FEBRUARY 2025

MONTEREY ONE WATER
PURE WATER MONTEREY
GROUNDWATER REPLENISHMENT PROJECT

Engineering Report
Volume I

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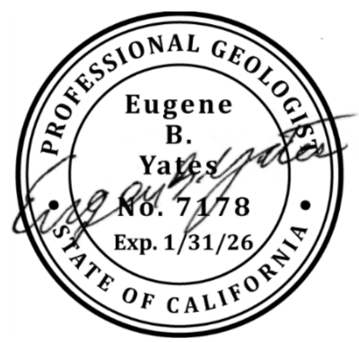

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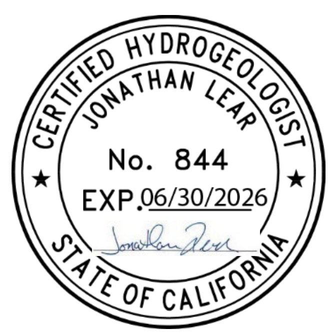

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PREFACE

Pure Water Monterey Engineering Report History

The Engineering Report for the Pure Water Monterey (PWM) Groundwater Replenishment Project (Project) was prepared in July 2016 and accepted by the State Water Resources Control Board, Division of Drinking Water (DDW) on November 7, 2016.

The Engineering Report was revised in April 2019 to increase the Advanced Water Purification Facility (AWPF) capacity to 5.0 million gallons per day (mgd) and deliver an additional 600 AFY of purified water to Marina Coast Water District (MCWD) for landscape irrigation. DDW accepted the revised Engineering Report on August 20, 2019.

This February 2025 Engineering Report satisfies the requirement for submittal of a Five-Year Engineering Report including describing changes to PWM facilities and operations for the Expanded PWM Project (or Expanded Project) which is currently under construction with completion planned for summer of 2025. The Expanded Project will increase the AWPF peak capacity to 7.6 mgd and increase the injection volume to Seaside Groundwater Basin to an annual average of 5,750 AFY (and a maximum of 5,950 AFY).

Scope of February 2025 Engineering Report

The Engineering Report includes the following as required for a Five-Year Engineering Report by the Project's Monitoring and Reporting Program (MRP, page MRP-12, Provision III.5.):

a. A description of any inconsistencies between previous groundwater model predictions and the observed and/or measured values. For this requirement, M1W shall summarize the groundwater flow and transport including the injection and extraction operations for the M1W groundwater injection project during the previous five calendar years. This summary shall also use the most current data for the evaluation of the transport of recycled water; such evaluations shall include, at a minimum, the following information:

i. Total quantity of advanced treated recycled water injected into Seaside Basin, and quantities of water injected into each individual injection well;

ii. Estimates of the rate and path of flow of the injected water within the aquifer;

iii. Projections of the arrival time of the recycled water at all monitoring and extraction wells and the percent of recycled water at each location;

iv. Clear presentation on any assumptions and/or calculations used for determining the rates of flow and for projecting arrival times and dilution levels;

v. A discussion of the underground retention time of recycled water, a numerical model, or other methods used to determine the recycled water contribution to each aquifer;

vi. A revised flow and transport model to match actual flow patterns observed within the aquifer if the flow paths have significantly changed; and *vi. Revised estimates, if applicable, on hydrogeologic conditions including the retention time and the amount of the recycled water in the aquifers and at the production well field at the end of that calendar year. The revised estimates shall be based upon actual data collected during that year on recharge rates (including recycled water and native water), hydrostatic head values, groundwater production rates, basin storage changes, and any other data needed to revise the estimates of the retention time and the amount of the recycled water in the aquifers and at the production well field. Significant differences, and the reasons for such differences, between the estimates presented in the 2019 Engineering Report and subsequently revised estimates, shall be clearly presented. Additionally, M1W shall use the most recently available data to predict the retention time of recycled water in the subsurface.*

b. Evaluation of the ability of M1W to comply with all regulations and provisions over the following five years.

c. The Five-Year Engineering Report shall be prepared by a properly qualified engineer registered and licensed in California and experienced in the field of wastewater or water treatment.

As part of requirement b (above), Monterey One Water (M1W) is constructing new facilities and making changes to create an Expanded Project by summer of 2025. This Engineering Report describes the following Project changes either completed or underway since 2019:

- Expanded AWPF capacity of 7.6 mgd (increased from 5.0 mgd).
- Locations, construction, and operational details of the new deep injection wells (DIW-3, DIW-4 already installed and DIW-5, DIW-6 under construction currently).
- Injection of 5,950 AFY (maximum) of purified recycled water to Seaside Groundwater Basin.
- Intrinsic and extrinsic tracer study results.
- Incorporation of completed tracer study results for updated groundwater modeling and determination of future subsurface travel times.
- Updated pathogen log removal credits for the Expanded Project, including chloramine credit in the conveyance pipeline and underground retention time.
- Revised Response Retention Time (RRT) consistent with the tracer studies and groundwater modeling results.
- New primary and secondary zones of controlled drinking water well construction.

ACRONYMS

A	Ampere
AF	Acre-feet
AFY	Acre-feet per year
AOP	Advanced oxidation process
AGR	Agricultural Supply Beneficial Use
ASR	Aquifer Storage and Recovery
ASTM	American Society for Testing and Materials International
ATS	Automatic Transfer Switch
AWPF	Advanced Water Purification Facility
AWT	Advanced water treatment
AWWA	American Water Works Association
BW	Membrane backwash
HCO_3^-	Bicarbonate ion
BOD_5	Biochemical oxygen demand – five day
BPTC	Best Practicable Treatment or Control
°C	Degrees Celsius
$CaCl_2$	Calcium chloride
$CaCO_3$	Calcium carbonate
Cal-Am	California American Water Company
$Ca(OH)_2$	Hydrated lime
$CBOD_5$	Carbonaceous biochemical oxygen demand – five day
CDFW	California Department of Fish and Wildlife
CFR	Code of Federal Regulations
CHG	Certified Hydrogeologist
CIP	Clean in place
CCPP	Calcium Carbonate Precipitation Potential
CCR	California Code of Regulations
CECs	Constituents of Emerging Concern
CEPT	Chemically Enhanced Primary Treatment
CEQA	California Environmental Quality Act
C_i	Feed concentration
CIWQS	California Integrated Water Quality System
CIU	Categorical Industrial User
CMMS	Computerized Maintenance Management System
CO_2	Carbon dioxide

CSIP	Castroville Seawater Intrusion Project
CT	Concentration multiplied by contact time
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
d	Day
DBPs	Disinfection by-products
DDW	State Water Resources Control Board Division of Drinking Water
DEET	N,N-diethyl-meta-toluamide
DIT	Direct Integrity Tests
DIW	Deep Injection Well
D x SWD	Diameter by side water depth
DFA	State Water Resources Control Board Division of Financial Assistance
DO_3	Dissolved ozone
DOC	Dissolved organic carbon
DWR	California Department of Water Resources
EC	Electrical conductivity
EFM	Enhanced flux maintenance
EIR	Environmental Impact Report
ELAP	Environmental Laboratory Accreditation Program
EQ	Equalization
ESCA	Environmental Services Cooperative Agreement
fps	Feet per second
FRP	Fiberglass reinforced plastic
FTAE	FactoryTalk Alarm and Event
ft	Feet
gal	Gallons
G:L	Gas to liquid ratio
gpd	Gallons per day
gph	Gallons per hour
gpm	Gallons per minute
GRRP	Groundwater Replenishment Reuse Project
H_2O_2	Hydrogen peroxide
HDPE	High density polyethylene
HDLPE	High density linear polyethylene
HFO	Hydrous ferric oxide
HMI	Human-machine Interface
hp	Horsepower
HRT	Hydraulic residence time

IAP	Independent Advisory Panel
In	Inch
I/O	Input and output
IU	Industrial user
IWTF	Salinas Industrial Waste Treatment Facility
kDa	kilodaltons
kV	Kilovolt
kW	Kilowatts
lbs/day	Pounds per day
LOX	Liquid oxygen
LPUV	Low pressure, high intensity UV
LSI	Langelier Saturation Index
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
LRV	Log reduction value
M1W	Monterey One Water
MCC	Motor control center
MCL	Maximum Contaminant Level
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Agency
meq/L	milliequivalents per liter
min	minute
MF	Membrane filtration
MF/UF	Microfiltration/Ultrafiltration
mgd	Million gallons per day
mgal	Million gallons
mg/L	Milligrams per liter
mJ/cm^2	Millijoules per square centimeter
MPN	Most probable number
MPUV	Medium pressure, high intensity UV
MPWMD	Monterey Peninsula Water Management District
MRL	Method Reporting Level
MRP	Monitoring and Reporting Program
msl	Mean sea level
MTL	Monitoring Trigger Level
MUN	Municipal and Domestic Supply Beneficial Use
MW	Monitoring Wells
N	Nitrogen
N/A	Not applicable

NaCl	Sodium chloride
NaOCl	Sodium hypochlorite
NaOH	Sodium hydroxide
ND	Not detected above MRL
NDMA	N-nitrosodimethylamine
NEPA	National Environmental Policy Act
ng/L	Nanograms per liter
NH_3	Ammonia
NL	Notification Level
nm	Nanometers
NMFS	National Marine Fisheries Service
NO_3	Nitrate
NOM	Natural organic matter
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric turbidity units
NWRI	National Water Research Institute
O	Oxygen
O_3	Ozone
O_3:TOC	Ozone to Total Organic Carbon Ratio
OEM	Original Equipment Manufacturers
O&M	Operation and Maintenance
OOP	Operation Optimization Plan
ORP	Oxidation-Reduction Potential
OSS	Ozone system supplier
P	Phosphorus
P_L	Total lamp power
PCA	Pretreatment Compliance Audit
pCi/L	Picocuries per liter
PDT	Pressure decay test
PE	Professional Engineer
PG	Professional Geologist
PG&E	Pacific Gas and Electric Company
PhD	Doctor of Philosophy
PLC	Programmable Logic Controller
PM	Preventative maintenance
ppm	Parts per million
Project	Pure Water Monterey Groundwater Replenishment Project
psi	Pounds per square inch

psid	Pounds per square inch – differential
psig	Pounds per square inch gage
PSU	Power supply unit
PVC	Polyvinyl chloride
PVDF	Polyvinylidene difluoride
PWM	Pure Water Monterey
PWPS	AWPF Product Water Pump Station
PWS	Public water system
Q	Flowrate
QA/QC	Quality assurance/quality control
RMA	Running monthly average
RO	Reverse osmosis
rpm	Revolutions per minute
RRT	Response Retention Time
RTP	Regional Treatment Plant
RUWAP	Regional Urban Water Augmentation Project
RWC	Recycled Municipal Wastewater Contribution
RWQCB	Regional Water Quality Control Board
S	Storativity
SAR	Sodium Adsorption Ratio
SCADA	Supervisory Control and Data Acquisition
scfm	Standard cubic feet per minute
scfh	Standard cubic feet per hour
SDI	Silt Density Index
SIU	Significant Industrial User
SNMP	Salt and Nutrient Management Plan
SOPs	Standard Operating Procedures
SRF	State Revolving Fund
SRT	Solids retention time
SS	Stainless steel
Sqf	Square foot
SVRP	Salinas Valley Reclamation Project
SWRCB	State Water Resources Control Board
SEIR	Supplemental EIR
SWPS	Source Water Pump Station
SWTR	Surface Water Treatment Rule
T	Transmissivity

t_{10}	Time for 10% of the input concentration to be observed at the outlet of the system, or at a downgradient monitoring well during a groundwater tracer study
t_{50}	Time for 50% of the input concentration to be observed at the outlet of the system, or at a downgradient monitoring well during a groundwater tracer study
t_{peak}	Time for the peak concentration of a dye to be observed at the outlet of the system, or at a downgradient monitoring well during an extrinsic groundwater tracer study
TDS	Total Dissolved Solids
TIPS	Thermally induced phase separation
T&O	Taste and odor
TOC	Total Organic Carbon
TMF	Technical Managerial and Financial Assessment
TMP	Transmembrane pressure
TNT	2,4,5-trinitrotoluene
TSS	Total Suspended Solids
µg/L	microgram per liter
UIC	Underground Injection Control
µmhos/cm	Micromhos per centimeter (equivalent to µS/cm)
µS/cm	Microsiemens per centimeter
UPS	Uninterruptible power supplies
USEPA	United States Environmental Protection Agency
UV	Ultraviolet light
UV/H_2O_2	Ultraviolet light with hydrogen peroxide
UVI	Ultraviolet light intensity
UVT	Ultraviolet light transmittance
VAC	Volts alternating current
VFD	Variable frequency drive
WDR/WRR	Waste Discharge Requirements/Water Reclamation Requirements
WIFIA	Water Infrastructure Finance and Innovation Act
WQ	Water Quality
WY	Water Year
XLPE	Cross-linked polyethylene

1 PROJECT OVERVIEW

1.1 BACKGROUND

The Pure Water Monterey Project (Project) is a groundwater replenishment and reuse project (GRRP defined in Title 22, Section 60301.390) that serves northern Monterey County, California. Monterey One Water (M1W) is the project sponsor. The Expanded Project will increase the operating capacity of the Advanced Water Purification Facility (AWPF) to 7.6 million gallons per day (mgd), increase Seaside Basin groundwater replenishment to up to 5,950 acre-feet per year (AFY), and continue water production of 600 AFY of purified recycled water for urban landscape irrigation by Marina Coast Water District (MCWD). The Expanded Project includes new facilities to accommodate the increased operations, including a new backflush basin with two cells and two new deep injection wells (DIW) (for a total of six deep and two existing shallow wells). The planned date for the Expanded Project startup is August 2025.

1.1.1 Existing Pure Water Monterey Operations and Facilities

The Central Coast Regional Water Quality Control Board (RWQCB) adopted Waste Discharge Requirements and Water Recycling Requirements (WDR/WRR) for the Project on March 9, 2017 (Order No. R3-2017-0003). The Existing (or base) Project started operations in February 2020 and provides: (1) purified recycled water (product water) for replenishment of the Seaside Groundwater Basin (Seaside Basin) that serves as a drinking water supply; and (2) purified recycled water (product water) for landscape irrigation by MCWD. The Existing Project began operation with two deep injection wells (DIW-1, DIW-2) and two vadose zone wells (VZW-1, VZW-2). As authorized by the WDR/WRR, two additional deep injection wells (DIW-3, DIW-4) began operating in March and April 2022, respectively.

Replenishment of the Seaside Basin. The Existing Project enables California American Water Company (Cal-Am) to reduce its diversions from the Carmel River system by injecting product water into the Seaside Basin for later extraction. The product water is produced at the AWPF, located at the M1W[1] Regional Wastewater Treatment Plant (RTP) site, and is conveyed for irrigation and injection into the Seaside Basin via a pipeline. The injected water mixes with the existing groundwater and is stored for future extraction as a source of potable supply for customers in the Cal-Am system in collaboration with the Monterey Peninsula Water Management District (MPWMD).[2]

Landscape irrigation by MCWD. The Existing Project provides up to 600 AFY of product water for landscape irrigation by MCWD customers. MCWD owns and operates the product water conveyance pipeline in collaboration with M1W.[3] The quality of the product water meets all

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[1] Monterey One Water was formerly known as Monterey Regional Water Pollution Control Agency (MRWPCA).

[2] The arrangement for Cal-Am to purchase the water and the relationship between the three agencies was memorialized in a Water Purchase Agreement, dated September 19, 2016, which was recently superseded and replaced by the Amended and Restated Water Purchase Agreement, dated March 31, 2023.

[3] The partnership between the two agencies is memorialized in the "Pure Water Delivery and Supply Project Agreement" and Amendment No. 1 to the Agreement dated April 8, 2016 and December 18, 2017, respectively.

recycled water quality requirements for landscape irrigation, as it is treated to the higher water quality standards that are required for groundwater replenishment and reuse (or indirect potable reuse).

The Existing Project included the ability to store water in the Seaside Groundwater Basin in wet months of most years to consistently meet the average project supply yield in dry years. Therefore, the maximum annual injection volume includes an additional 200 AFY of product water for injection into the Seaside Basin. During dry years, M1W can deliver less than 3,500 AFY of water to the Seaside Basin when the reserve balance is positive (stored water available from prior years), such that Cal-Am is able to extract the banked water to make up the full 3,500 AFY supply. The project agreement between M1W, MPWMD, and Cal-Am requires the establishment of an Operating Reserve of 1,750 AF of stored water in the Seaside Basin during the first three years of operating. Currently, the Operating Reserve contains 1,870 AF.

Facilities constructed as part of the Existing Project in 2018 through 2022 include the following, which are described in more detail below:

- Source water facilities to divert and convey PWM Source Waters;
- The AWPF, product water pump station, and other improvements to the RTP;
- A treated water conveyance system, including pipeline, a reservoir, and connections to the pipeline for landscape irrigation (these are owned and operated by MCWD);
- Groundwater injection and monitoring wells and a backflush percolation basin; and
- Potable water distribution system improvements (owned and operated by Cal-Am).

Source Water Diversion and Storage. PWM Source Waters are diverted by M1W to the collection system and RTP headworks to supplement incoming municipal wastewater flows. The source waters (described below) do not contain domestic wastewater and currently have an alternative method of discharge, so they are considered to be interruptible:

1. Water from the City of Salinas separate industrial wastewater (IWW) collection system, which is commonly referred to as agricultural wash water (or Ag Wash Water),
2. Treated IWW and stormwater flows from the southern part of Salinas in the City’s Industrial Wastewater Treatment Facility (IWTF) Pond 3,
3. Mixed natural, urban, and agricultural drainage surface water in the Reclamation Ditch, and
4. Surface water and agricultural tile drain water that flows in the Blanco Drain.

These source waters are combined within the existing wastewater collection system before arriving at the RTP; with the exception of water from the Blanco Drain, which is conveyed directly to the headworks of the RTP. The California Environmental Quality Act (CEQA) Environmental Impact Report (EIR) adopted for the base Project included these new sources as well as agricultural drainage water from Tembladero Slough and stormwater diversions from the Lake El Estero facility in Monterey. The Tembladero Slough diversions considered in the Base PWM Project EIR are no longer being pursued as part of the PWM/GWR Project due to conditions imposed by the SWRCB in water rights permits for the Blanco Drain and the Reclamation Ditch source water diversions and will not be reconsidered in the future.

However, the City of Monterey is currently proceeding with the Lake El Estero diversion facility using grants from the State. Source waters that are not sent to the AWPF during dry years have the potential to be used for the Salinas Valley Reclamation Project (SVRP) to increase supplies for the Castroville Seawater Intrusion Project (CSIP). However, M1W does not currently have secured funding from the customers of those projects, so it is not currently able to supply these PWM Source Waters to the SVRP.

Treatment facilities at the RTP. The AWPF was constructed at the RTP site. This facility includes a full advanced treatment system that meets the requirements in Title 22. Article 5.2. Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application. The term “Title 22 Criteria,” as used in this report, refers to the State Water Resources Control Board Division of Drinking Water (DDW) Water Recycling Criteria. Treatment at the AWPF consists of ozone pre-treatment, low-pressure membrane filtration, reverse osmosis treatment, advanced oxidation, and product water stabilization. The AWPF also contains the product water pump station (PWPS), which conveys water to injection wells and urban irrigation customers.

Product water conveyance. A pipeline, pump station, reservoir, and appurtenant facilities were constructed to transport the product water from the AWPF to the Seaside Groundwater Basin for injection. The pipeline included connections to provide purified recycled water to MCWD for landscape irrigation.

Injection well facilities. The injection well facilities included injection and monitoring wells (in the shallow and deep aquifers), back-flush facilities, pipelines, electricity/power distribution facilities, and an electrical/motor control building.

Distribution of groundwater from Seaside Basin. Cal-Am water distribution system improvements were made to enable Cal-Am to deliver the 3,500 AFY PWM Project yield to Cal-Am customers.

1.1.2 Expanded Pure Water Monterey Operations and Facilities

The Expanded Project will utilize the facilities constructed as part of the Existing Project as well as new facilities and will utilize the same PWM Source Waters as the Existing Project. The Expanded Project will increase AWPF capacity, increase the annual volume of purified recycled water injected into the Seaside Basin, and continue to provide purified recycled water for landscape irrigation by MCWD customers.

AWPF Capacity. The AWPF capacity will be increased from 5 mgd to a peak capacity of 7.6 mgd.

Injection into the Seaside Basin. The Expanded Project will increase the annual volume of purified recycled water injected into the Seaside Basin and allow Cal-Am to further reduce its diversions from the Carmel River system. Injection will increase to an annual average of 5,750 AFY (5,950 AFY when reserves are replenished). The product water will be distributed to injection well facilities using the existing and new conveyance pipeline and injection to the Seaside Basin will be accomplished using existing and additional injection wells. Additional backflush pipelines and a percolation basin with two interconnected cells (i.e., a double-compartment backflush basin) will be installed to percolate backflush water that is required to maintain the new injection wells.

Landscape Irrigation by MCWD. The Expanded Project will continue to provide 600 AFY of purified recycled water for landscape irrigation by MCWD customers. **Table 1-1** provides a summary of the existing and expanded project facilities and operations.

Table 1-1. Pure Water Monterey Operations and Facilities (Existing and Expanded Projects)

Facilities	Existing Project	Expanded Project
Operating Capacity of AWPF (mgd)	5	7.6
Average Annual Injection Volume (AFY)	3,500	5,750
Additional Injection Volume for Reserves (AFY)	600	200
Minimum Operating Reserve Volume (AF)*	1,750	2,875
Capacity to Marina Coast Water District (AFY)	600	600
# of Deep Injection Wells	4	6
# of Vadose Wells	2	2
# of Backflush Basins	1	2**
# of Monitoring Well Clusters	4	4

* A Drought Reserve can also be created, but is limited to only 1,000 AF maximum. As of the date of this report, the Operating Reserve contains 1,870 AF and the Drought Reserve has not been created.
** The new Backflush Basin will have two cells separated by an earthen berm, to enable M1W to work on one side while continuing to be able to backflush wells in the other side.

This Engineering Report describes the increased AWPF capacity, new equipment installed at the AWPF and injection well facilities, groundwater impacts of additional injection to the Seaside Basin, and operational changes. The Existing Project Engineering Report (April 2019) was accepted by the State Water Resource Control Board Division of Drinking Water (DDW) in November 2019. The treatment train for the Project remains the same as described in the April 2019 Engineering Report, except for the capacity increase from 5 mgd to 7.6 mgd. The injection system design and groundwater modeling have been revised to reflect the additional injection volume. The WDR/WRR for the Existing Project must be amended or reissued by the RWQCB by the fall of 2025 to enable production and injection of the Expanded Project yields upon completion of construction. MCWD submitted a separate Engineering Report to DDW that addressed recycled water distribution, program administration, and uses for landscape irrigation. The MCWD recycled water program is governed under a separate permit. A regional map showing the location of major project components is presented in **Figure 1-1**.[4]

[4] This Engineering Report does not address Regional Water Quality Control Board Order No. 94-82, Water Reclamation Requirements for MRWPCA (now M1W) for use of recycled water for agricultural irrigation. Order No. 94-82 includes reclamation specifications for the amount of recycled water use (average daily flow over each month not to exceed 29.6 million gallons. *See* Reclamation Specifications B.1).

Figure 1-1. Project Facilities Overview

1.2 PUBLIC OUTREACH AND COORDINATION

M1W's community outreach activities include posting Project documents, opportunities for public comment, and Project plans on the Pure Water Monterey website (https://purewatermonterey.org/). In 2015, M1W completed the installation of a permanent AWPF Demonstration Facility. This facility features all of the treatment technologies included in the full-scale AWPF and is used to facilitate tours, educate the public, and allow visitors to taste purified recycled water.

As part of the CEQA processes for the Existing and Expanded Projects, the following outreach activities took place:

- 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, M1W's and Monterey Peninsula Water Management District's (MPWMD's) websites and offices, and key project sites; and posted with the Monterey County Clerk.
- Public meetings to provide information on the Existing Project and CEQA process were held on May 20 and 21, 2015.
- Notices about the availability of the Final 2015 EIR were distributed in September 2015 to all entities that received the Draft EIR. The public was provided with a 45-day comment

period for the Draft EIR.

- The Final 2015 EIR was certified, and the Project was approved at a public hearing held on October 8, 2015.
- Notices regarding the three Addenda to EIRs (one in 2016 and two in 2017) were distributed with M1W Board packets, posted on the Pure Water Monterey Website, and sent to entities that requested notice.
- A Notice of Preparation for a Supplemental EIR was published in 2019.
- Public meetings to provide information and solicit public comment on the Expanded Project and CEQA process were held on June 5, 2019, and December 12, 2019.
- A Notice of Availability was distributed and posted broadly for the Draft Supplemental EIRs in early November 2019. Public comments were accepted through January 31, 2020 (extending the public review period for more than a month beyond the minimum public review period).
- A Notice of Availability was distributed broadly for the Final Supplemental EIR in April 2020 and a hearing was conducted on April 27, 2020.
- The Final 2021 Supplemental EIR was certified and Expanded Project was approved at a public hearing held on April 26, 2021.

As part of Engineering Report acceptance for the Existing Project, the following outreach activities took place:

- A public hearing was held on August 22, 2016, with 30-days prior notice (via emails and letters) given to well owners in the Seaside Groundwater Basin.
- A notice was published in the Monterey County Herald and posted on the M1W website. Public comments were solicited by M1W during the hearing and 10 days after the hearing.

For the development and adoption of the WDR/WRR (Order No. R3-2017-0003) for the Existing Project, the following outreach activities took place:

- The Tentative Order WDR/WRR was posted on the RWQCB's website for a 30-day public comment period.
- The RWQCB provided public notice of the March 9, 2017, permit adoption hearing.
- Public comments were accepted during the permit adoption hearing on March 9, 2017.

1.3 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 Project. The IAP was comprised of experts in disciplines relevant to groundwater replenishment projects: engineering, regulatory criteria, public health, hydrogeology, risk assessment, and other relevant fields.

1.3.1 IAP Activities to Date

The IAP has held four meetings to date (October 2013, May 2014, February 2015, and October 2018) and provided reports on their findings and recommendations (see **Appendix A**). 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; brine management; regulatory implications; operational planning; and permitting and compliance.

1.4 ENVIRONMENTAL COMPLIANCE

M1W acted as the lead agency for the environmental review of the base and Expanded Project under CEQA. The CEQA process for the Existing Project consisted of the following steps:

- September 2013: M1W issued the Notice of Preparation and conducted EIR scoping.
- December 2014: M1W issued the Supplemental Notice of Preparation.
- April 22, 2015: M1W issued the Draft EIR.
- April 22 through June 5, 2015: M1W provided a 45-day public review period.
- September 25, 2015: M1W issued the Final EIR.
- October 8, 2015: The M1W Board of Directors certified the Final EIR (including Oct. 5, 2015 Errata to the Final EIR), adopted findings and approved mitigation measures, adopted a Statement of Overriding Considerations, and approved the Project.

Three (3) Addenda to the certified Final EIR were prepared and approved by MPWMD and M1W (dated June 14, 2016, February 13, 2017, and October 24, 2017) to include changes to Cal-Am's potable water supply facilities, changes related to the shared conveyance facility arrangements (partnering with MCWD), delivering purified recycled water for urban irrigation, and the capacity change from 4 mgd to 5 mgd.

A Supplemental EIR (SEIR) was prepared in 2019 through 2021 and certified for the modifications to the PWM Project for the Expanded Project on April 26, 2021. An Addendum to the SEIR was completed in November 2021, which included the changes for the new deep injection wells, backflush basin, and pipelines. The CEQA process for the Expanded Project consisted of the following steps:

- **May and June 2019:** M1W prepared the Notice of Preparation and conducted SEIR scoping.
- **November 2019:** M1W completed the Draft SEIR and distributed it for public review.
- **December 12, 2019:** M1W conducted a public meeting.
- **December 19, 2019:** M1W held a special Board of Directors meeting and voted to extend the public review period to January 31, 2020.
- **April 13, 2020:** M1W issued the final SEIR. M1W Board considered but did not certify the SEIR nor approve the Expanded Project.
- Prior to the certification of the Final SEIR, an Environmental Memorandum was prepared to address certain changes. Namely, in early 2020, M1W constructed two more of the previously approved injection wells (i.e., approved by the M1W Board in October 2015 and by the RWQCB in March 2017). Information gathered during the construction of the two previously approved injection wells led M1W to the conclusion that only two additional deep wells were necessary in the Expanded Injection Well Area. The 2020 Final SEIR included three wells in the Expanded Injection Well Area, one new well and two previously approved relocated wells. The Environmental Memorandum identified the Expanded Injection Well Area would include only one new well and two sites for potential future replacement wells if replacement of existing wells were to be needed, but no replacement

wells were proposed for approval at that time. The Environmental Memorandum summarizes the changes to the project description and resulting changes to the environmental analysis and conclusions by topical area since the 2020 Final SEIR.

- **April 26, 2021:** M1W Board of Directors certified the 2020 Final SEIR as amended by the Environmental Memorandum, referred to as the 2021 Certified SEIR.
- **November 2021:** The Addendum to the SEIR was issued, which changed the locations of conveyance pipelines and injection well facilities, including backflush facilities.

The U.S. Bureau of Reclamation completed a review of the base Project and the Expanded Project under the National Environment Policy Act (NEPA) to support its grant funding. In addition, the State Water Resource Control Board (SWRCB), the Department of Water Resources, and the United States Environmental Protection Agency (USEPA) have also completed environmental review, including for the federal funding and the associated compliance with federal regulations through consultation with affected federal agencies (U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the State Office of Historic Preservation).

Links to download all environmental documents are available at the Project website (https://purewatermonterey.org/).

1.5 GROUNDWATER REPLENISHMENT PROJECT GOALS

The goal of the Expanded Project is to produce an average of 5,750 AFY of purified recycled water for injection into the Seaside Basin to enable Cal-Am to reduce its diversions from the Carmel River system and its use of native Seaside Basin groundwater and to provide water for growth in the Cal-Am service area. This is an increase of 2,250 AFY from current operations. Cal-Am is under a SWRCB Cease and Desist Order (SWRCB Order No. 2009-0060, as amended by Order No. 2016-0016) to cease pumping the Carmel River system water above the legal limit by January 2022 and to date, has not violated the Order. In fact, in WY 2023, Cal-Am produced less water from the Carmel River than was allowed to be diverted. Use of native Seaside Basin groundwater is limited by an adjudication filed on March 27, 2006, by the Superior Court of the State of California in the County of Monterey (Superior Cour, 2006).

The Expanded Project also continues the Existing Project’s ability to store water in the Seaside Basin to carry over water supplies from one year to the next using one of two “reserve” accounts, referred to as an Operating Reserve and a Drought Reserve in the Water Purchase Agreement. Namely, the Existing Project can produce and inject an additional 200 AFY into the Seaside Basin in wet and normal years, totaling 1,000 AF over five years. Thus, the Expanded Project proposes to inject up to 5,950 AFY of product water into the Seaside Basin in some years. This will result in a “banked” reserve or storage that can carry over to future years. During dry years, less than 5,750 AFY of product water may be delivered to the Seaside Basin and Cal-Am can use stored “reserve” water to meet their full yield of 5,750 AFY. In the base Project, M1W anticipated the PWM Source Waters that are in excess of the needs of the AWPF could undergo tertiary treatment for agricultural irrigation when demand exists. No ongoing permanent funding has been provided for using the PWM Source Waters in this way to date.

1.6 MANAGERIAL AND TECHNICAL CAPABILITIES

As discussed in **Section 2**, one of the requirements in Title 22 (Section 60320.200(f)) is that a project sponsor must demonstrate that it possesses adequate managerial and technical capability to comply with the regulations. DDW has developed a Technical Managerial and Financial Assessment (TMF) form to assess project sponsors' managerial and technical capabilities for public drinking water supply systems. Portions of the requirements discussed in the TMF form are applicable to the Title 22 Criteria for groundwater replenishment, including the requirements for information regarding the project operations, including certified operators, training, and emergency response. The following sections of the Engineering Report address the TMF requirements applicable to the Project:

- **Section 13** – General Operations Plan
- **Section 13.2** – Training
- **Section 13.3** – Operational Strategies and Contingency Plans

1.7 PURPOSE OF THIS REPORT

The purpose of this Engineering Report is to present detailed information on the Project, describe the overall plan for compliance with Title 22 Criteria for groundwater replenishment by subsurface application, and satisfy the requirement for a Five-Year Engineering Report.

2 PROJECT PARTICIPANTS AND REGULATIONS

2.1 PROJECT PARTICIPANTS

M1W is the Project Sponsor and implementation is achieved through the cooperative efforts of the project participants listed in **Table 2-1**.

Operational responsibilities are defined by water purchase agreements between M1W, MPWMD, and Cal-Am approved by the California Public Utilities Commission and an agreement between M1W and MCWD. The agreements specify that M1W is responsible for the design, construction, operation, and ownership of facilities for the production and injection of product water, including the RTP, AWPF, conveyance, and injection well facilities. MPWMD buys product water from M1W for the purpose of securing financing and paying for the operating costs of the Project. MPWMD then sells the water to Cal-Am. MCWD buys product water from M1W to resell to its irrigation customers. Cal-Am’s responsibility for extracting Project water for supplying it to customers is also described in the water purchase agreement.

M1W has entered into separate agreements with the Monterey County Water Resources Agency (MCWRA) and the City of Salinas for source waters from the jurisdictions of these two agencies. On March 17, 2017, SWRCB issued Water Rights Permits 21376 and Permit 21377 for the diversion of surface waters from Blanco Drain and Reclamation Ditch, respectively. Water Rights Permit 21376 limits the diversion from Blanco Drain to no more than 6 cubic feet per second (fps) by direct diversion, totaling up to 3,000 AFY. Water Rights Permit 21377 limits the diversion from Reclamation Ditch to 6 cubic fps by direct diversion, totaling up to 2,000 AFY. These permits include terms and conditions developed with the National Marine Fisheries Service (NMFS) and the California Department of Fish and Wildlife (CDFW) to reduce potential impacts to fisheries, including the South-Central California Coast steelhead.

The City of Salinas source water required a wastewater change petition from the SWRCB because this source water was previously disposed of in percolation ponds adjacent to the Salinas River at the Salinas Industrial Waste Treatment Facility (IWTF). Accordingly, the City of Salinas filed a wastewater change petition with the SWRCB Division of Water Rights. The City of Salinas petition was publicly noticed on November 3, 2015, and no protests to the petition were submitted. The SWRCB Division of Water Rights issued an Order Approving Change in Place of Use, Purpose of Use, and Quantity of Discharge on November 30, 2015 (WW0089). In addition, M1W issued an Industrial Wastewater Discharge Permit to the City of Salinas as a Significant Industrial User (SIU). This permit is the control mechanism M1W utilizes to ensure its Pretreatment Program requirements are met to prevent passthrough or upset of M1W facilities. See **Section 4** for more information on the M1W Source Control and Pretreatment Program activities.

Table 2-1. Project Participants

Project Participants	Roles
Federal Agencies	
U.S. Environmental Protection Agency (USEPA)	Administration of the Clean Water State Revolving Fund Loan and WIFIA Loan programs; maintains inventory of Class V injection wells as part of the Underground Injection Program
U.S. Army Corps	Approved of Clean Water Act Section 404 permit for fill of Waters of the U.S. at Reclamation Ditch and Blanco Drain
U.S. Fish and Wildlife Service (USFWS)	Issued Biological Opinion for Compliance with Federal Endangered Species Act, Section 7
National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS) and Monterey Bay National Marine Sanctuary	Biological Opinion or concurrence letter for Compliance with Federal Endangered Species Act, Section 7 and authorization of Regional Water Quality Control Board issued National Pollutant Discharge Elimination System Permit
State of California Agencies	
SWRCB – Division of Water Rights	Approval of water rights permits for diversions of surface water; construction storm water permit for specific project components, and Clean Water Act Section 401 Water Quality
SWRCB – Division of Financial Assistance	Approval of CWSRF loan and Recycled Water Project Grant; federal action agency (with USEPA) for compliance with Section 7 Endangered Species act and Section 106 National Historic Preservation Act
SWRCB – Division of Drinking Water	Acceptance of Project and Engineering Report; conditions prescribed for Project Waste Discharge Requirements/Water Reclamation Requirements issued by the RWQCB
SWRCB – Division of Water Quality (Groundwater Ambient Monitoring and Assessment)	Provides hydrogeologic technical services to the SWRCB Division of Drinking Water (DDW)
State Office of Historic Preservation	Letter of Concurrence of National Historic Preservation Act Section 106 Compliance
RWQCB – Central Coast Region	Modified National Pollutant Discharge Elimination System (NPDES) permit for RTP effluent discharge/reverse osmosis concentrate discharge; Project Waste Discharge Requirements/Water Reclamation Requirements; General Permit for Low Threat Discharges (for extrinsic tracer study)
Department of Fish and Wildlife (CDFW)	Approval of Streambed Alteration Agreement (Fish and Game Code Section 1602)

Project Participants	Roles
State Lands Commission	Approval of land lease for Salinas River pipeline crossing for Blanco Drain diversion
Public Utilities Commission	Approval of Cal-Am Water Purchase Agreement; State lead agency for the Monterey Peninsula Water Supply Project [a]
CA State University Monterey Bay	Approval of land lease, easement/right of way
Regional and Local Agencies/Districts	
County of Monterey – Resource Management Agency/Planning Dept	Approval of use permit(s) and/or grading permit(s) for Reclamation Ditch, Blanco Drain, 33-inch industrial wastewater pipeline slip-lining RTP, AWPF, and product water conveyance system.
County of Monterey – Environmental Health	Approval of hazardous materials storage/use; permitting for construction, destruction, and repairs/modification of a domestic, irrigation, agricultural, cathodic protection, monitoring, or heat exchange wells
County of Monterey – Water Resources Agency (MCWRA)	Agreements and/or land lease, easements, water rights agreements/contracts, rights of way for surface water diversions
City of Marina	Approval of easements/rights of way for Existing Project
City of Salinas	Agreements for construction of improvements to the Salinas IWTF site; source water agreements and grants coordination
City of Seaside	Approval of easements/rights of way
Marina Coast Water District (MCWD)	Approval of easements/rights of way; water purchase and operations and maintenance (O&M) agreements, Water Wheeling Agreement with Cal-Am (existing)
Monterey Peninsula Water Management District (MPWMD)	Approval of Water Distribution System Permit; water purchase agreement and operations and maintenance agreements with M1W and Cal-Am
Seaside Basin Watermaster	Approval of storage agreement
Private Entities	
California American Water Company (Cal-Am)	Water Purchase Agreement; O&M agreements with MPWMD; proponent of the Monterey Peninsula Water Supply Project[a]
Private Landowners	Agreements for easements/rights of way to access the Reclamation Ditch and Blanco Drain diversions sites; temporary use/access to the sites needed for source water facilities

[a]The Monterey Peninsula Water Supply Project, proposed by Cal-Am, would augment existing supplies and would produce up to 6.4 mgd of water using slant wells and an ocean desalination facility.

2.1.1 Division of Drinking Water: Groundwater Replenishment

The regulations for subsurface application of recycled water for groundwater replenishment are contained in the Title 22 Criteria. The groundwater replenishment regulations, which became effective June 18, 2014, establish the requirements applicable for obtaining approval and permitting of GRRPs) The Project WDR/WRR implements the following requirements.

2.1.1.1 General Requirements

Per Title 22 Section 60320.200, prior to GRRP operation, the Project Sponsor must obtain DDW approval of a plan to provide an alternate source of drinking water or a DDW-approved treatment system for wells impacted by the GRRP. Provision of the alternate drinking water supply or well treatment will only be needed if the operation of the GRRP impacts a drinking water well so that it violates drinking water standards, has been degraded so that it is no longer a safe source of drinking water, or fails to meet the pathogen control requirements in Title 22 Criteria (Section 60320.208).

The Project Sponsor must ensure the GRRP continuously uses full advanced treatment, in accordance with Title 22 Section 60310.201, to treat the entire volume of recycled water prior to subsurface application.

The applied recycled water must be retained underground to meet the more stringent of retention times determined for pathogen control (Section 60320.208) or response retention time (RRT) per Title 22 Section 60320.224. The GRRP must be designed and operated such that water beyond the boundary established by the zone of controlled drinking water well construction (defined below) meets the Recycled Municipal Wastewater Contribution (RWC) requirements in Title 22 Section 60320.216.

The Project Sponsor must provide a map that shows the location of the GRRP, monitoring wells established pursuant to Title 22 Section 60320.226, and potable wells within two years travel time of the GRRP based on groundwater flow directions and velocities expected under GRRP operating conditions, and two zones:

- The boundary represents a zone of controlled drinking water well construction – the greatest of the horizontal and vertical distances reflecting the retention time for virus removal credit or the RRT.
- A secondary boundary represents a zone of potential controlled drinking water well construction, depicting the zone within which a well would extend the boundary of controlled drinking water well construction to include existing or potential drinking water wells, thus requiring more study and potential mitigation prior to drinking water well construction.

Prior to operating a GRRP, the Project Sponsor must collect at least four samples (one sample each quarter) from each potentially affected aquifer. The samples must be analyzed for the chemicals, contaminants, and characteristics specified in Sections 60320.210 (nitrogen compounds), 60320.212 (regulated constituents and physical characteristics), 60320.218 (total organic carbon or TOC), and 60320.220 (additional chemicals).

The Project Sponsor must ensure that recycled water used for the GRRP is from a wastewater management agency that is not in violation of effluent limits pertaining to groundwater replenishment as established in the agency's RWQCB permit.

Prior to operations, the Project Sponsor must demonstrate adequate managerial and technical capability.

Prior to operations, the Project Sponsor must demonstrate that all treatment processes have been installed and can be operated to meet their intended function.

If a Project Sponsor is directed by DDW or the RWQCB to suspend recycled water application, it cannot resume the application without obtaining approval from DDW and the RWQCB.

2.1.1.2 Advanced Treatment Criteria

Per Title 22 Section 60320.201, GRRPs that utilize subsurface application are required to use full advanced treatment (reverse osmosis [RO] and an advanced oxidation treatment process [AOP]) that, at a minimum, meets the criteria of Title 22 Section 60320.201.

For RO, each membrane element must achieve a minimum sodium chloride (NaCl) rejection greater than or equal to 99.0% and an average (nominal) NaCl rejection greater than or equal to 99.2% using the 2008 American Society for Testing and Materials International (ASTM) Method D4194-03 and the following substitute test conditions:

- Tests are operated at a recovery greater than or equal to 15%.
- NaCl rejection is based on three or more successive measurements.
- An influent pH between 6.5 and 8.0.
- An influent NaCl concentration less than or equal to 2,000 milligrams per liter (mg/L).

During the first 20 weeks of full-scale operation, the membrane must produce a permeate having no more than 5% of the sample results with Total Organic Carbon (TOC) concentrations greater than 0.25 mg/L based on monitoring no less frequently than weekly.

To address when the integrity of the RO process has been compromised, the Project Sponsor must propose for approval at least one form of continuous performance monitoring (for example, conductivity or TOC) as well as the associated surrogate and/or operational parameter limits and alarm settings.

To demonstrate that a sufficient oxidation process has been designed, the Title 22 Criteria allows two options for demonstration. Option 2 has been selected for the Project, which requires the Project Sponsor to conduct testing that includes challenge or spiking tests to demonstrate that the AOP process removes 0.5-log of 1,4-dioxane and establish surrogate or operational parameters that reflect whether the 0.5-log reduction of 1,4-dioxane is attained. The criteria specify that at least one surrogate or operational parameter must be capable of being monitored continuously.

The advanced treated recycled water must also meet drinking water maximum contaminant levels (MCLs).

2.1.1.3 Public Hearing

Per Title 22 Section 60320.202, the Project Sponsor must hold a public hearing for a GRRP prior to DDW submittal of GRRP permit conditions to the RWQCB and any time an increase in maximum RWC has been proposed but has not been addressed in a prior public hearing. The Project Sponsor must provide information it intends to present at the hearing to DDW for review and approval prior to the hearing and place the information on a website for public access 30 days prior to the hearing. The Project Sponsor must notify the downgradient potable water owners whose drinking water wells are within ten years of the GRRP based on groundwater flow directions and velocities.

2.1.1.4 Lab Analyses

Per Title 22 Section 60320.204, analyses for contaminants with primary and secondary MCLs must be performed using drinking water methods.

2.1.1.5 Wastewater Source Control

Per Title 22 Section 60320.206, entities that supply recycled water to a GRRP must administer a comprehensive source control program that includes: (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.

2.1.1.6 Pathogenic Microorganism Control

Per Title 22 Section 60320.208, the treatment system 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. For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than a 1.0-log reduction. For each month retained underground as validated by a tracer test, the recycled water will be credited with a 1-log virus reduction.

To validate underground retention time, a tracer study must be conducted prior to the end of the third month of operation[5]. The retention time represents the difference from when the water with the tracer is applied at the GRRP to when either 2% of the initially introduced tracer concentration has reached the downgradient monitoring point, or 10% of the peak tracer unit value is observed at the downgradient monitoring point. If the effectiveness of a treatment train's ability to reduce enteric virus is less than 10-logs, or *Giardia* cyst or *Cryptosporidium* oocyst reduction is less than 8-logs, the Project Sponsor must immediately notify DDW and the RWQCB and discontinue application of recycled water unless directed otherwise by DDW or the RWQCB.

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[5] M1W has satisfied this condition of the regulations using the 2020-2023 Tracer Studies conducted for DIW-1, DIW-2, DIW-3, and DIW-4. Therefore, use of the calibrated and validated Seaside Groundwater Basin hydrogeologic model provides results that, when applied to the existing and new deep injection and extraction well operations, are reliable with a high degree of accuracy.

2.1.1.7 Nitrogen Compounds Control

Per Title 22 Section 60320.210, the Project Sponsor must collect at least two total nitrogen samples each week at least three days apart (grab or 24-hour composite) from the recycled water or recharge water[6] before or after subsurface application. The analytical laboratory must analyze the sample within 72 hours and report results greater than 10 mg/L to the Project Sponsor within the same 72 hours. If the average of two consecutive samples exceeds 10 mg/L, the Project Sponsor must collect a confirmation sample and notify DDW and RWQCB within 48 hours of being notified of the results by the laboratory. The Project Sponsor must also investigate the cause of the exceedance, take actions to reduce the total nitrogen concentrations and initiate monitoring for additional nitrogen compounds at different locations in the groundwater basin. If the average of four consecutive samples exceeds 10 mg/L, injection of recycled water must be suspended and not resumed until corrective actions are implemented and at least two consecutive samples are less than 10 mg/L.

2.1.1.8 Regulated Contaminants and Physical Characteristics Control

Per Title 22 Section 60320.212, the Project Sponsor must monitor recycled water quarterly and meet all primary MCLs and action levels (except nitrogen compounds which are addressed by special provisions). For disinfection byproducts, compliance can be determined in the recharge water in lieu of recycled water if the fraction of recycled water in the recharge water is equal to or greater than the average fraction of recycled water in the recharge water applied over the quarter.[7] Compliance is based on the running annual average of quarterly samples. If the running four-week average exceeds the contaminants' MCL for 16 consecutive weeks, the Project Sponsor must notify DDW and the RWQCB within 48 hours of knowledge of the exceedance, and if directed by DDW or the RWQCB, suspend application of recycled water. If four quarterly results for asbestos are below detection, monitoring may be reduced to one sample every three years.

For a contaminant whose compliance with its MCL or action level is not based on a running annual average, if the average of the initial and confirmation sample is greater than the MCL or action level, the Project Sponsor must notify DDW and the RWQCB and initiate weekly sampling until four consecutive weekly results are below the MCL. If the running four-week average exceeds the contaminant's MCL, the Project Sponsor must notify DDW and the RWQCB within 24 hours, and if directed by DDW or the RWQCB, suspend application of recycled water.

For constituents with secondary MCLs, the Project Sponsor must collect an annual recycled water sample. If the annual average exceeds a secondary MCL in California Health and Safety Code Table 64449-A or the upper limit in Table 64449-B, the Project Sponsor must initiate quarterly monitoring of the recycled water for the contaminant. If the running annual average of quarterly averaged results exceeds an MCL, the Project Sponsor must describe the reasons and any corrective actions in a report submitted to the RWQCB and DDW no later than 45 days

[6] Recharge water is the combination of recycled water and credited diluent water. Based on the approved recycled water contribution of 100%, diluent water will not be used for the Project.

[7] Ibid.

following the quarter when the exceedance occurred. Annual monitoring may resume when the running annual average of quarterly results does not exceed a secondary MCL.

2.1.1.9 Recycled Municipal Wastewater Contribution Requirements

The Project is approved for an RWC of 1.0, so diluent water is not required.

Per Title 22 Sections 60301.705 and 60320.214, the RWC is defined as follows:

- The RWC means the fraction equal to the quantity of recycled water applied at the GRRP divided by the sum of the quantity of recycled water and credited diluent water. Each month, the Project Sponsor must calculate the running monthly average (RMA) RWC based on the total volume of the recycled municipal wastewater and credited diluent water for the preceding 120 months.
- The initial maximum RWC, which may be up to 1.0, will be determined by DDW based on, but not limited to, DDW's review of the Engineering Report, information obtained as a result of the public hearings, and a Project Sponsor's demonstration that the treatment processes will reliably achieve a TOC concentration no greater than 0.5 mg/L. A GRRP may increase its maximum RWC if (1) it is approved by DDW and the RWQCB; (2) for the previous 52 weeks, the TOC 20-week running average has not exceeded 0.5; and (3) the permit allows the increase.

