statutory and regulatory requirements for the production and use of recycled water per California Water Code Sections 13500 – 13577 and California Code of Regulations, Title 22, Sections 60301 – 60357.

The GWR Project also includes a drought reserve component to support greater use of the new source waters for crop irrigation during dry years. The GWR Project will provide for an additional 200 AFY of purified water that will be injected in the Seaside Basin in wet and normal years up to a total of 1,000 acre feet (AF). Thus, the expanded GWR Project will inject up to 5,950 AFY into the Seaside Basin in some years, rather than the 5,750 AF needed for CalAm supplies. This would result in a "banked" drought reserve. During dry years, less than 5,750 AF of purified water will be delivered to the Seaside Basin, and the RTP secondary effluent not sent to the AWPF will be further treated at the SVRP and sent to CSIP to increase irrigation supplies for the agricultural lands. CalAm will be able to extract the banked water to make up the difference to its supplies, such that its extractions and deliveries would not fall below 5,750 AFY.

[1] Salinas River water is stored and used for irrigation during the period April 1 to October 31, but is not a source of supply for the tertiary treatment facility.

Planning for the GWR Project included a pilot study using some of the source waters and treatment technologies intended to be part of the new AWPF. The treatment train of the newly constructed full-scale AWPF includes pre-oxidation with ozone; membrane filtration (MF); reverse osmosis (RO); advanced oxidation (AOP) using ultraviolet light and hydrogen peroxide; and post-treatment stabilization. In addition, hydrogeologic modeling and soil and geochemical analyses have been performed for the GWR Project. The California State Water Resources Control Board Division of Drinking Water (DDW), the Central Coast Regional Water Quality Control Board (RWQCB), and a National Water Research Institute Independent Advisory Committee have provided oversight for these studies and project planning. Final acceptance of the current 5 MGD GWR Project was issued by DDW on August 20, 2019. The RWQCB adopted Waste Discharge Requirements and Water Recycling Requirements for the Pure Water Monterey AWPF and GWR Project (Order No. R3-2017-0003) on March 9, 2017. The Order will be revised to address any requirements related to the expanded AWPF.

In conjunction with the Supplemental EIR, this technical report was prepared to present pertinent information related to the following: (1) the status of recycled water regulations pertaining to groundwater replenishment; (2) studies of other similar projects that have assessed the effects of using recycled water for groundwater replenishment on groundwater quality and public health; (3) studies that have been specifically conducted for the project related to the AWPF design and performance; (4) studies that have been specifically conducted for the project regarding protection of groundwater quality and quantity; (5) current and expanded GWR Project compliance with applicable statutes, policies, and regulations; (6) current and expanded GWR Project effects on groundwater; and (7) the significance of this information for the Supplemental EIR. At this time, the GWR Project expansion is considered a "back-up plan" to the Monterey Peninsula Water Supply Project (MPWSP), CalAm's planned 6.4 mgd desalination project. The GWR Project expansion would be implemented in the event that the MPWSP encounters obstacles that prevent timely, feasible implementation. The 2019 update of this Technical Report provides updated information on the AWPF production capacities and additional water quality data for the source waters being diverted to the RTP.

This evaluation has concluded that:

- California has established numerous state laws, regulations and policies governing the use of recycled water for groundwater replenishment to protect groundwater quality and the health of individuals who drink groundwater that is replenished using recycled water, including:
    - Comprehensive regulations for the use of purified water for replenishment of groundwater by subsurface application (CCR Title 22, Chapter 3, Article 5.2 "Groundwater Replenishment Regulations");
    - State policy related to maintaining high quality water (State Water Resource Control Board Resolution No. 68-16 "Statement of Policy with Respect to Maintaining High Quality Waters in California"); designating water bodies that are suitable as a domestic water supply (State Water Resources Control Board Resolution No. 88-63 "Sources of Drinking Water"); and encouraging the safe use of recycled water from wastewater sources (State Water Resources Control Board Resolution No. 2018-0057 "Water Quality Control Policy for Recycled Water");
    - The Water Quality Control Plan for the Central Coast Basin (Basin Plan) implemented by the RWQCB that includes standards, objectives, and guidelines for the protection of groundwater quality in the GWR Project area; and
    - Effective July 1, 2014, consolidation of the regulatory structure for water, recycled water and wastewater into one agency, the State Water Resources Control Board, to protect public health and promote comprehensive protection of drinking water and other beneficial uses of the state's waters.

- Studies have been conducted for other similar potable reuse projects , including epidemiology studies, risk assessments, and investigations that analyze and compare the toxicological properties of recycled water to those of drinking water. These studies have shown:
  - There is no association between the use of recycled water and adverse health outcomes in individuals consuming groundwater containing recycled water; and
  - Purified water from an appropriately designed and operated AWPF presents less risk from regulated chemicals, pathogens, and trace organics compared to the risk from conventional drinking water sources.
- The following findings are based on the analytical results of source water monitoring for the GWR Project, the water quality results of the pilot plant testing (using ozone, MF, and RO), information on the predicted performance and water quality of the proposed full-scale AWPF based, and on other existing groundwater replenishment projects and related research/studies:
  - The GWR Project will comply with the Groundwater Replenishment Regulations and will meet all Central Coast Basin Plan standards, objectives, and guidelines.
  - An Independent Advisory Panel and DDW have reviewed the GWR Project concept.
  - The RWQCB has approved the current Project and adopted Waste Discharge Requirements and Water Recycling Requirements that govern operation.
  - The current and expanded AWPF and groundwater replenishment operations will provide reliability and redundancy through the use of multiple treatment barriers. Through the integration of treatment at the RTP, the AWPF, and underground retention, chemical constituent removal redundancy will be achieved by employing at least two treatment processes for each constituent type and at least four treatment processes for each pathogen category, as shown in the table below.

Proposed Groundwater Replenishment Project Treatment Barriers

Process	Chemical Constituents					Pathogenic Microorganisms		
	Nitrogen	TOC[a]	DPBs[b]	Inorganics	CECs[c]	Bacteria	Viruses	Protozoa
RTP Primary/ Secondary	✓	✓		✓	✓	✓	✓	✓
Ozone			✓		✓	✓	✓	✓
MF		✓		✓[d]		✓		✓
RO	✓	✓	✓	✓	✓	✓	✓	✓
UV/AOP	✓		✓		✓	✓	✓	✓
Aquifer - Underground Residence Time						✓	✓	✓

a. Total organic carbon – TOC.
b. Disinfection by-products – DBPs.
c. Constituents of emerging concern – CECs
d. Particulate inorganics (e.g., iron and manganese)

- To evaluate compliance with the Groundwater Replenishment Regulations, studies were conducted to (1) analyze the recharge components of the GWR Project, including recharge wells, operational facilities, and the fate and transport of the purified water in the groundwater basin, and (2) conduct geochemical modeling to test stabilized RO pilot test water[2] compatibility with ambient groundwater. The studies found that:

- No documented groundwater contamination or contaminant plumes were identified in the GWR Project area. Therefore, injection of purified water associated with the GWR Project would not exacerbate existing groundwater contamination or cause plumes of contaminants to migrate.
- When two water types with different water chemistry are mixed (such as the GWR Project purified water and groundwater), geochemical reactions could occur in the groundwater system that could potentially result in leaching of natural or anthropogenic constituents, which could also potentially impact groundwater quality. The risk of geochemical impacts from incompatibility will be addressed at the GWR Project AWPF by including a stabilization process, using decarbonation and lime addition, to ensure that the purified water is stabilized and non-corrosive. The design and acceptability of the post-treatment stabilization process and finished water quality target concentrations have been verified by geochemical modeling studies and bench-scale tests of the geochemical stability of the Seaside Basin aquifer with stabilized AWPF treated water.

- A Salt and Nutrient Management Plan (SNMP) has been prepared for the Seaside Basin to comply with the Recycled Water Policy. As documented in the SNMP, ambient groundwater generally exceeds the Basin Plan groundwater objective for total dissolved solids (TDS) in many areas of the Seaside Basin, while nitrate and chloride concentrations generally meet Basin Plan objectives. Studies conducted to evaluate the water quality of the stabilized RO pilot test water found that the concentrations of TDS, nitrate, and chloride in the RO water met all Basin Plan objectives. Further, these concentrations were generally lower than average concentrations in groundwater. As such, replenishment of the Seaside Basin using the AWPF purified water will not degrade, but will provide benefits to local groundwater quality.
- Based on the source water sampling, results of the pilot testing and hydrogeologic studies, other relevant research, and information from other groundwater replenishment projects, the following conclusions are offered with regards to the GWR Project's effect on groundwater resources:
    - The GWR Project purified water will meet groundwater quality standards in the Basin Plan and state drinking water quality standards. A monitoring program will document project performance.
    - The GWR Project purified water will contain much lower concentrations of TDS and chloride than ambient groundwater and will be expected to provide a benefit to the Seaside Basin groundwater quality.
    - No documented groundwater contamination or contaminant plumes have been identified in the GWR Project area. Therefore, injection associated with the GWR Project will not exacerbate any groundwater contamination or cause plumes of contaminants to migrate because there are no contaminant plumes within the basin project area.
    - Injection of AWPF purified water will not degrade groundwater quality.
    - The purified water will be stabilized as part of the AWPF treatment processes to ensure no adverse geochemical impacts. Geochemical modeling will be used to inform the AWPF

[2] The samples were RO permeate collected in 2014 from the M1W pilot plant, and in 2019 from the AWPF Demonstration Facility. In the 2014 sample, the RO permeate was stabilized using a bench-scale post-treatment stabilization unit to better approximate the water quality anticipated for the full-scale AWPF. For the 2019 sample, the RO permeate was stabilized using bench-scale decarbonation procedures and hydrated lime addition with the same lime that is used in the full-scale AWPF.

stabilization procedures, which can be adjusted as needed.

The GWR Project will result in both higher and lower water levels in wells throughout the Seaside Basin at various times. Although water levels will be slightly lower during some time periods, the difference is generally small and judged insignificant. Modeling indicates the GWR Project will increase water levels in coastal wells and will help protect the basin against seawater intrusion.

2. Introduction

In accordance with the provisions of the California Environmental Quality Act (CEQA), the Monterey One Water (M1W), previously Monterey Regional Water Pollution Control Agency, as the CEQA lead agency, is preparing an Supplemental Environmental Impact Report (SEIR) for the proposed modifications to the Pure Water Monterey Groundwater Replenishment Project (PWM/GWR Project or GWR Project). The current GWR Project, currently under construction, was designed to produce 5 MGD of purified water. The proposed AWPF capacity expansion would result in a maximum plant capacity of 7.6 MGD. The GWR Project expansion is being proposed by M1W in partnership with the Monterey Peninsula Water Management District (Water Management District). At this time, the expanded GWR Project is considered a "back-up plan" to the Monterey Peninsula Water Supply Project (MPWSP)--CalAm's planned 6.4 mgd desalination project. The expanded GWR Project would be implemented in the event that the MPWSP encounters obstacles that prevent timely, feasible implementation.

The initial version of this report (*Pure Water Monterey Groundwater Replenishment Project Water Quality Statutory and Regulatory Compliance Technical Report*) was prepared in February 2015, as part of the approved 5 MGD GWR Project EIR. Margaret H. Nellor (Nellor Environmental Associates, Inc.) was lead author of the initial 2015 report, and was assisted by Denise Duffy & Associates and James Crook, along with Todd Groundwater and Trussell Technologies who also prepared this revised 2019 report.

The GWR Project provides reliable source of water supply by collecting a variety of new source waters that will be combined with existing incoming raw wastewater flows for conveyance to and treatment at M1W's Regional Wastewater Treatment Plant (RTP). RTP secondary effluent that is not further treated and used for agricultural irrigation in northern Salinas Valley, as part of the Salinas Valley Reclamation Project (SVRP), will be conveyed to the advanced water purification facility (AWPF) for "full advanced treatment" and production of highly-purified recycled water (purified water). The purified water will be used to replenish the Seaside Groundwater Basin (Seaside Basin) by injecting this water into a series of shallow and deep injection wells. Once injected into the Seaside Basin, the purified water mixes with the groundwater present in the aquifers and is stored for future extraction from existing potable water supply wells and from new wells EW-1 through EW-4. The primary purpose of the GWR Project expansion is to provide 5,750 acre-feet per year (AFY)[3] of high quality replacement water to California American Water Company (Cal-Am) for extraction and delivery to its customers in the Monterey District service area. The expanded GWR Project will increase the AWPF peak capacity from the current 5 mgd to 7.6 mgd and increase recharge of the Seaside Groundwater Basin with high quality purified water by an additional 2,250 AFY (for a total yield of 5,750 AFY).The 5,750 AFY production capacity will enable CalAm to reduce its diversions from the Carmel River system by the same amount, since CalAm is under a Cease and Desist Order issued by the State Water Resources Control Board to secure replacement water supplies and cease over-pumping of the Carmel River by December 2021.

The GWR Project expansion will continue to provide for a drought reserve component that will offer an additional 200 AFY of purified water to be injected in the Seaside Basin in wet and normal years up to a total of 1,000 acre feet (AF). This component will result in a "banked" drought reserve. During dry years, the GWR Project expansion would deliver less than 5,750 AF to the Seaside Basin, and the source waters that are not sent to the AWPF during dry years would be sent to the SVRP to increase irrigation supplies for the agricultural lands. CalAm would be able to extract the banked water to make up the difference to its supplies, such that its extractions and deliveries would not fall below 5,750 AFY.

Finally, the GWR Project expansion will continue to produce additional tertiary recycled water supply for agricultural irrigation in northern Salinas Valley. Currently and prior to the 5 MGD AWPF startup, the only

[3] An acre-foot (AF) is enough water to flood one-acre (which is approximately the size of a football field) to be 1 foot deep (325,861 gallons). A family of five on the Monterey Peninsula typically uses about 0.5 AFY.

sources of supply for the SVRP was municipal wastewater and small amounts of urban dry weather runoff.[4] Municipal wastewater flows have declined in recent years due to aggressive water conservation efforts by the M1W member entities. By increasing the amount of source waters entering the existing wastewater collection system, additional recycled water can be provided for use in the Castroville Seawater Intrusion Project's (CSIP) agricultural irrigation system. It is anticipated that approximately 5,290 AFY of additional recycled water supply could be created for CSIP irrigation purposes after the expansion. Some modifications would be made to the water recycling facility to optimize and enhance the delivery of recycled water to growers. The tertiary recycled water complies with statutory and regulatory requirements for the production and use of recycled water per California Water Code (CWC) Sections 13500 – 13577 and California Code of Regulations (CCR), Title 22, Sections 60301 – 60357, and is regulated under Central Coast Regional Water Quality Control Board (RWQCB) Order No. 94-82.

M1W currently operates the RTP that includes primary and secondary treatment, the tertiary water recycling facility (SVRP), the tertiary recycled water distribution system (CSIP), sewage collection pipelines, wastewater pump stations, and an ocean outfall. The RTP has a permitted average dry weather design capacity to treat 29.6 million gallons per day (mgd) of wastewater, but currently treats only approximately 17 to 18 mgd. M1W facilities treat wastewater to two different standards: (1) recycled water that meets criteria in CCR Title 22 for unrestricted use of recycled water for agricultural irrigation (tertiary filtration and disinfection), and (2) secondary effluent for discharge through the ocean outfall that meets standards in the California Ocean Plan. Disinfected tertiary recycled water is distributed to nearly 12,000 acres of farmland in the northern Salinas Valley for irrigation. While the RTP predominantly treats municipal wastewater, it also accepts some dry weather urban runoff and other discrete wastewater flows.

The GWR Project expansion includes the following components:

- Source water diversion and storage – To produce up to 5,950 AFY of purified water for injection into the Seaside Basin and approximately, 5,290 AFY of additional CSIP irrigation water, and 600 AFY of purified recycled water for Marina Coast Water District urban irrigation customers, the GWR Project expansion requires the diversion of additional source waters volumes to the existing municipal wastewater collection system and conveyance of those waters to the existing RTP. New source waters are not required to produce the additional purified water capacity to meet the expanded yields. The source waters originate from (1) City of Salinas agricultural wash water, (2) surface water and agricultural tile drain water that is captured in the Salinas Reclamation Ditch, (3) surface water and agricultural tile drain water that flows in the Blanco Drain, and (4) stormwater flows from the southwestern part of Salinas and the Lake El Estero facility in Monterey. Although Lake El Estero is not currently being pursued for the current 5 MGD AWPF, the City of Monterey and M1W may choose in the future to pursue this project component; therefore, it is still included in the GWR Project as approved.
- Treatment facilities at the RTP – These will consist of the existing primary and secondary treatment facilities at the RTP, an expanded AWPF to produce the purified water, stabilization of water after AOP, purified water pump station, and reverse osmosis (RO) concentrate disposal facilities. The AWPF will include: pre-treatment (using ozone); membrane filtration (MF); RO; and advanced oxidation (AOP) using ultraviolet light (UV) and hydrogen peroxide. Water stabilization will use decarbonation and calcium and alkalinity addition.
- Purified water conveyance facilities – These will consist of up to two miles of new pipelines, an initial purified water pump station and a booster pump station, and appurtenant facilities to move the purified water from the AWPF to the Seaside Basin injection well facilities.
- Injection well facilities – These will include one new injection well at a new expanded injection well area to the northeast of the existing wellfield and associated infrastructure, and relocation of

[4] Salinas River water is stored and used for irrigation during the period April 1 to October 31, but is not a source of supply for the tertiary treatment facility.

two approved injection well sites with associated infrastructure to the eastern wellfield area, to inject the purified water into the Seaside Basin, backflushing facilities to percolate water pumped for well maintenance back into the Seaside Basin, pipelines, electricity/power distribution facilities, and electrical/motor control buildings.

- Distribution of groundwater from Seaside Basin – This will include new CalAm distribution system improvements needed to convey extracted groundwater and deliver it to CalAm customers.

An understanding of the potential public health implications for the use of purified water as a groundwater replenishment source is a fundamental and essential component of the EIR. As part of the work being performed for the EIR, this technical study was undertaken to evaluate (1) the status of recycled water regulations pertaining to groundwater replenishment; (2) studies of other similar projects that have assessed the effects of using recycled water for groundwater replenishment on groundwater quality and public health; (3) studies that have been specifically conducted for the GWR Project related to the AWPF design and performance; (4) studies that have been specifically conducted for the GWR Project regarding protection of groundwater quality and quantity; (5) GWR Project compliance with applicable statutes, policies, and regulations; (6) GWR Project effects on groundwater; and (7) the significance of this information for the EIR. This 2019 update of this Report provides updated information on the AWPF production capacities and additional water quality data for the source waters being diverted to the RTP.

The remainder of this report is organized into the following sections:

- Section 3 - Overview of Statutory Requirements for Groundwater Replenishment
- Section 4 – Environmental Impact Report Groundwater Significance Criteria
- Section 5 - California Recycled Water Regulations for Groundwater Replenishment
- Section 6 - Overview of Drinking Water Standards and Advisory Levels
- Section 7 - State Water Resources Control Board Policies
- Section 8 - Central Coast Regional Water Quality Control Board Requirements
- Section 9 - Permitting Groundwater Replenishment Projects
- Section 10 - Studies and Tools to Assess the Safety of the Use of Recycled Water for Groundwater Replenishment
- Section 11 - Role and Activities of the Independent Advisory Panel
- Section 12 - Proposed Groundwater Replenishment Project Treatment Design
- Section 13 - Summary of the Groundwater Replenishment Project Water Quality and Compliance with Groundwater Replenishment Regulations and Central Coast Basin Plan
- Section 14 - Summary of Hydrogeologic and Geochemical Modeling
- Section 15 - Constituents of Emerging Concern – Source Waters and Pilot Testing Results
- Section 16 - Environmental Impact Report Groundwater Resources Significance Determination
- Seciton 17 - Summary of the Groundwater Replenishment Project Compliance with Regulations and Policies
- Section 18 - References
- Section 19 - Acronyms
- Section 20 - Glossary

- Appendix A – March 9, 2017 - Waste Discharge Requirements and Water Recycling Requirements for the Pure Water Monterey AWPF and GRP issued to Monterey One Water. Order No R3-2017-0003.
- Appendix B1 – Results of the 2013-2014 Source Water Sampling Program for All Constituents Analyzed in the Untreated Source Waters
- Appendix B2 – Results of the 2018 Local Limits Source Water Sampling Program for All Constituents Analyzed in the Untreated Source Waters
- Appendix C – Projected Monthly Flows of Source Waters to the Regional Treatment Plant Influent

3. Overview of Statutory Requirements for Groundwater Replenishment

The use of recycled water for planned groundwater replenishment projects in California is regulated under the Federal Safe Drinking Water Act, and several State laws, regulations, and policies, with different responsibilities assigned to the State Water Resources Control Board (SWRCB), the nine RWQCBs, and the SWRCB Division of Drinking Water (DDW) formerly the California Department of Public Health (CDPH).[5,6] Applicable federal statutes related to drinking water standards and regulations related to injection wells are addressed in later sections of this report.

The California Water Code (CWC) and Health and Safety Code (H&SC) contain California's statutes that regulate the use of water and recycled water, and the protection of water quality and public health, which are applicable to all groundwater replenishment projects that use recycled water. Some of the key statutes that ensure protection of water quality and public health are presented in **Table 1**.

Table 1. Key California Statutes for Protection of Water Quality and Public Health

Code	Purpose
Recycled Water Definitions	
CWC Sections 13050, 13512, 13576, 13577, 13350, and 13552-13554[7]	Recycled water is defined in the CWC as water, which as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and therefore considered a valuable resource.
CWC Sections 13561	Defines direct potable reuse and indirect potable reuse for groundwater replenishment.
Water Quality	
CWC Section 13170	Authorizes the SWRCB to adopt State policies for water quality control.
CWC Sections 13240-42	Authorizes the RWQCB to adopt Water Quality Control Plans (Basin Plans) that assign beneficial uses for surface waters and groundwaters, and contain numeric and narrative water quality objectives that provide reasonable protection of the beneficial uses of the groundwater. One of the factors that must be considered when establishing water quality objectives is the need to develop and use recycled water. Basin Plans must include an implementation program for achieving the water quality objectives.
H&SC Sections 116270 et seq.	This is the California Safe Drinking Water Act that establishes primary and secondary maximum contaminant levels (MCLs) as included in the California Code of Regulations, Title 17 – Public Health, Chapter 5, Subchapter 1, Group 4 – Drinking Water Supplies, Sections 7583 through 7630.[8]
H&SC Section 116455	Requires public water systems to take certain actions if drinking water exceeds Notification Levels (NLs). NLs are health-based advisory levels established by the DDW for chemicals in drinking water that lack MCLs. When chemicals are found at concentrations greater than their NLs, certain requirements and recommendations apply.[9]
Recycled Water Permits	
CWC Sections 13260, 13263, 13269, 13523.1	Dischargers proposing to discharge waste that could affect the quality of waters of the state must file a report of waste discharge (ROWD) to the RWQCB. After receiving this report, the RWQCB

[5] Note disposal of concentrate resulting from advanced treatment of recycled water that is mixed with secondary effluent for ocean discharge is regulated under the Clean Water Act and state laws, regulations, and policies. This aspect of the GWR Project is assessed in a separate Technical Memo and concludes that the GWR Project will comply with California Ocean Plan objectives (Trussell Technologies, 2015).

[6] Effective July 1, 2014, the CDPH Drinking Water Program (including recycled water responsibilities) was transferred to the SWRCB, and named the Division of Drinking Water.

[7] The Porter-Cologne Water Quality Control Act is contained in CWC Division 7 Water Quality, Sections 13000 et seq.

[8] See http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/dwregulations-2014-07-01.pdf

[9] See http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/NotificationLevels.shtml

Code	Purpose
	can issue specific or general Waste Discharge Requirements (WDRs) and/or Water Recycling Requirements (WRRs) that reasonably protect all beneficial uses and that implement any relevant water quality control plans and policies. The RWQCB adopted WDRs/WRRs for the GWR Project, Order No. R3-2017-0003, on March 9, 2017.
CWC Section 13552.5	Authorizes the SWRCB to adopt General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water to streamline tertiary disinfected recycled water use. The General Permit was adopted in 2009. In 2016, the SWRCB adopted a new General Permit that supersedes this permit and covers all non-potable reuse applications.[10]
H&SC Section 116271	Effective July 1, 2014 transfers the DDW Drinking Water Program to the SWRCB, including water reclamation and direct and indirect potable reuse; creates the Deputy Director of the new SWRCB DDW.
CWC Section 13528.5	Effective July 1, 2014, the SWRCB may carry out the duties and authority granted to a RWQCB pursuant to Chapter 7 of the CWC (Water Reclamation Sections 13500 – 13557, which include issuing potable reuse permits).
Recycled Water Regulations	
CWC Sections 13500-13529.4; H&SC 116800 et seq.	Requires DDW to establish uniform statewide recycling criteria. DDW has developed these criteria for non-potable reuse and groundwater replenishment, and they are codified in Title 22 of the CCR. Regulations for cross connections are codified in Title 17.
CWC Section 13540	Prohibits the use of any waste well that extends into a water-bearing stratum that is, or could be, used as a water supply for domestic purposes; injection wells or vadose zone wells used for replenishment are part of this category (injection wells or vadose zone wells are considered waste wells under the CWC). An exception can be provided if (1) the RWQCB finds that water quality considerations do not preclude controlled replenishment by direct injection, and (2) DDW finds, following a public hearing, that the proposed replenishment will not degrade groundwater quality as a source of domestic water supply. This Section of the CWC also allows DDW to make and enforce regulations pertaining to replenishment of recycled water using injection wells.
CWC Sections 13522.5 and 13523	Requires any person who proposes to recycle or to use recycled water to file an Engineering Report with the RWQCB on the proposed use. After receiving the report, and consulting with and receiving recommendations from DDW, and any necessary evidentiary hearing, the RWQCB must issue a permit (WDRs and/or WRRs) for the use.
CWC Sections 13562-13563	Requires DDW to adopt uniform water recycling criteria for groundwater replenishment by June 30, 2014 as emergency regulations, and for surface water augmentation by December 31, 2016 and requires DDW to investigate the feasibility of developing criteria for direct potable reuse and to provide a final report on that investigation to the Legislature by Decembser 31, 2016. By February 14, 2015, DDW must convene an expert panel to advise DDW on water recycling criteria for surface water augmentation and the feasibility of direct potable reuse.
CWC Section 13523, Recycled Water Policy	The Recycled Water Policy was adopted by the SWRCB in February 2009. It was amended in 2013 to specify monitoring requirements for constituents of emerging concern (CECs) and in 2018 to ensure consistent statewide permitting/reporting and to update CEC monitoring requirements based on recent research findings. The Recycled Water Policy created uniformity in how RWQCBs were individually interpreting and implementing Resolution No. 68-16 for water recycling projects, including groundwater replenishment projects.
	Project must comply with the Title 22 criteria for groundwater replenishment, including monitoring requirements for priority pollutants contained in California Code of Regulations, Title 17 and California Code of Regulations, Title 22 (including subsequent revisions), and recommendations by the State Water Board for the protection of public health pursuant to Water Code section 13523. Projects must implement a CEC monitoring program that is consistent with Attachment A of the Recycled Water Policy and any recommendations from the SWRCB.

[10] See https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2016/wqo2016_0068_ddw.pdf

Code	Purpose
Attachment A, Amended Recycled Water Policy	Recycled Water Policy Attachment A was amended in December 2018 to include the implementation of a monitoring program for CECs and bioanalytical screening (Bioassays) for recycled water that is used for groundwater recharge and surface water augmentation.

4. Environmental Impact Report Groundwater Significance Criteria

CEQA is a California statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The CEQA Guidelines are the regulations that explain and interpret the law for both the public agencies required to administer CEQA and for the public generally. The Guidelines are found in the California Code of Regulations, in Chapter 3 of Title 14.

Appendix G of the CEQA Guidelines provides the following two questions regarding groundwater resources:

- Would the project substantially deplete groundwater supplies or interfere substantially with groundwater replenishment such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?
- Would the project violate any water quality standards or otherwise degrade water quality?

The following factors are relevant to addressing the above-listed questions from the CEQA Guidelines Appendix G:

- Whether the GWR Project, taking into consideration the proposed treatment processes and groundwater attenuation and dilution, would:
  - (1) Impact groundwater quality so that it no longer met standards (e.g., Basin Plan beneficial uses and water quality objectives, including drinking water MCLs established to protect public health).
  - (2) Degrade groundwater quality subject to statutory requirements, and to the SWRCB Anti-degradation Policy[11] and Recycled Water Policy.
- Whether operation of the GWR Project would result in groundwater mounding, change groundwater gradients, or lower groundwater levels such that nearby municipal or private groundwater production wells experience a reduction in well yield or physical damage (due to exposure of well screens) resulting in a well not being capable of supporting existing land uses or planned uses for which permits have been granted.
- Whether the GWR Project would result in changes to groundwater levels such that it would exacerbate seawater intrusion.

This report focuses on the effects of the proposed GWR Project on water quality, groundwater levels, and groundwater quantity, including compliance with standards and the potential to degrade groundwater quality.

5. Recycled Water Regulations for Groundwater Replenishment

5.1. Regulations in Title 22 Prior to June 2014

Prior to June 18, 2014, the Water Recycling Criteria (Title 22 of the California Code of Regulations) included narrative requirements (e.g., general descriptions of requirements rather than numeric limits or specified treatment schemes) for planned groundwater replenishment projects. The regulations required that recycled

[11] Also included in the RWQCB Water Quality Control Plan.

water must be at all times of a quality that fully protected public health with DDW recommendations made on an individual case basis taking into consideration all relevant aspects of each project, including the following factors: treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to withdrawal. Since 1976, DDW issued numerous draft versions of progressively more detailed groundwater replenishment regulations that served as guidance for the several existing groundwater replenishment projects (see **Table 2**), as well as for planned groundwater replenishment projects.[12]

Table 2. Permitted Groundwater Replenishment Projects in California

Project	Type of Groundwater Replenishment Application	Years of Operation	Recycled Water Treatment	Dilution Water	Recycled Water Volume AFY	Planned Recycled Water Expansion AFY
Montebello Forebay Project, Los Angeles County	Surface spreading	52	Disinfected tertiary	Storm water, potable water, groundwater underflow	55,000[a]	21,000[a]
West Coast Basin Seawater Intrusion Barrier, Los Angeles County	Injection	20	Full Advanced Treatment	Potable water; will use 100% recycled water for future expansion	17,000[a]	7,200[a,b]
Dominquez Gap Seawater Intrusion Barrier, Los Angeles County	Injection	11	Full Advanced Treatment	Potable water; will use 100% recycled water for future expansion	5,400[a]	7,500[a,c]
Chino Basin Project, San Bernardino County	Surface spreading	9	Disinfected tertiary	Storm water, potable water, groundwater underflow	22,000[d]	---
Alamitos Gap Seawater Intrusion Barrier Project, Los Angeles County	Injection	9	Full Advanced Treatment	Potable water; will use 100% recycled water for future expansion	3,400[a]	8,900[a,b]
Groundwater Replenishment System (GWRS), Orange County	Injection (seawater barrier) and spreading	5[e]	Full Advanced Treatment	100% recycled water	78,000[f]	25,000[f]

a. Source: information used for the Central and West Basin Salt Nutrient Management Plan (Nellor et al., 2012). The permit was amended in April 2014 to allow up to 45% recycled water to be used for replenishment.

[12] In November 2014, the Central Coast RWQCB adopted a permit for the Cambria Emergency Water Supply Project. Unlike planned groundwater replenishment projects using recycled water, this project treats well water through an AWP Facility for injection into groundwater near potable supply wells. The well water being treated is comprised mostly of brackish groundwater, but depending on groundwater pumping it will also include secondary effluent from nearby secondary effluent disposal ponds. The project is necessary because of drought conditions and lack of natural replenishment water for the local groundwater basin. It is intended to only operate on a limited basis. The AWP Facility consists of MF, RO, UV/peroxide AOP, and free chlorine treatment. It was conditionally approved by DDW based on the June 2014 Groundwater Replenishment Regulations.

b. Expected to be online in 2019. The permit was amended in June 2014 to allow up to 100% recycled water to be used for replenishment.
c. Expected to be online in 2017/18.
d. Source: from RWQCB Order No. R8-2005-0033.
e. Prior to GWRS, the Orange County Water District operated Water Factory 21 that blended AWT recycled water and local groundwater for injection to serve as a seawater intrusion barrier.
f. Source: http://www.gwrsystem.com/images/stories/GWRS%20Expansion_State%20and%20Local.pdf; construction to be completed in 2015.

5.2. June 2014 Groundwater Replenishment Regulations

Final Groundwater Replenishment with Recycled Water Regulations hereafter, referred to as "Groundwater Replenishment Regulations," went into effect June 18, 2014 (SWRCB, 2014).

The overarching principles taken into consideration by DDW in developing the Groundwater Replenishment Regulations were:

- Groundwater replenishment projects are replenishing groundwater basins that are used as sources of drinking water.
- Control of pathogenic microorganisms should be based on a low tolerable risk that was defined as an annual risk of infection[13] from pathogenic microorganisms in drinking water of one in 10,000 (10^{-4}). This risk level is the same as that used for the federal Surface Water Treatment Rule for drinking water.
- Compliance with drinking water standards for regulated chemicals.
- Controls for unregulated chemicals.
- No degradation of an existing groundwater basin used as a drinking water source.
- Use of multiple barriers to protect water quality and human health.
- Projects should be designed to identify and respond to a treatment failure. A component of this design acknowledges that groundwater replenishment projects inherently will include storage in a groundwater aquifer and include some natural treatment.

The key provisions of the Groundwater Replenishment Regulations that apply to subsurface application (e.g., the use of injection or vadose zone wells) that use 100% recycled water for application are summarized in **Table 3**.

Table 3. Summary of June 2014 Groundwater Replenishment Regulations

Control Mechanism	Requirements
Source Control	Entities that supply recycled water to a groundwater replenishment project must administer a comprehensive source control program to prevent undesirable chemicals from entering wastewater. The source control program must include: (1) an assessment of the fate of DDW and RWQCB-specified contaminants through the wastewater and recycled water treatment systems; (2) provisions for contaminant source investigations and contaminant monitoring that focus on DDW and RWQCB-specified contaminants; (3) an outreach program to industrial, commercial, and residential communities; and (4) an up-to-date inventory of contaminants.
Pathogen Control	To meet the low tolerable risk level (a basic principle of the regulations), pathogen reduction requirements have been established for treatment of recycled water similar to the approach used for drinking regulations. The Groundwater Replenishment Regulations require a project

[13] There is a difference between infection and disease. Infection, often the first step, occurs when a pathogen enters a body and begins to multiply. Disease occurs when the cells in the body are damaged as a result of the infection and signs and symptoms of an illness appear. Infection necessarily precedes disease, but infection typically only leads to disease in a fraction of cases. Many factors influence the infection-to-disease ratio.

Control Mechanism	Requirements
	to achieve a 12-log enteric virus reduction, a 10-log *Giardia* cyst reduction, and a 10-log *Cryptosporidium* oocyst reduction using at least 3 treatment barriers. To ensure that a barrier is significant, each barrier must achieve at least 1.0-log reduction. No treatment process can be credited with more than 6-log reduction. The log reductions must be verified using a procedure approved by DDW. Log reduction refers to the reduction of pathogenic microorganism concentrations on a log-scale (e.g., 3 logs is 99.9% removal). Failure to meet the specified reductions requires notification to DDW and RWQB, investigation, and/or discontinuation of recycled water use until a problem is corrected. Trussell et al. (2013) conducted an extensive review of the proposed pathogen reduction requirements in the Groundwater Replenishment Regulations and concluded that the assumptions used to derive the log reductions were conservative and provide a large factor of safety that likely reduces the actual risk of infection below the 10^{-4} level, particularly for control of the amount of a particular disease present in a community.
Nitrogen Control	To ensure protection of groundwater, the concentration of total nitrogen in recycled water must meet 10 milligrams per liter (mg/L) before or after recharge. Failure to meet this value requires follow-up sampling, notification to DDW and RWQCB, and/or discontinuation of recycled water use until a problem is corrected.
Regulated Chemicals Control	The recycled water must meet drinking water MCLs as specified by the Groundwater Replenishment Regulations. Failure to meet MCLs requires follow-up sampling, notification to DDW and RWQCB, and/or discontinuation of recycled water use until the problem is corrected.
Unregulated Chemicals Control	Monitoring the concentrations and toxicities of thousands of potential organic compounds in any water supply would be an infeasible task. Control of unregulated chemicals for all groundwater replenishment projects using 100% AWP recycled water is accomplished through limits for Total Organic Carbon (TOC) and performance of treatment for constituents of emerging concern (CECs)[14]. TOC is used as a surrogate for unregulated and unknown organic chemicals. For subsurface application projects (injection and vadose wells), the entire recycled water flow must be treated using RO and AOP. After treatment, the TOC in the recycled water cannot exceed an average of 0.5 mg/L. Specific performance criteria for RO and AOP processes have been included in the Groundwater Replenishment Regulations. Failure to meet the requirements established for a groundwater replenishment project results in notifications to DDW and RWQCB, response actions, and in some cases cessation of the use of recycled water.
Response Retention Time (RRT)	The intent of the RRT is to provide time to retain recycled water underground to identify any treatment failure so that inadequately treated recycled water does not enter a potable water system. Sufficient time must elapse to allow for: a response that will protect the public from exposure to inadequately treated water; and provide an alternative source of water or remedial treatment at the wellhead if necessary. The RRT is the aggregate period of time between treatment verification samples or measurements; time to make the measurement or analyze the sample; time to evaluate the results; time to make a decision regarding the appropriate response; time to activate the response; and time for the response to work. The minimum RRT is 2 months, but must be justified by the groundwater replenishment project sponsor.
Monitoring Program	Comprehensive monitoring programs are established for recycled water and groundwater for regulated and unregulated constituents.
Operation and Optimization Plan	The intent of the plan is to assure that the facilities are operated to achieve compliance with the Groundwater Replenishment Regulations, to achieve optimal reduction of contaminants, and to identify how the project will be operated and monitored.
Boundaries Restricting Locations of Drinking Water Wells	Project sponsors must establish a "zone of controlled well construction," which represents the greatest of the horizontal and vertical distances reflecting the underground retention times required for pathogen control or for the RRT. Drinking water wells cannot be located in this zone. Project sponsors must also create a "secondary boundary" representing a zone of *potential* controlled well construction that may be beyond the zone of controlled well construction, thereby requiring additional study before a drinking water well is drilled.

[14] CECs include pharmaceuticals, ingredients in personal care products, and endocrine disrupting chemicals.

Control Mechanism	Requirements
Adequate Managerial and Technical Capability	A project sponsor must demonstrate that it possess adequate managerial and technical capability to comply with the regulations.
Engineering Report	The project sponsor must submit an Engineering Report to DDW and RWQCB that indicates how a groundwater replenishment project will comply with all regulations and includes a contingency plan to insure that no untreated or inadequately treated water will be used. The report must be approved by DDW.
Reporting	Annual reports must be submitted to DDW, RWQCB, and groundwater providers downgradient of injection wells; the Engineering Report must be updated every 5 years.
Alternatives	Alternatives to any of the provisions are allowed if: the project sponsor demonstrates that the alternative provides the same level of public health protection; the alternative has been approved by DDW; and an expert panel has reviewed the alternative unless otherwise specified by DDW.
Public Hearing	The project sponsor must hold a public hearing for a groundwater replenishment project after DDW approves the Engineering Report; based on the Engineering Report, the hearing, and public comments, DDW issues a conditional approval letter to the RWQCB for inclusion in the WDRs and/or WRRs issued by the RWQCB. Thus, including the hearing for the RWQCB permit, there are two public hearings for a groundwater replenishment project. Should DDW obtain primacy for issuing groundwater replenishment permits, the RWQCB would provide recommendations and conditions for inclusion in the WDRs and/or WRRs and the SWRCB would hold the permit hearing.

6. Overview of Drinking Water Standards and Advisory Levels

The Federal Safe Drinking Water Act allows the U.S. Environmental Protection Agency (USEPA) to promulgate national primary drinking water standards specifying MCLs for each contaminant present in a public water system with an adverse effect on human health, taking into consideration cost and technical feasibility. Primary MCLs have been established for approximately 90 contaminants in drinking water.[15] In cases where the MCLs cannot be feasibly ascertained, the USEPA may elect to identify and establish a schedule of "treatment techniques" preventing adverse effects on human health to the extent feasible. DDW has established its own set of MCLs either based on the Federal MCLs or as part of its own regulatory process. For example, California has an MCL for perchlorate while there is no Federal MCL.[16]

Drinking water MCLs are established in two steps. For the Federal process, the USEPA establishes MCL goals (MCLGs) and, for the State purposes, DDW establishes Public Health Goals (PHGs), which are the maximum levels of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allow an adequate margin of safety. The MCLGs have been historically set at zero for microbial and carcinogenic contaminants; chemical PHGs for carcinogens are set at the 10^{-6} risk level. Once the MCLG or PHG is established, the USEPA or DDW determines the feasible MCL or treatment technology level that may be achieved with the use of the best available technology and treatment techniques, and taking cost into consideration.

There are also a variety of chemicals of health concern whose occurrence is too infrequent in conventional drinking water sources to justify the establishment of national standards, but are addressed using advisory levels. The USEPA establishes health advisories to address many of these latter chemicals. The DDW has established its own health advisories for chemicals in drinking water without MCLs: NLs and Response Levels.[17] If a chemical concentration is greater than its NL in drinking water, the utility that distributes the water must inform its customers and consumers about the presence of the chemical, and about health concerns associated with exposure to it. If a chemical is present in drinking water that is provided to consumers at concentrations greater than the NL (10 to 100 times greater depending on the toxicological endpoint of the constituent), DDW recommends that the source be taken out of service (this concentration is

[15] For a current list of MCLs, see http://www.epa.gov/safewater/contaminants/index.html.
[16] For a comparison see: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.shtml
[17] See http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/NotificationLevels.shtml

called the Response Level). The Groundwater Replenishment Regulations include requirements for monitoring recycled water for NLs and actions to be taken if concentrations exceed NLs.

7. State Water Resources Control Board Policies

There are two policies of particular importance with respect to groundwater replenishment projects for protection of water quality and human health: (1) anti-degradation policies, and (2) the Recycled Water Policy.

7.1. Anti-degradation Policies

California's anti-degradation policies are found in Resolution 68-16, Policy with Respect to Maintaining Higher Quality Waters in California, and Resolution 88-63, Sources of Drinking Water Policy.[18] These resolutions are binding on all State agencies. They apply to both surface waters and groundwaters (and thus groundwater replenishment projects), protect both existing and potential beneficial uses of surface water and groundwater, and are incorporated into RWQCB Basin Plans.

Resolution 68-16 (Anti-degradation Policy)

The Anti-degradation Policy requires that existing high water quality be maintained to the maximum extent possible, but allows lowering of water quality if the change is "consistent with maximum benefit to the people of the state, will not unreasonably effect present and anticipated use of such water (including drinking), and will not result in water quality less than prescribed in policies." The Anti-degradation Policy also stipulates that any discharge to existing high quality waters will be required to "meet waste discharge requirements which will result in the best practicable treatment or control of the discharge to ensure that (a) pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."

Resolution 88-63 (Sources of Drinking Water Policy)

The Sources of Drinking Water Policy designates the municipal and domestic supply (MUN) beneficial use for all surface waters and groundwater except for those: (1) with total dissolved solids (TDS) exceeding 3,000 mg/L, (2) with contamination that cannot reasonably be treated for domestic use, (3) where there is insufficient water supply, (4) in systems designed for wastewater collection or conveying or holding agricultural drainage, or (5) regulated as a geothermal energy producing source. Resolution 88-63 addresses only designation of water as drinking water source; it does not establish objectives for constituents that threaten source waters designated as MUN.

7.2. Recycled Water Policy

The Recycled Water Policy was adopted by the SWRCB in February 2009. It was subsequently amended in 2013 with regards to CEC monitoring for groundwater replenishment projects. The Recycled Water Policy was also amended in 2018 with regards to the addition of bioanalytical screening and monitoring for CECs, including performance indicators, surrogates, and health-based indicators. The purpose of this is to evaluate performance and integrity of the RO/AOP processes, and to monitor CECs that are of toxicological relevance to human health. Monitoring must be conducted by a three-phased approach, which includes an initial assessment monitoring phase, followed by a baseline monitoring phase, and then a standard operation monitoring phase.

The Recycled Water Policy was a critical step in creating uniformity in how RWQCBs were individually interpreting and implementing Resolution 68-16 for water recycling projects, including groundwater replenishment projects. The critical provisions in the Policy related to groundwater replenishment projects are discussed in the following subsections.

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18 See http://www.swrcb.ca.gov/plans_policies/.

CECs Monitoring Plan

Prior to the initial assessment monitoring phase, M1W will develop and submit a Quality Assurance Project Plan (QAPP) for monitoring CECs using Guidance for Quality Assurance Project Plans, EPA QA/G-5 (EPA/240/R-2/009, 2002) to the SWRCB. QAPP will be updated annually if changes are made to the monitoring procedures. M1W will follow the Recycled Water Policy Amendment requirements for the selection of analytical methods and laboratories:

"Laboratories shall use analytical methods that have been validated and approved for the analytes in the applicable matrix and can achieve the reporting limits in Table 1 and Table 3 [of the Policy Amendment]. This includes methods that have been approved by U.S. EPA, the Standards Methods Committee, the American Society for Testing and Materials International, or other methods that have been validated and approved by the regional water boards or State Water Board for the analytes in the applicable matrix."

"A laboratory providing analyses of CECs and bioanalytical screening must hold a valid certificate of accreditation from the State of California Environmental Laboratory Accreditation Program (ELAP) for the analytical test methods or analytes selected, if such methods or analytes are accredited by ELAP at the time that monitoring is required to begin. If ELAP accreditation for analytical test methods or an analyte becomes available after monitoring is initiated, then the laboratory providing analysis of CECs shall be accredited by ELAP for those methods or analytes within one year of such accreditation becoming available. If ELAP accreditation is unavailable for a method or an analyte, the recycled water producer shall use a laboratory that has been accredited for a similar analytical method, instrumentation, or analyte until ELAP accreditation becomes available, unless otherwise approved by the regional water board or State Water Board for bioanalytical screening tools."

Salt and Nutrient Management Plans

In recognition that some groundwater basins in the state contain salts and nutrients that exceed or threaten to exceed Basin Plan groundwater objectives, and that some Basin Plans do not have adequate implementation measures to achieve compliance, the Recycled Water Policy includes provisions for managing salts and nutrients on a regional or watershed basis through development of Salt and Nutrient Management Plans (SNMPs) rather than imposing requirements on individual recycled water projects (which had been the practice prior to adoption of the Recycled Water Policy). Unfavorable groundwater salt and nutrient conditions can be caused by natural soils, discharges of waste, irrigation using surface water, groundwater, or recycled water, and water supply augmentation using surface or recycled water. Regulation of recycled water alone will not address these conditions.

SNMPs are to be developed for every groundwater basin/sub-basin by May 2014 (May 2016 with a RWQCB-approved extension). This requirement was updated in the most recent amendment to include only basins that are identified by each regional water board in their evaluations. The SNMP must identify salt and nutrient sources; identify basin/sub-basin assimilative capacity and loading estimates; and evaluate the fate and transport of salts and nutrients. The SNMP must include implementation measures to manage salt and nutrient loadings in the basin on a sustainable basis and an anti-degradation analysis demonstrating that all recycling projects identified in the plan will collectively satisfy the requirements of Resolution No. 68-16. The SNMP must also include an appropriate cost-effective network of monitoring locations to determine if salts, nutrients and other constituents of concern (as identified in the SNMPs) are consistent with applicable water quality objectives.

Regional Water Quality Control Board Groundwater Requirements

The Recycled Water Policy does not limit the authority of a RWQCB to include more stringent requirements for groundwater replenishment projects to protect designated beneficial uses of groundwater, *provided* that any proposed limitations for the protection of public health may only be imposed following regular consultation with DDW. The Recycled Water Policy also does not limit the authority of a RWQCB to impose additional requirements for a proposed groundwater replenishment project that has a substantial adverse effect on the fate and transport of a contaminant plume (for example those caused by industrial contamination or gas stations), or changes the geochemistry of an aquifer thereby causing the dissolution of naturally occurring constituents, such as arsenic, from the geologic formation into groundwater. These provisions require additional assessment of the impacts of a groundwater replenishment project on areas of contamination in a basin and/or if the quality of the water used for replenishment causes constituents, such as naturally occurring arsenic, to become mobile and impact groundwater.

Anti-degradation and Assimilative Capacity

Assimilative capacity is the ability for groundwater to receive contaminants without detrimental effects to human health or other beneficial uses. It is typically derived by comparing background ambient chemical concentrations in groundwater to the concentrations of the applicable Basin Plan groundwater quality objectives. The difference between the ambient concentration and groundwater quality objective is the available assimilative capacity.

The Recycled Water Policy establishes two assimilative capacity thresholds in the absence of an adopted SNMP. A groundwater replenishment project that utilizes less than 10% of the available assimilative capacity in a groundwater basin/sub-basin (or multiple projects utilizing less than 20% of the available assimilative capacity in a groundwater basin/sub-basin) are only required to conduct an anti-degradation analysis verifying the use of the assimilative capacity. In the event a project or multiple projects utilize more than the designated fraction of the assimilative capacity (e.g., 10% for a single project or 20% for multiple projects), the project proponent must conduct a RWQCB-deemed acceptable (and more elaborate) anti-degradation analysis. A RWQCB has the discretionary authority to allocate assimilative capacity to groundwater replenishment projects. There is a presumed assumption that allocations greater than the Recycled Water Policy thresholds would not be granted without concomitant mitigation or an amendment to the Basin Plan groundwater quality objective to create more assimilative capacity for allocation. Groundwater replenishment projects that utilize AWP recycled water will use very little to essentially none of the available assimilative capacity because of the high quality of the water. A project-specific anti-degradation analysis was conducted as part of the permitting process. The analysis demonstrated use of less than 10% of the available assimilative capacity of constituents of concern.[19]

7.3. <u>Constituents of Emerging Concern</u>

Background on CECs

Among the perceived risks of using recycled water for groundwater replenishment is concern about the presence of trace concentrations of pharmaceuticals, ingredients in personal care products (such as insecticides and flame retardants), and chemicals that can affect the human endocrine system in terms of growth, reproduction, and sexual behavior (e.g., endocrine disrupting chemicals). These chemicals are often grouped together and are called CECs in the Recycled Water Policy. Low concentrations of CECs have been found in wastewater, recycled water, surface water, drinking water, and groundwater. The ability to detect these chemicals at very low levels has outpaced the ability to completely remove them (if needed) from the environment.

CECs are effectively removed by many recycled water treatment processes, including the oxidative processes and RO in AWPF, but can sometimes be detected after treatment. For example, N,N-diethyl-metatoluamide

[19] November 18, 2016 Technical Memorandum prepared by Todd Groundwater for MRWPCA, “Antidegradation Analysis in Support of Proposed AWPF Recycled Water Concentration Limits, Pure Water Monterey Groundwater Replenishment Project (Project)”

(DEET), is the active ingredient in many insect repellent products, specifically used to repel mosquitoes and ticks. DEET has been measured in tertiary recycled water at a 90th percentile[20] concentration of 1.52 micrograms per liter (µg/L)[21] (Anderson et al., 2010) and is removed in AWP by more than 90% (Drewes et al., 2008). More information on CECs in the context of the pilot testing for the GWR Project is provided later in the report.

Simply detecting a compound, however, does not mean that its presence is of health significance. Because many CECs do not have established drinking water standards or advisory levels, researchers have developed a method to estimate concentrations that can be ingested daily over a lifetime without appreciable risk. This method utilizes information on chemical toxicity (often described on a per-body-weight basis), along with assumptions about the population and their water consumption. The procedure to derive this estimated "safe" amount involves collecting all relevant toxicity data, ascertaining the completeness of the data, determining the most sensitive toxicity outcome (taking into account sensitive population groups such as infants, children, pregnant women, and those with compromised health), and applying appropriate safety factors. Health outcomes include therapeutic doses of medications, the no observed adverse effect level (NOAEL), the lowest observed no adverse effect level (LOAEL), and carcinogenicity. To account for the variability and uncertainty that are reflected in differences between test animals and humans and variability within the human population, the numerical health outcomes are lowered by applying uncertainty factors thereby adding a layer of conservatism. Depending on the researcher conducting the study, these estimated safe amounts are called different names: Tolerable Daily Intakes (TDIs), Acceptable Daily Intakes (ADIs), or Predicted No Effect Concentrations (PNEC) (Schwab et al., 2005, Environment Protection and Heritage Council et al., 2008, Environment Protection and Heritage Council et al, 2008, Anderson et al., 2010, Bruce et al., 2010a,b).

These research projects have selected CECs for evaluation, considering the approximately 3,000 most used chemicals that might be present in recycled or drinking water, including prescription drugs, drugs of abuse, over-the-counter drugs, veterinary pharmaceuticals, personal care products, components of household products, and chemicals that can disrupt the human endocrine system. The selection process considers:

- The likelihood of occurrence in recycled water on the basis of evidence of detection in wastewater treatment plant effluents, effluent-dominated surface waters, and/or drinking water; the rate of pharmaceutical use; or physical/chemical properties predictive of resistance to water treatment and the potential to migrate in groundwater.
- The likelihood to cause adverse health effects in humans at very low, chronic exposure levels, particularly given any evidence of carcinogenicity, impairment of fertility, or developmental toxicity in animal or human studies.
- Public, scientific, and regulatory interest.
- The ability of different chemical or drug groups to represent different mechanisms of action or use patterns.

In order to compare the estimated safe amounts to concentrations of chemicals in recycled water or drinking water, researchers calculate a Drinking Water Equivalent Level (DWEL). The DWEL represents the concentration of a chemical in drinking water that would be equivalent to the TDI/ADI/PNEC, assuming a 150-pound person (70 kilograms or kg) consumes 2 liters (L) of water per day (d) (or about 8½ cups) using the following equation:

$$\textbf{DWEL } (\mu g/L) = \frac{\textbf{TDI } (\mu g/kg/day) \times 70 \text{ kg}}{2 \text{ L/day}}$$

[20] 90% of the samples tested are less than this value.

[21] A µg/L is one part per billion, or the equivalent of two drops of water in a typical 15,000-gallon backyard swimming pool.

Anderson et al. (2010) presents a compendium of TDIs, ADIs, PNECs, and DWELs for over 400 CECs.

To put the DWELs into understandable terms to support risk communication, they can be compared to the highest (worst case) concentrations that have been detected in wastewater, recycled water, or drinking water sources. It is then possible to calculate the number of 8-ounce glasses of water containing the detected concentrations that a person would have to drink to reach the upper limit of acceptable levels (the DWEL).

$$\textbf{Required water consumption (L/day)} = \frac{\textbf{DWEL }(\mu\textbf{g/L})\textbf{ x 2L/day}}{\textbf{Detected water concentration }(\mu\textbf{g/L})}$$

Some examples of DWELs and water consumption rates to reach the DWEL are presented in **Table 4**.

Table 4. Daily Water Consumption Equal to the Drinking Water Equivalent Level[a]

Compound	Type of Compound	DWEL µg/L	Consumption Rate Required to Equal DWEL (8-ounce Glasses/Day)[b]
Alprazolam	Anti-anxiety medication	14	39
Ciprofloxacin	Antibiotic	17	4,800
Clonidine	Blood pressure medication	0.028	>99
DEET	Insecticide	81	3,500
Ibuprofen	Analgesic	34	290
Morphine	Analgesic	1.0	42
Primidone	Anticonvulsant	0.85	55
Salicylic acid	Skin care product ingredient	54	420
TCEP[c]	Flame retardant	4.4	84
Di-*n*-butyl phthalate	Plasticizer	14	200

a. Source: Bruce et al., 2010a.

b. The water concentrations used to derive the consumption rates are to serve as an example only and are based on Bruce et al. (2010a), and do not reflect the data for the GWR Project. Bruce et al. (2010a) used the highest concentration of a CEC detected in water (surface and groundwater) and wastewater found in the literature, from studies in the U.S. and overseas, and thus was a very conservative approach.. As discussed later in this report, none of the example CECs were detected in the RO permeate from the pilot testing or would be found after treatment at the full-scale AWPF.

c. TCEP - Tris(2-chloroethyl)phosphate.

In general, for those CECs whose presence in recycled water, drinking water or other water sources has been evaluated, CECs were many times lower than the acceptable concentrations based on the DWELs.

CEC Monitoring

As part of the SWRCB Recycled Water Policy, a Science Advisory Panel was formed to identify a list of CECs for monitoring in recycled water used for groundwater replenishment. The Panel completed its report in June 2010 and recommended monitoring a specific list of selected health-based and treatment performance indicator CECs and surrogates (Anderson et al., 2010). The groundwater replenishment monitoring recommendations were directed at (1) surface spreading using tertiary recycled water, specifically monitoring recycled water and groundwater; and (2) injection projects using RO and AOP, specifically monitoring recycled water. The framework used to select CECs for monitoring compared Measured Environmental Concentrations (MECs) in recycled water to Monitoring Trigger Levels (MTLs). The MTLs are equivalent to DWELs discussed in the CEC background section of this report.
The Panel embedded a number of conservative assumptions within the framework used to identify CECs for monitoring in recycled water:

- The Panel elected to use available MEC data for secondary and tertiary recycled water. This approach results in MECs that are on the order of 40 to 800 times higher than what is likely observed in purified water that has also received AWP.

- No credit was given to the MECs for dilution through mixing with native groundwater, although this will naturally occur for both of the aquifers involved in the GWR Project.
- The 90th percentiles of MECs were used, which provides a safety factor of approximately 10-fold.
- The derivation of the MTLs include safety factors ranging from 100 to 10,000.

Overall, the assumptions used by the Panel to identify CECs for monitoring groundwater replenishment projects included between 6 to 11 orders of magnitude of conservatism. Some of the CECs were selected for monitoring based on their potential to pose a human health risk if present in drinking water, while others were selected to evaluate recycled water treatment performance, or both.

The SWRCB amended the Recycled Water Policy in 2013 (Resolution No. 2013-0003) to include the Panel's recommended CEC monitoring program, including the a list of specific performance indicator and health-based CECs, and surrogates, their respective monitoring, and procedures to evaluate the data and for responding to the monitoring results. The Panel was reconvened in 2017 to review available data and update its 2010 recommendations. The Final Report was released in April 2018 and included revisions to the list of indicators and surrogates and recommendations to conduct bioanalytical screening. The Panel's findings were incorporated into Appendix A of the 2018 Recycled Water Policy Amendment. The final list of specific CECs and monitoring frequencies for groundwater replenishment projects (subsurface application) can be seen in **Table 5**. The procedures to evaluate the data and for responding to the monitoring results can be seen in **Table 6**. For health-based CECs, the responses in **Table 6** are based on comparing measured concentrations in recycled water after treatment (RO or RO with AOP for subsurface application projects) to the MTLs. The monitoring and response requirements will be incorporated into groundwater replenishment project permits. As part of the Groundwater Replenishment Regulations, DDW has its own CEC requirements and monitoring locations that must be met (and established on a project-by-project basis) in addition to the Recycled Water Policy requirements.

For groundwater recharge with subsurface application and reservoir augmentation projects, the producer shall evaluate the bioanalytical screening results for the recycled water following treatment prior to release to the aquifer or surface water reservoir. The required equivalency agonists and MTLs for bioanalytical screening tools can be seen in **Table 7**. For bioanalytical tools, the recycled water producer shall compare bioanalytical equivalent concentrations (BEQs) to their respective MTL listed in **Table 7**. The responses actions are based on the BEQ/MTL ratios as presented in **Table 8**.

Table 5. Recycled Water Policy - Monitoring for Constituents of Emerging Concern for Groundwater Replenishment Projects (SWRCB, Dec. 2018)

Constituent	Constituent Group	Relevance / Indicator Type	Method Reporting Limit (μg/L)[a,b]	MTL (μg/L)	Example of Treatment % Removal[c]
1,4-Dioxane	Industrial Chemical	Health	0.1	1	--[g]
NDMA[d]	Disinfection byproduct	Health & Performance	0.002	0.01	25-50, >80[e]
N-Nitrosomorpholine	Industrial chemical	Health	0.002	0.012	--
Perfluorooctane sulfonate (PFOS)	Consumer/industrial chemical	Health	0.0065	0.013	--
Perfluorooctanoic acid (PFOA)	Consumer/industrial chemical	Health	0.007	0.014	--
Sulfamethoxazole	Antibiotic	Performance	0.01	--	>90
Sucralose	Food additive	Performance	0.1	---[f]	>90

a. The Method Reporting Level is the smallest measured concentration of a substance that can reliably be measured using a given analytical method.

b. Monitoring frequency is quarterly for the initial assessment phase; semi-annually for the baseline phase; and semi-annually to annually for the standard operation phase; CEC monitoring can be removed or increased based on the results.
c. These percentages are one example from one study that evaluated treatment performance; specific removal percentages are to be established for each groundwater replenishment project.
d. NDMA – N-nitrosodimethylamine.
e. For RO, the range is 25-50%; for RO with AOP, the removal is greater than 80%.
f. The Panel used "N/A" in its report for the MTL but showed the MEC/MTL ratio equal to 0.02. Based on the sucralose MEC of 26,390,000 µg/L, a calculated MTL would be 527,800 µg/L. This value is higher than a calculated DWEL of 175,000 µg/L based on the Food and Drug Administration's ADI for sucralose, which is an artificial sweetener. Because sucralose is present in wastewater (and is not toxic), it serves as an excellent treatment performance indicator.
g. Not applicable

Table 6. Recycled Water Policy - Thresholds and Response Actions for Health-based CECs

MEC/MTL Threshold	Response Action[a]
If greater than 75% of the MEC/MTL ratio results for a CEC are less than or equal to 0.1 during the baseline monitoring phase and/or subsequent monitoring	A) After completion of the baseline-monitoring phase, consider requesting removal of the CEC from the monitoring program.
If MEC/MTL ratio is greater than 0.1 and less than or equal to 1	B) Continue to monitor.
If MEC/MTL ratio is greater than 1 and less than or equal to 10	C) Check the data. Continue to monitor.
If MEC/MLT ratio is greater than 10 and less than or equal to 100	D) Check the data, resample within 72 hours of notification of the result and analyze to confirm CEC result. Continue to monitor.
If MEC/MLT ratio is greater than 100	E) Check the data, resample within 72 hours of notification of the result and analyze to confirm CEC result. Continue to monitor. Contact the RWQCB and DDW to discuss additional actions. (Additional actions may include, but are not limited to, additional monitoring, toxicological studies, engineering removal studies, modification of facility operation, implementation of a source identification program, and monitoring at additional locations.)

a. If a CEC also has a notification level, additional follow-up monitoring may be required by the State Water Board or regional water board per requirements in California Code of Regulations, title 22.

Table 7 - Recycled Water Policy - Required Equivalency Agonists and MTLs for Bioanalytical Screening Tools

Constituent/Parameter	Equivalency Agonist	MTL (ng/L)[a]
Estrogen receptor-α (ER- α)	17-beta-estradiol	3.5
Aryl hydrocarbon receptor (AhR)	2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	0.5

a. The MTL for (ER- α) represents a health-based MTL. The MTL for AhR represents a level which may or may not be indicative of a health-based effect due to the wide variation in health-based predicted no-effect concentrations of agonists.

Table 8 - Recycled Water Policy - BEQ/MTL Thresholds and Response Actions for Bioanalytical Screening Tools

BEQ/MTL Threshold	Response Action[a]
If BEQ/MTL ratio is consistently less than or equal to 0.15 for ER- α or 1.0 for AhR	A) After completion of the baseline monitoring phase, consider decreasing monitoring frequency or requesting removal of the endpoint from the monitoring program.
If BEQ/MTL ratio is greater than 0.15 and less than or equal to 10 for ER- α or greater than 1.0 and less than or qual to 10 for AhR.	B) Continue to monitor.
If BEQ/MTL ratio is greater than 10 and less than or equal to 1000	C) Check the data, resample within 72 hours of notification of the result and analyze to confirm bioassay result. Continue to monitor. Contact the RWQCB and DDW to discuss additional actions, which may include, but are not limited to, targeted analytical chemistry monitoring, increased frequency of bioassay monitoring, and implementation of a source identification program.
If BEQ/MTL ratio is greater than 1000	D) Check the data, resample within 72 hours of notification of the result and analyze to confirm bioassay result. Continue to monitor. Contact the RWQCB and DDW to discuss additional actions, which may include, but are not limited to, targeted and/or non-targeted analytical chemistry monitoring, increased frequency of bioassay monitoring, toxicological studies, engineering removal studies, modification of facility operation, implementation of a source identification program, and monitoring at additional locations.

8. Central Coast Regional Water Quality Control Board Requirements

The Central Coast RWQCB is currently responsible for regulating recycled water discharges to groundwater, which are subject to state water quality regulations and statutes.

8.1. Groundwater Beneficial Uses and Water Quality Objectives

WDRs issued by the Central Coast RWQCB are required to implement applicable State water quality control policies and plans, including water quality objectives and implementation policies established in the Basin Plan.[22] The Basin Plan designates beneficial uses and groundwater quality objectives on a sub-basin basis. Groundwater throughout the Central Coast Basin (except for the Soda Lake Sub-basin) is suitable for agricultural water supply (AGR), MUN, and industrial use. The Basin Plan has:

- General narrative groundwater objectives that apply to all groundwaters for taste and odor and radioactivity.
- For MUN beneficial uses - groundwater criteria for bacteria and DDW primary and secondary MCLs.
- For AGR beneficial uses - objectives to protect soil productivity, irrigation, and livestock watering.

[22] See http://www.waterboards.ca.gov/rwqcb3/publications_forms/publications/basin_plan/.

Permit limits for groundwater replenishment projects are set to ensure that groundwater does not contain concentrations of chemicals in amounts that adversely affect beneficial uses or degrade water quality. For some specific groundwater sub-basins, the Basin Plan establishes specific mineral water quality objectives for TDS, chloride, sulfate, boron, sodium, and nitrogen. No specific numeric objectives have been established in the Basin Plan for the Seaside Basin for these constituents other than those with MCLs. The Central Coast RWQCB issued Order No. R3-2017-0003 (WDRs/WRRs) on March 9, 2017 to regulate the GWR Project operations and impacts.

9. Permitting Groundwater Replenishment Projects

9.1. Division of Drinking Water and Regional Water Quality Control Board Roles

The process for project approval and permitting of groundwater replenishment projects is depicted in **Figure 1**.

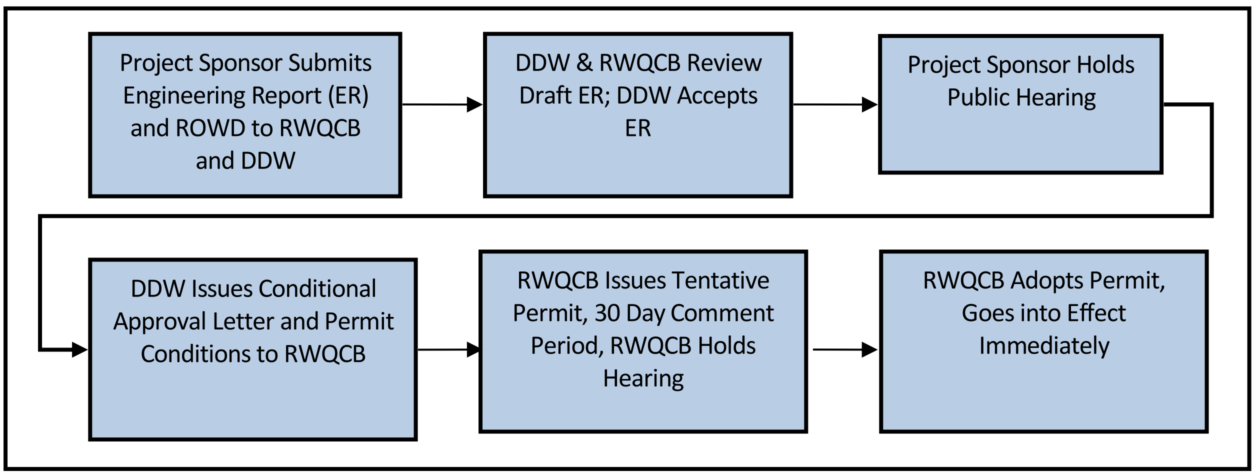

Figure 1. Regulatory Process for Groundwater Replenishment Projects Using Recycled Water

In some cases, as a step before proceeding with an Engineering Report, a project sponsor will seek conditional approval from DDW of a conceptual project proposal. This approach was taken for the GWR Project. In May 2014, MRWPCA submitted a proposal, which was reviewed by the IAP, for review by DDW (MRWPCA, 2014). On June 5, 2014, DDW submitted a letter to MRWPCA that conditionally approved the GWR Project proposal. On March 2017, the project was granted final approval (WDRs/WRRs) for the 5 mgd project (see Appendix A). This permit will need to be amended to address any requirements associated with GWR Project expansion (7.6 mgd). DDW also listed the following future submittal requirements:

- The Engineering Report, final design and Contingency Plan (Final Submitted April 2019)
- The Operation Optimization Plan (Draft Submitted January 2019
- The Response Plan (Included in the Engineering Report)
- The Water Quality Monitoring Plan (MRP included in the March 2017 WDRs/WRRs; a revised MRP was issued to M1W in 2019)
- Monitoring well program justification.
- Information on M1W's technical and managerial capacity with a focus on treatment plant operators**.**

9.2. Federal Requirements for Groundwater Replenishment Projects (Underground Injection Control)

At this time there are no Federal permitting requirements for surface application groundwater replenishment projects; the USEPA's underground injection control (UIC) program does apply to injection wells, but has no permitting consequences for the GWR Project. The UIC program has categorized injection wells into five classes, only one of which (Class V) applies to groundwater replenishment projects. Under the existing Federal regulations, Class V injection wells are "authorized by rule" which means they do not require a Federal permit if they do not endanger underground sources of drinking water and comply with other UIC program requirements. For California, USEPA Region 9 is the permitting administrator for Class V wells. Any injection project planned in California must meet the State Sources of Drinking Water Policy, which ensures protection of groundwater quality for drinking water supplies, and therefore a Federal permit would not be necessary.[23] All Class V injection well owners in California are required to submit information to USEPA Region 9 on the well for USEPA's inventory.[24]

10. Studies and Tools to Assess the Safety of the Use of Recycled Water for Groundwater Replenishment

This Section presents information on studies and tools designed to evaluate the effects of recycled water used for groundwater replenishment on human health. These types of studies and tools show that the use of recycled water for such use is a safe sustainable practice.

- Epidemiological studies.
- Risk assessments.
- Bioanalytical screening tools.

The Recycled Water Policy was amended in 2013 to specify monitoring requirements for constituents of emerging concern (CECs) and in 2018 to ensure consistent statewide permitting/reporting and to update CEC monitoring requirements based on recent research findings. The Final Report was released in April 2018 and included revisions to the list of indicators and surrogates and recommendations to conduct bioanalytical screening, evidencing the importance of these tools. More details are presented in the following subsections.

10.1. Epidemiology Studies

Epidemiological studies evaluate the relation between an environmental pollutant and human health using data to characterize exposures to the pollutant, including concentrations in the environment, the probability and characteristics of human exposure, and the distributions of internal doses, as well as trends or differences in the health status of exposed people. Over the past 30 years, a limited number of epidemiology studies have specifically been conducted to evaluate the public health implications of using recycled water for groundwater replenishment and for direct potable reuse.[25]

The epidemiology studies rely on exposure and outcome data for groups rather than individuals. The diseased persons in the study may not be the most exposed individuals, but this cannot be determined. Nor is information on important risk factors (such as smoking, alcohol consumption, and occupational/environmental exposure that might affect disease incidence) typically available or controllable in the analysis. Other confounding factors can include population migration in and out of the study areas and the use of bottled water. Although epidemiology is helpful as part of an evaluative suite of analytical tools used to assess risk, epidemiology may be most useful at bounding the extent of risk, rather than actually determining the presence of risk at any level (NRC, 2012).

A summary of the relevant projects and related studies is presented in **Table 9**. The Montebello Forebay Project, which uses tertiary recycled water for groundwater replenishment, has been the subject of three epidemiology studies that have shown that there was no association between use of tertiary recycled water

[23] See http://water.epa.gov/type/groundwater/uic/class5/frequentquestions.cfm#do_i.
[24] http://www.epa.gov/region9/water/groundwater/uic-classv.html, and http://www.epa.gov/region9/water/groundwater/injection-wells-register.html.
[25] California law defines direct potable reuse as the planned introduction of recycled water either directly into a public water system or into a raw water supply immediately upstream of a water treatment plant.

and mortality or morbidity. This summary of potable reuse epidemiology studies has not been updated since the initial 2015 version of this report, which was prepared as part of the approved 5 MGD PWM Project because there have been no more recent epidemiology studies published (R. Trussell, 2019 and A. Olivieri, 2019).

Table 9. Summary of Potable Reuse Epidemiology Studies

Project	Description	Studies/Results
Groundwater Replenishment using Tertiary Treated wastewater, not treated with Advanced Water Purification		
Montebello Forebay Groundwater Recharge Study, Los Angeles County, California (Nellor, et al., 1984; Sloss et al., 1996; Sloss et al. 1999)	Recycled water has been used as a source of replenishment since 1962; other replenishment sources are imported river water (Colorado River and State Project water) and local storm runoff. Water is percolated into the groundwater using two sets of spreading grounds. From 1962 to 1977, the water used for replenishment was disinfected secondary effluent. Granular media filtration was added later to enhance virus inactivation during final disinfection. During this time period, the amount of recycled water spread annually averaged 27,000 acre-feet (AF), which was 16% of the inflow to the groundwater basin. At that time an arbitrary cap of 32,700 AFY of recycled water had been established. In 1987, the project was allowed in increase the amount of recycled water to 50,000 AFY. The current permit allows for a maximum recycled water contribution of 35% based on a 10-year average. The recycled water meets drinking water standards for chemical constituents and also meets California recycling criteria for total coliforms < 2.2/100 milliliters (mL), and turbidity < 2 Nephelometric Turbidity Units (NTU).	The studies have looked at health outcomes for 900,000 people that received some recycled water in their household water supplies in comparison to 700,000 people in a control population. Three sets of studies have been conducted: 1) the Health Effects Study, which evaluated mortality, morbidity, cancer incidence, and birth outcomes for the period 1962-1980; 2) the Rand Study (Sloss et al., 1996), which evaluated mortality, morbidity, and cancer incidence for the period 1987-1991; and 3) the second Rand Study (Sloss et al. 1999), which evaluated adverse birth outcomes for the period 1982-1993. Health Effects Study (1962-1980): the epidemiological studies focused on a broad spectrum of health concerns that could potentially be attributed to constituents in drinking water. Health parameters evaluated included: mortality (death from all causes, heart disease, stroke, all cancers and cancers of the colon, stomach, bladder and rectum); cancer incidence (all cancers, and cancers of the colon, stomach, bladder, and rectum); infant and neonatal mortality; low birth weight; congenital malformations; and selected infectious diseases (including *Hepatitis A* and *Shigella*). Another part of the study consisted of a telephone interview of adult females living in recycled water and control areas. Information was collected on spontaneous abortions and other adverse reproductive outcomes, bed-days, disability-days, and perception of well being. The survey was able to control for the confounding factors of bottled water usage and mobility. Rand (1987–1991): the study evaluated cancer incidence (all cancers, and cancer of the bladder, colon, esophagus, kidney, liver, pancreas, rectum, stomach); mortality (death from all causes, cancer, cancer of the bladder, colon, esophagus, kidney, liver, pancreas, rectum, stomach, heart disease, cerebrovascular disease); and infectious diseases (including *Giardia*, *Hepatitis A*, *Salmonella*, *Shigella*). Rand (1982–1993): the evaluation focused on two types of adverse birth outcomes: (a) prenatal development and infant mortality (including: low birth weight (full term only), low birth weight (all births), very low birth weight, preterm birth, infant mortality); and (b) birth defects (all defects, neural tube defects, other nervous system defects, ears, eyes, face, neck defects; major cardiac defects, patent ductus arteriosus, other cardiac defects, and respiratory system defects; cleft defects, pyloric stenosis, intestinal artesias, other digestive system defects; limb, other musculoskeletal, integument and all other defects; chromosomal syndromes and syndromes other than chromosomal).

Project	Description	Studies/Results
		These three studies found that after almost 30 years of groundwater replenishment, there was no association between tertiary recycled water consumption and higher rates of cancer, mortality, infectious disease, or adverse birth outcomes.
Direct Potable Reuse		
Windhoek, Namibia (Isaacson and Sayed, 1988)	This is an ongoing direct reuse project that began in 1968. At the time the study was conducted, the recycled water was treated using sand filtration and granular activated carbon (GAC), and the recycled water was added to the drinking water supply system. The treatment system for this project has been upgraded since this work was conducted. The highly treated recycled water is blended with treated dam water and/or groundwater. The maximum portion of recycled water fed into the potable water distribution system is 50% in times of low water demand (winter season) (Lahnsteiner and Lempert, 2007). The drinking water system serves 250,000 people. Water quality guarantee values have been established for the project based on the World Health Organization Guidelines, the Rand Water Guidelines (South Africa), and the Namibian Guidelines for Group A Water.	The study, which was conducted for the period 1976–1983, looked at cases of diarrheal diseases. For the Caucasian population of similar socio-economic status studied, disease incidence was marginally lower in persons supplied with recycled water than those with water from conventional sources. Incidence rates were significantly higher in black populations, all of whom received conventional water only. Age-specific incidence rates in children of the various ethnic groups also showed differences characteristically associated with socio-economic stratification. The study concluded that the consumption of recycled water did not increase the risk of diarrheal diseases caused by waterborne infectious agents.
Chanute, Kansas (Metzler et al., 1958)	This project provided emergency use of recycled water during a drought for 150 days during 1956-57. The Neosho River was dammed below the outfall of the sewage treatment plant and the treated effluent backed up to the water intake. The impounding acted as waste stabilization and water was chlorinated prior to service. The use ended when heavy rains washed out the temporary dam. The river water source already contained wastewater prior to this event.	An epidemiology study showed fewer cases of stomach and intestinal illness during the period when recycled water was used than the following winter when Chanute returned to using river water.

10.2. Risk Assessment

Risk assessment can be defined as the determination of a quantitative or qualitative value of risk related to a specific situation and a recognized threat (or hazard). Typically, the goal of an environmental risk assessment is to estimate the severity and likelihood of harm to human health or the environment occurring from exposure to a (chemical or microbiological) risk agent (Cohrssen and Covello, 1989). Information obtained from risk assessments can be used to make risk management and policy decisions.

In 1983, in response to a request by the U.S. Congress, the National Academy of Sciences National Research Council (NRC), developed a risk assessment framework that primarily addressed human health effects associated with exposure to chemical contaminants in the environment and how risk assessment should be addressed as part of the development of regulations (NRC, 1983). The framework has also served as a template for the development of numerous subsequent risk assessments and risk assessment frameworks. Those steps in that framework include:

- Hazard identification: Evaluate data and identify detected chemicals that can be used to represent the potential carcinogenic risk and noncarcinogenic hazard posed by the test waters.
- Dose response assessment: Evaluate the potential carcinogenicity and noncarcinogenic effects of the chemicals of concern.
- Exposure assessment: Estimate the potential doses based on observed concentrations and assumed intake levels or rates.
- Risk characterization: Compute the potential health risks associated with the test waters.

Risk assessment following a modified form of this framework can also be conducted for microorganisms.

The 1983 risk assessment framework was enhanced in 2009 by expanding on problem formulation and risk-based decision-making, and by including provisions for internal and external stakeholder involvement in all stages of risk assessment (NRC, 2009).

The USEPA Office of Drinking Water uses a “regulatory window” of 10^{-6} to 10^{-4} for evaluation of risk where 10^{-4} is the baseline risk for all regulations and 10^{-6} is the *de minimis* risk level, where *de minimis* risk levels infer that the activity is essentially “risk free.” Acceptable risk differs from *de minimis* risk in that it incorporates factors beyond health-based criteria alone, such as the technological feasibility or economic impacts of achieving a given level of risk. Under ideal conditions, the acceptable risk would meet the *de minimis* criteria while being technically and economically practical. However, a compromise between the lower levels of risk and the availability of technology and/or economic limitations is sometimes justified.

Several representative quantitative risk assessment studies have been conducted evaluating the risks to human health associated with the use of recycled water for groundwater replenishment. Quantitative “relative” risk assessments (QRRAs) differ from conventional risk assessments in that they calculate doses on the basis of observed concentrations in water and an *assumed* standard water intake in lieu of deriving a site-specific water intake rate, because determinations of absolute exposure in terms of the amount of water consumed in a study population cannot be reliably or easily derived. For example, absolute exposure is impacted by use of bottled water, consuming different water at home rather than at work, population mobility, etc. Thus, a QRRA does not assess the absolute risk from ingestion of water at the tap but rather compares the relative risk of the scenario being evaluated assuming everyone is drinking the same amount of water at the same concentration. This is likely a more conservative approach than using absolute exposure information.

QRRAs were conducted for the Montebello Forebay Project and the Chino Basin Project. The recycled water used for these projects meets the Title 22 Water Recycling Criteria standard for disinfected filtered recycled water and federal and state drinking water MCLs in recycled water before or after surface application. Both of these projects apply recycled water using spreading basins. Dilution waters are also used for replenishment (stormwater, potable water, or other sources of non-wastewater origin) such that the recycled water contributions (RWCs) for the projects range from 35% to 45%.[26] The QRRAs were based on chemicals that are currently regulated or under consideration for regulation (Soller and Nellor, 2011, a,b).

[26] The RWC is the ratio of the volume of recycled water applied divided by the sum of the volume of recycled water and dilution water (called diluent water in the Groundwater Replenishment Regulations). For surface application projects, the maximum allowable RWC is also a function of the TOC in recycled water (before or after recharge). For subsurface application projects, the TOC cannot exceed an average of 0.5 mg/L.

Relative human health risks were used to evaluate the potential human health risks rather than using a more traditional approach of making comparisons to drinking water standards because MCLs are based on varying levels of risk. The study evaluated eight years of historical data including approximately 200 chemicals, and identified constituents that were detected in groundwater and had associated health-based criteria such as noncarcinogenic toxicity information and/or cancer slope factors that could be used to quantify the estimated relative potential risk presented by ingestion of groundwater. The wells studied included those with and without recycled water.

The hazard index method was used to assess the overall potential for noncarcinogenic effects. This approach calculated the ratio between the concentration of a detected chemical in groundwater and its toxicity (either the NOAEL or LOAEL). The ratios were added together for all detected chemicals. If the cumulative sum of the added ratios was equal to or greater than unity ("1"), there was a potential risk. If the cumulative sum was less than 1, there was no risk. The QRRAs found that for non-carcinogenic risk, the hazard index for all of the wells was below 1.

The QRRAs also assessed carcinogenic risks. Carcinogenic risks were estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Probabilistic simulations were conducted to estimate the carcinogenic risk associated with a hypothetical drinking water exposure for the wells under investigation using cancer slope factors. Twenty-five thousand (25,000) individual simulations were carried out for each well. The results of the carcinogenic risk assessment showed no significant difference in risk for groundwater wells with and without recycled water; the carcinogenic risks were in the range of 1 in 100,000.

The results showed that for both groundwater replenishment projects, it was unlikely that recycled water used for groundwater replenishment contributed substantially to the human health risk. Naturally occurring arsenic (not impacted by recycled water used for groundwater replenishment) was the highest contributor to risk in groundwater.

The Orange County Water District (OCWD) in Southern California conducted a QRRA (Soller et al., 2000) using available chemical and microbial data to compare alternative water sources used to replenish the potable Orange County Groundwater Basin. The alternatives considered were Santa Ana River water (which includes a substantial contribution of wastewater from upstream dischargers), Colorado River water (which also includes a substantial contribution of wastewater from upstream dischargers), California State Water Project water, and AWP recycled water. The QRRA found that for non-carcinogenic risk, the hazard index for each type of water was below 1, where 1 is considered the threshold for potential health effects, with the AWP recycled water index lower than the Colorado River and State Water Project waters (imported waters) and the Santa Ana River water. For carcinogenic risks, the risk levels were lower for the AWP recycled water and imported waters in comparison to the Santa Ana River water. Although the levels of arsenic were below the then existing drinking water MCL of 50 µg/L and the then proposed MCL of 10 µg /L, arsenic represented the majority of risk. Arsenic concentrations in the AWP recycled water were 60 times lower than the Santa Ana River water and 35 times lower than the imported water levels. The results also showed that the AWP recycled water was projected to present much less risk than the other waters from bacteria, parasites, and viruses provided that all unit treatment processes in the AWPF were fully operational and operating properly.

As part of the NRC's evaluation of potable reuse, the NRC conducted an analysis that was termed as a "risk exemplar," which compared the estimated risks of a common drinking water source generally perceived as safe (but which was comprised of a 5% wastewater component, e.g., *de facto* potable reuse[27]) against the estimated risks of two planned potable reuse scenarios: (1) a deep well in a groundwater aquifer fed by recycled water through soil percolation (receiving soil aquifer treatment or SAT) and (2) a deep well drawing

[27] *De facto* reuse is defined as a drinking water supply that contains a significant fraction of wastewater effluent. This can occur in surface water from upstream discharge of treated wastewater and in groundwater from land disposal of wastewater or discharge from septic tanks. This term is also called unplanned or unintended reuse.

from a groundwater aquifer fed by direct injection of recycled water from an AWPF (NRC, 2012). The analysis examined the presence of selected pathogens and trace organic chemicals (for example, chemicals of emerging concern) in final recycled waters from the *de facto* potable reuse scenario and the two potable reuse scenarios to assess whether there are likely to be significantly greater human health concerns from exposure via ingestion to contaminants in these hypothetical reuse scenarios, compared with a common *de facto* reuse scenario. For the chemicals in each of the scenarios, a risk-based action level was used, such as USEPA's MCLs, Australian drinking water guidelines, or World Health Organization drinking water guideline values. Also, a margin of safety was applied, which was defined as the ratio between a risk-based action level (such as an MCL) and the actual concentration of a chemical in recycled water. For microorganisms, the dose-response relationships were used to compute risk from a single day of exposure. The NRC focused on four pathogens commonly of concern in reuse applications and selected 24 chemicals representing different classes of contaminants.

The results showed that following proper design and operational strategies, potable reuse systems can provide protection from trace organic contaminants comparable to what the public experiences in many drinking water supplies today. For microbial agents, the analysis showed that the potable reuse scenarios represented a reduction in microbial risk when compared with the *de facto* reuse example.

10.3. Bio-analytical Screening Tools

A number of studies have sought to analyze and compare the toxicological properties of recycled water to those of drinking water; some of these studies attempted to use the combination of toxicology assays and chemical methods to isolate and identify constituents of potential health significance in recycled water used for planned potable reuse. A summary of these projects and related studies is presented in **Table 10**. In general these studies show that bio-analytical methods can be used to evaluate treatment effectiveness, but are not yet ready to evaluate health significance.

Table 10. Summary of Bio-analytical Screening Studies

Project	Types of Water Studied	Health-effects data
Montebello Forebay Project (Nellor, et al., 1984)	Disinfected tertiary effluent, storm water, and imported river water used for groundwater replenishment; also recovered groundwater.	This study used the Ames *Salmonella* test and mammalian cell transformation assay using organic concentrates of the different waters (concentrated 10,000 to 20,000 times), and subsequent chemical identification was attempted using the Ames assays. Samples were collected from the late 1970s to the early 1980s. The level of mutagenic activity (in decreasing order) was storm runoff > dry weather runoff > tertiary recycled water > groundwater > imported water. No relation was observed between the percentage of tertiary recycled water in wells and observed mutagenicity of residues isolated from wells. The residues did not yield significant cytotoxicity in the mammalian cell assays. To facilitate the isolation and identification of the components in sample concentrates, the residues were first fractionated by high performance liquid chromatography followed by testing of the fractions for mutagens and analysis of the mutagenic fractions by gas chromatography-electron ionization mass spectrometry. Results indicated that mutagenicity generally occurred in the least polar (most hydrophobic) fractions of each sample. In most cases, the sum of the mutagenicity in sample fractions was similar in magnitude to that observed in the whole sample. There was no evidence of synergistic effects in these assays. The chemical analysis of mutagenic fractions from 34 samples yielded only four known Ames mutagens in six samples (fluoranthene, benzo(a)pyrene, N-nitrosomorpholine, and N-nitrosopiperidine). However, these

Project	Types of Water Studied	Health-effects data
		compounds were considered to contribute little to the observed overall mutagenicity of the samples. Several unknown compounds detected in the mutagenic fractions could not have caused the mutagenicity in all of the samples, because their frequency of occurrence, distribution in the fractions, and concentrations were not consistent with the bioassay results. Selected sample residues were then evaluated qualitatively by chemical derivatization techniques to determine which classes of compounds might be contributing to the mutagenic activity. Since mutagens are considered to be electrophilic, two nucleophilic reagents were used to selectively remove epoxide and organohalide mutagens from the residues. Analysis of mutagenic residues of groundwater and replenishment water by negative ion chemical ionization gas chromatography-mass spectrometry and Ames assay before and after derivatization supported (but did not unequivocally prove) the role of at least these two classes of electrophiles in the observed mutagenicity. Several samples had more than 100 reactive components, containing chlorine, bromine, iodine, or epoxides, with concentrations at the part-per-trillion level. However, the structures of these compounds could not be determined, nor were the sources of the compounds identified. Because positive chemical identifications of specific mutagens could not be made and because the estimated concentrations of the components were so low, the biological significance of these materials remained in doubt. Follow-up toxicity testing of tertiary recycled water residues in the mid-1990s (not published) showed no Ames test response, while preserved residues from the earlier testing still showed a response indicating that the character of the recycled water has changed over time, perhaps as a result of increased source-control activities.
Denver Potable Water Reuse Demonstration Project (Lauer et al., 1996; NRC, 1988)	AWP effluent (with ultrafiltration or RO) and finished drinking water (current supply). The purpose of the project was to evaluate the feasibility of direct potable reuse by producing high quality recycled water; the proposed project was not implemented.	This study used 150 to 500 times organic residue concentrates in 2-year *in vivo* chronic/carcinogenicity study in rats and mice and a reproductive/teratology study in rats. No treatment-related effects were observed.
Tampa Water Resource Recovery Project (CH2M Hill, 1993, Pereira et al., undated; NRC, 1988)	AWP effluent (using GAC and ozone disinfection) and Hillsborough River water using ozone disinfection (the current drinking water supply). The proposed project involved augmentation of the Hillsborough River raw water supply; it was not implemented.	This study used Ames *Salmonella*, micronucleus, and sister chromatid exchange tests for three dose levels with organic concentrates (up to 1,000 times). No mutagenic activity was observed in any of the samples. *In vivo* testing included mouse skin initiation, strain A mouse lung adenoma, a 90-day subchronic assay on mice and rats, and a reproductive study on mice. All tests were negative, except for some fetal toxicity exhibited in rats, but not mice, for the AWP sample.
Total Resource Recovery Project, City of San Diego (Western Consortium for Public Health, 1996; NRC, 1988; Erickson, 2004)	AWP effluent (RO and GAC) and raw reservoir water (after treatment this is the current drinking water supply). This is a proposed surface water augmentation project that would	This study used organic concentrates (150–600 times) in the Ames *Salmonella* test, mouse micronucleus, 6-thoguanine resistance, and mammalian cell transformation assays. The Ames test showed some weak mutagenic activity, but recycled water was less active than the drinking water. The micronucleus test showed positive results only at the high

Project	Types of Water Studied	Health-effects data
	utilize AWP recycled water to supplement the raw reservoir water. The project and treatment system are currently being re-evaluated.	(600 times) doses for both types of water. The 6-thoguanine assay run on whole samples and fractions of each type of water showed no mutagenic effect. The mammalian cell transformation assay, showed a strong response for the reservoir sample, but the single test may not have been significant. *In vivo* fish bio-monitoring using fathead minnows (28-day bioaccumulation and swimming tests) showed no positive results. There was greater evidence of bioaccumulation of pesticides in fish exposed to raw water than recycled water.
Potomac Estuary Experimental Wastewater Treatment Plant (James M. Montgomery, Inc., 1983; NRC, 1988)	Study of the wastewater-contaminated Potomac River Estuary; 1:1 blend of estuary water and nitrified secondary effluent, AWP effluent (filtration and GAC), and finished drinking waters from three water treatment plants.	This study used 150 times organic concentrates in the Ames *Salmonella* and mammalian cell transformation tests. Results showed low levels of mutagenic activity in the Ames test, with AWP water exhibiting less activity than finished drinking water. The cell-transformation test showed a small number of positive samples with no difference between AWP water and finished drinking water.
Essex & Suffolk Water Langford Recycling Scheme, UK (Walker, 2000)	Secondary treatment, coagulant and polymer addition, sedimentation, nitrification/denitrification in biologically aerated filter, ultraviolet radiation disinfection.	Toxicological tests using fish indicated no significant estrogenic effects
Singapore Water Reclamation Study (Kahn and Roser, 2007)	AWP effluent (MF, RO, UV) and untreated reservoir water. The largest amount of Singapore's NeWater is currently used for industrial (semi-conductor manufacturing) and commercial use. At the time the study was conducted, a smaller amount was blended with raw water in reservoirs, which is then treated for domestic use.	Japanese medaka fish (*Oryzias latipes*) testing over a 12-month period with two generations of fish showed no evidence of carcinogenic or estrogenic effects in AWP effluent; however, the study was repeated owing to design deficiencies. The repeated fish study was completed in 2003 and confirmed the findings of no estrogenic or carcinogenic effects. Groups of mouse strain (B6C3F1) fed 150 times and 500 times concentrates of AWP effluent and untreated reservoir water over 2 years. The results presented to an expert panel indicated that exposure to concentrated AWP effluent did not cause any tissue abnormalities or health effects.
Santa Ana River Water Quality Monitoring Study (Deng, 2008)	Shallow groundwater adjacent to the Santa Ana River and control water. This is an unplanned indirect potable reuse project where the OCWD diverts Santa Ana River water for recharge into the Orange County Groundwater Basin. The Santa Ana River base flow is comprised primarily of tertiary-treated effluent.	Three rounds of testing were conducted in 2004 and 2005. In the first two rounds, Japanese Medaka fish were analyzed for tissue pathology, vitellogenin induction, reproduction, and gross morphology. In the third round, fish were analyzed for vitellogenin induction, reproduction, limited tissue pathology, and gross morphology. In the first two rounds, no statistically significant differences in gross morphological endpoints, gender ratios, tissue pathology, or reproduction were observed between the test water (shallow groundwater adjacent to the Santa Ana River) and the control water. In the third round, no statistically significant differences were observed in reproduction, tissue pathology (limited to evaluation of gonads and ovaries), or vitellogenin induction between the test water and the control water.
Soil Aquifer Treatment Study (Fox et al., 2006)	Wastewater (various facilities), soil aquifer treatment water, storm water.	The study used a variety of analytical methods to characterize and measure chemical estrogenicity: *in vitro* methods (estrogen binding assay, glucocorticoid receptor competitive binding assay, yeast-based reporter gene assay, and MCF-7 cell proliferation assay); *in vivo* fish vitellogenin synthesis assay; enzyme-linked immunosorbent assays; and gas

Project	Types of Water Studied	Health-effects data
		chromatography–mass spectrometry. Procedures were developed to extract estrogenic compounds from solids, liquid/liquid methods for direct extraction from aqueous suspensions such as primary and secondary effluents, and concentration of estrogenic (and other) organics on hydrophobic resins followed by organic fractionation during elution in a solvent (alcohol/water) gradient. Field applications of these techniques were designed to measure estrogenic activity derived from conventional wastewater treatment and from SAT. The stability of estrogenic contaminants that are removed on soils SAT was investigated by extracting and measuring nonylphenol from infiltration basin soils as well as by measuring total estrogenic activity in soil extracts. The researchers attempted to separate and measure estrogenic and anti-estrogenic activities in wastewater effluent and conducted a multi-laboratory experiment in which a variety of wastewater effluents and effluents spiked with known concentrations of specific estrogenic chemicals were tested for estrogenic activity. Significant variability in recycled water estrogenicity was observed in bioassay results. Facilities with the longest hydraulic retention times tended to have the lowest observed levels of estrogenicity. Estrogenicity was efficiently removed during SAT. The study also presented information on the advantages and disadvantages of the bioassay test procedures evaluated.
Toxicological Relevance of EDCs and Pharmaceuticals in Drinking Water – Water Research Foundation #3085 (Snyder, 2007; Bruce et al., 2010b)	Drinking water (20 facilities), wastewater (4 facilities - raw and recycled), and food products.	The researchers used an *in vitro* cellular bioassay (E-screen) with a method reporting limit of 0.16 nanograms per liter (ng/L); results were also converted to estradiol equivalents. The results showed that the vast majority of drinking waters were less than the method reporting limit. The level of estrogenicity (in decreasing order) was food and beverage products (particularly soy based products) > raw wastewater > recycled water > finished drinking water.

11. Role and Activities of the Independent Advisory Panel

M1W contracted with the National Water Research Institute (NWRI) to form and coordinate the activities of an Independent Advisory Panel (IAP) to provide expert peer review of the technical, scientific, regulatory, policy, and outreach aspects of the GWR Project. The IAP has been tasked with providing specific input on:

- Review of bench-scale testing of the source waters
- Review of source water quality sampling plan and results
- The proposed treatment technologies and operations, including the design and testing protocol for the pilot system.
- Review of the performance and operations of the pilot system.
- Review of water quality data from the pilot system.
- Feedback on the anticipated water quality of the proposed AWPF based on pilot system results.
- Feedback on hydrodynamics, hydrology, and the fate and transport of constituents in the AWPF project water after subsurface application.
- Feedback on protection of public health and groundwater quality.
- Feedback on project planning, permitting, and public outreach.

The IAP is comprised of four experts in disciplines relevant to groundwater replenishment projects such as engineering, regulatory criteria, public health, hydrogeology, risk assessment, and other relevant fields. The IAP members are:

- George Tchobanoglous, Ph.D., P.E., NAE; University of California, Davis (Davis, CA)[28]
- Jean-François Debroux, Ph.D., Kennedy/Jenks Consultants (San Francisco, CA)
- Martin B. Feeney, P.G. CHG, Consulting Hydrogeologist (Santa Barbara, CA)[29]
- Michael P. Wehner, MPA, REHS, OCWD (Fountain Valley, CA)[30]

The IAP held three meetings (October 2013, May 2014 and October 2018) and provided reports on their findings and recommendations. In the 2013 and 2014 meetings, topics reviewed included source water characterization; the preliminary results of the pilot testing; information on groundwater quality, groundwater modeling, and the vadose zone leaching analysis; public outreach; water rights; source control; and the conceptual project proposal submitted to DDW. For the 2018 meeting, M1W had already received an amended NPDES permit and WDRs/WRRs for operating the AWPF, and construction of the full-scale AWPF was underway. Topics reviewed with the IAP during this 2018 meeting included source waters; permitting and compliance; injection facilities, groundwater flow modeling, and tracer study planning; public opinion and outreach; and operations planning.

12. Proposed Groundwater Replenishment Project Treatment Design

Treatment for the GWR Project would be provided by the RTP's existing primary and secondary treatment processes and the AWPF as described below. A description and analysis of the treatment provided for the SVRP for tertiary recycled water for the Castroville Seawater Intrusion Project area is not provided herein, but is provided in the Water and Wastewater Section of the EIR.

12.1. <u>Regional Treatment Plant and New Source Waters</u>

The existing RTP would provide primary and secondary treatment, the latter of which consists of non-nitrifying trickling filters, bioflocculation, and clarification. The RTP currently receives and treats approximately 17 to 18 mgd of residential, commercial, and industrial wastewater[31] and also accepts some dry weather urban runoff, septage, and other discrete wastewater flows. It has an average dry weather design capacity of 29.6 mgd and a peak wet weather design capacity of 81.2 mgd; therefore, the RTP has capacity to treat additional flows. As part of the GWR Project, new source waters will be diverted to the M1W headworks and combined with municipal wastewater for treatment at the RTP. The new source waters will be:

- Monterey Peninsula urban stormwater and runoff (including water that flows into Lake El Estero)**.** Although Lake El Estero is not currently being pursued to be constructed, the City of Monterey and the agency may choose in the future to pursue this project component; therefore, it is still included in the GWR Project as approved.
- City of Salinas urban stormwater and runoff from the southwest portion of the city;
- Salinas Industrial Wastewater (SIWW), also refered to as agricultural wash water since 80 to 90% of the is water used for washing produce;
- Surface runoff and tile drainage water from the Reclamation Ditch and Tembladero Slough (to which the Reclamation Ditch is tributary). Tembladero Slough is not currently included in the

[28] Ph.D. – Doctor of Philosophy, P.E. – Professional Engineer, NAE – National Academy of Engineering.
[29] P.G. – Professional Geologist, CHG – Certified Hydrogeologist.
[30] MPA – Masters of Public Administration, REHS – Registered Environmental Health Specialist.
[31] In some years, Salinas Industrial Wastewater is diverted to meet water recycled demands and those flows increase the daily average by 1 to 3 mgd.

source water portfolio, but M1W may pursue this source in the future and therefore it is still included in the GWR Project as approved; and

- Water from the Blanco Drain, an artificial, open-channel, drainage ditch that collects agricultural tile drainage from approximately 6,400 acres of agricultural lands near Salinas.

The Title 22 Recycled Water Regulations (§60302) are applicable to recycled water from sources that contain domestic waste, in whole or in part, meaning that these new source waters are approved sources for the PWM/GWR Project. Importantly, these new source water are combined with municipal wastewater and treated at the RTP before being pumped to the AWPF for full advanced treatment. The water quality of these source waters were fully characterized during a source water sampling program (see Section 13), and then reviewed by DDW in determining applicable for meeting the regulatory groundwater recharge project criteria.

The PWM/GWR Project expansion will not bring new source waters to the RTP. Rather, the expansion can occur by M1W taking-in more of the same source waters, and accounting for treatment recycle flows that previously were not accounted for.

12.2. Advanced Water Purification Facility

The expanded AWPF will have a design capacity to produce up to 7.6 mgd of purified water—an additional 2.6 mgd of capacity above the current AWPF. The facility would be operated to produce up to 5,750 AFY of purified water for injection.

- Pilot Testing of the Advanced Treatment Facility

The AWPF provides full advanced treatment (treatment of secondary effluent by MF, RO, and AOP) as required in the Groundwater Replenishment Regulations for subsurface application projects. The AWPF also includes ozone as membrane pretreatment and post-treatment stabilization after AOP.

A pilot plant testing program was conducted between mid-October 2013 and mid-July 2014, with extensive sampling conducted between December 2013 and June 2014. The pilot facility treated a flow of 30 gallons per minute (gpm) of undisinfected RTP secondary effluent with the goals of (1) evaluating the performance of the ozone-MF-RO portion of the AWPF processes, and (2) developing design criteria for each unit process. Although AOP is included in the AWPF, it was not included in the pilot testing and sampling program as design of an AOP system typically does not require a pilot demonstration and sufficient information on treatment efficacy is available from existing groundwater replenishment projects. During the pilot testing and the source water sampling campaign, agricultural wash water was diverted to the RTP as influent to the headworks and mixed with municipal wastewater from April 1, 2014 through the end of the sampling program.[32] Data from this period are reflective of the blended water quality of these two sources. The results of the pilot testing are presented later in the report.

The three main design parameters investigated in the pilot were:

- Ozone dose: High concentrations of large organic molecules present in the RTP secondary effluent result in MF fouling, which reduces the flux[33] through the membrane treatment systems; ozone pretreatment can increase MF flux by breaking down these large molecules. The optimal ozone dose would allow for a higher MF flux without generating excess ozone.
- MF flux: Standard practice is to pilot MF systems to develop the design flux, which is influenced by the quality of water undergoing treatment and by pretreatment, such as ozone.
- RO recovery: This refers to the proportion of RO influent that becomes feedwater to the AOP system (RO permeate) versus the fraction of the influent that will be a waste stream containing the

[32] Source water was sampled in September 2013 prior to the beginning of the pilot testing.
[33] Flux is the flow rate through an individual membrane filter module expressed per unit of membrane surface area.

concentrated contaminants by RO (RO concentrate). Theoretical demonstrations of RO recovery are limited; thus, RO piloting is necessary to increase confidence in the design recovery of the RO system.

Description of the Advanced Water Purification Facility

The AWPF receives secondary effluent from the RTP for treatment. The following is a list of the AWPF structures and facilities:

- Inlet source water diversion facilities to bring new source waters to the AWPF;
- Advanced treatment process facilities, including
    - Ozonation.
    - MF treatment.
    - Booster pumping of the membrane filtration filtrate (with intermediate storage).
    - Cartridge filtration.
    - Chemical addition.
    - RO membrane treatment.
    - AOP using UV light and hydrogen peroxide.
    - Decarbonation and stabilization with calcium, alkalinity and pH adjustment.
- Final purified water storage and distribution pumping.

Figure 2 provides a simplified process flow diagram illustrating the proposed treatment facilities.

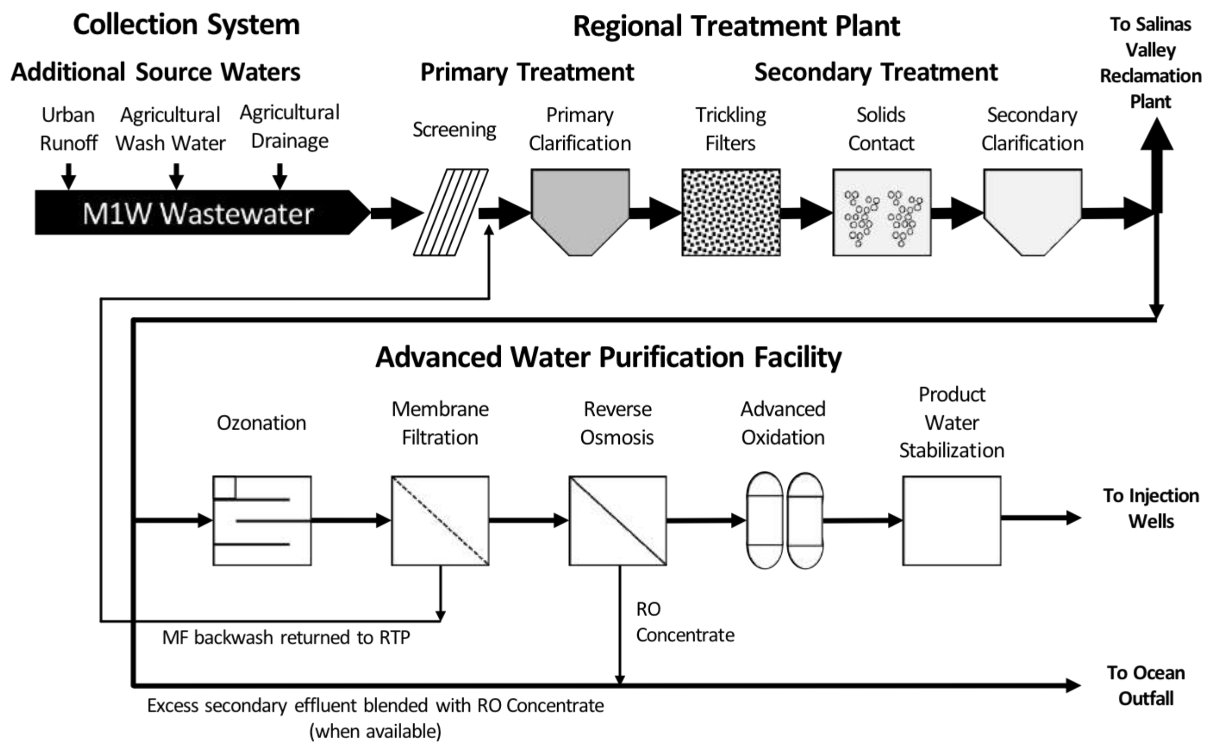

Figure 2. Simplified Flow Schematic of Regional Treatment Plant and Proposed Advanced Water Treatment Facility Processes

13. Summary of the Groundwater Replenishment Project Water Quality and Compliance with Groundwater Replenishment Regulations and Central Coast Basin Plan

This Section summarizes the water quality requirements for groundwater replenishment via subsurface application of recycled water pursuant to (1) the 2014 Title 22 Groundwater Replenishment Regulations and (2) Central Coast Region Basin Plan, as well as the GWR Project's ability to meet these water quality requirements. This analysis was conducted using water quality data for source waters[34] to the AWPF, data from the pilot plant testing that evaluated several of the AWPF processes (ozone, MF, and RO) for the removal of selected parameters, and documented removal efficiencies for the proposed AWPF processes. In addition to the AWPF processes piloted, the GWR Project will also include AOP using hydrogen peroxide and UV and water stabilization following AOP.

13.1. <u>Water Quality Requirements Specified in the Groundwater Replenishment Regulations</u>

The Groundwater Replenishment Regulations (SWRCB, 2014) specify compliance with recycled water quality requirements, including controls for microbial pathogens (virus, *Giardia*, and *Cryptosporidium*), compliance with drinking water standards for regulated chemicals, and controls for nitrogen and unregulated chemicals. More specifically, the recycled water used for subsurface application must comply with the following:

- Pathogenic microorganism treatment requirements: the wastewater must receive treatment that achieves at least 12-log enteric virus reduction, 10-log *Giardia* cyst reduction, and 10-log *Cryptosporidium* oocyst reduction using at least three treatment barriers, including residence time underground for virus
- Primary MCLs in the CCR, Title 22:
  - inorganic chemicals in Table 64431-A, except for nitrogen compounds
  - radionuclide chemicals in Tables 64442 and 64443
  - organic chemicals in Table 64444-A-A
  - disinfection byproducts in Table 644533-A
- Secondary MCLs in CCR, Title 22, Tables 64449-A and 64449-B (upper limit)
- Title 22 action levels for lead and copper
- Other constituents:
  - 10 mg/L total nitrogen
  - 0.5 mg/L TOC
- NLs[35]
- Recycled Water Policy:

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[34] Secondary-treated effluent from the RTP will be the major source water for the AWP Facility. Additional sources of water will be diverted into the existing M1W wastewater collection system and treated by the RTP's primary and secondary processes. These additional source waters include: Lake El Estero and City of Salinas urban stormwater and runoff; Salinas agricultural wash water; and agricultural and other drainage waters from the Blanco Drain, Tembladero Slough, and the Reclamation Ditch. Although Lake El Estero has been proposed as a potential source water, its use would only occur if all other sources do not provide adequate quantities for the recycled water needs. In addition, under the GWR Project its contribution to total influent flows to the RTP would be small (maximum 6% in some circumstances, with a monthly average of 2% only in a very dry year). Excess wastewater that has been treated to a secondary level at the RTP that would otherwise be discharged to the ocean would be included as feed water to the AWP Facility.

[35] The NL requirements are more complex than a single exceedance of the numeric NL. The purified water used for replenishment is monitored quarterly for NLs with accelerated monitoring initiated if the result is greater than an NL. If the running 4-week average is greater than the NL for 16 consecutive weeks, the project sponsor must notify DDW and RWQCB and the project sponsor must take corrective actions.

- o Bioanalytical screenings (Bioassays)
- o CECs

As discussed in the Title 22 Recycled Water Regulations and in the Order issued to M1W for the AWPF (Order No. R3-2017-0003), M1W will be responsible for monitoring treatment performance throughout the AWPF treatment train as well as regular monitoring of the purified recycled water prior to injection. The Order and Monitoring and Reporting Plan (MRP) are included in Appendix A. For all regulated constituents, the laboratory conducting the analyses must be ELAP certified or approved by DDW.

13.2. Source Water Monitoring

A one-year monitoring program from July 2013 to June 2014 was conducted for five of the potential source waters. Regular monthly and quarterly sampling was carried out for the RTP secondary effluent, agricultural wash water, and Blanco Drain drainage water. Limited sampling of stormwater from Lake El Estero was performed due to seasonal availability, and there was one sampling event for the Tembladero Slough drainage water.[36] Additional local limits monitoring was conducted in May 2018 for the RTP secondary effluent, SIWW (i.e., agricultural ag wash), Blanco Drain, and Reclamation Ditch.

Pathogenic Microorganisms

To protect public health, groundwater replenishment projects must inactivate or remove pathogenic microorganisms from the wastewater that is treated to produce recycled water prior to distribution. The Groundwater Replenishment Regulations require minimum pathogenic reductions of 12, 10, and 10 logs for viruses, *Giardia* cysts, and *Cryptosporidium* oocysts, respectively.

During the 2013 to 2014 time period, source waters were monitored for *Cryptosporidium* oocysts*, Giardia* cysts*,* total coliform, and *E. coli*. The source waters were not monitored for viruses as part of the pilot testing based on the expected low number of indigenous virus expected to be present in runoff (Rajal et al., 2007) and RTP secondary effluent (Rose et al., 2004). Instead, indicator bacteria (total coliform and E. *coli*) were used as surrogates for virus. A summary of the concentrations of pathogens and indicator organisms measured in the source waters is presented in **Table 11**. The concentrations of pathogens and indicator organisms are typical of a non-disinfected secondary effluent and are well below the pathogen concentrations that DDW assumed when developing the pathogen control requirements as part of the Groundwater Replenishment Regulations.

Table 11. Summary of Pathogens Measured in Source Waters (2013-2014)

Parameter[a]	Undisinfected RTP Secondary Effluent N = 12[b]	Agricultural Wash Water N = 10	Blanco Drain N = 11	Lake El Estero N = 2	Tembladero Slough N = 1
Cryptosporidium[c] (oocysts/L)	0.38 (<0.10 – 0.9)	<0.33	0.185 (<0.18 – 0.2)	<0.3	<0.09
Giardia[c] (cysts/L)	<0.1 (<0.1 – 0.2)	<0.33	<0.18	<0.3	<0.09
Total coliform[d] (MPN²/100 mL)	$7.1x10^5$ ($1.9x10^5$ – $1.6x10^6$)	$7.7x10^6$ ($6.2x10^5$ –$9.6x10^7$)	$4.3x10^4$ ($8.4x10^3$ –$2.0x10^6$)	$3.5x10^3$	$1.7x10^5$
E. coli[d] (MPN/100 mL)	$1.8x10^5$ ($2.9x10^4$ –$5.8x10^5$)	<20 (<20 – 18)	$2.4x10^2$ (75 – $2x10^3$)	<100	$7.5x10^2$

a. N is the number of samples.

[36] A Salinas stormwater sample was collected on December 2, 2014 and analyzed for an abridged set of chemical parameters, but these data were not included in this assessment.

b. Four of the samples included diversion of agricultural wash water mixed with sewage and treated at the RTP.
c. Values are median values and data range (minimum concentration to maximum concentration) where applicable.
d. Values are geometric means with the observed range (minimum concentration to maximum concentration) where applicable.

The source waters that were sampled are all expected to have a lower pathogenic microorganism count than raw municipal wastewater. Therefore, adding the new source waters would not increase the concentrations of these organisms; the RTP and AWPF treatment technologies typical for groundwater replenishment projects would remove these organisms as demonstrated by existing groundwater replenishment projects elsewhere, and as discussed later in the report based on the pilot testing.

Water Quality Constituents

The 2013-2014 source water sampling program and pilot study included a detailed characterization of the source waters (RTP effluent, agricultural wash waster, and Blanco Drain on a quarterly basis; Lake El Estero and Tembladero Slough one time each), with an expanded monitoring list for pesticides given the high levels of agricultural activity in the area. The 2013-2014 source water sampling and monitoring analysis was designed to assess the full list of water quality parameters – including many not required to be monitored for groundwater replenishment projects. Additional local limits sampling was conducted in 2018. Although 2018 sampling events tested for several parameters, the constituents list was not as extensive as the 2013-2014 sampling events. A summary of the 2013-2014 sampling campaign is provided in Appendix B-1, and a summary of the 2018 Local Limits sampling program is provided in Appendix B-2.

The types of constituents that were included in the 2013-2014 source water monitoring program are the following:

- General water quality parameters, including total nitrogen and TOC
- Constituents with California Primary and Secondary MCLs
    - Inorganic chemicals
    - Organic chemicals
    - Disinfection by-products (DBPs)
    - Radionuclides
- Constituents with California action levels for lead and copper
- Constituents with California NLs
    - Current NLs as of December 14, 2010
    - Archived Advisory Levels (AALs)[37]
- Priority Pollutants
- Constituents included in the USEPA Unregulated Contaminant Monitoring Rule (UCMR) Lists 1, 2 and 3 (excluding pathogenic organisms)
- Pesticides of local interest (PoLi) based on the agricultural activity/usage in the area[38]
- CECs

As previously noted, the Groundwater Replenishment Regulations include numeric water quality criteria for primary and secondary MCLs, action levels for lead and copper, total nitrogen, and TOC. The Groundwater Replenishment Regulations include requirements for numeric NLs based on the results of monitoring

[37] Per the H&S Code, advisory levels were renamed as NLs.
[38] Many of these constituents had applicable MCLs or AALs, and thus are addressed under those regulatory requirements/goals.

recycled water. For purposes of this project, the numeric NLs were used as compliance goals. Therefore, the source waters were analyzed for the constituents (also referred to as analytes) with regulatory criteria and goals.

The Groundwater Replenishment Regulations also require that the recycled water be monitored for additional constituents, but do not specify numeric criteria for the following: priority pollutants; chemicals specified by DDW based on the Engineering Report, affected groundwater basin, and source control program; and indicator chemicals to characterize the presence of CECs. Although the Groundwater Replenishment Regulations do not require monitoring for AALs, contaminants included in the UCMR, PoLi, or all of the CECs sampled in the source waters, they were included in the source water sampling program to provide a comprehensive data set to evaluate source water quality and the performance of the pilot system.

During 2013-2014 source water sampling and pilot testing programs, the sampling program evaluated a total of 435 analytes, including constituents with and without regulatory criteria/goals. Of these, 194 analytes were detected in at least one sample, and 241 were below detection limits in all of the source waters. During 2018 source water sampling and pilot testing programs, the sampling program evaluated a total of 173 analytes, including constituents with and without regulatory criteria/goals. Of these, 44 analytes were detected in at least one sample, and 129 were below detection limits in all of the source waters tested. The median concentration and concentration range of each analyte, as well as number of samples with positive detections, for both the 2013-2014 and 2018 campaigns, are provided in Appendix B. Some analytes are listed more than once in the appendix because different analytical techniques were used to determine their concentrations.

As previously noted, the GWR Project includes the collection of a variety of new source waters that would be combined with existing incoming wastewater flows for conveyance to and treatment at the RTP. Constituent reduction prior to use of the purified water for replenishment would occur in two ways.

1. In many cases, the blending of waters prior to treatment at the RTP would reduce concentrations of some constituents in each source water. The average flow of municipal wastewater currently receiving primary and secondary treatment at the RTP is approximately 17 mgd in comparison to an annual total of 7.6 mgd for the other source waters. Based on a combined total flow of 24.6 mgd, the new source waters would represent 31% of the flow, with seasonal differences (e.g., less source water in the winter and more during the summer). The estimated quantities of source waters, for the proposed PWM/GWR expansion, that would be mixed with the RTP municipal wastewater influent and receive primary and secondary treatment prior to treatment in the AWPF are provided in Appendix C.
2. Some constituents in the new source waters would be reduced prior to reaching the AWPF through the RTP primary and secondary treatment.[39]
3. The secondary treated wastewater that is not sent to the SVRP tertiary treatment plant for agricultural irrigation will be treated at the AWPF. The AWPF treatment train includes ozonation, MF, RO, AOP using UV/peroxide, and finished water stabilization. These treatment technologies are typical for groundwater replenishment projects and will effectively remove these constituents as demonstrated by existing groundwater replenishment projects elsewhere and as discussed in the following sections of this report.

Constituents with Maximum Contaminant Levels and Notification Levels

[39] Effects of the new source waters on the water quality of recycled water produced at the tertiary treatment facility, the Salinas Valley Reclamation Plant, at the RTP for the Castroville Seawater Intrusion Project area is not provided herein, but is provided in the Water and Wastewater Section of the PWM/GWR Final EIR (certified in October 2015).

During the pilot study, two monitoring frequencies were used for source water monitoring: (1) quarterly monitoring of all parameters to understand occurrence of the various constituents, and (2) monthly monitoring of a select list of constituents for understanding the variability of key design parameters. The quarterly sampling list for constituents/parameters with primary MCLs, secondary MCLs, and NLs are listed in **Table 12**, **Table 13**, and **Table 14**, respectively.

Table 12. Constituents with Primary Maximum Contaminant Levels Included in the Source Water Monitoring

1,1-Dichloroethane	Carbon Tetrachloride	Nickel
1,1-Dichloroethylene	Chlordane	Nitrate[a]
1,1,1-Trichloroethane	Chlorite	Nitrate+Nitrite[a]
1,1,2-Trichloro-1,2,2-Trifluoroethane	Chromium	Nitrite (as N)[a]
1,1,2-Trichloroethane	cis-1,2-Dichloroethylene	Oxamyl
1,1,2,2-Tetrachloroethane	Cyanide	Pentachlorophenol
1,2-Dichlorobenzene	Dalapon	Perchlorate
1,2-Dichloroethane	Di(2-ethylhexyl)adipate	Picloram
1,2-Dichloropropane 1,2,3-Trichloropropane[b]	Di(2-ethylhexyl)phthalate	Polychlorinated Biphenyls
1,2,4-Trichlorobenzene	Dibromochloropropane	Radium-226
1,3-Dichloropropene	Dichloromethane	Radium-228
1,4-Dichlorobenzene	Dinoseb	Selenium
2,3,7,8-TCDD	Diquat	Simazine
2,4-D	Endothall	Strontium-90
2,4,5-TP	Endrin	Styrene
Alachlor	Ethylbenzene	Tetrachloroethylene
Aluminum	Ethylene Dibromide	Thallium
Antimony	Fluoride	Thiobencarb
Arsenic	Glyphosate	Toluene
Asbestos	Gross Alpha Particle	Total Haloacetic acids
Atrazine	Heptachlor	Toxaphene
Barium	Heptachlor Epoxide	Total trihalomethanes
Bentazon	Hexachlorobenzene	trans-1,2-Dichloroethylene
Benzene	Lindane	Trichloroethylene
Benzo(a)pyrene	Hexachlorocyclopentadiene	Trichlorofluoromethane
Beryllium	Mercury	Tritium
Beta/photon emitters (K40 adjusted)	Methoxychlor	Uranium
Bromate	Methyl-tert-butyl ether	Vinyl Chloride
Cadmium	Molinate	Xylenes
Carbofuran	Monochlorobenzene	

a. The Groundwater Replenishment Regulations do not require that the MCLs for nitrate, nitrite, and nitrate + nitrite be met. The regulations require that the total nitrogen concentration in the recycled water not exceed 10 mg/L as nitrogen (N). However, also see later discussion in the report regarding compliance with Basin Plan MCL-based groundwater objectives, which include nitrate, nitrite, and nitrate+nitrite.

b. Previously part of the notification levels list.

Table 13. Constituents with Secondary Maximum Contaminant Levels Included in the Source Water Monitoring

Aluminum	Iron	Thiobencarb
Chloride	Manganese	Total Dissolved Solids
Color	Methyl-tert-butyl ether	Turbidity
Conductivity	Odor-Threshold	Zinc
Copper	Silver	
Foaming Agents	Sulfate	

Table 14. Constituents with Notification Levels Included in the Source Water Monitoring

	Nitrosamines (List of 9)[a]
1,2,4-Trimethylbenzene	N-nitrosodi-n-propylamine
1,3,5-Trimethylbenzene	N-nitrosodiethyamine
1,4-Dioxane	NDMA
2-Chlorotoluene	N-nitroso-di-n-butylamine
2,4,6-Trinitrotoluene	N-nitrosodiphenylamine
4-Chlorotoluene	N-nitrosomorpholine
Perfluorooctane sulfonate (PFOS)	N-nitrosopiperidine
Perfluorooctanoic acid (PFOA)	N-nitroso-methylethylamine
Boron	N-nitrosopyrrolidine
Carbon disulfide	Naphthalene
Chlorate	n-Propylbenzene
Diazinon	Propachlor
Dichlorodifluoromethane (Freon 12)	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
Ethylene glycol	sec-Butylbenzene
Formaldehyde	tert-Butylbenzene
HMX (or Octogen)	Tertiary butyl alcohol
Isopropylbenzene	Vanadium
Manganese	
Methyl isobutyl ketone	
n-Butylbenzene	

a. DDW NLs include only three nitrosamines: N-nitrosodiethyamine, NDMA, and N-nitrosodi-n-propylamine; the source water monitoring included a total of nine nitrosamine compounds.

A summary of the numbers of constituents/parameters with MCLs, NLs, and AALs detected[40] in each of the "untreated" source waters during 2013-2014 campaign is presented in **Table 15**, whereas the summary for the 2018 campaign is seen in **Table 16**. In this context, untreated means the following:

- For the RTP effluent, prior to AWPF treatment.
- For the other source waters, prior to treatment at the RTP/AWPF.

Table 15 and **Table 16** also includes the numbers of constituents above their relevant regulatory limits, NLs or AALs. It is noted that in many cases, the constituents were detected above their regulatory limits in one or more of the untreated source waters. Therefore, the numbers in each category are not additive.

Table 15. Number of Constituents with Maximum Contaminant Levels and Notification Levels Detected in Untreated Source Waters (2013-2014 Campaign)

Source Water	Number of Constituents Detected			
	Primary MCLs	Secondary MCLs	NLs	AALs
RTP Effluent	12 (1)[a]	12 (6)	9 (1)	3 (0)
Agricultural Wash Water	20 (5)	12 (8)	9 (2)	2 (0)
Blanco Drain	15 (2)	12 (9)	6 (0)	3 (1)

[40] Detected means that the concentration was above the Minimum Reporting Level (MRL). The MRL represents an estimate of the lowest concentration of a compound that can be detected in a sample for which the concentration can be quantified and reported with a reasonable degree of accuracy and precision.

Source Water	Number of Constituents Detected			
	Primary MCLs	Secondary MCLs	NLs	AALs
Lake El Estero	12 (0)	11 (7)	5 (0)	0
Tembladero Sough	13 (2)	9 (8)	3 (0)	1 (0)

a. Numbers in parentheses are the number of analytes detected (at least once) above a regulatory limit or advisory level.

Table 16. Number of Constituents with Maximum Contaminant Levels and Notification Levels Detected in Untreated Source Waters (2018 Campaign)

Source Water	Number of Constituents Detected			
	Primary MCLs	Secondary MCLs	NLs	AALs
RTP Effluent	9 (0)	6 (2)	2 (0)	0
Agricultural Wash Water	14 (4)	6 (2)	2 (0)	0
Blanco Drain	11 (2)	5 (4)	2 (0)	0
Reclamation Ditch	11 (3)	7 (2)	2 (0)	1 (0)

a. Numbers in parentheses are the number of analytes detected (at least once) above a regulatory limit or advisory level.

Table 17 and **Table 19** provide the concentrations of constituents with primary and secondary MCLs that were determined to be above their regulatory limits in at least one sample in any of the untreated source waters for the 2013-2014 and 2018 campaigns, respectively. Very few constituents were above primary or secondary MCLs in the various untreated source waters for both campaigns. For the NLs, only two constituents were found in two of the five untreated source waters (RTP effluent and agricultural wash water) above the current NLs for the 2013-2014 campaign, as shown in **Table 18**. PFOA and PFOS are a special case. During the 2013 to 2014 sampling program, PFOA and PFOS were included because they were on the Federal Unregulated Contaminant Monitoring Rule (UCMR) list. Since then, California issued a NL for PFOA and PFOS of 14 ng/L and 13 ng/L, respectively. In July 2019, these NLs were reduced even further, to 5.1 ng/L for PFOA and 6.5 ng/L for PFOS. The response level for both contaminants is 70 ng/L. Sampling results shown in Appendix B-1 showed PFOA and PFOS were each detected at only one location. The analytical detection limit at that time was greater than the current NLs. Both of these contaminants are effectively removed by RO treatment (i.e., estimated > 99% removal), so expected concentrations in the purified recycled water are expected to be below the analytical detection limits for these constituents.

None of the detected NLs were above regulatory levels during the 2018 campaign. For the AALs, only three constituents were detected with one above the advisory level for the 2013-2014 campaign, whereas only one (below regulatory level) was detected during the 2018 campaign. Treatment will occur through the primary and secondary processes at the RTP and AWPF. These treatment technologies are typical for groundwater replenishment projects and will remove these constituents to below regulatory levels and goals as demonstrated by existing groundwater replenishment projects elsewhere and as discussed later in the report.

Table 17. Constituents with Maximum Contaminant Levels Above Regulatory Limits in at Least One Sample of Any of the Untreated Source Waters (2013-2014 Campaign)

Source Water	Comparison to Primary MCLs			Comparison to Secondary MCLs		
	Constituent	Primary MCL	Highest Concentration Detected	Constituent	Secondary MCL	Highest Concentration Detected
RTP Effluent	Di(2-ethylhexyl)phthalate	4 µg/L	78 µg/L	Color	15 units	75 units
				Conductivity	900 µS/cm[a]	1623 µS/cm
				Iron	0.3 mg/L	0.537 mg/L
				Odor-Threshold	3 units	200 units
				TDS	500 mg/L[b]	803 mg/L
				Aluminum	0.2 mg/L	0.256 mg/L
Agricultural Wash Water	Fluoride	2 mg/L	31.9 mg/L	Chloride	250 mg/L[c]	292 mg/L
	1,3-Dichloropropene	0.5 µg/L	0.7 µg/L	Color	15 units	175 units
	Di(2-ethylhexyl)phthalate	4 µg/L	16 µg/L	Conductivity	900 µS/cm[a]	1830 µS/cm
	Total haloacetic acids (HAAs)	60 µg/L	390 µg/L	Iron	0.3 mg/L	0.875 mg/L
	Total trihalomethanes	80 µg/L	160 µg/L	Odor-Threshold	3 units	350 units
				TDS	500 mg/L[b]	1594 mg/L
				Turbidity	5 NTU	72 NTU
				Aluminum	0.2 mg/L	0.598 mg/L
Blanco Drain	Aluminum	1 mg/L	2.04 mg/L	Chloride	250 mg/L[c]	307 mg/L
	1,3-Dichloropropene	0.5 µg/L	0.62 µg/L	Color	15 units	85 units
				Conductivity	900 µS/cm[a]	2929 µS/cm
				Iron	0.3 mg/L	3.891 mg/L
				Odor-Threshold	3 units	40 units
				Sulfate		530 mg/L
				TDS	500 mg/L[b]	2066 mg/L
				Turbidity	5 NTU	150 NTU
				Aluminum	0.2 mg/L	2.04 mg/L
Lake El Estero	None		--	Chloride	250 mg/L[c]	514 mg/L
				Color	15 units	75 units
				Conductivity	900 µS/cm[a]	2559 µS/cm
				Iron	0.3 mg/L	0.508 mg/L
				TDS	500 mg/L[b]	1506 mg/L
				Turbidity	5 NTU	18 NTU
				Aluminum	0.2 mg/L	0.402 mg/L
Tembladero Slough	Aluminum	1 mg/L	1.54 mg/L	Chloride	250 mg/L[c]	394 mg/L
	Di(2-ethylhexyl)phthalate	4 µg/L	78 µg/L	Color	15 units	175 units
				Conductivity	900 µS/cm[a]	2939 µS/cm
				Iron	0.3 mg/L	2.962 mg/L
				Sulfate	250 mg/L[c]	412 mg/L
				TDS	500 mg/L[b]	1968 mg/L
				Turbidity	5 NTU	50 NTU

Source Water	Comparison to Primary MCLs			Comparison to Secondary MCLs		
	Constituent	Primary MCL	Highest Concentration Detected	Constituent	Secondary MCL	Highest Concentration Detected
				Aluminum	0.2 mg/L	1.54 mg/L

a. µS/cm – Micro-siemens per centimeter; recommended consumer acceptance level; upper range 1600 µS/cm.
b. Recommended consumer acceptance level; upper range 1000 mg/L.
c. Recommended consumer acceptance level; upper range 500 mg/L.

Table 18. Constituents with Concentrations Above Notification Levels or Archived Action Levels in at Least One Sample in Any of the Untreated Source Waters (2013-2014 Campaign)

Source Water	Comparison to NLs			Comparison to AALs		
	Constituent	NL	Highest Levels Detected	Constituent	AAL	Highest Levels Detected
RTP Effluent	NDMA	10 ηg/L	16 ηg/L	None	---	---
Agricultural Wash Water	Formaldehyde NDMA	100 µ/L 10 ηg/L	120 µg/L 340 ηg/L	None	---	---
Blanco Drain	None	---		Dieldrin	0.002 µg/L	0.028 µg/L
Lake El Estero	None	---	--	None	---	---
Tembladero Slough	None	---	--	None	---	---

Table 19. Constituents with Maximum Contaminant Levels Above Regulatory Limits in at Least One Sample of Any of the Untreated Source Waters (2018 Campaign)

Source Water	Comparison to Primary MCLs			Comparison to Secondary MCLs		
	Constituent	Primary MCL	Highest Concentration Detected	Constituent	Secondary MCL	Highest Concentration Detected
RTP Effluent	None	--	--	Conductivity (Specific Conductance) Total Dissolved Solids	900 µS/cm[a] 500 mg/L	1797 µS/cm 837 mg/L
Agricultural Wash Water	Nitrate Nitrite Nitrate+Nitrite Fluoride	10 mg-N/L 1 mg-N/L 10 mg-N/L 2 mg/L	10 mg-N/L 1.8 mg-N/L 10.1 mg-N/L 7.5 mg/L	Conductivity (Specific Conductance) Total Dissolved Solids	900 µS/cm[a] 500 mg/L	1443 µS/cm 1295 mg/L
Blanco Drain	Nitrate Nitrate+Nitrite	10 mg-N/L 10 mg-N/L	61.5 mg-N/L 61.6 mg-N/L	Chloride Conductivity (Specific Conductance) Sulfate TDS	250 mg/L[c] 900 µS/cm[a] 250 mg/L 500 mg/L[b]	301 mg/L 2717 µS/cm 530 mg/L 1980 mg/L
Reclamation Ditch	Nitrate	10 mg-N/L	42.9 mg-N/L	Conductivity (Specific Conductance)	900 µS/cm[a]	1556 µS/cm

Source Water	Comparison to Primary MCLs			Comparison to Secondary MCLs		
	Constituent	Primary MCL	Highest Concentration Detected	Constituent	Secondary MCL	Highest Concentration Detected
	Nitrite Nitrate+Nitrite	1 mg-N/L 10 mg-N/L	1.7 mg-N/L 44.6 mg-N/L	TDS	500 mg/L[b]	983 mg/L

a. µS/cm – Micro-siemens per centimeter; recommended consumer acceptance level; upper range 1600 µS/cm.
b. Recommended consumer acceptance level; upper range 1000 mg/L.
c. Recommended consumer acceptance level; upper range 500 mg/L.

Lead and Copper Action Levels

The Groundwater Replenishment Regulations require that recycled water not exceed the action levels for lead and copper, which are 0.015 mg/L and 1.3 mg/L, respectively. The maximum concentrations of lead and copper measured in any of the untreated source waters (2013-2014 and 2018 sampling campaigns) was 0.0022 mg/L, and 0.073 mg/L, respectively. Thus, the source water sampling program found that lead and copper were below their respective action levels in all of the untreated source waters sampled. Further, the GWR Project will include post-treatment water stabilization, which will control corrosion.

Total Organic Carbon

The Groundwater Replenishment Regulations require that, prior to injection, the TOC concentration in recycled water not exceed 0.5 mg/L, based on the 20-week running average of all TOC results and the average of the last four TOC results. As shown in **Table 20**, the median concentration and range of TOC in the various untreated source waters are similar except for the agricultural wash water, which has a significantly higher TOC concentration. However, all of the untreated source waters will undergo treatment through the primary and secondary processes at the RTP and advanced treatment at the AWPF. These treatment technologies are typical for groundwater replenishment projects and will produce TOC concentrations at or below 0.5 mg/L as demonstrated by existing groundwater replenishment projects elsewhere. The MF and RO membranes are the primary barriers for TOC removal. During the piloting program (described later) the TOC concentration in the RO permeate consistently was less than 0.5 mg/L when the system was operated in a manner consistent with how the full-scale system would be operated. The reclamation ditch source water has not yet been sampled for TOC and it is not included in **Table 20**. Tembladero Slough and Lake El Estero are not expected to be included as source waters at this point, but they both are approved sources and can be utilized, if so decided by the project team in the future.

Table 20. Summary of Total Organic Carbon Concentrations Measured in Untreated Source Waters

Parameter[a]	RTP Effluent[b]	Agricultural Wash Water	Blanco Drain	Lake El Estero	Tembladero Slough
TOC (mg/L)	17 (11-24)	295 (66-340)	3 (2.5-11)	14	8.8

a. Median values and data range (minimum concentration to maximum concentration) where applicable.
b. Representative from 2018.

Total Nitrogen

The Groundwater Replenishment Regulations require that the applied recycled water not exceed a total nitrogen concentration of 10 mg/L. the summary of total nitrogen concentrations in untreated wastewaters can be seen in **Table 21**, which includes data from both 2013-2014 and 2018 sampling campaigns. Samples may be collected before or after subsurface application. As indicated in **Table 21**, the total nitrogen concentration in untreated Lake El Estero water meets the requirement, while the other untreated source waters do not. However, after treatment at the AWPF, all of the source waters would meet the total nitrogen requirement based on the treatment technologies to be provided that are typical for groundwater replenishment projects and as demonstrated by existing groundwater replenishment projects elsewhere. The average total nitrogen removal observed through the piloting program (described later) was 94.3%, which is sufficient to reduce these concentrations to levels below 10 mg/L. The principal AWPF nitrogen removal mechanism would be reduction through the RO membranes.

Table 21. Summary of Total Nitrogen Concentrations in Untreated Source Waters

Parameter[a]	RTP Effluent[b]	Agricultural Wash Water	Blanco Drain	Reclamation Ditch[c]	Lake El Estero[b]	Tembladero Slough[b]
Total nitrogen (mg/L as N)	44.2 (35.7-50.5)	27 (19-51.1)	66 (62-77.3)	31 (26-50)	1.3	58

a. Median values and data range (minimum concentration to maximum concentration) where applicable.
b. Representative from 2013-2014 only.
c. Representative from 2018 only.

Priority Pollutants

The Groundwater Replenishment Regulations require that recycled water and groundwater (from downgradient monitoring wells) be monitored for priority pollutants (chemicals listed in 40 CFR Section 131.38, "Establishment of numeric criteria for priority toxic pollutants for the State of California") specified by DDW, based on the DDW's review of the project's engineering report.

A total of 32 of the 126 priority pollutants were detected during 2013-2014 source waters sampling, while 19 were detected during 2018 local limits source water sampling. Of the 32 chemicals detected in 2013-2018, 19 were chemicals with either MCLs or NLs. Of 19 chemicals detected in 2018, 13 were chemicals with either a MCL or NL. As described later, 16 priority pollutants were found in the RO permeate during pilot testing, all of which had MCLs or NLs.

13.3. Pilot Plant Results and Compliance with Groundwater Replenishment Regulations

Pathogenic Microorganisms

The Groundwater Replenishment Regulations grant log reduction credits for unit processes that have been demonstrated to remove pathogens under expected operating conditions. The proposed pathogen reduction credits for the unit processes in the full-scale AWPF are shown in **Table 22**, and have been approved by DDW. The log reduction credits listed in the table are typical of what other advanced water treatment facilities in California operating under similar conditions have achieved. The AWPF is expected to achieve log reduction credits of 13.9, 12.5, and 12.5 for viruses, *Giardia* cysts, and *Cryptosporidium* oocysts, respectively, which exceed the minimum log reduction requirements in the Groundwater Replenishment Regulations. The extra credits, not including additional credits that can be granted for primary and secondary treatment at the RTP, will provide additional redundancy of pathogenic microorganisms removal to achieve the total credits required by the Groundwater Replenishment Regulations.

Table 22. Proposed Pathogen Reduction Credits for the Proposed Full-scale Advanced Water Treatment Facility Processes

Process	Conditions	Log Reduction Credits		
		Virus	*Giardia*	*Crypto*
Ozone[a]	Not pursing credit for ozone	0	0	0
MF	Daily pressure decay test and turbidity monitoring	0	4	4
RO	Daily grab samples (strontium) and online monitoring (TOC and conductivity)[d]	2.5	2.5	2.5
UV/Peroxide	UV dose monitoring[b]	6	6	6
Underground Residence Time	6-month underground residence or retention time[c]	5.4	0	0
Regulatory Requirement		12	10	10
Total Credits Achieved by Proposed AWPF Processes		13.9	12.5	12.5

a. Ozone CT (contact time multiplied by ozone residual) may be included in the future if additional credit for redundancy is needed.
b. The UV dose will be determined through online monitoring of the UVT, UV intensity, and flowrate.
c. Actual residence time is expected to exceed 6 months. When the tracer test (using an intrinsic tracer) confirms the modeled underground retention time of 10.8 months, the Project would be credited with virus removal of 7.2-log (applying the 0.67 log safety factor for an intrinsic tracer listed in the California Recycled Water Regulations).
d. Pathogen credit is based on the maximum measured log reduction of strontium, TOC or conductivity.

Pilot plant testing of the ozone, MF, and RO portion of AWPF processes was conducted to evaluate the reduction of *Cryptosporidium* oocysts, *Giardia* cysts, total coliforms, and *E. coli*. The influent to the pilot plant treatment train was secondary effluent from the RTP. As indicated in **Table 23**, pathogen and indicator organism levels were observed to be below detection after treatment by the pilot plant. In addition, the UV/peroxide AOP, which was not included in the pilot testing, would be designed for 6-logs of removal credit for viruses, *Cryptosporidium oocysts*, and *Giardia cysts*.

Table 23. Summary of Pathogen and Indicator Removal Observed Through the Pilot Plant

Pathogen/Indicator[a]	Pilot Influent	Ozone Effluent	MF Effluent	RO Permeate
Cryptosporidium (oocysts/L)	0.35 (<0.09-0.9)	*2.65*[b] (0.3-23.3)	<0.09	--
Giardia (cysts/L)	0.15 (<0.09-1.1)	<0.2[b] (<0.09-4.4)	<0.09	--
Total coliform[c] (MPN/100 mL)	$2.8x10^5$ ($2.4x10^3 – 1.6x10^6$)	$6.3x10^2$ ($5.5x10^1 – 3.1x10^3$)	<1	<1
E. coli[c] (MPN/100 mL)	$6.0x10^4$ ($4.9x10^2 – 3.3x10^5$)	$2.7x10^1$ ($<1 – 5.5x10^2$)	<1	<1

a. Median values and data range (minimum concentration to maximum concentration) where applicable.
b. There were consistently higher *Cryptosporidium* concentrations in the ozone effluent than the pilot influent. This effect appears to be an artifact of the method of sampling and water quality analysis. The ozonation of the water likely increased the method recovery for *Cryptosporidium* since ozone made it easier to detect protozoa in the samples.
c. Values are geometric means with the observed range (minimum – maximum) where applicable. Most probable number per 100 milliliters (MPN/100 mL).

The data in **Table 22** and **Table 23** clearly indicate that the GWR Project will meet all of the pathogen control requirements specified in the Groundwater Replenishment Regulations. Based on the results of the source water testing and pilot performance, the inclusion of the additional source waters not used/treated by the pilot testing would also be able to be treated to meet the regulations because they had lower concentrations of pathogens than the municipal wastewater.

Constituents with Maximum Contaminant Levels

A summary of the constituents detected in RO permeate with primary and secondary MCLs, is presented in **Table 24**. Fourteen constituents with MCLs were detected in the RO permeate at least once as shown in **Table 24**, and with the exception of the odor threshold secondary MCL, none of them exceeded their regulatory limit. For the full-scale AWPF, odor would be reduced to levels below the MCL after UV/peroxide AOP treatment (Agus et al., 2011). Thus, results of the pilot testing based on the ozone-MF-RO portion of the AWPF and the expected benefit from full-scale treatment with AOP show that the water treated by RO and AOP will comply with all of the MCLs that are required to be met for groundwater replenishment of recycled water. Based on the results of the source water testing (e.g., the types of constituents detected above the MCLs) and pilot performance for these constituents, the inclusion of the additional source waters not used/treated by the pilot testing will also be able to be treated to meet the MCLs.

Table 24. Constituents with Maximum Contaminant Levels Detected in Pilot Plant Reverse Osmosis Permeate

Parameter	Unit	MCL	Median[a] (Range)
Secondary MCLs Consumer Acceptance			
Chloride	mg/L	250	3 (<1-6)
Conductivity	µS/cm	900	38 (32-46)
Odor threshold	units	3	5[b]
Sulfate	mg/L	250	<1 (<1 – 1)
TDS	mg/L	500	<10 (<10 – 26)
Turbidity	NTU	5	<0.05 (<0.05 – 0.1)
Primary MCLs Inorganics			
Aluminum	mg/L	0.2	<0.01 (<0.01 – 0.045)
Arsenic	mg/L	0.01	<0.001 (<0.001 – 0.002)
Chromium	mg/L	0.05	0.005
Cyanide	mg/L	0.15	<0.005 (<0.005 – 0.007)
Fluoride	mg/L	2	<0.1 (<0.1 – 0.2)
Selenium	mg/L	0.05	<0.002 (<0.002 – 0.01)
Primary MCLs Synthetic Organic Compounds			
Total trihalomethanes	µg/L	80	1.85 (0.68 – 5)
Primary MCLs Radionuclides			
Radium-226	pCi/L	5	0.298±0.327

a. Parameters with no range were only sampled for during one complete MCL/NL sampling event. Includes samples when the agricultural wash water was combined with raw wastewater and treated at the RTP.
b. The odor threshold test was conducted on the RO permeate without dechlorination, and the majority of odor is assumed to be a result of the chloramine residual. The chloramine residual would be reduce through the UV/peroxide AOP and further reduced as a

result of chloramine decay at the injection site. In addition, UV/peroxide AOP has been shown to significantly reduce odor compounds in RO permeate (Agus et al., 2011), such that the secondary MCL for odor would be met in the purified water.

Constituents with Notification Levels and Advisory Action Levels

Five constituents with NLs were detected at least once in the RO permeate as shown in **Table 25**, but only NDMA was found at concentrations above its NL. None of the constituents with AALs were detected in RO permeate.[41] For NDMA, the full-scale AWPF will include a UV/AOP process that would be designed to produce purified water at or below the NDMA NL. The addition of the other source waters not evaluated during pilot testing should not impact NDMA levels based on the data from the source water testing (e.g., low NDMA and low TOC levels in comparison to the agricultural wash water and municipal wastewater).

Table 25. Constituents with Notification Levels and Archived Action Levels Detected in Reverse Osmosis Permeate

Constituent	Unit	NL	Median[a] (Range)
Boron	mg/L	1	0.18 (0.16 – 0.23)
Formaldehyde	mg/L	0.1	0.050 (0.028 – 0.071)
NDMA	ηg/L	10	27 (20 – 32)
N-Nitrosodi-n-propylamine (NDPA)	ηg/L	10	<2 (<2 – 2.9)
Chloropicrin	µg/L	50	3.5
2,3,5,6-Tetrachloroterephthalate	mg/L	3.5	0.0001

a. Parameters with no range were only sampled once during a complete MCL/NL/AAL sampling event.

Total Organic Carbon

The Groundwater Replenishment Regulations require that the recycled water must meet an average TOC concentration not exceeding 0.5 mg/L. The TOC concentrations in the RO permeate are impacted by the ozone dose used in the ozone pretreatment unit process. The TOC concentrations in the RO permeate at a time when ozone dose was 10 mg/L were consistently below 0.5 mg/L, ranging from 0.27 mg/L to 0.42 mg/L, including the period when the agricultural wash water was added to the municipal wastewater for treatment at the RTP. However, when the ozone dose was increased to 20 mg/L, the TOC concentration in some of the RO permeate samples exceeded 0.5 mg/L. This information helped in the selection of the design ozone dose chosen for the full-scale AWPF; namely the lower dose of 10 mg/L, which, coupled with the expected reduction in TOC from blending with other low-TOC source waters and treatment through the other AWPF unit processes (primarily RO), would consistently produce purified water not exceeding 0.5 mg/L TOC. Thus, the TOC limit will readily be met in the purified water in compliance with the Groundwater Replenishment Regulations.

Total Nitrogen

The Groundwater Replenishment Regulations require that the applied recycled water not exceed a total nitrogen concentration of 10 mg/L (before or after subsurface application). The total nitrogen concentration for all tests conducted during pilot plant testing of the ozone-MF-RO portion of AWPF processes found that the total nitrogen ranged from 1.5 mg/L to 2.9 mg/L, significantly lower than the 10 mg/L regulatory limit.

Although two of the source waters (Blanco Dain and Tembladero Slough) were found to have total nitrogen concentrations greater than that in the RTP secondary effluent (concentration of 44.2 mg/L), an analysis of monthly flows for the composite of all projected flows to the RTP and (after secondary treatment) to the

[41] Dieldrin is removed by RO (99%) and would be further reduced by UV/AOP.

AWPF predicted that the total nitrogen in the effluent from the AWPF pilot plant would have a maximum concentration of 3.1 mg/L. Therefore, despite the high levels of total nitrogen in some of the untreated source waters, the full-scale AWPF would meet the total nitrogen requirement specified in the Groundwater Replenishment Regulations.

Lead and Copper

As previously discussed, lead and copper were below their respective action levels in all of the source waters sampled and, thus, would not exceed their action levels in the purified water after treatment in the AWPF. Therefore, there was no need to sample for lead and copper in the pilot plant testing.

Priority Pollutants

Sixty-four priority pollutants were sampled and analyzed during the pilot plant sampling program. Of these constituents, 48 were found to be below detection limits in the RO permeate. Sixteen constituents were detected, all of which had either MCLs or NLs that are addressed elsewhere in this Section. It is noted that of the 16 priority pollutants detected, only NDMA was found above its NL. The UV/peroxide AOP process, which will follow the RO process in the full-scale AWPF, will be designed to reduce the NDMA concentration to below the NL of 10 ηg/L.

13.4. Reliability and Redundancy

The full-scale AWPF and recharge of the purified water would provide reliability and redundancy through the use of multiple treatment barriers for each type of constituent as shown in **Table 26**. Including the RTP in combination with the AWPF, the integrated treatment system would achieve chemical constituent removal redundancy by employing at least two treatment technologies for most constituent types and at least five technologies for each pathogen category, as shown in the **Table 26** below.

Table 26. Proposed Groundwater Replenishment Project Treatment Barriers

Process	Chemical Constituents					Pathogenic Microorganisms		
	Nitrogen	TOC	DPBs	Inorganics	CECs	Bacteria	Viruses	Protozoa
Primary/ Secondary	✓	✓		✓	✓	✓	✓	✓
Ozone			✓		✓	✓	✓	✓
MF		✓		✓		✓		✓
RO	✓	✓	✓	✓	✓	✓	✓	✓
UV/H_2O_2	✓		✓		✓	✓	✓	✓
Aquifer						✓	✓	✓

13.5. Basin Plan Compliance

For the Seaside Basin, the Basin Plan includes general narrative groundwater objectives for taste and odor and radioactivity, and numeric objectives based on primary and secondary MCLs. As previously discussed, the RO permeate followed by AOP would meet all MCLs, including those that would satisfy the narrative objectives. Based on the results of the source water testing (e.g., the types of constituents detected above the MCLs) and pilot performance for these constituents, the inclusion of the additional source waters not used/treated by the pilot testing would also be able to be treated to meet the MCLs.

The Basin Plan also includes guidelines to protect soil productivity, irrigation, and livestock watering. The guidelines are shown in **Table 27** along with the highest detected concentrations in the untreated source waters for both sampling campaigns (2013-2014, 2018). With regard to salinity and chloride, the RO permeate concentrations were below the guidelines. One of the Basin Plan guidelines is the Sodium Adsorption Ration (SAR), which is used to determine if irrigation water affects the rate of water infiltration. It is not a constituent, but a calculated value based on the square root of the ratio of sodium to calcium plus magnesium. The cations (calcium, magnesium, and sodium) used to derive an SAR would be removed by RO as part of the full-scale AWPF. As discussed earlier in this Section, even including all of the source waters, the predicted total nitrogen concentration after secondary treatment at the RTP and treatment through the full-scale AWPF would result in maximum purified water concentration of 3.1 mg/L, which is below the individual guidelines for ammonia and nitrate. The chemical stabilization process following AOP in the full-scale AWPF will influence bicarbonate and pH concentrations in the purified water. These concentrations will be within the Basin Plan Guidelines as demonstrated by existing groundwater replenishment projects elsewhere.

Table 27. Basin Plan Guidelines for Interpretation of Water Quality for Irrigation

Source Water	Constituent	Guideline[a]	Highest Concentration Detected in Untreated Water	Median/Range in RO Permeate
RTP Effluent	Salinity (EC)[b]	750 µS/cm	1797 µS/cm	38 (32-46)
	Permeability (EC)	>500 µS/cm	1797 µS/cm	38 (32-46)
	Permeability SAR (unit less)	<6.0 (adjusted)[c]	6.4[d](not adjusted)	1.6[e](not adjusted)
	Chloride (foliar absorption, e.g., sprinklers)	< 106 mg/L	238	6 mg/L
	Ammonia-N	< 5 mg/L	39.7 mg/L	---
	Nitrate-N	< 5 mg/L	42 mg/L	0.7 mg/L
	Bicarbonate	< 90 mg/L	420 mg/L	---
	pH	Normal range	8	---
Agricultural Wash Water	Salinity (EC)	750 µS/cm	1830 µS/cm	---
	Permeability (EC)	>500 µS/cm	1830 µS/cm	
	Permeability SAR (unit less)	<6.0 (adjusted)	4.3 (not adjusted)	
	Chloride (foliar absorption, e.g., sprinklers)	< 106 mg/L	292 mg/L	
	Ammonia-N	< 5 mg/L	7.5 mg/L	
	Nitrate-N	< 5 mg/L	10 mg/L	
	Bicarbonate	< 90 mg/L	310 mg/L	
	pH	Normal range	7.5	
Blanco Drain	Salinity (EC)	750 µS/cm	2776 µS/cm	---
	Permeability (EC)	>500 µS/cm	2776 µS/cm	
	Permeability SAR, unit less	<6.0 (adjusted)	3.4 (not adjusted)	
	Chloride (foliar absorption, e.g., sprinklers)	< 106 mg/L	307 mg/L	
	Ammonia-N	< 5 mg/L	< 0.5 mg/L	
	Nitrate-N	< 5 mg/L	352 mg/L	
	Bicarbonate	< 90 mg/L	455 mg/L	
	pH	Normal range	8.6	

Source Water	Constituent	Guideline[a]	Highest Concentration Detected in Untreated Water	Median/Range in RO Permeate
Lake El Estero	Salinity (EC)	750 µS/cm	2559 µS/cm	---
	Permeability (EC)	>500 µS/cm	2559 µS/cm	
	Permeability SAR, unit less	<6.0 (adjusted)	5.6 (not adjusted)	
	Chloride (foliar absorption, e.g., sprinklers)	< 106 mg/L	514 mg/L	
	Ammonia-N	< 5 mg/L	< 0.05 mg/L	
	Nitrate-N	< 5 mg/L	< 0.1 mg/L	
	Bicarbonate	< 90 mg/L	259 mg/L	
	pH	Normal range	8.3	
Tembladero Slough	Salinity (EC)	750 µS/cm	2939 µS/cm	---
	Permeability (EC)	>500 µS/cm	2939 µS/cm	
	Permeability SAR, unit less	<6.0 (adjusted)	4.4 (not adjusted)	
	Chloride (foliar absorption, e.g., sprinklers)	< 106 mg/L	394 mg/L	
	Ammonia-N	< 5 mg/L	< 0.5	
	Nitrate-N	< 5 mg/L	0.5 mg/L	
	Bicarbonate	< 90 mg/L	443 mg/L	
	pH	Normal range	8	
Reclamation Ditch	Salinity (EC)	750 µS/cm	1556 µS/cm	--
	Permeability (EC)	>500 µS/cm	1556 µS/cm	
	Chloride (foliar absorption, e.g., sprinklers)	< 106 mg/L	224 mg/L	
	Ammonia-N	< 5 mg/L	3.1 mg/L	
	Nitrate-N	< 5 mg/L	43 mg/L	
	pH	Normal range	8.1	

a. No problems expected at these levels with interpretation based on possible effects on crops and/or soils. Guidelines are flexible and should be modified when warranted by local experience or special conditions of crops, soils, and method of irrigation.

b. Electrical Conductivity (EC).

c. Adjusted mathematically to account for calcium precipitation. Because the non-adjusted SAR values for the source waters and RO permeate are slightly higher or substantively less than the guideline, it was not necessary to convert the SAR values to adjusted SARs.

d. Based on RTP secondary effluent.

e. Based on a stabilized RO permeate sample from the pilot testing.

Finally, the Basin Plan includes water quality objectives for agricultural use for irrigation supply and livestock watering as shown in Table 27. Of the 21 constituents with objectives, 14 have MCLs (aluminum, arsenic, beryllium, cadmium, chromium, fluoride, iron, manganese, mercury, nickel, nitrate+nitrite, nitrite, selenium, and zinc). All of the agricultural objectives are set at higher concentrations than the MCLs with the exception of the three constituents shown in **Table 28**, along with the RO permeate results from the pilot testing. Thus, the RO permeate for these MCL-based constituents either meets MCLs or meets the less stringent Basin Plan agricultural objectives.

Table 28. Constituents with Maximum Contaminant Levels Less Stringent than Basin Plan Agricultural Objectives and Pilot Plan Reverse Osmosis Permeate Results

Parameter	Agricultural Objective[a]	MCL	Piloting RO Permeate Concentration Median (Range)
Secondary MCLs Consumer Acceptance			
Zinc, mg/L	5	5	ND[b]
Primary MCLs Inorganics			
Fluoride, mg/L	1	2	<0.1 (<0.1 – 0.2)
Selenium, mg/L	0.02	0.05	<0.002 (<0.002 – 0.01)

a. Maximum values – considered as 90th percentile values not to be exceeded.
b. ND – not detected.

The Basin Plan also includes agricultural objectives for copper and lead. In the case of copper, the objectives for irrigation supply (0.2 mg/L) and livestock watering (0.5 mg/L) are more stringent than the drinking water action level (1.3 mg/L). The maximum concentrations of copper measured in any of the untreated source waters was 0.073 mg/L, which is below the agricultural objectives prior to advanced treatment. For lead, the Basin Plan objectives for irrigation supply (5.0 mg/L) and livestock watering (0.1 mg/L) are less stringent than the drinking water action level (0.015 mg/L). The maximum concentration of lead measured in any of the untreated source waters was 0.0022 mg/L, which is well below the agricultural objectives prior to advanced treatment. Thus, the source water sampling program found that lead and copper were below their respective agricultural basin plan objectives in all of the untreated source waters sampled.

The Basin Plan includes agricultural objectives for two constituents with NLs: boron and vanadium. In the case of boron, the agricultural objective for irrigation supply (0.75 mg/L) is more stringent than the NL of 1 mg/L. Vanadium was not detected in the RO permeate from the pilot testing. The median boron concentration in the RO permeate was 0.18 mg/L (range 0.16 to 0.23 mg/L). Thus, the piloting testing found that boron and vanadium were below their respective agricultural basin plan objectives in RO permeate.

The three remaining agricultural objectives do not have regulatory standards or goals: cobalt, lithium, and molybdenum. Studies of RO treatment have shown that it is effective in removing metals such as these from secondary wastewater. Cobalt and molybdenum were removed to below detection levels, and lithium was removed by 68% with a median concentration of 0.01 mg/L, which is below agricultural objectives for irrigation supply ranging from 0.075 to 2.5 mg/L (Department of Health, Western Australia, 2009).

Based on the source water sampling, piloting testing results, and pertinent research, the purified water that would be produced by the RTP and full-scale AWPF would meet Basin Plan guidelines for irrigation and the objectives for agricultural reuse.

14. Summary of Hydrogeologic and Geochemical Modeling

The Proposed Modifications to the PWM/GWR Project would inject additional purified water within a portion of the adjudicated Seaside Subbasin of the Salinas Valley Groundwater Basin (Seaside Subbasin). The 2006 adjudication established a natural perennial yield for the Seaside Subbasin of 2,581 to 2,913 acre-feet per year (AFY). Groundwater pumping in the Seaside Groundwater Basin provides water supply for municipal, (primarily golf course) irrigation, and industrial uses. Prior to the adjudication, pumping exceeded the natural perennial yield, resulting in significant basin-wide water level declines. Over-pumping in the coastal subareas has resulted in water levels near the coast to decline below sea level, placing aquifers at risk of seawater intrusion. Since 2008, groundwater pumping has decreased in response to the adjudication. In addition, the Monterey Peninsula Aquifer Storage and Recovery Project (ASR Project) has provided about 1,500 to 1,800

AFY of treated Carmel River Basin groundwater for injection and recovery into the basin.[42] The ASR project is located hydraulically downgradient (north) and within about 1,000 feet from the PWM/GWR Project injection well facilities.

Replenishment will occur in the two aquifer systems used for water supply in the Seaside Basin – the shallow Paso Robles Aquifer (PR Aquifer) and the deeper Santa Margarita Aquifer (SM Aquifer) – and will be accomplished using two types of injection wells: (1) deep injection wells (DIWs), which will inject purified recycled water directly into the SM Aquifer, and (2) shallower vadose zone wells (VZWs), which will inject recycled water into the unsaturated zone (Aromas Sand Formation) for percolation to the underlying PR Aquifer.

In support of the approved PWM/GWR Project EIR, a series of hydrogeologic investigations/studies were completed to predict future groundwater response to and assess potential impacts from the PWM/GWR Project.

- In 2013-2014, Todd Groundwater (Todd) conducted a hydrogeologic investigation evaluating potential project impacts on groundwater levels and water quality. The hydrogeologic study incorporated findings from a field investigation that included drilling and installation of a Paso Robles monitoring well, groundwater quality sampling of local production and monitoring wells, sediment core leaching tests, and aqueous geochemical modeling to evaluate the geochemical compatibility between stabilized RO permeate and ambient groundwater. Results were documented in a report, titled *Hydrogeologic Field Investigation: MRWPCA Monitoring Well 1 (MW-1) Installation, Groundwater Quality Characterization, and Geochemical Assessment* (Todd, February 2015).
- Findings from the field investigation were incorporated in the report titled, *Recharge Impacts Assessment Report* (Todd, March 2015), included as Appendix L of the Consolidated Final Environmental Impact Report (EIR) (DDA, January 2016). The Recharge Impacts Assessment Report also described the injection well facilities and general information on project construction and operations and addressed the fate and transport of purified recycled water in the Basin based on groundwater model simulations.
- Groundwater model simulations for the PWM/GWR Project EIR were completed by Montgomery & Associates (formerly HydroMetrics Water Resources, Inc. [Hydrometrics WRI]) to satisfy Division of Drinking Water (DDW) recycled water recharge regulations. Results are documented in a TM titled, "*Groundwater Replenishment Project Development Modeling*" (Hydrometrics WRI, October 2013).

At the time of the EIR development for the PWM/GWR Project, wells in the Injection Facilities Area had yet to be constructed or sampled for water quality. Thus, the evaluation of groundwater impacts was based on groundwater level and water quality data from then-existing production and monitoring wells in the Basin through 2013. Since the PWM/GWR EIR, two DIWs, two VZWs, and seven monitoring wells have been constructed in the Injection Facilities Area as part of two construction phases for the approved project. To comply with DDW requirements, the DIWs and monitoring wells have been collectively sampled for a comprehensive suite of analytes from 2017 to 2019 to establish baseline groundwater quality conditions prior to Project startup. In addition to the PWM/GWR Project wells, groundwater quality data from other wells (water supply, ASR, and monitoring wells) from 2014 through 2019 have also been collected as part of the basin-wide groundwater quality monitoring program managed by Monterey Peninsula Water Management District (MPWMD). Additionally, groundwater levels have continued to be routinely measured by MPWMD in fulfillment of its Seaside Basin Watermaster obligations.

In 2019, Todd completed an updated evaluation of groundwater conditions and water quality impacts. Findings are documented in a TM titled, *Update of Groundwater Conditions and Water Quality Impacts*

[42] Currently, Carmel River Basin water (extracted from wells in the alluvial aquifer) is treated to drinking water standards and conveyed to the ASR wells for recharge when excess water is available.

Evaluation for Pure Water Monterey Groundwater Replenishment Proposed Modifications Supplemental Environment Impact Report (SEIR)" (Todd, 2019). The TM describes proposed injection areas and facilities associated with the proposed modifications and presents an updated assessment of potential groundwater impacts based on updated groundwater level and water quality data. Key findings and conclusions on groundwater levels and subsurface travel times from recently completed groundwater model simulations of the proposed modifications to the PWM/GWR Project are also summarized to address DDW regulations pertaining to pathogen reduction credit and response retention time. Full documentation of groundwater model simulations of proposed modifications is presented in a separate TM, with subject: "E*xpanded PWM/GWR Project SEIR Groundwater Modeling Analysis*" (Montgomery & Associates, 2019). Together, the two new TMs support the SEIR for proposed modifications to the PWM/GWR Project (Todd Groundwater, 2019).

Additional studies/reports associated with permitting and operational plans for the approved PWM/GWR Project (that have been completed since the approved EIR) include an Intrinsic Tracer Work Plan that describes the approach and methods to demonstrating the minimum subsurface retention time of purified recycled water under varying hydrologic and operating conditions for the approved project (Todd, August 2019. Additionally, a focused geochemical evaluation by MPWMD was recently completed, involving bench-scale leaching tests of PWM recycled water to address leaching concerns by the Seaside Basin Watermaster Technical Advisory Committee's (TAC) from recharge of purified recycled water. Results are documented in a TM, titled "*Supplemental Bench Testing of PWM Waters for Artificial Recharge of the Santa Margarita Sandstone Aquifer System*" (Pueblo Water Resources, 2019).

14.1. Compliance with Underground Retention Time Requirements

The Groundwater Replenishment Regulations establish specific requirements for underground retention time of recycled water:

- The Response Retention Time (RRT) that requires recycled water to be retained underground for a sufficient period of time (as proposed by a project sponsor) to identify and respond to any treatment failure so that inadequately treated recycled water does not enter a potable water system. The RRT has to be at least two months.
- To meet the 12-log virus reduction requirement, projects can be credited with a 1-log virus reduction per month up to 6 months (i.e., 6-logs).

Notwithstanding the effectiveness of the RTP[43] and AWPF in controlling pathogens, the approved PWM/GWR Project also includes 5.4-log virus reduction credit by keeping the purified water underground for 10.8 months prior to arrival at the closest downgradient production wells, as currently modeled and soon to be demonstrated by tracer test using an intrinsic tracer. The RRT for the PWM/GWR Project is 5.25 months, as discussed in M1W's final Engineering Report for the 5 MGD AWPF (April 2019), similar to the RRT approved by DDW for the Alamitos Barrier Groundwater Replenishment Project. The underground retention time will be demonstrated through a field tracer test which must commence with the first three months of operation in compliance with the Groundwater Replenishment Regulations. The injection and municipal recovery wells for the PWM/GWR expansion will be located so that the RRT is not expected to change.

The groundwater modeling conducted for the Proposed Modifications demonstrates a much longer underground retention time of 615 days (20.2 months), which would represent 10.1-log virus reduction credit except that there is a maximum of 6-logs of credit due to the increased distance from injection to extraction.

For the purposes of planning projects, the Groundwater Replenishment Regulations allow for use of models with safety factors to estimate retention times. For the PWM/GWR Project, the Watermaster groundwater model was used to demonstrate underground retention time. Preliminary modeling for the approved 5 MGD

[43] The PWM/GWR Project is not taking credit for removal of pathogens through primary and secondary treatment, nor through ozonation, both of which are known to reduce pathogens.

PWM/GWR Project indicated that PWM/GWR the minimum travel time for purified water injected at one injection well to reach a drinking water well is 328 days under certain pumping conditions. This travel time, with the applicable safety factor of 0.5 for using a model, is 5.4 months, and the RRT is 5.25 months.

The Proposed Modifications would increase travel time to 10.1 months (0.5 x 20.2 months) providing additional time for response and thus an RRT of 5.25 months remains adequate.

In accordance with Title 22 Section 60320.224, the RRT can be no less than two months. While the required underground retention time of greater than 10.25 months remains applicable to the PWM/GWR Project, demonstration of compliance will be made with an intrinsic tracer test rather than modeling alone.

14.2. Compliance with Anti-degradation and Recycled Water Policies

Assessment of Impact of GWR Project on Contaminant Plumes

The Recycled Water Policy does not limit the authority of a RWQCB to impose additional requirements for a proposed groundwater replenishment project that has a substantial adverse effect on the fate and transport of a contaminant plume. Thus, a study was performed to evaluate the potential impacts of the PWM/GWR Project in areas of contamination in the Seaside Basin (Todd Groundwater, 2015a).

The PWM/GWR Project injection well facilities would be located on a portion of the former Fort Ord military base (referred to as Site 39), which provided training and staging for U.S. troops from 1917 to 1994. Site 39 contained at least 28 firing ranges that were used for small arms and high explosive ordnance training using rockets, artillery, mortars and grenades. Considerable expended and unexploded ordnance have been documented in various areas of Site 39. Beginning in 1984, numerous environmental investigation and remediation activities have occurred on Site 39. During these investigations, metals and various compounds associated with explosives have been detected in soil. Remediation, including removal of munitions and explosives, has been more extensive in areas targeted for redevelopment, an area that includes the PWM/GWR Project injection well facilities site (Todd Groundwater, 2015a which is available in the PWM/GWR Final EIR . Groundwater analyses do not indicate that former Fort Ord activities have impacted groundwater in the existing wells near the PWM/GWR Project injection site (Todd Groundwater, 2015a). This conclusion also applies to the Expanded Injection Well area that is located north and east of the approved injection wells.

No documented groundwater contamination or contaminant plumes have been identified in the PWM/GWR Project injection well facilities area. Therefore, injection associated with the PWM/GWR Project would not exacerbate existing groundwater contamination or cause plumes of contaminants to migrate. As a result, additional RWQCB requirements related to groundwater contaminants would not be necessary for the PWM/GWR Project.

Assessment of Impact of PWM/GWR Project on Dissolution of Natural or Anthropogenic Constituents

The Recycled Water Policy does not limit the authority of a RWQCB to impose additional requirements for a proposed groundwater replenishment project that causes constituents, such as naturally occurring arsenic, to become mobile and impact groundwater quality.

When two water types with different water chemistry are mixed (such as the PWM/GWR Project purified water and groundwater), geochemical reactions could occur in the groundwater system. These reactions could potentially result in leaching of natural or anthropogenic constituents, which could potentially impact groundwater quality. The risk of geochemical impacts from incompatibility would be addressed at the proposed AWPF by including a stabilization process to ensure that purified water is stabilized and non-corrosive.

Laboratory leaching tests were conducted using the stabilized RO pilot water[44], with the results used to conduct a detailed geochemical modeling analysis that will be used to inform the design of the AWPF stabilization system (Todd Groundwater, 2015b). The geochemical modeling assessment is summarized in a field investigation report. Based on modeling results, potential changes in groundwater concentrations as a result of the PWM/GWR Project are expected to be minor and would not result in exceedances of groundwater quality standards (Todd Groundwater, 2015b). Additional bench scale leaching tests of the purified recycled water modified to be slightly corrosive (Langlier Index of -0.1) indicated leaching of transition metals to be very minor (Pueblo Water Resources, Inc. 2019). The purified recycled water will meet water quality standards.

Salt/Nutrient Management Plan

A SNMP has been prepared for the Seaside Basin to comply with the Recycled Water Policy (HydroMetrics, 2014). The SNMP was developed with basin stakeholder input through the Seaside Basin Watermaster and has been adopted by the Water Management District. The SNMP has been submitted to the Central Coast Region RWQCB for consideration as a Basin Plan amendment.

As documented in the SNMP, ambient groundwater generally exceeds the TDS Basin Plan groundwater objective in many areas of the Seaside Basin, while nitrate and chloride concentrations generally meet Basin Plan objectives (Todd Groundwater, 2015a). A study that evaluated the water quality of the stabilized RO pilot water found that the concentrations of TDS, nitrate, and chloride in the purified water meet all Basin Plan objectives (Todd Groundwater, 2015a). Further, these concentrations are generally lower than average concentrations in groundwater. As such, replenishment of the Seaside Basin using the Proposed Modifications to the PWM/GWR Project purified water would not adversely impact salt and nutrient loading in the basin and would provide benefits to local groundwater quality

Anti-degradation

Per the results of the SNMP, the Proposed Modifications to the PWM/GWR Project would not degrade groundwater or utilize assimilative capacity above the 10% threshold cited in the Recycled Water Policy that requires a more detailed anti-degradation analysis. As described in previous sections of this report, the PWM/GWR Project purified water including the Proposed Modifications would be treated and stabilized to meet all drinking water quality objectives and other Basin Plan objectives. Further, the additional purified water would be expected to be higher quality water than ambient groundwater with respect to TDS, chloride, and nitrate. As such, the PWM/GWR Project will neither cause a violation of a groundwater quality standard nor adversely impact beneficial uses. Rather, the Proposed Modifications to the PWM/GWR Project purified water would have a beneficial effect on local groundwater quality.

14.3. Studies of Groundwater Levels and Storage

Because the PWM/GWR Project provides additional water for downgradient groundwater extraction, it results in both higher and lower water levels in existing basin wells over time depending on the timing of extraction and the buildup of storage in the basin. For the approved PWM/GWR Project, Hydrometrics (2015) examined changes in water levels for eight key production wells for a 33-year simulation period (including 25 years of the PWM/GWR Project operation). The results showed that the water levels would be sometimes lower because of increased pumping at existing extraction wells. However, water levels would be lowered only about 10 feet or less and would be lowered for a relatively short duration, typically for a few months. In addition, water levels would be generally higher than pre- PWM/GWR Project levels. As such, none of the municipal or private production wells would experience a reduction in well yield or physical damage. All existing wells would be capable of pumping the current level of production or up to the permitted production rights (Todd, Groundwater, 2015a).

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[44] The samples were RO permeate collected from the M1W pilot plant. The RO permeate was stabilized using a bench-scale post-treatment stabilization unit to better approximate the water quality anticipated for the proposed AWP Facility.

The analysis of the closest shallow coastal well indicated that increased pumping of the PWM/GWR Project water would not result in water levels falling below elevations protective of seawater intrusion (Hydrometrics, 2015). Although it would take time for the beneficial impacts of recharge to reach coastal pumping wells, the increased pumping of nearby production wells would only reduce water levels about two feet near the coast. The analysis showed that for the duration of the model simulation period, the closest coastal well would remain above protective elevations for seawater intrusion.

In addition, Todd Groundwater (2015a) found that there would be no adverse impacts to the quantity of groundwater resources. Because the PWM/GWR Project would only recover the amount of purified water injected, there would be no long-term change in groundwater storage because the purified water being injected would eventually be extracted for municipal use.

For the Proposed Modifications to the PWM/GWR Project, Hydrometrics (2019) examined changes in water levels for eight existing and three new production wells for a 33-year simulation period (including 25 years of the PWM/GWR Project operation). The results showed that the water levels would be sometimes lower because of increased pumping at existing extraction wells. However, water levels would be lowered only about 10 feet or less and would be lowered for a relatively short duration, typically for a few months. In addition, water levels would be generally higher than pre-PWM/GWR Project levels.

The analysis of the closest shallow coastal well indicated that increased pumping of the Proposed Modifications to the PWM/GWR Project water would also not result in water levels falling below elevations protective of seawater intrusion (Hydrometrics, 2019). Although it would take time for the beneficial impacts of recharge to reach coastal pumping wells, the increased pumping of nearby production wells would increase water levels near the coast. The analysis showed that for the duration of the model simulation period, the closest coastal well would remain above protective elevations for seawater intrusion.

In addition, Todd Groundwater (2019) found that there would be no adverse impacts to the quantity of groundwater resources. Because the Proposed Modifications to the PWM/GWR Project would recover no more additional water than was injected, there would be no long-term change in groundwater storage because the purified water being injected would eventually be extracted for municipal use.

15. Constituents of Emerging Concern – Source Waters and Pilot Testing Results

Constituents of emerging concern were evaluated using the Eurofins Eaton Analytical Liquid Chromatography Tandem Mass Spectrometry method that specifically addresses 92 constituents. For the source waters, samples were collected quarterly for one year from the RTP effluent, agricultural wash water, and Blanco Drain, and once from in the Lake El Estero and Tembladero Slough waters.

The highest occurrence of CECs, during 2013-2014 campaign, was in the RTP secondary effluent. This was expected, as these compounds are common in wastewater and are often not significantly removed by conventional primary and secondary wastewater treatment. For the 92 CECs that were included in the Eurofins method, 59 were detected in at least one source water, with the maximum concentrations being observed in the RTP secondary effluent for 50 of the 59 constituents. Of the nine other constituents, five were seen at the highest concentration in the agricultural wash water, and the other four maximum concentrations were detected in the drainage waters. It should be noted that for the new source waters, the concentrations presented in **Figure 3** are raw water concentrations that do not take into account blending with the other waters and treatment reduction through the RTP primary and secondary treatment processes, nor treatment through the pilot test facility or full scale AWPF.

The pilot testing was conducted using both the existing RTP secondary effluent and a combination of RTP secondary effluent and the agricultural washwater, which captured the waters with the overall highest levels of CECs. Samples were collected in the pilot influent, ozone effluent, and RO permeate. Ozonation consistently reduced the concentrations of many of the CECs to levels below detection. On average, there were approximately 40 CECs detected in the pilot influent and 26 detected in the ozone effluent. With a few exceptions described below, the RO system removed the remaining CECs to below levels of detection. In addition, the full-scale AWPF would include AOP, which would create an additional barrier to destroy CECs. The CECs removals observed across the pilot system are shown in **Figure 4** (Trussell Technologies, 2014).

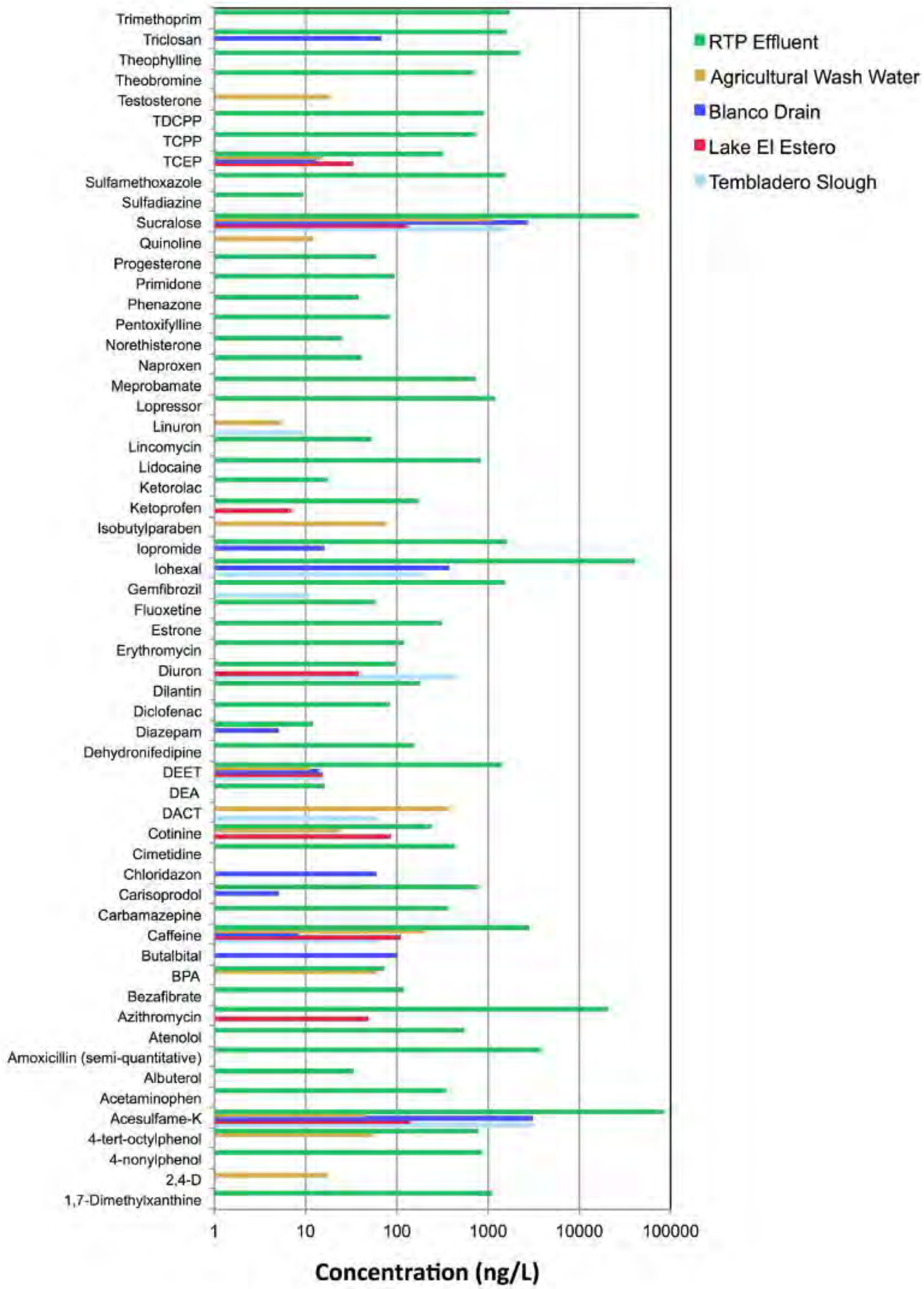

Figure 3. Constituents of Emerging Concern – Maximum Values Detected in the Various Proposed Project Source Waters

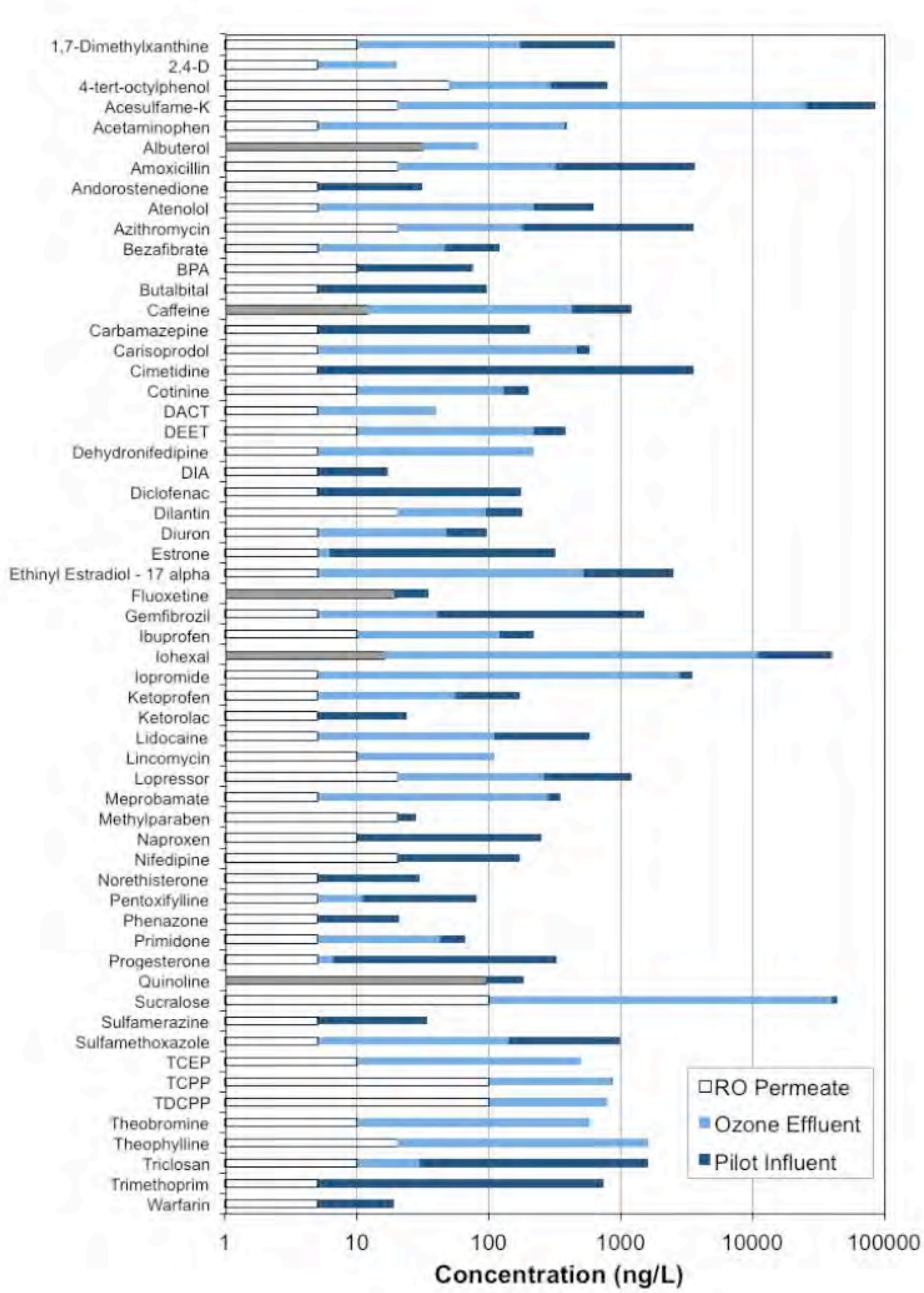

Figure 4. Constituents of Emerging Concern - Removal During Pilot Testing (Maximum Values Observed)[45]

In three of the seven monthly sampling events, there were a few CECs detected in the RO permeate (not including previously discussed NDMA). These compounds were erythromycin, caffeine, iohexal, albuterol, carbadox, fluoxetine, and quinolone. In all cases, these constituents were detected in only one sample, and it is likely that several of the detections were actually false laboratory positives due to sample or laboratory contamination. Specifically, erythromycin and carbadox (both antibiotics) were not detected in either the pilot influent or the ozone effluent, and thus the RO permeate detection from these compounds

[45] For the RO permeate, white (open) boxes indicate that the constituent was not detected and the reported value is the detection limit, while gray boxes indicate the constituent was detected. No ozone effluent value is shown for cases where the constituent was below detection in the ozone effluent. In addition, in cases where there was no reduction through the ozone system (i.e., the pilot influent was equal to or less than the ozone effluent), only the ozone effluent concentration is shown.

was excluded from the analysis. For quinoline (a chemical found in cigarettes and automobile exhaust) and fluoxetine (an antidepressant), the RO permeate values exceeded the ozone effluent value, and it is strongly suspected that these results are false positives as well. The remaining compounds detected in the RO permeate were caffeine (a simulant), iohexal (a contrast agent), and albuterol (an asthma medication). They were detected at concentrations near the detection limit and it is unclear whether or not they are actual values. For all of these constituents, it is important to keep in mind that (1) the concentrations detected were many orders of magnitude below any demonstrated health related levels as shown in **Table 29**, and (2) these compounds have all been shown to be effectively removed (up to 90%) by UV/peroxide AOP that will be part of the full-scale AWPF. With this additional treatment barrier, it is expected that all of these CECs would be below current detection levels in the purified water.

Table 29. Comparison of Detected Constituents of Emerging Concern in Reverse Osmosis Permeate to Drinking Water Equivalent Levels

Constituent	Classification	Maximum Observed Concentration in RO Permeate (ηg/L)	DWEL (ηg/L)
Caffeine	Stimulant	10	87,000,000[a]
Iohexal	Contrast agent	10	725,000[b]
Albuterol	Asthma medication	50	41,000[c]

a. Intertox, 2009.
b. Environment Protection and Heritage Council et al., 2008.
c. Schwab, 2005.

16. Environmental Impact Report Groundwater Resources Significance Determination

There would be no new significant impact nor an increase in severity of an impact. Based on the groundwater characterization, recent groundwater sampling results, stabilized pilot water quality/chemistry and projected Advanced Water Purification Facility purified recycled water quality, and results from the M1W field program, the following conclusions were made in the relevant technical reports.

- Stabilized pilot plant water samples and projected purified recycled water quality would meet SWRCB Regulations for groundwater replenishment projects and Basin Plan groundwater quality standards, including drinking water MCLs. Further, the treatment processes to be used have already been determined to meet the requirements in the DDW Groundwater Replenishment Regulations and the Advanced Water Purification Facility is required by its existing WDR/WRR to ensure that all water quality standards would be met in both the purified recycled water and groundwater. A monitoring program would document project performance.
- Stabilized pilot plant water samples and projected purified recycled water exhibit much lower concentrations of total dissolved solids and chloride than in ambient groundwater and would be expected to provide a localized benefit to groundwater quality. Such a benefit would expand over time with continuous replenishment from the Proposed Project wells.
- No documented groundwater contamination or contaminant plumes have been identified in the area in the Injection Well Facilities, including in the Expanded Injection Well Area. Therefore, replenishment associated with the Proposed Modifications would not exacerbate existing groundwater contamination or cause plumes of contaminants to migrate.
- Injection of additional purified recycled water from the Advanced Water Purification Facility would not degrade groundwater quality such that a significant impact would occur. This conclusions is consistent with the RWQCB findings in their March 2017

approval of the WDR/WRR for the approved PWM/GWR Proejct. A monitoring plan would be implemented to meet RWQCB and DDW requirements.

- The additional purified recycled water from the Advanced Water Purification Facility would be stabilized to ensure ther would be no adverse geochemical impacts. Geochemical modeling associated with the M1W and the Seaside Basin Watermaster's field programs indicated that no adverse groundwater quality impacts are expected from leaching or other geochemical reactions.
- Groundwater flow modeling indicates that the Proposed Modifications would not lower water levels below protective levels in coastal wells and would not exacerbate seawater intrusion. The Proposed Modifications would have additional beneficial impacts related to salinity and, in some cases, nutrient concentrations in groundwater and would have a less-than-significant impact on groundwater quality for all other constituents, including those related to the seawater intrusion conditions of the basin, the safety of the water supply for human consumption, and the beneficial use of the Seaside Basin.

Overall, the impacts of the Proposed Modifications would be the same as those of the approved PWM/GWR Project on groundwater quality in the Seaside Basin. Specifically, the Proposed Modifications would have a beneficial impact with respect to TDS, chloride, and nitrate and a less-than-significant impact for all other constituents. No mitigation measures would be required.

17. Summary of the Groundwater Replenishment Project Compliance Regulation and Policies

Table 30 presents a summary of how the GWR Project will comply with applicable regulations and policies for the use of recycled water for groundwater replenishment.

Table 30. Proposed Groundwater Replenishment Project Compliance Summary

	Requirements	Proposed Compliance Description
Groundwater Replenishment Regulations		
Source Control	Entities that supply recycled water to a groundwater replenishment project must administer a comprehensive source control program that includes: (1) an assessment of the fate of Division of Drinking Water (DDW) and Regional Water Quality Control Board (RWQCB)-specified contaminants through the wastewater and recycled water treatment systems; (2) provisions for contaminant source investigations and contaminant monitoring that focus on DDW and RWQCB-specified contaminants; (3) an outreach program to industrial, commercial, and residential communities; and (4) an up-to-date inventory of contaminants.	Monterey One Water (M1W) administers an approved pretreatment program under National Pollutant Discharge Elimination System (NPDES) Permit R3-2008-0008. These activities are conducted in accordance with M1W Ordinance No. 2019-01[46] and federal pretreatment regulations pursuant to 40 Code of Federal Regulations Part 403 (40 CFR 403) and Sections 307 and 402 of the Clean Water Act (CWA). The M1W source control program would meet the requirements as follows: - Contaminant Assessment. The GWR Project's pilot testing evaluated the fate of chemicals and contaminants through the Regional Treatment Plant (RTP) and treatment systems for the Advanced Water Purification (AWP) Facility. This list of chemicals and contaminants being evaluated included priority pollutants, constituents with maximum contaminant levels (MCLs) and notification levels (NLs), and constituents of emerging concern (CECs), and pesticides of local interest. Future studies will be conducted at the request of DDW and RWQCB or based on monitoring data collected by M1W. - Contaminant Source Investigation. M1W will conduct investigations and monitoring as requested by DDW and RWQCB or based on monitoring data collected by M1W. - Outreach: M1W currently administers an effective outreach program that consists of RTP facility tours, classroom presentations, information on the GWR Project, information on pharmacies offering drug take-back programs, participation/exhibits in community events, school outreach (presentations, materials, teacher curriculum training and workshops), RTP tours, commercials and advertising for controlling fats, oil and grease, and participation in the Monterey County Oil Recycling Program. The program will be modified with the implementation of the GWR Project. - Contaminant Inventory. M1W's source control program tracks and identifies industrial users and discharges, including contaminants discharged through industrial monitoring. M1W maintains its industrial inventory by reviewing the phone book and online telephone information sites, referrals from the M1W Customer Service Department for new or

[46] An *Ordinance Establishing Regulations for the Interception, Treatment and Disposal of Sewage and Wastewater; Providing for and Requiring Charges and Fees Therefore; and Fixing Penalties for Violation of Said Regulations*.

	Requirements	Proposed Compliance Description
		expanded sewer connections, building permit sign-offs from all member entity building inspection departments, and service area canvassing. The inventory will also address the new source waters based on the results of the source water monitoring and subsequent monitoring when the source waters and any related industrial contributors are delivered to the RTP. - Annual Reporting. M1W currently prepares an annual report on the pretreatment program. Future reports would address compliance with the source control provisions pending implementation of the GWR Project.
Pathogen Control	Groundwater replenishment projects must achieve a 12-log enteric virus reduction, a 10-log *Giardia* cyst reduction, and a 10-log *Cryptosporidium* oocyst reduction using at least 3 treatment barriers that each achieve at least 1.0-log reduction. No treatment process can be credited with more than 6-logs reduction. The log reductions must be verified using a monitoring procedure approved by DDW. Failure to meet the specified reductions requires notification to DDW and RWQB, investigation, and/or discontinuation of recycled water use until a problem is corrected.	The GWR Project will meet the pathogen log reduction requirements by using the combination of treatment afforded by: (1) the RTP primary and secondary unit treatment processes (no credit is being sought for the reductions through these treatment processes); (2) the AWPF, which includes ozonation, membrane filtration (MF), reverse osmosis (RO), and advanced oxidation (AOP) using ultraviolet light (UV) and hydrogen peroxide; and; (3) six-month residence time underground prior to withdrawal at any potable water supply well (as validated by a tracer study). The tracer study, which will be approved by DDW, will start after the first 3 months of operation. M1W will ensure achievement of the pathogen reductions by monitoring the RTP and AWPF treatment system performance using operational parameters and surrogates per DDW requirements.
Nitrogen Control	The concentration of total nitrogen in recycled water must meet 10 milligrams per liter (mg/L) before or after subsurface application. Failure to meet this value requires follow-up sampling, notification to DDW and RWQCB, and/or discontinuation of recycled water use until a problem is corrected.	The GWR Project will meet the 10 mg/L total nitrogen limit in the AWPF purified water. The RO membrane treatment system will be the key process to remove nitrogen. The predicted total nitrogen concentration in the purified water produced by the AWPF will achieve an expected maximum total nitrogen concentration of 3.1 mg/L including all source waters, based on the piloting and source water monitoring. M1W will determine compliance with the with the 10 mg/L limit by monitoring RO performance using operational parameters and by monitoring the quality of AWPF purified water.
Regulated Chemicals Control	The recycled water must meet primary and secondary drinking water maximum contaminant levels (MCLs). Failure to meet MCLs requires follow-up sampling, notification to DDW and RWQCB, and/or discontinuation of recycled water use until the problem is corrected.	The GWR Project will meet MCLs in the AWPF purified water. The results of the pilot testing based on the ozone-MF-RO portion of the AWPF and the expected benefits of full-scale treatment with AOP show that the water treated by RO and AOP would comply with all MCLs. Based on the results of the source water testing (e.g., the types of constituents detected above the MCLs) and pilot performance for these constituents, the inclusion of the additional source waters not used/treated by the pilot testing would also be able to be treated to meet the MCLs. M1W will determine compliance with

	Requirements	Proposed Compliance Description
		MCLs by monitoring treatment performance and the quality of the AWPF purified water.
Notification Levels (NLs)	The recycled water is monitored quarterly for NLs with accelerated monitoring if the result is greater than the NL; if the running 4-week average is greater than the NL for 16 consecutive weeks, the project sponsor must notify DDW and RWQCB.	Based on the results of the pilot testing and the inclusion of the AOP system, the full-scale AWPF will produce purified water below NLs, including the additional source waters to be treated.
Unregulated Chemicals Control	Control of unregulated chemicals for all groundwater replenishment projects using 100% AWP recycled water is accomplished through limits for total organic carbon (TOC) and performance of treatment for constituents of emerging concern (CECs). TOC is used as a surrogate for unregulated and unknown organic chemicals. For subsurface application projects, the entire recycled water flow must be treated using RO and AOP. After treatment, the TOC cannot exceed an average of 0.5 mg/L. Specific performance criteria for RO and AOP processes have been included in the Groundwater Replenishment Regulations. Failure to meet the requirements established for a groundwater replenishment project results in notifications to DDW and RWQCB, response actions, and in some cases cessation of the use of recycled water.	The GWR Project will address unregulated constituents by meeting TOC limits in the AWPF purified water and the AWP treatment performance criteria for RO and AOP. M1W will monitor unregulated chemicals and surrogates specified by DDW after AOP and in the AWPF purified water.
Response Retention Time (RRT)	The intent of the RRT is to provide time to retain recycled water underground to identify any treatment failure so that inadequately treated recycled water does not enter a potable water system. Sufficient time must elapse to allow for: a response that will protect the public from exposure to inadequately treated water; and provide an alternative source of water or remedial treatment at the wellhead if necessary. The RRT is the aggregate period of time between: identifying that the recycled water is out of compliance, treatment verification samples or measurements; time to make the measurement or analyze the sample; time to evaluate the results; time to make a decision regarding the appropriate response; time to activate the response; and time for the response to become effective. The minimum RRT is 2 months, but must be justified by the groundwater replenishment project sponsor.	M1W will develop a RRT taking into consideration the following safety features that are part of the GWR Project: (1) continuous online monitoring of RO treatment with real-time results reviewed by the AWPF operators; (2) multiple levels of critical control points for RTP and AWPF operations, alarms, and unit process redundancy; and (3) the ability to shut down the AWPF at a moment's notice. As part of the RRT development, M1W will also consider the time necessary to provide an alternative water supply should DDW determine that the GWR Project has impacted a drinking water well so that it can no longer be used as a drinking water supply. The RRT would be validated by a tracer study approved by DDW.
Monitoring Program	Comprehensive monitoring programs are established for recycled water and groundwater for regulated and unregulated constituents.	M1W will develop a monitoring program that satisfies DDW and RWQCB requirements for the RTP, AWPF, and groundwater for nitrogen, TOC, and regulated and unregulated constituents, including CECs. The monitoring program will be included in the approved groundwater replenishment permit for the GWR Project, including sampling locations, sampling frequencies, analytical methods, and reporting.
Operation and Optimization Plan	The intent of the plan is to assure that the facilities are operated to achieve compliance with the Groundwater Replenishment Regulations, to achieve optimal reduction of contaminants, and to identify how the project will be operated and monitored.	Prior to startup of the GWR Project, M1W will develop and submit an Operations and Optimization Plan to DDW and the RWQCB that identifies the operations, maintenance, analytical methods, and monitoring necessary to meet DDW and RWQCB requirements. M1W will update the Plan as

	Requirements	Proposed Compliance Description
		necessary to make sure that it is representative of current operations, maintenance, and monitoring of the GWR Project.
Response Plan	A project sponsor must obtain approval from DDW on a plan that describes the steps that will be taken to provide an alternative source of potable water to all users of a producing drinking water well or a DDW-approved treatment system for a well that as a result of a replenishment project as determined by DDW causes the well to violate drinking water standards, has been degraded so that is no longer a safe source of drinking water, or fails to meet the pathogen control requirements.	Prior to start-up of the GWR Project, M1W will develop and submit a plan to DDW to provide an alternative source of water or a DDW-approved treatment system should the GWR Project impact a drinking water well so that it cannot be used was a water supply or the GWR Project fails to meet the pathogen control requirements.
Boundaries Restricting Locations of Drinking Water Wells	Project proponents must establish a "zone of controlled well construction," which represents the greatest of the horizontal and vertical distances reflecting the underground retention times required for pathogen control or for the RRT. Drinking water wells cannot be located in this zone. Project proponents must also create a "secondary boundary" representing a zone of *potential* controlled well construction that may be beyond the zone of controlled well construction, thereby requiring additional study before a drinking water well is drilled.	Based on the greater of the retention times established to meet the DDW pathogen control requirements or the RRT, M1W will submit a map to DDW depicting the boundary representing the zone of controlled potable well construction and the secondary boundary. The map will also show the location of all monitoring wells and drinking water wells within a two-year travel time of the GWR Project.
Adequate Managerial and Technical Capability	A project sponsor must demonstrate that it possess adequate managerial and technical capability to comply with the regulations. The Safe Drinking Water Act (SDWA) requires public water systems to demonstrate their capability to provide a safe drinking water supply. To that end, DDW has developed a Technical Managerial and Financial Assessment (TMF) Form. For groundwater replenishment projects, DDW has indicated that project sponsors can use portions of the TMF form to demonstrate compliance with the managerial and technical capability requirements in the Groundwater Replenishment Regulations.	Prior to startup, M1W will provide information demonstrating managerial and technical capability using the TMF Form; namely, information on certified operators, the operations plan, training, organization, the emergency response plan, and (as appropriate) policies. M1W has operated an AWP pilot facility to demonstrate technical experience with operation of the AWPF and will provide DDW with an Operations and Optimization Plan for the GWR Project.
Engineering Report	The project sponsor must submit an Engineering Report to DDW and RWQCB that indicates how a groundwater replenishment project will comply with all regulations and includes a contingency plan to insure that no untreated or inadequately treated water will be used. The report must be approved by DDW.	M1W developed an Engineering Report that contains a description of the design of the GWR Project and clearly indicates how the GWR Project will comply with the Groundwater Replenishment Regulations. The engineering report was approved by DDW in 2019.
Alternatives	Alternatives to any of the provisions in the Groundwater Replenishment Regulations are allowed if the project sponsor demonstrates that: the alternative provides the same level of public health protection; the alternative has been approved by DDW; and an expert panel has reviewed the alternative unless otherwise specified by DDW.	MW1 will not seek alternatives to any of the provisions of the Groundwater Replenishment Regulations.
SWRCB Policy and RWQCB Basin Plan Requirements		
	Requirement	Proposed Compliance Descriptions
Anti-degradation Policy	The State Anti-degradation Policy requires that existing high quality (including groundwater be maintained to the maximum extent possible, but allows lowering of water quality if the change is consistent with maximum benefit to the people of	The GWR Project will meet the Anti-degradation Policy by creating purified water for injection that is of higher quality than the local groundwater, meets Basin Plan objectives, and protects groundwater beneficial uses; by utilizing

	Requirements	Proposed Compliance Description
	the state, will not unreasonably effect present and anticipated use of such water, and will not result in water quality less than prescribed in policies. The Anti-degradation Policy also stipulates that any discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge to ensure that (a) pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.	advanced treatment technologies that result in best practicable treatment or control; and by recycling water, which in accordance with the State Recycled Water Policy is a maximum benefit to the people of the State.
Recycled Water Policy	Assimilative Capacity - A groundwater replenishment project that utilizes less than 10% of the available assimilative capacity in a groundwater basin/sub-basin (or multiple projects utilizing less than 20% of the available assimilative capacity in a groundwater basin/sub-basin) is only required to conduct an anti-degradation analysis verifying the use of the assimilative capacity. In the event a project or multiple projects utilize more than the fraction of the assimilative capacity (e.g., 10% for a single project or 20% for multiple projects), the project proponent must conduct a RWQCB-deemed acceptable (and more elaborate) anti-degradation analysis.	The GWR Project would utilize less than 10% of the assimilative capacity and therefore does not require a more detailed anti-degradation analysis. The GWR Project purified water would be treated and stabilized to meet all drinking water quality objectives and other Basin Plan objectives. Further, the GWR Project purified water will be expected to have a higher quality water than ambient groundwater with respect to total dissolved solids (TDS), chloride, and nitrate. As such, the GWR Project will neither cause a violation of a groundwater quality standard nor adversely impact beneficial uses, and would have a beneficial effect on local groundwater quality.
	Impact on Contaminant Plumes – If necessary, a RWQCB may impose requirements on a proposed groundwater replenishment project that has a substantial adverse effect on the fate and transport of a contaminant plume (for example those caused by industrial contamination or gas stations.	No documented groundwater contamination or contaminant plumes have been identified in the GWR Project area. Therefore, injection associated with the GWR Project would not exacerbate existing groundwater contamination or cause plumes of contaminants to migrate. As a result, additional RWQCB requirements related to groundwater contaminants would not be necessary for the GWR Project.
	Dissolution of Contaminants - If necessary, a RWQCB may impose requirements on a proposed groundwater replenishment project that changes the geochemistry of an aquifer thereby causing the dissolution of naturally occurring constituents, such as arsenic, from the geologic formation into groundwater.	The risk of geochemical impacts from incompatibility would be addressed at the proposed AWPF by including a stabilization process to ensure that the purified water is stabilized, non-corrosive, and prevents dissolution in the geologic formation.
	CEC Monitoring - For subsurface injection projects, based on the recommendations of an expert panel, the Recycled Water Policy establishes a list of specific health-based CEC indicators, performance-based CEC indicators, and surrogates that must be monitored in recycled water after RO or after RO/AOP, depending on the specific indicator/surrogate. The Recycled Water Policy also establishes procedures for evaluating data and actions to be taken depending on the monitoring results.	M1W will monitor the CECs and unregulated chemicals and surrogates in the AWPF purified water as specified by the Recycled Water Policy, and will evaluate data and implement any follow-up actions based on monitoring results. For performance indicator CECs, M1W will compare water quality before treatment by RO/AOP and prior to injection. If the performance changes over time, M1W will evaluate if there are changes in the incoming concentration of the CEC indicator or if RO/AOP treatment system performance has changed. For health indicator CECs, M1W will compare the purified water quality to the Policy's Monitoring Trigger Levels (MTLs), and based on the results take follow up actions including additional monitoring, discussion with DDW and RWQCB, and implementing studies.

	Requirements	Proposed Compliance Description
Basin Plan Requirements	Per the Basin Plan, the Seaside Groundwater Basin is suitable for agricultural (AGR), municipal and domestic supply (MUN), and industrial use. The Basin Plan establishes general narrative groundwater objectives for taste and odor and radioactivity that apply to all groundwater basins; for MUN, groundwater objectives for bacteria and primary and secondary MCLs, and for AGR beneficial uses, groundwater guidelines and objectives to protect soil productivity, irrigation, and livestock watering and objectives for irrigation supply and livestock watering.	Based on the source water sampling, piloting testing results, and pertinent research, the purified water that would be produced by the RTP and full-scale AWPF would meet all Basin Plan objectives and guidelines. M1W will confirm compliance with the Basin Plan by monitoring the quality of the AWPF purified water and groundwater.

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19. Acronyms

AALs	Archived Action Levels
ADI	Acceptable Daily Intakes
AF	Acre-feet
AFY	Acre-feet per year
AGR	Agricultural Water Supply
AOP	Advanced oxidation process
ASR Project	Monterey Peninsula Aquifer Storage and Recovery Project
AWPF	Advanced water purification facility
BAF	Biologically activated filtration
CalAm	California American Water Company
CCR	California Code of Regulations
CDPH	California Department of Public Health
CECs	Constituents of Emerging Concern
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CHG	Certified Hydrogeologist
CSIP	Castroville Seawater Intrusion Project
CT	Chlorine residual in mg/L times contact time in minutes
CWA	Clean Water Act
CWC	California Water Code
d	day
DBPs	Disinfection by-products
DDW	Division of Drinking Water
DEET	N,N-diethyl-meta-toluamide
DWEL	Drinking Water Equivalent Level
EC	Electrical Conductivity
EIR	Environmental Impact Report
ER	Engineering report
GAC	Granular activated carbon
gpm	Gallons per minute
GWR	Groundwater replenishment
GWRS	Groundwater Replenishment System
H&SC	Health and Safety Code
IAP	Independent Advisory Panel

kg	kilogram
L	Liter
LOAEL	Lowest observed no adverse effect level
M1W	Monterey One Water
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MCWD	Marina Coast Water District
MEC	Measured Environmental Concentration
mgd	Million gallons per day
mg/L	Milligrams per liter
mJ/cm^2	Millijoules per square centimeter
mL	Milliliters
MF	Membrane filtration (or microfiltration)
MOU	Memorandum of Understanding Regarding Source Waters and Water Recycling
MPA	Masters of Public Administration
MPN/100 mL	Most probable number per 100 milliliters
MRL	Minimum Reporting Level
MRWPCA	Monterey Regional Water Pollution Control Agency
MTL	Monitoring Trigger Level
MUN	Municipal and Domestic Supply
N	Nitrogen
NAE	National Academy of Engineering
ND	Not detected
NDMA	N-nitrosodimethylamine
ηg/L	Nanograms per liter
NOAEL	No observed adverse affect level
NL	Notification Level
NPDES	National Pollutant Discharge Elimination System
NRC	National Academy of Sciences National Research Council
NTU	Nephelometric Turbidity Units
NWRI	National Water Research Institute
OCWD	Orange County Water District
P.E.	Professional Engineer
P.G.	Professional Geologist
Ph.D.	Doctor of Philosophy

PHG	Public Health Goal
PNEC	Predicted No Effect Concentrations
PoLi	Pesticides of local interest
QRRA	Quantitative Relative Risk Assessment
REHS	Registered Environmental Health Specialist
RO	Reverse osmosis
ROWD	Report of Waste Discharge
RRT	Response Retention Time
RTP	Regional Wastewater Treatment Plant
RWC	Recycled Water Contribution
RWQCB	Regional Water Quality Control Board
SAR	Sodium Adsorption Ratio
SAT	Soil aquifer treatment
SDWA	Safe Drinking Water Act
SNMP	Salt Nutrient Management Plan
SVGB	Salinas Valley Groundwater Basin
SVRP	Salinas Valley Reclamation Project
SWRCB	State Water Resources Control Board
TCEP	Tris(2-chloroethyl)phosphate
TDI	Tolerable Daily Intakes
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TMF	Technical Managerial and Financial Assessment
μg/L	micrograms per liter
μS/cm	Micro-siemens per centimeter
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
UV	Ultraviolet light
WDRs	Waste Discharge Requirements
WRRs	Water Recycling Requirements

20. Glossary

Acre-foot – A unit of volume that is one acre in area by one foot in depth.

Advanced Oxidation – A chemical oxidation process that relies on the production of a hydroxyl radical for the destruction of trace organic constituents found in water.

Advanced Water Treatment – Wastewater treatment technologies used to remove total dissolved solids, pathogens, trace organics, and or other trace constituents for specific reuse applications.

Alkalinity – The acid neutralizing capacity of solutes in a water sample, reported in mill equivalents of calcium carbonate per liter.

Anthropogenic – Being derived from human activities, as opposed to those occurring in natural environments without human influences.

Aquifer – A geologic formation under the ground that is saturated with groundwater and sufficiently permeable to allow movement of quantities of water to wells and springs.

Assimilative Capacity – The condition in which existing water quality is better than that required to support the most sensitive beneficial use(s) of a groundwater basin, i.e., a contaminant concentration in groundwater is below the applicable water quality objective. It is also the difference between water quality objectives and average ambient groundwater quality in the groundwater basin.

Biologically Activated Filtration – Biological filters that remove contaminants by three main mechanisms: biodegradation, adsorption, and filtration of suspended solids.

Brine – A waste stream containing elevated concentrations of total dissolved solids.

California Environmental Quality Act (CEQA) – A California law that requires State and local agencies determine the potential significant environmental impacts of proposed projects and identify measures to avoid or mitigate these impacts where feasible. The CEQA Guidelines, which provide the protocol by which State and local agencies comply with CEQA requirements, are detailed in California Code of Regulations, Title 14 § 15000 et seq. The basic purposes of CEQA are to: (1) inform decision makers and public about the potential significant environmental effects of a proposed project, (2) identify ways that environmental damage may be mitigated, (3) prevent significant, avoidable damage to the environment by requiring changes in projects, through the selection of alternative projects or the use of mitigation measures when feasible, and (4) disclose to the public why an agency approved a project if significant effects are involved (California Code Regulations, Title 14, § 15002(a)).

Concentrate – The portion of a feed stream that retains the constituents that were rejected during reverse osmosis treatment.

Constituent – A term used to describe either a chemical or compound.

Constituents of Emerging Concern – Constituents of emerging concern are generally chemicals for which there are no established water quality standards. These chemicals may be present in waters at very low concentrations and are now detected as the result of more sensitive analytical methods. CECs include several types of chemicals such as pesticides, pharmaceuticals and ingredients in personal care products, veterinary medicines, endocrine disruptors, and others.

Clean Water Act – Federal law that is the cornerstone of surface water quality protection in the United States. The statute employs a variety of regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff.

Conductivity – A measure of the ability of an aqueous solution to carry an electric current.

***De Minimis* Risk** – A level of risk that the scientific and regulatory community asserts is too insignificant to regulate.

Disinfection By-products – Chemicals that are formed with the residual matter found in treated reclaimed water as a result of the addition of a strong oxidant, such as chlorine or ozone, for the purpose of disinfection.

Environmental Impact Report (EIR) – An EIR is a detailed report written by the lead agency describing and analyzing the significant environmental effects of a proposed project, identifying alternatives and discussing ways to reduce or avoid the possible environmental damage.

Endocrine Disrupting Chemicals – Synthetic and natural compounds that mimic, block, stimulate or inhibit natural hormones in the endocrine systems of animals, humans, and aquatic life.

Epidemiology – The study of disease patterns in human populations.

Flux – The flow rate per unit of membrane surface area.

Groundwater – Water found in the spaces between soil particles and cracks in rocks underground.

Groundwater Gradient – The slope of the water table.

Groundwater Mounding – An outward and upward expansion of the free water table caused by surface or sub-surface recharge. Mounding can alter groundwater flow rates and direction; however, the effects are usually localized and may be temporary, depending upon the frequency and duration of the surface recharge events.

Groundwater Replenishment – The process of adding a water source such as recycled water to aquifers under controlled conditions to supplement groundwater or act as a barrier to prevent seawater from entering the aquifer. Water can be recharged by infiltration in spreading basins, injection wells, or vadose zone wells.[47]

Indicator – An individual compound or chemical that represents the physical, chemical, and biodegradable characteristics of a specific family of trace organics.

In vitro – Biological studies that take place in isolation from a living organism, such as a test tube or Petri dish.

In vivo – Biological studies that take place within a living organism.

Maximum Contaminant Levels (MCLs) – The highest level of a contaminant that is allowed in drinking water and is protective of human health.

Membrane – A membrane is thin layer of material that will only allow certain constituents to pass through it. Which material will pass through the membrane is determined by the size and the chemical characteristics of the membrane and the material being filtered.

Membrane Treatment (or Microfiltration) – A treatment system that passes liquid through semipermeable membranes to exclude suspended solids (typically solids that are larger than 0.03 to 0.3 μm).

Microgram per liter – A concentration unit of measurement that is one millionth of a gram per volume of water in liters. It is equivalent to one part per billion.

Milligram per liter – A unit of measurement that is one thousandth of a gram per volume of water in liters. It is equivalent to one part per million.

Minimum Reporting Level – An estimate of the lowest concentration of a compound that can be detected in a sample for which the concentration can be quantified and reported with a reasonable degree of accuracy and precision.

Monitoring Well – Specially constructed wells used for collecting representative samples of ground water for water quality testing.

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[47] Note: The CWC defines groundwater recharge as follows: "Indirect potable reuse for groundwater recharge" means the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system, as defined in Section 116275 of the Health and Safety Code.

Most Probable Number – An index of the number of coliform bacteria that, more probably than any other number, would give the results shown by laboratory examination; it is not an actual enumeration.

Nanogram per liter – A unit of measurement that is one billionth of a gram per volume of water in liters. It is equivalent to a part per trillion.

National Pollutant Discharge Elimination System (NPDES) Permit – Permit required for all point sources discharges of pollutants to surface waters.

Notification Levels (NLs) – Health-based advisory levels established by the State Water Resources Control Board Division of Drinking Water for chemicals in drinking water that lack Maximum Contaminant Levels. When chemicals are found at concentrations greater than their NLs, certain requirements and recommendations apply to drinking water purveyors.

Ozonation – A chemical oxidation treatment process that uses ozone to react with contaminants in water. It is also used for disinfection.

Pathogens – Microorganisms including bacteria, protozoa, helminthes, and viruses capable of causing disease in animals and humans.

Percolation – The flow or filtering of water or other liquids through subsurface rock or soil layers, usually continuing to groundwater.

Permeate – The liquid stream that passes through a membrane.

Pesticide – (a) Chemical used to kill destructive insects or other small animals. (b) A general term for insecticides, herbicides and fungicides. Insecticides kill or prevent the growth of insects. Herbicides control or destroy plants. Fungicides control or destroy fungi. Some pesticides can accumulate in the food chain and contaminate the environment.

pH – A measure of the acidity or alkalinity of a substance.

Pilot-scale Treatment Studies – Studies that typically use treatment units that are significantly smaller than needed for full-scale operation, but that are large enough to accurately represent treatment behavior at full-scale. They can be used to evaluate the effectiveness of different types of treatment processes or different vendors of the same treatment process.

Protozoa – Single celled organisms such as *Giardia* and *Cryptosporidium*.

Plume – A body of contaminated groundwater flowing from a specific source.

Potable Reuse – The planned use of recycled water to augment drinking water supplies.

Publicly Owned Treatment Work – A wastewater treatment plant owned by a state or municipality.

Primary Maximum Contaminant Level – Numeric standards or treatment technologies established by the United States Environmental Protection Agency and the California Water Resources Control Board Division of Drinking Water to protect public health.

Primary Treatment – A treatment process that allows for heavier solids in raw sewage to settle to the bottom of a tank and for the lighter materials, like plastic and grease, which float to the top, to be skimmed and removed and recycled back into the treatment process.

Priority Pollutants – The 126 chemical pollutants regulated by the U.S. Environmental Protection Agency. The current list chemicals can be found in Appendix A of Section 40 of the Code of Federal Regulations, Part 423.

Purified Water – Recycled water that has been produced using advanced treatment.

Quality Assurance/Quality Control – A set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality.

Quality of the water – Refers to chemical, physical, biological, bacteriological, radiological, and other properties and characteristics of water that affect its use.

Recycled Water – Domestic or municipal wastewater which has been treated to a quality suitable for a beneficial use.

Redundancy – The use of multiple treatment barriers for the same contaminant, so that if one fails, performs ineffectively, or is taken off-line for maintenance, the system still effectively performs and risk is reduced

Reliability – For direct potable reuse, to consistently achieve the desired water quality. A reliable system is redundant, robust and resilient.

Reverse Osmosis – A treatment process where pressure greater than the osmotic pressure is applied to water to drive the more concentrated solution to the other side of the membrane and the membrane acts as a barrier to contaminants, such as salts. The permeate water passes through the membrane and has reduced contaminant concentration. A reject flow stream is produced that contains salts and other constituents rejected by the membrane process.

Runoff – Rainfall or snow melt which is not absorbed by soil, evaporated, or transpired by plants, but finds its way into streams as surface flow.

Safe Drinking Water Act – The main federal law that ensures the quality of United States drinking water.

Salinity – Of, characteristic of, or containing common salt, or sodium chloride; salty.

Salt Water Intrusion – The invasion of a body of fresh water (surface or ground water) by a body of salt water.

Secondary Maximum Contaminant Level – Water quality standard established to manage drinking water for aesthetic considerations, such as taste, color, and odor. Contaminants with only secondary MCLs are not considered to pose a risk to human health.

Secondary Treatment – A biological treatment process used for the removal of soluble organic matter and particulates using microorganisms. The microorganisms form flocculant particles that are separated from the water using sedimentation (settling), and the settled material is returned to the biological process or wasted.

Surrogate – A measurable physical or chemical property that has can be used to measure the effectiveness of trace organic removal by a treatment process. For example, a reverse osmosis treatment process is expected to substantially reduce the electrical conductivity (salinity) of the recycled water being treated. Surrogates, such as coliforms, are also used in place of directly measuring pathogens.

Tertiary Recycled Water – Recycled water that has been processes using tertiary treatment and meets requirements in California Code of Regulations, Title 22.

Tertiary Treatment – A treatment process where wastewater that has undergone secondary treatment is processed using granular media or carbon filters and then disinfected.

Total Dissolved Solids – An overall measure of the minerals in water. Total salinity is commonly expressed in terms of TDS as milligrams per liter (mg/L). Elevated TDS concentrations above the Secondary Maximum Contaminant Level of 1,000 mg/L are undesirable for aesthetic reasons related to taste, odor, or appearance of the water and not for health reasons.

Total Nitrogen – The sum of organic nitrogen, nitrate, nitrite, and ammonia expressed as nitrogen.

Total Organic Carbon – The concentration of organic carbon present in water, both dissolved and suspended.

Tracer – A non-reactive substance, with measurable characteristics distinctly different from the receiving groundwater. Tracers can be added to recycled water or intrinsically present in recycled water.

Treatment – Any process that changes the physical, chemical, or biological character of a water or wastewater.

Treatment Process – A combination of treatment operations and processes used to produce water meeting specific water quality levels.

Ultraviolet – UV irradiation is the process by which chemical bonds of the contaminants are broken by the energy associated with UV light (photolysis). UV also has germicidal properties and is used for disinfection.

Vadose Zone (also called **Unsaturated** zone) – The area between the land surface and the regional groundwater table (upper surface of the groundwater).

Vadose Zone well – A vadose zone well is an injection well installed in the unsaturated zone above the water table. These wells typically consist of a large-diameter borehole with a casing/screen assembly installed with a filter pack. The well is used as a conduit for transmitting water into the subsurface, allowing infiltration into the vadose zone through the well screen and percolation to the underlying water table.

Water Quality – A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water Quality Standards – Beneficial uses of groundwater and water quality objectives to protect beneficial uses.

Wastewater – Liquid waste discharged from municipal activities, including residential, commercial, and industrial activities.

Well Yield – The amount of water that can be pumped from a given well per unit of time.

Appendix A
March 9, 2017 - Waste Discharge Requirements and Water Recycling Requirements for the Pure Water Monterey AWPF and GRP issued to Monterey One Water.
Order No R3-2017-0003.

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION
ORDER NO. R3-2017-0003

WASTE DISCHARGE REQUIREMENTS AND WATER RECYCLING REQUIREMENTS

FOR THE

PURE WATER MONTEREY
ADVANCED WATER PURIFICATION FACILITY
AND
GROUNDWATER REPLENISHMENT PROJECT

ISSUED TO

MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY

The California Regional Water Quality Control Board, Central Coast Region (Central Coast Water Board) finds that:

I. BACKGROUND

1. The Monterey Regional Water Pollution Control Agency (MRWPCA) in partnership with the Monterey Peninsula Water Management District (MPWMD) has developed the “Pure Water Monterey Groundwater Replenishment Project” (Project) to deliver 3,500 acre-feet per year (AFY) of purified recycled water to replenish the Seaside Groundwater Basin (Seaside Basin), in Monterey County.

2. The MRWPCA is a joint powers authority (JPA) operating in the Monterey Bay area, with 11 members including Monterey County, City of Salinas, Boronda County Sanitation District, Castroville Community Services District, City of Del Rey Oaks, City of Monterey, City of Pacific Grove, City of Sand City, City of Seaside, Marina Coast Water District, and Moss Landing County Sanitation District.

3. The MRWPCA is the facility owner and is responsible for complying with all requirements of this Order and the Monitoring and Reporting Program.

4. Each JPA member has had sewage conveyance or treatment responsibilities in the past for its respective area of jurisdiction and is currently responsible for maintaining and operating its own collection system. The collection systems of the 11 member agencies all connect to MRWPCA’s Regional Treatment Plant (RTP).

5. The MRWPCA currently serves a population of approximately 250,000 people and treats approximately 18.5 million gallons per day (MGD) of municipal wastewater at its RTP located two miles north of the City of Marina.

6. The RTP currently has a design capacity of 29.6 MGD.

7. California American Water Company (CalAm) is under a State Water Resources Control Board (SWRCB) cease and desist order (SWRCB Order No. 2009-0060) to secure replacement water supplies and cease over-pumping of the Carmel River. The Project will help CalAm to comply with the cease and desist order by allowing it to reduce diversions from the Carmel River system by 3,500 AFY by injecting the same amount of purified recycled product water into the Seaside Basin.
8. The Project will also include a drought reserve component by providing for an additional 200 AFY of product water that will be injected in the Seaside Basin in wet and normal years up to a total of 1,000 acre-feet (AF). Thus, the Project will inject up to 3,700 AF of product water into the Seaside Basin in some years, rather than the 3,500 AF needed for CalAm supplies. This will result in a “banked” drought reserve.
9. The Advanced Water Treatment Facility (AWPF) will be located adjacent to the RTP and will consist of ozone pre-treatment, low-pressure membrane filtration, reverse osmosis treatment, advanced oxidation, and product water stabilization.
10. Purified recycled water from the AWPF will be conveyed by pipeline to the Seaside Basin for groundwater recharge using both deep injection and vadose zone wells. The injected water will then mix with existing groundwater and be stored for future urban use, including use as a potable water source.
11. Additional recycled water from the RTP’s tertiary treatment system will augment the existing Castroville Seawater Intrusion Project’s agricultural irrigation supply.
12. The Project will supplement sewage flows to the RTP in order to increase the quantity of secondary effluent available as feed water. The sewage flows will be supplemented with:
    - agricultural wash water from the City of Salinas;
    - storm water flows from the southern part of Salinas;
    - storm water and urban agricultural runoff from the Reclamation Ditch; and
    - surface and agricultural tile drain waters from the Blanco Drain.
13. AWPF treated water will be conveyed by pipeline to the Seaside Basin for groundwater recharge using injection and vadose zone wells owned by MRWPCA. The injection wells will be arrayed just east of General Jim Moore Blvd. and south of Eucalyptus Road (see Figure 1).

II. PURPOSE OF ORDER

14. This Order authorizes the treatment of recycled water at the AWPF and injection of the treated water into the Seaside Basin aquifer.
15. On February 25, 2016, the MRWPCA submitted a Report of Waste Discharge requesting new waste discharge requirements and water recycling requirements (WDRs/WRRs) to reflect a proposal to operate the AWT facility and inject recycled water into the Seaside Basin.

16. On November 29, 2016, the Water Board sent a letter to MRWPCA notifying it that the Report of Waste Discharge letter was complete.

17. On August 22, 2016, the MRWPCA held a public hearing on the draft Title 22 Engineering Report for this project and on October 21, 2016, submitted a final version the Title 22 Engineering Report (Pure Water Monterey Groundwater Replenishment Title 22 Engineering Report) for operation of the Facility to the Central Coast Water Board and the State Water Resources Control Board Division of Drinking Water (DDW). The final Engineering Report was accepted by DDW on November 7, 2016.

18. MRWQCA has made changes to the project since the final Engineering Report was accepted by DDW.

19. DDW submitted a letter to the Central Coast Water Board with recommendations for conditions to properly regulate the Project on November 10, 2016.

20. The DDW conditions are incorporated into the provisions of this Order.

III. PURE WATER MONTEREY ADVANCED WATER PURIFICATION PROJECT

21. The Monterey Regional Water Pollution Control Agency (hereafter “MRWPCA” or “Discharger”) owns and operates the Advanced Water Purification Facility located at 14811 Del Monte Boulevard, located north east of Marina in Monterey County (see Figure 1). The facility is located just south of the Salinas River.

22. **Primary Project Components**:

    1. The following source waters will be treated to secondary standards at the RTP:
        - Sewage from the MRWPCA member entities
        - Agricultural wash water from the City of Salinas
        - Storm water flows from the southern part of Salinas
        - Storm water and urban and agricultural runoff from the Reclamation Ditch
        - Surface and agricultural tile drain waters from the Blanco Drain
    2. The Advanced Water Purification Facility (AWPFAWPF) has the following major components:
        - Supply water pump station
        - Ozonation (membrane filtration pretreatment)
        - Membrane filtration feed water pump station
        - Low Pressure Membrane Filtration (MF)
        - Reverse osmosis (RO) feed water pump station
        - RO system
        - Ultraviolet light (UV) with hydrogen peroxide advanced oxidation Process (AOP)
        - Post treatment stabilization
        - Product water pump station
    3. Aquifer recharge by injection of purified recycled water into the Seaside

Basin.

Figure 1 - shows the approximate locations of the AWPF and the injection wells site.

Figure 2 - shows a simplified process flow diagram of the existing RTP and the AWPF.

Figure 3 - is a map of wells associated with and in the vicinity of the Project.

23. **AWPF Design Flows and Waste Streams** - The proposed AWPF will have a design capacity to produce 4.0 MGD of advanced treated recycled water. The facility will also produce seven waste streams: ozone injection strainer waste, MF backwash waste, neutralized MF enhanced flux maintenance waste, neutralized MF clean-in-place waste, neutralized RO clean-in-place waste, analytical instrument waste, and RO concentrate. The RO concentrate will be piped to MRWPCA's existing ocean outfall along with secondary wastewater effluent, and trucked brine. The other AWPF waste streams will be diverted to the RTP headworks or the RTP sludge thickening process for treatment.

24. **Ocean Discharge** - The RO concentrate will be sent to the existing ocean outfall regulated by Water Board Order No. R3-2014-0013, NPDES No. CA0048551 for disposal.

    Because there will be new waste streams entering the RTP, and these waste streams will have seasonal variations in water quality, the Central Coast Water Board must modify MRWPCA's existing NPDES permit for discharge to the Pacific Ocean prior to project operation.

IV. RECYCLED WATER INJECTION SYSTEM

25. **Injection Facilities** – Injection facilities will be constructed along a strip of land on the eastern boundary of the City of Seaside, about 1.5 miles inland from Monterey Bay, in an area is located within the Northern Inland Subarea of the Seaside Basin. Each vadose zone well will be paired with a deep injection well (i.e. a well cluster) at each of the four proposed injection well locations. (Figure 3)

26. **Vadose Zone Wells** - Up to four vadose zone injection wells are planned (VZW-1 through VZW-4) in the Paso Robles aquifer. These wells are targeted to receive 10 percent of the advanced treated recycled water.

27. **Deep Injection Wells** - Up to four deep water injection wells (DIW-1 through DIW-4) are planned in the Santa Margarita aquifer. These wells are targeted to receive 90 percent of the advanced treated recycled water.

28. **Water Supply Wells Near the Injection Area** - Most supply wells near the injection facilities are located in the adjacent Northern Coastal Subarea. The closest water supply wells include Seaside No. 4 (operated by the City of Seaside) and two aquifer storage and recovery (ASR) wells, ASR-1 and ASR-2 (operated by the Monterey Peninsula Water Management District for CalAm). Each of these wells is located about 1,000 feet downgradient from a Project injection well (Figure 3).

29. **Monitoring Wells** - MRWPCA will construct two monitoring wells downgradient of each injection well cluster. One monitoring well must be located between two weeks to six months travel time and at least 30 days upgradient of the nearest drinking water well, and one monitoring well must be located between each well cluster and the nearest downgradient drinking water well. The monitoring wells will allow for samples to be obtained independently from each aquifer and validated as receiving recharge water from the Project.

30. **Recycled Water Retention Time** - The SWRCB Division of Drinking Water (DDW - formerly the California Department of Public Health) has adopted groundwater replenishment regulations (June 2014) for the recharge of recycled water. The DDW regulations contain requirements for underground retention time of recycled water that could also potentially affect well spacing. Recycled water must be retained underground for a sufficient period of time to identify and respond to any treatment failure so that inadequately treated recycled water does not enter a potable water system (referred to as the response retention time). The response retention time must be at least two months. The 1,000-ft distance between proposed project wells and the closest downgradient production wells is expected to result in a travel time of approximately one year. MRWPCA will propose a tracer study to DDW and the Central Coast Water Board and when approved, will conduct the study to confirm the underground retention time.

V. SEASIDE GROUNDWATER SUBBASIN

31. **Seaside Groundwater Basin** - Groundwater Bulletin 118 defines the Salinas Valley Groundwater Basin - Seaside Area Subbasin 3-4.08 as having a surface area of 25,900 acres, or approximately 40 square miles. The subbasin underlies the coastal communities of Seaside and Marina as well as the western portion of the former Fort Ord. The main water-bearing units of the subbasin are the Santa Margarita Formation and the Paso Robles Formation. The Santa Margarita Formation is poorly consolidated marine sandstone, has a maximum thickness of 225 feet, and underlies the Paso Robles Formation. The Paso Robles Formation is the major water-bearing unit in the Seaside area and consists of sand, gravel, and clay interbedded with some minor calcareous beds. The storage capacity of the subbasin is estimated to be 1,000,000 acre-feet.

32. **Seaside Groundwater Basin Salt & Nutrient Management Plan -** A salt and nutrient management plan (SNMP) was prepared for the Monterey Peninsula Management District, pursuant to the State Water Board's Recycled Water Policy in June of 2014. The SNMP has not been adopted by the Central Coast Water Board and will not be brought before the Board in its current form.

VII. REGULATION OF RECYCLED WATER

33. Legislation was adopted, effective July 1, 2014, that transferred personnel in the California Department of Public Health Drinking Water Program, which includes those working on permitting of recycled water projects, to the State Water Board as the new Division of Drinking Water (DDW). The regional water quality control boards are responsible for issuing water reclamation requirements for the beneficial use of recycled water. The State Water Board and regional water quality control boards are responsible for issuing waste discharge requirements for the production

of recycled water.

34. State authority to oversee production and reuse of recycled water use is shared by the State Water Board Division of Drinking Water and the Regional Water Boards. DDW is the division with the primary responsibility for establishing water recycling criteria under Title 22 of the Code of Regulations to protect the health of the public using the groundwater basins as a source of potable water.

35. The State Water Board adopted Resolution No. 77-1, Policy with Respect to Water Reclamation in California, which includes principles that encourage and recommend funding for water recycling and its use in water-short areas of the state. On September 26, 1988, the Central Coast Water Board adopted Resolution No. 88-012, which encourages the beneficial use of recycled water and supports water recycling projects.

36. The State Water Board adopted the Recycled Water Policy (State Water Board Resolution No. 2009-0011) on February 3, 2009, and amended the Policy on January 22, 2013. The purpose of the Recycled Water Policy is to protect groundwater resources and to increase the beneficial reuse of recycled water from municipal wastewater sources in a manner consistent with state and federal water quality laws and regulations. The Recycled Water Policy describes the respective authorities of DDW and the regional water quality control boards as follows:

    Regional Water Boards shall appropriately rely on the expertise of DDW for the establishment of permit conditions needed to protect human health. (section 5.b)

    Nothing in this paragraph shall be construed to limit the authority of a Regional Water Board to protect designated beneficial uses, provided that any proposed limitations for the protection of public health may only be imposed following regular consultation by the Regional Water Board with DDW, consistent with State Water Board Orders WQ 2005-0007 and 2006-0001. (section 8.c)

    Nothing in this Policy shall be construed to prevent a Regional Water Board from imposing additional requirements for a proposed recharge project that has a substantial adverse effect on the fate and transport of a contaminant plume or changes the geochemistry of an aquifer thereby causing dissolution of constituents, such as arsenic, from the geologic formation into groundwater. (section 8.d)

    In addition, the Policy notes the continuing obligation of the Regional Water Boards to comply with the state's anti-degradation policy, Resolution No. 68-16:

    The State Water Board adopted Resolution No. 68-16 as a policy statement to implement the legislature's intent that waters of the state shall be regulated to achieve the highest water quality consistent with the maximum benefit to the people of the state. (section 9.a)

37. Section 13523(a) of the Water Code provides that a regional water quality control board, after consulting with and receiving recommendations from DDW, and after any necessary hearing, shall, if it determines such action to be necessary to protect the health, safety, or welfare of the public, prescribe water recycling requirements for water that is used or proposed to be used as recycled water. Pursuant to Water Code section 13523, the Central Coast Water Board has consulted with DDW and received its recommendations. On August 22, 2016, DDW participated in a public hearing to consider the proposed Pure Water Monterey Groundwater Replenishment Project. On October 21, 2016, DDW transmitted to the Central Coast Water Board its conditions concerning the Pure Water Monterey Project. DDW's recommendations are included in this order as requirements.

38. Section 13540 of the Water Code requires that recycled water may only be injected into an aquifer used as a source of domestic water supply if DDW finds the recharge will not degradethe quality of the receiving aquifer as a source of water supply for domestic purposes. DDW determined that as long as the water reclamation requirements meet all of its conditions, the Pure Water Monterey Groundwater Replenishment Project can provide injection recharge water that will not degrade groundwater basins as a source of water supply for domestic purposes. This Order requires that the Discharger comply with all of the recommended DDW conditions.

39. Section 13523(b) of the Water Code provides that reclamation requirements shall be established in conformance with the uniform statewide recycling criteria established pursuant to Water Code section 13521. Section 60320 of Title 22 currently includes requirements for groundwater recharge projects.

40. The State Water Resources Control Board adopted uniform water recycling criteria for groundwater recharge on July 15, 2014. This Order is consistent with those criteria.

VIII. OTHER APPLICABLE PLANS, POLICIES AND REGULATIONS

A. Regional Board Water Quality Control Plan (Basin Plan)

41. The Central Coast Water Board has adopted the *Water Quality Control Plan for the Central Coastal Basin* (Basin Plan). The Basin Plan designates beneficial uses for surface water and groundwater; establishes narrative and numeric water quality objectives that must be attained or maintained to protect the designated (existing and potential) beneficial uses and to conform with the state's anti-degradation policy; and includes implementation provisions, programs, and policies to protect all waters in the region. In addition, the Basin Plan incorporates applicable State Water Board and Central Coast Water Board plans and policies and other pertinent water quality policies and regulations.

42. The Basin Plan incorporates the California Code of Regulations (CCR) Title 22 primary Maximum Contaminant Levels (MCLs) by reference. This incorporation is prospective, including future changes to the incorporated provisions as the changes take effect. The Basin Plan states that groundwater designated for use as domestic or municipal supply shall not contain concentrations of chemical

constituents and radionuclides in excess of the MCLs. The Basin Plan also specifies concentrations that cause nuisance or adversely affect beneficial uses.

43. For the Seaside Basin, the Basin Plan includes general narrative groundwater objectives for taste and odor and radioactivity and numeric objectives for:

- Bacteria - the median concentration of coliform organisms (i.e., total coliform) over any seven-day period must be less than 2.2/100 mL; and
- Chemical constituents - groundwater shall not contain chemical concentrations in excess of primary and secondary MCLs.:

Table 1 – Water Quality Goals

	Receiving Water			Beneficial Uses		
	Seaside Aquifer			Municipal and Domestic Water Supply (MUN) Industrial Service Supply (IND) Agricultural Supply (AGR)		
			Water Quality Goals - Sources			
	WQG	Units	CA Primary MCL	CA Secondary MCL	CA Public Health Goal for Drinking Water	Water Quality for Agriculture (Basin Plan)
Aluminum	1,000	µg/L	X			
Arsenic	10	µg/L	X			
Barium	1,000	µg/L	X			
Boron	750	µg/L				X
Cadmium	10	µg/L				X
Chloride	250	mg/L		X		
Chromium VI	0.02	µg/L			X	
Iron	300	µg/L		X		
Lead	0.2	µg/L			X	
Manganese	50	µg/L		X		
Nitrate - N	10	mg/L	X			
pH	6.5-8.4	pH Units				X
Sodium	69	mg/L	*WQ Goals – Marshak, WQ for Ag (Ayers & Wescot)*			
Sulfate	250	mg/L		X		
TDS	500	mg/L		X		
Zinc	**2.0**	**mg/L**				X

44. Four wells were used to establish existing groundwater water quality and assimilative capacity of the aquifer and sub-aquifers. The most recent five years of data (2011-2016) were analyzed for each well and the data are presented in Table 2. Two of the wells draw their water from both the Paso Robles and Santa Margarita aquifers (Ord Grove No. 2 and Paralta). One well draws water exclusively from the Paso Robles aquifer (City of Seaside No. 4) and one well draws exclusively from the Santa Margarita aquifer (ASR-1).

Table 2 - Existing Groundwater Quality in the Seaside Basin

Constituent	City of Seaside No.4	ASR-1	Ord Grove No. 2	Paralta	Basin-Wide Averages
Aluminum	50	50	26	50	42
Arsenic	1.2	1.8	2.0	2.5	2.1
Barium	28	100	100	100	94
Boron	46	95	132	96	108
Chloride	72	63	129	94	103
Chromium-total	3.6	9.3	10	10	9.1
Chromium VI	-	1.0	0.8	2.3	1.4
Lead	5	3.7	5.0	5.0	4.5
Nitrate as N	1.9	0.1	1.7	0.5	1.1
Sodium	50	60	94	79	79.7
Sulfate	13	77	63	58	54.9
TDS	237	406	524	435	449
TOC	0.5	1.0	0.6	0.6	0.7

**Source: averages of well water quality data submitted by MRPCA on November 9, 2016*

**Concentrations are in μg/L except chloride, nitrate, sodium, sulfate, TDS, and TOC, which are mg/L*

45. MRWPCA completed a focused groundwater quality evaluation, utilizing the available groundwater quality data for the four water supply wells named in Table 2, and constructed a three-dimensional solute transport model to predict localized and basin-wide groundwater quality changes resulting from the mixing of injected recycled water and ambient groundwater. The model analyzed the percentage of assimilative capacity consumed by the Project after 25 years. The results of the evaluation are presented in Table 3. MRWPCA also demonstrated that when effluent limits are equal to the applicable water quality objective for each constituent, the percentage of recycled water present in the aquifer equals the percentage of assimilative capacity consumed. This analysis confirms that less than 10% of the basin's assimilative capacity will be utilized by this project and that beneficial uses will be protected.

Table 3. Volume-Weighted Average = % Assimilative Capacity Consumed

Modeled Layer	Volume–Weighted Average Recycled Water Percentage				
	Northern Coastal	Northern Inland	Southern Coastal	Laguna Seca	All Subareas
1	0.1%	0.0%	0.0%	0.0%	0.0%
2	0.5%	2.2%	0.0%	0.0%	1.0%
3	4.0%	2.1%	0.0%	0.0%	1.7%
4	2.1%	0.6%	0.0%	0.0%	0.8%
5	5.3%	7.2%	0.0%	0.0%	3.8%
Paso Robles Aquifer	1.8%	1.7%	0.0%	0.0%	1.1%
Santa Margarita Aquifer	5.3%	7.2%	0.0%	0.0%	3.8%
All Model Layers	3.3%	4.2%	0.0%	0.0%	2.4%

46. Any constituent that currently exceeds its applicable water quality objective in the groundwater basin will see its water quality improved by discharges of recycled water below the water quality objective concentration.

47. The Basin Plan contains the following specific water quality objectives for groundwater:

MUNICIPAL AND DOMESTIC SUPPLY (MUN)

- Bacteria - The median concentration of coliform organisms over any seven-day period shall be less than 2.2/100 mL.
- Organic Chemicals - Ground waters shall not contain concentrations of organic chemicals in excess of the limiting concentrations set forth in California Code of Regulations, Title 22, Chapter 15, Article 5.5, Section 64444.5 Table 5, and listed in Basin Plan Table 3-1.
- Chemical Constituents - Ground waters shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Article 4, Section 64435, Tables 2 and 3. Radioactivity - Ground waters shall not contain concentrations of radionuclides in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Article 5, Section 64443, Basin Plan Table 4.

AGRICULTURAL SUPPLY (AGR)

- Ground waters shall not contain concentrations of chemical constituents in amounts that adversely affect such beneficial use. Interpretation of adverse effect shall be as derived from the University of California Agricultural Extension Service guidelines provided in Basin Plan Table 3-3.
- In addition, water used for irrigation and livestock watering shall not exceed the concentrations for those chemicals listed in Basin Plan Table 3-4. No controllable water quality factor shall degrade the quality of any ground water resource or adversely affect long-term soil productivity. The salinity control aspects of ground water management will account for effects from all sources.

This Order protects Seaside Basin groundwater water quality objectives and is therefore consistent with the Basin Plan.

B. State Water Resources Control Board Policies

48. The Sources of Drinking Water Policy (Resolution No. 88-63) provides that all waters of the state, with certain exceptions, are to be protected as existing or potential sources of municipal and domestic supply. Exceptions include waters with existing high dissolved solids (i.e., greater than 3,000 mg/L), low sustainable yield (less than 200 gallons per day for a single well), waters with contamination that cannot be treated for domestic use using best management practices or best economically achievable treatment practices, waters within particular municipal, industrial and agricultural wastewater conveyance and holding facilities, and regulated geothermal ground waters. This Order protects existing or potential sources of drinking water and is therefore consistent with Resolution No. 68-63.

49. On October 28, 1968, the State Water Board adopted Resolution No. 68-16,

Statement of Policy with Respect to Maintaining High Quality of Waters in California (Resolution 68-16), establishing an anti-degradation policy for the State Water Board and Regional Water Boards. Resolution No. 68-16 requires that existing high quality of waters be maintained unless a change is demonstrated to be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial uses of waters, and will not result in water quality less than that prescribed in applicable policies. Resolution No. 68-16 also requires that waste discharge requirements be prescribed for discharges to high quality waters that will result in the best practicable treatment or control of the discharge necessary to ensure that a pollution or nuisance will not occur and the highest water quality consistent with maximum benefit to the people of the State will be maintained. The Central Coast Water Board's Basin Plan implements, and incorporates by reference, the state anti-degradation policy.

50. This order is consistent with Resolution No. 68-16 (anti-degradation policy). Groundwater recharge with recycled water for later extraction and use in accordance with the Recycled Water Policy and state and federal water quality laws is to the benefit of the people of the State of California.

    Compliance with this Order will protect present and anticipated beneficial uses of groundwater, ensure attainment of water quality prescribed in applicable policies, and avoid any conditions of pollution or nuisance. Although this Order may allow some degradation to water quality, the Order does not authorize the Project to cause exceedances of applicable water quality goals or objectives for the basin.

51. A goal of the Recycled Water Policy, Resolution No. 2013-0003, is to increase the beneficial use of recycled water from municipal wastewater sources in a manner consistent with state and federal water quality laws and regulations. The Policy directs the Regional Water Boards to collaborate with generators of municipal wastewater and interested parties in the development of salt and nutrient management plans (SNMPs) to manage the loading of salts and nutrients to groundwater basins in a manner that is protective of beneficial uses, thereby supporting the sustainable use of local waters. No SNMP has been adopted by the Central Coast Water Board for the Seaside Basin.

    The Recycled Water Policy also states that until such time as a salt and nutrient management plan has been approved by the Water Board and is in effect, compliance with Resolution No. 68-16 for projects that consume less than 10 percent of the available assimilative capacity in a basin/sub-basin may be demonstrated by conducting an antidegradation analysis verifying the use of assimilative capacity. This Order supports the sustainable use of local waters and ensures that the Project will consume less that 10 percent of available assimilative capacity, which is consistent with the Recycled Water Policy

52. DDW has established a notification level of 10 nanograms per liter (ng/L) for N-nitrosodimethylamine (NDMA). NDMA can be produced by reactions that occur during chlorination and has been determined to be a potent carcinogen. The notification level is the concentration of a contaminant in drinking water delivered for human consumption that DDW has determined, based on available scientific information, does not pose a significant health risk but warrants notification. Notification levels are established as precautionary measures for contaminants that

may be considered candidates for establishment of maximum contaminant levels, but have not yet undergone or completed the regulatory standard setting process prescribed for the development of maximum contaminant levels and are not drinking water standards. DDW has established a response level of 300 ng/L for NDMA. The response level is the concentration of a contaminant in drinking water delivered for human consumption at which DDW recommends that additional steps, beyond notification, be taken to reduce public exposure to the contaminant.

C. California Water Code

53. Pursuant to California Water Code (Water Code) section 106.3, it is the policy of the State of California that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking and sanitary purposes.

54. Pursuant to Water Code section 13263(g), discharges of waste into waters of the state are privileges, not rights. Nothing in this order creates a vested right to continue the discharge. Water Code section 13263 authorizes the Central Coast Water Board to issue waste discharge requirements that implement any relevant water quality control plan.

55. Section 13267(b) of the Water Code states, in part:

    In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging or who proposes to discharge within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste outside of its region shall furnish under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs of these reports shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports.

    Section 13267(d) of the Water Code states, in part:

    [A] regional board may require any person, including a person subject to waste discharge requirements under section 13263, who is discharging, or who proposes to discharge, wastes or fluid into an injection well, to furnish the state board or regional board with a complete report on the condition and operation of the facility or injection well, or any other information that may be reasonably required to determine whether the injection well could affect the quality of the waters of the state.

56. The need for the technical and monitoring reports required by this order, including the Monitoring and Reporting Program, is based on the Report of Waste Discharge (ROWD), the DDW's recommended conditions, the California Environmental Quality Act (CEQA) environmental impact report, the Title 22 Engineering Report, and other information in the Central Coast Water Board's files for the facility. The technical and

monitoring reports are necessary to ensure compliance with these waste discharge requirements and water recycling requirements. The burden, including costs, of providing the technical reports required by this Order bears a reasonable relationship to the need for the reports and the benefits to be obtained from the reports.

57. This order includes limits on quantities and concentrations of chemical, physical, biological, and other pollutants in the advanced treated recycled water that is injected into groundwater.

58. This order does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code, §§ 2050 to 2097) or the federal Endangered Species Act (16 U.S.C.A. §§ 1531 to 1544). This Order requires compliance with requirements to protect the beneficial uses of waters of the state. The Discharger is responsible for meeting all applicable requirements of the endangered species acts.

IX. CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) AND NOTIFICATION

59. An environmental impact report (EIR) was prepared for the proposed Pure Water Monterey Groundwater Replenishment Project with MRWPCA serving as the lead agency. (State Clearinghouse # 2013051094)

    a. Notices regarding the April 2015 draft EIR were emailed to 700 agencies, interested organizations, and individuals; placed as newspaper advertisements; distributed to state agencies through the State Clearinghouse; placed in public locations such as libraries, MRWPCA's and Monterey Peninsula Water Management District's (MPWMD's) websites and offices and key project sites; and posted with the Monterey County Clerk.

    b. Public meetings to provide information on the Project and CEQA process were held on May 20 and 21, 2015.

    c. The public was provided a 45-day comment period for the draft EIR.

    d. Notices about the availability of the final EIR were distributed in September 2015 to all entities that received the draft EIR, commented on the Draft EIR, or requested a copy or copies.

    e. The MRWPCA adopted Resolution No. 2015-24 on October 8, 2015, after a public hearing, which certified the final EIR, adopted the CEQA findings, approved mitigation measures and a mitigation monitoring and reporting program, adopted a statement of overriding considerations, and approved the project as modified. This Order, at General Requirement IV.10, requires that the Discharger comply with the mitigation measures and mitigation monitoring program identified in the final EIR.

    f. The final EIR contains oral and written comments received on the draft EIR and presents responses to environmental issues raised in the comments. In addition to the responses to comments, the final EIR contains revisions, updates, and clarifications in response to public comment on the draft EIR.

g. A notice of determination (NOD) was filed with the State Clearinghouse and the Monterey County Clerk's office on October 8, 2015. The Project has completed the notification and review process required by CEQA. The Central Coast Water Board is a responsible agency for purposes of CEQA. The Central Coast Water Board, as a responsible agency under CEQA, has considered the EIR and associated documents and concurs with MRWPCA's approval of the relevant CEQA documents. The Central Coast Water Board finds that all environmental effects have been identified for project activities that it is required to approve and that the Project will not have significant adverse impacts on the environment provided that the mitigation presented in the EIR for components of the Project being approved by this Order and the required Operation Optimization Plan are carried out as conditioned in this Order (see General Requirement IV.10 in this Order). In adopting this Order, the Central Coast Water Board has eliminated or substantially lessened the less-than-significant effects on water quality, and therefore approves the project.

60. Any person aggrieved by this action may petition the State Water Resources Control Board (State Water Board) to review the action in accordance with Water Code section 13320 and California Code of Regulations, Title 23, section 2050 and following. The State Water Board must receive the petition by 5:00 p.m., 30 days after the date of this Order, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the internet at:

    http://www.waterboards.ca.gov/public_notices/petitions/water_quality/

61. The Central Coast Water Board has notified the MRWPCA and interested agencies and persons of its intent to issue this Order for the production and use of recycled water and has provided them with an opportunity to submit written comments. The Central Coast Water Board, in a public meeting, heard and considered all comments pertaining to these WDRs/WRRs.

THEREFORE, IT IS HEREBY ORDERED that Order No. R3-2017-0003, with MRP No. R3-2017-0003, is effective as of the date of this order, and, in order to meet the provisions contained in division 7 of the Water Code (commencing with section 13000) and regulations and guidelines adopted thereunder, and California Code of Regulations Title 22, division 4, chapter 3, the MRWPCA shall comply with the requirements in this Order.

I. INFLUENT SPECIFICATIONS

The influent to the MRWPCA Advanced Water Treatment Facility shall consist of secondary treated wastewater discharged from the RTP. The wastewater coming into the RTP will be augmented with agricultural wash water from the City of Salinas, storm water flows from the southern part of Salinas, and surface and agricultural tile drain waters from the Reclamation Ditch and Blanco Drain as described in the approved 2016 Title 22 Engineering Report.

II. RECYCLED WATER TREATMENT SPECIFICATION

Treatment of the recycled water is as described in the findings of this Order and in the recommended conditions issued by DDW.

III. RECYCLED WATER DISCHARGE LIMITS

1. The advanced treated recycled water injected into any well at the injection facility shall not contain pollutants in excess of the following limits:

Table 4 – Recycled Water Reinjection Discharge Limits

Constituents	Units	Concentration	Monitoring Frequency	Compliance Interval
***Arsenic**	mg/L	0.01	Monthly	Running Annual Average
***Boron**	µg/L	750	Monthly	Running Annual Average
***Chloride**	mg/L	250	Monthly	Running Annual Average
***Nitrate as N**	mg/L	10	Weekly	Sample Result: no averaging
****Nitrogen - Total**	mg/L	10	Twice per Week	Average of Last 4 Results
***Sodium**	mg/L	69	Monthly	Running Annual Average
***Sulfate**	mg/L	250	Monthly	Running Annual Average
***TDS**	mg/L	500	Monthly	Running Annual Average
****Total Organic Carbon (TOC)**	mg/L	0.5	Weekly	20-week running average and average of last 4 results
****Total Coliform**	MPN/ 100mL	<2.2	Daily	7-day Median

**Limits equal to Water Quality Objectives, except **TOC, Total Nitrogen, and Total Coliform, which are Title 22 limits*

IV. GENERAL REQUIREMENTS

1. Recycled water shall not be used for direct human consumption or for the processing of food or drink intended for human consumption.

2. Bypass, discharge, or delivery to the use area of inadequately treated recycled water, at any time, are prohibited.

3. The AWPF and all injection wells shall be adequately protected from inundation and damage by storm flows.

4. Recycled water use or disposal shall not result in earth movement in

geologically unstable areas.

5. Odors of sewage origin shall not be perceivable at any time outside the boundary of the Facility.

6. The MRWPCA shall at all times properly operate and maintain all treatment facilities and control systems (and related appurtenances) that are installed or used by the MRWPCA to achieve compliance with the conditions of this order. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls (including appropriate quality assurance procedures).

7. A copy of these requirements shall be maintained at the Facility and available at all times to operating personnel.

8. For any material change or proposed change in character, location, or volume of recycled water or its uses, the MRWPCA shall submit at least 120 days prior to the proposed change an engineering report or addendum to the existing engineering report to the Central Coast Water Board and DDW (pursuant to Water Code Division 7, Chapter 7, Article 4, section 13522.5 and CCR Title 22, Division 4, Chapter 3, Article 7, section 60323) for approval. The engineering report shall be prepared by a qualified engineer registered in California.

9. MRWPCA shall revise the Title 22 Engineering Report to reflect operational choices made and to correct no longer applicable and incorrect information discovered during the permitting process. MRWPCA shall have the revised report approved by DDW and the Water Board prior to commencing groundwater injection discharges to the Seaside Basin.

10. MRWPCA shall comply with the mitigation measures and mitigation monitoring and reporting program described in the final EIR for this project, as described in the findings of this Order. Mitigation measures of concern to and within the jurisdiction of the Central Coast Water Board include BT-1a, BF-1a, BF-1b, BF-1c, BF-2a, alternate BF-2a, and HS-4.

V. PROVISIONS

1. Injection of the advanced treated recycled water shall not cause or contribute to an exceedance of water quality objectives in Seaside Basin groundwater.

2. The MRWPCA shall submit to the Central Coast Water Board, under penalty of perjury and signed by a designated responsible party, self-monitoring reports according to the specifications contained in the MRP, as directed by the Executive Officer.

3. The MRWPCA shall notify the Central Coast Water Board, DDW and all water purveyors drawing potable water from the Seaside Basin (immediately following notification to the Water Board and DDW) by telephone or electronic means as soon as MRWPCA becomes aware, but no later than 24 hours after obtaining knowledge of any violations of this order, or any adverse conditions as a result of the use of recycled water from this facility; written confirmation shall

follow to the Central Coast Water Board and DDW within five working days from date of notification. The report shall include, but not be limited to, the following information, as appropriate:

a. The nature and extent of the violation;

b. The date and time when the violation started, when compliance was achieved, and when injection was suspended and restored, as applicable;

c. The duration of the violation;

d. The cause(s) of the violation;

e. Any corrective and/or remedial actions that have been taken and/or will be taken with a time schedule for implementation to prevent future violations; and,

f. Any impact of the violation.

4. This Order does not exempt the MRWPCA from compliance with any other laws, regulations, or ordinances which may be applicable, it does not legalize the recycling and use facilities, and it leaves unaffected any further constraint on the use of recycled water at certain sites that may be contained in other statutes or required by other agencies.

5. This Order does not alleviate the responsibility of the MRWPCA to obtain other necessary local, state, and federal permits to construct facilities necessary for compliance with this Order, nor does this Order prevent imposition of additional standards, requirements, or conditions by any other regulatory agency.

6. This Order may be modified, revoked and reissued, or terminated for cause, including but not limited to, failure to comply with any condition in this Order; endangerment of human health or environment resulting from the permitted activities in this Order; obtaining this Order by misrepresentation or failure to disclose all relevant facts; or acquisition of new information that could have justified the application of different conditions if known at the time of Order adoption. The filing of a request by the MRWPCA for modification, revocation and reissuance, or termination of the Order or a notification of planned changes or anticipated noncompliance does not stay any condition of this Order.

7. The MRWPCA shall furnish, within a reasonable time, any information the Central Coast Water Board or DDW may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order. The MRWPCA shall also furnish the Central Coast Water Board, upon request, with copies of records required to be kept under this Order for at least three years.

8. In an enforcement action, it shall not be a defense for the MRWPCA that it would have been necessary to halt or to reduce the permitted activity in order to maintain compliance with this Order. Upon reduction, loss, or failure of the treatment facility, the MRWPCA shall, to the extent necessary to maintain

compliance with this Order, control production of all discharges until the facility is restored or an alternative method of treatment is provided. This provision applies, for example, when the primary source of power of the treatment facility fails, is reduced, or is lost.

9. This Order includes the attached *Standard Provisions and Reporting Requirements for Waste Discharge Requirements*. If there is any conflict between the provisions stated in this Order and the Standard Provisions, the provisions stated in this Order shall prevail.

10. This Order includes the attached MRP No. R3-2017-0003. If there is any conflict between provisions stated in the MRP and the Standard Provisions, those provisions stated in the MRP prevail. The MRP may be modified by the Central Coast Water Board's Executive Officer; however, any such modified requirements must still achieve the MRP's primary purpose, which is to detect violations, confirm effective treatment, and to ensure that neither excessive degradation in the aquifer nor adverse impacts to beneficial uses occurs. Excessive degradation is defined as the discharge consuming 10 percent or more of available assimilative capacity.

11. The DDW conditions that are not explicitly included in this Order are incorporated herein by this reference, and are enforceable requirements of this Order. Any violation of a term in this Order that is identical to a DDW condition will constitute a single violation.

VI. STATE WATER RESOURCES CONTROL BOARD DIVISION OF DRINKING WATER (DDW) REQUIREMENTS

1. The Pure Water Monterey Groundwater Replenishment Project (Project) shall comply with Article 5.2 - Indirect Potable Reuse: Groundwater Replenishment-Subsurface Application, sections 60320.200 through 60320.228 of Title 22, California Code of Regulations.
2. The Project's advanced water treatment facility (AWPF) shall conduct startup and commissioning testing that meets the requirement in Title 22 section 60320.201. Advanced Treatment Criteria. A test protocol must be submitted to DDW for approval prior to commencement of testing.
3. The Project AWPF shall be operated to meet the requirements in section 60320.222. Operation Optimization and Plan.
4. As required by Title 22 section 60320.222. (Operation Optimization Plan), prior to operation, MRWPCA shall submit an Operation Optimization Plan for review and approval to DDW and the Central Coast Water Board. At a minimum, the Operation Optimization Plan shall identify and describe the operations, maintenance, analytical methods, monitoring (grab and online) necessary for the Project to meet the requirements and the reporting of monitoring results. MRWPCA must submit a draft of the Operation Optimization Plan prior to completion of construction and commissioning. The draft Operation Optimization Plan can be amended and finalized after the completion of full-scale commissioning and startup testing. A final Operation Optimization Plan must be submitted to DDW 90 days after completion of startup operations.