2.1.1.10 Total Organic Carbon Requirements

Per Title 22 Section 60320.218, the Project Sponsor must monitor total organic carbon (TOC) weekly in the applied recycled water prior to replenishment. For subsurface application projects, TOC cannot exceed 0.5 mg/L based on (1) the 20-week running average of all TOC results; and (2) the average of the last four TOC results. If the GRRP exceeds the 20-week running average, the Project Sponsor must suspend operations until at least two consecutive results (three days apart) are less than the limit, notify DDW and RWQCB within seven days of suspending operations, and submit a report to the regulators within 60 days describing the reasons for the exceedance and corrective actions. If the GRRP exceeds the TOC limit based on the average of the last four results, the Project Sponsor must notify DDW and RWQCB within 60 days and submit a report describing the reasons for the exceedance and corrective actions.

2.1.1.11 Additional Chemical and Contaminant Monitoring

Per Title 22 Section 60320.220, the Project Sponsor must monitor recycled water and groundwater quarterly for Priority Pollutants; chemicals specified by DDW based on the Engineering Report and the affected groundwater basin; and the Project Sponsor's source control program. Each quarter, the Project Sponsor must monitor the recycled water for DDW-specified chemicals having notification levels (NL)s. If a result exceeds an NL, the Project Sponsor must collect a confirmation sample within 72 hours of notification of the result. If the average of the initial and confirmation sample is greater than the NL, the Project Sponsor must initiate weekly monitoring until the running 4-week average no longer exceeds the NL. If the running 4-week average is greater than the NL, the Project Sponsor must describe the reason and provide a schedule for corrective actions in a report submitted to the RWQCB and DDW no later than 45 days following the quarter in which the exceedance occurred. If the running 4-week average is greater than the NL for 16 consecutive weeks, the Project Sponsor must notify DDW and the RWQCB within 48 hours of receiving knowledge of the exceedance.

In addition, the Project Sponsor must monitor the recycled water for indicator compounds specified by DDW and RWQCB based on the review of the Engineering Report, the source control inventory, the affected groundwater basin(s), and an indicator compound's ability to characterize the presence of pharmaceuticals, endocrine disrupting chemicals, personal care projects, and the presence of wastewater, and the availability of analytical test methods.

Any detected compounds that are part of this additional contaminant monitoring program must be reported to DDW and RWQCB no later than the following quarter in which the results are received by the Project Sponsor.

2.1.1.12 Operation Optimization Plan

Per Title 22 Section 60320.222, prior to operation, the Project Sponsor must submit an Operation Optimization Plan (OOP) to DDW and the RWQCB for review and approval. At a minimum, the OOP must identify the operations, maintenance, analytical methods, and monitoring necessary for the GRRP to meet regulatory requirements, as well as the reporting of monitoring results to DDW and the RWQCB. The OOP must be representative of current operations and updated as appropriate.

2.1.1.13 Response Retention Time

Per Title 22 Section 60320.224, recycled water applied by a GRRP must be retained underground for a period of time necessary to allow a Project Sponsor sufficient response time to identify treatment failures and implement actions, including the plan to provide an alternative water supply or well-head treatment. The minimum allowable RRT is two months. To demonstrate the actual retention time underground is no less than the required RRT, an intrinsic or added tracer may be used. For each month of retention time estimated utilizing the approved intrinsic tracer, the Project Sponsor shall receive no more than 0.67 months credit. For each month of retention time utilizing an approved added tracer, the Project Sponsor shall receive 1.0 months credit. The actual retention time is the time representing the difference between when the water containing the tracer is applied at the GRRP and when either 2% of the initially introduced tracer concentration has reached the downgradient monitoring point, or 10% of the peak tracer unit value arrives at the downgradient monitoring point.

2.1.1.14 Monitoring Well Requirements

Per Title 22 Section 60320.226, the Project Sponsor must site and construct at least two monitoring wells downgradient of the GRRP. 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 the GRRP and the nearest downgradient drinking water well. The monitoring wells must allow for samples to be obtained independently from each aquifer and validated as receiving recharge water from the GRRP. For new projects, the Project Sponsor must collect two samples prior to GRRP operation[8] and at least one sample each quarter after operations begin. Each sample must be analyzed for nitrogen, nitrate, nitrite, secondary MCLs, Priority Pollutants, contaminants specified by DDW or the RWQCB taking into consideration the groundwater basin quality, the source control inventory, and the results of the recycled water monitoring.

If a quarterly monitoring result exceeds 80% of a nitrate, nitrite, or nitrate plus nitrite MCL, the Project Sponsor must collect another sample within 48 hours of being notified of the result and have it analyzed. If the average of the initial and confirmation sample exceeds an MCL, the Project Sponsor must notify DDW and the RWQCB within 24 hours of being advised by the laboratory of the result and discontinue application of recycled water until corrective actions are taken or evidence is provided to DDW and RWQCB that the contamination is not the result of the GRRP.

For DDW-specified chemical analyses completed each month, the Project Sponsor must ensure the laboratory electronically submits results to DDW no later than 45 days after the end of the month in which monitoring occurred in a manner such that data are readily uploaded to the DDW database.

2.1.1.15 Reporting

Per Title 22 Section 60320.228, no later than six months after the end of each calendar year, the Project Sponsor must submit a report to DDW and the RWQCB that provides information including the project compliance status, any corrective actions or suspensions of recycled water applications, monitoring data, the location of the recharged recycled water, changes in operations or treatment, and predictions of RWC for the next calendar year. Public water systems and drinking water well owners with downgradient sources potentially affected by the GRRP and within ten years of groundwater travel time from the GRRP must be notified by direct mail and/or electronic mail of the availability of the report.

Every five years from the date of the initial approval of the Engineering Report, the Project Sponsor must update the report to address any project changes and submit the report to DDW and the RWQCB. The update must address anticipated injection increases, compliance with retention time requirements, descriptions of inconsistencies between previous groundwater modeling predictions and the observed values, and how subsequent predictions will be determined.

2.1.1.16 Filtered Wastewater

Per Title 22 Section 60301.320, filtered wastewater, as it relates to the Project, is oxidized wastewater that has been passed through microfiltration, ultrafiltration, or reverse osmosis such

[8] Title 22 Section 60320.200(c) requires the Project Sponsor to conduct background monitoring consisting of least four samples (one sample each quarter) from each potentially affected aquifer before operations begin for nitrogen compounds, regulated constituents and physical characteristics, TOC, Priority Pollutants, and any contaminants specified by DDW or the RWQCB taking into consideration the groundwater basin quality and the source control inventory.

that the turbidity does not exceed 0.2 Nephelometric turbidity units (NTU) more than 5% of the time within a 24-hour period and does not exceed 0.5 NTU at any time.

2.1.1.17 Reliability Requirements

Per Title 22 Sections 60341 through 60355, reliability requirements related to this Project, include redundancy and alarms, or long-term disposal options, for primary treatment, biological treatment, secondary sedimentation, filtration, and disinfection.

2.1.1.18 Regional Water Quality Control Board Requirements

The RWQCB is responsible for regulating recycled water application to groundwater and irrigation with recycled water, which are subject to state water quality regulations and statutes.

A WDR/WRR issued by the RWQCB is required to implement applicable state water quality control policies and plans, including water quality objectives and implementation policies established in the Water Quality Control Plan for the Central Coast Basin (Basin Plan).[9] The Basin Plan designates beneficial uses and surface water/groundwater quality objectives.

Groundwater throughout the Central Coast Basin (except for the Soda Lake Sub-basin) is suitable for agricultural water supply (AGR), municipal and domestic supply (MUN), and industrial use. The Basin Plan includes:

- General narrative groundwater objectives that apply to all groundwaters for taste, odor, and radioactivity.
- Groundwater objectives for bacteria and DDW primary and secondary MCLs for the MUN beneficial use.
- Groundwater objectives to protect soil productivity, irrigation, and livestock watering for the AGR beneficial use.

Permit limits for GRRPs are set to ensure groundwater does not contain concentrations of chemicals in amounts that adversely affect beneficial uses or degrade existing water quality. For some groundwater sub-basins, the Basin Plan establishes specific mineral water quality objectives for total dissolved solids (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 RWQCB adopted Order No. R3-2017-0003 (WDR/WRR) on March 9, 2017, to regulate Project operations and impacts. A revised WDR/WRR are expected in 2025 for the Expanded Project.

2.2 STATE WATER RESOURCES CONTROL BOARD REQUIREMENTS

The California Water Code allows the SWRCB to adopt state policies for water quality control. There are two policies particularly relevant to GRRPs: the Anti-degradation Policy and the Recycled Water Policy.

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[9] See http://www.waterboards.ca.gov/rwqcb3/publications_forms/publications/basin_plan/.

2.2.1 Anti-Degradation Policy

The State's Anti-degradation Policy is captured in Resolution No. 68-16, which is titled "Statement of Policy with Respect to Maintaining High Water Quality in California." It is also specifically cited in the Basin Plan. The first two sections of the Policy declare that:

1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high-quality water will be maintained until it has been demonstrated to the state that any change will be consistent with maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies.
2. Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to 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 necessary 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.

2.2.2 Recycled Water Policy

The Recycled Water Policy was adopted by the SWRCB in February 2009, amended in 2013 to specify monitoring requirements for constituents of emerging concern (CECs), and amended in 2018 to update CEC monitoring requirements based on recent research findings. The Recycled Water Policy ensures consistent statewide permitting/enforcement and creates uniformity in how RWQCBs individually interpret and implement Resolution No. 68-16 for water recycling projects, including GRRPs. The critical provisions in the Policy related to GRRPs are discussed in the following subsections.

2.2.2.1 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 were to be developed for every groundwater basin/sub-basin by May 2014 (May 2016 with a RWQCB-approved extension). However, this requirement was updated in the most recent amendment to include only basins that are identified by each RWQCB 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.

An SNMP was prepared for the Seaside Basin to comply with the Recycled Water Policy (HydroMetrics, 2014a). The SNMP was developed with basin stakeholder input through the Seaside Basin Watermaster, adopted by the MPWMD, and submitted to the RWQCB on July 9, 2014. The RWQCB has deemed the submittal to be insufficient in terms of its anti-degradation findings and does not intend to adopt it as Basin Plan amendment.[10]

2.2.2.2 Groundwater Replenishment Provisions

The Recycled Water Policy and the Cross-Connection Control Policy Handbook[11] includes specific provisions for the approval of GRRPs.

- Projects must comply with the Title 22 Criteria for groundwater replenishment (including subsequent revisions), including monitoring requirements for priority pollutants, backflow prevention and cross-connection control measures, and recommendations by the SWRCB for the protection of public health pursuant to California 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.

Nothing in the Recycled Water Policy limits the authority of the RWQCB to protect beneficial uses provided any proposed limitations for the protection of public health may only be imposed following consultation with DDW, consistent with SWRCB Orders WQ 2005-0007 and 2006-0001.

In addition, nothing in the Recycled Water Policy limits a RWQCB from imposing additional requirements for a GRRP that has a substantial adverse effect on the fate and transport of a contaminant plume or changes the geochemistry of an aquifer, causing dissolution of constituents.

2.2.2.3 Anti-degradation and Assimilative Capacity

The Recycled Water Policy states that until such a time as an SNMP is in effect, compliance with Resolution No. 68-16 can be demonstrated by evaluating two assimilative capacity thresholds. A 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 anti-degradation analysis. The RWQCB has the discretionary authority to allocate assimilative

[10] *See* October 10, 2016 email from Harvey Packard, RWQCB to M1W staff.

[11] Adopted by the SWRCB on December 19, 2023 and becomes effective on July 1, 2024.

capacity to GRRPs. The analysis conducted for the Existing Project demonstrated the use of less than 10% of the available assimilative capacity for all constituents of concern.[12] An updated assimilative capacity will be completed for the Expanded Project.

2.2.2.4 Constituents of Emerging Concern

When the Recycled Water Policy was adopted in 2009, the SWRCB acknowledged the need for more scientific information and work with respect to test methods and more specific determinations as to how CECs may impact public health or the environment. As a result, the SWRCB convened an expert panel, in consultation with DDW, to make recommendations for monitoring CECs in recycled water. The first expert panel report was published in June 2010 with specific recommendations for CEC monitoring for GRRPs. The SWRCB amended the Recycled Water Policy in 2013 (Resolution No. 2013-0003) to include the Panel's recommended CEC monitoring program, including a list of specific performance indicators, health-based CECs, and performance surrogates; their respective monitoring frequencies; and procedures to evaluate the data and for responding to the monitoring results.

The Panel was reconvened in 2017 to review available recycled water data and update its 2010 recommendations. The Final Report (Drewes et al., 2018) included a new list of health-based and performance indicators (1,4-dioxane, NDMA, NMOR, PFOS, PFOA, sucralose, sulfamethoxazole), a new list of performance surrogates (EC, DOC, UV Absorbance), and recommendations to conduct bioanalytical screening (estrogen receptor-α and aryl hydrocarbon receptor). The Panel's findings were incorporated into Appendix A of the 2018 Recycled Water Policy.

2.3 FEDERAL REQUIREMENTS FOR GROUNDWATER REPLENISHMENT PROJECTS (UNDERGROUND INJECTION CONTROL)

The USEPA's underground injection control (UIC) program applies to injection wells. The UIC program has categorized injection wells into five classes, only one of which (Class V) applies to GRRPs. 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 the protection of groundwater quality for drinking water supplies, and therefore a Federal permit would not be necessary.[13] All Class V injection well owners in California are required to submit information to U.S. EPA Region 9 on the wells to update the U.S. EPA's inventory.[14]

[12] November 18, 2016 Technical Memorandum prepared by Todd Groundwater for MRWPCA, "Antidegradation Analysis in Support of Proposed AWTF Recycled Water Concentration Limits, Pure Water Monterey Groundwater Replenishment Project (Project)"

[13] See http://water.epa.gov/type/groundwater/uic/class5/frequentquestions.cfm#do_i.

[14] http://www.epa.gov/region9/water/groundwater/uic-classv.html, and http://www.epa.gov/region9/water/groundwater/injection-wells-register.html.

3 PROJECT FACILITIES

This section summarizes information, including design criteria, regarding the M1W RTP and the AWPF unit processes and reliability features, product water transmission systems, and the Injection Facilities. The AWPF design information presented in this Engineering Report is based on a combination of:

- The AWPF as-built drawings generated at the completion of construction in 2020.
- The AWPF and Product Water Pump Station contract drawings completed in May 2017 for re-bidding the construction of the facilities.
- Changes made to the post-treatment stabilization chemical feed system in November 2020.
- Changes to AWPF capacity from expansion from 5.0 mgd to 7.6 mgd as reflected in the design drawings and specification that were issued for construction and are the basis for contracts for the AWPF Expansion Project and the Injection Well Phase 4 Project.

3.1 REGIONAL TREATMENT PLANT

3.1.1 Overview of Monterey One Water's System

M1W, which currently serves a population of approximately 279,000, was created in 1972. M1W consists of and provides regional wastewater treatment, disposal, and reclamation facilities for the Cities of Monterey, Pacific Grove, Del Rey Oaks, Sand City, Marina, and Salinas; the Seaside County Sanitation District; the Castroville and Boronda Community Services Districts; and Fort Ord lands. Each member entity retains ownership and O&M responsibility for wastewater collection and transport systems up to the point of connection with interceptors owned and operated by M1W (some member entities contract with M1W for O&M services of their collection systems). Residential, commercial, and industrial wastewater and some dry-weather urban runoff are conveyed to the RTP for treatment. M1W also accepts an average 6,400 gallons per day (gpd) of hauled saline waste by truck from businesses, which would otherwise discharge to the sanitary sewer system and into the RTP. These wastewaters include water softener regenerant waste and RO brines. Because irrigation uses of recycled water are sensitive to TDS, M1W has sought to keep elevated TDS wastewater segregated from the influent flow to the RTP. Hauled saline waste (trucked to the RTP from the water treatment process) is either held in a lined holding pond and ultimately discharged directly to, or blended with, secondary treatment wastewater before being discharged through M1W's ocean outfall or discharged to a dedicated Drying Bed (#31) for evaporation, depending on water quality.

3.1.2 Regional Treatment Plant Facilities

The RTP is located in Marina, CA (see **Figure 3-1**). It has an average dry weather flow design treatment capacity of 29.6 mgd, a peak wet weather design capacity of 75.6 mgd, and an ocean outfall capacity of 81.2 mgd. The RTP currently receives and treats approximately 16 mgd of municipal wastewater on average and, at times, additional source waters. An aerial image annotated with the key treatment facilities at the RTP is presented in **Figure 3-2**.

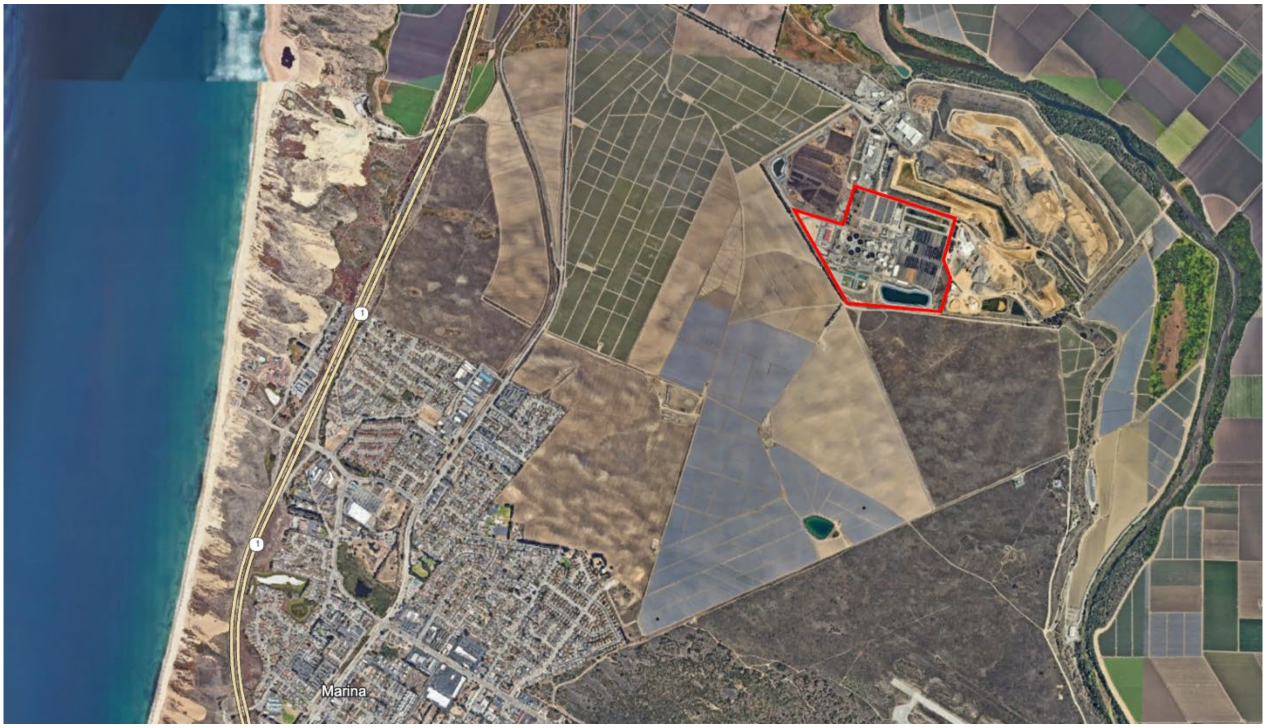

Figure 3-1. Regional Treatment Plant Location

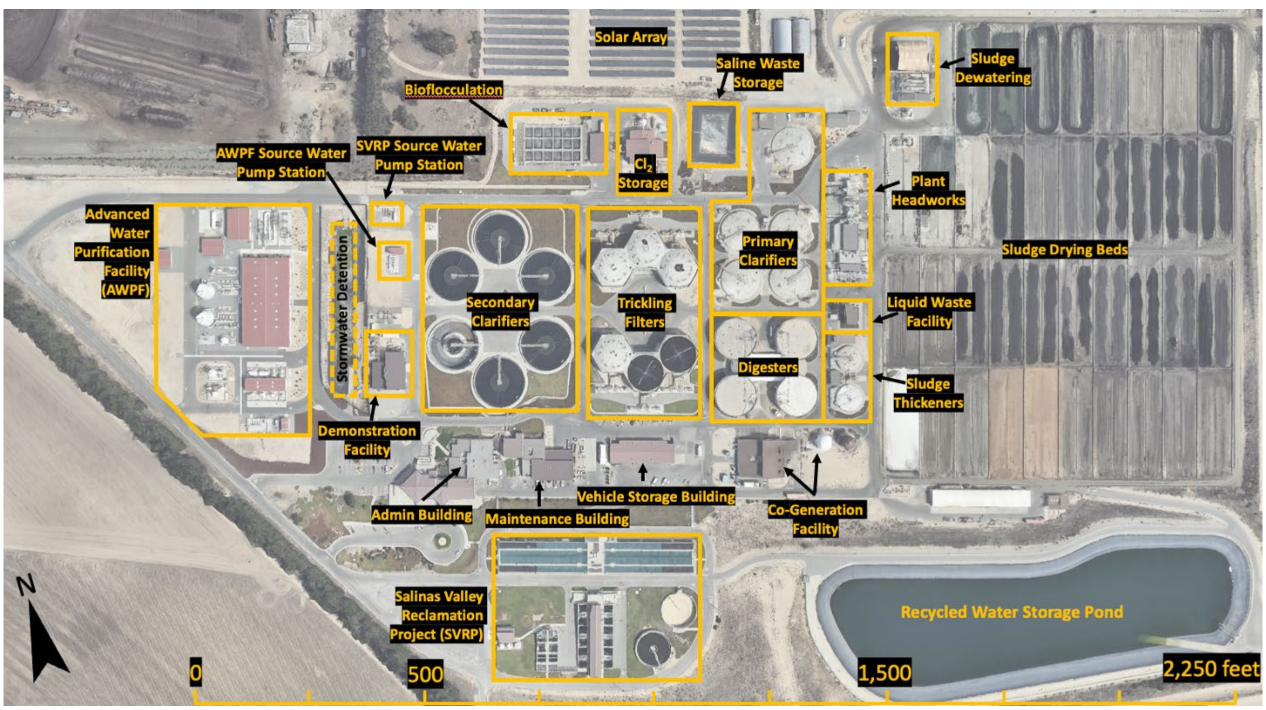

Figure 3-2. Existing Regional Treatment Plant Facilities

Wastewater treatment at the RTP consists of aerated grit removal, primary clarifiers, trickling filters, solids contact, and secondary clarifiers. Undisinfected secondary clarifier effluent is (1) discharged to the ocean pursuant to NPDES Permit requirements, (2) used as influent for the SVRP for the production of disinfected tertiary recycled water, or (3) used as influent to the AWPF.

When influent flowrates exceed recycled water production capacity or demand, secondary effluent is discharged to Monterey Bay through the ocean outfall, which includes diffusers and extends 11,299 feet offshore at a depth of approximately 100 feet.

Tertiary recycled water produced at the SVRP is used for irrigation of 12,000 acres of farmland in the northern Salinas Valley pursuant to RWQCB Orders No. 94-82 (WRRs issued to M1W) and No. 97-52 (Recycled Water User Requirements for CSIP issued to the MCWRA). Typically, demand for tertiary treated water varies from very low to zero in winter months to maximum demands in June through September. The existing facilities at the SVRP, including upstream treatment at the RTP, are designed to produce up to 29.6 mgd of tertiary recycled water. The SVRP includes an 80 AF storage pond that holds tertiary-treated wastewater and disinfected Salinas River water (when available) before it is distributed for irrigation. The use of recycled water for irrigation reduces regional dependence on and use of local groundwater, which, in turn reduces groundwater pumping-related seawater intrusion into the Salinas Valley aquifers.

Sludge/biosolids produced by the RTP are anaerobically digested and sent to two screw presses, which replaced a belt filter press. The holding lagoons and drying beds are still utilized as part of the biosolids management operations. Dried solids are hauled to ReGen Monterey (formerly Monterey Regional Waste Management District) landfill adjacent to the RTP, where it is mixed with refuse. However, pursuant to SB 1383, biosolids will soon be hauled offsite and processed for beneficial reuse by a third party.

3.1.3 Regional Treatment Plant Flow Projections

Actual municipal wastewater flows to the RTP, including PWM Source Water flows, are reported annually to the RWQCB. Projections for future wastewater and PWM Source Water flows for the next three calendar years are also estimated. The actual and projected average monthly flows reported in the 2023 NPDES Annual Report are shown in **Figure 3-3** below. The average RTP influent flowrate for 2021 to December 2023 was 17.6 mgd, including PWM Source Water flows.

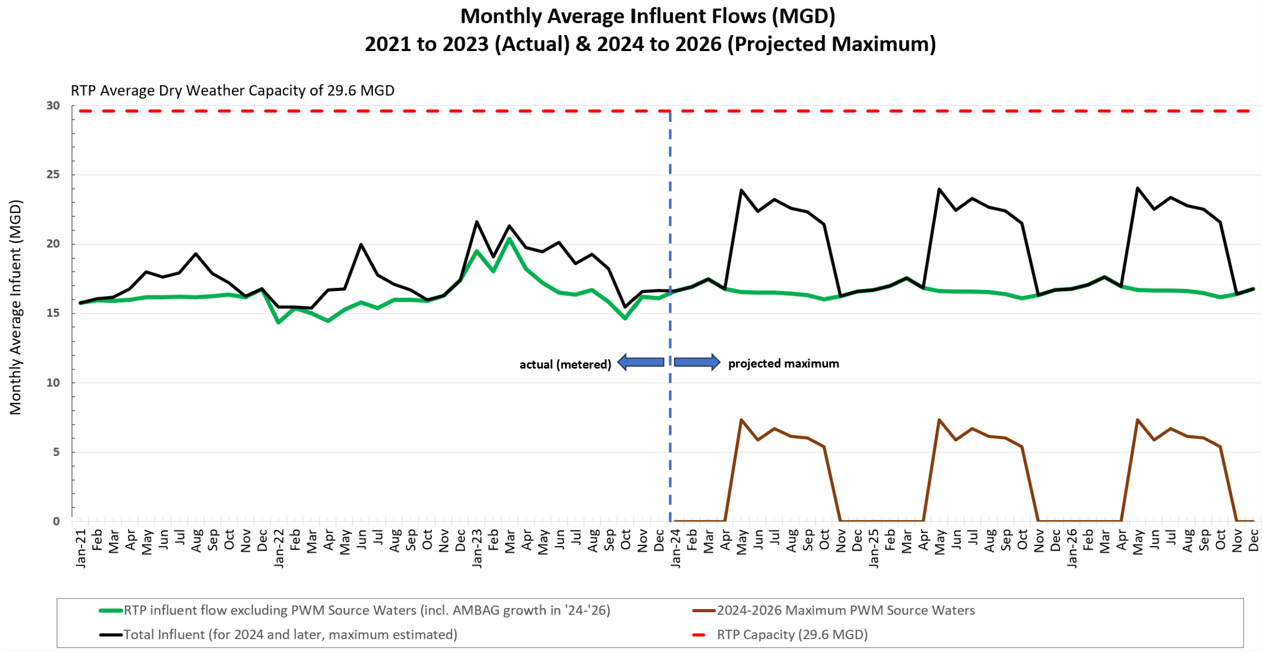

Figure 3-3. 2021-2023 Actual and Projected RTP Flows

3.2 ADVANCED WATER PURIFICATION FACILITY

The advanced treatment facilities for AWPF expansion consist of the same processes as the existing facilities, with additional equipment to support the higher flow rate. A simplified process flow diagram is shown in **Figure 3-4.** The full-scale AWPF consists of the following major components:

- Secondary effluent diversion structure,
- AWPF influent pump station,
- Ozonation (membrane filtration pretreatment),
- Membrane filtration (MF) feed water pumps
- MF system,
- RO feed water pumps,
- RO system,
- Ultraviolet light (UV) with hydrogen peroxide advanced oxidation process (AOP),
- Post-treatment stabilization including decarbonation and chemical addition,
- Product water pump station and transmission line,
- RO concentrate discharge facilities,
- Waste neutralization/equalization and pumping facilities, and
- Chemical storage facilities and pumping equipment.

To ensure that all treatment processes installed as part of the Expanded Advanced Water Purification Facility (AWPF) are properly installed and integrated with the existing facilities, the following design and construction requirements are specified for the vendors and contractors. These requirements will be verified during commissioning:

- **Operation Integration**: New units must operate seamlessly with existing units, with control functions aligned with those of the existing equipment.

- **SCADA System Integration**: The new units must interface correctly with the existing Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) software system.
- **Commissioning Process**: The new units will undergo testing individually and in combination with existing units to validate specific and overall system performance. During equipment commissioning AWPF product water can be recycled back to the M1W RTP headworks through the Waste Equalization pump station or, if adequately treated, diverted to M1W's reclamation pond for safe use for agricultural irrigation.
- **Performance Test**: The new units must operate continuously with existing units for an extended time, demonstrating functionality without major mechanical or electrical issues and with minimal operator intervention.
- **Ensure Regulatory Compliance** The performance test will include verification of regulatory requirements including turbidity monitoring and pressure decay testing.

Verification procedures are in place with the Construction Manager, M1W, and the contractors to ensure these requirements are met during startup. Through updates to the existing Operation and Optimization Plan (OOP) and during startup, M1W will collaborate with DDW including to develop an agenda for their inspection prior to startup of the expanded PWM components. During the inspection, the integration and performance of the new equipment with the existing systems will be demonstrated. The inspection will also cover critical control point monitors and follow-up for any non-compliance or potential water quality issues. The OOP will include detailed information on the new equipment and its integration, ensuring compliance with all critical control points, pressure decay testing, and automatic response requirements of the original project. Note that alarms, critical control points, and compliance points remain unchanged for the Expanded AWPF as only new process units (functionally the same as existing units) are being added to the treatment train.

MONTEREY ONE WATER RTP, AWPF & SVRP TREATMENT PROCESS SCHEMATIC

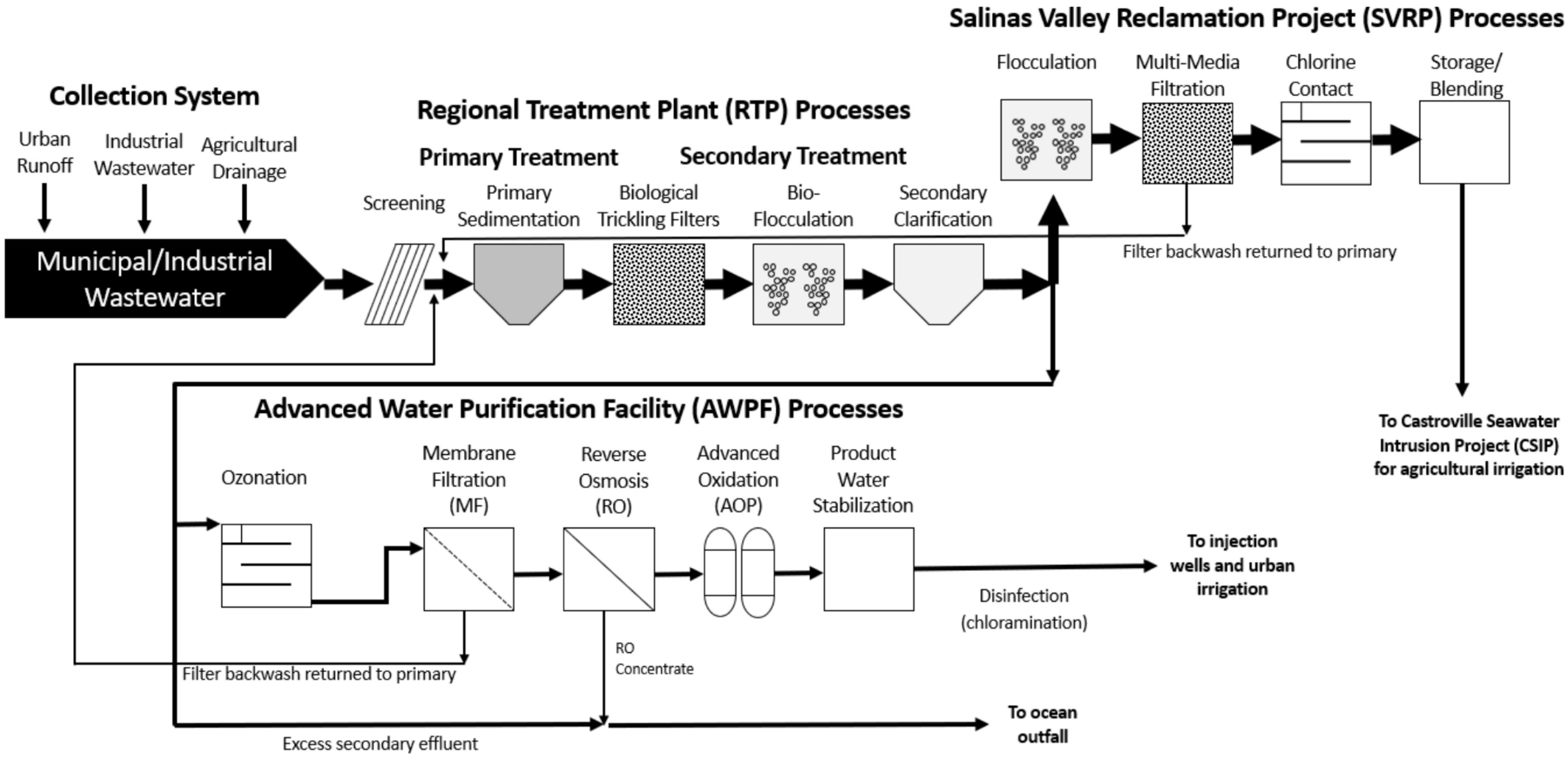

Figure 3-4. Simplified process flow diagram of M1W RTP primary and secondary, SVRP tertiary, and AWPF treatment processes (NOTE: This will not change when the Expanded Project operates.)

The design treatment capacity of the AWPF after expansion is 6.5 mgd and the peak treatment capacity is 7.6 mgd. A process flow summary for the major treatment processes of the AWPF is provided in **Table 3-1**.

Table 3-1. AWPF Process Flow Summary

Treatment Process	Design Flows (6.5 mgd)	Peak Flows (7.6 mgd)
Ozonation Influent and Effluent	9.12	10.66
MF Feed	9.12	10.66
MF Filtrate	8.02	9.38
RO Feed	8.02	9.38
RO Permeate	6.5	7.6
AOP Influent and Effluent	6.5	7.6
Post Treatment Influent and Effluent	6.5	7.6

3.2.1 Secondary Effluent Diversion Structure and AWPF Influent Pump Station

Secondary effluent pulled between the Rapid Mix facility of the RTP and the SVRP diversion facility, is diverted to the AWPF via the secondary effluent diversion structure and the AWPF influent pump station (also known as the Source Water Pump Station, SWPS).

3.2.2 Membrane Filtration Pretreatment

Sodium hypochlorite is injected ahead of the AWPF ozone system at an average dose of 12 mg/L (as Cl_2) and an anticipated maximum dose of 25 mg/L (as Cl_2). The target combined chlorine residual ahead of the RO system is approximately 3 mg/L as Cl_2. Residual ammonia in the RTP secondary effluent is present at sufficient concentrations to react with the sodium hypochlorite to form chloramines. The chemical storage tank and chemical delivery pump for sodium hypochlorite provide adequate capacity for expansion flows. Design criteria for the system is provided in **Table 3-2**.

Table 3-2. Sodium Hypochlorite Addition System

Sodium Hypochlorite Addition Systems	
Tank	
Solution strength, %	12.5
Number of Storage Tanks	2
Capacity, gal (each)	10,300
Material	HDLPE or XLPE with anti-oxidant liner
Pumps	
Number (Duty + Standby)	1+1
Type	Peristaltic
Maximum Capacity per Pump, gph	132
Rated Pressure, psig	60

gal – gallons; HDLPE – High density linear polyethylene; XLPE – Cross-linked polyethylene; Psig – Pounds per square inch gage

3.2.3 Ozonation

The ozone treatment system treats chloraminated secondary effluent from the RTP prior to filtration by the downstream MF system.

For the Expanded Project, two additional ozone auto-strainers with individual pumps (auto-strainers to be relocated from the MF feed areas), a new side stream injector skid, additional plates for the cooling water heat exchangers, one new vaporizer, and a new Liquid Oxygen (LOX) tank will be added to the ozonation system.

The number of ozone generators and the configuration of the ozone contactor will remain the same. Two additional air release valves will be added at the beginning of the ozone contactor. The associated control wiring and the supervisory control and data acquisition (SCADA) programming will be updated based on the additional equipment. The SCADA programming changes will include operating the second ozone generator at high flows and ozone doses to meet the dose setpoints.

3.2.3.1 Ozone Pretreatment

Ozone pretreatment can provide a number of benefits to a potable reuse treatment system, including: (1) low-pressure membrane pretreatment, (2) CEC destruction, and (3) pathogen disinfection. Ozonation prior to MF (also referred to as preozonation) can increase MF run times and flux for some waters. Non-nitrified secondary effluent, such as the RTP effluent, contains large organic molecules (defined here as greater than 10 kilodaltons [kDa]), which rapidly foul low-pressure membranes. Ozonation of these large organic molecules reduces their size to less than 1 kDa via oxidation, and allows them to pass through the MF system with minimal fouling (the organic molecules are then well-rejected by the downstream RO system). With the fouling potential of the water reduced by preozonation, the MF system run times are increased and the MF system can be designed for higher fluxes. Long run times allow for less chemical usage and a greater recovery while designing the MF system for a higher flux reduces the number of membrane modules required. Preozonation can also reduce the concentration of CECs in the RO feed, which can lead to a reduction in both the concentration of known health-significant CECs in the RO permeate and the concentration of CECs in the RO concentrate that is ultimately discharged to the ocean.

3.2.3.2 Ozone Piloting Summary

Piloting and water quality sampling were conducted from 2013 to 2014 at the M1W RTP to aid in the design of preozonation (see **Appendix B** for Pilot Report). Select key findings from that effort are summarized below:

- The downstream MF run time increased by approximately a factor of four with an ozone dose of 10 mg/L;
- The downstream MF run time was not adversely affected by higher ozone doses (e.g., 20 mg/L);
- Secondary effluent contained high concentrations of TOC (12 to 18 mg/L, typical for a non-nitrified secondary effluent), which exert significant ozone demand;
- Significant CEC removal was observed at an ozone dose of 10 mg/L (an ozone to TOC ratio [O_3:TOC] of about 0.4; see **Figure 3-5** for removal observed during pilot testing); and,
- Secondary effluent contained variable concentrations of nitrite (ranging from < 0.1 to 2.2 mg/L as Nitrogen [N]) due to partial nitrification in the RTP trickling filters, which exerts significant ozone demand (3.4 mg/L of ozone per 1 mg/L of nitrite as N); however, ozone dose control methods are available that automatically account for influent nitrite concentrations (*e.g.*, trimming to a dissolved ozone [DO_3] residual).

The key treatment objectives for including ozone pretreatment (i.e., improved MF performance and significant CEC destruction) were both successfully demonstrated at an ozone dose of 10 mg/L. Therefore, this dose was selected as the average design ozone dose for the full-scale facility. The average design dose of 10 mg/L will remain the same for the Expanded Project.

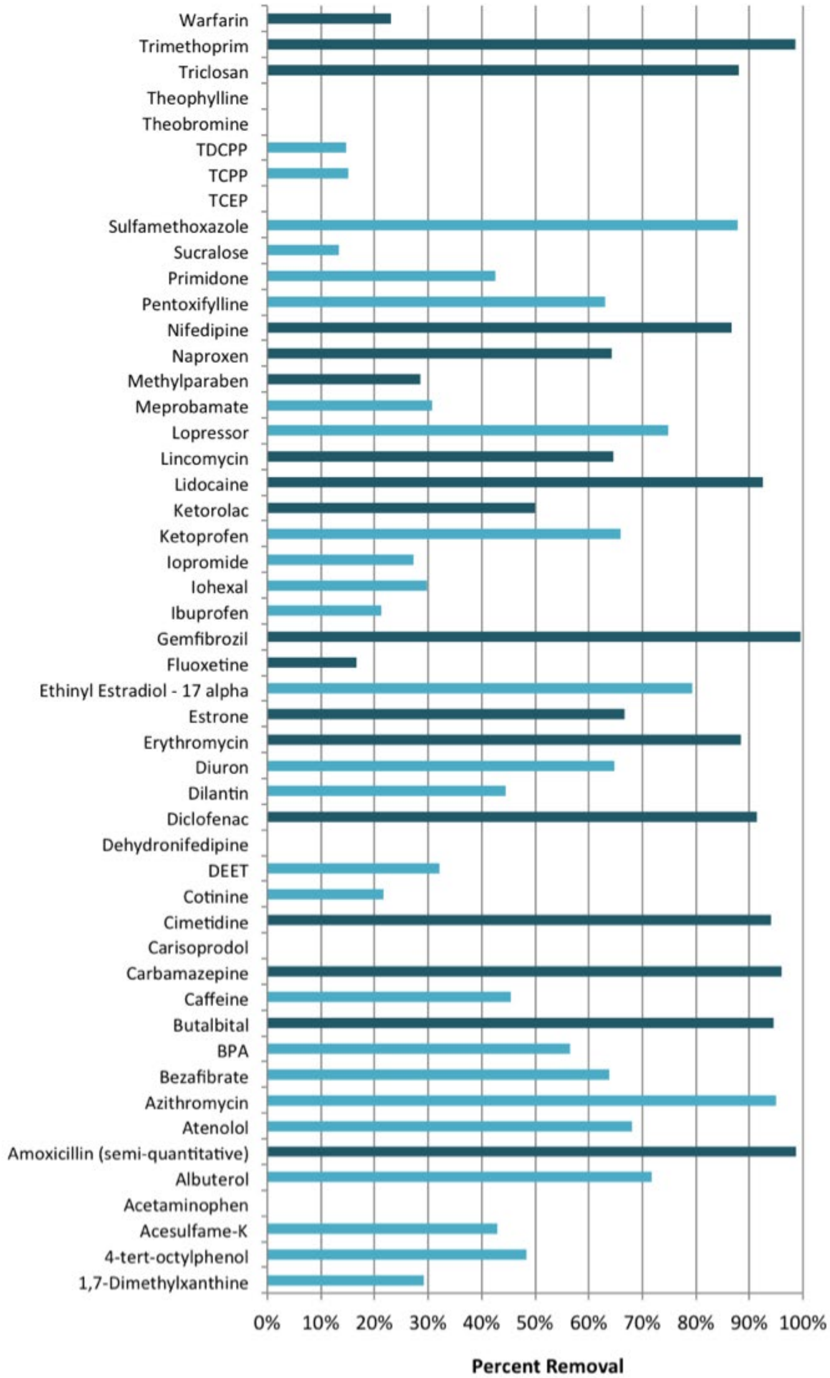

Figure 3-5. Median removal of CECs observed during piloting at an ozone dose of 10 mg/L, where dark bars indicate removal to below the detection limit. (Constituents with no bars were not removed.)

3.2.3.3 Design Ozone Dose

The ozone system was designed based on ozone piloting, where an average applied ozone dose of 10 mg/L proved successful for MF pretreatment. From this average dose, a maximum and minimum design dose were selected, considering maximum and minimum design water qualities, average pilot water qualities, as well as full-scale and pilot-scale ozone transfer efficiencies. For the Expanded Project, the average design ozone dose will remain at 10 mg/L. The following sections discuss the selection of the maximum and minimum design water quality and the full-scale design transfer efficiency.

3.2.3.3.1 Design Water Quality

Design water quality assumptions were developed from historical water quality data. Three years of dissolved organic carbon (DOC), total suspended solids (TSS), and nitrite data from January 2011 through May 2014 (24-hour composite samples)[15] were used to develop the design assumptions. TOC was estimated from the DOC and TSS data, and the 95th percentile values for TOC and nitrite were chosen as the maximum ozone design water qualities. The minimum values for both TOC and nitrite from these datasets were chosen as the minimum ozone design water qualities. These maximum and minimum design water qualities were compared to the average water quality conditions observed during the 10 mg/L phase of piloting to develop the design ozone doses, which were extracted from the same RTP 24-hour composite dataset (the development of the design ozone doses is discussed in the next section)[16]. A summary of the maximum and minimum design water qualities and the average water qualities observed during the piloting of the 10 mg/L applied ozone dose are shown in **Table 3-3**. For the Expanded Project, 2017 to 2021, operational data from the full-scale plant was also considered. Full-scale operational data have validated the original design water quality and design ozone dose assumptions.

Table 3-3. Design and Pilot Water Quality

Parameter	Average Piloting Concentrations at 10 mg/L, Applied	Max Design Concentration	Min Design Concentration
Nitrite, mg/L as N	0.63	2.2	0
Estimated TOC, mg/L	16	20	11

Nitrite exerts an immediate ozone demand on a 1:1 stoichiometric basis, thereby decreasing the concentration of ozone available for the oxidation of organics. When more nitrite is present, more ozone must be applied (e.g., an increase in nitrite concentration of 1 mg/L as N requires an increase of 3.4 mg/L transferred ozone). The design TOC concentration is factored into the design ozone dose by keeping the pilot O_3: TOC ratio constant. When the influent TOC increases, the ozone dose must also increase to maintain a sufficient O_3: TOC ratio to adequately reduce MF fouling (e.g., if the TOC concentration doubles, then the transferred ozone dose must also

[15] Nitrite data was from January 2011 to July 2014.
[16] The 10 mg/L phase of testing occurred over the following date range: 1/16/14 - 2/17/14, 2/26/14 - 3/13/14, and 4/7/14 - 5/19/14.

double). The maximum and minimum design ozone doses take into account the maximum and minimum nitrite and TOC concentrations accordingly.

3.2.3.3.2 Transfer Efficiency

In addition to design water qualities, the design ozone doses factor is the difference in ozone transfer efficiency that can be achieved at full-scale compared to pilot-scale. The pilot transfer efficiency ranged from 94% to 96%. The AWPF utilizes side-stream ozone injection, where the full-scale system routinely exceeds a mass transfer efficiency of 95%. Therefore, the original design assumptions remain conservative.

3.2.3.3.3 Design Doses

The design ozone doses were initially developed based on the design influent water quality and a conservative full-scale transfer efficiency (**Table 3-4**) and were later adjusted based on operational data. For context, these design ozone doses are higher than ozone doses required for drinking water disinfection (e.g., 1 to 4 mg/L) and higher than those required for sulfide removal in drinking water (e.g., 10 to 12 mg/L).

Table 3-4. Design Applied Ozone Doses

Design Applied Ozone Dose (mg/L)	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Maximum	20	20
Average	10	10
Minimum	5	5

3.2.3.4 Design Flows

The design flows for the ozone system are a function of the recoveries of the downstream processes and are presented in **Table 3-5**. The RO permeate flow set point is the critical factor that impacts design flows upstream. The minimum flow of the ozone system was based on producing 1.20 mgd of RO permeate and the maximum and peak flows were based on producing 6.5 mgd and 7.0 mgd of RO permeate, respectively. The ozone system must be able to turn down to the minimum flow. The maximum and minimum flows impact the ozone equipment sizing and number of sidestream injectors. Flow surges to the downstream MF system will be addressed through flow equalization (EQ) tanks upstream and downstream of the MF. Flow through the ozone system will only vary when the RO permeate production set point is changed.

Table 3-5. Ozone Design Flows

Design Flow Rate	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Maximum	6.85	8.9
Minimum	1.64	1.64

3.2.3.5 Ozone Generator

Based on the design flows and applied ozone doses, a design capacity of the ozone generator was developed (**Table 3-6**). An ozone concentration of 10% and 9% were used for 6.5 mgd and 7.6 mgd design flows, respectively.

The ozone generators each have a power turndown of 10:1 with a total power turndown of 20:1 for two duty ozone generators. Additionally, the gas flow system has a turndown of 10:1, resulting in a maximum possible ozone generator system turndown capability of 200:1. The design flow turndown is 5.5:1 and the design ozone dose turndown is 4:1 for a total design ozone production turndown of 22:1. The maximum turndown capability of the ozone system exceeds the design ozone production turndown requirements for the Expanded Project design.

Ozone generators typically require minimal regular maintenance and failure is typically infrequent. Modern generators include fuses for each dielectric tube, which allows the generator to continue production if a dielectric tube fails. A redundant generator has not been included in the Project. The AWPF may operate for short periods of time without preozonation with more frequent MF cleaning as needed.

Table 3-6. Ozone Generator Design Criteria

Parameter	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number of ozone generators (duty + standby)	2+0	2+0
Design ozone concentration, % by weight	10	9
Capacity at 10% by weight per generator, pounds per day (lbs/day)	850	890

The generator has a corresponding power supply unit (PSU) to supply power to the ozone generator. As discussed in the following subsection, the PSU and ozone generator are connected to the cooling water system to dissipate heat.

3.2.3.6 Cooling Water System

The ozone generator and PSU must be cooled to avoid overheating and dissipating excess heat into the surroundings. A closed-loop cooling system with a plate and frame heat exchanger, interfacing with an open loop system, is used and the design criteria are summarized in **Table 3-7**. The open water source used for the cooling system is the MF filtrate, which is low in solids to reduce build-up on the exchanger. A filter is included in the closed loop to ensure that particles are neither deposited in the ozone generator nor on the heat exchanger surface if particles accidentally enter the closed loop system (e.g., particles from maintenance activities).

Table 3-7. Cooling System Design Criteria

Parameter	Design flow (6.5 mgd)	Peak flow (7.6 mgd)
Heat exchanger type	Plate and frame	Plate and frame
No. of cooling systems (duty + standby)	1+1	1+1
Particle filter size, µm	0.1	0.1
Closed loop cooling water temperature (max.) °C	29.4	29.4

3.2.3.7 Oxygen System

High-purity oxygen gas is fed to the ozone generator to achieve a high concentration of ozone gas. For this size system, the oxygen feed is achieved through the use of offsite generation and delivery of LOX. The LOX system consists of a LOX storage tank, a pressure regulating system, vaporizers, and a nitrogen boost system, which is included to increase the efficiency of ozone generation.