5. AWPF commissioning shall validate and confirm the actual setpoints for hydrogen peroxide and UV parameters, demonstrating that the advanced oxidation process (AOP) will provide no less than 0.5-log (69 percent) reduction of 1,4-dioxane.
6. MRWPCA shall follow what is described in the approved Operation Optimization Plan.
7. The Project's Operation Optimization Plan shall, at all times, be representative of the current operations, maintenance, and monitoring.
8. The Project's AWPF shall provide continuous real-time monitoring and reporting of UV dose, UV Transmittance, and power used in the AOP.
9. The Project must have alarms as stated in the approved Title 22 Engineering Report. Commissioning shall validate and confirm the actual setpoints and they shall be specified in the Operation Optimization Plan.
10. For reporting, MRWPCA shall submit to DDW a summary of monthly operational parameters for UV dose and hydrogen peroxide for the AWPF.
11. MRWPCA shall verify that the recycled municipal wastewater used for the Project meets the requirements in Title 22 section 60320.206. Wastewater Source Control.
12. Pursuant to Title 22 section 60320.208 (a) Pathogenic Microorganism Control (a), MRWPCA shall operate the Project such that the recycled municipal wastewater used as recharge water receives treatment that achieves at least 12-log enteric virus reduction, 10-log Giardia cyst reduction, and 10-log Cryptosporidium oocyst reduction.
13. If a pathogen reduction in Title 22 section 60320.208 (a) is not met based on the on-going monitoring required pursuant to subsection (c), within 24 hours of being aware, MRWPCA shall immediately investigate the cause and initiate corrective actions. MRWPCA shall immediately notify the DDW and the Central Coast Water Board if the Project fails to meet the pathogen reduction criteria longer than 4 consecutive hours, or more than a total of 8 hours during any 7-day period. Failures of shorter duration shall be reported to the Central Coast Water Board by MRWPCA no later than 10 days after the month in which the failure occurred.
14. Per the approved Title 22 Engineering Report, the initial maximum Recycled Water Contribution (RWC) shall be 1.0, meaning that the Project is approved to use 100% recycled water for recharging the aquifer at the beginning. As long as the Project can demonstrate that it can reliably meet Total Organic Carbon (TOC) requirements, they will be allowed to maintain the RWC of 1.0.
15. The Project contains a multi-barrier treatment facility in order to comply with the Groundwater Replenishment Regulations. The following monitoring (grab and online) and reporting requirements will need to be included in the Operation Optimization Plan and reported to DDW and the Central Coast Water Board monthly.
    a. Membrane integrity testing (MIT) shall be performed on each of the MF membrane units, a minimum of once every 24 hours of operation.

i. The log removal value (LRV) for Cryptosporidium shall be calculated and the value reported after the completion of each MIT.

ii. The MIT shall have a resolution that is responsive to an integrity breach on the order of 3 μm or less.

iii. Calculations of the LRV shall be based on a pressure decay rate (PDR) value with an ending pressure that provides a resolution of 3 μm or less.

iv. The MIT shall have a sensitivity to verify a LRV equal to or greater than 4.0.

b. The Reverse Osmosis (RO) system shall be credited pathogen reduction at this facility in accordance with the amount demonstrated via online monitoring to ensure the integrity of the RO system. MRWPCA must monitor the effluent of each RO train (including each stage) continuously for conductivity at the AWPF. The daily average and maximum conductivity reading, and the percent of time that the reduction of conductivity is less than 1.0 log removal must be reported. The MRWPCA shall calculate the minimum removal achieved at the AWPF. An alternative surrogate may be utilized if approved by the Division of Drinking Water and the Central Coast Water Board.

c. The RO effluent will be monitored for TOC via grab sample weekly and reported in the monthly report. The RO influent and effluent will be monitored for TOC online and reported in the monthly report. The daily average and maximum TOC reading and the percent of time that the TOC is greater than 0.5 mg/L must be reported.

d. In accordance with the Recycled Water Policy, NDMA and sucralose are performance surrogates for RO and shall be analyzed quarterly both prior to the RO and after RO prior to the AOP.

e. The UV/peroxide system shall be operated, as has been designed, to meet the Groundwater Replenishment Regulations, providing a minimum 0.5-log reduction of 1,4- dioxane. AOP commissioning will validate and confirm the actual setpoints for peroxide and UV parameters

f. The UV system must be operated with online monitoring and built-in automatic reliability features that must trigger automatic diversion of effluent to waste by the following critical alarm setpoints.

i. UV dose less than 900 mJ/cm^2, or a new setpoint approved by DDW after the AOP commissioning.

ii. UV transmittance less than 95%

iii. Complete UV reactor failure

iv. Peroxide residual less than 3.0 mg/L, or a new setpoint approved by DDW after the AOP commissioning.

g. On-line monitoring of UV dose, UV intensity, flow, and UV transmittance must be provided at all times. Flow meters, UV intensity sensors, and UV transmittance monitors must be properly calibrated.

h. At least monthly, all duty UV intensity sensors must be checked for calibration against a reference UV intensity sensor.

i. The UV transmittance meter must be inspected and checked against a reference bench-top unit weekly to document accuracy.

j. The monitoring and reliability features, including automatic shutdown capability, shall be demonstrated to DDW during a plant inspection prior to final approval.

k. Based on the calculation of log reduction achieved daily by the entire treatment facility, from the WWTP to the public water supply wells, the MRWPCA will report a "Yes" or "No" for each day as to whether the necessary log reductions (12-logs virus, 10-logs for Giardia and Cryptosporidium) have been achieved. An overall log reduction calculation will be provided only for those days when a portion of the treatment facility does not achieve the necessary log reductions.

16. MRWPCA shall submit the required annual and five-year reports per Title 22, section §60320.228 (Reporting).

17. MRWPCA must submit for approval a draft AOP commissioning and testing protocol, to demonstrate the AOP will provide no less than 0.5-log (69 percent) reduction of 1,4-dioxane.

18. MRWPCA must submit a draft of the Operation Optimization Plan prior to completion of construction and commissioning. This draft Operation Optimization Plan can be amended and finalized after the completion of full-scale commissioning and startup testing. A final Operation Optimization Plan must be submitted to DDW 90 days after completion of startup operations.

19. MRWPCA must submit an addendum to the Title 22 Engineering Report to include information on final well configurations and locations (injection wells, vadose zone wells, and monitoring wells). MRWPCA must conduct a Water Board-approved tracer test, and submit a completed tracer study report to DDW and the Central Coast Water Board.

VII. REOPENER

1. This Order may be reopened to include the most scientifically relevant and appropriate limitations for this discharge, including a revised Basin Plan limit based on monitoring results, anti-degradation studies, or other Central Coast Water Board or State Water Board policy, or the application of an attenuation factor based upon an approved site-specific attenuation study.

2. This Order may be reopened to modify limitations for pollutants to protect beneficial uses, based on new information not available at the time this Order was adopted, including additional monitoring, reporting and trend analysis documenting aquifer conditions.

3. After additional monitoring, reporting, and trend analysis documenting aquifer conditions, this Order may be reopened to ensure the groundwater is protected in a manner consistent with state and federal water quality laws, policies and regulations.

4. This Order may be reopened to incorporate any new regulatory requirements for sources of drinking water or injection of recycled water for groundwater recharge to aquifers that are used as a source of drinking water, that are adopted after the effective date of this Order.

5. This Order may be reopened upon a determination by DDW that treatment and disinfection of the Monterey Regional Water Pollution Control Agency advanced treated product water is not sufficient to protect human health.

VIII. ENFORCEMENT

The requirements of this Order are subject to enforcement under Water Code sections 13261, 13265, 13268, 13350, and enforcement provisions in Water Code, Division 7, Chapter 7 (Water Reclamation).

IX. EFFECTIVE DATE OF THE ORDER

This Order takes effect on March 9, 2017.

I, John M. Robertson, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an order adopted by the Regional Water Quality Control Board, Central Coast Region on March 9, 2017.

John M. Robertson
Executive Officer

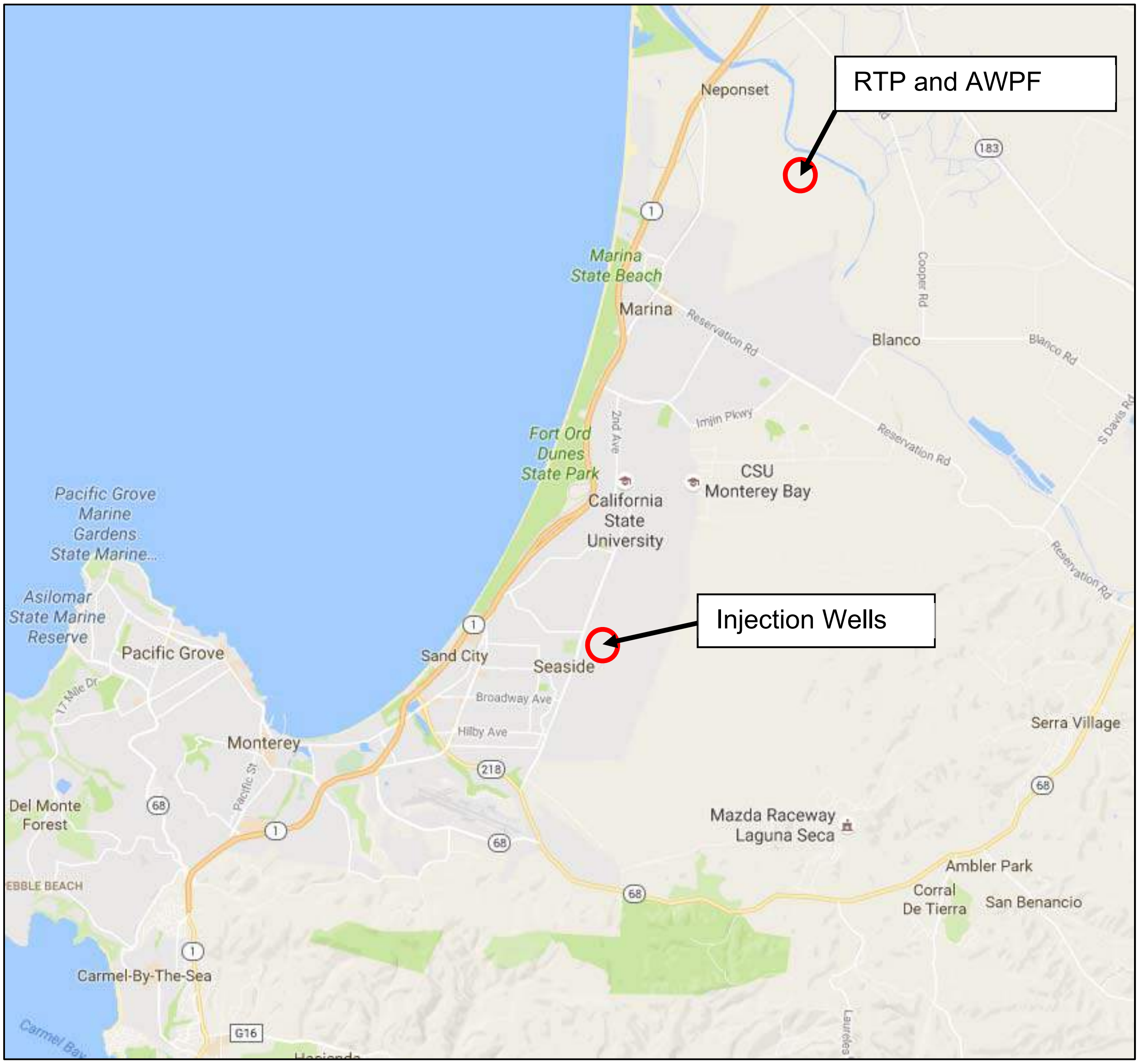

Figure 1 - Location of MRWPCA's RTP, AWPF and Injection Wells

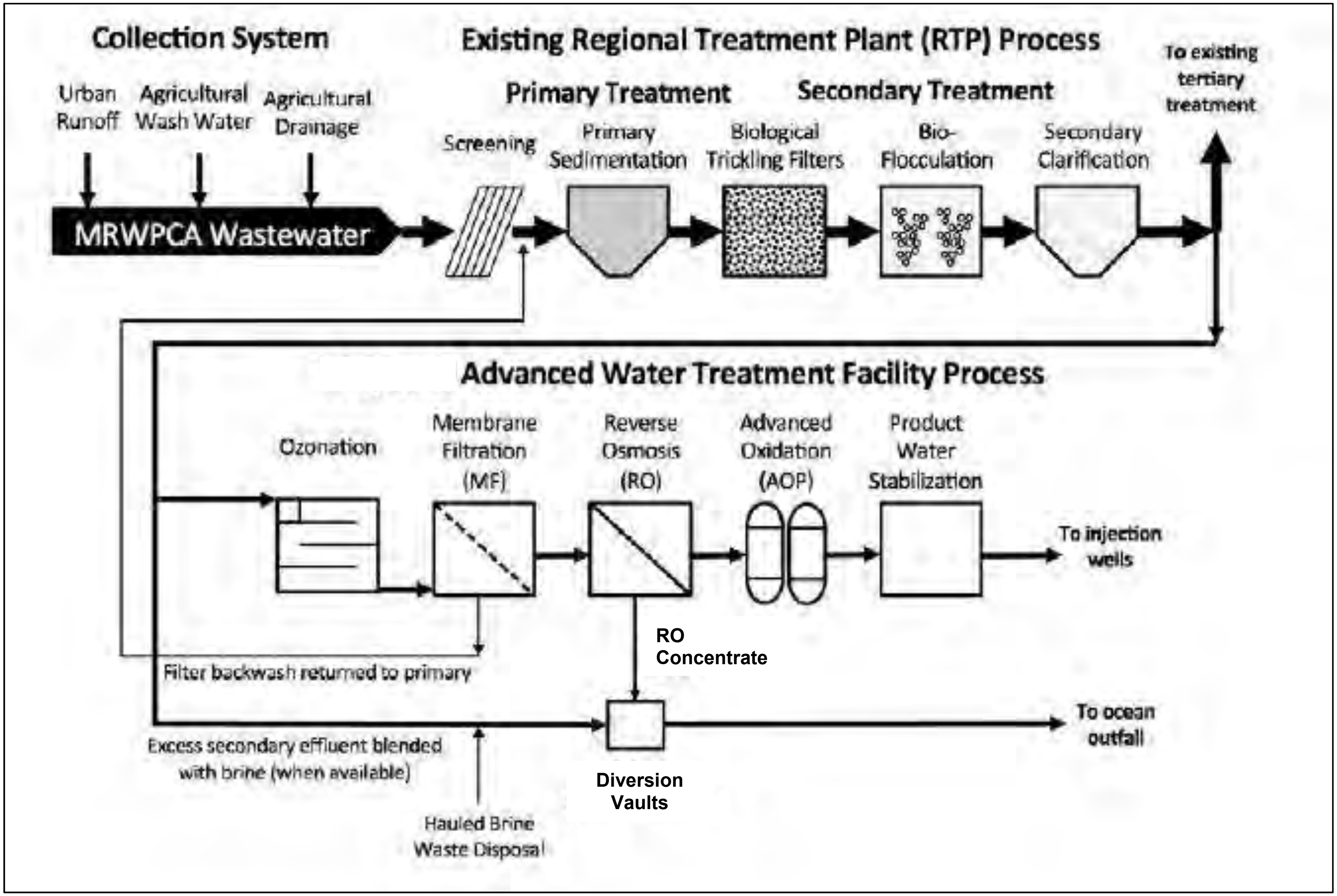

Figure 2 – Simplified Process Flow Diagram of MRWPCA RTP and AWPF

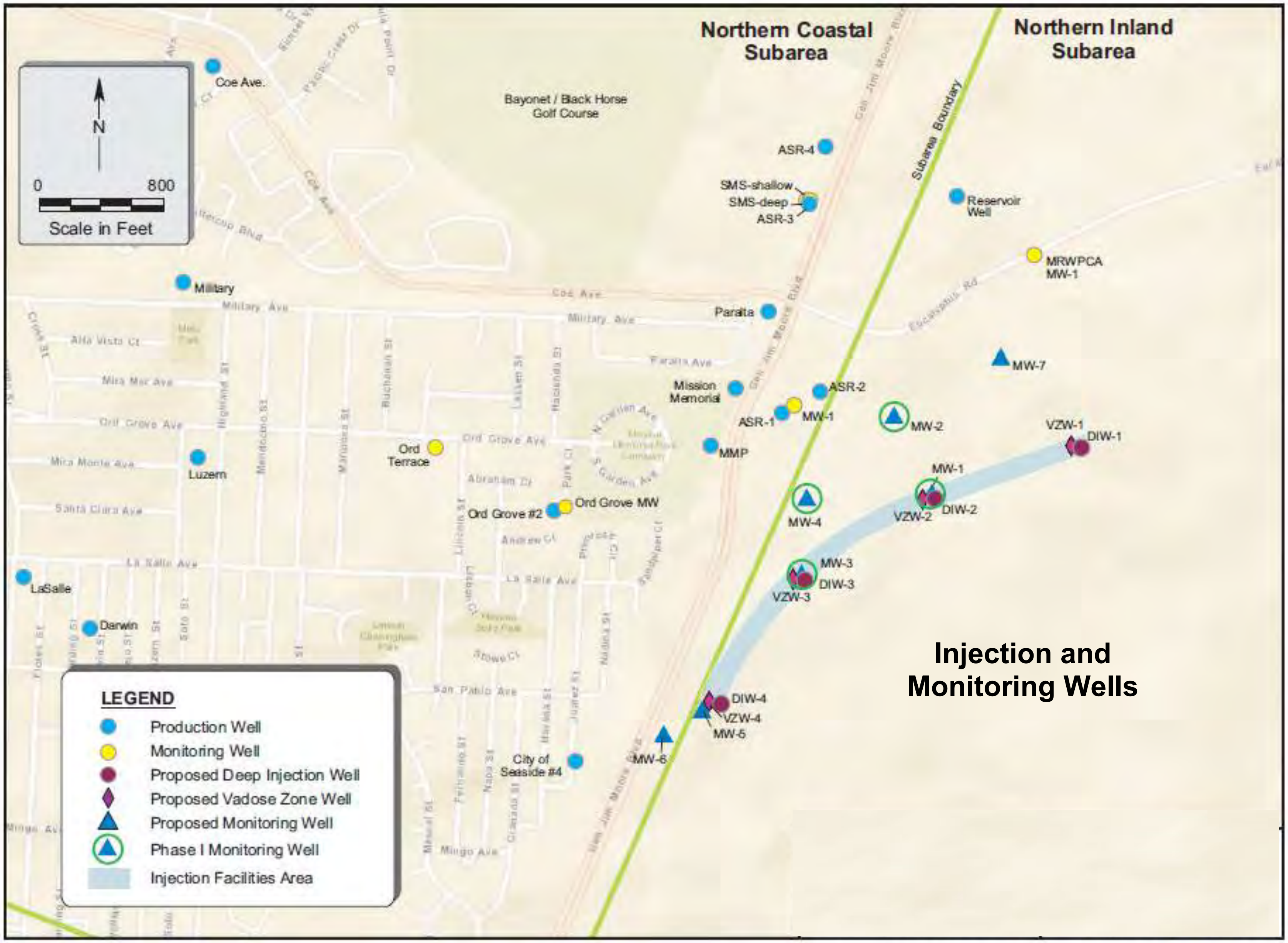

Figure 3- Proposed Injection Wells, Monitoring Wells and Production Wells

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION
MONITORING AND REPORTING PROGRAM
NO. R3-2017-0003

FOR THE

PURE WATER MONTEREY
ADVANCED WATER PURIFICATION FACILITY
AND
GROUNDWATER REPLENISHMENT PROJECT

ISSUED TO

MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY

Table of Contents

THIS MONITORING AND REPORTING PROGRAM IS CURRENTLY BEING AMENDED; THEREFORE, IS NOT INCLUDED IN ITS ENTIRETY.

Appendix B-1

Results of the 2013 - 2014 Source Water Sampling Program for All Constituents Analyzed in the Untreated Source Waters

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
General Water Quality Parameters													
Aggressiveness index	--	SM2330	-	--	12.4 (12-12.4)	4 / 4	11.6 (11.3-12)	3 / 3	13.3 (13.2-14)	4 / 4	13.0 (12.8-13.1)	2 / 2	13.3
Alkalinity (in CaCO3 units)	--	SM 2330B	mg/L	--	316 (277-344)	12 / 12	168 (157-260)	3 / 3	356 (327-373)	4 / 4	185 (157-212)	2 / 2	363
-Bicarbonate alkalinity as HCO3	--	SM 2330B	mg/L	--	384 (338-420)	9 / 9	205 (192-310)	3 / 3	427 (399-455)	4 / 4	226 (192-259)	2 / 2	443
Ammonia as N	--	SM 4500NH3F,G	mg/L	--	32.6 (31.3-39.7)	11 / 11	5.0 (2.4-7.5)	2 / 2	(<0.05-<0.5)	1 / 3	<0.05	0 / 1	<0.5
Anion sum	--	SM 1030E	meq/L	--	14.49 (14.05-15.91)	9 / 9	16 (13.51-16.1)	3 / 3	30.36 (17.46-30.89)	4 / 4	15.18	1 / 1	
BOD, 5-day @ 20°C	--	SM 5210B	mg/L	-	84 (10-160)	12 / 12	483 (56-656)	10 / 10	<2 (<2-5)	4 / 11	14	1 / 1	<2
Bromide	--	EPA 300.0	mg/L	--	<0.2 (<0.1-0.5)	10 / 11	<0.2 (<0.1-4.6)	6 / 9	1.9 (1.2-2.9)	10 / 10	0.6	1 / 1	2.5
Calcium	--	EPA 200.7	mg/L	--	58 (54-62)	12 / 12	81 (76-100)	10 / 10	155 (128-169)	11 / 11	100 (77-122)	2 / 2	166
Cation sum	--	SM 1030E	meq/L	--	14.19 (13-15.28)	9 / 9	18 (15.25-18.01)	3 / 3	28.87 (19.32-30.18)	4 / 4	14.2	1 / 1	
Chemical Oxygen Demand (COD)	--	EPA 410.4/Hach 8000	mg/L	--	110 (33-158)	12 / 12	1004 (250-1152)	10 / 10	48 (<5-163)	9 / 11	92	1 / 1	23
Chloride	sMCL	EPA 300.0	mg/L	250	217 (183-235)	12 / 12	237 (154-292)	9 / 9	274 (241-307)	10 / 10	423 (332-514)	2 / 2	394
Color	sMCL	SM 2120B	units	15	60 (45-75)	4 / 4	170 (150-175)	3 / 3	73 (45-85)	4 / 4	75	1 / 1	175
Conductivity (Specific Conductance)	sMCL	SM 2510B	µS/cm	900	1578 (1508-1623)	12 / 12	1625 (1279-1830)	10 / 10	2861 (2647-2929)	11 / 11	2083 (1607-2559)	2 / 2	2939
Copper	sMCL, EPA PP	EPA 200.8	mg/L	1.3/1.0	<0.0095 (0.009-<0.01)	2 / 4	0.012 (<0.01-0.073)	2 / 3	<0.01 (<0.01-0.013)	2 / 4	<0.009 (0.008-<0.01)	1 / 2	<0.01
Dissolved organic carbon (DOC)		SM 5310C	mg/L	--	14 (12-14)	10 / 10	280 (100-320)	9 / 9	3.2 (2.6-8.2)	10 / 10	11	1 / 1	7.9
Dissolved oxygen (DO)	--	Field/SM4500-O	mg/L	--	7.6 (5.8-10.5)	11 / 11	7.9 (3.9-8.5)	9 / 9	9.5 (6.9-13.3)	10 / 10	10.9	1 / 1	6.8
Foaming Agents (MBAS)	sMCL	SM 5540C	mg/L	0.5	0.17 (0.16-0.18)	2 / 2	0.066 (0.05-0.082)	2 / 3	0.11 (0.07-0.14)	2 / 2		0 / 1	
Iron	sMCL	EPA 200.7	mg/L	0.3	0.339 (0.175-0.537)	12 / 12	0.43 (0.3-0.875)	3 / 3	1.563 (0.639-3.891)	4 / 4	0.355 (0.202-0.508)	2 / 2	2.962
Langelier index (15C)	--	SM 2330B	-	--	0.44 (0.41-0.48)	4 / 4	0.34	1 / 1	1.22 (1.07-1.9)	4 / 4	1.22 (1.06-1.37)	2 / 2	
Magnesium	--	EPA 200.7	mg/L	--	22 (20-24)	12 / 12	34 (28-39)	4 / 4	146 (140-177)	5 / 5	42 (32-52)	2 / 2	159
Manganese	sMCL, NL	EPA 200.8	mg/L	0.5/0.5	0.045 (0.034-0.051)	12 / 12	0.049 (0.039-0.051)	3 / 3	0.243 (0.06-0.449)	4 / 4	0.281 (0.219-0.342)	2 / 2	0.108

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Nitrate (as NO3)	pMCL	EPA 300.0	mg/L	45	21.5 (<1-42)	11 / 12	22.5 (<1.1-28)	9 / 10	292 (70.3-352)	11 / 11	<1	0 / 2	255
Nitrite (as N)	pMCL	EPA 300.0	mg-N/L	1	1.4 (0.4-2.2)	12 / 12	0.6 (<0.1-1.5)	3 / 5	0.3 (0.2-0.8)	6 / 6	<0.1	0 / 2	0.5
Nitrate+Nitrite (sum as N)	pMCL	EPA 300.0	mg-N/L	10	6.5 (2.3-11)	11 / 11	6.2 (<0.1-7.7)	4 / 5	69.6 (63-77.3)	6 / 6	<0.1 (<0.1-0.1)	1 / 2	58
Odor-Threshold	sMCL	SM 2150B	units	3	19 (8-200)	4 / 4	300 (200-350)	3 / 3	7 (2-40)	4 / 4	2	1 / 1	2
Oil and Grease	--	EPA 1664	mg/L	--	<5	0 / 4	<5 (<5-7)	1 / 3	<5	0 / 4	<5	0 / 1	
pH	--	SM 2330B/SM4500H +B	pH	--	7.75 (7.34-8)	12 / 12	6.95 (6.46-7.3)	10 / 10	8.1 (7.7-8.6)	11 / 11	8.3	2 / 2	8
Phosphate (Orthophosphate as P)	--	EPA 300.0	mg/L	--	3.1 (2.2-13)	11 / 11	15.8 (3.1-47.2)	9 / 9	<0.1 (<0.1-0.2)	2 / 10	<0.1	0 / 2	<0.1
Potassium	--	EPA 200.7	mg/L	--	21 (19-23)	12 / 12	36 (32-42)	5 / 5	2.3 (1-2.7)	6 / 6	7.8 (6.2-9.3)	2 / 2	4.9
Settleable Solids	--	SM 2540F	mL/L	--	<0.1 (<0.1-0.2)	2 / 4	0.7 (<0.1-1.75)	2 / 3	<0.1 (<0.1-0.2)	1 / 4	<0.1	0 / 1	<0.1
Silica	--	EPA 200.7	mg/L	--	40.5 (39-44)	12 / 12	44 (41-48)	10 / 10	29 (26-63)	11 / 11	<0.5	0 / 1	30
Silver	sMCL, EPA PP	EPA 200.8	mg/L	0.1	<0.01	0 / 4	<0.01	0 / 3	<0.01	0 / 4	<0.01	0 / 2	<0.01
Sodium	--	EPA 200.7	mg/L	--	161 (144-173)	12 / 12	177 (133-201)	9 / 9	241 (196-266)	10 / 10	235 (174-296)	2 / 2	333
Sulfate	sMCL	EPA 300.0	mg/L	250	89 (83-151)	12 / 12	170 (153-172)	3 / 3	523 (498-530)	4 / 4	157 (127-186)	2 / 2	412
Temperature	--	Field/SM 2550B	°C	--	12.3 (6.1-25.8)	10 / 11	12.9 (7.7-16)	9 / 9	15.5 (9.7-25)	10 / 10	19	1 / 1	18
Total Dissolved Solids (TDS)	sMCL	EPA 160.1/SM 2540C	mg/L	500	793 (771-803)	12 / 12	1282 (797-1591)	10 / 10	2003 (1822-2066)	11 / 11	1226 (946-1506)	2 / 2	1968
Total hardness as CaCO3	--	SM 2340B	mg/L	--	233 (220-250)	10 / 10	358 (318-420)	4 / 4	981 (908-1118)	5 / 5	422 (324-519)	2 / 2	1069
Total Kjehldahl Nitrogen (TKN)	--	EPA 351.2/SM 4500B,C	mg/L	--	37.2 (23.8-42.7)	12 / 12	19.5 (12.5-43.6)	10 / 10	<0.5 (<0.2-8.8)	4 / 11	1.2	1 / 1	<1
Total Nitrogen	--	calculation	mg/L	--	44.2 (26.6-50.5)	12 / 12	25.3 (19-51.1)	5 / 5	70.1 (63-77.3)	6 / 6	1.3	1 / 1	58
Total Organic Carbon (TOC)	--	SM 5310C	mg/L	--	15 (12-17)	12 / 12	295 (66-340)	10 / 10	3 (2.5-11)	11 / 11	14	1 / 1	8.8
Total Phosphorus as P	--	SM 4500-PE/EPA 365.1	mg/L	--	3.9 (3.4-4.3)	4 / 4	45 (6.9-45)	3 / 3	0.36 (0.3-0.66)	4 / 4	0.39	1 / 1	0.82
Dissolved Phosphorus	--	SM 4500-PE/EPA 365.1	mg/L	--	4.1 (3.4-8.6)	4 / 4	17 (6.4-27)	2 / 2	0.27 (0.26-0.47)	3 / 3	0.26	1 / 1	0.65
Total Suspended Solids (TSS)	--	SM 2540D	mg/L	--	<6 (9-<10)	11 / 12	98 (54-140)	10 / 10	48 (16-335)	11 / 11	18	1 / 1	62
Turbidity	sMCL	EPA 180.1	NTU	5	3.2 (1.5-4.8)	12 / 12	51 (28-72)	10 / 10	28 (7.1-150)	11 / 11	15 (12-18)	2 / 2	50

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
UV-254 Absorbance	--	SM 5910	cm^{-1}	--	0.208 (0.189-0.226)	12 / 12	0.278 (0.207-0.488)	3 / 3	0.225 (0.198-0.253)	4 / 4	0.279	1 / 1	0.318
UV Transmittance	--	calculation	%	--	62% (59%-65%)	12 / 12	53% (33%-62%)	3 / 3	60% (56%-63%)	4 / 4	0.526	1 / 1	48.10%
Zinc	sMCL, EPA PP	EPA 200.8	mg/L	5	<0.018 (0.016-<0.05)	1 / 4	0.112 (0.062-0.135)	3 / 3	(<0.01-<0.05)	1 / 4	0.032 (0.022-0.042)	2 / 2	
Microbiological Quality													
Cryptosporidium	--	EPA 1623	oocysts/L	TT	0.39 (<0.10-0.9)	3 / 4	<0.38	0 / 3	<0.19 (<0.18-0.2)	1 / 4	<0.3	0 / 1	<0.09
Giardia	--	EPA 1623	cysts/L	-	<0.1 (<0.1-0.2)	1 / 4	<0.38	0 / 3	<0.18	0 / 4	<0.3	0 / 1	<0.09
Total coliform[1]	pMCL	SM 9223B	MPN/100 mL	TT	$7.3x10^6$ ($1.9x10^5$-$1.6x10^6$)	9 / 11	$7.7x10^6$ ($6.2x10^5$-$9.6x10^7$)	2 / 3	$7.3x10^4$ ($8.4x10^3$-$2.0x10^6$)	4 / 4	$3.5x10^3$	1 / 1	$1.7x10^5$
E. coli[1]	pMCL	SM 9223B	MPN/100 mL	TT	$1.8x10^5$ ($2.9x10^4$-$5.8x10^5$)	11 / 11	<$2x10^1$ ($1.8x10^1$-<$1.0x10^2$)	1 / 3	$2.7x10^2$ ($7.5x10^1$-$2.0x10^3$)	4 / 4	<$1.0x10^2$	0 / 1	$7.5x10^2$
Enterococcus[1]	--	SM 9230B	MPN/100 mL	-	$1.95x10^4$ ($3.7x10^3$-$8.2x10^4$)	4 / 4	<$2x10^1$ ($2.0x10^1$-<$1.0x10^2$)	2 / 3	$1.6x10^2$ ($1.0x10^1$-$2.2x10^2$)	4 / 4	$2.0x10^2$	1 / 1	$8.4x10^1$
DDW Drinking Water Maximum Contaminant Levels (MCLs) - primary MCLs (pMCLs) and secondary MCLs (sMCLs)													
MCLs -- Inorganics													
Aluminum	pMCL, sMCL, EPA CCL	EPA 200.8	mg/L	1/0.2	0.048 (0.021-0.256)	10 / 11	0.237 (0.14-0.598)	3 / 3	0.77 (0.26-2.04)	4 / 4	0.296 (0.189-0.402)	2 / 2	1.54
Antimony	pMCL, EPA PP	EPA 200.8	mg/L	0.006	<0.001	0 / 4	<0.001	0 / 3	<0.001	0 / 4	<0.001 (<0.001-0.001)	1 / 2	0.001
Arsenic	pMCL, EPA PP	EPA 200.8	mg/L	0.01	0.0025 (0.002-0.0041)	4 / 4	0.0039 (0.003-0.004)	3 / 3	0.0075 (0.007-0.0085)	4 / 4	0.004	2 / 2	0.011
Asbestos	pMCL, EPA PP	EPA 100.2	MFL	7	<6.4 (<4.02-<6.8)	0 / 4	<6.4 (<4.02-<6.8)	0 / 3	<6.4 (<4.02-<6.8)	0 / 4	1	1 / 1	<6.7
Barium	pMCL	EPA 200.8	mg/L	1	0.012 (0.011-0.026)	4 / 4	0.096 (0.082-0.109)	3 / 3	0.068 (0.054-0.079)	4 / 4	0.086 (0.065-0.107)	2 / 2	0.119
Beryllium	pMCL, EPA PP	EPA 200.8	mg/L	0.004	<0.001	0 / 4	<0.001	0 / 3	<0.001	0 / 4	<0.001	0 / 2	<0.001
Cadmium	pMCL, EPA PP	EPA 200.8	mg/L	0.005	<0.0005	0 / 4	<0.0005 (<0.0005-0.002)	1 / 3	<0.0005	0 / 4	<0.0005 (<0.0005-0.0005)	1 / 2	<0.0005
Chromium	pMCL, EPA PP, UCMR 3	EPA 200.8	mg/L	0.05	0.0016 (0.00092-0.003)	4 / 4	0.009 (0.0049-0.01)	3 / 3	0.0046 (0.0017-0.019)	4 / 4	0.0025 (0.002-0.003)	2 / 2	0.019
Cyanide	pMCL, EPA PP	SM 4500CN-F	mg/L	0.15	0.049 (0.006-0.13)	4 / 4	0.075 (0.011-0.089)	3 / 3	<0.005 (<0.005-0.127)	1 / 4	<0.005	0 / 1	<0.005
Fluoride	pMCL	SM 4500F-C/EPA 300.0	mg/L	2	0.6 (0.4-0.8)	4 / 4	0.3 (<0.1-31.9)	2 / 3	0.7 (0.66-0.9)	4 / 4	0.3	2 / 2	0.7

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Mercury	pMCL, EPA PP	EPA 245.1	mg/L	0.002	<0.0002	0 / 4	<0.0002	0 / 3	<0.0002	0 / 4	<0.0002	0 / 2	<0.0002
Nickel	pMCL, EPA PP	EPA 200.8	mg/L	0.1	<0.01	0 / 4	<0.01 (<0.01-**0.01**)	1 / 3	**0.025** **(0.02-0.038)**	4 / 4	<0.0085 (**0.007**-<0.01)	1 / 2	**0.034**
Perchlorate	pMCL, UCMR 1	EPA 314	mg/L	0.006	<0.002	0 / 4	<0.002	0 / 3	<0.002	0 / 4	<0.002	0 / 1	<0.002
Selenium	pMCL, EPA PP	EPA 200.8	mg/L	0.05	**0.0025** (**0.002**-<0.005)	3 / 4	<0.005 (<0.005-**0.005**)	2 / 3	**0.013** **(0.0092-0.018)**	4 / 4	**0.0055** **(0.005-0.006)**	2 / 2	**0.015**
Thallium	pMCL, EPA PP	EPA 200.8	mg/L	0.002	<0.001	0 / 4	<0.001	0 / 3	<0.001 (<0.001-**0.001**)	1 / 4	<0.001	0 / 2	<0.001
MCLs - Volatile Organic Chemicals (VOCs)													
1,1-Dichloroethane	pMCL, EPA PP, UCMR 3	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,1-Dichloroethylene	pMCL, EPA PP	EPA 524.2	µg/L	6	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,1,1-Trichloroethane	pMCL, EPA PP	EPA 524.2	µg/L	200	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	pMCL	EPA 524.2	µg/L	1,200	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,1,2-Trichloroethane	pMCL, EPA PP	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,1,2,2-Tetrachloroethane	pMCL, EPA PP	EPA 524.2	µg/L	1	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,2-Dichlorobenzene	pMCL, EPA PP	EPA 524.2	µg/L	600	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,2-Dichloroethane	pMCL, EPA PP	EPA 524.2	µg/L	0.5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,2-Dichloropropane	pMCL, EPA PP	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,2,4-Trichlorobenzene	pMCL, EPA PP	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,3-Dichloropropene	pMCL, PoLI, EPA PP	EPA 524.2	µg/L	0.5	<0.5	0 / 4	<0.5 (<0.5-**0.7**)	1 / 3	<0.5 (<0.5-**0.62**)	1 / 4	<0.5	0 / 1	<0.5
1,4-Dichlorobenzene	pMCL, EPA PP	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Benzene	pMCL, EPA PP	EPA 524.2	µg/L	1	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Carbon Tetrachloride	pMCL, EPA PP	EPA 524.2	µg/L	0.5	<0.5	0 / 4	<0.5 (<0.5-**0.52**)	1 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
cis-1,2-Dichloroethylene	pMCL	EPA 524.2	µg/L	6	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Dichloromethane	pMCL, EPA PP	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5 (<0.5-**0.94**)	1 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Ethylbenzene	pMCL, EPA PP	EPA 524.2	µg/L	300	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Methyl-tert-butyl ether (MTBE)	pMCL, sMCL, UCMR 1	EPA 524.2	µg/L	13	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5

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					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Monochlorobenzene	pMCL	EPA 524.2	µg/L	70	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Styrene	pMCL	EPA 524.2	µg/L	100	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Tetrachloroethylene	pMCL, EPA PP	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Toluene	pMCL, EPA PP	EPA 524.2	µg/L	150	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
trans-1,2-Dichloroethylene	pMCL	EPA 524.2	µg/L	10	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Trichloroethylene	pMCL, EPA PP	EPA 524.2	µg/L	5	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Trichlorofluoromethane	pMCL	EPA 524.2	µg/L	150	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Vinyl Chloride	pMCL, EPA PP	EPA 524.2	µg/L	0.5	<0.3	0 / 4	<0.3	0 / 3	<0.3	0 / 4	<0.3	0 / 1	<0.3
Xylenes	pMCL	EPA 524.2	µg/L	1,750	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
MCLs - Non-Volatile Synthetic Organic Chemicals (SOCs)													
2,4-D	pMCL	EPA 515.4	µg/L	70	**0.29 (<0.1-0.78)**	2 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Alachlor	pMCL, UCMR 2	EPA 505	µg/L	2	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.05
Atrazine	pMCL	EPA 525.2	µg/L	1	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Bentazon	pMCL	EPA 515.4	µg/L	18	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Benzo(a)pyrene	pMCL, EPA PP	EPA 525.2	µg/L	0.2	<0.02	0 / 4	<0.02	0 / 3	<0.02	0 / 4	<0.02	0 / 1	<0.02
Carbofuran	pMCL	EPA 531.2	µg/L	18	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chlordane	pMCL, EPA PP	EPA 505	µg/L	0.1	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.1
Chlordane	pMCL, EPA PP	EPA 608	µg/L	0.1			<0.05	0 / 1	<0.05	0 / 1	<0.05	0 / 1	<0.05
Dalapon	pMCL	EPA 515.4	µg/L	200	<1	0 / 4	<1	0 / 3	<1	0 / 4	<1	0 / 1	<1
Di(2-ethylhexyl)adipate	pMCL	EPA 525.2	µg/L	400	<0.6	0 / 4	<0.6 (<0.6-**0.95**)	1 / 3	<0.6	0 / 4	<0.6	0 / 1	<0.6
Di(2-ethylhexyl)phthalate	pMCL, EPA PP	EPA 525.2	µg/L	4	**1.5 (1-78)**	4 / 4	**3.2 (<0.6-5.9)**	2 / 3	<0.6	0 / 4	<0.6	0 / 1	**78**
Di(2-ethylhexyl)phthalate	pMCL, EPA PP	EPA 8720C	µg/L	4	<4	0 / 4	**10 (<4-16)**	2 / 3	<4	0 / 4	<4	0 / 1	<4
Dibromochloropropane	pMCL	EPA 551.1	µg/L	0.2	<0.01	0 / 4	<0.01	0 / 3	<0.01	0 / 4	<0.01	0 / 1	<0.01
Dinoseb	pMCL	EPA 515.4	µg/L	7	<0.2	0 / 4	<0.2	0 / 3	<0.2	0 / 4	<0.2	0 / 1	<0.2
Diquat	pMCL, PoLI	EPA 549.2	µg/L	20	<0.4	0 / 4	<0.4	0 / 3	<0.4	0 / 4	<0.4	0 / 1	<0.4

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Endothall	pMCL	EPA 548.1	µg/L	100	*<20*	**0 / 4**	*<20*	**0 / 3**	*<20*	**0 / 4**	*<20*	**0 / 1**	*<20*
Endrin	pMCL	EPA 505	µg/L	2	*<0.01*	**0 / 4**	*<0.01*	**0 / 3**	*<0.01*	**0 / 9**	*<0.01*	**0 / 1**	*<0.01*
Ethylene Dibromide	pMCL	EPA 551.1	µg/L	0.05	*<0.01*	**0 / 4**	*<0.01*	**0 / 3**	*<0.01*	**0 / 4**	*<0.01*	**0 / 1**	*<0.01*
Glyphosate	pMCL, PoLI	EPA 547	µg/L	700	*<6*	**0 / 4**	*<6*	**0 / 3**	**7.5** (*<6*-**9.2)**	**2 / 4**	*<6*	**0 / 1**	*<6*
Heptachlor	pMCL, EPA PP	EPA 505	µg/L	0.01	*<0.01*	**0 / 4**	*<0.01*	**0 / 3**	*<0.01*	**0 / 9**	*<0.01*	**0 / 1**	*<0.01*
Heptachlor Epoxide	pMCL, EPA PP	EPA 505	µg/L	0.01	*<0.01*	**0 / 4**	*<0.01*	**0 / 3**	*<0.01*	**0 / 9**	*<0.01*	**0 / 1**	*<0.01*
Hexachlorobenzene	pMCL	EPA 525.2	µg/L	1	*<0.05*	**0 / 4**	*<0.05*	**0 / 3**	*<0.05*	**0 / 4**	*<0.05*	**0 / 1**	*<0.05*
Hexachlorocyclopentadiene	pMCL	EPA 525.2	µg/L	50	*<0.05*	**0 / 4**	*<0.05*	**0 / 3**	*<0.05*	**0 / 4**	*<0.05*	**0 / 1**	*<0.05*
Lindane	pMCL, PoLI	EPA 505	µg/L	0.2	*<0.01*	**0 / 4**	*<0.01*	**0 / 3**	*<0.01*	**0 / 9**	*<0.01*	**0 / 1**	*<0.01*
Methoxychlor	pMCL	EPA 505	µg/L	30	*<0.05*	**0 / 4**	*<0.05*	**0 / 3**	*<0.05*	**0 / 9**	*<0.05*	**0 / 1**	*<0.05*
Methoxychlor	pMCL	EPA 608	µg/L	30			*<0.01*	**0 / 1**	*<0.01*	**0 / 1**	*<0.01*	**0 / 1**	*<0.01*
Molinate	pMCL, UCMR 1	EPA 525.2	µg/L	20	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Oxamyl	pMCL, PoLI	EPA 531.2	µg/L	50	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5* (*<0.5*-**2.4**)	**1 / 4**	*<0.5*	**0 / 1**	*<0.5*
Pentachlorophenol	pMCL, EPA PP	EPA 515.4	µg/L	1	*<0.04*	**0 / 4**	*<0.04*	**0 / 3**	*<0.04* (*<0.04*-**0.06**)	**1 / 4**	**0.06**	**1 / 1**	*<0.04*
Picloram	pMCL	EPA 515.4	µg/L	500	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Polychlorinated Biphenyls	pMCL	EPA 505	µg/L	0.5	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 7**	*<0.1*	**0 / 1**	*<0.1*
Simazine	pMCL, PoLI	EPA 525.2	µg/L	4	*<0.05*	**0 / 4**	*<0.05*	**0 / 3**	*<0.05*	**0 / 4**	*<0.05*	**0 / 1**	*<0.05*
Thiobencarb	pMCL, sMCL, PoLI	EPA 525.2	µg/L	70	*<0.2*	**0 / 4**	*<0.2*	**0 / 3**	*<0.2*	**0 / 4**	*<0.2*	**0 / 1**	*<0.2*
Toxaphene	pMCL, EPA PP	EPA 505	µg/L	3	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 8**	*<0.5*	**0 / 1**	*<0.5*
2,3,7,8-TCDD (Dioxin)	pMCL, EPA PP	EPA 1613	µg/L	3.00E-05	*<2.1E-06*	**0 / 4**	*<1.90E-06*	**0 / 3**	*<1.9E-06*	**0 / 4**	*<1.9E-06*	**0 / 1**	*<1.9E-06*
2,4,5-TP (Silvex)	pMCL	EPA 515.4	µg/L	50	*<0.2*	**0 / 4**	*<0.2*	**0 / 3**	*<0.2*	**0 / 4**	*<0.2*	**0 / 1**	*<0.2*
MCLs - Radionuclides													
Gross Alpha Particle (excluding radon and uranium)	pMCL	EPA 900.0	pCi/L	15	*<2.02±0.95* (*<1.35±0.828*-**4.55±2.07)**	**1 / 4**	**2.4±1.3** **(***<2.07±1.27*-**6.32±2.64)**	**2 / 3**	**8.9±2.21 (4.47±2.21-9.62±2.47)**	**4 / 4**	**2.15±1.33**	**1 / 1**	**1.81±5.89**
Gross Beta			pCi/L	4 mrem/yr	**15±4.5 (14.9±1.59-16±2.45)**	**4 / 4**	**21±2.3 (17.6±2.09-25±2.41)**	**2 / 2**	**3.8±3.0** (*<3±3.7*-**4.68±2.29)**	**1 / 2**	**15.2±2.05**	**1 / 1**	*<6.110±3.66*

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Radium-226	pMCL	EPA 903.1	pCi/L	5 (Combined)	<0.906±0.364 (**0.318±0.38**-<0.94±0.552)	1 / 4	(<0.764±0.479-<0.827±0.487)	0 / 3	(<0.51±0.374-<0.923±0.398)	0 / 4	<0.784±0.549	0 / 1	<0.602±0.311
Radium-228	pMCL	EPA 904.0	pCi/L		(<0.82±0.388-<0.971±0.484)	0 / 4	<0.95±0.403 (<0.671±0.333-**0.95±0.504**)	1 / 3	(<0.609±0.266-<0.976±0.439)	0 / 4	<0.814±0.394	0 / 1	<0.991±0.452
Strontium-90	pMCL	EPA 905.0	pCi/L	8	(<0.38±0.204-<1.44±0.569)	0 / 4	(<0.545±0.29-<1.26±0.584)	0 / 3	(<0.756±0348-<1.7±0.872)	0 / 4	<0.571±0.225	0 / 1	<0.738±0.409
Tritium	pMCL	EPA 906.0	pCi/L	20,000	(<193±112-<222±127)	0 / 4	(<204±107-<215±118)	0 / 3	(<213±115-<217±129)	0 / 4	<230±126	0 / 1	<225±124
Uranium	pMCL	EPA 900.0	pCi/L	20	**2.15 (1.9-2.4)**	4 / 4	**5.7 (3.2-6.7)**	3 / 3	**12.5 (11-13)**	4 / 4	**1.4**	1 / 1	**10**
MCLs - Disinfection By-Products (DBPs)													
Bromate	pMCL	EPA 317	µg/L	10	<1	0 / 4	<1	0 / 3	<1	0 / 4	<1	0 / 1	<1
Chlorite	pMCL	EPA 300.1	µg/L	1,000	<10	0 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Total Haloacetic acids (HAAs)	pMCL	SM6251B	µg/L	60	**3.7 (2.4-4.4)**	4 / 4	**200 (62-390)**	3 / 3	<2	0 / 4	<2	0 / 1	**2.6**
Total trihalomethanes (TTHM)	pMCL	EPA 551.1	µg/L	80	<0.5 (<0.5-**0.82**)	1 / 4	**63 (2.6-160)**	3 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
DDW Drinking Water Notification Levels													
Boron	NL	EPA 200.7	µg/L	1,000	**300 (290-350)**	4 / 4	**210 (190-290)**	3 / 3	**670 (590-700)**	4 / 4	**180 (110-240)**	2 / 2	**510**
n-Butylbenzene	NL	EPA 524.2	µg/L	260	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
sec-Butylbenzene	NL, EPA CCL	EPA 524.2	µg/L	260	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
tert-Butylbenzene	NL	EPA 524.2	µg/L	260	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Carbon disulfide	NL	EPA 524.2	µg/L	160	<0.5	0 / 4	<0.5 (<0.5-**0.67**)	1 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chlorate	NL, UCMR 3	EPA 300.1	µg/L	800	<20	0 / 4	<20 (<20-**420**)	1 / 3	<20	0 / 4	**3.9**	1 / 1	<20
2-Chlorotoluene	NL	EPA 524.2	µg/L	140	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.4	0 / 1	<0.5
4-Chlorotoluene	NL	EPA 524.2	µg/L	140	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Diazinon	NL, UCMR 1, PoLI	EPA 525.2	µg/L	1.2	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 11	<0.1	0 / 1	<0.1
Dichlorodifluoromethane (Freon 12)	NL	EPA 524.2	µg/L	1,000	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
1,4-Dioxane	NL, UCMR 3	EPA 522	µg/L	1	<1 (<1-**1.2**)	4 / 11	<1	0 / 10	<1	0 / 11	<1	0 / 1	<1
Ethylene glycol	NL	EPA 8270C	µg/L	14,000	<40	0 / 4	<40	0 / 3	<40	0 / 4	<40	0 / 1	<40

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Formaldehyde	NL, EPA CCL	EPA 556	µg/L	100	**11 (9.7-13)**	**4 / 4**	**70 (6.9-120)**	**3 / 3**	*<5* (*<5*-**6.3)**	**1 / 4**	**5.3**	**1 / 1**	*<5*
HMX (or Octogen)	NL	LC-MS-MS	µg/L	350	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Isopropylbenzene	NL	EPA 524.2	µg/L	770	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
Methyl isobutyl ketone (MIBK)	NL	EPA 524.2	µg/L	120	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Naphthalene	NL	EPA 524.2	µg/L	17	*<0.3*	**0 / 4**	*<0.3*	**0 / 3**	*<0.3*	**0 / 4**	*<0.3*	**0 / 1**	*<0.3*
N-Nitrosodiethyamine (NDEA)	NL, UCMR 2	EPA 521	ng/L	10	**2.1** (*<2*-**3.7)**	**2 / 4**	*<2* (*<2*-**3.2)**	**1 / 3**	*<2*	**0 / 4**	*<2*	**0 / 1**	*<2*
N-Nitrosodimethylamine (NDMA)	NL, EPA PP, UCMR 2	EPA 521	ng/L	10	**5.1 (2.0-16)**	**11 / 11**	**10** (*<2*-**340)**	**7 / 10**	*<2* (*<2*-**2.4)**	**1 / 11**	*<2*	**0 / 1**	*<2*
N-Nitrosodi-n-propylamine (NDPA)	NL, EPA PP, UCMR 2	EPA 521	ng/L	10	*<2* (*<2*-**6.9)**	**1 / 4**	*<2*	**0 / 3**	*<2*	**0 / 4**	*<2*	**0 / 1**	*<2*
Propachlor	NL	EPA 525.2	µg/L	90	*<0.05*	**0 / 4**	*<0.05*	**0 / 3**	*<0.05*	**0 / 4**	*<0.05*	**0 / 1**	*<0.05*
n-Propylbenzene	NL	EPA 524.2	µg/L	260	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	NL, UCMR 1&2	LC-MS-MS	µg/L	0.3	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Tertiary butyl alcohol (TBA)	NL	EPA 524.2m	µg/L	12	**2.9 (2.6-3.3)**	**4 / 4**	*<2* (*<2*-**3)**	**1 / 3**	*<2* (*<2*-**2)**	**1 / 4**	*<2*	**0 / 1**	*<2*
1,2,3-Trichloropropane (1,2,3-TCP)	NL	EPA 524.2m	µg/L	0.005	*<0.005*	**0 / 4**	*<0.005*	**0 / 3**	*<0.005*	**0 / 4**	*<0.005*	**0 / 1**	*<0.005*
1,2,4-Trimethylbenzene	NL, EPA PP	EPA 524.2	µg/L	330	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
1,3,5-Trimethylbenzene	NL	EPA 524.2	µg/L	330	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
2,4,6-Trinitrotoluene (TNT)	NL, UCMR 2	LC-MS-MS	µg/L	1	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Vanadium	NL, UCMR 3	EPA 200.8	µg/L	50	**4 (3.4-9.8)**	**4 / 4**	**16 (13-18)**	**3 / 3**	**16 (13-30)**	**4 / 4**	**3.3**	**1 / 1**	**21**
DDW Drinking Water Archived Advisory Levels													
3-Hydroxycarbofuran	EPA CCL 3	EPA 531.2	µg/L	--	**1.5 (1.4-2.1)**	**4 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
Aldicarb	aNL	EPA 531.2	µg/L	7	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
Aldrin	aNL	EPA 505	µg/L	0.002	*<0.01*	**0 / 4**	*<0.01*	**0 / 3**	*<0.01*	**0 / 8**	*<0.01*	**0 / 1**	*<0.01*
Baygon	aNL	EPA 531.2	µg/L	30	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 5**	*<0.5*	**0 / 1**	*<0.5*
alpha-BHC	aNL	EPA 8081A	µg/L	0.015	*<0.05*	**0 / 4**	*<0.05*	**0 / 3**	*<0.05*	**0 / 4**	*<0.05*	**0 / 1**	*<0.05*
alpha-BHC	aNL	EPA 608	µg/L	0.015			*<0.01*	**0 / 1**	*<0.01*	**0 / 1**	*<0.01*	**0 / 1**	*<0.01*
beta-BHC	aNL	EPA 8081A	µg/L	0.025	*<0.05*	**0 / 4**	*<0.05*	**0 / 3**	*<0.05*	**0 / 4**	*<0.05*	**0 / 1**	*<0.05*

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
beta-BHC	aNL	EPA 608	µg/L	0.025			*<0.005*	**0 / 1**	*<0.005*	**0 / 1**	*<0.005*	**0 / 1**	*<0.005*
Captan	aNL, EPA CCL, PoLI	EPA 8081/8082	µg/L	15	*<0.05*	**0 / 3**	*<0.05*	**0 / 2**	*<0.05*	**0 / 4**	*<0.05*	**0 / 1**	*<0.05*
Carbaryl	aNL, PoLI	EPA 531.2	µg/L	700	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
Chloropicrin	aNL, PoLI	EPA 551.1	µg/L	50	*<0.5*	**0 / 4**	*<0.5* (*<0.5*-**0.51)**	**1 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
Chloropropham (CIPC)	aNL	EPA 8321	µg/L	1,200	*<2*	**0 / 4**	*<2*	**0 / 3**	*<2*	**0 / 4**	*<2*	**0 / 1**	*<2*
1,3-Dichlorobenzene	aNL	EPA 8270C	µg/L	600	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Dieldrin	aNL, EPA PP	EPA 525.2	ng/L	2	*<200*	**0 / 4**	*<200*	**0 / 3**	*<200*	**0 / 11**	*<200*	**0 / 1**	*<200*
Dieldrin	EPA PP, aNL	EPA 505	ng/L	2	*<10*	**0 / 4**	*<10*	**0 / 3**	**17 (**<10**-28)**	**8 / 9**	*<10*	**0 / 1**	*<10*
Dieldrin	aNL, EPA PP	EPA 8081/8082	ng/L	2	*<50*	**0 / 4**	*<50*	**0 / 3**	*<50*	**0 / 4**	*<50*	**0 / 1**	*<50*
Dieldrin	aNL, EPA PP	EPA 608	ng/L	2			*<10*	**0 / 1**	**31**	**1 / 1**	*<10*	**0 / 1**	*<10*
Dimethoate	aNL, UCMR 2, PoLI	EPA 525.2	µg/L	1	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
2,4-Dimethylphenol	aNL, EPA PP	EPA 8270C	µg/L	100	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Diphenamide	aNL	EPA 8141	µg/L	200	*<0.1*	**0 / 3**	*<0.1*	**0 / 2**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Ethion	aNL	EPA 8141	µg/L	4	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Malathion	aNL, PoLI	EPA 525.2	µg/L	160	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1* (*<0.1*-**0.14)**	**1 / 4**	*<0.1*	**0 / 1**	*<0.1*
Methylisothiocyanate	aNL	EPA 131	µg/L	190	*<1* (*<1*-**7.4)**	**1 / 4**	*<1*	**0 / 3**	*<1*	**0 / 4**	*<1*	**0 / 1**	*<1*
Methyl parathion	aNL	EPA 8141	µg/L	2	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Parathion	aNL	EPA 525.2	µg/L	40	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Pentachloronitrobenzene	aNL	EPA 8270C	µg/L	20	*<10*	**0 / 4**	*<10*	**0 / 3**	*<10*	**0 / 4**	*<10*	**0 / 1**	*<10*
Phenol	aNL, EPA PP	EPA 8270C	µg/L	4,200	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<1*	**0 / 1**	*<5*
2,3,5,6-Tetrachloroterephthalate (DCPA)	aNL	EPA 515.4	µg/L	3,500	**0.56 (0.52-0.66)**	**4 / 4**	*<0.1* (*<0.1*-**0.16)**	**1 / 3**	**38 (36-40)**	**4 / 4**	*<0.1*	**0 / 1**	**17**
Trithion	aNL	EPA 8081/8082	µg/L	7	*<0.05*	**0 / 2**	*<0.05*	**0 / 2**	*<0.05*	**0 / 3**	*<0.05*	**0 / 1**	
EPA Unregulated Contaminant Monitoring Rule (UCMR) Lists 1 through 3													
1,1-Dichloroethane	UCMR 3	EPA 524.3	µg/L	--	*<0.03*	**0 / 4**	*<0.03*	**0 / 3**	*<0.03*	**0 / 4**	*<0.03*	**0 / 1**	*<0.03*
1,2,3-Trichloropropane (1,2,3-TCP)	UCMR 3	EPA 524.3	µg/L	--	*<0.03*	**0 / 4**	*<0.03*	**0 / 3**	*<0.03*	**0 / 4**	*<0.03*	**0 / 1**	*<0.03*

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
1,3-Butadiene	UCMR 3	EPA 524.3	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
1,3-Dinitrobenzene	UCMR 2	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
2,2',4,4'-tetrabromodiphenyl ether (BDE-47)	UCMR 2	EPA 527	µg/L	--	<0.3	0 / 4	<0.3	0 / 3	<0.3	0 / 4	<0.3	0 / 1	<0.3
2,2',4,4',5-pentabromodiphenyl ether (BDE-99)	UCMR 2	EPA 527	µg/L	--	<0.9	0 / 4	<0.9	0 / 3	<0.9	0 / 4	<0.9	0 / 1	<0.9
2,2',4,4',5,5'-hexabromobiphenyl (HBB)	UCMR 2	EPA 527	µg/L	--	<0.7	0 / 4	<0.7	0 / 3	<0.7	0 / 4	<0.7	0 / 1	<0.7
2,2',4,4',5,5'-hexabromodiphenyl ether (BDE-153)	UCMR 2	EPA 527	µg/L	--	<0.8	0 / 4	<0.8	0 / 3	<0.8	0 / 4	<0.8	0 / 1	<0.8
2,2',4,4',6-pentabromodiphenyl ether (BDE-100)	UCMR 2	EPA 527	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
2-methyl-Phenol (o-cresol)	UCMR 1	EPA 8270C	µg/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<1	0 / 1	<5
4-androstene-3,17-dione	CECs	EPA 539	µg/L	--	**0.0040 (0.002-0.0047)**	4 / 4	**0.00062 (<0.0003-0.0011)**	2 / 3	<0.0003 (<0.0003-0.00044)	1 / 4	<0.0003	0 / 1	<0.0003
Acetochlor	UCMR 1&2	EPA 525.2	µg/L	--	<0.01	0 / 4	<0.01	0 / 3	<0.01	0 / 4	<0.1	0 / 1	<0.1
Acetochlor ethanesulfonic acid (ESA)	UCMR 2	EPA 535	µg/L	--	<1	0 / 4	<1	0 / 3	<1	0 / 4	<1	0 / 1	<1
Acetochlor oxanilic acid (OA)	UCMR 2	EPA 535	µg/L	--	<2	0 / 4	<2	0 / 3	<2	0 / 4	<2	0 / 1	<2
Alachlor ethanesulfonic acid (ESA)	UCMR 1&2	EPA 535	µg/L	--	<1	0 / 4	<1	0 / 3	<1	0 / 4	<1	0 / 1	<1
Alachlor oxanilic acid (OA)	UCMR 2	EPA 535	µg/L	--	<2	0 / 4	<2	0 / 3	<2	0 / 4	<2	0 / 1	<2
Chromium-6	UCMR 3	EPA 218.6	µg/L	--	<0.02	0 / 4	**3.8 (<0.02-4.9)**	2 / 3	**0.53 (0.36-1.1)**	4 / 4	**0.082**	1 / 1	**0.72**
Cobalt	UCMR 3	EPA 200.8	µg/L	--	<1	0 / 4	<1 (<1-**2.1**)	1 / 3	**1.6 (1.3-3.8)**	4 / 4	<1	0 / 1	<1
DCPA mono and di-acid degradate	UCMR 1	EPA 515.4	µg/L	--	**0.56 (0.52-0.66)**	4 / 4	<0.1 (<0.1-**0.16**)	1 / 3	**38 (36-40)**	4 / 4	<0.1	0 / 1	**17**
Disulfoton	UCMR 1	EPA 8270C	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<10	0 / 1	<0.1
Diuron	UCMR 2	EPA 8321	µg/L	--	<1	0 / 4	<1	0 / 3	<1	0 / 4	<1	0 / 1	**1**
EPTC	UCMR 1, PoLI	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Equilin	UCMR 3	EPA 539	µg/L	--	<0.004	0 / 4	<0.004	0 / 3	<0.004	0 / 4	<0.004	0 / 1	<0.004

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Estradiol (17-beta estradiol)	UCMR 3	EPA 539	µg/L	--	0.0044 (0.0026-0.0091)	4 / 4	<0.0004	0 / 3	<0.0004	0 / 4	<0.0004	0 / 1	<0.0004
Estriol	UCMR 3	EPA 539	µg/L	--	<0.0022 (<0.0008-0.0042)	3 / 4	<0.0008	0 / 3	<0.0008	0 / 4	<0.0008	0 / 1	<0.0008
Estrone	UCMR 3	EPA 539	µg/L	--	0.21 (0.084-0.35)	4 / 4	<0.002 (<0.002-0.0037)	1 / 3	<0.002 (<0.002-0.0022)	1 / 4	<0.002	0 / 1	<0.005
Ethinyl Estradiol (17-alpha ethynyl estradiol)	UCMR 3	EPA 539	µg/L	--	<0.0009 (<0.0009-0.011)	1 / 4	<0.0009	0 / 3	<0.0009	0 / 4	<0.0009	0 / 1	<0.0009
Fonofos	UCMR 1	EPA 526	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Halon 1011 (bromochloromethane)	UCMR 3	EPA 524.3	µg/L	--	<0.06	0 / 4	0.075 (<0.06-0.26)	2 / 3	<0.06	0 / 4	<0.06	0 / 1	<0.06
Halon 1011 (bromochloromethane)	UCMR 3	EPA 524.2	µg/L	--	<0.5	0 / 3	<0.5	0 / 2	<0.5	0 / 3	<0.5	0 / 1	<0.5
HCFC-22 (Chlorodifluoromethane)	UCMR 3	EPA 524.3	µg/L	--	<0.08	0 / 4	<0.08	0 / 3	<0.08	0 / 4	<0.08	0 / 1	<0.08
Linuron	UCMR 1	EPA 8321	µg/L	--	<1	0 / 4	<1	0 / 3	<1	0 / 4	<1	0 / 1	<1
Metolachlor	UCMR 2	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Metolachlor ethanesulfonic acid (ESA)	UCMR 2	EPA 535	µg/L	--	<1	0 / 4	<1	0 / 3	<1	0 / 4	<1	0 / 1	<1
Metolachlor oxanilic acid (OC)	UCMR 2	EPA 535	µg/L	--	<2	0 / 4	<2	0 / 3	<2	0 / 4	<2	0 / 1	<2
Molybdenum	UCMR 3	EPA 200.8	µg/L	--	6.8 (4-13)	4 / 4	43 (23-78)	3 / 3	105 (92-220)	4 / 4	12	1 / 1	62
N-nitroso-di-n-butylamine (NDBA)	UCMR 2	EPA 521	ng/L	--	4.3 (<2-6.7)	3 / 4	<2	0 / 3	<2	0 / 4	<2	0 / 1	<2
N-nitroso-methylethylamine (NMEA)	UCMR 2	EPA 521	ng/L	--	<2	0 / 4	<2	0 / 3	<2	0 / 4	<2	0 / 1	<2
N-Nitrosopyrrolidine (NPYR)	UCMR 2	EPA 521	ng/L	--	2.05 (<2-2.5)	2 / 4	<2 (<2-4.7)	1 / 3	<2	0 / 4	<2	0 / 1	<2
N-Nitrosomorpholine	--	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
N-Nitrosopiperidine (NPIP)	--	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Perfluorooctane sulfonic acid (PFOS)	UCMR 3	EPA 537	µg/L	--	<0.04	0 / 4	0.073 (<0.04-0.3)	2 / 3	<0.04	0 / 4	<0.04	0 / 1	<0.04
Perfluorooctanoic acid (PFOA)	UCMR 3	EPA 537	µg/L	--	<0.02	0 / 4	<0.02	0 / 3	<0.02	0 / 4	0.021	1 / 1	<0.02
Perfluorononanoic acid (PFNA)	UCMR 3	EPA 537	µg/L	--	<0.02	0 / 4	<0.02	0 / 3	<0.02	0 / 4	<0.02	0 / 1	<0.02
Perfluorohexanesulfonic acid (PFHxS)	UCMR 3	EPA 537	µg/L	--	<0.03	0 / 4	<0.03	0 / 3	<0.03	0 / 4	<0.03	0 / 1	<0.03

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Perfluoroheptanoic acid (PFHpA)	UCMR 3	EPA 537	µg/L	--	*<0.01*	**0 / 4**	*<0.01*	**0 / 3**	*<0.01*	**0 / 4**	*<0.01*	**0 / 1**	*<0.01*
Perfluorobutanesulfonic acid (PFBS)	UCMR 3	EPA 537	µg/L	--	*<0.09*	**0 / 4**	*<0.09*	**0 / 3**	*<0.09*	**0 / 4**	*<0.09*	**0 / 1**	*<0.09*
Prometon	UCMR 1	EPA 526	µg/L	--	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
Strontium	UCMR 3	EPA 200.8	µg/L	--	**365 (290-740)**	**4 / 4**	**580 (510-1300)**	**3 / 3**	**1250 (990-2200)**	**4 / 4**	**500**	**1 / 1**	**1800**
Terbacil	UCMR 1	EPA 525.2	µg/L	--	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
Terbufos	UCMR 1	EPA 526	µg/L	--	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
Terbufos sulfone	UCMR 2	EPA 527	µg/L	--	*<0.4*	**0 / 4**	*<0.4*	**0 / 3**	*<0.4*	**0 / 4**	*<0.4*	**0 / 1**	*<0.4*
EPA Clean Water Act Priority Pollutants (PPs)													
1,2-diphenylhydrazine	EPA PP, UCMR 1	EPA 8270C	µg/L	--	*<10*	**0 / 4**	*<10*	**0 / 3**	*<10*	**0 / 4**	*<1*	**0 / 1**	*<10*
1,2-trans-dichloroethylene	EPA PP	EPA 524.2	µg/L	--	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
1,3-dichlorobenzene	EPA PP	EPA 524.2	µg/L	--	*<0.5*	**0 / 4**	*<0.5*	**0 / 3**	*<0.5*	**0 / 4**	*<0.5*	**0 / 1**	*<0.5*
2-chloroethyl vinyl ethers	EPA PP	EPA 524.2	µg/L	--	*<0.5*	**0 / 6**	*<0.5*	**0 / 5**	*<0.5*	**0 / 8**	*<0.5*	**0 / 1**	*<0.5*
2-chloronaphthalene	EPA PP	EPA 8270C	µg/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<1*	**0 / 1**	*<5*
2-chlorophenol	EPA PP	EPA 8270C	µg/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<1*	**0 / 1**	*<5*
2-nitrophenol	EPA PP	EPA 8270C	µg/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5.1*	**0 / 1**	*<5*
2,4-dichlorophenol	EPA PP, UCMR 1	EPA 8270C	µg/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<1*	**0 / 1**	*<5*
2,4-dinitrophenol	EPA PP, UCMR 1	EPA 8270C	µg/L	--	*<50*	**0 / 4**	*<50*	**0 / 3**	*<50*	**0 / 4**	*<5.1*	**0 / 1**	*<50*
2,4-dinitrotoluene	EPA PP, UCMR 1	EPA 525.2	µg/L	--	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<1*	**0 / 1**	*<0.1*
2,4,6-trichlorophenol	EPA PP, UCMR 1	EPA 8270C	µg/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<1*	**0 / 1**	*<5*
2,6-dinitrotoluene	EPA PP, UCMR 1	EPA 525.2	µg/L	--	*<0.1*	**0 / 4**	*<0.1*	**0 / 3**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*
3,3-dichlorobenzidine	EPA PP	EPA 8270C	µg/L	--	*<50*	**0 / 4**	*<50*	**0 / 3**	*<50*	**0 / 4**	*<2*	**0 / 1**	*<50*
4-bromophenyl phenyl ether	EPA PP	EPA 8270C	µg/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5.1*	**0 / 1**	*<5*
4-chlorophenyl phenyl ether	EPA PP	EPA 8270C	µg/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<1*	**0 / 1**	*<5*
4-nitrophenol	EPA PP	EPA 8270C	µg/L	--	*<10*	**0 / 4**	*<10*	**0 / 3**	*<10*	**0 / 4**	*<5.1*	**0 / 1**	*<10*
4,4-DDD	EPA PP	EPA 525.2	µg/L	--	*<0.1*	**0 / 4**	*<0.1*	**0 / 4**	*<0.1*	**0 / 4**	*<0.1*	**0 / 1**	*<0.1*

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
4,4-DDD	EPA PP	EPA 8081A/8082	µg/L	--	<0.05	0 / 4	<0.05	0 / 4	<0.05	0 / 4	<0.05	0 / 1	<0.05
4,4-DDD	EPA PP	EPA 608	µg/L	--			<0.01	0 / 1	<0.01	0 / 1	<0.01	0 / 1	<0.01
4,4-DDE	EPA PP, UCMR 1	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 4	<0.1	0 / 4	<0.1	0 / 1	<0.1
4,4-DDE	EPA PP, UCMR 1	EPA 8081A/8082	µg/L	--	<0.05	0 / 4	<0.05	0 / 4	<0.05	0 / 4	<0.05	0 / 1	<0.05
4,4-DDE	EPA PP, UCMR 1	EPA 608	µg/L	--			<0.01	0 / 1	**0.021**	1 / 1	<0.01	0 / 1	**0.012**
4,4-DDT	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 4	<0.1	0 / 4	<0.1	0 / 1	<0.1
4,4-DDT	EPA PP	EPA 8081A/8082	µg/L	--	<0.05	0 / 4	<0.05	0 / 4	<0.05	0 / 4	<0.05	0 / 1	<0.05
4,4-DDT	EPA PP	EPA 608	µg/L	--			<0.01	0 / 1	<0.01	0 / 1	<0.01	0 / 1	<0.01
4,6-dinitro-o-cresol	EPA PP	EPA 8270C	µg/L	--	<50	0 / 4	<50	0 / 3	<50	0 / 4	<5.1	0 / 1	<50
Acenaphthene	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Acenaphthylene	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Acrolein	EPA PP, EPA CCL	EPA 624	µg/L	--	<2	0 / 4	**4.8 (<2-22)**	2 / 3	<2	0 / 4	<2	0 / 1	<2
Acrylonitrile	EPA PP	EPA 624	µg/L	--	<2	0 / 4	**3.6 (<2-4.2)**	2 / 3	<2	0 / 4	<2	0 / 1	<2
Aldrin	EPA PP	EPA 505	µg/L	--	<0.01	0 / 4	<0.01	0 / 3	<0.01	0 / 4	<0.01	0 / 1	<0.01
Alpha-BHC	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Alpha-endosulfan	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Alpha-endosulfan	EPA PP	EPA 608	µg/L	--			<0.01	0 / 1	<0.01	0 / 1	<0.01	0 / 1	<0.01
Anthracene	EPA PP	EPA 525.2	µg/L	--	<0.02	0 / 4	<0.02	0 / 3	<0.02	0 / 4	<0.02	0 / 1	<0.02
Benzidine	EPA PP	EPA 8270C	µg/L	--	<50	0 / 4	<50	0 / 3	<50	0 / 4	<5.1	0 / 1	<50
benzo(a) anthracene	EPA PP	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<5
Benzo(b) fluoranthene	EPA PP	EPA 525.2	µg/L	--	<0.02	0 / 4	<0.02	0 / 3	<0.02	0 / 4	<0.02	0 / 1	<0.02
Benzo(ghi) perylene	EPA PP	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Benzo(k) fluoranthene	EPA PP	EPA 525.2	µg/L	--	<0.02	0 / 4	<0.02	0 / 3	<0.02	0 / 4	<0.02	0 / 1	<0.02
Beta-BHC	EPA PP	EPA 525.2	µg/L	--	<0.1 (<0.1-**0.15**)	1 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Beta-endosulfan	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1

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					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Beta-endosulfan	EPA PP	EPA 608	µg/L	--			<0.01	0 / 1	<0.01	0 / 1	<0.01	0 / 1	<0.01
Bis(2-chloroethoxy) methane	EPA PP	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<1	0 / 1	<10
Bis(2-chloroethyl) ether	EPA PP	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<1	0 / 1	<10
Bis(2-chloroisopropyl) ether	EPA PP	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<1	0 / 1	<10
Bromoform	EPA PP	EPA 524.2	µg/L	--	<0.5	0 / 4	**0.95 (<0.5-2.4)**	**2 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Bromoform	EPA PP	EPA 551.1	µg/L	--	<0.5	0 / 4	**1.2 (<0.5-1.8)**	**2 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Butyl benzyl phthalate	EPA PP	EPA 525.2	µg/L	--	<0.5	0 / 4	**1.2 (<0.5-1.9)**	**2 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chlorobenzene	EPA PP	EPA 524.2	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chlorodibromomethane	EPA PP	EPA 524.2	µg/L	--	<0.5	0 / 4	**2.2 (<0.5-11)**	**2 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chlorodibromomethane	EPA PP	EPA 551.1	µg/L	--	<0.5	0 / 4	**3.6 (<0.5-8.3)**	**2 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chloroethane	EPA PP	EPA 524.2	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chloroform	EPA PP	EPA 524.2	µg/L	--	<0.5 (<0.5-**0.76)**	**1 / 4**	**36 (2.5-96)**	**3 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chloroform	EPA PP	EPA 551.1	µg/L	--	<0.5 (<0.5-**0.82)**	**1 / 4**	**49 (2.6-150)**	**3 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Chrysene	EPA PP	EPA 525.2	µg/L	--	<0.02	0 / 4	<0.02	0 / 3	<0.02	0 / 4	<0.02	0 / 1	<0.02
Delta-BHC	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Delta-BHC	EPA PP	EPA 608	µg/L	--			<0.005	0 / 1	<0.005	0 / 1	<0.005	0 / 1	<0.005
Di-N-Butyl Phthalate	EPA PP	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<1	0 / 1	<10
Di-n-octyl phthalate	EPA PP	EPA 8270C	µg/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<2	0 / 1	<10
Dibenz(a,h) anthracene	EPA PP	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Dichlorobromomethane	EPA PP	EPA 524.2	µg/L	--	<0.5	0 / 4	**5.8 (0.52-26)**	**3 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Dichlorobromomethane	EPA PP	EPA 551.1	µg/L	--	<0.5	0 / 4	<0.5 (<0.5-**9)**	**1 / 3**	<0.5	0 / 4	<0.5	0 / 1	<0.5
Diethyl Phthalate	EPA PP	EPA 525.2	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Dimethyl phthalate	EPA PP	EPA 525.2	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Endosulfan sulfate	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Endosulfan sulfate	EPA PP	EPA 608	µg/L	--			<0.01	0 / 1	<0.01	0 / 1	<0.01	0 / 1	<0.01

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Endrin	EPA PP	EPA 525.2	µg/L	--	<0.2	0 / 4	<0.2	0 / 3	<0.2	0 / 5	<0.2	0 / 1	<0.2
Endrin	EPA PP	EPA 608	µg/L	--			<0.01	0 / 1	<0.01	0 / 1	<0.01	0 / 1	<0.01
Endrin aldehyde	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Endrin aldehyde	EPA PP	EPA 608	µg/L	--			<0.01	0 / 1	<0.01	0 / 1	<0.01	0 / 1	<0.01
Fluoranthene	EPA PP	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Fluorene	EPA PP	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Gamma-BHC	EPA PP	EPA 505	µg/L	--	<0.01	0 / 4	<0.01	0 / 3	<0.01	0 / 4	<0.01	0 / 1	<0.01
Hexachlorobenzene	EPA PP	EPA 8270C	µg/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<1	0 / 1	<5
Hexachlorobutadiene	EPA PP	EPA 524.2	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Hexachloroethane	EPA PP	EPA 8270C	µg/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<1	0 / 1	<5
Hexachlorocyclopentadiene	EPA PP	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Indeno (1,2,3-cd) pyrene	EPA PP	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Isophorone	EPA PP	EPA 525.2	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Lead	EPA PP	EPA 200.8	µg/L	--	<0.5	0 / 4	**0.93 (0.6-1.3)**	3 / 3	**0.7 (<0.5-0.98)**	2 / 4	**3**	1 / 1	**1.8**
Methyl bromide	EPA PP, UCMR 3, PoLI	EPA 524.2	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Methyl chloride	EPA PP, UCMR 3	EPA 524.2	µg/L	--	**0.51 (<0.5-0.54)**	2 / 4	<0.5 (<0.5-**1.7**)	2 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Methyl chloride	EPA PP, UCMR 3	EPA 524.3	µg/L	--	<0.2	0 / 4	**0.37 (<0.2-0.404)**	2 / 3	<0.2	0 / 4	<0.2	0 / 1	<0.2
Nitrobenzene	EPA PP, UCMR 1	EPA 8270C	µg/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<1	0 / 1	<5
N-nitrosodiphenylamine	EPA PP, EPA CCL	EPA 8270C	µg/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<1	0 / 1	<5
Naphthalene	EPA PP	EPA 525.2	µg/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<0.3	0 / 1	<0.3
Parachlorometa cresol (p-Chloro-m-cresol)	EPA PP	EPA 8270C	µg/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
PCB–1016 (Arochlor 1016)	EPA PP	EPA 505	µg/L	--	<0.08	0 / 4	<0.08	0 / 3	<0.08	0 / 9	<0.08	0 / 1	<0.08
PCB–1221 (Arochlor 1221)	EPA PP	EPA 505	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.1
PCB–1232 (Arochlor 1232)	EPA PP	EPA 505	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.1
PCB–1242 (Arochlor 1242)	EPA PP	EPA 505	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.1

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
PCB–1248 (Arochlor 1248)	EPA PP	EPA 505	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.1
PCB–1254 (Arochlor 1254)	EPA PP	EPA 505	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.1
PCB–1260 (Arochlor 1260)	EPA PP	EPA 505	µg/L	--	<0.1	0 / 4	<0.1	0 / 3	<0.1	0 / 9	<0.1	0 / 1	<0.1
Phenanthrene	EPA PP	EPA 525.2	µg/L	--	<0.04	0 / 4	<0.04	0 / 3	<0.04	0 / 4	<0.04	0 / 1	<0.04
Pyrene	EPA PP	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 4	<0.05	0 / 1	<0.05
Pesticides of Local Interest (PoLI)													
Chlorothalonil (Draconil, Bravo)	PoLI	EPA 525.2	µg/L	--	<0.1	0 / 4	<0.1 (<0.1-**0.1**)	1 / 3	<0.1	0 / 4	<0.1	0 / 1	<0.1
Chlorpyrifos	PoLI	EPA 525.2	µg/L	--	<0.05	0 / 4	<0.05	0 / 3	<0.05	0 / 11	<0.05	0 / 1	<0.05
Chlorthal-Dimethyl (DCPA)	PoLI	EPA 515.4	µg/L	--	**0.56 (0.52-0.66)**	4 / 4	<0.1 (<0.1-**0.16**)	1 / 3	**38 (36-40)**	4 / 4	<0.1	0 / 1	**17**
Glyphosate, Isopropylamine Salt	PoLI	EPA 547	µg/L	--	<6	0 / 4	<6	0 / 3	**7.5** (<6-**9.2**)	2 / 4	<6	0 / 1	**8.1**
Methidathion	PoLI	EPA 8141	µg/L	--	<0.1	0 / 3	<0.1	0 / 2	<0.1	0 / 4	<0.1	0 / 1	<0.5
Methomyl	PoLI	EPA 531.2	µg/L	--	<0.5 (<0.5-**0.53**)	1 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Naled	PoLI	EPA 8141	µg/L	--	<0.5	0 / 4	<0.5	0 / 3	<0.5	0 / 4	<0.5	0 / 1	<0.5
Oxydemeton-Methyl (Demeton)	PoLI	EPA 8141A	µg/L	--	<0.2	0 / 4	<0.2	0 / 3	<0.2	0 / 4	<0.2	0 / 1	<0.2
Sulfur	PoLI	EPA 200.7	mg/L	--	**38 (36-41)**	4 / 4	**68 (62-80)**	3 / 3	**200 (200-210)**	4 / 4	**50**	1 / 1	**140**
Contaminants of Emerging Concern (CECs)													
1,7-Dimethylxanthine	CECs	LC-MS-MS	ng/L	--	**125** (<10-**1100**)	2 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
2,4-D	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5 (<5-**17**)	1 / 3	<5	0 / 4	<5	0 / 1	<5
4-nonylphenol - semi quantitative	CECs	LC-MS-MS	ng/L	--	<100 (<100-**860**)	1 / 4	<100	0 / 3	<100	0 / 4	<100	0 / 1	<100
4-tert-octylphenol	CECs	LC-MS-MS	ng/L	--	**95** (<50-**790**)	2 / 4	<50 (<50-**53**)	1 / 3	<50	0 / 4	<50	0 / 1	<50
Acesulfame-K	CECs	LC-MS-MS	ng/L	--	**33000 (22000-85000)**	4 / 4	**38 (22-44)**	3 / 3	**1490 (580-3000)**	4 / 4	**140**	1 / 1	**3100**
Acetaminophen	CECs	LC-MS-MS	ng/L	--	<5 (<5-**350**)	1 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Albuterol	CECs	LC-MS-MS	ng/L	--	**14** (<5-**33**)	2 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Amoxicillin (semi-quantitative)	CECs	LC-MS-MS	ng/L	--	**2450 (2000-3700)**	4 / 4	<20	0 / 3	<20	0 / 4	<20	0 / 1	<20

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					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Andorostenedione	CECs, UCMR 3	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Atenolol	CECs	LC-MS-MS	ng/L	--	330 (<5-540)	3 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Atrazine	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Azithromycin	CECs	LC-MS-MS	ng/L	--	1160 (<20-20000)	2 / 4	<20	0 / 3	<20	0 / 4	48	1 / 1	<20
Bendroflumethiazide	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Bezafibrate	CECs	LC-MS-MS	ng/L	--	33 (<5-120)	2 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
BPA	CECs	LC-MS-MS	ng/L	--	<10 (<10-71)	1 / 4	31 (<10-59)	2 / 3	<10	0 / 4	<10	0 / 1	<10
Bromacil	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Butalbital	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5 (<5-100)	1 / 4	<5	0 / 1	<5
Butylparben	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Caffeine	CECs	LC-MS-MS	ng/L	--	1065 (820-2800)	4 / 4	150 (39-200)	3 / 3	6.3 (<5-8.3)	2 / 4	110	1 / 1	63
Carbadox	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Carbamazepine	CECs	LC-MS-MS	ng/L	--	225 (120-360)	4 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Carisoprodol	CECs	LC-MS-MS	ng/L	--	106 (<5-770)	3 / 4	<5	0 / 3	<5 (<5-5.1)	1 / 4	<5	0 / 1	<5
Chloramphenicol	CECs	LC-MS-MS	ng/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Chloridazon	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5 (<5-59)	1 / 4	<5	0 / 1	<5
Chlorotoluron	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Cimetidine	CECs	LC-MS-MS	ng/L	--	98 (<5-430)	2 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Clofibric Acid	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Cotinine	CECs	LC-MS-MS	ng/L	--	115 (25-240)	4 / 4	16 (<10-24)	2 / 3	<10	0 / 4	86	1 / 1	<10
Cyanazine	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
DACT	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5 (<5-370)	1 / 3	<5	0 / 4	<5	0 / 1	58
DEA	CECs	LC-MS-MS	ng/L	--	<5 (<5-16)	1 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
DEET	CECs	LC-MS-MS	ng/L	--	325 (120-1400)	4 / 4	<10 (<10-11)	1 / 3	<10 (<10-14)	1 / 4	15	1 / 1	15

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					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Dehydronifedipine	CECs	LC-MS-MS	ng/L	--	67 (62-150)	4 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
DIA	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Diazepam	CECs	LC-MS-MS	ng/L	--	<5 (<5-12)	1 / 4	<5	0 / 3	<5 (<5-5)	1 / 4	<5	0 / 1	<5
Diclofenac	CECs	LC-MS-MS	ng/L	--	37 (<5-81)	2 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Dilantin	CECs	LC-MS-MS	ng/L	--	140 (120-180)	4 / 4	<20	0 / 3	<20	0 / 4	<20	0 / 1	<20
Diuron	CECs	LC-MS-MS	ng/L	--	45 (<5-96)	3 / 4	<5	0 / 3	<5	0 / 4	38	1 / 1	450
Erythromycin	CECs, EPA CCL	LC-MS-MS	ng/L	--	30 (<10-120)	2 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Estradiol	CECs, UCMR 3	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Estrone	CECs, UCMR 3	LC-MS-MS	ng/L	--	90 (12-300)	4 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Ethinyl Estradiol - 17 alpha	CECs, UCMR 3	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Ethylparaben	CECs	LC-MS-MS	ng/L	--	<20	0 / 4	<20	0 / 3	<20	0 / 4	<20	0 / 1	<20
Flumeqine	CECs	LC-MS-MS	ng/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Fluoxetine	CECs	LC-MS-MS	ng/L	--	30 (<10-57)	3 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Gemfibrozil	CECs	LC-MS-MS	ng/L	--	1150 (<5-1500)	3 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	11
Ibuprofen	CECs	LC-MS-MS	ng/L	--	<10	0 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Iohexal	CECs	LC-MS-MS	ng/L	--	11700 (7800-40000)	4 / 4	<10	0 / 3	105 (<10-370)	2 / 4	<10	0 / 1	190
Iopromide	CECs	LC-MS-MS	ng/L	--	1400 (<5-1600)	3 / 4	<5	0 / 3	<5 (<5-16)	1 / 4	<5	0 / 1	<5
Isobutylparaben	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	7 (<5-74)	2 / 3	<5	0 / 4	<5	0 / 1	<5
Isoproturon	CECs	LC-MS-MS	ng/L	--	<100	0 / 4	<100	0 / 3	<100	0 / 4	<100	0 / 1	<100
Ketoprofen	CECs	LC-MS-MS	ng/L	--	68 (<5-170)	2 / 4	<5	0 / 3	<5	0 / 4	6.9	1 / 1	<5
Ketorolac	CECs	LC-MS-MS	ng/L	--	<5 (<5-17)	1 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Lidocaine	CECs	LC-MS-MS	ng/L	--	485 (260-800)	4 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Lincomycin	CECs	LC-MS-MS	ng/L	--	26 (<10-51)	2 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Linuron	CECs, PoLI	LC-MS-MS	ng/L	--	<5	0 / 4	<5 (<5-5.3)	1 / 3	<5	0 / 4	<5	0 / 1	9.2

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Lopressor	CECs	LC-MS-MS	ng/L	--	**610 (*<20*-1200)**	**3 / 4**	*<20*	**0 / 3**	*<20*	**0 / 4**	*<20*	**0 / 1**	*<20*
Meclofenamic Acid	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Meprobamate	CECs	LC-MS-MS	ng/L	--	**395 (220-730)**	**4 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Metazachlor	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Methylparaben	CECs	LC-MS-MS	ng/L	--	*<20*	**0 / 4**	*<20*	**0 / 3**	*<20*	**0 / 4**	*<20*	**0 / 1**	*<20*
Metolachlor	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Naproxen	CECs	LC-MS-MS	ng/L	--	*<10* **(*<10*-41)**	**1 / 4**	*<10*	**0 / 3**	*<10*	**0 / 4**	*<10*	**0 / 1**	*<10*
Nifedipine	CECs	LC-MS-MS	ng/L	--	*<20*	**0 / 4**	*<20*	**0 / 3**	*<20*	**0 / 4**	*<20*	**0 / 1**	*<20*
Norethisterone	CECs	LC-MS-MS	ng/L	--	*<5* **(*<5*-25)**	**1 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Oxolinic Acid	CECs	LC-MS-MS	ng/L	--	*<10*	**0 / 4**	*<10*	**0 / 3**	*<10*	**0 / 4**	*<10*	**0 / 1**	*<10*
Pentoxifylline	CECs	LC-MS-MS	ng/L	--	**14 (*<5*-80)**	**3 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Phenazone	CECs	LC-MS-MS	ng/L	--	*<5* **(*<5*-37)**	**1 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Primidone	CECs	LC-MS-MS	ng/L	--	**49 (31-94)**	**4 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Progesterone	CECs	LC-MS-MS	ng/L	--	**5 (*<5*-59)**	**2 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Propazine	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Propylparaben	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Quinoline	CECs, EPA CCL	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5* **(*<5*-12)**	**1 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Simazine	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Sucralose	CECs	LC-MS-MS	ng/L	--	**37500 (35000-44000)**	**4 / 4**	**280 (*<100*-1100)**	**2 / 3**	**765 (110-2700)**	**4 / 4**	**130**	**1 / 1**	**1600**
Sulfachloropyridazine	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Sulfadiazine	CECs	LC-MS-MS	ng/L	--	*<5* **(*<5*-9.4)**	**1 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Sulfadimethoxine	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Sulfamerazine	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*
Sulfamethazine	CECs	LC-MS-MS	ng/L	--	*<5*	**0 / 4**	*<5*	**0 / 3**	*<5*	**0 / 4**	*<5*	**0 / 1**	*<5*

Sampling Constituent	Contam-inant List	Analytical Method	Units	DDW MCL/NL	RTP Effluent		Ag Wash Water		Blanco Drain		Lake El Estero		Tembladero Slough
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	
Sulfamethizole	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Sulfamethoxazole	CECs	LC-MS-MS	ng/L	--	860 (470-1500)	4 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Sulfathiazole	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
TCEP	CECs	LC-MS-MS	ng/L	--	120 (<10-320)	3 / 4	<10 (<10-15)	1 / 3	<10 (<10-13)	1 / 4	33	1 / 1	<10
TCPP	CECs	LC-MS-MS	ng/L	--	570 (440-720)	4 / 4	<100	0 / 3	<100	0 / 4	<100	0 / 1	<100
TDCPP	CECs	LC-MS-MS	ng/L	--	635 (510-880)	4 / 4	<100	0 / 3	<100	0 / 4	<100	0 / 1	<100
Testosterone	CECs, UCMR 3	LC-MS-MS	ng/L	--	<5	0 / 4	<5 (<5-18)	1 / 3	<5	0 / 4	<5	0 / 1	<5
Theobromine	CECs	LC-MS-MS	ng/L	--	<10 (<10-700)	1 / 4	<10	0 / 3	<10	0 / 4	<10	0 / 1	<10
Theophylline	CECs	LC-MS-MS	ng/L	--	225 (<20-2200)	2 / 4	<20	0 / 3	<20	0 / 4	<20	0 / 1	<20
Triclosan	CECs	LC-MS-MS	ng/L	--	325 (180-1600)	4 / 4	<10	0 / 3	<15 (<10-67)	1 / 4	<10	0 / 1	<10
Trimethoprim	CECs	LC-MS-MS	ng/L	--	505 (48-1700)	4 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5
Warfarin	CECs	LC-MS-MS	ng/L	--	<5	0 / 4	<5	0 / 3	<5	0 / 4	<5	0 / 1	<5

Appendix B-2

Results of the 2018 Local Limits Source Water Sampling Program for All Constituents Analyzed in the Untreated Source Waters

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
General Water Quality Parameters												
Ammonia as N	--	SM 4500NH3F,G	mg/L	--	-	-	0.88 (0.05-2.1)	7/8	*<0.05*	0/8	*0.11 (0.05-3.1)*	5/8
cBOD	--	SM 5210B	mg/L	--	-	-	471 (226-659)	8/8	1.0 (0.7-2.0)***	8/8	4.2 (3-10)***	8/8
Bromide	--	EPA 300.0	mg/L	--	0.4 (0.34-0.4)	7/7	0.3 (0.2-1.3)	8/8	1.8 (1.8-1.9)	7/7	0.8 (0.7-1.0)	8/8
Chloride	sMCL	EPA 300.0	mg/L	250	228 (220-238)	7/7	194 (159-209)	8/8	287 (252-301)	7/7	175.5 (162-224)	8/8
Conductivity (Specific Conductance)	sMCL	SM 2510B	µS/cm	900	1746 (1717-1797)	7/7	1322 (1196-1443)	8/8	2717 (1325-2776)	7/7	1334 (1293-1556)	7/7
Copper	sMCL, EPA PP	EPA 200.8	mg/L	1.3/1.0	*0.0112 (0.01-0.0129)*	7/7	0.0226 (0.0175-0.0286)	8/8	0.0139 (0.0128-0.0147)	7/7	0.00885 (0.0077-0.0101)	8/8
Nitrate (as N)	pMCL	EPA 300.0	mg/L	10	5.2 (4.8-6.1)	7/7	7.6 (5.7-10)	8/8	58.8 (57.4-61.5)	7/7	27.3 (22.6-42.9)	8/8
Nitrite (as N)	pMCL	EPA 300.0	mg-N/L	1	0.7 (0.7-0.8)	7/7	0.3 (0.01-1.8)	8/8	0.2 (0.15-0.4)	7/7	0.7 (0.1-1.7)	8/8
Nitrate+Nitrite (sum as N)	pMCL	EPA 300.0	mg-N/L	10	5.9 (5.5-6.9)	7/7	7.9 (7.2-10.1)	8/8	59 (57.8-61.6)	7/7	27.55 (23.3-44.6)	8/8
Oil and Grease	--	EPA 1664	mg/L	--	-	-	5.1 (5.0-7.9)	5/8	*<5*	8/8	5 (5-9.8)	8/8
pH	--	SM 2330B/SM4500H+B	pH	--	7.37 (7.3-7.49)	7/7	7.29 (6.57-7.5)	7/7	8.19 (7.79-8.35)	7/7	8.02 (7.75-8.11)	7/7
Phosphate (Orthophosphate as P)	--	EPA 300.0	mg/L	--	3.91 (3.4-4.2)	7/7	30.5 (16.3-35.2)	8/8	0.28 (0.2-0.37)	7/7	0.535 (0.33-0.72)	8/8
Silver	sMCL, EPA PP	EPA 200.8	mg/L	0.1	*<0.0001*	0/7	0.00015 (0.0001-0.001)*	4/8	*<0.0001*	0/7	*<0.0001 (0.0001-0.00014)**	2/8
Sodium	--	EPA 200.7	mg/L	--	163 (146-184)	7/7	151.5 (139-164)	8/8	224 (201-256)	7/7	114 (96-128)	8/8
Sulfate	sMCL	EPA 300.0	mg/L	250	98 (95-105)	7/7	160 (157-165)	8/8	538 (507-574)	7/7	136 (118-173)	8/8
Temperature	--	Field/SM 2550B	ºC	--	21.1 (18.2-21.8)	7/7	12.7 (11.9-13.7)	7/7	18.4 (16.9-19.7)	7/7	16.9 (15.5-18.9)	7/7
Total Dissolved Solids (TDS)	sMCL	EPA 160.1/SM 2540C	mg/L	500	820 (800-837)	7/7	1215 (1060-1295)	8/8	1929 (1865-1980)	8/8	864 (830-983)	8/8

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
Total Nitrogen	--	calculation	mg/L	--	-	-	38 (22-31)	8/8	66 (62-70)	8/8	31 (26-50)	8/8
Total Phosphorus as P	--	SM 4500-PE/EPA 365.1	mg/L	--	-	-	39.85 (18.6-43)	8/8	<2	0/7	<2	0/8
Total Suspended Solids (TSS)	--	SM 2540D	mg/L	--	*4.4 (4.0-4.8)*	2/2	102 (83-115)	9/9	6.5 (2.8-17)	7/7	29 20-56)	8/8
Zinc	sMCL, EPA PP	EPA 200.8	mg/L	5	*0.015 (0.014-0.019)*	7/7	0.098 (0.079-0.157)	8/8	*<0.01 (0.0099-0.01)**	0/7	*0.014 (0.012-0.019)*	8/8
DDW Drinking Water Maximum Contaminant Levels (MCLs) - primary MCLs (pMCLs) and secondary MCLs (sMCLs)												
MCLs -- Inorganics												
Antimony	pMCL, EPA PP	EPA 200.8	mg/L	0.006	-	-	0.0009 (0.0008-0.0012)	8/8	0.00046 (0.0004-0.0006)*	7/7	0.0006 (0.0005-0.0009)	8/8
Arsenic	pMCL, EPA PP	EPA 200.8	mg/L	0.01	0.0015 (0.0013-0.002)	7/7	0.0015 (0.0012-0.002)	8/8	0.0054 (0.0052-0.0061)	7/7	0.00495 0.0044-0.0054	8/8
Beryllium	pMCL, EPA PP	EPA 200.8	mg/L	0.004	-	-	*<0.0001*	0/7	*<0.0001*	0/7	*<0.0001*	0/8
Cadmium	pMCL, EPA PP	EPA 200.8	mg/L	0.005	*<0.0001*	0/7	0.0007 (0.0006-0.0008)	8/8	0.00014 (<0.0001-0.0002)*	6/7	0.000105 (0.0001-0.00011)*	4/8
Chromium	pMCL, EPA PP, UCMR 3	EPA 200.8	mg/L	0.05	0.0028 (0.0013-0.0035)	7/7	0.0151 (0.0129-0.0167)	8/8	0.0054 (0.003-0.0084)	7/7	0.00425 (0.0026-0.0146)	8/8
Cyanide	pMCL, EPA PP	SM 4500CN-F	mg/L	0.15	0.0033 (0.0028-0.0043)	14/14	0.0535 (0.012-0.130)	16/16	0.002 0.0015-0.0034	14/14	0.0018 (0.0001-0.0027)	14/16
Fluoride	pMCL	SM 4500F-C/EPA 300.0	mg/L	2	0.5 (0.4-0.6)	7/7	1.55 (0.8-7.5)	8/8	0.7 (0.6-0.7)	7/7	0.5 (0.5-0.6)	8/8
Mercury	pMCL, EPA PP	EPA 245.1	mg/L	0.002	*<0.00001*	0/14	*<0.00002*	0/16	*<0.00002*	0/13	*<0.00002*	0/16
Nickel	pMCL, EPA PP	EPA 200.8	mg/L	0.1	0.0057 (0.0053-0.0062)	7/7	0.0089 (0.0081-0.0109)	8/8	0.0253 (0.0241-0.287)	7/7	0.0096 (0.0084-0.0121)	8/8
Selenium	pMCL, EPA PP	EPA 200.8	mg/L	0.05	0.003 (0.002-0.003)	7/7	0.003 (0.003-0.004)	8/8	0.013 (0.012-0.013)	7/7	0.004 (0.004-0.005)	8/8
Thallium	pMCL, EPA PP	EPA 200.8	mg/L	0.002	-	-	*<0.0001*	0/8	*<0.0001*	0/7	*<0.0001*	0/8
MCLs - Volatile Organic Chemicals (VOCs)												

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
1,1-Dichloroethane	pMCL, EPA PP, UCMR 3	EPA 524.2	µg/L	5	-	-	0.105 (<0.06-<0.15)**	0/2	-	-	*<0.06*	0/2
1,1-Dichloroethylene	pMCL, EPA PP	EPA 524.2	µg/L	6	-	-	0.153 (<0.086-<0.22)**	0/2	-	-	*<0.086*	0/2
1,1,1-Trichloroethane	pMCL, EPA PP	EPA 624	µg/L	200	-	-	0.085 (<0.05-0.12)**	0/2	-	-	*<0.05*	0/2
1,1,2-Trichloroethane	pMCL, EPA PP	EPA 624	µg/L	5	-	-	0.14 (<0.08-<0.2)**	0/2	-	-	*<0.08*	0/2
1,1,2,2-Tetrachloroethane	pMCL, EPA PP	EPA 624	µg/L	1	-	-	0.195 (<0.11-<0.28)**	0/2	-	-	*<0.11*	0/2
1,2-Dichloroethane	pMCL, EPA PP	EPA 524.2	µg/L	0.5	-	-	0.16 (<0.09-<0.23)**	0/2	-	-	*<0.09*	0/2
1,2-Dichloropropane	pMCL, EPA PP	EPA 624	µg/L	5	-	-	0.01 (<0.06-<0.14)**	0/2	-	-	*<0.06*	0/2
1,2,4-Trichlorobenzene	pMCL, EPA PP	EPA 625	µg/L	5	-	-	0.66 (<0.09-<1.1)**	0/4	-	-	*<1.1*	0/2
1,3-Dichloropropene	pMCL, PoLI, EPA PP	EPA 624	µg/L	0.5	-	-	0.16 (<0.09-<0.23)**	0/2	-	-	*<0.09*	0/2
1,4-Dichlorobenzene	pMCL, EPA PP	EPA 624	µg/L	5	-	-	0.64 (<0.072-<1.1)**	0/4	-	-	*<0.072*	0/2
Benzene	pMCL, EPA PP	EPA 624	µg/L	1	-	-	0.091 (<0.05-<0.13)**	0/2	-	-	*<0.05*	0/2
Carbon Tetrachloride	pMCL, EPA PP	EPA 624	µg/L	0.5	-	-	0.120 (<0.07-0.17)	1/2	-	-	*<0.069*	0/2
Dichloromethane	pMCL, EPA PP	EPA 624	µg/L	5	-	-	0.436 (<0.052-0.82)*	1/2	-	-	*<0.052*	0/2
Ethylbenzene	pMCL, EPA PP	EPA 624	µg/L	300	-	-	0.085 (<0.05-<0.12)**	0/2	-	-	*<0.05*	0/2
Tetrachloroethylene	pMCL, EPA PP	EPA 624	µg/L	5	-	-	0.141 (<0.082-<0.2)	0/2	-	-	*<0.082*	0/2
Toluene	pMCL, EPA PP	EPA 624	µg/L	150	-	-	0.07 (<0.04-<0.1)**	0/2	-	-	*<0.04*	0/2
trans-1,2-Dichloroethylene	pMCL	EPA 524.2	µg/L	10	-	-	0.105 (<0.06-<0.15)**	0/2	-	-	*<0.06*	0/2

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
Trichloroethylene	pMCL, EPA PP	EPA 624	µg/L	5	-	-	0.105 (<0.06-<0.15)**	0/2	-	-	*<0.06*	0/2
Trichlorofluoromethane	pMCL	EPA 624	µg/L	150	-	-	0.084 (<0.05-<0.12)**	0/2	-	-	*<0.05*	0/2
Vinyl Chloride	pMCL, EPA PP	EPA 624	µg/L	0.5	-	-	0.145 (<0.07-0.22)*	1/2	-	-	*<0.07*	0/2
Xylenes	pMCL	EPA 624	µg/L	1,750	-	-	0.435 (<0.25-<0.62)**	0/2	-	-	*<0.25*	0/2
MCLs - Non-Volatile Synthetic Organic Chemicals (SOCs)												
Chlordane	pMCL, EPA PP	EPA 608	µg/L	0.1	-	-	0.127 (<0.023-<0.23)**	0/2	-	-	*<0.0023*	0/2
Heptachlor	pMCL, EPA PP	EPA 608	µg/L	0.01	-	-	0.023 (<0.0041-<0.041)**	0/2	-	-	*<0.00041*	0/2
Heptachlor Epoxide	pMCL, EPA PP	EPA 608	µg/L	0.01	-	-	0.014 (<0.0025-<0.025)**	0/2	-	-	*<0.00025*	0/2
Hexachlorobenzene	pMCL	EPA 625	µg/L	1	-	-	*<0.87*	0/2	-	-	*<0.87*	0/2
Methoxychlor	pMCL	EPA 505	µg/L	30	-	-	0.007 (<0.0012-<0.012)**	0/2	-	-	*<0.00012*	0/2
Toxaphene	pMCL, EPA PP	EPA 608	µg/L	3	-	-	0.141 (<0.02-<0.1)**	0/2	-	-	*<0.002*	0/2
DDW Drinking Water Notification Levels												
Boron	NL	EPA 200.7	µg/L	1,000	320 (300-360)	7/7	170 (160-190)	8/8	650 (610-970)	7/7	140 (120-180)	8/8
N-Nitrosodimethylamine (NDMA)	NL, EPA PP, UCMR 2	EPA 625	ng/L	10	-	-	*<0.0036*	0/2	-	-	*<0.0036*	0/2
N-Nitrosodi-n-propylamine (NDPA)	NL, EPA PP, UCMR 2	EPA 625	ng/L	10	-	-	*<0.0017*	0/2	-	-	*<0.0017*	0/2
DDW Drinking Water Archived Advisory Levels												
Aldrin	aNL	EPA 608	µg/L	0.002	-	-	0.0154 (<0.0028-<0.028)**	0/2	-	-	*<0.00028*	0/2

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
Dieldrin	aNL, EPA PP	EPA 608	µg/L	0.002	-	-	0.008 (<0.0014- <0.014)**	0/2	-	-	0.0102 (0.0094-0.011)	2/2
EPA Unregulated Contaminant Monitoring Rule (UCMR) Lists 1 through 3												
Molybdenum	UCMR 3	EPA 200.8	µg/L	--	5.6 (5.1-6.4)	7/7	45.6 (27.7-59.5)	8/8	98.8 (93-101)	7/7	41.55 (23.7-69.3)	8/8
EPA Clean Water Act Priority Pollutants (PPs)												
1,2-diphenylhydrazine	EPA PP, UCMR 1	EPA 625	µg/L	--	-	-	*<0.77*	0/2	-	-	*<0.77*	0/2
2-chloroethyl vinyl ethers	EPA PP	EPA 624	µg/L	--	-	-	*<0.5*	0/2	-	-	*<0.5*	0/2
2-chloronaphthalene	EPA PP	EPA 625	µg/L	--	-	-	*<1.2*	0/2	-	-	*<1.2*	0/2
2,4-dinitrophenol	EPA PP, UCMR 1	EPA 625	µg/L	--	-	-	*<4.2*	0/2	-	-	*<4.2*	0/2
2,4-dinitrotoluene	EPA PP, UCMR 1	EPA 625	µg/L	--	-	-	*<0.82*	0/2	-	-	*<0.082*	0/2
2,4,6-trichlorophenol	EPA PP, UCMR 1	EPA 625	µg/L	--	-	-	*<1.1*	0/2	-	-	*<1.1*	0/2
2,6-dinitrotoluene	EPA PP, UCMR 1	EPA 625	µg/L	--	-	-	*<0.98*	0/2	-	-	*<0.96*	0/2
3,3-dichlorobenzidine	EPA PP	EPA 625	µg/L	--	-	-	*<0.68*	0/2	-	-	*<0.67*	0/2
4-bromophenyl phenyl ether	EPA PP	EPA 625	µg/L	--	-	-	*<0.82*	0/2	-	-	*<0.82*	0/2
4-chlorophenyl phenyl ether	EPA PP	EPA 625	µg/L	--	-	-	*<0.98*	0/2	-	-	*<0.96*	0/2
Acenaphthene	EPA PP	EPA 525.2	µg/L	--	-	-	*<1.2*	0/2	-	-	*<1.2*	0/2
Acrolein	EPA PP, EPA CCL	EPA 624	µg/L	--	-	-	*<2.5*	0/2	-	-	*<2.5*	0/2
Acrylonitrile	EPA PP	EPA 624	µg/L	--	-	-	6.15 (2.3-10)	2/2	-	-	*<1*	0/2

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
Aldrin	EPA PP	EPA 608	µg/L	--	-	-	0.0154 (<0.0028-<0.028)**	0/2	-	-	*<0.00028*	0/2
Benzidine	EPA PP	EPA 625	µg/L	--	-	-	*<1.4*	0/2	-	-	*<1.4*	0/2
Bis(2-chloroethoxy) methane	EPA PP	EPA 8270C	µg/L	--	-	-	*<1.5*	0/2	-	-	*<1.5*	0/2
Bis(2-chloroethyl) ether	EPA PP	EPA E625	µg/L	--	-	-	*<1.2*	0/2	-	-	*<1.2*	0/2
Bis(2-chloroisopropyl) ether	EPA PP	EPA E625	µg/L	--	-	-	*<1.4*	0/2	-	-	*<1.3*	0/2
Chlorobenzene	EPA PP	EPA E624	µg/L	--	-	-	0.085 (<0.05-<0.12)**	0/2	-	-	*<0.005*	0/2
Chlorodibromomethane	EPA PP	EPA E624	µg/L	--	-	-	3.27 (0.74-5.8)	2/2	-	-	*<0.08*	0/2
Chloroethane	EPA PP	EPA 524.2	µg/L	--	-	-	0.545 (<0.31-<0.78)**	0/2	-	-	*<0.31*	0/2
Chloroform	EPA PP	EPA E624	µg/L	--	-	-	38 (11-65)	2/2	-	-	*<0.064*	0/2
Di-N-Butyl Phthalate	EPA PP	EPA 625	µg/L	--	-	-	*<1.5*	0/2	-	-	*<1.4*	0/2
Di-n-octyl phthalate	EPA PP	EPA 625	µg/L	--	-	-	*<1.3*	0/2	-	-	*<1.3*	0/2
Dichlorobromomethane	EPA PP	EPA 624	µg/L	--	-	-	12.25 (1.5-23)	2/2	-	-	*<0.02*	0/2
Diethyl Phthalate	EPA PP	EPA 625	µg/L	--	-	-	*<0.73*	0/2	-	-	*<0.72*	0/2
Dimethyl phthalate	EPA PP	EPA 625	µg/L	--	-	-	*<0.87*	0/2	-	-	*<0.87*	0/2
Endosulfan sulfate	EPA PP	EPA 608	µg/L	--	-	-	*<0.05*	0/2	-	-	*<0.05*	0/2
Endrin	EPA PP	EPA 608	µg/L	--	-	-	*<0.02*	0/2	-	-	*<0.02*	0/2
Endrin aldehyde	EPA PP	EPA 608	µg/L	--	-	-	0.03 (0.053-0.0053)**	0/2	-	-	*<0.00053*	0/2

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
Fluoranthene	EPA PP	EPA 625	µg/L	--	-	-	*<0.87*	0/2	-	-	*<0.87*	0/2
Hexachlorobutadiene	EPA PP	EPA 625	µg/L	--	-	-	*<1.2*	0/2	-	-	*<1.2*	0/2
Hexachloroethane	EPA PP	EPA 625	µg/L	--	-	-	*<1.4*	0/2	-	-	*<1.4*	0/2
Hexachlorocyclopentadiene	EPA PP	EPA 625	µg/L	--	-	-	*<5.8*	0/2	-	-	*<5.8*	0/2
Isophorone	EPA PP	EPA 625	µg/L	--	-	-	*<1.5*	0/2	-	-	*<1.5*	0/2
Lead	EPA PP	EPA 200.8	µg/L	--	*<0.1 (0.1-0.15)**	2/7	0.985 (0.83-2.2)*	8/8	0.19 (0.1-0.22)*	6/7	1.05 (0.9-1.5)*	8/8
Nitrobenzene	EPA PP, UCMR 1	EPA 625	µg/L	--	-	-	*<1.5*	0/2	-	-	*<1.5*	0/2
N-nitrosodiphenylamine	EPA PP, EPA CCL	EPA 625	µg/L	--	-	-	*<0.87*	0/2	-	-	*<0.87*	0/2
Naphthalene	EPA PP	EPA 625	µg/L	--	-	-	*<1.2*	0/2	-	-	*<1.2*	0/2
Additional Constituents												
1,2-Dibromoethane (EDB)	--	EPA 624	µg/L	--	-	-	0.21 (0.12-0.3)**	0/2	-	-	*<0.12*	0/2
2-Methylnaphthalene	--	EPA 625	µg/L	--	-	-	<1.4	0/2	-	-	*<1.4*	0/2
2-Methylphenol (o-cresol)	--	EPA 625	µg/L	--	-	-	<0.92	0/2	-	-	*<0.92*	0/2
2-Nitroaniline	--	EPA 625	µg/L	--	-	-	<6.3	0/2	-	-	*<6.2*	0/2
2,4,5-Trichlorophenol	--	EPA 625	µg/L	--	-	-	<1	0/2	-	-	*<1*	0/2
3 & 4-Methylphenol (m,p-Cresol)	--	EPA 625	µg/L	--	-	-	<0.92	0/2	-	-	*<0.91*	0/2
3-Nitroaniline	--	EPA 625	µg/L	--	-	-	<5.8	0/2	-	-	*<5.8*	0/2
4-Chloro-3-methylphenol	--	EPA 625	µg/L	--	-	-	<1.3	0/2	-	-	*<1.3*	0/2

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
4-Chloroaniline	--	EPA 625	µg/L	--	-	-	<1.6	0/2	-	-	*<1.6*	0/2
4-Nitroaniline	--	EPA 625	µg/L	--	-	-	<5.8	0/2	-	-	*<5.8*	0/2
4,6-dinitro-2-methylphenol	--	EPA 625	µg/L	--	-	-	<4.7	0/2	-	-	4.9 (<4.7-5.1)•	1/2
Bis (2-ethylhexyl) Adipate	--	EPA 625	µg/L	--	-	-	<2.4	0/2	-	-	*<2.4*	0/2
Bis(2-ethyl-hexyl)phthalate	EPA PP	EPA 625	µg/L	--	-	-	13.4 (9.8-17)	2/2	-	-	*<1.6*	0/2
Butylbenzyl Phthalate	EPA PP	EPA 625	µg/L	--	-	-	<1.4	0/2	-	-	*<1.4*	0/2
Chlorinated Phenolics	--	EPA 625	µg/L	--	-	-	<2.4	0/2	-	-	*<2.4*	0/2
cis-1,3-Dichloropropene	--	EPA 624	µg/L	--	-	-	0.16 (0.09-0.23)**	0/2	-	-	*<0.09*	0/2
DDT	EPA PP	EPA 608	µg/L	--	-	-	0.01 (<0.0018-0.018)**	0/2	-	-	0.0103 (0.0084-0.0121)	2/2
Dibenzofuran	--	EPA 625	µg/L	--	-	-	<1.0	0/2	-	-	*<1.0*	0/2
Dichlorobenzenes	EPA PP	EPA 624	µg/L	--	-	-	0.65 (0.08-1.1)**	0/4	-	-	*<0.08*	0/2
Endrin Ketone	--	EPA 608	µg/L	--	-	-	<0.03	0/2	-	-	*<0.00026*	0/2
g-Chlordane	--	EPA 608	µg/L	--	-	-	<0.02	0/2	-	-	*<0.00015*	0/2
Halomethanes	--	EPA 624	µg/L	--	-	-	0.68 (0.16-1.2)	1/2	-	-	*<0.16*	0/2
Hexachlorocyclohexane	--	EPA 608	µg/L	--	-	-	<0.07	0/2	-	-	*<0.0007*	0/2
PAHs	--	EPA 625	µg/L	--	-	-	<1.2	0/2	-	-	*<1.2*	0/2
PCBs	EPA PP	EPA 608	µg/L	--	-	-	<0.38	0/2	-	-	*<0.0038*	0/2

Sampling Constituent	Contaminant List	Analytical Method	Units	DDW MCL/ NL	RTP Effluent		Ag Wash Water		Blanco Drain		Reclamation Ditch	
					Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured	Median (Range)	Detected / Measured
Phenolic compounds (non-chlorinated)	--	EPA 625	µg/L	--	-	-	<8.2	0/2	-	-	*<8.2*	0/2
trans-1,2-Dichloroethene	--	EPA 624	µg/L	--	-	-	0.11 (0.06-0.15)**	0/2	-	-	*<0.06*	0/2
trans-1,3-Dichloropropene	--	EPA 624	µg/L	--	-	-	0.125 (0.07-0.18)**	0/2	-	-	*<0.07*	0/2
Tributyltin	--	GF/FPD	µg/L	--	-	-	<0.014	0/4	*<0.014*	0/4	*<0.01*	0/2

* Laboratory flagged estimated data between DL and MRL were considered for calculating the median and reporting the range of values

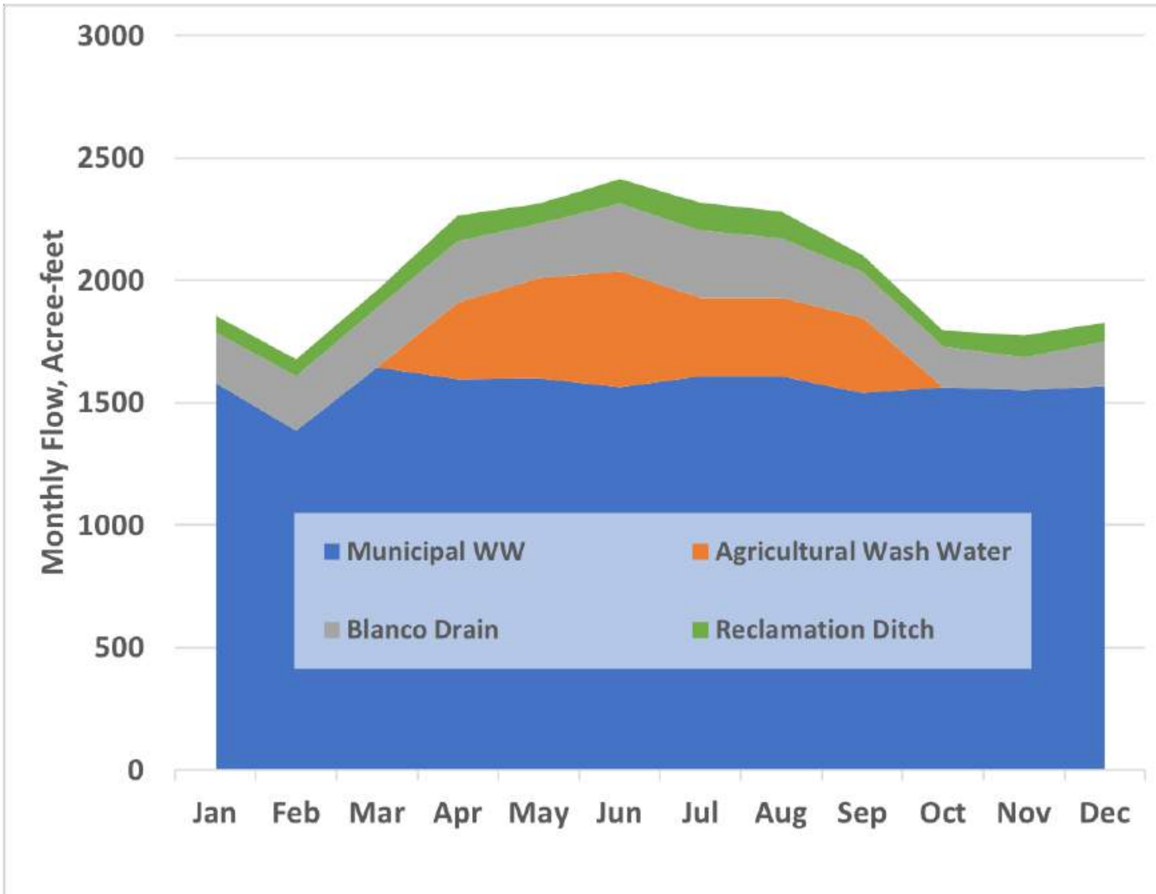
**All samples were ND, but different DLs were reported.

Appendix C

Projected Monthly Flows of Source Waters to the Regional Treatment Plant Influent

RTP Source Water Flow Blends by Scenario and Month (flows in ac-ft per month)

	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Maximum New Source Waters	Municipal WW	1,578	1,387	1,643	1,598	1,601	1,563	1,609	1,610	1,541	1,563	1,551	1,567	18810
	Agricultural Wash Water	0	0	0	309	407	477	318	319	307	0	0	0	2137
	Blanco Drain	209	223	246	252	225	274	277	244	184	168	133	185	2620
	El Estero	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tembladero Slough	0	0	0	0	0	0	0	0	0	0	0	0	0
	Reclamation Ditch	70	66	70	106	79	99	113	109	72	65	89	76	1014
Winter Peaking Operation	Municipal WW	1,578	1,387	1,643	1,598	1,601	1,563	1,609	1,610	1,541	1,563	1,551	1,567	18810
	Ag Wash	0	0	0	309	407	477	318	319	307	0	0	0	2137
	Blanco Drain	0	0	246	252	225	274	277	244	184	168	0	0	1870
	El Estero	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tembladero Slough	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rec Ditch	0	0	70	106	79	99	113	109	72	65	5	0	718



Monthly Blend Composition from Various Source Waters under Phase B, Drought Scenario

See the following reference documents for more information about source waters. These documents are available as Appendices to the *Supplemental Environmental Impact Report for the Proposed Modifications to the Pure Water Monterey Groundwater Replenishment Project, (M1W/DD&A,* November 2019):

- Perkins Coie, 2019. *Water Rights Analysis for Proposed Modifications to the Pure Water Monterey Groundwater Replenishment Project*, October 3.
- Schaaf & Wheeler Consulting Engineers, 2019. *Proposed Modifications to the Pure Water Monterey Groundwater Replenishment Project –Source Water Availability, Yield, and Use.* November 1.

Appendix F

Air Quality and Greenhouse Gas Emissions Impacts Technical Memorandum

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality
429 E. Cotati Ave
Cotati, CA 94931
Tel: 707-794-0400 Fax: 707-794-0405
www.illingworthrodkin.com illro@illingworthrodkin.com

Technical Memo – Air Quality and GHG

Date: October 23, 2019

To: **Denise Duffy**
Denise Duffy & Associates, Inc.
947 Cass St. Suite 5
Monterey, CA. 93940

From: James A. Reyff
Illingworth & Rodkin, Inc.

RE: Expanded Pure Water Monterey Groundwater Replenishment Project - Monterey County, CA

SUBJECT: Air Quality and Greenhouse Gas Emission Impacts Job#19-142

This memo addresses changes to air quality and greenhouse gas emissions associated with the Expanded Pure Water Monterey Groundwater Replenishment Project.

Introduction

The Expanded Pure Water Monterey Groundwater Replenishment Project (PWM/GWR), proposed by MW1, is an expansion of the capacity of the Approved PWM/GWR Project that is currently under construction. As a back-up to the California American (CalAm) Monterey Peninsula Water Supply Project (MPWSP), the Expanded PWM/GWR Project would increase the amount of purified recycled water produced by the PWM/GWR Project. The PWM/GWR Project's Advanced Water Purification Facility (AWPF) would be expanded from the current 5 million gallons per day (mgd) plant to up to a 7.6 mgd maximum capacity plant. The proposed Expanded PWM/GWR Project also includes associated conveyance, injection and extraction facilities.

The PWM/GWR Project Final EIR (certified October 2015) analyzed the air quality and greenhouse gas emissions from the approved project. The CPUC certified the MPWSP EIR/EIS that included an evaluation of air quality and greenhouse gas emissions on September 13, 2018.

Impacts associated with air quality and greenhouse gas emissions were evaluated as part of the PWM/GWR Final EIR; this study is referred to in this memo as the 2015 Air Quality Study. The study identified less-than-significant impacts or less-than-significant impacts with mitigation with respect to both construction and operational period air quality and greenhouse gas emissions. The 2015 Air Quality Study identified Mitigation Measure AQ-1 that is assumed to apply to this project:

> *Mitigation Measure AQ-1: Construction Fugitive Dust Control Plan. (Applies to all Project Component Sites where ground disturbance would occur.)*
>
> *The following standard Dust Control Measures shall be implemented during construction to help prevent potential nuisances to nearby receptors due to fugitive dust and to reduce contributions to exceedances of the state ambient air quality standards for PM10, in accordance with MBUAPCD's CEQA Guidelines.*
>
> a) *Water all active construction areas at least twice daily as required with water (preferably from non-potable sources to the extent feasible); frequency should be based on the type of operation, soil, and wind exposure and minimized to prevent wasteful use of water.*
> b) *Prohibit grading activities during periods of high wind (over 15 mph).*
> c) *Cover all trucks hauling soil, sand, and other loose materials and require trucks to maintain at least 2 feet of freeboard.*
> d) *Sweep daily (with water sweepers) all paved access roads, parking areas, and staging areas at construction sites.*
> e) *Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets;*
> f) *Enclose, cover, or water daily exposed stockpiles (dirt, sand, etc.);*
> g) *Replant vegetation in disturbed areas as quickly as possible.*
> h) *Wheel washers shall be installed and used by truck operators at the exits of the construction sites to the AWT Facility site and the Injection Well Facilities.*
> i) *Post a publicly visible sign that specifies the telephone number and person to contact regarding dust complaints. This person shall respond to complaints and take corrective action within 48 hours. The phone number of the*

Many of the PWM/GWR Project components have been constructed. This memo evaluates the potential air quality and greenhouse gas (GHG) emission impacts that could result from the Expanded GWR Project compared to the 2015 project, including temporary impacts during construction and long-term impacts during operation.

Project Description

The Expanded Pure Water Monterey Groundwater Replenishment Project (PWM/GWR), proposed by MW1, is an expansion of the capacity of the Approved PWM/GWR Project that is currently under construction. As a back-up to the California American (CalAm) Monterey Peninsula Water Supply Project (MPWSP), the Expanded PWM/GWR Project would increase the amount of purified recycled water produced by the PWM/GWR Project. The PWM/GWR Project's Advanced Water Purification Facility would be expanded from the current 5 million gallons per day (mgd) plant to up to a 7.6 mgd maximum capacity plant. The proposed Expanded PWM/GWR

Project also includes associated conveyance, injection and extraction facilities. The Expanded PWM/GWR Project would be located within northern Monterey County and would include facilities located within portions of unincorporated Monterey County and the City of Seaside, and near the City of Marina. This proposed project is referred to as the Expanded PWM/GWR Project and includes the following components:

Advanced Water Purification Facility

The AWPF would be expanded to produce up to 7.6 mgd of recycled water. This would require installation of additional treatment and pumping equipment, chemical storage, pipelines and facility appurtenances within the 3.5-acre existing building area. The AWPF would be modified by installing additional equipment. Construction activities would include cutting, laying, and welding pipelines and pipe connections; pouring concrete footings for foundations, tanks, and other support equipment; installing piping, pumps, storage tanks, and electrical equipment; and testing and commissioning facilities. Construction equipment would include excavators, backhoes, graders, pavers, rollers, bulldozers, concrete trucks, flatbed trucks, boom trucks and/or cranes, forklifts, welding equipment, dump trucks, air compressors, and generators.

Expanded Injection Well Facilities

The approved PWM/GWR Project included four (4) well sites; however, only two (2) of the four (4) approved well sites were constructed based on final design. The two (2) remaining well sites would be relocated as part of the Proposed Expansion Project. More specifically, the locations for the remaining two (2) deep injection wells have been modified from the location originally planned and described in the PWM/GWR Project Final EIR. In addition, the Proposed Modifications also include the construction of an additional well site. The proposed modifications include an increase in the amount of injection to achieve an additional 2,250 AFY of injections. Construction would be similar to the same methods discussed in the PWM/GWR Project Final EIR, involving: (1) Well construction (drilling, logging and installation), (2) Testing and equipment installation, (3) Back-flush pipeline facilities construction, (4) Percolation basins construction, and (5)Motor control/electrical conveyance construction.

Product Water Conveyance Pipeline

The Product Water Conveyance Pipeline consist of the construction of a new product water conveyance pipeline extending from the existing Blackhorse Reservoir to the Expanded Injection Well area. In total the pipeline would be approximately 1 mile to the first injection well and an additional 1/4 mile from well site #5 to well site #7. The pipeline would be a maximum of 30 inches in diameter. Additional pipeline for back-flushing wells would include up to 2,000 feet of additional pipeline. The pipeline would be constructed using open trench methods that would typically involve clearing and grading the ground surface along the pipeline alignment; excavating the trench; preparing and installing pipeline sections; installing vaults, manhole risers, manifolds, and other pipeline components; backfilling the trench with non-expansive fills; restoring preconstruction contours; and revegetating or paving the pipeline alignments, as appropriate. A conventional backhoe, excavator, or other mechanized equipment would be used to excavate trenches. The typical trench width would be 6 feet; however, vaults, manhole risers, and other pipeline components could require wider excavations. Some trench widths may be up to 12 feet.

New CalAm Extraction Wells

The Proposed Modifications include a total of four (4) extraction wells; two at the Seaside Middle School Property (Extraction Well #1 and #2) and two near the Fitch Park Community (Extraction Wells #3 and #4), located southeast of the intersection of General Jim Moore Bouvard and Ardennes Circle. All extraction wells would be constructed with associated appurtenances, electrical works, pipeline tie-ins, access road, and other site works including grading and fencing. Construction of the new facilities for the Extraction Wells would occur using the same methods described in the PWM/GWR Project Final EIR.

Extracted raw water from all four new wells would be conveyed in new raw water pipelines using pipelines in General Jim Moore Boulevard for treatment at the site for Extraction Well #3. The treatment at Extraction Well #3 would include a small building that includes raw and treated water pipelines and appurtenances, chemical delivery, storage, metering, and feed/injection systems, SCADA/electrical instrumentation and controls, and safety and climate control equipment. It is anticipated that construction of the new pipelines would occur using open trench construction methods. Where it is not feasible or desirable to perform open-cut trenching, trenchless methods such as jack-and-bore, drill-and-burst, horizontal directional drilling, and/or microtunneling would be employed. Pipeline segments located within heavily congested underground utility areas would likely be installed using horizontal directional drilling or microtunneling. Jack-and-bore methods may also be used for pipeline segments that cross beneath highways, major roadways, or drainages.

Air Quality Attainment Status and Clean Air Plans

Similar to conditions in 2015, the region is in attainment of all National Ambient Air Quality Standards (NAAQS) and is not subject to any air basin-specific State Implementation Plan (SIP) requirements. The region in considered nonattainment for inhalable Particulate matter (PM10) and Nonattainment-Transitional for ozone with respect to the California Ambient Air Quality standards. As a result, the District continues to document progress toward attaining the State ozone standard through updates to the Air Quality Management Plan (AQMP) first prepared in 1991. The 2016 AQMP (MBARD 2017) is the latest triennial update to the plan. The plan indicates that reducing NOx is "crucial for reducing ozone formation" and that projections indicate lower future NOx emissions both in the air basin and in adjacent air basins where transport of ozone is an issue. The plan also identified fewer exceedances of the ozone standard than in the past.

Significance Thresholds

Appendix G of the CEQA Guidelines published by the California Natural Resources Agency was recently updated in 2019. Under these updated guidelines, a project would have a significant air quality impact if it would:

a) Conflict with or obstruct implementation of the applicable air quality plan;
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the

project region is non-attainment under an applicable federal or state ambient air quality standard;

c) Expose sensitive receptors to substantial pollutant concentrations;
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people;
e) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment; or
f) Conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing emissions of greenhouse gas emissions.

The Monterey Air Resources District (MBARD), formally the Monterey Bay Unified Air Pollution Control District or MBUAPCD, provides guidance in assessing air quality impacts related to proposed projects. In 2008, MBARD adopted CEQA Air Quality Guidelines that included thresholds of significance to assist in the review of projects under CEQA. The significance thresholds, all of which except GHG emissions are adopted thresholds of the MBUAPCD and used in this analysis, are summarized in Table1 and are the same thresholds used in the 2015 Air Quality Study.

MBUAPCD had not adopted significance thresholds for GHG emissions. Therefore, the 2015 Air Quality Study used an interim threshold. In February 2013, MBARD staff presented threshold options to the MBARD Board and an analysis of the options evaluated. In February 2014, MBARD staff proposed the following options for operational significance thresholds for land use projects: (1) a bright-line threshold of 2,000 metric tons CO2e per year, (2) incorporation of mitigation measures to reduce GHG emissions by 16%, or (3) compliance with an applicable adopted GHG reduction plan/climate action plan (Monterey Bay Unified Air Pollution Control District, 2014). There are no adopted GHG reduction plans or climate action plans that would apply to the Proposed Expansion Project; therefore, the third option would not be applicable to the Expanded PWM/GWR Project. A threshold of 10,000 metric tons CO2e per year was recommended for stationary source projects that are subject to MBARD permitting requirements; however, the Expanded PWM/GWR Project is not considered a stationary source project so this threshold would not be applicable to this analysis.

The evidence supporting the MBARD staff recommendations in February 2013 and February 2014 is considered by MRWPCA to constitute substantial evidence. Based on the evidence provided by the MBUAPCD staff recommendation, this EIR first considers whether the Proposed Expansion Project's GHG emissions would be below 2,000 MT of CO_2e per year including amortized construction emissions. If the GHG emissions are determined to be above 2,000 MT of CO_2e per year, this analysis would then consider whether GHG emissions have been reduced at least 16% below business as usual emissions due to alternative energy use and energy efficiency measures. If project GHG emissions are below 2,000 MT of CO2e per year, or if GHG emissions have been reduced at least 16% below business as usual emissions, the project would be considered to have less-than-significant GHG emissions.

Table 1 Air Quality Significance Thresholds

Criteria Pollutant, Precursor or Contaminant	Construction Thresholds Maximum Daily Emissions (lbs./day)	Operational Thresholds Average Daily Emissions (lbs./day)
Criteria Air Pollutants		
Volatile organic compound (VOC) or Reactive Organic Gases (ROG)	Not applicable1	137
Nitrogen oxides (NOx)	Not applicable1	137
Carbon monoxide (CO)	Not applicable1	550[2]
Particulate matter with aerodynamic diameter < 10 micrometers (PM10)		82 (on site)[2]
Sulfur dioxide (SO2)	Not applicable1	150
Toxic Air Contaminants		
Increased cancer risk due to exposure to toxic air contaminants	Greater than one incident per 100,000 population	
Greenhouse Gas Emissions		
Quantified GHG Annual Emissions	2,000 metric tons of Co2eq per year or failure to reduce GHG emissions by 16% using alternative energy, energy efficiency, or other GHG reduction measures [3]	

[1]MBUAPCD applies the emission threshold of 137 pounds per day of ROG or NOx to construction activities that involve non-typical equipment (i.e., grinders, and portable equipment). The District specifies examples of typical equipment as scrapers, tractors, dozers, graders, loaders, and rollers (MBUAPCD, 2008; see page 5-3 at: http://mbuapcd.org/pdf/CEQA_full%20%281%29.pdf). For this project, well construction was the only construction activity assumed to use non-typical equipment not normally used in the District (e.g., drilling rigs).
[2] Emissions exceeding these thresholds are considered significant if dispersion modeling shows that the ambient air quality standard for that pollutant would be exceeded. Since air pollutant dispersion modeling was not conducted for this project, the emissions thresholds are used to judge the significance. This threshold applies to stationary sources, not indirect sources.
[3] See discussion above. Based on the substantial evidence developed and presented by the MBUAPCD staff in February 2013 and 2014, MRWPCA, as lead agency for this EIR, has elected to use these thresholds to determine if the Expanded PWM/GWR Project would make a considerable contribution to significant cumulative global climate change impacts. The Expanded PWM/GWR Project would not have any direct, stationary sources of greenhouse gas emissions during operations.

Approach to Analysis

As identified in the 2015 Air Quality Study for the PWM/GWR Final EIR, the primary source of air pollutant emissions associated with the Proposed Expansion Project would be construction activities for the various project components. The California Emissions Estimator Model or CalEEMod is typically used to predict project construction, operational, and greenhouse gas emissions[1] for land use development projects. Since the PWM/GWR Project is not a typical land use project, use of CalEEMod was found to be inappropriate, because the model does not predict fugitive emissions from trenching/pipeline construction and well drilling. Therefore, the analysis in the 2015 Air Quality Study and this assessment used a spreadsheet analysis using project-specific construction assumptions and applying the most appropriate published emissions factors for the different types of emission-generating activities. The different emission factors used in the analysis were specific to the proposed construction equipment, vehicle emissions (worker and

1 CalEEMod is a statewide land use emissions computer model designed to provide a uniform platform for lead agencies, land use planners, and environmental professionals to quantify potential criteria pollutant and greenhouse gas (GHG) emissions associated with both construction and operation from a variety of land use projects.

truck trips), and fugitive dust from ground disturbances. For the purposes of this assessment, ROG were assumed to be equivalent for VOC in accordance with MBUAPCD guidance. Due to the low ambient concentrations of CO, SO_2, and lead in the Air Basin and the low potential for these emissions from the Proposed Expansion Project, these emissions were considered to not have a significant impact during construction and operation of the project.

Construction Analysis

Construction of the Proposed Expansion Project would generate emissions of criteria pollutants (ROG, NO_X, CO, PM_{10}, $PM_{2.5}$) that would result in short-term effects on ambient air quality in the air quality study area and GHGs (primarily CO_2 and CH_4) that would add to the existing global GHG emissions that cause climate change. Emissions would originate from mobile and portable construction equipment exhaust, construction worker vehicle exhaust, dust from ground disturbances, and electrical transmission. Most of these emissions would be temporary (i.e., limited to the construction period) and would cease when construction activities are completed. The Proposed Expansion Project includes the construction of several project components at various locations lasting approximately 24 months, with some activities occurring concurrently. In addition, there would be about four months at the end of the construction period for some painting, paving, testing and start-up activities. Assuming an average of 21 workdays per month, there would be about 500 workdays of construction activity.

Construction equipment emissions were computed based on the quantity, types, size, and duration of equipment usage. A worksheet for each project construction component was developed that provided the type of equipment, quantity, size, load factor, number of days in use and average hours of usage. This inventory of construction activity was combined with the equipment emissions factors that are used in the CalEEMod Version 2016.3.2 model. These emissions factors are based on CARB's latest OFFROAD model that is used to develop statewide emissions inventories (by county) for various types of construction-type equipment. The emission factors were obtained from the CalEEMod technical appendix (see Appendix D of the CalEEMod User's Guide at www.caleemod.com). Unless specifically known, the horsepower and load factor for each type of equipment was based on the statewide average used in CalEEMod. Construction equipment exhaust emissions were computed for each construction phase of each proposed modification. CalEEMod emissions factors for year 2020 were used in this analysis.

Emissions from construction-related vehicle traffic were computed using emission factors produced by CalEEMod. The CalEEMod emission factors are based on CARB's EMFAC2014 mobile emissions model. These factors were modeled in the spreadsheet to represent annual conditions in Monterey County. Emission factors, which were generated in terms of grams per mile and vehicle trip end emissions, were applied to projected vehicle travel activity for each project component. In the case of ROG, emission factors also included running losses that account for emissions from evaporating fuel and oil while the vehicle is operating. PM_{10} and $PM_{2.5}$ emission factors also include those from brake and tire wear. Emission rates were developed for light-duty trucks (assumed to be worker trips), light-heavy heavy-duty trucks (assumed to be vendor trips), and heavy-heavy duty truck trips assumed to be soil hauling, equipment delivery and cement truck trips. The average distances used by CalEEMod were applied to these trips to estimate vehicle miles traveled. The vehicle activity in terms of trips and miles traveled for each project component were used with the CalEEMod mobile emission factors to generate emissions.

Emissions associated with ground disturbance were developed for area disturbance (e.g., grading and vehicle activity), trenching for pipeline construction, and vehicle travel on unpaved surfaces. These emissions were computed for the maximum daily projected activity. This maximum day was estimated to occur the peak month of overlapping construction (specifically, when the greatest number of sites involving earth moving activities were anticipated to be occurring simultaneously). Area disturbance emissions are those from general ground disturbance at construction sites. This factor was developed by Midwest Research Institute based on an emission factor of 0.11 tons of PM_{10} per acre of disturbance per day. (CARB, 2013) Since this emission factor assumed some level of construction area watering for dust management, the unmitigated emission factor was computed as twice that factor (i.e., watering was assumed to provide 50% control of emissions). This unmitigated area source emission factor was computed at 20 pounds of PM_{10} emitted per disturbed acre per day.

Emissions for pipeline trenching were based on EPA's AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors (EPA, 2006a). The emission factor is based on the amount of material moved (i.e., excavated and then replaced) in cubic yards, mean wind speed, and material moisture content. The amount of material moved was computed based on the length of pipeline that would be constructed in one day times the assumed width of 6 feet and depth of 6 feet. This amount was then doubled to assume soil would be moved twice, once to excavate, and then to either backfill or load in a truck to export. The wind speed was based on that used by CalEEMod of 7.1 miles per hour. While CalEEMod uses a soil moisture content of 7.9%, a drier moisture content of 2.5% was used since the equation was developed for a range of soil conditions from 0.25% to 4.8%. This is a conservative assumption, since soil excavated for pipeline construction is anticipated to be moist (i.e., probably greater than 4.8%) and drier soil would be more likely to become airborne.

Unpaved roadway travel emissions were computed assuming worker and truck travel at all sites of 0.1 miles. The traffic projections for the maximum daily activity construction period were used to compute daily vehicle miles traveled (VMT) for worker and truck trips. Emission factors were based on the EPA's Unpaved Roadway Emission Factor that is based on silt content and vehicle weight (EPA, 2006b). The silt content of 6.9% used by CalEEMod was applied. The average assumed vehicle weight was 16.4 tons for trucks (i.e., 80% weigh 20 tons and 20% weigh 2 tons).

The construction schedule and equipment usage assumptions and emissions calculations are provided in **Attachment 1**.

Operational Analysis

Operation of the Proposed Expansion Project would generate minor emissions of criteria pollutants (ROG, NO_X, CO, PM_{10}, $PM_{2.5}$) that would result in short-term effects on ambient air quality in the air quality study area and GHGs (CO_2, CH_4, and N_2O) that would add to the existing global GHG emissions that cause climate change. Operational emissions include some vehicle trips associated with any commuting workers, maintenance trips, truck deliveries and increased electrical demand of the Proposed Expansion Project facilities and changes to electricity demand due to modifications to treatment and pumping facilities (such as the Advanced Water Treatment Plant facility). There would be no new direct, stationary source emissions due to the Proposed Expansion Project; in the unlikely event that emergency back-up power supplies would be needed, the existing emergency generators owned by MRWPCA would likely be used and these are already tested by MRWPCA as part of treatment plant operations. The project has not identified any emergency generators that would be located at any of the well sites or facilities.

Mobile emissions are assumed to be minor as there would only be a few trips added by the project. These were not computed as they are assumed to be negligible, consistent with the findings of the 2015 Air Quality Study.

GHG emissions from changes in electricity demand were computed based on electrical demand of the new and modified facilities and emission factors for electricity generation. Emissions rates associated with electricity consumption were based on Pacific Gas & Electric utilities (PG&E) projected 2020 CO_2 intensity rate (PG&E, 2013). These rates are based, in part, on the requirement of a renewable energy portfolio standard of 33% by the year 2020. The derived 2020 rate for PG&E was estimated at 290 pounds of CO_2 per megawatt of electricity delivered and is based on the California Public Utilities Commission (CPUC) GHG Calculator. Electricity demand for each component of the project was estimated. This included changes to electricity demand at each of the existing facilities whose use would be modified by the Proposed Expansion Project. Note that PG&E's CO2 emissions rate for all of PG&E's delivered electricity, including power purchased from third parties was 294 pounds per megawatt-hour (PG&E 2018 https://www.pgecurrents.com/2018/03/26/independent-registry-confirms-record-low-carbon-emissions-for-pge/).

Impacts

Conflict with or obstruct implementation of the applicable air quality plan (i.e., updates to the AQMP);

The Pure Water Monterey GWR Project Consolidated Environmental Impact Report found no impact associated with the original project because of the following:

- Overall construction emissions associated with the Project would be consistent with the District's 2016 AQMP, and not be considered significant with respect to District-recommended thresholds;

- The Project would not create any new stationary sources of air pollution that would be inconsistent with air quality management and clean air planning efforts;

- The Project would not result in population growth through development of new residential or commercial uses, and would not induce population growth; and

- The Project would not interfere with attainment of the National Ambient Air Quality Standards, as the air basin does not violate standards and is not subject to a federally enforced air quality attainment or maintenance plan.

The Proposed Expansion Project would have the same findings. An evaluation of construction impacts, described later, indicates emissions would be below the significance thresholds recommended by the District, no new stationary sources that would be inconsistent with District rules, regulations or Clean Air Planning projections are proposed, the Project would continue to serve the projected demand in the area and the air basin continues to attain or maintain the NAAQS.

Impact AQ-1: Construction Criteria Pollutant Emissions. Construction of the Proposed Expansion Project would result in emissions of criteria pollutants, specifically PM_{10}, that may conflict with or obstruct implementation of the applicable air quality plan and may violate an air quality standard or contribute substantially to an existing or projected air quality violation in a region that is non-attainment under State ambient air quality standards. (Less-than-significant with Mitigation previously identified)

Construction Emissions

Construction emissions for each project component were computed and the calculations are provided in **Attachment 1**. The expansion project would include construction activities for the following components:

The Advance Water Treatment Facility, which is currently under construction, would be expanded. Construction of this facility, designed to operate at a peak capacity of 5.0 million gallons per day (mgd), was evaluated in the 2015 Air Quality Study. This project proposes to expand the facility to 7.6 mgd.

Extraction well facilities and extracted water conveyance pipelines would be constructed as part of this expansion project. This includes the construction of 800 feet of pipelines, four extraction wells that include small motor/electrical buildings at each site, along with testing activities.

The expansion project would construct injection well facilities. There would be four deep injection wells, two monitoring wells, a small motor/electrical building at each of the four sites, on-site pipelines, a backflush basin and some access roadway grading.

The expansion project would require additional potable and raw water pipelines to convey the water from the new extraction wells to treatment facilities and to the existing CalAm distribution system. An up to 36-inch pipeline that would be up to approximately 2½ miles in length would be installed in the General Jim Moore Boulevard right of way. The pipeline would be constructed on both paved and unpaved areas. This new potable water pipeline was not included in the Approved PWM/GWR Project.

Total emissions for construction of each proposed modification were computed. Daily emissions were then assessed based on the potential for overlapping activities and compared against MBUAPCD thresholds.

Table 2 Daily Construction Emissions by Project Component

Construction Component	Emissions (lbs/day)			
	ROG	NO_X	PM_{10}	$PM_{2.5}$
Extraction Wells – 2020 through 2021				
Exhaust	3	33	2	1
Fugitive PM	--	--	25	5
Injection Wells – 2020 through 2021				
Exhaust	2	21	1	1
Fugitive PM	--	--	27	5
Advanced Water Treatment Facility Expansion - 2021				
Exhaust	2	31	1	1
Fugitive PM	--	--	7	1
Extraction Pipeline - 2021				
Exhaust	2	21	1	1
Fugitive PM	--	--	4	1
Testing and Cleanup – late 2021				
Exhaust	2	22	1	1

A credible worst-case scenario was evaluated predicting maximum emissions for each year. In 2020, maximum emissions would under the scenario where one injection well and grading of the Backflush Basin could occur simultaneously. In 2021, the highest daily emissions are anticipated during the simultaneous construction of the Advanced Water Treatment Facility expansion interior building construction, extraction well construction, Injection Well building and pipeline construction. Note that drilling, a 24-hour per day operation, would not occur simultaneously at multiple well sites. only at one well site. In 2022, there would be Extraction Well building construction and on-site pipelines along with Conveyance pipeline construction. Testing and cleanup activities would follow completion of that work.

Table 3 Maximum Daily Construction Emissions by Project Component

Construction Component	Maximum Emissions (lbs/day)			
	ROG	NO_X	PM_{10}	$PM_{2.5}$
Injection Well and Back Flush Basin Construction – 2020				
Exhaust and fugitive	9	89	31	9
AWOF Building Interior, Conveyance Pipeline, Extraction Well and Injection Well Building Construction in 2021				
Exhaust and fugitive	12	117	63	15
Extraction Well Building and Pipeline Construction - 2022				
Exhaust and fugitive	3	22	8	2
Testing and Cleanup - 2022				
Exhaust	2	22	1	1

Impact Conclusion

The Expanded PWM/GWR Project construction would not result in a significant impact due to regional emissions of ozone precursors. With implementation of Mitigation Measure AQ-1 identified in the MPWSP EIR/EIS, maximum daily on-site construction PM_{10} emissions were estimated to be 64 pounds per day, which would not exceed the MBUAPCD's threshold of 82 pounds per day.

Impact AQ-2. Construction Exposure of Sensitive Receptors to Pollutant Emissions. Construction of the Expanded PWM/GWR Project would not expose sensitive receptors to substantial pollutant concentrations. (Less than Significant)

Sensitive receptors are locations where an identifiable subset of the general population (such as children, asthmatics, the elderly, and the chronically ill) that are at greater risk than the general population may be exposed to the effects of air pollutants. These locations include residences, schools, playgrounds, childcare centers, retirement homes, hospitals, and medical clinics. Table 4, Nearest Sensitive Receptors and Approximate Distances summarizes the nearest sensitive receptors and approximate distances to each of the Proposed Expansion Project component sites.

Table 4. Nearest Sensitive Receptors and Approximate Distances

Project Component	Type of Receptor	Closest Distance from Project
Advanced Water Purification Facility (AWPF)	Farmhouse on Monte Road	One mile
Product Water Conveyance Pipeline	Residences – Ardennes Circle	300 feet
Expanded Injection Well Facilities	Residences – Ardennes Circle	850 feet
CalAm Extraction Wells 1 and 2	Seaside Middle School	Just north of playfields, >500 feet from classrooms
CalAm Extraction Wells 3 and 4	Residences – Ardennes Circle	<100 feet
CalAm Pipelines	Residences (e.g., Del Monte Boulevard and Marina Drive) and Schools	50-100 feet

As identified in the 2015 Air Quality Study, the Expanded PWM/GWR Project would expose sensitive receptors to temporary emissions of toxic air contaminants while construction takes place in the vicinity of these receptors. The primary concern for nearby sensitive receptors would be exposure to diesel particulate matter emissions from diesel-powered construction equipment and diesel trucks associated with construction activities. Diesel particulate matter is classified as a toxic air contaminant by CARB for the cancer risk associated with long-term (i.e., 70 years) exposure. As shown in Table 4, the nearest receptors to non-pipeline work would be located as close as approximately 25 feet from pipeline work, pipeline construction in residential areas would progress at a rate of about 2,000 feet per day, thus limiting nearby receptors' exposure to diesel particulate matter to several days. Construction at the Regional Treatment Plant and New Injection Wells would be over 850 feet from sensitive receptors, and therefore, not have adverse effects. Construction of new Extraction Wells, EW-1 and EW-2, would be near Seaside Middle School. These wells would be slightly over 500 feet from the nearest classrooms. Extraction Wells EH-3 and EH-4, which would be about 25 feet from residences, were studied under the CalAm Monterey Peninsula Water Supply Project (MPWSP) Final EIR/EIS as ASR Injection Wells (CalAm Project) and found to have less than significant impacts. These findings were based on predictions of increased lifetime cancer risk of less than 10 chances per million.2 The Extraction Wells, EH-1 and EH-2 would be much further from Seaside Middle School receptors, so those same conclusions from the Cal Am Project could be applied to support the findings of a less-than-significant impact in terms of effects to sensitive receptors.

Therefore, a significant cancer risk based on lifetime exposure would not occur due to Expanded PWM/GWR Project construction. Specifically, the cancer risk from the Proposed Expansion Project -associated diesel emissions over a 70-year lifetime would be small and below significance thresholds (10 in one million). Therefore, the impacts related to diesel particulate matter exposure and construction health risk would be less than significant and no additional mitigation measures would be required.

Impact AQ-3: Construction Odors. Construction of the Expanded PWM/GWR Project would not create objectionable odors affecting a substantial number of people. (Less than Significant)

As identified in the 2015 Air Quality Study, there may be intermittent odors from construction associated with diesel exhaust that could be noticeable at times to residences in close proximity. However, given the distance of receptors from most construction sites and the limited construction duration at any one location for pipeline installation, potential odors from construction equipment are not anticipated to result in odor complaints and would not affect a substantial number of people. Odor impacts during construction would be less than significant and no mitigation measures would be required.

Impact AQ-4: Construction Greenhouse Gas Emissions. Construction of the Expanded PWM/GWR Project would generate greenhouse gas emissions, either directly or indirectly, but would not make a considerable contribution to significant cumulative impacts due to greenhouse gas emissions and the related global climate change impacts. (Criterion f) (Less than Significant)

Construction GHG emissions in units of metric tons (MT) of carbon dioxide equivalent (CO_2e) per year were estimated (see modeling worksheets included in **Attachment 1**). Construction of the Proposed Expansion Project would result in a one-time emission total of up to 843 MT of CO_2e during the construction period. The MBUAPCD does not have adopted nor recommended quantified thresholds for assessing the significance of GHG emissions during construction. MBUAPCD staff recommended including construction emissions within operational totals based on the 30-year amortization to provide a full analysis of construction and operational GHG emissions (Clymo, 2014). Accordingly, the total construction period emissions from the Expanded PWM/GWR Project were amortized over a 30-year life and the resulting average annual emissions were added to the annual operational emissions and compared to the GHG significance threshold. The annual amortized GHG emissions are 28 MT/year. Note that some of these emissions were identified in the 2015 Air Quality Study. As explained later under Impact AQ-8, the total GHG emissions from the Proposed Expansion Project would not make a cumulatively considerable

[2] See pages 4.10-27 through 4.10-29 of the MPWSP EIR/EIS.

contribution to significant cumulative impacts associated with GHG emissions and the effects of climate change.

Impact AQ-5: <u>Operational Criteria Pollutant Emissions.</u> Operation of the Expanded PWM/GWR is not expected to increase of criteria pollutants in a cumulatively considerable manner (Less than Significant)

The Expanded PWM/GWR Project would not result in a new stationary source of emissions. Operational emissions due to maintenance truck trips and employee trips would be negligible. Operation of the Project would have a less-than-significant operational air emissions impact.

In the unlikely event of failure of all power supplies at the Advanced Water Purification Facility or well sites, there are provisions to provide electricity from mobile, stand-by diesel generators that are currently used at the RTP in emergencies and are permitted and tested regularly. The Proposed Project would not include any new fixed or stationary generators, nor increased testing of generators. No significant impact would occur due to emissions of criteria pollutants and therefore, no mitigation measures would be required.

Impact AQ-6: <u>Operational Exposure of Sensitive Receptors to Pollutants.</u> Operation of the Expanded PWM/GWR Project would not expose sensitive receptors to substantial pollutant concentrations. (Less than Significant)

Operation of the Expanded PWM/GWR is not anticipated to result in emissions of TACs that could affect sensitive receptors. The Expanded PWM/GWR Projectwould have no direct sources of operational TAC emissions, and vehicular and truck traffic generated by the project would be negligible and spread across the region. Health risks in terms of excess cancer risk or hazards would be less than significant and no mitigation measures would be required.

Impact AQ-7: <u>Operational Odors.</u> Operation of the Expanded PWM/GWR Project would not create objectionable odors affecting a substantial number of people. (Less than Significant)

The expansion of the Expanded PWM/GWR Project includes modifications to the new AWTF at the existing Regional Treatment Plant where treatment-related odors may already be produced. However, the proposed expansion project would add AWT Facility processes that are not anticipated to result in generation of any additional odors.

Impact AQ-8: <u>Operational Greenhouse Gas Emissions.</u> Operation of the Expanded PWM/GWR Project would generate greenhouse gas emissions, either directly or indirectly. These emissions would not exceed significance thresholds such that they would result in a considerable contribution to significant cumulative impacts of greenhouse gas emissions and the related global climate change impacts. In addition, the Expanded PWM/GWR Project would not conflict with applicable plan, policy or regulation adopted for the purpose of reducing greenhouse gas emissions. (Less than Significant)

Once constructed and operational, the Expanded PWM/GWR Project facilities may require new maintenance and employee vehicle trips; however, these would generate relatively small amounts of GHG emissions and are considered to be negligible. Indirect GHG emissions from energy usage at the proposed facilities would occur. Anticipated electricity demand (mWh/year) was provided by the M1W and used to calculate annual GHG emissions using emissions rates published for PG&E's projected 2020 (the first possible full year of operation would be 2022) CO_2 intensity rate.

The increase in project electricity demand, without incorporation of new energy-saving features, was computed as a total of 22,915 mega-watt hours per year (mWh/year). This was considered as the "Business as Usual" emissions. The Expanded PWM/GWR Project facilities would include numerous energy saving features in the design and operation that would reduce energy demand, which in turn would reduce GHG emissions. These include electricity production from cogeneration at the Regional Treatment Plant, a reduction of 2,999 mWh/year, a purchase agreement with the Monterey Regional Waste Management District to obtain electricity generated from biogas (a renewable fuel source), a reduction of 19,871 mWh/year. The cogeneration plant receives biogas from the anaerobic digesters and produces power using internal combustion engines that run on the biogas. Power from the cogeneration plant is used at the treatment plant. The cogeneration plant produces enough power to operate the secondary treatment process and also produces heat that is used in the digestion process. The use of variable flow drivers (VFD motors) on AWT and product water pumps are estimated to reduce electricity demand. There are other features indirectly associated with the project that would reduce overall electricity demand and facility operating costs that were not included in this analysis. For example, the Salinas Valley Reclamation Plant obtains about half of its electricity from on-site solar panels that were constructed after the AB32 greenhouse gas emission reduction requirements went into effect. With incorporation of the Expanded PWM/GWR Project's energy saving features and use of electricity generated from renewable sources, the net increase in electricity demand for the Expanded PWM/GWR Project is estimated to be 45 mWh/year.

As described above under Impact AQ-4C, construction emissions of GHG were also included in the assessment. Total project-related construction GHG emissions of 1,031 MT were amortized over 30 years and that annual amount was added to the annual Expanded PWM/GWR Project operational emissions. Table 5 summarizes computed annual GHG emissions. As shown in Table 5, annual GHG emissions would be below the project specific GHG significance threshold of 2,000 MT CO_2e per year. Therefore, the Expanded PWM/GWR Project would not make a cumulatively considerable contribution to any significant global climate change impacts and, thus, would have a less-than-significant impact due to GHG emissions. No mitigation measures would be required to reduce GHG emissions; however, the Expanded PWM/GWR Project would use electricity generated through the purchase of landfill gas (or biogas), include energy efficient pumps and treatment processes to minimize GHG emissions.

Table 5. Annual GHG Emissions from Operation (metric tons/year CO2)

Project Component	Electricity Demand (mWh/year)	CO2e MT/yr
Total Construction Emissions (2020-2022) = 843 MT or amortized over 30 years		28 MT/year
Total Net New Expanded PWM/GWR Project Electricity Demand	22,915	
New Electricity Demand Emissions – using Cogeneration, Biogas and PG&E	Net increase = 2,999 Cogeneration* 19,871 Biogas* 45 PG&E	6
Total Net New Expanded PWM/GWR Project GHG Emissions	-	34
Project-Specific Significance Threshold	2,000 MT/year or 16% below Business as Usual	
Exceed Threshold?	No	
*Emissions from cogeneration and purchased landfill gas (biogas) are considered renewable energy sources.		

ATTACHMENT 1

Expanded Pure Water Monterey Project

Total Project Construction Emissions

	2020 Computed Emissions (pounds)								
	TOG	ROG	CO	NOX	SO2	PM10 Exhaust	PM2.5 Exhaust	CO2	CH4
Total Pounds									
AWPF		27	0	336	0	15	11	81064	5
Injection Wells		270		2670		128	122	571177	126
Extraction Wells		391		3814		182	174	699252	120
Extraction Pipeline		265		2594		145	135	474614	81
Testing		17		174		11	10	25007	8
Total Metric Tons (GHG)								843	
Amortized over 30 years								28	
Average Pounds/Day									
AWPF (11 days)		2		31		1	1		
Injection Wells (125 days)		2		21		1	1		
Extraction Wells (115 days)		3		33		2	2		
Extraction Pipeline (126 days)		2		21		1	1		
Total (27 months, 594 days)		**2**		**19**		**1**	**1**		
Maximum Pounds/Day 2020									
Injection Wells		8		73		3	3		
Grade Backflush Basin		1		16		1	1		
Fugitive dust						27	5		
		9		89		31	9		
Maximum Pounds/Day 2021									
AWPF Building Interior		5		51		2	2		
Injection Well Buildings		1		6		0	0		
Extraction Well		4		39		2	2		
Injection Well Pipeline		2		21		1	1		
Fugitive dust						57	10		
		12		117		63	15		
Maximum Pounds/Day 2022									
Extraction Well Buildings		1		6		0	0		
Extraction Well Pipelines		2		16		1	1		
Fugitive dust						7	1		
		3		22		8	2		
Maximum Pounds/Day 2022									
Testing (pumping)		2		22		1	1		

Project Name: Pure Water Monterey Groundwater Replenishment

Site Name: Advanced Water Treatment Facility

Includes AWTF, Diversion Structure and pipeline, and the brine mixing faciltiy. Pump station is on the conveyance tab.

See Equipment Type TAB/sheet for type, horsepower and load factor

2020 Computed Emissions (pounds)

Qty	Description	HP	Load Factor	Hours/day	Total Work Days	Annual Hours	Comments		TOG	ROG	CO	NOX	SO2	PM10	PM2.5	CO2	CH4
	Site Preparation	**Start Date:**	**2/1/2021**		2		Any pavement demolished and hauled? _0_ tons										
		End Date:	2/7/2021														
1	Tractors/Loaders/Backhoes	97	0.37	4	2	8			0.2	0.2	2.3	2.1	0.0	0.1	0.1	300.5	0.1
1	Dumpers/Tenders	16	0.38	4	2	8	Assumed in truck traffic calculations		0.1	0.1	0.3	0.5	0.0	0.0	0.0	60.9	0.0
1	Rubber Tired Dozers	255	0.4	4	2	8			1.3	1.1	4.3	11.7	0.0	0.6	0.5	853.4	0.3
									Sum=	1.4		14.3		0.7	0.7	1214.8	0.4
	Grading / Excavation	**Start Date:**	**2/1/2021**						Per Day =	0.7		7.1		0.4	0.3		
		End Date:	2/7/2021				**Soil Hauling Volume**										
1	Tractors/Loaders/Backhoes	97	0.37	4	2	8	Export volume = _510_ cubic yards?		0.2	0.2	2.3	2.1	0.0	0.1	0.1	300.5	0.1
1	Crawler Tractors	208	0.43			0	Import volume = _2,100_ cubic yards?		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Excavators	162	0.38			0	Computed Truck Trips: 326		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Graders	174	0.41			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Rollers	80	0.38			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Rubber Tired Loaders	199	0.36			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Rough Terrain Forklifts	100	0.4			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Dumpers/Tenders	16	0.38			0	Assumed in truck traffic calculations										
	Other Equipment?	0	0			0			**Sum=**	0.2		2.1		0.1	0.1	300.5	0.1
									Per Day =	0.1		1.1		0.1	0.1		
	Building/Facilities	**Start Date:**	**3/1/2021**		5		Cement Trucks? _720_ Total Round-Trips										
		End Date:	3/21/2021				Computed Vendor Truck Trips: 1440										
1	Aerial Lifts	62	0.31	8	5	40	Electric? (Y/N) _Y__ Otherwise assumed diesel		0.2	0.2	5.4	3.2	0.0	0.1	0.1	799.5	0.3
2	Air Compressors	78	0.48	8	5	80	Liquid Propane (LPG)? (Y/N) _N__ Otherwise Assumed diesel		99.0	5.8	48.4	40.7	0.1	2.5	2.5	7498.5	0.5
1	Cement and Mortar Mixers	9	0.56	4	2	8	Or temporary line power? (Y/N) _Y__		0.0	0.0	0.1	0.2	0.0	0.0	0.0	41.5	0.0
2	Concrete/Industrial Saws	81	0.73	4	2	16			13.6	3.0	10.0	18.5	0.0	0.8	0.8	2368.5	0.3
1	Cranes	226	0.29	8	2	16			9.3	0.9	8.2	7.3	0.0	0.4	0.4	1312.6	0.1
1	Forklifts	89	0.2	8	2	16			0.3	0.2	1.1	2.9	0.0	0.1	0.1	296.7	0.1
1	Generator Sets	84	0.74	0	0	0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Graders	174	0.41			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Other Construction Equipment	171	0.42			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Rollers	80	0.38			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Rubber Tired Loaders	199	0.36			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Skid Steer Loaders	64	0.37			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Surfacing Equipment	253	0.3			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Truck-Mounted Pump Rig	84	0.74			0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Welders	46	0.45	8	5	80			2.1	1.8	10.3	17.1	0.0	0.6	0.6	3462.1	1.1
1	Tractors/Loaders/Backhoes	97	0.37	8	5	40			1.5	1.2	10.2	13.0	0.0	0.7	0.6	1486.1	0.5
1	Dumpers/Tenders	16	0.38	8	5	40	Assumed in truck traffic calculations		**Sum=**	13.2		102.8		5.2	5.1	17265.6	2.8
	Other Equipment?	0	0			0			Per Day =	2.6		20.6		1.0	1.0		
	Paving	**Start Date:**	**4/15/2021**		2												
		Start Date:	**4/22/2021**														
1	Cement and Mortar Mixers	9	0.56	8	2	16			0.3	0.1	0.6	0.8	0.0	0.0	0.0	100.9	0.0
1	Graders	174	0.41	8	2	16			22.2	1.0	8.6	8.1	0.0	0.5	0.5	1428.8	0.1
1	Rollers	80	0.38	8	2	16			0.5	0.4	3.8	4.2	0.0	0.3	0.2	507.7	0.2
1	Pavers	125	0.42	8	2	16			0.4	0.3	6.0	4.5	0.0	0.2	0.2	875.1	0.3
1	Paving Equipment	130	0.36	8	2	16			1.2	1.0	3.9	10.7	0.0	0.5	0.5	783.1	0.3
1	Sweepers/Scrubbers	64	0.46	8	2	16			0.4	0.3	1.3	3.5	0.0	0.1	0.1	487.1	0.2
									Sum=	3.2		31.9		1.6	1.5	4182.8	1.0
Traffic					Total	Peak Day			Per Day =	1.6		15.9		0.8	0.8		
	Type	**Total**	**Peak Day**	**Travel Distance**	**VMT**	**VMT**											
	Worker	800	73	10.8	8640	785				1.9		4.2		0.9	0.4	6578.1	0.3
	Delivery (includes cement trucks)	1440	131	7.3	10512	956				5.4		104.9		4.6	2.6	28216.5	0.3
	Large Trucks	326	30	20	6520	593				2.0		75.7		1.7	0.8	23305.9	0.3
					25672	2334				9.3		184.7		7.2	3.8	58100.4	1.0
						0.0909091											
									Total =	**27.3**		**335.7**		**14.9**	**11.2**	**81064.1**	**5.3**

Project Name:		**Pure Water Monterey Groundwater Replenishment**					**Includes injection wells, monitoring wells, backflush basin, connecting pipelines and conduits, road surfacing**										
Site Name:		**Injection Well Facilities**															
	See Equipment Type TAB/sheet for type, horsepower and load factor								2020 Computed Emissions (pounds)								
Qty	**Description**	**HP**	**Load Factor**	**Hours/day**	**Total Work Days**	**Annual Hours**	**Comments**		TOG	ROG	CO	NOX	SO2	PM10	PM2.5	CO2	CH4
	Site Preparation	**Start Date:**	**9/1/2021**		20		Any pavement demolished and hauled? _0_ tons										
	Access Road Grading	**End Date:**	9/30/2021														
1	Graders	174	0.41	6	20	120			7.9	6.6	25.3	88.2	0.1	2.8	2.6	8,963	2.9
1	Rubber Tired Dozers	255	0.4	6	20	120			19.9	16.7	63.9	175.3	0.1	8.6	7.9	12,801	4.2
1	Tractors/Loaders/Backhoes	97	0.37	6	20	120			3.7	3.1	34.2	31.5	0.0	2.0	1.8	4,507	1.5
2	Dumpers/Tenders	16	0.38	6	22	264	Assumed in truck traffic calculations		**Sum=**	26.5		295.1		13.4	12.3	26,271	8.5
	Other Equipment?	0	0			0			Per Day =	1.3		14.8		0.7	0.6		
	Grading / Excavation	**Start Date:**	**10/1/2021**		25												
	Backflush Basin	**End Date:**	12/31/2021				**Soil Hauling Volume**										
1	Tractors/Loaders/Backhoes	97	0.37	5	22	110	Export volume = _1500_ cubic yards?		3.4	2.9	31.3	28.9	0.0	1.8	1.7	4131.9	1.3
1	Excavators	162	0.38	6	25	150	Import volume = _500_ cubic yards?		5.6	4.7	62.8	46.3	0.1	2.2	2.1	9606.0	3.1
1	Graders	174	0.41	3	20	60	Computed Truck Trips: 250		3.9	3.3	12.7	44.1	0.0	1.4	1.3	4481.3	1.5
1	Crawler Tractors	208	0.43	6	10	60			5.1	4.3	18.4	54.8	0.1	2.1	1.9	5590.3	1.8
2	Dumpers/Tenders	16	0.38	7	22	308	Assumed in truck traffic calculations										
1	Rubber Tired Dozers	255	0.4	6	15	90			14.9	12.5	47.9	131.5	0.1	6.4	5.9	9600.4	3.1
	Other Equipment?	0	0			0			**Sum=**	27.7		305.6		14.0	12.9	33,410	10.8
									Per Day =	1.1		12.2		0.6	0.5		
	Trenching/Pipelines	**Start Date:**	**2/1/2021**		40												
		End Date:	4/30/2021				**Material Deliveries (pipeline/conduit)**										
1	Excavators	162	0.38	8	30	240	Deliveries by Tractor-Trailer: _15_		9.0	7.5	100.4	74.1	0.2	3.6	3.3	15369.6	5.0
1	Tractors/Loaders/Backhoes	97	0.37	8	40	320	Deliveries by smaller trucks: _30_		10.0	8.4	91.1	84.1	0.1	5.3	4.9	12019.9	3.9
1	Plate Compactors	8	0.43	6	30	180	Computed Truck Trips: 90		1.1	0.9	4.7	5.6	0.0	0.2	0.2	775.1	0.1
2	Concrete/Industrial Saws	81	0.73	4	30	240			252.7	25.1	221.0	197.7	0.4	11.9	11.9	35528.0	2.3
1	Welders	46	0.45	6	30	180			80.7	7.7	39.7	35.3	0.1	2.0	2.0	4664.1	0.7
1	Dumpers/Tenders	16	0.38	8	30	240	Assumed in truck traffic calculations										
1	Rollers	80	0.38	6	30	180			5.6	4.7	42.6	46.8	0.1	3.0	2.7	5711.4	1.8
	Other Equipment?	0	0			0			**Sum=**	54.2		443.8		25.9	25.0	74,068	13.7
									Per Day =	1.4		11.1		0.6	0.6		
	Building/Facilities	**Start Date:**	**10/1/2020**														
	Deep Injection Wells (1 site)	**End Date:**	10/31/2020				**Material Deliveries (deep wells)**										
1	Tractors/Loaders/Backhoes	97	0.37	4	20	80	Deliveries by Tractor-Trailer: 8		2.5	2.1	22.8	21.0	0.0	1.3	1.2	3005.0	1.0
1	Bucket Auger Drill Rig	600	0.5	12	4	48	Deliveries by smaller trucks: 25		5.4	4.5	33.9	57.3	0.2	1.6	1.5	14807.1	4.8
1	Reverse Rotary Drill Rig	600	0.5	24	7	168	Computed Vendor Truck Trips: 66		18.8	15.8	118.5	200.6	0.6	5.8	5.3	51824.8	16.8
1	Forklifts	89	0.2	6	14	84			1.8	1.5	12.4	13.6	0.0	1.0	0.9	1552.9	0.5
1	Truck-Mounted Pump Rig	84	0.74	24	7	168			203.2	8.9	78.9	74.0	0.1	4.3	4.3	13072.0	0.8
1	Pumps	84	0.74	24	2	48			58.0	2.5	22.6	21.2	0.0	1.2	1.2	3734.9	0.2
1	Generator Sets	84	0.74	8	20	160			161.7	8.0	74.0	69.5	0.1	3.9	3.9	12449.5	0.7
1	Welders	46	0.45	8	10	80			35.9	3.4	17.7	15.7	0.0	0.9	0.9	2072.9	0.3
1	Cranes	226	0.29	10	5	50			3.3	2.8	12.9	32.9	0.0	1.4	1.2	3413.8	1.1
									Sum=	49.5		506.0		21.5	20.6	105932.8	26.1
									Per Day =	2.5		25.3		1.1	1.0		
	Building/Facilities	**Start Date:**							**All Well Sum**	98.9		1011.9		43.0	41.3	211865.6	52.3
	Building/Facilities	**Start Date:**	**4/1/2021**		~~40~~		Cement Trucks? _35_ Total Round-Trips										
	Elec. Buildings (1 added)	**End Date:**	6/30/2021				Computed Vendor Truck Trips: 70										
1	Tractors/Loaders/Backhoes	97	0.37	4	40	160	Electric? (Y/N) _Y_ Otherwise assumed diesel		5.0	4.2	45.6	42.1	0.1	2.7	2.4	6,010	1.9
1	Welders	46	0.45	4	10	40	Liquid Propane (LPG)? (Y/N) _N_ Otherwise Assumed diesel		17.9	1.7	8.8	7.8	0.0	0.4	0.4	1,036	0.2
1	Aerial Lifts	62	0.31	8	15	120	Or temporary line power? (Y/N) _N_		0.7	0.6	16.1	9.5	0.0	0.2	0.2	2,398	0.8
1	Air Compressors	78	0.48	8	5	40			24.7	1.5	12.1	10.2	0.0	0.6	0.6	1,875	0.1
1	Generator Sets	84	0.74	8	30	240	**Material Deliveries (building, typ of 4)**		242.6	12.0	111.1	104.3	0.2	5.9	5.9	18,674	1.1
1	Cement and Mortar Mixers	9	0.56	8	15	120	Deliveries by Tractor-Trailer: _5_		4.3	1.0	3.2	5.9	0.0	0.2	0.2	757	0.1
1	Forklifts	89	0.2	4	15	60	Deliveries by smaller trucks: _30_		1.3	1.1	8.8	9.7	0.0	0.7	0.7	1,109	0.4
1	Concrete/Industrial Saws	81	0.73	4	30	120	Computed Vendor Truck Trips: 70		63.2	6.3	55.2	49.4	0.1	3.0	3.0	8,882	0.6
1	Skid Steer Loaders	64	0.37	4	15	60			0.7	0.6	10.3	7.8	0.0	0.3	0.3	1,477	0.5
	Other Equipment?	0	0			0			**Sum=**	28.8		246.8		14.1	13.8	42,219	5.5
	Other Equipment?	0	0			0			Per Day =	0.7		6.2		0.4	0.3		
									All Well Sum	28.8	0.0	246.8	0.0	14.1	13.8	168,875	22.2
	Paving	**Start Date:**	**6/1/2021**		25												
		Start Date:	**6/30/2021**														
1	Cement and Mortar Mixers	9	0.56	8	3	24			0.9	0.2	0.6	1.2	0.0	0.0	0.0	151	0.0
1	Graders	174	0.41	8	14	112			7.4	6.2	23.6	82.3	0.1	2.6	2.4	8,365	2.7
1	Rollers	80	0.38	8	25	200			6.2	5.2	47.3	52.0	0.1	3.3	3.1	6,346	2.0
1	Tractors/Loaders/Backhoes	97	0.37	8	10	80			2.5	2.1	22.8	21.0	0.0	1.3	1.2	3,005	1.0
2	Paving Equipment	130	0.36	8	25	400			24.3	20.5	249.4	210.7	0.4	10.6	9.7	38820.2	12.5
3	Dumpers/Tenders	16	0.38	8	25	600	Assumed in truck traffic calculations		**Sum=**	34.1		367.2		17.9	16.5	56,688	18.3
									Per Day =	1.4		14.7		0.7	0.7		
Traffic					Total	Peak Day											
	Type	**Total**	**Peak Day**	**Travel Distance**	**VMT**	**VMT**				ROG		NOx		PM10	PM2.5	CO2	CH4
	Worker	1200	10	10.8	12960	104				2.8		6.2		1.4	0.6	9,867	0.5
	Delivery (includes cement trucks)	206	21	7.3	1504	150				0.8		15.0		0.7	0.4	4,037	0.0
	Large Trucks	340	34	20	6800	680				2.1		78.9		1.8	0.9	24,307	0.3
					21264	934			**Sum=**	5.7		100.2		3.8	1.8	38,210	0.9
						0.0439272			Estimated Peak Day	0.2		4.0		0.2	0.1		

Project Name: Pure Water Monterey Groundwater Replenishment

Site Name: Extraction Well Facilities

Includes injection wells, monitoring wells, backflush basin, connecting pipelines and conduits, road surfacing

See Equipment Type TAB/sheet for type, horsepower and load factor

2016 Computed Emissions (pounds)

Qty	Description	HP	Load Factor	Hours/day	Total Work Days	Annual Hours	Comments		TOG	ROG	CO	NOX	SO2	PM10	PM2.5	CO2	CH4
	Site Preparation	**Start Date:**	**9/1/2020**		20		Any pavement demolished and hauled? _**0**_ **tons**										
	Access Road Grading	**End Date:**	9/30/2020														
1	Graders	174	0.41	6	20	120			7.9	6.6	25.3	88.2	0.1	2.8	2.6	8,963	2.9
1	Rubber Tired Dozers	255	0.4	6	20	120			19.9	16.7	63.9	175.3	0.1	8.6	7.9	12,801	4.2
1	Tractors/Loaders/Backhoes	97	0.37	6	20	120			3.7	3.1	34.2	31.5	0.0	2.0	1.8	4,507	1.5
2	Dumpers/Tenders	16	0.38	6	22	264	Assumed in truck traffic calculations		**Sum=**	26.5		295.1		13.4	12.3	26,271	8.5
	Other Equipment?	0	0			0			Per Day =	1.3		14.8		0.7	0.6		
	Trenching/Pipelines	**Start Date:**	**5/1/2021**		10												
		End Date:	7/31/2021				**Material Deliveries (pipeline/conduit)**										
1	Excavators	162	0.38	8	10	80	Deliveries by Tractor-Trailer: _15_		3.0	2.5	33.5	24.7	0.1	1.2	1.1	5,123	1.7
1	Tractors/Loaders/Backhoes	97	0.37	8	10	80	Deliveries by smaller trucks: _30_		2.5	2.1	22.8	21.0	0.0	1.3	1.2	3,005	1.0
1	Plate Compactors	8	0.43	6	10	60	Computed Vendor Truck Trips: 90		0.4	0.3	1.6	1.9	0.0	0.1	0.1	258	0.0
2	Concrete/Industrial Saws	81	0.73	4	10	80			84.2	8.4	73.7	65.9	0.1	4.0	4.0	11842.7	0.8
1	Welders	46	0.45	6	10	60			26.9	2.6	13.2	11.8	0.0	0.7	0.7	1,555	0.2
1	Dumpers/Tenders	16	0.38	8	10	80	Assumed in truck traffic calculations										
1	Rollers	80	0.38	6	10	60			1.9	1.6	14.2	15.6	0.0	1.0	0.9	1,904	0.6
	Other Equipment?	0	0			0			**Sum=**	17.4		140.9		8.2	7.9	23,688	4.3
									Per Day =	1.7		14.1		0.8	0.8		
	Building/Facilities	**Start Date:**	**10/1/2020**		20												
	Extraction Wells (typ of 4)	**End Date:**	2/28/2021				**Material Deliveries (deep wells, typ of 4)**										
1	Tractors/Loaders/Backhoes	97	0.37	4	20	80	Deliveries by Tractor-Trailer: 8		2.5	2.1	22.8	21.0	0.0	1.3	1.2	3,005	1.0
1	Bucket Auger Drill Rig	600	0.5	12	4	48	Deliveries by smaller trucks: 25		5.4	4.5	33.9	57.3	0.2	1.6	1.5	14,807	4.8
1	Reverse Rotary Drill Rig	600	0.5	24	7	168	Computed Vendor Truck Trips: 66		18.8	15.8	118.5	200.6	0.6	5.8	5.3	51,825	7.2
1	Forklifts	89	0.2	6	14	84			1.8	1.5	12.4	13.6	0.0	1.0	0.9	1,553	0.5
1	Truck-Mounted Pump Rig	84	0.74	24	7	168			203.2	8.9	78.9	74.0	0.1	4.3	4.3	13,072	0.8
1	Pumps	84	0.74	24	2	48			58.0	2.5	22.6	21.2	0.0	1.2	1.2	3,735	0.2
1	Generator Sets	84	0.74	8	20	160			161.7	8.0	74.0	69.5	0.1	3.9	3.9	12,450	0.7
1	Welders	46	0.45	8	10	80			35.9	3.4	17.7	15.7	0.0	0.9	0.9	2,073	0.3
1	Cranes	226	0.29	10	5	50			3.3	2.8	12.9	32.9	0.0	1.4	1.2	3,414	1.1
									Sum=	49.5		506.0		21.5	20.6	105,933	16.6
									Per Day =	2.5		25.3		1.1	1.0		
									All Well Sum	197.8	0.0	2023.8	0.0	86.0	82.5	423731.1	66.4
	Building/Facilities	**Start Date:**	**3/1/2021**		~~40~~		Cement Trucks? **35** Total Round-Trips										
	Elec. Buildings (typ of 4)	**End Date:**	7/31/2021				Computed Vendor Truck Trips: 70										
1	Tractors/Loaders/Backhoes	97	0.37	4	40	160	Electric? (Y/N) _Y__ Otherwise assumed diesel		5.0	4.2	45.6	42.1	0.1	2.7	2.4	6,010	1.9
1	Welders	46	0.45	4	10	40	Liquid Propane (LPG)? (Y/N) _N__ Otherwise Assumed diesel		17.9	1.7	8.8	7.8	0.0	0.4	0.4	1,036	0.2
1	Aerial Lifts	62	0.31	8	15	120	Or temporary line power? (Y/N) _N__		0.7	0.6	16.1	9.5	0.0	0.2	0.2	2,398	0.8
1	Air Compressors	78	0.48	8	5	40			24.7	1.5	12.1	10.2	0.0	0.6	0.6	1,875	0.1
1	Generator Sets	84	0.74	8	30	240	**Material Deliveries (building, typ of 4)**		242.6	12.0	111.1	104.3	0.2	5.9	5.9	18,674	1.1
1	Cement and Mortar Mixers	9	0.56	8	15	120	Deliveries by Tractor-Trailer: _5_		4.3	1.0	3.2	5.9	0.0	0.2	0.2	757	0.1
1	Forklifts	89	0.2	4	15	60	Deliveries by smaller trucks: _30_		1.3	1.1	8.8	9.7	0.0	0.7	0.7	1,109	0.4
1	Concrete/Industrial Saws	81	0.73	4	30	120	Computed Vendor Truck Trips: 70		63.2	6.3	55.2	49.4	0.1	3.0	3.0	8,882	0.6
1	Skid Steer Loaders	64	0.37	4	15	60			0.7	0.6	10.3	7.8	0.0	0.3	0.3	1,477	0.5
	Other Equipment?	0	0			0			**Sum=**	28.8		246.8		14.1	13.8	42,219	5.5
	Other Equipment?	0	0			0			Per Day =	0.7		6.2		0.4	0.3		
									All Well Sum	115.2		987.0		56.4	55.1	168,875	22.2
	Paving	**Start Date:**	**8/1/2021**		25												
		Start Date:	**8/31/2021**														
1	Cement and Mortar Mixers	9	0.56	8	3	24			0.9	0.2	0.6	1.2	0.0	0.0	0.0	151	0.0
1	Graders	174	0.41	8	14	112			7.4	6.2	23.6	82.3	0.1	2.6	2.4	8,365	2.7
1	Rollers	80	0.38	8	25	200			6.2	5.2	47.3	52.0	0.1	3.3	3.1	6,346	2.0
1	Tractors/Loaders/Backhoes	97	0.37	8	10	80			2.5	2.1	22.8	21.0	0.0	1.3	1.2	3,005	1.0
2	Paving Equipment	130	0.36	8	25	400			24.3	20.5	249.4	210.7	0.4	10.6	9.7	38820.2	12.5
3	Dumpers/Tenders	16	0.38	8	25	600	Assumed in truck traffic calculations		**Sum=**	34.1		367.2		17.9	16.5	56,688	18.3
									Per Day =	1.4		14.7		0.7	0.7		
Traffic					Total	Peak Day											
	Type	**Total**	**Peak Day**	**Travel Distance**	**VMT**	**VMT**				ROG		NOx		PM10	PM2.5	CO2	CH4
	Worker	2400	21	10.8	25920	225				5.6		12.5		2.7	1.2	19,734	1.0
	Delivery (includes cement trucks)	266	26.6	7.3	1942	194				1.0		19.4		0.8	0.5	5,212	0.1
	Large Trucks	46	4.6	20	920	92				0.3		10.7		0.2	0.1	3,289	0.0
					28782	512				6.9		42.5		3.8	1.8	28,235	1.2
						0.0177741			Estimated Peak Day	0.3		1.7		0.2	0.1		

Extracted Water Conveyance - Pipelines

Product Water Pipeline - RUWAP AWT to BPS

Qty	Description	HP	Load Factor	Hours/day	Total Work Days	Annual Hours
1	Pavers	160	0.42	6	21	126
1	Rollers	90	0.38	6	126	756
1	Backhoe	150	0.37	8	126	1008
1	Excavators	200	0.38	8	126	1008
1	Cranes	200	0.29	6	5	30
0	Jack-and-Bore Rig	350	0.50	8	0	0
1	Loader	90	0.37	8	126	1008
1	Generator	200	0.74	8	126	1008

Notes: Construction would last 6 months. Jack and bore is not anticipated. There would be approximately 21 workdays per month.

2020 Computed Emissions (pounds)

TOG	ROG	CO	NOX	SO2	PM10	PM2.5	CO2	CH4
6.1	5.1	56.1	54.4	0.1	2.6	2.4	8817.4	2.9
26.3	22.1	201.1	221.1	0.3	14.1	13.0	26986.2	8.7
48.5	40.8	443.8	409.8	0.6	25.9	23.8	58550.7	19.0
46.5	39.0	520.7	384.5	0.8	18.6	17.2	79694.1	25.8
1.8	1.5	6.9	17.5	0.0	0.7	0.7	1812.6	0.6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29.1	24.5	266.3	245.9	0.4	15.5	14.3	35130.4	11.4
2426.0	119.6	1110.7	1042.6	2.0	58.8	58.8	186742.6	10.5
Sum=	252.5		2375.8		136.2	130.2	397734.0	78.8

Traffic

Type	Total	Peak Day	avel Distan	Total VMT	Peak Day VMT
Worker	2000	18	10.8	21600	194
Delivery (includes cen	1260	12	7.3	9198	88
Large Trucks	500	12	20	10000	240
				40798	522
					0.012795

	ROG	NOx	PM10	PM2.5	CO2	CH4
	4.6	10.4	2.3	1.0	16445.3	0.9
	4.7	91.8	4.0	2.3	24689.4	0.3
	3.1	116.1	2.6	1.3	35745.2	0.5
Sum=	12.4	218.2	8.9	4.5	76,880	1.7

Project Name: **Pure Water Monterey Groundwater Replenishment**
Site Name: **Advanced Water Treatment Facility**

Includes AWTF, Diversion Structure and pipeline, and the brine mixing faciltiy. Pump station is on the conveyance tab.

See Equipment Type TAB/sheet for type, horsepower and load factor

2020 Computed Emissions (pounds)

Qty	Description	HP	Load Factor	Hours/day	Total Work Days	Annual Hours	Comments		TOG	ROG	CO	NOX	SO2	PM10	PM2.5	CO2	CH4
	Site Preparation	**Start Date:**	**9/1/2021**		8		Any pavement demolished and hauled? _0_ tons										
		End Date:	12/31/2021														
1	Generator Sets	500	0.74	8	8	64			20.5	17.3	187.8	173.5	0.3	11.0	10.1	24783.4	8.0
Traffic					Total	Peak Day											
	Type	**Total**	**Peak Day**	**Travel Distance**	**VMT**	**VMT**											
	Worker	5	5	10.8	54	54				0.0		0.0		0.0	0.0	41.1	0.0
	Delivery (includes cement trucks)	2	2	7.3	15	15				0.0		0.1		0.0	0.0	39.2	0.0
	Large Trucks	2	2	20	40	40				0.0		0.5		0.0	0.0	143.0	0.0
					109	109				0.0		0.6		0.0	0.0	223.3	0.0
						1											
									Total =	**17.3**		**174.1**		**11.0**	**10.1**	**25006.7**	**8.0**

Off Road Equipment Emission Factors from CalEEMod

	Typical Equipment Type & Load Factors			2020								
	OFFROAD Equipment Type	Horsepower	Load Factor	TOG	ROG	CO	NOX	SO2	PM10	PM2.5	CO2	CH4
7	Aerial Lifts	63	0.31	0.136778	0.115	3.1768	1.86859	0.005	0.042	0.038	472.1142	0.153
8	Air Compressors	78	0.48	7.502	0.442	3.67	3.083	0.006	0.19	0.19	568.299	0.039
9	Bore/Drill Rigs	221	0.5	0.169462	0.142	1.06766	1.80732	0.005	0.052	0.048	466.8342	0.151
10	Cement and Mortar Mixers	9	0.56	3.265	0.723	2.397	4.442	0.007	0.187	0.187	568.299	0.065
11	Concrete/Industrial Saws	81	0.73	4.042	0.401	3.535	3.163	0.006	0.19	0.19	568.299	0.036
12	Cranes	231	0.29	0.45669	0.384	1.7904	4.56329	0.005	0.188	0.173	472.9488	0.153
13	Crawler Tractors	212	0.43	0.428471	0.36	1.55491	4.63225	0.005	0.175	0.161	472.941	0.153
14	Crushing/Proc. Equipment	85	0.78	2.348	0.473	3.722	3.249	0.006	0.206	0.206	568.299	0.042
15	Dumpers/Tenders	16	0.38	0.819	0.685	2.339	4.336	0.007	0.165	0.165	568.299	0.061
16	Excavators	158	0.38	0.275327	0.231	3.08597	2.27838	0.005	0.11	0.102	472.2891	0.153
17	Forklifts	89	0.2	0.545921	0.459	3.75954	4.13299	0.005	0.308	0.283	471.5285	0.153
18	Generator Sets	84	0.74	7.383	0.364	3.38	3.173	0.006	0.179	0.179	568.299	0.032
19	Graders	187	0.41	0.41877	0.352	1.34183	4.67787	0.005	0.15	0.138	475.3037	0.154
20	Off-Highway Tractors	124	0.44	0.322507	0.271	3.21511	2.89032	0.005	0.14	0.129	472.9169	0.153
21	Off-Highway Trucks	402	0.38	0.292906	0.246	1.41417	2.34677	0.005	0.086	0.079	474.5787	0.153
22	Other Construction Equipment	172	0.42	0.461441	0.388	3.23528	4.11203	0.005	0.217	0.2	469.9837	0.152
23	Other General Industrial Equipment	88	0.34	0.53075	0.446	3.77073	4.06079	0.005	0.296	0.272	469.9998	0.152
24	Other Material Handling Equipment	168	0.4	0.299922	0.252	3.17089	2.36653	0.005	0.118	0.109	472.2193	0.153
25	Pavers	132	0.42	0.324615	0.273	3.0097	2.91833	0.005	0.142	0.131	472.7746	0.153
26	Paving Equipment	130	0.36	0.294586	0.248	3.02393	2.55498	0.005	0.128	0.118	470.7359	0.152
27	Plate Compactors	8	0.43	0.79	0.661	3.469	4.142	0.008	0.161	0.161	568.299	0.059
28	Pressure Washers	13	0.2	1.78	0.646	3.546	4.516	0.008	0.212	0.212	568.299	0.058
29	Pumps	84	0.74	8.832	0.386	3.432	3.219	0.006	0.189	0.189	568.299	0.034
30	Rollers	80	0.38	0.462004	0.388	3.53135	3.88153	0.005	0.247	0.228	473.8594	0.153
31	Rough Terrain Forklifts	100	0.4	0.225188	0.189	3.25575	2.45218	0.005	0.103	0.094	472.9842	0.153
32	Rubber Tired Dozers	247	0.4	0.737248	0.619	2.37104	6.50332	0.005	0.318	0.293	474.7928	0.154
33	Rubber Tired Loaders	203	0.36	0.345399	0.29	1.26885	3.42116	0.005	0.114	0.104	469.5127	0.152
34	Scrapers	361	0.48	0.380326	0.32	2.40063	3.78254	0.005	0.148	0.136	472.1751	0.153
35	Signal Boards	6	0.82	1.04	0.661	3.469	4.142	0.008	0.161	0.161	568.299	0.059
36	Skid Steer Loaders	65	0.37	0.224183	0.188	3.2771	2.5046	0.005	0.108	0.1	471.9075	0.153
37	Surfacing Equipment	263	0.3	0.173203	0.146	1.21902	1.83755	0.005	0.067	0.062	471.6331	0.153
38	Sweepers/Scrubbers	64	0.46	0.618762	0.52	3.82752	4.4821	0.005	0.36	0.331	474.1157	0.153
39	Tractors/Loaders/Backhoes	97	0.37	0.393883	0.331	3.60147	3.32571	0.005	0.21	0.193	475.1543	0.154
40	Trenchers	78	0.5	0.726229	0.61	3.83272	5.51952	0.005	0.413	0.38	475.1265	0.154
41	Welders	46	0.45	9.83	0.937	4.84	4.304	0.007	0.238	0.238	568.299	0.084

Fugitive Dust Emission Factors

Type = Area

General Grading and Earth Moving Fugitive Dust

	Uncontrolled			Mitigated	
PM10 =	20.0	lbs/acre		7.0	lbs/acre
PM2.5=	4.16	lbs/acre		1.5	lbs/acre

The Midwest Research Instituteidentifed a PM10 fugitive dust emission rate of 0.11 tons/acre/month, which converts to 10 pounds per day. Since the factor includes some watering at sites, it was adjusted assuming 50% control. Sites with best management practices could attain 65% control (with mitigation).

Type = Pipeline/Trench

Fugitive Dust from Excavation and Soil Handling

	pounds PM per ton material	tons material per cubic yard	PM pounds per cubic yard
PM10 =	0.001292763	1.2641662	0.00163427
PM2.5=	0.000195761	1.2641662	0.00024747

Based on AP-42 Emission Factor: EF (lbs/ton) = k (0.0032)(U/5)^1.3 / (M/2)^1.4

Where:

EF = emission rate in pounds PM10 or PM2.5 per ton material handled.

k = particle size multiplier (assumed 0.35 for PM10 and 0.0.053 for PM2.5)

U = mean wind speed (assummed to be 7.1 mph per CalEEMod)

M = material moisture content (assummed 7.9% per CalEEMod for bulldozing).

Type = Road (unpaved)

Unpaved Fugitive Dust From Truck Travel

	Trucks	Workers
PM10 =	2.0	0.8
PM2.5=	0.2	0.1

Based on AP-42 Emission Factor: E (lbs/VMT) = k (s/12)^a (W/3)^b

Where:

E = emission rate in pounds per vehicle mile traveled

k = particle size multiplier (assumed 1.5 lb/VMT for PM10 and 0.15 lb/VMT for PM2.5 per AP-42, Table 13.2.2-2)

a = 0.9

b = 0.45

s = silt content (assumed 6.9% per CalEEMod)

W, truck weight = 80% wiegh 20 tons and 20% weigh 2 tons = 16.4 tons

W, worker vehicle weight = 2 tons

Monterey Peninsula Groundwater Repleneshment Project

Daily Air Pollutant Emissions

Project Component	Worst Day Analysis Daily Dimensions (feet) Length	Width	Size	Units	Emission Type (Area, Pipe. Road)	Unmitigated Emissions Emission Factor (lbs/unit/day) PM10	PM2.5	Mitigated Emissions Emission Factor (lbs/unit/day) PM10	PM2.5
Advanced Water Treatment Facility									
Facility construction	--	--	0.86	acres	Area	17.2	3.6		
Salinas Valley Reclamation Plant pipeline	100	6	267	cy	Pipeline/trench	0.4	0.1		
Truck travel	vehicles =	161	0.10	miles	Road	31.5	3.2		
Worker travel	vehicles =	73	0.10	miles	Road	5.5	0.6		
						54.7	7.4	19.1	2.6
Product Water Conveyance - Pipelines/Pumps									
General Disturbance	400	24	0.22	acres	Area	4.4	0.9		
Material movement	200	12	1067	cy	Pipeline/trench	1.7	0.5		
Truck travel	vehicles =	24	0.10	miles	Road	4.7	0.5		
Worker travel	vehicles =	18	0.10	miles	Road	1.4	0.1		
						12.2	2.1	4.3	0.7
Injection Well Facilities									
Facility Well cluster construction (x4)	100	100	0.23	acres	Area	4.6	1.0		
Back-flush basin	280	150	2.50	acres	Area	50.0	10.4		
Monitoring Well construction (x2)	100	100	0.23	acres	Area	4.6	1.0		
Access Roads to Injection wells (conduit trenching)	250	5	556	cy	Pipeline/trench	0.9	0.3		
Access roads to monitoring wells	100	20	0.05	acres	Area	0.9	0.2		
Access Roads to Injection wells	250	40	0.23	acres	Area	4.6	1.0		
Truck travel	vehicles =	55	0.10	miles	Road	10.8	1.1		
Worker travel	vehicles =	10	0.10	miles	Road	0.8	0.1		
						77.1	14.9	27.0	5.2
Extraction Wells									
Facility Well cluster construction (x4)	100	100	0.23	acres	Area	4.6	1.0		
Station (one of two optional sites)	100	60	0.14	acres	Area	2.8	0.6		
Access Roads to Injection wells	250	40	0.23	acres	Area	4.6	1.0		
Truck travel	vehicles =	32	0.10	miles	Road	6.3	0.6		
Worker travel	vehicles =	21	0.10	miles	Road	1.6	0.2		
						19.8	3.3	6.9	1.1
					Total	**163.8**	**27.6**	**57.3**	**9.7**

Appendix G

Terrestrial Biological Resources Technical Memorandum

PURE WATER MONTEREY

GROUNDWATER REPLENISHMENT PROJECT

EXPANDED CAPACITY PROJECT

Biological Resources Report

October 2019

Prepared by:

Denise Duffy & Associates, Inc.

947 Cass St. Suite 5

Monterey, CA 93940

Prepared for:

Monterey One Water

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APPENDICES

Chapter 1 INTRODUCTION

DENISE DUFFY & ASSOCIATES, Inc. (DD&A) was contracted by the Monterey One Water (M1W) to prepare a Biological Resources Report (report) for the Expanded Pure Water Monterey Project (Proposed Modifications). This report provides the regulatory setting, methodology, and results of the biological surveys conducted in the spring and summer of 2019 for the Proposed Modifications. A Biological Resources Report was developed by DD&A for the *PWM/GWR Project Final EIR (DD&A 2017)*; this report consists of an update to that analysis that is intended to supplement the existing documentation with additional information concerning the potential impacts to biological resources within a Biological Study Area (BSA) that was developed by Monterey One Water (M1W) (Figure 1, Appendix A). The BSA did not include improvements at the Advanced Water Purification Facility. Given that the site is under active construction and has been completely developed it was determined that the Expanded Capacity Project would not have the potential to impact any biological resources at that location.

The BSA intended to include all areas of potential temporary and permanent surface ground disturbance, including areas proposed for construction staging, stockpiling of materials, vehicle travel, and equipment use. The emphasis of this study is to describe existing biological resources within and surrounding the Proposed Modifications, identify any special-status species and sensitive habitats within the project site, assess potential impacts that may occur to biological resources, and recommend the appropriate mitigation measures from the *PWM/GWR Project Final EIR* and the associated Mitigation Monitoring and Reporting Program (MMRP) (DD&A 2015, to reduce those impacts in accordance with the California Environmental Quality Act (CEQA).

1.1 OVERVIEW OF THE PROPOSED MODIFICATIONS

The Proposed Modifications include the following new or modified M1W facilities (Figure 2):

- improvements to the existing PWM/GWR Project Advanced Water Purification Facility (AWPF; adding equipment, pipelines, and storage within the existing plant site);
- up to two miles of new product water conveyance pipelines;
- one new injection well in the Expanded Injection Well Area (commonly referred to as "Expanded Injection Well Area") and associated infrastructure;
- relocation of two approved injection well site and associated infrastructure to the Expanded Injection Well Area; and,
- relocation of previously approved monitoring well sites to the area between the Expanded Injection Well Area and CalAm extraction wells (described below) located along General Jim Moore Boulevard.

In order for CalAm to pump additional groundwater injected by the Proposed Modifications into the Seaside Groundwater Basin and deliver it to meet its system demands, the following CalAm potable water system improvements would be required:

- four new extraction wells and associated infrastructure (e.g., treatment facilities, electrical buildings, etc.), including two new extraction wells located at Seaside Middle School, and two new extraction wells located off General Jim Moore Boulevard[1]; and,

[1] The two (2) new extraction wells located off General Jim Moore Boulevard are located at the site of proposed ASR Wells 5 and

- potable and raw water pipelines along General Jim Moore Boulevard and at the Seaside Middle School site.

Chapter 2 REGULATORY SETTING

2.1 FEDERAL REGULATIONS

As identified above this report is a supplemental to the *PWM/GWR Project Final EIR*, in an effort to simplify these materials only the regulatory setting relevant to the BSA have been identified below.

2.1.1 FEDERAL ENDANGERED SPECIES ACT (ESA)

Provisions of the ESA of 1973 (16 USC 1532 et seq., as amended) protect federally listed threatened or endangered species and their habitats from unlawful take. Listed species include those for which proposed and final rules have been published in the Federal Register. The ESA is administered by the Service or National Oceanic and Atmospheric Administration Marine Fisheries Service (NOAA Fisheries). In general, NOAA Fisheries is responsible for the protection of ESA-listed marine species and anadromous fish, whereas other listed species are under Service jurisdiction.

Section 9 of ESA prohibits the take of any fish or wildlife species listed under ESA as endangered or threatened. Take, as defined by ESA, is "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." Harm is defined as "any act that kills or injures the fish or wildlife…including significant habitat modification or degradation that significantly impairs essential behavioral patterns of fish or wildlife." In addition, Section 9 prohibits removing, digging up, and maliciously damaging or destroying federally listed plants on sites under federal jurisdiction. Section 9 does not prohibit take of federally listed plants on sites not under federal jurisdiction. If there is the potential for incidental take of a federally listed fish or wildlife species, take of listed species can be authorized through either the Section 7 consultation process for federal actions or a Section 10 incidental take permit process for non-federal actions. Federal agency actions include activities that are on federal land, conducted by a federal agency, funded by a federal agency, or authorized by a federal agency (including issuance of federal permits).

2.1.2 CRITICAL HABITAT

Critical habitat is a term defined and used in the federal ESA. It is a specific geographic area that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. An area is designated as "critical habitat" after the United States Fish and Wildlife Service (USFWS) publishes a proposed federal regulation in the Federal Register and then public comments are received and considered on the proposal. The final boundaries of the critical habitat area are also published in the Federal Register. Federal agencies are required to consult with the USFWS on actions they carry out, fund, or authorize to ensure that their actions will not destroy or adversely modify critical habitat. In this way, a critical habitat designation protects areas that are necessary for the conservation of the species.

2.1.3 RECOVERY PLANS

The ultimate goal of the federal ESA is the recovery (and subsequent conservation) of endangered and threatened species and the ecosystems on which they depend. A variety of methods and procedures are used to recover listed species, such as protective measures to prevent extinction or further decline, consultation to avoid adverse impacts of federal activities, habitat acquisition and restoration, and other on-the-ground activities for managing and monitoring endangered and threatened species. The collaborative efforts of the USFWS and its many partners (federal, state, and local agencies, tribal governments, conservation organizations, the business community, landowners, and other concerned citizens) are critical to the recovery of listed species.

2.2 STATE REGULATIONS

2.2.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT

The California Environmental Quality Act (CEQA) was enacted in 1970, modeled after the National Environmental Policy Act (NEPA). CEQA encourages the protection of all aspects of the environment, requiring state and local agencies to prepare multi-disciplinary environmental impact analyses and make decisions based on those studies' findings regarding the environmental effects of the proposed action. CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. CEQA also applies to private activities that require discretionary government approvals.

2.2.2 CALIFORNIA ENDANGERED SPECIES ACT

The California Endangered Species Act (CESA) was enacted in 1984. The California Code of Regulations (Title 14, Section 670.5) lists animal species considered Endangered or Threatened by the state. Section 2090 of CESA requires state agencies to comply with endangered species protection and recovery and to promote conservation of these species. Section 2080 of the Fish and Game Code prohibits "take" of any species that the commission determines to be an Endangered species or a Threatened species. "Take" is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." It does not include habitat destruction in the definition of take. A Section 2081 Incidental Take Permit from the CDFW may be obtained to authorize "take" of any state listed species.

2.2.3 CALIFORNIA FISH AND GAME CODE

Birds: Section 3503 of the Fish and Game Code prohibits the killing, possession, or destruction of bird eggs or bird nests. Section 3503.5 and 3513 prohibit the killing, possession, or destruction of all nesting birds (including raptors and passerines). Section 3503.5 states that it is "unlawful to take, possess, or destroy the nest or eggs of any such bird except otherwise provided by this code or any regulation adopted pursuant thereto." Section 3513 prohibits the take or possession of any migratory nongame birds designated under the federal Migratory Bird Treaty Act (MBTA). Section 3800 prohibits take of nongame birds.

2.2.4 FULLY PROTECTED SPECIES

The classification of Fully Protected was the state's initial effort in the 1960's to identify and provide additional protection to those animals that were rare or faced possible extinction. Lists were created for fish (Section 5515), mammals (Section 4700), amphibians and reptiles (Section 5050), and birds (Section 3511). Most Fully Protected species have also been listed as threatened or endangered species under the more recent endangered species laws and regulations. Fully Protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation of the bird species for the protection of livestock.

2.2.5 SPECIES OF SPECIAL CONCERN

The CDFW also maintains a list of animal "species of special concern." Although these species have no legal status, the CDFW recommends considering these species during analysis of proposed project impacts to protect declining populations and avoid the need to list them as endangered in the future.

2.2.6 NATIVE PLANT PROTECTION ACT

The California Native Plant Protection Act (NPPA) of 1977 directed the CDFW to carry out the legislature's intent to "preserve, protect and enhance rare and endangered plants in the state." The Act prohibits importing rare and endangered plants into California, taking rare and endangered plants, and selling rare and endangered plants. The CESA and NPPA authorized the California Fish and Game Commission to designate endangered, threatened and rare species and to regulate the taking of these species (§2050-2098, Fish and Game Code). Plants listed as rare under the NPPA are not protected under CESA.

2.3 LOCAL REGULATIONS LOCAL REGULATIONS

2.3.1 FORT ORD HABITAT MANAGEMENT PLAN

The U.S. Army's decision to close and dispose of the Fort Ord military base was considered a major federal action that could affect listed species under the ESA. In 1993, USFWS issued a BO on the disposal and reuse of former Fort Ord requiring that an Habitat Management Plan (HMP) be developed and implemented to reduce the incidental take of listed species and loss of habitat that supports these species (USFWS, 1993, updated to USFWS, 2017). The HMP was prepared to assess impacts on vegetation and wildlife resources and provide mitigation for their loss associated with the disposal and reuse of former Fort Ord (United States Army Corps of Engineers [USACOE], 1997).

The HMP establishes guidelines for the conservation and management of species and habitats on former Fort Ord lands by identifying lands that are available for development, lands that have some restrictions with development, and habitat reserve areas. The intent of the plan is to establish large, contiguous habitat conservation areas and corridors to compensate for future development in other areas of the former base. The HMP identifies what type of activities can occur on each parcel at former Fort Ord; parcels are designated as "development with no restrictions," "habitat reserves with management requirements," or "habitat reserves with development restrictions." The HMP sets the standards to assure the long-term viability of former Fort Ord's biological resources in the context of base reuse so that no further mitigation should be necessary for impacts to species and habitats considered in the HMP. This plan has been approved by USFWS; the HMP, deed restrictions, and Memoranda of Agreement between the Army and various land recipients provide the legal mechanism to assure HMP implementation. It is a legally binding document, and all recipients of former Fort Ord lands are required to abide by its management requirements and procedures.

The HMP anticipates some losses to special-status species and sensitive habitats as a result of redevelopment of the former Fort Ord. With the designated reserves and corridors and habitat management requirements in place, the losses of individuals of species and sensitive habitats considered in the HMP are not expected to jeopardize the long-term viability of those species, their populations, or sensitive habitats on former Fort Ord. Recipients of disposed land with restrictions or management guidelines designated by the HMP will be obligated to implement those specific measures through the HMP and through deed covenants.

However, the HMP does not provide specific authorization for incidental take of federal or state listed species to existing or future non-federal land recipients under the ESA or CESA. In compliance with the ESA and CESA, FORA is currently in the process of obtaining a Section 10(a)(1)(B) Incidental Take Permit from USFWS and Section 2081 Incidental Take Permit from CDFW, which will provide base-wide coverage for the take of federal and state listed wildlife and plant species to all non-federal entities receiving land on the former Fort Ord. This process involves the preparation of a Habitat Conservation Plan (HCP). The Draft Fort Ord HCP (ICF International, Inc., 2017) is currently in draft form and being reviewed by the resource agencies. The base-wide incidental take permits are expected to be issued by USFWS and CDFW by the end of 2019.

The BSA is located within designated “development” parcels. Parcels designated as “development” have no management restrictions. However, the 2017 Programmatic BO and HMP require the identification of sensitive botanical resources within the development parcels that may be salvaged for use in restoration activities in reserve areas (USFWS, 2017 and ACOE, 1997).

2.3.2 City of Seaside Municipal Code Chapter 8.54

The City of Seaside Municipal Code Chapter 8.54 (Trees) outlines the policies regarding tree removal and planting. The policies applicable to this Project include Section 8.54.030 (Permit—Required for certain tree removal, alteration or planting), Section 8.54.060 (New construction, development, subdivisions and site plans), and Section 8.54.070 (Replacement of Trees). As outlined in Section 8.54.070, if removal of a tree from a site has been authorized on an undeveloped parcel, the developer shall replace the tree with a minimum five-gallon specimen tree of a species and in a location approved by the board of architectural review, if applicable, or other individual or body responsible for the approval of applicant's plans. This requirement may be modified or waived if it is determined that replacement on one-for-one basis constitutes an unreasonable hardship.

2.4 Special-status Species

Special-status species are those plants and animals that have been formally listed or proposed for listing as endangered or threatened, or are candidates for such listing under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA). Listed species are afforded legal protection under the ESA and CESA. Species that meet the definition of rare or endangered under CEQA Guidelines Section 15380. are also considered special-status species. Animals on the CDFW’s list of “species of special concern” (most of which are species whose breeding populations in California may face extirpation if current population trends continue) meet this definition and are typically provided management consideration through the CEQA process, although they are not legally protected under the ESA or CESA. Additionally, the CDFW also includes some animal species that are not assigned any of the other status designations in the California Natural Diversity Database (CNDDB) “Special Animals” list. The CDFW considers the taxa on this list to be those of greatest conservation need, regardless of their legal or protection status.

Plants listed as rare under the California Native Plant Protection Act (CNPPA) or included listed in California Native Plant Society (CNPS) California Rare Plant Ranks (CRPR, formerly known as CNPS Lists) 1A, 1B, 2A, and 2B are also treated as special-status species as they meet the definitions of Sections 2062 and 2067 of the CESA and in accordance with CEQA Guidelines Section 15380[2]. In general, the CDFW requires that plant species on CRPR 1A (Plants presumed extirpated in California and Either Rare or Extinct Elsewhere), CRPR 1B (Plants rare, threatened, or endangered in California and elsewhere), CRPR 2A (Plants presumed extirpated in California, but more common elsewhere); and CRPR 2B (Plants rare, threatened, or endangered in California, but more common elsewhere) of the CNPS *Inventory of Rare and Endangered Vascular Plants of California* (CNPS, 2019) be fully considered during the preparation of environmental documents relating to CEQA[3]. In addition, species of vascular plants, bryophytes, and lichens listed as having special-status by CDFW are considered special-status plant species (CDFW, 2019a). Species with no formal special-status designation but thought by experts to be rare or in serious

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[2] CNPS initially created five CRPR in an effort to categorize degrees of concern; however, in order to better define and categorize rarity in California’s flora, the CNPS Rare Plant Program and Rare Plant Program Committee have developed the new CRPR 2A and CRPR 2B.

[3] Species on CRPR 3 (Plants about which we need more information – a review list) and CRPR 4 (Plants of limited distribution – a watch list) may, but generally do not, meet the definitions of Sections 2062 and 2067 of CESA, and are not typically considered in environmental documents relating to CEQA. However, this analysis considers species on CRPR 3 or 4 as special-status species when the species is also an HMP species.

decline may also be considered special-status animal species in some cases, depending on project-specific analysis and relevant, localized conservation needs or precedence.

Raptors (e.g., eagles, hawks, and owls) and their nests are protected under both federal and state laws and regulations. The California Fish and Game Code Section 3513 prohibit killing, possessing, or trading migratory birds except in accordance with regulation prescribed by the Secretary of the Interior. Birds of prey are protected in California under Fish and Game Code Section 3503.5. This section states that it is "unlawful to take, possess, or destroy the nest or eggs of any such bird except otherwise provided by this code or any regulation adopted pursuant thereto." In addition, fully protected species under the Fish and Game Code Section 3511 (birds), Section 4700 (mammals), Section 5515 (fish), and Section 5050 (reptiles and amphibians) are also considered special-status animal species. Species with no formal special-status designation but thought by experts to be rare or in serious decline are also considered special-status animal species (CDFW, 2019b).

2.5 SENSITIVE HABITATS

Sensitive habitats include riparian corridors, wetlands, habitats for legally protected species, areas of high biological diversity, areas supporting rare or special-status wildlife habitat, and unusual or regionally restricted habitat types. Vegetation types considered sensitive include those identified as sensitive on the CDFW's list of *California Sensitive Natural Communities* (i.e., those habitats that are rare or endangered within the borders of California) (CDFW, 2010) and those that are occupied by species listed under ESA or are critical habitat in accordance with ESA. Specific habitats may also be identified as sensitive in city or county general plans or ordinances. Sensitive habitats are regulated under federal regulations (such as the Clean Water Act [CWA] and Executive Order [EO] 11990 – Protection of Wetlands), state regulations (such as CEQA and the CDFW Streambed Alteration Program), or local ordinances or policies (such as city or county tree ordinances and general plan policies).

Chapter 3 METHODS

3.1 DATA SOURCES

The primary literature and data sources reviewed in order to determine the occurrence or potential for occurrence of special-status species within the BSA are as follows: current agency status information from the USFWS (Appendix B) and CDFW for species listed, proposed for listing, or candidates for listing as threatened or endangered under the Federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA), and those considered CDFW "species of special concern;" the California Native Plant Society (CNPS) *Inventory of Rare and Endangered Vascular Plants of California* (CNPS, 2019); and the CNDDB RareFind occurrence reports (CDFW, 2019c) (Appendix C). The CNDDB RareFind occurrence reports were reviewed from the Seaside quadrangle and the surrounding quadrangles (Monterey, Marina, Salinas, Spreckels, Soberanes Point, Mt. Carmel, Carmel Valley).

From these resources, a list of special-status plant and wildlife species known or with the potential to occur in the vicinity of the BSA was developed. This list identifies these species along with their regulatory status, habitat requirements, and a brief statement regarding the likelihood for the species to occur (Appendix D).

3.1.1 BOTANY

The generalized vegetation classification schemes for California described by Holland (1986) and Sawyer et al. (2009) were consulted in classifying the vegetation within the BSA. The final classification and characterization of the vegetation within the BSA is based on field observations and the List of Vegetation Alliances and Associations (or Natural Communities List) (Sawyer et al. 2009).

Information regarding the distribution and habitats of local and state vascular plants was also reviewed (Howitt and Howell, 1964 and 1973; Munz and Keck, 1973; Hickman, 1993; Baldwin, et al., 2012; Matthews, 2015; Jepson Flora Project, 2019). All plants observed within the BSA were identified using keys and descriptions in Hickman (1993) and Matthews (2015). Scientific nomenclature for plants in this report follows Baldwin, et al., (2012) and common names follow Matthews (2015). A full botanical inventory was not recorded for the BSA; however, the dominant species within each habitat were recorded and all plant species encountered were identified to the intraspecific taxon necessary to eliminate them as being special-status species.

DD&A conducted focused botanical surveys within the boundaries of the BSA. Due to the timing of the survey effort (spring and summer 2019) occurring early in the design phase of the Expanded Capacity Project, the survey area did not include the entire BSA. This area will be referred to as the Focused Botanical Survey Area (FBSA, Figure 3) for the remainder of this report. The smaller FBSA was surveyed for botanical resources following the applicable guidelines outlined in: *Guidelines for Conducting and Reporting Botanical Inventories for Federally listed, Proposed and Candidate Plants* (USFWS, 2000), *Protocols for Surveying and Evaluating Impacts to Special-status Native Plant Populations and Natural Communities* (CDFW, 2018), and *CNPS Botanical Survey Guidelines* (CNPS, 2001).

3.1.2 WILDLIFE

The following literature and data sources were reviewed: CDFW reports on special-status wildlife (Thomson et. Al., 2016; Remsen, 1978; Williams, 1986; Thelander, 1994); California Wildlife Habitat

Relationships life history accounts and range maps (CDFW, 2019d); and general wildlife references (Stebbins, 2003).

3.2 SURVEY DATES AND PERSONNEL

Numerous biological surveys have been conducted within the BSA in 2019 by DD&A biologists, Matt Johnson, Patric Krabacher, Max Hofmarcher, and Liz Camilo. The dates for each of these surveys are outlined in **Table 1**.

Table 3.2.1 2019 Survey Dates within the BSA

Survey Type	Date(s)
Reconnaissance-level wildlife and general habitat survey	April 19, 22, 23, 24; May 6, 14, 15, 17, 28; July 16, 17, 19; August 7, 12
Focused spring-flowering plant species survey	April 19, 22, 23, 24; May 6, 14, 15, 17, 28
Focused summer-flowering plant species survey	July 16, 17, 19; August 7, 12

3.3 FOCUSED BOTANICAL SURVEY

Prior to conducting focused botanical surveys, an analysis of special-status plant species known to occur within the vicinity was conducted to determine the potential for their presence within the FBSA based on presence of suitable habitats, soils, elevation range, and currently known geographic range. An effort was made to identify local reference populations for species determined to have the potential to occur within the FBSA in order to determine the appropriate survey timing (i.e., peak bloom) for these species. Reference populations were identified for several species, such as Monterey spineflower (*Chorizanthe pungens* var. *pungens*), sand gilia (*Gilia tenuiflora* ssp. *arenaria*), Yadon's piperia (*Piperia yadonii*), Coast wallflower (*Erysimum ammophilum*), Menzie's wallflower (*E. menziesii*), and Seaside bird's-beak (*Cordylanthus rigidus* ssp. *littoralis*). Several perennial shrub species were also determined to have the potential to occur within the FBSA; however, reference locations for these species were not evaluated, as these species can be identified outside of the blooming period. Identified reference populations were checked on an approximately weekly basis from early April until the time of the survey to ensure these species would be in peak bloom during the time of the survey.

DD&A biologists surveyed the FBSA for special-status plant species in accordance with the regulatory protocols identified above. Focused botanical surveys were conducted in March, April, July, and August 2019 during the appropriate blooming period for special-status species likely to be found in their respective habitats. Where identified, the locations of any special-status plant species were mapped using a Trimble® Geo 7x Series global positioning system (GPS) with an external Zephyr Model 2 antenna or delineated on an aerial and digitized in office.

Individual counts were made for all special-status species populations composed of less than 5 individuals. Any populations greater than five were mapped as polygons. Additionally, Monterey Ceanothus (*Ceanothus rigidus*), Sandmat manzanita (*Arctostaphylos pumila*), and Monterey spineflower populations consisting of greater than five individuals were characterized according to the absolute percent of cover. The density classes used for percent cover were:

- Low (< 33 percent absolute cover),
- Medium (33-66 percent absolute cover), and

- High (66-100 percent absolute cover).

GPS data defining the population boundaries and/or point location(s), were exported to shapefile format. Shapefiles were then imported into the Geographic Information System (GIS) ESRI® ArcGIS 10.6 software platform and overlaid on high-resolution aerial photography/satellite imagery and other background data.

3.4 EXISTING ENVIRONMENT

3.4.1 HABITAT TYPES

The BSA is dominated by ruderal/disturbed habitat; but also includes central maritime chaparral, central coastal scrub, coast live oak woodland, and developed habitats (Appendix E). The approximate acreage of each habitat within the BSA is:

- Central Maritime Chaparral – 16.1 Acres
- Central Coastal Scrub – 8.8 Acres
- Coast Live Oak Woodland – 10.2 Acres
- Ruderal/Disturbed – 46.4 Acres
- Developed – 43.4 Acres

These habitat types are consistent with those documented previously in the *PWM/GWR Project Final EIR* therefore detailed descriptions have not been included for them below. Please refer to the *PWM/GWR Project Final EIR* for detailed descriptions of each habitat type. Included below is a discussion of each habitat type's potential for special-status species within the BSA.

3.4.1.1 CENTRAL MARITIME CHAPARRAL

Maritime chaparral is identified as a sensitive habitat on the CNDDB's working list of high priority and rare natural communities (CDFW, 2010). Special-status plant species identified within this habitat type during the 2019 surveys include Monterey spineflower, Monterey gilia, sandmat manzanita, Monterey ceanothus, and Eastwood's goldenbush (Appendix F). Special-status wildlife that may occur within this habitat type include California legless lizard (*Anniella pulchra*)[4], Monterey ornate shrew, coast horned lizard (*Phrynosoma blainvillii*) and Monterey dusky-footed woodrat (*Neotoma macrotis luciana*). Special-status avian may also forage and or nest within this habitat type.

3.4.1.2 CENTRAL COASTAL SCRUB

The following special-status plant species were identified within this habitat type: Monterey spineflower, Monterey gilia, and sandmat manzanita (Appendix F). No special-status wildlife species were observed within this habitat type; however, California legless lizard, coast horned lizard, Monterey dusky-footed woodrat, and Monterey ornate shrew may occur throughout the central coastal scrub within the BSA. Special-status avian may also nest and forage within this habitat type.

3.4.1.3 COAST LIVE OAK WOODLAND

Oak woodlands are considered important natural communities because they provide a variety of ecological, aesthetic, and economic values. The extent of oak woodland in California has declined due to agricultural conversion, urban development, fuel wood harvesting, and grazing activities. Coast live oak woodland is

[4] Includes *A. p. nigra* and *A. p. pulchra* as recognized by the CDFW.

not considered a sensitive habitat by CDFW (CDFW, 2010); however, coast live oak trees and woodland are typically protected under local tree removal ordinances. Kellogg's horkelia (*Horkelia cuneata* ssp. *sericea*) and Monterey spineflower were identified in coast live oak woodland habitat within the BSA (Appendix F). Special-status wildlife species with the potential to occur within this habitat type include Monterey dusky-footed woodrat, Monterey ornate shrew, nesting raptors, and other migratory bird species.

3.4.1.4 RUDERAL/DISTURBED

Special-status wildlife species that may occur in the ruderal habitat areas include the California legless lizard and coast horned lizard, particularly in the open, sandy areas. Raptors may forage and nest within trees that occur within and adjacent to ruderal areas within the BSA. (Appendix D). Special-status plant species identified within the ruderal/developed areas of the BSA include Monterey spineflower, Kellogg's horkelia, Monterey gilia, Monterey ceanothus, Eastwood's goldenbush, and sandmat manzanita (Appendix F).

3.5 SURVEY RESULTS

3.5.1 SPECIAL-STATUS PLANT SPECIES

Surveys for special-status plant species were conducted within the FBSA as described above. Six special-status plant species were identified within the FBSA (Appendix F). All other potential special-status plant species identified in Appendix D are assumed not present based upon the results of the focused botanical surveys.

- **Sandmat manzanita** – CNPS List 1B[5],
- **Monterey ceanothus** – CNPS List 4,
- **Monterey spineflower** – FT/CNPS List 1B,
- **Eastwood's goldenbush** – CNPS List 1B,
- Kellogg's horkelia – CNPS List 1B, and
- **Sand gilia** – FE/ST/CNPS List 1B

A short description of each special-status plant species, including the number of known CNDDB occurrences within the quadrangles analyzed and the total area documented within the FBSA is presented below and in Table 3.5.1.

Table 3.5.1 Special-Status Plant Species Documented within the FBSA

Scientific Name	**Common Name**	**Listing Status**	**Polygons Within FBSA (Acre)**	**Points Within FBSA (Individual Plants)**
Arctostaphylos pumila	Sandmat manzanita	CNPS List 1B, HMP	6.4	6(10)
Ceanothus rigidus	Monterey ceanothus	CNPS List 4, HMP	9.5	48(60)
Chorizanthe pungens var. *pungens*	Monterey spineflower	FT/CNPS List 1B, HMP	1.3	308(621)
Ericameria fasciculata	Eastwood's goldenbush	CNPS List 1B, HMP	2.6	8(14)
Horkelia kellogii	Kellogg's horkelia	CNPS List 1B	0.4	35(78)

[5] FE: Federally Endangered; SE: State Endangered; SSC: California Species of Special Concern; CFP: California Fully Protected; CNPS List 1B: California Native Plant Society List 1B Species (rare, threatened, or endangered in California and elsewhere); CNDDB: species on the CDFW's "Special Animals" list. **Bold text** indicates HMP Species.

Gilia tenuiflora ssp. *arenaria*	Monterey gilia	FE/ST/CNPS List 1B, HMP	0.1	23(31)

3.5.1.1 Sandmat Manzanita

Sandmat manzanita is a CNPS CRPR 1B and Fort Ord HMP species. This evergreen shrub in the Ericaceae family blooms from February to May. Sandmat manzanita is associated with openings in chaparral, central coastal scrub, closed cone coniferous forest, coastal dunes, and cismontane woodland habitats on sandy soils at elevations between 3-205 meters.

The CNDDB reports 17 occurrences of this species in the eight quadrangles reviewed, two of which include portions of the FBSA. DD&A documented eight polygons (all with a cover class of low) of sandmat manzanita, totaling approximately 6.4 acres and six points (10 individuals) within the FBSA.

3.5.1.2 Monterey Ceanothus

Monterey ceanothus is a CNPS CRPR 4 and Fort Ord HMP species. This evergreen shrub in the Rhamnaceae family blooms from February to April (sometimes through June). This species is associated with closed-cone coniferous forests, chaparral, and central coastal scrub on sandy soils at elevations between 3-550 meters.

The CNDDB does not report any occurrences of this species within the eight quadrangles reviewed; however, it is known to occur throughout Fort Ord. DD&A documented 16 polygons (three high, six medium, and seven low cover class) of Monterey ceanothus, totaling approximately 9.5 acres and 48 points (60 individuals) within the FBSA.

3.5.1.3 Monterey Spineflower

Monterey spineflower is a federally threatened, CNPS CRPR 1B, and Fort Ord HMP species. There is designated critical habitat in the vicinity of the FBSA and a recovery plan has been approved for this species. It is a small, prostrate annual herb in the Polygonaceae family that blooms from April to June. The white to rose floral tube of Monterey spineflower distinguishes it from the more common, but closely related, diffuse spineflower (*Chorizanthe diffusa*), which has a lemon-yellow floral tube. Monterey spineflower typically occurs on open sandy or gravelly soils on relic dunes in coastal dune, central coastal scrub, and central maritime chaparral habitats, though it can also be associated with cismontane woodlands and valley and foothill grasslands, within a range of 3-450 meters in elevation.

The CNDDB reports 18 occurrences of this species in the eight quadrangles reviewed. DD&A documented 156 polygons (four medium and 152 low cover class) of Monterey ceanothus, totaling approximately 1.3 acres and 308 points (621 individuals) within the FBSA.

3.5.1.4 Eastwood’s Goldenbush

Eastwood’s goldenbush is a CNPS CRPR 1B and Fort Ord HMP species. This evergreen shrub in the Asteraceae family blooms from July to October. Eastwood’s goldenbush is associated with openings in maritime chaparral, central coastal scrub, closed cone coniferous forest, and coastal dune habitats on sandy soils at elevations between 30-275 meters.

The CNDDB reports 12 occurrences of this species in the eight quadrangles reviewed. DD&A documented five polygons (all low cover class) of Eastwood's goldenbush, totaling approximately 2.6 acres and 8 points (14 individuals) within the FBSA.

3.5.1.5 KELLOGG'S HORKELIA

Kellogg's horkelia is a CNPS CRPR 1B species. It is a perennial herb in the Rosaceae family and blooms April through June. Kellogg's horkelia is typically associated with openings in closed cone coniferous forest, maritime chaparral, and central coastal scrub in sandy or gravelly soils on relic dunes, within a range of 10-200 meters in elevation.

The CNDDB reports 17 occurrences of Kellogg's horkelia in the eight quadrangles reviewed. DD&A documented 10 polygons of Kellogg's horkelia, totaling approximately 0.4 acre and 23 points (31 individuals) within the FBSA.

3.5.1.1 MONTEREY GILIA

Monterey gilia is a federally Endangered, state Threatened, and CNPS CRPR 1B species. This annual herb in the Polemoniaceae blooms from April through June and is found in sandy openings of maritime chaparral, cismontane woodland, coastal dune and central coastal scrub habitats within the range of 0-45 meters in elevation.

The CNDDB reports 26 occurrences of Monterey gilia in the eight quadrangles reviewed. DD&A documented 22 polygons of Monterey gilia, totaling approximately 0.1 acre and 35 points (78 individuals) within the FBSA.

3.5.2 SPECIAL-STATUS WILDLIFE SPECIES

The special-status species in the following section are discussed due to their potential or known presence within the BSA and potential to be impacted by the Proposed Modifications. Suitable habitat for six special-status wildlife species is present within and/or immediately adjacent to the BSA.

- Cooper's hawk (*Accipiter cooperii*) – CNDDB,
- **California legless lizard**[6] – SSC,
- Coast horned lizard – SSC,
- Monterey dusky-footed woodrat – SSC,
- **Monterey ornate shrew** (*Sorex ornatus salarius*) – SSC, and
- American badger **(***Taxidea taxus*) – SSC.

In addition, trees and shrubs throughout the site may provide nesting habitat for raptor and other avian species protected under California Fish and Game Code, such as red-tailed, red-shouldered hawk (*Buteo lineatus*), great horned owl, American kestrel (*Falco sparverius*), and turkey vulture(*Cathartes aura*). CDFW Code 3503 prohibits take, possession, and needless destruction of nests or eggs of any bird and avoidance.

Migratory bird species that may be nesting within the BSA include, but are not limited to, common poorwill, western meadowlark (*Sturnella neglecta*), Townsend's warbler (*Setophaga townsendii*), black phoebe (*Sayornis nigricans*), white-crowned sparrow (*Zonotrichia aleucophrys*), California thrasher (*Toxostoma*

[6] **Bold text** indicates HMP Species.

redivivum), ash-throated fly catcher (*Myiarchus cinerascens*), tree swallow (*Tachycineta bicolor*), and horned lark (*Eremophila alpestris*).

DD&A observed coast horned lizards within portions of the BSA that were classified as central maritime chaparral and central coast scrub. Monterey dusky-footed woodrat nests were observed within the densely vegetated portions of central coast scrub, central maritime chaparral, oak woodland and ruderal habitat types throughout the BSA.

Chapter 4 IMPACTS AND MITIGATION

This section describes the methods used to analyze potential terrestrial biological resources impacts of the Proposed Modifications. This impact analysis addresses direct and indirect impacts that may result from the construction of the Proposed Modifications. Direct impacts are those effects of a project that occur at the same time and place of project implementation, such as removal of habitat from ground disturbance. Indirect impacts are those effects of a project that occur either later in time or at a distance from the BSA but are reasonably foreseeable. Direct and indirect impacts can also vary in duration and result in temporary, short-term, and long-term effects on biological resources. A temporary effect would occur only during an activity that would happen for a short period of time, then end. A short-term effect would last from the time an activity ceases to some intermediate period of approximately one to five years (i.e., repopulation of habitat following restoration). A long-term or permanent effect would last longer than 5 years after an activity ceases. Long-term effects may result from ongoing maintenance and operation of a project, or may result from a permanent change in the condition of a resource, in which case it could be considered a permanent impact.

4.1 IMPACT ANALYSIS APPROACH

4.1.1 CONSTRUCTION IMPACTS

This impact analysis assumes that the construction activities would be limited to the BSA. The Proposed Modifications would result in the construction of a variety of permanent features required for operation, including, but not limited to, pipelines, pump stations, a water treatment facility, and Injection Well Facilities. Some components would be located underground (e.g., pipelines) and, therefore, construction activities may result in temporary, short-term impacts to biological resources but would not result in long-term permanent impacts. For the above-ground Proposed Modifications construction activities would potentially result in permanent, long-term impacts to biological resources.

4.1.2 HMP SPECIES

All of the BSA is located within parcels designated by the HMP as “development.” Through implementation of the HMP, impacts to HMP species and habitats occurring within the designated development parcels were anticipated and mitigated through the establishment of habitat reserves and corridors, and the implementation of habitat management requirements within habitat reserve parcels on former Fort Ord. As described in the Regulatory discussion above, parcels designated as “development” have no management restrictions. However, the Biological Opinion (BO) and HMP require the identification of sensitive biological resources within these parcels that may be salvaged for use in restoration activities in reserve areas.

The HMP species known or with the potential to occur within the BSA include Monterey spineflower, sandmat manzanita, Monterey ceanothus, Eastwood’s goldenbush, Monterey gilia, California legless lizard, and Monterey ornate shrew. With the designated habitat reserves and corridors and habitat management requirements of the HMP in place, the loss of one or more individuals of these species is not expected to jeopardize the long-term viability of these species and their populations on the former Fort Ord (USFWS, 1993). This is because the recipients of disposed land with restrictions or management guidelines designated by the HMP would be obligated to implement those specific measures through the HMP and deed covenants. In addition to the HMP species identified, impacts to sensitive central maritime chaparral habitat are also addressed in the HMP and, therefore, impacts to this habitat are also considered mitigated through the implementation of the HMP based on the same conclusions. Because the project is: 1) only proposing development activities within designated development parcels; 2) required to comply with the habitat management restrictions identified in the HMP; and 3) would not result in any additional impacts to HMP species and habitats beyond those anticipated in the HMP, no additional mitigation measures for these HMP species or central maritime chaparral habitat are required, with the exception of State-listed plant species. Impacts to these special-status species and central maritime chaparral are considered less-than-significant. However, because the BO and HMP require the identification of sensitive biological resources within development parcels that might be salvaged for use in restoration activities in reserve areas, additional mitigation measures are identified where appropriate to comply with and ensure consistency with the BO and HMP.

The one exception to this is the State-listed Monterey gilia. Impacts to this species will require compliance with CESA. Additional Mitigation Measures are described below if impacts to this species cannot be avoided.

4.2 IMPACTS AND MITIGATION MEASURES IDENTIFIED IN THE FEIR

This impact analysis was prepared in support of the Supplemental Environment Impact Report for the Expanded Pure Water Monterey Groundwater Replenishment Project. Listed below are the applicable impacts and the corresponding mitigation measures from the *PWM/GWR Project Final EIR* and the associated Mitigation Monitoring and Reporting Program (MMRP) (DD&A 2015).

4.2.1 IMPACT BT-1: CONSTRUCTION IMPACTS TO SPECIAL-STATUS SPECIES AND HABITAT.

Proposed construction may adversely affect, either directly or through habitat modification, special-status plant and wildlife species and their habitat within the BSA. (Less Than Significant with Mitigation)

Construction of the Proposed Modifications could result in direct and indirect impacts to special-status plant and wildlife species. Impacts to special-status species would occur due to use of heavy equipment and other construction activities that could result in the loss of individuals, soil compaction, dust, vegetation removal/loss of habitat, wildlife harassment or mortality, root damage, erosion, destruction or disturbance of nests, and introduction and spread of non-native, invasive species.

In addition, nighttime construction activities could introduce temporary nighttime lighting at the Proposed Modifications. The majority of construction activities would occur during the daytime and would not result in new or increased sources of light or glare. However, extended work hours into the night could be necessary during construction of certain components.

Impact Conclusion

The Proposed Modifications could result in impacts to special-status species due to construction activities within the BSA. Impacts to special-status species would be considered a significant impact. Implementation of Mitigation Measures BT-1a through BT- 1f, BT-1h through BT-1k, and BT-1m would reduce potentially significant impacts to special-status species during construction to a less-than-significant level.

Mitigation Measures

Mitigation Measure BT-1a: Implement Construction Best Management Practices.

The following best management practices shall be implemented during all identified phases of construction (i.e., pre-, during, and post-) to reduce impacts to special-status plant and wildlife species:

1. A qualified biologist must conduct an Employee Education Program for the construction crew prior to any construction activities. A qualified biologist must meet with the construction crew at the onset of construction at the site to educate the construction crew on the following: 1) the appropriate access route(s) in and out of the construction area and review project boundaries; 2) how a biological monitor will examine the area and agree upon a method which would ensure the safety of the monitor during such activities, 3) the special-status species that may be present; 4) the specific mitigation measures that will be incorporated into the construction effort; 5) the general provisions and protections afforded by the USFWS and CDFW; and 6) the proper procedures if a special-status species is encountered within the site.

2. Trees and vegetation not planned for removal or trimming shall be protected prior to and during construction to the maximum extent possible through the use of exclusionary fencing, such as hay bales for herbaceous and shrubby vegetation, and protective wood barriers for trees. Only certified weed-free straw shall be used, to avoid the introduction of non-native, invasive species. A biological monitor shall supervise the installation of protective fencing and monitor at least once per week until construction is complete to ensure that the protective fencing remains intact.

3. Protective fencing shall be placed prior to and during construction to keep construction equipment and personnel from impacting vegetation outside of work limits. A biological monitor shall supervise the installation of protective fencing and monitor at least once per week until construction is complete to ensure that the protective fencing remains intact.

4. Following construction, disturbed areas shall be restored to pre-construction contours to the maximum extent possible and revegetated using locally-occurring native species and native erosion control seed mix, per the recommendations of a qualified biologist.

5. Grading, excavating, and other activities that involve substantial soil disturbance shall be planned and carried out in consultation with a qualified hydrologist, engineer, or erosion control specialist, and shall utilize standard erosion control techniques to minimize erosion and sedimentation to native vegetation (pre-, during, and post-construction).

6. No firearms shall be allowed on the construction sites at any time.

7. All food-related and other trash shall be disposed of in closed containers and removed from the project area at least once a week during the construction period, or more often if trash is attracting avian or mammalian predators. Construction personnel shall not feed or otherwise attract wildlife to the area.

8. To protect against spills and fluids leaking from equipment, the project proponents shall require that the construction contractor maintains an on-site spill plan and on-site spill containment measures that can be easily accessed.

9. Refueling or maintaining vehicles and equipment should only occur within a specified staging area that is at least 100 feet from a waterbody (including riparian and wetland habitat) and that has sufficient management measures that will prevent fluids or other construction materials including water from being transported into waters of the state. Measures shall include confined concrete washout areas, straw wattles placed around stockpiled materials and plastic sheets to cover materials from becoming airborne or otherwise transported due to wind or rain into surface waters.

10. The project proponents and/or their contractors shall coordinate with the City of Seaside on the location of Injection Well Facilities and the removal of sensitive biotic material.

Mitigation Measure BT-1b: Implement Construction-Phase Monitoring.

> The project proponents shall retain a qualified biologist to monitor all ground disturbing construction activities (i.e., vegetation removal, grading, excavation, or similar activities) to protect any special-status species encountered. Any handling and relocation protocols of special-status wildlife species shall be determined in coordination with CDFW prior to any ground disturbing activities and conducted by a qualified biologist with appropriate scientific collection permit. After ground disturbing project activities are complete, the qualified biologist shall train an individual from the construction crew to act as the on-site construction biological monitor. The construction biological monitor shall be the contact for any special-status wildlife species encounters, shall conduct daily inspections of equipment and materials stored on site and any holes or trenches prior to the commencement of work, and shall ensure that all installed fencing stays in place throughout the construction period. The qualified biologist shall then conduct regular scheduled and unscheduled visits to ensure the construction biological monitor is satisfactorily implementing all appropriate mitigation protocols. Both the qualified biologist and the construction biological monitor shall have the authority to stop and/or redirect project activities to ensure protection of resources and compliance with all environmental permits and conditions of the project. The qualified biologist and the construction monitor shall complete a daily log summarizing activities and environmental compliance throughout the duration of the project. The log shall also include any special-status wildlife species observed and relocated.

Mitigation Measure BT-1c: Implement Non-Native, Invasive Species Controls.

The following measures shall be implemented to reduce the introduction and spread of non-native, invasive species:

1. Any landscaping or replanting required for the project shall not use species listed as noxious by the California Department of Food and Agriculture (CDFA).
2. Bare and disturbed soil shall be landscaped with CDFA recommended seed mix or plantings from locally adopted species to preclude the invasion on noxious weeds in the BSA.
3. Construction equipment shall be cleaned of mud or other debris that may contain invasive plants and/or seeds and inspected to reduce the potential of spreading noxious weeds, before mobilizing to arrive at the construction site and before leaving the construction site.
4. All non-native, invasive plant species shall be removed from disturbed areas prior to replanting.

Mitigation Measure BT-1d: Conduct Pre-Construction Surveys for California Legless Lizard.

The project proponents shall retain a qualified biologist to prepare and implement a legless lizard management plan in coordination with CDFW, which shall include, but is not limited to, the protocols for pre-construction surveys, construction monitoring, and salvage and relocation. The management plan shall include, but is not limited to, the following:

1. Pre-Construction Surveys. Pre-construction surveys for legless lizards shall be conducted in all suitable habitat proposed for construction, ground disturbance, or staging. The qualified biologist shall hold or obtain a CDFW scientific collection permit for this species. The pre-construction surveys shall use a method called "high-grading." The high grading method shall include surveying the habitat where legless lizards are most likely to be found, and the survey must occur under the conditions when legless lizards are most likely to be seen and captured (early morning, high soil moisture, overcast, etc.). The intensity of a continued search may then be adjusted, based on the results of the first survey in the best habitat.
2. A "three pass method" shall be used to locate and remove as many legless lizards as possible. A first pass shall locate as many legless lizards as possible, a second pass should locate fewer lizards than the first pass, and a third pass should locate fewer lizards than the second pass. All search

passes shall be conducted in the early morning when legless lizards are easiest to capture. Vegetation may be removed by hand to facilitate hand raking and search efforts for legless lizards in the soil under brush. If lizards are found during the first pass, an overnight period of no soil disturbance must occur before the second pass, and the same requirement shall be implemented after the second pass. If no lizards are found during the second pass, a third pass is not required. Installation of a barrier, in accordance with the three-pass method, shall be required if legless lizards are found at the limits of construction (project boundaries) and sufficient soft sand and vegetative cover are present to suspect additional lizards are in the immediate vicinity on the adjacent property. A barrier shall prevent movement of legless lizards into the property. All lizards discovered shall be handled according to the salvage procedures outlined below.

3. Construction Monitoring. Monitoring by a qualified biologist shall be ongoing during construction. The onsite monitor shall be present during all ground-disturbing construction activities. To facilitate the careful search for lizards during construction, vegetation may need to be removed. If removal by hand is impractical, equipment such as a chainsaw, string trimmer, or skid-steer may be used, if a monitor and crew are present. The task of the vegetation removal is to remove plants under the direction of the monitor, allowing the monitor to watch for legless lizards. After plants are removed, the monitor and crew shall search the exposed area for legless lizards. If legless lizards are found during pre-construction surveys or construction monitoring, the protocols for salvage and relocation identified below shall be followed. Upon completion of pre-construction surveys, construction monitoring, and any resulting salvage and relocation actions, a report shall be submitted to the CDFW. The CDFW must be notified at least 48 hours before any field activity begins.
4. Salvage and Relocation. Only experienced persons may capture or handle legless lizards. The monitor must demonstrate a basic understanding, knowledge, skill, and experience with this species and its habitat. Once captured, a lizard shall be placed in a lidded, vented box containing clean sand. Areas of moist and dry sand need to be present in the box. The boxes must be kept out of direct sunlight and protected from temperatures over 72°F. The sand must be kept at temperatures under 66°F. Ideal temperatures are closer to 60°F. On the same day as capture, the lizards shall be examined for injury and data recorded on location where found as well as length, color, age, and tail condition. Once data is recorded, lizards shall be relocated to appropriate habitat, as determined through coordination with the CDFW, qualified biologist, and potential landowners.
5. Suitability of habitat for lizard release must be evaluated and presented in a management plan. The habitat must contain habitat factors most important to the health and survival of the species such as appropriate habitat based on soils, vegetated cover, native plant species providing cover, plant litter layer and depth, soil and ambient temperature, quality and composition of invertebrate population and prey availability. Potential relocation sites that contain the necessary conditions may exist within the habitat reserves on the former Fort Ord, including the Fort Ord National Monument. Lizards shall be marked with a unique tag (pit or tattoo) prior to release. Release for every lizard shall be recorded with GPS. GPS locations shall be submitted as part of the survey result report to document the number and locations of lizards relocated.

Mitigation Measure BT-1e: Prepare and Implement Rare Plant Restoration Plan to Mitigate Impacts to Kellogg's Horkelia.

Impacts to rare plant species individuals shall be avoided through project design and modification, to the extent feasible while taking into consideration other site and engineering constraints. If avoidance is not possible, the species shall be replaced at a 1:1 ratio for area of impact through preservation, restoration, or combination of both. A Rare Plant Restoration Plan, approved by the lead agency prior to commencing construction on the component site upon which the rare plant species would be impacted, shall be prepared and implemented by a qualified biologist. The plan shall include, but is not limited to, the following:

1. A detailed description of on-site and/or off-site mitigation areas, salvage of seed and/or soil bank, plant salvage, seeding and planting specifications, including, if appropriate, increased planting ratio to ensure the applicable success ratio. Specifically, seed shall be collected from the on-site individuals that would be impacted and grown in a local greenhouse, and then transplanted within the mitigation area. Plants shall be transplanted while they are young seedlings in order to develop a good root system. Alternatively, the mitigation area may be broadcast seeded in fall; however, if this method is used, some seed shall be retained in the event that the seeding fails to produce viable plants and contingency measures need to be employed.
2. A description of a 3-year monitoring program, including specific methods of vegetation monitoring, data collection and analysis, restoration goals and objectives, success criteria, adaptive management if the criteria are not met, reporting protocols, and a funding mechanism.

The mitigation area shall be preserved in perpetuity through a conservation easement or other legally enforceable land preservation agreement. Exclusionary fencing shall be installed around the mitigation area to prevent disturbance until success criteria have been met.

Mitigation Measure BT-1f: Conduct Pre-Construction Protocol-Level Botanical Surveys within the remaining portion of the BSA.

The project proponents shall retain a qualified biologist to conduct protocol-level botanical surveys for special-status plant species within the BSA, where impacts are anticipated and where surveys were not conducted in 2019. Protocol-level surveys shall be conducted by a qualified biologist at the appropriate time of year for species with the potential to occur within the site. A report describing the results of the surveys shall be provided to the project proponents prior to any ground disturbing activities. The report shall include, but is not limited to: 1) a description of the species observed, if any; 2) map of the location, if observed; and 3) recommended avoidance and minimization measures, if applicable. The avoidance and minimization measures shall include, but are not limited to, the following:

1. Impacts to species individuals shall be avoided through project design and modification, to the extent feasible while taking into consideration other site and engineering constraints.
2. If impacts to State listed plant species cannot be avoided, the project proponents shall comply with the CESA and consult with the CDFW to determine whether authorization for the incidental take of the species is required prior to commencing construction. If it is determined that authorization for incidental take is required from the CDFW, the project proponents shall comply with the CESA to obtain an incidental take permit prior to commencing construction on the site upon which state listed plant species could be taken. Permit requirements typically involve preparation and implementation of a mitigation plan and mitigating impacted habitat at a 3:1 ratio through preservation and/or restoration. At a minimum, the impacted plant species shall be replaced at a 1:1 ratio through preservation and/or restoration, as described below. The project proponents shall retain a qualified biologist to prepare a mitigation plan, which shall include, but is not limited to identifying; avoidance and minimization measures; mitigation strategy, including a take assessment, avoidance and minimization measures, compensatory mitigation lands, and success criteria; and funding assurances. The project proponents shall be required to implement the approved plan and any additional permit requirements.
3. If impacts to non-State listed, special-status plant species cannot be avoided, the species shall be replaced at a 1:1 ratio for acreage and/or individuals impacted through preservation, restoration, or combination of both. A Rare Plant Restoration Plan, approved by the project proponents prior

to commencing of construction on the site upon which the rare plant would be impacted, shall be prepared and implemented by a qualified biologist. The plan shall include, but is not limited to, the following:

4. A detailed description of on-site and/or off-site mitigation areas, salvage of seed and/or soil bank, plant salvage, seeding and planting specifications, including, if appropriate, increased planting ratio to ensure the applicable success ratio. Specifically, seed shall be collected from the on-site individuals that will be impacted and grown in a local greenhouse, and then transplanted within the mitigation area. Plants shall be transplanted while they are young seedlings in order to develop a good root system. Alternatively, the mitigation area may be broadcast seeded in fall; however, if this method is used, some seed shall be retained in the event that the seeding fails to produce viable plants and contingency measures need to be employed.
5. A description of a 3-year monitoring program, including specific methods of vegetation monitoring, data collection and analysis, restoration goals and objectives, success criteria, adaptive management if the criteria are not met, reporting protocols, and a funding mechanism.
6. The mitigation area shall be preserved in perpetuity through a conservation easement or other legally enforceable land preservation agreement. Exclusionary fencing shall be installed around the mitigation area to prevent disturbance until success criteria have been met.

Mitigation Measure BT-1h: Implementation of Mitigation Measures BT-1a and BT-1b to Mitigate Impacts to the Monterey Ornate Shrew, Coast Horned Lizard, Coast Range Newt, Two-Striped Garter Snake, and Salinas Harvest Mouse (Reithrodontomys megalotis ssp. distichlis).

If these species are encountered, implementation of Mitigation Measures BT-1a and BT-1b, which avoid and minimize impacts through implementing construction best management practices and monitoring, would reduce potential impacts to these species to a less-than-significant level.

Mitigation Measure BT-1i: Conduct Pre-Construction Surveys for Monterey Dusky-Footed Woodrat.

To avoid and reduce impacts to the Monterey dusky-footed woodrat, the project proponents shall retain a qualified biologist to conduct pre-construction surveys in suitable habitat proposed for construction, ground disturbance, or staging within three days prior to construction for woodrat nests within the project area and in a buffer zone 100 feet out from the limit of disturbance. All woodrat nests shall be flagged for avoidance of direct construction impacts and protection during construction, where feasible. Nests that cannot be avoided shall be manually deconstructed prior to land clearing activities to allow animals to escape harm. If a litter of young is found or suspected, nest material shall be replaced, and the nest left alone for 2-3 weeks before a re-check to verify that young are capable of independent survival before proceeding with nest dismantling.

Mitigation Measure BT-1j: Conduct Pre-Construction Surveys for American Badger.

To avoid and reduce impacts to the American badger, the project proponents shall retain a qualified biologist to conduct focused pre-construction surveys for badger dens in all suitable habitat proposed for construction, ground disturbance, or staging no more than two weeks prior to construction. If no potential badger dens are present, no further mitigation is required. If potential dens are observed, the following measures are required to avoid potential significant impacts to the American badger:

1. If the qualified biologist determines that potential dens are inactive, the biologist shall excavate these dens by hand with a shovel to prevent badgers from re-using them during construction.
2. If the qualified biologist determines that potential dens may be active, the den shall be monitored for a period sufficient (as determined by a qualified biologist) to determine if the den is a maternity den occupied by a female and her young, or if the den is occupied by a solitary badger.
3. Maternity dens occupied by a female and her young shall be avoided during construction and a

minimum buffer of 200 feet in which no construction activities shall occur shall be maintained around the den. After the qualified biologist determines that badgers have stopped using active dens within the project boundary, the dens shall be hand-excavated with a shovel to prevent re-use during construction.

4. Solitary male or female badgers shall be passively relocated by blocking the entrances of the dens with soil, sticks, and debris for three to five days to discourage the use of these dens prior to project construction disturbance. The den entrances shall be blocked to an incrementally greater degree over the three to five-day period. After the qualified biologist determines that badgers have stopped using active dens within the project boundary, the dens shall be hand-excavated with a shovel to prevent re-use during construction.

Mitigation Measure BT-1k: Conduct Pre-Construction Surveys for Protected Avian Species, including, but not limited to, white-tailed kite and California horned lark.

Prior to the start of construction activities at each project component site, a qualified biologist shall conduct pre-construction surveys for suitable nesting habitat within the project area and within a suitable buffer area from the project area. The qualified biologist shall determine the suitable buffer area based on the avian species with the potential to nest at the site.

In areas where nesting habitat is present within the component project area or within the determined suitable buffer area, construction activities that may directly (e.g., vegetation removal) or indirectly (e.g., noise/ground disturbance) affect protected nesting avian species shall be timed to avoid the breeding and nesting season. Specifically, vegetation and/or tree removal can be scheduled after September 16 and before January 31. Alternatively, a qualified biologist shall be retained by the project proponents to conduct pre-construction surveys for nesting raptors and other protected avian species where nesting habitat was identified and within the suitable buffer area if construction commences between February 1 and September 15. Pre-construction surveys shall be conducted no more than 14 days prior to the start of construction activities during the early part of the breeding season (February through April) and no more than 30 days prior to the initiation of these activities during the late part of the breeding season (May through August). Because some bird species nest early in spring and others nest later in summer, surveys for nesting birds may be required to continue during construction to address new arrivals, and because some species breed multiple times in a season. The necessity and timing of these continued surveys shall be determined by the qualified biologist based on review of the final construction plans.

If active raptor or other protected avian species nests are identified during the pre-construction surveys, the qualified biologist shall notify the project proponents and an appropriate no-disturbance buffer shall be imposed within which no construction activities or disturbance shall take place until the young have fledged and are no longer reliant upon the nest or parental care for survival, as determined by a qualified biologist.

Mitigation Measure BT-1m: Minimize effects of nighttime construction lighting.

Nighttime construction lighting shall be focused and downward directed to preclude night illumination of the adjacent open space area.

4.2.2 IMPACT BT-2: CONSTRUCTION IMPACTS TO SENSITIVE HABITATS.

Proposed construction may adversely affect sensitive habitats (including riparian, wetlands, and/or other sensitive natural communities) within the BSA. (Less than Significant)

The construction of the Proposed Modifications may result in impacts to central maritime chaparral (approximately 30.2 acres). This habitat type is considered a sensitive habitat by CDFW. This entire BSA is located within the former Fort Ord and outside of the coastal zone. As described in the above, impacts to sensitive maritime chaparral habitat are analyzed and addressed in the HMP and, therefore, impacts to this habitat are also considered mitigated through the implementation of the HMP. Therefore, impacts are considered less-than-significant and no additional mitigation measures are required.

4.2.3 Impact BT-4: Construction Conflicts with Local Policies, Ordinances, or Approved Habitat Conservation Plan.

Proposed construction would potentially conflict with local policies or ordinances protecting biological resources. A conflict may occur if the HMP plant species within the BSA on the former Fort Ord that do not require a take authorization from the Service or CDFW are impacted, and seed salvage is not conducted. There are no approved hcps applicable to the Proposed Modifications. (Less than Significant with Mitigation)

The BSA is not located within an approved Habitat Conservation Plan or Natural Community Conservation Plan area. However, the BSA is located within development parcels inside the Fort Ord HMP boundaries and the plan area associated with a Draft HCP. Construction of these Proposed Modifications would be consistent with the approved HMP because all sites are located on parcels designated as “developed,” if the construction activities comply with specific requirements. In particular, the BO and HMP require the identification of sensitive biological resources within development parcels that might be salvaged for use in restoration activities in reserve areas. If those species are identified, the seeds from those plants to be removed should be salvaged for restoration, if possible, of other areas of the former Fort Ord. Plant species salvage requirements are described below in Mitigation Measure BT-4 to comply and ensure consistency with the BO and HMP, and would reduce this potentially significant impact to a less-than-significant level.

Impact Conclusion

There is potential for inconsistency with the local requirements for the HMP plant species for components located within the boundaries of former Fort Ord. Implementation of Mitigation Measure BT-4 would reduce this potentially significant impact to a less-than-significant level.

Mitigation Measure BT-4. HMP Plant Species Salvage.

For impacts to the HMP plant species within the BSA that do not require take authorization from USFWS or CDFW, salvage efforts for these species shall be evaluated by a qualified biologist per the requirements of the HMP and BO. A salvage plan shall be prepared and implemented by a qualified biologist, which shall include, but is not limited to: a description and evaluation of salvage opportunities and constraints; a description of the appropriate methods and protocols of salvage and relocation efforts; identification of relocation and restoration areas; and identification of qualified biologists approved to perform the salvage efforts, including the identification of any required collection permits from USFWS and/or CDFW. Where proposed, seed collection shall occur from plants within the BSA and topsoil shall be salvaged within occupied areas to be disturbed. Seeds shall be collected during the appropriate time of year for each species by qualified biologists. At the time of seed collection, a map shall also be prepared that identifies the specific locations of the plants for any future topsoil preservation efforts. The collected seeds shall be used to revegetate temporarily disturbed construction areas and reseeding and restoration efforts on- or off-site, as determined appropriate in the salvage plan.