3.2.3.7.1 LOX Delivery Scheduling

A level-sensor device in the LOX tank allows the LOX supplier to track usage. When the level reaches a predetermined capacity (e.g., 45%), a delivery truck is dispatched to refill the tank. Delivery trucks have a trailer capacity of 6,000 gals, and deliveries can typically be made within 24 to 48 hours.

3.2.3.7.2 LOX Tank Size

For the Expanded Project, a second LOX tank will be added to the ozonation system. Each LOX tank is 13,000 gals, which represents 8 days of LOX consumption at the maximum design dose and 16 days of LOX consumption at the average design dose for 6.5 mgd. At 7.6 mgd, a LOX tank represents 6 days of LOX consumption at the maximum design dose and 12 days of LOX consumption at the average design dose. Therefore, the storage time for both LOX tanks at the average design dose will provide 33 days of storage at the design flow of 6.5 mgd and 25 days of storage at the peak flow of 7.6 mgd. These storage times are conservative in case of difficulties with dispatching LOX deliveries.

3.2.3.7.3 Vaporizers

Vaporizers volatilize the LOX and are chilled in the process. While one vaporizer is in operation, the second warms in ambient air to prepare for operation. For the Expanded Project, a third vaporizer will be added to the two existing vaporizers (two duty, one standby). Design criteria for the LOX storage and vaporizers are shown in **Table 3-8**. These design criteria are based on an ozone concentration of 10% at 6.5 mgd and 9% at 7.6 mgd.

Table 3-8. LOX Design Criteria

Parameters	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
LOX consumption, gal/day	800 (average dose) 1,599 (maximum dose)	1039 (average dose) 2077 (maximum dose)
Storage tank volume, gal	13,000 (26,000 total)	13,000 (26,000 total)
Storage time days	33 (average dose) 16 (maximum dose)	25 (average dose) 12 (maximum dose)
Number of tanks	2	2
Configuration	Horizontal	Horizontal
Vaporizer type	Ambient air	Ambient air
Vaporizer size, scfh, minimum, each	173	173
Number of vaporizers	2+1	2+1

Note - Design criteria based on 10% ozone concentration at 6.5 mgd and 9% ozone concentration at 7.6 mgd.

3.2.3.7.4 Pressure Regulating System

A pressure regulating system is installed to regulate the delivered oxygen pressure coming from the LOX system.

3.2.3.8 Nitrogen Boost System

Nitrogen addition (0.5% to 2% nitrogen) with gaseous oxygen improves ozone generation performance. Nitrogen is present in sufficient quantities in the air; however, the air must be conditioned to remove moisture before sending it through the ozone generator. The nitrogen boost system contains the following components:

- Air compressors
- Receiver tank
- Aftercooler
- Desiccant dryers
- Particulate and oil-coalescing filters

3.2.3.9 Ozone Injection System

Sidestream injection with a venturi injector is used to inject ozone into the process water to mix the gaseous ozone with the sidestream flow. The sidestream injection system efficiency is a function of the gas-to-liquid (G:L) ratio. The sidestream injection system is designed for a low G:L ratio (i.e., 0.35 or less) to achieve good mixing. Low sidestream injection G:L ratios are necessary to avoid low ozone transfer efficiencies when treating secondary effluent (personal communication with Jim Jackson of Mazzei Injector and Kerwin Rakness of Process Application, Inc.).

The low G:L ratio necessitates a large sidestream flow, given the ozone doses. The sidestream system is designed for an ozone concentration of 10% at 6.5 mgd and 9% ozone concentration at 7.6 mgd.

After injection, the sidestream flow is a combination of water, dissolved and gaseous ozone and oxygen, which is mixed with the bulk flow using flash reactors where additional dissolution of the gaseous ozone occurs.

Multiple sidestream pumps, and corresponding injectors, are installed to efficiently meet turndown requirements. After ozone comes in contact with the water, the system material is comprised of 316 stainless steel, until the ozone is removed in the contactor or the downstream quenching system. The injection system design criteria are summarized in **Table 3-9**.

Table 3-9. Injection System Design Criteria

Parameter	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Injection system type	Sidestream injection	Sidestream injection
Injector type	Venturi injector	Venturi injector
Venturi injectors (duty + standby)	3+1	4+0
Venturi injector size, inches	6	6
Sidestream pumps (duty + standby)	3+1	4+0
Pump flow estimate (each), gallons per minute (gpm)	1,070	1,070
Sidestream injection G:L ratio, max	0.35	0.35
Mixers, minimum number	1	1
Mixer type	Flash Reactor	Flash Reactor
Transfer efficiency, minimum	92%	92%

3.2.3.10 Ozone Contactor

The ozone contactor provides head to the upstream mixing structure, facilitates further ozone dissolution, provides contact time, and facilitates the removal of ozone off-gas. These features of the ozone contactor are described in more detail in the following subsections. Ozone contactor design criteria are provided in **Table 3-10** and **Table 3-11**.

The upstream flash reactor requires backpressure to ensure that fine bubbles are created in the mixing process. Fine bubbles have a larger surface area to volume ratio than coarse bubbles, which increases ozone gas dissolution into the liquid stream. Increasing backpressure leads to finer bubbles and, thus, more efficient ozone gas dissolution (with diminishing returns at approximately 24 feet of pressure). The backpressure to the centerline of the contactor-will primarily come from the MF feed tank inlet structure and not primarily from a head loss device, such as a valve downstream of the flash mixer.

3.2.3.10.1 Contact Time

The ozone contactor also provides contact time for the DO_3 to react and dissipate. After gaseous ozone mixes with the secondary effluent, it dissolves into the liquid. Most of the DO_3 reacts rapidly (within seconds) with organics and other reduced chemicals, such as reduced iron, manganese, and nitrite; however, some organics require more time (multiple minutes). This reaction time must occur upstream of the membrane systems because membranes are sensitive to ozone, which may degrade their performance through the oxidation of the membrane surface. The ozone contactor gives time for the DO_3 to react with recalcitrant organics and time to dissipate before the ozonated effluent is discharged to the MF system.

The contact time at the pilot proved sufficient for dissipating the DO_3 residual for moderate ozone doses (hydraulic residence time [HRT] of 3 minutes (min), and assumed baffling efficiency of 90%: t_{10} of 2.7 minutes, where t_{10} is the time for 10% of an input concentration to be observed at the outlet of the contactor system). Given the imperative to not send a DO_3 residual downstream, the contact time was designed for equal to, or greater, than the contact time observed during piloting. This contact time acts as a redundant barrier to the quenching system for protecting downstream membrane equipment. As shown in **Table 3-10**, the configuration of the ozone contactor will not change for the Expanded Project. The contact time at design flow (4.2 min) and peak flow (3.6 min) will still exceed the 3-minute benchmark.

3.2.3.10.2 Ozone Off-gas

The ozone contactor traps the ozone off-gas and directs it to the ozone destruct units. Due to inefficiencies in mixing, limitations of ozone solubility, or variability in the ozone demand, not all of the injected ozone is dissolved into the liquid. Some of the applied ozone remains in the gaseous form, and some of the DO_3 may volatilize during contacting. This ozone gas is captured by the ozone destruct system.

3.2.3.10.3 Contactor Configuration

A serpentine pipeline contactor is used at the AWPF because it can achieve reasonable baffling efficiencies, facilitate additional ozone dissolution, and meets space constraints. Two additional air release valves will be added at the beginning of the ozone contactor.

Table 3-10. General Ozone Contactor Design Criteria

Parameter	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Configuration	Serpentine pipeline contactor	Serpentine pipeline contactor
Contact time HRT, min	4.2	3.6

Table 3-11. Specific Ozone Contactor Design Criteria

Parameter	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Contactor Design		
Influent flow rate, mgd	6.85	8.90
Contact time, minutes	4.2	3.6
Liquid volume, gal	26,319	26,319
Dimensions:		
Diameter, feet	4.0	4.0
Length, feet	280	280

3.2.3.10.4 Foam

The water quality received during pilot testing and the AWPF did not create excessive foam. For the Expanded Project, the two existing air-water separators will be replaced with three or more larger air-water separators to accommodate the increased flows. It is expected that foam generated within the contactor will be mitigated by air-water separators.

3.2.3.11 Ozone Destruct System

Un-dissolved ozone that off-gases inside of the ozone contactor is piped to the ozone destruct system. The design criteria for the ozone destruct system are shown in **Table 3-12.**

Large concentrations of ozone may be sent to the ozone destruct system when the ozone system is shut down and the generator is purged of gas with a high ozone concentration. In normal operation, the ozone destruct only receives the gaseous ozone that did not dissolve into the bulk flow. The fraction of excess ozone should be low, as the specified transfer efficiency is greater than 90%. Gaseous ozone sensors are located prior to and after the ozone destruct. The sensors upstream of the destruct will be used to calculate the ozone transfer efficiency, while the downstream sensors will be used to ensure ozone destruction.

Table 3-12. Ozone Destruct Design Criteria

Parameter	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number of destructs	2+1	2+1
Maximum ozone concentration in ozone vent-gas, ppm[a]	0.05	0.05
Maximum offgas flowrate from ozone contactor, scfm	128	166
Offgas capacity of each destruct unit, scfm	127	127
Total offgas capacity of duty destruct units, scfm	254	254

a. Occupational Safety & Health Administration heavy work, 8-hour limit; parts per million – ppm.

3.2.3.12 Instrumentation

3.2.3.12.1 Sample Taps

Sample taps are included: (1) immediately before the contactor; (2) immediately downstream of ozone injection, (3) at the end of the ozone contactor; and (4) after the quenching system (the quenching system is used, if needed, to quench residual DO_3). The sample lines are directed to instrumentation manifolds. Redundant instrumentation is installed to maintain ozone control during instrumentation maintenance. The ozone effluent and quenching effluent sample times lead to dedicated instruments to keep sample-piping length to a minimum, which allows for a representative DO_3 concentration and accurate dosing of the quenching chemical.

3.2.3.12.2 Instrumentation & Control

Instrumentation is required to monitor the ozone influent and effluent water quality, control the ozone dose, and to control the ozone residual quenching system. Instruments are provided for each contactor to help diagnose operational issues. The instrument locations are summarized in **Table 3-13**.

The ozone dose is controlled by trimming to a DO_3 residual. This method of control leads to an automatic adjustment of ozone dose based on changes in ozone demand (e.g., caused by changes in nitrite or TOC concentrations), thereby maintaining the O_3:TOC ratio close to the O_3:TOC ratio associated with the design ozone dose and water quality. For example, if the nitrite or TOC concentrations in the ozone feed increase and correspondingly increase the ozone demand, the ozone residual will decrease, which would cause the control system to respond by increasing the ozone dose until the ozone residual reaches the ozone residual setpoint. This method of control (feedback) does not require online nitrite or TOC analyzers (feed-forward) or grab samples, and bromate formation is minimized by maintaining the O_3:TOC ratio close to the design O_3:TOC ratio.

Table 3-13. Sensors for Ozone Control

Sensor[a]	Number of Sensors	Locations
DO_3	2	Immediately after injection (2)
ORP	7	Before ozone contactor (1) Immediately after injection (2) After ozone contactor (1+1)[b] After quenching (1+1)[b]

a. Ultraviolet light transmittance – UVT; Oxidation-reduction potential – ORP; sensors should be applicable to ozonated secondary effluents.
b. Duty+standby

3.2.3.13 Quenching System

An ozone quenching system is included to increase operational flexibility. The system consists of two ORP sensors (one duty and one standby) before quenching, and two ORP sensors (one duty and one standby) after quenching. Quenching will be achieved with sodium bisulfite.

The system is sized to dose 1.1 mg/L sodium bisulfite (enough chemical to quench a maximum of 0.5 mg/L of DO_3 at 6.5 mgd and 0.43 mg/L at 7.6 mgd). Mixing is provided immediately downstream of the quenching chemical addition. Rapid mixing allows the quenching agent to react more readily with the stronger oxidant, ozone, instead of consuming chloramines. The quenching system design criteria are shown in **Table 3-14.**

Table 3-14. Quenching System Design Criteria

Parameter	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Quenching chemical	Sodium bisulfite	Sodium bisulfite
Solution strength, %	38	38
Tank Volume, gal	2750	2750
Design dose, mg/L sodium bisulfite	1.1	1.1
Metering Pumps		
Number (duty + standby)	1+1	1+1
Maximum capacity per pump, gallons per hour (gph)	5.3	5.3

3.2.3.14 Layout and Materials

3.2.3.14.1 Layout

- The following equipment are placed indoors:
- Ozone generator
- Cooling water systems
- PSU
- Nitrogen boost system

The following equipment are placed outside:

- LOX equipment
- Injection system
- Ozone destruct units

3.2.3.14.2 Materials

Wetted parts that may contact an ozone residual are made of one of the following materials:

- Stainless steel 316 or 316 L grade piping
- Concrete contactor
- Teflon gaskets
- Polyvinyl chloride (PVC) sample piping

3.2.4 Membrane Filtration Treatment System

The MF treatment system processes water pretreated by the ozone system to condition it further for downstream treatment by the RO system. The MF system is proficient at removing particulate matter from the RO feed water that would otherwise foul the RO process membranes. The MF system includes the following components:

- MF feed tank and pumps
- MF feed strainers
- MF membrane process units
- MF filtrate tank
- Membrane backwash (BW) pumps
- Compressed air system
- Clean in place (CIP) system

With the Expanded Project, the MF system will have a design feed capacity of 9.12 mgd and a peak feed capacity of 10.67 mgd, which assumes an MF strainer recovery of 98% and an MF process recovery of 92% after accounting for losses due to backwashing. This capacity is sufficient to support an RO system design capacity of 6.5 mgd of RO permeate and a peak capacity of 7.6 mgd of RO permeate, operating at 81% RO recovery. Individual subsystem components of the MF system are discussed in the following subsections.

3.2.4.1 Raw Water Characteristics

The secondary effluent quality related to the MF and RO systems is shown in **Table 3-15.**

Table 3-15. Design Typical MF Influent Quality

Average MF Influent Water Quality[a]		
Alkalinity (in $CaCO_3$ units)	mg/L	321
Ammonia as N	mg/L	37
Bromide	mg/L	--
Calcium	mg/L	68
Chloride	mg/L	253
Conductivity (Specific Conductance)	µS/cm	--
Iron	mg/L	0.085
Magnesium	mg/L	31
Manganese	mg/L	0.044
Nitrate (as NO_3)	mg/L	1
Nitrite (as N)	mg /L	0.2
Nitrate + Nitrite as N	mg /L	1.1
pH	pH	6.8
Phosphate (Orthophosphate as P)	mg/L	2.9
Potassium	mg/L	24
Silica	mg/L	42
Sodium	mg/L	177
Sulfate	mg/L	104
Sulfide	mg/L	--

Temperature	°C	23
TDS	mg/L	882
Total hardness as $CaCO_3$	mg/L	--
Total Kjeldahl Nitrogen	mg/L	--
Total N	mg/L	--
Turbidity	NTU	4

Calcium carbonate–- $CaCO_3$; Nitrate–- NO_3; Phosphorus–- P; Microsiemens per centimeter - µS/cm; Nephelometric turbidity units – NTU.

3.2.4.2 Membrane Filtration Feed Tank and Pumps

The MF feed tank and pumps receive secondary effluent from the source water pump station that is pretreated by the ozone system and the addition of sodium hypochlorite upstream of the ozone system. The feed tank volume is sufficient to equalize variable flows into the MF membrane units during normal cycles of filtration and backwash, allowing a steady flow through the upstream ozone system. The feed pumps are horizontal, split case type, configured in a lead, lag, standby arrangement. The pumps are equipped with variable speed drives to allow operation at variable flow and pressure conditions related to operating sequences of the MF units and auto-strainers. The variable speed drives also operate when pressure fluctuations occur due to changes in permeability of the MF process membranes between CIP sequences. An additional feed pump was added to accommodate the increased flows for the Expanded Project. Design criteria for the expanded MF feed tank and pumps are provided in **Table 3-16.**

Table 3-16. MF Feed Tank and Pumps

MF Feed Tank and Pumps		
MF Feed Tank	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Type	Above-grade, welded steel	Above-grade, welded steel
Dimensions, D x SWD, ft x ft[a]	30 x 25	30 x 25
Capacity, gal	132,200	132,200
Hydraulic residence time, min	24	18
MF Feed Pumps	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number of pumps (duty + standby)	3+1	4+0
Operating configuration	Lead/Lag/Standby	Lead/Lag/Standby
Pump type	Horizontal Split Case	Horizontal Split Case
Design operating flow per pump, gpm	2,205	2,205
Design operating head per pump, feet	115	115
Pump motor size, horse power (hp)	100	100
Pump drive	Variable Speed	Variable Speed

a. D x SWD – diameter by side water depth

3.2.4.3 Membrane Filtration Automatic Strainers

The feed automatic strainers (autostrainers) provide particulate removal prior to the MF units and also protect the hollow fiber membranes. The strainers are an automatic backwashing type, which can continue to filter water during the backwash process, which is a cyclical process that lasts for a brief period of time. The process can be triggered by time, differential pressure loss, or remote-manual initiation. The anticipated recovery of the automatic strainers is greater than 98%. The three existing strainers will be removed (two moved to the ozone area to serve as autostrainers for the ozone system) and five new Amiad brand strainers will be installed to provide more screen surface area to accommodate the increased flows. The Expanded Project design criteria are presented in **Table 3-17.**

Table 3-17. Automatic Strainers

Automatic Strainers[a]		
	Design Flow (6.5 mgd)	**Peak Flow (7.6 mgd)**
Number of strainers (Duty + Standby)	4+1	5+0
Operator configuration	--	--
Type	Auto Backwashing Basket Strainer	Auto Backwashing Basket Strainer
Max strainer flow rates, gpm	7,548	8,826
Maximum pressure drop at rated flow, pounds per square inch differential (psid)	10	10
Screen size (rating), microns	200	200
Screen type	Weave wire/wire mesh	Weave wire/wire mesh
Recovery, %	98	98

3.2.4.4 Membrane Filtration System

The piloting program (**Appendix B**) revealed that the outside-in filtration path outperformed the inside-out alternative; and that the polyvinylidene difluoride (PVDF) membranes formed by thermally induced polymerization exhibited stable permeability at a flux rate of 30 gallons per day per square foot (gfd). Therefore, this type of MF system was selected for the AWPF. An additional MF skid was added to accommodate the increased flows. The Expanded Project design criteria are presented in **Table 3-18.**

The core of a typical MF system is the MF block, or unit. Each unit incorporates the following, which is mounted on a coated steel frame:

- Hollow fiber MF membrane modules mounted vertically on high-density polyethylene (HDPE) manifolds,
- Process flow piping and valves,
- Instruments, and
- Electrical and pneumatic panels.

Individual units are connected via a manifold from one common feed, and a set of feed pumps operating on variable frequency drives (VFD) provides the influent flow (MF Feed Pumps described previously). The speed of these pumps is adjusted to attain a desired filtrate flow rate, with modulating valves on each unit controlling its respective flow. The individual units are all equipped with backwashing and mini-CIP capabilities, control air, drains, air scour connections and backwash headers to achieve the desired rate of system production.

During operation, MF system feed water enters the bottom of a module and travels through large holes to the exterior of the fibers in the main body of the module. The feed water within the module housing permeates through the hollow fiber membranes into the interior lumens. The filtered water then exits through the top of the module and continues to the permeate connection.

Aside from normal operation, the three other automatic operating modes include:

1. Membrane BW: removes accumulated particulates from the membranes,
2. Mini-CIP: restores permeability or reduces membrane fouling, and
3. Direct integrity tests (DIT): verify membrane integrity.

The MF backwash sequence is a periodic reversal of flow through a filter, which may be accompanied by water in conjunction with air generally associated with the intermittent waste stream (every 15 to 90 minutes) discharged from an MF. The mini-CIPs are run once a day per MF unit or as needed to maintain transmembrane pressure (TMP). The modules are cleaned via a mini-CIP clean cycle, which takes approximately 60 minutes to complete. Mini-CIPs use the CIP system for daily cleaning. These cleans can be initiated by a timer, totalized flow, or manually by the operator. Mini-CIPs can be hypochlorite/sodium hydroxide ("caustic/chlorine cleans") or sulfuric acid ("acid cleans"). Caustic/chlorine mini-CIPs will initially be conducted with a free chlorine residual of 1,000 mg/L as Cl_2 and a sodium hydroxide dose of 0.025%, which yields a pH in the range of 11 to 11.5 (the pH will not exceed 12.5). Acid mini-CIPs will initially yield a pH of 1 to 2 (the pH will not drop below 1).

The existing MF units were designed as universal racks that can accommodate multiple membrane module types. Each MF unit contains only one type of membrane and does not have multiple membrane types. The controls for each MF unit are programmed to use pressure decay test equations specific to the membrane type installed.

While the existing units use Scinor modules, the new MF unit being added for the Expanded Project will employ Toray modules (model no. HFU-2020AN) that is a well-established and proven technology. Toray's predecessor to this model, HFU-2020N, was evaluated and pre-qualified through pilot testing (**Appendix B**). The pilot test results demonstrate that the Toray unit provided excellent turbidity performance set by Title 22 regulations.

The HFU-2020N membrane has a conditional acceptance letter from the DDW dating back to 2016. The HFU-2020AN has the same fiber chemistry and type as the HFU-2020N, but cosmetic changes were made to the end caps to be integrated with the module as opposed to being separate. The OOP will be updated to add the conditional acceptance letter along with integrity testing protocol for Toray while the existing OOP already includes the same information for Scinor membranes currently used at the AWPF.

The MF units for Toray and MF units for Scinor each will have unique pressure decay coefficients. The correct pressure decay test coefficients and equations for each MF unit will be programmed into the control system. The contractor is responsible for verifying their accuracy during startup which will be witnessed by the construction manager and M1W.

The MF units are open platform units also known as “universal rack” and can accommodate different MF membrane types such as Toray and Scinor models. However, a MF unit will never contain two different types of membranes and will only contain a single type of membrane and only use the pressure decay test equations for that specific membrane.

Table 3-18. Membrane Filtration System

Membrane Filtration System		
	Design Flow (6.5 mgd)	**Peak Flow (7.6 mgd)**
System rated capacity, mgd	8.23	9.62
Number of MF skids (Duty + Standby)[(1)]	5+1	6+0
Number of MF modules per skid	102 (Scinor) 102 (Toray)	102 (Scinor) 102 (Toray)
Maximum design instantaneous flux, gfd	27	27
Membrane type	Pressure, PVDF	Pressure, PVDF
Module model number	SMT600-P72 (Scinor) HFU-2020N (Toray)	SMT600-P72 (Scinor) HFU-2020N (Toray)
Membrane area per nodule, square feet	775	775
Maximum flow per unit, gpm	1,482	1,482
BW/AS cycle interval, min	--	--
BW flux, gfd	--	--
AS Air Flow (scfm/module)	3.0-7.5	3.0-7.5
Mini-CIP Frequency (days)	5	5
Minimum Recovery (%)	92	92

[(1)]At expansion startup, the configuration will be 5 Scinor skids and 1 Toray skid. M1W is permitted to swap between any of the pre-approved modules (i.e., Dow, Toray, or Scinor).

3.2.4.5 Compressed Air System

The main components of the compressed air system are listed in **Table 3-19** and the main components of the air scour blowers are listed in **Table 3-20**. Air blowers are used in the backwash sequence, and compressed air is used for the DIT as well as in controlling valves operating air throughout the system. The air used is dry and oil-free, per the Instrument Society of America Standard S7.3.

Table 3-19. Compressed Air System

Compressed Air System		
Air Compressors	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number (Duty + Standby)	1+1	1+1
Operating Configuration	--	--
Capacity, scfm	30	30
Minimum Design Pressure, psig	145	145
Motor Size, hp	15	15
Air Receiver (Control Air)	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number (duty + standby)	1+0	1+0
Volume, gals	200	200
Design Pressure, psig	150	150
Air Receiver (Integrity Test)	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number (duty + standby)	1+0	1+0
Capacity, gals	600	600
Design Pressure, psig	150	150
Operating Range, psig	30-120	30-120

Table 3-20. Air Scour Blowers

Air Scour Blowers		
Air Scour Blowers	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number (duty + standby)	1+0	1+0
Type	Rotary	Rotary
Capacity, scfm	500	500
Minimum Design Pressure, psig	11.5	11.5
Motor Size, HP	50	50
Drive	VFD	VFD

3.2.4.6 Clean-in-Place System

The function of the CIP system is to regenerate the membranes when they become fouled with constituents that are not removed by the periodic BW and mini-CIP sequences. The main components of the CIP system are summarized in **Table 3-21**, and the chemical transfer systems are detailed in **Table 3-22**. During the cleaning of a unit, the remaining units maintain the maximum required system production level at the design flow.

The mini-CIPs are run once a day per MF unit or as needed to maintain TMP. The modules are cleaned via a mini-CIP clean cycle, which takes approximately 60 minutes to complete. Mini-CIP cleans use the CIP system for daily cleans. These cleans can be initiated by a timer, totalized flow, or manually by the operator. Mini-CIP cleans can be hypochlorite/sodium hydroxide ("caustic/chlorine cleans") or sulfuric acid ("acid cleans"). Caustic/chlorine mini-CIP cleans will initially be conducted with a free chlorine residual of 1,000 mg/L as Cl2 and a sodium hydroxide dose of 0.025%, which yields a pH in the range of 11 to 11.5 (the pH will not exceed 12.5). Acid mini-CIP cleans will initially yield a pH of 1 to 2 (the pH will not drop below 1).

Table 3-21. Clean-in-Place System

CIP System[a]		
MF CIP Tanks	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number	2	2
Type	Fiberglass Reinforced Plastic (FRP)	FRP
Capacity, gal	3,000	3,000
MF CIP Heater	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number	2	2
Size, kw	75	75
Strainer	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number (duty + standby)	1	1
MF CIP Pump	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number (duty + standby)	1+1	1+1
Materials	FRP	FRP
Design flow per Pump, gpm	1,020	1,020
Drive	Variable speed	Variable speed
Motor Size, hp	25	25
Maximum Motor Speed (rpm/enclosure)	1,800	1,800

Table 3-22. Chemical Transfer Systems

Chemical Transfer Systems		
Sulfuric Acid	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number of Tanks	1	1
Solution Strength, %	93	93
Capacity, gal	3,000	3,000
Number of Pumps	1	1
Capacity per Pump, gph	300	300
Sodium Hydroxide	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number of Tanks	1	1
Solution Strength, %	25	25
Capacity, gal	3,000	3,000
Number of Pumps	1	1
Capacity per Pump, gph	300	300
Sodium Hypochlorite	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number of Tanks	2	2
Solution Strength, %	12.5	12.5
Capacity per Tank, gal	10,300 (operating) 8,755 (nominal)	10,300 (operating) 8,755 (nominal)
Number of Pumps	1	1
Materials	PVC	PVC
Capacity per pump, gph	300	300

3.2.4.7 Backwash System

The BW system is provided to perform routine regeneration of the membrane fibers (components are summarized in **Table 3-23**). The system reverses the flow of the MF system, moving filtrate from the inside of the fibers, through the membrane and to drain. The BW pumps are equipped with variable speed drives to maintain the target flow over variable TMP losses through the MF modules based on the degree of fouling.

Table 3-23. Backwash System

Backwash System		
	Design Flow (6.5 mgd)	**Peak Flow (7.6 mgd)**
Number of pumps (duty + standby)	1+1	1+1
Operating Configuration	--	--
Primary design capacity per pump, gpm	2,200	2,200
Drive	Variable speed	Variable speed
Motor size, hp	100	100
Max. motor speed, rpm	1,800	1,800

3.2.5 Reverse Osmosis Membrane Criteria

The RO process is used to remove dissolved constituents such as dissolved salts, pathogens, pesticides, organics, pharmaceutical compounds, and other CECs. The RO system includes:

- Cartridge filters,
- RO membrane trains,
- RO CIP system, and
- RO membrane flush system.

The Expanded Project RO system-rated permeate design flow capacity will be from 1.2 to 6.5 mgd and peak flow capacity will be up to 7.6 mgd. Capacities are based on operation at 81% recovery.

3.2.5.1 Membrane Filtrate Storage Tank and Transfer Pump Station

Filtrate from the MF system flows to an MF filtrate tank for intermediate storage and pumping ahead of the RO system. The MF filtrate tank provides equalization storage between variable rates of MF filtrate flow (due to backwash and cleaning cycles) and the continuous, stable flow required by the RO system. The pumps are low-pressure, providing flow through the pretreatment cartridge filters and chemical addition systems ahead of the inline high-pressure booster pumps feeding the RO membrane trains. An additional 50 HP RO transfer pump was added to accommodate the increased flows for the expansion. Design criteria for the RO feed pump station are provided in **Table 3-24.**

Table 3-24. RO Feed Pump Station

RO Feed Pump Station		
MF Filtrate Storage Tank	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Type	Abovegrade, Welded Steel	Abovegrade, Welded Steel
Hydraulic residence time, min	27	20
Dimensions, D x SWD[a], ft x ft	30 x 25	30 x 25
Capacity (gals)	114,200 (operational) 132,200 (nominal)	114,200 (operational) 132,200 (nominal)
RO Transfer Pumps	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number of pumps (duty + standby)	4+1	5+0
Operating configuration	--	--
Pump type	End suction centrifugal	End suction centrifugal
Pump capacity, gpm	1,400	1,400
Pump head, ft	92	92
Pump motor size, hp	50	50
Pump drive	Variable Speed	Variable Speed

[a] D x SWD – Diameter x Side Water Depth

3.2.5.2 Pretreatment Facilities

RO pretreatment facilities include cartridge filtration and the addition of sulfuric acid and a scale inhibitor (see **Table 3-25 and Table 3-26**). Three new larger cartridge filtration units are replacing the existing cartridge filter units to accommodate the increased flows. The cartridge filter vessels are horizontal type to facilitate the loading and unloading of filter elements.

The sulfuric acid and threshold inhibitor tank and pumps have enough capacity to accommodate the increased flows. The cartridge filters remove any large particles in the MF filtrate that could interfere with RO filtration. Sulfuric acid is used to lower the feed pH to the RO system and help prevent mineral scaling with the assistance of the scale inhibitor (see **Table 3-26**). The primary scalants of concern are calcium phosphate and silica; pH adjustment (down to a set point as low as 6.0) is the primary control of the calcium phosphate scale, while the scale inhibitor is relied on to prevent the scaling of silica. The above approach worked well in keeping scaling at a minimum during the first four years of AWPF operations.

Table 3-25. RO Cartridge Filters

RO Cartridge Filters		
	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number (Duty + Standby)	3+0	3+0
Operating configuration	--	--
Rated capacity of housing, mgd	4.0	4.0
Max. loading rate, gpm/10-inch equivalent	2.5	2.5
Cartridge element rating (microns)	5	5

Table 3-26. Reverse Osmosis Chemical Systems

RO Chemical Systems		
Scale Inhibitor	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Scale Inhibitor Tank		
Number	1	1
Type	XLPE	XLPE
Capacity, gal	1,250	1,250
Scale Inhibitor Pumps		
Number (duty + standby)	1+1	1+1
Capacity, gph	5.3	5.3
Sulfuric Acid	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Sulfuric Acid Tank		
Solution strength, %	93	93
Number	2	2
Type	Lined Steel	Lined Steel
Capacity, gal	9,675	9,675
Sulfuric Acid Pumps		
Number (duty + standby)	1+1	1+1
Capacity, gph	70	70
Rated Pressure, pounds per square inch (psi)	100	100

3.2.5.3 Reverse Osmosis Trains

The Expanded Project RO system will include four trains. The existing RO trains use Hydranautics ESPA2-LD membranes. The new RO train will feature Toray membranes (model no. TMG20D-400), which were evaluated and prequalified through pilot testing (**Appendix B**). The TMG20D-400 membrane is a well-established and proven unit used in multiple DDW-approved potable reuse facilities that meets regulatory requirements and complies with ASTM standards (**Appendix L**). The RO system design criteria are provided in **Table 3-27**. Each vessel will contain seven 8-inch diameter RO membrane elements. M1W is allowed to use any of the pre-qualified RO elements for the AWPF, which include:

- Dow XFRLE-400/34i
- Toray TMG20D-400
- Hydranautics ESPA2-LD

Each train will exclusively contain one type of element, with no mixing of different elements permitted across various vessels or stages within a single train. M1W has implemented inventory management and control procedures designed to document and verify the types of elements present in each train, ensuring that mixing of elements does not occur during the replacement of RO elements. Additionally, the surrogates employed for monitoring critical control points concerning pathogen log reduction values will remain consistent, irrespective of the specific RO train or the RO elements utilized within that train. This ensures that the same performance standards will be required, regardless of the RO train and its associated elements.

The trains are connected to common feed, permeate, concentrate, flush feed, flush waste, and cleaning system headers. RO permeate from each train is combined and piped to the UV system reactors. RO concentrate (reject) from the trains is combined and sent to the existing RTP outfall for disposal per NPDES permit requirements. Cleaning and flushing residuals are neutralized and sent to the plant Waste Equalization (Waste EQ) Basin prior to return to the RTP headworks.

Table 3-27. Reverse Osmosis System

RO System		
RO Feed Pumps	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number	4	4
Type	Vertical Turbine	Vertical Turbine
Materials	316 SST	316 SST
Primary design operating flow per pump, gpm	1,300 (Train 3) 1,750 (Trains 1 and 2) 1,800 (Train 4)	1,300 (Train 3) 1,750 (Trains 1 and 2) 1,800 (Train 4)
Head at design point, feet (ft)	150–- 580	150–- 580
Drive	Variable Speed	Variable Speed

Motor size, hp	250 (Train 3) 350 (Trains 1, 2, and 4)	250 (Train 3) 350 (Trains 1, 2, and 4)
Max. motor speed, revolutions per min (rpm)	1,800	1,800
RO Membrane Trains	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number	4	4
Permeate capacity (each), mgd	1.5 (Train 3) 2.0 (Trains 1 and 2) 2.1 (Train 4)	1.5 (Train 3) 2.0 (Trains 1 and 2) 2.1 (Train 4)
Recovery (%)	81	81
Pressure vessel array	30:15 (Train 3) 40:20 (Trains 1 and 2) 42:21 (Train 4)	30:15 (Train 3) 40:20 (Trains 1 and 2) 42:21 (Train 4)
Pressure Vessels	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Type	FRP	FRP
Design operating pressure, psig	450	450
Size	8 x 7M	8 x 7M
Membrane Elements[1]	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number (total)	1,596	1,596
Element type	High Rej. PA Composite	High Rej. PA Composite
Membrane type	PA composite	PA composite
Element length, inch (in)	40	40
Element diameter, in	8	8
Membrane element area, square feet (sqf)	400	400
Average rejection, %	99.7 (Toray) 99.6 (Hydranautics)	99.7 (Toray) 99.6 (Hydranautics)
Average flux at rated capacity,gfd	12	12

[1]Upon Expanded Project startup, Trains 1, 2 and 3 will use Hydranautics elements and Train 4 (the new train) will use Toray elements. M1W is permitted to use any of the pre-approved RO elements (Dow, Toray, or Hydranautics).

3.2.5.4 Clean-in-Place System

The CIP system is an ancillary facility provided for in-situ chemical cleaning of the RO membranes. This permanently piped system is used to prepare and recirculate a chemical cleaning solution independently through each stage of the RO membrane trains. The CIP system is operated from a local control panel. See **Table 3-28** for system components.

Cleaning chemicals are loaded into the CIP tank using a bag loader or eductor for batching of dry-fed chemicals directly to the tank, which are diluted with RO permeate. The CIP pump draws from the CIP tank to mix the contents and is capable of circulating the solution to either the RO train or back to the CIP tank. The cleaning tank is fitted with a pair of flanged immersion heaters to achieve the required temperature of the cleaning solution. A small liquid chemical addition system is provided to adjust the cleaning solution pH if necessary. Two process lines are provided to the RO train; one pipeline is used to convey the cleaning solution to the membranes while the other is to return the cleaning solution to the CIP tank. Piping connections at each RO train allow for each membrane stage to be cleaned independently. Piping and valving at the CIP tank allow the cleaning solution to be recirculated back to the tank or sent directly to the AWPF Waste EQ for return to the RTP.

The CIP tank flanged immersion heaters are controlled to maintain a temperature setpoint entered at the temperature controller.

Table 3-28. RO Clean-in-Place System

RO CIP		
CIP Tank	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number	1	1
Type	FRP	FRP
Capacity, gal	7,600	7,600
CIP Pump	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Capacity at design point, gpm	1,500	1,500
Drive	Variable speed	Variable speed
Motor size, hp	75	75
Max. motor speed, rpm	1,800	1,800
CIP Tank Heater	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Number	2	2
Size, Kilowatts (kW)	75	75

3.2.5.5 Reverse Osmosis Membrane Flush System

The flush system is an ancillary facility provided for periodic *in-situ* flushing of the RO membranes. This permanently piped system is used to displace residual feed and concentrate from the RO membranes on train shutdown. It can also be used to periodically displace stagnated solution during extended train shutdowns.

Source water for flushing is RO permeate stored in an above-grade storage tank. The tank is filled to an Operator inputted level. A dedicated flush pump drawing from the tank provides flow to the inlet side of the RO membrane feed pumps, which pumps the solution through the membrane pressure vessels. The majority of the flush supply remains on the feed/concentrate side of the membrane elements due to the relatively low delivery pressure. A waste valve on the final concentrate line is opened during flushing to discharge displaced waters to waste. To avoid the creation of backpressure during flushing, the permeate dump valve also opens to discharge accumulated permeate to waste.

A separate set of pumps draw from the flush tank to provide MF and RO CIP solution makeup water. The transfer pumps can also be used to fill the UV reactors by valving to the UV influent header. Design criteria for components of the flush system are provided in **Table 3-29**.

Table 3-29. RO Flush System

RO Flush System		
Flush Tank	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number	1	1
Capacity, gal	15,230	15,230
Flush Pump	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number (duty + standby)	1+0	1+0
Capacity at design point, gpm	500	500
Drive	Variable speed	Variable speed
Motor size, hp	30	30
Flush Transfer Pumps	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Number (duty + standby)	1+1	1+1
Operating configuration	--	--
Capacity at design point, gpm	250	250
Drive	Fixed speed	Fixed speed
Motor size, hp	7.5	7.5

3.2.6 Advanced Oxidation Process Design

Advanced Oxidation Processes (AOPs) include the generation of hydroxyl radicals at ambient temperature and pressure in order to facilitate oxidation of organic compounds. Hydroxyl radicals react rapidly with organics, making AOP an effective strategy for reducing the concentration of specific trace organic compounds and recalcitrant compounds. Advantages of

AOPs include their ability to significantly reduce the concentrations of many CECs to acceptable levels, and the relatively short hydraulic residence time required. An AOP is also able to provide a high level of pathogen inactivation.

The AOP system is a low-pressure UV with hydrogen peroxide (UV/H_2O_2) where H_2O_2 reacts with UV light to form hydroxyl radicals, which then oxidize the target compounds.

3.2.6.1 Reduce Recalcitrant Compounds

In full advanced treatment, an AOP follows RO, which is capable of reducing the concentration of many organic and inorganic compounds to very low levels. However, some particularly recalcitrant, low molecular weight compounds are removed less effectively (e.g., N-nitrosodimethylamine (NDMA) and 1,4-dioxane). During pilot testing, NDMA removal through RO was approximately 40%. The Title 22 Criteria require 0.5-log reduction for 1,4-dioxane. Thus, AOPs are designed to achieve a certain level of removal of preselected recalcitrant compounds such as 1,4-dioxane and NDMA.

This concept of AOP as a treatment barrier is illustrated in **Figure 3-6**, which shows the log removal of various CECs based on an AOP dose required to achieve 0.5-log removal of 1,4-dioxane. If 0.5-log removal of 1,4-dioxane is achieved, 0.5-log or greater removal of CECs that appear in **Figure 3-6** to the left of 1,4-dioxane will be accomplished. This is important because it demonstrates that the UV/H_2O_2 process provides an effective barrier against CECs in potable reuse applications.

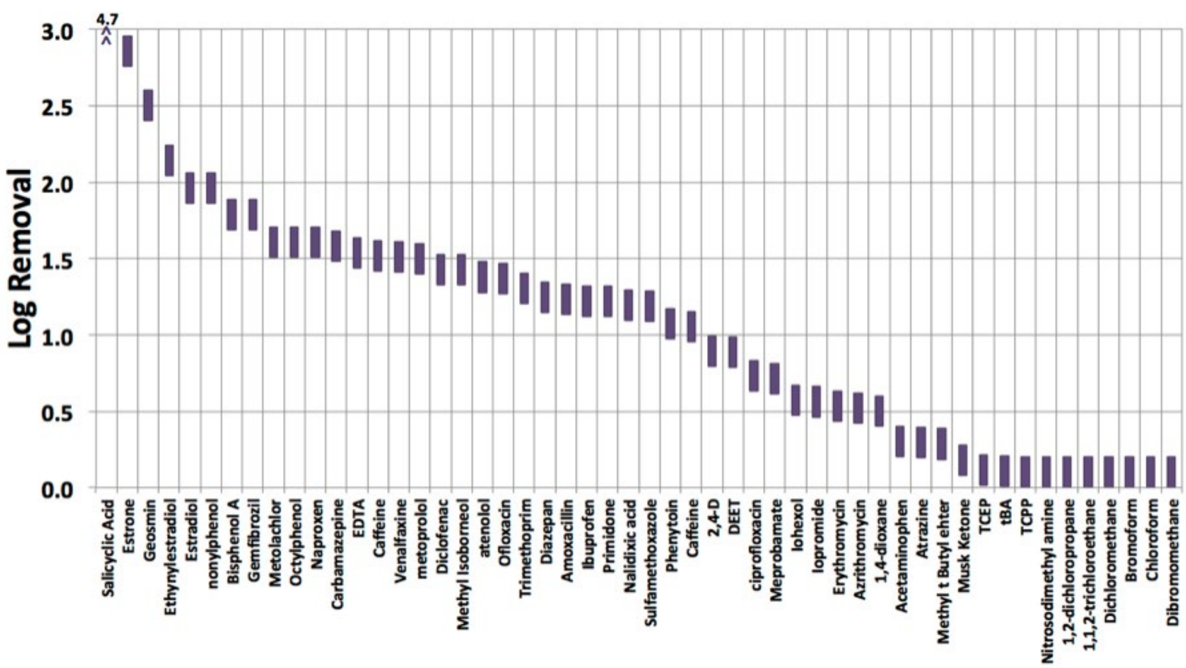

Figure 3-6. Log removal of CECs achieved when AOP dose removes 0.5-log 1,4-dioxane

3.2.6.2 Factors Affecting Advanced Oxidation Processes

Several factors affect the performance of AOPs by interfering with the production of hydroxyl radicals or by reacting with them. While these factors are of limited concern for the Project based on the high quality of RO permeate, additional information is provided in the following subsections for background.

3.2.6.2.1 Presence of Hydroxyl Radical Scavengers

The presence of bicarbonate and carbonate ions can reduce the efficacy of AOPs because these species are reactive with hydroxyl radicals. Although they react much slower than many organic compounds, the concentrations of these hydroxyl radical scavengers are often orders of magnitude higher than those of the target compounds. Natural organic matter (NOM) also reacts with hydroxyl radicals and can have a more detrimental impact on AOP performance than the carbonate species for some waters. Because bicarbonate, carbonate, and NOM are removed through the RO to a high degree, these are not a concern when performing AOP on RO permeate, making UV/AOP a very effective process for such applications.

3.2.6.2.2 Photolysis of Hydrogen Peroxide

In a UV/ H2O2 process, oxidation is driven by the absorption of photons by H2O2 and the subsequent release of energy. The effectiveness of this process is dependent on the extent to which H2O2 undergoes photolysis. The presence of chemicals or organic molecules that absorb UV light can reduce the quantity of photons available to react with H2O2 and thus reduce the extent of oxidation. These constituents include NOM, NO3, and iron, as well as the target compounds to a smaller degree (e.g., CECs, 1,4-dioxane). While these compounds undergo photolysis due to UV exposure, the reduction of their concentrations is often more efficient via hydroxyl radicals generated by H2O2photolysis, as many compounds are not amenable to UV photolysis alone in the absence of hydroxyl radicals. Hydroxyl radicals react rapidly with organics, and their second-order hydroxyl radical (·OH) rate constants are generally several orders of magnitude faster than the rate constants for any conventional oxidant (Crittenden et al., 2012).

3.2.6.2.3 UV Lamp Technology

Initially, two types of lamps were considered for the Project: low pressure, high-intensity (LPUV) lamps, and medium pressure, high intensity (MPUV) lamps. LPUV lamp technology was selected for the AWPF AOP system based on the following considerations:

- LPUV emits energy at one specific wavelength of 254 nanometers (nm), which is a wavelength that has been shown to be highly effective for NDMA destruction and
- MPUV lamps have been shown to require higher energy inputs to achieve the same level of NDMA destruction as LPUV lamps.
- MPUV lamps emit energy in the UV spectrum from 200 to 400 nm. Since H_2O_2 only absorbs photons in the 200-300 nanometer (nm) wavelength range, a portion of the energy emitted in the UV spectrum from 300 to 400 nm cannot be used to generate hydroxyl radicals.

3.2.6.2.4 Advanced Oxidation Process Design

The AWPF UV AOP system is designed to treat 6.5 mgd flow and a peak flow 7.6 mgd for specific log reductions of recalcitrant compounds, as defined in the following subsections.

3.2.6.2.5 1,4-Dioxane Design Target

The design targets for 1,4-dioxane are based on the regulatory requirements to provide at least 0.5-log reduction and ensure the product water concentration is below the NL of 1 µg/L. The UV/AOP system has been operated according to the design targets, and the concentration of 1,4-dioxane measured in the product water has been below the method detection limit (MDL) of 0.09 µg/L in all quarterly samples since startup in February 2020.

3.2.6.2.6 NDMA Design Target

The design targets for NDMA are to provide at least 1.5-log reduction and ensure the product water concentration is below the NL of 10 ng/L. The 1.5-log reduction was based on conservative goals established from pilot testing data. The UV/AOP system has been operated according to the design targets, and the product water NDMA concentration has been below the MDL of 1 ng/L in all quarterly samples since startup in February 2020.

3.2.6.2.7 Feed Water Quality

Based on the pilot testing results, the feed water quality for the UV/H_2O_2 AOP system is provided in **Table 3-30**.

Table 3-30. Advanced Oxidation Feed Water Quality

UV Peroxide AOP Feed Water Quality	
NDMA, ng/L	≤ 113[a]
1,4-dioxane, µg/L	≤ 3
Temperature, °C	16-24
UV transmittance at 254 nm	≥ 95%
Alkalinity, mg/L as $CaCO_3$	≤ 20
TOC, mg/L	≤ 0.5
TDS, mg/L	≤ 60
TSS, mg/L	< 1
pH	5-6.5
Calcium hardness, mg/L as $CaCO_3$	≤ 5
Iron, mg/L	< 0.1
Manganese, mg/L	< 0.02

[a]Value for UV influent is based on a historical maximum measured NDMA concentration of 150 ng/L in RO feed quarterly sampling and assumes an anticipated 25% rejection of NDMA by the RO process. Up to 316 ng/L of NDMA could be present in the UV feed to meet product water concentrations at or below the NL at the design UV dose of 1,600 mJ/cm^2.

3.2.6.3 General UV Design Criteria

General design criteria for the UV/H_2O_2 system are defined in **Table 3-31**. Testing was conducted to validate the UV dose algorithm and demonstrate log removal of NDMA under varying operating conditions, which resulted in modifications to the UV dose (i.e., NDMA reduction equivalent dose) algorithm based on the observed NDMA log-reduction. A validation study was conducted to determine the operating setpoints required for the 1,4-dioxane reduction requirements. This testing indicated the UV system (operated at a reactor flowrate of 1.4 mgd or less) would need to deliver a UV-H_2O_2 dose product (the product of UV dose, in mJ/cm^2, times the hydrogen peroxide dose, in mg/L) of 8,455 mJ-mg/cm^2-L to meet the 1,4-dioxane goal. The dose required for 0.5-log removal of 1,4-dioxane has been accepted by the DDW (**Appendix C**).

Table 3-31. UV AOP System General Design Criteria

Parameter	Design Flow Rate	Peak Flow Rate
Flow rate, mgd	6.5	7.6
UV reactors (standby + duty)	6+2	7+1
H_2O_2 dose, mg/L as H_2O_2	2.2 to 7	2.2 to 7
UVT, % at 254 nm	≥ 95	≥ 95
NDMA reduction requirement	≥ 1.5-log	≥ 1.5-log
NDMA concentration in UV AOP treated water[a], ng/L	≤ 10	≤ 10
1,4-Dioxane reduction requirement	≥ 0.5-log	≥ 0.5-log
1,4-Dioxane concentration in UV AOP treated water[a], µg/L	≤ 1	≤ 1
UV dose, millijoules per square centimeter (mJ/cm^2)	1,600	1,600

[a]Design targets for NDMA and 1,4-dioxane represent their respective NLs.

3.2.6.4 Ultraviolet System

The UV system is designed for a flow rate of 6.5 mgd and a peak flow rate of 7.6 mgd. Six duty reactors will be provided, along with two standby reactors. Each reactor contains 60 600-W lamps (480 lamps total, 288 kW total lamp power). Design criteria are provided in **Table 3-32**.

Table 3-32. Design Criteria for the UV system

Parameter	Design Flow Rate	Peak Flow Rate
UV system manufacturer	WEDECO/Xylem	WEDECO/Xylem
UV reactor model	LBX 1500e	LBX 1500e
Reactors (duty + standby)	6+2	7+1
Operating configuration	In parallel	In parallel
Flow rate, mgd	6.5	7.6
Influent UVT at 253.7 nm, %	≥ 95	≥ 95
Influent temperature, °C	14-27	14-27
Lamps, total (duty + standby)	480	480
Lamps, total (duty)	360	420
Lamps per reactor	60	60
Power per lamp, W	600	600
Total lamp power, P_L (duty + standby), kW	288	288
Total lamp power, P_L (duty), kW	216	252
Total lamp power, P_L, per reactor, kW	36	36
UV Intensity Sensors per reactor	2	2
UV Intensity Sensors, total (duty + standby)	16	16
UV Intensity Sensors, total (duty)	12	14

3.2.6.5 Hydrogen Peroxide Feed System

H_2O_2 will be dosed upstream of the UV reactors, with a design dose range from 2.2 to 7.0 mg/L. The H_2O_2 system will consist of two metering pumps (duty + standby), a 3,760-gal chemical storage tank, chemical containment system, and an in-line static mixer. H_2O_2 addition will be flow-paced at a dose controlled by the UV/AOP system. Due to the increased flow demand for the Expanded Project peak flow rate (7.6 mgd), the H_2O_2 chemical storage tank will be replaced with a larger volume tank. This will support delivery schedules expected from chemical suppliers. The design criteria for the H_2O_2 dosing system are summarized in **Table 3-33**.

Table 3-33. Design Criteria for Hydrogen Peroxide Dosing System

Parameter	Design Flow Rate (6.5 mgd)	Peak Flow Rate (7.6 mgd)
H_2O_2 dose range, mg/L as H_2O_2	2.2 to 7	2.2 to 7
Static mixer type	In-line	In-line
H_2O_2 solution strength, %	50	50
H_2O_2 storage tank volume, gal	3,760	3,760
Maximum H_2O_2 dosing rate (at 7.0 mg/L), gph	3.2	3.7
Storage at flow rate (days)	45	38

3.2.7 Product Water Stabilization

Several issues could arise due to the softness and low alkalinity of RO permeate product water, including conveyance pipe corrosion, the potential for groundwater aquifer leaching and mineral mobilization, as well as changes in taste or smell that affect consumer acceptance. In addition, microbial regrowth can occur during storage and conveyance. For these reasons, most advanced treatment facilities producing RO permeate practice pH and/or alkalinity adjustment as a control strategy for mitigating corrosion, leaching, and undesirable taste and odor (T&O). And residual disinfectants are typically added to control microbial regrowth.

3.2.7.1 Purpose of Product Water Stabilization

3.2.7.1.1 Minimize Corrosion in Conveyance Pipeline

The conveyance pipeline will transport water from the AWPF to the injection wells. Without post-treatment stabilization, corrosion could occur in the conveyance pipeline. Corrosion degrades the integrity of the pipeline and can lead to the formation of corrosion by-products, which may contribute to plugging of the injection wells and may impact downstream T&O.

3.2.7.1.2 Minimize Leaching in Groundwater Aquifer

Another issue with RO permeate is the potential for leaching of minerals and other chemicals present within the aquifer of the Seaside Basin. Leaching could impact the water quality by increasing dissolved solids or mobilizing unwanted compounds such as arsenic.

3.2.7.1.3 Preventing Microbial Regrowth

The purpose of secondary disinfection is to prevent microbial regrowth in the product water conveyance pipeline and to provide disinfection Log reduction value (LRV) credits when needed.

3.2.7.1.4 Consumer Acceptance / Landscape Irrigation Compatibility

Consumer acceptance is important for the overall success of the project. Minimizing changes in water quality associated with T&O and appearance can help maintain positive customer perception. Since the AWPF product water mixes with existing groundwater prior to extraction and distribution to potable water consumers, there is a low likelihood that any water quality changes that cause public concern will occur. Parameters of concern for landscape irrigation such as pH, salinity, sodium, chloride, calcium, magnesium, and boron are within acceptable levels.

3.2.7.2 Post-Treatment Parameters

The Langelier Saturation Index (LSI), Calcium Carbonate Precipitation Potential (CCPP), and the Aggressive Index all indicate the ability of a solution to dissolve or precipitate calcium carbonate mineral. Waters that tend to precipitate calcium carbonate (LSI > 0) may form a protective layer of calcium carbonate in the conveyance piping. Waters that tend to dissolve calcium carbonate can erode these protective layers, eventually exposing iron or steel. The ability of a solution to dissolve calcium carbonate is a function of pH, calcium concentration (related to hardness), carbonate concentration (related to alkalinity), temperature and TDS. The following is a description of the other water quality parameters that make up the post-treatment water quality goals:

- The chloride concentration relates to the corrosivity of the water with respect to iron and steel;
- The Silt Density Index (SDI) and turbidity are measurements of the particulate and colloidal make-up of the water, which relate to the particle loading of the water and may indicate the presence of pathogenic bacteria; and
- A chlorine residual is used to control biofilm growth in the conveyance pipeline and injection wellhead and to achieve disinfection LRV credits, when needed.

3.2.7.2.1 Post-Treatment Design Goals for AWPF

The post-treatment system is designed and operated with a goal to produce water with the characteristics that minimize corrosion and control leaching in the aquifer. The characteristics are shown in **Table 3-34.** This system treats up to the peak design flow of 7.6 mgd from the UV/AOP system, including a turndown to as low as 1.2 mgd. To ensure correct post treatment water quality goals are in place to prevent arsenic mobilization from aquifer solids, M1W requested advice from Dr. Scott Fendorf (Professor, Earth System Science, Stanford University). Dr. Fendorf reviewed current conditions in the Santa Margarita Aquifer, investigated potential for arsenic mobilization, and provided recommendations to prevent arsenic mobilization. His findings and recommendations are presented in **Appendix I** which include maintaining stabilized injected water pH less than or equal to 8.5 and continuing purified water injection to maintain aerobic and oxidizing conditions. This approach is consistent with the stabilization methods implemented by M1W, adding calcium chloride and caustic to adjust the pH and LSI, and adding chlorine to maintain oxidizing conditions. To maintain LSI targets, a pH of ≤8.8 is targeted at the PWPS. During conveyance, the pH decreases slightly assuring a pH of ≤8.5 at the injection wells. The post stabilization water quality goals in **Table 3-34** are consistent with Dr. Fendorf's recommendations.

Table 3-34. Post Treatment Design Criteria

Parameter	Post Stabilization Water Quality Goals
Temperature, °C	16 - 24
Alkalinity, mg/L as $CaCO_3$	40-80
pH	7.5-8.8
Calcium hardness, mg/L as $CaCO_3$	40-80
LSI	0-0.1
SDI,	< 2
Turbidity, NTU	< 0.2
TOC, mg/L	< 0.5
Total Cl_2, mg/L	3 - 5
Total nitrogen, mg/L as N	< 10

3.2.7.3 Decarbonation

Decarbonation of the UV/AOP product water is achieved through air stripping, which promotes the transfer of Carbon Dioxide (CO_2) out of the product water and into the atmosphere. By reducing CO_2 levels, the decarbonated water can more easily be manipulated to achieve the post-treatment water quality goals. The decarbonation design criteria are shown in **Table 3-35**. The primary benefit is a reduction in the amount of chemicals needed to achieve the water quality targets. Modeling suggests that a range of flows between 70-100% of the flow may require decarbonation prior to stabilization. To meet this range and provide added flexibility, the Expanded Project will replace the existing air stripping tower with a larger tower designed to accommodate a peak flow rate of 7.6 mgd, as well as support the hydraulic needs of the post treatment system at this peak flow rate. A bypass line is included to adjust the fraction of flow passing through the air stripper. This stripper will have a weir influent flow structure to increase the turndown of the stripper (typically 10:1 with the influent weir structure). Below a turndown of 10:1, the media may not fully wet and CO_2 removal becomes unreliable.

A redundant blower will be provided for continuous operation during blower maintenance. Stripper maintenance is typically negligible unless fouling occurs, or the media is damaged. Media damage may occur if operations or maintenance staff walk on the media. This damage is not expected to occur during normal operation; however, if the media must be accessed, the manufacturer recommendation will be followed to avoid damage. Fouling is not typically a concern when using RO permeate.

Table 3-35. Decarbonation Design Criteria

Parameter	Design Flow Rate (6.5 mgd)	Peak Flow Rate (7.6 mgd)
Free CO_2 removal efficiency (minimum)	94%	94%
Number of decarbonator towers	1	1
Diameter of decarbonator tower, ft	14	14
Inlet structure type	Weir	Weir
Packing depth, ft	10	10
Air to water ratio, $ft^3:ft^3$	25	25
Fraction of flow through bypass, %	0-30	0-30
Max flow through decarbonator, mgd	6.5	7.6
Min flow through decarbonator, mgd	1.2	1.2
Tower loading rate, gpm/sf	27.9	32.6
Blowers (duty + standby)	1+1	1+1
Blower capacity, each, scfm	18,100	18,100
Blower motor size, each, hp	15	15
Blower motor speed, each, rpm	1,280	1,280
Blower motor type	Centrifugal fan	Centrifugal fan

3.2.7.3.1 Design Criteria for Calcium Chloride and Sodium Hydroxide Addition

The addition of calcium chloride plus sodium hydroxide to the process flow adjusts the decarbonated water alkalinity, pH, and calcium hardness. Calcium chloride adds calcium to the water but does not change the alkalinity or the pH. To achieve the target LSI, sodium hydroxide is added to the water to adjust the alkalinity and pH. The Expanded Project will include two storage tanks and two feed pumps for calcium chloride addition and two storage tanks and two pumps for sodium hydroxide addition. Calcium chloride and sodium hydroxide are fed into the decarbonated water process flow through injection quills. Sodium hydroxide is added at the first injection quill and calcium chloride is added at the second injection quill. Inline mechanical mixers are located immediately after chemical addition. **Table 3-36** summarizes the post-treatment design criteria for the calcium chloride and sodium hydroxide addition system.

Table 3-36. Post-Treatment Calcium Chloride and Sodium Hydroxide Design Criteria

Parameter	Design Flow Rate	Peak Flow Rate
Design capacity, mgd	6.5	7.6
Average calcium chloride dose, mg/L as CaCl2	47	47
Calcium chloride bulk solution strength, % wt./wt.	35	35
Calcium chloride storage tanks	2	2
Storage volume, gals	10,540	10,540

Number of calcium chloride feed pumps (duty+standby)	2+0	2+0
Type	Peristaltic	Peristaltic
Average calcium chloride feed rate per pump (gph)	26.9	31.5
Average sodium hydroxide dose, mg/L as NaOH	30	30
Sodium hydroxide bulk solution strength, % wt./wt.	25	25
Sodium hydroxide storage tanks	2	2
Storage volume, gals	9,300	9,300
Number of sodium hydroxide feed pumps (duty+standby)	2+0	2+0
Type	Peristaltic	Peristaltic
Average sodium hydroxide feed rate per pump (gph)	25.4	29.7

3.2.7.3.2 Post-Treatment Chlorine Addition

Additional virus removal by disinfection with chloramines is achieved via addition of sodium hypochlorite and ammonium sulfate (as needed). Residual ammonia that passes through the AWPF and ammonium sulfate (added as needed) and sodium hypochlorite react to form monochloramine, an oxidant that inactivates microorganisms and provides LRV credit. The goal is to obtain a chloramine residual of 2 to 4 mg/L as Cl_2 residual at the injection wellfield. Chemical dosing to obtain 3 to 5 mg/L as Cl_2 at the PWPS is typically needed to meet the injection well goal.

3.2.8 Waste Collection and Disposal

Ozone injection strainer waste, MF strainer backwash, MF reverse flow waste, MF enhanced flux maintenance (EFM) waste, MF CIP waste, RO CIP waste, RO flush waste, and miscellaneous analyzer waste travel to a Waste EQ Pump Station for neutralization. The Waste EQ Pump Station is a below-ground wet-well type. The combined waste stream is treated with sulfuric acid, sodium hydroxide, sodium bisulfite, and Ferric chloride, as needed. The neutralized waste is subsequently returned to headworks of the RTP. The Expanded Project will add one (1) additional vertical turbine pump to the Waste EQ Pump Station. Criteria for the Waste EQ Pump Station are provided in **Table 3-37.**

Table 3-37. Waste Equalization Pump Station

Waste Equalization Pump Station		
Parameter	**Design Flow (6.5 mgd)**	**Peak Flow (7.6 mgd)**
Waste Equalization Wetwell		
Number	1	1
Length, ft	30	30
Width, ft	15	15
Max water level elevation, ft	94	94
Min water level elevation, ft	83	83
Operational water depth, ft	11	11
Total operational volume, gal	37,026	37,026
Average operational hydraulic residence time, min	45	39
Waste Transfer Pumps		
Number of pumps (duty + standby)	2+1	3+0
Type	Vertical turbine	Vertical turbine
Rated flow per pump, gpm	765	765
Primary design operating point, gpm @ ft	765 @ 134	765 @ 134
Motor size, hp	50	50
Drive	VFD	VFD
Maximum motor speed, rpm	1200	1200
Ferric Chloride System		
Solution strength, %	40	40
Average dose, mg/L	15	15
Tank	1	1
Tank type	Cross-linked polyethylene	Cross-linked polyethylene
Tank nominal capacity, gal	900	900
Metering pump (duty + standby)	1+1	1+1
Maximum capacity per pump, gph	5.3	5.3
Neutralization Chemical Transfer Systems		
Sulfuric Acid		
Solution strength, %	93	93
Neutralization pump	1+0	1+0

Rated capacity per pump, gph	516	516
Sodium hydroxide		
Solution strength, %	25	25
Neutralization pump	1+0	1+0
Rated capacity per pump, gph	516	516
Sodium bisulfite		
Solution strength, %	38	38
Neutralization pump	2+0	2+0
Rated capacity per pump, gph	516	516

3.3 RECYCLED WATER TRANSMISSION FACILITIES

The transmission facilities consist of the AWPF PWPS, the Purified Water Reservoir (Blackhorse Reservoir), and the Product Water Pipeline.

The PWPS is located within the site of the AWPF, within the boundary of the RTP. The PWPS pumps product water into the Product Water Pipeline and into the Purified Water Reservoir. The pipeline includes connections to supply purified recycled water for landscape irrigation by MCWD. The reservoir is used to maintain system pressure balance out diurnal demands from landscape irrigation and weekly backflush of deep injection wells. M1W and MCWD ownership of the transmission system components is described below. M1W is responsible for O&M of its facilities as described in this Engineering Report. MCWD is responsible for maintenance O&M of the MCWD-owned transmission facilities and distribution facilities downstream of the transmission main as described in the MCWD Title 22 Engineering Report.

M1W Facilities

- The PWPS is owned and operated by M1W.
- Transmission main pipeline located on the RTP site and at the injection well site is owned and operated by M1W. (M1W ownership at the injection well site includes all facilities outside the right of way of the General Jim Moore Blvd. right-of-way).

MCWD Facilities

- Transmission main pipeline consisting of approximately 50,000 linear feet (9.5 miles) of 16 to 24-inch diameter transmission main is owned and operated by MCWD. (MCWD ownership extends from the southern boundary of the RTP site to the east edge of General Jim Moore Blvd. boundary at the injection well site).
- The 2.0 mg Blackhorse reservoir is owned[17] and operated by MCWD in collaboration with M1W operations and maintenance staff. (The Reservoir is located at the site of MCWD's potable water storage tanks supplying zones D and E.)

[17] In an agreement between M1W and MCWD, the 2-MG Blackhorse Reservoir is considered to be 25% for Injection Facilities (i.e., M1W use) and 75% for Distribution Facilities (i.e., MCWD use).

3.3.1 AWPF Product Water Supply Pump Station

3.3.1.1 Background Information

The PWPS receives flow from the AWPF. The product water flows by gravity to the wet well of the PWPS. The PWPS pumps the product water into the Product Water Pipeline, and ultimately to the Injection Facilities area. There is a tee off of the Product Water Pipeline to the Blackhorse Reservoir site which is used for flow equalization to balance diurnal demands from MCWD's landscape irrigation, in order to maintain a nearly constant injection rate. The reservoir also facilitates injection well backwashes without reducing AWPF production.

3.3.1.2 Physical Description

The PWPS is located within the site of the AWPF. The PWPS is cast-in-place, concrete-type structure with vertical-turbine pumps mounted outdoors on a concrete deck over an intake wet well reservoir. Electrical and control equipment for the pumps are housed in a small, electrical enclosure, located adjacent to the PWPS. All electrical and control equipment within the enclosure are located with easy access for maintenance.

Pump motors, discharge piping and valves, and monitoring and sampling equipment are located on the deck area over the wet well. The PWPS is rectangular in shape with the plan dimensions being determined based on pump and other equipment space requirements in the pump deck area and to a secondary extent, storage volume in the wet well.

The PWPS has four pumps and space for an additional pump which is being installed as part of the AWPF Expansion project. With the addition of the fifth pump, the PWPS will provide 6.5 mgd capacity with four pumps (four duty, one stand by) and 7.6 mgd peak flow capacity with all five pumps operating.

3.3.1.3 Pump Station Discharge Pipeline

Sizing of the discharge pipeline (forcemain) and selecting the type and size of the pumps presented certain challenges. The ground elevation at the PWPS site is at about Elevation 100 ft. There are intermediate high points along the route. Also, friction loss in the pipeline was one of the factors in the determination of the amount of horsepower required. Backflow prevention to the PWPS is provided by the combination of a check valve on each pump discharge and MCWD's transmission main has a CCR Title 17 compliant backflow prevention device on each pipeline connecting to a MCWD turnout to serve irrigation customer(s).

3.3.1.4 Pump Selection

Pump selection was based on the pipeline size of 16-inch to 24-inch diameter, ground profiles and static lifts (difference in ground elevations between pump station elevation and discharge elevation).

3.3.1.5 Mechanical Design Considerations

3.3.1.5.1 Surge Control

A surge tank is provided. Detailed hydraulic transient analyses were performed during the final design.

3.3.1.5.2 Valves and Appurtenances

Each pump discharge has a manual isolation butterfly valve and a check valve. A manual isolation butterfly valve is also provided on the discharge header downstream of the flow meter to isolate the meter from the transmission line.

Each pump discharge also has an air release valve to release air on pump start-up. Air release valves are provided on the pump discharge header at high points where air may accumulate.

3.3.1.5.3 Electrical Design Considerations

Power supply to the pump motors is 480-Volt, 3-phase, 60-Hertz power fed from a motor control center (MCC) located within an electrical equipment enclosure.

3.3.1.6 Instrumentation, Monitoring and Control Design Considerations

3.3.1.6.1 Pump Control

The PWPS pumps are automatically controlled by the water level in the wet well. In that way, the pumps match the combined water supply rate from the AWPF. Manual pump start and stop and speed control are also provided at the AWPF by the Programmable Logic Controller (PLC). Control interlocks with other systems are as follows:

- All of the PWPS pumps are automatically stopped on high pressure in the Product Water Pipeline, or low level in the pump station wet well.
- All of the PWPS pumps are automatically stopped on detection of critical alarm conditions at any of the upstream or downstream conveyance systems.

Under any of the hydraulic or process performance alarm conditions that shut down the pumps, the product water is routed to M1W's ocean outfall, headworks, or SVRP storage pond until the alarm conditions have been addressed and cleared.

3.3.1.6.2 Monitoring

The following monitoring tasks are implemented:

- The water level in the wet well is continuously monitored using an ultrasonic level sensor, with separate float switches for high and low level alarms in the event of failure of the level sensor. The water level signal is used for pump control as described above.
- A magnetic flow meter is provided on the PWPS discharge header to measure pump flow rate. The flow signal is used for regulatory and product water inventory record keeping, for PWPS monitoring, and for pump control as described above.
- A pressure transducer is provided on the PWPS discharge header to continuously measure header pressure for the purposes of monitoring pump operation and head conditions in the transmission system.
- A locally indicating pressure gauge is provided on the discharge header and on each pump discharge.

3.3.1.6.3 Equipment Protection

The following equipment protection measures are implemented:

- Monitoring of motor winding and bearing temperature with automatic pump shutdown on high temperature condition.

- Due to the relatively high operating pressures, providing pump vibration monitoring with automatic pump shut down on high vibration condition.

3.3.1.7 Design Criteria

Design criteria for the PWPS are presented in **Table 3-38**.

Table 3-38. Product Water Pump Station Design Criteria

Parameter	Units	Design Flow (6.5 mgd)	Peak Flow (7.6 mgd)
Pump Units			
Type	---	Vertical Turbine	Vertical Turbine
Total/Duty/Standby	Number	5/4/1	5/5/0
Design capacity per pump	gpm	1,160	1,160
Pump operation	---	Variable	Variable
Pump Motors			
Size, each unit	hp	200	200
Drive type	---	VFD	VFD
Synchronous speed	rpm	1,800	1,800

3.3.2 Product Water Pipeline and MCWD's Urban Irrigation Supply

A pipeline conveys product water from the AWPF to the Injection Well Facilities at Seaside Basin for groundwater replenishment (**Figure 3-7**). The alignment generally follows the RUWAP alignment through the City of Marina and the middle of the Fort Ord area, now in the jurisdictions of the City of Marina and the City of Seaside. The pipeline size ranges from 16 to 24 inches in diameter.

The pipeline includes flow control valves, isolation valves, blow down structures for maintenance, air and vacuum release valves, and other appurtenant facilities. Other general design features include standby pumping units for pump stations; in-line isolation valves on the pipeline approximately every 2,000 ft, in case an unforeseen leak occurs, or subsequent construction activities result in damage to the pipeline; and compliance with DDW pipeline separation requirements.

In addition to providing purified recycled water for groundwater replenishment, the Project provides purified recycled water to MCWD for landscape irrigation. The purified water from the AWPF shares a single conveyance system, from which water is used for groundwater injection and irrigation. A new Product Water Pipeline will be constructed from the existing Blackhorse Reservoir to the Expanded Injection Well Area to accommodate the increased product water flow rate and deliver it to the injection wells. In total, the new 24-in diameter pipeline will be approximately 2.3 miles long, extending from the Blackhorse Reservoir past the proposed well sites and terminating at the existing DIW-3 wellsite. An additional 1,000 ft of 12-in diameter pipeline for backflushing wells will be installed between the two new DIW-5 and DIW-6 well sites along the same alignment as the Product Water Pipeline (**Figure 3-8**). MCWD is responsible for conveyance and distribution of recycled water for non-potable purposes (more information can be found in MCWD's Title 22 Engineering Report). The existing shared facilities between the Project and the MCWD non-potable system are approximately 50,000 ft of 16 to 24-in diameter transmission mains and the 2.0 million-gallon Blackhorse Reservoir. For the Expanded Project, M1W will add another pipeline segment from the Blackhorse Reservoir to the new injection wells and create a looped transmission system for the entire well field.

CCR Title 17 compliant backflow prevention devices have been installed at each connection to the transmission main. Where distribution mains (8-in to 12-in diameter) connect to the transmission main, a Double Check Valve Backflow Prevention Assembly (per American Water Works Association (AWWA) Standard C510) was installed. Where 1-in diameter irrigation services connect directly to the transmission main, a Reduced-Pressure Principle Backflow Prevention Assembly (per AWWA Standard C511) was installed.

3.3.3 Purified Water Reservoir

Blackhorse Reservoir is owned by MCWD, shared with M1W, and located at the Blackhorse site, east of General Jim Moore Boulevard and approximately 8 miles from the PWPS. In M1W's AWPF design drawings, the reservoir is referenced as the Purified Water Reservoir, while in MCWD's Title 22 Engineering Report, it is called the Blackhorse Reservoir. The Reservoir is connected to the conveyance pipeline and provides pressure control and flow equalization for the overall purified water system (including for diurnal demands and well backflush cycles). Purified recycled water from the AWPF is pumped into the conveyance pipeline and flows to the Blackhorse Reservoir and to the Seaside Basin Injection Well Facilities. Purified water flows by gravity from the Blackhorse Reservoir to the Injection Well Facilities. A schematic showing the location of the Blackhorse Reservoir site relative to the PWPS and the Injection Facilities is presented as **Figure 3-8.**

The 2.0 mgal Blackhorse Reservoir is a covered welded steel reservoir which provides pressure control, flow equalization and operational storage for the Project. The Reservoir is designed in accordance with AWWA Manual of Practices M42 for Steel Water Storage Tanks and constructed in accordance with AWWA Standard D100 for Welded Carbon Steel Tanks for Water Storage. The tank diameter is 104.5-ft, with an outside wall height of 35-ft. The operational storage capacity of the Reservoir is 1.8 mgal. The Reservoir has one common 24-inch diameter inlet/outlet pipe connecting to the conveyance pipeline and within the reservoir there is a Tideflex mixing system consisting of multiple inlets and outlets. The direction of flow into or out of the Reservoir is controlled by the influences of the supply from the AWPF, the demands from the Injection Well Facilities, and the demands of MCWD's non-potable irrigation customers.

The Blackhorse Reservoir has an emergency supplemental water supply through an air gap from a nearby potable water tank and booster pump but is only needed for construction testing of

MCWD's conveyance facilities. To prevent unintentional use, a steel flange plate with padlocks is installed at the emergency water supply air gap, requiring it to be manually unlocked. If future use of this emergency water supply at the Reservoir is needed by M1W, approval to add this potable supply into the Reservoir will first be obtained from DDW and the RWQCB through submittal of revisions to the Engineering Report.

Reservoir Operational Strategy

The Blackhorse Reservoir "floats" on the system, meaning the water level is based on flow rate from the PWPS, injection well demand flow rate (including backwashes), and MCWD customer irrigation demand flow rate. M1W operates and controls flow rates at the PWPS and injection wells. Adjustments in M1W's operation allow the Reservoir elevation to increase or decrease, causing flow to go into and out of the Reservoir. The Blackhorse Reservoir has one common inlet and outlet pipe connecting the Reservoir to the conveyance pipeline. To encourage mixing within the Reservoir, a Tideflex mixing system that provides separate inlet/outlet locations within the Reservoir is included to ensure mixing during each drain/fill cycle, thereby preventing temperature and water quality stratification.

The detention time of water in the Reservoir is managed by increasing and decreasing production at the AWPF to provide turnover in the Reservoir and to regulate the average detention time in the reservoir to 3 to 5 days. Two to three times per week, the AWPF operates at production rates that are lower than the injection rates to reduce the level in the Reservoir to the low level setpoint. Following drawdown of the Reservoir, AWPF operators increase AWPF production to rates that are higher than the injection rates to increase the water level in the Reservoir to the high-level setpoint. Flows from the AWPF are then adjusted to lower the Reservoir level back down for steady state, automatic operation. This operation reduces water age in the Reservoir.

In automatic Reservoir operation, the water level is allowed to vary within operational range setpoints. Through feedback control, the SCADA system communicates the water level in the Reservoir to the PWPS which automatically adjusts AWPF production rate. If the level rises too high, the AWPF production rate is reduced or shut down. If the Reservoir level drops too low, the AWPF production rate is increased.

A combined chlorine residual is maintained in the product water leaving the AWPF to control biofilm growth in the conveyance pipeline and injection wells. The target chlorine residual concentration at the injection wellfield is 2-4 mg/L as Cl2. If chlorine residual at the injection wellheads drops below this target due to low chlorine residual in the water from the Blackhorse Reservoir, the detention time in the Reservoir can be reduced by decreasing production at the AWPF and/or increasing the chlorine dose at the PWPS. M1W measures chlorine residual continuously at the PWPS and at the Injection Well Facilities (including at DIW-4 for the existing project and at DIW-4 and DIW-6 for the Expanded Project). All chlorine monitoring results are recorded through the AWPF SCADA system to allow M1W to calculate and report daily virus log reduction through the conveyance pipeline. Virus log reduction credit with chloramine for the Expanded Project is discussed in more detail in **Section 5** of this Engineering Report.

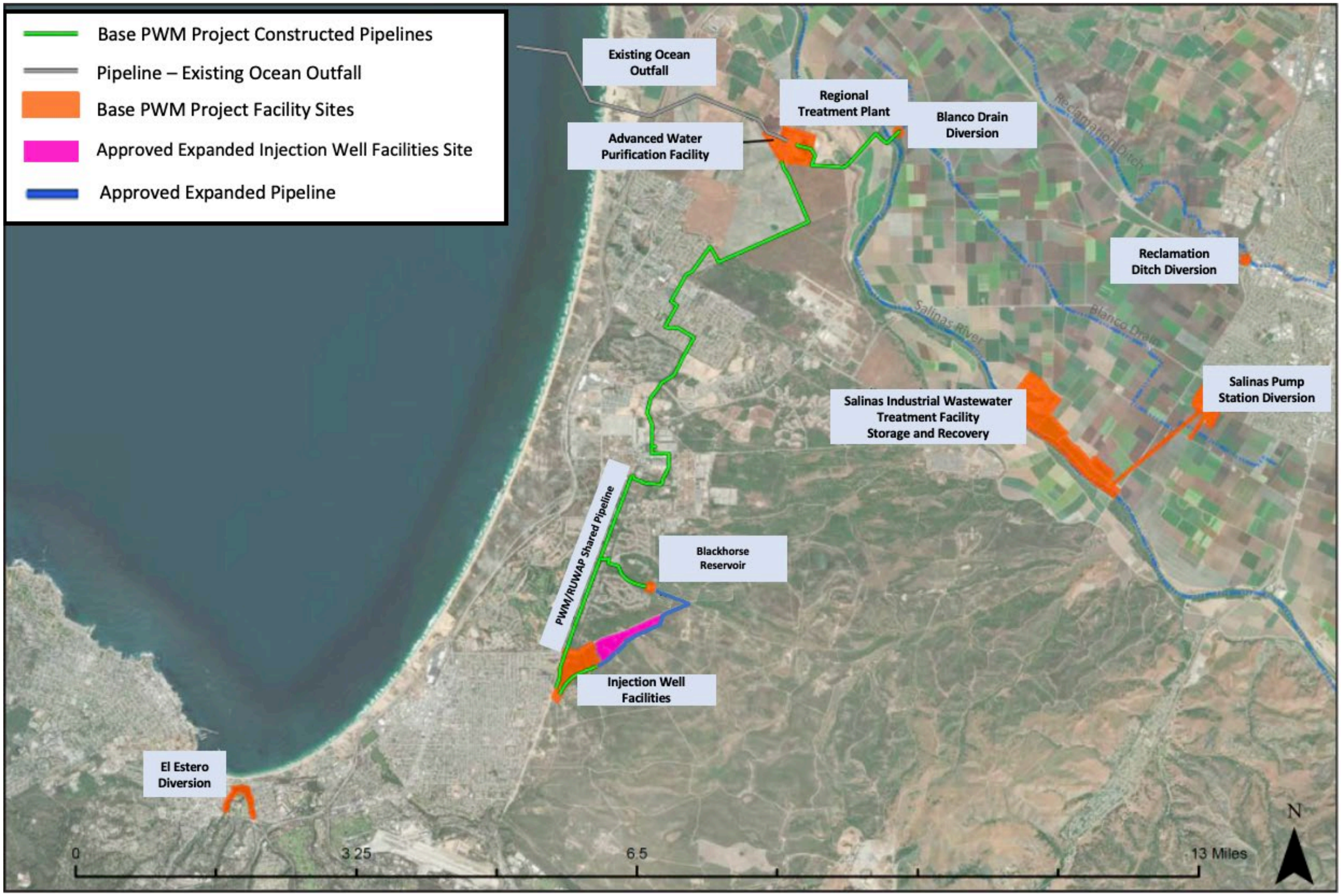

Figure 3-7. Existing Product Water Transmission Facilities

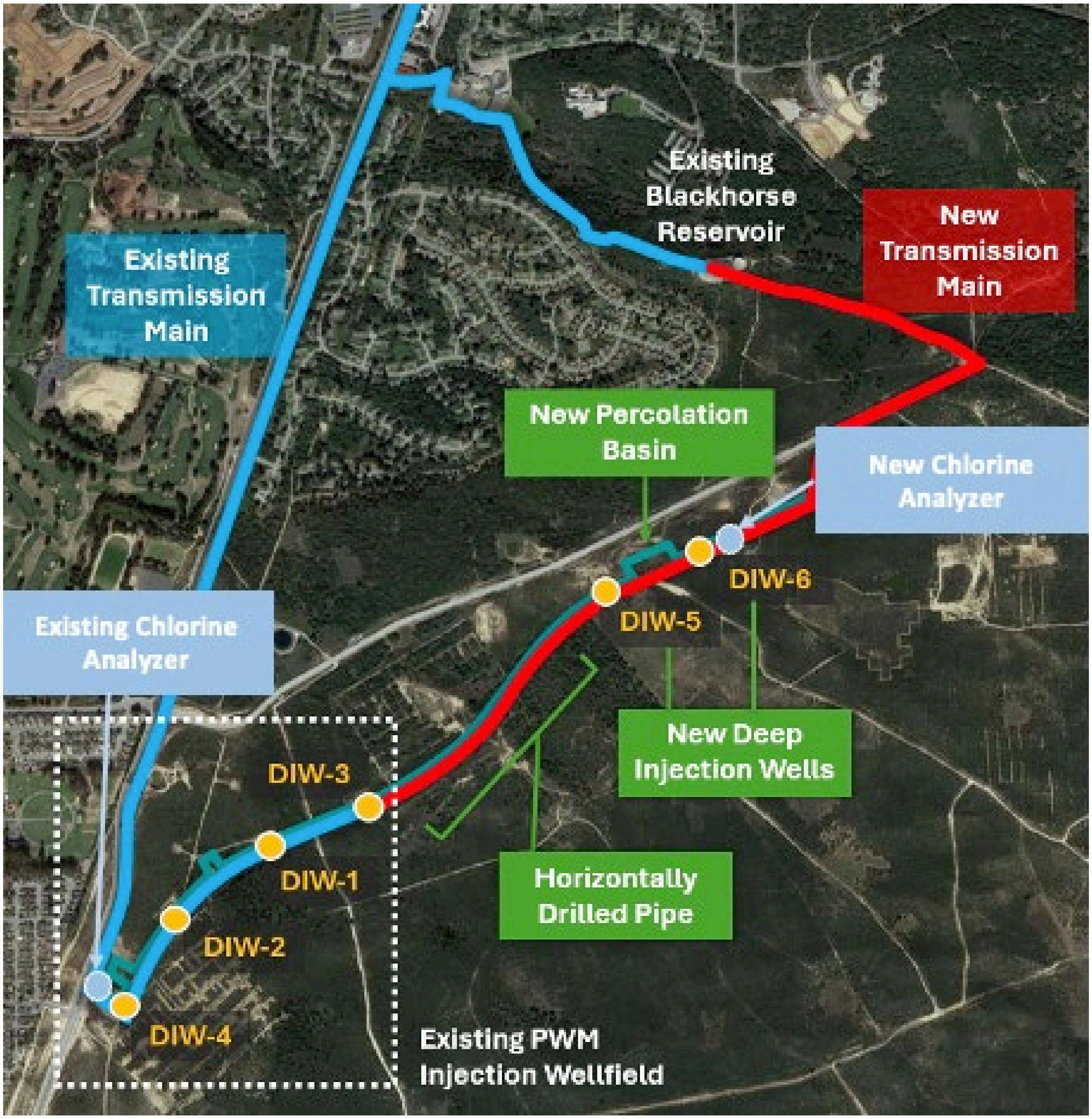

Figure 3-8. Map of AWPF Product Water Conveyance Pipeline to Existing and New Injection Well Facilities

3.4 INJECTION FACILITIES

The existing injection facilities include four deep injection wells (DIW), two vadose zone injection wells (VZ), seven monitoring wells (MW), a backflush water percolation basin, ancillary pipelines, and electrical and control infrastructure. The locations of DIW-1 through DIW-4, VZ-1 and VZ-2 and the monitoring wells are shown in **Figures 3-9a** and **3-9b**. The Expanded Project will add DIW-5, DIW-6 and one new backflush percolation basin. All Existing and Expanded facilities are located on former Fort Ord lands east of General Jim Moore Boulevard on the eastern boundary of the City of Seaside, approximately 1.5 miles inland from Monterey Bay. As discussed in more detail in **Section 9**, the area is located within the Northern Inland Subarea of the Seaside Basin.

The existing facilities are operated to inject an annual total of 3,500 AFY, with an additional 200 AFY in years when increasing the amount of water stored in the Operating and/or Drought Reserves. The Expanded Project will increase annual injection to 5,750 AFY (5,950 AFY when reserves are being replenished).

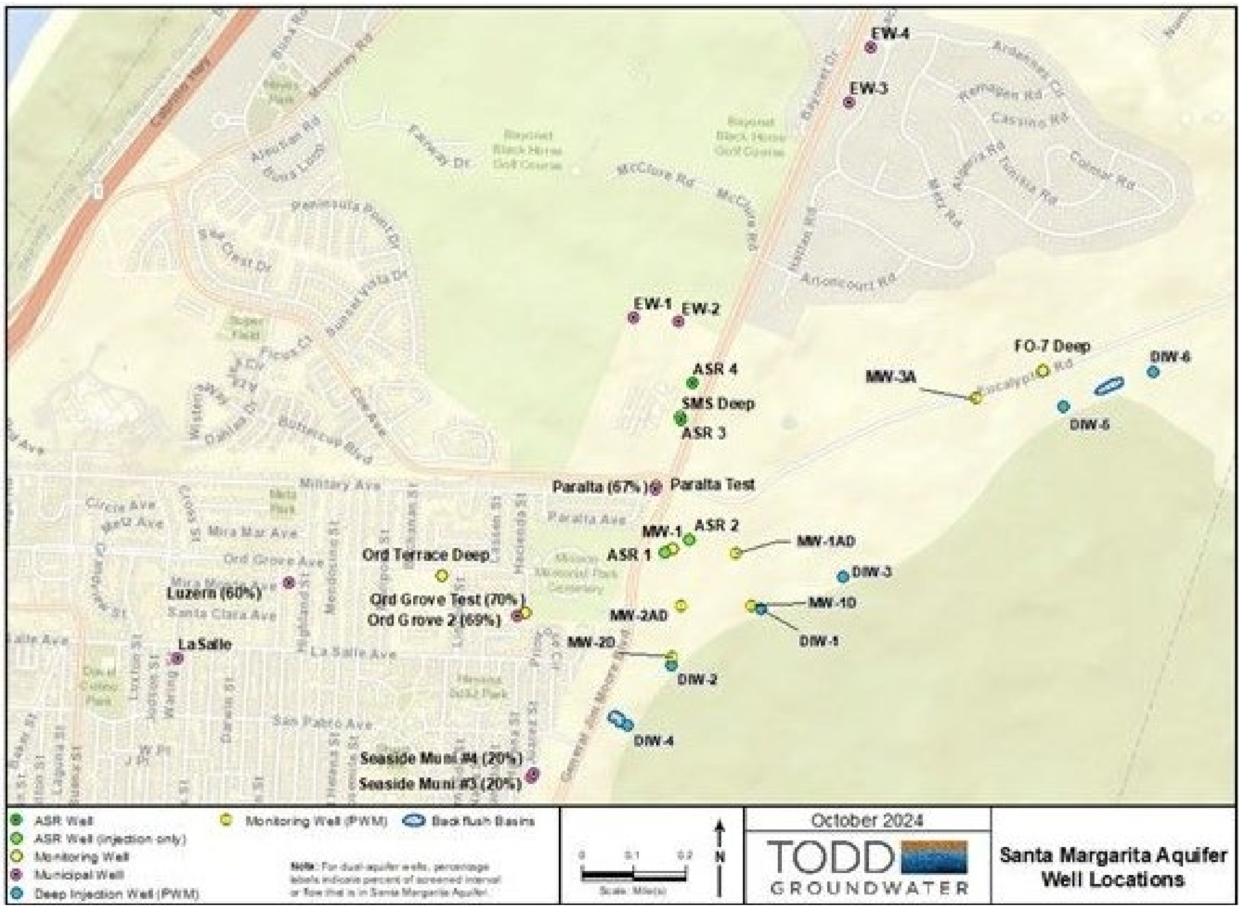

Figure 3-9a. Wells in Santa Margarita Aquifer in the Project Area

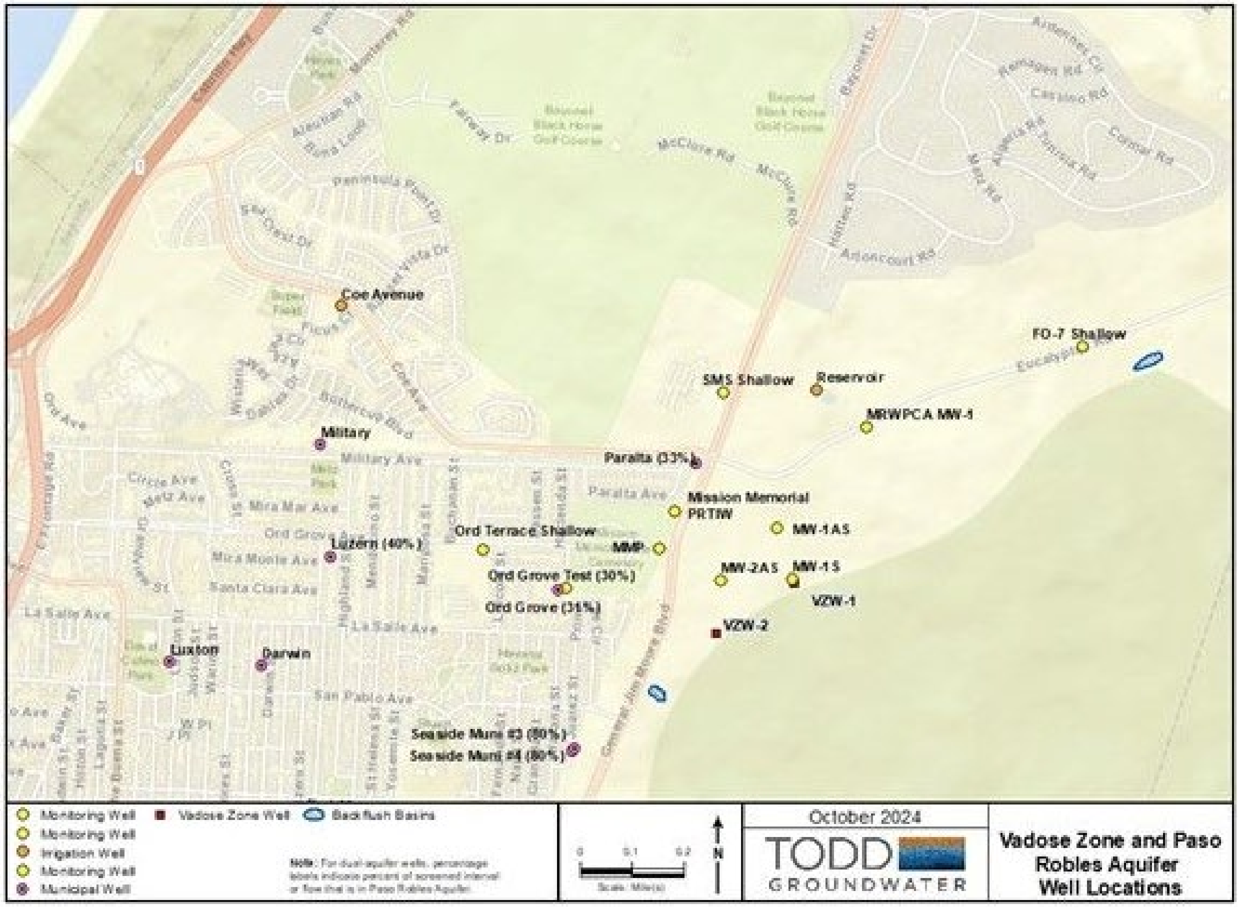

Figure 3-9b. Wells in Paso Robles Aquifer in the Project Area

The DIWs inject purified recycled water directly into the Santa Margarita Aquifer. The VZWs inject a small fraction of purified recycled water in the unsaturated Aromas Sand Formation for percolation to the underlying Paso Robles Aquifer. **Table 3-39** lists the long-term, sustainable physical injection capacities of the existing wells and estimates for the two Expansion wells. Backflush rates, and therefore injection rates, are limited in each of the injection wells. Pumping in DIW-1 is limited to prevent dewatering of the pump. The capacity of DIW-2 is limited by screen depth, local geology, and aquifer transmissivity. Pumping and injection in DIW-3 and DIW-4 is limited by the pump capacity. All of the DIWs are backflushed for approximately 2 hours per week at a rate equal to double the injection rate. After correcting for extraction during the backflush cycles, net injection is 96.4 % of the gross injection rate. Backflush water does accrue to basin storage because it percolates from the backflush basins. However, the vertical travel time to the Santa Margarita Aquifer is probably large. Accordingly, the discussion here does not consider return flow of backflush water to the Santa Margarita Aquifer.

Table 3-39. Injection Well Characteristics

Well	Aquifer	Aquifer Depth (ft bgs)	Well Screened Interval (ft bgs)	Sustainable Injection Rate (gpm)[1]	
				Gross	Net[2]
VZ-1B	Aromas	0-330	28-130	35	35
VZ-2	Aromas	0-280	28-98	20	20
DIW-1	Santa Margarita	520-820	529-808	1,000	964
DIW-2	Santa Margarita	400-605	436-605	400	386
DIW-3	Santa Margarita	655-1,020	671-956	1,300	1,253
DIW-4	Santa Margarita	395-585	402-579	900	868
DIW-5[3]	Santa Margarita	830-1,220	830-1,120	1,300	1,253
DIW-6[3]	Santa Margarita	730-1,220	745-1,020	1,300	1,253

Notes:

TBD = to be determined

[1] Physical capacities of the wells. M1W may operate some wells at lower rates to meet travel time objectives, as discussed in Section 6.4.

[2] Net injection equals gross injection minus periodic backflush extraction.

[3] Construction of DIW-5 and DIW-6 is known, but injection capacities are estimated until wells come on-line.

DIW-1 and DIW-2 were initially operated at over half of their backflush capacity, which is higher than the recommended 2:1 backflush to injection ratio. This led to decreasing injection capacity over time, which was largely mitigated by increasing the backflush frequency. When DIW-3 and DIW-4 came on-line in 2022, injection rates at the first two DIWs were reduced. Vadose zone wells VZ-1B and VZ-2 currently inject at 35 gpm and 20 gpm, respectively, and together they account for less than 2 percent of total injection. However, initial testing indicated that the wells were capable of injecting approximately 100 gpm. Injection into the vadose zone wells is substantially less than anticipated due to unstable surface and subsurface conditions.

The combined injection capacity of all wells is 5,855 gpm. Assuming year-round operation with weekly backflush cycles (for deep injection wells only; vadose wells are not backflushed), net annual injection capacity is 9,114 AFY, or 53 percent greater than the target annual injection volume. This surplus capacity is intentional. It allows flexibility to shift injection among the wells to manage underground travel times to DIW-1, to accommodate seasonal variations in monthly injection volumes, and to maintain total injection at the target level if one well is out of service for preventative maintenance and/or repairs.

3.4.1 Deep Injection Wells

The DIWs are all screened exclusively in the Santa Margarita Aquifer. The depth and thickness of the aquifer vary due to an anticline near DIW-2, but depth and thickness increase to the northeast (see Section 9 for a description of local hydrogeology). The wells all have similar construction with a 24-inch stainless steel casing that extends down to a 24-inch screened interval with 0.050-inch slots, except for DIW-2 which has 0.060-inch screen slots. The screen openings are opposite coarse-grained layers logged from geologic and geophysical surveys when the borehole was first drilled. A pump with sufficient capacity to extract at twice the injection rate is installed in the well. A flow-control valve is installed below the pump to ensure that water maintains positive pressure as it flows down the well during injection. The flow control valve prevents water from cascading into the well. If water is allowed to free-fall, it becomes aerated and leads to air entrainment into the aquifer, corrosion and accelerated pump wear. A separate tube for measuring water levels extends down the annular space between the casing and borehole wall and enters the well casing near the top of the screen. This tube is for measuring water levels. A second tube extends down the annulus to the top of the filter pack, which extends the length of the screened interval. The second tube allows additional filter pack to be added in case the filter pack material settles over time. The filter pack starts approximately 20 feet above the shallowest screened interval and extends the length of the well to the bottom of the borehole. The artificial filter pack consists of clean gravel material with specified size gradation that provides optimal flow from the aquifer into the well. **Figures 3-10a** through **3-10f** show as-built diagrams of DIW-1 through DIW-6.