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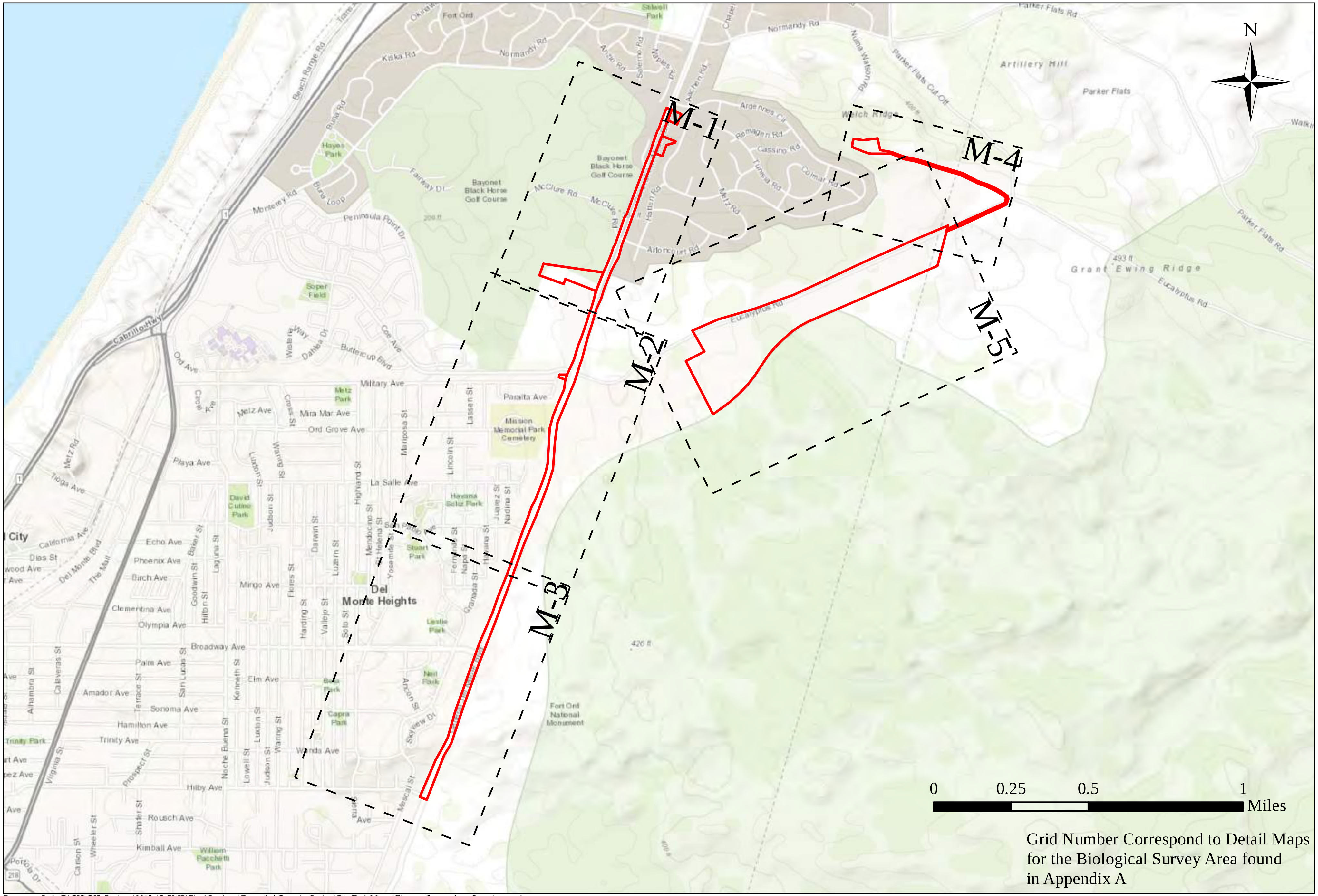


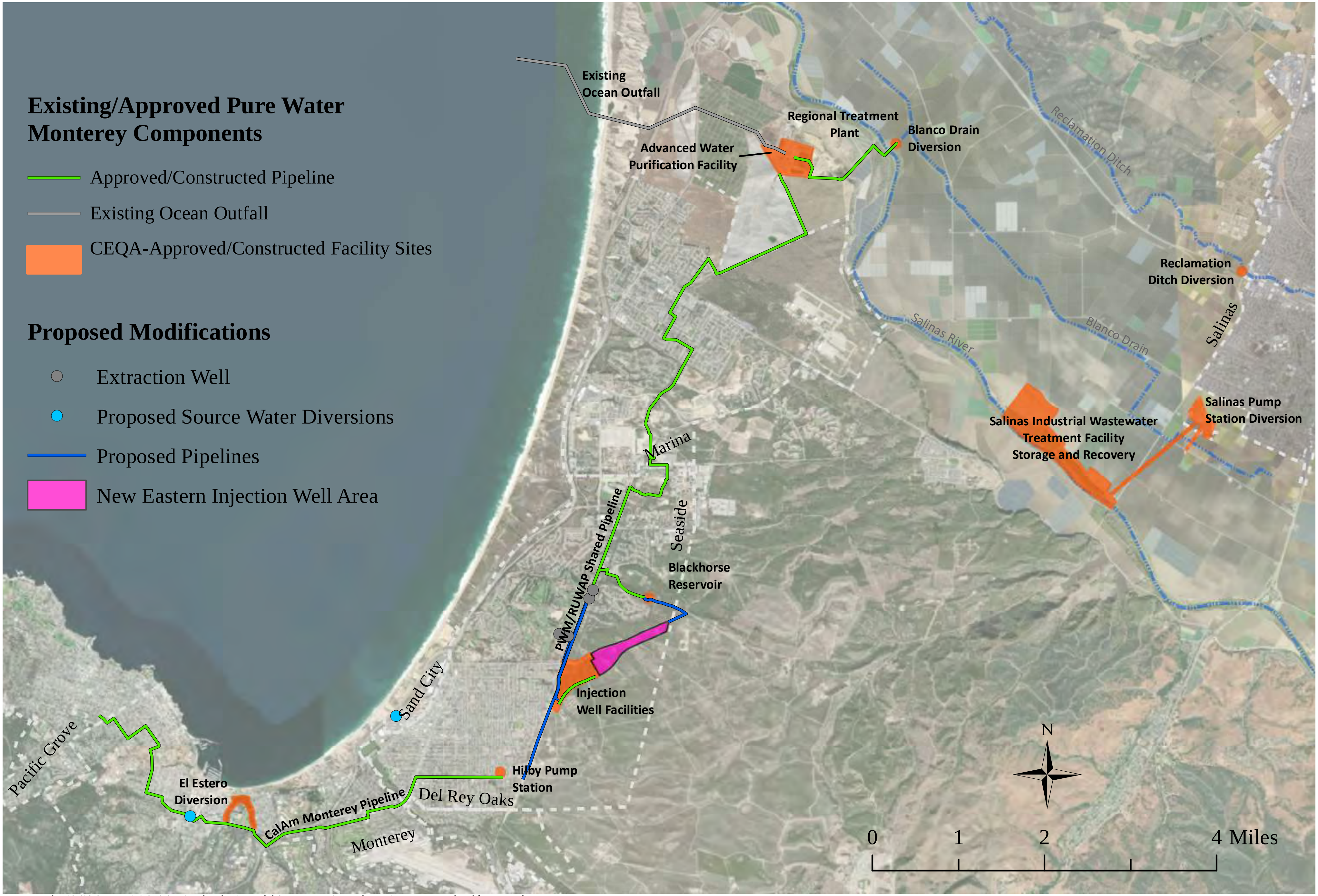
Document Path: F:\GIS\GIS_Projects\2013-13 GWR\Final Products\Expanded Capacity Project\Bio Tech Memo\Figure 1 Survey Area Overview.mxd

GWR Expanded Capacity Project
Biological Study Area

Date: 10/29/2019
Scale: 1 in = 0.4 miles
Project: 2013-13

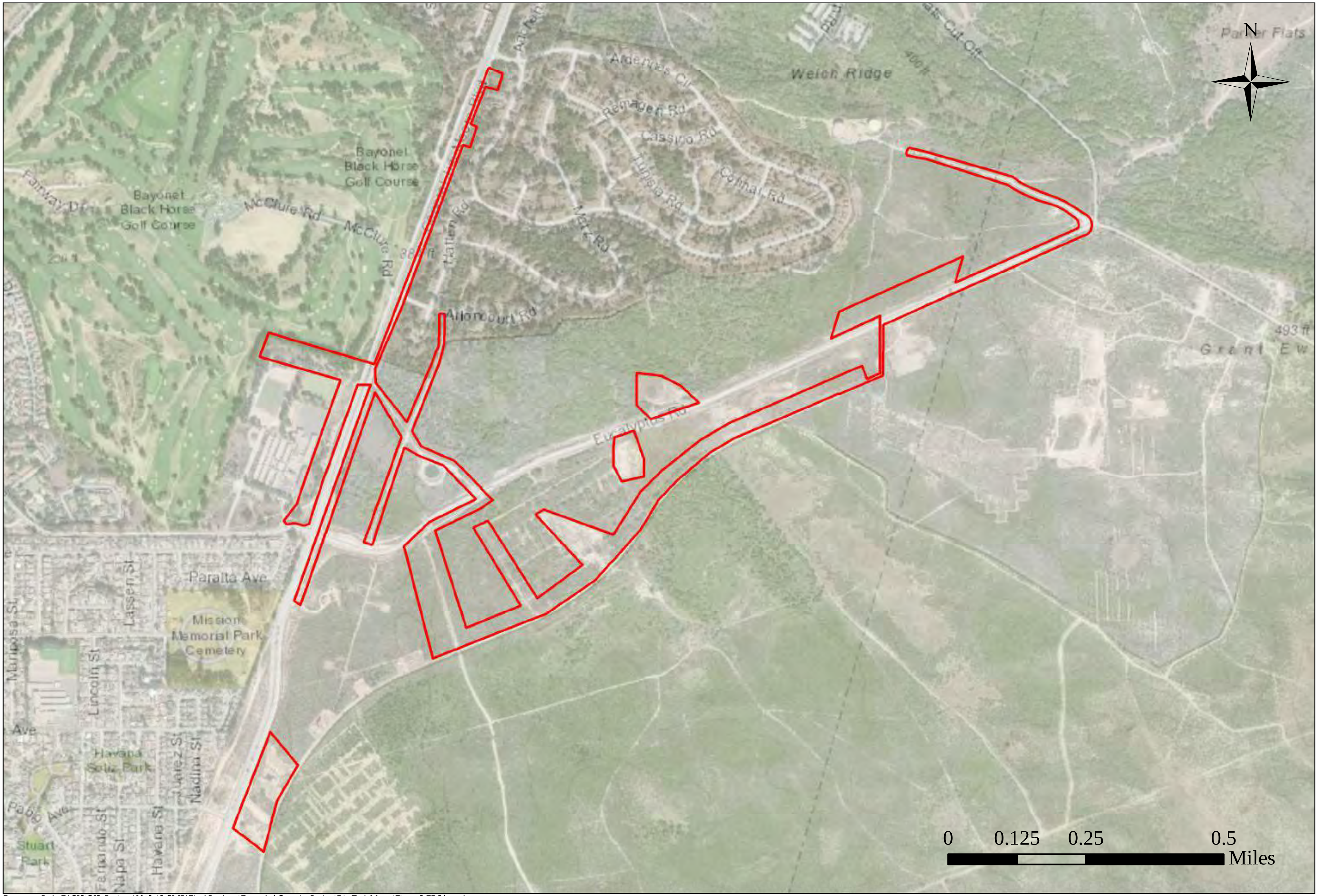
Monterey | San Jose
Denise Duffy and Associates, Inc.
Environmental Consultants Resource Planners
947 Cass Street, Suite 5
Monterey, CA 93940
(831) 373-4341

Figure
1



Document Path: F:\GIS\GIS_Projects\2013-13 GWR\Final Products\Expanded Capacity Project\Bio Tech Memo\Figure 2 Proposed Modifications.mxd

GWR Expanded Capacity Project Proposed Modifications	Date: 9/20/2019 Scale: 1 in = 1 miles Project: 2013-13	DD&A Monterey | San Jose Denise Duffy and Associates, Inc. Environmental Consultants Resource Planners 947 Cass Street, Suite 5 Monterey, CA 93940 (831) 373-4341	Figure 2



Document Path: F:\GIS\GIS_Projects\2013-13 GWR\Final Products\Expanded Capacity Project\Bio Tech Memo\Figure 3 FBSA.mxd

GWR Expanded Capacity Project
Focused Botanical Survey Area

Date: 10/29/2019

Scale: 1 in = 1,000 feet

Project: 2013-13

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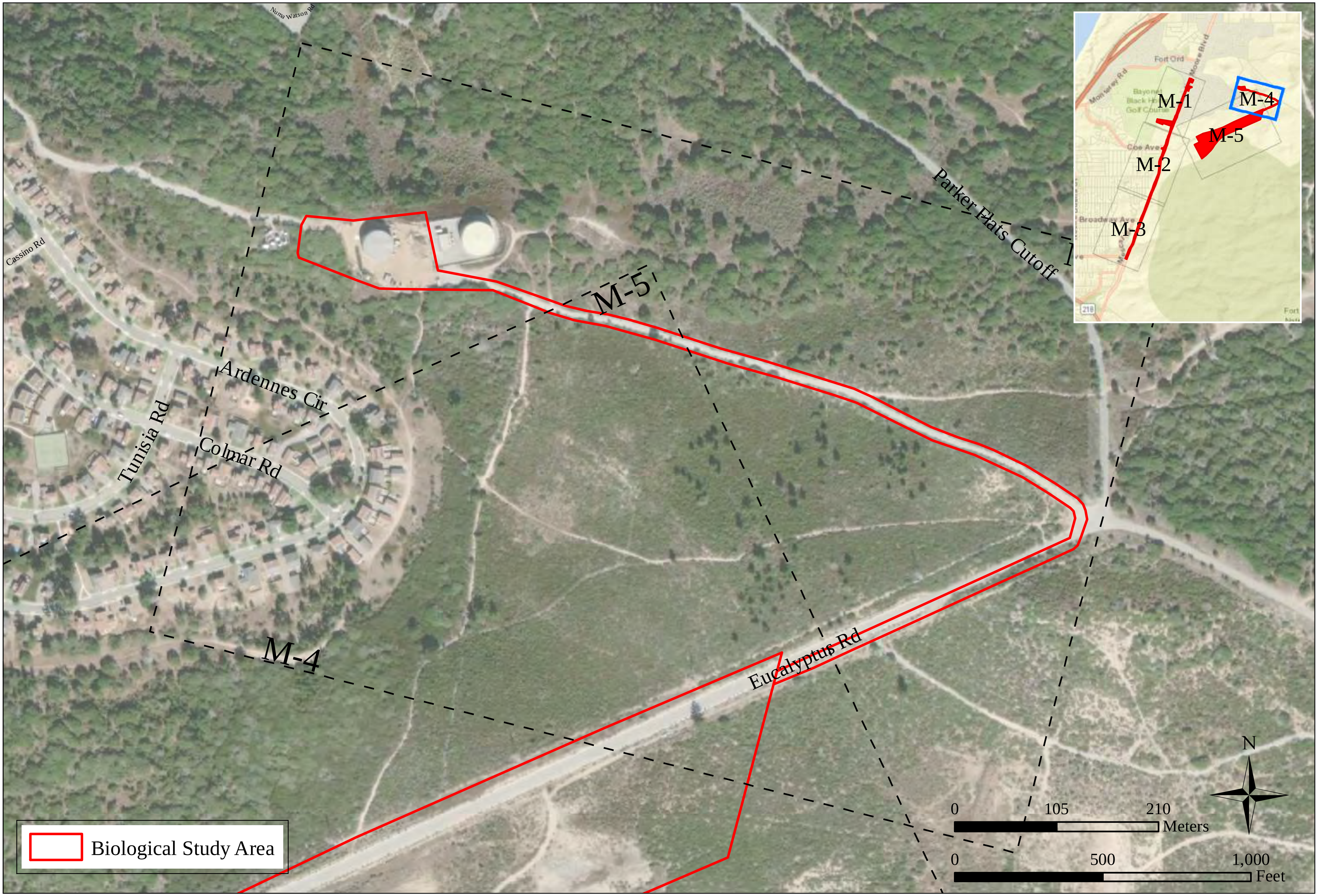
947 Cass Street, Suite 5
Monterey, CA 93940
(831) 373-4341

Figure 3

Appendix A

Biological Study Area Detail Maps



GWR Expanded Capacity Project
Biological Study Area

Date:	10/29/2019
Scale:	1 inch = 400 feet
Project:	2013-13

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Monterey, CA 93940
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Appendix A

GWR Expanded Capacity Project
Biological Study Area

Date: 10/29/2019
Scale: 1 inch = 700 feet
Project: 2013-13

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Monterey, CA 93940
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Appendix A

GWR Expanded Capacity Project
Biological Study Area

Date: 10/29/2019

Scale: 1 inch = 800 feet

Project: 2013-13

DD&A

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Monterey, CA 93940
(831) 373-4341

Appendix A

GWR Expanded Capacity Project
Biological Study Area

Date: 10/29/2019

Scale: 1 inch = 900 feet

Project: 2013-13

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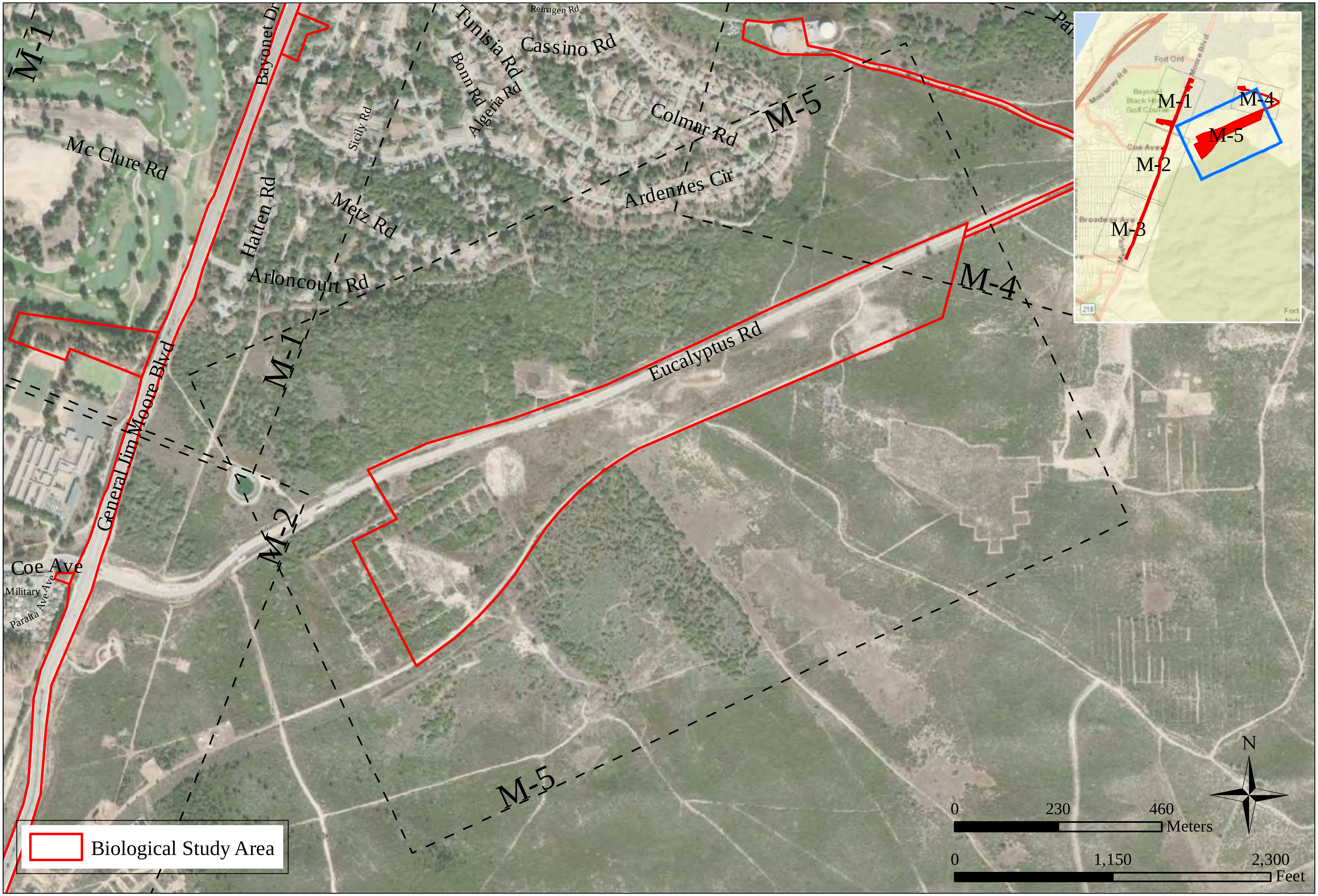
Monterey, CA 93940
(831) 373-4341

Appendix

A



GWR Expanded Capacity Project
Biological Study Area

Date: 10/29/2019

Scale: 1 inch = 900 feet

Project: 2013-13

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Monterey, CA 93940
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Appendix

A

Appendix B

United States Fish and Wildlife Service IPaC Resource List

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Monterey County, California

Local office

Ventura Fish And Wildlife Office

(805) 644-1766
(805) 644-3958

2493 Portola Road, Suite B
Ventura, CA 93003-7726

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Birds

NAME	STATUS

California Condor Gymnogyps californianus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8193	Endangered
California Least Tern Sterna antillarum browni No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8104	Endangered
Least Bell's Vireo Vireo bellii pusillus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/5945	Endangered
Marbled Murrelet Brachyramphus marmoratus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/4467	Threatened
Southwestern Willow Flycatcher Empidonax traillii extimus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/6749	Endangered
Western Snowy Plover Charadrius nivosus nivosus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8035	Threatened

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander Ambystoma californiense There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/2076	Threatened
Santa Cruz Long-toed Salamander Ambystoma macrodactylum croceum There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/7405	Endangered

Fishes

NAME	STATUS
Tidewater Goby *Eucyclogobius newberryi* There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/57	Endangered

Insects

NAME	STATUS
Smith's Blue Butterfly *Euphilotes enoptes smithi* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/4418	Endangered

Crustaceans

NAME	STATUS
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/498	Threatened

Flowering Plants

NAME	STATUS
Clover Lupine *Lupinus tidestromii* No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4459	Endangered
Contra Costa Goldfields *Lasthenia conjugens* There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/7058	Endangered
Marsh Sandwort *Arenaria paludicola* No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2229	Endangered
Menzies' Wallflower *Erysimum menziesii* No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2935	Endangered

Monterey Gilia Gilia tenuiflora ssp. arenaria — Endangered

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/856

Monterey Spineflower Chorizanthe pungens var. pungens — Threatened

There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/396

Yadon's Piperia Piperia yadonii — Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/4205

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Allen's Hummingbird Selasphorus sasin This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15
Black Oystercatcher Haematopus bachmani This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Clark's Grebe Aechmophorus clarkii This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jan 1 to Dec 31
Common Yellowthroat Geothlypis trichas sinuosa This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/2084	Breeds May 20 to Jul 31

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Lawrence's Goldfinch Carduelis lawrencei — Breeds Mar 20 to Sep 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9464

Long-billed Curlew Numenius americanus — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/5511

Marbled Godwit Limosa fedoa — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9481

Nuttall's Woodpecker Picoides nuttallii — Breeds Apr 1 to Jul 20

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9410

Oak Titmouse Baeolophus inornatus — Breeds Mar 15 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9656

Rufous Hummingbird selasphorus rufus — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8002

Short-billed Dowitcher Limnodromus griseus — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9480

Song Sparrow Melospiza melodia — Breeds Feb 20 to Sep 5

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Spotted Towhee Pipilo maculatus clementae This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/4243	Breeds Apr 15 to Jul 20
Tricolored Blackbird Agelaius tricolor This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Whimbrel Numenius phaeopus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9483	Breeds elsewhere
Willet Tringa semipalmata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wrentit Chamaea fasciata This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Mar 15 to Aug 10
Yellow-billed Magpie Pica nuttalli This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9726	Breeds Apr 1 to Jul 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ “Proper Interpretation and Use of Your Migratory Bird Report” before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that

week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

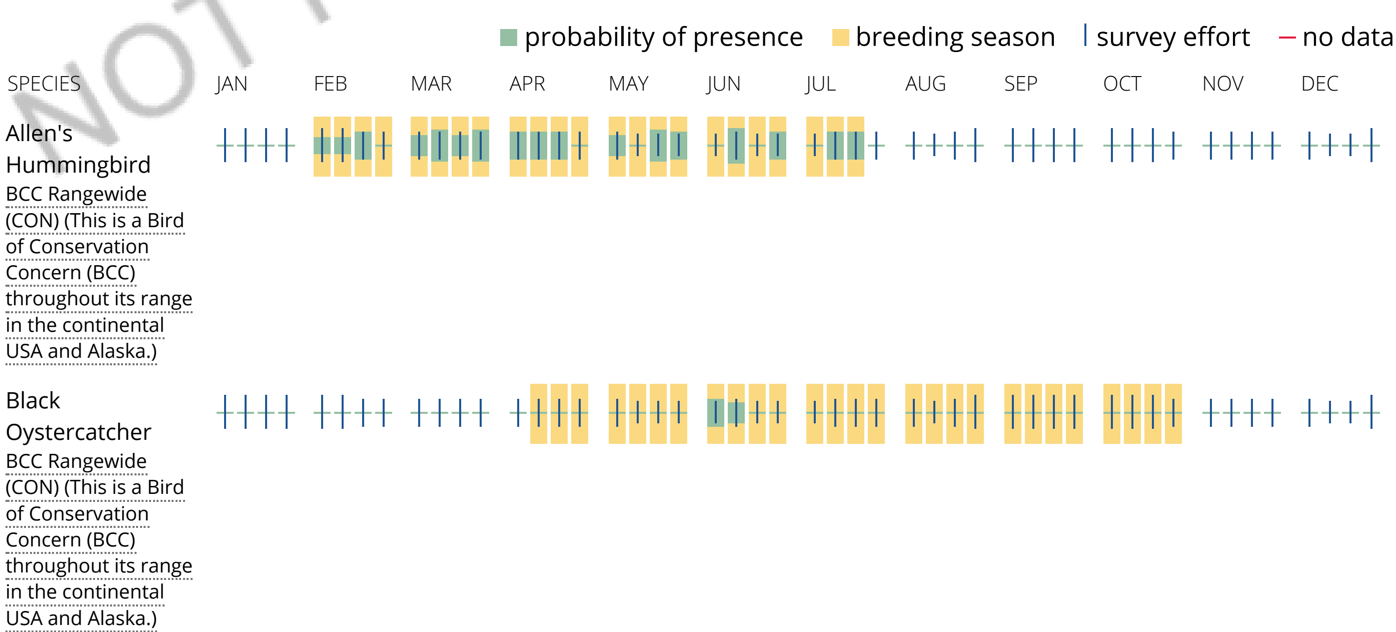
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

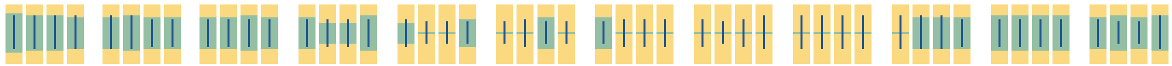
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

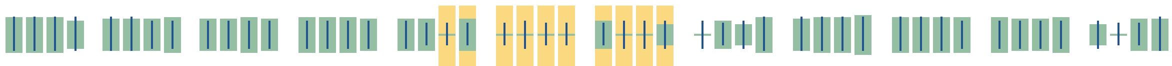
Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



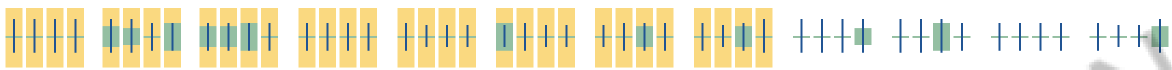
Clark's Grebe
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



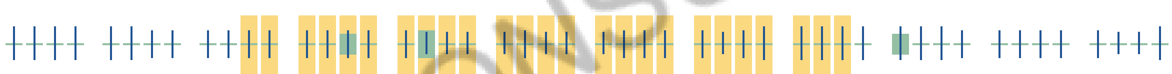
Common Yellowthroat
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Golden Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



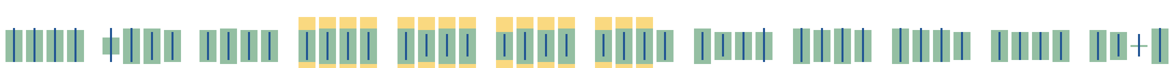
Lawrence's Goldfinch
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



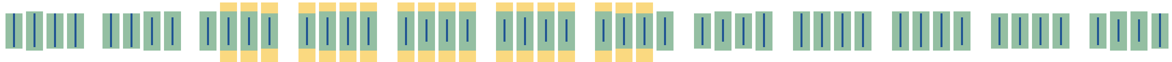
Long-billed Curlew
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Marbled Godwit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

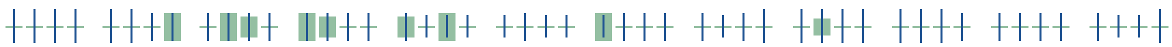
Nuttall's Woodpecker
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



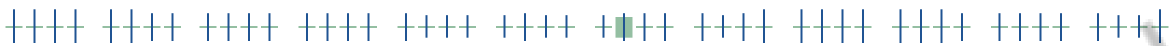
Oak Titmouse
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Rufous Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

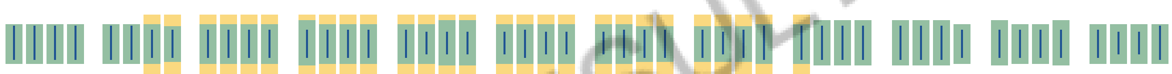


Short-billed Dowitcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

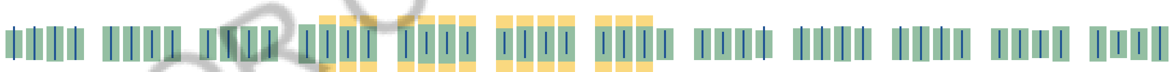


SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

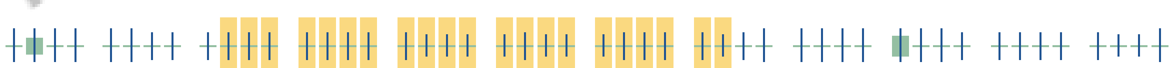
Song Sparrow
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Spotted Towhee
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



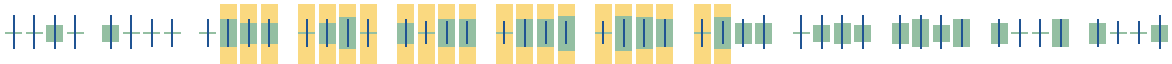
Tricolored Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



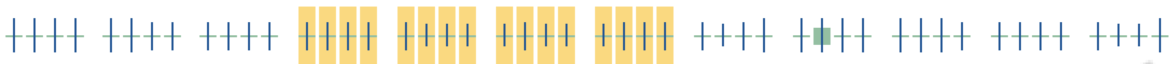
Whimbrel
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Willet
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Wrentit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Yellow-billed Magpie
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

Wildlife refuges and fish hatcheries

REFUGE AND FISH HATCHERY INFORMATION IS NOT AVAILABLE AT THIS TIME

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER POND
- PUBKr

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix C

California Department of Fish and Wildlife California Natural Diversity Database Selected Elements by Scientific Name

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (Marina (3612167) OR Monterey (3612158) OR Seaside (3612157) OR Mt. Carmel (3612147) OR Carmel Valley (3612146) OR Soberanes Point (3612148) OR Salinas (3612166) OR Spreckels (3612156))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Threatened	G2G3	S1S2	SSC
Agrostis lacuna-vernalis vernal pool bent grass	PMPOA041N0	None	None	G1	S1	1B.1
Allium hickmanii Hickman's onion	PMLIL02140	None	None	G2	S2	1B.2
Ambystoma californiense California tiger salamander	AAAAA01180	Threatened	Threatened	G2G3	S2S3	WL
Anniella pulchra northern California legless lizard	ARACC01020	None	None	G3	S3	SSC
Arctostaphylos edmundsii Little Sur manzanita	PDERI04260	None	None	G2	S2	1B.2
Arctostaphylos hookeri ssp. hookeri Hooker's manzanita	PDERI040J1	None	None	G3T2	S2	1B.2
Arctostaphylos montereyensis Toro manzanita	PDERI040R0	None	None	G2?	S2?	1B.2
Arctostaphylos pajaroensis Pajaro manzanita	PDERI04100	None	None	G1	S1	1B.1
Arctostaphylos pumila sandmat manzanita	PDERI04180	None	None	G1	S1	1B.2
Astragalus tener var. tener alkali milk-vetch	PDFAB0F8R1	None	None	G2T1	S1	1B.2
Astragalus tener var. titi coastal dunes milk-vetch	PDFAB0F8R2	Endangered	Endangered	G2T1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC
Bombus caliginosus obscure bumble bee	IIHYM24380	None	None	G4?	S1S2	
Bombus occidentalis western bumble bee	IIHYM24250	None	Candidate Endangered	G2G3	S1	
Bryoria spiralifera twisted horsehair lichen	NLTEST5460	None	None	G3	S1S2	1B.1
Buteo regalis ferruginous hawk	ABNKC19120	None	None	G4	S3S4	WL
Castilleja ambigua var. insalutata pink Johnny-nip	PDSCR0D403	None	None	G4T2	S2	1B.1
Central Dune Scrub Central Dune Scrub	CTT21320CA	None	None	G2	S2.2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Central Maritime Chaparral Central Maritime Chaparral	CTT37C20CA	None	None	G2	S2.2	
Centromadia parryi ssp. congdonii Congdon's tarplant	PDAST4R0P1	None	None	G3T1T2	S1S2	1B.1
Charadrius alexandrinus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S2S3	SSC
Chorizanthe minutiflora Fort Ord spineflower	PDPGN04100	None	None	G1	S1	1B.2
Chorizanthe pungens var. pungens Monterey spineflower	PDPGN040M2	Threatened	None	G2T2	S2	1B.2
Clarkia jolonensis Jolon clarkia	PDONA050L0	None	None	G2	S2	1B.2
Coelus globosus globose dune beetle	IICOL4A010	None	None	G1G2	S1S2	
Collinsia multicolor San Francisco collinsia	PDSCR0H0B0	None	None	G2	S2	1B.2
Cordylanthus rigidus ssp. littoralis seaside bird's-beak	PDSCR0J0P2	None	Endangered	G5T2	S2	1B.1
Corynorhinus townsendii Townsend's big-eared bat	AMACC08010	None	None	G3G4	S2	SSC
Coturnicops noveboracensis yellow rail	ABNME01010	None	None	G4	S1S2	SSC
Cypseloides niger black swift	ABNUA01010	None	None	G4	S2	SSC
Danaus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	None	None	G4T2T3	S2S3	
Delphinium californicum ssp. interius Hospital Canyon larkspur	PDRAN0B0A2	None	None	G3T3	S3	1B.2
Delphinium hutchinsoniae Hutchinson's larkspur	PDRAN0B0V0	None	None	G2	S2	1B.2
Delphinium umbraculorum umbrella larkspur	PDRAN0B1W0	None	None	G3	S3	1B.3
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Eremophila alpestris actia California horned lark	ABPAT02011	None	None	G5T4Q	S4	WL
Ericameria fasciculata Eastwood's goldenbush	PDAST3L080	None	None	G2	S2	1B.1
Eriogonum nortonii Pinnacles buckwheat	PDPGN08470	None	None	G2	S2	1B.3
Erysimum ammophilum sand-loving wallflower	PDBRA16010	None	None	G2	S2	1B.2

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Erysimum menziesii Menzies' wallflower	PDBRA160R0	Endangered	Endangered	G1	S1	1B.1
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	SSC
Euphilotes enoptes smithi Smith's blue butterfly	IILEPG2026	Endangered	None	G5T1T2	S1S2	
Falco mexicanus prairie falcon	ABNKD06090	None	None	G5	S4	WL
Fritillaria liliacea fragrant fritillary	PMLIL0V0C0	None	None	G2	S2	1B.2
Gilia tenuiflora ssp. arenaria Monterey gilia	PDPLM041P2	Endangered	Threatened	G3G4T2	S2	1B.2
Hesperocyparis goveniana Gowen cypress	PGCUP04031	Threatened	None	G1	S1	1B.2
Hesperocyparis macrocarpa Monterey cypress	PGCUP04060	None	None	G1	S1	1B.2
Horkelia cuneata var. sericea Kellogg's horkelia	PDROS0W043	None	None	G4T1?	S1?	1B.1
Horkelia marinensis Point Reyes horkelia	PDROS0W0B0	None	None	G2	S2	1B.2
Lasiurus cinereus hoary bat	AMACC05030	None	None	G5	S4	
Lasthenia conjugens Contra Costa goldfields	PDAST5L040	Endangered	None	G1	S1	1B.1
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3G4T1	S1	FP
Layia carnosa beach layia	PDAST5N010	Endangered	Endangered	G2	S2	1B.1
Legenere limosa legenere	PDCAM0C010	None	None	G2	S2	1B.1
Linderiella occidentalis California linderiella	ICBRA06010	None	None	G2G3	S2S3	
Lupinus tidestromii Tidestrom's lupine	PDFAB2B3Y0	Endangered	Endangered	G1	S1	1B.1
Malacothamnus palmeri var. involucratus Carmel Valley bush-mallow	PDMAL0Q0B1	None	None	G3T2Q	S2	1B.2
Malacothrix saxatilis var. arachnoidea Carmel Valley malacothrix	PDAST660C2	None	None	G5T2	S2	1B.2
Meconella oregana Oregon meconella	PDPAP0G030	None	None	G2G3	S2	1B.1
Microseris paludosa marsh microseris	PDAST6E0D0	None	None	G2	S2	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Monardella sinuata ssp. nigrescens northern curly-leaved monardella	PDLAM18162	None	None	G3T2	S2	1B.2
Monolopia gracilens woodland woollythreads	PDAST6G010	None	None	G3	S3	1B.2
Monterey Cypress Forest Monterey Cypress Forest	CTT83150CA	None	None	G1	S1.2	
Monterey Pine Forest Monterey Pine Forest	CTT83130CA	None	None	G1	S1.1	
Monterey Pygmy Cypress Forest Monterey Pygmy Cypress Forest	CTT83162CA	None	None	G1	S1.1	
Neotoma macrotis luciana Monterey dusky-footed woodrat	AMAFF08083	None	None	G5T3	S3	SSC
Northern Bishop Pine Forest Northern Bishop Pine Forest	CTT83121CA	None	None	G2	S2.2	
Northern Coastal Salt Marsh Northern Coastal Salt Marsh	CTT52110CA	None	None	G3	S3.2	
Oceanodroma homochroa ashy storm-petrel	ABNDC04030	None	None	G2	S2	SSC
Oncorhynchus mykiss irideus pop. 9 steelhead - south-central California coast DPS	AFCHA0209H	Threatened	None	G5T2Q	S2	
Pelecanus occidentalis californicus California brown pelican	ABNFC01021	Delisted	Delisted	G4T3T4	S3	FP
Phrynosoma blainvillii coast horned lizard	ARACF12100	None	None	G3G4	S3S4	SSC
Pinus radiata Monterey pine	PGPIN040V0	None	None	G1	S1	1B.1
Piperia yadonii Yadon's rein orchid	PMORC1X070	Endangered	None	G1	S1	1B.1
Plagiobothrys chorisianus var. chorisianus Choris' popcornflower	PDBOR0V061	None	None	G3T1Q	S1	1B.2
Plagiobothrys uncinatus hooked popcornflower	PDBOR0V170	None	None	G2	S2	1B.2
Potentilla hickmanii Hickman's cinquefoil	PDROS1B0U0	Endangered	Endangered	G1	S1	1B.1
Ramalina thrausta angel's hair lichen	NLLEC3S340	None	None	G5	S2?	2B.1
Rana boylii foothill yellow-legged frog	AAABH01050	None	Candidate Threatened	G3	S3	SSC
Rana draytonii California red-legged frog	AAABH01022	Threatened	None	G2G3	S2S3	SSC
Reithrodontomys megalotis distichlis Salinas harvest mouse	AMAFF02032	None	None	G5T1	S1	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
Rosa pinetorum pine rose	PDROS1J0W0	None	None	G2	S2	1B.2
Sidalcea malachroides maple-leaved checkerbloom	PDMAL110E0	None	None	G3	S3	4.2
Sorex ornatus salarius Monterey shrew	AMABA01105	None	None	G5T1T2	S1S2	SSC
Spea hammondii western spadefoot	AAABF02020	None	None	G3	S3	SSC
Stebbinsoseris decipiens Santa Cruz microseris	PDAST6E050	None	None	G2	S2	1B.2
Taricha torosa Coast Range newt	AAAAF02032	None	None	G4	S4	SSC
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Thamnophis hammondii two-striped gartersnake	ARADB36160	None	None	G4	S3S4	SSC
Tortula californica California screw moss	NBMUS7L090	None	None	G2G3	S2S3	1B.2
Trifolium buckwestiorum Santa Cruz clover	PDFAB402W0	None	None	G2	S2	1B.1
Trifolium hydrophilum saline clover	PDFAB400R5	None	None	G2	S2	1B.2
Trifolium polyodon Pacific Grove clover	PDFAB402H0	None	Rare	G1	S1	1B.1
Trifolium trichocalyx Monterey clover	PDFAB402J0	Endangered	Endangered	G1	S1	1B.1
Valley Needlegrass Grassland Valley Needlegrass Grassland	CTT42110CA	None	None	G3	S3.1	

Record Count: 97

Appendix D

Advanced Water Treatment Facility Expanded Capacity Project Special-Status Species Table

GWR Expansion Special-Status Species Table
(Seaside, Monterey, Marina, Salinas, Spreckels, Soberanes Point, Mt. Carmel, Carmel Valley Quadrangles)

Species	**Status** (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
MAMMALS			
Corynorhinus townsendii Townsend’s big-eared bat	-- / SSC / --	Found primarily in rural settings from inland deserts to coastal redwoods, oak woodland of the inner Coast Ranges and Sierra foothills, and low to mid-elevation mixed coniferous-deciduous forests. Typically roost during the day in limestone caves, lava tubes, and mines, but can roost in buildings that offer suitable conditions. Night roosts are in more open settings and include bridges, rock crevices, and trees.	**Unlikely** The BSA has limited open areas and lacks rocky areas for roosting.
Lasiurus cinereus hoary bat	-- /CNDDB/--	Prefers open habitats or habitat mosaics with access to trees for cover and open areas or edge for feeding. Generally, roost in dense foliage of trees; does not use buildings for roosting. Winters in California and Mexico and often migrates towards summer quarters in the north and east during the spring. Young are born and reared in summer grounds, which is unlikely to occur in California.	**Unlikely** The BSA has limited open areas for roosting.
Neotoma macrotis luciana Monterey dusky-footed woodrat	--/SSC/-- --/SSC/--	Forest and oak woodland habitats of moderate canopy with moderate to dense understory. Also occurs in chaparral habitats. Forest and oak woodland habitats of moderate canopy with moderate to dense understory. Also occurs in chaparral habitats.	**Present:** Suitable habitat is present within oak woodland, coastal scrub, and chaparral habitats within the BSA. Woodrat nests were observed during surveys in 2019. **High:** Suitable habitat is present within the oak woodland, coastal scrub, and maritime chaparral habitats within the Project Study Area. Woodrat nests were observed during surveys in 2014. The riparian habitat at Roberts Lake and the coastal scrub near the Intake Wells Site are likely not dense enough to provide woodrat habitat and the species is unlikely to occur there.

Species	Status (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Reithrodontomys megalotis distichlis Salinas harvest mouse	-- / SSC / --	The Salinas harvest mouse (*Reithrodontomys megalotis distichlis*) is a DFG species of special concern. This subspecies of the western harvest mouse is known only to occur in the Monterey Bay region in fresh and brackish water wetlands and probably in the adjacent uplands around the mouth of the Salinas River. Nests of woven dried vegetation are constructed in thick grass at the base of shrubs or amidst debris, litter, or slash. The Salinas harvest mouse is nocturnal and active year-round. Breeding occurs year-round in lower elevations and late spring to early fall at higher elevations. Litter sizes average from 2-4 young and females can have up to 14 litters in a year.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Sorex ornatus salarius Monterey ornate shrew	--/SSC/--	The Monterey ornate shrew ranges along the southern two-thirds of coastal California, and it is also found in central California. Ornate shrews typically are found in brackish water marshes; along streams; in brushy areas of valleys and foothills; and in forests. They especially favor low, dense vegetation that forms a cover for worms and insects.	**Moderate:** The CNDDB reports 5 occurrences within the 8 Quadrangless analyzed. Figure B-18 in the Fort Ord HMP identifies portions of the BSA as containing potential habitat for this species and this species is known to occur within the vicinity of the BSA (Bolster, 1998).
Taxidea taxus American badger	--/SSC/--	Dry, open grasslands, fields, pastures savannas, and mountain meadows near timberline are preferred. The principal requirements seem to be sufficient food, friable soils, and relatively open, uncultivated grounds.	**Moderate:** Suitable habitat within the BSA is present within the ruderal habitats. The CNDDB reports 9 occurrences within the 8 Quadrangless analyzed.
BIRDS			
Accipiter cooperii Cooper’s hawk	--/WL/--	Resident throughout most of the wooded portion of the state. Dense stands of live oak, riparian deciduous, or other forest habitats near water used most frequently. Seldom found in areas without dense tree stands, or patchy woodland habitats.	**Moderate:** Although no occurrences are reported within the quadranglesrangles analyzed, possible nesting and foraging habitat is present within the BSA.
Agelaius tricolor Tricolored blackbird (nesting colony)	-- / SC&SSC / --	Nest in colonies in dense riparian vegetation, along rivers, lagoons, lakes, and ponds. Forages over grassland or aquatic habitats.	**Unlikely:** No suitable habitat within or adjacent to BSA.

Species	Status (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Athene cunicularia Burrowing owl (burrow sites & some wintering sites)	-- / SSC / --	Year-round resident of open, dry grassland and desert habitats, and in grass, forb and open shrub stages of pinyon-juniper and ponderosa pine habitats. Frequent open grasslands and shrublands with perches and burrows. Use rodent burrows (often California ground squirrel) for roosting and nesting cover. Pipes, culverts, and nest boxes may be substituted for burrows in areas where burrows are not available.	**Unlikely:** No suitable nesting habitat within or adjacent to BSA.
Aquila chrysaetos Golden eagle	--/FP/--	Use rolling foot-hills, mountain terrain, wide arid plateaus deeply cut by streams and canyons, open mountain slopes, cliffs, and rocky outcrops. Nest in secluded cliffs with overhanging ledges as well as large trees.	**Low:** Foraging habitat is present within the BSA, no nesting habitat present.
Buteo regalis Ferruginous hawk	--/CNDDB/--	This species is an uncommon winter resident and migrant at lower elevation and open grasslands in the Modoc Plateau, Central Valley, and Coast Ranges and a fairly common winter resident of grassland and agricultural areas in southwestern California. Ferruginous hawks' frequent open grasslands, sagebrush flats, desert scrub, low foothills surrounding valleys, and fringes of pinyon-juniper habitats. They search for prey from low flights over open, treeless areas and glide to intercept prey on the ground. Prey is mostly lagomorphs, ground squirrels, and mice, but they may also take birds, reptiles, and amphibians. Breeding does not occur in California.	**Unlikely:** Potential foraging habitat exist within the BSA however; this species does not breed in California and is therefore unlikely to be impacted by the Project.
Brachyramphus marmoratus Marbled murrelet	FT / SE / --	Occur year-round in marine subtidal and pelagic habitats from the Oregon border to Point Sal. Partial to coastlines with stands of mature redwood and Douglas-fir. Requires dense mature forests of redwood and/or Douglas-fir for breeding and nesting.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Charadrius alexandrinus nivosus Western snowy plover (nesting)	FT / SSC / --	Sandy beaches on marine and estuarine shores, also salt pond levees and the shores of large alkali lakes. Requires sandy, gravelly or friable soil substrate for nesting.	**Unlikely:** No suitable habitat within or adjacent to BSA.

Species	**Status** (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Coturnicops noveboracensis yellow rail	-- / SSC / --	Wet meadows and coastal tidal marshes. Occurs year round in California, but in two primary seasonal roles: as a very local breeder in the northeastern interior and as a winter visitor (early Oct to mid-Apr) on the coast and in the Suisun Marsh region	**Unlikely:** No suitable habitat within or adjacent to BSA.
Cypseloides niger black swift	-- /SSC/--	Coastal belt of Santa Cruz and Monterey counties; central & southern Sierra Nevada; San Bernardino & San Jacinto mountains.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Empidonax traillii extimus Southwestern willow flycatcher	FE / SE / --	Breeds in riparian habitat in areas ranging in elevation from sea level to over 2,600 meters. Builds nest in trees in densely vegetated areas. This species establishes nesting territories and builds, and forages in mosaics of relatively dense and expansive areas of trees and shrubs, near or adjacent to surface water or underlain by saturated soils. Not typically found nesting in areas without willows (*Salix sp*.), tamarisk (*Tamarix ramosissima)*, or both.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Eremophila alpestris actia California horned lark	--/CNDDB/--	California horned larks are a common to abundant resident in a variety of open habitats and are frequently found in grasslands with low, sparse vegetation. This species builds a grass-lined cup nest in a depression on the ground, generally in the open. Breeding occurs between March and July, with peak activity occurring in May. California horned larks often form large flocks which forage and roost gregariously after breeding. This species eats mainly insects, snails, and spiders during the breeding season, and add grass and forb seeds (as well as other plant material) to their diet seasonally.	**Unlikely:** No suitable habitat within or adjacent to BSA.

Species	**Status** (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Falco mexicanus Prairie falcon	--/CNDDB/--	This species is an uncommon, permanent resident and migrant that ranges from southeastern deserts, northwest along the inner Coast Ranges and Sierra Nevada. The prairie falcon is generally distributed from annual grasslands to alpine meadows, but is associated primarily with perennial grasslands, savannas, rangeland, some agricultural fields, and desert scrub areas. Prairie falcons mainly prey upon small mammals, some small birds, and reptiles. Prey are taken in the air and on the ground in open areas. Prairie falcons require sheltered cliff ledges for cover. Nests are generally a scrape on the sheltered ledge of a cliff overlooking a large, open area. Nests are sometimes built on old raven or eagle stick nests on cliffs, bluffs, or rocky outcrops. Aerial courtship displays occur near the nest site.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Gymnogyps californianus California condor	FE / SE / --	Roosting sites in isolated rocky cliffs, rugged chaparral, and pine covered mountains 2000-6000 feet above sea level. Foraging area removed from nesting/roosting site (includes rangeland and coastal area - up to 19-mile commute one way). Nest sites in cliffs, crevices, potholes.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Laterallus jamaicensis coturniculus California black rail	-- / ST&CFP / --	Inhabits freshwater marshes, wet meadows & shallow margins of saltwater marshes bordering larger bays. Needs water depths of about 1 inch that does not fluctuate during the year & dense vegetation for nesting habitat.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Oceanodroma homochroa Ashy storm-petrel	--/SSC/--	Tied to land only to nest, otherwise remains over open sea. Nests in natural cavities, sea caves, or rock crevices on offshore islands and prominent peninsulas of the mainland.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Progne subis purple martin	--/SSC/--	Inhabits woodlands, low elevation coniferous forest of Douglas-fir, ponderosa pine, and Monterey pine.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Riparia riparia bank swallow	--/ST/--	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Sterna antillarum browni California Least Tern	FE / SE&CFP / --	Sea beaches, bays; large rivers, bars.	**Unlikely:** No suitable habitat within or adjacent to BSA.

Species	Status (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Vireo bellii pusillus Least Bell's vireo	FE / SE / --	Riparian areas and drainages. Breed in willow riparian forest supporting a dense, shrubby understory. Oak woodland with a willow riparian understory is also used in some areas, and individuals sometimes enter adjacent chaparral, coastal sage scrub, or desert scrub habitats to forage.	**Unlikely:** No suitable habitat within or adjacent to BSA.
REPTILES AND AMPHIBIANS			
Ambystoma californiense California tiger salamander	FT / ST /--	Annual grassland and grassy understory of valley-foothill hardwood habitats in central and northern California. Need underground refuges and vernal pools or other seasonal water sources.	**Unlikely:** No breeding habitat is present within the BSA. Several breeding locations are known within Fort Ord; however, all of these are located 2.0 miles or greater from the BSA, outside of the known dispersal range for this species.
Ambystoma macrodactylum Croceum Santa Cruz Long-toed Salamander	FE / SE&CFP / --	Preferred habitats include ponderosa pine, montane hardwood-conifer, mixed conifer, montane riparian, red fir and wet meadows. Occurs in a small number of localities in Santa Cruz and Monterey Counties. Adults spend the majority of the time in underground burrows and beneath objects. Larvae prefer shallow water with clumps of vegetation.	**Unlikely:** No suitable habitat within or adjacent to BSA. Outside of the known range for this species.
Anniella pulchra California legless lizard (includes *A. p. nigra* and *A. p. pulchra* as recognized by the CDFW)	--/SSC/--	Requires moist, warm habitats with loose soil for burrowing and prostrate plant cover, often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas.	**High:** Suitable habitat present within the undeveloped areas of the BSA, where loose soil and prostrate plant cover occur. Figure B-16 in the Fort Ord HMP identifies portions of the BSA as containing potential habitat for this species. The CNDDB reports 47 occurrences within the quadrangles analyzed.

Species	**Status** (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Phrynosoma blainvillii Coast horned lizard	--/SSC/--	Horned lizards occur in valley-foothill hardwood, conifer, and riparian habitats, as well as in pine-cypress, juniper, chaparral, and annual grass habitats. This species generally inhabits open country, especially sandy areas, washes, flood plains, and wind-blown deposits in a wide variety of habitats. Coast horned lizards rely on camouflage for protection and will often lay motionless when approached. Horned lizards often bask in the early morning on the ground or on elevated objects such as low boulders or rocks. Predators and extreme heat are avoided by burrowing into loose soil. Periods of inactivity and winter hibernation are spent burrowed into the soil or under surface objects. Little is known about the habitat requirements for breeding and egg-laying of this species. Prey species include ants, beetles, wasps, grasshoppers, flies, and caterpillars.	**Present:** Multiple individuals identified during survey effort. The CNDDB reports 6 occurrences within the quadrangles analyzed.
Rana boylii foothill yellow-legged frog	-- / SC&SSC / --	Partly shaded, shallow streams and riffles with a rocky substrate in a variety of habitats, including hardwood, pine, and riparian forests, scrub, chaparral, and wet meadows. Rarely encountered far from permanent water.	**Unlikely:** Suitable habitat does not exist within or adjacent to BSA, no permanent water resources within the BSA.
Rana draytonii California red-legged frog	FT / SSC / --	Lowlands and foothills in or near permanent or late-season sources of deep water with dense, shrubby, or emergent riparian vegetation. During late summer or fall adults are known to utilize a variety of upland habitats with leaf litter or mammal burrows.	**Unlikely:** Suitable habitat does not exist within or adjacent to BSA, no permanent water exists within the BSA.

Species	**Status** (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Spea hammondii Western spadefoot toad	--/SSC/--	Western spadefoot toads are distributed throughout the Central Valley and adjacent foothills and are typically quite common where they occur. In the Coast Ranges, this species is found from Point Conception in Santa Barbara County, south to the Mexican border. Elevations of occurrence extend from near sea-level to 1,360 meters. Rarely found on the surface, spadefoot toads spend most of the year in underground burrows, which they may construct themselves or may improve (from small mammals). Breeding and egg laying occur almost exclusively in shallow, temporary pools formed by heavy winter rains. Egg masses are attached to plant material or the upper surfaces of submerged rocks. Tadpoles consume planktonic organisms and algae but are also carnivorous and may consume dead aquatic larvae of amphibians (including cannibalism). Recently metamorphosed juveniles seek refuge in the immediate vicinities of breeding ponds.	**Unlikely:** Moderately suitable habitat within and adjacent to BSA, but outside historical range of occurrence. The closest known CNDDB occurrence is from 1922 approximately 6km from BSA.
Taricha torosa Coast Range newt	--/SSC/--	This species was historically distributed in coastal drainages from the vicinity of Sherwoods (central Mendocino County) in the North Coast Ranges, south to Boulder Creek, in San Diego County (CDFW, 2008). Populations in southern California appear to be highly fragmented, even historically. This species has been depleted by large-scale historical commercial exploitation coupled with the loss and degradation of stream habitats, particularly in Los Angeles, Orange, Riverside, and San Diego Counties. The records of Slevin (1928) for Baja California are thought to be erroneous (Stebbins, 1951). The known elevation range of this species extends from near sea-level to 1830 meters (Stebbins, 1985).	**Unlikely:** No suitable habitat within or adjacent to BSA.

Species	Status (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Thamnophis hammondii Two-striped garter snake	--/SSC/--	The two-striped garter snake is distributed throughout the South Coast Range and the Transverse Range, from the eastern slope of the Diablo Range to the Mexican border. This species is associated with permanent or semi-permanent bodies of water in a variety of habitats from sea level to 2,400 meters (8,000 feet). Habitat types include perennial and intermittent streams with rocky riverbeds, large sandy bottom riverbeds, natural and artificial ponds (Jennings and Hayes, 1994). Two-striped garter snakes forage primarily for fish and their eggs, amphibians, and amphibian larvae, but small mammals and invertebrates are also taken. Courtship and mating occur in the spring and one to 25 young are born in later summer and fall.	**Low:** Moderately suitable habitat found within and adjacent to BSA. The closest known CNDDB occurrence is from 2001 approximately 11 km from BSA.
FISH			
Eucyclogobius newberryi tidewater goby	FE / SSC / --	Brackish water habitats along the California coast from Agua Hedionda Lagoon, San Diego County to the mouth of the Smith River.	**Unlikely** No suitable habitat within BSA.
Oncorhynchus mykiss irideus Steelhead (Central California Coast DPS)	FT / -- / --	Coastal perennial and near perennial streams, with suitable spawning and rearing habitat and no major barriers.	**Unlikely** No suitable habitat within BSA.
INVERTEBRATES			
Coelus globosus globose dune beetle	-- / CNDDB / --	Coastal dunes. These beetles are primarily subterranean, tunneling through sand underneath dune vegetation.	**Unlikely:** No suitable habitat within or adjacent to BSA.
Danaus plexippus pop. 1 monarch - California overwintering population	-- / CNDDB / --	Overwinters in coastal California using colonial roosts generally found in Eucalyptus, pine and acacia trees. Overwintering habitat for this species within the Coastal Zone represents ESHA. Local ordinances often protect this species as well.	**Unlikely:** No suitable overwintering habitat within or adjacent to BSA.
Euhilotes enoptes smithi Smith's blue butterfly	FE / -- / --	Most commonly associated with coastal dunes and coastal sage scrub plant communities in Monterey and Santa Cruz Counties. Plant hosts are *Eriogonum latifolium* and *E. parvifolium*.	**Unlikely:** No suitable habitat within or adjacent to BSA. Obligate host plants for this species were not identified within the BSA during survey efforts.

Species	Status (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
PLANTS			
Agrostis lacuna-vernalis Vernal pool bent grass	--/--/1B	Vernal pool mima mounds at elevations of 115-145 meters. Annual herb in the Poaceae family; blooms April-May. Known only from Butterfly Valley and Machine Gun Flats of Ft. Ord National Monument.	**Not Present:** Not identified during focused botanical surveys in 2019
Allium hickmanii Hickman's onion	-- / -- / 1B	Closed-cone coniferous forests, maritime chaparral, coastal prairie, coastal scrub, and valley and foothill grasslands at elevations of 5-200 meters. Bulbiferous herb in the Alliaceae family; blooms March-May.	**Not Present:** Not identified during focused botanical surveys in 2019.
Arctostaphylos edmundsii Little Sur manzanita	-- / -- / 1B	Coastal bluff scrub and chaparral on sandy soils at elevations of 30-105 meters. Evergreen shrub in the Ericaceae family; blooms November-April.	**Not Present:** Not identified during focused botanical surveys in 2019
Arctostaphylos hookeri ssp. *hookeri* Hooker's manzanita	-- / -- / 1B	Closed-cone coniferous forest, chaparral, cismontane woodland, and coastal scrub on sandy soils at elevations of 85-536 meters. Evergreen shrub in the Ericaceae family; blooms January-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Arctostaphylos montereyensis Toro manzanita	-- / -- / 1B	Maritime chaparral, cismontane woodland, and coastal scrub on sandy soils at elevations of 30-730 meters. Evergreen shrub in the Ericaceae family; blooms February-March.	**Not Present:** Not identified during focused botanical surveys in 2019
Arctostaphylos pajaroensis Pajaro manzanita	-- / -- / 1B	Chaparral on sandy soils at elevations of 30-760 meters. Evergreen shrub in the Ericaceae family; blooms December-March.	**Not Present:** Not identified during focused botanical surveys in 2019
Arctostaphylos pumila Sandmat manzanita	-- / -- / 1B	Closed-cone coniferous forests, maritime chaparral, cismontane woodland, coastal dunes, and coastal scrub on sandy soils at elevations of 3-205 meters. Evergreen shrub in the Ericaceae family; blooms February-May.	**Present:** Observed throughout the BSA during focused botanical surveys in 2009 and 2010.
Astragalus tener var. *tener* Alkali milk-vetch	-- / -- / 1B	Playas, valley and foothill grassland on adobe clay, and vernal pools on alkaline soils at elevations of 1-60 meters. Annual herb in the Fabaceae family; blooms March-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Astragalus tener var. *titi* Coastal dunes milk-vetch	FE / SE / 1B	Coastal bluff scrub on sandy soils, coastal dunes, and mesic areas of coastal prairie at elevations of 1-50 meters. Annual herb in the Fabaceae family; blooms March-May.	**Not Present:** Not identified during focused botanical surveys in 2019

Species	Status (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Castilleja ambigua var. *insalutata* Pink Johnny-nip	-- / -- / 1B	Coastal prairie and coastal scrub at elevations of 0-100 meters. Annual herb in the Orobanchaceae family; blooms May-August.	**Not Present:** Not identified during focused botanical surveys in 2019
Ceanothus cuneatus ssp. *rigidus* Monterey ceanothus	-- / -- / 4	Closed cone coniferous forest, chaparral, and coastal scrub on sandy soils at elevations of 3-550 meters. Evergreen shrub in the Rhamnaceae family, blooms February-June.	**Present:** Observed throughout BSA during focused botanical surveys in 2019. Considered special-status SSCspecies due to listing in HMP.
Centromadia parryi ssp. *congdonii* Congdon's tarplant	-- / -- / 1B	Valley and foothill grassland on alkaline soils at elevations of 1-230 meters. Annual herb in the Asteraceae family; blooms June-November.	**Not Present:** Not identified during focused botanical surveys in 2019
Chorizanthe minutiflora Fort Ord spineflower	-- / -- / 1B	Sandy openings in maritime chaparral and coastal scrub at elevations of 55-100 meters. Annual herb, blooms April-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Chorizanthe pungens var. *pungens* Monterey spineflower	FT / -- / 1B	Maritime chaparral, cismontane woodland, coastal dunes, coastal scrub, and valley and foothill grassland on sandy soils at elevations of 3-450 meters. Annual herb in the Polygonaceae family; blooms April-June.	**Present:** Observed throughout BSA during focused botanical surveys in 2019
Clarkia jolonensis Jolon clarkia	-- / -- / 1B	Cismontane woodland, chaparral, riparian woodland, and coastal scrub at elevations of 20-660 meters. Annual herb in the Onagraceae family; blooms April-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Collinsia multicolor San Francisco collinsia	-- / -- / 1B	Closed-cone coniferous forest and coastal scrub, sometimes on serpentinite soils, at elevations of 30-250 meters. Annual herb in the Scrophulariaceae family; blooms March-May.	**Not Present:** Not identified during focused botanical surveys in 2019
Cordylanthus rigidus ssp. *littoralis* Seaside bird's-beak	-- / SE / 1B	Closed-cone coniferous forests, chaparral, cismontane woodlands, coastal dunes, and coastal scrub on sandy soils, often on disturbed sites, at elevations of 0-425 meters. Hemi-parasitic, annual herb in the Scrophulariaceae family; blooms April-October.	**Not Present:** Not identified during focused botanical surveys in 2019
Delphinium hutchinsoniae Hutchinson's larkspur	-- / -- / 1B	Broadleaved upland forest, chaparral, coastal scrub, and coastal prairie at elevations of 0-427 meters. Perennial herb in the Ranunculaceae family; blooms March-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Delphinium umbraculorum Umbrella larkspur	-- / -- / 1B	Cismontane woodland at elevations of 400-1600 meters. Perennial herb in the Ranunculaceae family; blooms April-June.	**Not Present:** Not identified during focused botanical surveys in 2019

Species	**Status** (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Ericameria fasciculata Eastwood's goldenbush	-- / -- / 1B	Closed-cone coniferous forest, maritime chaparral, coastal dunes, and openings in coastal scrub on sandy soils at elevations of 30-275 meters. Evergreen shrub in the Asteraceae family; blooms July-October.	**Present:** Observed within BSA during focused botanical surveys in 2019
Erysimum ammophilum Sand-loving (coast) wallflower	-- / -- / 1B	Maritime chaparral, coastal dunes, and openings in coastal scrub on sandy soils at elevations of 0-60 meters. Perennial herb in the Brassicaceae family; blooms February-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Erysimum menziesii ssp. *menziesii* Menzies' wallflower	FE / SE / 1B	Coastal dunes at elevations of 0-35 meters. Perennial herb in the Brassicaceae family; blooms March-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Fritillaria liliacea Fragrant fritillaria	-- / -- / 1B	Cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland, often serpentinite, at elevations of 3-410 meters. Bulbiferous perennial herb in the Liliaceae family; blooms February-April.	**Not Present:** Not identified during focused botanical surveys in 2019
Gilia tenuiflora ssp. *arenaria* Monterey gilia	FE / ST /1B	Maritime chaparral, cismontane woodland, coastal dunes, and openings in coastal scrub on sandy soils at elevations of 0-45 meters. Annual herb in the Polemoniaceae family; blooms April-June.	**Present:** Observed throughout BSA during focused botanical surveys in 2010.
Hesperocyparis goveniana Gowen cypress	-- / -- / 1B	Closed-cone coniferous forest and maritime chaparral at elevations of 30-300 meters. Evergreen tree in the Cupressaceae family. Natively occurring only at Point Lobos near Gibson Creek and the Huckleberry Hill Nature Preserve near Highway 68.	**Not Present:** Not identified during focused botanical surveys in 2019. BSA outside of currently known range for this species.
Hesperocyparis macrocarpa Monterey cypress	-- / -- / 1B	Closed-cone coniferous forest at elevations of 10-30 meters. Evergreen tree in the Cupressaceae family. Natively occurring only at Cypress Point in Pebble Beach and Point Lobos State Park; widely planted and naturalized elsewhere.	**Not Present:** BSA is outside of currently known range for this species. Although several individuals of this species were observed within the BSA, these individuals are planted specimens or volunteers from planted specimens and are not considered special-status. Therefore, no natively occurring Monterey cypress trees are present within the BSA.
Horkelia cuneata ssp. *sericea* Kellogg's horkelia	-- / -- / 1B	Closed-cone coniferous forests, maritime chaparral, and openings in coastal scrub on sandy or gravelly soils at elevations of 10-200 meters. Perennial herb in the Rosaceae family; blooms April-September.	**Present:** Observed throughout BSA during focused botanical surveys in 2019.

Species	Status (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Horkelia marinensis Point Reyes horkelia	-- / -- / 1B	Coastal strand, coastal prairie, northern coastal scrub at elevations of 5-75 meters. Perennial herb; blooms May to September.	**Not Present:** Not identified during focused botanical surveys in 2019
Lasthenia conjugens Contra Costa goldfields	FE / -- / 1B	Mesic areas of valley and foothill grassland, alkaline playas, cismontane woodland, and vernal pools at elevations of 0-470 meters. Annual herb in the Asteraceae family; blooms March-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Layia carnosa Beach layia	FE / SE / 1B	Coastal dunes and coastal scrub on sandy soils at elevations of 0-60 meters. Annual herb in the Asteraceae family; blooms March-July.	**Not Present:** Not identified during focused botanical surveys in 2019
Legenere limosa Legenere	-- / -- / 1B	Vernal pools and wetlands at elevations of 1-880 meters. Annual herb in the Campanulaceae family; blooms April- June.	**Not Present:** Not identified during focused botanical surveys in 2019
Lupinus tidestromii Tidestrom's lupine	FE / SE / 1B	Coastal dunes at elevations of 0-100 meters. Perennial rhizomatous herb in the Fabaceae family; blooms April-June. Only Monterey County plants are state-listed Endangered as var. *tidestromii*.	**Not Present:** Not identified during focused botanical surveys in 2019
Malacothamnus palmeri var. *involucratus* Carmel Valley bush-mallow	-- / -- / 1B	Chaparral, cismontane woodland, and coastal scrub at elevations of 30-1100 meters. Deciduous shrub in the Malvaceae family; blooms May-August.	**Not Present:** Not identified during focused botanical surveys in 2019
Malacothrix saxatilis var. *arachnoidea* Carmel Valley malacothrix	-- / -- / 1B	Chaparral and coastal scrub on rocky soils at elevations of 25-1036 meters. Perennial rhizomatous herb in the Asteraceae family; blooms June-December (uncommon in March).	**Not Present:** Not identified during focused botanical surveys in 2019
Microseris paludosa Marsh microseris	-- / -- / 1B	Closed-cone coniferous forest, cismontane woodland, coastal scrub, and valley and foothill grasslands at elevations of 3-300 meters. Perennial herb in the Asteraceae family; blooms April-June (July).	**Not Present:** Not identified during focused botanical surveys in 2019
Monardella sinuate ssp. *nigrescens* Northern curly-leaved monardella	-- / -- / 1B	Closed-cone coniferous forest, chaparral, coastal dunes, coastal prairie, coastal scrub, and lower montane coniferous forest (ponderosa pine sandhills) on sandy soils at elevations of 0-305 meters. Annual herb in the Lamiaceae family; blooms May-September.	**Not Present:** Not identified during focused botanical surveys in 2019
Monolopia graciliens Woodland woollythreads	-- / -- / 1B	Openings of broadleaved upland forest, chaparral, cismontane woodland, North Coast coniferous forest, and valley and foothill grassland on serpentinite soils at elevations of 100-1200 meters. Annual herb in the Asteraceae family; blooms February-July.	**Not Present:** Not identified during focused botanical surveys in 2019

Species	**Status** (Service/ Department/CNPS)	General Habitat	Potential Occurrence within Project Vicinity
Pinus radiata Monterey pine	-- / -- / 1B	Closed-cone coniferous forest at elevations of 25-185 meters. Evergreen tree in the Pinaceae family. Only three native stands in CA, at Ano Nuevo, Cambria, and the Monterey Peninsula; introduced in many areas.	**Not Present:** Several Monterey pine trees are present within the Project Site; however, the majority of these individuals are planted specimens or volunteers from planted specimens and are not considered special-status.
Piperia yadonii Yadon's rein orchid	FE / -- / 1B	Sandy soils in coastal bluff scrub, closed-cone coniferous forest, and maritime chaparral at elevations of 10-510 meters. Annual herb in the Orchidaceae family; blooms May-August.	**Not Present:** Not identified during focused botanical surveys in 2019
Plagiobothrys chorisianus var. *chorisianus* Choris' popcorn flower	-- / -- / 1B	Mesic areas of chaparral, coastal prairie, and coastal scrub at elevations of 15-160 meters. Annual herb in the Boraginaceae family; blooms March-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Plagiobothrys uncinatus Hooked popcorn flower	-- / -- / 1B	Chaparral, cismontane woodlands, and valley and foothill grasslands on sandy soils at elevations of 300-760 meters. Annual herb in the Boraginaceae family; blooms April-May.	**Not Present:** Not identified during focused botanical surveys in 2019
Potentilla hickmanii Hickman's cinquefoil	FE / SE / 1B	Coastal bluff scrub, closed-cone coniferous forests, vernally mesic meadows, and freshwater marshes and swamps at elevations of 10-149 meters. Perennial herb in the Rosaceae family; blooms April-August.	**Not Present:** Not identified during focused botanical surveys in 2019
Rosa pinetorum Pine rose	-- / -- / 1B	Closed-cone coniferous forest at elevations of 2-300 meters. Shrub in the Rosaceae family; blooms May-July. Possible hybrid of *R. spithamea*, *R. gymnocarpa*, or others; further study needed.	**Not Present:** Not identified during focused botanical surveys in 2019
Sidalcea malachroides Maple-leaved checkerbloom	-- / -- / 4	Broadleaved upland forest, coastal prairie, coastal scrub, north coast coniferous forest, and riparian woodlands, often in disturbed areas, at elevations of 2-700 meters. Perennial herb in the Malvaceae family; blooms April-August.	**Not Present:** Not identified during focused botanical surveys in 2019
Stebbinsoseris decipiens Santa Cruz microseris	-- / -- / 1B	Broadleaved upland forest, closed-cone coniferous forest, chaparral, coastal prairie, coastal scrub, and openings in valley and foothill grassland, sometimes on serpentinite, at elevations of 10-500 meters. Annual herb in the Asteraceae family; blooms April-May.	**Not Present:** Not identified during focused botanical surveys in 2019
Trifolium buckwestiorum Santa Cruz clover	-- / -- / 1B	Broadleaved upland forest, cismontane woodland, and margins of coastal prairie on gravelly soils at elevations of 105-610 meters. Annual herb in the Fabaceae family; blooms April-October.	**Not Present:** Not identified during focused botanical surveys in 2019

Species	**Status** (Service/ Department/CNPS)	**General Habitat**	**Potential Occurrence within Project Vicinity**
Trifolium depauperatum var. *hydrophilum* Saline clover	-- / -- / 1B	Marshes and swamps, valley and foothill grassland (mesic, alkaline), and vernal pools at elevations of 0-300 meters. Annual herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Trifolium polyodon Pacific Grove clover	-- / SR / 1B	Closed-cone coniferous forest, coastal prairie, meadows and seeps, and mesic areas in valley and foothill grassland at elevations of 5-120 meters. Annual herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused botanical surveys in 2019
Trifolium trichocalyx Monterey clover	FE / SE / 1B	Sandy openings and burned areas of closed-cone coniferous forest at elevations of 30-240 meters. Annual herb in the Fabaceae family; blooms April-June.	**Not Present:** Not identified during focused botanical surveys in 2019

STATUS DEFINITIONS

Federal

FE	= listed as Endangered under the federal Endangered Species Act
FT	= listed as Threatened under the federal Endangered Species Act
FC	= Candidate for listing under the federal Endangered Species Act
--	= no listing

State

SE	= listed as Endangered under the California Endangered Species Act
ST	= listed as Threatened under the California Endangered Species Act
SR	= listed as Rare under the California Endangered Species Act
SC	= Candidate for listing under the California Endangered Species Act
SSC	= California Department of Fish and Wildlife Species of Concern
CFP	= California Fully Protected Animal
CNDDB	= This designation is being assigned to animal species with no other status designation defined in this table. These animal species are included in the Department's CNDDB "Special Animals" list (2010), which includes all taxa the CNDDB is interested in tracking, regardless of their legal or protection status. This list is also referred to as the list of "species at risk" or "special-status species." The Department considers the taxa on this list to be those of the greatest conservation need.
--	= no listing

California Native Plant Society

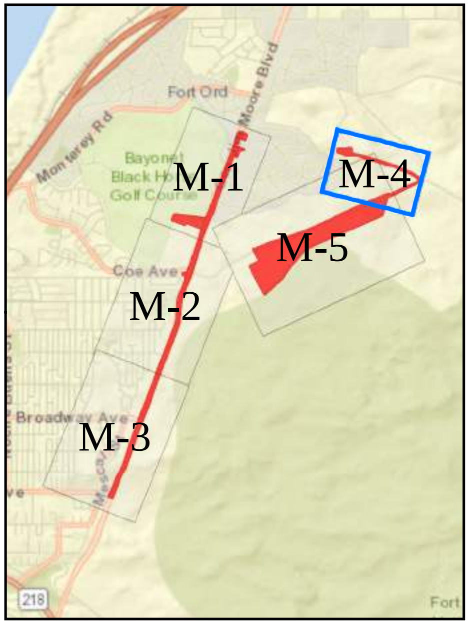
1B	= List 1B species; rare, threatened or endangered in California and elsewhere
List 4	= Limited distribution (CNPS Watch List)
--	= no listing

POTENTIAL TO OCCUR

Present	= known occurrence of species within the site; presence of suitable habitat conditions; or observed during field surveys
High	= known occurrence of species in the vicinity from the CNDDB or other documentation; presence of suitable habitat conditions
Moderate	= known occurrence of species in the vicinity from the CNDDB or other documentation; presence of marginal habitat conditions within the site
Low	= species known to occur in the vicinity from the CNDDB or other documentation; lack of suitable habitat or poor quality
Unlikely	= species not known to occur in the vicinity from the CNDDB or other documentation, no suitable habitat is present within the site
Not Present	= species was not observed during surveys

Appendix E

GWR Expanded Capacity Project Habitat Type Detail Maps



Biological Study Area

Central Coastal Scrub (8.8 Acres)

Central Maritime Chaparral (16.1 Acres)

Coast Live Oak Woodland (10.2 Acres)

Ruderal/Disturbed (46.4 Acres)

Developed (43.4 Acres)

N

0 40 80 160 Meters

0 205 410 820 Feet

GWR Expanded Capacity Project
Habitat Type Detail Maps

Date: 10/29/2019

Scale: 1 inch = 400 feet

Project: 2013-13

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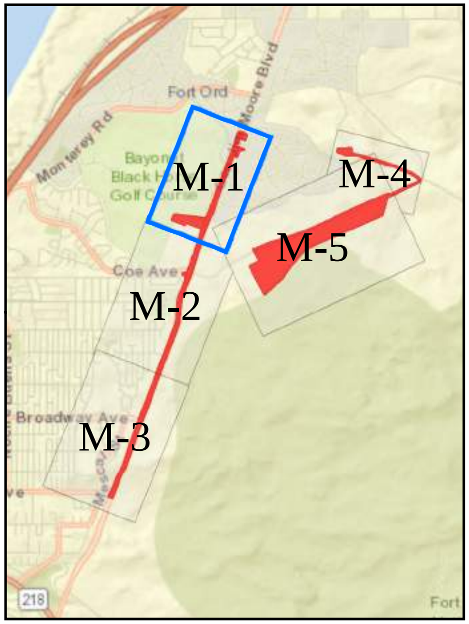
E



Biological Study Area

Central Coastal Scrub (8.8 Acres)

Central Maritime Chaparral (16.1 Acres)

Coast Live Oak Woodland (10.2 Acres)

Ruderal/Disturbed (46.4 Acres)

Developed (43.4 Acres)

N

0 62.5 125 250 Meters

0 312.5 625 1,250 Feet

GWR Expanded Capacity Project
Habitat Type Detail Maps

Date: 10/29/2019

Scale: 1 inch = 700 feet

Project: 2013-13

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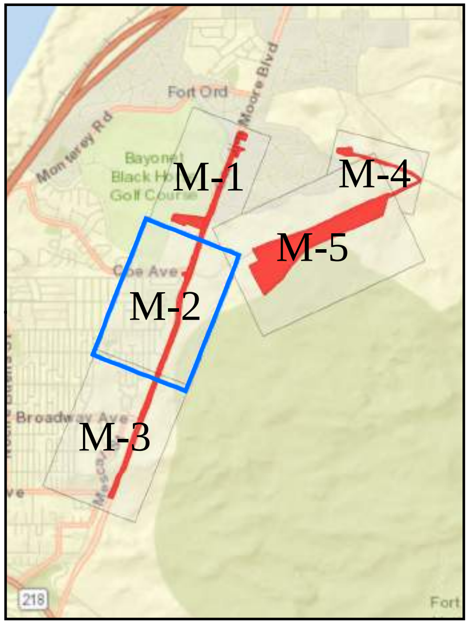

Biological Study Area

Central Coastal Scrub (8.8 Acres)

Central Maritime Chaparral (16.1 Acres)

Coast Live Oak Woodland (10.2 Acres)

Ruderal/Disturbed (46.4 Acres)

Developed (43.4 Acres)

N

0 75 150 300 Meters

0 375 750 1,500 Feet

GWR Expanded Capacity Project
Habitat Type Detail Maps

Date: 10/29/2019

Scale: 1 inch = 800 feet

Project: 2013-13

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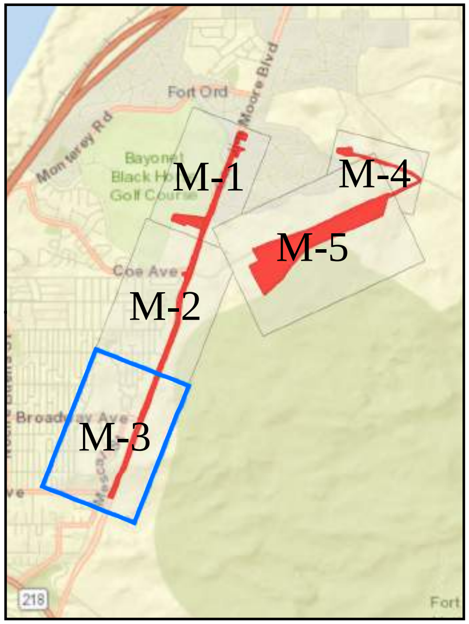

Biological Study Area

Central Coastal Scrub (8.8 Acres)

Central Maritime Chaparral (16.1 Acres)

Coast Live Oak Woodland (10.2 Acres)

Ruderal/Disturbed (46.4 Acres)

Developed (43.4 Acres)

N

0 75 150 300 Meters

0 375 750 1,500 Feet

GWR Expanded Capacity Project Habitat Type Detail Maps

Date: 10/29/2019

Scale: 1 inch = 800 feet

Project: 2013-13

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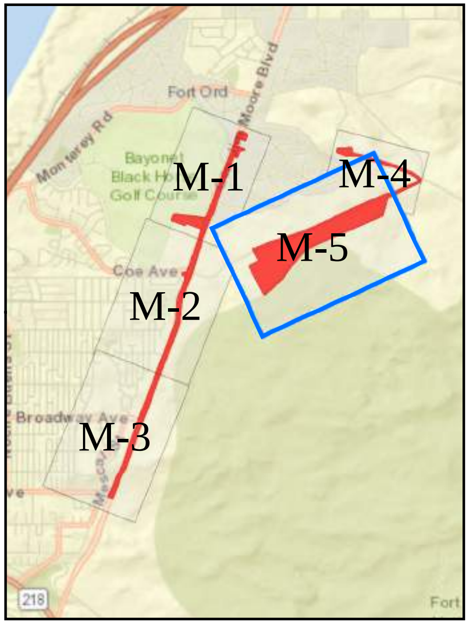

- Biological Study Area
- Central Coastal Scrub (8.8 Acres)
- Central Maritime Chaparral (16.1 Acres)
- Coast Live Oak Woodland (10.2 Acres)
- Ruderal/Disturbed (46.4 Acres)
- Developed (43.4 Acres)

N

0 80 160 320 Meters

0 410 820 1,640 Feet

GWR Expanded Capacity Project
Habitat Type Detail Maps

Date: 10/29/2019
Scale: 1 inch = 900 feet
Project: 2013-13

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Appendix E

Appendix F

GWR Expanded Capacity Project Special-Status Plant Species Survey Results

Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) < 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) < 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) < 5 Individuals

Sandmat Manzanita (*Arctostaphylos pumila*) < 5 Individuals

Eastwood's Goldenbush (*Ericameria Fasciculata*) < 5 Individuals

Monterey Spineflower (*Chorizanthe pungens* var. *pungens*) < 5 Individuals

Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) ≥ 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) ≥ 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) ≥ 5 Individuals Low Density

Sandmat Manzanita (*Arctostaphylos pumila*) ≥ 5 Individuals Low Density

Eastwood's Goldenbush (*Ericameria fasciculata*) Low Density

Monterey Spineflower *Chorizanthe pungens* var. *pungens* ≥ 5 Individuals

Low Density

Medium Density

N

0 25 50 Meters

0 50 100 200 Feet

Focused Botanical Survey Area

GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019

Scale: 1 inch = 100 feet

Project: 2013-13

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Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
< 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
< 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
< 5 Individuals

Sandmat Manzanita
(Arctostaphylos pumila)
< 5 Individuals

Eastwood's Goldenbush
(Ericameria Fasciculata)
< 5 Individuals

Monterey Spineflower
(Chorizanthe pungens var.
pungens)
< 5 Individuals

Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
≥ 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
≥ 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
≥ 5 Individuals
Low Density

Sandmat Manzanita
(Arctostaphylos pumila)
≥ 5 Individuals
Low Density

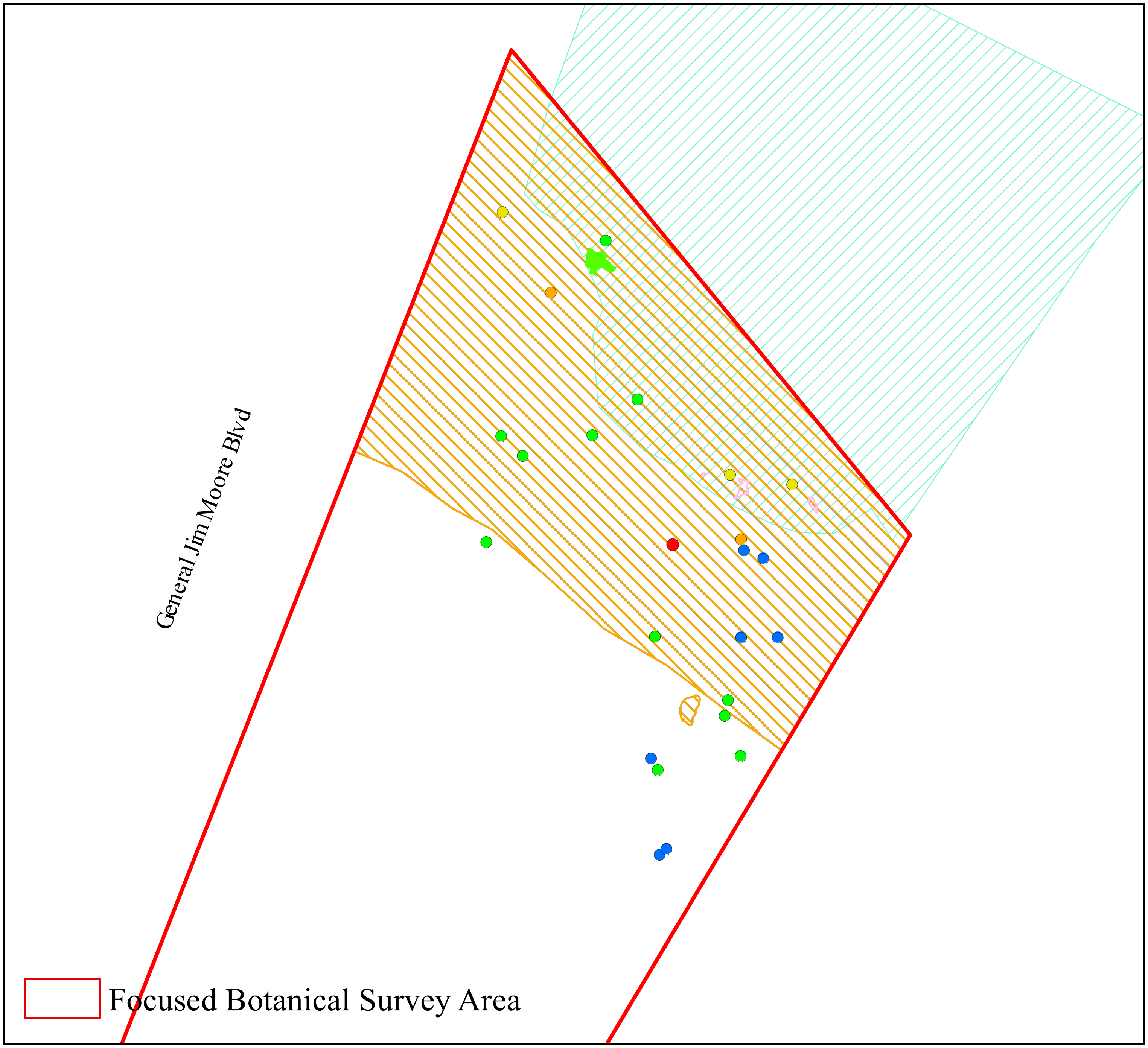
Eastwood's Goldenbush
(Ericameria fasciculata)
Low Density

Monterey Spineflower
Chorizanthe pungens
var. *pungens*
≥ 5 Individuals
Low Density
Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019
Scale: 1 inch = 100 feet
Project: 2013-13

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Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) < 5 Individuals

Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) ≥ 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) < 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) ≥ 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) < 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) ≥ 5 Individuals Low Density

Sandmat Manzanita (*Arctostaphylos pumila*) < 5 Individuals

Sandmat Manzanita (*Arctostaphylos pumila*) ≥ 5 Individuals Low Density

Eastwood's Goldenbush (*Ericameria Fasciculata*) < 5 Individuals

Eastwood's Goldenbush (*Ericameria fasciculata*) Low Density

Monterey Spineflower (*Chorizanthe pungens* var. *pungens*) < 5 Individuals

Monterey Spineflower *Chorizanthe pungens* var. *pungens* ≥ 5 Individuals

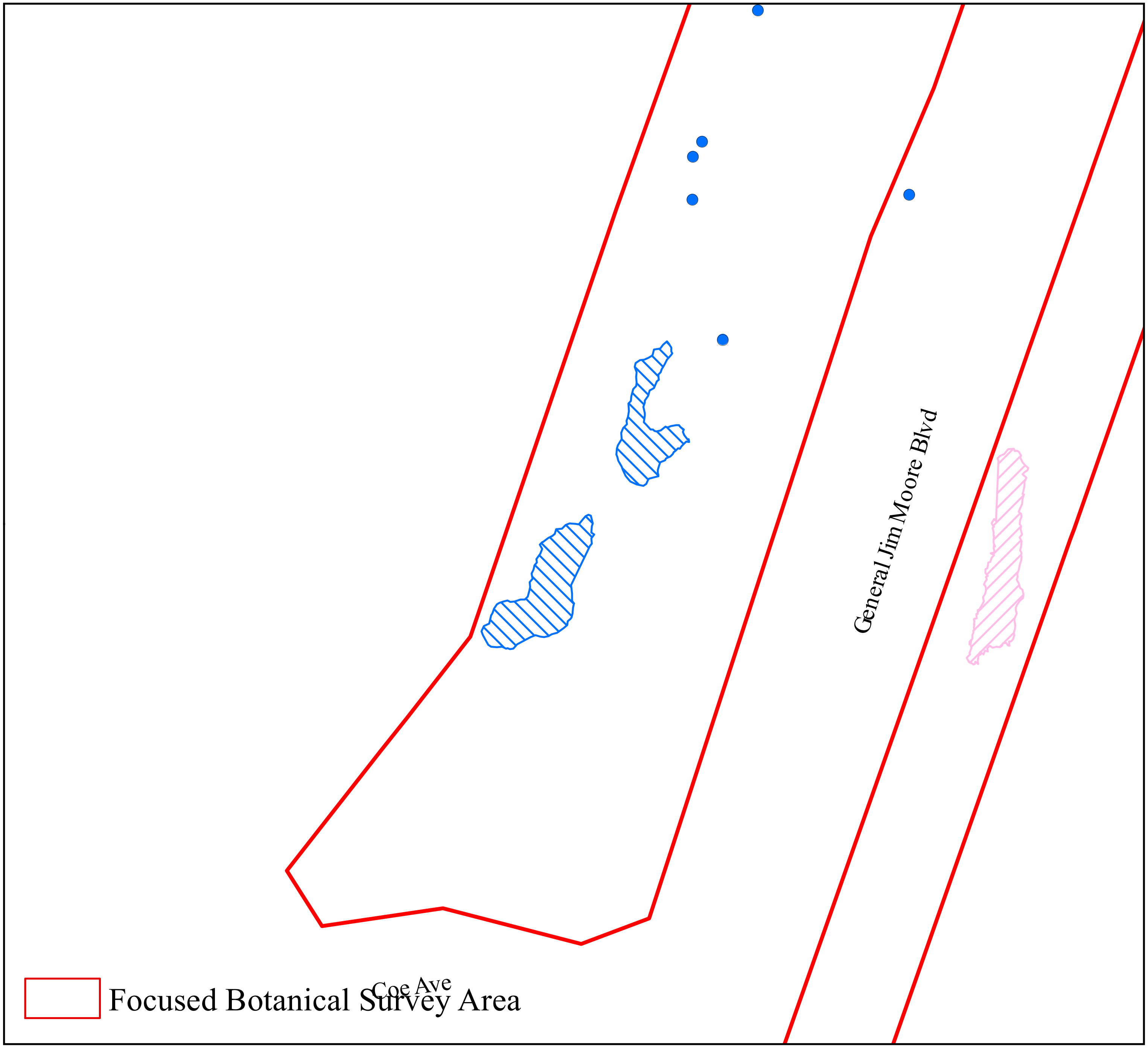
Low Density

Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



Focused Botanical Survey Area

GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019

Scale: 1 inch = 100 feet

Project: 2013-13

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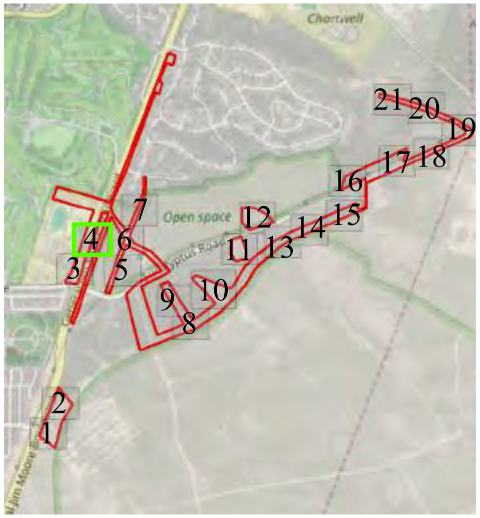
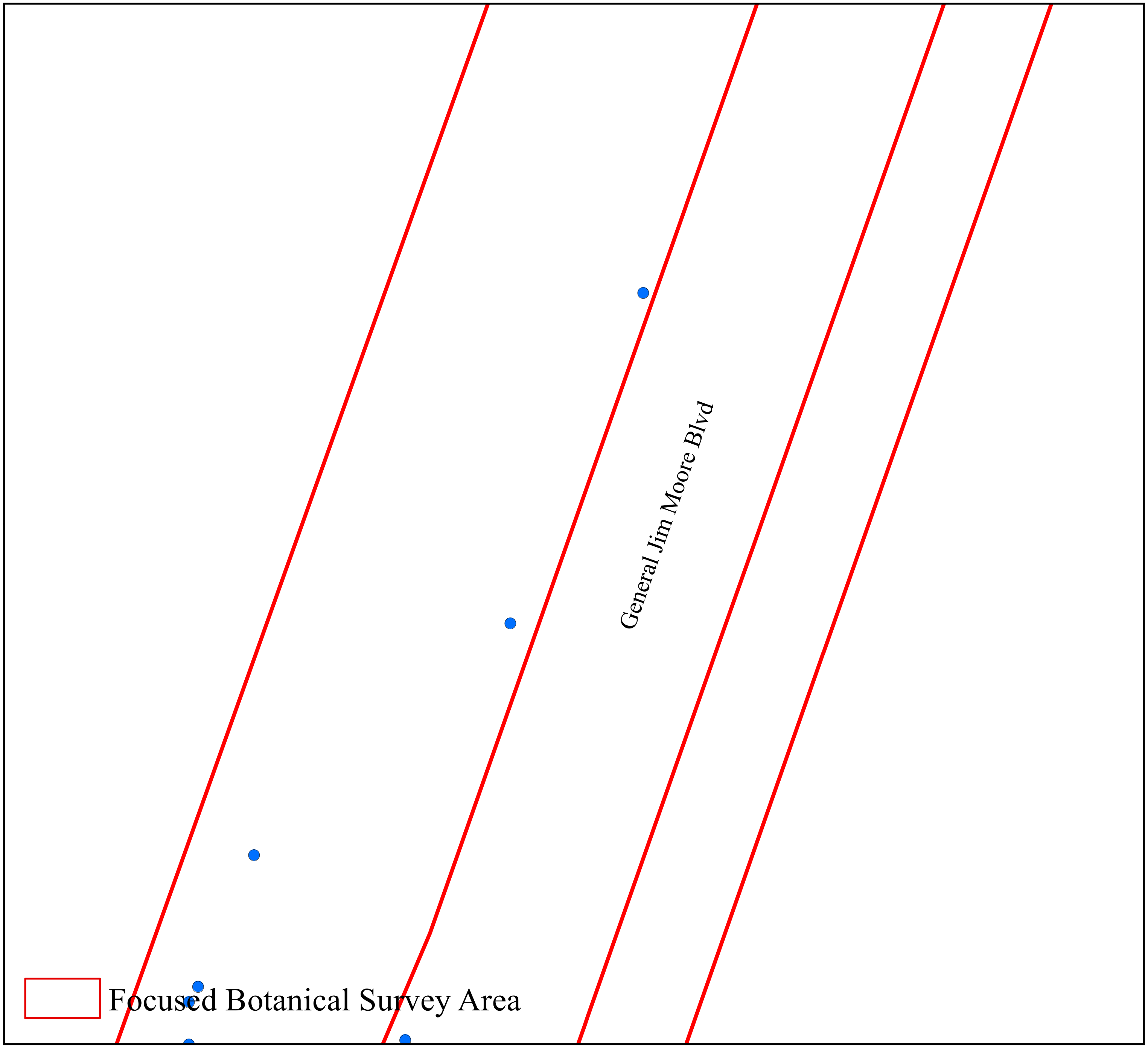


Sand Gilia (*Gilia tenuiflora* ssp. *arenaria)* < 5 Individuals	Sand Gilia (*Gilia tenuiflora* ssp. *arenaria)* ≥ 5 Individuals
Kellog's Horkelia (*Horkelia cuneata* var. *sericea)* < 5 Individuals	Kellog's Horkelia (*Horkelia cuneata* var. *sericea)* ≥ 5 Individuals
Monterey Ceanothus (*Ceanothus rigidus)* < 5 Individuals	Monterey Ceanothus (*Ceanothus rigidus)* ≥ 5 Individuals Low Density
Sandmat Manzanita (*Arctostaphylos pumila)* < 5 Individuals	Sandmat Manzanita (*Arctostaphylos pumila)* ≥ 5 Individuals Low Density
Eastwood's Goldenbush (*Ericameria Fasciculata)* < 5 Individuals	Eastwood's Goldenbush (*Ericameria fasciculata*) Low Density
Monterey Spineflower (*Chorizanthe pungens* var. *pungens)* < 5 Individuals	Monterey Spineflower *Chorizanthe pungens* var. *pungens* ≥ 5 Individuals Low Density Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019
Scale: 1 inch = 100 feet
Project: 2013-13

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Sand Gilia (*Gilia tenuiflora* ssp. *arenaria)* < 5 Individuals

Sand Gilia (*Gilia tenuiflora* ssp. *arenaria)* ≥ 5 Individuals

Kellog's Horkelia *(Horkelia cuneata* var. *sericea)* < 5 Individuals

Kellog's Horkelia *(Horkelia cuneata* var. *sericea)* ≥ 5 Individuals

Monterey Ceanothus *(Ceanothus rigidus)* < 5 Individuals

Monterey Ceanothus *(Ceanothus rigidus)* ≥ 5 Individuals Low Density

Sandmat Manzanita *(Arctostaphylos pumila)* < 5 Individuals

Sandmat Manzanita *(Arctostaphylos pumila)* ≥ 5 Individuals Low Density

Eastwood's Goldenbush *(Ericameria Fasciculata)* < 5 Individuals

Eastwood's Goldenbush (*Ericameria fasciculata*) Low Density

Monterey Spineflower *(Chorizanthe pungens* var. *pungens)* < 5 Individuals

Monterey Spineflower *Chorizanthe pungens* var. *pungens* ≥ 5 Individuals

Low Density

Medium Density

N

0 25 50 Meters

0 50 100 200 Feet

GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019

Scale: 1 inch = 100 feet

Project: 2013-13

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Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
< 5 Individuals

Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
≥ 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
< 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
≥ 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
< 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
≥ 5 Individuals
Low Density

Sandmat Manzanita
(Arctostaphylos pumila)
< 5 Individuals

Sandmat Manzanita
(Arctostaphylos pumila)
≥ 5 Individuals
Low Density

Eastwood's Goldenbush
(Ericameria Fasciculata)
< 5 Individuals

Eastwood's Goldenbush
(*Ericameria fasciculata*)
Low Density

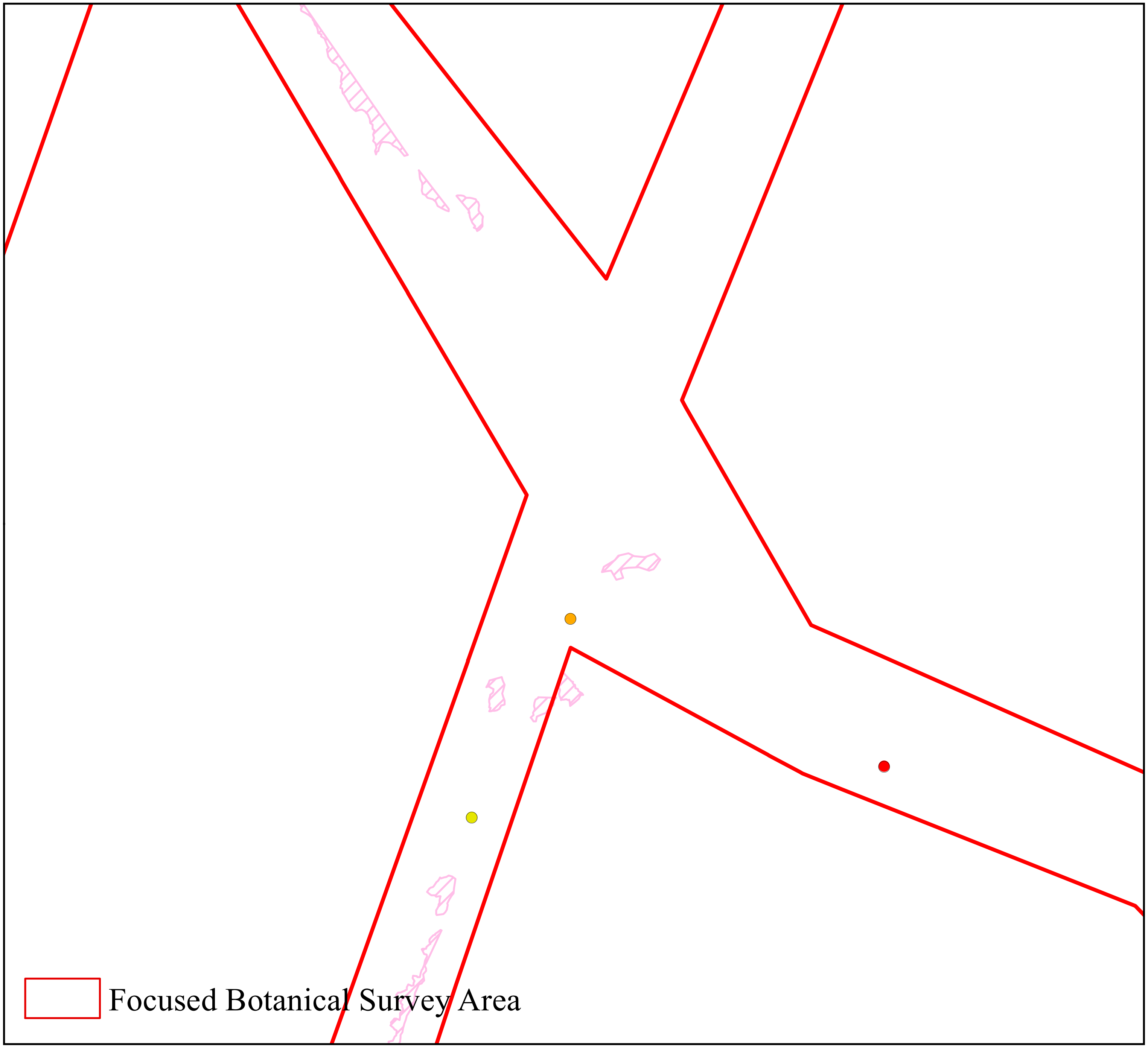
Monterey Spineflower
(Chorizanthe pungens var.
pungens)
< 5 Individuals

Monterey Spineflower
Chorizanthe pungens
var. *pungens*
≥ 5 Individuals
Low Density
Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019
Scale: 1 inch = 100 feet
Project: 2013-13

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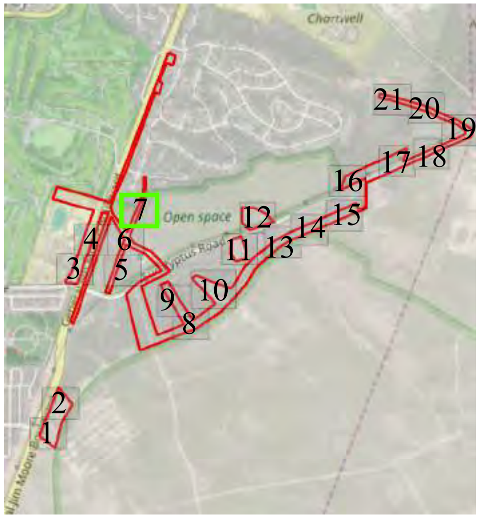


Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) < 5 Individuals

Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) ≥ 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) < 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) ≥ 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) < 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) ≥ 5 Individuals Low Density

Sandmat Manzanita (*Arctostaphylos pumila*) < 5 Individuals

Sandmat Manzanita (*Arctostaphylos pumila*) ≥ 5 Individuals Low Density

Eastwood's Goldenbush (*Ericameria Fasciculata*) < 5 Individuals

Eastwood's Goldenbush (*Ericameria fasciculata*) Low Density

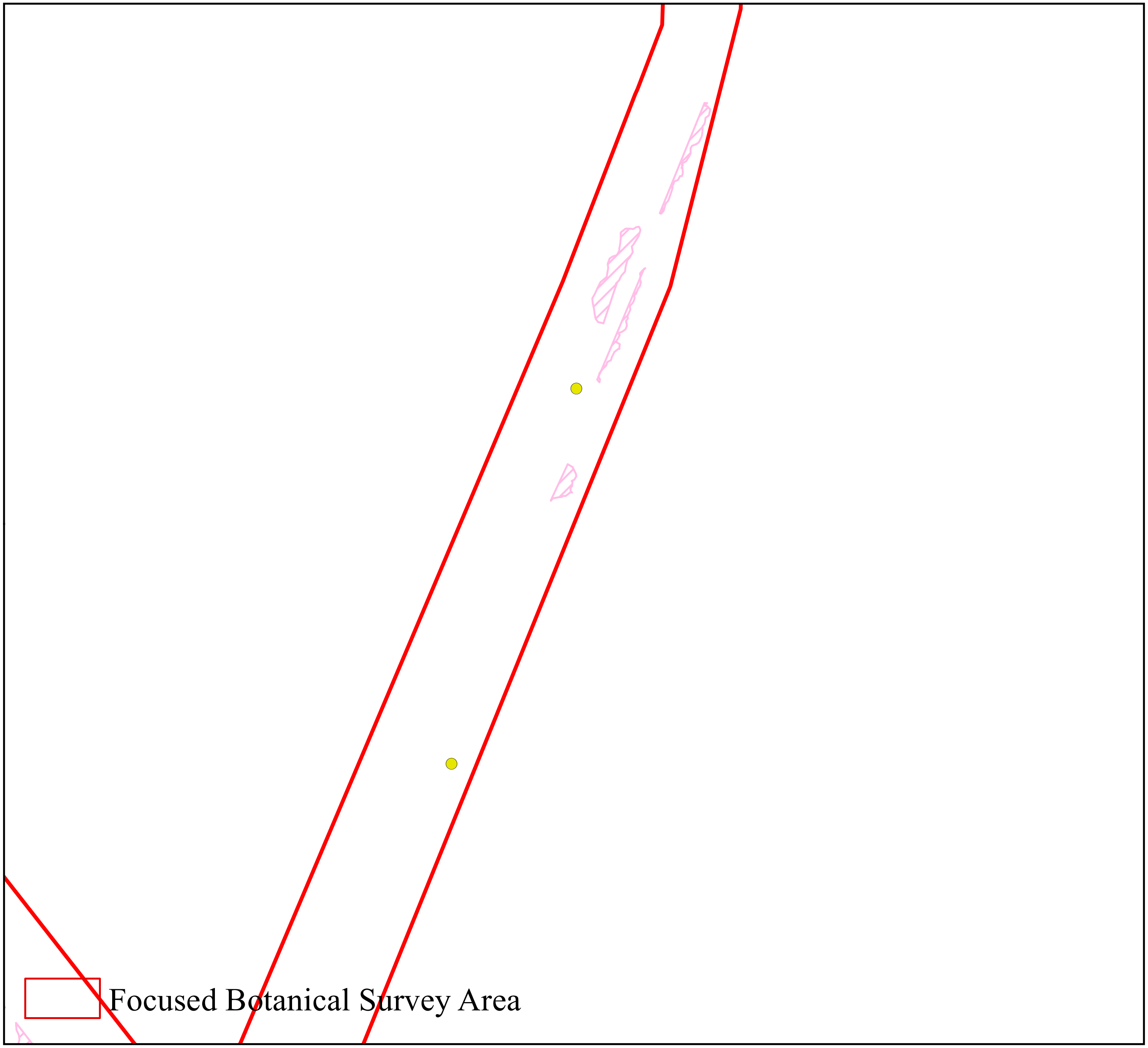
Monterey Spineflower (*Chorizanthe pungens* var. *pungens*) < 5 Individuals

Monterey Spineflower *Chorizanthe pungens* var. *pungens* ≥ 5 Individuals
- Low Density
- Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019

Scale: 1 inch = 100 feet

Project: 2013-13

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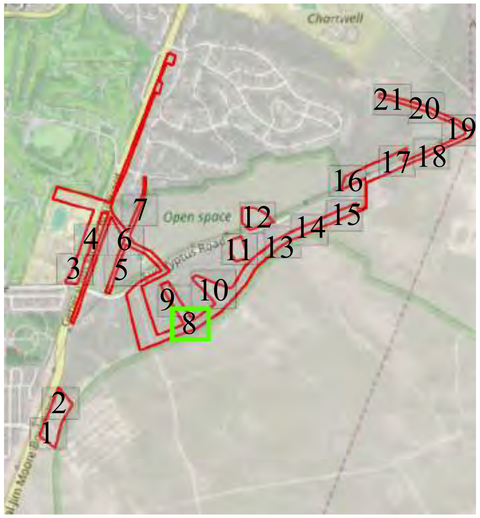


Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) < 5 Individuals

Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*) ≥ 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) < 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea*) ≥ 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) < 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus*) ≥ 5 Individuals Low Density

Sandmat Manzanita (*Arctostaphylos pumila*) < 5 Individuals

Sandmat Manzanita (*Arctostaphylos pumila*) ≥ 5 Individuals Low Density

Eastwood's Goldenbush (*Ericameria Fasciculata*) < 5 Individuals

Eastwood's Goldenbush (*Ericameria fasciculata*) Low Density

Monterey Spineflower (*Chorizanthe pungens* var. *pungens*) < 5 Individuals

Monterey Spineflower *Chorizanthe pungens* var. *pungens* ≥ 5 Individuals

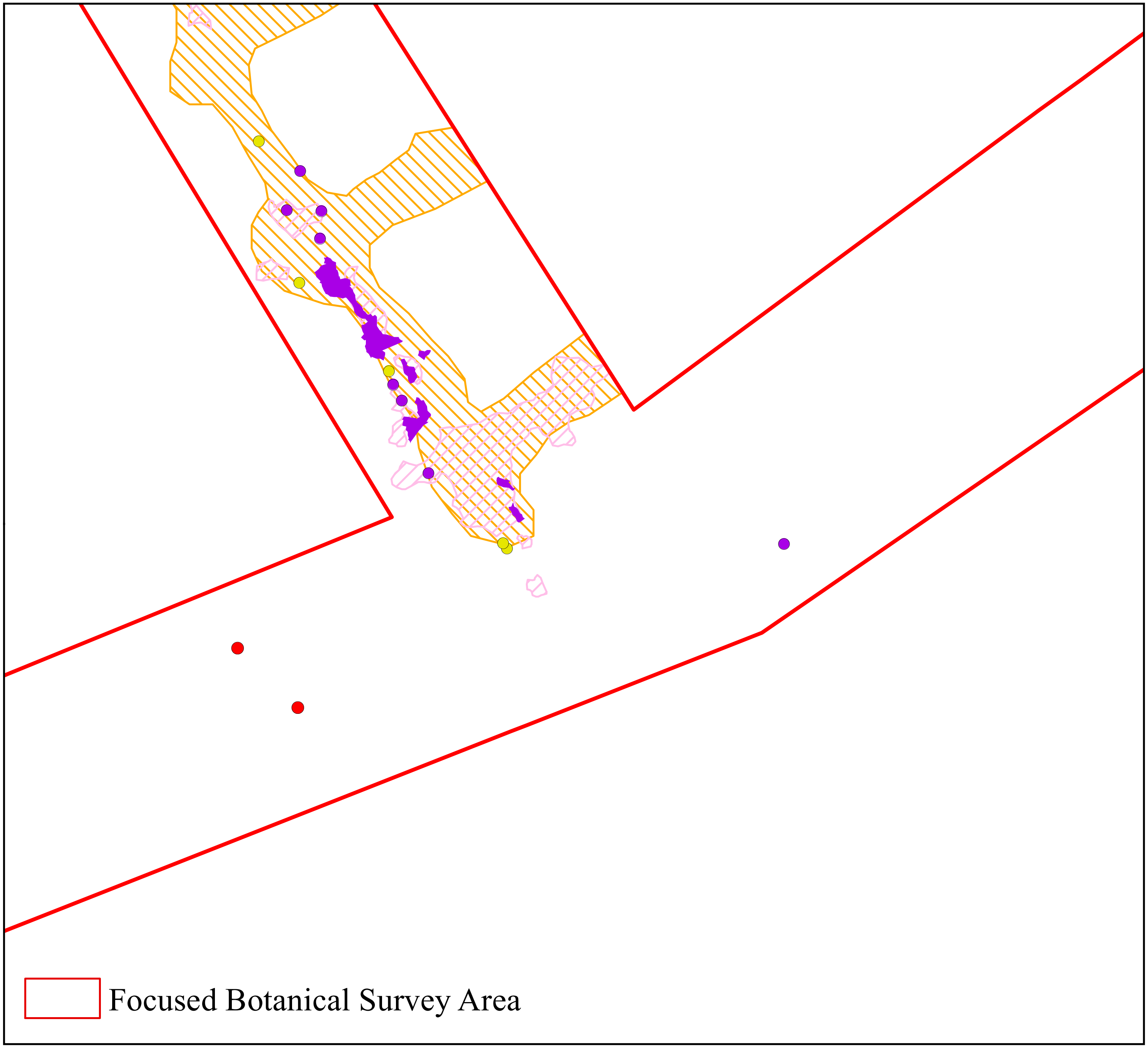
Low Density

Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019

Scale: 1 inch = 100 feet

Project: 2013-13

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Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
< 5 Individuals

Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
≥ 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
< 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
≥ 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
< 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
≥ 5 Individuals
Low Density

Sandmat Manzanita
(Arctostaphylos pumila)
< 5 Individuals

Sandmat Manzanita
(Arctostaphylos pumila)
≥ 5 Individuals
Low Density

Eastwood's Goldenbush
(Ericameria Fasciculata)
< 5 Individuals

Eastwood's Goldenbush
(Ericameria fasciculata)
Low Density

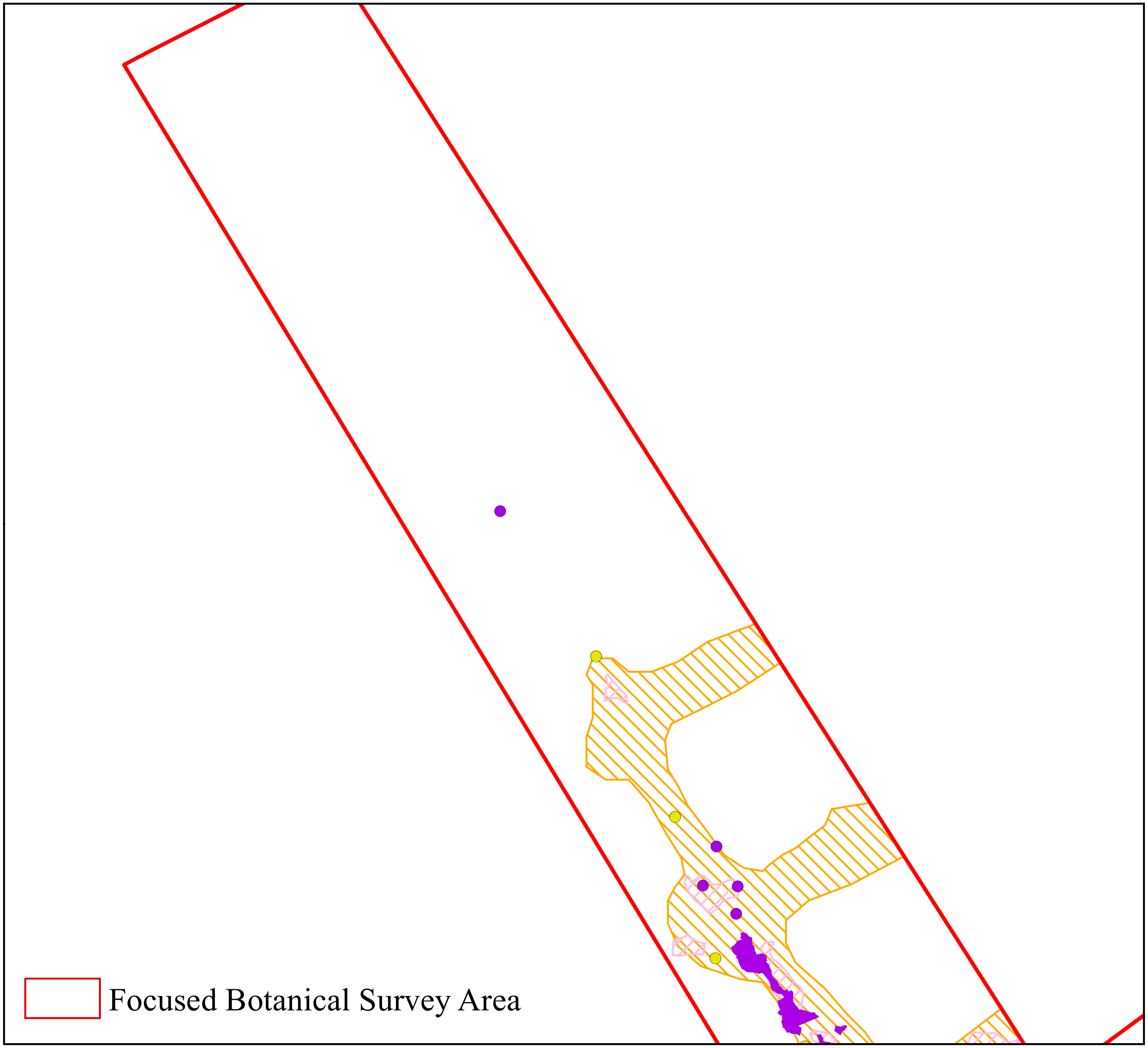
Monterey Spineflower
(Chorizanthe pungens var.
pungens)
< 5 Individuals

Monterey Spineflower
Chorizanthe pungens
var. *pungens*
≥ 5 Individuals
Low Density
Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019
Scale: 1 inch = 100 feet
Project: 2013-13

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Sand Gilia (*Gilia tenuiflora* ssp. *arenaria)* < 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea)* < 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus)* < 5 Individuals

Sandmat Manzanita (*Arctostaphylos pumila)* < 5 Individuals

Eastwood's Goldenbush (*Ericameria Fasciculata)* < 5 Individuals

Monterey Spineflower (*Chorizanthe pungens* var. *pungens)* < 5 Individuals

Sand Gilia (*Gilia tenuiflora* ssp. *arenaria)* ≥ 5 Individuals

Kellog's Horkelia (*Horkelia cuneata* var. *sericea)* ≥ 5 Individuals

Monterey Ceanothus (*Ceanothus rigidus)* ≥ 5 Individuals Low Density

Sandmat Manzanita (*Arctostaphylos pumila)* ≥ 5 Individuals Low Density

Eastwood's Goldenbush (*Ericameria fasciculata*) Low Density

Monterey Spineflower *Chorizanthe pungens* var. *pungens* ≥ 5 Individuals

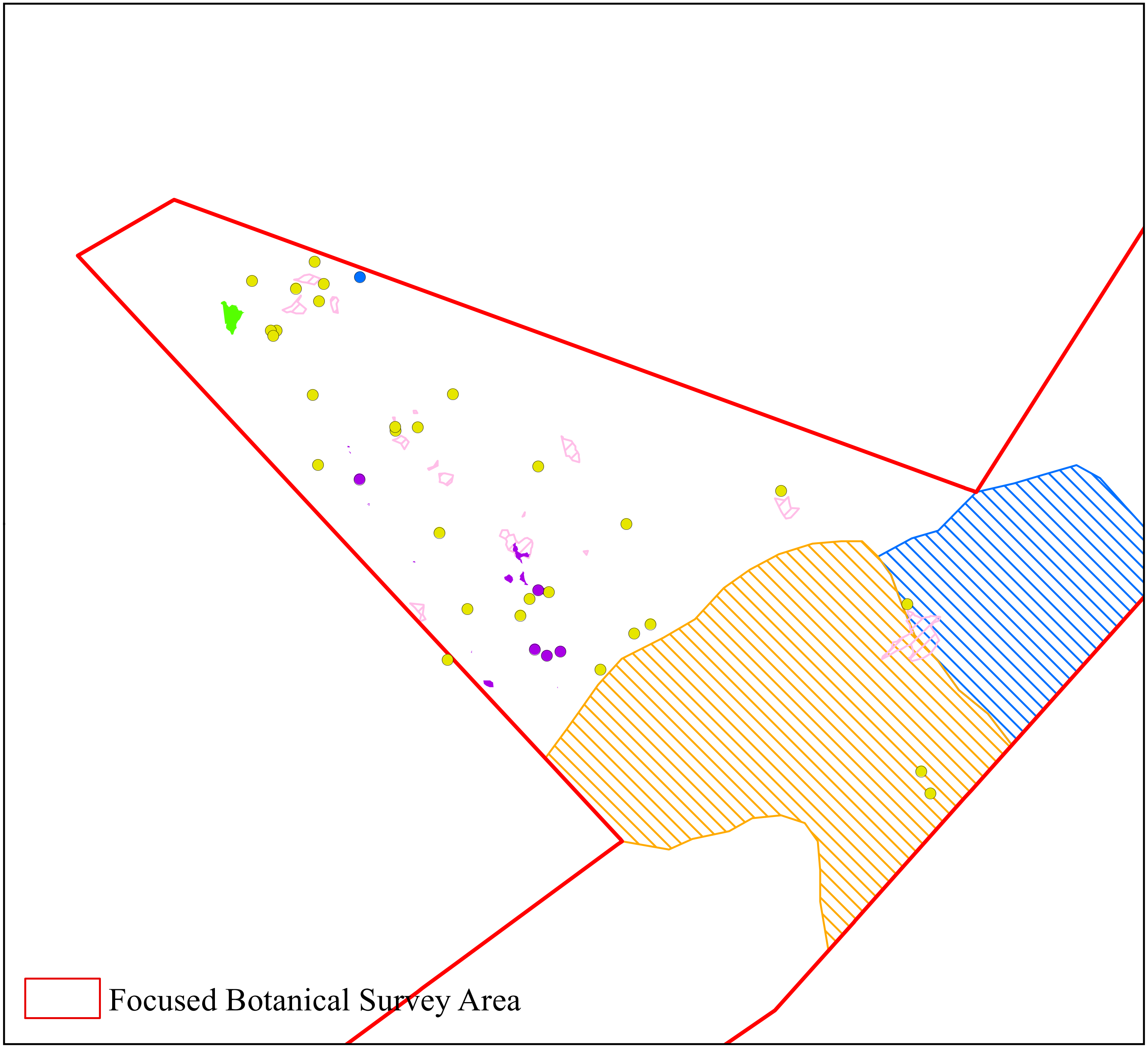
Low Density

Medium Density

N

0 30 60 Meters

0 65 130 260 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019

Scale: 1 inch = 100 feet

Project: 2013-13

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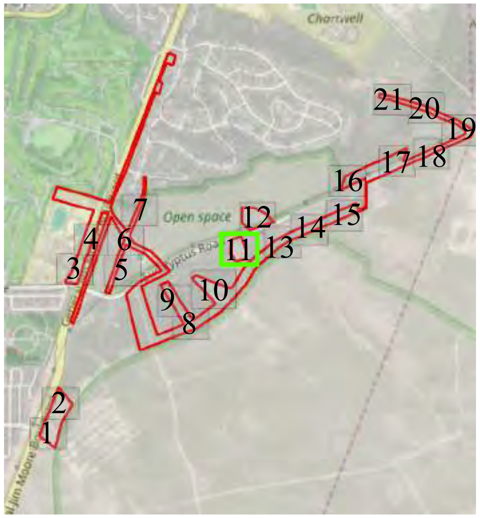


Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
< 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
< 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
< 5 Individuals

Sandmat Manzanita
(Arctostaphylos pumila)
< 5 Individuals

Eastwood's Goldenbush
(Ericameria Fasciculata)
< 5 Individuals

Monterey Spineflower
(Chorizanthe pungens var.
pungens)
< 5 Individuals

Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
≥ 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
≥ 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
≥ 5 Individuals
Low Density

Sandmat Manzanita
(Arctostaphylos pumila)
≥ 5 Individuals
Low Density

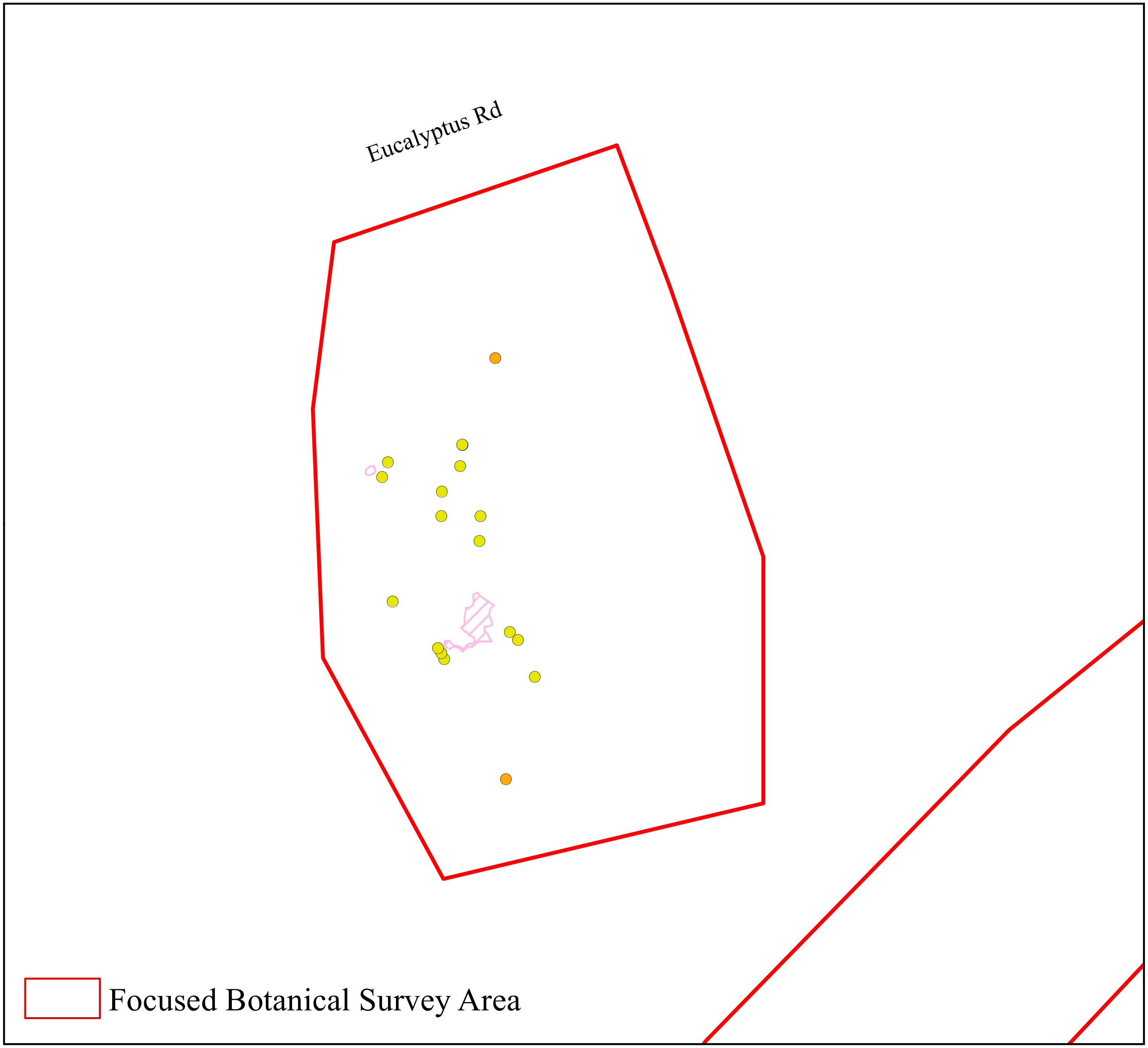
Eastwood's Goldenbush
(Ericameria fasciculata)
Low Density

Monterey Spineflower
Chorizanthe pungens
var. *pungens*
≥ 5 Individuals
Low Density
Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



Focused Botanical Survey Area

GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019
Scale: 1 inch = 100 feet
Project: 2013-13

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Appendix
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Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
< 5 Individuals

Sand Gilia
(Gilia tenuiflora ssp.
arenaria)
≥ 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
< 5 Individuals

Kellog's Horkelia
(Horkelia cuneata var.
sericea)
≥ 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
< 5 Individuals

Monterey Ceanothus
(Ceanothus rigidus)
≥ 5 Individuals
Low Density

Sandmat Manzanita
(Arctostaphylos pumila)
< 5 Individuals

Sandmat Manzanita
(Arctostaphylos pumila)
≥ 5 Individuals
Low Density

Eastwood's Goldenbush
(Ericameria Fasciculata)
< 5 Individuals

Eastwood's Goldenbush
(*Ericameria fasciculata*)
Low Density

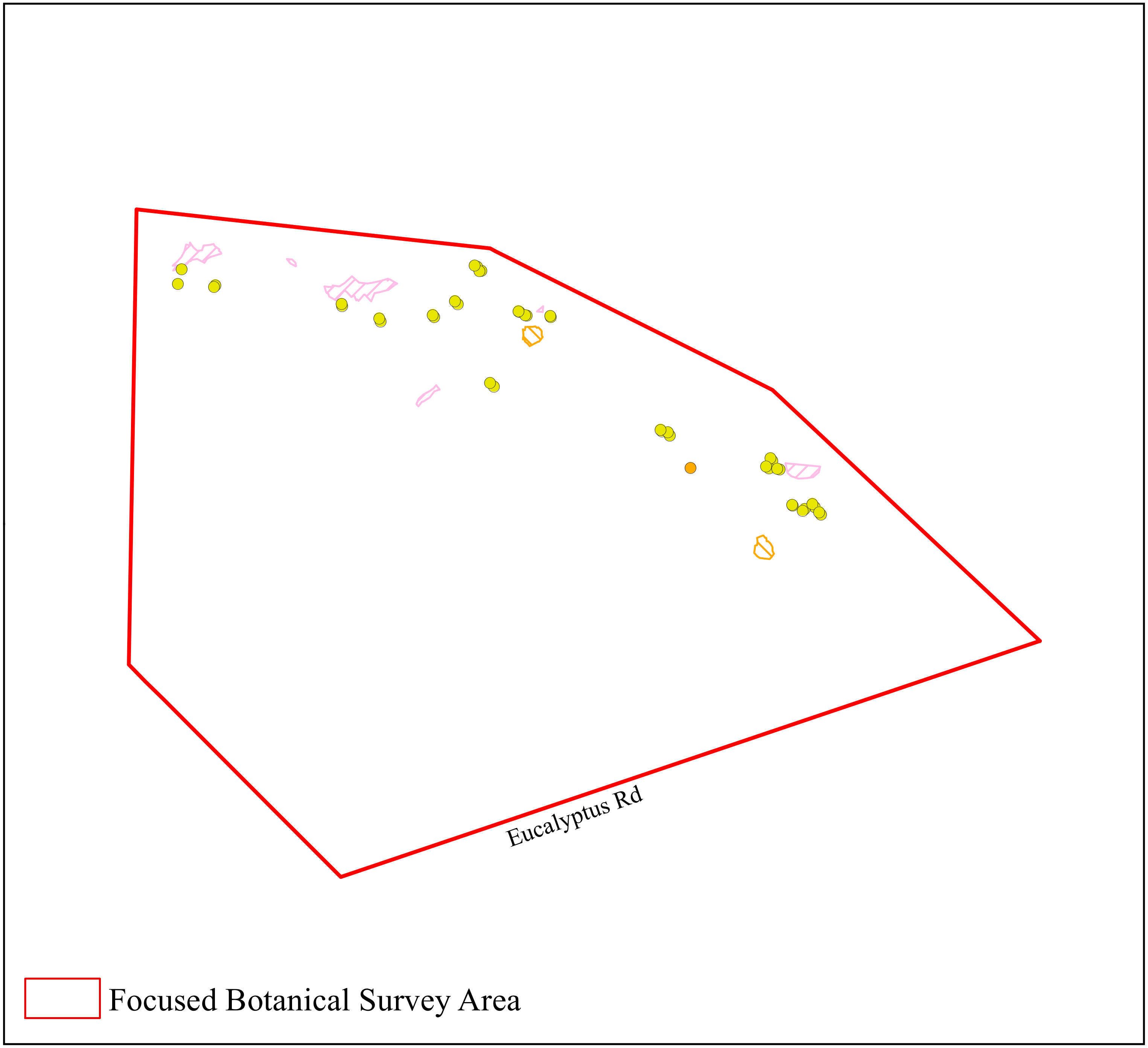
Monterey Spineflower
(Chorizanthe pungens var.
pungens)
< 5 Individuals

Monterey Spineflower
Chorizanthe pungens
var. *pungens*
≥ 5 Individuals
Low Density
Medium Density