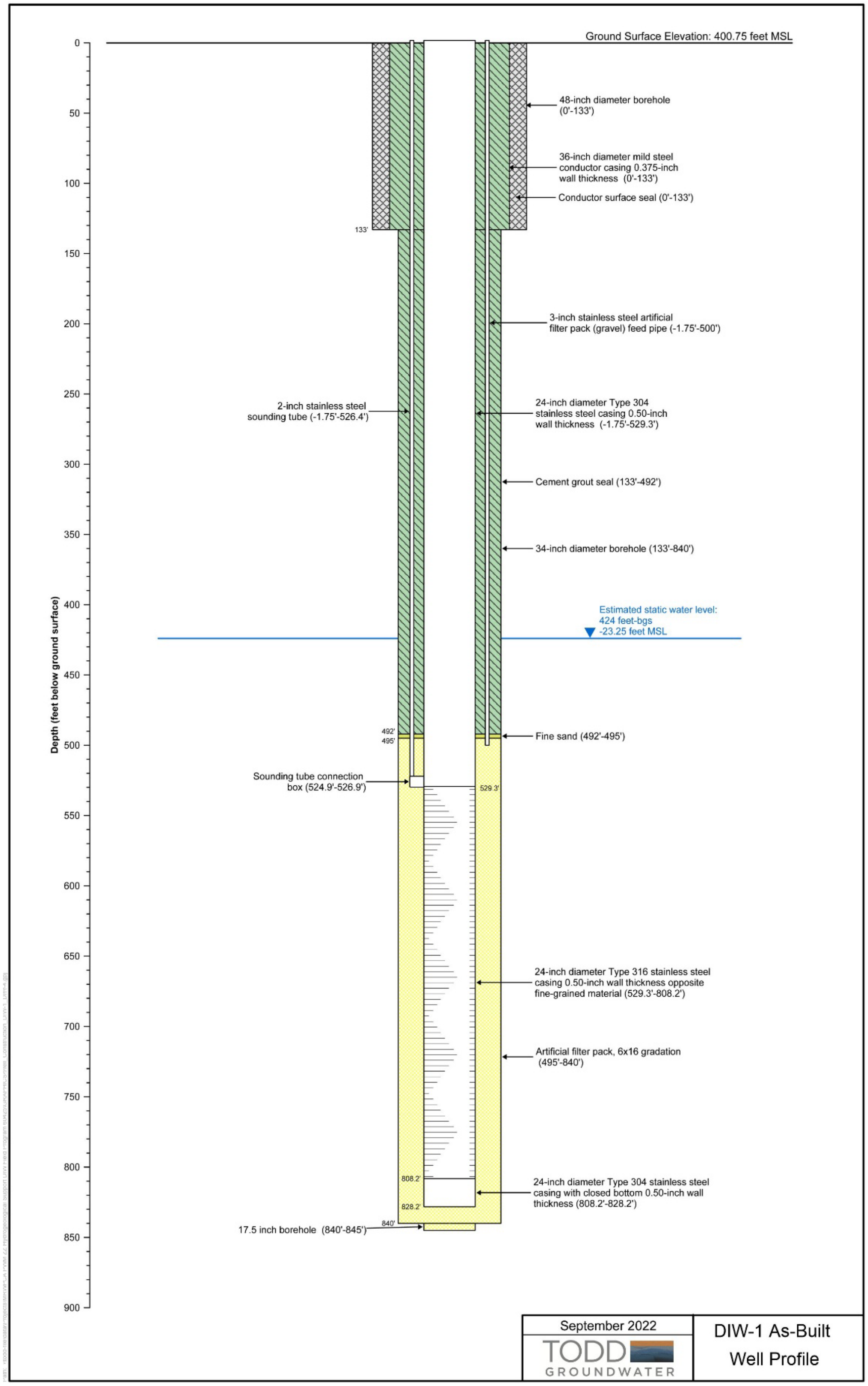

Figure 3-10a. DIW-1 As-Built Well Profile

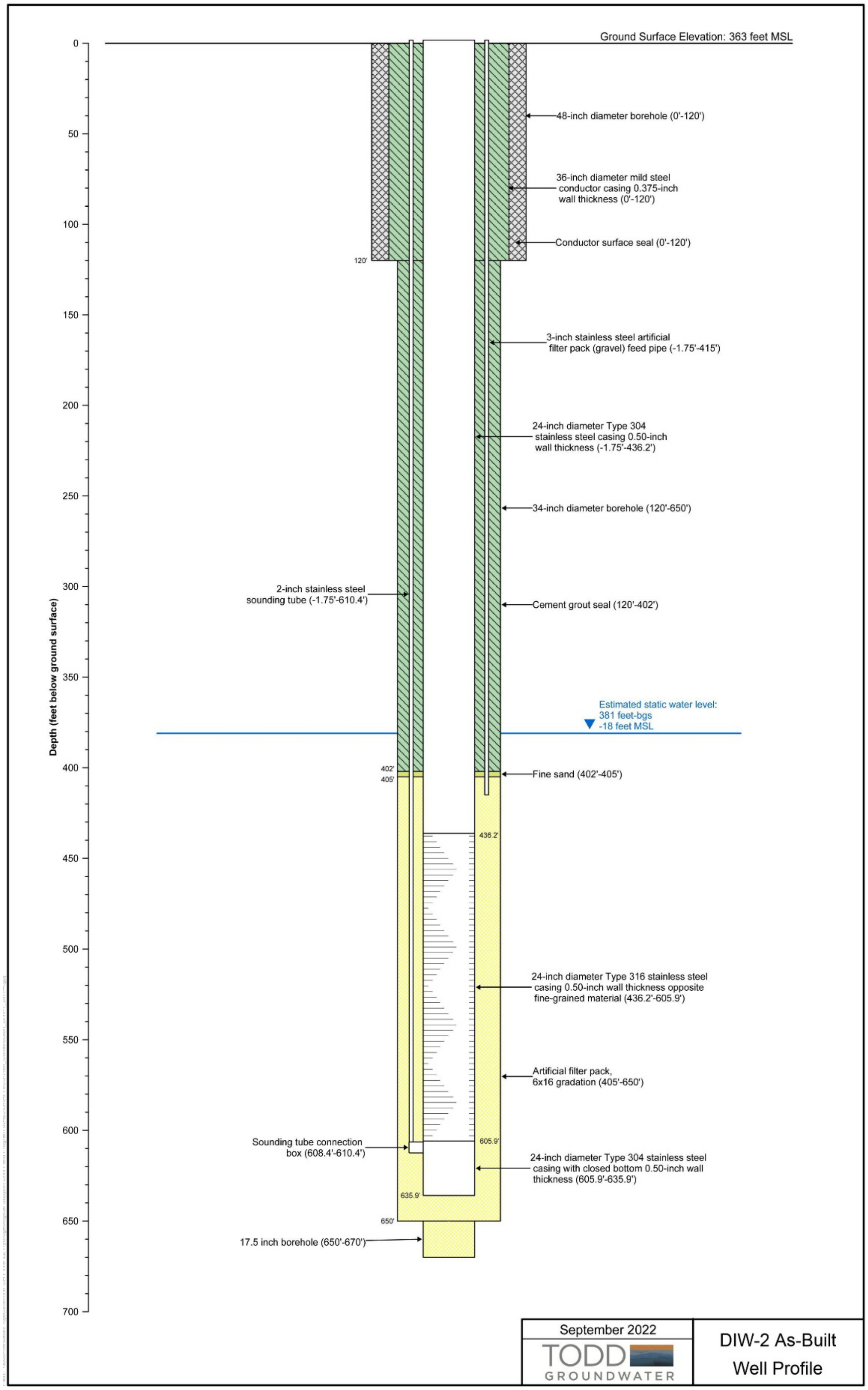

Figure 3-10b. DIW-2 As-Built Well Profile

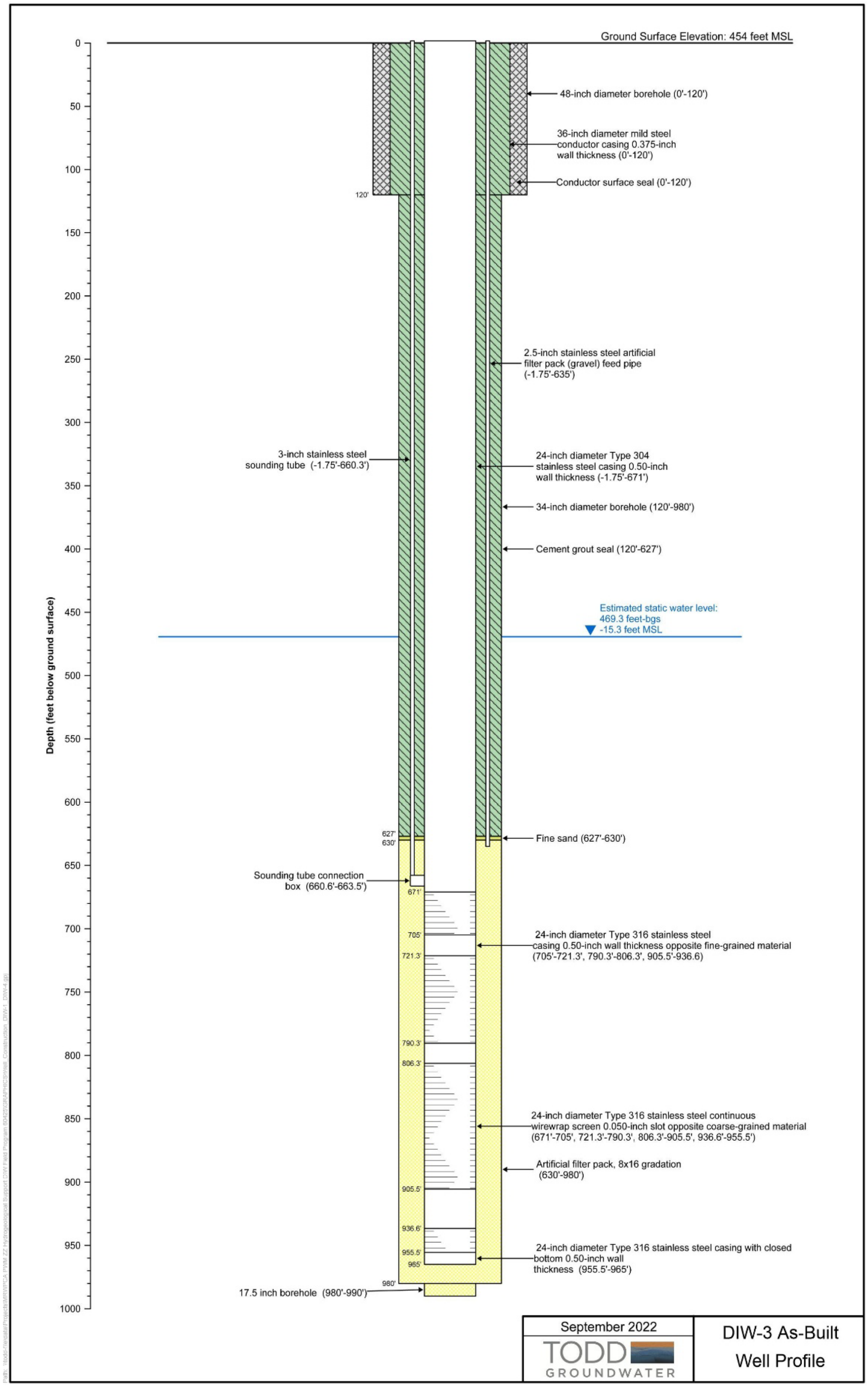

Figure 3-10c. DIW-3 As-Built Well Profile

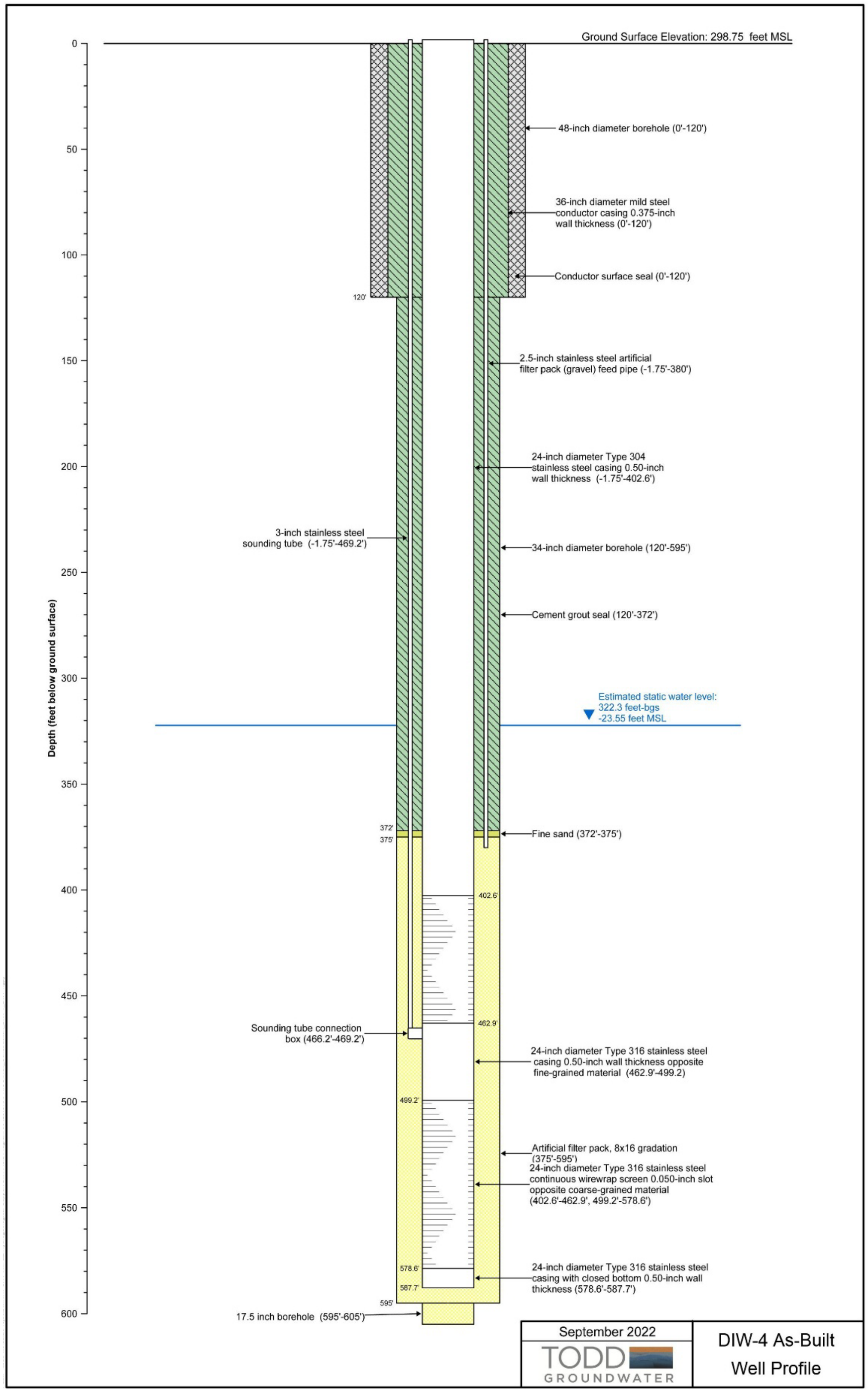

Figure 3-10d. DIW-4 As-Built Well Profile

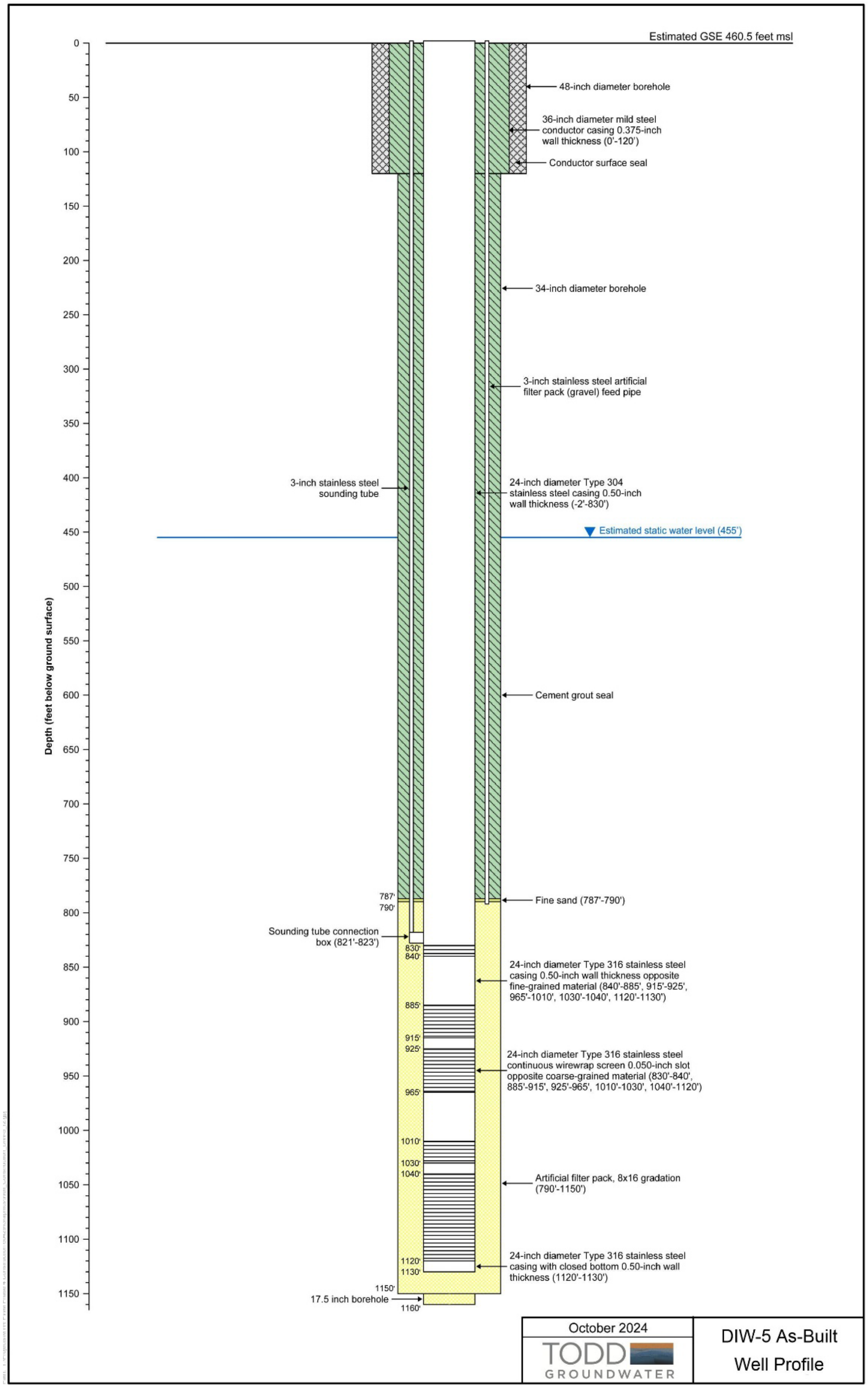

Figure 3-10e. DIW-5 As-Built Well Profile

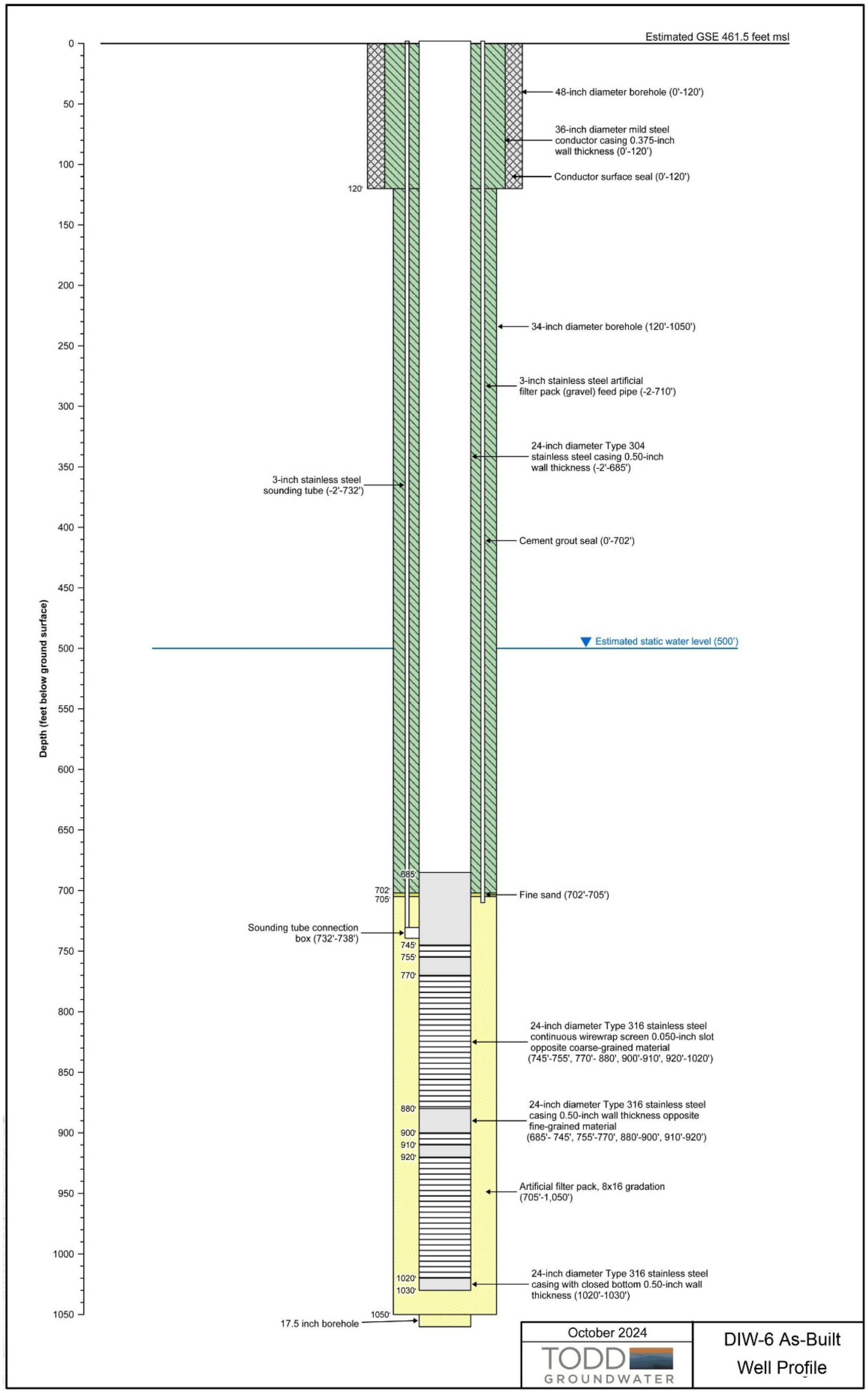

Figure 3-10f. DIW-6 As-Built Well Profile

The locations of the DIWs were selected based on several considerations. They are all located on the most eastern lands owned by the City of Seaside, which avoids loss of injected water to the ocean and provides the greatest readily-available underground residence times for injected water. Relative costs of conveyance and land acquisition were also considered. Individually, the DIWs were spaced sufficiently far apart to minimize well interference, which is the effect of injection at one DIW on water levels at adjacent DIWs. Excessive interference reduces injection capacity by raising the water levels too high. During the initial design phase of the project, a separation distance of 1,000 feet was selected as adequate to prevent excessive interference. For example, after above-average Aquifer Storage and Recovery (ASR) injection in 2023, water levels 1,000 ft from ASR-1 and ASR-2 were raised by approximately 6 feet (Lear, 2024), which would not significantly affect injection or extraction.

Section 6 summarizes tracer studies and modeling that were used to determine underground residence time, with details in **Appendices F** and **G**. **Section 8** provides more information on the total injection amounts and how the amounts can vary with Project operation. **Section 9** briefly describes the hydrogeologic framework and the two targeted aquifer systems.

3.4.2 Vadose Zone Wells

The two vadose zone injection wells VZW-1B and VZW-2 are located 70 ft from DIW-1 and DIW-2, respectively. They inject water into the unsaturated Aromas Sand Formation. At those locations, the water table is near the top of the underlying Paso Robles Formation. The injected water enters the unsaturated (vadose) zone and percolates down to the water table.

VZ-1B consists of a 16-in diameter PVC casing installed in a 36-in diameter borehole and screened from 28-138 ft. The casing is slotted from 28-198 ft. The annulus between the casing and borehole wall is filled with pea gravel. VZ-2 is similarly constructed except the borehole diameter is 48 ins, the casing diameter is 14 ins, and the screened interval is 28 to 98 ft. An as-built diagram of VZW-2 is shown in **Figure 3-11.**

The original hydrogeologic and design analysis for the vadose zone injection wells was documented in the April 2019 Final Engineering Report. This analysis indicated that one vadose zone well alone could likely recharge 242 gpm. However, operation of these two wells following construction has shown substantially lower injection capacity: 35 gpm for VZW-1B and 20 gpm for VZW-2. The two vadose zone wells currently account for approximately 2 percent of total Project injection, and that percentage will be smaller following completion of the Expanded Project.

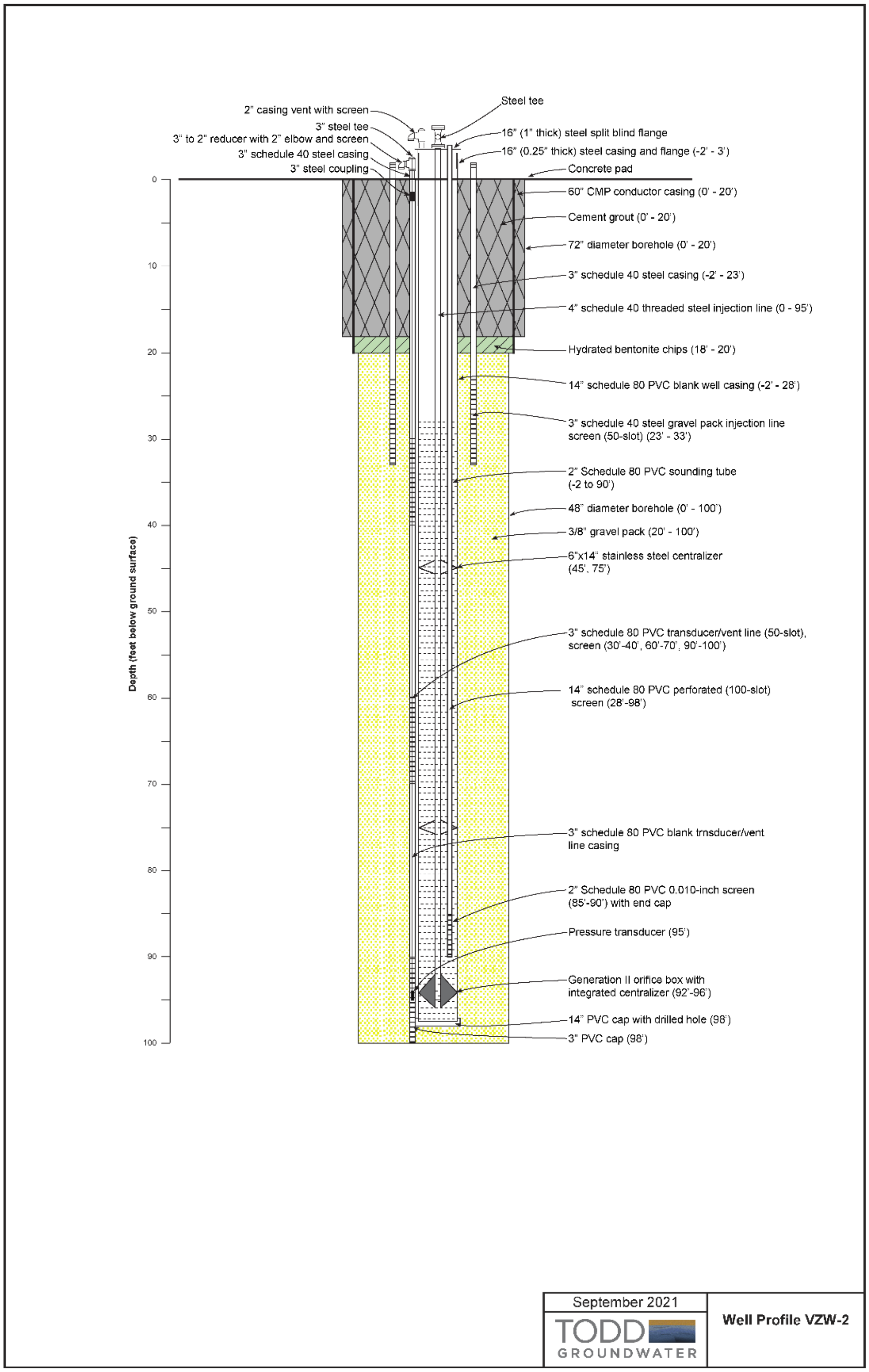

Figure 3-11. Vadose Zone Well 2 As-Built Well Profile

3.4.3 Monitoring Wells

Monitoring wells were installed to support tracer tests and to meet long-term monitoring requirements for the GRRP (Title 22 Section 60320.226). M1W installed four groundwater monitoring well clusters. Each cluster consists of a shallow monitoring well screened in the Paso Robles Aquifer (designated with the letter “S”) and a deep monitoring well screened in the Santa Margarita Aquifer (designated by the letter “D”). Two clusters are located close to each DIW and VZW pair, one cluster on the same site as DIW-1 and VZW-1b, the second cluster on the same site as DIW-2 and VZW-2. The other two clusters are 608-615 ft to the northwest, between each injection well site and the closest production wells. MW-2S was not able to be developed (would not make water) due to the low static water level in the Paso Robles Aquifer at that location, so there are seven functional monitoring wells.

In addition, there is a MPWMD monitoring well next to ASR-1 (SMTIW MW-1) located 1,200 ft from DIW-2 that is sampled periodically. This monitoring well is located between the injection wells and Cal-Am’s Paralta production well.

All of the monitoring wells are in the direction of the nearest downgradient drinking water well, which is Cal-Am’s Paralta well. Paralta is 1,605 ft from DIW-1 and 1,808 ft from DIW-2. Tracer studies and model simulations have demonstrated that the underground travel time from DIW-1 to Paralta is consistently the fastest travel time from any DIW to any downgradient drinking water well. Thus, the monitoring wells are in the best location for detecting and responding to any water quality problems associated with injection.

3.4.4 Backflush Basin

The deep injection wells are pumped periodically to mitigate well clogging and maintain injection capacity, a process known as backflushing. A shallow basin was constructed in a natural depression near DIW-4 to receive backflush water from DIW-1 through DIW-4. The basin covers a footprint of approximately 150 ft by 120 ft and is approximately 12 ft deep. The storage volume is approximately 2.1 AF (684,300 gal). Water is piped from the wells to the basin, where it infiltrates through the permeable sediments on the open basin bottom and percolates down to the water table. By allowing the water to recharge, pumped water is conserved.

Vadose zone wells do not penetrate the saturated zone and consequently are not backflushed.

The existing backflush basin was designed based on an analysis of inflow and outflow to assure sufficient basin capacity. Based on the first year and a half of operation with DIW-1 and DIW-2, it was determined that basin design did not require modification to accommodate backflush water from DIW-3 and DIW-4.

A second backflush basin with two cells, or compartments, will be constructed between DIW-5 and DIW-6 as part of the Expanded Project and will receive backflush water from those two wells. The two cells are proposed to enable one cell to be maintained (i.e., scarified), while the other cell can continue to accept backflush water.

4 SOURCE WASTEWATER

This section describes the M1W Pretreatment and Source Control Programs and information on the characteristics of secondary effluent produced at the RTP that serves as influent to the AWPF.

4.1 INDUSTRIAL PRETREATMENT AND SOURCE CONTROL PROGRAM

4.1.1 Legal Authority

As required by its NPDES permit, M1W administers an approved Pretreatment Program in accordance with Title 40 of the Code of Federal Regulations (CFR) Part 403 ("General Pretreatment Regulations") to prevent discharges that may adversely affect its facilities-. The objectives of the Pretreatment Program are: (1) to enhance M1W's ability to comply with effluent discharge requirements and any other discharge criteria, which are required or authorized by state or federal law; (2) to derive the maximum public benefit by regulating the quality and quantity of wastewater discharged into the sewerage system; (3) to protect the public, the environment, M1W personnel and facilities from potentially harmful industrial wastes; and (4) to ensure that industrial users (IU) pay their fair share of treatment O&M costs.

M1W operates its facilities pursuant to legal authority enforceable in Federal, State and local courts, which authorizes or enables POTWs to apply and to enforce the requirements of Sections 307(b) and (c), and 402(b)(8) of the federal Clean Water Act and all regulations implementing those sections, including the following M1W Ordinances:

- Ordinance No. 2019-01 (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 [Wastewater Discharge Ordinance]).
- Ordinance No. 2015-01 (An Ordinance Establishing Rule and Regulations Regulating the Discharge of Hauled Wastes [Hauled Waste Ordinance]).
- Ordinance No. 2023-01 (An Ordinance Modifying Regulations for the Interception, Treatment, and Disposal of Sewage and Wastewater [Modifications of the Wastewater Discharge Ordinance]).

4.1.2 Program Description

M1W's Pretreatment Program maintains a staff of 3 full-time positions (a Supervisor and two Environmental Compliance Inspectors) that perform a wide range of duties required to implement the Program. These duties include but are not limited to permitting, inspection, sample collection/analysis, data review, incident response and investigation, enforcement actions, program, and administration (including record keeping and data management. Annual Pretreatment Program reports which include a summary of Program activities during the course of the year are submitted to the RWQCB, USEPA Region 9, and are publicly available on the California Integrated Water Quality System (CIWQS) database. The number and type of industries in the Pretreatment Program as of 2023 are presented in **Table 4-1.**

4.1.2.1 Industrial User Inventory

An essential step for identifying IU noncompliance is to accurately account for industrial/commercial users that discharge non-residential waste into the Community Sanitary Sewer or the RTP, where they are located, and the nature and volume of the waste being discharged. This information is kept by M1W in the IU inventory which is updated at least annually and included in the Annual Pretreatment Program Report. Because M1W is a Joint Powers Authority spanning multiple member entity jurisdictions, M1W employs several methods for updating the IU inventory:

- Liquid Waste Hauler Program – M1W implements the Liquid Waste Hauler Program as described in Sections 2.09 – 2.10 of Ordinance 2023-01 to regulate approved trucked or hauled-in wastes.
- M1W Site Visits – M1W may identify new or previously undetected IUs in the course of their normal operations or through surveillance and investigations.
- Internet Searches – Periodically, M1W staff may identify new or previously undetected IUs by performing internet searches for businesses within its service area.
- Plan Checks – M1W will discover IUs by performing plan reviews which may include blueprints and site plans.
- Member Agency Assistance – M1W member entities carry out their own processes and procedures for reviewing and issuing approvals to operate businesses within their jurisdictions. Member agencies may provide M1W with the following information as they perform their processes:
    - Business name
    - Business physical address
    - Point of contact (name, title, phone, email)
    - Description of the business activity
    - Standard Industrial Classification (SIC) code (if known)

M1W subsequently follows-up with these businesses to determine whether they are required to obtain an M1W Industrial Wastewater Discharge Permit for discharges to the Community Sanitary Sewer. The IU inventory as of 2023, including the City of Salinas whose discharges are monitored by M1W and their diversion controlled by M1W operators, is presented in **Table 4-1**.

Table 4-1. M1W Industrial Inventory

2023 Industrial Users Inventory	
CATEGORICAL INDUSTRIAL USERS (CIUs)	
1	Incotec Integrated Coating and Seed Technology 1293 Harkins Rd., Salinas, CA 93901 40 CFR 455 Subpart C – Pesticide Chemicals Formulating and Packaging Subcategory (NSCIU - Zero Discharge)
SIGNIFICANT NON-CATEGORICAL INDUSTRIAL USERS (SIUs)	
1	City of Salinas Industrial Wastewater Facility 240 Davis Rd. Salinas, CA 93907
2	Mission Linen and Uniform Supply Mission Linen Supply # 0300 435 W Market St. Salinas, CA 93901
3	Mission Linen and Uniform Supply Mission Linen Supply # 2100 315 Kern St. Salinas, CA 93905
4	Ocean Mist Farms 10855 Ocean Mist Pkwy Castroville, CA 95012
5	Sabor Farms 845 Vertin Ave Salinas, CA 93901
OTHER REGULATED INDUSTRIAL USERS (ORIUs)	
1	Montage Health Community Hospital of the Monterey Peninsula 23625 Holman Highway Monterey, CA 93940
2	Culligan Water Culligan Water Conditioning 625 W. Market St. Salinas, CA 93901
3	SeQuential Environmental Services dba SeQuential 671 Work St Salinas, CA 93901

4	Monterey Bay Aquarium 886 Cannery Row Monterey, CA 93940
5	County of Monterey Natividad Medical Center 1441 Constitution Blvd. Salinas, CA 93906
6	Salinas Valley Memorial Hospital District 450 E. Romie Lane Salinas, CA 93901
7	City of Pacific Grove Urban Runoff 300 Forest Ave. Pacific Grove, CA 93950
8	City of Pacific Grove Water Recycling Project 1313 Ocean View Blvd. Pacific Grove, CA 93950
9	Simplot Growers Solutions (GW) 945 Johnson Ave. Salinas, CA 93901

4.1.2.2 Local Limits and Discharge Standards

A critical component of controlling the discharge of conventional, non-conventional and toxic pollutants entering the sanitary sewer system is the development, implementation, periodic review, and update of local limits in response to changes in treatment infrastructure or operations, regulations, and/or IU base. Procedures for developing and updating local limits are described in USEPA's *Local Limits Development Guidance* (July 2004) and include the following steps: (1) determining pollutants of concern; (2) collecting and analyzing data; (3) calculating maximum allowable headworks loadings (MAHLs) and maximum allowable industrial loadings (MAILs) for each pollutant of concern; and, (4) designating and implementing local limits.

Per 40 CFR 403.5(c)(1), as a POTW with an approved Pretreatment Program, M1W performs periodic Local Limits Evaluations (LLE) to assess whether the existing local limits are adequately protective of the RTP, downstream recycled water projects, and receiving waters. Most recently, M1W completed LLEs in 2017 in preparation for the acceptance of new source waters for the Base PWM Project and in 2021 in response to rising concentrations of TDS in SVRP tertiary recycled water. These LLEs triggered subsequent updates to the Wastewater Discharge Ordinance in 2019 and 2023, including its local limits, to reflect the changes in the wastewater characteristics associated with new source waters to the RTP and to control TDS. Narrative prohibitions are also specified for temperature, pH, toxicity, oil and grease, biochemical oxygen demand, and TSS. M1W performed required notifications as described in 40 CFR 403.18 including to M1W IUs, USEPA Region 9, and RWQCB.

M1W also develops pretreatment standards for specific sources as necessary. For example, M1W developed pretreatment standards for silver to regulate activities of photo processors, x-ray developers, and printers. In addition, M1W requires hospitals to implement a program for waste management and reduction based on the USEPA *Guidance Manual for Controlling Waste from Hospitals and Medical Facilities, including dentists*. Hospitals are required to submit annual reports that list waste minimization accomplishments from the previous year and goals for the new year.

Table 4-2 outlines M1W local limits applicable to all discharges per Section 2.11.2 of Ordinance 2023-01.

Table 4-2. M1W Local Limits

Constituent	Local Limit mg/L
Ammonia as N	44
Arsenic	0.42
Cadmium	.27
Chromium	1.7
Copper	1.9
Cyanide	0.53
Lead	2.5
Mercury	0.018
Molybdenum	90
Nickel	1.5
Selenium	.80
Silver	1.1
Zinc	2.6
Phenolic Compounds	8.1
Total Dissolved Solids	1,800

4.1.2.3 Industrial Wastewater Discharge Permits

Per Ordinance 2023-01, Section 4.05, IUs are required to obtain a permit in order to discharge to the Community Sanitary Sewer. The permit includes discharge limits, prohibitions, monitoring and reporting requirements, and other provisions pursuant to the Ordinance and/or federal regulations. Such permits are issued for a term not to exceed five years but may be amended at any time as deemed necessary to ensure compliance with Pretreatment Program objectives and protect treatment process integrity. M1W most recently revised and updated these control mechanisms in 2023 in response to the adoption of revised Ordinance 2023-01 which incorporated the revised TDS local limit.

4.1.2.4 Hauled Liquid Waste Permits

All waste haulers that dispose of hauled waste at the RTP must have a waste hauler permit issued by M1W and have proof of insurance meeting specified coverage limits, current registration as a septage or chemical toilet hauler with the County of Monterey Department of Public Health, and copies of Safety Data Sheets for any chemical deodorant additives and confirming that the additives are on the EPA's approved list. This information is reviewed by M1W Source Control prior to initial permit issuance and annually thereafter. Limitations and prohibitions are detailed in Section 2.09 of Ordinance 2023-01. Liquid Waste Hauler Permits are issued for a three-year term but may be amended at any time as deemed necessary.

Prior to discharge to the designated discharge location, each load is tested for pH and a sample is collected for storage. When the receiving location is full, M1W operations staff collect a sample, verify pH, and conduct a respirometer test. If it passes, the contents are pumped to the RTP headworks. If the test fails, a respirometer test will be conducted on every stored sample to determine which hauler discharged the problem load and appropriate actions will subsequently be taken against the hauling company. If the waste in the receiving location cannot be pumped into the RTP, the hauler that discharged the problem load is required to return to the RTP and pump out the waste for treatment or hauling to an appropriate disposal site.

4.1.2.5 Industrial User Surveillance, Monitoring, and Reporting

M1W maintains an active monitoring program to ensure continued compliance by its IUs. M1W can, if needed, perform surveillance monitoring aimed at facilitating the detection of actual and potential problems caused by the illegal discharge of prohibited materials. M1W conducts a field inspection program, which includes visiting industrial facilities to investigate their compliance status, identifying industrial sources responsible for treatment plant upsets or incidents, and disseminating information on the Pretreatment Program to the IUs.

IUs that are found through inspection or monitoring to be out of compliance are subject to enforcement action by M1W. Standardized enforcement procedures have been developed in M1W's Enforcement Response Plan (ERP) to achieve timely and effective compliance.

4.1.2.6 Enforcement Response Plan

Per the requirements of 40 CFR Part 403.8(f)(5), M1W must develop and implement an ERP to outline procedures to be followed to identify, document, and respond to IU pretreatment violations and other noncompliance. M1W periodically reviews the ERP to assess its effectiveness at achieving the Pretreatment Program goals. The ERP was last revised by M1W in 2023 commensurate with the adoption of Ordinance 2023-01 and includes the following provisions. The ERP was developed following the USEPA's *Guidance for Developing Control Authority Enforcement Response Plans* ("ERP Guidance") and incorporated requirements received from the SWRCB and RWQCB during the 2022 routine Pretreatment Compliance Audit (PCA).

- Identifies by title, the official(s) responsible for each type of response.
- Describes how M1W will investigate instances of noncompliance.
- Describes the types of escalating enforcement responses M1W will take in response to anticipated types of IU violations and the time periods within which responses will take place.
- Reflects M1W's primary responsibility to enforce all applicable pretreatment requirements and standards as detailed in 40 CFR 403.8(f)(1) (*Legal Authority*) and (f)(2) (*Procedures*).

4.1.2.7 Compliance Audits

The RWQCB's pretreatment program includes PCAs and Pretreatment Compliance Inspections (PCI), report reviews, program modifications, and enforcement activities. PCIs verify the compliance status of POTWs, focusing on the POTW's own compliance monitoring and enforcement activities whereas PCAs involve a comprehensive review of all elements of a POTW's pretreatment program. PCAs take place at least every five years and PCIs usually occur every year, except when an audit is scheduled.

The SWRCB, in consultation with the RWQCB and USEPA Region 9, conducted a routine PCA on July 18, 2022 (virtual audit) and September 14-15, 2022 (onsite inspections). A summary PCA Report was sent to M1W in July 2023. The summary report identified several requirements and recommendations for the Pretreatment Program, Wastewater Discharge Ordinance, and ERP. The PCA report requirements included modifications to the Pretreatment Program permit language, updating the Ordinance to include certain requirements, requiring enforcement actions for improper notification of monitoring violations, updating the ERP for pretreatment requirements, and developing a control mechanism for wastewater from the Salinas IWTF. M1W responded to the PCA report on October 6, 2023, and included recommended revisions to the PCA as well as responses to the report findings including completed and ongoing requirements. M1W has implemented the following program improvements in response to the PCA report:

- Developing and adopting Ordinance 2023-01 which includes language to address pretreatment language requirements and recommendations;
- Reissuing permits to all permitted industrial users for compliance with Ordinance 2023-01 (ongoing);
- Revision of the local limits ordinance to incorporate a revised local limit for TDS (and several other constituents);
- Updating M1W's ERP (adopted by the M1W Board of Directors, October 30, 2023);
- Issuing a permit to City of Salinas that includes the necessary control mechanism for M1W to enforce pretreatment requirements related to the Salinas Industrial Wastewater System (M1W holds control of whether or not to divert Industrial Wastewater or Agricultural Wash Water and Treated Effluent and stormwater in Pond 3 at the Industrial Wastewater Treatment Facility to the RTP); and
- Continuing the development and implementation of IU fact sheets.

4.1.2.8 Contract Services

M1W provides various services under contract with its member entities including the Salinas Industrial Pretreatment Inspection and Sampling Program; the City of Monterey Food Preparation Facility Storm Water Inspection and Grease Reduction Programs; and the City of Pacific Grove Food Preparation Facility Storm Water Inspection and Grease Reduction Programs.

The City of Salinas owns and operates a collection system that receives industrial wastewater that is delivered to the City's IWTF. The IWTF is regulated by the RWQCB under a WDR permit. The City therefore has its own WDR-only industrial pretreatment program for the IWTF, for which M1W performs contract inspection and sampling services. In addition, M1W issued an Industrial Wastewater Discharge Permit to the City of Salinas to regulate ag wash water diversions from the City's industrial wastewater collection and treatment facilities, including from Pond 3 at the IWTF. The City's sanitary sewer collection system, as with M1W's member entities, is tributary to the RTP and therefore subject to M1W's direct jurisdiction and Pretreatment Program requirements.

Several of the current regional stormwater member entities previously contracted with M1W to provide stormwater inspection services and may request future inspections. These include the Cities of Sand City, Marina, and Del Rey Oaks. New stormwater NPDES permits were issued in 2018 to the Monterey Peninsula Cities and in 2019 to the City of Salinas which are more stringent and include inspections and monitoring associated with the various commercial and industrial facilities located within each jurisdiction. Therefore, requests for assistance by M1W could include additional stormwater inspection services for the affected member entities.

M1W's community outreach activities directly related to the source control program include:

- M1W Got Drugs Program, which provides information to residents about proper disposal of medications and a list of pharmacies with take-back programs.
- Commercials and advertising for controlling fats, oils, and grease.
- Participation in the Monterey County Oil Recycling Program.
- Dissemination of information on Monterey County's household hazardous waste program and an on-line household hazardous waste disposal chart.
- Semi-Annual and Annual Pretreatment Program Reports are publicly available on CIWQS.

4.1.3 PWM Source Waters for the Regional Treatment Plant

Existing Project included the addition of new source waters to supplement existing municipal wastewater flows at the RTP. The source waters include the following: (1) water from the City of Salinas agricultural wash water system (direct diversion before treatment and diversion after Salinas IWTF treatment), (2) storm water flows from the southern part of Salinas, (3) surface water and agricultural tile drain water that is captured in the Reclamation Ditch, and (4) surface water and agricultural tile drain water that flows in the Blanco Drain. All of the source waters (except Blanco Drain) are combined within the existing wastewater collection system before arriving at the RTP. Water from Blanco Drain is conveyed separately to the RTP before being comingled with other all other flows at the headworks influent structure. The Project EIR included these sources as well as storm water diversions from the Lake El Estero facility in Monterey and agricultural drain water from Tembladero Sough. The City of Monterey is currently proceeding with implementing the Lake El Estero diversion facility using grants from the State; however, those diversions will not be allowed without prior source characterization and assessment of compliance with M1W sewer use ordinance in consultation with the RWQCB and EPA. The Tembladero Slough diversions considered in the Base PWM Project environmental and engineering reports are no longer being pursued as part of the PWM/GWR Project due to conditions prohibiting such diversions as imposed by the SWRCB in water rights permits for the Blanco Drain and the Reclamation Ditch source water diversions and will not be reconsidered in the future.

Prior to implementing the base PWM project, M1W conducted extensive source characterization, including conducting a pilot study of diverting Lake El Estero in 2015. The results of that work is available at https://purewatermonterey.org/reports-docs/engineering-report/ (**Appendix B**). The City of Monterey is planning to implement the Lake El Estero diversion facility using grants from the State; however, those diversions will not be allowed without updated source characterization and assessment of compliance with M1W sewer use ordinance[18] in consultation with the Regional Water Board and the United States Environmental Protection Agency (USEPA). Use of the Tembladero Slough as a source water considered in the PWM Project Environmental Impact Report (EIR) and the March 2019 Engineering Report is no longer able to be implemented as part of the PWM Project due to conditions prohibiting such diversions imposed by the State Water Board in water rights permits for the Blanco Drain and the Reclamation Ditch source water diversions and will not be proposed by M1W in the future. Changes to discharges to M1W collection system, such as non-municipal wastewaters, will be reviewed and updated as necessary to ensure adequate protection of the RTP, Salinas Valley Reclamation Project (SVRP), and AWPF treatment integrity. The State Water Board, Regional Water Board and the USEPA Region 9 will be consulted and notified of such revisions.

The M1W source control plans and programs were reviewed and updated as discussed above to address the new water sources including (a) review of existing local limits and development of new local limits to reflect changes in the treatment system including plans to develop the AWPF, changes in the service area sources (i.e., the addition of new sources waters), and changes in regulations; (b) permitting the City of Salinas IWTF; and (c) adding an interruptible rate program that includes the control mechanisms and prohibitions described below. These plans and programs will continue to be reviewed and updated as necessary to ensure adequate protection of the RTP, SVRP, and AWPF treatment integrity. The SWRCB, RWQCB, and USEPA Region 9 will continue to be consulted and notified of such revisions as discussed previously.

4.1.3.1 Agricultural Washwater

The City of Salinas collects and treats wastewater from approximately 31 agricultural processes and related businesses that heretofore were conveyed to the Salinas IWTF for biological treatment and discharge via percolation ponds. As described in Section 4.1.2.8, M1W assists the City of Salinas with implementing its WDR-only pretreatment program which directly regulates dischargers to the IWTF. Additionally, M1W issued an Industrial Wastewater Discharge Permit to the City of Salinas for the IWTF. The IWTF is regulated by M1W as an SIU based on the volume and character of its process discharges, the majority of which are from vegetable packers, with the remainder originating from seafood processing, refrigerated warehousing, and manufacturing of ice and corrugated paper boxes. The discharges are also regulated by the RWQCB under a General WDR Permit.