N

0 25 50 Meters

0 50 100 200 Feet



GWR Expanded Capacity Project
Special-Status Plant Species Survey Results

Date: 10/29/2019
Scale: 1 inch = 100 feet
Project: 2013-13

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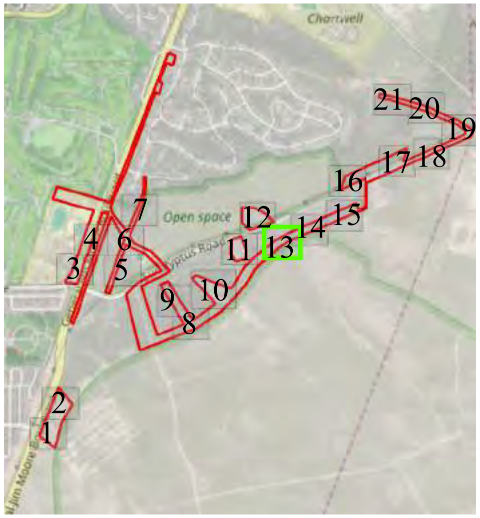

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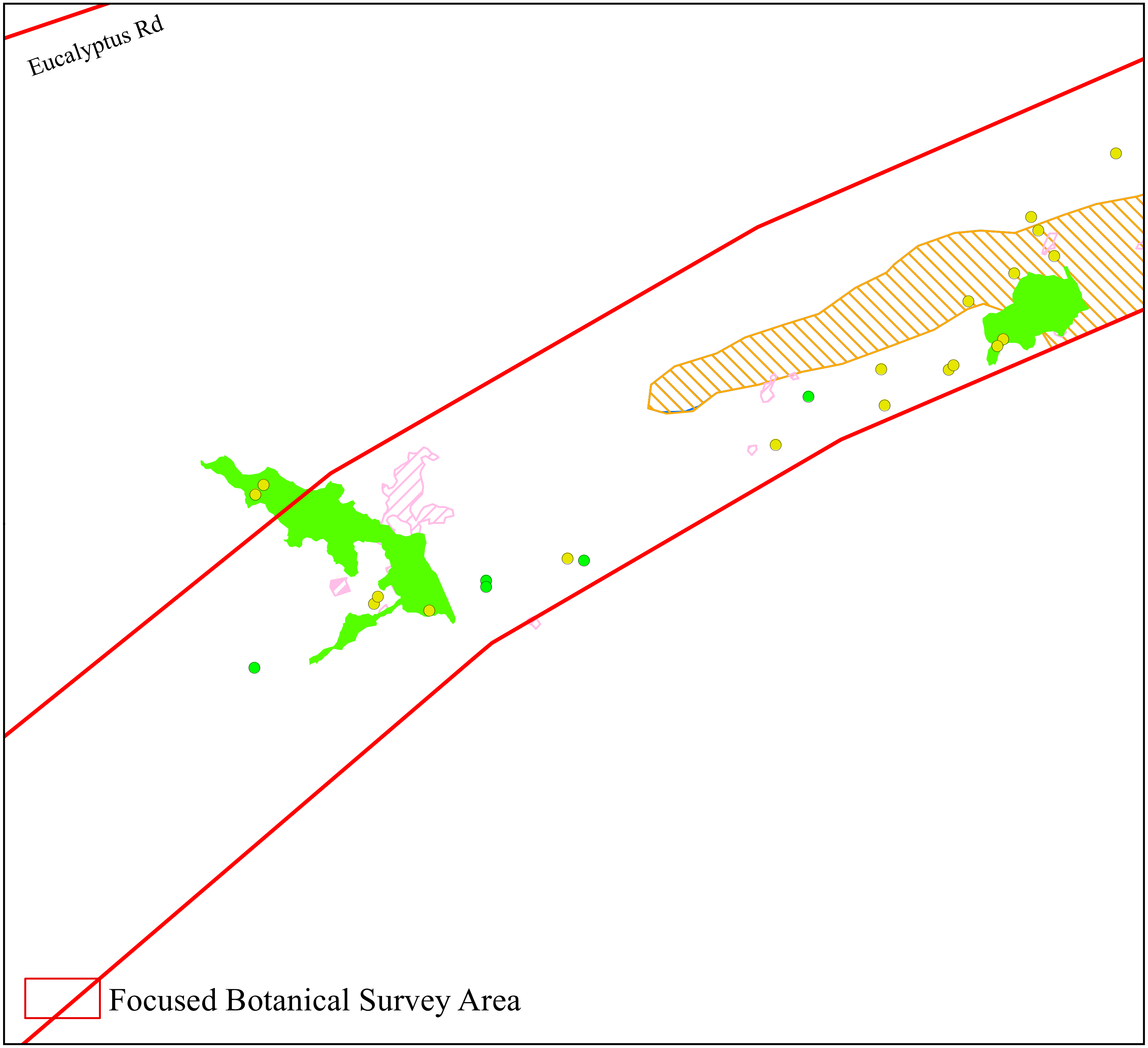

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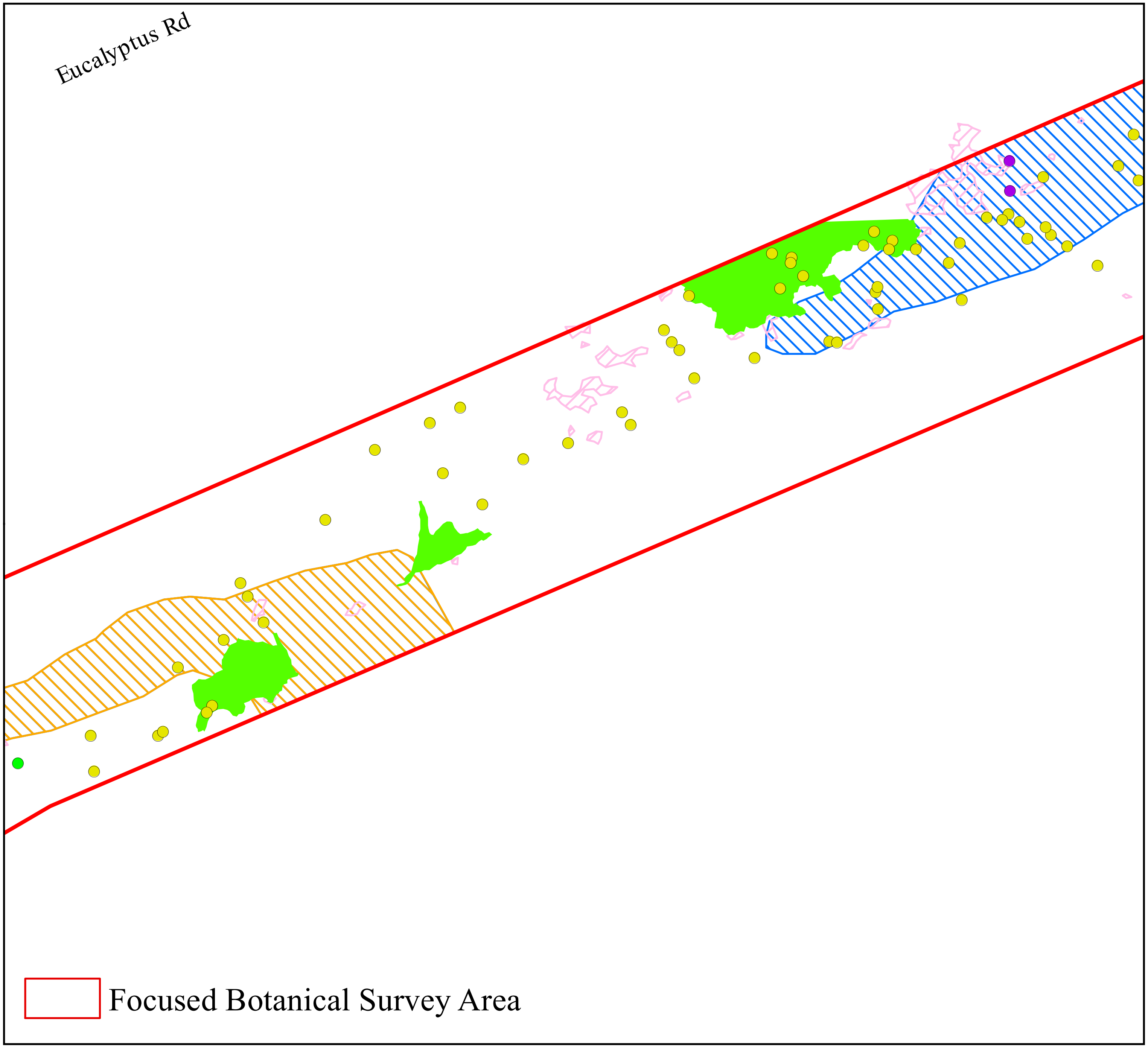

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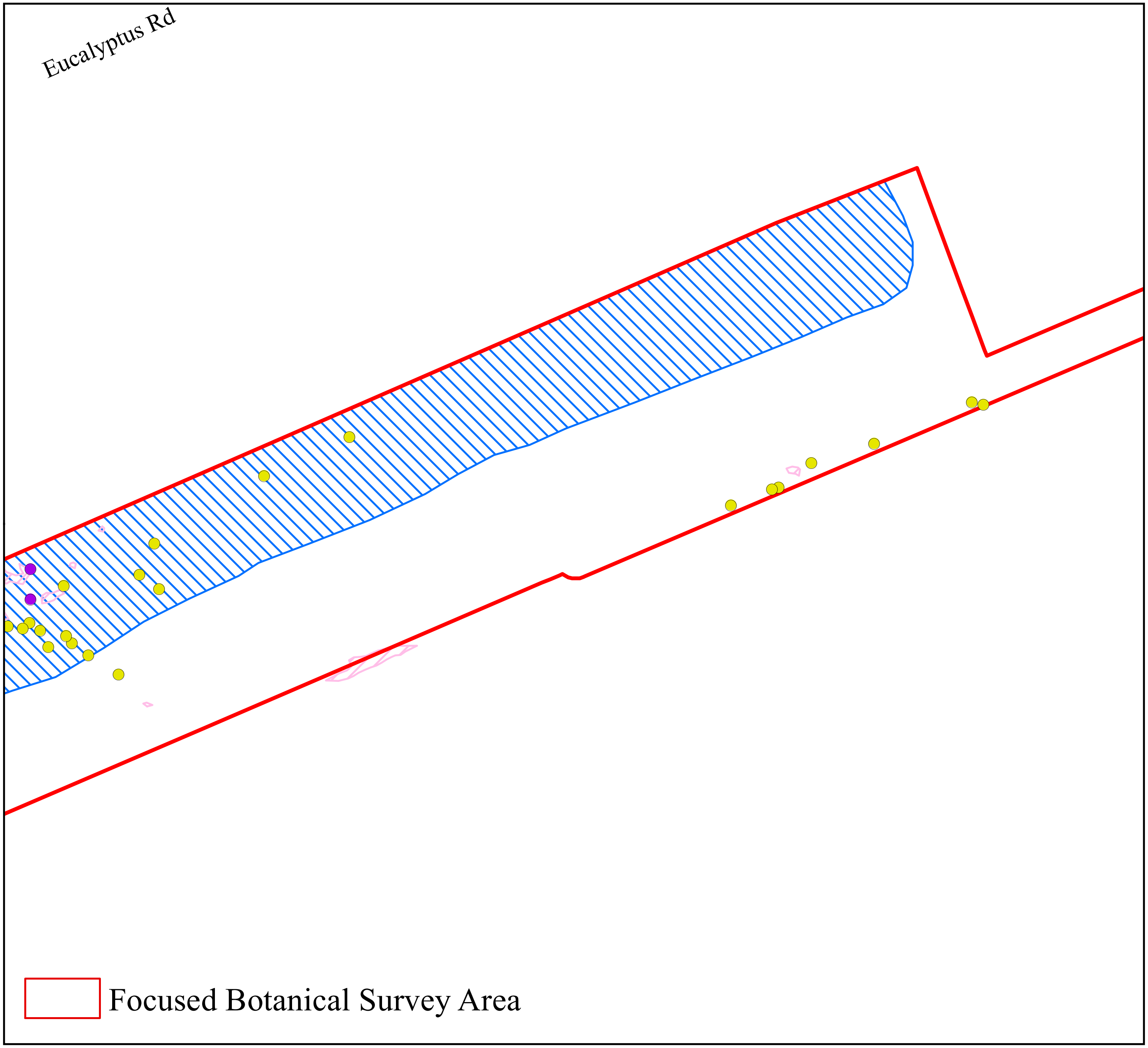

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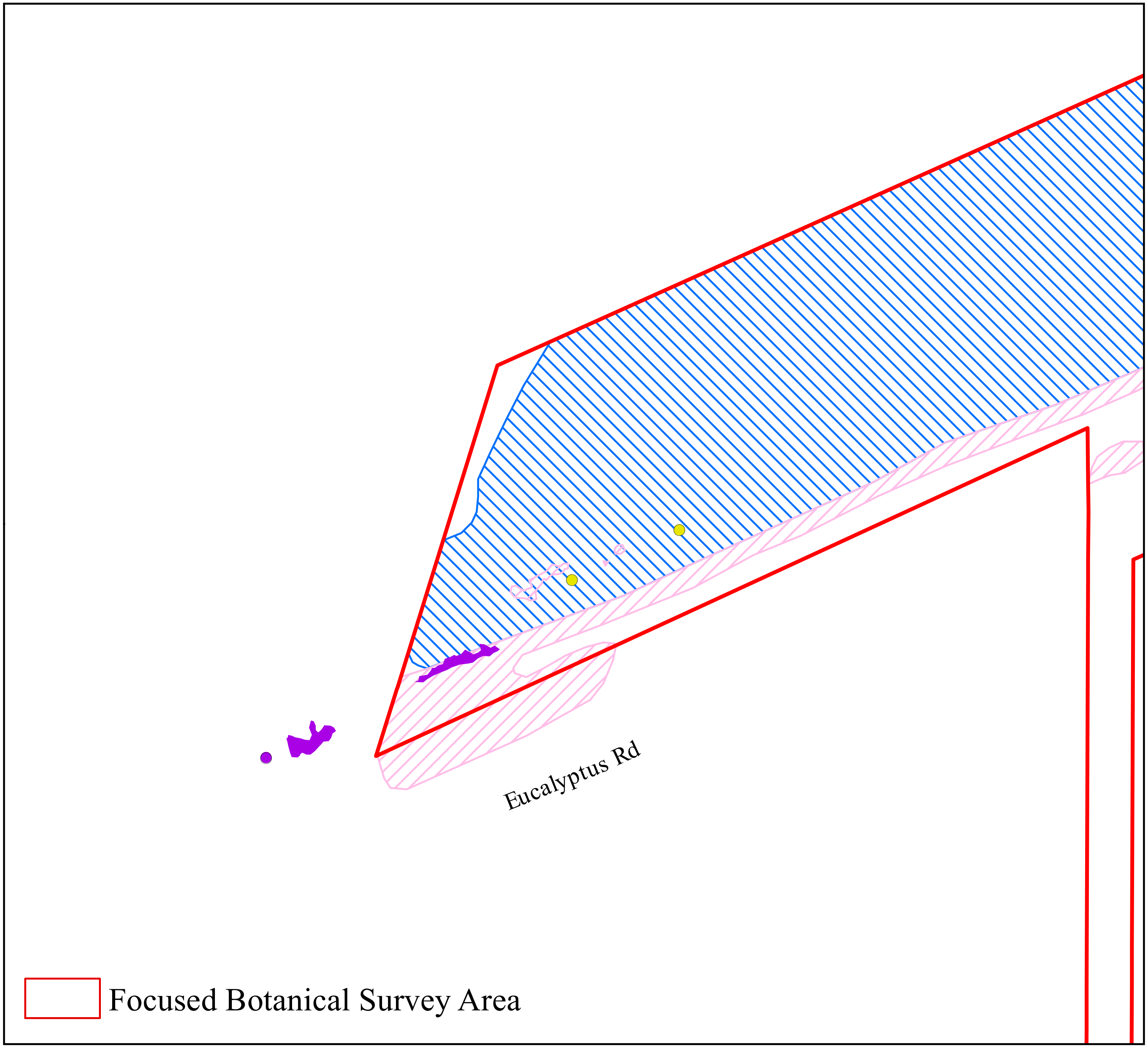

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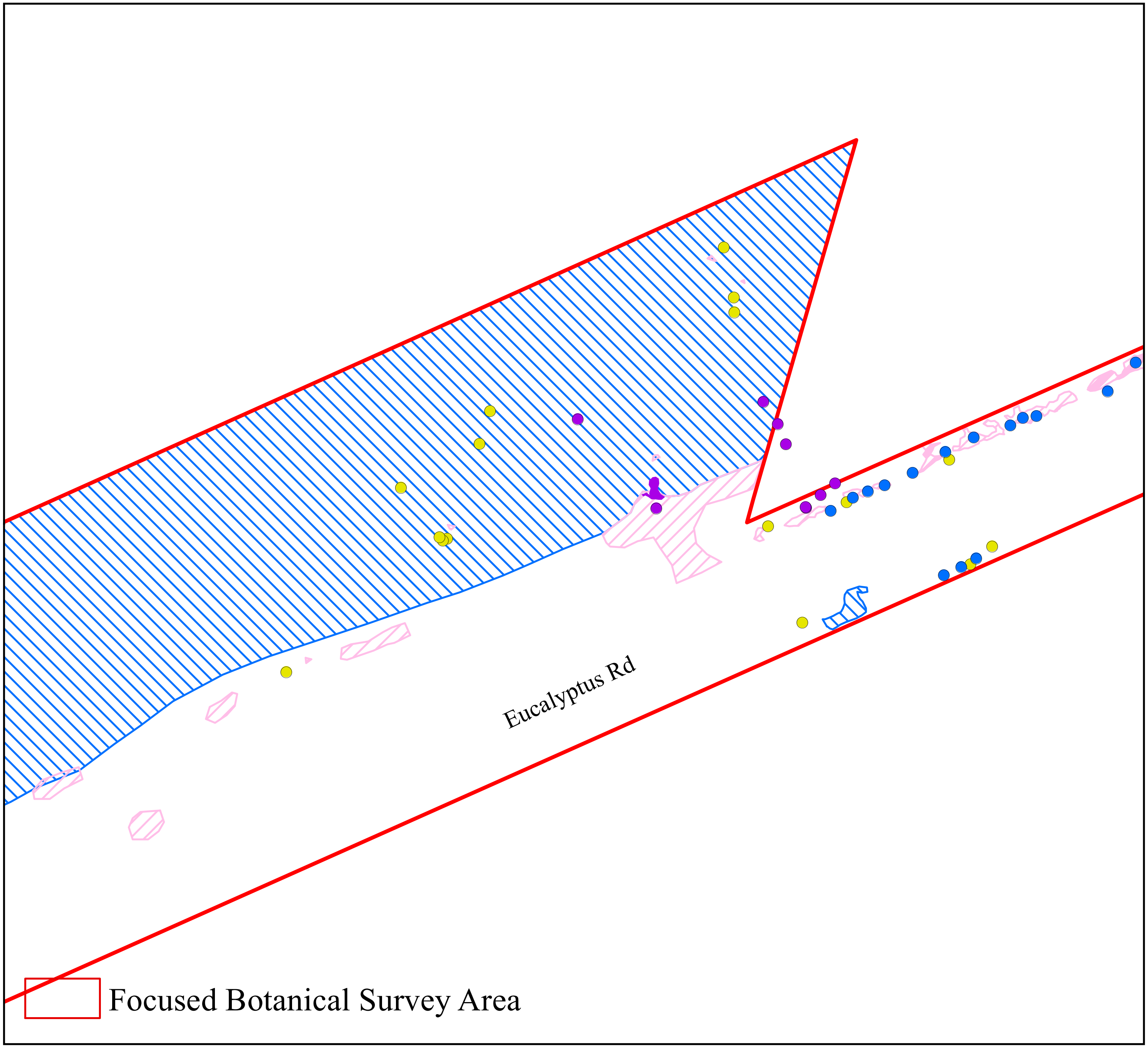

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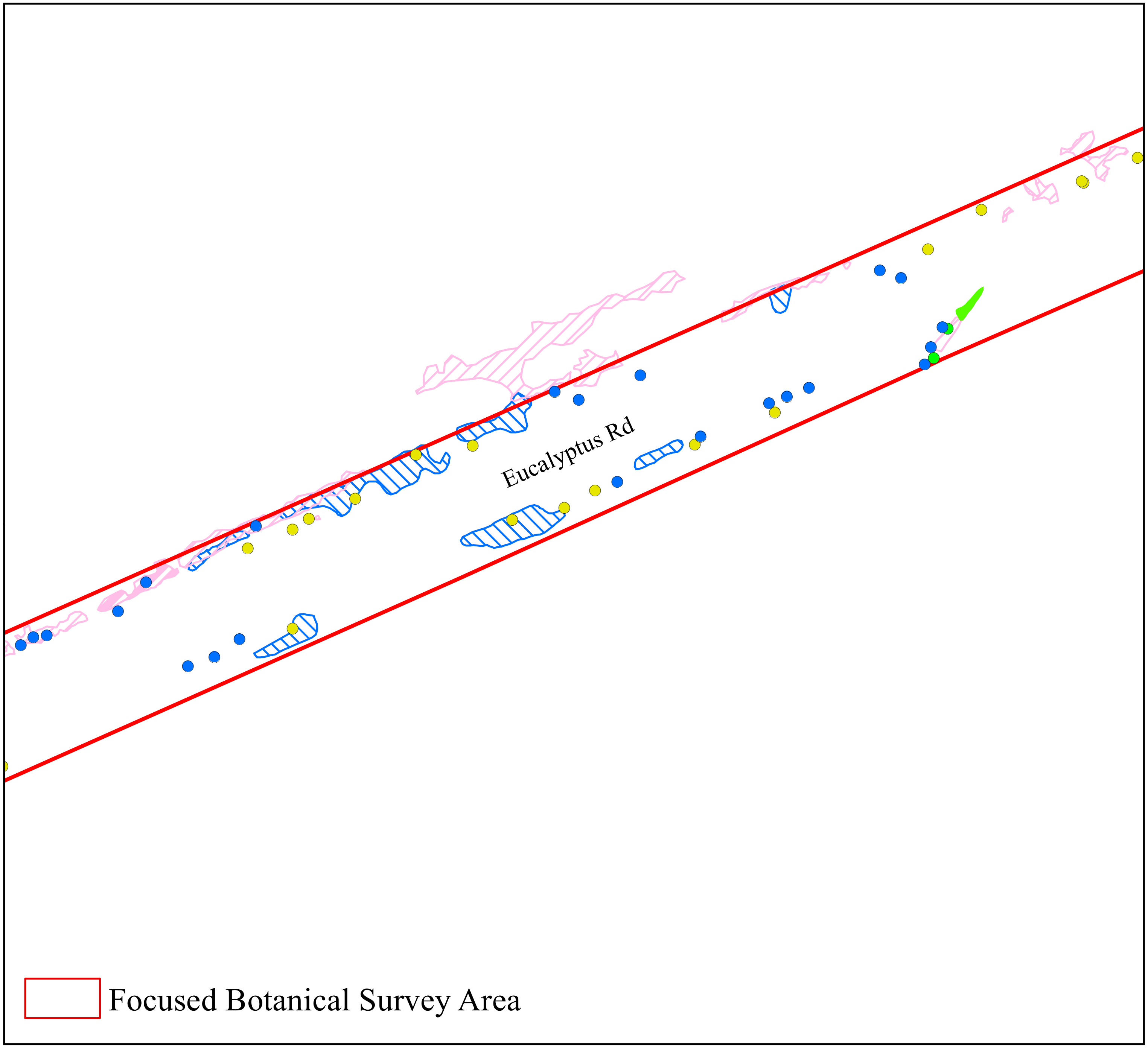

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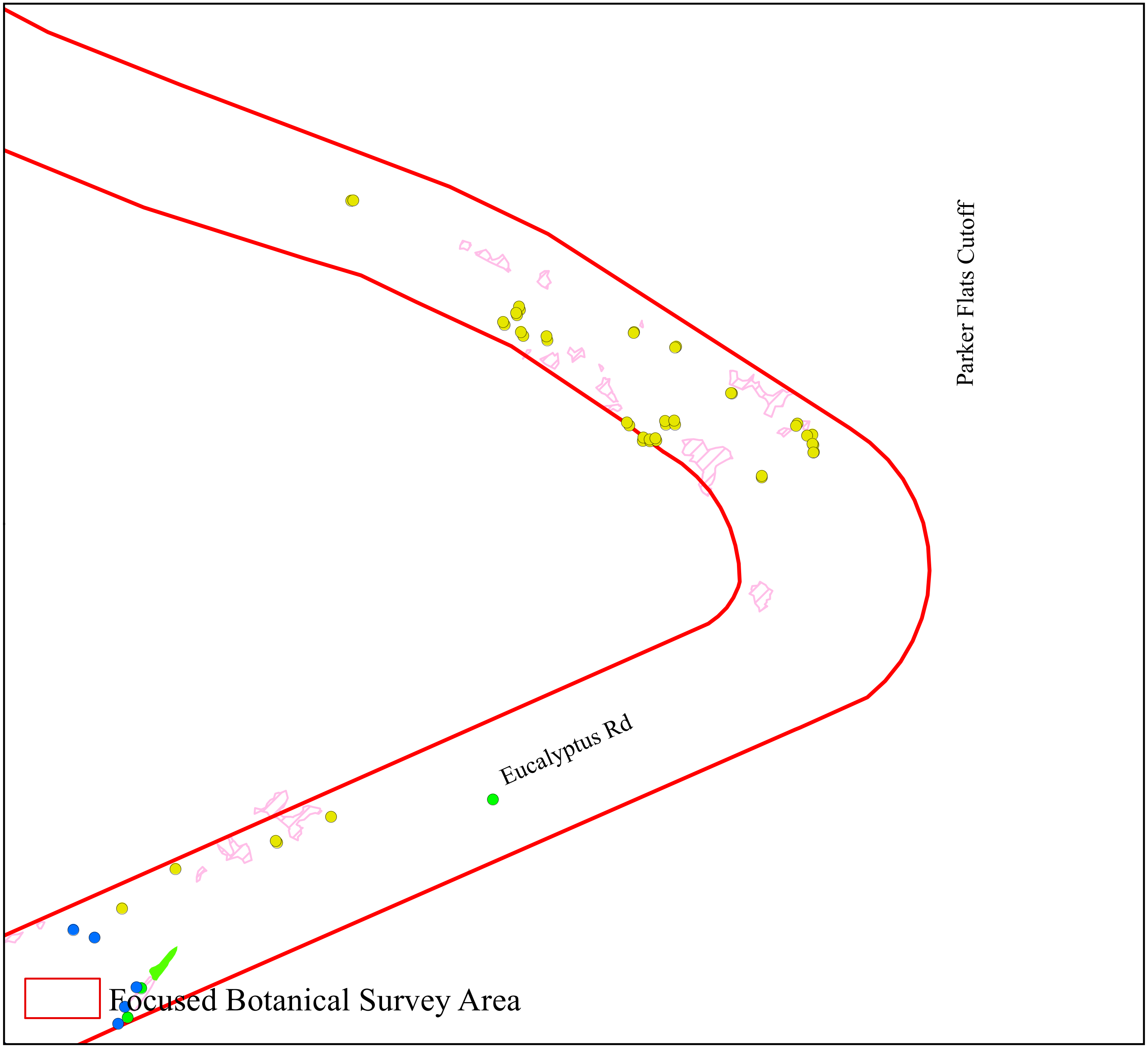

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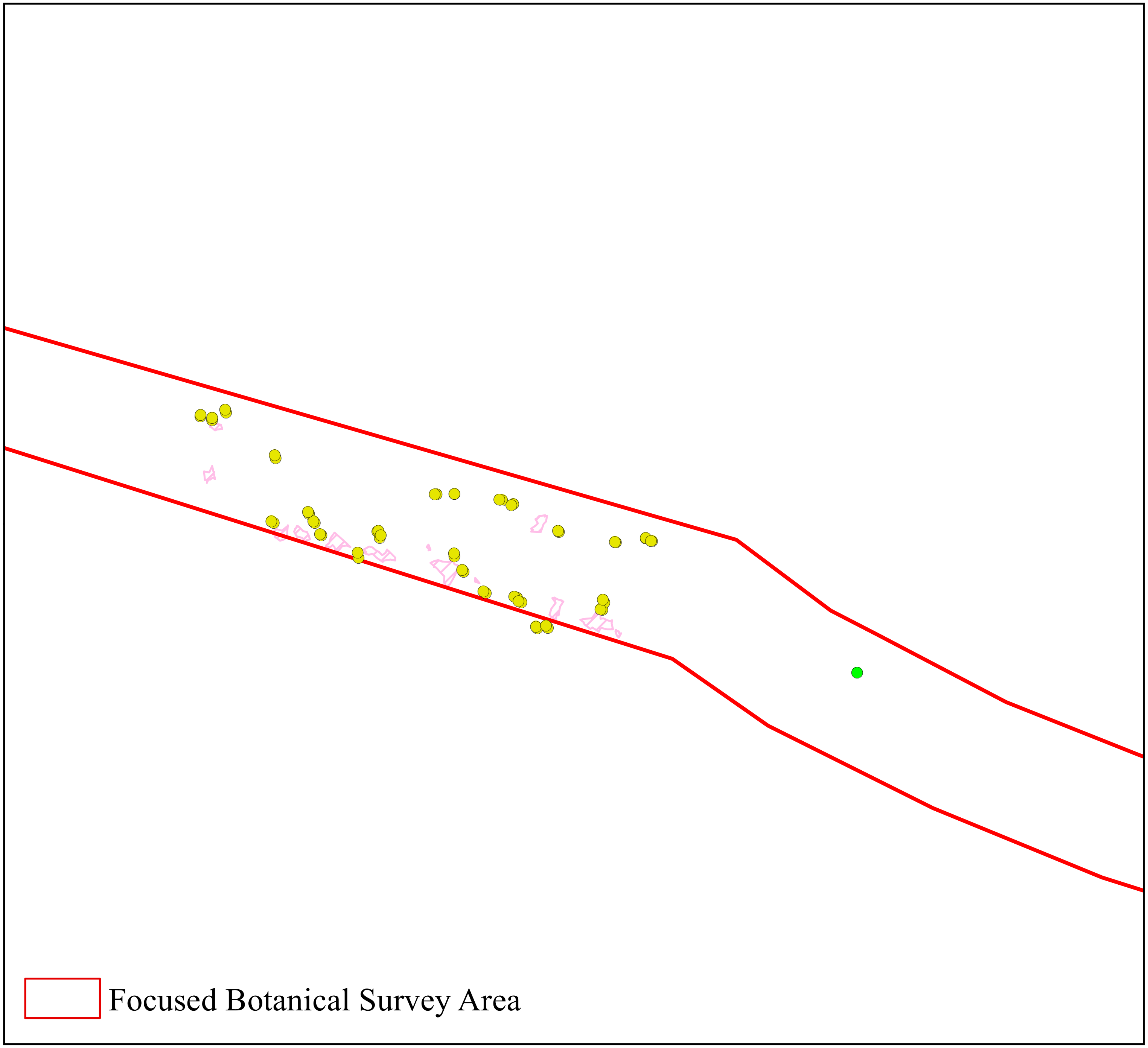

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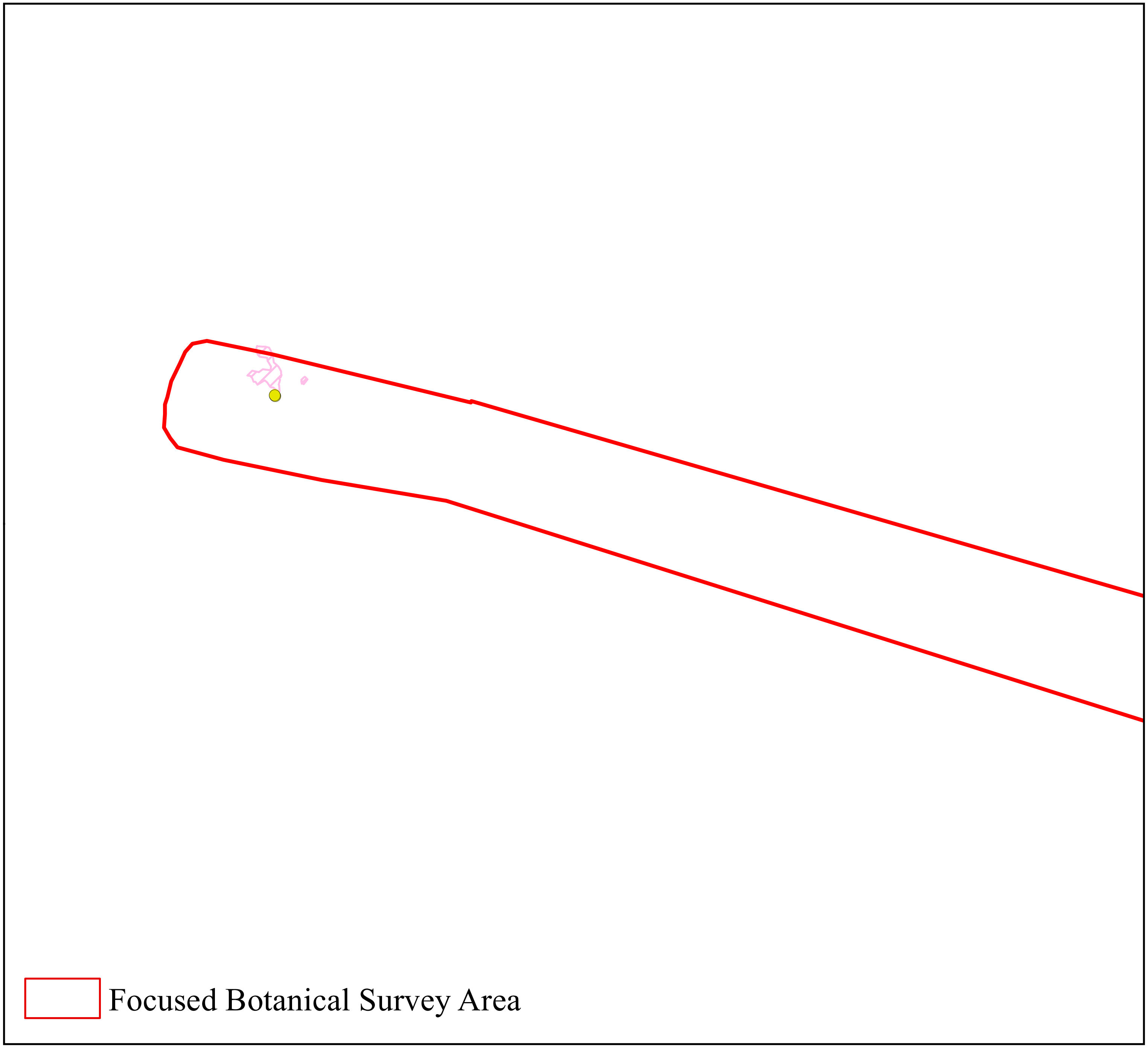

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Appendix F

Appendix H

Groundwater Quality Update Technical Memorandum

TODD GROUNDWATER

October 24, 2019

TECHNICAL MEMORANDUM

To: Alison Imamura, PE, Associate Engineer
Monterey One Water
5 Harris Court #D, Monterey, CA 93940
Alison@my1water.org

From: Edwin Lin, PG, CHg, Principal Hydrogeologist
Cynthia Maroney, PhD, RG, Staff Engineer

Re: Update of Groundwater Conditions and Water Quality Impacts Evaluation for Pure Water Monterey Groundwater Replenishment Proposed Modifications Supplemental Environment Impact Report (SEIR)

Monterey One Water (M1W) is preparing the Supplemental Environmental Impact Report (SEIR) for the proposed expansion of the Pure Water Monterey Groundwater Replenishment (PWM/GWR) Project (Proposed Modifications). The Proposed Modifications will provide an additional 2,250 AFY of advanced purified recycled water to the approved PWM/GWR Project volume of 3,500 acre-feet per year (AFY) for recharge in the Seaside Groundwater Basin (Basin), for a total average annual recharge rate of 5,750 AFY. Approximately commensurate with the volume of replenishment, the Proposed Modifications will increase the yield of the Basin to meet future water demands of the California American Water Company (CalAm) Monterey District service area.

Replenishment will occur in the two aquifer systems used for water supply in the Seaside Basin – the shallow Paso Robles Aquifer (PR Aquifer) and the deeper Santa Margarita Aquifer (SM Aquifer) – and will be accomplished using two types of injection wells: (1) deep injection wells (DIWs), which will inject purified recycled water directly into the SM Aquifer, and (2) shallower vadose zone wells (VZWs), which will inject recycled water into the unsaturated zone (Aromas Sand Formation) for percolation to the underlying PR Aquifer. The Proposed Modifications include two relocated DIWs,[1] one new DIW, and one or two new monitoring wells screened in the SM Aquifer.

For the 3,500-AFY PWM/GWR Project, Todd Groundwater completed a hydrogeologic study evaluating potential project impacts on groundwater levels and water quality. Findings from the hydrogeologic study were documented in the Recharge Impacts Assessment Report

[1] For the PWM/GWR Project EIR, four DIWs and four VZWs in the Injection Well Facilities Area were assumed and evaluated. Only two of each have been constructed.

(Todd, March 2015), included as Appendix L of the Consolidated Final Environmental Impact Report (EIR) (DDA, January 2016). The Recharge Impacts Assessment Report described the injection well facilities and general information on project construction and operations. It also addressed the fate and transport of purified recycled water in the Basin based on groundwater model simulations (conducted by Montgomery & Associates; formerly HydroMetrics Water Resources, Inc. [Hydrometrics WRI]) to satisfy the Division of Drinking Water (DDW) Groundwater Replenishment Regulations.

At the time of the PWM/GWR Project EIR development, DIWs or monitoring wells in the Injection Facilities Area had not been constructed or sampled for water quality. Thus, the evaluation of PWM/GWR Project impacts were based on groundwater level and water quality data from then-existing production and monitoring wells in the Basin through 2013. Since the Recharge Impacts Assessment Report, two DIWs, two VZWs, and seven monitoring wells have been constructed in the Injection Facilities Area as part of two construction phases for the PWM/GWR Project. To comply with DDW requirements, the DIWs and monitoring wells have been collectively sampled for a comprehensive suite of analytes from 2017 to 2019 to establish baseline groundwater quality conditions prior to Project startup. In addition to the PWR/GWR Project wells, groundwater quality data from other wells (water supply, ASR, and monitoring wells) from 2014 through 2019 have also been collected as part of the basin-wide groundwater quality monitoring program managed by Monterey Peninsula Water Management District (MPWMD). Additionally, groundwater levels have continued to be routinely measured by MPWMD in fulfillment of its Seaside Basin Watermaster obligations.

This technical memorandum (TM) provides details on proposed injection areas and facilities associated with the 5,750-AFY Proposed Modifications and presents an updated assessment of potential groundwater impacts based on updated groundwater level and water quality data. Key findings and conclusions on groundwater levels and subsurface travel times from recently completed groundwater model simulations of the Proposed Modifications are also briefly summarized to address DDW regulations pertaining to pathogen reduction credit and response retention time. Full documentation of groundwater model simulations are presented in the TM, titled "Pure Water Monterey Expansion SEIR Groundwater Modeling Analysis" (Montgomery & Associates, October 2019).

PWM/GWR PROJECT AND PROPOSED MODIFICATIONS WELLS

Figure 1 shows the locations of the PWM/GWR Project and Expanded Injection Well Facilities Areas and associated facilities. The PWM/GWR Project includes the following eleven (11) wells:

- 2 DIWs screened in the SM Aquifer (DIW-1 and DIW-2)
- 2 VZWs screened in the Aromas Sand above the PR Aquifer (VZW-1B and VZW-2)
- 3 monitoring wells screened in the PR Aquifer (MW-1S, MW-1AS, and MW-2AS)
- 4 monitoring wells screened in the SM Aquifer (MW-1D, MW-2D, MW-1AD, and MW-2AD).

The EIR for the PWM/GWR Project included evaluation of four DIWs (two more DIWs than actually constructed) at four well sites within the Injection facilities Area (blue strip on Figure 1). The two DIWs that have not been constructed to date for the PWM/GWR Project will be needed to accommodate injection of the additional 2,250 AFY of purified recycled water for the Proposed Modifications. The new and relocated DIWs will be located at three new injection well sites northeast of the PWM/GWR Project Injection Facilities Area (pink rectangles in orange Expanded Injection Facilities Area on Figure 1).

Additionally, one or more monitoring wells screened in the SM Aquifer may also be needed to monitor groundwater quality changes between the new DIWs and nearest drinking water supply wells. Monitoring wells are currently envisioned to be located along roadway rights of way, for example along Eucalyptus Road.

Finally, four proposed new extraction wells would be located north of the PWM/GWR Project and Expanded Injection Facilities Areas to increase CalAm's well pumping capacity to meet future water demands in the Monterey District service area.

CURRENT GROUNDWATER LEVEL CONDITIONS AND IMPACTS ASSESSMENT

Current groundwater level conditions in the Seaside Basin are considered to provide an updated reference point to assess groundwater level impacts from the Proposed Modifications. Groundwater conditions in the PR Aquifer and SM Aquifer are unconfined and confined conditions, respectively. Both aquifers consist of semi-consolidated to consolidated sedimentary units that dip generally northward. Groundwater flow is generally toward the coast for both the PR and SM Aquifers. Flow is altered by local pumping and groundwater depressions resulting from historic overpumping.

Groundwater modeling was used to simulate potential impacts of the Proposed Modifications on groundwater levels. To quantify potential groundwater level impacts, simulated future groundwater level conditions under the Proposed Modifications were compared with simulated conditions under a No-Project Baseline Scenario (Montgomery and Associates, 2019).

Current (2018) Groundwater Levels in the Paso Robles Aquifer

Figures 2 and 3 show two groundwater level contour maps of the PR Aquifer in the 2nd Quarter (January-March 2018) and 4th Quarter (July-September 2018) of Water Year (WY) 2017-18, respectively. Contours shown on both figures are replicated from the Seaside Basin 2018 Seawater Intrusion Analysis Report (Montgomery & Associates, November 2018). As shown on the figures, minimum groundwater elevation contours range from -40 to -20 feet above sea level (feet msl), with some minor seasonal variability. It is noted that groundwater levels in Ord Grove #2 were not included in the 4th Quarter 2018 contour map, which may influence the depth of the depression in that area. As shown on the figures, groundwater levels beneath the PWM/GWR Project and Expanded Injection Facilities Areas range from 0 to 20 feet msl[2]. Water levels in the adjacent Southern Coastal Subarea are minimally influenced by the pumping depression with a westerly groundwater flow toward the coast. WY 2017-18 groundwater levels are similar to the conditions observed in WY 2013 for the Recharge Impacts Assessment Report.

Current (2018) Groundwater levels in the Santa Margarita Aquifer

Figures 4 and 5 show groundwater level contour maps of the SM Aquifer in 2nd and 4th Quarters of WY 2017-18. Similar to the PR Aquifer contour maps, contours in the SM Aquifer were replicated from the Seawater Intrusion Analysis Report (Montgomery & Associates, November 2018). The maps indicate that groundwater level contours in the SM Aquifer range from -30 to 0 feet msl across the Northern Coastal Subarea and the western half of the Northern Inland Subarea. The pumping depression in the SM Aquifer extends beyond the northern boundary of the Subarea but does not encroach into the Southern Coastal Subarea. Water levels measured in monitoring and DIWs beneath the PWM Injection Facilities Area range from -25 to -11 feet msl, in agreement with the contours shown on Figure 4 and 5. Collectively, Figures 2 through 5 indicate a downward vertical gradient exists between the PR and SM Aquifers.

Assessment of the Proposed Modifications Impacts on Groundwater Levels

Simulated future groundwater elevations under the Proposed Modifications were estimated (Montgomery and Associates, October 2019) for the following eight wells:

- ASR 1&2
- City of Seaside #3
- Ord Grove #2
- Paralta
- Luzern
- PCA-West (Shallow)
- PCA-West (Deep)
- Sentinel #3

Modeling results reveal the following trends[3]:

- Simulated future groundwater elevations at the PCA-West Shallow well are consistently above the protective elevation for the PR Aquifer both under the Proposed Modifications and No-Project baseline scenarios and reach over five feet

[2] It is noted that water level measurements collected as part of the Phase 2 Injection Well Facilities construction were not used to generate contours shown on Figures 2 and 3. Water levels measured in the PWM monitoring wells screened in the PR Aquifer range from -21 to 30 ft msl.
[3] Well locations shown on Figures 2 to 5. Sentinel Well 3 is located northeast of FO-09-Deep along the coast.

above the protective elevation by the end of the 25-year future Proposed Modifications simulation period.

- Simulated future groundwater elevations at the PCA-West Deep well are consistently below the protective elevation for the SM Aquifer under both the No-Project baseline and Proposed Modifications scenarios, indicate that there is a potential for seawater intrusion with and without the Project at this location. However, predicted groundwater elevations for the PCA-West Deep well are 5 to 10 feet higher under the Proposed Modifications scenario than under the No-Project scenario, indicating that the Proposed Modifications decreases the potential/risk of seawater intrusion at this location.
- The hydrographs for the Sentinel 3 monitoring well shows a similar behavior as PCA-West Deep, whereas the No-Project baseline water levels are always below the protective elevation established for the well. The Alternative Scenario water levels increase on average between 5 to 10 feet above the No-Project levels and are above the protective elevation for periods of time, indicating that the Expanded Project decreases the potential for seawater intrusion at this location.

Based on the modeling results for the Expanded Project, the following conclusions pertaining to Proposed Modifications impacts on groundwater levels can be made:

1. The Proposed Modifications result in higher groundwater levels in wells across the Basin. Groundwater levels under the Expanded Project scenario can be slightly lower than under No-Project groundwater levels for short periods of time during periods of extended drought, reflecting the extraction of PWM water during droughts. However, the difference in groundwater levels is small and deemed to be insignificant.

2. Groundwater levels under the Proposed Modification scenario are higher along the coast in comparison to groundwater elevations under the No-Project scenario, thereby decreasing the potential/risk of seawater intrusion in the future.

Estimated Subsurface Retention Times

Groundwater modeling with particle tracking was used to predict the minimum subsurface travel time of purified recycled water to the nearest drinking water well (Montgomery and Associates, October 2019). Particle tracking results indicate that subsurface travel time is influenced by seasonal pumping/extraction cycles, with travel times from DIWs influenced by the injection-extraction cycles of the nearby ASR wells. For No-Project Baseline and Expanded Project simulations, ASR-1 and ASR-2 were simulated as injection wells only (with no extraction). This condition was determined to be a feasible, given the need for increased CalAm well capacity satisfied by the addition of four extraction wells for the Proposed Modifications (EW-1 through EW-4).

Model predictions showed that the shortest simulated subsurface travel time of purified recycled water to reach a drinking water well is 599 days (19.7 months, or 1.6 years) for the Proposed Modifications (from DIW-3 to Ord Grove #2 in the SM Aquifer), providing the

Proposed Modifications a maximum 6-log pathogen reduction credit for subsurface retention time (even with the 50 percent credit for model-simulated values). For reference, the shortest subsurface retention time for the PR Aquifer is much longer (5,890 days, or approximately 16 years), also providing the 6-log pathogen reduction credit for subsurface retention time.

The model-simulated subsurface retention time would be verified with a tracer test at the onset of injection for the Proposed Modifications, per DDW regulations.

CURRENT GROUNDWATER QUALITY CONDITIONS AND IMPACTS ASSESSMENT

To assess impacts potential impacts on groundwater quality from the PWM GWR Project, both ambient groundwater and Project purified recycled water quality were characterized. A summary of all constituents analyzed by median and range for each PWM well is included in the Appendix. More recent water quality data and characterization provides a baseline for assessing impacts in support of the SEIR for the Proposed Modifications. Additionally, new geochemical evaluations completed since the PWM/GWR Project EIR have been completed to assess the interaction of the existing geologic sediments with anticipated purified recycled water quality generated from the AWPF.

Existing Groundwater Quality and Purified Recycled Water Quality

Table 1 shows the number of wells and analyte categories and time periods of groundwater quality data obtained to provide a comprehensive update of existing groundwater quality condition in the vicinity of the PWM/GWR Project and Proposed Modifications study area. **Table 2** provides general and well construction information of wells for which water quality data were obtained for this evaluation. Since completion of the Recharge Impacts Assessment Report for the PWM/GWR Project, two DIWs and seven monitoring wells have been installed in the Injection Facilities Area under two phases of construction for the PWM/GWR Project to provide site-specific groundwater quality data. Wells were sampled one or more times from December 2017 to May 2019 and analyzed for a comprehensive suite of 300+ analytes to satisfy PWM/GWR Project monitoring and reporting requirements. Water quality data from PWM wells were combined with groundwater quality data collected from 2009 to 2018 for 17 production (potable and non-potable), ASR, and monitoring wells in the Basin. These data were provided by MPWMD for this evaluation update.

Table 3 presents water quality data for purified recycled water (based on results of pilot reverse osmosis (RO) treatment) and groundwater samples collected from PWM monitoring wells for the following selected parameters:

- Salinity indicators (Specific conductance [SC] and total dissolved solids [TDS]) and selected major and minor ions (upper table)
- Trace constituents consistently detected in the RO permeate during pilot testing
- Trace constituents inconsistently detected in the RO permeate during pilot testing

Concentrations shown for each well in Table 3 represent the median concentration from samples collected from December 2017 to May 2019.

It is noted that trace constituents not shown in Table 3 were not detected during RO pilot testing and are not expected to be detected in purified recycled water generated from the AWPF.

TDS and SC: In the PWM/GWR Project Study Area, TDS concentrations in the PR Aquifer are well below the Recommended Consumer Acceptance Contaminant Level of 500 mg/L. Median concentrations range from 190 to 280 mg/L. TDS concentrations are higher in the SM Aquifer but are lower than the Upper Consumer Acceptance Contaminant Level of 1,000 mg/L (Table 3). Median TDS concentrations in the SM Aquifer beneath the Injection Facilities Area range from 630 mg/L (MW-2D) to 760 mg/L (MW-1D). Median TDS concentrations are lower in the off-site monitoring wells that are closer to the ASR wells, ranging from 495 mg/L in MW-1D to 615 mg/L in MW-2AD. Analysis of TDS, specific conductance, and major ion concentrations for the Intrinsic Tracer Work Plan for the PWM/GWR Project shows partial mixing is occurring between the injected Carmel River water and ambient groundwater at MW-1D and MW-2D (Todd, 2019).

As expected, the same pattern is reflected in SC concentrations in the PWM wells. Specific conductance is lower in the PR Aquifer, with median well concentrations ranging from 310 to 445 microSiemens per centimeter (µS/cm). Median specific conductance in the SM Aquifer beneath the Injection Facilities Area ranges from 1,050 µg/cm in MW-2D) to 1,200 µg/cm in MW-1D). Median specific conductance in off-site monitoring wells range from 815 µg/cm in MW-1AD to 925 µg/cm in MW-2AD.

The same patterns are repeated with chloride and other ions (Table 3). Chloride concentrations in the PR Aquifer are lower than in the SM Aquifer. Median chloride concentrations in PR Aquifer wells range from 54 to 67 mg/L. Median chloride concentrations are higher in onsite SM Aquifer wells, ranging from 145 mg/L in MW-2D to 180 mg/L in MW-1D. Concentrations are below the Recommended Consumer Acceptance Contaminant Level for chloride of 250 mg/L.

The estimated range of purified recycled water concentrations (for regulated constituents detected in the RO permeate during pilot testing) is shown in Table 3. The estimated minimum concentrations are below concentrations in native groundwater for some constituents (e.g., manganese), in which case the recycled water is expected to improve groundwater quality. For some constituents, the estimated maximum concentrations of purified recycled water are greater than the groundwater concentrations, in which case groundwater concentrations may increase. The recycled water quality is expected to meet all regulatory limits. Accordingly, the introduction of recycled water is not expected to cause the groundwater quality to exceed regulatory values.

Inorganic Water Quality - Water Source Geochemical Plots

For the 2015 Recharge Impacts Assessment Report, geochemical plotting of inorganic water quality was performed to characterize ambient groundwater in the vicinity of the Injection Facilities Area relative to purified recycled water and ASR injectate (treated Carmel River water). As noted previously, wells in the Injection Facilities Area were not available during preparation of the PWM/GWR Project EIR to characterize site-specific conditions. For this evaluation, water quality data for the nine new PWM wells and more recent water quality data for other Basin wells have been incorporated to update water source geochemical plots.

Stiff Diagrams

Figures 6 and 7 shows Stiff Diagram for Basin wells. Stiff Diagrams are color-coded to reflect the aquifer screened for each well. Yellow and green Stiff diagrams indicate a well screened in the PR Aquifer or the SM Aquifer, respectively, while an orange Stiff diagrams indicate the well is screened in both aquifers. Also shown on the map are Stiff diagrams representing treated Carmel River water injectate for the ASR wellfields (labeled ASR injectate) and purified recycled water.

The Stiff diagrams for groundwater samples obtained from Seaside Groundwater Basin wells between December 2017 and August 2019 (Figure 6) are similar to Stiff diagrams presented in the Recharge Impacts Assessment Report (Todd, 2015). Concentrations of sodium, potassium, chloride, and bicarbonate are lower in the PR Aquifer relative to wells screened in the SM Aquifer. Stiff Diagrams of wells screened in both aquifers indicate are generally similar to wells screened in the Santa Margarita Aquifer but show influence from the Paso Robles Aquifer.

As described in the Recharge Impacts Assessment Report (Todd, 2015), ASR injectate (Carmel River water source) is less mineralized than ambient groundwater, has lower ionic concentrations than in the SM Aquifer, and has slightly higher Mg and SO_4 content than the PR Aquifer. The Stiff diagrams for water samples obtained from the ASR operating and monitoring wells reflect the chemistry of the ASR injectate. Samples from the ASR wells were obtained during the winter of WY 2017/18 and from ASR-MW1 during May of WY 2017/18. During WY 2016/17, high flows in the Carmel River resulted in injection of a substantial volume of treated Carmel River water. Only a portion of this injectate had been removed at the time the ASR operating and monitoring wells were sampled.

Stiff diagrams for the PWM wells are shown in **Figure 7**. The Stiff diagrams for the shallow monitoring wells MW-1S and MW-1AS plot like the nearby City of Seaside #4 and MRWPCA MW-1, while MW-2AS plots near the PRTIW well. These three PWM and three Seaside Basin wells are all screened in the Paso Robles and are all similar to the Stiff diagrams presented in the Recharge Impact Assessment for the PWM project (Todd, 2015).

Stiff diagrams of PWM wells screened in the SM Aquifer have similar shapes compared to other Seaside Basin SM Aquifer wells. Wells beneath the Injection Well Facilities Area (MW-1D and MW-2D) are larger, indicating higher ionic strength/salinity in this area.

Trilinear (Piper) Diagrams

Figures 8 and 9 show Trilinear (Piper) Diagrams for groundwater samples from Seaside Groundwater Basin wells and PWM wells, respectively. Ambient groundwater in both the PR Aquifer and SM Aquifer range from neutral-type to sodium-type (cations) and bicarbonate-carbonate-type to neutral-type to chloride-type (anions). The recent data for both the Basin wells and Project wells plot in the center of the diamond portion of the diagram, similar to the data presented in Recharge Impacts Assessment Report for the PWM/GWR Project EIR.

The ASR injectate and ASR wells plot in a cluster. During the winter of 2016-17, a large volume of Carmel River water was injected. Much of this injectate was still present in the SM Aquifer when samples were collected from ASR wells from November 2017 through January 2018 resulting in water quality of sampled groundwater appearing similar to ASR injectate (Carmel River water).

Schoeller (Water Source/Fingerprint) Diagrams

Figure 10 shows Schoeller Diagrams obtained from Seaside Groundwater Basin wells between December 2017 and August 2019. The upper diagram shows wells screened in the PR Aquifer and both the PR and SM aquifers. The lower diagram includes only those wells screened in the SM Aquifer. As shown on the figure, and complementary of the Stiff Diagrams, wells screened in the PR Aquifer have lower ionic concentrations compared to SM Aquifer. Fingerprints of wells screened in both the PR and SM Aquifers are more similar to wells screened in SM Aquifer than PR Aquifer, likely reflecting the greater contribution of water from the SM Aquifer during sampling/production. The ASR injectate plots close to the ASR wells indicating the presence of ASR injectate in the Santa Margarita Aquifer in the region of the ASR wells. The Schoeller Diagrams of wells closely resemble those presented in the Recharge Impacts Assessment Report (Todd, 2015).

Figure 11 shows Schoeller Diagrams for PWM wells screened in the PR Robles Aquifer (upper diagram) and SM Aquifer (lower diagram). Groundwater quality from the PWM wells between December 2017 and August 2019 have water source fingerprints similar to the other wells in the Seaside Groundwater Basin. The shallow PWM monitoring wells have similar relative ionic concentrations to the nearby City of Seaside 4, FO-7 Shallow, and MRWPCA MW-1.

Potential Constituents of Concern and Other Water Analyses

Constituents Exceeding California Primary and Secondary MCLs

More than 300 constituents and parameters were analyzed for each sample collected from the nine PWM wells sampled through May 2019. Water quality results were assessed for potential constituents of concern for regulated constituents with MCLs. The occurrence/frequency and range of concentrations for constituents that were detected above drinking water standards (California Primary or Secondary MCL) or notification level (NL) for those constituents without established standards are summarized in **Table 4**. As shown in the table, the constituents with concentrations above Primary and Secondary MCLs included chloride, bromate, nitrate, two metals, one chlorinated pesticide, and one volatile organic compound (VOC). Detections of the other seven constituents were at concentrations above the California Secondary MCL or NL.

One detection above the MCLs occurred for arsenic, chromium, and color was found in the three PR Aquifer monitoring wells. It is noted that for chromium and color, concentrations were below the MCLs in other samples collected from the same well. Only one sample was collected from MW-1AS, for which arsenic was detected at 14 ug/cm.

Three physical parameters (odor, specific conductance, and TDS) were detected above the Secondary MCLs in the one sample collected from DIW-1 and DIW-2. Five out of six of the samples obtained from the adjacent monitoring wells, MW-1D and MW-2D, had concentrations above the MCL for these same physical parameters. Chloride, nitrate, and toluene were detected once in these two monitoring wells. Nitrate was detected at 17 mg/L in MW-1D (however, was not detected in three other samples, including the subsequent re-sampling following the detection). Manganese was also detected above the Secondary MCL in three of the six samples obtained from MW-1D and MW-2D.

Detections of odor, specific conductance, and TDS above the Secondary MCLs were found in MW-2AD and MW-2D. However, the concentrations were not as high as in the DIWs. Three of eight groundwater samples collected from these two monitoring wells also showed elevated levels of manganese, with concentrations were similar to those observed in MW-1D and MW-2D. Bromate, aldrin, and heptachlor were detected above the associated MCLs or NLs in one of four SM Aquifer monitoring wells.

Former Fort Ord Constituents

Groundwater sampling of PWM wells included analyses for chemicals of concern related to former Fort Ord activities including analyses for 17 explosive compounds by U.S. EPA method 8330B and two metals (beryllium and lead). **Table 5** compares the water quality data to available California Primary MCLs and NLs.

The table shows that nitroaromatics and nitroamines were detected above the Method Reporting Limit (MRL) in three samples. 1,3-Dinitrobenzene was detected in DIW-2 and MW-1AS at levels above the MRL. Pentaerythritol Tetranitrate was detected above the MRL in MW-1AD. Beryllium was detected one time and lead was detected three times. Only the lead detection in MW-1AD is above the minimum reporting limit for the metals. However, it is well below the Primary MCL.

Given the inconsistent, low level detects of nitroaromatics and nitroamines and low levels of lead and beryllium, the data do not show that chemicals of concern associated with former Fort Ord activities have impacted groundwater in the vicinity of the PWM Injection Facilities Area.

Constituents of Emerging Concern (CECs)

Monitoring for constituents of emerging concern (CECs) are included in groundwater monitoring and reporting requirements for the PWM/GWR Project based on the recommendations of the SWRCB's Science Advisory Panel for CEC monitoring. With the exception of Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanesulfonic acid (PFOA), CECs were previously assessed for the Recharge Impacts Assessment Report (Todd, 2015). Health-based notification levels (NLs) for PFOS And PFOA were more recently established by the State Water Resources Control Board (SWRCB) in July 2018. The following eight analytes were included to establish baseline conditions for the PWM wells and are based on health-based and/or treatment/performance-based indicators as listed below.

- Caffeine – stimulant (health-based and performance-based indicator)
- Deet (N,N-diethyl-metatoluamide) – personal care product (performance-based indicator)

- 17-β-estradiol - steroid hormone (health-based indicator)
- N-nitrosodimethylamine (NDMA) – disinfection byproduct (health-based and performance-based indicator)
- Perfluorooctanesulfonic acid (PFOS) – industrial contaminant (health-based indicator)
- Perfluorooctanoic acid (PFOA) – industrial contaminant (health-based indicator)
- Sucralose – food additive (performance-based indicator)
- Triclosan – antimicrobial (health-based indicator)

None of the CECs currently have Primary MCLs. NDMA has an NL of 0.01 micrograms per liter (µg/L). Compliance with new NLs of 5.1 nanograms per liter (ng/L) for PFOA and 6.5 ng/L for PFOS will require reporting limits that are lower than can be achieved with EPA Method 537. US EPA Method 537.1 is reportedly able to achieve lowest concentration minimum reporting levels (LCMRL) of 0.82 ng/L (PFOA) and 2.7 ng/L (PFOS).

Groundwater samples for all seven PWM wells were analyzed for the eight CECs. **Table 6** provides a summary of the results/detections.

- Caffeine was inconsistently detected in the one groundwater sample from MW-1AS and one of four groundwater samples from MW-1AD. The method detection limit (MDL) is 0.001 µg/L. Caffeine was detected in one of seven Pilot RO permeate samples with a concentration of 0.012 µg/L. The MDL is 0.005 µg/L. The full-scale AWPF also includes UV/AOP oxidation after RO treatment. It is expected that caffeine concentrations will be below the MDL in purified recycled water (Trussell Technologies, October 6, 2019 email).

- DEET was detected in one or more samples in MW-1S, MW-2AS, MW-1D, MW-2D, MW-1AD, and MW-2AD. overall, DEET was detected in 7 of 21 groundwater samples. Concentrations for six of the seven detections were between the MDL and MRL (designated as a "J" value by the analytical laboratory). DEET was not detected in pilot RO permeate and is expected to be below the laboratory MDL for purified recycled water.

- NDMA was detected in all 14 samples of Pilot RO permeate at an average concentration of 0.027 µg/L. The full-scale AWPF includes UV/AOP oxidation following RO treatment and is designed to remove 1.5-log NDMA which will result in NDMA concentrations less than 0.001 µg/L (the method detection limit) in purified recycled water (Trussell Technologies, October 6, 2019 email). NDMA was not detected in any of the PWM groundwater samples from the seven PWM monitoring wells.

- PFOS and PFOA are two newer CECs for which the EPA has established health advisories and represent fluorinated organic compounds used in many consumer products. PFOS was not detected in any of the groundwater samples. However, PFOA was detected in one of two samples for MW-1D, one of four samples for MW-1AD, and one of two samples for MW-2AS. PFOA concentrations ranged from 0.00028 to 0.0008 µg/L (equivalent to 0.28 to 0.8 ng/L). Purified recycled water was not tested for PFOS or PFOA. However, source waters were tested in 2014, but the MDLs for the laboratory tests were greater than the NLs. RO is expected to remove greater than 99 percent of PFOS/PFOA. Based on the detection limit and RO removal rate, the concentration of PFOS and PFOA is expected to be less than the method detection limit in the purified recycled water (Trussell Technologies, October 1, 2019 email).

- Estradiol, sucralose, or triclosan were not detected above their associated MDLs in any PWM monitoring wells or in pilot RO permeate and are not expected to be detected in purified recycled water from the full-scale AWPF.

Updated Geochemical Compatibility Analysis

Injection of water into an aquifer results in mixing of two water types (purified recycled water and ambient groundwater) with different water chemistry raising the concern regarding compatibility of the water types. Geochemical reactions result in dissolution or leaching of metals or natural anthropogenic constituents, which could alter the groundwater quality.

A geochemical assessment was performed for the Recharge Impacts Assessment Report (Todd, 2015) using the data from the initial PWM field program involving the drilling and installation of MRWPCA MW-1 on Eucalyptus Road (Todd, 2015a). Stabilized recycled water from the pilot plant was used in laboratory leaching tests on vadose zone core samples to establish a preliminary estimate of leaching potential. Aqueous geochemical modeling was used to analyze the potential for leaching of chromium, arsenic, and lead from the Aromas Sand and PR Aquifer. Results indicated that chromium has the highest potential for leaching but this leaching does not have a long-term affect as the available chromium is limited. The estimated maximum concentration of 4.0 µg/L is well below the total chromium MCL of 50 µg/L. Dissolution of arsenic and lead is expected to result in low concentrations below regulatory standards (Todd, 2015 and 2015a).

Geochemical impacts to the SM Aquifer were also evaluated. Risk of trace metal desorption due to injection was inferred from previous studies of injected Carmel River water. The Carmel River water and the purified recycled water have similar pH and oxidation-reduction potential and are expected to have similar adsorption/desorption processes. No studies indicate significant metal concentrations would dissolve. This assumption has been applied to injection of the purified recycled water (Todd, 2015).

The previous geochemical modeling completed for the PWM/GWR Project EIR indicated that purified recycled water is compatible with ambient groundwater and aquifer materials (Todd, 2015).

Additional Geochemical Compatibility Analysis since PWM/GWR Project EIR

Bench-scale leaching tests of PWM recycled water for groundwater replenishment was conducted by MPWMD to address leaching concerns by the Seaside Basin Watermaster Technical Advisory Committee's (TAC) from recharge of purified recycled water. Slightly corrosive water could have the potential to dissolve constituents (metals) or otherwise react with aquifer materials or native groundwater resulting in altered groundwater quality.

The PWM Operation Optimization Plan (Trussell Technologies, 2019) water quality ranges for purified recycled water for replenishment are 40 to 80 mg/L (as $CaCO_3$) for alkalinity and 7.5 to 8.5 for pH with a Langlier Index of +0.1 or larger. A 'worst case' purified recycled water with alkalinity of 40 mg/L and pH of 7.5 is slightly out of the Langlier Index requirement of +1 or greater (non-corrosive). This 'worst case' water has a slightly negative Langlier Index of -0.1 (slightly corrosive). Bench testing with "worst case" water was conducted by McCampbell Analytic Laboratories of Pittsburg, CA and evaluated by Pueblo Water Resources (PWR, 2019).

Batch-reactor leaching tests using the 'worst case' recycled water and cuttings collected from the SM Aquifer (during pilot borehole drilling of DIW-2) revealed detections of four transition metals compared with the original bench scale test. The lithology represented by the cuttings collected at 595 feet-bgs only represent 3 to 5 percent of the portion of the SM Aquifer in which the injection well is screened. The levels were near the laboratory MDLs and significantly below drinking water standards. This minor leaching may be undetectable in a composite water sample representative of the entire well (PWR, 2019). Similar to the original bench scale testing, no significant leaching or ion exchange reactions took place between the synthetic recycled water and the SM Aquifer materials.

POTENTIAL GROUNDWATER QUALITY IMPACTS

The assessment of potential impacts from the Proposed Modifications on local groundwater quality is based on the characterization of current (2017 to 2019) ambient groundwater and purified recycled water (based on best estimates from pilot scale AWPF treatment studies completed to date).

Thresholds of Significance

The following guidelines were applied to the PWM/GWR Project and apply to the Proposed Modifications. Appendix G of the 2013 CEQA Guidelines provides the primary question relating to potential GWR impacts on groundwater quality is as follows:

> *Would the project violate any water quality standards or otherwise degrade water quality?*

The following factors were developed for the Project to clarify how this question would be applied in the impact analyses. Implementation of the Project or the Expanded Project would be considered to have a significant impact on groundwater quality if:

- The Project, taking into consideration the proposed treatment processes and groundwater attenuation and dilution, were to:
    - Impact groundwater so that it would not meet a water quality standard (e.g., Basin Plan beneficial uses and water quality objectives, including drinking water MCLs established to protect public health).

- o Degrade groundwater quality subject to California Water Code statutory requirements for the DDW, and to the SWRCB Antidegradation Policy and Recycled Water Policy.

- The Proposed Project were to result in changes to basin recharge such that it would adversely affect groundwater quality by exacerbating seawater intrusion.

Potential Degradation of Groundwater Quality

Stabilized pilot plant water samples and projected purified recycled water quality would meet SWRCB Regulations for groundwater replenishment projects and Basin Plan groundwater quality standards, including drinking water MCLs. Further, the treatment processes to be used satisfy DDW Groundwater Replenishment Regulations, and the Advanced Water Purification Facility is required to ensure that all water quality standards would be met in both the purified recycled water and groundwater.

Purified recycled water for both the PWM/GWR Plan and Proposed Modifications will be treated and stabilized to meet all drinking water quality objectives and other basin objectives, including not utilizing assimilative capacity above the 10% threshold. Treatment of recycled water will include UV/AOP oxidation after the RO process and removes additional CECs.

Injection of purified recycled water will help to meet Basin Plan objectives with regard to TDS, chloride, and nitrate concentrations. The purified recycled water is designed to be higher quality than ambient groundwater with respect to TDS, chloride, and nitrate concentrations. The approved PWM GWR Project with Proposed Modifications will not result in violation of groundwater quality standards nor adversely impact beneficial uses. The Proposed Modifications to the PWM GWR Project will result in a beneficial effect on local groundwater quality.

Compliance groundwater monitoring will be used to ensure any risk of groundwater degradation from trace ions detected in purified recycled water are tracked and mitigated. CECs are expected to be below MDLs in purified recycled water which will be confirmed as part of compliance recycled water and groundwater monitoring programs.

Geochemical Compatibility Purified Recycled Water and Groundwater

Geochemical modeling indicates that injection of purified recycled water through the vadose zone and deep injection wells will not have a significant adverse impact on ambient groundwater quality. Key findings are summarized below.

- Chemicals associated with Fort Ord activities include nitroaromatics and nitroamines (explosives), perchlorate, beryllium, and lead were either not detected or inconsistently detected at very low concentrations in PWM GWR monitoring wells and are not expected to significantly impact groundwater quality.

- Purified recycled water quality injected through vadose zone wells is unlikely to change due to geochemical reactions with the vadose zone materials. The leaching analysis with artificially modified pilot water with a slightly corrosive Langlier Index indicated leaching of transition metals to be very minor. The purified recycled water will meet water quality standards.

- Based on the water chemistry of the PWM wells, purified recycled water, and observations from the ASR wellfield, adverse impacts from geochemical incompatibility are unlikely in the SM Aquifer in the vicinity of the deep injection wells.

LIST OF TABLES

LIST OF FIGURES

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Table 1. Summary of Groundwater Quality Data

Analytes	PWM Wells	Other Basin Wells
# Wells	9	17
Time Period	2017-2019	2009-2018
Anions	X	X
Metals (including major cations)	X	X
Conventional Chemistry Parameters	X	X
Chlorinated Pesticides and PCBs	X	X
Nitrogen and Phosphorus Pesticides	X	X
Organic Analytes	X	X
Chlorinated Acids	X	X
Carbamates	X	X
Volatile Organic Compounds (VOCs)	X	X
Semivolatile Organic Compounds	X	X
Haloacetic Acids	X	X
Herbicides	X	X
Nitroaromatics and Nitramines (Explosives)	X	
PFOS-PFOA	X	
Other (e.g., isotopes)	X	

Notes:

PWM wells sampled between 7/5/2017 and 5/16/2019

VZW-1 and VZW-2 are screened in the unsaturated Aromas Sand Formation and thus were not sampled.

Table 2. Well Construction Information for PWM and Seaside Basin Wells

Well	Type	Screened Aquifer	Well Depth (feet-bgs)	Screened Interval (fee-bgs)
ASR 1	ASR	Santa Margarita	720	480 – 700
ASR 2	ASR	Santa Margarita	790	540 – 650; 670 - 770
ASR 3	ASR	Santa Margarita	960	700 – 780; 800 – 840; 860 - 940
DIW-1	Injection	Santa Margarita	830	530 - 810
DIW-2	Injection	Santa Margarita	635	435 - 605
PRTIW	Irrigation	Paso Robles	460	345 – 445
Darwin	Production	Paso Robles	228	124 - 224
Military	Production	Paso Robles	266	184 - 264
Seaside Muni 4	Production	Paso Robles	550	330 - 350; 380 - 420; 430 - 470; 490 - 550
Luzern	Production	Paso Robles & Santa Margarita	32	172-282
Ord Grove	Production	Paso Robles & Santa Margarita	486	3560 - 396; 436 - 481
Paralta	Production	Paso Robles & Santa Margarita	960	440 - 810
FO-7 Shallow	Monitoring	Paso Robles	650	600 - 640
MW-1S	Monitoring	Paso Robles	450	380 – 440
MW-1AS	Monitoring	Paso Robles	470	380 – 460
MW-2S	Monitoring	Paso Robles	410	340 – 400
MW-2AS	Monitoring	Paso Robles	430	340 – 420
MRWPCA MW-1	Monitoring	Paso Robles	521	421 - 446; 466 – 516
ASR MW-1	Monitoring	Santa Margarita	740	480 - 590; 610 - 700
Seaside Middle School Deep	Monitoring	Santa Margarita	110	750 – 830; 860 – 920; 930 - 990
FO-7 Deep	Monitoring	Santa Margarita	850	800 - 840
MW-1D	Monitoring	Santa Margarita	820	520 - 810
MW-1AD	Monitoring	Santa Margarita	880	610 - 870
MW-2D	Monitoring	Santa Margarita	620	480 - 610
MW-2AD	Monitoring	Santa Margarita	700	480 - 690
Ord Terrace Shallow	Monitoring	Santa Margarita	340	280 – 330
Ord Terrace Deep	Monitoring	Santa Margarita	450	390 - 440

Notes:

feet bgs = feet below ground surface

Table 3. Concentrations of Selected Constituents in PWM Purified Recycled Water and PWM Monitoring Wells

Selected Ions

Constituent	Units	Regulatory Limit	Estimated Purified Recycled Water		Paso Robles Aquifer			Santa Margarita Aquifer			
			Min	Max	MW-1S	MW-1AS	MW-2AS	MW-1D	MW-2D	MW-1AD	MW-2AD
Specific Conductance (EC)	µS/cm	900 (SMCL)	45	170	310	310	445	1200	1050	815	925
Total Dissolved Solids	mg/L	500 (SMCL)	30	110	195	190	280	760	630	495	615
Nitrate as N	mg/L	10 (MCL)	0.03	5	0.805	ND	0.825	8.585	ND	0.170	0.103
Chloride	mg/L	250 (SMCL)	<3	17	64	54	67	180	145	96	99
Sulfate	mg/L	250 (SMCL)	1	11	7.45	21	13	113	99	55	110
Manganese, Total	mg/L	0.5 (NL)	<0.007	0.028	21	23	11	53	79	56	47

Trace Constituents that were Consistently Detected in the RO Permeate during Pilot Testing

Constituent	Units	Regulatory Limit	Estimated Purified Recycled Water		Paso Robles Aquifer			Santa Margarita Aquifer			
			Min	Max	MW-1S	MW-1AS	MW-2AS	MW-1D	MW-2D	MW-1AD	MW-2AD
Boron	µg/L	1,000 (NL)	120	320	ND	ND	0.082	0.22	0.28	0.10	0.14
Chromium	µg/L	50 (MCL)	4	14	4.55	ND	4.35	0.47	ND	ND	ND
Formaldehyde[b]	µg/L	100 (NL)	20	90	ND	130	ND	3.9	38	28	52
Gross Alpha Particles	pCi/L	15 (MCL)	2	5	0.887 ± 1.04	2.08±1.41	3.201 ± 1.30	5.61 ± 1.45	5.30 ± 2.47	5.27 ± 2.52	3.61 ± 1.55
NDMA	ng/L	10 (NL)	<1	1	ND	ND	ND	ND	ND	ND	ND
Radium-226	pCi/L	5 (MCL)	0	0.8	0.000 ± 0.066	0.059±0.086	0.0735 ± 0.132	0.555 ± 0.216	0.795 ± 0.266	0.426 ± 0.213	0.948 ± 0.276
Total Trihalomethanes (THMs)[a]	µg/L	80 (MCL)	0.4	31	23.6	ND	7.8	ND	ND	22	6.2

Notes:

a - Assuming 90% removal of source water THMs through the RTP; THMs = sum of chloroform, dichlorobromoform, chlorodibromoform, and bromoform

b - Expected to be well removed in the aquifer

Trace Constituents that were Inconsistently Detected in the RO Permeate during Pilot Testing

Constituent	Units	Regulatory Limit	Estimated Purified Recycled Water		Paso Robles Aquifer			Santa Margarita Aquifer			
			Min	Max	MW-1S	MW-1AS	MW-2AS	MW-1D	MW-2D	MW-1AD	MW-2AD
Aluminum, Total	µg/L	1,000 (MCL)	< 10	131	48	ND	ND	7.4	ND	ND	ND
Arsenic, Total	µg/L	10 (MCL)	< 1	3	1.85	14	2.65	1.5	ND	1.7	0.86
Cyanide	mg/L	0.15 (MCL)	< 0.005	0.009	0.0042	ND	ND	0.00425	ND	ND	ND
N-Nitrosodi-n-propylamine	µg/L	0.01 (NL)	< 0.002	0.0036	ND	ND	ND	ND	ND	ND	ND
Selenium, Total	µg/L	100 (MCL)	< 2	18	0.68	ND	2.45	1.45	0.88	2.65	0.83

Notes:

Estimated Purified Recycled Water quality based on Trussell, 2018

MCL = Primary Maximum Contaminent Level

SMCL = Secondary Maximum Contaminant Level

NL = DDW Notification Level

ND = not detected

mg/L = milligrams per liter

µg/L = micrograms per liter

µmhos/cm - micromhos per centimeter

Table 4. Range of Detections Above Drinking Water Standards

Paso Robles Aquifer

Analyte	Method	Regulatory Requirements		Units	MDL	MW-1S		MW-1AS		MW-2AS	
		Type	Level			Samples with Detects / Total Samples	Detected Concentrations above Drinking Water Standard	Samples with Detects / Total Samples	Detected Concentrations above Drinking Water Standard	Samples with Detects / Total Samples	Detected Concentrations above Drinking Water Standard
Chloride (Cl–)	EPA 300.0	SMCL	250	mg/L	1	0/4	-	0/1	-	0/2	-
Bromate (BrO3–)	EPA 317.0	MCL	0.01	mg/L	0.001	0/4	-	0/1	-	0/2	-
Nitrate as N	EPA 300.0	MCL	10	mg/L	0.04	0/4	-	0/1	-	0/2	-
Arsenic (As) - Dissolved	EPA 200.8	MCL	10	µg/L	0.2	0/4	-	1/1	14	0/2	-
Chromium (Cr) - Dissolved	EPA 200.8	MCL	50	µg/L	0.08	1/4	52	0/1	-	0/2	-
Manganese (Mn) - Dissolved	EPA 200.8	SMCL	50	µg/L	0.9	0/4	-	0/1	-	0/2	-
Color	SM2120B	SMCL	15	Color Units	3	0/4	-	0/1	-	1/2	25
Odor	EPA 140.1	SMCL	3	T.O.N.	–	0/4	-	0/1	-	0/2	-
Specific Conductance	SM2510B	SMCL	900	µmhos/cm	1	0/4	-	0/1	-	0/2	-
Total Dissolved Solids (TDS)	SM2540C	SMCL	500	mg/L	5	0/4	-	0/1	-	0/2	-
Aldrin	EPA 508	NL	0.002	µg/L	0.01	0/4	-	0/1	-	0/2	-
Heptachlor	EPA 508	MCL	0.01	µg/L	0.01	0/4	-	0/1	-	0/2	-
Toluene	EPA 524.2	MCL	150	µg/L	0.3	0/4	-	0/1	-	0/2	-

Santa Margarita Aquifer

Analyte	Method	Regulatory Requirements		Units	MDL	MW-1D		MW-2D		MW-1AD		MW-2AD		DIW-1	DIW-2
		Type	Level			Samples with Detects / Total Samples	Detected Concentrations above Drinking Water Standard	Samples with Detects / Total Samples	Detected Concentrations above Drinking Water Standard	Samples with Detects / Total Samples	Detected Concentrations above Drinking Water Standard	Samples with Detects / Total Samples	Detected Concentrations above Drinking Water Standard		
Chloride (Cl–)	EPA 300.0	SMCL	250	mg/L	1	1/4	480	0/2	-	0/4	-	0/4	-		
Bromate (BrO3–)	EPA 317.0	MCL	0.01	mg/L	0.001	0/4	-	0/2	-	1/4	6.7	0/4	-		
Nitrate as N	EPA 300.0	MCL	10	mg/L	0.04	1/4	17	0/2	-	0/4	-	0/4	-		
Arsenic (As) - Dissolved	EPA 200.8	MCL	10	µg/L	0.2	0/4	-	0/2	-	0/4	-	0/4	-		
Chromium (Cr) - Dissolved	EPA 200.8	MCL	50	µg/L	0.08	0/4	-	0/2	-	0/4	-	0/4	-		
Manganese (Mn) - Dissolved	EPA 200.8	SMCL	50	µg/L	0.9	2/4	61-64	1/2	110	2/4	61-100	1/4	52		
Color	SM2120B	SMCL	15	Color Units	3	0/4	-	0/2	-	0/4	-	0/4	-		
Odor	EPA 140.1	SMCL	3	T.O.N.	–	3/4	8-67	2/2	8-40	2/4	8-40	3/4	8-100	67	50
Specific Conductance	SM2510B	SMCL	900	µmhos/cm	1	3/4	1200-1300	2/2	1000-1100	0/4	-	2/4	1000-1100	1100	970
Total Dissolved Solids (TDS)	SM2540C	SMCL	500	mg/L	5	3/4	740-870	2/2	600-660	2/4	520-530	3/4	550-680	620	620
Aldrin	EPA 508	NL	0.002	µg/L	0.01	0/4	-	0/2	-	0/4	-	1/4	0.013		
Heptachlor	EPA 508	MCL	0.01	µg/L	0.01	0/4	-	0/2	-	1/4	0.015	0/4	-		
Toluene	EPA 524.2	MCL	150	µg/L	0.3	0/4	-	1/2	290	0/4	-	0/4	-		

Notes:

MCL = Primary Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

NL = Notification Level

mg/L = milligrams per liter

µg/L = micrograms per liter

T.O.N. = Threshold Odor Number

µmhos/cm - micromhos per centimeter

Table 5. Groundwater Analyses for Explosives and Associated Metals

Constituent	Wells with Detections*	Samples with Detects / Total Samples	Method Dectection Limit (MRL)	Method Reporting Limit (MRL)	Detected or Reported Concentration	California Primary MCL	California NL
			µg/L				
Nitroaromatics and Nitroamines (Explosives)*							
HMX	None		0.1	0.099-0.12	ND	None	None
RDX	None		0.2	0.099-0.12	ND	None	0.3
1,3,5-Trinitrobenzene	MW-1S	1/4	0.2	0.20-0.22	0.16	None	None
1,3-Dinitrobenzene	DIW-2	1/1	0.1	0.098-0.12	**0.26**	None	None
	MW-1S	1/4			0.049		
	MW-1AS	1/1			**0.12**		
3,5-Dinitroaniline	None		0.2	0.098-0.30	ND	None	None
Tetryl	None		0.2	0.10-0.12	ND	None	None
Nitrobenzene	MW-1S	1/4	0.1	0.099-0.12	0.059 J	None	None
4-Amino-2,6-dinitrotoluene	None		0.1	0.098-0.11	ND	None	None
2-Amino-4,6-dinitrotoluene	None		0.1	0.098-0.11	ND	None	None
2,4,6-Trinitrotoluene (TNT)	None		0.2	0.098-0.11	ND	None	None
2,6-Dinitrotoluene	None		0.2		ND	None	1
2,4-Dinitrotoluene	None		0.2	0.1	ND	None	None
2-Nitrotoluene	None		0.1	0.11	ND	None	None
4-Nitrotoluene	None		0.1	0.098-0.12	ND	None	None
3-Nitrotoluene	None		0.1	0.098-0.12	ND	None	None
Nitroglycerin	None		1	0.99-1.2	ND	None	None
Pentaerythritol Tetranitrate	MW-1AD	1/3	1	0.49-0.56	**0.73**	None	None
Metals**							
Beryllium (Be) - Dissolved	DIW-1	1/1	0.02	0.1	<0.1	4	
Lead (Pb) - Dissolved	DIW-1	1/1	0.06	0.25	<0.25	15	
	MW-1AD	1/4			**0.27**		
	MW-1S	1/4			0.09		

Notes:

Concentration in BOLD = Above MRL

* Nitroaromatics and nitramines by U.S. EPA Method 8330B: Samples received and submitted by Alpha Analytical Laboratory, Ukiah, CA to ALS Environmental (ALS), Kelso, WA on February 5, 2014; analyzed by ALS on February 8, 2014.

** Metals by U.S. EPA Method 200.8 analyzed by Alpha Analytical Laboratory, Ukiah, CA, February 5-11, 2014.

µg/L = micrograms per liter

MCL = Maximum Contaminant Level

MDL = Method Detection Limit

MRL = Method Reporting Limit

ND = Not detected above the MRL for any sample

NL = Notification Level

J = Concentration above MDL and below MRL.

Table 6. Constituents of Emerging Concern

Constituent	Units	NL	MDL	MRL	Purified Recycled Water		Paso Robles Aquifer			Santa Margarita Aquifer			
					RO Permeate Detections / Samples[1]	Estimated Full-Scale AWPF Concentration	MW-1S	MW-1AS	MW-2AS	MW-1D	MW-2D	MW-1AD	MW-2AD
Caffeine[2]	µg/L	-	0.005	0.01	1/7	ND	ND	0.28	ND	ND	ND	0.015	ND
DEET[3]	µg/L	-	0.001	0.01	0/7	ND	0.019	ND	0.0035J	0.0024J	0.0072 J	0.0083 J	0.0021 J
Estradiol	µg/L	-	0.005	0.01	0/7	ND	ND	ND	ND	ND	ND	ND	ND
NDMA	µg/L	0.01	0.001	0.002	14/14	ND (<1)	ND	ND	ND	ND	ND	ND	ND
Perfluorooctanesulfonic acid (PFOS)	µg/L	-	2E-04	2E-04	Not Analyzed	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorooctanoic acid (PFOA)	µg/L	-	2E-04	2E-04	Not Analyzed	ND	ND	ND	0.00028	0.0004	ND	0.00081	ND
Sucralose	ng/L	-	49	100	0/7	ND	ND	ND	ND	ND	ND	ND	ND
Triclosan	ng/L	-	10	20	0/7	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

1 - Purified recycled water detections reflect concentations of RO Permeate from pilot study of the AWPF process train, for which samples were collected monthly between December 2013 and June 2014 (Trussell, 2016). The full-scale AWPF also includes UV/AOP oxidation after RO treatment.

2 - Detected in one of seven samples in with a sample concentration of 12 ng/L. (Email from Elaine Howe, Trussell Technologies, Inc., on 10/6/2019)

3 - Detected in 14/14 samples of pilot process. The UV/AOP process (not piloted) is designed to remove 1.5-log NDMA, meaning the concentrations in the product water (after UV/AOP) would be <1 ng/L, which is below the detection limit and well below the NL of 10 ng/L. (Email from Elaine Howe, Trussell Technologies, Inc., on 10/6/2019)

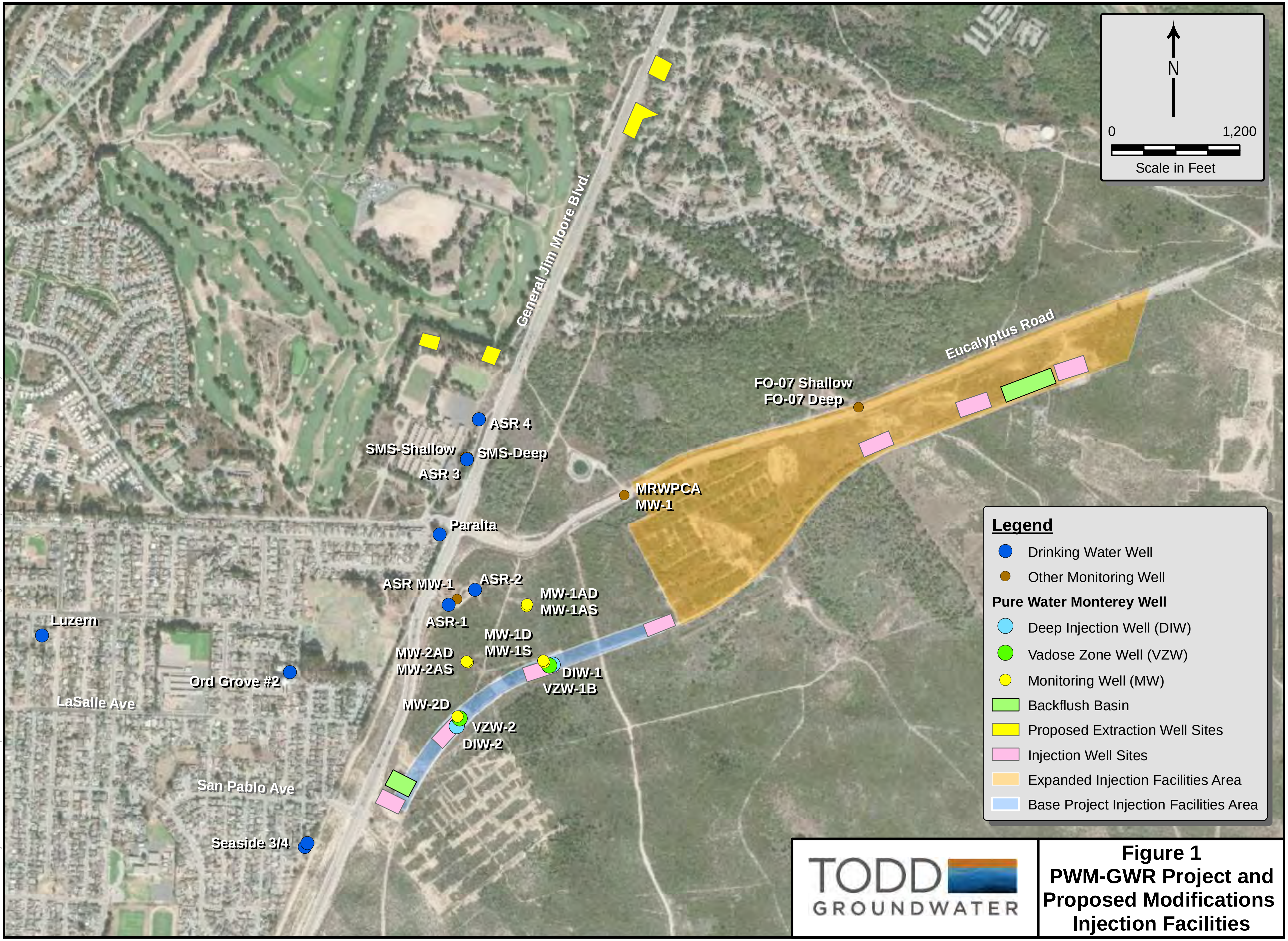


Figure 1
PWM-GWR Project and Proposed Modifications Injection Facilities

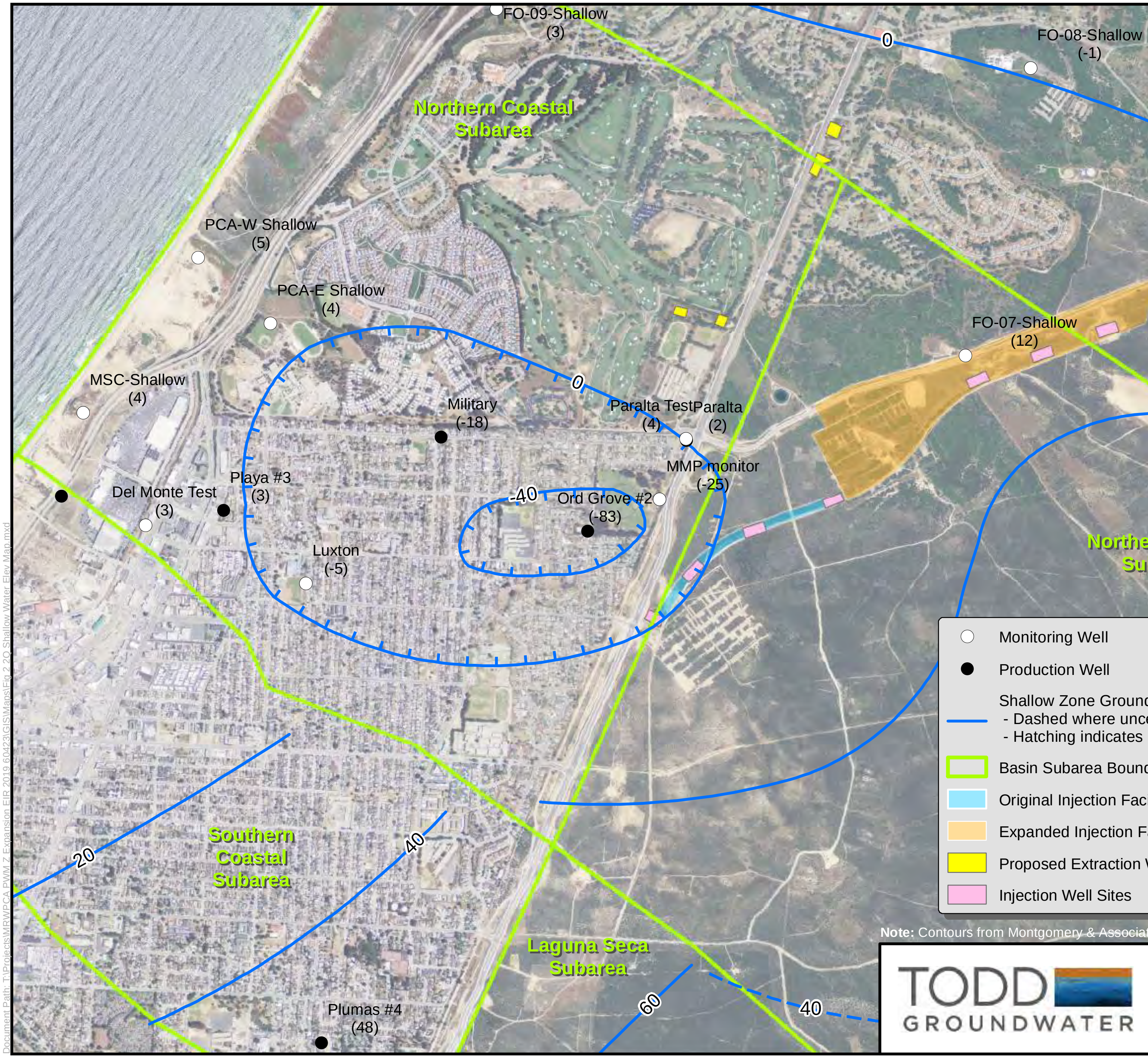


Figure 2
Paso Robles
Water Levels
Second Quarter 2018

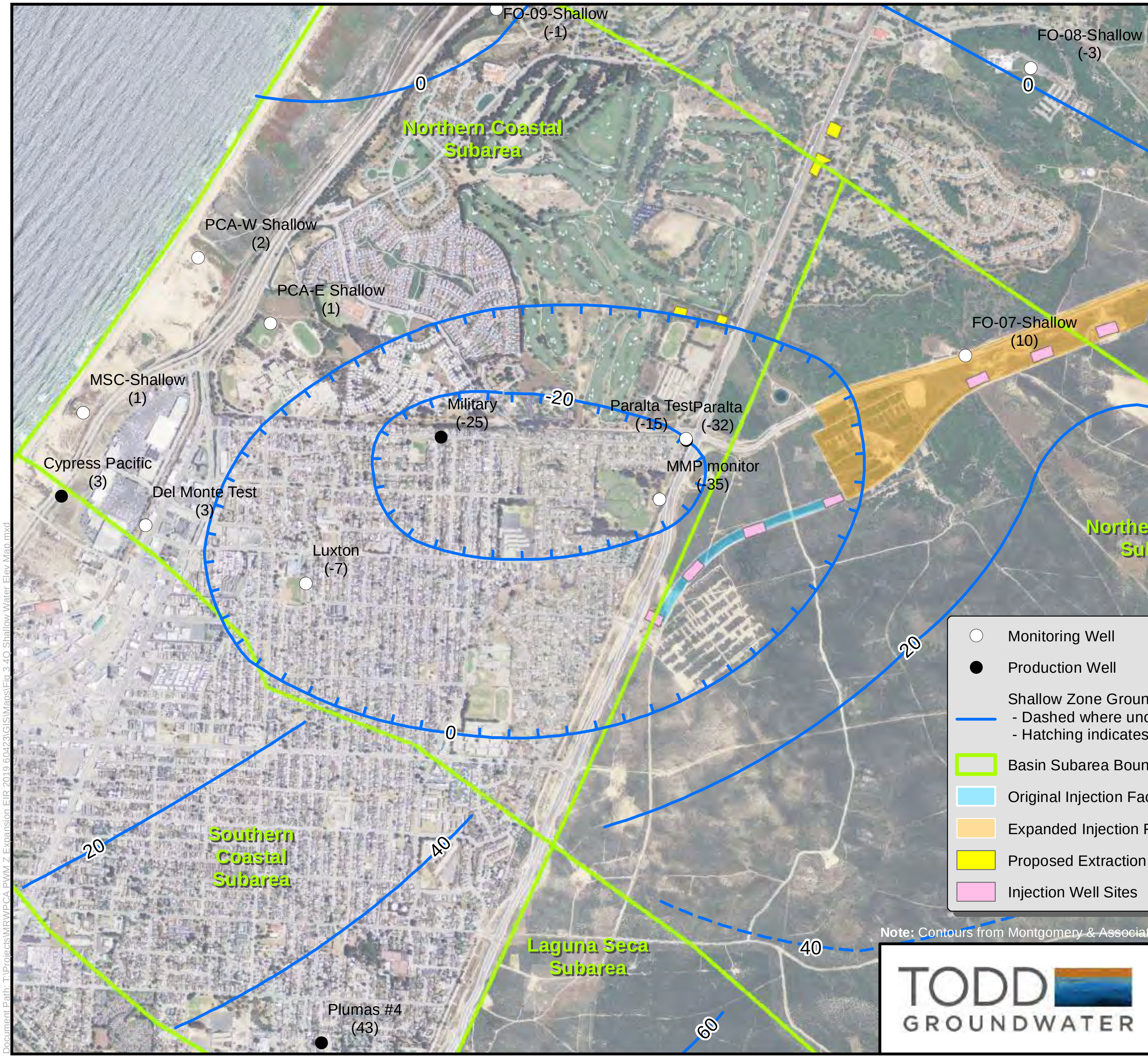


Figure 3
Paso Robles Water Levels
Fourth Quarter 2018

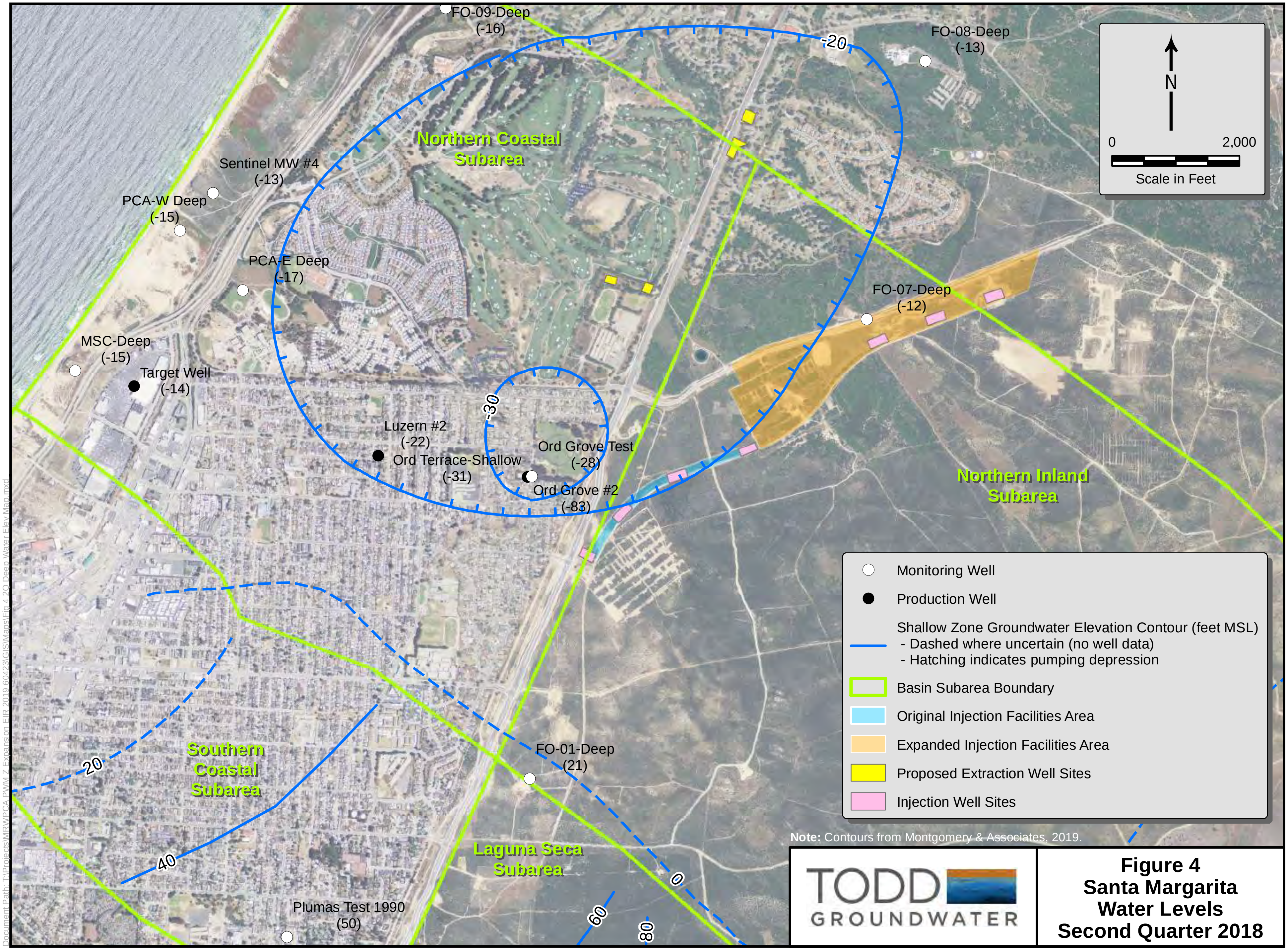


Figure 4
Santa Margarita Water Levels
Second Quarter 2018

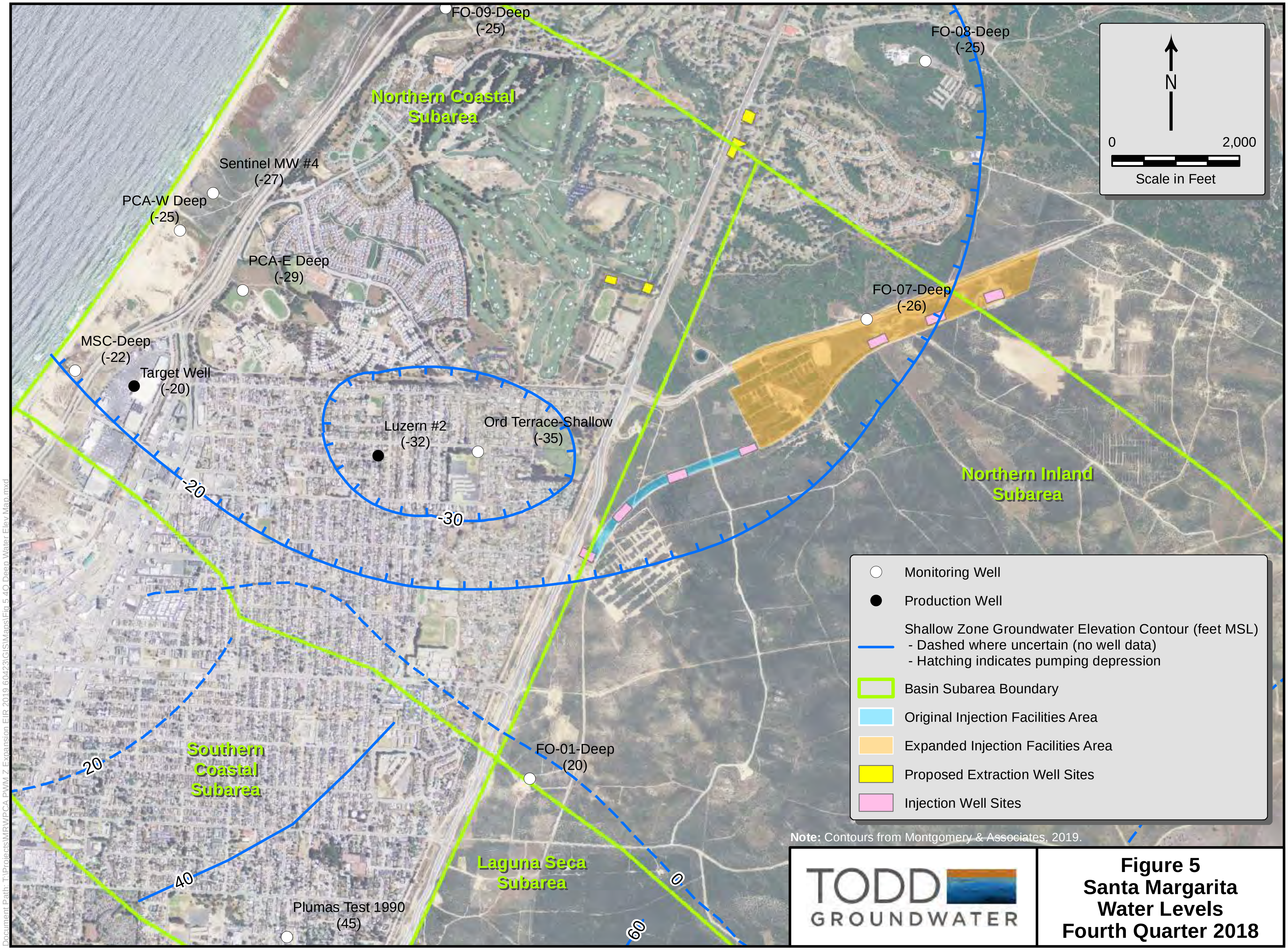


Figure 5
Santa Margarita
Water Levels
Fourth Quarter 2018

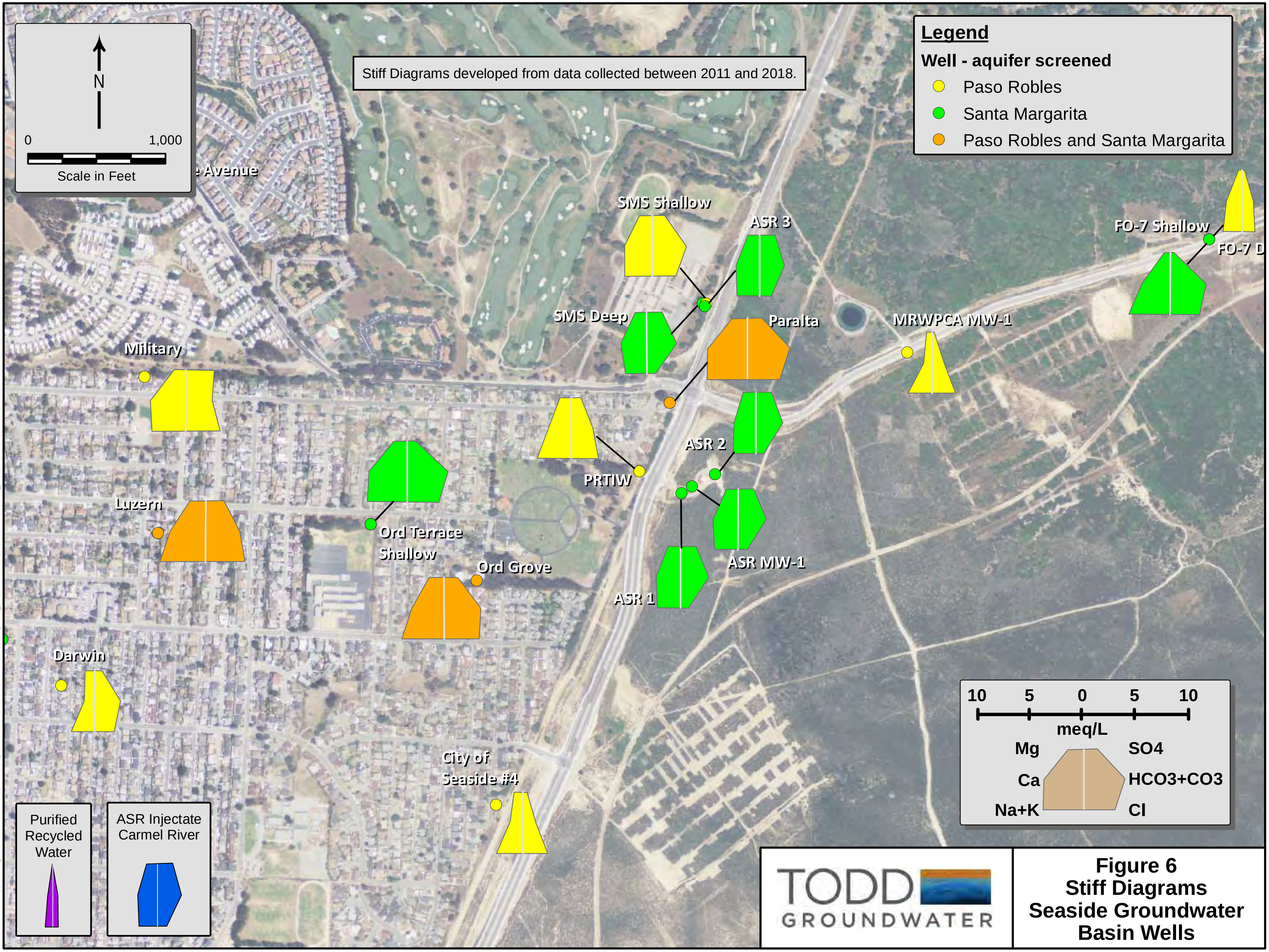


Figure 6
Stiff Diagrams
Seaside Groundwater Basin Wells

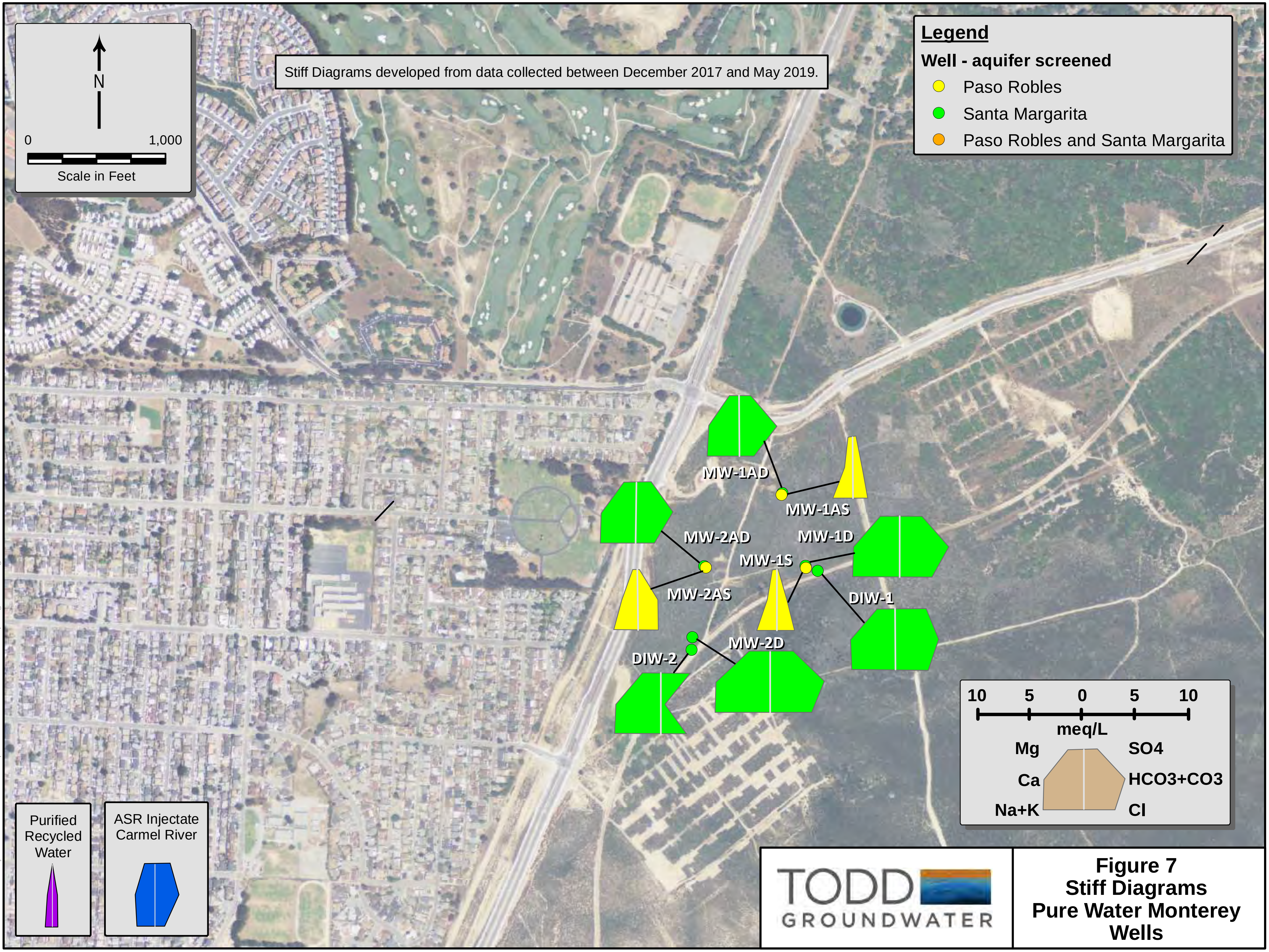
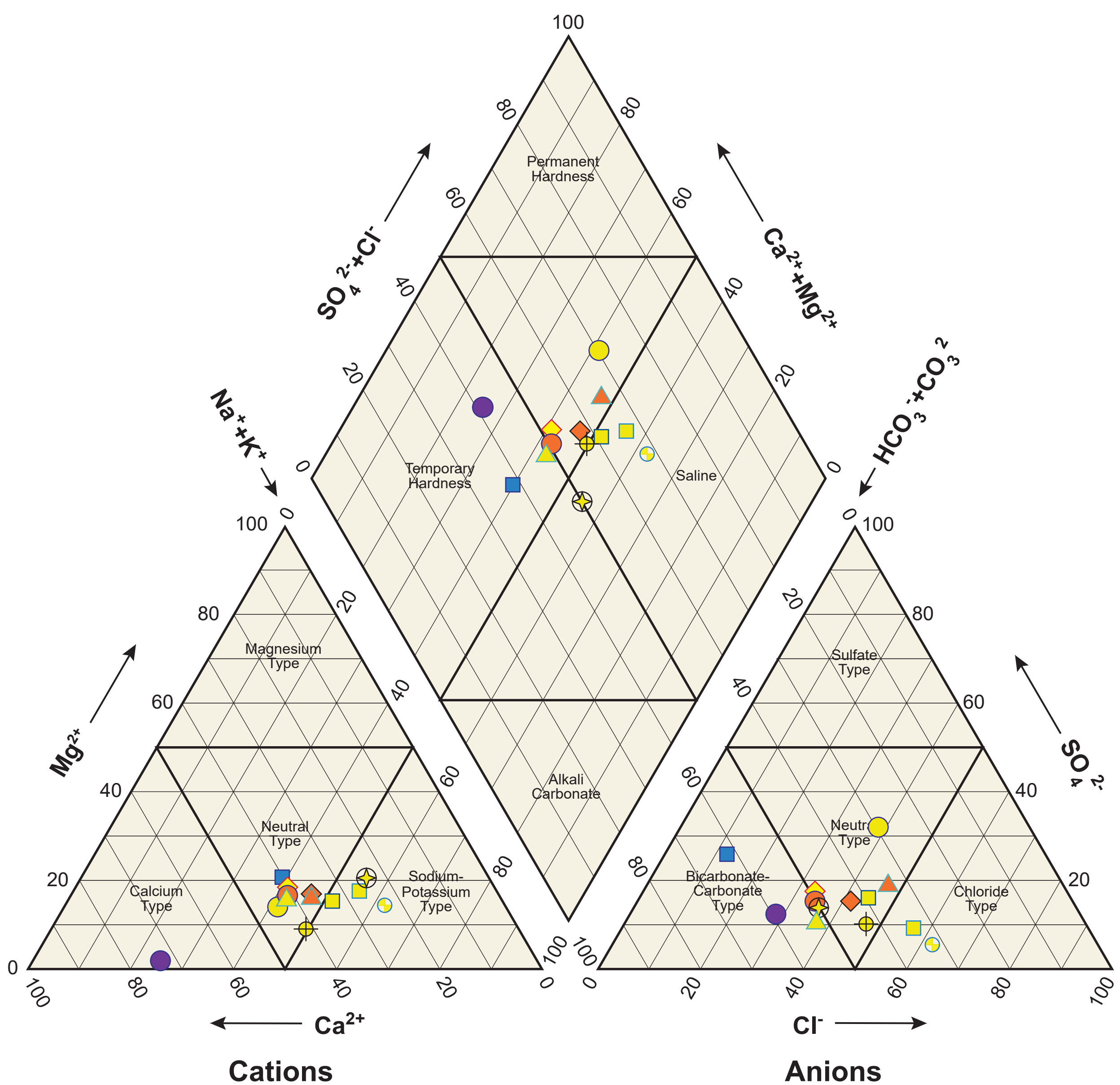


Figure 7
Stiff Diagrams
Pure Water Monterey Wells

Seaside Groundwater Basin Wells Screened in the Paso Robles Aquifer and Both the Paso Robles and Santa Margarita Aquifers



Legend

Paso Robles Aquifer

- PRITW Mission Memorial
- Darwin
- Military
- City of Seaside 4
- FO-7 Shallow
- MRWPCA MW-1
- Seaside Middle School Shallow
- Ord Terrace Shallow

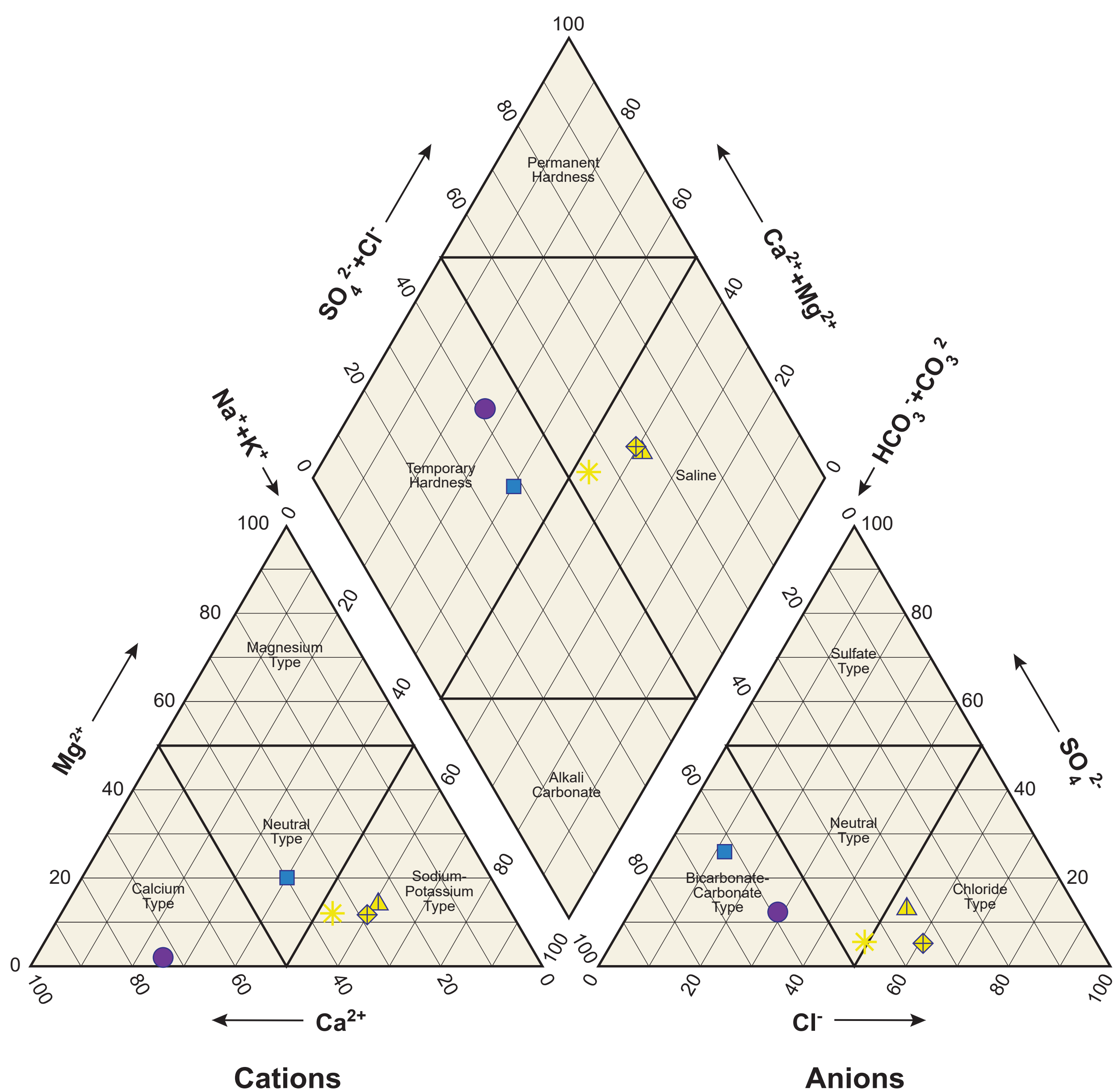
Both Aquifers

- Paralta
- Luzern
- Ord Grove

ASR Injectate

- ASR Injectate - Carmel River
- Purified Recycled Water

Pure Water Monterey Wells Screened in the Paso Robles Aquifer



Legend

Paso Robles Aquifer

- MW-1S
- MW-1AS
- MW-2AS

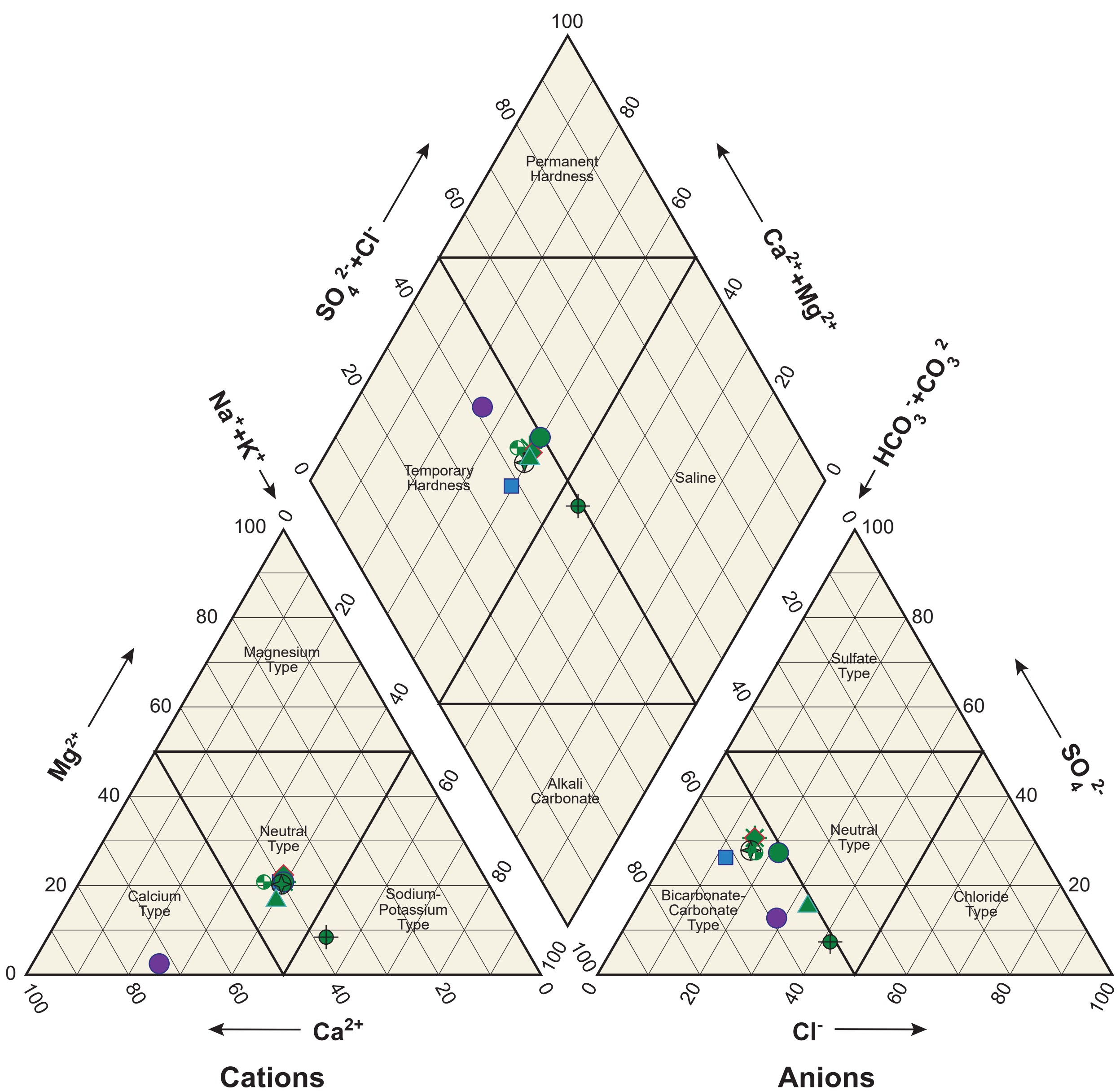
ASR Injectate

- ASR Injectate - Carmel River
- Purified Recycled Water

TODD GROUNDWATER

Figure 8
Piper Diagrams
Paso Robles Aquifer

Seaside Groundwater Basin Wells
Screened in the Santa Margarita Aquifer

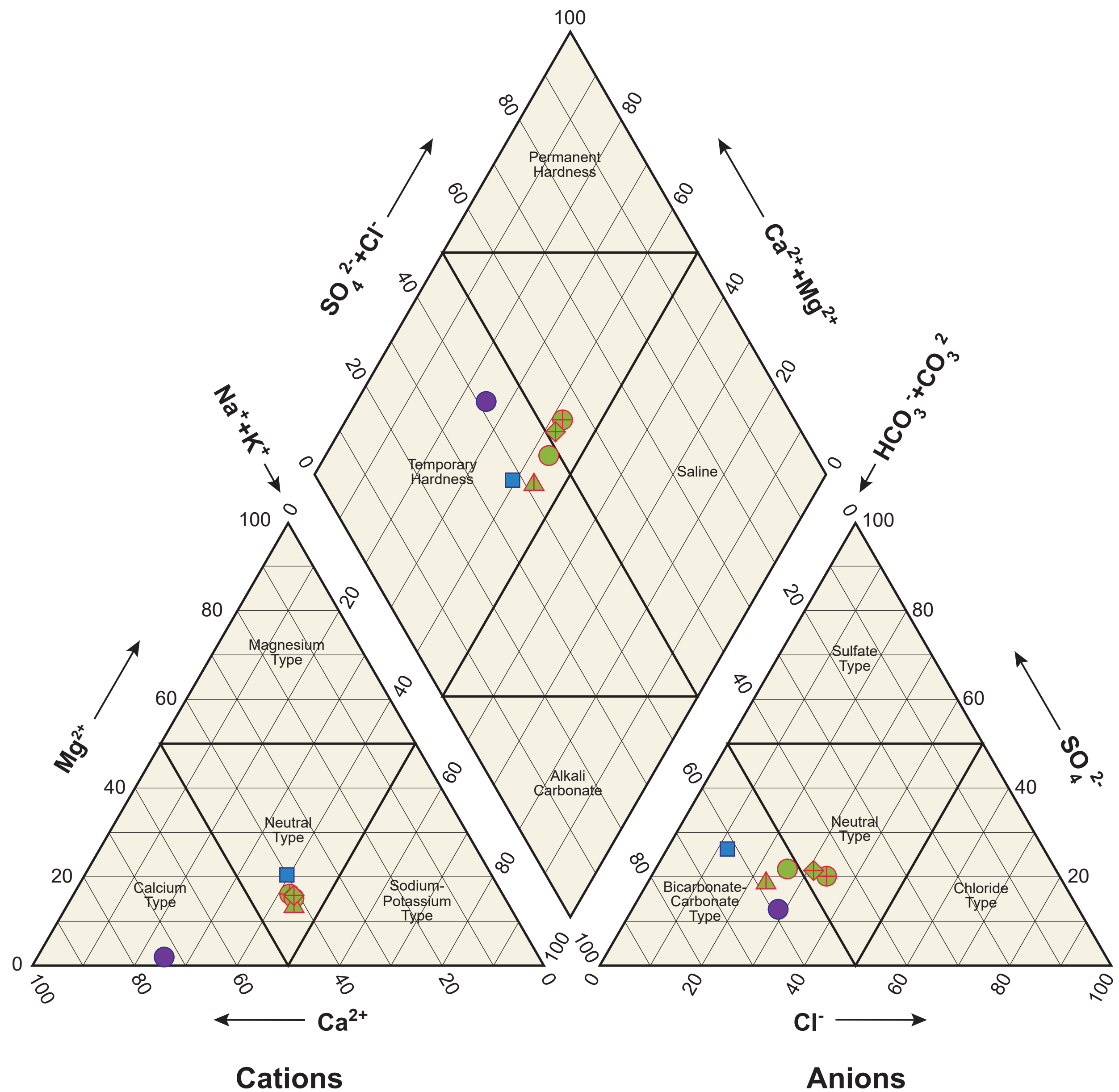


Legend

Santa Margarita Aquifer
- ASR-1
- ASR-2
- ASR-3
- ASR MW-1
- Seaside Middle School Deep
- FO-7 Deep
- Ord Terrace