The IWTF diversions are intermittently accepted by M1W based on recycled water demand, or City of Salinas needs for maintaining freeboard or providing emergency relief during storm conditions as requested by and/or in consultation with the RWQCB. Direct diversion and Pond 3 water quality is continuously monitored by M1W via SCADA for pH, conductivity, turbidity, and oxidation reduction potential (ORP). To optimize treatment efficiency M1W Source Control also

[18] https://www.montereyonewater.org/DocumentCenter/View/1411/Ordinance-No-2023-01-Modifying-Regulation-for-the-Interception-Treatment-and-Disposal-of-Sewage-and-Wastewater

collects bi-monthly samples from the IWTF (Pond 3) for analysis of specified constituents of interest. This data is supplied to M1W engineering team and consultants for continuous monitoring of water quality impacts on the RTP. In addition, as with all M1W SIUs, M1W conducts annual Agency monitoring and inspection and requires the City to submit Semi-Annual Self-Monitoring Reports (SMRs) which assist in verifying compliance.

4.1.3.2 Blanco Drain

The Blanco Drain is a man-made reclamation ditch draining approximately 6,400 acres of agricultural lands east of the City of Salinas. The watershed for the Blanco Drain is between the Salinas River and Alisal Slough, and discharges to the Salinas River. The Blanco Drain is separated from the Salinas River by a flap gate, which prevents high-water conditions in the Salinas River from migrating up the Blanco Drain channel. Summer flows in the Blanco Drain are generally tile drainage and runoff from irrigated agriculture. Winter flows include storm water runoff, although some fields remain in production and are irrigated year-round. Improvements completed for the Existing Project enable water in the Blanco Drain to be diverted and conveyed to the RTP for treatment. The MCWRA has flood control responsibility for the natural and man-made storm water channels within the County, including the Blanco Drain and the Reclamation Ditch system in northern Monterey County.

4.1.3.3 Salinas Stormwater Collection System

Prior to AWPF construction, storm water from urban areas in southern portions of the City of Salinas was collected and released to the Salinas River through an outfall near Davis Road. The runoff system drained an area of approximately 2.5 square miles of urban area which flowed to the Salinas River through a 66-in gravity pipeline. Improvements completed as part of the Existing Project enable the Salinas stormwater to be conveyed to the RTP for beneficial reuse after treatment and seasonal storage occurs at the Salinas IWTF.

4.1.3.4 Reclamation Ditch

The Reclamation Ditch, created between 1917 and 1920, is a network of excavated earthen channels used to drain natural, urban, and agricultural runoff and agricultural tile drainage. The Reclamation Ditch watershed is approximately 157 square miles that includes headlands, agricultural areas, the City of Salinas and portions of Castroville and Prunedale. It collects water from Alisal Creek at Smith Lake southeast of the City of Salinas, Gabilan and Natividad Creeks within Salinas at Carr Lake, and Santa Rita Creek west of Salinas. The Reclamation Ditch is a major drainage channel that flows from east to west through Salinas and continues west where it drains into Tembladero Slough, thence to the Old Salinas River Channel, and ultimately into Moss Landing Harbor through the Potrero Road Tide Gates. Alisal, Gabilan, and Natividad Creeks are seasonal in their upper reaches. The Reclamation Ditch is perennial downstream of agricultural and urban development. However, the presence of dry-season flow is a consequence of dry-season urban discharges and agricultural runoff and tile drain water. The Existing Project included improvements that enable water from the Reclamation Ditch watershed to be diverted from the Reclamation Ditch at Davis Road in Salinas for conveyance to the RTP for treatment and beneficial reuse.

4.1.3.5 Interruptible Rate Program

On October 26, 2015, M1W adopted an Interruptible Rate Program for acceptance of the new water sources into the sewer system on a seasonal or interruptible basis. The program was updated in April 2017, 2021, 2022, and 2024. M1W has developed eligibility criteria and conditions to qualify for this rate that include the following source control mechanisms:

- The applicable discharger will be required to obtain and comply with a wastewater discharge permit issued by M1W that includes discharge limits, prohibitions, self-monitoring, spill control, reporting and other provisions in accordance with the Wastewater Discharge Ordinance.
- The water source cannot contain domestic sewage as verified by M1W's Source Control Division.
- The water source cannot be from a groundwater remediation site.
- The discharger must provide water quality data for the proposed discharge so that M1W can determine if the discharge requirements per the Wastewater Discharge Ordinance, including compliance with M1W's permits and protection of recycled water can be achieved. The permit application clarifies the number of samples, analyses, reporting levels, etc. The discharger will be responsible for the costs related to developing and implementing M1W water quality objectives, including prohibitions that will allow M1W to shut off the flow of source water.
- The discharger must allow M1W to control the amount, timing, and duration of the discharge through motorized valves using a SCADA connection with M1W's RTP and continuous flow metering. M1W has the authority and access to reduce or terminate the discharge. The discharger, if needed, shall have pre-treatment for the removal of trash and/or other unacceptable discharges as identified in the newly created discharge permit.
- The discharger must have an alternative legal means of disposing of the wastewater should M1W discontinue the diversion. M1W will reduce or shut off flow when needed so that existing flow capacities of M1W facilities will not be exceeded or when the discharged water quality is not appropriate for the M1W facilities.
- The discharger will not be allowed to exceed the existing capacity of M1W infrastructure, and will not be given an allocation or right to existing capacity.
- M1W will inspect and monitor the discharge, and if necessary, take enforcement action for permit violations in accordance with the Wastewater Discharge Ordinance and ERP.

4.1.4 Compliance with Title 22 Criteria Source Control Requirements

The M1W Source Control Program is designed to protect operation of the RTP, tertiary recycled water quality for the SVRP, Monterey Bay receiving water quality, and purified recycled water quality for injection into the Seaside Groundwater Basin. The source control program meets the Title 22 Criteria for GRRPs as follows:

- **Contaminant Assessment.** The AWPF treats the recycled water to meet all requirements specified by the RWQCB and DDW (see Section 7).
- **Contaminant Source Investigation.** M1W conducts investigations and monitoring (a) in the

event of interference or pass through 19 at the RTP or AWPF, (b) at the request of DDW or RWQCB, or (c) based on monitoring data collected by M1W.

- **Outreach**: M1W administers an effective outreach program that consists of RTP tours, classroom presentations, information on the Project, information on pharmacies offering drug take-back programs, participation/exhibits in community events, school outreach (presentations, materials, teacher curriculum training and workshops), commercials and advertising for controlling fats, oil and grease, participation in the Monterey County Oil Recycling Program, and tours of the AWPF demonstration facility. These outreach efforts are similar to programs implemented by other agencies involved with potable reuse.
- **Contaminant Inventory**. M1W tracks and identifies IUs and discharges, including contaminants discharged through industrial monitoring. M1W maintains an industrial inventory of monitoring results and includes the source waters based on the results of the source water monitoring.
- **Local Limits Evaluations and Revisions**. M1W periodically evaluates its local limits and makes revisions as needed to prevent interference with and/or upset of treatment operation at the RTP, SVRP, and AWPF; passthrough of conventional and toxic pollutants; harm to the collection system, RTP, SVRP, or AWPF; contamination of municipal biosolids and recycled water; and worker exposure to chemical hazards.
- **Annual Reporting**. M1W prepares annual reports on its Pretreatment and Source Control programs that address compliance with the Title 22 source control provisions.

4.2 RAW WASTEWATER CHARACTERISTICS

4.2.1 RTP Inflows

In 2023, M1W analyzed the future monthly and annual availability of potential PWM Source Waters for the M1W system, including the Blanco Drain, Lake El Estero, Pond 3 (IWW and SW), Reclamation Ditch and agricultural wash water[20]. The predicted highest RTP flows are presented in **Figure 4-1** based on two different rainfall/water year types and management scenarios:

- **Normal/Wet Year** considers flows when normal to above average rainfall is experienced and the reserve supply is full; and
- **Drought/Dry Year** considers flows when below normal rainfall is experienced and there are higher demands for tertiary treated recycled water.

The total flows entering the RTP are relevant because some predictions regarding water quality entering the AWPF are based on the blending that will occur with PWM Source Waters and raw wastewater entering the RTP.

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[19] Interference is defined as an industrial discharge which alone or in combination with a discharge or discharges from other sources (1) inhibits or disrupts the RTP or AWPF, their treatment processes or operations, the RTPs sludge processes, uses or disposal, or the use of recycled water and (2) is therefore a cause of a permit violation. Pass is defined as a discharge that exits the RTP or AWPF in quantities or concentrations, which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a permit violation.

[20] Flow predictions of diverted source waters were based on estimated availability of the source waters, wastewater flows (based on average monthly municipal wastewater flows), AWPF production levels, CSIP demands, and the RTP capacity.

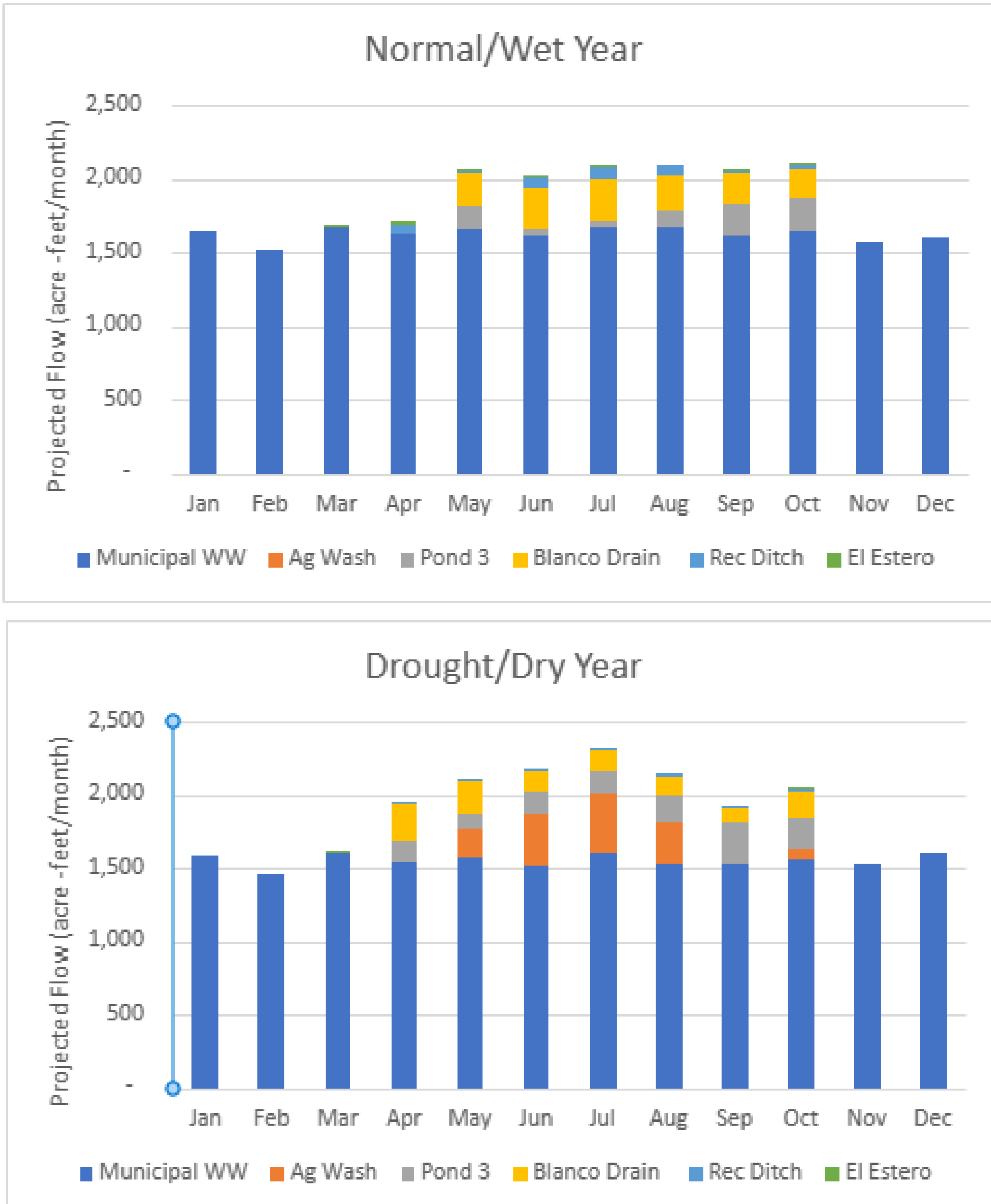

Figure 4-1. Estimated Availabilities for Source Waters entering the RTP during Normal/Wet Year (top) and Drought/Dry Year (bottom)

4.2.2 AWPF Influent Quality

As specified in the WDR/WRR, AWPF influent quality is monitored on a weekly or continuous basis for nitrogen compounds, TOC, carbonaceous biochemical oxygen demand (CBOD), TSS, minerals, total coliform, turbidity, and UV Transmittance (UVT). The results are submitted electronically to the DDW database and uploaded quarterly to the State of California GeoTracker database for public review and download.

5 PATHOGENIC MICROORGANISM CONTROL

As required by the Title 22 Criteria, the pathogen reduction requirements for GRRPs are 12-log, 10-log, and 10-log reduction for viruses, *Giardia* cysts, and *Cryptosporidium* oocysts, respectively (“12/10/10”). In order to achieve these 12/10/10 pathogen log reduction values (LRVs), M1W must utilize at least three separate treatment processes. Each treatment process can only receive up to 6-log reduction credit, and at least three processes must achieve at least 1.0-log reduction credit. Additionally, 1-log of virus credit can be earned for each month the water is retained underground if verified by an added tracer study. The pathogen removal assumed for each treatment process is discussed in the following sections. The combined LRVs for the Project meet the Title 22 requirements.

5.1 RTP (PRIMARY AND SECONDARY TREATMENT)

Secondary treatment achieved at the RTP consists of bar screens, grit removal, primary clarification (with optional chemically enhanced primary treatment (CEPT) for additional phosphorus removal), biological trickling filters, bio-flocculation (solids contact), and secondary clarification. The solids contact process is an aeration basin that operates with a short solids retention time (SRT), which is used to improve the trickling filter effluent water quality. At this time, no credits for primary or secondary treatment are being pursued because of limited data from the RTP. This is a conservative approach since some degree of pathogen removal does occur during primary and secondary treatment. Rose, et al. (2004) reported pathogen removals through secondary treatment were 96% - 99.9% for viruses and bacteria, 97.7% - 99.8% for *Giardia* cysts, and 0% - 99.4% for *Cryptosporidium* oocysts. None of the treatment facilities included in the 2004 Rose study employed the trickling filters-solids contact secondary process and only one facility included primary treatment, where particle-associated pathogens may be removed through sedimentation. The one treatment facility that had primary clarification also had a short SRT aeration basin for the secondary process. At that facility, pathogen removals through primary and secondary treatment were 96% - 99.9% for viruses and bacteria, 99.1% for *Giardia* cysts, and 94% for *Cryptosporidium* oocysts.

Limited sampling was conducted for Giardia cysts, Cryptosporidium oocysts, total coliform, and E. Coli during pilot sampling and the results are presented in **Table 5-1**. The table summarizes pathogen and pathogen indicator results from the RTP influent, the RTP secondary effluent, ozone effluent, MF effluent, and RO permeate. Although no pathogen LRV credit is being pursued for treatment at the RTP at this time, M1W may pursue additional pathogen removal credits in the future. If M1W does pursue additional credits, a monitoring program that documents pathogen concentrations in the RTP raw influent and secondary effluent will be implemented.

Table 5-1. Pathogen and Pathogen Indicator Removal Observed through RTP, Ozone, MF, and RO during Pilot Testing

Parameter[a]	RTP Influent[c] N=6	Undisinfected RTP Secondary Effluent N=6-22[d]	Ozone Effluent N=6-25[d]	MF Effluent N=6-25[d]	RO Permeate N=27
Cryptosporidium (oocysts/L) Recovery[b]	<2 (1 - 8) 23%	<0.35 (<0.09 - 0.9) 30%	2.65[e] (0.3 – 23.3) 92%	<0.09 (<0.09 - <0.1) 26%	-- --
Giardia (cysts/L) Recovery[b]	8,847 (1,634 – 13,626)[b]	<0.15 (<0.09 – 1.1) <0.092%	<0.2 (<0.09 – 4.4) 76%	<0.09 (<0.09 - <0.1) 50%	-- --
Total coliform (Most probable number (MPN)/100 mL)	-- --	$2.8x10^5$ ($2.4x10^3$ – $1.6x10^6$)	$6.3x10^2$ ($5.5x10^1$ - $3.1x10^3$)	<1 (<1 – 71)[f]	<1 (<1 - <1)
E. Coli (MPN/100 mL)	-- --	$6.0x10^4$ ($4.9x10^2$ – $3.3x10^5$)	27 (<1 – $5.5x10^2$)	<1 (<1 - <1)	<1 (<1 -<1)

a. N is the number of samples; median values shown, with ranges in parentheses. Two of the protozoa samples and approximately ten of the bacteria samples included diversion of agricultural wash water mixed with sewage and treated at the RTP.
b. Recovery measured in one sample. ColorSeed not used on RTP influent matrix spike; thus, native giardia interfered (recovery of 658%).
c. Draft EPA method 1693, which omits the filtration step of EPA method 1623a, used for analysis.
d. Greater sampling frequency for total coliform and E. Coli
e. There were consistently higher concentrations of Cryptosporidium oocysts measured in the ozone effluent compared to the secondary effluent. This effect appears to be an artifact of the analysis in part, where the ozonation of the water seems to have dramatically improved method recovery.
f. The two total coliform detections in the MF effluent samples (71 and 2) are suspected to be due to sample contamination.

5.2 AWPF (ADVANCED TREATMENT)

The AWPF treatment train includes ozone, MF, RO, UV/H_2O_2 AOP, and chlorine disinfection. A discussion of the pathogen LRVs for each unit process proposed for pathogen removal credits is presented below. Ozone treatment has been shown to reduce viruses, but the process utilized at the AWPF requires validation that may be pursued for future LRV credits.

5.2.1 Ozone

Ozonation is the first treatment process in the AWPF treatment train. Its primary purpose is to reduce the size of the large organic molecules in the secondary effluent, which improves performance of the downstream MF system. Ozone also oxidizes CECs and pesticides and provides pathogen inactivation. Although ozone has disinfection capability, no pathogen LRV credit is being pursued for the ozone process at this time. At the design ozone dose (10 mg/L) for the AWPF, the ozone demand of the water is high enough such that a measurable ozone residual cannot typically be carried through a significant length of time in the ozone contactor. A higher ozone dose and more ozone residual monitors would be required in order to achieve significant ozone CT (concentration multiplied by the contact time) credit.

If additional pathogen inactivation credit is needed for redundancy, ozone CT credit may be pursued in the future. CT values for inactivation by ozone are provided in the USEPA drinking water Surface Water Treatment Rule (SWTR) Guidance Manual (U.S. EPA, 1990) for *Giardia* cysts and virus, and in the USEPA Long Term 2 Enhanced SWTR (LT2ESWTR) Toolbox Guidance Manual for *Cryptosporidium* oocysts. Equations derived from these CT tables are the following (U.S. EPA, 2010):

- Cryptosporidium oocyst log credit = 0.0397 x (1.09757)Temperature(ºC) x CT
- Giardia cyst log credit = 1.038 x (1.0741)Temperature(ºC) x CT
- Virus log credit = 2.1744 x (1.0726)Temperature(ºC) x CT

Substantially more ozone is required for *Cryptosporidium* oocyst inactivation than for either *Giardia* cysts or virus. For example, to receive 2-log virus inactivation credit at 25°C, a CT of only 0.160 mg/L-minute would be required, which would concurrently provide 1-log *Giardia* cyst inactivation but only 0.06-log *Cryptosporidium* oocyst inactivation.

This CT approach can be challenging for secondary and tertiary wastewater matrices for two key reasons. The first challenge is that ozone demand in wastewater is high, so it can be difficult to sustain the dissolved ozone residuals that are necessary for CT calculations. The second challenge is that the high ozone doses necessary to generate sufficient residuals can form disinfection by-products (DBP)(e.g., bromate, NDMA, formaldehyde). Several ozone system suppliers (OSS) have recently conducted disinfection validation studies based on an applied O_3:TOC ratio, rather than the achieved CT, and it was confirmed that significant virus inactivation occurs rapidly, before generating a measurable CT. M1W may pursue additional virus inactivation credit via ozonation in the future. More information is provided in **Appendix D** of this Engineering Report.

5.2.2 Membrane Filtration

MF follows ozone in the AWPF process train. MF is used as a physical barrier for removal of pathogens. The membranes that were pilot tested had nominal pore size of 0.01 microns. For this project, 4-log removal credit for *Giardia* cysts and 4-log removal credit for *Cryptosporidium* oocysts have been established, but no virus removal credit has been requested even though some particulate-associated viruses are removed through MF. The LRVs are based on product-specific performance challenge tests conducted by the membrane manufacturer. Daily pressure decay tests (PDTs) will be conducted to confirm no broken fibers or other breach of membrane integrity, based on product-specific minimum test pressure and maximum allowable pressure decay. The membranes will be required to have passed the required challenge tests to demonstrate the desired 4-log *Giardia* cyst and *Cryptosporidium* oocyst removal.

Drinking water regulations provide a framework for Microfiltration/Ultrafiltration (MF/UF) to receive log removal credit for virus, *Giardia* cysts, and *Cryptosporidium* oocysts. Specifically, the

California SWTR allows the use of MF/UF as an alternative filtration technology, provided the technology demonstrates at least 2-log *Giardia* cyst removal, 1-log virus removal, and 2-log *Cryptosporidium* oocyst removal and meets certain turbidity performance standards in the, Title 22 Criteria (Section 64653(e)). The State and Federal LT2ESWTR include additional regulations and guidance on achieving additional removal credit for *Cryptosporidium* oocysts. The LT2ESWTR Toolbox Guidance Manual (U.S. EPA, 2010) and Membrane Filtration Guidance Manual (U.S. EPA, 2005) provide detailed guidelines for performing the pathogen removal challenge tests on membrane filters to determine log removal credits (U.S. EPA, 2010). The daily PDT is performed to confirm the integrity of the membranes. A product specific minimum test pressure and a maximum allowable decay rate are used for the PDT, which is able to detect a 3-micron hole (i.e., the resolution of the test is 3-microns).

Given the pore size of the existing and new MF membranes, the Project has been given 4-log removal credit for *Giardia* cysts and 4-log removal credit for *Cryptosporidium* oocysts. Although the challenge tests confirm virus removal (0.5 to 1 LRV is typical), no credit is being pursued for virus removal for the Project. To receive pathogen reduction credit for the MF process, continuous monitoring of the system using online turbidimeters (i.e., indirect integrity monitoring) and daily PDTs (i.e., direct integrity monitoring) is necessary to ensure proper MF performance.

The WDR/WRR requires MF filtrate turbidity to not exceed 0.2 NTU more than 5% of the time within a 24-hour period and 0.5 NTU at any time, which is equivalent to the Water Recycling Criteria for filtered wastewater through MF. Thus, in addition to providing sufficient pathogen control for groundwater replenishment, the Project meets the Title 22 Criteria for filtered wastewater, which, after disinfection, will allow the product water to be used for irrigation.

5.2.3 Reverse Osmosis

Pathogen removal credits for virus, *Giardia* cysts and *Cryptosporidium* oocysts are achieved through the RO membranes. RO process performance for pathogen removal is confirmed by measuring an approved surrogate parameter (i.e., conductivity, TOC, or strontium) that demonstrates the RO membrane integrity. LRVs based on these parameters are a conservative estimate of pathogen removal.

Most advanced treatment facilities measure TOC or electrical conductivity (EC) reduction across the RO membranes as surrogates for pathogen log reduction. At the Demonstration Facility, M1W conducted parallel sampling of EC, TOC, and strontium rejection across the RO membranes for 8 months from June 2018 to January 2019. Strontium LRVs were consistently greater than 2.5-log (typically 2.9 to 3.1-log), TOC LRVs were consistently greater than 1.5-log, and EC LRVs were consistently greater than 1.0-log. Approval was granted by DDW for M1W to use a tiered approach, depending on the surrogate being monitored, for pathogen log removal.

M1W currently monitors the rejection of all three surrogate parameters—strontium, TOC and conductivity—across the RO membranes, and applies a three-tiered process for calculating applicable virus, *Giardia* cyst, and *Cryptosporidium* oocyst log reduction for the RO system. The first tier of pathogen credit is based on strontium rejection measured once daily in the RO feed and the permeate of each RO train. If strontium samples must be collected later in the day, arrangements have been made with the nearby contract laboratory to provide same day results (as long as the lab receives the samples by noon that day). The second tier is based on TOC rejection calculated from continuous online monitoring of the RO feed and the combined RO permeate. The third tier for pathogen credit is based on continuous online EC monitoring of the RO feed and the combined RO permeate of each RO train. Log reduction is reported to DDW for all three surrogates unless data are not available for all surrogate(s), and M1W indicates which tier is to be used for reporting pathogen log reduction. However, M1W is not required to report LRVs for all three surrogates each day. The surrogate that provides the largest log reduction is used for calculating pathogen LRV. For strontium, the lowest per train LRV is reported; for TOC, the average daily LRV is reported; and for conductivity, the minimum daily LRV is reported.

Prior to AWPF operation, the expected minimum pathogen LRV for each surrogate was at least (1) 2.5-log for strontium rejection, (2) 1.5-log for TOC rejection, and (3) 1.0-log for EC rejection. Beginning at AWPF startup, TOC and conductivity log reductions were monitored for pathogen log removal credits. In May 2021, M1W began monitoring strontium rejection for pathogen credits. Monthly average conductivity, TOC, and strontium LRV's at the full-scale facility are shown in **Figure 5-1**. For the period shown, the average strontium LRV was 3.0-log, the average TOC LRV was 1.8-log, and the average EC (conductivity) LRV was 1.4-log.

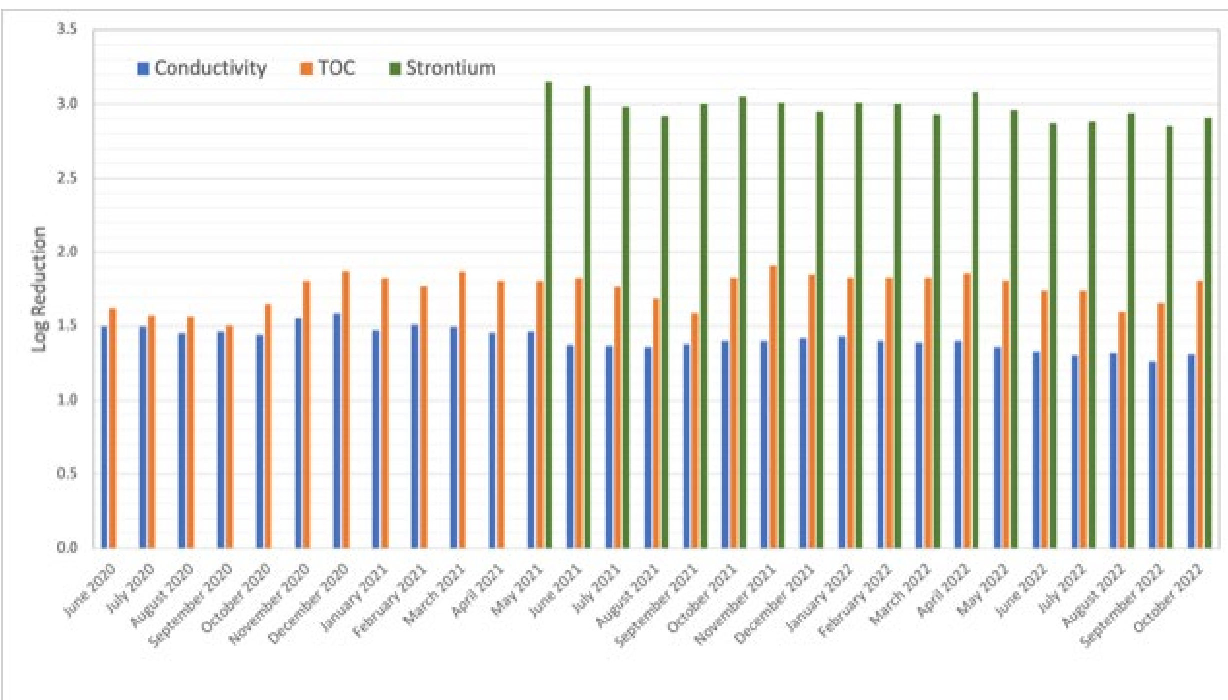

Figure 5-1. Monthly Average Log Removals for EC, TOC and Strontium Measured at the PWM Full-Scale AWPF

5.2.4 Advanced Oxidation

The next treatment process is AOP using UV/H_2O_2 with a UV design dose of 1,600 mJ/cm^2. Pathogen inactivation credits being pursued through the UV/AOP system are 6-log each for

Cryptosporidium oocysts, *Giardia* cysts, and virus. The design dose is based on what is needed to achieve the required 0.5-log 1,4-dioxane reduction as well as other AOP goals (e.g., 1.5-log reduction of NDMA), as discussed in **Section 3**.

For pathogen inactivation with UV/AOP, the USEPA's Innovative Approaches for Validation of Ultraviolet Disinfection Reactors for Drinking Water. Systems (USEPA, 2020) specifies the UV dose requirements for achieving up to 4-log *Cryptosporidium* oocyst, *Giardia* cysts, and virus credit with UV disinfection. The UV doses are shown in the **Table 5-2**. With a dose of 1,600 mJ/cm^2, greater than 6-log inactivation of these pathogens is expected. Virus inactivation requires a higher UV dose than *Cryptosporidium* oocyst or *Giardia* cyst inactivation. Extrapolating the data in **Table 5-2**, a dose of 236 mJ/cm^2 is needed for 6-log virus inactivation, which is more than 6 times lower than the design UV dose. The UV doses required for 0.5 log removal of 1,4-dioxane at the AWPF were determined during start-up and commissioning.

Table 5-2. UV Dose (mJ/cm^2) Required for Pathogen Inactivation

Target Pathogens	Log Inactivation[a]							
	0.5	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**
Cryptosporidium	1.6	2.5	3.9	5.8	8.5	12	15	22
Giardia	1.5	2.1	3.0	5.2	7.7	11	15	22
Virus	39	58	79	100	121	143	163	186

a. Source USEPA, 2006b.

Given the high dose of UV, it is not anticipated that any small variability in process performance will have an impact on the ability of the system to meet the pathogen reduction targets for this system. To ensure the design dose is delivered, several parameters will be continuously measured—UV intensity (UVI), power, UVT—to provide information approximately proper functioning of the system.

In order to meet the disinfected tertiary recycled water requirements in the Water Recycling Criteria, the disinfection process must, along with filtration, inactivate or remove 5-log of MS2 or poliovirus. The NWRI UV Disinfection Guidelines for Drinking Water and Water Reuse suggest a UV dose of at least 50 mJ/cm^2 for RO permeates with a turbidity equal to or less than 0.2 NTU 95% of the time and not to exceed 5 NTU and a UVT of 90% or greater. The guidelines state that at least 2-log virus will be removed through the RO process, and that 3-log inactivation of poliovirus can be achieved with a UV dose of approximately 30 mJ/cm^2. A design dose of 50 mJ/cm^2 is suggested in the guidelines to account for variability in the effluent quality. The guidelines include MS2 inactivation data that suggests 5-log removal can be achieved with a UV dose of 110 to 150 mJ/cm^2. Assuming no removal through RO, using the more conservative virus surrogate (MS2) and taking the upper range, 150 mJ/cm^2 is a conservative requirement for the Project to meet the Water Recycling Criteria for disinfected tertiary recycled water based on the NWRI UV Guidelines. This UV dose is less than the UV dose required for groundwater replenishment. Accordingly, the AWPF will meet the Water Recycling Criteria for disinfected tertiary recycled water by meeting the requirements for groundwater replenishment.

5.2.5 Chlorine Disinfection

Chloramines are used for post-stabilization secondary disinfection. The treatment goal is a total chlorine concentration of 3 to 5 mg/L as Cl_2 entering the conveyance pipeline and at the injection wellhead, although a higher chlorine residual leaving the PWPS can be applied if required for virus inactivation credit. Any residual chloramines in the water degrade prior to reaching any of the MWs, so water extracted from the potable supply wells does not contain chloramines.

M1W received approval from DDW in January 2022 for a virus inactivation credit for chloramine disinfection in the conveyance pipeline. The goal is to achieve minimum 2-log and maximum 3.5-log virus inactivation credit from chloramine residuals of 2 to 4 mg/L as Cl_2. Due to chloramine decay in the conveyance pipeline, a chloramine residual of 2 to 4 mg/L as Cl_2 at the injection wells corresponds to a chloramine residual of approximately 3 to 5 mg/L as Cl_2 at the post-treatment monitoring location (i.e., the PWPS). At this time, no inactivation credit for *Giardia* from chlorine is being pursued. Accounting for virus disinfection credit through the conveyance pipeline is generally not a critical treatment process for meeting the required 12-log virus reduction. Virus disinfection credit in the conveyance pipeline typically just provides a LRV buffer.

The CT values for virus inactivation with chloramines in the USEPA's Surface Water Treatment Rule (SWTR) Guidance Manual (USEPA, 1991) assume that chlorine is applied ahead of ammonia. When chlorine is applied downstream of ammonia, a bench-test of virus inactivation with pre-formed chloramines, using bacteriophage MS2, is recommended by USEPA. At the AWPF, ammonia is present upstream of sodium hypochlorite addition. A MS2 bench-testing plan was developed using a hydraulic residence time (T10) values that correspond to product water flowrates of 1.2 to 17 MGD. DDW approved the MS2 bench-testing plan on October 1, 2021 and Trussell Technologies performed the virus inactivation bench tests in October 2021. DDW approved the resulting report on January 5, 2022, after which M1W began reporting virus LRV through the conveyance pipeline. The report documenting the bench test MS2 inactivation results and the resultant LRV equation is provided in **Appendix E,** along with email approval from DDW for the crediting approach.

To be credited with virus inactivation through the conveyance pipeline, total chlorine residual, pH, and water temperature are continuously monitored at the injection well field and flow is continuously monitored at the PWPS. Two amperometric analyzers (one duty and one standby) are located at the site of DIW-4 and two analyzers will be added at the site of DIW-6 (one duty and one standby). Continuous recording of these parameters has been added to the AWPF's SCADA system and continuous virus LRV is calculated based on 15-minute rolling averages of chlorine residual and temperature. The lower total chlorine value measured at the two analyzer stations will be used for concentration in the CT calculation. The daily minimum LRV is reported using the approved virus LRV-CT relationship as shown below.

$$LRV = 3.62 \log\left(CT_{10} 2^{\frac{Temp - 20℃}{10℃}}\right) - 8.45$$ [21]

[21] LRV-CT relationship applicable for product water flowrates of 1.2 to 17 MGD

5.3 SUBSURFACE PATHOGEN REDUCTION CREDIT

The Project qualifies for a virus reduction credit associated with the time the recycled water remains underground (from injection to extraction). The Title 22 requirements for groundwater replenishment by subsurface application allow for a 1-log LRV for each month underground. This allowance applies only when underground retention times are confirmed with an extrinsic tracer study. Other methods of estimating underground retention times are assigned less than 1-log LRV per month, specifically 0.5-log reduction credit per month for travel times estimated by numerical modeling and 0.67-log reduction credit per month for travel times estimated from an intrinsic tracer study.

M1W has measured underground retention time by completing four intrinsic and four extrinsic tracer studies. The first intrinsic and extrinsic tracer studies were performed on DIW-1 and DIW-2 after they were constructed. The second intrinsic and extrinsic tracer studies were performed on DIW-3 and DIW-4 after they were constructed. After the DIW-1 and DIW-2 studies were conducted, and before DIW-3 and DIW-4 were constructed, M1W calibrated an existing groundwater flow model to the first extrinsic tracer study travel times and then simulated a range of Project operational scenarios. The second round of tracer studies on DIW-3 and DIW-4 validated that the calibrated model is successfully conservative in simulating Project operations. Because the modeling is more conservative than the extrinsic tracer studies demonstrated, an LRV credit of 1-log is warranted. In a letter dated August 30, 2022, containing comments on the June 2022 version of this Engineering Report, DDW staff accepted the results of the first extrinsic tracer study to establish travel time from DIW-1 and DIW-2 to the Paralta Well as the nearest downgradient well. DDW also accepted operational simulation results that demonstrated that the Project injection has a minimum 4 months of underground travel time to the closest downgradient extraction well (i.e., from DIW-1 to the Paralta Well). A virus log reduction credit of 1-log per month was granted for operation of DIW-1 through DIW-4, with the condition that an extrinsic tracer study be conducted at DIW-3 and DIW-4 to confirm the model results (which was completed as described above). Details of all the tracer studies are documented in **Appendix G** and summarized below.

The evaluation of operational scenarios demonstrated that for a wide range of injection/ extraction patterns—including the Expanded Project and water supply wells—a minimum underground residence time of 4.0 months can be achieved. Accordingly, M1W is including a subsurface pathogen reduction credit of 4-log virus inactivation in its reporting of total log virus removals.

5.3.1 Summary of Previous Estimates of Underground Retention Time

Underground retention times have been estimated by progressively more accurate methods over the course of the Project. In 2019, travel times of injected water from Project wells to downgradient wells were estimated using a numerical model—referred to herein as the Watermaster Model – which was developed, calibrated, and documented by the Seaside Basin Watermaster in 2009 (Hydrometrics, 2009). The Watermaster Model is a transient five-layer model built on the MODFLOW platform and calibrated over a 22-year period from January 1987 through December 2008. The model has been widely applied for numerous basin-wide groundwater management assessments and represents a technically credible and accepted tool for simulating groundwater scenarios in the Seaside Basin (Hydrometrics, 2014a). Additional details of the Watermaster Model are summarized in **Section 9.1.3.2** of the April 2019 Final Engineering Report.

Because the model was originally designed to simulate flow and water levels only, effective porosity was added to the model to simulate subsurface travel time of injected water. Prior to M1W conducting intrinsic and extrinsic tracer studies, measured data were not available for model calibration, so effective porosity was estimated based on the texture of sediments in the Santa Margarita aquifer and experience of MPWMD with ASR well operations.

A second estimate of underground travel times was obtained in 2020-2021 by implementing an intrinsic tracer study when Project injection first commenced after DIW-1 and DIW-2 were constructed. The results were documented and submitted to DDW (including assumptions about future increases in injection and extraction). Following review and comment by DDW, M1W and MPWMD initiated an extrinsic tracer study in 2021 for DIW-1 and DIW-2 and intrinsic/extrinsic Tracer Studies in 2022 for DIW-3 and DIW-4. The extrinsic tracer studies were undertaken to pursue more refined results for underground travel time and to achieve 1-log of virus LRV credits for each 1 month of underground retention time. The results are discussed in the following sections.

5.3.2 Extrinsic Tracer Study Results

Results of the two completed extrinsic tracer studies are summarized here and details are presented in **Appendix G**. The first extrinsic tracer study was initiated in October 2021 and continued through May 2022. Pursuant to the DDW-approved tracer study work plan, fluorescein and eosine dyes were added to DIW-1 and DIW-2, respectively, during normal injection operation on October 26, 2021. Dye concentrations were measured twice a week to weekly at downgradient monitoring wells MW-1AD, MW-2AD, MW-1D, MW-2D, MW-1 near ASR-1 and drinking water wells Paralta and Ord Grove 2 (see **Figures 3-9a** and **3-9b** for well locations). Fluorescein was detected at MW-1AD and eosine at MW-2AD as expected. Graphs of dye concentrations over time are shown in **Figure 5-2**. The maximum concentration at MW-1AD occurred 65 days after injection. At MW-2AD, the maximum concentration occurred 70 days after injection. In an ideal aquifer, the peak concentration occurs when 50 percent of the mass of dye has reached the downgradient well ($t_{50} = t_{peak}$, in this case). Some of the measured breakthrough curves are asymmetrical, with more than 50 percent of the total mass arriving after the peak. The groundwater flow model simulates the movement of the center of mass (t_{50}). For this analysis, the model was calibrated to match the timing of the peak concentration (t_{peak}), which produces conservatively shorter estimates of travel time than using the t_{50}.

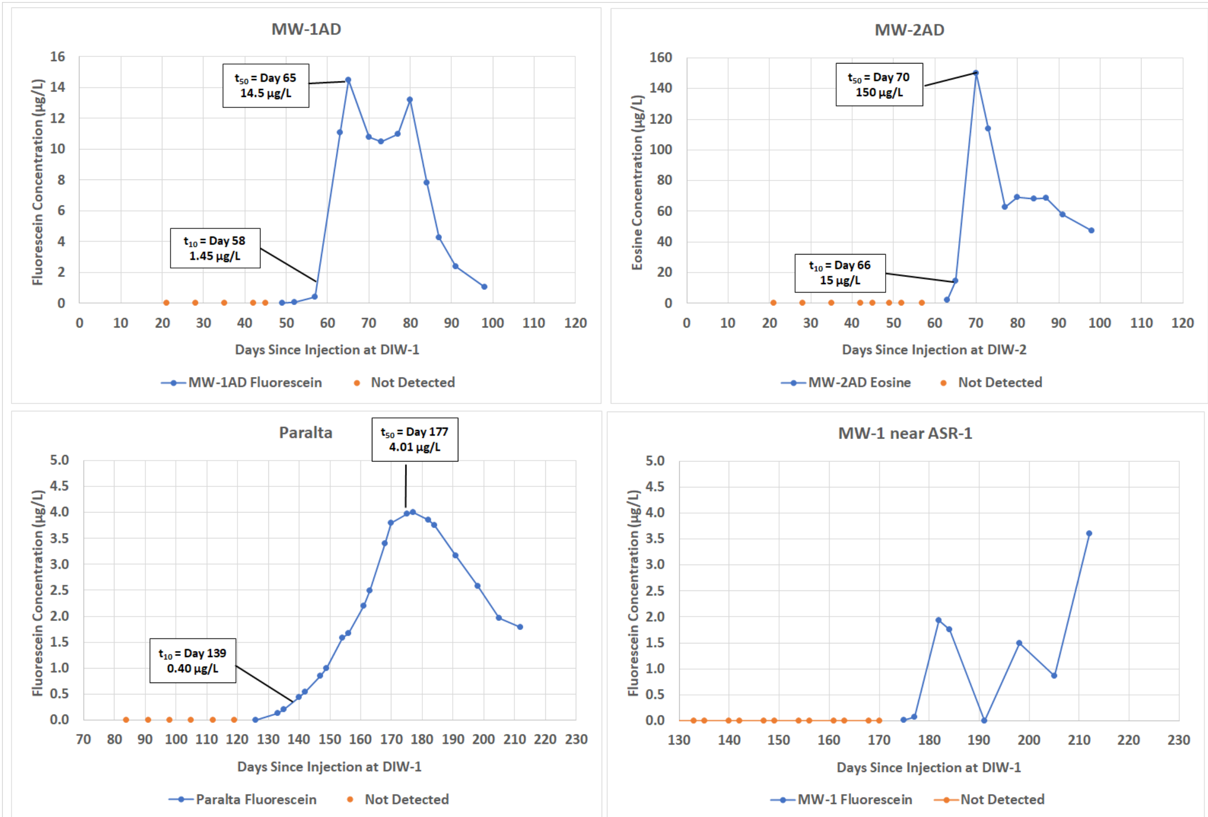

Figure 5-2. Downgradient Dye Concentrations for the First Extrinsic Tracer Study

The GRRP regulations require the underground retention time to be based on the travel time of an assumed leading edge of the plume of injected water, not the center of mass. Spatial variability in permeability of aquifer materials results in multiple flow pathways, some faster than others. Title 22 Criteria (Table 60320.208) specifies that the underground retention time shall be represented by 10 percent of the peak tracer concentration measured at the downgradient monitoring point, or t_{10} travel time. For MW-1AD and MW-2AD, t_{10} travel times were calculated from the shape of the time-concentration plots (**Figure 5-2**) and were 58 and 66 days, respectively. The ratio of t_{10}/t_{peak} was 0.89 at MW-1AD and 0.94 at MW-2AD.

Fluorescein dye was first detected at Paralta 133 days after it was injected and reached a peak concentration at 177 days. The t_{10} travel time calculated from the curve was 139 days or 4.6 months. The ratio of t_{10}/t_{peak} at Paralta was 0.79, which reflects the greater amount of total dispersion over the longer flow path, compared with MW-1AD and MW-2AD. The decrease in the t_{10}/t_{peak} ratio was assumed to be linear with distance, and the calculated slope of the ratio between MW-1AD and Paralta was -0.00010 per foot of distance. This relationship was used to estimate the t_{10}/t_{peak} ratio for other downgradient wells in order to obtain estimates of t_{10} travel times from the simulated t_{peak} travel times. DDW accepted the results of the extrinsic tracer study in the August 30, 2022 letter to M1W.

The second extrinsic tracer study was initiated on October 25, 2022 with the injection of fluorescein dye into DIW-3 and DIW-4. Concentrations were subsequently monitored at ASR-3, Paralta, Ord Grove 2 and Seaside Muni #4 wells. Monitoring results through January 9, 2024 are shown in **Figure 5-3**.

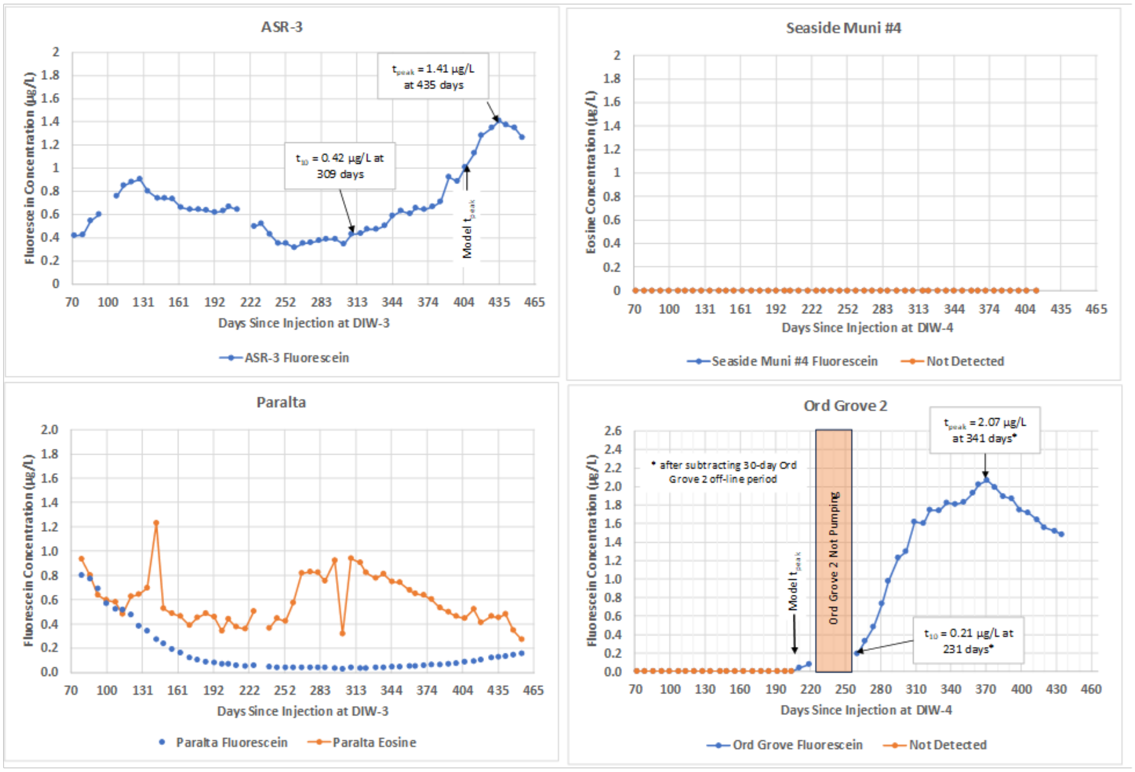

Figure 5-3. Downgradient Dye Concentrations for Second Extrinsic Tracer Study

The results from the second extrinsic tracer study confirm that the model is conservative with respect to travel times, evidenced by the model simulating t_{peak} travels times equal to or faster than observed.

Fluorescein from DIW-3 had not arrived at Paralta as of the 420th day (month 13.8) following injection. Model simulations following the first added tracer study indicated a travel time of 9.7 months for a scenario with a similar rate of DIW-3 injection. The longer observed travel time is likely the result of injection of Carmel River water at ASR-1 and ASR-2 during January to March 2023. This injection deflects DIW-3 water into a longer, curved flow path on its way to the Paralta well.

Eosine from the first extrinsic tracer study was detected at Paralta during the second extrinsic tracer study. Eosine monitoring was continued to determine if eosine injected at DIW-2 for the first tracer study had finally arrived. Eosine was present at Paralta throughout the second tracer study monitoring period and exhibited a peak on August 23, 2023, or 21.9 months after injection. This is roughly three times longer than the simulated t_{peak} travel time. This peak might be a delayed secondary peak representing flow through a less permeable part of the aquifer. Notably, the eosine concentration was declining for the first 4 months of monitoring, suggesting a prior peak had occurred between the monitoring periods for the first and second tracer studies.

At ASR-3, the measured fluorescein peak from injection at DIW-3 occurred 14.5 months after injection, almost exactly at the time previously simulated by the model (14.6 months).

Dye was not detected at Seaside Muni #4, as expected from modeling results. Seaside Muni #4 is the drinking water well that is geographically closest to DIW-4, but it is not downgradient of DIW-4 except at high rates of injection. Water injected at DIW-4 moves toward Ord Grove 2 because the regional gradient is aligned in that direction, Ord Grove 2 has a higher pumping rate (typically approximately 120 AF/month versus approximately 15 AF/month at Seaside Muni #4) and it has more screen length in the Santa Margarita Aquifer. At the DIW-4 injection rate in the likely operating scenario, all of the injected water flows toward Ord Grove 2 and none flows towards Seaside Muni #4. In test simulations with higher injection rates, the initial radial component of flow outward from DIW-4 created flow paths that reached Seaside Muni #4, but only after 13 months or more. Thus, for travel time compliance purposes, Ord Grove 2 is the nearest drinking water well downgradient of DIW-4.

At Ord Grove 2, the peak fluorescein concentration appears to have occurred on day 371 following injection. However, Ord Grove 2 was off-line for one month in summer 2023, so the t_{peak} travel time can be more accurately stated as 341 days. The model indicated significantly faster travel, with a t_{peak} travel time of 213 days. Thus, the measured travel time was 1.6 times slower than the simulated travel time. The discrepancy cannot be attributed to injection at the ASR wells, which are far away and is likely due to two assumptions in the model that proved to be too conservative and produced excessively fast simulated travel times.

The first conservative assumption was the presence of a totally impermeable flow barrier parallel to the DIW-4 to Ord Grove 2 flow path but offset to the northeast. The presence of such a barrier was hypothesized based on several pieces of evidence: the crest of a known anticline, where pinching and faulting could reduce aquifer transmissivity; the absence of drawdown effects at wells on one side of the barrier from pumping at wells on the other side; and the lack of water quality effects at Ord Grove 2 from Carmel River water injected at ASR-1 and ASR-2 after more than 15 years of ASR operation. However, the tracer study showed that the assumption of a completely impermeable barrier was too extreme. Sensitivity tests indicate the barrier shortened simulated travel time between DIW-4 and Ord Grove 2 by approximately 20 percent (see **Appendix K**).

The second conservative assumption was that all water produced by Ord Grove 2 was derived from the Santa Margarita Aquifer. Recent mixing calculations based on differences in chloride and TDS concentrations between the Paso Robles and Santa Margarita Aquifers indicate 58-80 percent of the water produced by Ord Grove 2 is from the Santa Margarita Aquifer. The model currently retains an older assumption that all of the water derives from the Santa Margarita Aquifer, which overestimated actual withdrawal from that aquifer by a factor of 1.4. Travel time between the well pair is inversely proportional to pumping rate, so the pumping error would translate directly to a travel time error. Combining the potential errors from the two conservative assumptions produces an overall error approximately equal to the observed discrepancy (1.2 x 1.4 = 1.68).

A sensitivity analysis was completed with a more accurate 70:30 split in Paso Robles:Santa Margarita Aquifer flow into DIW-4, and the anticline was omitted. This increased the simulated

t_{10} travel time from 4.8 to 6.6 months (much closer to the tracer study t_{10} travel time of 7.7 months). The Sensitivity Analysis of Simulated Subsurface Travel Time from DIW-4 to Ord Grove 2 is provided in **Appendix K**. The results demonstrate that simulated travel times for that well pair are conservatively fast.

The sensitivity analysis in **Appendix K** reaffirms that the DIW-1 to Paralta travel time is the shortest for all well pairs; therefore, this is the only well pair where monitoring wells are appropriate and the correct measure for establishing a minimum travel time and minimum project virus log removal and response retention time.

5.3.3 Model Calibration

The results of the DIW-1 and DIW-2 extrinsic tracer study in 2021 were used to calibrate the Watermaster Model and estimate travel times to other downgradient drinking water wells. The first step was to adjust the calibrated value of effective porosity to match the observed t_{peak} travel times. This single variable was used to account for the combined effects of effective porosity and preferential flow, which is flow through layers of coarse sediment that are much narrower and thinner than the width and thickness of the model layer. A global effective porosity value of 0.062 (dimensionless) accurately reproduced the peak arrival time at Paralta and it is reasonable to apply this effective porosity to simulate travel to other downgradient wells at similar distances. This value of effective porosity is smaller than the normal range of values for aquifer materials because in the model the effective porosity also accounts for the small cross-sectional area of preferential flow paths. Details of model calibration are presented in **Appendix F**, including tables added with assumptions and results requested by DDW.

5.3.4 Simulation of Expanded Project Operational Scenarios

The model was used to simulate operation of Project injection and Cal-Am extraction over a 3-year period nominally starting in 2025, after DIW-5, DIW-6, and extraction from existing and new Cal-Am wells are expected to become operational. This differs from modeling for the 2019 Engineering Report, which used a 25-year simulation period to test the extent to which ASR operations and wet and dry years affect water levels and travel times. That modeling showed hydrologic year type had a negligible effect on travel time. A 3-year simulation period is sufficiently long to determine travel times of interest, which are on the order of 4 months. The scenarios were run in sequence in a single, long model run. The first year of each scenario allowed flow conditions to adjust from the prior scenario. Particles of injected water were released in each month of the second year, and the third year allowed travel times for particles released late in the second year to be simulated until they arrived at downgradient extraction wells.

Previous modeling also showed that ASR injection always slowed travel times. Accordingly, the current set of simulations conservatively assumes no ASR injection. Because of its location, ASR injection slows the movement of injected water from DIW-1 and DIW-2 to Paralta, which is the nearest downgradient drinking water well.

Added tracer tests and subsequent model calibration demonstrate the shortest underground retention times are in the order of months. Therefore, it is not necessary to complete a 25-year simulation with variable hydrology to calculate travel times.

5.3.4.1 Assumptions and Data for Operational Scenario Simulations

The extraction pattern on the Monterey Peninsula changed significantly beginning in January 2022 when Cal-Am began to comply with the State Water Board Cease and Desist Order 95-10 annual volumetric limits of diversions (3,376 AFY) from the Carmel River alluvial aquifer. The two major pressure zones of the Cal-Am system are inter-connected and, with the recent addition of the Monterey Pipeline and parallel General Jim Moore Pipeline, these systems can now feed each other. Production data after compliance with the annual volumetric limits are used for extraction modeling in an effort to simulate real-life pressure limitations, losses, and well capacities since the recent shift of substantial production volumes from the Carmel Valley to the Seaside Groundwater Basin. Water year 2022 was the second of two hydrologically dry years and water year 2023 was an extremely wet hydrologic year.

The amount of water which Cal-Am produces from its Seaside Basin wells was assumed to equal the system water demand minus the amounts of water available to Cal-Am from Carmel Valley sources and from the Sand City desalination facility. Cal-Am is able to use its legal water rights to the Carmel River alluvial water system and meet the remaining system demand with its Seaside Basin wells. Accordingly, preparation of the Seaside Basin extraction (production) data set for a scenario begins with assumptions regarding the availability of Carmel Valley water.

Travel times were simulated using: (1) actual operation of the PWM injection wells and basin extraction wells under recent historical conditions (June 2022 through July 2024) based on regression equations, (2) future conditions with the Expanded PWM Project operations and basin extraction wells operated to recover native, ASR and Expanded PWM Project water. Only the existing operational DIWs and Cal-Am wells were included in the analysis of recent travel times. Equations relating simulated t_{10} travel times from each injection-extraction well pair to their combined injection and extraction rates were developed based on the results of numerous prior model simulations. The equations relied upon relationships from the model after it was calibrated using the four tracer studies of existing wells. Those relationships are documented in **Appendix F**.

A 4-month travel time is used to monitor compliance with GRRP regulations because the minimum travel time target is 4 months for this Project. The 4-month t_{10} travel time is determined by the 4-month average injection-extraction rates at each well pair.[22]

[22] The equations were developed when operation of the Carmel River ASR project was not occurring as ASR operations build up a mound of injected Carmel River water between the PWM injection and extraction well couplet and does not represent the fastest travel times between injection and extraction. Modeling of ASR and PWM operations has shown that 1 month of ASR operations will build a mound of groundwater under the ASR site that will make the equations non-applicable because they would calculate travel times much faster than are occurring. Conversely, after stopping injection at the ASR facility it takes 1 month for the mound under the ASR facility to subside before the developed equations become applicable again. This is reflected in Figures 5-4 and 5-5 where travel times are not plotted during, or for the month immediately after, ASR operations.

The results of the analyses of travel time from June 2022 to July 2024 under actual operating conditions for the two closest well pairs (DIW-1 to Paralta and DIW-4 to Ord Grove 2) are shown in **Figures 5-4** and **5-5.** For DIW-1 to Paralta, the estimated t_{10} travel time ranged from 4.8 to 5.5 months. For DIW-4 to Ord Grove 2, the estimated t_{10} travel time ranged from 6.6 to 7.8 months. The data reflected in the charts were presented in the Monterey Peninsula Water Operations Committee meeting (previously referred to as the Seaside Basin Water Quality and Operations meetings). Every quarter the Monterey Peninsula water operators and regulators meet to review past and future project operations and plans, including presentation of past and predicted future Project travel times based on information received from the Quarterly Water Supply Strategy and Budget Meetings held in accordance with SWRCB Orders 95-10, 98-04, 2002-02, and 2016-0016, the Seaside Basin Adjudication Decision, and District Rule 160. During the Quarterly Water Supply Strategy and Budget Meetings, Cal-Am submits 'water budgets' which show the anticipated makeup of water supplies for the next 3-month period to assure fisheries agencies and the State Water Board that extractions will comply with CDO requirements and other water rights restrictions. This water budget is presented during that meeting and approved, after which MPWMD uses it to develop the range of extraction and associated injection scenarios for the upcoming quarter to ensure a minimum 4-months travel time will always be met. In addition, Cal-Am is required to submit daily volumetric data to MPWMD by the 15th of the month following extraction from its wells which are used in the past actual travel time calculations. Since Project startup, there has never been a time when the 4-month travel time has not been met as verified by this quarterly exercise that is reviewed with stakeholders.

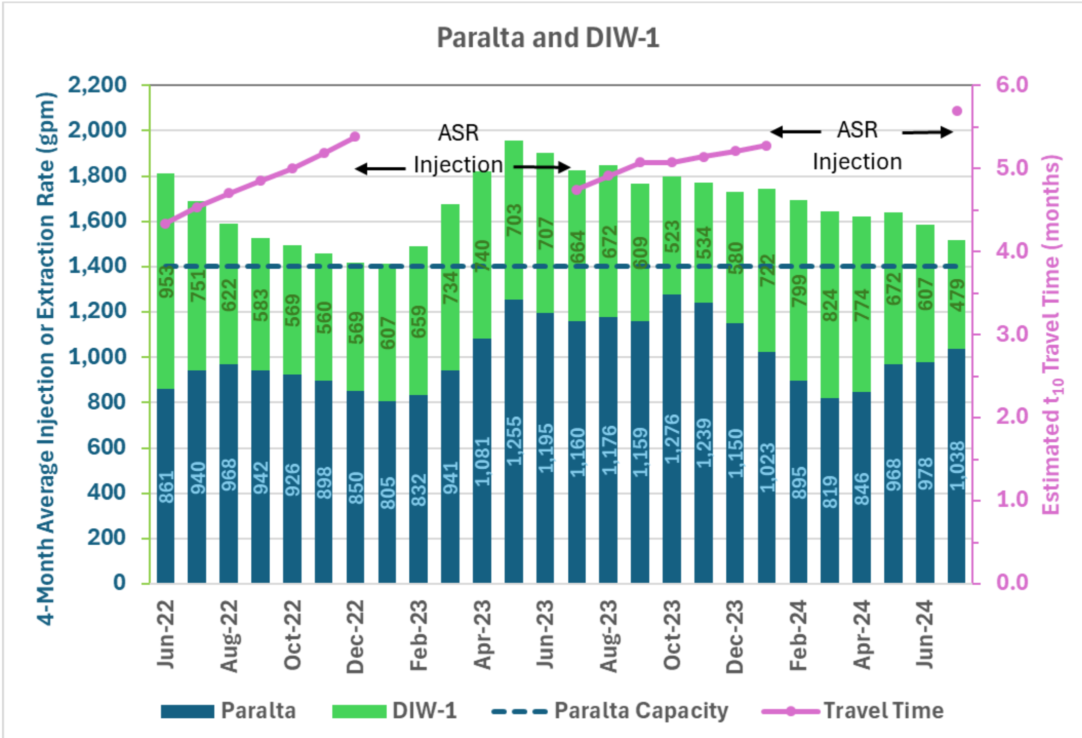

Figure 5-4. Simulated t_{10} Travel Time from DIW-1 to Paralta during 2022-2024

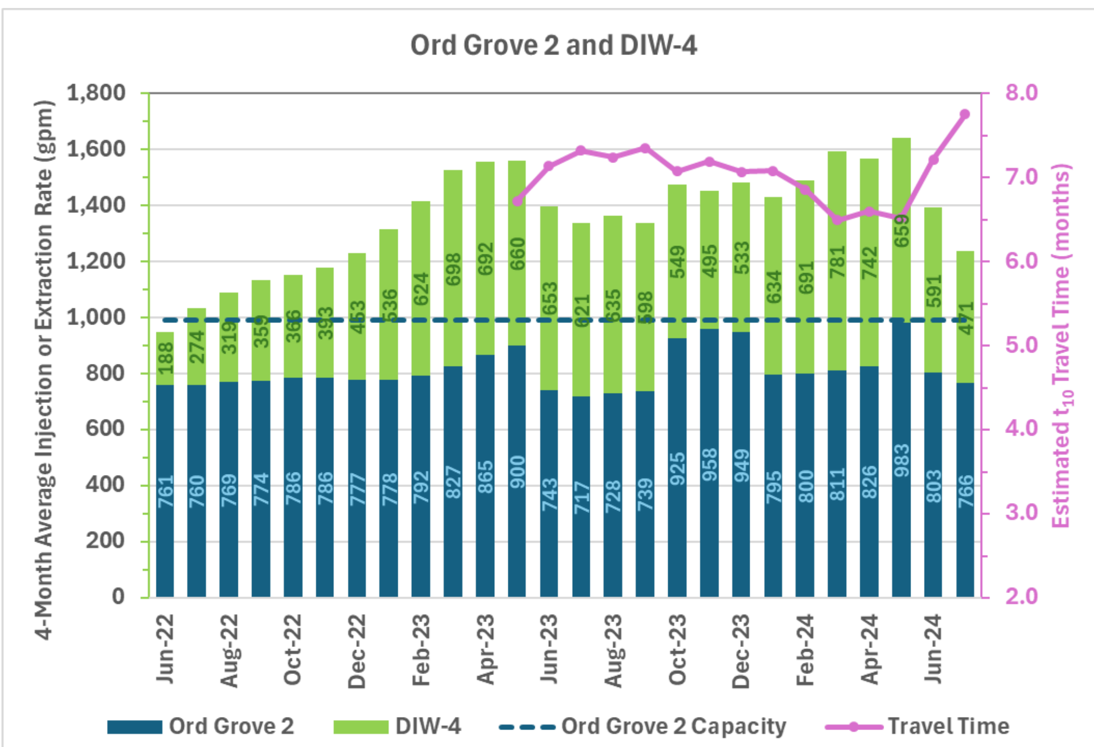

Figure 5-5. Simulated t_{10} Travel Time from DIW-4 to Ord Grove 2 during 2022-2024

Simulations of Expanded Project operation under future conditions included DIW-5, DIW-6, up to four additional Cal-Am extraction wells (EW-1, EW-2, EW-3 and EW-4), and the recently permitted ASR-4. The results of these future condition modeling efforts are presented in the subsequent sections on a monthly timestep.

In response to a question from DDW regarding why Carmel Valley wells are related to the groundwater modeling, Cal-Am typically maximizes its use of available Carmel Valley water and supplies the remaining demand with its Seaside Basin wells on an annual basis. Accordingly, preparation of the pumping dataset for a scenario begins with assumptions regarding the planned use of Carmel Valley water. In a phone call with Maureen Hamilton, PE (MPWMD District Engineer), Chris Cook, PE (Cal-Am (former) Operations Director) confirmed M1W's Carmel Valley pumping assumptions for the modeling scenarios including under the Expanded PWM Project conditions with either two new Extraction Wells (EW-1 and EW-2) or with all four new Extraction Wells (EW-1 through EW-4) operating.[23] In addition, Tim O'Halloran, PE (Cal-Am's Vice President of Engineering) also confirmed the assumptions about capacities of EW-1 and EW-2 in an email on September 19, 2024.

For a given month, a conservative estimate of Seaside Groundwater Basin extraction is calculated by subtracting the average Lower Carmel Valley extraction for that month from a conservative maximum total water extraction for the same month. Maximum total water extraction comes from the Seaside Groundwater Basin and the Carmel Valley, which may include the Upper Carmel Valley if there is enough flow in the river to meet the permit conditions for Upper Carmel Valley wells. Extraction for ASR injection is not counted because ASR injection results in much longer Seaside Groundwater Basin travel times and is assumed to not occur during the modeling scenarios as a conservative assumption. The formula for a given month is shown below for ease of reading:

SGB Extraction = Maximum (SGB + CV excluding ASR Injection) – Average (LCV)
SGB – Seaside Groundwater Basin
CV – Carmel Valley, includes Upper Carmel Valley and LCV
LCV – Lower Carmel Valley

The annual extraction is calculated as the sum of each month's extraction and provides a validation of the approach.

- The annual Lower Carmel Valley extraction total was 3,400 AFY, which is a valid and conservative estimate of the Cease and Desist Order compliant extraction limit of 3,376 AFY plus the Mal Paso water right extraction limit of 85.6 AFY.
- The combined annual extraction for customer service from the Seaside Groundwater Basin

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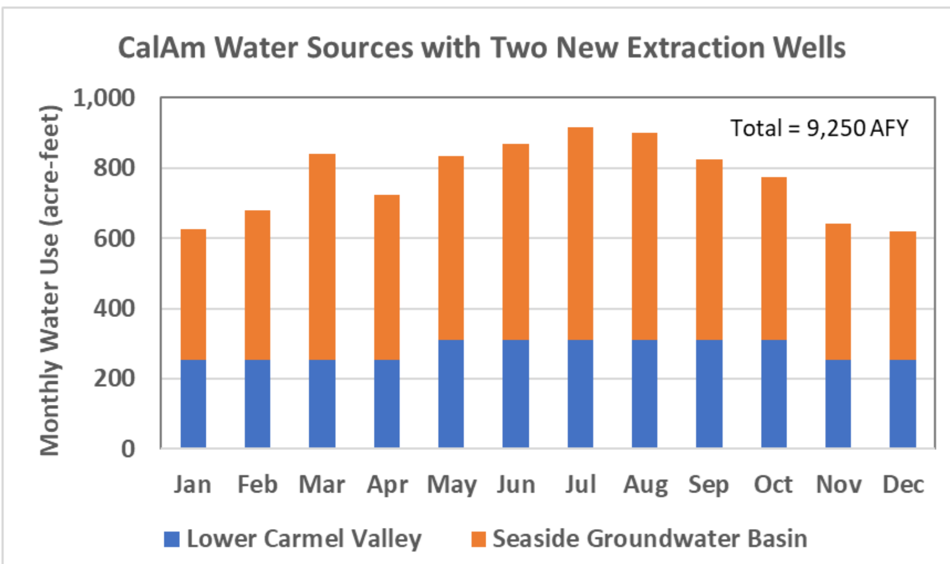
[23] Email from M. Hamilton, MPWMD to G. Yates, Todd Groundwater summarizing a telephone conversation with C. Cook, Cal-Am's former Operations Manager on Nov. 14, 2023.

and Lower Carmel Valley was 9,250 AFY which is a valid estimate of customer demand when additional water supply sources of the Sand City Desalination Plant and Upper Carmel Valley extractions are considered.

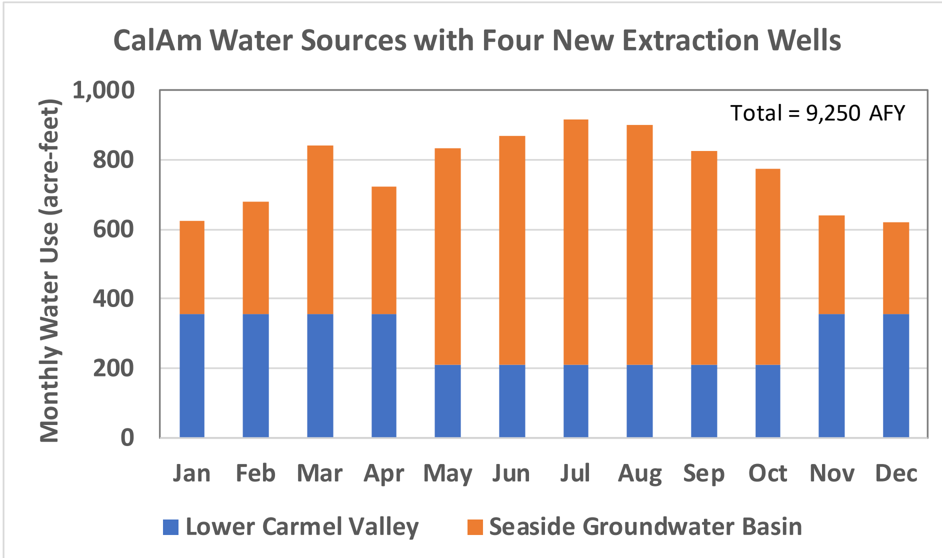
- Lastly, assuming the entire 5,850 AFY of Seaside Groundwater Basin extraction is coming from the deeper Santa Margarita aquifer is conservative because Seaside Groundwater Basin extraction also comes from the shallow Paso Robles aquifer.

The seasonal pattern of Cal-Am extraction depends on the availability of new extraction wells in the Seaside Groundwater Basin. With only its existing wells and two new extraction wells (EW-1 and EW-2), Cal-Am will need to take some of its Carmel Valley allocation during the summer months when water demand is highest. With construction of the two planned additional extraction wells (EW-3 and EW-4), more of the summer demand can be supplied by the Seaside Groundwater Basin wells. This allows the Carmel Valley diversions to be shifted more toward the winter months, thereby reducing impacts on summer flows in the Carmel River.[24]

Figure 5-6 shows the seasonal pattern of water sources for these two conditions. The greater use of Seaside Groundwater Basin wells in scenarios with four new Cal-Am wells affects simulated travel times of injected Project water.



[24] Email from M. Hamilton, MPWMD to G. Yates, Todd Groundwater summarizing a telephone conversation with C. Cook, Cal-Am's former Operations Manager on Nov. 14, 2023.



Note: Excludes water from the Sand City desalination plant, upper Carmel Valley wells, and Table 13, which are relatively small or conservatively assumed to be zero in the scenarios.

Figure 5-6. Seasonal Pattern of Cal-Am Water Use

Cal-Am has some flexibility for distributing groundwater extraction among its wells, more so when all four new extraction wells are constructed. The simulated scenarios tested extraction patterns that were most likely to produce the fastest travel times from the Project's deep injection wells. The scenarios tested several extraction distributions, each focusing extraction in one geographic area (for example, at ASR-3 and ASR-4, or EW-1 and EW-2, or EW-3 and EW-4) to the extent possible to test for fast travel times.

Cal-Am has two service areas: (1) the Seaside Pressure Zone in and near the City of Seaside and supplied by Ord Grove 2, Luzern, Playa #3, Plumas #4, and (2) a connection to the surrounding higher pressure zone in the Monterey Peninsula service area. The higher pressure zone is supplied by Seaside Groundwater Basin extraction from ASR-3, ASR-4, and eventually by the four new Cal-Am extraction wells along General Jim Moore Boulevard (EW-1 and EW-2 are currently in construction). Paralta can feed into the Seaside Pressure Zone or the higher pressure zone.

Currently Paralta is plumbed to the higher pressure zone, resulting in higher well capacities at both Paralta and Ord Grove 2. The scenario with the fastest travel times to both Paralta and Ord Grove 2 is the current condition with injection only at DIW-1 through DIW-4 (prior to DIW-5 and DIW-6 operation). Additionally, construction of future Cal-Am extraction wells EW-1 and EW-2 will reduce the extraction required by Paralta and can reduce the required Ord Grove 2 extraction.

When EW-1 and EW-2 are operational, Paralta will again feed water into the Seaside Pressure Zone due to the need to conduct chemical treatment at the Ord Grove 2 site. Both Paralta and Ord Grove 2 capacities decline when Paralta serves the Seaside Pressure Zone due to hydraulic (demand) limitations. Of the Seaside Pressure Zone wells, Paralta and Ord Grove 2 have the highest capacities and are closest to the Project wells. It was conservatively assumed that Playa

#3 and Plumas #4 supplied no water and that all demand was met by Paralta, Ord Grove 2, and Luzern (in that order of priority). This extraction distribution for the Seaside Pressure Zone wells was the same in all scenarios.

The Project also has substantial flexibility regarding the allocation of injection among the deep injection wells. If all six of the deep injection wells were operated at their physical capacities, they could produce approximately 53 percent more than the target annual injection volume of 5,950 AFY (in wet years, when 200 AFY is banked in the drought reserve). The difference between injection capacity and actual injection for the scenario simulations is shown in **Figure 5-7.** The remaining overall surplus injection capacity provides flexibility in the event that one or two injection wells are out of service for maintenance or other issues. The shortest travel time for all scenarios is 4.4 months from DIW-1 to Paralta.

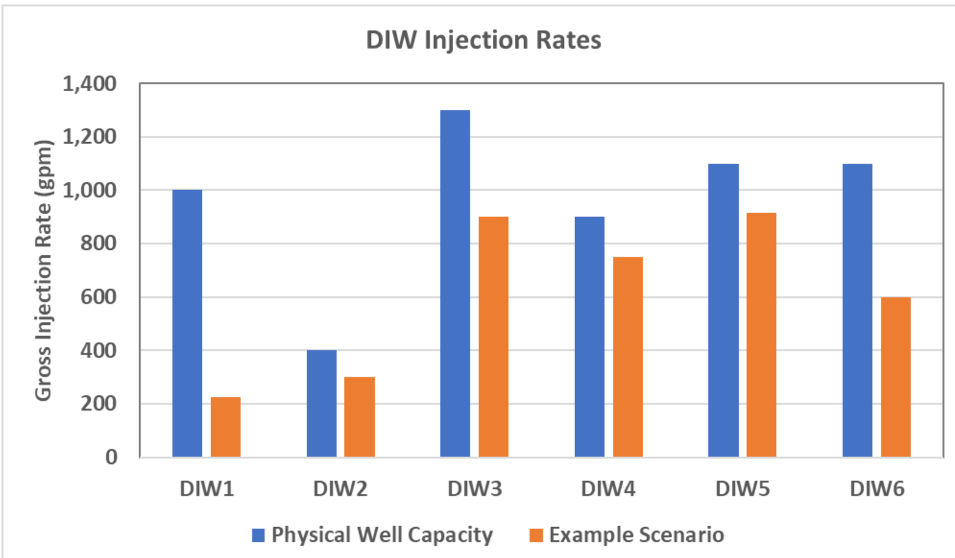


Figure 5-7. Injection Rates at Deep Injection Wells

Injection at the deep injection wells varies seasonally in a pattern opposite that of Cal-Am's extraction. Injection is lower in the summer when source waters are utilized as agricultural irrigation in the Salinas Valley. There is sufficient capacity at the AWPF and at the injection wells to support seasonal variations in injection. Accordingly, Project injection was assumed to be low in summer and high in winter to maintain relatively constant travel times. The advantage of seasonal variation in injection is that it avoids fast travel times in summer.

Travel time between an injection well and extraction well is proportional to the sum of their pumping rates. Cal-Am's extraction rates follow the seasonal pattern of water demand: high in summer and low in winter exclusive of ASR injection seasons. During ASR injection, travel time greatly increases as a mound of ASR injection water is created in between the project injection wells and Cal-Am extraction wells. To provide the most conservative (fastest travel time) model results, all modeling scenarios assumed ASR injection is *not* occurring.

The seasonal pattern used in all scenarios is shown in **Figure 5-8**. The maximum winter month injection volumes (637 AF) are 81 percent of the combined physical capacities of the deep injection wells, so the assumed seasonality pattern retains some flexibility to rearrange injection among the wells in the event one well is out of service or to manage travel times.

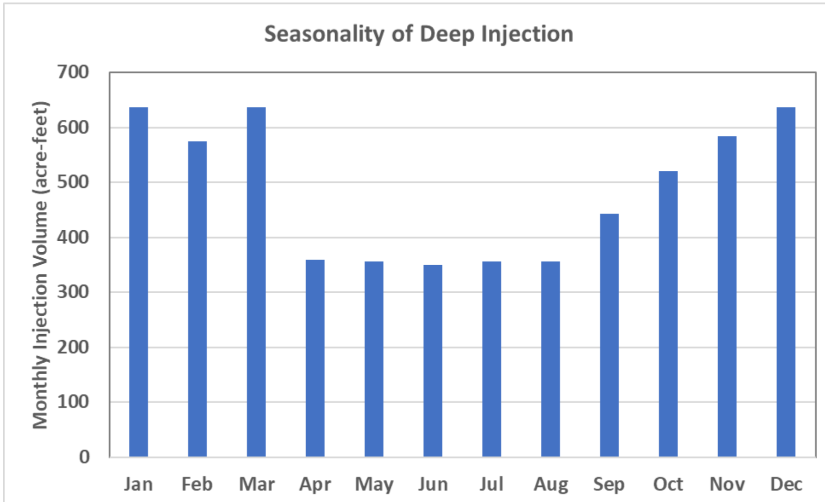


Figure 5-8. Seasonality of Deep Injection

5.3.4.2 Results of Operational Scenario Simulations

The key results from the operational scenario simulations are the underground travel times of injected water to the nearest downgradient drinking water wells and the delineation of zones of control for construction of future drinking water wells. Simulated travel times were first converted from average travel time (t_{peak}) to 10th-percentile travel time (t_{10}) to compare them with regulatory requirements for underground residence time.

Six operational scenarios represent different geographic distributions of injection and extraction among the wells. Each scenario tested an injection-extraction combination likely to produce fast travel times by concentrating the Cal-Am extraction in groups of neighboring wells. The patterns are plausibly within the range of normal operating conditions, which are the conditions required for extrinsic tracer studies (Title 22 Section 60320.224(c)). The results of the particle tracking analysis for an operational scenario with only two new Cal-Am extraction wells are shown in **Figure 5-9.** Each colored trace emanating from a deep injection well represents the movement of a particle of water from a set of starting locations surrounding the well. The color bands along the length of the traces represent one month of travel. This scenario assumed Cal-Am extraction was focused first at ASR-3 followed by ASR-4 and EW-2 and was expected to produce fast travel times from DIW-3. This assumption did indeed produce the fastest simulated travel times from DIW-3 to ASR-3 (t_{10} = 5.6 months), but they were still longer than the travel times from DIW-3 to Paralta (5.2 months) or from DIW-1 to Paralta (4.5 months).

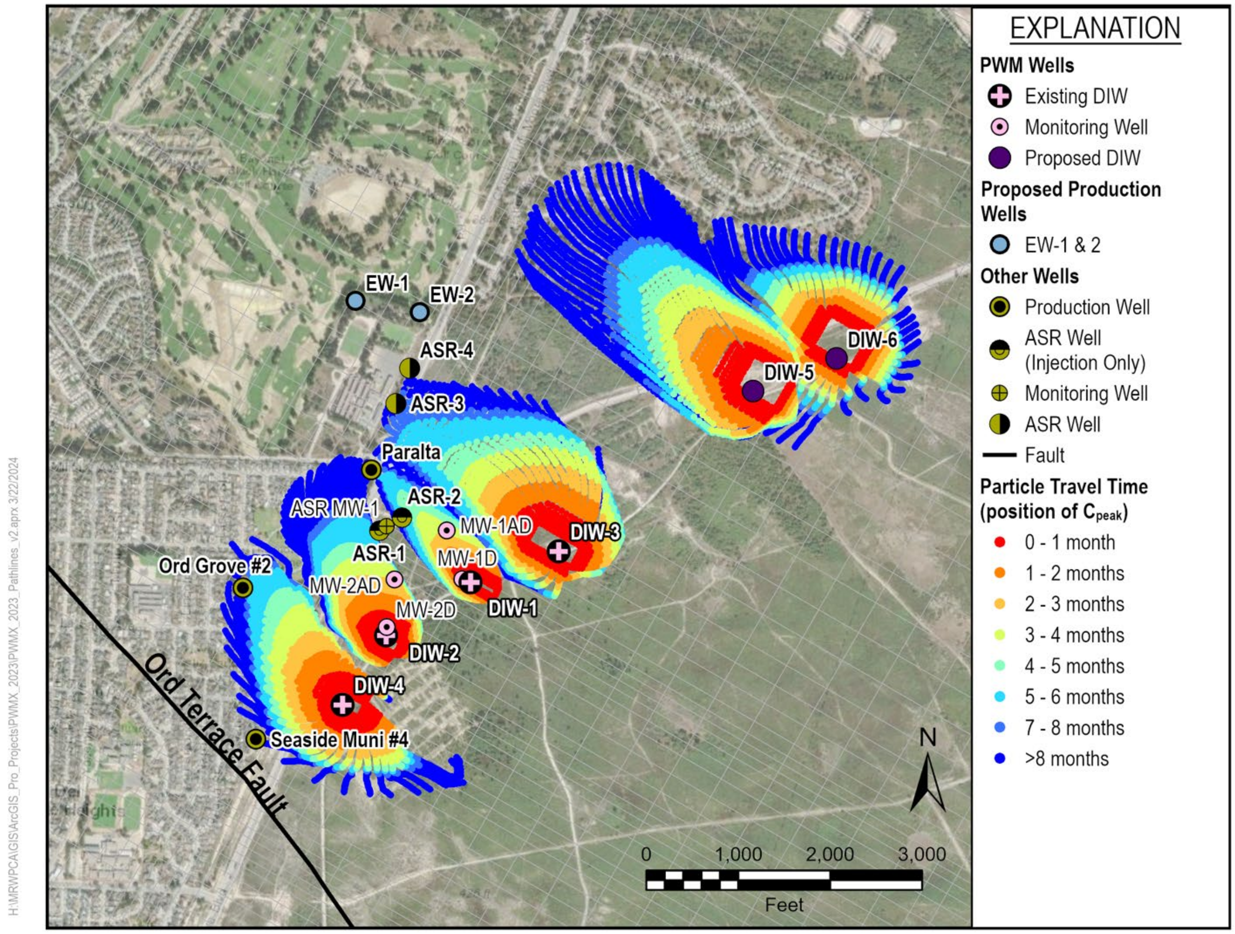


Figure 5-9. Simulated Particle Traces for One Operational Scenario

To illustrate the ability of the Project to maintain the target travel time of greater than 4 months under a wide range of Cal-Am extraction patterns, particle traces for a second operational scenario are shown in **Figure 5-10.** That scenario included the two additional Cal-Am extraction wells and assumed Cal-Am extraction from the General Jim Moore Boulevard wells was focused on EW-3, EW-4, and EW-2 (in order of priority). This was expected to produce the fastest travel times from DIW-5 and DIW-6 to those wells. The simulated travel time from DIW-5 to EW-3 was 7.4 months, much longer than the 4-month target. Because of interference from the DIW-5 plume, travel time from DIW-6 to EW-3 was twice as long as the travel time from DIW-5. Travel time was long in spite of relatively high injection at DIW-5 simply because the distance to EW-3 is large (over twice the distance between DIW-1 and Paralta).

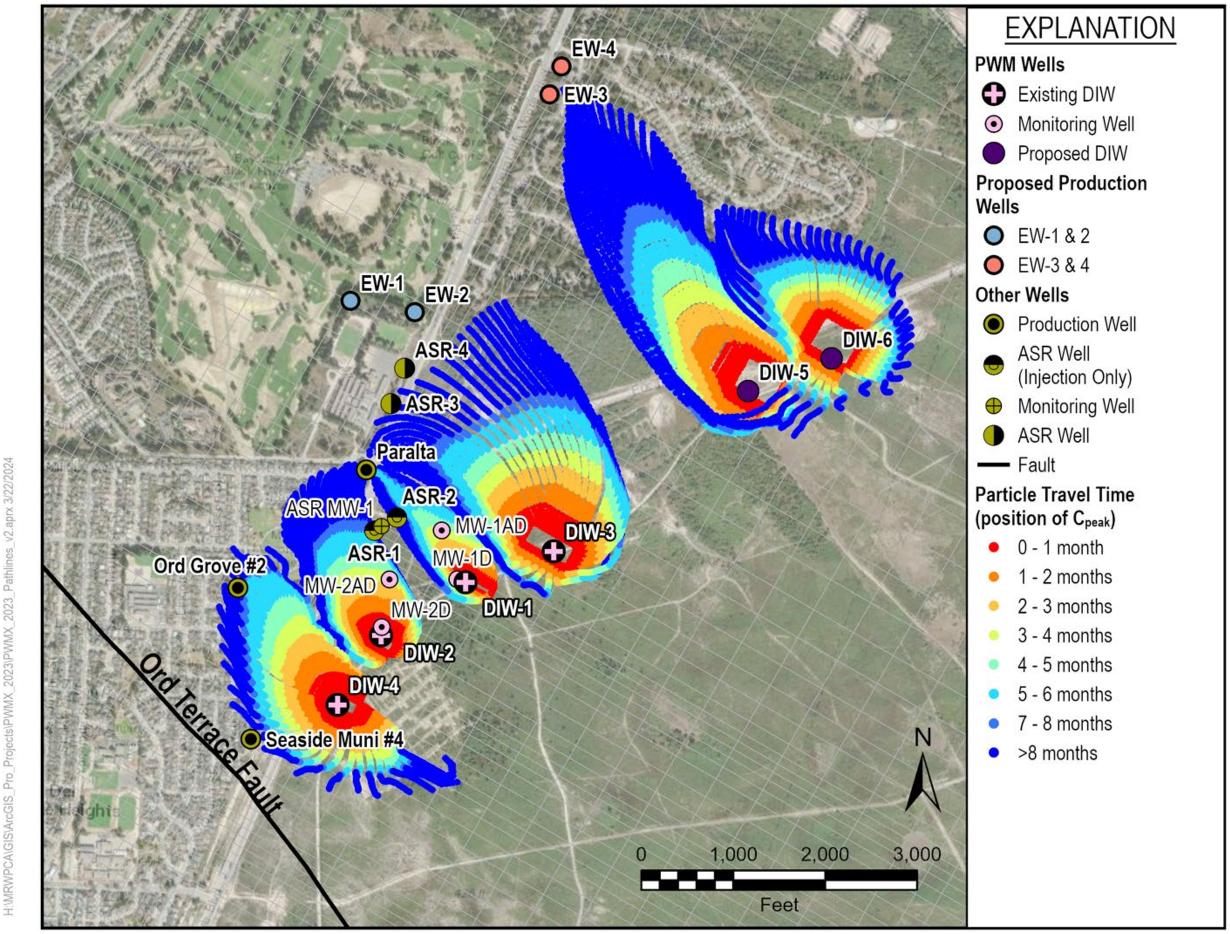


Figure 5-10. Simulated Particle Traces for Another Operational Scenario

A key finding of the scenario simulations was that the Project can operate to achieve a t_{10} travel time of 4.4 months or greater for all DIWs under every Cal-Am extraction scenario even without ASR injections. The two scenarios shown here had the shortest travel times--the first had the shortest travel time with only EW-1 and EW-2 operating (and not EW-3 and EW-4), and the second produced the shortest travel time with all four EWs operating.

The injection allocations and resulting travel times are summarized in **Table 5-3**. This simplifies Project operation, because adjustments to the injection pattern will be needed only in unusual circumstances, such as when one of the wells is out of service. The “extra” 0.4 month of simulated travel time (4.4 versus the target of 4.0 months) provides additional assurance that there is flexibility to implement variations in the injection pattern without causing travel times of less than 4 months.

Table 5-3. Injection Rates and Simulated Travel Times for Operational Scenarios

	DIW-1	DIW-2	DIW-3	DIW-4	DIW-5	DIW-6	Total
Annual Injection[1]							
Acre-Feet	354	472	1,415	1,181	1,441	945	5,809
% of Total	6.1%	8.1%	24.4%	20.3%	24.8%	16.3%	100%
Maximum Winter Injection[1]							
Gallons Per Minute	289	385	1,155	963	1,175	770	4,737
Acre-feet Per Month	40	53	158	132	161	106	649
% of Capacity[2]	29%	96%	89%	107%	107%	70%	82%
Minimum t_{10} Travel Time							
Nearest Extraction Well[3]	Paralta	Paralta	ASR-3	Ord Grove 2	EW-3 & 4	EW-3 & 4	
Average Injection Rate (AF/month)[4,6]	36	46	126	112	117	81	518
Average Injection Rate (% of capacity)	28%	88%	74%	94%	81%	56%	68%
Average Extraction Rate (AF/month)[4,7]	136	133	167	70	282	179	653
Average Extraction Rate (% of capacity)[7]	72%	71%	83%	53%	70%	44%	70%
T_{10} Travel Time (months)[4]	4.4	5.5	5.4	6.6	7.5	15.4	

Notes:

1. Injection amounts are net after backflushing and also do not include Vadose zone well injection.
2. The injection-apportioning algorithm resulted in two instances with injection slightly above the well's long-term capacity. Because travel time exceeded 4 months even at those high rates of injection, the simulation was not revised to have a slightly different injection allocation.
3. The nearest extraction well is based on travel time, not map distance.
4. Injection and extraction amounts are averages over the number of months equal to the t_{50} travel time that corresponds to the reported t10 travel time. All months are assumed to be 365/12 = 30.4 days long when converting from AF/day to AF/month.
5. The listed travel times are the shortest times between a well pair among the six simulated scenarios.
6. Total annual and monthly injection volumes at DIW wells were the same in all scenarios, as was the distribution among the deep injection wells.
7. Total CalAm production and capacity is for the downgradient wells: Paralta, ASR-3, Ord Grove 2, EW-3 and EW-4.

n.a. = not applicable

The upper part of **Table 5-3** shows the distribution of annual injection among the deep injection wells used in all of the scenarios. The middle part shows the maximum injection rate in winter for each DIW and confirms that additional capacity is available at four of the six wells. The third section shows the shortest t_{10} travel time for each DIW and downgradient Cal-Am well simulated in any of the six scenarios. Also shown are the average injection and extraction rates over the travel time period. The shortest t_{10} travel time was 4.4 months from DIW-1 to Paralta. For all other well pairs, the shortest simulated travel time was 5.4 months or more. Although for some well pairs, higher injection or extraction *continuously* for four months or more would result in shorter travel times; therefore, DDW requested additional simulations which are provided in the next section.

5.3.4.3 Results of Maximum-Capacity Simulations

The operational scenarios described above include conservative assumptions that produce relatively fast travel times but are within the range of "normal operating conditions." DDW requested additional simulations of travel times with individual Cal-Am wells operating at their maximum physical capacities continuously for 4 or more months. Cal-Am has not operated any of its wells that way historically. Prolonged pumping at maximum capacity would only conceivably occur under temporary emergency conditions, such as multiple Cal-Am wells being out of service or an interruption in delivery of any Carmel Valley water to Cal-Am customers in much of their service area. Specifically, DDW requested additional simulations of two well pairs: DIW-1 to Paralta and DIW-4 to Ord Grove 2. For the other well pairs, the travel times from the scenario simulations were sufficiently long and/or the injection and extraction rates were sufficiently close to the maximum physical capacities that it was clear travel times would exceed 4 months even at maximum capacity.

The simulation of Paralta pumping at maximum capacity incorporates multiple conservative assumptions that from a practical standpoint have a low chance of occurring at the same time:

- No Upper Carmel Valley water supply available to CalAm.
- No ASR injection.
- Paralta extracting at 1,400 gpm (6.19 acre-feet/day, AF/d), which is only possible when it is supplying the high pressure zone.
- Paralta extracting at maximum capacity for 12 months continuously.
- ASR-3 concurrently extracting at maximum capacity for 12 months (ASR-3 is located close to Paralta and in line with the DIW-1 to Paralta flow path, and ASR-3 extraction consequently accelerates travel from DIW-1 to Paralta slightly).

Injection at DIW-1 was incrementally decreased from 100 percent of its physical capacity to 75, 50, and 25 percent, each for a period of 3 years. Details of the injection and extraction time series for all wells are provided in **Appendix F**.

The results of the simulation are shown in **Figure 5-11**, which plots travel time versus the sum of DIW-1 injection rate and Paralta extraction rate. Travel time is proportional to this sum, so the datapoints create a linear pattern. Paralta extraction is constant at its maximum physical capacity of 6.19 AF/d, which equals a pumping rate of 1,400 gpm. From left to right, the data points are the fastest t_{10} travel time for any month of the simulation for DIW-1 injection at 25, 50, 75 and 100 percent of capacity. The line through the datapoints crosses the 4-month travel time threshold at a combined injection-plus-extraction rate equal to 7.14 AF/d. Thus, for any Paralta extraction rate, the four-month average DIW-1 injection rate that will always exceed the 4-month travel time target is:

$$\text{DIW-1} \leq 7.14 - \text{Paralta}$$

(all rates in acre-feet per day)

These flows are average flows over the 4 months of simulated travel time. Brief periods of above-average injection or extraction can be balanced by other periods with below-average injection or extraction over the course of the four months. If Paralta is extracting at its maximum physical capacity (6.19 AF/d), the maximum DIW-1 injection rate would be 0.95 AF/d. This corresponds to 215 gpm, or 22 percent of its physical capacity (after accounting for backflush cycles).

The four-month average DIW-1 injection rate that will always exceed the 4-month travel time target expressed in units of acre-feet per month is:

DIW-1 ≤ 217 – Paralta
(all rates in acre-feet per month)

In these units, the Paralta maximum capacity is 188 AF/mo and DIW-1 maximum capacity is 131 AF/mo.

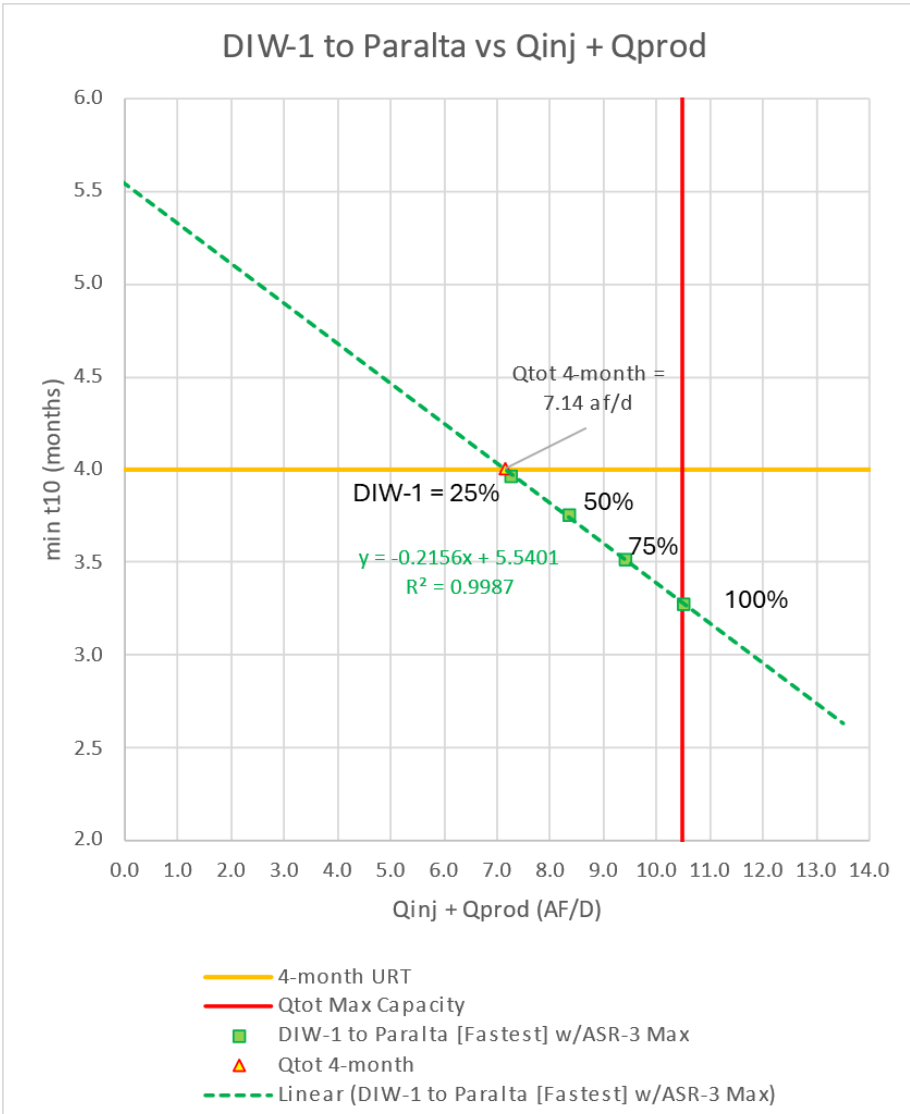


Figure 5-11. Relationship of Travel Time and Combined Injection and Extraction Rate (DIW-1 to Paralta)

The same equation indicates the Paralta extraction rate below which DIW-1 can inject at its full capacity is 217 – 131 = 86 AF/mo, or 640 gpm. During 2022-2024, Paralta extracted 86 AF/mo or less 16 percent of the time. This indicates DIW-1 will need to inject at less than its physical capacity 84 percent of the time, by varying amounts depending on concurrent Paralta extraction.