ASR Injectate
- ASR Injectate - Carmel River
- Purified Recycled Water

Pure Water Monterey Wells
Screened in the Santa Margarita Aquifer



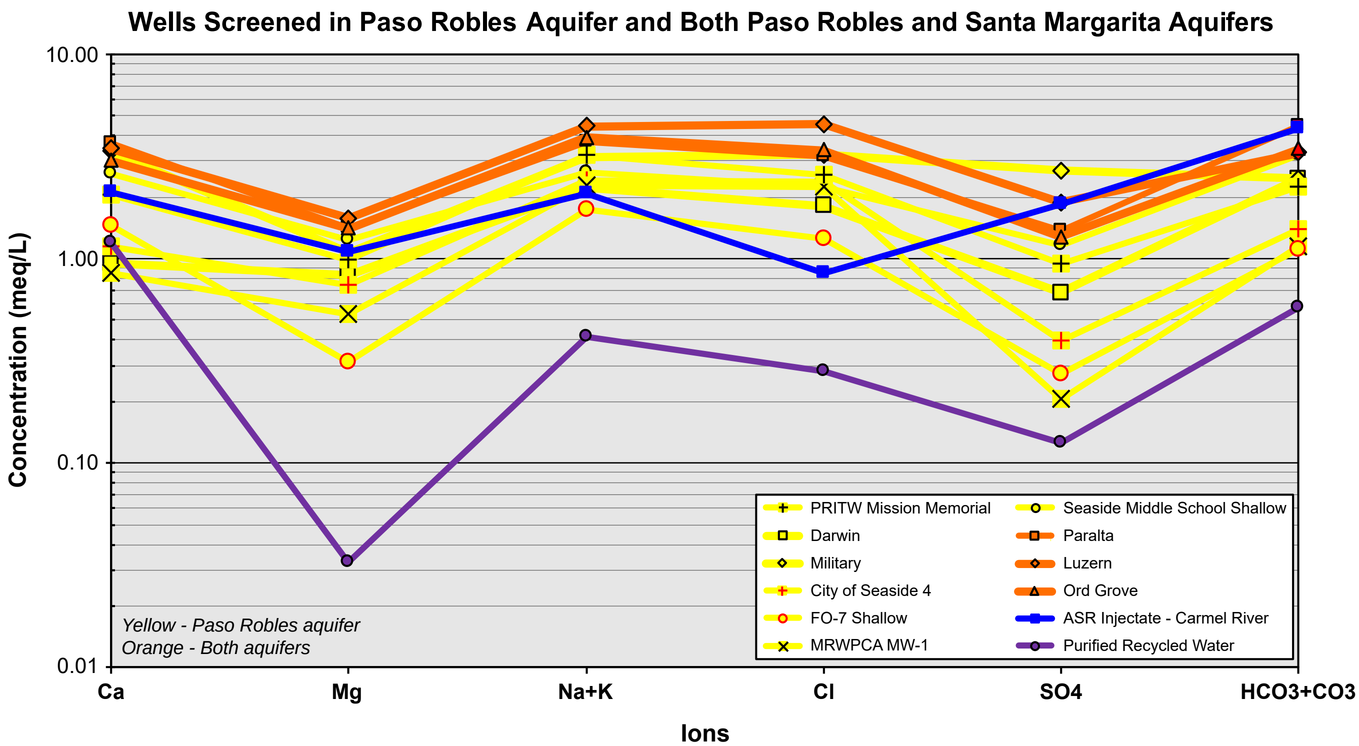
Legend

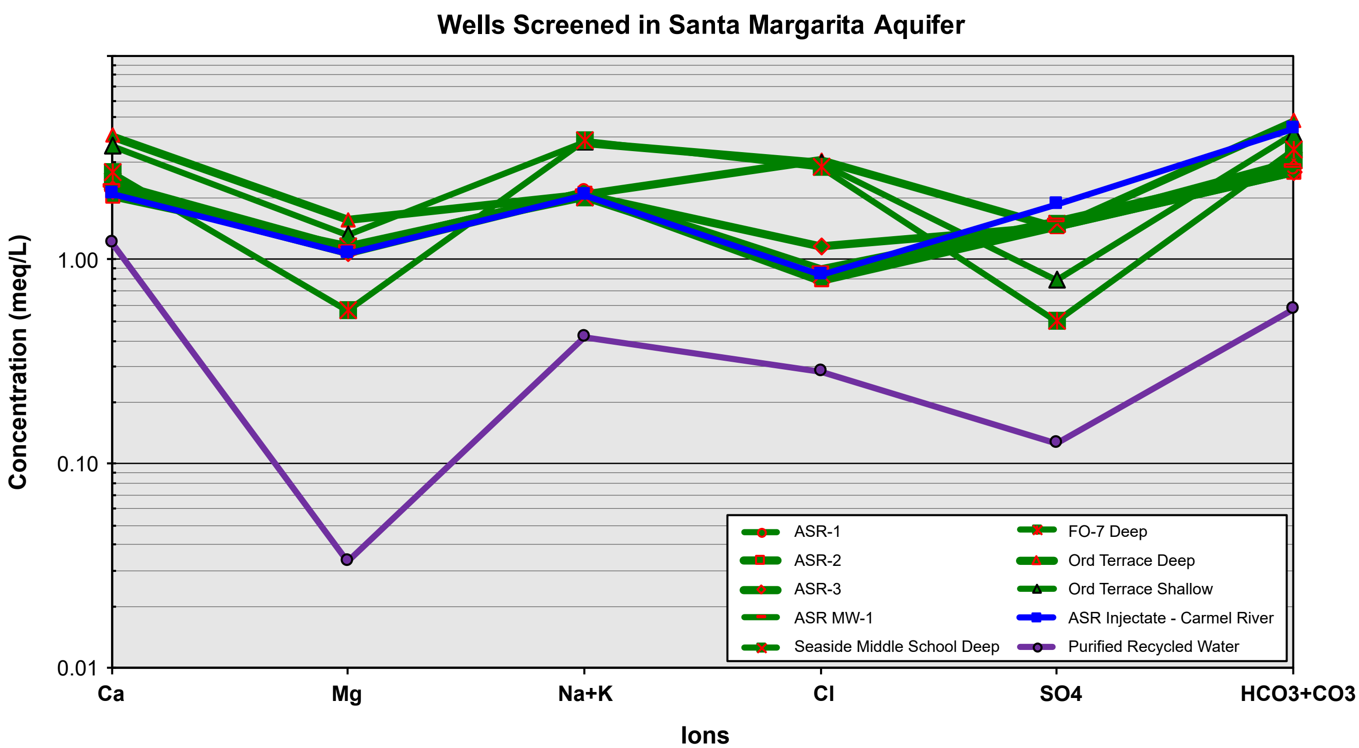
Santa Margarita Aquifer
- MW-1D
- MW-1AD
- MW-2D
- MW-2AD

ASR Injectate
- ASR Injectate - Carmel River
- Purified Recycled Water

TODD GROUNDWATER

Figure 9
Piper Diagrams
Santa Margarita Aquifer

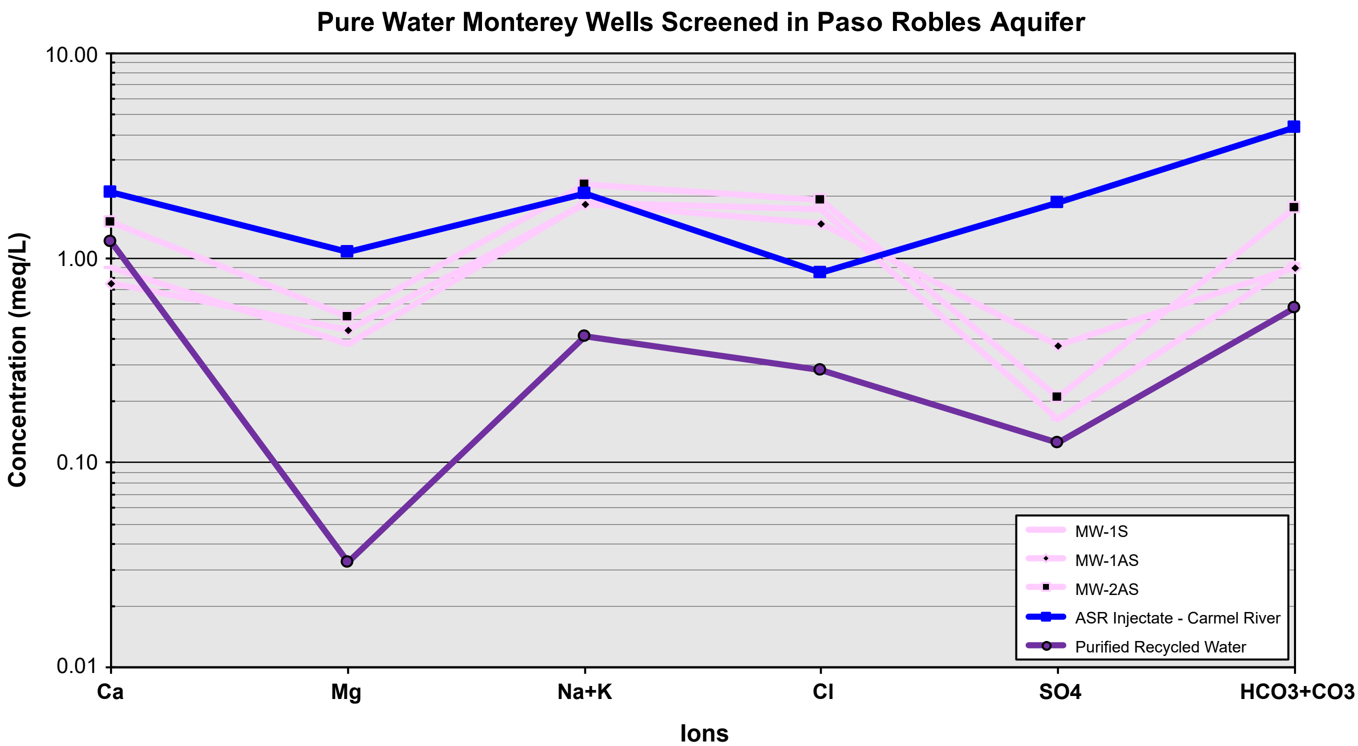


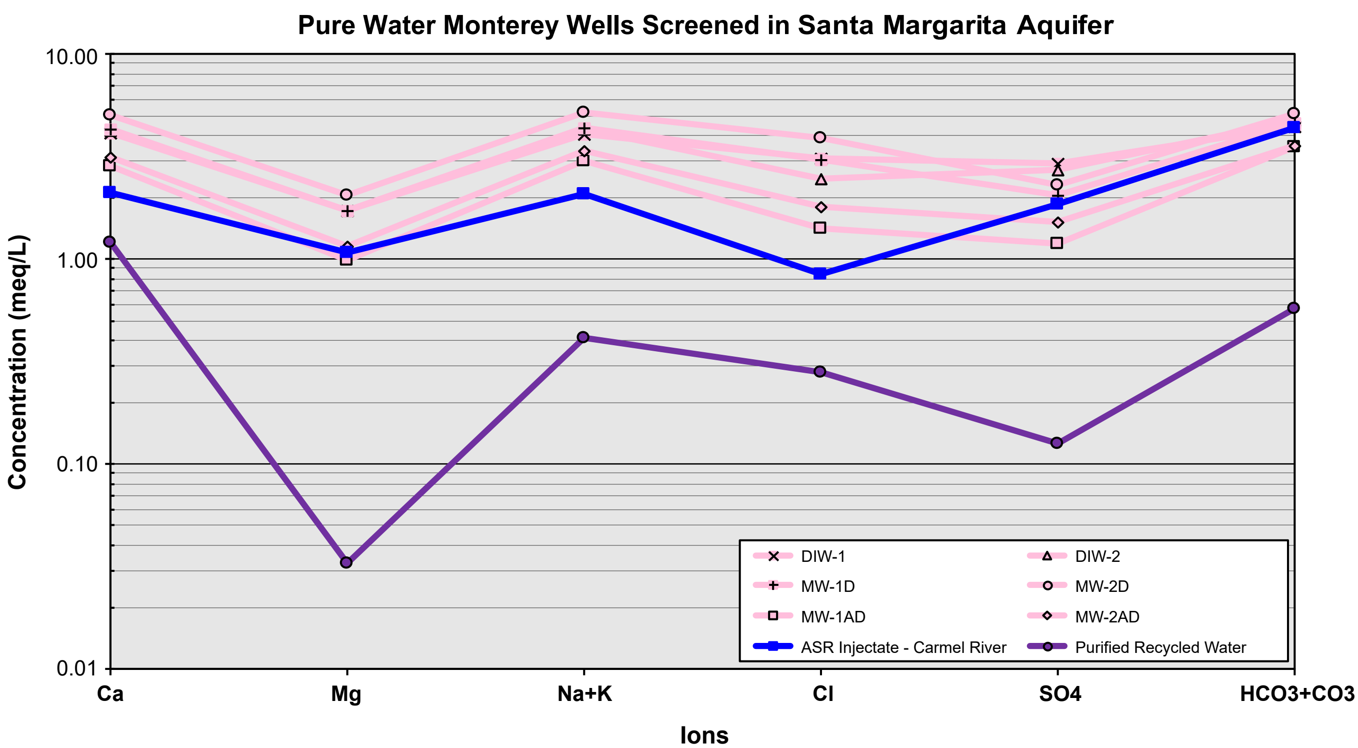


Note:
Water samples collected between
December 2017 and August 2019

TODD GROUNDWATER

Figure 10
Schoeller Diagrams
Seaside Groundwater
Basin Wells





Note:
Water samples collected between
December 2017 and August 2019

TODD GROUNDWATER

Figure 11
Schoeller Diagrams
Pure Water
Monterey Wells

Analyte						Paso Robles Aquifer					Santa Margarita Aquifer									
	Method	Units	Regulatory Requirements		MDL	MW-1S		MW-1AS	MW-2AS		DIW-1	DIW-2	MW-1D		MW-2D		MW-1AD		MW-2AD	
			Type	Level		Median	Range	Median	Median	Range	Median	Median	Median	Range	Median	Range	Median	Range	Median	Range
Major Ions																				
Calcium (Ca)	EPA 200.7	mg/L	-	-	0.2	14.5	13 - 15	15	30	26 - 34	83	85	104	44 - 120	92	85 - 98	75	48 - 75	84	50 - 98
Calcium (Ca) Dissolved	EPA 200.7	mg/L	-	-	0.2	14.0	14 - 15	13	31	26 - 35	88	85	105	44 - 120	93	92 - 94	74	47 - 77	84	52 - 100
Magnesium (Mg)	EPA 200.8	mg/L	CPMCL-EPMCL	-	0.03	4.3	4.1 - 4.3	4.7	6.5	5.8 - 7.2	21	21	24	13 - 28	22	21 - 23	17	10 - 18	20	12 - 23
Magnesium (Mg) Dissolved	EPA 200.8	mg/L	CPMCL-EPMCL	-	0.03	4.2	3.9 - 4.4	4.5	6.4	5.7 - 7.1	22	20	24	12 - 27	23	22-23	17	11 - 18	19	12 - 23
Potassium - Dissolved	EPA 200.7	mg/L	-	-	0.04	2.3	1.9 - 2.4	2.5	2.5	2.1 - 2.9	5.1	4.8	6.0	5.2 - 7.1	6.1	5.9 - 6.2	4.5	3.6 - 5.4	5.0	3.9 - 5.8
Sodium (Na) - Dissolved	EPA 200.7	mg/L	-	-	0.5	40.5	36 - 46	37	54	45 - 62	91	96	110	79 - 130	120	130 - 140	80	60 - 92	93	68 - 110
Bicarbonate (HCO3-)	SM2120B	mg/L	-	-	1	59.5	ND - 62	62	120	100 - 140	270	290	310	210 - 340	315	310 - 320	270	200 - 270	250	190 - 290
Chloride (Cl-)	EPA 300.0	mg/L	CSMCL-ESMCL	250	1	64.0	60 - 68	54	67	62 - 72	140	130	180	57 - 480	145	140 - 150	96	46 - 110	99	53 - 140
Sulfate (SO42-)	EPA 300.0	mg/L	CSMCL/EPMCL	250 / 500	1	7.5	6.5 - 10	21	13	9.4 - 16	110	87	113	50 - 160	99	98 - 100	55	48 - 63	110	74 - 120
Other Anions																				
Bromate (BrO3-)	EPA 317.0	mg/L	CPMCL-EPMCL	0.01	0.001	ND	ND	ND	ND	ND	<0.001	ND	ND	ND	ND	ND	6.7	ND - 6.7	ND	ND
Chlorite (ClO2-)	EPA 300.1	mg/L	CPMCL-EPMCL	1	0.005	ND	ND	ND	ND	ND	<0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride (F-)	EPA 300.0	mg/L	CPMCL/EPMCL	2.0 / 4.0	0.07	0.1	0.089 - 0.11	0.12	0.14	0.13 - 0.15	0.16	0.27	0.30	0.18 - 0.31	0.32	0.31 - 0.32	0.39	0.37 - 0.40	0.26	0.25 - 0.34
Nitrite as N	EPA 300.0	mg/L	CPMCL/EPMCL	1	0.05	ND	ND	ND	ND	ND	<0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate as N	EPA 300.0	mg/L	CPMCL/EPMCL	10	0.04	0.8	0.73 - 0.85	ND	0.83	0.81 - 0.84	0.33	ND	8.59	ND - 17	ND	ND	0.17	0.1-.47	0.10	ND - 0.15
Nitrate +Nitrite as N	Calculation	mg/L	CPMCL/EPMCL	10	0.0086	0.8	0.73 - 0.85	0.038	0.83	0.81 - 0.84	0.33	ND	8.59	ND - 17	0.026	ND - 0.026	0.17	0.1-.47	0.10	ND - 0.15
Total Kjeldahl Nitrogen	SM4500-Norg	mg/L	-	-	0.2	0.2	0.07 - 0.42	ND	ND	ND	0.35	0.35	0.57	0.38 - 0.70	0.49	0.46 - 0.52	0.14	ND - 0.18	0.29	0.12 - 0.35
Total Nitrogen	SM4500-N	mg/L	-	-	0.2	0.9	0.84 - 1.2	ND	0.84	-	0.68	0.35	0.63	0.52 - 18	0.51	0.46 - 0.55	0.28	0.25 - 0.61	0.32	0.27 - 0.35
Metals																				
Aluminum (Al) - Dissolved	EPA 200.8	µg/L	CPMCL/CSMCL	1,000 / 200	5	48.0	ND - 48	ND	ND	ND	<10	ND	7.4	ND - 7.4	ND	ND	ND	ND	ND	ND
Antimony (Sb) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL	6	0.02	0.3	ND - 0.31	ND	ND	ND	0.5	ND	0.34	ND - 0.34	ND	ND	ND	ND	ND	ND
Arsenic (As) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL	10	0.2	1.9	1.5 - 2.5	14	2.7	2.4 - 2.9	0.56	ND	1.5	ND - 1.7	ND	ND	1.7	0.91 - 2.2	0.86	ND - 0.86
Barium (Ba) - Dissolved	EPA 200.8	µg/L	CPMCL/EPMCL	1,000 / 2000	0.05	5.8	4.5 - 13	51	42	39 - 44	58	58	69	49 - 80	79	77 - 80	61	50 - 77	66	41 - 71
Beryllium (Be) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL	4	0.02	ND	ND	ND	ND	ND	<0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron (B) - Dissolved	EPA 200.7	µg/L	NL	1000	0.06	ND	ND	ND	0.082	ND - 0.082	0.12 J	0.21	0.22	0.20 - 90	0.28	0.26 - 0.29	0.10	ND - 0.11	0.14	0.1 - 0.18
Cadmium (Cd) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL	5	0.03	ND	ND	ND	ND	ND	<0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium (Cr) - Dissolved	EPA 200.8	µg/L	CPMCL/CMCL	50 / 100	0.08	4.6	4.2 - 52	ND	4.4	1.7 - 7	0.41	ND	0.47	ND - 0.47	ND	ND	ND	ND	ND	ND
Cr(VI)	EPA 218.6	µg/L	CPMCL	See total Cr	0.2	4.5	4 - 9.8	ND	4.2	1.0 - 7.4	<1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt (Co) - Dissolved	EPA 200.8	µg/L	-	-	0.03	1.3	1.3 - 1.3	ND	ND	ND	0.18	ND	0.56	ND - 1.0	0.13	ND - 0.13	0.45	ND - 0.49	0.19	0.19 - 0.19
Copper (Cu) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL/ CSMCL-ESMCL	1,300 / 1,000	0.4	2.2	2.2 - 2.2	ND	2.5	ND - 2.5	0.98	ND	1.3	ND - 2.1	0.53	ND - 0.53	0.42	ND - 0.42	3.1	0.57 - 5.9
Iron (Fe) - Dissolved	EPA 200.7	µg/L	CSMCL-ESMCL	300	0.02	0.0	ND - 0.046	0.2	ND	ND	<0.1	0.059	ND	ND	ND	ND	0.43	ND - 0.43	0.081	ND - 0.081
Lead (Pb) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL	15	0.06	0.1	ND - 0.09	ND	ND	ND	<0.25	ND	ND	ND	ND	ND	0.27	ND - 0.27	ND	ND
Manganese (Mn) - Dissolved	EPA 200.8	µg/L	CSMCL-ESMCL	50	0.9	21.0	ND - 21	23	11	ND - 11	31	32	53	42 - 64	79	47 - 110	56	50 - 100	47	29 - 52
Mercury (Hg) - Dissolved	EPA 245.1	µg/L	CPMCL-EPMCL	2	0.01	0.0	ND - 0.036	ND	ND	ND	<0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum - Dissolved	EPA 200.8	µg/L	-	-	0.07	1.3	NA - 3.1	3.6	5.4	3.6 - 7.2	16	1.3	5.2	4.5-6.5	3.9	0.8 - 7.0	12	8.8 - 14	7.9	6.7 - 16
Nickel (Ni) - Dissolved	EPA 200.8	µg/L	CPMCL	100	0.3	1.8	0.84 - 1.9	ND	1.2	1.0 - 1.3	<0.5	2.2	1.62	ND - 2.3	1.9	ND - 1.9	2.7	2.0 - 3.3	2.2	2.1 - 2.8
Selenium (Se) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL	50	0.2	0.7	ND - 0.71	ND	2.5	2.0 - 2.9	1.4	ND	1.45	ND - 1.6	0.88	ND - 0.88	2.7	2.0 - 3.4	0.83	ND - 0.83
Silver (Ag) - Dissolved	EPA 200.8	µg/L	CSMCL-ESMCL	100	0.05	0.7	ND - 0.68	ND	ND	ND	<0.1	ND	ND	ND	ND	ND	0.22	ND - 0.22	ND	ND
Thallium (Tl) - Dissolved	EPA 200.8	µg/L	CPMCL-EPMCL	2	0.05	ND	ND	ND	ND	ND	<0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Uranium (U)	EPA 200.8	pCi/L	CPMCL-EPMCL	20 / 30	0.8	0.3	ND - 0.25	1.4	ND	ND	0.82 J	ND	1.1	ND - 1.1	ND	ND	ND	ND	0.35	ND - 0.35
Vanadium (V) - Dissolved	EPA 200.8	µg/L	-	-	0.5	5.2	4.3 - 5.9	3.2	12	7.7 - 16	ND	ND	0.99	ND - 0.99	ND	ND	0.84	ND - 0.84	ND	ND
Zinc (Zn) - Dissolved	EPA 200.8	µg/L	CSMCL-ESMCL	5000	2	48.0	ND - 57	46	120	ND - 120	3.2	8.1	13	ND - 13	15	ND - 15	18	ND - 97	23	ND - 24
Conventional Chemistry Parameters																				
Asbestos by TEM*	EPA 100.2	MFL	CPMCL-EPMCL	7	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Color	SM2120B	Color Units	CSMCL-ESMCL	15	3	5.5	ND - 8	ND	25	ND - 25	6	10	3.0	ND - 3.0	10	ND - 10	3.0	ND - 15	4.0	3 - 5
Bicarbonate Alkalinity as CaCO3	SM2320B	mg/L	-	-	1	49.5	47 - 55	51	102	84 - 120	220	240	260	170 - 280	260	-	220	160 - 220	210	160 - 240
Carbonate Alkalinity as CaCO3	SM2320B	mg/L	-	-	1	ND	ND	ND	ND	ND	<5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hydroxyl Alkalinity as CaCO3	SM2320B	mg/L	-	-	1	ND	ND	ND	ND	ND	<5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity as CaCO3	SM2320B	mg/L	-	-	1	49.5	47 - 55	51	102	84 - 120	220	240	260	170 - 280	260	-	220	160 - 220	210	160 - 240
Hardness, Total	SM2340B	mg/L	-	-	1	54.0	50 - 55	56	101	88 - 114	295	298	353	164 - 420	319	298 - 340	209	0.61 - 259	223	0.35 - 313
MBAS, calculated as LAS, mw 340	SM5540C	mg/L	CSMCL-ESMCL	0.5	0.03	ND	ND	ND	ND	ND	0.032	ND	0.033	ND - 0.033	ND	ND	ND	ND	ND	ND

Analyte	Method	Units	Regulatory Requirements		MDL	Paso Robles Aquifer					Santa Margarita Aquifer									
						MW-1S		MW-1AS	MW-2AS		DIW-1	DIW-2	MW-1D		MW-2D		MW-1AD		MW-2AD	
			Type	Level		Median	Range	Median	Median	Range	Median	Median	Median	Range	Median	Range	Median	Range	Median	Range
Odor	EPA 140.1	T.O.N.	CSMCL-ESMCL	3	-	ND	ND	ND	ND	ND	67	50	32	ND - 67	24	8 - 40	5.0	2.0 - 40	40	ND - 100
Perchlorate (ClO4-)	EPA 314.0	µg/L	CPMCL	6	0.9	5.6	ND - 5.6	ND	ND	ND	<4	ND	ND	ND	ND	ND	1.7	ND - 1.7	ND	ND
pH	FSM4500-H+B	units	ESMCL	6.5-8.5	1.68	7.6	7.55 - 7.72	7.8	7.8	7.7 - 7.9	7.37	7.06	7.3	7.2 - 7.8	7.2	7.0 - 7.3	7.4	7.3 - 7.7	7.1	7.05 - 7.46
Specific Conductance	SM2510B	µmhos/cm	CSMCL	900	1	310.0	310 - 360	310	445	410 - 480	1100	970	1200	650 - 1300	1050	1000 - 1100	815	590 - 880	925	650 - 1100
Total Dissolved Solids (TDS)	SM2540C	mg/L	CSMCL-ESMCL	500	5	195.0	180 - 430	190	280	270 - 290	620	620	760	400 - 870	630	600 - 660	495	350 - 530	615	410 - 680
Turbidity	SM2130B	NTU	CPMCL-EPMCL/	500	0.05	2.3	0.16 - 4.9	0.61	6.9	1.8 - 12	0.58	0.54	0.97	0.5 - 3.9	23	0.60 - 46	0.57	0.29 - 5.0	0.69	0.47 - 1.5
Total Organic Carbon (TOC)	SM5310C	mg/L	-	-	0.2	0.7	0.398 - 4.19	0.37	0.39	ND - 0.39	0.861	0.503	2.105	0.63 - 3.9	2.3	0.69 - 3.9	1.9	0.46 - 4.2	1.4	0.905 - 2.46
Cyanide (CN-)	10-204-00-1X	mg/L	CPMCL/EPMCL	0.15/0.20	0.002	0.0042	ND - 0.0042	ND	ND	ND	<0.3	ND	0.0043	ND - 0.0049	ND	ND	ND	ND	ND	ND
Chlorinated Pesticides and PCBs																				
Aldrin	EPA 508	µg/L	NL	0.002	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.013	ND - 0.013
Chloroneb	EPA 508	µg/L	-	-	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorbenzilate	EPA 508	µg/L	-	-	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorothalonil	EPA 508	µg/L	-	-	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DCPA	EPA 508	µg/L			0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	EPA 508	µg/L	NL	0.002	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	EPA 508	µg/L	CPMCL-EPMCL	2	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HCH-alpha (α-BHC)	EPA 508	µg/L	-	-	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HCH-beta (β-BHC)	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HCH-delta (δ-BHC)	EPA 508	µg/L	-	-	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HCH-gamma (γ-BHC) (Lindane)	EPA 508	µg/L	CPMCL-EPMCL	0.2	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	EPA 508	µg/L	CPMCL/EPMCL	0.01/0.4	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.015	ND - 0.015	ND	ND
Heptachlor epoxide	EPA 508	µg/L	CPMCL/EPMCL	0.01/0.2	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	EPA 508	µg/L	CPMCL-EPMCL	1	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclo-pentadiene	EPA 508	µg/L	-	-	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	EPA 508	µg/L	CPMCL/EPMCL	30/40	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-Permethrin	EPA 508	µg/L	-	-	0.07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-Permethrin	EPA 508	µg/L	-	-	0.09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propachlor	EPA 508	µg/L	NL	90	0.07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.32	ND - 0.32
Trifluralin	EPA 508	µg/L	-	-	0.02	ND	ND	ND	ND	ND	ND	ND	0.056	ND - 0.056	ND	ND	ND	ND	ND	ND
PCB (Aroclor)-1016	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB (Aroclor)-1221	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB (Aroclor)-1232	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB (Aroclor)-1242	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB (Aroclor)-1248	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB (Aroclor)-1254	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB -(Aroclor)1260	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total PCBs	EPA 508	µg/L	CPMCL-EPMCL	0.5	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	EPA 508	µg/L	CPMCL-EPMCL	3	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane (tech)	EPA 508	µg/L	CPMCL/EPMCL	0.1/2	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrogen and Phosphorus Pesticides																				
Alachlor	EPA 507	µg/L	CPMCL-EPMCL	2	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atrazine	EPA 507	µg/L	CPMCL-EPMCL	43103	0..30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromacil	EPA 507	µg/L	-	-	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butachlor	EPA 507	µg/L	-	-	0.4	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	ND	ND	ND	ND
Dimethoate	EPA 507	µg/L	NL	1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metolachlor	EPA 507	µg/L	-	-	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte	Method	Units	Regulatory Requirements		MDL	Paso Robles Aquifer					Santa Margarita Aquifer									
						MW-1S		MW-1AS	MW-2AS		DIW-1	DIW-2	MW-1D		MW-2D		MW-1AD		MW-2AD	
			Type	Level		Median	Range	Median	Median	Range	Median	Median	Median	Range	Median	Range	Median	Range	Median	Range
Metribuzin	EPA 507	µg/L	-	-	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molinate	EPA 507	µg/L	CPMCL	20	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Prometryn	EPA 507	µg/L	-	-	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propachlor	EPA 507	µg/L	NL	90	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simazine	EPA 507	µg/L	CPMCL-EPMCL	4	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thiobencarb	EPA 507	µg/L	CPMCL/CSMCL	70/1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Organic Analytes										-										
1,2-Dibromo-3-chloropropane	EPA 504.1	µg/L	CPMCL-EPMCL	0.2	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dibromoethane (EDB)	EPA 504.1	µg/L	CPMCL-EPMCL	0.05	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorooctanesulfonic acid (PFOS)	EPA 537	µg/L			0.0002	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorooctanoic acid (PFOA)	EPA 537	µg/L			0.00023	ND	ND	ND	0.00028	ND - 0.00028	-	ND	0.0004	ND - 0.0004	ND	ND	0.00081	ND - 0.00081	ND	ND
Chlorinated Acids																				
2,4,5-T	EPA 515.1	µg/L	-	-	70	ND	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (Silvex)	EPA 515.1	µg/L	CPMCL/EPMCL	50	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	EPA 515.1	µg/L	-	-	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DB	EPA 515.1	µg/L	-	-	4	ND	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	EPA 515.1	µg/L	-	-	0.7	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acifluorfen	EPA 515.1	µg/L	-	-	0.5	ND	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND
Bentazon	EPA 515.1	µg/L	CPMCL	18	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dalapon	EPA 515.1	µg/L	CPMCL-EPMCL	200	6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dicamba	EPA 515.1	µg/L	-	-	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorprop	EPA 515.1	µg/L	-	-	1	ND	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND
Dinoseb	EPA 515.1	µg/L	CPMCL-EPMCL	7	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	EPA 515.1	µg/L	CPMCL-EPMCL	1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Picloram	EPA 515.1	µg/L	CPMCL-EPMCL	500	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbamates*																				
3-Hydroxycarbofuran	EPA 531.1	µg/L	-	-	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb	EPA 531.1	µg/L	EPMCL/NL	43160		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb sulfone	EPA 531.1	µg/L	EPMCL	3	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aldicarb sulfoxide	EPA 531.1	µg/L	EPMCL	4	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbaryl	EPA 531.1	µg/L	NL	700	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbofuran	EPA 531.1	µg/L	CPMCL/EPMCL	18/40	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methomyl	EPA 531.1	µg/L	-	-	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oxamyl	EPA 531.1	µg/L	CPMCL/EPMCL	50/200	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Other Organic Compounds																				
Diquat	EPA 549.2	µg/L	CPMCL-EPMCL	20	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endothal	EPA 548.1	µg/L	CPMCL-EPMCL	100	40.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	EPA 547	µg/L	CPMCL-EPMCL	700	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatile Organic Compounds (VOCs)																				
Acetone	EPA 524.2	µg/L	-	-	0.2	7.0	ND - 17	ND	10	ND - 10	<5	ND	8.4	ND - 11	4.3	3.0 - 5.5	10	ND - 14	5.2	ND - 5.2
Acrylonitrile	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	EPA 524.2	µg/L	CPMCL/EPMCL	43105	0.3	ND	ND	ND	ND	ND	<0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromobenzene	EPA 524.2	µg/L	-	-	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromochloromethane	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	EPA 524.2	µg/L	CPMCL-EPMCL	80	0.5	3.4	ND - 3.4	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	5.9	ND - 5.9	2.6	ND - 2.6
Bromoform	EPA 524.2	µg/L	CPMCL-EPMCL	80	0.5	3.1	ND - 3.1	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Butylbenzene	EPA 524.2	µg/L	NL	260	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sec-Butylbenzene	EPA 524.2	µg/L	NL	260	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tert-Butylbenzene	EPA 524.2	µg/L	-	-	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon disulfide	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon tetrachloride	EPA 524.2	µg/L	CPMCL/EPMCL	0.5/5	0.3	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	EPA 524.2	µg/L	CPMCL/EPMCL	70/100	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte	Method	Units	Regulatory Requirements		MDL	Paso Robles Aquifer					Santa Margarita Aquifer									
						MW-1S		MW-1AS	MW-2AS		DIW-1	DIW-2	MW-1D		MW-2D		MW-1AD		MW-2AD	
			Type	Level		Median	Range	Median	Median	Range	Median	Median	Median	Range	Median	Range	Median	Range	Median	Range
Chloroethane	EPA 524.2	µg/L	-	-	0.3	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	EPA 524.2	µg/L	CPMCL-EPMCL	80	0.5	35.0	ND - 35	ND	7.8	1.6 - 14	<0.5	ND	1.0	ND - 1.0	ND	ND	12	ND - 12	4.2	ND - 5.6
Chloromethane	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorotoluene	EPA 524.2	µg/L	NL	140	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorotoluene	EPA 524.2	µg/L	-	-	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	EPA 524.2	µg/L	CPMCL-EPMCL	80	0.5	3.4	ND - 3.4	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	3.5	ND - 3.5	1.4	ND - 1.4
1,2-Dibromo-3-chloropropane	EPA 524.2	µg/L	CPMCL-EPMCL	0.2	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dibromoethane (EDB)	EPA 524.2	µg/L	CPMCL-EPMCL	0.05	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	EPA 524.2	µg/L	CPMCL-EPMCL/ ESMCL	600/100	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	EPA 524.2	µg/L	NL	600	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	EPA 524.2	µg/L	-	-	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,4-Dichloro-2-butene	EPA 524.2	µg/L	-	-	0.3	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	EPA 524.2	µg/L	-	-	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	EPA 524.2	µg/L	CPMCL	5	0.1	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	EPA 524.2	µg/L	CPMCL/EPMCL	0.5/5	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	EPA 524.2	µg/L	CPMCL	5	0.1	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cis-1,2,-Dichloroethene	EPA 524.2	µg/L	CPMCL/EPMCL	25720	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,2-Dichloroethene	EPA 524.2	µg/L	CPMCL/EPMCL	10/100	0.2	ND	ND	ND	ND	ND	<5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	EPA 524.2	µg/L	CPMCL/EPMCL	10/100	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropane	EPA 524.2	µg/L	-	-	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,2-Dichloropropane	EPA 524.2	µg/L	-	-	0.1	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloropropene	EPA 524.2	µg/L	-	-	0.1	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cis-1,3-Dichloropropene	EPA 524.2	µg/L	CPMCL	0.5	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3,Dichloropropene	EPA 524.2	µg/L	-	-	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropene(total)	EPA 524.2	µg/L	-	-	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	EPA 524.2	µg/L	-	-	4	ND	ND	ND	ND	ND	<5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	EPA 524.2	µg/L			0.1	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobuteadiene	EPA 524.2	µg/L	CPMCL	1200	0.3	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isopropylbenzene	EPA 524.2	µg/L	-	-	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Isopropyltoluene	EPA 524.2	µg/L	-	-	0.1	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl ethyl ketone	EPA 524.2	µg/L	-	-	0.6	6.2	ND - 24	ND	2.6	ND - 2.6	<1	ND	ND	ND	1.6	ND - 1.6	ND	ND	ND	ND
Methyl iodide	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl isobutyl ketone	EPA 524.2	µg/L	-	-	0.8	ND	ND	ND	ND	ND	<1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	EPA 524.2	µg/L	CPMCL/EPMCL	5/70	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	EPA 524.2	µg/L	-	-	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Propylbenzene	EPA 524.2	µg/L	-	-	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Styrene	EPA 524.2	µg/L	CPMCL/EPMCL	100/100	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	EPA 524.2	µg/L	CPMCL	1	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	EPA 524.2	µg/L	CPMCL/EPMCL	5/70	0.2	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	EPA 524.2	µg/L	CPMCL/EPMCL	150/1,000	0.3	20.0	ND - 25	4.0	2.0	0.58 - 3.4	<0.5	ND	6.9	ND - 6.9	163	35 - 290	6.3	ND - 14	14	ND - 21
1,2,3-Trichlorobenzene	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	EPA 524.2	µg/L	CPMCL/EPMCL	5/70	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	EPA 524.2	µg/L	CPMCL/EPMCL	200/200	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	EPA 524.2	µg/L	CPMCL/EPMCL	5/70	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene (TCE)	EPA 524.2	µg/L	CPMCL/EPMCL	5/70	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	EPA 524.2	µg/L	CPMCL	150	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorotrifluoroethane	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	EPA 524.2	µg/L	-	-	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	EPA 524.2	µg/L	NL	330	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	EPA 524.2	µg/L	NL	330	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	EPA 524.2	µg/L	CPMCL/EPMCL	0.5/2	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
m,p-Xylene	EPA 524.2	µg/L	CPMCL/EPMCL	1,750/ 10,000	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte	Method	Units	Regulatory Requirements		MDL	Paso Robles Aquifer					Santa Margarita Aquifer									
						MW-1S		MW-1AS	MW-2AS		DIW-1	DIW-2	MW-1D		MW-2D		MW-1AD		MW-2AD	
			Type	Level		Median	Range	Median	Median	Range	Median	Median	Median	Range	Median	Range	Median	Range	Median	Range
o-Xylene	EPA 524.2	µg/L	CPMCL/EPMCL	1,750/10,000	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes (total)	EPA 524.2	µg/L	CPMCL/EPMCL	1,750/10,000	0.5	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trihalomethanes (total)	EPA 524.2	µg/L	-	-	0.3	23.6	ND - 45	ND	7.8	1.6 - 14	<0.5	ND	ND	ND	ND	ND	22	ND	6.2	ND - 9.6
Methyl tert-butyl ether	EPA 524.2	µg/L	CPMCL/CSMCL	13/5	0.5	ND	ND	ND	ND	ND	<3	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl tert-butyl ether	EPA 524.2	µg/L	-	-	0.4	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tert-amyl methyl ether	EPA 524.2	µg/L	-	-	0.3	ND	ND	ND	ND	ND	<0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Semi-Volatile Organic Compounds (SVOCs)																				
Benzo(a)pyrene	EPA 525.2	µg/L	CPMCL/EPMCL	0.2	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di(2-ethylhexyl)adipate	EPA 525.2	µg/L	CPMCL/EPMCL	400/400	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di(2-ethylhexyl)phthalate	EPA 525.2	µg/L	CPMCL/EPMCL	43196	0.2	0.69	0.52 - 2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	ND - 11
2,3,7,8-Tetrachlorodibenzo-p-Dioxin*	EPA 1613	µg/L	CPMCL-EPMCL	0.00003	0.000005	3.11E-06	0.00000177 - 0.00000467	4.09E-06	3.33E-06	2.59E-06 - 4.06E-06	1.94E-06	4.21E-06	4.29E-06	ND - 4.6E-6	3.40E-06	2.73E-6 - 4.1E-6	4.23E-06	3.92E-6 - 4.78E-6	4.10E-06	0.00000361 - 0.00000478
Haloacetic Acids																				
Monobromoacetic Acid	EPA 552.2	µg/L	CPMCL-EPMCL	60	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Monochloroacetic Acid	EPA 552.2	µg/L	CPMCL-EPMCL	60	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromoacetic Acid	EPA 552.2	µg/L	CPMCL-EPMCL	60	0.8	2.0	ND - 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloroacetic Acid	EPA 552.2	µg/L	CPMCL-EPMCL	60	1	18.6	ND - 18.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND - 1.3	ND	ND
Trichloroacetic Acid	EPA 552.2	µg/L	CPMCL-EPMCL	60	1	36.4	ND - 36.4	ND	4.0	ND - 4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Haloacetic Acids (HAA5)	EPA 552.2	µg/L	*	*	57	ND	ND	ND	4.0	ND - 4.0	ND	ND	ND	ND	ND	ND	1.3	ND - 1.3	ND	ND
Nitroaromatics and Nitroamines (Explosives)																				
HMX	8330B	µg/L	-	-	0.1	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RDX	8330B	µg/L	NL	0.3	0.2	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trinitrobenzene	8330B	µg/L	-	-	0.2	0.16	ND - 0.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dinitrobenzene	8330B	µg/L	-	-	0.1	0.049	ND - 0.049	0.12	ND	ND	ND	0.26	ND	ND	ND	ND	ND	ND	ND	ND
3,5-Dinitroaniline	8330B	µg/L	-	-	0.2	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetryl	8330B	µg/L	-	-	0.2	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	8330B	µg/L	-	-	0.1	0.059	ND - 0.059	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Amino-2,6-dinitrotoluene	8330B	µg/L	-	-	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Amino-4,6-dinitrotoluene	8330B	µg/L	-	-	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trinitrotoluene (TNT)	8330B	µg/L	-	-	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	8330B	µg/L	NL	1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	8330B	µg/L	-	-	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrotoluene	8330B	µg/L	-	-	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrotoluene	8330B	µg/L	-	-	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Nitrotoluene	8330B	µg/L	-	-	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitroglycerin	8330B	µg/L	-	-	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentaerythritol Tetranitrate	8330B	µg/L	-	-	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.73	ND - 0.73	ND	ND
Pharmaceutical and Personal Care Products (PPCPs)																				
N-nitrosodiethylamine	EPA 1625M/521	µg/L	NL	0.01	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodimethylamine	EPA 1625M/521	µg/L	NL	0.01	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodi-n-butylamine	EPA 1625M/521	µg/L			0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodimethylethylene	EPA 1625M/521	µg/L			0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosomorpholine	EPA 1625M/521	µg/L			0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosopiperdine	EPA 1625M/521	µg/L			0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopyrrolidine	EPA 1625M/521	µg/L			0.002	0.0011	ND - 0.0011	ND	0.0010	ND - 0.0010	ND	ND	ND	ND	ND	ND	ND	ND	0.0017	ND - 0.002
Acetaminophen	EPA 1694M/ESI+	µg/L			0.02	0.0090	ND - 0.009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Amoxicillin	EPA 1694M=ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atenolol	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	0.0095	ND - 0.0095	ND	ND	ND	ND	ND	ND
Atorvastatin	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	ND	ND	ND	ND
Azithromycin	EPA 1694M-ESI+	µg/L			0.01	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	ND	ND	ND	ND
Bisphenol A	EPA 1694M-ESI–	µg/L			0.001	0.078	ND - 0.078	0.063	0.0380	0.005-.071	ND	ND	ND	ND	ND	ND	0.020	ND - 0.030	0.0042	ND - 0.0073
Caffeine	EPA 1694M-ESI+	µg/L			0.001	ND	ND	0.28	ND	ND	ND	ND	ND	ND	ND	ND	0.015	ND - 0.015	ND	ND
Carbamazepine	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyte	Method	Units	Regulatory Requirements		MDL	Paso Robles Aquifer					Santa Margarita Aquifer									
						MW-1S		MW-1AS	MW-2AS		DIW-1	DIW-2	MW-1D		MW-2D		MW-1AD		MW-2AD	
			Type	Level		Median	Range	Median	Median	Range	Median	Median	Median	Range	Median	Range	Median	Range	Median	Range
Ciprofloxacin	EPA 1694M-ESI+	µg/L			0.005	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	ND	ND	ND	ND
Cotinine	EPA 1694M-ESI+	µg/L			0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DEET	EPA 1694M-ESI+	µg/L			0.001	0.019	ND - 0.019	ND	ND	ND	ND	ND	ND	ND	0.0072	ND - 0.0072	0.0083	ND - 0.010	0.0021	ND - 0.0021
Diazepam	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diclofenac	EPA 1694M-ESI–	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Estrone	EPA 1694M-API	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Estradiol	EPA 1694M-API	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethinyl Estradiol - 17 alpha	EPA 1694M-API	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoxetine	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Gemfibrozil	EPA 1694M-ESI–	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ibuprofen	EPA 1694M-ESI–	µg/L			0.001	12	ND - 12	ND	ND	ND	ND	ND	0.012	ND - 0.012	ND	ND	ND	ND	ND	ND
Iopromide	EPA 1694M-ESI–	µg/L			0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Meprobamate	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methadone	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	ND	ND	ND	ND
Naproxen	EPA 1694M-ESI–	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Oxybenzone	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	ND	ND	ND	ND
Phenyloin (Dilantin)	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Primidone	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Progesterone	EPA 1694M-API	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Salicylic acid	EPA 1694M-ESI–	µg/L			0.05	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sucralose	EPA 1694M-ESI+	µg/L			0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sulfamethoxazole	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCEP	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCPP	EPA 1694M-ESI+	µg/L			0.001-0.002	0.024	ND - 0.024	ND	0.028	0.025 - 0.031	ND	2.50E-02	ND	ND	0.037	ND - 0.037	0.10	ND - 0.18	0.018	ND - 0.021
TDCPP	EPA 1694M-ESI+	µg/L			0.001	ND	ND	ND	0.031	ND - 0.031	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Testosterone	EPA 1694M-API	µg/L			0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triclosan	EPA 1694M-ESI–	µg/L			0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trimethoprim	EPA 1694M-ESI+	µg/L			0.001-0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Radiogenic Compounds																				
Gross Alpha	900	pCi/L	CPMCL-EPMCL	15	1.32/0.994/1.19	0.887 ± 1.04	0.793 - 2.02 ± 0.618 - 1.26	2.08±1.41	3.201 ± 1.30	0.302 - 6.10 ± 1.19 - 1.41	5.06±1.25	10.5±2.61	5.61 ± 1.45	4.12 - 8.13 ± 2.57 - 1.45	5.30 ± 2.47	4.00 - 6.59 ± 1.78 - 3.15	5.27 ± 2.52	2.87 - 8.03 ± 1.46 - 3.31	3.61 ± 1.55	2.12 - 8.85 ± 1.22 - 3.50
Gross Beta	900	pCi/L	CPMCL-EPMCL	50	1.21/0.895/1.75	0.827 ± 1.04	0.554 - 1.66 ± 0.682 - 1.11	1.86±1.21	7.77 ± 1.49	2.54 - 13.0 ± 1.21 - 1.76	4.46±1.35	1.98±1.30	2.98 ± 1.33	2.32 - 3.38 ± 0.945 - 2.04	4.35 ± 1.71	2.77 - 5.93 ± 1.57 - 1.84	3.13 ± 1.43	1.92 - 3.98 ± 1.21 - 1.98	3.48 ± 1.51	1.94 - 6.85 ± 1.20 - 1.68
Radium 226	903	pCi/L	-	3	0.363/0.322/0.342	0.000 ± 0.066	0.000 ± 0.054 - 0.094	0.059±0.086	0.0735 ± 0.132	0.054 - 0.093 ± 0.106 - 0.158	0.440±0.247	0.607±0.242	0.555 ± 0.216	0.439 - 2.72 ± 0.228 - 0.501	0.795 ± 0.266	0.755 - 0.835 ± 0.228 - 0.303	0.426 ± 0.213	0.257 - 0.573 ± 0.16-.222	0.948 ± 0.276	0.399 - 1.71 ± 0.183 - 0.432
Radium 228	Ra-05	pCi/L	-	2	0.383/0.322/0.0506	0.000 ± 0.586	0.000 - 0.075 ± 0.561 - 0.607	0.000±0.571	0.0995 ± 0.760	0.082 - 0.117 ± 0.718 - 0.801	0.071±0.630	0.000±0.496	0.0725 ± 0.566	0.00-.176 ± 0.528 - 0.739	0.000 ± 0.560	0.000 ± 0.523 - 0.596	0.018 ± 0.626	0.00-.194 ± 0.552 - 0.692	0.0645 ± 0.699	0.00-.279 ± 0.544 - 0.770
Combined Radium (Ra226+Ra228)	calculated	pCi/L	CPMCL-EPMCL	5†	-	< 5.0	<5.0	< 5.0	< 5.0	< 5.0	<5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Strontium 90	905	pCi/L	CPMCL-EPMCL	8	0.541/0.682	0.030 ± 0.340	0.000 - 0.300 ± 0.289 - 2.12	0.000±0.225	0.0715 ± 0.264	0.00-.143 ± 0.212 - 0.316	0.392±0.213-0.215	0.249±0.258	0.536 ± 0.616	0.023 - 0.725 ± 0.272 - 0.616	0.620 ± 0.316	0.000 - 1.24 ± 0.193 - 0.438	0.184 ± 0.314	0.00-.808 ± 0.272 - 0.355	0.904 ± 0.294	0.238 - 0.646 ± 0.218 - 0.396
Tritium	906	pCi/L	CPMCL	20000	434	42.2 ± 268	0.000 - 91.3 ± 267 - 272	256±276	86 ± 268	0.000 - 172 ± 267 - 269	168±270	0.000±272	178 ± 270	121 - 223 ± 268 - 280	112 ± 267	57.9 - 167 ± 264 - 270	5.25 ± 267	0.000 - 87.8 ± 265 - 271	155 ± 272.5	0.000 - 249 ± 263 - 274
Uranium	200.8	pCi/L	CPMCL/EPMCL†	20/30‡	0.08	≤ 20	ND - ≤ 20	1.4	ND	-	0.82	ND	≤ 20	ND - ≤ 20	ND	-	ND	-	ND	ND - 0.35
Cation/Anion Balance																				
Total Cation/Total Anion Ratio						1.0	-	ND	ND	-	0.97	-	1.1	-	ND	-	ND	-	ND	-
Percent Balance Error		%				-2.4	-	ND	ND	-	-1.76	-	4.56	-	ND	-	ND	-	ND	-
Additional Analytes (Added for Phase 2)																				
Chlorine, Free	SM4500-C1 F	mg/L			0.1	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorine, Total	SM4500-C1 F	mg/L			0.1	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	ND	ND	ND	ND
Coliforms, Total	SM9223B	MPN/100ml				10.8	ND - 10.8	4.1	15	ND - 15	<1	2.0	9.65	ND - 17.3	5.1	ND - 5.1	7.4	ND - 10	7.9	1 - 62
E. Coli	SM9223B	MPN/100ml				ND	ND	ND	ND	ND	<1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Coliforms, Fecal	SM9223B	MPN/100ml			1.1	1.1	ND - 1.1	ND	ND	ND	<1.1	ND	2.2	ND - 2.2	ND	ND	1.1	ND - 1.1	ND	ND
Biological Oxygen Demand (BOD)	SM5210B	mg/L			2	ND	ND	3.5	ND	ND	-	ND	9.55	ND - 15	15	ND - 15	4.7	ND - 4.8	7.2	ND - 9
Oil and Grease	EPA 1664A	mg/L			1.4	4.1	ND - 4.1	ND	2.6	ND - 2.6	-	8.6	3.95	ND - 5.0	4.1	4 - 4.2	2.1	ND - 2.5	4.3	ND - 6.4

Appendix I

Source Water Availability, Yield and Use Technical Memorandum

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

3 Quail Run Circle, Suite 101
Salinas, CA 93907-2348
831-883-4848
FAX 831-758-6328
asterbenz@swsv.com

MEMORANDUM

TO:	Bob Holden, PE and Alison Imamura, PE Monterey One Water	DATE:	November 1, 2019
CC:	Diana Staines, Denise Duffy & Assoc.		
FROM:	Andrew Sterbenz, PE	JOB #:	MRWP.01.14
SUBJECT:	Proposed Modifications to the Pure Water Monterey Groundwater Replenishment Project –Source Water Availability, Yield, and Use		

The purpose of this memorandum is to summarize the source water availability and yield estimates for proposed modifications to the approved Pure Water Monterey Groundwater Replenishment Project (as modified, the full project is referenced as the Expanded PWM/GWR Project), to explain the seasonal storage yield estimates, and to provide the proposed maximum and typical (or normal) water use estimates for the Proposed Modifications. This memorandum updates the earlier analysis prepared for the approved PWM/GWR Project Final Environmental Impact Report (EIR)[1] and Addendum 3 to the EIR[2]. Our analysis uses the same baseline assumptions as the earlier analysis, updates the projected surface water yields based on the final water right permits, adds demands for the Regional Urban Water Augmentation Project (RUWAP) as described under Addendum 3, and analyzes the effects of expanding the capacity of the approved PWM/GWR Project under the Proposed Modifications.

The approved PWM/GWR Project developed various source water diversions and conveyance facilities for bringing new influent flows to the Monterey One Water (M1W, formerly MRWPCA) Regional Treatment Plant (RTP) where they undergo primary and secondary treatment with the current municipal wastewater flows. After secondary treatment, a portion of the flow will undergo advanced treatment at the PWM Advanced Water Purification Facility (AWPF) before being conveyed for injection in the Seaside Groundwater Basin. Source waters conveyed to the RTP which are not treated by the AWPF for injection into the Seaside Basin will undergo tertiary treatment at the Salinas Valley Reclamation Plant (SVRP) and will be distributed for agricultural land irrigation with the Castroville Seawater Intrusion Project (CSIP).

A number of technical documents were prepared to analyze and confirm available source water supplies for the approved PWM/GWR Project. Source waters for the approved PWM/GWR Project and for the Proposed Modifications are unchanged and include: 1) surface water diversions, 2) agricultural wash water (Salinas industrial wastewater), 3) urban stormwater runoff, and 4) unused secondary-treated effluent from the RTP which would otherwise be discharged to the ocean, as further described below. The source water availability studies that have been used as the basis for estimating yield are cited throughout this report. These reports and studies include:

1. Schaaf & Wheeler, *Reclamation Ditch Yield Study*, March 2015
2. Schaaf & Wheeler, *Blanco Drain Yield Study*, August 2015

[1] Schaaf & Wheeler Memorandum, 9/23/2015
[2] Schaaf & Wheeler Memorandum, 10/23/2017

3. Data on Source Water Estimates provided by Bob Holden, MRWPCA, February 2014
4. Todd Groundwater, *Memorandum: Pure Water Monterey Groundwater Replenishment Project: Impacts of Changes in Percolation at the Salinas Industrial Wastewater Treatment Facility on Groundwater and the Salinas River*, February 2015
5. Schaaf & Wheeler, *Groundwater Replenishment Project, Salinas River Inflow Impacts,* August 2015
6. Schaaf & Wheeler, *Groundwater Replenishment Project, Urban Runoff Capture at Lake El Estero,* April 2014
7. Data from *Monterey County Water Recycling Projects/Salinas Valley Water Project/Salinas River Diversion Facility Update,* MCWRA Board Packet, February 24, 2014

The approved PWM/GWR Project's primary objective is to provide high quality replacement water to allow California American Water Company (CalAm) to extract 3,500 acre-feet per year (AFY) more water from the Seaside Basin for delivery to its customers in the Monterey District service area and reduce Carmel River system water use by an equivalent amount. To achieve this objective, the approved PWM/GWR Project produces purified recycled water using existing primary and secondary treatment processes at the RTP and further treatment at the AWPF currently in construction. After treatment by the AWPF, the purified recycled water will be conveyed to the Seaside Groundwater Basin for subsurface using a series of shallow and deep wells. In the Seaside Groundwater Basin, the treated water mixes with the groundwater present in the aquifers and is stored for future urban use. CalAm will use existing wells and improved potable water supply distribution facilities to extract and distribute the water produced by the approved PWM/GWR Project, enabling CalAm to reduce its diversions from the Carmel River system by this same amount. The approved PWM/GWR Project will also provide up to 600 AFY of purified recycled water to the Marina Coast Water District for urban irrigation, as the recycled water component of the Regional Urban Water Augmentation Project (RUWAP). This use is unchanged under the proposed Expanded PWM Project.

A secondary objective of the approved PWM/GWR Project is to provide additional water to the Regional Treatment Plant that can be recycled at the existing tertiary treatment facility (the SVRP) and used for crop irrigation using the CSIP system. The SVRP produces tertiary-treated, disinfected recycled water for agricultural irrigation within the CSIP service area. Municipal wastewater and certain urban dry weather runoff diversions treated at the RTP are currently the only sources of supply for the SVRP. Municipal wastewater flows have declined in recent years due to aggressive water conservation efforts by the M1W member entities. The new sources of water supply developed for the approved PWM/GWR Project increase supply available at the RTP for use by the SVRP during the peak irrigation season (April to September). In addition, the approved PWM/GWR Project included SVRP modifications to allow tertiary treatment at lower daily production rates, facilitating increased use of recycled water during the late fall, winter and early spring months when demand drops below 5 million gallons per day (MGD).

The Proposed Modifications would increase the PWM/GWR Project replacement supply for CalAm by 2,250 AFY, for a total yield of 5,750 AFY on average. The Proposed Modifications would enable CalAm to meet the State Water Resources Control Board Cease and Desist Order, as amended, and the requirements of the court-ordered adjudication of the Seaside Groundwater Basin. The Proposed Modifications would create this additional purified recycled water by using source waters described below through the existing primary and secondary treatment processes at the RTP and through a modified AWPF. The additional purified recycled water would be conveyed to the Seaside Groundwater Basin for subsurface injection. The additional injected water would be stored for future extraction and delivery by CalAm using new and existing wells; whereas the approved PWM/GWR Project would rely on only existing wells.

Agricultural Wash Water

The City of Salinas owns and operates an industrial wastewater collection and treatment system which serves approximately 25 agricultural processing and related businesses located in the southeast corner of the City. This wastewater collection system is separate from the Salinas municipal sewage collection system. These flows, referred to as agricultural wash water, are conveyed in a network of gravity pipelines to the Salinas Industrial Wastewater Treatment Facility (SIWTF), where they are treated using aeration and disposed of using evaporation and percolation. These flows may be seasonally redirected into the municipal wastewater system for conveyance to the RTP as a source of supply for the approved PWM/GWR Project, including treatment in either the AWPF or the SVRP.

Annual inflows to the SIWTF were analyzed and a projection of year 2017 flows was prepared by the M1W[3], as shown in the first row of Table 1, below. Recorded monthly inflows for calendar years 2007-2013 were tabulated and the annual averaged plotted (see Figure 1). A linear trend line was used to estimate future flows, and the projected annual average of 3.37 mgd in 2017 was used to scale the 2013 monthly inflow values.[4]

The SIWTF consists of an aeration basin, three storage/percolation ponds covering 108 acres, drying beds coving 67 acres and three rapid infiltration basins covering 1.3 acres. To assess the effects of diverting flows treated at the SIWTF, Todd Groundwater[5] estimated the percentages of flows disposed as evaporation, percolation from the main ponds, and disposal through the drying beds and rapid infiltration basins (RIBs). These values are show in Table 1, below, and are used in the estimation of seasonal storage losses discussed later in this memorandum.

Table 1: Agricultural Wash Water Projection (acre-feet)

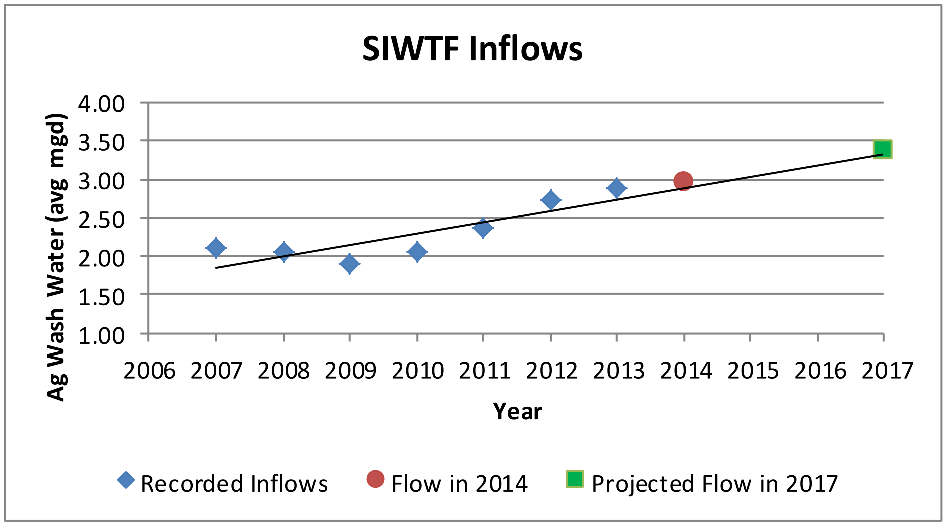
Source \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ag. Wash Water	156	158	201	307	311	391	435	444	367	410	329	223	3,732
Rainfall	26.4	23.7	21.3	11.1	3.0	0.8	0.2	0.4	1.7	5.7	14.2	23.7	132
Evaporation	-12	-16	-29	-41	-46	-52	-45	-43	-32	-28	-15	-12	-372
Percolation from ponds 1, 2, and 3	-143	-129	-143	-138	-143	-138	-143	-143	-138	-143	-138	-143	-1,680
RIBs/Drying Beds	-28	-37	-51	-139	-125	-202	-247	-258	-198	-245	-190	-92	-1,812

[3] Estimation by Bob Holden, MRWPCA, February 2014

[4] The actual rate of increase is slower than projected. SIWTF inflows in 2017 were 2.9 mgd.

[5] Todd Groundwater, *Memorandum: Pure Water Monterey Groundwater Replenishment Project: Impacts of Changes in Percolation at the Salinas Industrial Wastewater Treatment Facility on Groundwater and the Salinas River*, February 2015

Figure 1: Agricultural Wash Water Projection



Urban Stormwater Runoff

The approved PWM/GWR Project EIR included capture and diversion of urban stormwater and dry weather runoff from several watersheds containing urban land uses. Stormwater and urban runoff from the southern portion of the City of Salinas is pumped to the Salinas River (the rest of the City drains into the Reclamation Ditch system). Schaaf & Wheeler[6] estimated the amount of stormwater flow which could be diverted to the municipal wastewater system or the SIWTF for use in the Proposed Modifications. The estimated average annual yield is provided in Table 2, below.

Stormwater and urban runoff from 2,400 acres within the City of Monterey flow to Lake El Estero, which is maintained as part of El Estero Park. Excess stormwater is pumped to a discharge point on Del Monte State Beach. Schaaf & Wheeler[7] estimated the amount of stormwater flow which could be diverted to the municipal wastewater system for use in the PWM Project. The estimated average annual yield is provided in Table 2.

Table 2: Urban Runoff Sources (acre-feet)

Source \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
South Salinas	52	41	34	16	2	0	0	0	2	8	23	47	225
Lake El Estero[8]	24	15	14	5	1	0	0	0	1	4	10	13	87

Surface Water Rights for Stream Flows

The approved PWM/GWR Project includes two surface water diversion sites to provide new source waters for recycling. The first is on the Reclamation Ditch, which has a drainage area of 157 square-miles. The

[6] Schaaf & Wheeler, *Groundwater Replenishment Project, Revised Salinas River Inflow Impacts,* August 2015
[7] Schaaf & Wheeler, *Groundwater Replenishment Project, Urban Runoff Capture at Lake El Estero,* April 2014
[8] A larger drainage basin to the west (including flows from Hartnell Gulch watershed) flows to a box culvert at Figueroa and Pearl Streets. Currently, those flows are redirected to discharge onto Del Monte Beach. This basin is approximately 1.85 square miles and produces an estimated average runoff of 227 acre-feet per year. If this drainage basin were reconnected to flow to the Lake, the average yield would increase to 136 acre-feet per year.

Reclamation Ditch carries seasonal stormwater flows, urban runoff from the City of Salinas and agricultural irrigation return flows. The Reclamation Ditch diversion is located just west of Davis Road, near an existing wastewater conveyance facility. A second diversion point downstream on the Tembladero Slough at Castroville was studied, but a permit for that site was not obtained. The yield from the Reclamation Ditch diversion under the final permit conditions was estimated, based on historic daily flow rates, allowing a maximum 6 cfs diversion rate and leaving an in-stream flow of 2 cfs in the winter, 1.0 cfs in June and 0.7 cfs in the summer and fall, with additional controls to allow fish passage when flows exceed 20 cfs. The estimated monthly yields are shown in Table 3, below.

The second diversion is from the Blanco Drain, just above its confluence with the Salinas River. The Blanco Drain conveys seasonal stormwater flows and agricultural tile drainage from 6,400 acres. Schaaf & Wheeler[9] estimated the yield from this system, assuming a maximum diversion rate of 6 cfs, as shown in Table 3.

Table 3: Surface Water Sources (acre-feet)

Source \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Reclamation Ditch	70	66	70	106	79	99	113	109	72	65	89	76	1,014
Blanco Drain	209	223	246	252	225	274	277	244	184	168	133	185	2,620

Secondary Treated Effluent

Secondary treated municipal wastewater from the RTP is used as influent to the SVRP, which produces recycled water for the CSIP. Average recycled water production for the period 2009-2013 was 12,955 AFY.[10] Average wastewater inflow to the RTP during that period was 21,764 AFY.[11] An average of 8,809 AFY of treated wastewater in excess of what was delivered to the CSIP was discharged to the Monterey Bay through the M1W's ocean outfall. The average monthly inflows and outflows from the RTP are shown in Table 4, below.

Table 4: Average RTP Inflows and Outflows, 2009-2013[12] (acre-feet)

Source/ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
RTP Inflows[13]	1,798	1,678	1,867	1,796	1,850	1,799	1,893	1,888	1,813	1,844	1,762	1,776	21,764
SVRP Deliveries	13	459	726	1,376	1,763	1,750	1,866	1,854	1,698	984	448	18	12,955
Ocean Outfall	1,785	1,219	1,141	420	88	49	27	34	114	859	1,314	1,759	8,809

Additional wastewater originating from domestic use within the M1W facility and the adjacent Monterey Regional Waste Management District (landfill) plus Salinas River Diversion Facility (SRDF) screening backwash flows and Salinas Valley Reclamation Project (SVRP) filter backwash enters the RTP at a point after the headworks meter. A portion of these flows (on-site and landfill domestic flows) are metered at M1W's Recycle Sump #1. The average monthly inflow from this source is shown in Table 5, below. M1W treats metered backwash flows from the SVRP filters and unmetered backwash flows from the SRDF screens when those systems are operating. The SRDF brings water into the RTP site where it is filtered, disinfected, and added to SVRP reclamation storage pond. The reclamation water is distributed though the

[9] Schaaf & Wheeler, *Blanco Drain Yield Study*, August 2015.

[10] This is consistent with the 2018 SVRP production of 12,272 AFY.

[11] This is 9% greater than the latest 3-year average (2016-2018) RTP influent volume of 19,869 AFY.

[12] Data provided by Bob Holden, MRWPCA, February 2014.

[13] Flows measured at the headworks meter (Parshall Flume).

CSIP system to meet irrigation demands. The filter screens are periodically backwashed and that backwash water flows to the RTP headworks after the influent flow meter, so it represents an addition to the RTP flow. The SVRP backwash is process water, so it is not a net inflow or outflow from the RTP in the system flow balance.

Table 5: Average Unmetered RTP Inflows [14] (acre-feet)

Source/ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Recycle Sump #1 (Domestic Wastewater)	14	5	10	9	5	4	5	8	5	5	5	7	82
SRDF Backwash [15]	0	0	0	0	13	49	50	50	22	8	0	0	192

It is conservatively assumed that future CSIP recycled water demands will be consistent with the recycled water use in the baseline time period. This period included one drought year (2013) and that the SRDF operated for only four of the five years (the SRDF was not placed into operation until the year 2010). The SRDF has operated in 8 of the 10 years since its commissioning, validating the earlier assumption that it will operate four out of every five years on a long-term average.

CSIP use of all water sources are shown in Table 6, below. Under current conditions, CSIP supplemental wells are used to maintain pressure in the distribution system and meet peak day demands that exceed the distribution system capacity and available recycled and river water supplies. Supplemental wells also meet small demands below the lower production limit of the SVRP (approximately 5 mgd). The CSIP groundwater use conservatively includes one year when the SRDF did not operate (similar to a multi-year drought condition such as occurred in 2014 and 2015).

Table 6: Average CSIP Use by Source, 2009-2013[16] (acre-feet)

Source/ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CSIP-Wells	448	195	304	412	324	606	519	504	300	75	233	352	4,271
SRDF-River	0	0	0	100	561	819	886	739	266	56	0	0	3,427
SVRP-Recycled	5	483	733	1,383	1,738	1,748	1,843	1,853	1,698	984	452	18	12,939

Note: The SVRP numerical difference between Tables 4 and 6 is due to rounding differences, loss of yield through evaporation from the SVRP storage pond, and inflows at Recycling Sump #1 Meter. SRDF screening backwash has also been available for recycling as discussed previously.

PWM Project and CSIP Demands

[14] Data provided by Bob Holden, M1W, July 2019.

[15] SRDF Backwash during 2018. Because this source of inflow to the plant is intermittent (i.e., occurs in only 8 out of the 10 years of the SRDF project), these flows are not considered as an additional wastewater volume available for recycling in the flow analysis. Flows were estimated using the backwash pump run times and the pump flow rate.

[16] Data from MCWRA *Monterey County Water Recycling Projects/Salinas Valley Water Project/Salinas River Diversion Facility Update*, February 2014

The Proposed Modifications would increase production of the PWM/GWR Project by 2,250 AFY for an average yield of 5,750 AFY of purified recycled water for injection in the Seaside Groundwater Basin to allow CalAm to extract the same amount for treatment and distribution to their customers in their Monterey District service area. To produce that volume, approximately 7,098 AFY of source water inflows are required at the AWPF reverse-osmosis unit (19% of the influent flow is lost as RO concentrate discharge). During wet or normal water years, an additional 200 AFY may be produced and injected in the winter months to develop a drought reserve or to increase the operational reserve. This would require an additional 248 AFY of source water. The monthly distribution of this demand is shown in Table 7, below. For the Proposed Modifications, the average incremental increase in volume needed as inflow to the expanded AWPF is 12 AF/day in the winter months when secondary treated effluent would otherwise be discharged to the ocean, and is about 3.7 AF/day in the peak irrigation months (approximately April 1 through September 30).

Producing 600 AFY for the MCWD RUWAP will require 741 AFY of source water at the AWPF reverse-osmosis unit. Under previous agreements among MCWD, M1W and MCWRA, the source of supply for the RUWAP is municipal wastewater and not the additional sources developed under the approved PWM/GWR Project.

Source flows not required for the approved PWM/GWR Project would be made available to create additional recycled water for the CSIP. Table 7, Line 5 includes an estimate of new source water flows available in excess of the AWPF inflow needs during the months of April through September when the SVRP typically runs at its maximum production. These values assumes seasonal storage of agricultural wash water (discussed below), full diversion of surface water, and AWPF demands for a normal year building a drought reserve.

The CSIP system distributes recycled water, Salinas River water and well water from the Salinas Valley Groundwater Basin to agricultural irrigation demands in the northern Salinas Valley. Under existing conditions, well water is used to meet peak summer demands in excess of the supply available from the other sources, and also to meet low demands below the minimum production capacity of the SVRP (currently 5 MGD). As part of the approved PWM/GWR Project, the SVRP would be modified to meet recycled water demands as low as 0.5 MGD. With this modification the MCWRA could reduce the use of the CSIP wells, particularly in the winter months when secondary treated effluent is available. The average CSIP well use for the period 2009-2013[17] is shown in Table 7. This provides a reasonable estimate of how much additional recycled water could be used by the existing CSIP system in average year conditions.

[17] Data from *Monterey County Water Recycling Projects/Salinas Valley Water Project/Salinas River Diversion Facility Update,* MCWRA Board Packet, February 24, 2014

Table 7: Monthly PWM and CSIP Use of New Supplies (acre-feet) [18]

Use \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
PWM (Base) Project Demand	367	331	367	355	367	355	367	367	355	367	355	367	4,320
Drought Reserve	42	38	42							42	41	42	248
RUWAP	28	19	33	70	108	110	113	94	85	51	21	9	741
Proposed Modifications to PWM/GWR Project (added) Demands	362	333	357	114	106	101	105	111	109	340	357	382	2,778
Excess New Source Waters for SVRP (Apr-Sept, only)[19]	-	-	-	249	245	480	353	319	162	-	-	-	1,808
CSIP (Average Well Usage)	448	195	304	412	324	606	519	504	300	75	233	352	4,272

Seasonal Storage at the SIWTF

To maximize the available supply during the peak irrigation months, the main ponds at the SIWTF will be used for seasonal storage of agricultural wash water and Salinas' urban stormwater. The analysis of source water yield and proposed diversions assumes that during the months of October through March, these flows are directed to the SIWTF. In addition, for the source water assumptions, the use of the drying beds and infiltration basins are discontinued, so the only losses are evaporation and percolation from the main ponds. During the months of April through September, industrial wastewater may be directly diverted into the municipal wastewater collection system, or may be routed through the SIWTF ponds and then pumped into the Salinas Interceptor and thence to the RTP. Winter flows collected in the SIWTF ponds (comprised of stormwater and treated industrial wastewater) will also be diverted to the Salinas Interceptor for recycling and injection into the Seaside Basin and tertiary treatment for CSIP during peak irrigation months (typically April through September).

Results of Source Water Availability Analysis

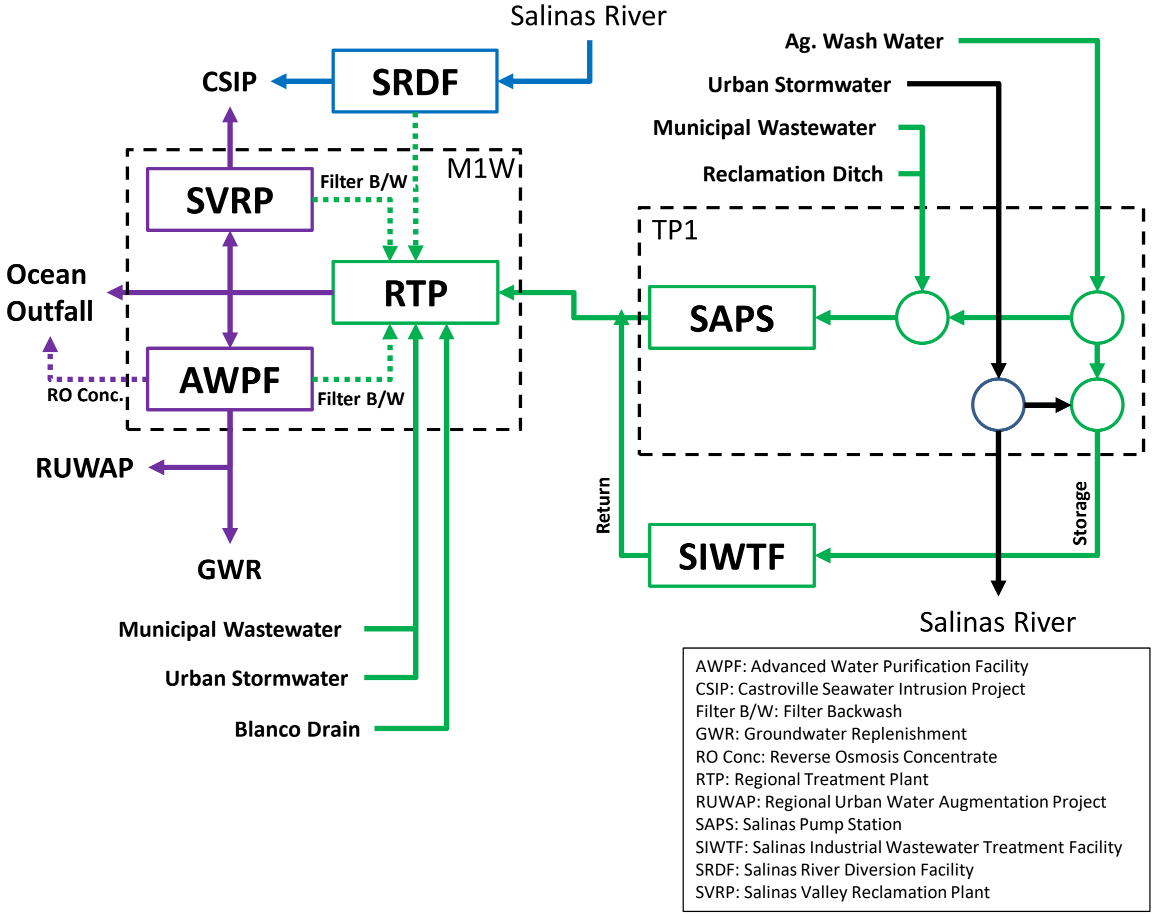
The Source Water Availability Analysis uses a net flow balance methodology and average monthly flows to evaluate the project yields under the scenarios described below. The net flows are assessed as they enter and exit the M1W RTP property (see Figure 2, below). New flows from SRDF (namely, screening backwash waters), and domestic wastewater generated on-site and at adjacent sites can be assumed as additive influent flows in the flow balance. Internal recycling of flows from all treatment processes (SVRP filter backwashing, mixed liquor suspended solids, RSSL) to the RTP headworks occur but are ignored, as they do not affect the net inflows or outflows on an average monthly basis. Similarly, minor evaporative losses and hauled liquid waste inflows are ignored. Deliveries from the AWPF or from the SVRP to CSIP are considered beneficial uses flowing out of the RTP site, and discharges to the Ocean Outfall as secondary treated effluent or as RO concentrate/reject water are considered losses. Water rights are covered by another memo which considers internal flow and not just the net flow balance as considered here.[20]

[18] This is the net RTP influent needed to produce 3,500 AFY. Process backwash flows which are recycled to the headworks are assumed to be recaptured with no net loss.

[19] Excess new source water supplies April through September are calculated as the total of new source water (not including secondary treated effluent) minus the AWPF demand. In October through March, new source waters are not typically needed, but could provide additional flows to meet all SVRP demands, including with SVRP "winter" modifications.

[20] Perkins Coie, *Memorandum RE: Water Rights Analysis for Proposed Modifications to the Pure Water Monterey Groundwater Replenishment Project*, September 27, 2019.

Figure 2: Project Inflows and Outflows



In the attached Table 8: Source Water Analysis, the existing inflows to the RTP headworks prior to the influent flow meter are entered in the top line under "Sources." Local sources of wastewater that bypass the headworks meter are entered separately, immediately below that. New Source Waters, starting with those originating from the City of Salinas infrastructure, are then listed. The monthly storage balance in the SIWTF ponds is calculated for a normal water year. The inflow, rainfall, evaporation and percolation from Table 1 are shown in rows 1, 3, 4 and 5, respectively. Urban Runoff from South Salinas is carried from Table 2 into line 2. Assuming the ponds are empty at the start of October, they would remain fully or partially wet for nine months per year.[21] The net yield of agricultural wash water and Salinas stormwater for the PWM Project is shown on line 8. Other source flows from Tables 2 and 3 are shown on lines 9 through 12, and the net new supply is shown on line 13. Under the Demands heading are included the average SVRP deliveries to the CSIP and the average groundwater use by the CSIP, as well as the AWPF feed-water demands. Line 21 shows the projected net supply to the CSIP (sum of existing and augmented flows), and Line 26 shows the supply for the PWM/GWR Project, after Proposed Modifications are operational, while developing a drought reserve. Assuming the agencies divert all of the water shown on this table (i.e., under an assumption that the PWM/GWR Project with modifications would divert the maximum available source waters), there would still be approximately 3,500 AFY of secondary-treated municipal wastewater discharged through the ocean outfall (line 28) during normal rainfall years.

[21] Full diversion of flows was analyzed in the report: *Groundwater Replenishment Project, Salinas River Inflow Impacts*, and the wastewater change petition (WW0089) issued by the State Water Resources Control Board on November 30, 2015 allows all Salinas industrial wastewater to be diverted to the RTP.

Diversion and Use Scenarios

The M1W has a goal of maximizing recycling and reuse of the secondary treated municipal effluent at the RTP and operating the system as efficiently as possible to reduce the energy demand. Therefore, rather than divert all waters as described in the last section and in Table 8, the Proposed Modifications would prioritize the use of secondary treated effluent above the diversion of surface water sources, to the extent possible, which would minimize adverse environmental impacts and maximize system efficiency. The proposed priority of source usage would be:

1. Secondary treated effluent not used at the SVRP
2. Salinas storm water
3. Reclamation Ditch
4. Blanco Drain
5. Agricultural wash water [22]
6. Lake El Estero (if available)

The analysis assumes that the Monterey County Water Resources Agency has funded capital and operational, maintenance, and repair/replacement costs of the projects and facilities needed to divert, convey to the RTP, and treat the new source waters listed in lines 1 through 12 of the attached tables. In the attached scenario tables (Tables 9 through 11), the use of the various sources is reduced to just meet the demands of the AWPF and offset the current CSIP groundwater use in the wet season (October-March). During the dry season (April-September), surface water diversions are shown meeting the monthly AWPF demands and providing extra flow for the CSIP, such that the annual use of new sources exceeds the annual AWPF demands. In practice, the surface water diversions could be reduced or increased based on the actual CSIP system demands, up to the total yields shown in Table 7. The demand scenarios considered are:

Table 9: A normal water year while developing a drought reserve (AWPF producing 6,550 AFY)
Table 10: A normal water year with a full drought reserve (AWPF producing 6,350 AFY)
Table 11: A drought year starting with a full reserve (AWPF producing 5,550 AFY)

In the drought year scenario, the stormwater and wastewater availability were reduced. Urban runoff from Salinas was assumed to be one-third of the historic average. Rainfall on the SIWTF ponds used the 2013 rainfall record (critically dry year). The unused secondary treated effluent values from 2013 were used, also the historic low. The CSIP groundwater well use from OCT 2013 to SEP 2014 was used as the CSIP augmentation target. Under this scenario, surface water diversions were required from the Reclamation Ditch, Blanco Drain and Lake El Estero, and the diversions were needed from March through November.

Reduced Benefit to CSIP

The additional flows available to CSIP under the PWM/GWR Project with Proposed Modifications are summarized in Table 12 and explained herein. New sources of supply developed in excess of the AWPF demands will be available for treatment at the SVRP and delivery to CSIP. During drought years, the PWM/GWR Project production may be reduced by the volume of drought reserve supply previously produced and stored in the Seaside Groundwater Basin, leaving more source water available for the SVRP. In the original PWM/GWR Project EIR, the estimated amount of additional water available to CSIP was 5,460 AFY in a normal year, and 5,728 AFY in a drought year. In the analysis for EIR Addendum 3, the estimated additional water available to CSIP was revised down to 4,970 in a normal year and 5,150 AFY in a drought year as a result of reductions needed to supply the RUWAP with municipal wastewater per

[22] For this analysis, the agricultural wash water is assumed to be used only after all other sources are diverted to the RTP and there remains unmet demands for secondary effluent for recycling.

contractual agreements between M1W, MCWRA and MCWD. Adjusting for the final surface water rights, the additional water for CSIP became 4,250 AFY in a normal year and 2,870 AFY in a drought year. The Tembladero Slough diversion was removed during the permitting process, and the yield of the Reclamation Ditch diversion declined by 270 AFY due to the final water right permit conditions. Adding the Proposed Modifications, the estimated additional water for CSIP becomes 3,600 AFY in a normal year and 2,858 AFY in a drought year. The drought year change occurs in the winter months, when the expanded AWPF is still projected to operate at full capacity. The model assumes that once the CSIP historic demand is met, no additional flow is needed in the winter months, so no surface water diversions are projected during the months of December through February. An estimated additional 880 AFY of surface water is available during those months, if there is a CSIP demand for it.

Table 12: Estimated Additional Supply to CSIP under Differing Scenarios[23]

	Normal Year	Drought Year
PWM/GWR Project Final EIR	5,460 AFY	5,728 AFY
PWM/GWR Project EIR Addendum 3	4,970 AFY	5,150 AFY
Water Right Adjustments	4,250 AFY	2,870 AFY
PWM/GWR Project with Proposed Modifications	3,600 AFY	2,858 AFY

[23] Assumes MCWRA participates in funding capital, operation, maintenance/repair, and replacement costs of new source water facilities, SVRP modifications are completed, and drought-reserve is available.

References:

City of Salinas, Industrial Wastewater Treatment Facility, 2013 Annual Report, January 2014

Monterey County Water Resources Agency, *Monterey County Water Recycling Projects/Salinas Valley Water Project/Salinas River Diversion Facility Update*, MCWRA Board Packet, February 24, 2014

Monterey County Water Resources Agency, *Salinas Valley Water Project, Annual Flow Monitoring Reports for Water Years 2010 – 2013.*

Monterey County Water Resources Agency, *Amended and Restated Water Recycling Agreement Between Monterey Regional Water Pollution Control Agency and Monterey County Water Resources Agency*, November 3, 2015

Monterey Peninsula Water Management District, *Industrial Ponds Percolation and Evaporation Technical Memorandum 2015-01*, July 2015.

Schaaf & Wheeler, *Groundwater Replenishment Project, Urban Runoff Capture at Lake El Estero*, April 2014

Schaaf & Wheeler, *Blanco Drain Yield Study*, August 2015

Schaaf & Wheeler, *Groundwater Replenishment Project, Salinas River Inflow Impacts*, August 2015

Schaaf & Wheeler, *Reclamation Ditch Yield Study*, March 2015

Schaaf & Wheeler, *Memorandum: Pure Water Monterey Groundwater Replenishment Project – Proposed Source Water Availability, Yield, and Use*, September 23, 2015

Schaaf & Wheeler, *Memorandum: 600 AFY RUWAP Recycled Water Urban Irrigation Use and Implications for CSIP Yields*, October 23, 2017

State Water Resources Control Board, Division of Water Rights, *Order Issuing Water Rights for Applications A32263A and A32263B*, March 17, 2017.

Todd Groundwater, *Memorandum: Pure Water Monterey Groundwater Replenishment Project: Impacts of Changes in Percolation at the Salinas Industrial Wastewater Treatment Facility on Groundwater and the Salinas River*, February 2015

Table 8: Source Water Analysis for the Pure Water Monterey Groundwater Replenishment Project

Full Surface Water Yields, Normal Water Year, Building a Drought Reserve

All facilities built [1] - average water year conditions - all flows in acre-feet **10/14/2019**

		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
	SOURCES													
	Existing RTP Inflows (Average 2009 to 2013)	**1,798**	**1,678**	**1,867**	**1,796**	**1,850**	**1,799**	**1,893**	**1,888**	**1,813**	**1,844**	**1,762**	**1,776**	**21,764**
	Existing domestic flows to RTP (wells at RTP and MRWMD)	**14**	**5**	**10**	**9**	**5**	**4**	**5**	**8**	**5**	**5**	**5**	**7**	**82**
	New Source Water													
	City of Salinas													
1	Salinas Agricultural Wash Water [2]	156	158	201	307	311	391	435	444	367	410	329	223	3,732
	Agricultural Wash Water (AWW) to Ponds [3]	*156*	*158*	*201*	*0*	*0*	*0*	*0*	*0*	*0*	*410*	*329*	*223*	*1,477*
	AWW directly to RTP	*0*	*0*	*0*	*307*	*311*	*391*	*435*	*444*	*367*	*0*	*0*	*0*	*2,255*
2	Salinas Urban Storm Water Runoff [4]	52	41	34	16	2	0	0	0	2	8	23	47	225
	Urban runoff to ponds	*52*	*41*	*34*	*0*	*0*	*0*	*0*	*0*	*0*	*8*	*23*	*47*	*205*
	Urban runoff to RTP	*0*	*0*	*0*	*16*	*2*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*20*
3	Rainfall (on SIWTF, 121 acre pond area) [5]	26	24	21	11	3	1	0	0	2	6	14	24	132
4	Evaporation (from SIWTF, 121 acre pond area) [6]	(12)	(16)	(29)	(41)	(46)	(52)				(28)	(15)	(12)	(251)
5	Percolation [7]	(143)	(129)	(143)	(138)	(143)	(138)				(143)	(138)	(143)	(1,257)
6	SIWTF pond storage balance [8]	684	763	847	647	362	0	0	0	0	253	466	605	
7	Recovery of flow from SIWTF storage ponds to RTP	0	0	0	32	100	172	0	0	0	0	0	0	304
8	AWW and Salinas Runoff to RTP	0	0	0	355	413	563	435	444	369	0	0	0	2,579
	Water Rights Applications to SWRCB													
9	Blanco Drain [9]	209	223	246	252	225	274	277	244	184	168	133	185	2,620
10	Reclamation Ditch at Davis Road [10]	70	66	70	106	79	99	113	109	72	65	89	76	1,014
11	Tembladero Slough at Castroville [11]	0	0	0	0	0	0	0	0	0	0	0	0	0
12	City of Monterey - Diversion at Lake El Estero	24	15	14	5	1	0	0	0	1	4	10	13	87
13	**Subtotal New Waters Available**	**303**	**304**	**330**	**718**	**718**	**936**	**825**	**797**	**626**	**237**	**232**	**274**	**6,299**
	Total Projected Water Supply	**2,115**	**1,987**	**2,207**	**2,523**	**2,574**	**2,739**	**2,723**	**2,692**	**2,443**	**2,085**	**1,999**	**2,057**	**28,145**
	DEMANDS	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
	Average SVRP deliveries to CSIP (2009-2013)	13	459	726	1,376	1,763	1,750	1,866	1,854	1,698	984	448	18	12,955
14	FIVE YEAR AVERAGE CSIP AREA WELL WATER USE (2009-2013)	448	195	304	412	324	606	519	504	300	75	233	352	4,272
	TOTAL CSIP Demand (excludes SRDF use)	**461**	**654**	**1,030**	**1,788**	**2,087**	**2,356**	**2,385**	**2,358**	**1,998**	**1,059**	**681**	**370**	**17,227**
15	FEEDWATER AMOUNT AT RTP TO PWM BASE PROJECT AWPF	367	331	367	355	367	355	367	367	355	367	355	367	4,320
16	FEEDWATER TO ESTABLISH CSIP AREA DROUGHT RESERVE (200 AFY AWTF PRODUCT WATER) [14]	42	38	42							42	41	42	248
	FEEDWATER FOR 2250 AFY EXPANSION	362	333	357	114	106	101	105	111	109	340	357	382	2,778
17	FEEDWATER TO AWPF FOR MCWD RUWAP[18]	28	19	33	70	108	110	113	94	85	51	21	9	741
18	**TOTAL TO GWR ADVANCED WATER TREATMENT FACILITY**	**799**	**721**	**800**	**539**	**581**	**566**	**585**	**572**	**549**	**800**	**773**	**800**	**8,087**
	Total Projected Water Demand	**1,260**	**1,376**	**1,829**	**2,328**	**2,668**	**2,922**	**2,971**	**2,929**	**2,547**	**1,860**	**1,455**	**1,169**	**25,314**
	Use of Source Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
19	Secondary effluent to SVRP for CSIP [12]	461	654	1,030	1,735	1,747	1,693	1,785	1,802	1,733	1,059	681	370	14,750
20	New sources available to CSIP [13]	0	0	0	249	245	480	353	319	162	0	0	0	1,808
21	**Total Supply to CSIP**	**461**	**654**	**1,030**	**1,984**	**1,993**	**2,173**	**2,138**	**2,121**	**1,894**	**1,059**	**681**	**370**	**16,558**
	Net CSIP Increase													**3,603**
22	Surface waters at RTP to AWPF	303	304	330	114	106	101	105	111	109	237	232	274	2,325
23	Secondary effluent to AWPF	468	398	437	0	0	0	0	0	0	513	520	517	2,854
24	AWW and Salinas urban runoff to AWPF	0	0	0	355	367	355	367	367	355	0	0	0	2,166
25	Secondary effluent to AWPF for MCWD RUWAP	28	19	33	70	108	110	113	94	85	51	21	9	741
26	**Feedwater to AWPF**	**799**	**721**	**800**	**539**	**581**	**566**	**585**	**572**	**549**	**800**	**773**	**800**	**8,086**
	Subtotal- all waters (including secondary effluent)	**1,260**	**1,376**	**1,829**	**2,523**	**2,574**	**2,739**	**2,723**	**2,692**	**2,443**	**1,860**	**1,455**	**1,169**	**24,644**
27	FIVE YEAR AVERAGE WASTE WATER EFFLUENT TO OCEAN OUTFALL (2009-2013)[15]	1,785	1,219	1,141	420	88	49	27	34	114	859	1,314	1,759	8,809
28	WASTE WATER EFFLUENT TO OCEAN OUTFALL WITH PROPOSED DIVERSIONS TO CSIP/AWT/RUWAP [16]	854	611	377	0	0	0	0	0	0	226	545	887	3,501
29	NEW SUPPLIES IN EXCESS OF AWT DEMANDS FOR GWR [17]	(468)	(398)	(437)	249	245	480	353	319	162	(513)	(520)	(517)	(1,046)
30	AWT BRINE TO OCEAN OUTFALL	152	137	152	102	110	108	111	109	104	152	147	152	1,536

Notes

1 Presumes all facilities associated with diversions are completed, including SVRP modifications.

2 Table 2-1, p. 5, Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler Consulting Engineers, August 2015.

3 Volume of effluent from City of Salinas agricultural wash water to be directed into ponds 1,2,3, and the aeration pond for storage.

4 Average monthly flow from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015.

5 Rainfall from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015. Pond area presumed to be Ponds 1,2, 3 + Aeration lagoon. No rainfall/evaporation or storage assigned to drying beds.

6 Table 3, Todd Groundwater, Memorandum, Pure Water Monterey Groundwater Replenishment Project: Impacts of Changes in Percolation at the Salinas Industrial Wastewater Treatment Facility on Groundwater and the Salinas River, February 11, 2015.

7 Table 4, Ibid.

8 Ponds 1,2,3 and aeration basin hold up to 1,065 acre-feet (one foot of freeboard). If flow to ponds would exceed the maximum volume, it is presumed that excess flow can be diverted to the RIBs or drying beds or flow can be diverted to the RTP. Presume that pond storage goes to zero sometime during the year (shown here starting in July).

9 Water right application 32263A. Max diversion = 6 cfs diversion. If SRDF is not operating (drought year), 2 cfs is bypassed to the Salians River. See final water right permit 21376

10 Water right applciation 32263B. Max. diversion = 6 cfs. See final water right permit 21377. Assumes 2 cfs instream bypass requirement Dec-May, 1 cfs bypass in June and 0.7 cfs instream bypass requirement for July-Nov. Also assumes diversion stopped when flows reach 30 cfs (migration window) and restart when flow declines to 20 cfs. See final water right permit 21377

11 Water right application 32263C. Max. diversion = 3 cfs. Removed from project portfolio during water rights process. See RECLAMATION DITCH YIELD STUDY, Schaaf and Wheeler, March 2015.

12 Includes secondary effluent wastewater currently used to produce recycled water at the Salinas Valley Reclamation Project (SVRP), and additional amounts which may be used during periods of low demand (<5 mgd) with the proposed improvements to the SVRP.

13 New source waters not used by AWPF will be available to SVRP for CSIP.

14 A drought reserve of up to 1,000 AF would be created over five years by producing 200 AFY additional product water from the GWR Project AWTF during winter months and storing the water in the Seaside Basin. This would establish a "water bank" that the CSIP can draw on in droughts. The drought reserve would allow flow at the RTP for the GWR Project to be temporarily reduced during critically dry periods, thus freeing up more of the newly available inflows to the RTP to be sent to the CSIP area. Extraction from the Seaside Basin would continue at the average rate to supply the Monterey Peninsula.

15 Average monthly RTP discharge, 2009-2013 (reported by M1W).

16 Secondary treated municipal effluent not used for SVRP or the AWPF.

17 Excess is calculated as Line 13 minus Lines 15 & 16

18 RUWAP supply comes from existing RTP inflows of municipal wastewater. Demands reflect existing urban irrigation customers along trunk main.

Table 9: Source Water Analysis for the Pure Water Monterey Groundwater Replenishment Project

Diversion Pattern for a Normal Water Year, Building a Drought Reserve

All facilities built [1] - average water year conditions - all flows in acre-feet **10/14/2019**

SOURCES	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Existing RTP Inflows (Average 2009 to 2013)	**1,798**	**1,678**	**1,867**	**1,796**	**1,850**	**1,799**	**1,893**	**1,888**	**1,813**	**1,844**	**1,762**	**1,776**	**21,764**
Existing domestic flows to RTP (wells at RTP and MRWMD)	**14**	**5**	**10**	**9**	**5**	**4**	**5**	**8**	**5**	**5**	**5**	**7**	**82**
New Source Water													
City of Salinas													
1 Salinas Agricultural Wash Water [2]	156	158	201	307	311	391	435	444	367	410	329	223	3,732
Agricultural Wash Water (AWW) to Ponds [3]	*156*	*158*	*201*	*0*	*0*	*0*	*0*	*0*	*0*	*410*	*329*	*223*	*1,477*
AWW directly to RTP	*0*	*0*	*0*	*307*	*311*	*391*	*435*	*444*	*367*	*0*	*0*	*0*	*2,255*
2 Salinas Urban Storm Water Runoff [4]	52	41	34	16	2	0	0	0	2	8	23	47	225
Urban runoff to ponds	*52*	*41*	*34*	*0*	*0*	*0*	*0*	*0*	*0*	*8*	*23*	*47*	*205*
Urban runoff to RTP	*0*	*0*	*0*	*16*	*2*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*20*
3 Rainfall (on SIWTF, 121 acre pond area) [5]	26	24	21	11	3	1	0	0	2	6	14	24	132
4 Evaporation (from SIWTF, 121 acre pond area) [6]	(12)	(16)	(29)	(41)	(46)	(52)				(28)	(15)	(12)	(251)
5 Percolation [7]	(143)	(129)	(143)	(138)	(143)	(138)				(143)	(138)	(143)	(1,257)
6 SIWTF pond storage balance [8]	684	763	847	647	362	0	0	0	0	253	466	605	
7 Recovery of flow from SIWTF storage ponds to RTP	0	0	0	32	100	172	0	0	0	0	0	0	304
8 AWW and Salinas Runoff to RTP	0	0	0	355	413	563	435	444	369	0	0	0	2,579
Water Rights Applications to SWRCB													
9 Blanco Drain [9]	0	0	0	252	225	274	277	244	184	0	0	0	1,456
10 Reclamation Ditch at Davis Road [10]	0	0	0	106	79	99	113	109	72	11	0	0	589
11 Tembladero Slough at Castroville [11]	0	0	0	0	0	0	0	0	0	0	0	0	0
12 City of Monterey - Diversion at Lake El Estero	0	0	0	5	1	0	0	0	1	0	0	0	7
13 **Subtotal New Waters Available**	**0**	**0**	**0**	**718**	**718**	**936**	**825**	**797**	**626**	**11**	**0**	**0**	**4,631**
Total Projected Water Supply	**1,812**	**1,683**	**1,877**	**2,523**	**2,574**	**2,739**	**2,723**	**2,692**	**2,443**	**1,860**	**1,767**	**1,783**	**26,477**

DEMANDS	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Average SVRP deliveries to CSIP (2009-2013)	13	459	726	1,376	1,763	1,750	1,866	1,854	1,698	984	448	18	12,955
14 FIVE YEAR AVERAGE CSIP AREA WELL WATER USE (2009-2013)	448	195	304	412	324	606	519	504	300	75	233	352	4,272
TOTAL CSIP Demand (excludes SRDF use)	**461**	**654**	**1,030**	**1,788**	**2,087**	**2,356**	**2,385**	**2,358**	**1,998**	**1,059**	**681**	**370**	**17,227**
15 FEEDWATER AMOUNT AT RTP TO PWM BASE PROJECT AWPF	367	331	367	355	367	355	367	367	355	367	355	367	4,320
16 FEEDWATER TO ESTABLISH CSIP AREA DROUGHT RESERVE (200 AFY AWTF PRODUCT WATER) [14]	42	38	42							42	41	42	248
FEEDWATER FOR 2250 AFY EXPANSION	362	333	357	114	106	101	105	111	109	340	357	382	2,778
17 FEEDWATER TO AWPF FOR MCWD RUWAP[18]	28	19	33	70	108	110	113	94	85	51	21	9	741
18 **TOTAL TO GWR ADVANCED WATER TREATMENT FACILITY**	**799**	**721**	**800**	**539**	**581**	**566**	**585**	**572**	**549**	**800**	**773**	**800**	**8,087**
Total Projected Water Demand	**1,260**	**1,376**	**1,829**	**2,328**	**2,668**	**2,922**	**2,971**	**2,929**	**2,547**	**1,860**	**1,455**	**1,169**	**25,314**

Use of Source Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
19 Secondary effluent to SVRP for CSIP [12]	461	654	1,030	1,735	1,747	1,693	1,785	1,802	1,733	1,059	681	370	14,750
20 New sources available to CSIP [13]	0	0	0	249	245	480	353	319	162	0	0	0	1,808
21 **Total Supply to CSIP**	**461**	**654**	**1,030**	**1,984**	**1,993**	**2,173**	**2,138**	**2,121**	**1,894**	**1,059**	**681**	**370**	**16,558**
Net CSIP Increase													**3,603**
22 Surface waters at RTP to AWPF	0	0	0	114	106	101	105	111	109	11	0	0	657
23 Secondary effluent to AWPF	771	702	767	0	0	0	0	0	0	738	752	791	4,522
24 AWW and Salinas urban runoff to AWPF	0	0	0	355	367	355	367	367	355	0	0	0	2,166
25 Secondary effluent to AWPF for MCWD RUWAP	28	19	33	70	108	110	113	94	85	51	21	9	741
26 **Feedwater to AWPF**	**799**	**721**	**800**	**539**	**581**	**566**	**585**	**572**	**549**	**800**	**773**	**800**	**8,086**
Subtotal- all waters (including secondary effluent)	**1,260**	**1,376**	**1,829**	**2,523**	**2,574**	**2,739**	**2,723**	**2,692**	**2,443**	**1,860**	**1,455**	**1,169**	**24,644**

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
27 FIVE YEAR AVERAGE WASTE WATER EFFLUENT TO OCEAN OUTFALL (2009-2013)[15]	1,785	1,219	1,141	420	88	49	27	34	114	859	1,314	1,759	8,809
28 WASTE WATER EFFLUENT TO OCEAN OUTFALL WITH PROPOSED DIVERSIONS TO CSIP/AWT/RUWAP [16]	552	308	47	0	0	0	0	0	0	0	313	614	1,833
29 NEW SUPPLIES IN EXCESS OF AWT DEMANDS FOR GWR [17]	(771)	(702)	(767)	249	245	480	353	319	162	(738)	(752)	(791)	(2,714)
30 AWT BRINE TO OCEAN OUTFALL	152	137	152	102	110	108	111	109	104	152	147	152	1,536

Notes

1 Presumes all facilities associated with diversions are completed, including SVRP modifications.

2 Table 2-1, p. 5, Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler Consulting Engineers, August 2015.

3 Volume of effluent from City of Salinas agricultural wash water to be directed into ponds 1,2,3, and the aeration pond for storage.

4 Average monthly flow from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015.

5 Rainfall from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015. Pond area presumed to be Ponds 1,2, 3 + Aeration lagoon. No rainfall/evaporation or storage assigned to drying beds.

6 Table 3, Todd Groundwater, Memorandum, Pure Water Monterey Groundwater Replenishment Project: Impacts of Changes in Percolation at the Salinas Industrial Wastewater Treatment Facility on Groundwater and the Salinas River, February 11, 2015.

7 Table 4, Ibid.

8 Ponds 1,2,3 and aeration basin hold up to 1,065 acre-feet (one foot of freeboard). If flow to ponds would exceed the maximum volume, it is presumed that excess flow can be diverted to the RIBs or drying beds or flow can be diverted to the RTP. Presume that pond storage goes to zero sometime during the year (shown here starting in July).

9 Water right application 32263A. Max diversion = 6 cfs diversion. If SRDF is not operating (drought year), 2 cfs is bypassed to the Salians River. See final water right permit 21376

10 Water right applciation 32263B. Max. diversion = 6 cfs. See final water right permit 21377. Assumes 2 cfs instream bypass requirement Dec-May, 1 cfs bypass in June and 0.7 cfs instream bypass requirement for July-Nov. Also assumes diversion stopped when flows reach 30 cfs (migration window) and restart when flow declines to 20 cfs. See final water right permit 21377

11 Water right application 32263C. Max. diversion = 3 cfs. Removed from project portfolio during water rights process. See RECLAMATION DITCH YIELD STUDY, Schaaf and Wheeler, March 2015.

12 Includes secondary effluent wastewater currently used to produce recycled water at the Salinas Valley Reclamation Project (SVRP), and additional amounts which may be used during periods of low demand (<5 mgd) with the proposed improvements to the SVRP.

13 New source waters not used by AWPF will be available to SVRP for CSIP.

14 A drought reserve of up to 1,000 AF would be created over five years by producing 200 AFY additional product water from the GWR Project AWTF during winter months and storing the water in the Seaside Basin. This would establish a "water bank" that the CSIP can draw on in droughts. The drought reserve would allow flow at the RTP for the GWR Project to be temporarily reduced during critically dry periods, thus freeing up more of the newly available inflows to the RTP to be sent to the CSIP area. Extraction from the Seaside Basin would continue at the average rate to supply the Monterey Peninsula.

15 Average monthly RTP discharge, 2009-2013 (reported by M1W).

16 Secondary treated municipal effluent not used for SVRP or the AWPF.

17 Excess is calculated as Line 13 minus Lines 15 & 16

18 RUWAP supply comes from existing RTP inflows of municipal wastewater. Demands reflect existing urban irrigation customers along trunk main.

Table 10: Source Water Analysis for the Pure Water Monterey Groundwater Replenishment Project

Diversion Pattern for a Normal Water Year with a Full Reserve

	All facilities built[1] - average water year conditions - all flows in acre-feet													10/14/2019
	SOURCES	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
	Existing RTP Inflows (Average 2009 to 2013)	**1,798**	**1,678**	**1,867**	**1,796**	**1,850**	**1,799**	**1,893**	**1,888**	**1,813**	**1,844**	**1,762**	**1,776**	**21,764**
	Existing domestic flows to RTP (wells at RTP and MRWMD)	**14**	**5**	**10**	**9**	**5**	**4**	**5**	**8**	**5**	**5**	**5**	**7**	**82**
	New Source Water													
	City of Salinas													
1	Salinas Agricultural Wash Water[2]	156	158	201	307	311	391	435	444	367	410	329	223	3,732
	Agricultural Wash Water (AWW) to Ponds[3]	*156*	*158*	*201*	*0*	*0*	*0*	*0*	*0*	*0*	*410*	*329*	*223*	*1,477*
	AWW directly to RTP	*0*	*0*	*0*	*307*	*311*	*391*	*435*	*444*	*367*	*0*	*0*	*0*	*2,255*
2	Salinas Urban Storm Water Runoff[4]	52	41	34	16	2	0	0	0	2	8	23	47	225
	Urban runoff to ponds	*52*	*41*	*34*	*0*	*0*	*0*	*0*	*0*	*0*	*8*	*23*	*47*	*205*
	Urban runoff to RTP	*0*	*0*	*0*	*16*	*2*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*20*
3	Rainfall (on SIWTF, 121 acre pond area)[5]	26	24	21	11	3	1	0	0	2	6	14	24	132
4	Evaporation (from SIWTF, 121 acre pond area)[6]	(12)	(16)	(29)	(41)	(46)	(52)				(28)	(15)	(12)	(251)
5	Percolation[7]	(143)	(129)	(143)	(138)	(143)	(138)				(143)	(138)	(143)	(1,257)
6	SIWTF pond storage balance[8]	684	763	847	647	362	0	0	0	0	253	466	605	
7	Recovery of flow from SIWTF storage ponds to RTP	0	0	0	32	100	172	0	0	0	0	0	0	304
8	AWW and Salinas Runoff to RTP	0	0	0	355	413	563	435	444	369	0	0	0	2,579
	Water Rights Applications to SWRCB													
9	Blanco Drain[9]	0	0	0	252	225	274	277	244	184	0	0	0	1,456
10	Reclamation Ditch at Davis Road[10]	0	0	0	106	79	99	113	109	72	0	0	0	578
11	Tembladero Slough at Castroville[11]	0	0	0	0	0	0	0	0	0	0	0	0	0
12	City of Monterey - Diversion at Lake El Estero	0	0	0	5	1	0	0	0	1	0	0	0	7
13	**Subtotal New Waters Available**	**0**	**0**	**0**	**718**	**718**	**936**	**825**	**797**	**626**	**0**	**0**	**0**	**4,620**
	Total Projected Water Supply	**1,812**	**1,683**	**1,877**	**2,523**	**2,574**	**2,739**	**2,723**	**2,692**	**2,443**	**1,849**	**1,767**	**1,783**	**26,466**
	DEMANDS	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
	Average SVRP deliveries to CSIP (2009-2013)	13	459	726	1,376	1,763	1,750	1,866	1,854	1,698	984	448	18	12,955
14	FIVE YEAR AVERAGE CSIP AREA WELL WATER USE (2009-2013)	448	195	304	412	324	606	519	504	300	75	233	352	4,272
	TOTAL CSIP Demand (excludes SRDF use)	**461**	**654**	**1,030**	**1,788**	**2,087**	**2,356**	**2,385**	**2,358**	**1,998**	**1,059**	**681**	**370**	**17,227**
15	FEEDWATER AMOUNT AT RTP TO PWM BASE PROJECT AWPF	367	331	367	355	367	355	367	367	355	367	355	367	4,320
16	FEEDWATER TO ESTABLISH CSIP AREA DROUGHT RESERVE (200 AFY AWTF PRODUCT WATER)[14]	0	0	0							0	0	0	0
	FEEDWATER FOR 2250 AFY EXPANSION	362	333	357	114	106	101	105	111	109	340	357	382	2,778
17	FEEDWATER TO AWPF FOR MCWD RUWAP[18]	28	19	33	70	108	110	113	94	85	51	21	9	741
18	**TOTAL TO GWR ADVANCED WATER TREATMENT FACILITY**	**757**	**683**	**757**	**539**	**581**	**566**	**585**	**572**	**549**	**758**	**733**	**758**	**7,839**
	Total Projected Water Demand	**1,218**	**1,338**	**1,787**	**2,328**	**2,668**	**2,922**	**2,971**	**2,929**	**2,547**	**1,818**	**1,414**	**1,127**	**25,066**
	Use of Source Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
19	Secondary effluent to SVRP for CSIP[12]	461	654	1,030	1,735	1,747	1,693	1,785	1,802	1,733	1,059	681	370	14,750
20	New sources available to CSIP[13]	0	0	0	249	245	480	353	319	162	0	0	0	1,808
21	**Total Supply to CSIP**	**461**	**654**	**1,030**	**1,984**	**1,993**	**2,173**	**2,138**	**2,121**	**1,894**	**1,059**	**681**	**370**	**16,558**
	Net CSIP Increase													**3,603**
22	Surface waters at RTP to AWPF	0	0	0	114	106	101	105	111	109	0	0	0	646
23	Secondary effluent to AWPF	729	664	724	0	0	0	0	0	0	707	712	749	4,285
24	AWW and Salinas urban runoff to AWPF	0	0	0	355	367	355	367	367	355	0	0	0	2,166
25	Secondary effluent to AWPF for MCWD RUWAP	28	19	33	70	108	110	113	94	85	51	21	9	741
26	**Feedwater to AWPF**	**757**	**683**	**757**	**539**	**581**	**566**	**585**	**572**	**549**	**758**	**733**	**758**	**7,839**
	Subtotal- all waters (including secondary effluent)	**1,218**	**1,338**	**1,787**	**2,523**	**2,574**	**2,739**	**2,723**	**2,692**	**2,443**	**1,818**	**1,414**	**1,127**	**24,397**
27	FIVE YEAR AVERAGE WASTE WATER EFFLUENT TO OCEAN OUTFALL (2009-2013)[15]	1,785	1,219	1,141	420	88	49	27	34	114	859	1,314	1,759	8,809
28	WASTE WATER EFFLUENT TO OCEAN OUTFALL WITH PROPOSED DIVERSIONS TO CSIP/AWT/RUWAP[16]	594	346	90	0	0	0	0	0	0	31	354	656	2,070
29	NEW SUPPLIES IN EXCESS OF AWT DEMANDS FOR GWR[17]	(729)	(664)	(724)	249	245	480	353	319	162	(707)	(712)	(749)	(2,477)
30	AWT BRINE TO OCEAN OUTFALL	144	130	144	102	110	108	111	109	104	144	139	144	1,489

Notes

1 Presumes all facilities associated with diversions are completed, including SVRP modifications.

2 Table 2-1, p. 5, Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler Consulting Engineers, August 2015.

3 Volume of effluent from City of Salinas agricultural wash water to be directed into ponds 1,2,3, and the aeration pond for storage.

4 Average monthly flow from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015.

5 Rainfall from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015. Pond area presumed to be Ponds 1,2, 3 + Aeration lagoon. No rainfall/evaporation or storage assigned to drying beds.

6 Table 3, Todd Groundwater, Memorandum, Pure Water Monterey Groundwater Replenishment Project: Impacts of Changes in Percolation at the Salinas Industrial Wastewater Treatment Facility on Groundwater and the Salinas River, February 11, 2015.

7 Table 4, Ibid.

8 Ponds 1,2,3 and aeration basin hold up to 1,065 acre-feet (one foot of freeboard). If flow to ponds would exceed the maximum volume, it is presumed that excess flow can be diverted to the RIBs or drying beds or flow can be diverted to the RTP. Presume that pond storage goes to zero sometime during the year (shown here starting in July).

9 Water right application 32263A. Max diversion = 6 cfs diversion. If SRDF is not operating (drought year), 2 cfs is bypassed to the Salians River. See final water right permit 21376

10 Water right applciation 32263B. Max. diversion = 6 cfs. See final water right permit 21377. Assumes 2 cfs instream bypass requirement Dec-May, 1 cfs bypass in June and 0.7 cfs instream bypass requirement for July-Nov. Also assumes diversion stopped when flows reach 30 cfs (migration window) and restart when flow declines to 20 cfs. See final water right permit 21377

11 Water right application 32263C. Max. diversion = 3 cfs. Removed from project portfolio during water rights process. See RECLAMATION DITCH YIELD STUDY, Schaaf and Wheeler, March 2015.

12 Includes secondary effluent wastewater currently used to produce recycled water at the Salinas Valley Reclamation Project (SVRP), and additional amounts which may be used during periods of low demand (<5 mgd) with the proposed improvements to the SVRP.

13 New source waters not used by AWPF will be available to SVRP for CSIP.

14 A drought reserve of up to 1,000 AF would be created over five years by producing 200 AFY additional product water from the GWR Project AWTF during winter months and storing the water in the Seaside Basin. This would establish a "water bank" that the CSIP can draw on in droughts. The drought reserve would allow flow at the RTP for the GWR Project to be temporarily reduced during critically dry periods, thus freeing up more of the newly available inflows to the RTP to be sent to the CSIP area. Extraction from the Seaside Basin would continue at the average rate to supply the Monterey Peninsula.

15 Average monthly RTP discharge, 2009-2013 (reported by M1W).

16 Secondary treated municipal effluent not used for SVRP or the AWPF.

17 Excess is calculated as Line 13 minus Lines 15 & 16

18 RUWAP supply comes from existing RTP inflows of municipal wastewater. Demands reflect existing urban irrigation customers along trunk main.

Table 11: Source Water Analysis for the Pure Water Monterey Groundwater Replenishment Project

Diversion Pattern for a Drought Year, Starting with a Full Reserve

All facilities built [1] - average water conditions - all flows in acre-feet													10/14/2019
SOURCES	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Minimum Year RTP Inflows (2013)	***1,725***	***1,494***	***1,645***	***1,657***	***1,722***	***1,675***	***1,748***	***1,773***	***1,715***	***1,690***	***1,634***	***1,612***	**20,090**
Existing domestic flows to RTP (wells at RTP and MRWMD)	**14**	**5**	**10**	**9**	**5**	**4**	**5**	**8**	**5**	**5**	**5**	**7**	**82**
New Source Water													
City of Salinas													
1 Salinas Agricultural Wash Water [2]	156	158	201	307	311	391	435	444	367	410	329	223	3,732
Agricultural Wash Water (AWW) to Ponds [3]	*156*	*158*	*201*	*0*	*0*	*0*	*0*	*0*	*0*	*410*	*329*	*223*	*1,477*
AWW directly to RTP	*0*	*0*	*0*	*307*	*311*	*391*	*435*	*444*	*367*	*0*	*0*	*0*	*2,255*
2 Salinas Urban Storm Water Runoff [4]	17	14	11	5	1	0	0	0	1	3	8	16	76
Urban runoff to ponds	*17*	*14*	*11*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*8*	*16*	*69*
Urban runoff to RTP	*0*	*0*	*0*	*5*	*1*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*7*
3 Rainfall (on SIWTF, 121 acre pond area) [5]	26	24	21	11	3	1	0	0	2	6	14	24	132
4 Evaporation (from SIWTF, 121 acre pond area) [6]	(12)	(16)	(29)	(41)	(46)	(52)				(28)	(15)	(12)	(251)
5 Percolation [7]	(143)	(129)	(143)	(138)	(143)	(138)				(143)	(138)	(143)	(1,257)
6 SIWTF pond storage balance [8]	598	650	711	511	226	0	0	0	0	248	446	554	
7 Recovery of flow from SIWTF storage ponds to RTP	0	0	0	32	100	36	0	0	0	0	0	0	168
8 AWW and Salinas Runoff to RTP	0	0	0	344	412	427	435	444	368	0	0	0	2,430
Water Rights Applications to SWRCB													
9 Blanco Drain [9]	0	0	246	252	225	274	277	244	184	168	133	0	2,003
10 Reclamation Ditch at Davis Road [10]	0	0	70	106	79	99	113	109	72	65	89	0	802
11 Tembladero Slough at Castroville [11]	0	0	0	0	0	0	0	0	0	0	0	0	0
12 City of Monterey - Diversion at Lake El Estero	0	0	14	5	1	0	0	0	1	4	10	0	35
13 **Subtotal New Waters Available**	**0**	**0**	**330**	**707**	**717**	**800**	**825**	**797**	**625**	**237**	**232**	**0**	**5,270**
Total Projected Water Supply	**1,739**	**1,499**	**1,985**	**2,373**	**2,444**	**2,479**	**2,578**	**2,578**	**2,345**	**1,931**	**1,871**	**1,619**	**25,442**
DEMANDS	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Max Year SVRP deliveries to CSIP (2013)	*0*	*692*	*1,558*	*1,669*	*1,799*	*1,675*	*1,786*	*1,803*	*1,725*	*1,548*	*1,127*	*88*	15,469
14 PEAK CSIP AREA WELL WATER USE (10/2013-09/2014)	*509*	*9*	*221*	*242*	*1,197*	*1,261*	*1,303*	*1,025*	*453*	*165*	*35*	*730*	7,150
TOTAL CSIP Demand (excludes SRDF use)	**509**	**701**	**1,779**	**1,911**	**2,996**	**2,936**	**3,089**	**2,828**	**2,178**	**1,713**	**1,162**	**818**	**22,619**
15 FEEDWATER AMOUNT AT RTP TO PWM BASE PROJECT AWPF	367	331	367	133	137	133	137	137	133	367	355	367	2,963
16 FEEDWATER TO ESTABLISH CSIP AREA DROUGHT RESERVE (200 AFY AWTF PRODUCT WATER) [14]	0	0	0							0	0	0	0
FEEDWATER FOR 2250 AFY EXPANSION	362	333	357	114	106	101	105	111	109	340	357	382	2,778
17 FEEDWATER TO AWPF FOR MCWD RUWAP [18]	28	19	33	70	108	110	113	94	85	51	21	9	741
18 **TOTAL TO GWR ADVANCED WATER TREATMENT FACILITY**	**757**	**683**	**757**	**317**	**351**	**344**	**355**	**342**	**327**	**758**	**733**	**758**	**6,482**
Total Projected Water Demand	**1,266**	**1,384**	**2,537**	**2,228**	**3,348**	**3,280**	**3,444**	**3,170**	**2,505**	**2,471**	**1,894**	**1,575**	**29,102**
Use of Source Water	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
19 Secondary effluent to SVRP for CSIP [12]	509	701	1,227	1,596	1,619	1,569	1,640	1,687	1,635	1,173	1,138	818	15,312
20 New sources available to CSIP [13]	0	0	0	460	474	567	583	549	383	0	0	0	3,015
21 **Total Supply to CSIP**	**509**	**701**	**1,227**	**2,056**	**2,093**	**2,136**	**2,223**	**2,236**	**2,018**	**1,173**	**1,138**	**818**	**18,328**
Net CSIP Increase													**2,858**
22 Surface waters at RTP to AWPF	0	0	330	114	106	101	105	111	109	237	232	0	1,445
23 Secondary effluent to AWPF	729	664	394	0	0	0	0	0	0	471	480	749	3,487
24 AWW and Salinas urban runoff to AWPF	0	0	0	133	137	133	137	137	133	0	0	0	809
25 Secondary effluent to AWPF for MCWD RUWAP	28	19	33	70	108	110	113	94	85	51	21	9	741
26 **Feedwater to AWPF**	**757**	**683**	**757**	**317**	**351**	**344**	**355**	**342**	**327**	**758**	**733**	**758**	**6,482**
Subtotal- all waters (including secondary effluent)	**1,266**	**1,384**	**1,985**	**2,373**	**2,444**	**2,479**	**2,578**	**2,578**	**2,345**	**1,931**	**1,871**	**1,575**	**24,810**
27 *DRY YEAR WASTEWATER EFFLUENT TO OCEAN OUTFALL (2013)* [15]	*1,725*	*802*	*87*	*0*	*0*	*0*	*0*	*0*	*0*	*142*	*507*	*1,607*	4,870
28 WASTE WATER EFFLUENT TO OCEAN OUTFALL WITH PROPOSED DIVERSIONS TO CSIP/AWT/RUWAP [16]	473	115	0	0	0	0	0	0	0	0	0	43	632
29 NEW SUPPLIES IN EXCESS OF AWT DEMANDS FOR GWR [17]	(729)	(664)	(394)	460	474	567	583	549	383	(471)	(480)	(749)	(471)
30 AWT BRINE TO OCEAN OUTFALL	144	130	144	60	67	65	68	65	62	144	139	144	1,232

Notes

1 Presumes all facilities associated with diversions are completed, including SVRP modifications.

2 Table 2-1, p. 5, Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler Consulting Engineers, August 2015.

3 Volume of effluent from City of Salinas agricultural wash water to be directed into ponds 1,2,3, and the aeration pond for storage.

4 Average monthly flow from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015.

5 Rainfall from Groundwater Replenishment Project, Salinas River Inflow Impacts, Schaaf & Wheeler, August 2015. Pond area presumed to be Ponds 1,2, 3 + Aeration lagoon. No rainfall/evaporation or storage assigned to drying beds.

6 Table 3, Todd Groundwater, Memorandum, Pure Water Monterey Groundwater Replenishment Project: Impacts of Changes in Percolation at the Salinas Industrial Wastewater Treatment Facility on Groundwater and the Salinas River, February 11, 2015.

7 Table 4, Ibid.

8 Ponds 1,2,3 and aeration basin hold up to 1,065 acre-feet (one foot of freeboard). If flow to ponds would exceed the maximum volume, it is presumed that excess flow can be diverted to the RIBs or drying beds or flow can be diverted to the RTP. Presume that pond storage goes to zero sometime during the year (shown here starting in July).

9 Water right application 32263A. Max diversion = 6 cfs diversion. If SRDF is not operating (drought year), 2 cfs is bypassed to the Salians River. See final water right permit 21376

10 Water right applciation 32263B. Max. diversion = 6 cfs. See final water right permit 21377. Assumes 2 cfs instream bypass requirement Dec-May, 1 cfs bypass in June and 0.7 cfs instream bypass requirement for July-Nov. Also assumes diversion stopped when flows reach 30 cfs (migration window) and restart when flow declines to 20 cfs. See final water right permit 21377

11 Water right application 32263C. Max. diversion = 3 cfs. Removed from project portfolio during water rights process. See RECLAMATION DITCH YIELD STUDY, Schaaf and Wheeler, March 2015.

12 Includes secondary effluent wastewater currently used to produce recycled water at the Salinas Valley Reclamation Project (SVRP), and additional amounts which may be used during periods of low demand (<5 mgd) with the proposed improvements to the SVRP.

13 New source waters not used by AWPF will be available to SVRP for CSIP.

14 A drought reserve of up to 1,000 AF would be created over five years by producing 200 AFY additional product water from the GWR Project AWTF during winter months and storing the water in the Seaside Basin. This would establish a "water bank" that the CSIP can draw on in droughts. The drought reserve would allow flow at the RTP for the GWR Project to be temporarily reduced during critically dry periods, thus freeing up more of the newly available inflows to the RTP to be sent to the CSIP area. Extraction from the Seaside Basin would continue at the average rate to supply the Monterey Peninsula.

15 Average monthly RTP discharge, 2009-2013 (reported by M1W).

16 Secondary treated municipal effluent not used for SVRP or the AWPF.

17 Excess is calculated as Line 13 minus Lines 15 & 16

18 RUWAP supply comes from existing RTP inflows of municipal wastewater. Demands reflect existing urban irrigation customers along trunk main.

Appendix J

Ocean Plan Compliance Assessment Technical Memorandum

Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project Expansion

Technical Memorandum
September 2019

Prepared for:

Partners for Pure Water Solutions
Monterey One Water
Monterey Peninsula Water Management District

Trussell Technologies Inc
1939 Harrison Street, Suite 600
Oakland, CA 94612

Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project Expansion

Technical Memorandum

September 2019

Prepared By:

Trussell Technologies, Inc.
Brie Post, P.E.
Elaine Howe, P.E., BCEE
John Kenny, P.E.
Rhodes Trussell, Ph.D., P.E., BCEE

Reviewed By:

Larry Walker Associates
Denise H. Conners
Mitchell Mysliwiec, Ph.D.

Table of Contents

1 Executive Summary

Monterey One Water (M1W) and the Monterey Peninsula Water Management District ("Project Partners") are in the process of implementing the Pure Water Monterey Groundwater Replenishment Project ("Project"). The Project involves treating secondary effluent from M1W's Regional Treatment Plant (RTP) through a new Advanced Water Purification Facility (AWPF) to produce 5 mgd of highly purified recycled water. This water is then injected into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply.

Compliance with numeric water quality objectives in the California Ocean Plan to protect marine aquatic life and human health was previously evaluate for discharge of the Project's reverse osmosis (RO) concentrate to the Pacific Ocean (Monterey Bay) through the RTP's ocean outfall (Trussell Technologies, 2017). The assessment determined that all potential discharge scenarios would comply with the Ocean Plan. The Project subsequently obtained a National Pollutant Discharge Elimination System (NPDES) permit (Order No. R3-2018-0017) and authorization from the Monterey Bay National Marine Sanctuary (MBNMS), and the AWPF is under construction.

In order to maximize this reliable source of water supply, changes to the Project that would expand the AWPF and injection well capacity to 7.6 mgd are being considered. With the expanded capacity, the amount of RO concentrate produced by the expanded AWPF would increase and an NPDES permit amendment would be needed to authorize the discharge. To assess Ocean Plan compliance with the increased RO concentrate flow, Trussell Technologies, Inc. (Trussell Tech) developed a conservative approach, which involved assuming the worst-case conditions for waste discharge such as (a) no constituent removal through treatment at the RTP (with exceptions discussed above), (b) worst-case constituent concentrations for each source water, (c) 100% rejection of constituents via RO, yielding a conservatively high concentration in the RO concentrate, and (d) the worst-case blends of available source waters to result in the highest constituent concentrations.

The estimated worst-case water quality of the discharge was compared to the Ocean Plan objectives to assess compliance. None of the constituents are expected to exceed their Ocean Plan objective. Compliance assessments could not be made for select constituents, as noted in the following TM, due to analytical limitations; however, this is a common occurrence for these Ocean Plan constituents. Ammonia is estimated to reach a concentration closest to its objective, where it is 82% of the objective in one of the discharge flow scenarios. Based on this analysis, the expanded Project is expected to comply with all Ocean Plan objectives.

2 Introduction

Monterey One Water (M1W) and the Monterey Peninsula Water Management District ("Project Partners") are in the process of implementing the Pure Water Monterey Groundwater Replenishment Project ("Project"). The Project involves treating secondary effluent from M1W's Regional Treatment Plant (RTP) through a new Advanced Water Purification Facility (AWPF) to produce 5 mgd of highly purified recycled water. This water is then injected into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply. The Project will also provide additional tertiary recycled water for agricultural irrigation in the northern Salinas Valley as part of the Castroville Seawater Intrusion Project (CSIP).

Compliance with numeric water quality objectives in the California Ocean Plan to protect marine aquatic life and human health was previously evaluate for discharge of the Project's reverse osmosis (RO) concentrate to the Pacific Ocean (Monterey Bay) through the RTP's ocean outfall (Trussell Technologies, 2017). The assessment determined that all potential discharge scenarios would comply with the Ocean Plan. The Project subsequently obtained a National Pollutant Discharge Elimination System (NPDES) permit (Order No. R3-2018-0017), and authorization from the MBNMS, and the AWPF is under construction.

In order to maximize this reliable source of water supply, a change to the Project that would expand the AWPF and injection capacity to 7.6 mgd (the Proposed Modifications) are being considered. To assess Ocean Plan compliance with the increased RO concentrate flow, Trussell Technologies, Inc. (Trussell Tech) conservatively estimated worst-case discharge conditions to determine whether the Project would consistently meet Ocean Plan water quality objectives. The purpose of this technical memorandum (TM) is to summarize the assumptions, methodology, results and conclusions of the Ocean Plan compliance assessment.

2.1 Treatment through the RTP and AWPF

The existing RTP treatment process includes screening, primary sedimentation, secondary biological treatment through trickling filters (TFs) and a solids contactor (*i.e.*, bio-flocculation), and then clarification (Figure 1). Much of the secondary effluent undergoes tertiary treatment (coagulation, flocculation, granular media filtration and disinfection) at the Salinas Valley Reclamation Project (SVRP) to produce recycled water used for agricultural irrigation through CSIP. Secondary effluent not needed to meet recycled water demand is discharged to the Monterey Bay through an existing ocean outfall. The RTP also accepts trucked saline waste ("hauled waste") for ocean disposal, which is stored in a pond prior to being discharged.

The AWPF includes advanced treatment technologies for purifying the secondary effluent prior to aquifer injection: ozone (O_3), membrane filtration (MF), RO, an advanced oxidation process (AOP) using ultraviolet light (UV) and hydrogen peroxide, and finished water stabilization. The Project Partners conducted a pilot-scale study of the ozone, MF, and RO processes of the AWPF from December 2013 through July 2014, successfully demonstrating the ability of the various treatment processes to produce highly-purified recycled water that complies with the California Water Recycling Criteria for Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application (Groundwater Replenishment

Regulations) (SWRCB, 2018) and Central Coast Water Quality Control Plan (Basin Plan) standards, objectives and guidelines for groundwater (CCRWQCB, 2011). After the pilot-scale study, an advanced water purification demonstration facility was built to gain additional experience operating ozone, MF, and RO processes with UV/hydrogen peroxide AOP and stabilization treatment. The demonstration facility is operated and maintained by M1W.

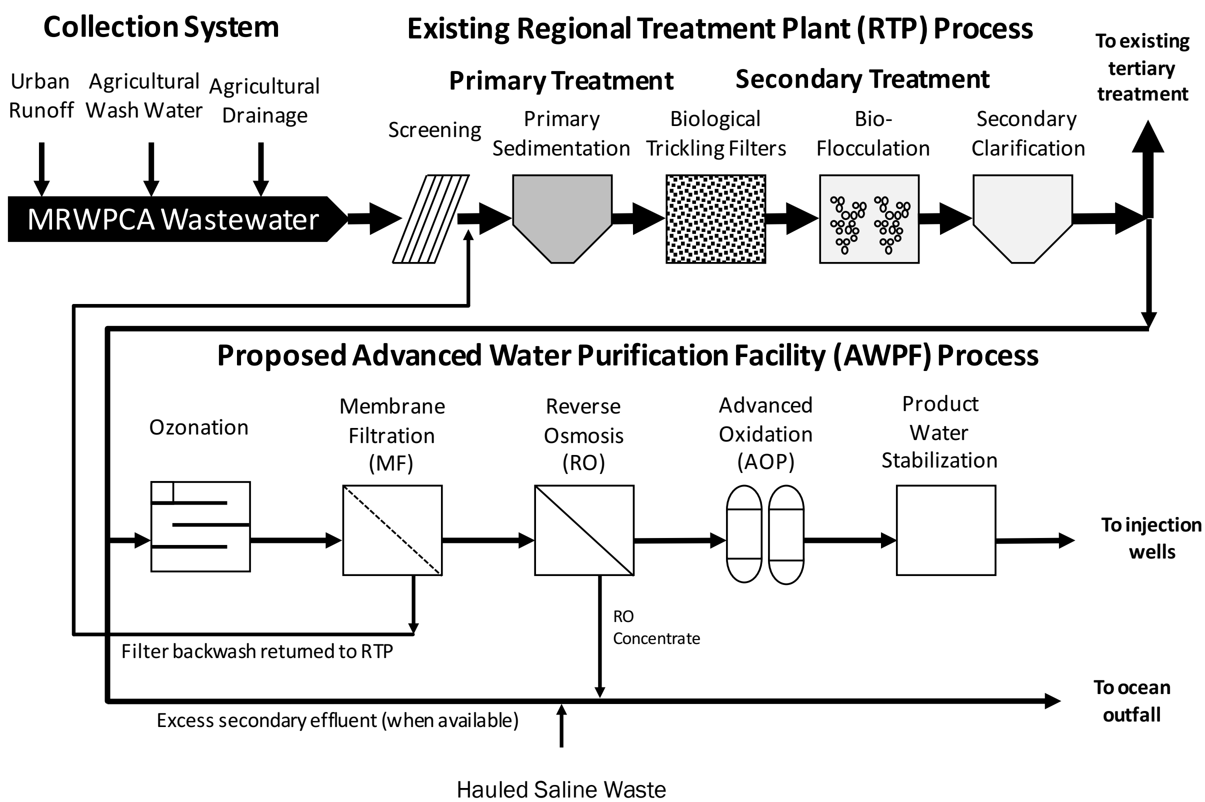


Figure 1 – Diagram of M1W RTP and AWPF treatment processes

Reverse osmosis is an excellent removal process, separating out most dissolved constituents from the recycled water. The dissolved constituents removed through RO are concentrated into a waste stream known as the RO concentrate. Unlike the waste from the MF, the RO concentrate cannot be recycled back to the RTP headworks and will be discharged through the existing ocean outfall. Discharges through the outfall are subject to NPDES permitting based on requirements specified in the California State Water Resources Control Board 2015 Ocean Plan ("Ocean Plan") (SWRCB, 2015).

M1W's NPDES permit allows for the discharge of three waste streams: up to 1.17 mgd of RO concentrate, up to 29.6 mgd secondary effluent (average dry weather flow)[1], and up to 0.05 mgd of trucked-in saline waste (hauled waste). For the Proposed Modifications to the Project, the amount of RO concentrate produced by the AWPF would exceed 1.17 mgd and an NPDES permit amendment and MBNMS authorization would be needed to allow the

[1] Secondary effluent can be discharged up 75.6 mgd during peak wet weather flow.

discharge. The following report documents the Ocean Plan compliance assessment conducted for this increased RO concentrate discharge.

2.2 California Ocean Plan and Current NPDES Permit

The California Ocean Plan sets forth numeric and narrative water quality objectives for ocean waters with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting (SWRCB, 2015). For typical municipal wastewater discharges, when released from an outfall, the wastewater and ocean water undergo rapid mixing due to the momentum and buoyancy of the discharge.[2] The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge into the ocean. The initial dilution occurs in an area known as the zone of initial dilution (ZID), and the Ocean Plan objectives are to be met at the edge of the ZID. The extent of dilution in the ZID is quantified as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are typically adjusted by the D_m to derive NPDES permit limits that are applied to a wastewater discharge prior to ocean dilution. Figure 2 is a schematic showing these key terms from the Ocean Plan.

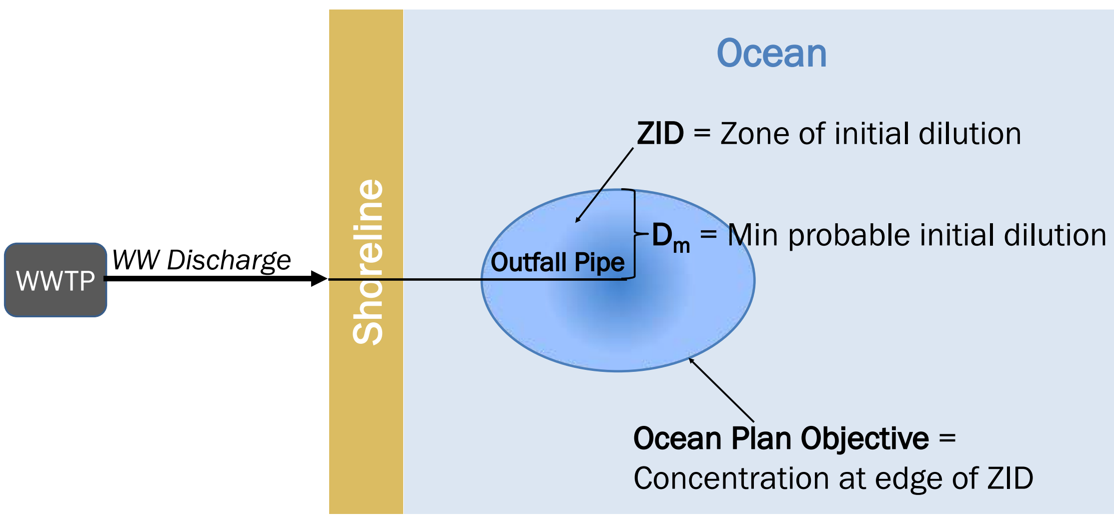


Figure 2 – Schematic showing some of the key terms in the Ocean Plan

The current RTP wastewater discharge is governed by Order No. R3-2018-0017 (NPDES permit No. CA0048551) issued by the Central Coast Regional Water Quality Control Board (CCRWQCB) (CCRWQCB, 2018). Unique to the current permit, the discharge limits are set to equal the Ocean Plan objectives, and compliance is shown by applying the D_m prior to reporting the concentration to the CCRWQCB. In addition, there are four D_m values included in the permit that are correlated with the blend of waste waters being discharged. As noted above, the current permit has a maximum allowable RO concentrate discharge flow of 1.17

[2] Municipal wastewater effluent, being low in salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water.

mgd. The Proposed Modifications will increase the size of the AWPF, leading to the production of up to 1.78 mgd of RO concentrate and requiring an amendment to M1W's current permit. It is anticipated that the discharge limits would remain the same for the RTP and AWPF with Proposed Modifications, *i.e.*, equal to the Ocean Plan objectives. Therefore, the estimated discharge concentrations developed through this analysis were compared to M1W's current discharge limits when determining whether the Project would have a significant impact on marine water quality.

3 Methodology for Ocean Plan Compliance Assessment

A Project technical team was established, including Trussell Technologies (Trussell Tech), Larry Walker Associates (LWA), and M1W staff, to analyze impacts due to ocean discharge of RO concentrate. LWA modeled ocean dilution, and Trussell Tech and M1W staff characterized the water quality of the commingled secondary effluent and RO concentrate. The Project's ability to comply with the Ocean Plan was evaluated by Trussell Tech. This multi-step process is summarized in Figure 3, and the following sections describe how this information was developed.

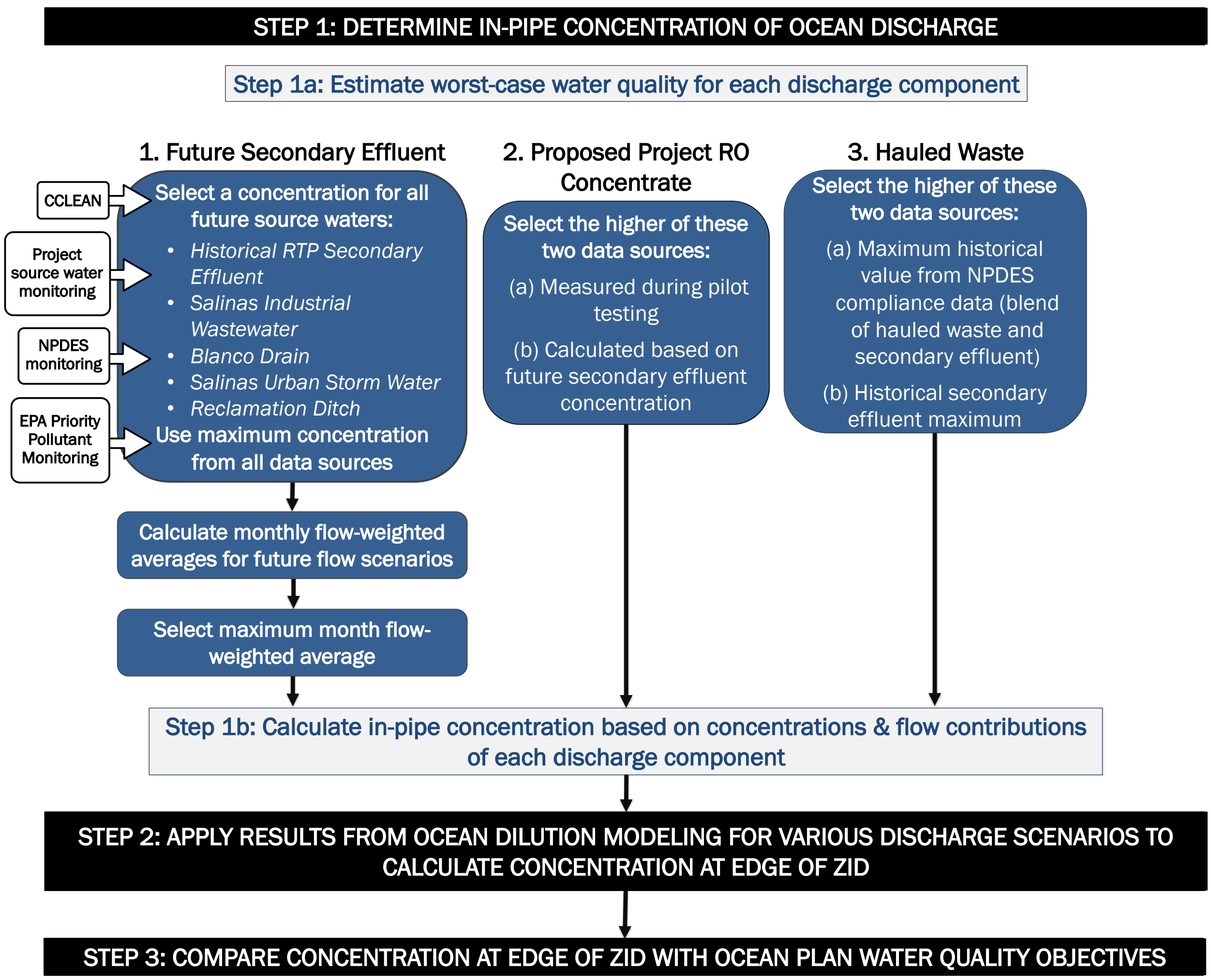


Figure 3 – Logic flow-chart for determination of project compliance with the Ocean Plan objectives

3.1 Determination of Waste Discharge Water Quality

The first step to assess Ocean Plan compliance was to estimate the worst-case water quality for each discharge component including secondary effluent, RO concentrate, and hauled waste (Figure 3). The water quality of the secondary effluent is dependent on the quality of the wastewater coming into the RTP as well as the treatment efficacy of the RTP. The quality of the RO concentrate is directly related to the quality of the secondary effluent, as the secondary effluent is the influent to the AWPF and after ozonation and membrane filtration it becomes influent to the RO membranes. The hauled waste is an intermittent flow and a small fraction of the total flow being discharged. The following subsections describe the methods used for determining the water quality of each type of waste discharge.

3.1.1 Determination of Source Water Flow Contributions

M1W participates in a highly successful non-potable reuse program, CSIP, by providing water from the SVRP. In the summer months, nearly all of the secondary effluent from the RTP is diverted to the SVRP, which allows for almost no secondary effluent being discharged for about half of the year. This non-potable reuse offers many benefits to the environment and local agriculture, but in order to have enough water available for the Project, including the expanded Project, additional source waters needed to be obtained.

During the initial evaluation of available source waters, a one-year monitoring campaign was conducted between July 2013 and June 2014 to understand the water quality of potential new source waters. The source waters included in the monitoring program were secondary effluent, Salinas Industrial Wastewater (SIWW), and waters from the Blanco Drain, Lake El Estero, and Tembladero Slough. The team collected and reviewed all available water quality data for secondary effluent and water quality monitoring results for these potential new source waters. Regular monthly and quarterly sampling was carried out for the secondary effluent, SIWW, and Blanco Drain drainage water. Limited sampling of stormwater from Lake El Estero was performed due to seasonal availability, and there was one sampling event for the Tembladero Slough drainage water.

Since the one-year monitoring campaign, Tembladero Slough is no longer planned to be used as a new source water for the Project, but drainage water from the Reclamation Ditch will provide a new source. In addition to SIWW, Salinas pond recovery water containing some urban stormwater runoff from Salinas may also be diverted to the RTP. Additional domestic wastewater flows from a local farmworker housing complex and various backwash waste streams recycled to the RTP make up the remaining water needed to produce the expanded capacity of 7.6 mgd Project water. Figure 4 shows the maximum projected monthly flows of the main source waters for the AWPF.

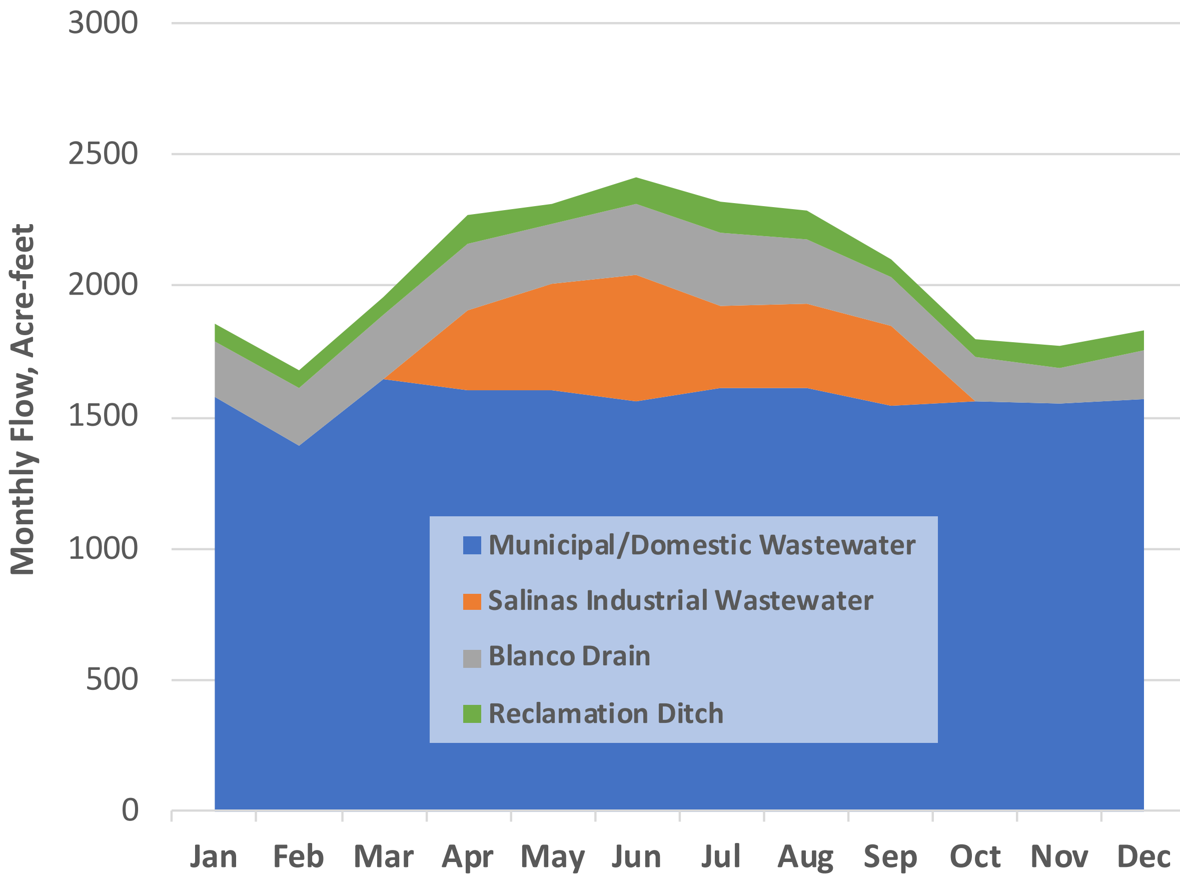


Figure 4 – Maximum projected monthly flows of source waters as influent to the Regional Treatment Plant with Proposed Modifications to the Project

At this time, the new source waters that will be brought to the RTP for the expansion Project include water from the Reclamation Ditch, Blanco Drain, and SIWW – including direct SIWW and pond recovery water (combined and treated SIWW and storm water). The amount of additional source waters brought into the RTP will vary throughout the year, with most of the additional water used during the summer months when agricultural irrigation demands are highest. In order to consider the full range of potential source water flow scenarios, two types of operational years have been assessed:

- **Maximum source water contribution** – divert all available source waters to the RTP year-round, regardless of demand for water (projected monthly flows shown in Figure 4)
- **Winter peaking operation** – maximize AWPF production during the winter months and divert available source waters as-needed, especially during the summer months when non-potable water demand is highest

3.1.2 Analysis of Water Quality Data

Various discharge blends of secondary effluent, RO concentrate, and hauled waste were evaluated to determine if the discharge was compliant with the Ocean Plan, regardless of discharge condition. The water quality of each individual discharge type was estimated using available water quality data. Previous operations have involved storing the hauled waste in a holding pond and diluting the waste with a small amount of secondary effluent. The majority of the hauled waste water quality data, including the most recent data, was collected under this operational strategy, and so the hauled waste water quality is also influenced by the secondary effluent quality. However, future proposed operations for the Project may involve diverting the hauled waste directly to the outfall, where it would mix with RO concentrate and available secondary effluent prior to discharge through the existing outfall. Because only limited and historical data are available for undiluted hauled waste, the concentration of each Ocean Plan objective in the hauled waste was estimated to be the maximum detected concentration in the secondary effluent, hauled waste, or a blend of the two.

The water quality of the three types of discharge waters was used to estimate the future combined water quality of the discharge under various Project conditions. First, Trussell Tech estimated the potential influence of the new source waters (*e.g.*, SIWW, Blanco Drain, *etc.*) on the worst-case water quality for each of the three types of discharge water. The volumetric contribution of each new source water will change throughout the year under the different flow scenarios that can occur under the Project. M1W staff provided estimates for the available volume of source waters for each month of the year. The monthly flows for each source water were estimated for two types of operational years: (1) base-loaded production, and (2) winter-time peaking production. For each constituent, a total of 24 future concentrations were estimated – 12 months of the year for the two projected future source water flow contributions. Of these concentrations, the maximum monthly flow-weighted concentration was selected for each constituent to be used for the Ocean Plan compliance analysis. This conservative approach used the highest observed concentrations from all data sources for each source water in the analysis.

It was also conservatively assumed that no constituent removal occurred through treatment at the RTP when considering the new source waters, so the concentration detected through the source water monitoring program was used to calculate the concentration in the RTP secondary effluent. Once the estimated worst-case water quality was determined for the RTP secondary effluent, these values were used in estimating the worst-case water qualities for the hauled waste and the RO concentrate (assuming 100% rejection through the RO membranes).

When a constituent could not be quantified or was not detected, it was reported as less than the Method Reporting Limit (<MRL).[3] Because the actual concentration could be any value

[3] The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (*i.e.*, the lower limit of quantitation). Therefore, acceptable quality control and quality assurance procedures are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the Method Detection Limit (or greater). The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero (40 Code of Federal Regulations Section 136 Appendix B).

equal to or less than the MRL, the conservative approach is to use the value of the MRL in the flow-weighting calculations. In some cases, constituents were not detected above the MRL in any of the source waters, so the concentrations for these constituents were reported as ND (<MRL) in this TM and the MRL was used in the numerical analysis. In cases where a constituent was detected but was not quantifiable, the results were also reported in this TM as less than the Method Reporting Limit, ND (<MRL). For some non-detected constituents, the MRL exceeds the Ocean Plan objective, and thus no compliance determination could be made. This phenomenon is common in the implementation of the Ocean Plan where for some constituents, suitable analytical methods are not capable of measuring low enough to quantify the minimum toxicologically relevant concentrations. For these constituents, a discharge is considered compliant if the monitoring results are less than the MRL.

The following approaches were used for addressing the cases where a constituent was reported as less than the MRL:

Aggregate constituents with multiple congeners or sub-components: Some Ocean Plan constituents are a combination of multiple congeners or sub-components (*e.g.*, chlordane, PAHs, PCBs, and TCDD equivalents, among others). Per the Ocean Plan, if individual congeners or sub-components are below the MRL, they are assumed to be zero for the purposes of calculating the aggregate parameter.

Combining different types of waters: The above approach was used for both combining different source waters (*i.e.*, estimating future secondary effluent concentrations based on a flow-weighted average of source water contributions) and for combining the different discharge components (*i.e.*, RTP secondary effluent, hauled waste, and RO concentrate). For each constituent:

- ***When all waters had maximum values reported above the MRL*:** The flow-weighted average of the maximum detected concentrations was used when all waters had values reported above the MRL.
- ***When some or all waters had maximum values reported as less than the MRL*:**
    - o When the MRL was at least two orders of magnitude greater (*i.e.*, at least 100 times greater) than the highest *detected* value from the other waters, only the detected value was used. This case is exclusive to times when CCLEAN data were reported as detections for the RTP secondary effluent, and all the other source waters were below the MRL[4] (*e.g.*, hexachlorobutadiene was detected at a concentration of 9.0×10^{-6} µg/L in the secondary effluent via CCLEAN, and the MRL of all other source waters was 0.5 µg/L). The analytical methods used for CCLEAN can detect concentrations many orders of magnitude below the detection limits for traditional methods, and thus to include the MRL value from the other methods would overshadow the CCLEAN data. Additionally, in cases where the traditional analytical method had an MRL greater than the Ocean Plan objective, performing the analysis using the high MRL from the non-CCLEAN methods would result in an inability to make a compliance determination for these constituents.

[4] Specifically, this case applies to endrin, fluoranthene, chlordane, heptachlor epoxide, hexachlorobenzene, hexachlorobutadiene, PCBs, and toxaphene.

- o When the MRL was not at least two orders of magnitude greater (*i.e.*, less than 100 times greater) than the highest detected value from the other waters, the constituents were reported as less than the MRL and were assumed to have a concentration equal to the MRL for the purposes of calculating a flow-weighted average (*e.g.*, mercury was detected in the secondary effluent at a concentration of 0.019 µg/L, but was not detected in any other source waters, where the MRL was 0.2 µg/L).

There were some exceptions to the analytical approach described above. When considering the effect of upstream treatment processes on the concentration of constituents, dieldrin and DDT were further assessed because they were detected in some of the new source waters. RTP sampling and bench-scale testing were conducted for these constituents to determine removal through the RTP, ozone and MF processes. The results presented represent calculated values assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, 36% and 44% removal through ozone for DDT and dieldrin, respectively, 92% and 97% removal through MF for DDT and dieldrin, respectively, recycling of the MF backwash to the RTP, complete rejection through the RO membrane, and an 81% RO recovery (Trussell Tech, 2016b).

When considering the worst-case concentrations of each constituent in the various source waters, the highest concentration was selected for all constituents except copper and ammonia. The maximum six-month median for ammonia was calculated using monthly data from 2000 to 2019 since the minimum Ocean Plan objective for ammonia is a running six-month median value. Similarly, the median copper concentration was calculated based on available data; however, because the dataset was limited with low data collection frequency, the median was calculated based on all available data, not a six-month median.

Additional information about the methodology used and the sources of data for each type of water is further described in the following subsections.

Estimated Secondary Effluent for the Project with Proposed Modifications

The Project involves bringing new source waters into the RTP; accordingly, the water quality of those source waters, as well as the existing secondary effluent, was taken into account to estimate the quality of the secondary effluent for the Project with Proposed Modifications. Although the new source waters will be brought into the RTP influent, as described previously it was assumed that no removal of constituents occurred through the RTP when calculating the secondary effluent worst-case concentrations (except dieldrin and DDT, as described in the previous section). The following sources of data were considered for determining an existing secondary effluent concentration for each constituent in the analysis:

- Source water monitoring conducted for the Project from July 2013 through June 2014 for the secondary effluent, SIWW, and Blanco Drain
- Local Limits Sampling results for the secondary effluent, Blanco Drain, and Reclamation Ditch (2018)

- NPDES storm water discharge monitoring for the City of Salinas (2012 – 2017) and the Waste Discharge Requirements (WDRs) permit monitoring for the Salinas Industrial Wastewater Treatment Facility (2017)
- RTP historical NPDES compliance data collected semi-annually by M1W (2005 – Fall 2018)
- Historical NPDES RTP Priority Pollutant data collected annually by M1W (2004 – 2018)
- Data collected semi-annually by the Central Coast Long-Term Environmental Assessment Network (CCLEAN) (2008 – 2019)

Limited data sources were available for several of the new source waters (*i.e.*, Farmworker Housing and Salinas River Diversion Facility backwash). SIWW and Blanco Drain water quality data was collected during the source water monitoring conducted for the Project as well as the Local Limits sampling effort. NPDES storm water discharge monitoring for the City of Salinas (2012 – 2017) and for the WDR permit monitoring for the Salinas Industrial Wastewater Treatment Facility (2017) provided additional data for the Reclamation Ditch and the SIWW.

AWPF RO Concentrate

Two potential worst-case estimates of constituent concentrations were available for assessing the expanded Project's RO concentrate:

- RO concentrate measurements from pilot testing
- Calculations from the blended future secondary effluent, using the following treatment assumptions[5]:
    - No removal prior to the RO process (*i.e.,* no removal through the RTP or AWPF ozone or MF), except for dieldrin and DDT
    - 81% RO recovery (*i.e.,* of the water feeding into the RO system, 81% is product water, also known as permeate, and 19% is the RO concentrate)
    - Complete rejection of each constituent by the RO membrane (i.e., 100% of the constituent is in the RO concentrate)

The higher of these two values was selected as the final concentration of the RO concentrate for all constituents, except as noted in the Table 1 footnotes.

Hauled Waste

Two potential values were available for the hauled waste constituent concentrations:

- Historical NPDES compliance data collected semi-annually by M1W (2005-Spring 2017) of hauled waste diluted with existing secondary effluent
- Calculated future secondary effluent constituent concentrations, as previously described.

[5] Based on the treatment assumptions, the RO concentrate would equal 5.3 times the AWPF influent (*i.e.*, blended future secondary effluent) concentration.

The hauled waste has historically been diluted with secondary effluent prior to discharge. However, M1W is not intending to dilute the hauled waste in future operations when the AWPF is producing water. Due to limited water quality data from undiluted hauled waste, the higher concentration from the two data sources listed above was selected for all constituents. Even if a constituent was not present in the hauled waste, if it was present in the secondary effluent it would be present in the combined discharge.

3.1.3 Combined Ocean Discharge Concentrations

The combined concentration prior to discharge was determined as a flow-weighted average of the contributions of each discharge component. Depending on water usage for agricultural irrigation, the amount of secondary effluent discharged to the ocean will vary. A range of potential discharge scenarios was considered to encompass the worst-case water quality conditions of the combined discharge, as described in Section 4.2.

3.2 Ocean Modeling and Compliance Analysis Methodology

The second and third steps of the analysis involved estimating ocean dilution and comparing estimated diluted discharged concentrations to the Ocean Plan objectives. Trussell Tech used: (1) the calculated in-pipe concentration (*i.e.*, pre-ocean dilution) of a constituent ($C_{in\text{-}pipe}$) as described in the previous section, (2) the minimum probable dilution for ocean mixing (D_m) for the relevant discharge flow scenarios modeled by LWA, and (3) the background concentration of the constituent in the ocean ($C_{Background}$) that is specified in the Ocean Plan's "Table 3." With this information, the concentration at the edge of the zone of initial dilution (C_{ZID}) was calculated using the following equation:

$$C_{ZID} = \frac{C_{In-pipe} + D_m * C_{Background}}{1 + D_m} \quad (1)$$

The C_{ZID} was then compared to the Ocean Plan objectives[6] in the Ocean Plan's "Table 1" (SWRCB, 2015). The D_m values for various flow scenarios were determined by ocean modeling. Note that this approach could not be applied for some constituents (*e.g.*, acute toxicity, chronic toxicity, and radioactivity[7]).

To model the extent of ocean mixing achieved during discharge, LWA used the mathematical model UM_3 in the United States Environmental Protection Agency's (EPA's) Visual Plume suite. The variation in ocean conditions throughout the year was considered in the model,

[6] Note that the Ocean Plan (see Ocean Plan Table 2) also defines effluent limitations for oil and grease, suspended solids, settable solids, turbidity, and pH. These parameters were not evaluated in this assessment. It is assumed that, if necessary, the pH of the water would be adjusted to be within acceptable limits prior to discharge; the current AWPF design does not include the ability to change the RO concentrate pH because pilot testing and RO performance modeling indicated it was not necessary. Oil and grease, suspended solids, settable solids, and turbidity in the RO concentrate are expected to be significantly lower than the secondary effluent. Prior to the RO treatment, the process flow will be treated by MF, which will reduce these parameters, and the waste stream from the MF will be returned to RTP headworks.

[7] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives (Trussell Technologies, 2015a and 2016a).

and three conditions were modeled for all flow scenarios: Davidson (December to February), Upwelling (March to September), and Oceanic (October to November)[8]. To conservatively demonstrate Ocean Plan compliance, the lowest D_m from the applicable ocean conditions was used for each flow scenario. Additional analysis assumptions were made as follows:

- **Flow**: A sensitivity analysis of the relationship between D_m and flow rate was performed for the various discharge types. The greatest D_m sensitivity to flow changes was determined to be from variations in the RTP secondary effluent flow. To simplify the analysis, the flow scenarios used in the compliance analysis only considered the maximum flows for the hauled waste and the RO concentrate because these flows result in the lowest D_m, thus making the analysis conservative. The flows considered for each discharge type are as follows:
  - ***Secondary effluent***: a range of conditions was modeled that reflect realistic future discharge scenarios (minimum flow, moderate flow, and maximum flow).
  - ***Project RO concentrate***: 1.78 mgd, which would be the resulting RO concentrate flow when the AWPF is producing 7.6 mgd of highly-purified recycled water. Although the AWPF will not be operated at this flowrate year-round, this is the highest potential RO concentrate flow and therefore the most conservative assessment.
  - ***Hauled waste:*** A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded when determining the D_m value. However, the impact of hauled waste on assumed in-pipe water quality was still assessed. A hauled waste flow of 0.05 mgd was used for calculating the in-pipe concentrations of each constituent.
- **Total Dissolved Solids**: the greatest dilution is achieved when the salinity of the discharge water is lower and the most different from the ambient ocean salinity; therefore, the most conservative total dissolved solids (TDS) will be the highest (*i.e.*, closest to ambient ocean salinity) of:
  - ***Secondary effluent:*** 1,200 milligram per liter (mg/L), which is the maximum expected future TDS, taking into account the flow contribution of each source water and the maximum observed TDS value from each source water
  - ***Project RO concentrate***: 6,200 mg/L, which is the maximum expected future TDS based on the maximum expected future secondary effluent TDS and the RO treatment assumptions listed in the section above.
- **Ocean salinity**: 32,070 mg/L to– 34,260 mg/L, depending on the ocean condition
- **Temperature**:
  - ***Secondary effluent***: 20˚C
  - ***Project RO concentrate***: 20˚C

The goal of ocean dilution modeling was to cover the full range of potential operating conditions. Representative flowrate ranges were chosen to simplify the calculation and presentation of these results. The balance between in-pipe dilution and dilution through the

[8] Note that these ranges assign the transitional months (March, September, and November) to the ocean condition that is typically more restrictive at relevant discharge flows.

outfall was considered in selecting the representative flow scenarios for compliance assessment. In general, higher secondary effluent flows discharged to the ocean will provide dilution of the Project RO concentrate; however, greater dilution due to ocean water mixing occurs at lower wastewater discharge flows. The balance of these influences was considered in determining compliance under the ten representative discharge conditions that are described in Section 4.2 for the Project.

4 Ocean Plan Compliance Results

4.1 Water Quality of Combined Discharge

A summary of the estimated worst-case water qualities for each component is given in Table 1. Additional considerations and assumptions for each constituent are documented in the Table 1 notes section.

Table 1 – Summary of estimated worst-case water quality for the three waste streams that would be discharged through the ocean outfall

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Ocean Plan water quality objectives for protection of marine aquatic life					
Arsenic	µg/L	45	45	12	1,11
Cadmium	µg/L	1.1	1.1	5.8	2,10
Chromium (Hexavalent)	µg/L	11.0	130	58	1,10
Copper	µg/L	13.7	39	72	2,10,15
Lead	µg/L	0.83	0.83	4.4	2,10
Mercury	µg/L	0.075	8.1	0.51	5,11
Nickel	µg/L	11.0	11.0	58	2,10
Selenium	µg/L	44.0	75	232	1,10
Silver	µg/L	0.25	0.25	1.32	2,10
Zinc	µg/L	51.9	170.0	273	2,10
Cyanide	µg/L	92.7	92.7	143	2,11
Total Chlorine Residual	µg/L	ND(<200)	ND(<200)	ND(<200)	n/a
Ammonia (as N), 6-month median	µg/L	43,950	43,950	231,316	9
Ammonia (as N), daily maximum	µg/L	49,700	49,700	261,579	1,10,16
Acute Toxicity	TUa	2.3	2.3	0.77	1,10,16
Chronic Toxicity	TUc	40	40	100	1,6,11
Phenolic Compounds (non-chlorinated)	µg/L	69	69	363	1,6,11
Chlorinated Phenolics	µg/L	ND(<20)	ND(<20)	ND(<20)	1,8,10
Endosulfan	µg/L	0.045	0.045	0.24	4,10
Endrin	µg/L	0.000113	0.000113	0.00059	5,8,10
HCH (Hexachlorocyclohexane)	µg/L	0.054	0.054	0.287	3,10
Radioactivity (Gross Beta)	pCi/L	32	307	34.8	5,8,10
Radioactivity (Gross Alpha)	pCi/L	18	457	14.4	1,6,11
Objectives for protection of human health - noncarcinogens					
Acrolein	µg/L	7.9	7.9	42	2,10
Antimony	µg/L	1.02	1.02	5.4	2,10
Bis (2-chloroethoxy) methane	µg/L	3.3	3.3	1.0	5,13
Bis (2-chloroisopropyl) ether	µg/L	ND(<3.5)	ND(<3.5)	ND(<1)	4,13
Chlorobenzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
Chromium (III)	µg/L	6.9	87	36	2,10
Di-n-butyl phthalate	µg/L	ND(<6)	ND(<6)	ND(<1)	4,13
Dichlorobenzenes	µg/L	1.6	1.6	8.4	5,10

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Diethyl phthalate	µg/L	0.46	5	1	5,13
Dimethyl phthalate	µg/L	ND(<2)	ND(<2)	ND(<0.5)	4,13
4,6-dinitro-2-methylphenol	µg/L	35	35	5	5,13
2,4-dinitrophenol	µg/L	ND(<7.2)	ND(<7.2)	ND(<5)	4,13
Ethylbenzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
Fluoranthene	µg/L	0.0079	0.0079	0.0417	3,10
Hexachlorocyclopentadiene	µg/L	ND(<1.7)	ND(<1.7)	ND(<0.05)	4,13
Nitrobenzene	µg/L	ND(<1.9)	ND(<1.9)	ND(<1)	4,13
Thallium	µg/L	0.33	0.50	1.7	2,10
Toluene	µg/L	0.47	0.47	2.5	5,10
Tributyltin	µg/L	ND(<0.06)	ND(<0.06)	ND(<0.02)	4,13
1,1,1-trichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
Objectives for protection of human health - carcinogens					
Acrylonitrile	µg/L	3.5	3.5	19	2,10
Aldrin	µg/L	ND(<0.01)	ND(<0.01)	ND(<0.01)	4,13
Benzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
Benzidine	µg/L	ND(<15.9)	ND(<15.9)	ND(<0.05)	4,13
Beryllium	µg/L	ND(<0.64)	0.07	ND(<0.5)	4,13
Bis(2-chloroethyl)ether	µg/L	ND(<3.5)	ND(<3.5)	ND(<1)	4,13
Bis(2-ethyl-hexyl)phthalate	µg/L	78	78	411	1,10
Carbon tetrachloride	µg/L	0.5	0.5	2.63	2,10
Chlordane	µg/L	0.00122	0.00122	0.0064	3,8,10
Chlorodibromomethane	µg/L	1.9	1.9	10	2,10
Chloroform	µg/L	31	31	163	2,10
DDT	µg/L	0.0018	0.0018	0.0002	8,10,14
1,4-dichlorobenzene	µg/L	1.6	1.6	8.4	5,10
3,3-dichlorobenzidine	µg/L	ND(<15.6)	ND(<15.6)	ND(<2)	4,13
1,2-dichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
1,1-dichloroethylene	µg/L	ND(<0.5)	0.5	ND(<0.5)	4,13
Dichlorobromomethane	µg/L	4.9	4.9	26	2,10
Dichloromethane (methylenechloride)	µg/L	1.60	1.60	8.4	1,10
1,3-dichloropropene	µg/L	0.54	0.54	2.8	2,10
Dieldrin	µg/L	0.0030	0.0030	0.0008	2,10,14
2,4-dinitrotoluene	µg/L	ND(<2)	ND(<2)	ND(<0.1)	4,13
1,2-diphenylhydrazine (azobenzene)	µg/L	ND(<3.5)	ND(<3.5)	ND(<1)	4,13
Halomethanes	µg/L	1.2	1.2	6.4	8,10
Heptachlor	µg/L	ND(<0.02)	ND(<0.02)	ND(<0.01)	4,13
Heptachlor epoxide	µg/L	0.000088	0.000088	0.000463	3,10
Hexachlorobenzene	µg/L	0.000088	0.000088	0.000463	3,10
Hexachlorobutadiene	µg/L	0.000009	0.000009	0.000047	3,10
Hexachloroethane	µg/L	ND(<1.9)	ND(<1.9)	ND(<0.5)	4,13
Isophorone	µg/L	ND(<0.7)	ND(<0.7)	ND(<0.5)	4,13
N-Nitrosodimethylamine	µg/L	0.871	0.871	0.150	2,11,12
N-Nitrosodi-N-Propylamine	µg/L	0.455	0.455	0.019	5,11,12
N-Nitrosodiphenylamine	µg/L	ND(<1.9)	ND(<1.9)	ND(<1)	4,13
PAHs	µg/L	0.44	0.44	2.32	5,10
PCBs	µg/L	0.00119	0.00119	0.00628	3,8,10
TCDD Equivalents	µg/L	1.37E-07	1.37E-07	7.23E-07	7,8,10
1,1,2,2-tetrachloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
Tetrachloroethylene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
Toxaphene	µg/L	0.0071	0.0071	0.0373	3,10
Trichloroethylene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
1,1,2-trichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,13
2,4,6-trichlorophenol	µg/L	ND(<1.9)	ND(<1.9)	ND(<1)	4,13
Vinyl chloride	µg/L	0.22	0.22	1.15	5,10

Table 1 Notes:

RTP Effluent and Hauled Waste Data

1. Existing RTP effluent exceeds concentrations observed in other proposed source waters; the value reported is the existing secondary effluent value.
2. The proposed new source waters may increase the secondary effluent concentration; the value reported is based on estimated source water blends.
3. RTP effluent value is based on CCLEAN data; no other source waters were considered due to MRL differences.
4. MRL provided represents the maximum flow-weighted MRL based on the blend of source waters.
5. The only water with a detected concentration was the RTP effluent, however the flow-weighted concentration increases due to higher MRLs for the proposed new source waters.
6. Calculation of the flow-weighted concentration was not feasible due to the constituent, and so the maximum observed value is reported.
7. SIWW data are based on an aerated sample, instead of a raw water sample.
8. This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.
9. For all waters, dechlorination will be provided when needed such that the total chlorine residual will be below detection.

RO Concentrate Data

10. The value presented represents a calculated value assuming no removal prior to RO, complete rejection through RO membrane, and an 81% RO recovery.
11. The value represents the maximum value observed during the pilot testing study.
12. The calculated value for the RO concentrate data (described in note 11) was not used in the analysis because it was not considered representative. It is expected that the value would increase as a result of treatment through the AWPF (e.g. formation of N-Nitrosodimethylamine as a disinfection by-product), or that it will not concentrate linearly through the RO (e.g. toxicity and radioactivity).
13. The MRL provided represents the limit from the source water and pilot testing monitoring programs.

General

14. The value presented represents a calculated value assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, 36% and 44% removal through ozone for DDT and dieldrin, respectively, 92% and 97% removal through MF for DDT and dieldrin, respectively, recycling of the MF backwash to the RTP, complete rejection through the RO membrane, and an 81% RO recovery. The assumed removals are based on results from ozone bench-scale testing of Blanco Drain water blended with secondary effluent and low detection sampling through the RTP.
15. The value reported for the secondary effluent was calculated using the median of the data collected for the new source waters and is an estimate of the potential increase in concentration of the secondary effluent based on estimated source water blends. The median value was used because the maximum values detected in new source waters appear to be outliers, and because the Ocean Plan objective is a 6-month median concentration, it is reasonable to use the median value detected from these source waters.
16. Ammonia (as N) represents the total ammonia concentration, i.e. the sum of unionized ammonia (NH3) and ionized ammonia (NH4).

4.2 Ocean Modeling Results

LWA modeled various ocean discharge scenarios that included combinations of RTP secondary effluent, hauled waste, and Project RO concentrate (Appendix A). Year-round compliance with the Ocean Plan objectives was assessed through the evaluation of ten representative discharge scenarios covering the expected range of secondary effluent discharge flows. These scenarios encompass the best- and worse-case ocean dilution conditions. All scenarios assume the maximum flow rate of RO concentrate, which is a conservative assumption in terms of constituent loading and minimum dilution.

The ten scenarios used for the compliance assessment, in terms of secondary effluent flow rates to be discharged with the other waste streams, are shown in Table 2, and include:

- **Minimum Wastewater Flow – Scenario 1:** the maximum influence of the Project RO concentrate on the ocean discharge (*i.e.*, no secondary effluent discharged). The Oceanic ocean condition was used since it represents the worst-case dilution for this flow scenario.
- **Low Wastewater Flow – Scenarios 2-3:** significant influence of the Project RO concentrate on the ocean discharge (*i.e.*, minimal secondary effluent discharged). The Oceanic ocean condition was used as it represents the worst-case dilution for these flow scenarios.
- **Moderate Wastewater Flow – Scenarios 4-7:** conditions with a moderate wastewater flow when the Project RO concentrate has a greater influence on the in-pipe water quality than in Scenario 8, but where the ocean dilution (D_m) is reduced due to the higher overall discharge flow (*i.e.*, compared to Scenarios 1-3). The Oceanic or Upwelling ocean conditions were used as they represent the worst-case dilution for these scenarios.
- **High Wastewater Flow – Scenarios 8-10:** conditions with high wastewater flow. The Upwelling ocean condition was used as it represents the worst-case dilution for these flow scenarios.

Table 2 – Flow scenarios to determine modeled D_m values used for Ocean Plan compliance analysis

Flow Scenario No.	Discharge Flows (mgd)			D_m [2]	Ocean Condition
	Secondary Effluent	RO Concentrate	Blended Hauled Waste [1]		
1	0	1.78	0	451	Oceanic
2	0.4	1.78	0	431	Oceanic
3	0.6	1.78	0	422	Oceanic
4	2	1.78	0	372	Oceanic
5	4	1.78	0	324	Upwelling
6	4.5	1.78	0	314	Upwelling
7	5	1.78	0	306	Upwelling
8	10	1.78	0	249	Upwelling
9	18	1.78	0	206	Upwelling
10	29.6	1.78	0	175	Upwelling

1: A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded from the D_m calculation.
2: The Ocean Plan defines D_m differently than typical modeling software. LWA provided dilution results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S - 1$. A value of 1 was subtracted from the dilution estimates provided by LWA prior to using Equation 1, and the D_m values used in the analysis are presented in this table.

4.3 Ocean Plan Compliance Results

The flow-weighted in-pipe concentration for each constituent was calculated for each modeled discharge scenario using the water quality presented in Table 1 and the flows presented in Table 2. The in-pipe concentration was then used to calculate the concentration at the edge of the ZID using the D_m values presented in Table 2. The resulting concentrations for each constituent in each scenario were compared to the Ocean Plan objective to assess compliance. The estimated concentrations for all ten flow scenarios are presented as concentrations at the edge of the ZID (Table 3) and as a percentage of the Ocean Plan objective (Table 4). As shown, none of the constituents are expected to exceed their Ocean Plan objective[9]. Ammonia is estimated to reach a concentration closest to its objective, where it is 82% of the objective in Scenario 1.

[9] Aldrin, benzidine, 3,3-dichlorobenzidine and heptachlor were not detected in any source waters, however their MRLs are greater than their Ocean Plan objectives. Therefore, no percentages are presented Table 4 as no compliance conclusions can be drawn for these constituents. This is a common occurrence for ocean discharges because the MRL is higher than the ocean plan objective for some constituents.

Table 3 – Estimated concentrations of Ocean Plan constituents at the edge of the ZID

Constituent	Units	Ocean Plan Objective	Estimated Concentrations at Edge of ZID by Discharge Scenario									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life												
Arsenic	µg/L	8	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.2	3.2
Cadmium	µg/L	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chromium (Hexavalent)	µg/L	2	0.14	0.12	0.12	0.10	0.08	0.08	0.08	0.08	0.08	0.08
Copper	µg/L	3	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Lead	µg/L	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mercury	µg/L	0.04	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
Nickel	µg/L	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Selenium	µg/L	15	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3
Silver	µg/L	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Zinc	µg/L	20	8.6	8.5	8.5	8.4	8.3	8.3	8.3	8.3	8.3	8.3
Cyanide	µg/L	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5
Total Chlorine Residual	µg/L	2	–	–	–	–	–	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	490	441	422	348	310	305	302	288	294	310
Ammonia (as N) - Daily Max	µg/L	2,400	–	–	–	–	–	–	–	–	–	–
Acute Toxicity[a]	TUa	0.3										
Chronic Toxicity[a]	TUc	1										
Phenolic Compounds (non-chlorinated)	µg/L	30	0.8	0.7	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chlorinated Phenolics	µg/L	1	<0.04	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan	µg/L	0.009	5E-04	5E-04	4E-04	4E-04	3E-04	3E-04	3E-04	3E-04	3E-04	3E-04
Endrin	µg/L	0.002	1E-06	1E-06	1E-06	9E-07	8E-07	8E-07	8E-07	7E-07	8E-07	8E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	6E-04	5E-04	5E-04	4E-04	4E-04	4E-04	4E-04	4E-04	4E-04	4E-04
Radioactivity (Gross Beta)[a]	pci/L	–										
Radioactivity (Gross Alpha)[a]	pci/L	–										
Objectives for protection of human health - noncarcinogens												
Acrolein	µg/L	220	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Antimony	µg/L	1200	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Bis (2-chloroethoxy) methane	µg/L	4.4	0.002	0.003	0.004	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.003	<0.004	<0.004	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02
Chlorobenzene	µg/L	570	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
Chromium (III)	µg/L	190000	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.05
Di-n-butyl phthalate	µg/L	3500	<0.003	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.03	<0.03
Dichlorobenzenes	µg/L	5100	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Diethyl phthalate	µg/L	33000	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003
Dimethyl phthalate	µg/L	820000	<0.001	<0.002	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.01
4,6-dinitro-2-methylphenol	µg/L	220	0.01	0.03	0.03	0.1	0.1	0.1	0.1	0.1	0.2	0.2
2,4-Dinitrophenol	µg/L	4.0	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.02	<0.03	<0.03	<0.04
Ethylbenzene	µg/L	4100	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
Fluoranthene	µg/L	15	9E-05	8E-05	8E-05	6E-05	6E-05	6E-05	5E-05	5E-05	5E-05	6E-05
Hexachlorocyclopentadiene	µg/L	58	<3E-04	<1E-03	<1E-03	<3E-03	<4E-03	<4E-03	<4E-03	<6E-03	<8E-03	<9E-03
Nitrobenzene	µg/L	4.9	<0.002	<0.003	<0.003	<0.004	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	µg/L	2	0.004	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002
Toluene	µg/L	85000	0.01	0.005	0.005	0.004	0.003	0.003	0.003	0.003	0.003	0.003
Tributyltin	µg/L	0.0014	<5E-05	<7E-05	<8E-05	<1E-04	<2E-04	<2E-04	<2E-04	<2E-04	<3E-04	<3E-04
1,1,1-Trichloroethane	µg/L	540000	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
Objectives for protection of human health - carcinogens												
Acrylonitrile	µg/L	0.10	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.03
Aldrin[b]	µg/L	0.000022	<2E-05	<2E-05	<2E-05	<3E-05	<3E-05	<3E-05	<3E-05	<4E-05	<5E-05	<6E-05

Constituent	Units	Ocean Plan Objective	Estimated Concentrations at Edge of ZID by Discharge Scenario									
			1	2	3	4	5	6	7	8	9	10
Benzene	µg/L	5.9	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
Benzidine[b]	µg/L	0.000069	<0.002	<0.01	<0.01	<0.02	<0.03	<0.04	<0.04	<0.1	<0.1	<0.1
Beryllium	µg/L	0.033	1E-03	1E-03	1E-03	2E-03	2E-03	2E-03	2E-03	2E-03	3E-03	4E-03
Bis(2-chloroethyl)ether	µg/L	0.045	<0.003	<0.004	<0.004	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.6
Carbon tetrachloride	µg/L	0.90	0.01	0.01	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.004
Chlordane	µg/L	0.000023	1E-05	1E-05	1E-05	1E-05	9E-06	8E-06	8E-06	8E-06	8E-06	9E-06
Chlorodibromomethane	µg/L	8.6	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chloroform	µg/L	130	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DDT	µg/L	0.00017	6E-07	1E-06	1E-06	3E-06	4E-06	4E-06	5E-06	6E-06	8E-06	1E-05
1,4-Dichlorobenzene	µg/L	18	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
3,3-Dichlorobenzidine[b]	µg/L	0.0081	<0.01	<0.01	<0.01	<0.03	<0.04	<0.04	<0.04	<0.1	<0.1	<0.1
1,2-Dichloroethane	µg/L	28	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
1,1-Dichloroethylene	µg/L	0.9	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.003
Dichlorobromomethane	µg/L	6.2	0.1	0.0	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Dichloromethane (methylenechloride)	µg/L	450	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,3-dichloropropene	µg/L	8.9	0.01	0.01	0.01	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Dieldrin	µg/L	0.00004	2E-06	3E-06	3E-06	5E-06	7E-06	8E-06	8E-06	1E-05	1E-05	2E-05
2,4-Dinitrotoluene	µg/L	2.6	<0.000	<0.001	<0.002	<0.003	<0.004	<0.005	<0.005	<0.01	<0.01	<0.01
1,2-Diphenylhydrazine (azobenzene)	µg/L	0.16	<0.003	<0.004	<0.004	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02
Halomethanes	µg/L	130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Heptachlor[b]	µg/L	0.00005	<2E-05	<3E-05	<3E-05	<4E-05	<4E-05	<4E-05	<5E-05	<6E-05	<7E-05	<9E-05
Heptachlor Epoxide	µg/L	0.00002	1E-06	9E-07	8E-07	7E-07	6E-07	6E-07	6E-07	6E-07	6E-07	6E-07
Hexachlorobenzene	µg/L	0.00021	1E-06	9E-07	8E-07	7E-07	6E-07	6E-07	6E-07	6E-07	6E-07	6E-07
Hexachlorobutadiene	µg/L	14	1E-07	9E-08	9E-08	7E-08	6E-08	6E-08	6E-08	6E-08	6E-08	6E-08
Hexachloroethane	µg/L	2.5	<0.001	<0.002	<0.002	<0.003	<0.005	<0.005	<0.005	<0.007	<0.009	<0.011
Isophorone	µg/L	730	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.003	<0.003	<0.004
N-Nitrosodimethylamine	µg/L	7.3	0.0004	0.001	0.001	0.001	0.002	0.002	0.002	0.003	0.004	0.005
N-Nitrosodi-N-Propylamine	µg/L	0.38	9E-05	3E-04	3E-04	7E-04	1E-03	1E-03	1E-03	2E-03	2E-03	2E-03
N-Nitrosodiphenylamine	µg/L	2.5	<0.002	<0.003	<0.003	<0.004	<0.005	<0.005	<0.005	<0.007	<0.009	<0.011
PAHs	µg/L	0.0088	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.003
PCBs	µg/L	0.000019	1E-05	1E-05	1E-05	9E-06	8E-06	8E-06	8E-06	8E-06	8E-06	8E-06
TCDD Equivalents	µg/L	3.9E-09	2E-09	1E-09	1E-09	1E-09	1E-09	1E-09	9E-10	9E-10	9E-10	1E-09
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
Tetrachloroethylene	µg/L	2.0	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
Toxaphene	µg/L	2.1E-04	8E-05	7E-05	7E-05	6E-05	5E-05	5E-05	5E-05	5E-05	5E-05	5E-05
Trichloroethylene	µg/L	27	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
1,1,2-Trichloroethane	µg/L	9.4	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.003
2,4,6-Trichlorophenol	µg/L	0.29	<0.002	<0.003	<0.003	<0.004	<0.005	<0.005	<0.005	<0.007	<0.009	<0.011
Vinyl chloride	µg/L	36	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the secondary effluent and RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives.

[b] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

Table 4 – Estimated concentrations of all COP constituents, expressed as percent of Ocean Plan Objective

Constituent	Units	Ocean Plan Objective	Estimated Percentage of Ocean Plan Objective at Edge of ZID by Discharge Scenario[c]									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life												
Arsenic	µg/L	8	38%	38%	38%	38%	39%	39%	39%	39%	40%	40%
Cadmium	µg/L	1	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Chromium (Hexavalent)	µg/L	2	7%	6%	6%	5%	4%	4%	4%	4%	4%	4%
Copper	µg/L	3	72%	71%	71%	70%	70%	70%	70%	69%	69%	70%
Lead	µg/L	2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mercury	µg/L	0.04	6%	6%	5%	4%	4%	4%	4%	3%	3%	3%
Nickel	µg/L	5	2%	2%	2%	2%	2%	2%	2%	1%	1%	2%
Selenium	µg/L	15	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%
Silver	µg/L	0.7	23%	23%	23%	23%	23%	23%	23%	23%	23%	23%
Zinc	µg/L	20	43%	43%	42%	42%	42%	42%	42%	42%	42%	42%
Cyanide	µg/L	1	31%	31%	30%	31%	33%	34%	34%	40%	47%	54%
Total Chlorine Residual	µg/L	2										
Ammonia (as N) - 6-mo median	µg/L	600	82%	73%	70%	58%	52%	51%	50%	48%	49%	52%
Ammonia (as N) - Daily Max	µg/L	2,400	–	–	–	–	–	–	–	–	–	–
Acute Toxicity[a]	TUa	0.3										
Chronic Toxicity[a]	TUc	1										
Phenolic Compounds (non-chlorinated)	µg/L	30	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Chlorinated Phenolics	µg/L	1	<4%	<5%	<5%	<5%	<6%	<6%	<7%	<8%	<10%	<11%
Endosulfan	µg/L	0.009	6%	5%	5%	4%	4%	4%	3%	3%	3%	4%
Endrin	µg/L	0.002	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HCH (Hexachlorocyclohexane)	µg/L	0.004	15%	14%	13%	11%	10%	9%	9%	9%	9%	10%
Radioactivity (Gross Beta)[a]	pci/L	–										
Radioactivity (Gross Alpha)[a]	pci/L	–										
Objectives for protection of human health - noncarcinogens												
Acrolein	µg/L	220	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Antimony	µg/L	1200	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bis (2-chloroethoxy) methane	µg/L	4.4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Chlorobenzene	µg/L	570	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Chromium (III)	µg/L	190000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Di-n-butyl phthalate	µg/L	3500	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Dichlorobenzenes	µg/L	5100	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Diethyl phthalate	µg/L	33000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dimethyl phthalate	µg/L	820000	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
4,6-dinitro-2-methylphenol	µg/L	220	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2,4-Dinitrophenol	µg/L	4.0	<0%	<0%	<0%	<0%	<1%	<1%	<1%	<1%	<1%	<1%
Ethylbenzene	µg/L	4100	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Fluoranthene	µg/L	15	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hexachlorocyclopentadiene	µg/L	58	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Nitrobenzene	µg/L	4.9	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Thallium	µg/L	2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Toluene	µg/L	85000	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tributyltin	µg/L	0.0014	<4%	<5%	<5%	<8%	<11%	<11%	<12%	<16%	<20%	<24%
1,1,1-Trichloroethane	µg/L	540000	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Objectives for protection of human health - carcinogens												
Acrylonitrile	µg/L	0.10	39%	35%	34%	28%	25%	25%	24%	23%	24%	25%

Constituent	Units	Ocean Plan Objective	Estimated Percentage of Ocean Plan Objective at Edge of ZID by Discharge Scenario[c]									
			1	2	3	4	5	6	7	8	9	10
Aldrin[b]	µg/L	0.000022	--	--	--	--	--	--	--	--	--	--
Benzene	µg/L	5.9	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Benzidine[b]	µg/L	0.000069	--	--	--	--	--	--	--	--	--	--
Beryllium	µg/L	0.033	3%	4%	4%	5%	5%	6%	6%	7%	9%	11%
Bis(2-chloroethyl)ether	µg/L	0.045	<6%	<8%	<9%	<14%	<19%	<20%	<21%	<28%	<35%	<42%
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	25%	22%	21%	18%	16%	15%	15%	15%	15%	16%
Carbon tetrachloride	µg/L	0.90	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%
Chlordane	µg/L	0.000023	59%	53%	51%	42%	37%	37%	36%	35%	35%	37%
Chlorodibromomethane	µg/L	8.6	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Chloroform	µg/L	130	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
DDT	µg/L	0.00017	0%	1%	1%	2%	2%	3%	3%	4%	5%	6%
1,4-Dichlorobenzene	µg/L	18	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3,3-Dichlorobenzidine[b]	µg/L	0.0081	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
1,1-Dichloroethylene	µg/L	0.9	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dichlorobromomethane	µg/L	6.2	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Dichloromethane (methylenechloride)	µg/L	450	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1,3-dichloropropene	µg/L	8.9	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dieldrin	µg/L	0.00004	5%	8%	9%	13%	18%	19%	20%	27%	34%	41%
2,4-Dinitrotoluene	µg/L	2.6	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
1,2-Diphenylhydrazine (azobenzene)	µg/L	0.16	<2%	<2%	<3%	<4%	<5%	<6%	<6%	<8%	<10%	<12%
Halomethanes	µg/L	130	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Heptachlor[b]	µg/L	0.00005	--	--	--	--	--	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	5%	4%	4%	3%	3%	3%	3%	3%	3%	3%
Hexachlorobenzene	µg/L	0.00021	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hexachlorobutadiene	µg/L	14	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hexachloroethane	µg/L	2.5	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Isophorone	µg/L	730	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
N-Nitrosodimethylamine	µg/L	7.3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%
N-Nitrosodiphenylamine	µg/L	2.5	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
PAHs	µg/L	0.0088	56%	50%	48%	40%	35%	35%	34%	33%	34%	35%
PCBs	µg/L	0.000019	70%	63%	60%	50%	44%	44%	43%	41%	42%	44%
TCDD Equivalents	µg/L	3.9E-09	39%	35%	34%	28%	25%	24%	24%	23%	24%	25%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Tetrachloroethylene	µg/L	2.0	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
Toxaphene	µg/L	2.1E-04	38%	34%	32%	27%	24%	23%	23%	22%	23%	24%
Trichloroethylene	µg/L	27	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
1,1,2-Trichloroethane	µg/L	9.4	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%	<0%
2,4,6-Trichlorophenol	µg/L	0.29	<1%	<1%	<1%	<1%	<2%	<2%	<2%	<2%	<3%	<4%
Vinyl chloride	µg/L	36	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the secondary effluent and RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives (see Section 4.4).
[b] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
[c] Note that if the percentage was determined to be less than 0.5 percent, then the value is shown as "0%" (*e.g.*, if the constituent was estimated to be 0.1% of the objective, for simplicity, it is displayed as 0%). Also, orange shading indicates constituent is expected to be greater than 80 percent of the ocean plan objective for that discharge scenario.

4.4 Toxicity

The current NPDES permit contains changes to the acute and chronic toxicity requirements compared to the previous permit, including the requirement to conduct toxicity testing four times per year, corresponding to each dilution factor in the new permit. The toxicity data evaluation process and reporting methods were also modified in the new permit to incorporate using the Test of Significant Toxicity (TST) method.

Although the NPDES permit is in effect now, toxicity testing of the combined discharge has not yet been done because the AWPF is under construction and is not producing recycled water. However, to understand the potential impact of RO concentrate on whole effluent toxicity of the discharge, toxicity testing was conducted of the RO concentrate produced during pilot plant operations (Trussell Technologies, 2015). A sample of RO concentrate collected on April 9, 2014 was sent to Pacific EcoRisk for acute and chronic toxicity analyses. The RO concentrate was diluted with filtered natural seawater and a range of RO concentrate dilutions were tested. The test samples ranged from 0.1% to 100% RO concentrate for acute toxicity and from 0.1% to 74.5% for chronic toxicity. The current NPDES permit requires testing of whole effluent dilutions ranging from 2.0% to 6.4% for acute toxicity and 0.21% to 0.69% for chronic toxicity, depending on the flow conditions during sampling and associated D_m values.

The acute toxicity testing during the pilot study showed no observable impact at 100% RO concentrate (i.e., the No Observed Effect Concentration (NOEC) was 100%). As specified in the NPDES permit, the associated D_m for a discharge consisting of only RO concentrate (no secondary effluent) corresponds to an acute toxicity instream waste concentration (IWC) of 2.0%, 50 times lower than the condition tested. Therefore, it is expected that the discharge will comply with the Ocean Plan objective for acute toxicity. The results from chronic toxicity testing during the pilot study showed the NOEC to be 1%. As specified in the NPDES Permit, the chronic toxicity IWC for discharge of RO concentrate only is 0.21%, five times lower than the condition tested. Due to this result, it is expected that the discharge will also comply with the Ocean Plan objective for chronic toxicity.

The toxicity results obtained during the 2014 RO concentrate study (described above) can be used to predict compliance using the TST evaluation method. LWA analyzed the data obtained from the 2014 RO concentrate study using the TST method, and the results are presented in Table 5. The TST makes a comparison to the control samples to determine a “Pass” or “Fail” result. There were two different control samples for acute toxicity evaluation and three different control samples for the chronic toxicity evaluation. Because the acute toxicity IWC in the NPDES permit is 2.0% for “RO Concentrate Only” and all results between 1% and 10% were “Pass,” a passing result can be predicted at the required IWC. Similarly, because the chronic toxicity IWC in the NPDES permit is 0.21% for “RO Concentrate Only” and all results between 0.1% and 1% were “Pass,” a passing result can be predicted at the required IWC.

Table 5 – TST analysis results of “RO Concentrate Only” from 2014 sample data

TST Results for Acute Testing:					
	Percent Effluent				
	0.1%	1%	10%	50%	100%
Lab Water Control	PASS	PASS	PASS	PASS	PASS
Zeolite Blank	PASS	PASS	PASS	PASS	FAIL
TST Results for Chronic Testing:					
	0.1%	1%	10%	50%	74.5%
Brine Control	PASS	PASS	FAIL	FAIL	FAIL
Lab Water Control	PASS	PASS	FAIL	FAIL	FAIL
Zeolite Blank	PASS	PASS	FAIL	FAIL	FAIL

5 Conclusions

The purpose of the analysis documented in this technical memorandum was to assess the ability of the expanded Project to comply with the numeric Ocean Plan water quality objectives. Trussell Tech developed a conservative approach for this analysis, which involved assuming the worst-case conditions for waste discharge such as (a) no constituent removal through treatment at the RTP (with exceptions discussed above), (b) worst-case constituent concentrations for each source water, (c) 100% rejection of constituents via RO, yielding a conservatively high concentration in the RO concentrate, and (d) the worst-case blends of available source waters to result in the highest constituent concentrations. Compliance assessments could not be made for select constituents, as noted, due to analytical limitations, but this is a common occurrence for these Ocean Plan constituents. Based on the data, assumptions, modeling, and analytical methodology presented in this technical memorandum, the expanded Project is expected to comply with all Ocean Plan objectives.

6 References

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Appendix A – Ocean Discharge Dilution Results (LWA)

Discharge Scenarios for the 7.6 MGD AWPF

	Discharge Flow (mgd)								2019 Dilution Results					
									UM3 Modeling Results			UM3 Modeling Results		
No.	RTP Secondary Effluent	Hauled Brine Waste	GWR Brine	Total Discharge	Density Upwelling	Density Davidson	Density Oceanic	D_m Used in Analysis	D_m Upwelling	D_m Davidson	D_m Oceanic	S Upwelling	S Davidson	S Oceanic
Pure Water Monterey GWR Project - 7.6 mgd AWPF														
A1	0.0	0	1.78	1.78	1,001.9	1,002.9	1,001.9	451.0	456.3	613.4	451.0	457.3	614.4	452.0
A2	0.1	0	1.78	1.88	1,001.7	1,002.7	1,001.7	445.7	451.7	605.7	445.7	452.7	606.7	446.7
A3	0.2	0	1.78	1.98	1,001.5	1,002.6	1,001.5	440.7	447.1	598.5	440.7	448.1	599.5	441.7
A4	0.3	0	1.78	2.08	1,001.4	1,002.4	1,001.4	435.4	442.2	591.1	435.4	443.2	592.1	436.4
A5	0.4	0	1.78	2.18	1,001.3	1,002.2	1,001.3	430.7	437.6	584.3	430.7	438.6	585.3	431.7
A6	0.5	0	1.78	2.28	1,001.1	1,002.1	1,001.1	426.0	433.0	577.4	426.0	434.0	578.4	427.0
A7	0.6	0	1.78	2.38	1,001.0	1,002.0	1,001.0	421.6	428.5	570.7	421.6	429.5	571.7	422.6
A8	0.7	0	1.78	2.48	1,000.9	1,001.9	1,000.9	417.2	424.1	564.2	417.2	425.1	565.2	418.2
A9	0.8	0	1.78	2.58	1,000.8	1,001.8	1,000.8	413.0	419.8	558.2	413.0	420.8	559.2	414.0
A10	1.0	0	1.78	2.78	1,000.6	1,001.6	1,000.6	405.0	411.5	546.8	405.0	412.5	547.8	406.0
A11	1.3	0	1.78	3.08	1,000.4	1,001.4	1,000.4	393.9	399.4	531.0	393.9	400.4	532.0	394.9
A12	1.5	0	1.78	3.28	1,000.3	1,001.2	1,000.3	387.0	391.8	521.5	387.0	392.8	522.5	388.0
A13	1.6	0	1.78	3.38	1,000.2	1,001.2	1,000.2	383.9	388.3	517.0	383.9	389.3	518.0	384.9
A14	1.8	0	1.78	3.58	1,000.1	1,001.0	1,000.1	377.7	381.2	508.4	377.7	382.2	509.4	378.7
A15	2.0	0	1.78	3.78	1,000.0	1,000.9	1,000.0	371.9	374.6	500.4	371.9	375.6	501.4	372.9
A16	2.5	0	1.78	4.28	999.8	1,000.7	999.8	358.7	359.5	482.8	358.7	360.5	483.8	359.7
A17	3.0	0	1.78	4.78	999.7	1,000.6	999.7	346.0	346.0	467.8	346.9	347.0	468.8	347.9
A18	3.5	0	1.78	5.28	999.5	1,000.4	999.5	334.1	334.1	454.7	336.7	335.1	455.7	337.7
A19	4.0	0	1.78	5.78	999.4	1,000.3	999.4	323.6	323.6	443.0	327.6	324.6	444.0	328.6
A20	4.5	0	1.78	6.28	999.3	1,000.2	999.3	314.2	314.2	432.2	319.3	315.2	433.2	320.3
A21	5.0	0	1.78	6.78	999.2	1,000.2	999.2	305.5	305.5	422.2	311.8	306.5	423.2	312.8
A22	5.5	0	1.78	7.28	999.2	1,000.1	999.2	297.8	297.8	412.7	304.8	298.8	413.7	305.8
A23	6.0	0	1.78	7.78	999.1	1,000.1	999.1	290.5	290.5	404.2	298.4	291.5	405.2	299.4
A24	7.0	0	1.78	8.78	999.0	1,000.0	999.0	277.9	277.9	388.7	287.0	278.9	389.7	288.0
A25	8.0	0	1.78	9.78	998.9	999.9	998.9	267.0	267.0	374.8	277.0	268.0	375.8	278.0
A26	9.0	0	1.78	10.78	998.9	999.8	998.9	257.6	257.6	362.3	268.1	258.6	363.3	269.1
A27	10.0	0	1.78	11.78	998.8	999.8	998.8	249.2	249.2	351.0	260.3	250.2	352.0	261.3
A28	12.0	0	1.78	13.78	998.7	999.7	998.7	235.2	235.2	331.5	246.8	236.2	332.5	247.8
A29	14.0	0	1.78	15.78	998.7	999.6	998.7	223.6	223.6	315.2	235.5	224.6	316.2	236.5
A30	18.0	0	1.78	19.78	998.6	999.5	998.6	205.9	205.9	289.3	217.8	206.9	290.3	218.8
A31	21.0	0	1.78	22.78	998.6	999.5	998.6	195.6	195.6	273.1	207.4	196.6	274.1	208.4
A32	22.0	0	1.78	23.78	998.5	999.5	998.5	192.6	192.6	268.0	204.4	193.6	269.0	205.4
A33	22.5	0	1.78	24.28	998.5	999.5	998.5	191.2	191.2	265.5	203.0	192.2	266.5	204.0
A34	23.0	0	1.78	24.78	998.5	999.5	998.5	189.8	189.8	263.1	201.6	190.8	264.1	202.6
A35	23.4	0	1.78	25.18	998.5	999.4	998.5	188.7	188.7	261.6	200.5	189.7	262.6	201.5
A36	29.6	0	1.78	31.38	998.5	999.4	998.5	174.7	174.7	236.5	186.2	175.7	237.5	187.2

Appendix K

Noise Assessment Report

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality
429 E. Cotati Avenue
Cotati, CA 94931
Tel: 707-794-0400 *Fax: 707-794-0405*
www.illingworthrodkin.com *illro@illingworthrodkin.com*

Technical Memo – Noise and Vibration

Date: **October 23, 2019**

To: **Denise Duffy, Denise Duffy & Associates, Inc.**

From: **Michael Thill, Illingworth & Rodkin, Inc.**

Subject: **Expanded Pure Water Monterey Groundwater Replenishment Project Noise and Vibration Assessment**
Job#19-142

This memo addresses changes to noise and vibration associated with the Expanded Pure Water Monterey Groundwater Replenishment Project.

Introduction

The Expanded Pure Water Monterey Groundwater Replenishment Project (PWM/GWR), proposed by MW1, is an expansion of the capacity of the Approved PWM/GWR Project that is currently under construction. As a back-up to the California American (CalAm) Monterey Peninsula Water Supply Project (MPWSP), the Expanded PWM/GWR Project would increase the amount of purified recycled water produced by the PWM/GWR Project. The PWM/GWR Project's Advanced Water Purification Facility would be expanded from the current 5 million gallons per day (mgd) plant to up to a 7.6 mgd maximum capacity plant. The proposed Expanded PWM/GWR Project also includes associated conveyance, injection and extraction facilities. The Expanded PWM/GWR Project would be located within northern Monterey County and would include facilities located within portions of unincorporated Monterey County and the City of Seaside, and near the City of Marina.

The PWM/GWR Project Final EIR (certified October 2015) analyzed the noise and vibration impacts from the approved project. The CPUC certified the MPWSP EIR/EIS, which included an evaluation of noise and vibration impacts, and approved the project in September 2018. This memo evaluates the potential noise and vibration impacts that could result from the Expanded PWM/GWR Project including temporary impacts during construction and long-term impacts during operation. The memo identifies sensitive receptors to noise and vibration that could be affected by the Expanded PWM/GWR Project, evaluates the potential effects of construction and operation on these receptors, and identifies mitigation measures as appropriate. Refer to the

PWM/GWR Project Final EIR for information on the fundamentals of noise and vibration and relevant noise and vibration regulations and Monterey County, the City of Seaside, and the City of Marina that continue to apply to the Expanded PWM/GWR Project.

Assessment of Noise and Vibration Impacts

The Expanded PWM/GWR Project includes the following components: 1) Improvements to Advanced Water Treatment Facility, 2) Product Water Conveyance System, 3) Expanded Injection Well Facilities, and 4) the CalAm Conveyance Pipeline and Extraction Wells. To increase the amount of water available to CalAm under the Expanded PWM/GWR Project, several changes to these PWM/GWR Project components would be required. The significance of noise and vibration impacts during construction and operation of each component are assessed. Measures to mitigate significant impacts are recommended.

Significance Criteria

Significance criteria are those used in the CFEIR for the PWM/GWR. Based on Appendix G of the CEQA Guidelines; applicable plans, policies, and/or guidelines described above; and agency and professional standards, the proposed project would cause a significant impact related to noise and vibration if the results indicate:

- Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

- Generation of excessive groundborne vibration or groundborne noise levels;

- For a project located within the vicinity of a private airstrip or an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, if the project would expose people residing or working in the project area to excessive noise levels.

The project's short-term construction impacts and long-term operational impacts on the ambient noise environment would be considered substantial if it would expose sensitive receptors or other identified land uses to noise levels in excess of regulatory standards or codes. In addition to concerns regarding the absolute noise level that might occur when a new source is introduced into an area, it is also important to consider the existing ambient noise environment. If the ambient noise environment is quiet and the new noise source greatly increases the noise exposure, even though a criterion level might not be exceeded, an impact may occur.

For both construction and operational noise, a "substantial" noise increase can be defined as an increase in noise levels to that which causes interference with activities normally associated with established nearby land uses during the day and/or night. One indicator that noise could interfere with daytime activities normally associated with residential land uses (for example) would be speech interference; whereas, an indicator that noise could interfere with nighttime activities normally associated with residential uses would be sleep interference. This analysis, therefore, uses the following criteria to define whether a temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the project would be substantial:

> *Speech Interference*. Speech interference is an indicator of an impact on daytime and evening activities typically associated with residential land uses, but which is also applicable to other similar land uses that are sensitive to excessive noise levels. Therefore, a speech interference criterion, in the context of impact duration and time of day, is used to identify substantial increases in ambient noise levels.
>
> Noise generated by construction equipment could result in speech interference in adjacent buildings if the noise level in the interior of the building were to exceed 45 to 60 dBA[1]. A typical building can reduce noise levels by 25 dBA with the windows closed (U.S. Environmental Protection Agency (EPA) 1974). This noise reduction could be maintained only on a temporary basis in some cases, since it assumes windows must remain closed at all times. Assuming a 25 dBA reduction with the windows closed, an exterior noise level of 70 dBA (L_{eq}) adjacent to a building would maintain an acceptable interior noise environment of 45 dBA. It should be noted that such noise levels would be sporadic rather than continuous in nature, because different types of construction equipment would be used throughout the construction process. Therefore, an exterior noise level in excess of 70 dBA L_{eq} during the daytime is used as the threshold for substantial construction noise.
>
> *Sleep Interference*. An interior nighttime level of 35 dBA is considered acceptable (U.S. EPA 1974). Assuming a 25 dBA reduction from a residential structure with the windows closed, an exterior noise level of 60 dBA adjacent to the building would maintain an acceptable interior noise environment of 35 dBA. An exterior threshold of 60 dBA L_{eq} is a reasonable threshold for short term impacts resulting from construction activities. With windows open, a typical house achieves an approximately 15-dBA reduction and, therefore, an exterior noise level of 50 dBA (L_{eq}) would be required to maintain an acceptable interior noise environment of 35 dBA. An exterior threshold of 60 dBA L_{eq} is a reasonable threshold for short term impacts resulting from long term operation of the Project.

The duration of exposure at any given noise-sensitive receptor is one consideration in determining an impact's significance. For example, this analysis generally assumes that temporary construction noise that occurs during the day for a relatively short period of time would not be significant. In addition, this analysis assumes that most people of average sensitivity that live in suburban or rural agricultural environments are accustomed to a certain amount of construction activity or heavy equipment noise from time to time. Therefore, for the purposes of this analysis, temporary exposure to construction noise levels that exceed the daytime speech interference threshold would not be considered to result in a substantial temporary increase in ambient noise levels if the duration is two weeks or less.

[1] For indoor noise environments, the highest noise level that permits relaxed conversation with 100 percent intelligibility throughout the room is 45 dBA. Speech interference is considered to become intolerable when normal conversation is precluded at three feet, which occurs when background noise levels exceed 60 dBA.

A numerical threshold to identify the point at which a vibration impact occurs has not been identified by local jurisdictions in the applicable standards or municipal codes. In the absence of local regulatory significance thresholds for vibration from construction equipment, it is appropriate to use the California Department of Transportation (Caltrans) identified PPV thresholds for risk of architectural damage to older residential dwellings, which is 0.30 in/sec. It is also appropriate to use the Caltrans identified PPV thresholds for perceptibility for long term operational vibration, which is 0.10 in/sec (Caltrans, 2013).

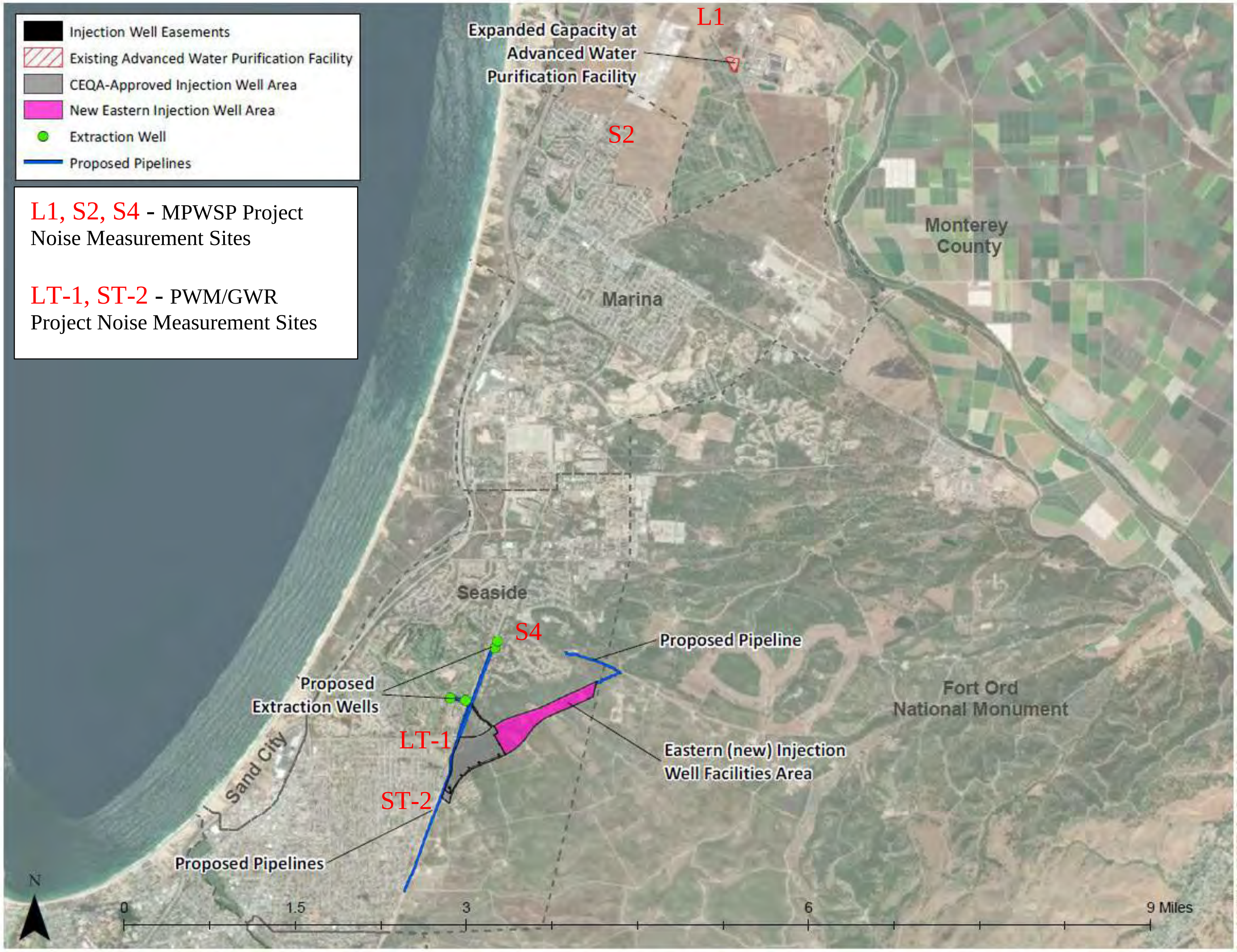
Regarding the last two significance criteria, because the Expanded PWM/GWR Project would not involve the development of noise-sensitive land uses that would be exposed to excessive aircraft noise, there would be no impacts associated with these criteria. Therefore, impacts associated with aviation noise are not addressed further in this memorandum.

This noise and vibration impact assessment evaluates short-term impacts associated with construction of the Expanded PWM/GWR Project. It also assesses long-term operational impacts (i.e., those resulting from operation of the expanded AWPF, injection well/back-flush facilities, and CalAm extraction wells). The impact discussion analyzes substantial increases in ambient noise levels in the vicinity of the facility sites. In addition, this assessment uses local noise standards and applicable daytime exceptions as the basis for significance thresholds related to "established" noise standards. The assessment of potential noise impacts was conducted using information on existing ambient noise levels and the anticipated noise that would be produced during construction and operation of the Project. The assessment of vibration impacts was conducted using information on anticipated vibration during construction and operation of the Project.

For the purposes of this analysis, only construction noise is considered under the criterion that addresses temporary or periodic increase in ambient noise. Periodic noise increases are defined herein as intermittent or short-term and only construction activities are consistent with this definition.

For clarity and efficiency, the following discussion of impacts and mitigation measures is organized by the action that causes the impact, these being construction noise, construction vibration, and operational noise and vibration. Each impact discussion addresses applicable checklist questions and presents measures to mitigate significant impacts that are identified. Figure 2-3 of the Project Description (Figure 1 of this report) is included for reference purposes.

Figure 1: Expanded Pure Water Monterey Project Overview Map and Receptors



Sensitive Receptors Near Project Components

The following paragraphs provide summary descriptions of the sensitive receptor locations in the vicinity of the project components.

Improvements to Advance Water Treatment Facility: The design and physical features of the Advanced Water Treatment Facility (AWPF) currently under construction (the Approved PWM/GWR Project) allow operation of the AWPF at a peak capacity of 5.0 mgd. Expanding the AWPF to produce up to 7.6 mgd will require installation of additional treatment and pumping equipment, chemical storage, pipelines, and facility appurtenances within the 3.5-acre existing building area. The AWPF would be designed to produce a seasonal peak of 7.6 mgd. The nearest sensitive receptors are located off Neponset Road in Monterey County located about 5,000 feet to the northwest of the AWPF site, and residences along Cosky Drive in Marina located at a distance of about 5,400 feet to the southwest of the AWPF site. Ambient noise measurements made as part of the CalAm Monterey Peninsula Water Supply Project EIR/EIS[2] indicate that noise levels along Charles Benson Road, to the northwest of the AWPF site, averaged 62 dBA L_{eq} during the daytime and averaged 49 dBA L_{eq} at night (Site L1). Noise levels measured near residences along Cosky Drive (Site S2) averaged 66 dBA L_{eq} during the daytime due to local traffic and a barking dog. At night, average noise levels at the same site were 42 dBA L_{eq}.

Expanded Injection Well Facilities: The Approved PWM/GWR Project includes subsurface groundwater recharge facilities, including shallow (or vadose zone) and deep injection wells located within the Seaside Groundwater Basin in the area. The PWM/GWR Project EIR evaluated four clusters of injection well facilities, each with one deep injection well and one shallow injection well at well sites #1 through #4 (going from northeast to southwest). For the Expanded PWM/GWR Project, M1W plans to complete construction of the remaining two (2) of the four (4) approved deep injection wells. Under the Expanded PWM/GWR Project, the remaining two approved deep injection well sites would be relocated farther to the northeast and one additional new injection well would be constructed northeast of the original injection well facilities area, in a new area called the Expanded Injection Well Area. No new vadose zone wells are proposed compared to the Approved PWM/GWR Project. Each well would be equipped with associated backwash pumps and appurtenances. Under the Approved PWM/GWR Project, monitoring wells were proposed to be installed between the deep injection well sites and the nearest downgradient extraction well. Due to the change in location of the deep injection wells, the location of each associated monitoring well will also need to be updated. Monitoring wells would be located in the area between General Jim Moore Boulevard and the Expanded Injection Well Area and could be within 850 feet of one or more residences in the Fitch Park neighborhood. This location would be different from the location for the monitoring wells under the Approved PWM/GWR Project. A new electrical building and percolation basin for backwash water disposal (percolation into the vadose zone) would be included at a central location within the Expanded Injection Well Area (east of the current injection well facilities). The Expanded PWM/GWR Project would potentially include increasing the capacity of the approved percolation basin. The nearest sensitive receptors are also Ardennes Circle residences located approximately 850 feet north-northwest of the proposed Injection Well Facilities. The CalAm Monterey Peninsula Water Supply Project EIR/EIS noise measurement site S4 averaged 54 dBA L_{eq} during the daytime and averaged 52 dBA L_{eq} at night.

The Expanded PWM/GWR Project would require an additional Product Water Conveyance System. To serve new injection well sites, the Expanded PWM/GWR Project would require the addition of up to 2 miles of 24-inch maximum diameter pipeline and appurtenances. The pipeline would be located within existing unpaved and paved roads from the Marina Coast Water District's Blackhorse Reservoir to a new injection well site located in the area on the south side of Eucalyptus Road near the eastern boundary of the City of Seaside. See Figure 1 for the location of this new purified recycled water pipeline that would carry water from the Blackhorse Reservoir to the Expanded Injection Well Area. The nearest sensitive receptors are located on Ardennes Circle, approximately 300 feet southwest from Product Water Conveyance System Pipeline proposed at the Blackhorse Reservoir site. As noted previously, the CalAm Monterey Peninsula Water Supply Project EIR/EIS noise measurement site S4 quantified noise levels averaging 54 dBA L_{eq} during the daytime and 52 dBA L_{eq} at night.

<u>CalAm Distribution System:</u> For CalAm to utilize the additional purified recycled water produced by the Expanded PWM/GWR Project, additional potable water extraction wells, wellhead treatment and pipelines would be required. See Figure 1 for proposed locations of the new CalAm facilities. CalAm would construct and operate four (4) new extraction wells. These new extraction wells are identified as Extraction Wells 1 through 4. Extraction Wells 1 and 2 would be located just north of Seaside Middle School. The Blackhorse Golf Course is located to the north and west of Extraction Well sites 1 and 2. Extraction Wells 3 and 4 would be located just to the east of General Jim Moore Boulevard, near the southeast corner of the intersection of General Jim Moore Boulevard and Ardennes Circle on U.S. Army-owned property in the Fitch Park neighborhood of the Ord Military Community. Extraction Wells 3 and 4 would be designed consistent with the Aquifer Storage and Recovery (ASR) Wells 5 and 6 as analyzed in previous environmental documentation prepared for the MPWSP; however, these wells would only include the capability to extract and treat groundwater, and would not include any above-ground facilities needed to enable injection. Each extraction well would include a well pump and motor, chlorination dosing equipment, and associated electrical equipment, which would be contained on an approximately 100 square foot concrete pad. CalAm may elect to install emergency generators at one or more extraction well sites, depending upon their need for system reliability. No new extraction wells were proposed as part of the Approved PWM/GWR Project, thus these extraction wells were not included in the construction areas of the Approved PWM/GWR Project approved on October 8, 2015.

In addition, for the Expanded PWM/GWR Project CalAm would construct and operate new potable and raw water pipelines to convey the water from the new extraction wells to treatment facilities and to the existing CalAm distribution system. An up to 36-inch pipeline that would be up to approximately 2 ½ miles in length would be installed in the General Jim Moore Boulevard right of way. The pipeline would begin at Extraction Well 4 (the northern most extraction well) and connect to the existing ASR pipe network at ASR Wells 1 and 2 (Santa Margarita site). From that point, water would be distributed to CalAm customers throughout the region. This new potable water pipeline was not included in the Approved PWM/GWR Project. The nearest sensitive receptors are located west and east of General Jim Moore Boulevard, which are represented by

CalAm Monterey Peninsula Water Supply Project EIR/EIS noise measurement site S4 and Pure Water Monterey GWR Project EIR noise measurement sites LT-1 and ST-2. Noise levels at Site S4 are discussed above. Hourly average noise levels at Site LT-1 typically ranged from 57 to 66 dBA L_{eq} during the day, and from 47 to 56 dBA L_{eq} at night. General Jim Moore Boulevard traffic produced noise levels ranging from 47 to 48 dBA L_{eq} at ST-2.

Impact 1: Construction activity would violate standards established in the local general plans or noise ordinances, and/or would adversely affect nearby sensitive receptors.

Construction activities would occur intermittently at several locations throughout northern Monterey County over a period of approximately 24 months. Such activities would result in the generation of noise associated with site preparation and building of each component of the project. The noise levels generated during construction of the project would vary during the construction period, depending upon the construction phase and the types of construction equipment used.

High noise levels would be created by the operation of heavy-duty trucks, backhoes, bulldozers, excavators, front-end loaders, compactors, cranes, pavers, and other heavy-duty construction equipment. Operating cycles for these types of construction equipment would involve fluctuations in power cycles that result in variations in noise levels, whereas other equipment such as directional drill rigs typically operate at a continuous level.

Construction noise levels were calculated using the Federal Highway Administration’s Roadway Construction Noise Model (RCNM). The maximum and hourly average noise levels for each phase of construction at the several project construction components are presented in Table 1. In some instances, maximum instantaneous noise levels are calculated to be slightly lower than hourly average noise levels. This occurs because the model calculates the maximum instantaneous noise level resulting from the single loudest piece of construction equipment operating during each construction phase. Hourly average noise levels add together multiple pieces of construction equipment, which results in hourly average noise levels that can be slightly higher than maximum instantaneous noise levels during construction phases involving several pieces of equipment. Construction equipment noise levels were modeled at a distance of 50 feet from the center of the construction site, typical of the distance that the vast majority of receptors would be located from project construction activities conducted along the project corridor. From these source data, calculations were made to estimate construction noise levels at receptors within 50 feet of the construction site or at more distant receptors assuming that the noise attenuation rate was 6 dBA for each doubling of distance from the source where the distance is over roadways and 7.5 dBA for each doubling of distance from the source where the distance is over fields.

Truck trips generated by project construction would be dispersed throughout the day and over the local road network, and commute trips by construction workers would primarily occur before and after project truck trips occur. Daily transportation of materials and construction workers would not be a substantial source of traffic noise levels along local roadways serving the project area.

Table 1
Construction Equipment Noise Levels Modeled at 50 feet

Project Component	Duration	Construction Phase	L_{max}	L_{eq}
Improvements to Advanced Water Treatment Facility (AWPF)	10 Months	Demolition	90	85
		Site preparation	84	83
		Grading/Excavation	85	87
		Trenching/Pipelines	90	87
		Building Facilities	90	89
		Paving	90	86
Expanded Injection Well Facilities and Product Water Conveyance Pipeline	19 Months	Site Preparation – Access Road Grading	85	85
		Grading/Excavation – Backflush Basin	85	87
		Trenching/Pipelines (1,000 feet/week)	90	89
		Building Facilities – Deep Injection Wells, Monitoring Wells	84	85
		Building Facilities – Electrical Building	90	87
		Paving	85	86
CalAm Extraction Well Facilities	19 Months	Site Preparation – Access Road Grading	85	85
		Trenching/Pipelines (1,000 feet/week)	90	89
		Building Facilities – Extraction Wells	84	85
		Building Facilities – Electrical Building	90	87
		Paving	85	86
CalAm Conveyance Pipeline	7 Months	Pipeline Installation (800 feet/week)	81	84

Improvements to Advanced Water Treatment Facility: Modifications to the approved AWPF facilities are proposed at the RTP site in a northern portion of Monterey County, north of the city limits of Marina. Construction activities would include cutting, laying, and welding pipelines and pipe connections; pouring concrete footings for foundations, tanks, and other support equipment; installing piping, pumps, storage tanks, and electrical equipment; and testing and commissioning facilities. Construction equipment would include excavators, backhoes, graders, pavers, rollers, bulldozers, concrete trucks, flatbed trucks, boom trucks and/or cranes, forklifts, welding equipment, dump trucks, air compressors, and generators. Mechanical components of the pretreatment, membrane filtration systems, reverse osmosis, advanced oxidation, and post-treatment facilities would be prefabricated and delivered to the site for installation. All construction and staging areas would be within the existing 3.5-acre site. Construction activities related to the AWPF are expected to occur over ten months. Potential sensitive receptors include residences approximately 5,000 feet to the northwest of the AWPF on Neponset Road in Monterey County and residences approximately 5,400 feet to the southwest along Cosky Drive in the City of Marina. Maximum noise levels generated by construction activities at the RTP would reach 90 dBA L_{max} and 89 dBA L_{eq} at a distance of 50 feet. As shown in Table 2, the source noise level would be attenuated due to distance resulting in noise levels up to 39 dBA at a distance of 5,000 feet and up to 39 dBA at 5,400 feet, which are the distances to the closest sensitive receptors. Construction noise levels would not exceed the daytime speech interference or nighttime sleep disturbance thresholds at the nearest residences.

Table 2
Maximum Construction Noise Levels – Improvements to Advanced Water Treatment Facility

Construction Activity Source	Receptors	Distance to Receptor	L_{max}	L_{eq}
Construction of Building Facilities	Monte Road Residence	5,000 feet (northwest)	39	38
	Cosky Drive Residences	5,400 feet (southwest)	39	38

Note: The noise attenuation rate is assumed to be approximately 6 dBA for each doubling of distance from the source where the distance is over and/or along roadways and developed areas and would be approximately 7.5 dBA for each doubling of distance from the source where the distance is over fields.

Expanded Injection Well Facilities Site: The proposed Expanded Injection Well Area would be located east of the existing injection well area in the City of Seaside. There would be one new deep injection well (Wellsite 6), two relocated deep injection wells (Wellsites 5 and 7), monitoring wells, and back-flush facilities. The nearest sensitive receptors are residences located north of the Expanded Injection Well Area along Arloncourt Road, Metz Road, and Ardennes Circle. The deep injection wells would be drilled with rotary drilling methods. To construct the back-flush pipeline, the contractor would excavate pipe trenches, spread spoilage on site, import and install bedding material, and lay pipe, backfill and compact trench. A main electrical power supply/transformer and motor control building would be built for PG&E power supply. The following activities will be required to construct the pump motor control and electrical conveyance facilities:

- Excavation, haul spoilage, import and install bedding material, building foundation, trench, place concrete, backfill and compact trench, and finish concrete floor of electrical building;
- Install exterior electrical control cabinets on the paved area at the four clusters of vadose and deep injection wells; and
- For electrical building, construct block walls, install building windows, doors and louvers, then roof and appurtenances, then interior finishes, lighting and HVAC, and electrical equipment and wiring.

The project is within the boundary of former Fort Ord and receptors are within the city limits of Seaside. Maximum noise levels generated the during the loudest construction phase (i.e., trenching/pipelines) at well sites are calculated to be 90 dBA L_{max} and 89 dBA L_{eq} at a distance of

50 feet. These source noise levels would be attenuated due to distance, resulting in noise levels of up to 59 dBA L_{max} and 58 dBA L_{eq} at a distance of 850 feet, which generally represents the distance from the majority of construction activities to the closest sensitive receptors (i.e., Ardennes Circle residences).

However, under the Approved PWM/GWR Project, monitoring wells were proposed to be installed between the deep injection well sites and the nearest downgradient extraction well. Due to the change in location of the deep injection wells, the location of each associated monitoring well will also need to be updated. Monitoring wells would be located in the area between General Jim Moore Boulevard and the Expanded Injection Well Area and could be within 850 feet of one or more residences at in the Fitch Park neighborhood for the proposed modifications. This location would be different from the location for the monitoring wells under the Approved PWM/GWR Project.

Well drilling activity was assumed to occur for 24 hours a day at a noise level of 85 dBA L_{eq} at a distance of 50 feet based on noise levels calculated using RCNM. The noise level from drilling would be attenuated due to distance resulting in noise levels up to 54 dBA L_{eq} at a distance of 850 feet. Table 3 shows worst-case noise levels at nearest noise sensitive receptors to Injection Well Facilities site (including back-flush facility).

Table 3
Maximum Construction Noise Levels – Expanded Injection Well Facilities

Construction Activity Source	Receptors	Distance to Receptor	L_{max}	L_{eq}
Construction of Injection Well Facilities – Trenching/Pipelines	Ardennes Circle Residences	850 feet (north)	59	58
Construction of Injection Well Facilities – Deep Injection Wells	Ardennes Circle Residences	850 feet (north)	53	54

Note: The noise attenuation rate is assumed to be approximately 6 dBA for each doubling of distance from the source where the distance is over and/or along roadways and developed areas and would be approximately 7.5 dBA for each doubling of distance from the source where the distance is over fields.

The City of Seaside has not adopted quantitative construction noise limits. Daytime construction activities would not exceed the daytime threshold of 70 dBA L_{eq}. However, drilling activities during nighttime hours would result in noise levels of up to 53 dBA L_{eq} at receiving properties during the construction of deep injection wells. This would be below the sleep disturbance threshold of 60 dBA L_{eq}.

The Expanded Project would include construction of up to two miles of 24-inch maximum pipeline and appurtenances to convey the new purified recycled water from the Blackhorse Reservoir to the Expanded Injection Well Area. The pipeline would be located within existing unpaved and paved roads from the Marina Coast Water District's Blackhorse Reservoir to a new injection well site located in the area on the south side of Eucalyptus Road near the eastern boundary of the City of Seaside. Appendix A shows the location of the proposed Product Water Conveyance Facilities.

For the purpose of modeling construction noise, worst-case construction noise levels would occur when construction activities are located at the connection point of the proposed pipeline to the Blackhorse Reservoir, approximately 300 feet from Ardennes Circle residences. The pipeline would be installed at a rate of about 1,000 feet per week, eventually reaching a distance of 2,300 feet from Ardennes Circle residences, as the pipeline reaches its easternmost point. The pipeline would then return to the southwest toward the Expanded Injection Well Area, approximately 1,400 feet from the nearest Ardennes Circle residences. Table 4 summarizes construction noise levels at receptors within 300 to 2,300 feet of proposed construction areas.

Noise levels resulting from the construction of the Product Water Conveyance Pipeline exceeding 70 dBA L_{eq} for more than two weeks at a sensitive receptor would represent a significant nuisance. Pipeline trenching activities would proceed along the project alignment at a rate of 1,000 feet per five working days; approaching and departing any one receptor location over a fairly short period of time. Assuming a source noise level of up to 89 dBA L_{eq} at a distance of 50 feet, and an attenuation rate of 7.5 dBA per doubling of distance between the noise source and receptor, pipeline construction activities occurring within 290 feet (in either direction) of a sensitive receptor would yield noise levels greater than 70 dBA L_{eq}. The nearest receptors are located 300 feet or further from the pipeline alignment and would, therefore, not be exposed to noise levels greater than 70 dBA L_{eq}. Construction noise resulting from the Product Water Conveyance Pipeline would not exceed the noise level and duration thresholds resulting in a less than significant impact.

Table 4
Maximum Construction Noise Levels – Product Water Conveyance Pipeline

Construction Activity Source	Receptors	Distance to Receptor	L_{max}	L_{eq}
Construction of Product Water Conveyance Pipeline	Ardennes Circle Residences	300 feet (southwest)	67	70
	Ardennes Circle Residences	2,300 feet (west)	44	47
	Ardennes Circle Residences	1,400 feet (northwest)	50	53

Note: The noise attenuation rate is assumed to be approximately 6 dBA for each doubling of distance from the source where the distance is over and/or along roadways and developed areas and would be approximately 7.5 dBA for each doubling of distance from the source where the distance is over fields.

<u>CalAm Distribution System:</u> For CalAm to utilize the additional purified recycled water produced by the Expanded PWM/GWR Project, additional potable water extraction wells, wellhead treatment and pipelines would be required. See Figure 1 for proposed locations of the new CalAm facilities. CalAm would construct and operate four (4) new extraction wells (EW-1 through EW-4). In addition, for the Expanded PWM/GWR Project CalAm would construct and operate new potable and raw water pipelines to convey the water from the new extraction wells to treatment facilities and to the existing CalAm distribution system.

The MPWSP EIR/EIS analyzed noise resulting from construction of new injection/extraction wells (designated ASR-5 and ASR-6) at the same locations as wells EW-3 and EW-4. The construction of the wells is essentially the same, except that the above ground equipment and the 900 s.f. building that would house the equipment associated with an injection well are not required. Each well pump and electrical control system would be housed in a fiberglass enclosure with sound-proofing and ventilation similar to CalAm's Rancho Canada well. The pump motor, switch gear and power panels are installed inside the enclosure. The following discussion for wells EW-3 and EW-4 is based upon the analysis and text from the MPWSP EIR/EIS. The analysis and discussion of wells EW-1 and EW-2 that follows and is based upon the same assumptions.

The proposed extraction wells (EW-3 and EW-4) would be constructed at the intersection of General Jim Moore Boulevard and Ardennes Circle, in the Fitch Park military housing area. The closest residential receptors to the proposed wells are located 50 feet away on Ardennes Circle. Noise monitoring location S4 represents the noise environment at the Fitch Park residential receptors (see MPWSP EIR/EIS Table 4.12-1 and Figure 4.12-1 and Appendix B).

Each proposed extraction well would require 24-hour construction activities for up to 7 days during well drilling. Temporary noise barriers would be installed as part of the project at each well site to reduce construction noise. A 10-foot noise barrier would be constructed to reduce noise levels at the nearest receptors to ASR-5 (EW-3), and a 15-foot noise barrier would be constructed to reduce noise levels at the nearest receptors to ASR-6 (EW-4). Accounting for the attenuation provided by the temporary barrier, the resultant daytime and nighttime construction noise levels at the Fitch Park residential receptors could be as high as 80 dBA L_{eq} (note: all fractional decibel levels from the MPWSP EIR have been rounded to the nearest whole decibel in this memo)[3]. This level exceeds the speech interference and sleep interference thresholds of 70 dBA and 60 dBA (with windows closed, or 35 dBA with windows open), respectively, and would result in a significant impact. Figures 4.12-2 and 4.12-4 of the MPWSP EIR/EIS illustrate the noise contours for construction of wells EW-3 and EW-4, respectively, without mitigation. While it is possible that implementation of Mitigation Measures 4.12-1a (Neighborhood Notice), 4.12-1b (General Noise Controls for Construction Equipment), 4.12-1d (Additional Noise Controls for ASR-5 and ASR-6 Wells), and 4.12-1e (Offsite Accommodations for Substantially Affected Receptors) would reduce the daytime noise impact to a less-than-significant level, this mitigation would not be sufficient to reduce noise to below the more stringent nighttime threshold. Figures 4.12-3 and 4.12-5 of the MPWSP EIR/EIS illustrate the noise contours for construction of wells EW-3 and EW-4, respectively, with mitigation. The nighttime noise impact would remain significant and unavoidable.

Extraction wells EW-1 and EW-2 would be located just north of Seaside Middle School. The Blackhorse Golf Course is located to the north and west of Extraction Well sites EW-1 and EW-2. The nearest residences are located approximately 700 feet to the northeast along Hatten Road. Assuming a maximum source noise level of 89 dBA L_{eq} at 50 feet for trenching and pipeline construction, daytime noise levels would reach 62 dBA L_{eq} at the Seaside Middle School and 60 dBA L_{eq} at the Hatten Road residences. Daytime well drilling would produce noise levels up to 85 dBA L_{eq} at 50 feet, resulting in noise levels about 4 dBA lower at the Seaside Middle School and Hatten Road residences. Daytime construction activities would not exceed the daytime threshold of 70 dBA L_{eq}. Nighttime well drilling would also produce noise levels up to 85 dBA L_{eq} at 50 feet. Well drilling noise levels are calculated to reach 56 dBA L_{eq} at the Hatten Road residences and would not exceed the nighttime threshold of 60 dBA L_{eq}. Further, 24-hour per day well drilling would only be required for about 7 days per well. This is a less-than-significant impact.

A new 36-inch potable water pipeline would be installed in General Jim Moore (GJM) Boulevard between the well EW-4 and the Monterey Pipeline at General Jim Moore Boulevard and Hilby Avenue. Raw water pipeline (sometimes referred to as a backwash pipeline) construction, including approximately 3,700 linear feet of 16-inch HDPE pipe and appurtenances, and recirculation pipeline construction, including approximately 3,700 linear feet of 30-inch DIP and appurtenances, would occur between the EW-4 site and the current backflush and recirculation pipeline terminations in General Jim Moore near the Seaside Middle School site for EW-1 and EW-2. Nighttime construction work is not proposed for these pipelines; therefore, there would be no impact related to nighttime noise increases.

The potable and raw water pipelines proposed along General Jim Moore Boulevard and associated with the extraction well facilities would be installed as close as 300 feet east of Seaside Middle School. The average noise level produced by construction of the pipelines would be 84 dBA L_{eq} at 50 feet. The

[3] CalAm Monterey Peninsula Water Supply Project 4.12-30 ESA / 205335.01 Final EIR/EIS March 2018

attenuated construction equipment noise level at 300 feet would be 65 dBA L_{eq}. These pipeline alignments are also as close as 100 feet from residential receptors, including residences on Ardennes Circle. The resultant daytime noise level at residential receptors during pipeline construction would be as high as 77 dBA L_{eq}. The construction schedule developed for the Expanded PWM/GWR Project shows these pipelines would be constructed at a rate of 800 feet per week. These receptors would be exposed noise levels at or above the 70 dBA L_{eq} threshold for less than one week, which would be less than the two-week exposure threshold resulting in a less-than-significant impact.

Mitigation Measures:

The following mitigation measures have been extracted from the MPWSP EIR/EIS (Mitigation Measures 4.12-a, 4.12-b, 4.12-d and 4.12-e) and applied to the CalAm Distribution System component of this project. Mitigation Measures 1a and 1b apply to the CalAm Distribution System pipelines along General Jim Moore Boulevard and EW-1 and EW-2. Mitigation Measures 1a – 1d apply to the construction of EW-3 and EW-4:

Mitigation Measure 1a: Neighborhood Notice and Construction Disturbance Coordinator

> The combination of public notice and the establishment of a construction disturbance coordinator can result in a lessening of the adversity of the impact at a given receptor by allowing them to prepare for pending construction activities and providing a contact to report any disturbances or violations to CalAm for appropriate response actions, including additional mitigation. Residents and other sensitive receptors within 300 feet of a daytime construction area and within 900 feet of a nighttime construction area shall be notified of the construction location, nature of activities, and schedule, in writing, at least 14 days prior to the commencement of construction activities. The notice shall also be posted along the proposed pipeline alignments, near the proposed facility sites, and at nearby recreational facilities. CalAm or the contractor(s) shall designate a construction disturbance coordinator who would be responsible for responding to construction complaints. The coordinator shall determine the cause of the complaint and ensure that reasonable measures are implemented to correct the problem. CalAm and/or its contractor shall return all calls within 24 hours to answer noise questions and handle complaints. Documentation of the complaint and resolution shall be submitted to the CPUC weekly. A contact number for the construction disturbance coordinator shall be conspicuously placed on construction site fences and included in the notice. Prior to distributing the notice to nearby residences, CalAm or the contractor(s) shall first submit the notice to the respective city planning and services manager for review and approval. This measure shall be implemented in conjunction with the noticing provisions in Mitigation Measure 4.9-1 (Traffic Control and Safety Assurance Plan).

Mitigation Measure 1b: General Noise Controls for Construction Equipment and Activities.

> The construction contractor(s) shall assure that construction equipment with internal combustion engines have sound control devices at least as effective as those provided by the original equipment manufacturer. No equipment shall be permitted to have an unmuffled exhaust.

Impact tools (i.e., jack hammers, pavement breakers, and rock drills) used for project construction shall be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. Where use of pneumatic tools is unavoidable, an exhaust muffler shall be placed on the compressed air exhaust to lower noise levels by up to approximately 10 dBA. External jackets shall be used on impact tools, where feasible, in order to achieve a further reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever feasible.

Mitigation Measure 1c: Additional Noise Controls for Nighttime Construction of Wells.

In addition to the general noise controls that will be implemented as part of Mitigation Measure 1b (General Noise Controls for Construction Equipment), the construction contractor(s) shall identify feasible noise controls for implementation during well drilling development activities within 500 feet of the Fitch Park military housing community. The construction contractor(s) shall locate all stationary noise-generating equipment as far as possible from nearby noise-sensitive receptors. Drill rigs within 500 feet of noise-sensitive receptors shall be equipped with noise-reducing engine housings or other noise-reducing technology. Additionally, acoustic barriers and/or enclosures shall be used with a goal of reducing noise from well drilling activities to 60 dBA L_{eq} or less at residences. There are a number of options available to achieve this performance standard. Barrier blankets are available with a sound transmission class rating of 32,which can provide 16 to 40 dBA of sound transmission loss, depending on the frequency of the noise source (ENC, 2014). The realized sound transmission reduction of barrier blankets needs to be sufficient to achieve the performance standard of 60 dBA L_{eq} or less at residences.

Mitigation Measure 1d: Offsite Accommodations for Substantially Affected Nighttime Receptors near Wells.

CalAm shall provide temporary hotel accommodations for all residences and any other nighttime sensitive receptors:

1. That would be exposed to 24-hour project construction activities and

2. Where nighttime construction noise would exceed 60 dBA with windows closed or 35 dBA with windows open, even with implementation of acoustic barriers and/or shielding measures.

The accommodations shall be provided for the duration of 24-hour construction activities. CalAm shall provide accommodations reasonably similar to those of the impacted residents in terms of number of beds and amenities. If identified accommodations do not include typical residential kitchen facilities (e.g., cooktop, oven, full size refrigerator), then CalAm shall provide displaced individuals with a per diem allowance to offset costs of meals for the period of relocation.

Significant impacts related to temporary increases in daytime noise levels would result during construction of the wells, but these impacts would be reduced to less-than-significant levels with implementation of the prescribed mitigation measures. Significant nighttime noise impacts would result during construction of the wells, and the impact would remain significant and unavoidable, even with implementation of mitigation.

Significance after Mitigation: Significant and Unavoidable.

Impact 2: Exposure to, or Generation of, Excessive Groundborne Vibration. Construction related vibration would not be excessive at nearby land uses.

For structural damage, Caltrans recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a conservative limit of 0.08 in/sec PPV for ancient buildings or buildings that are documented to be structurally weakened. There is the potential for human annoyance when there is sustained exposure to continuous or intermittent vibration, such as at residences near the proposed extraction well sites. For adverse human reaction, consistent with the MPWSP EIR/EIS, the analysis applies the "strongly perceptible" threshold of 0.1 in/sec PPV.

Structural Damage: All buildings in the project vicinity are assumed to be structurally sound, but these buildings may or may not have been designed to modern engineering standards. Vibration impacts would be considered significant if levels from proposed construction activities would exceed 0.3 in/sec PPV at nearby buildings. Vibration levels exceeding 0.3 in/sec PPV could result in cosmetic damage. No ancient buildings or buildings that are documented to be structurally weakened are known to exist along the project corridor.

Open trench construction activities with the potential of generating perceptible vibration levels would include the removal of pavement and soil, and the compacting of backfill after the new pipeline is installed. Extraction well construction activities would include site preparation, trenching/pipelines, well drilling, the construction of buildings, and paving. Equipment with the potential of generating perceptible vibration levels would include the removal of pavement and soil, and the compacting of soil, and well drilling. Table 5 summarizes typical vibration levels associated with varying pieces of construction equipment at a distance of 25 feet. All other proposed construction activities would occur at greater distances where groundborne vibration would not be of concern.

A review of the proposed equipment and the vibration level data provided in Table 5 indicates that, with the exception of impact or vibratory pile driving (not proposed as a construction technique), vibration levels generated by the proposed equipment would be below the 0.3 in/sec PPV criterion used to assess the potential for cosmetic or structural damage to buildings located beyond a distance of 25 feet. The nearest buildings would be a minimum distance of 25 feet from the work areas.

The nearest residential structure to the proposed well sites is located approximately 25 feet from proposed above ground facilities and 50 feet from the well. Vibration levels from vibratory rollers for construction of the above ground facilities would reach 0.21 in/sec PPV at a distance of 25 feet. At a distance of 50 feet, vibration levels from well drilling would be 0.03 in/sec. These levels would be below the 0.3 in/sec PPV threshold, resulting in a less-than-significant vibration impact related to damage to this building. The nearest structures to the pipelines associated with the extraction wells would be located approximately 50 feet away and are not historic structures. At 50 feet, vibration levels from roller operations would be attenuated to less than 0.1 in/sec PPV, which is below the threshold for non-fragile buildings of 0.3 in/sec PPV, resulting in a less-than significant impact related to damage to buildings.

Human Annoyance: The nearest sensitive land use to the proposed extraction well sites is a residence located approximately 50 feet away from where drilling would occur. The drilling would occur 24-hours per day, which has the potential to cause human annoyance during typical periods of rest. At this distance, drilling vibration would be attenuated to 0.03 in/sec. This level is below the “strongly perceptible” threshold of 0.1 in/sec PPV, resulting in a less-than-significant impact related to human annoyance. Ground vibration resulting from project construction would cause a is a less than significant impact.

Table 5
Vibration Source Levels for Construction Equipment

Equipment		**PPV at 25 ft. (in/sec)**
Pile Driver (Impact)	upper range	1.158
	typical	0.644
Pile Driver (Sonic)	upper range	0.734
	typical	0.170
Clam shovel drop		0.202
Hydromill (slurry wall)	in soil	0.008
	in rock	0.017
Vibratory Roller		0.210
Hoe Ram		0.089
Large bulldozer		0.089
Caisson drilling		0.089
Loaded trucks		0.076
Jackhammer		0.035
Small bulldozer		0.003

Source: Transit Noise and Vibration Impact Assessment Manual, United States Department of Transportation, Federal Transit Agency, September 2018.

Mitigation Measures: **None required.**

Impact 3: Operation of the proposed Cal Am facilities associated with the Proposed Project (EW-3 and EW-4) would potentially increase existing noise levels, which could exceed noise level standards and/or result in nuisance impacts at sensitive receptors.

Sources of noise associated with the operation of the Expanded PWM/GWR Project would include new pumps and other equipment at the RTP, the expanded injection well facilities, and the four new extraction wells (Cal Am facilities). Employee traffic and maintenance activities would not be considerable sources of noise.

<u>Improvements to Advanced Water Treatment Facility</u>: Expanding the AWPF (treatment facilities) at the RTP to produce up to 7.6 mgd will require installation of additional treatment and pumping equipment, chemical storage, pipelines, and facility appurtenances within the 3.5-acre existing building area. Noise resulting from new facilities would be generated from proposed stationary sources associated with facility operations, including primarily electric water pumps. Using data from the PWM/GWR Project EIR, the pumps would have an estimated combined noise level of 108 dBA L_{eq} at a distance of 3 feet. Typical operating conditions would result in pump reference noise levels of approximately 85 dBA L_{eq} at 50 feet assuming the pumps were at grade and not inside an enclosure. There are no other known sources of noise that would measurably increase the noise levels generated by the pumps. A residence to the northwest is in Monterey County and residences to the southwest are in the City of Marina. Maximum noise levels generated by operations at the RTP would be 35 dBA L_{eq} at a distance of approximately 1 mile. Due to the long distance between residences in Monterey County of the City or Marina and the AWPF (approximately 5,000 to 5,400 feet), operational noise levels resulting from the expanded AWPF Treatment Facilities at the RTP would not exceed the City of Marina or Monterey County noise standards. Noise levels would be substantially below ambient noise levels in the surrounding area, and plant operations would not result in an increase in ambient noise levels that would exceed local standards.

<u>Expanded Injection Well Facilities:</u>

The primary operational noise source at each injection well would be a well pump to back-flush the well. The estimated motor size for each pump is approximately 400 hp. Based on the experience of the Water Management District in the operation of its nearby Aquifer Storage and Recovery wells, back-flushing of each injection well would occur about weekly and would require discharge of the back-flush water to a percolation pond, or back-flush basin. The pump would operate for about 150 minutes during the daytime.

The 400 hp back-flush pump has an estimated noise level 85 dBA L_{eq} at 50 feet assuming the pumps are at grade and not inside an enclosure. The nearest residences to the back-flush pump are located 1,300 feet to the north along Ardennes Circle in Seaside. The maximum noise level, generated by back-flush operations, is calculated to be 50 dBA L_{eq}. Noise levels as a result of the operation of the back-flush pumps, as well as the remaining wells located further from receptors, would not exceed the City of Seaside noise standard of 65 dBA CNEL.

Extraction Well Facilities:

The EW-3 and EW-4 Wells would be 50 feet west of residences on Ardennes Circle. Each well would be equipped with a permanent 500-hp multistage vertical turbine pump. Each well pump and electrical control system would be housed in a fiberglass enclosure with sound-proofing and ventilation similar to CalAm's Rancho Canada well. The pump motor, switch gear and power panels are installed inside the enclosure.

The MPWSP EIR/EIS states that well pump motors would generate noise levels of up to 76 dBA L_{max} at 50 feet; however, placing the motors in a standard concrete pump house would attenuate noise levels by at least 20 dBA (to 56 dBA L_{max} at 50 feet). The increase in ambient noise levels at the residences on Ardennes Circle would be 5 to 6 dBA L_{eq}, which is above the 5 dBA threshold and thus would be a significant permanent noise increase over existing conditions.

The current design identifies a fiberglass enclosure that may not provide comparable attenuation to the concrete pump house. Furthermore, the fiberglass enclosure may not provide sufficient attenuation to achieve the interior sleep interference noise standard of 35 dBA L_{eq} inside the nearest residences assuming windows are open for ventilation. There is a potential that interior noise levels, that were previously designed to meet the 60 dBA CNEL exterior noise threshold with the use of a concrete block enclosure, would result in interior noise levels of approximately 38 dBA L_{eq} inside the nearest residential units exceeding the 35 dBA L_{eq} sleep interference threshold by 3 dBA.

The EW-1 and EW-2 Wells would be at least 600 feet north of the nearest classroom building at Seaside Middle School and 700 feet southwest of residences on Hatten Road. At 600 to 700 feet, noise levels would be reduced by 27 to 29 dBA respectively, due to distance alone. The pump motors would be enclosed in a standard concrete pump house that would attenuate noise levels by at least 20 dBA, resulting in noise levels of 29 dBA at the Seaside Middle School and 27 dBA at the Hatten Road residences. Operational noise levels related to EW-1 and EW-2 would be well below ambient conditions at the Seaside Middle School and nearest residential receptors.

Mitigation Measures:

The following mitigation measure has been extracted from the MPWSP EIR/EIS (Mitigation Measure 4.12-5), modified, and applied to this project:

Mitigation Measure 2: EW-3 and EW-4 Stationary-Source Noise Controls.

> CalAm shall retain an acoustical engineer to design stationary-source noise controls and ensure the applicable noise standards are met. At a minimum, all stationary noise sources at EW-3 and EW-4 shall be located within enclosed structures and with adequate noise control to maintain noise levels to no greater than 55 CNEL (or 48 dBA L_{eq} assuming 24-hour per day operation), at the property lines of nearby residences. Once the stationary noise sources have been installed, the contractor(s) shall conduct a single long-term (24-hour) monitoring of noise levels to ensure that noise levels resulting from the operation of the well comply recommended noise limits. CalAm shall submit a compliance monitoring report to the CPUC.

The implementation of Mitigation Measure 2 (Stationary Source Noise Controls) would reduce this impact to less than significant by ensuring that sufficient noise insulation or sound-absorbing material is provided to the pump enclosure to provide the additional noise attenuation required to meet City of Seaside noise level thresholds and thresholds to avoid the potential for sleep interference.

Significance after Mitigation: Less than Significant.

Impact 4: Noise levels produced by the operation of the Expanded Project, as compared to the noise levels produced by the PWM Project alone, would not be substantially more severe at sensitive receptors.

The resultant noise level due to project operations at receptors in the project vicinity is due to the closest source of operational noise, as discussed by project component above. The only instance where noise levels would be measurably increased as a result of the Expanded Project would be at receptors nearest to the AWPF Treatment Facilities at the RTP. Maximum noise levels generated by Expanded Project operations would be 35 dBA L_{eq} at a distance of approximately 1 mile due to the long distance between residences in Monterey County of the City or Marina and the AWPF (approximately 5,000 to 5,400 feet). The predicted noise level from Expanded Project operations would add to the operational noise levels produced by treatment facilities at the RTP (37 dBA L_{eq}) to yield an overall noise level of 39 dBA L_{eq}. Overall RTP noise levels would not exceed the City of Marina or Monterey County noise standards at the nearest sensitive receptors. Noise levels would be substantially below ambient noise levels in the surrounding area, and plant operations would not result in an increase in ambient noise levels that would exceed local standards. The impact related to noise generated by operations of the Expanded Project is less than significant.

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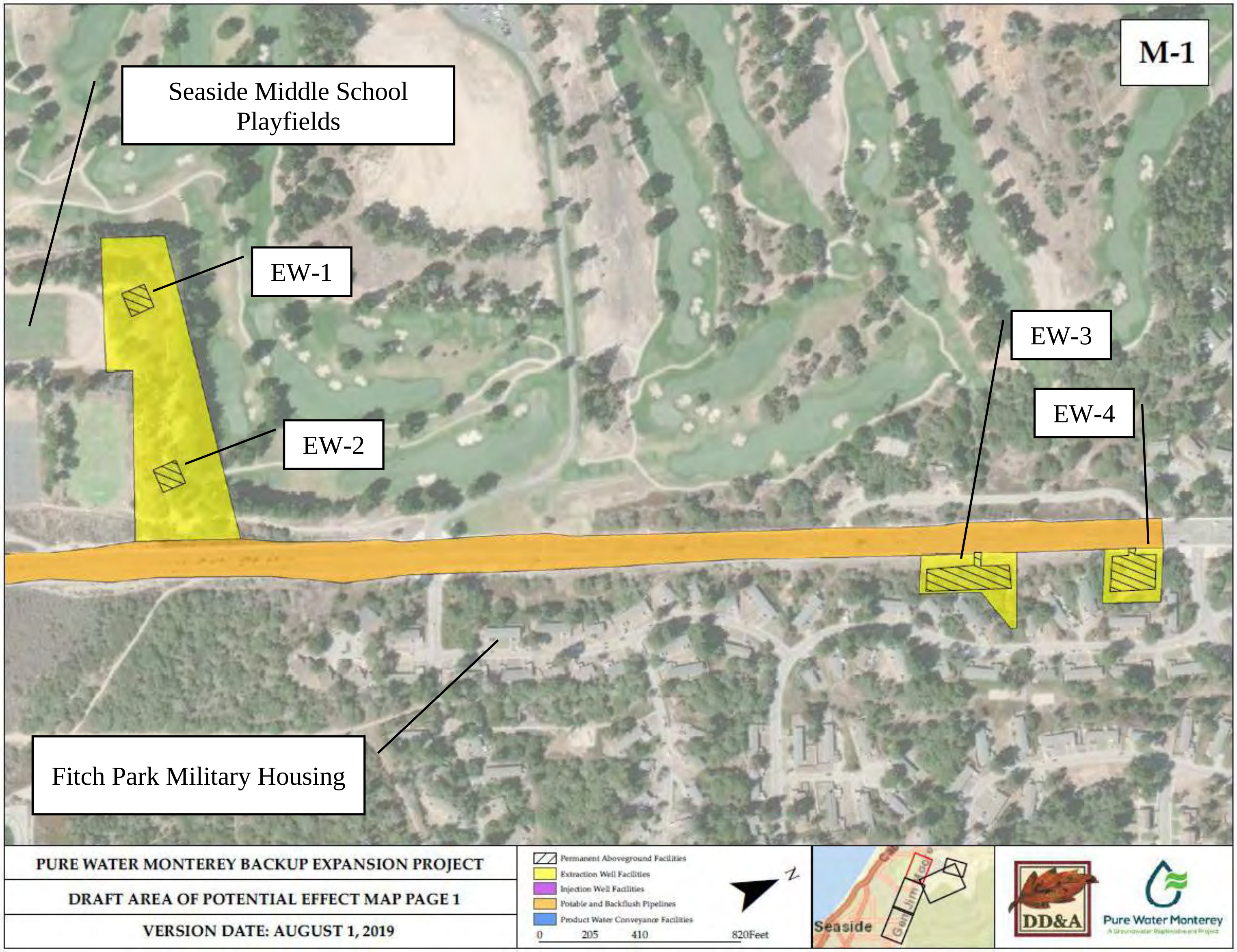
Appendix A

Pure Water Monterey Backup Expansion Project Draft Area of Potential Effect Maps M-1 through M-5

CalAm Conveyance Pipeline and Extraction Wells

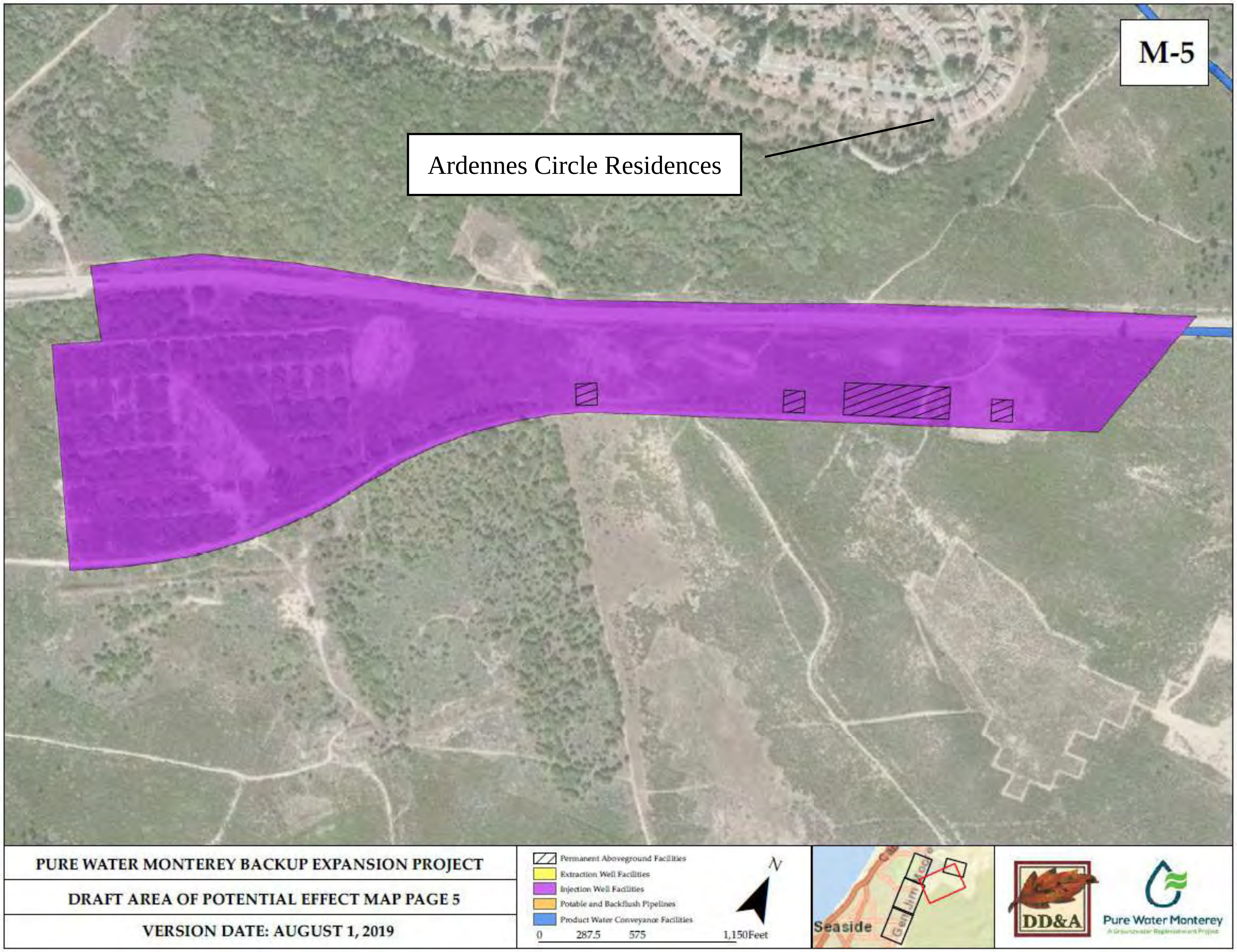


CalAm Conveyance Pipeline

CalAm Conveyance Pipeline

Product Water Conveyance System

Expanded Injection Well Facilities



Appendix B

CalAm Monterey Peninsula Water Supply Project Final EIR/EIS Figures 4.12-1 through 4.12-5

Figure 4.12-1
Noise Monitoring Locations

SOURCE: ESA, 2016

SOURCE: ESA, 2017

205335.01 Monterey Peninsula Water Supply Project

Figure 4.12-2

Construction Noise Contours for Well ASR-5

SOURCE: ESA, 2017

205335.01 Monterey Peninsula Water Supply Project

Figure 4.12-3

Construction Noise Contours for Well ASR-5 with10-foot barrier

SOURCE: ESA, 2017

205335.01 Monterey Peninsula Water Supply Project

Figure 4.12-4
Construction Noise Contours for Well ASR-6

SOURCE: ESA, 2017

205335.01 Monterey Peninsula Water Supply Project

Figure 4.12-5

Construction Noise Contours for Well ASR-6 with 15-foot barrier