The same exercise was applied to the DIW-4 and Ord Grove 2 well pair. Previous modeling has confirmed that travel times for this well pair are not significantly affected by injection and extraction at other wells. For the simulation, Ord Grove 2 extraction was held at its physical capacity of 990 gpm (equals 4.38 AF/d or 133 AF/mo) and DIW-4 injection capacity was 3.88 AF/d (118 AF/mo). The simulation tested 100, 75, 50, and 25 percent of DIW-4 capacity in a sequence of 3-year periods. The results are shown in **Figure 5-12**.

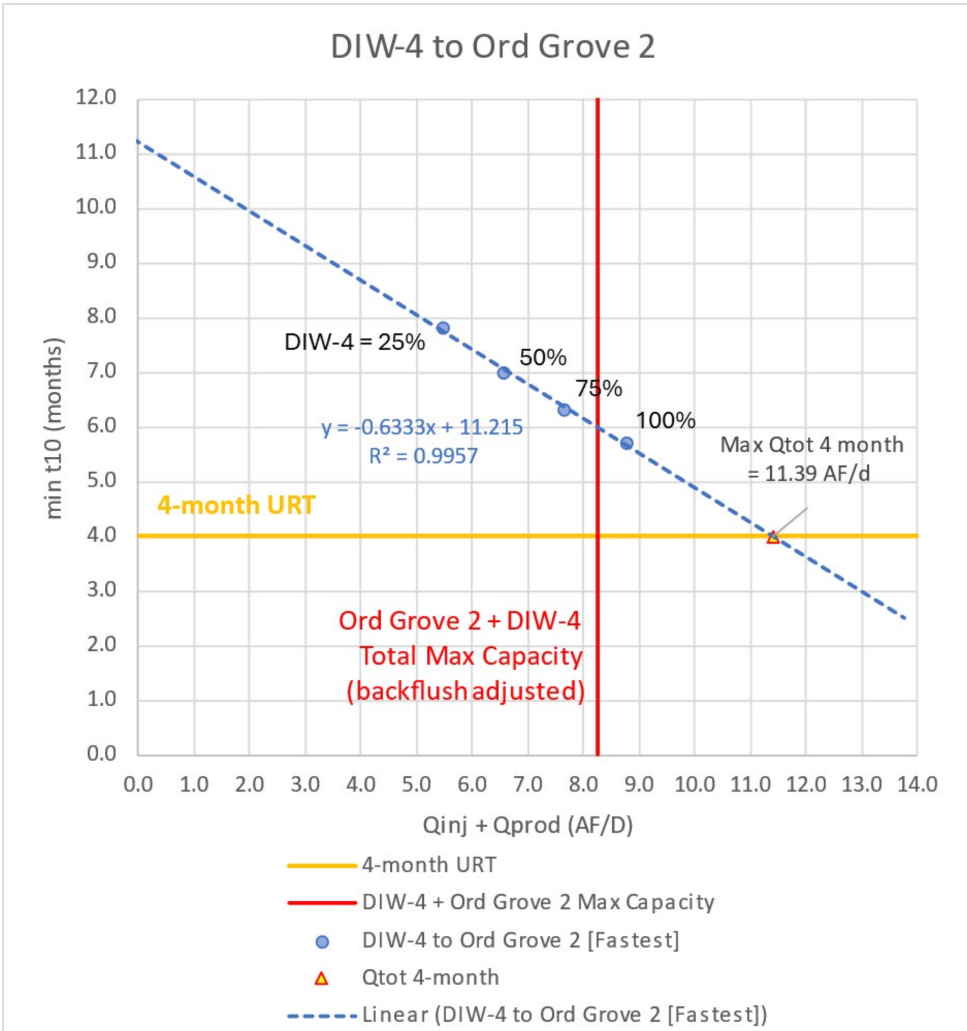


Figure 5-12. Relationship of Travel Time and Combined Injection and Extraction Rate (DIW-4 to Ord Grove 2)

For this well pair, the regression line through the datapoints intersects the 4-month travel time threshold at a combined injection plus extraction rate of 11.39 AF/d. This exceeds the combined capacities of the two wells, which is 8.25 AF/mo. This means DIW-4 can inject up to its physical capacity regardless of the amount of extraction at Ord Grove 2 and still achieve more than 4 months of travel time.

All travel times apply to recycled water injection into the Santa Margarita Aquifer. The Project injects small amounts of recycled water into vadose zone wells VZW-1 and VZW-2 which are located next to DIW-1 and DIW-2. The capacities of the vadose zone wells injecting into the Paso Robles Aquifer proved to be substantially smaller than expected, with injection rates of 20 to 35 gpm. Recycled water has not yet been positively identified as having arrived in any Paso Robles monitoring wells (i.e., MW-1S, MW-1AS and MW-2AS). Water injected into the vadose zone must first percolate downward to the water table, then horizontally through the Paso Robles Aquifer. In 2019, during Project design activities, the vertical travel time was estimated to be at least half a year and the horizontal travel time to off-site shallow monitoring wells was estimated to be approximately one year. Given that actual vadose zone well injection rates are an order of magnitude smaller than the rates assumed in 2019, the horizontal travel time is now estimated to be in excess of two years.

5.4 PATHOGENIC MICROORGANISM CONTROL SUMMARY

The expected pathogen log removal credits for the Project are summarized in **Table 5-4**. The total expected pathogen log removal credit shown in **Table 5-4** applies DDW's existing conditional acceptance of the underground retention time (4 months) and virus log reduction crediting (4-log) approach described in **Section 5.3**. Total pathogen credits for the Project will meet or exceed the Title 22 requirements of 12-log, 10-log, and 10-log for virus, *Giardia* cysts, and *Cryptosporidium* oocysts, respectively.

Table 5-4. Pathogen Log Removal Expectations and Requirements

Process	Treatment Confirmation	Log Reduction Credits		
		Virus	*Giardia*	*Crypto*
RTP Primary & Secondary[1]	Credit not pursued at this time	0	0	0
Ozone[1]	Credit not pursued at this time	0	0	0
MF	Daily PDT and turbidity monitoring	0	4	4
RO	Daily grab samples (strontium) and online monitoring (TOC and Electrical conductivity (EC))	1.5 – 3	1.5 – 3	1.5 – 3
AOP (UV/H_2O_2)	UV dose monitoring[2]	6	6	6
Chloramine - Conveyance Pipeline	Total chlorine residual measured at DIW-4 and DIW-6	2 - 3.5	0	0
Underground Retention Time in Aquifer	Credit determined from project extrinsic tracer study using modeling to extrapolate to DIW-5 and DIW-6	4	0	0
Total Expected Credit using Chloramine Decay at PWPS		13.5 – 16.5	11.5 – 13	11.5 – 13
Required Credit		12	10	10

1. Additional pathogen log reduction occurs during primary, secondary, and ozone treatment. Credit is not pursued at this time.
2. The UV dose is determined through online monitoring of the UVT, UV intensity, and flowrate.

6 RESPONSE RETENTION TIME

In accordance with Title 22 Criteria (Section 60320.224), a project sponsor must propose a response retention time (RRT) no less than two months. The intent of the RRT is to allow ample time to identify any treatment failure so that inadequately treated recycled water does not enter a potable water system. The RRT also allows time, if necessary, to provide an alternative water supply or well head treatment in the event that a GRRP impacts a well, preventing it from being used as a potable water supply. These goals are accomplished by retaining recycled water underground while the issue is diagnosed, and a resolution is implemented.

Underground retention time is conceptually similar to RRT in that they both refer to an amount of time required for water to move a certain distance through the aquifer. Underground retention time refers to the actual travel time of the water underground from the injection well to the downgradient potable supply well, while RRT refers to the time required for the project operator to detect, confirm, and respond to injection of water unacceptable for extraction by the potable supply well. RRT must be shorter than underground retention time.

To estimate the underground retention time, extrinsic tracer studies were conducted for DIW-1, DIW-2, DIW-3, and DIW-4 (see **Section 5**). The results were used to calibrate the Watermaster Model and determine the fastest travel time to the nearest downgradient production well under the most conservative assumptions for injection and extraction. This analysis showed a minimum underground retention time of at least 4 months.

The RRT is derived from the following hypothetical conservative scenario: a routine sample is taken for acutely toxic constituents, the results confirm exceedance of a regulatory limit in the product water, and “off-specification” (off-spec) product water from the AWPF has been inadvertently injected into the groundwater system. The RRT of 3 months was determined from the following response measure components:

a. Time to Identify Water Quality Problem and Complete Confirmation Sampling (see **Subsection 6.6.1**):

b. Identify: Time elapsed before product water exceedance is discovered is the sum of the (1) longest time elapsed between sample collection, and (2) longest time elapsed before laboratory results are shared with M1W.

c. Confirm: Time needed to confirm (1) problem exists through continued sampling at AWPF and (2) potential problem no longer exists by demonstrating four consecutive samples are below the MCL.

d. Time to Assess Results with DDW and RWQCB (see **Subsection 6.6.2**):

e. Time needed to share findings and make decision regarding the appropriate response(s).

f. Time to Provide a Safe Interim Drinking Water Supply (see **Subsection 6.6.3**):

g. Time necessary to provide an interim water supply if the Project has impacted a drinking water well so that it can no longer be used as a drinking water supply. An integral part of switching to a safe interim drinking water supply is advance planning of appropriate actions with public water system (PWS) owners and key stakeholders. **Section 6.5** describes the safe interim drinking water source that will be provided by utilizing an unimpacted Cal-Am well as a substitute water supply and using MCWD sources, as needed, as a supplemental water supply. MCWD finished water will be supplied by an intertie between MCWD's and Cal-Am's finished water systems. Coordination with the affected PWSs and the agreed-upon approach for notification of regulatory exceedances, conducting regular meetings, and developing plans to provide safe interim drinking water supplies is described in **Section 6.2**.

6.1 RESPONSE RETENTION TIME COMPONENTS

6.1.1 RRT Concept

The RRT aims to protect public health by allowing an interim safe drinking water source to be used in the unlikely event that purified recycled water is injected into the ground with an emphasis on constituents that pose acute (short-term) health risks. Most chemical contaminants monitored in drinking water pose chronic (long-term) health risks (i.e., short-term exceedances of a limit would not result in adverse health consequences). Thus, the RRT is based on microbial pathogens (using total coliform organisms as the indicator organism) and nitrogen compounds (nitrate and nitrite) because they represent acute risks (i.e., short-term health risks to the water consumers) that require immediate attention.

To ensure compliance with all Title 22 treatment and water quality requirements for the Project, M1W follows an extensive water quality sampling program using continuous on-line analyzers, 24-hour composite samples, and grab samples to monitor and evaluate water quality. The monitoring locations include the AWPF influent, RO feed, RO permeate, product water, and groundwater monitoring wells. This extensive water quality monitoring is required by the WDR/WRR[25] and its associated MRP[26], Title 22 Criteria[27], Recycled Water Policy[28], and the Central Coast Basin Plan[29]. Monitored constituents, monitoring locations, and monitoring frequency are described in the MRP. Details of the water quality monitoring plan are included in the OOP, along with required actions for exceedance of regulatory limits.

One of the key elements to a successful response to a water quality excursion is frequent communication with downgradient PWSs about AWPF operations and quality of the purified water. The approach presented in this section describes routine and non-routine communication between M1W and the PWSs, as well as communication protocols between M1W, DDW and the RWQCB in the event off-spec water is injected into the Seaside Basin.

This section is focused on the constituents that pose acute (short-term) health risks, which includes total coliform, nitrite, and nitrate. However, planned corrective actions are also provided for the unlikely event of a regulatory exceedance for a contaminant that poses chronic

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[25] Central Coast Regional Water Quality Control Board, Order R3-2017-0003.

[26] Central Coast Regional Water Quality Control Board, Order R3-2020-0122 (revised September 13, 2022).

[27] CCR Title 22, division 4, chapter 3

[28] Water Quality Control Policy for Recycled Water, State Water Resources Control Board Resolution No. 2018-0057.

[29] Water Quality Control Plan for the Central Coast Basin, Central Coast Regional Water Quality Control Board, June 2019.

health risks. While it is highly unlikely that an alternate interim safe drinking water supply will be needed, M1W's approach for using this interim supply is also discussed.

The contaminants posing acute risks that have been identified for this project are similar to those for other GRRPs. If the constituents in **Table 6-1** are measured above regulatory limits in the product water, DDW and the RWQCB will be informed, and the response outlined in **Section 6.2** will be initiated.

Table 6-1. Acute Contaminants and Concentrations at which RRT Response is Initiated

Acute Parameters	Regulatory Limit	Units
Total Coliform	2.2 (7-day rolling median) 23 (in more than 1 sample in any 30-day period) 240 (any sample)	MPN/100mL
Nitrate (as N)	10.	mg/L
Nitrite (as N)	1	mg/L

It is noteworthy that the exceedance of these acute parameters is highly unlikely as M1W has incorporated the following safety features into the Project: (1) continuous online monitoring of RO treatment with alarms and real-time results reviewed by the AWPF operators; (2) continuous online monitoring of ammonia-nitrogen (the predominant component of total nitrogen with a regulatory limit of 10 mg/L-N) at the product water pump station, (3) multiple levels of critical control points for AWPF operations, alarms, and unit process redundancy; and (4) the ability to go into recirculation mode, divert water to the tertiary treatment system, and then shut down the AWPF at a moment's notice. Additionally, results from the first four years and 10.5 months of operation support the reliability of the AWPF product water (**Table 6-2**).

Table 6-2. Summary of Results from AWPF Product Water (2/1/2020 to 10/14/2024)

Acute Parameters	Number of Samples Above Limit of Quantification/Total Number of Samples	Median (Range)	Maximum	Units
Total Coliform	1/1711	<1 (<1-3)	3	MPN/100mL
Nitrate (as N)	377/378	0.51 (<0.01-1.72)	1.72	mg/L
Nitrite (as N)	231/378	0.09 (<0.02-0.4)	0.4	mg/L

Pathogens present an acute health concern, and while total coliform can serve as an indicator of pathogens, the Project must also demonstrate 12-log reduction of enteric virus, 10-log reduction of *Giardia* cysts, and 10-log reduction of *Cryptosporidium* oocysts (i.e., 12/10/10 LRVs). The

AWPF treatment processes that are credited with pathogen reduction are continuously monitored. As required by GRRP regulations, if the Project fails to meet the pathogen reduction requirements for a period longer than 4 consecutive hours, or more than 8 hours in any 7-day period, M1W will notify DDW and the RWQCB immediately. If pathogen reduction is less than 10-log for virus, 8-log for *Giardia* cysts, or 8-log for *Cryptosporidium* oocysts (i.e., 10/8/8), the AWPF will enter recirculation mode and M1W will immediately notify DDW and the RWQCB. Because treatment performance is continuously monitored, the time to assess pathogen log reduction is not a component of the RRT. M1W will respond more aggressively to pathogen LRV results below 12/10/10 than required by the regulations. If pathogen reduction drops below 12/10/10 LRV, the SCADA system will alarm notifying Operators to investigate and the AWPF will go into recirculation mode.

Although pathogen LRV is not a component of the RRT, there are rare circumstances where the virus reduction could drop below 12-log (but not below 10-log). As discussed below, M1W has taken several operational steps to mitigate this possibility. Even though the existing RTP and ozone treatment processes have been demonstrated to achieve pathogen removal, the treatment processes that have been approved for virus log removal credits include: (1) RO, (2) UV advanced oxidation disinfection, (3) disinfection with chlorine through the conveyance pipeline, and (4) underground retention time validated by Extrinsic Tracer Studies. For the RO process, the virus LRV is based on a tiered approach using the greater of strontium rejection, TOC rejection, or EC rejection (see **Section 5.2.3**). Accounting for virus removal credit through the conveyance pipeline is generally not a critical treatment process for meeting the required 12-log virus reduction (see **Section 5.2.5**). Virus disinfection credit in the conveyance pipeline typically provides additional LRV credits and acts as a buffer. The only time there is potential for less than 12-log virus reduction is when a combination of two scenarios occurs: (1) RO process LRV is based on TOC or EC rejection, rather than strontium rejection, and (2) the chlorine residual measured at the Injection Well Field is very low. It is important to note that a low chlorine residual at the Injection Well Field does not indicate virus disinfection did not occur in conveyance, as M1W maintains and monitors a chloramine residual in the product water as it leaves the AWPF of 3 to 5 mg/L (or higher) which ensures disinfection occurs in conveyance regardless of measured residual at the Injection Well Field. To ensure greater than 12-log virus reduction, M1W is implementing the following operational strategies:

- Coordinate with contract laboratory to rush strontium sample analysis when samples must be collected later in the day due to AWPF operational issues. Arrangements have been made with the nearby contract lab to provide M1W with same day results as long as the lab receives the sample by noon that day.
- To reduce the frequency of power outages: (1) M1W is assisting ReGen with implementing a project to connect the AWPF to the adjacent landfill biogas electricity generator, and (2) M1W has programmed the purchase of backup power generation into its CIP to prevent the AWPF from shutting down during regional power outages in the event that landfill biogas electricity is not available.
- Adjust the dose of chlorine added to the purified water to maintain a higher chlorine concentration and minimize free ammonia in the product water leaving the PWPS. This strategy will avoid low chloramine residual at the injection wells where total chlorine is

measured and can be implemented immediately as needed.

- Implement an operational approach to increase the draw-down frequency at Blackhorse Reservoir to minimize excessive (and unaccounted for) contact time of water stored in the Reservoir. In addition, MCWD now takes water from the Blackhorse Reservoir for golf course irrigation, which moves more water through the Reservoir. However, Reservoir operations have to be balanced between increased draw-down frequency and maintaining sufficient pressure and quantities for injection and irrigation.

6.2 COMMUNICATION WITH PUBLIC WATER SYSTEMS AND REGULATORY AGENCIES

The only PWS with wells downgradient from the PWM Injection Well Facilities is currently Cal-Am; namely, extraction wells (ASR production wells (ASR-3 and ASR-4), Paralta, and Ord Grove 2 Wells) are downgradient and potentially within 2-years of underground travel time from PWM injection. The City of Seaside's Municipal Well #4 (Seaside Muni-4) is geographically close and modeling shows particles could be transported to this well, but dyes from the tracer study have not been detected. M1W will communicate with Cal-Am, City of Seaside, DDW, and the RWQCB, to discuss AWPF operations, water quality and regulatory concerns as detailed in the following sections. The Notification and Response Plan (NRP), which will be approved by DDW and Cal-Am prior to the start of AWPF delivery of expanded flows, reflects the agreed upon responses in the event of delivery of off-spec water, including communication protocols, monitoring, and time for procuring and interim safe drinking water supply.

6.2.1 Regular Meetings

In a December 2022 meeting between M1W, MPWMD and DDW (Recycled Water Unit and District 5), DDW staff requested that M1W and MPWMD foster better information sharing with Cal-Am and City of Seaside to ensure all parties are aware of Seaside Basin status and activities, including Project injection operations and compliance status. In response, the Seaside Basin Water Quality and Operations meetings, in place since July 2020, have been modified to better communicate planned injection and extraction volumes.

The organizer, name, and timing of the meetings have been changed. The MPWMD now organizes the meeting and it is called the Monterey Peninsula Water Operations (MPWO) meeting. It follows the Quarterly Water Supply Strategy and Budget Meetings, which are required as a component of Cal-Am's WDS Permit from MPWMD and hosted by MPWMD. The Quarterly Water Supply Strategy and Budget Meetings prescribe production within Cal-Am's Main and Laguna Seca Subarea systems and is cooperatively developed with MPWMD, Cal-Am, National Marine Fisheries Services, the SWRCB Division of Water Rights, and the CDFW. M1W ensures designated staff from each PWS with potentially impacted wells (Cal-Am and the City of Seaside, currently) are invited and encouraged to attend the MPWO quarterly meetings. Meeting invitations are emailed well in advance, and meeting recordings and slides are made available to agencies that are unable to attend.

In addition, Cal-Am, MPWMD, and M1W management meet quarterly and those meetings include an agenda item regarding regulatory compliance.

6.2.2 Notification to Public Water Systems and Regulatory Agencies of MCL or NL Exceedances

In the event of a regulatory exceedance at the PWPS, on-site deep monitoring wells (MW-1D and MW-2D), or off-site deep MWs (MW-1AD, MW-2AD), M1W will collect confirmation samples as required by Water Recycling Criteria and the MRP. M1W simultaneously monitors for total coliform and E. coli in the same sample. Within 24 hours of M1W becoming aware that total coliform or E. coli has been detected (> limit of quantification) in the product water at the PWPS or any regulatory exceedance caused by the injection of purified recycled water has occurred, M1W will notify MPWMD, DDW, and the RWQCB to discuss corrective actions, and then notify the impacted PWS and other stakeholders as directed by DDW and the RWQCB. **Table 6-3** provides a contact list for agency representative notification.

Table 6-3. Contact List for Notification of Regulatory Water Quality Exceedance

Agency / Role	Primary Contact	Secondary Contact
	Name/Title/Contact	Name/Title/Contact
MPWMD / Project Partner and Groundwater Management Agency	Jonathan Lear Water Resources Division Manager jlear@mpwmd.net Office: 831-658-5647 Cell: 831-227-6001	Maureen Hamilton District Engineer mhamilton@mpwmd.net Office: 831-658-5647 Cell: 831-227-6001
Cal-Am Water Company / PWS Owner	Jack Wang Water Quality Manager Jack.Wang@amwater.com Office: 831-646-3269	Spencer Vartanian Director of Operations Spencer.Vartanian@amwater.com Office: 831-646-3241 Cell: 831-238-7059
City of Seaside / PWS Owner	Monty Miller Water System Operator mmiller@ci.seaside.ca.us Office: 831-899-6827	Andreas Baer Senior Engineer abaer@ci.seaside.ca.us Office: 831-899-6886
MCWD / PWS Owner and Groundwater Management Agency	Garrett Haertel District Engineer ghaertel@mcwd.org Office: 831-883-5954	Derek Cray Operations and Maintenance Manager dcray@mcwd.org Office: 831-883-5903
Seaside Groundwater Basin Watermaster / Court-Appointed Entity for Adjudication	Robert Jaques Bobj83@comcast.net Office: 831-375-0517	Laura Paxton Administrative Officer watermasterseaside@sbcglobal.net

DDW - Recycled Water Unit / Implements Title 22 Recycled Water Criteria	Sherly Rosilela Senior Water Resource Control Engineer Sherly.Rosilela@waterboards.ca.gov Office: 916-341-5578	Ginachi Amah Superviser Ginachi.Amah@waterboards.ca.gov Office: 818-551-2046
DDW – District 5 / Implements Title 22 Drinking Water Requirements	Querube Moltrup Associate Sanitary Engineer Querube.Moltrup@waterboards.ca.gov Office: 831-655-6936	Jonathan Weininger District Engineer Jonathan.Weininger@waterboards.ca.gov Office: 831-655-6932
RWQCB / Issues Operating Permits and Implements Water Code Requirements	Rachel Hohn Engineering Geologist Rachel.Hohn@waterboards.ca.gov Office: 805-549-3147	Harvey Packard Permitting Unit Manager Harvey.Packard@waterboards.ca.gov Office: 805-542-4639
Monterey County Environmental Health Department / Implements Public Health Requirements	Roger Van Horn Supervisor Drinking Water Protection Service / Well Program vanhornrw@co.monterey.ca.us Office: 831-755-4761 Cell: 831-877-0958	Cheryl Sandoval Supervisor, Drinking Water Protection Services sandovalcl@co.monterey.ca.us Office: 831-755-4552

6.3 RESPONSE TO REGULATORY EXCEEDANCE OF CONSTITUENTS POSING ACUTE HEALTH RISKS

As discussed in **Section 6.1**, the contaminants that pose acute health risks are nitrite, nitrate, and total coliform. These constituents are measured in the product water at a frequency to ensure corrective actions can be quickly implemented. Results for these constituents can be expedited by performing in-house analyses at M1W's on-site laboratory. M1W will respond differently to elevated levels of nitrite/nitrate versus elevated levels of total coliform, as discussed in the subsections below.

6.3.1 Nitrite and Nitrate

Per the Title 22 Criteria (Section 60320.210), the total nitrogen concentration in the product water from the AWPF cannot exceed 10 mg/L as nitrogen. Total nitrogen includes nitrite, nitrate, ammonia, and organic nitrogen while Total Kjeldahl nitrogen (TKN) includes organic nitrogen and ammonia nitrogen. Because of the RO process at the AWPF, organic nitrogen is negligible and TKN is approximately equal to the ammonia nitrogen concentration. Nitrite and nitrate have primary maximum contaminant levels (MCLs), which are 1 mg/L as N and 10 mg/L as N, respectively. As shown in **Figure 6-1**, the total nitrogen concentration at the PWPS has been consistently below 4 mg/L as N. The two data points at approximately 6.5 mg/L as N, well below the nitrate MCL, are assumed outliers. Nitrite and nitrate have also been consistently below their respective primary MCLs.

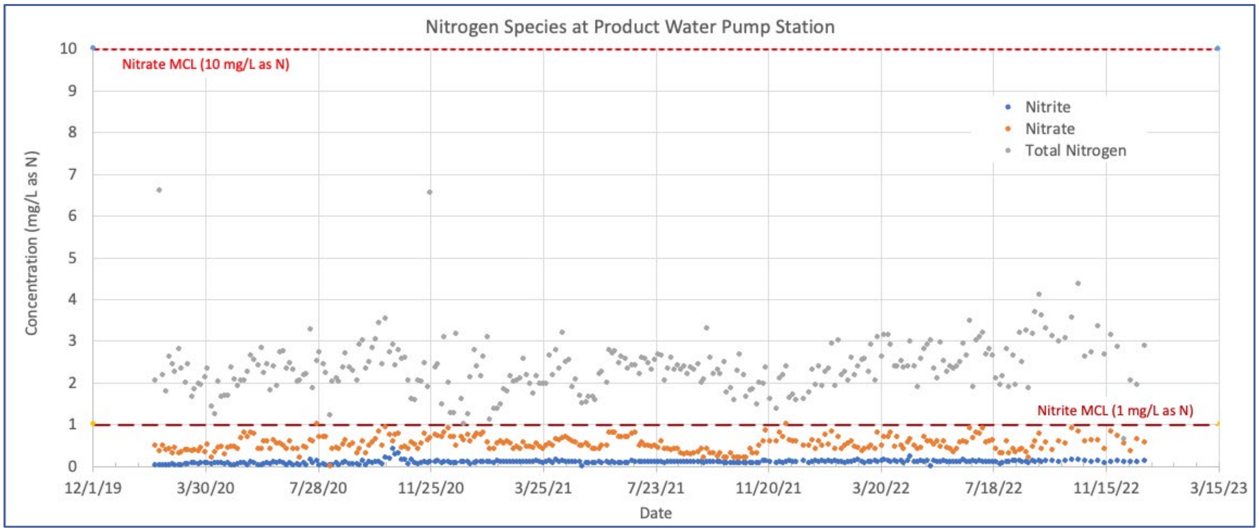

Figure 6-1. Nitrate, Nitrite, and Total Nitrogen in the AWPF Product Water

Nitrification is a natural microbial process where ammonia is sequentially oxidized to nitrite and nitrate. From a comparison of the nitrite concentrations in the product water with the nitrite concentrations at the MW-1D and MW-2D (**Figure 6-2**) and MW-1AD and MW-2AD (**Figure 6-3)**, it appears nitrification is taking place in the Blackhorse Reservoir and/or groundwater. Data demonstrates that nitrite concentrations at all MWs were consistently below the primary MCL of 1 mg/L as N during the first four years of AWPF operations. Nitrification of nitrite to nitrate is likely to continue underground due to oxygen in the Purified Recycled Water; however, without sufficient nitrogen in the purified water, water quality at extraction wells will remain below the “nitrate as N” MCL of 10 mg/L.

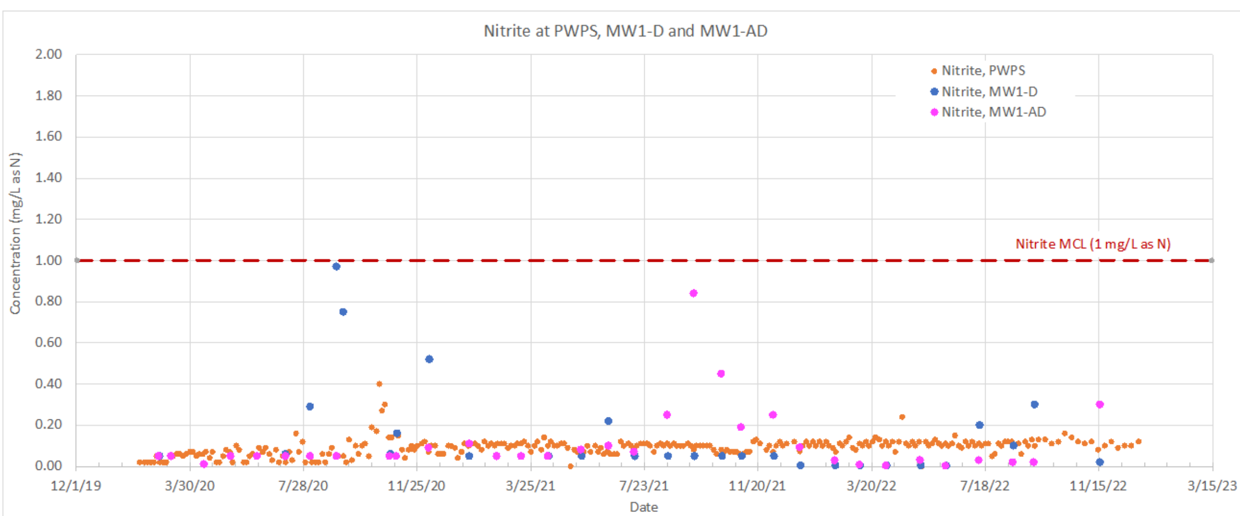

Figure 6-2. Nitrite Concentrations at the PWPS, MW-1D and MW-1AD

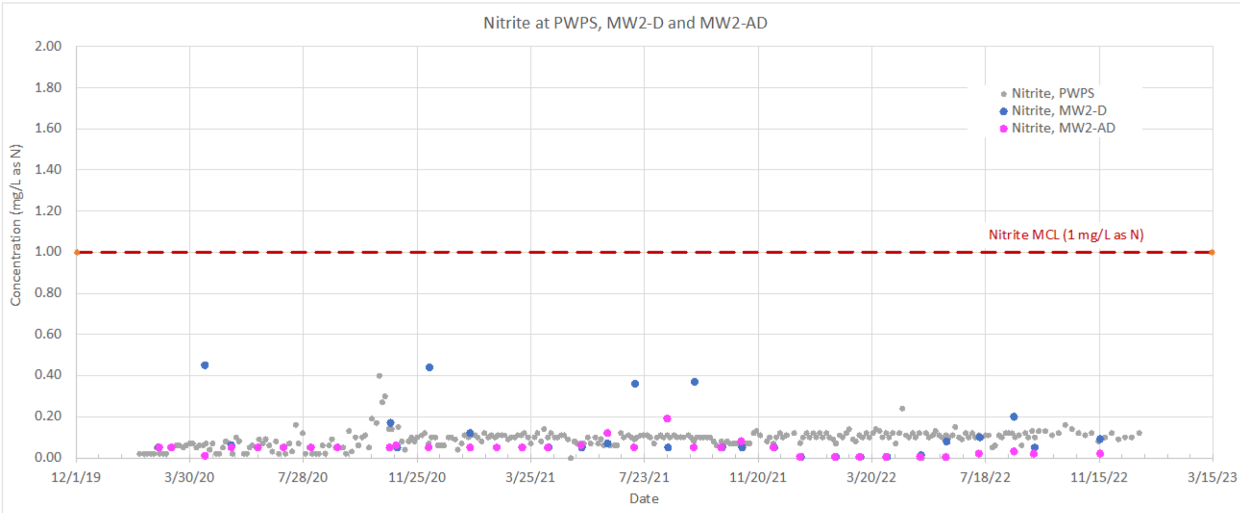

Figure 6-3. Nitrite Concentrations at the PWPS, MW-2D and MW-2AD

Figures 6-4 and **6-5** provide a comparison of total nitrogen levels in the product water along with nitrate concentrations in the product water and at the MWs. As shown:

- Nitrate concentrations in the groundwater never exceed the total nitrogen concentration in the product water.
- Nitrate concentrations at the off-site MWs are lower than nitrate concentrations in the on-site MWs, presumably because of dilution by native groundwater.
- Nitrate levels at all monitoring locations have been consistently well below the primary MCL of 10 mg/L as N.
- Nitrate levels in the groundwater can never exceed the regulatory limit as a result of the use of product water, as long as total nitrogen in the product water (predominantly ammonia-N) never increases to 10 mg/L as N.

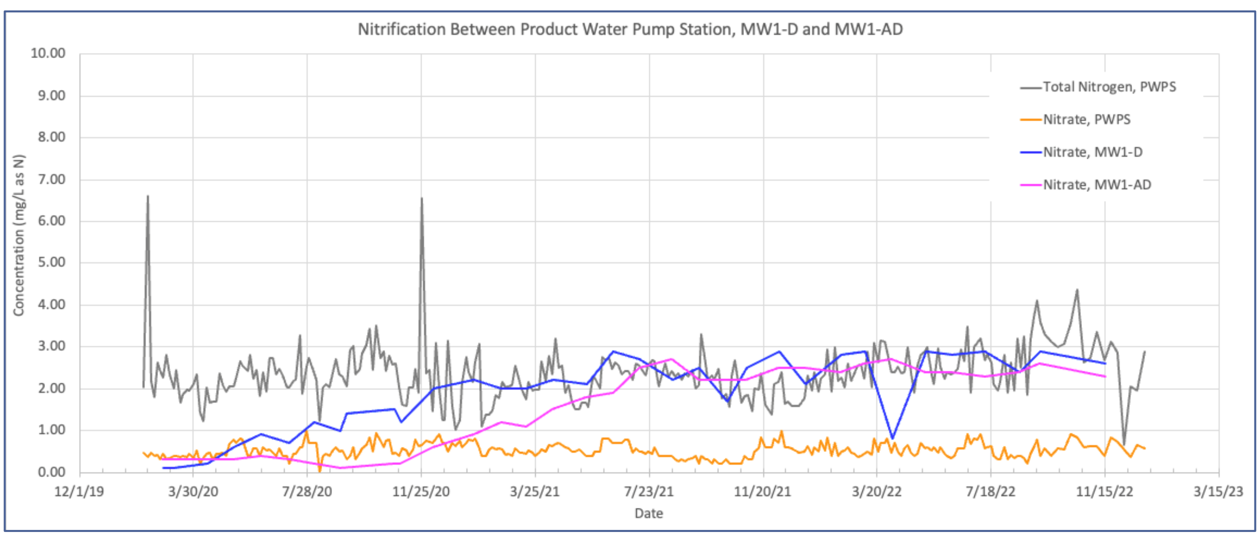

Figure 6-4. Nitrification between PWPS and Monitoring Wells MW-1D and MW-1AD

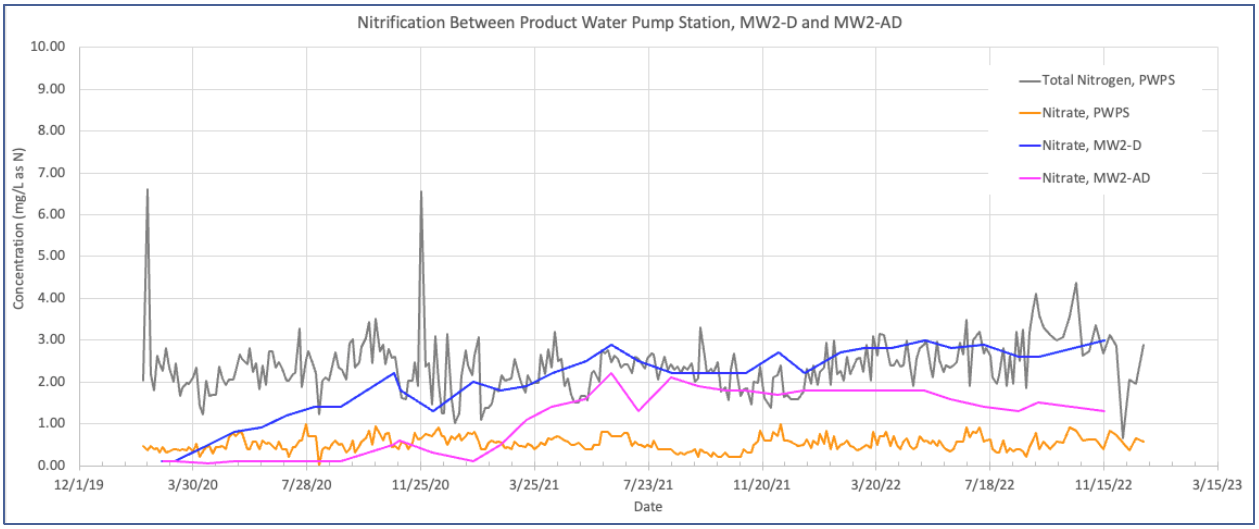

Figure 6-5. Nitrification between PWPS and Monitoring Wells MW-2D and MW-2AD

M1W currently provides continuous monitoring of ammonia-N concentrations at the stabilized water monitoring point (i.e., just ahead of chlorine boosting at the PWPS). Although ammonia-N concentrations have been consistently below 4 mg/L as N, M1W has programmed an alarm for this analyzer to notify operators if ammonia-N concentrations ever exceed an operator adjustable set point level (initially set at 6 mg/L-N). This alarm setpoint will maintain nitrite and nitrate concentrations in the groundwater well below their regulatory limits (primary MCLs). If the ammonia-N alarm is triggered, M1W will divert flows to the SVRP until the cause of the high ammonia levels is identified and corrected.

Importantly, as indicated by the data shown in **Figures 6-1** through **6-5** where total nitrogen levels at the PWPS are predominantly ammonia-N, MCL exceedances for nitrite or nitrate – as a result of the use of product water – would not be possible since the ammonia-N alarm will prevent high levels of total nitrogen in the product water.

Despite the safeguards, if AWPF failure occurred such that product water that exceeds primary MCLs is injected, M1W will collect and analyze a confirmation sample within 72 hours of being notified of a product water nitrite or nitrate exceedance by the laboratory (in accordance with the GRRP requirements, §60320.212(d)(1), and the WDR/WRR). If the average of the initial and confirmation sample exceeds the contaminant's primary MCL, M1W will notify DDW, RWQCB, and PWSs listed in **Table 6-3** within 24 hours and initiate weekly monitoring until four consecutive weekly results are below the MCL. If the running four-week average exceeds the MCL, M1W will suspend injection of the purified water until the water quality issue has been resolved. As described in §60320.226(c) for groundwater monitoring, if monitoring at one of the on-site or off-site monitoring wells exceeds 80% of a nitrate, nitrite, or nitrate plus nitrite primary MCL, M1W will collect another sample for analysis within 48 hours of being notified by the lab. If the average of the initial sample and confirmation sample exceeds a primary MCL, M1W will notify DDW and the RWQCB within 24 hours of being notified by the lab of the confirmation sample results and discontinue subsurface application until corrective actions have been taken.

In the highly unlikely event that nitrite or nitrate primary MCLs are exceeded in the product water or in the groundwater, M1W's response will be faster and more aggressive than required by the GRRP requirements based on a request from Cal-Am during development of an earlier draft response plan. In addition to the required monitoring and notification described above, M1W's response for an exceedance in the product water will consist of the following:

M1W Response for Product Water Exceedance of Nitrite or Nitrate Primary MCLs

- Investigate the reason(s) for the high ammonia, nitrate, or nitrite.
- Take corrective actions immediately, including at a minimum:
  - Divert the product water with high nitrite and/or nitrate to the SVRP Pond and/or return the water to the RTP headworks, and
  - Increase the ozone dose, if nitrite is above its MCL, since nitrite exerts an ozone demand.
- Collect daily confirmation samples of product water for ammonia, nitrite, and nitrate to assess if corrective actions are reducing nitrite or nitrate levels.
- Sample MW-1D and MW-2D twice weekly as soon as exceedance is detected, and sample MW-1AD and MW-2AD twice monthly based on the travel time calculated using actual injection and extraction rates before and immediately following the relevant sample dates showing an exceedance to ensure nitrite and nitrate primary MCLs are not exceeded.

6.3.2 Total Coliform

Total coliform is sampled daily from the AWPF product water. Detection of total coliform in the product water from the AWPF is highly unlikely since the advanced treatment train includes RO, UV disinfection, and chloramine disinfection in the conveyance pipeline. This is supported by sampling results from the first four and a half years of operation which showed total coliform was detected only once in the daily samples collected from the product water.

Response to Total Coliform Exceedance in Product Water. Because total coliform is considered a contaminant that poses acute health risks, M1W will respond quickly and aggressively in the unlikely event that total coliform is detected above the limit of quantification (1.0 MPN/100 mL). If total coliform is detected in the product water, M1W's response will be to immediately collect a confirmation sample and increase the chlorine dose at the PWPS. M1W always analyzes the same sample for *E. coli* and will report any detection of total coliform or *E. coli* at the PWPS to DDW, RWQCB, and the PWS within 24 hours of learning of the results. In an unlikely event that total coliform detection is confirmed or whenever *E. coli* is detected at the PWPS, M1W will divert the product water to the SVRP Pond or recirculate so the water won't be injected into the Seaside Basin.

Response to Total Coliform Detection in the Monitoring Wells. Total coliform detection at the MWs does not necessarily mean a public health risk, but it will be investigated and responded to. As discussed in the Federal Revised Total Coliform Rule (USEPA, Feb 13, 2013, 40 CFR Parts 141 and 142, Vol 78, No. 30), "Total coliforms are a group of closely related bacteria that, with a few exceptions, are not harmful to humans. Coliforms are abundant in the feces of warm-blooded animals, but can also be found in aquatic environments, in soil, and on vegetation"(see **Figure 6-6)**.[30]

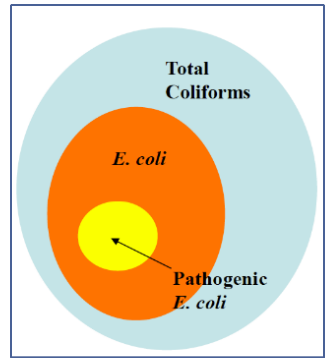

Figure 6-6. Revised Total Coliform Rule

Total coliform is sampled quarterly from the groundwater MWs. There have been detections of total coliform in the quarterly samples, however, none were considered to be the result of the application of recycled water. Regardless, M1W implements the following procedure if total coliform is detected at the on-site or off-site MWs:

- Analyze the same sample for *E. Coli*.
- Notify DDW and the RWQCB within 24 hours of being notified by the lab and collect confirmation samples based on their recommended sampling protocol.
- Increase the chlorine dose at the PWPS to achieve greater disinfection through the conveyance pipeline.
- If injection of water with a coliform exceedance has occurred, conduct dilution and groundwater flow modeling (using parameters from the applicable, completed tracer studies) with the calibrated Seaside Groundwater modeling for the actual and projected injection and extraction conditions applicable to the relevant time period to estimate travel time of the constituent to all applicable extraction wells and the applicable concentration upon extraction.
- If recommended by DDW and RWQCB, monitor for total coliform and *E. coli* daily at all potentially impacted production wells for an applicable time period that the off-spec water may arrive at the production well based on the modeled arrival time determined from the prior bullet.

6.4 RESPONSE TO REGULATORY EXCEEDANCE OF CONSTITUENTS POSING CHRONIC HEALTH RISKS

Each treatment process at the AWPF is continuously monitored as required by GRRP requirements to ensure effective treatment is provided. Critical control point alarms are in place to notify plant operators of declining treatment effectiveness or the need for maintenance before a regulatory exceedance occurs. Continuous monitoring points, critical control points, and associated alarms are detailed in the PWM OOP. Because of this rigorous, continuous monitoring of all treatment processes, use of RO to provide highly efficient contaminant rejection, and application of UV/AOP to remove CECs that may be poorly rejected by RO, it is highly unlikely that exceedances of primary MCLs, NLs, or other regulatory limits will occur in the

[30] Figure from Webinar by USEPA Office of Ground Water and Drinking Water. April 10, 2023. *The Revised Total Coliform Rule*.

product water. The sampling frequency for constituents that pose chronic health risks are defined in the PWM's MRP, in **Section 12** of this Engineering Report, and in the PWM OOP, and range from monthly to annually, except for asbestos, which has a sampling frequency of once every three years in product water.

In the unlikely event that a regulatory limit is exceeded in the product water, the GRRP requirements and the Project's WDR/WRR define the required actions associated with the following categories of exceedances:

- Exceedance of Primary MCL or Action Level (lead and copper)
- Exceedance of NL
- Exceedance of TOC Requirement
- Exceedance of Trigger Levels for CEC Response Actions
- Exceedance of NDMA

M1W's response to any regulatory exceedance will be consistent with GRRP requirements and the Project WDR/WRR. These responses include (1) confirmation sampling, (2) notifying DDW and the RWQCB, and (3) notifying potentially impacted PWSs. As soon as M1W is aware of a water quality issue, it will implement an aggressive confirmation monitoring schedule to minimize injection of off-spec water. The next section describes M1W's plans for accessing a safe interim drinking water supply in the rare event that all of the multiple levels of protection implemented at the AWPF and conveyance pipeline are not effective.

6.5 ACCESSING A SAFE INTERIM DRINKING WATER SOURCE

This section presents M1W's approach for providing a safe interim drinking water supply in the unlikely event that a water quality problem bypasses the multiple fail-safe measures associated with the AWPF and injection facilities. The components of the response approach, discussed below, provide a systematic and comprehensive approach for addressing a water quality issue in the Seaside Basin on both a short-term and long-term basis. The approach focuses on potential impacts to the downgradient drinking water well associated with the fastest subsurface arrival time of Project water (currently Paralta). However, the response approach also applies to other potentially impacted downgradient wells. For all other downgradient wells, the actions associated with the response remain the same, but even more time, natural attenuation, and dilution with native groundwater will be available to mitigate impacts (given the longer travel times to other wells). Although the response approach provides protection for both aquifers that receive recycled water, these actions target the Santa Margarita Aquifer first due to faster travel times, closer drinking water wells, and a higher reliance on this deeper aquifer for water supply. Also, because the AWPF will go into recirculation or would be shut down if water quality does not meet standards, any potential impacts to the groundwater supply are anticipated to be of relatively short duration and small extent.

6.5.1 Advance Coordination with PWS Owners and Key Stakeholders on Appropriate Actions

The key to successfully identifying and accessing viable alternative water supplies for an impacted PWS is effective coordination and advance planning with water purveyors and stakeholders in the Seaside Basin. To minimize the time required to procure a safe interim drinking water supply, a detailed plan of action must be developed collaboratively for each option. This can be the focus of the interagency meetings discussed, or separate planning meetings. M1W will work to facilitate collaboration with these agencies in an effort to ensure all parties are knowledgeable of the necessary steps and responsibilities ahead of time.

As soon as a regulatory exceedance is identified in the groundwater (as a result of recycled water injection), (1) DDW and the RWQCB will have been notified of the excursion, (2) downgradient PWSs (Cal-Am, City of Seaside) will have been notified as directed by DDW and RWQCB, (3) confirmation samples will have been collected and analyzed, and (4) the AWPF will have been shut down or the flow diverted to the SVRP or RTP headworks as the water quality issue is investigated and corrected.

Because the most likely affected well owners and operators are Project Participants (parties participating in PWM cooperative agreements), selection and implementation of effective actions can be readily coordinated, since all parties have a vested interest in remedying the water quality issue. The City of Seaside has been cooperating with M1W on Project development and implementation for almost a decade. In addition, the Seaside Basin Watermaster will be included in the notification process and subsequent response actions. Although the Watermaster is not a well owner/operator, it has groundwater basin management responsibilities and the Watermaster Technical Advisory Committee has closely tracked and supported the Project.

6.5.2 Anticipate Downgradient Water Supply Wells that may be Impacted

Using the calibrated Watermaster Model applied to the extrinsic tracer study conducted at DIW-1 and DIW-2, along with extrinsic tracer study results at DIW-3 and DIW-4, travel times to downgradient potable wells will be estimated. Based on the estimated travel times, water samples will be collected from downgradient MWs, along with the closest water supply wells, and analyzed for the constituent(s) of concern. Depending on the circumstances associated with the impact, wells will be monitored at an appropriate frequency determined in consultation with DDW and the RWQCB until impacts are fully addressed and the plume of water exceeding the regulatory limit(s) has passed the potable well(s). Only wells in the Santa Margarita Aquifer need to be monitored given the reduced injection capacities of the VZWs and the estimated travel time to the nearest downgradient well in excess of two years.

Depending on the constituent and concentrations, this lead time will be sufficient for potential remedies such as taking preparatory actions to shut down a well, arrangements for blending options, or securing wellhead treatment, but only if feasible and agreed to by the PWS and DDW.

6.5.3 Shift Production to Available, Unimpacted Drinking Water Wells

Well production could be shifted to available, unimpacted drinking water wells to meet demand if constituents of concern are detected above regulatory limits in a drinking water well or adjacent MW at concentrations deemed by DDW to make that well unsuitable as a drinking water source. The impacted drinking water well will be sampled periodically (i.e., weekly, depending on concentrations) to examine changes over time and to determine if contaminant concentrations are returning to acceptable levels.

If an extraction well exceeds the GRRP water quality requirements, it may be possible for the well to be shut down and for Cal-Am to use an alternative well (without exceedances); however, DDW and Cal-Am have both stated that the system may not be able to meet their maximum day demand without ALL of their existing larger capacity Seaside Groundwater Basin wells operational.

Cal-Am has stated that there are no other wells currently available that can be used in lieu of one of their major supply wells being unavailable. Also, DDW would like a signed agreement from Cal Am indicating that the proposed corrective action will not result in water shortages for the drinking water system and that Cal-Am will demonstrate to DDW its ability to comply with the source capacity requirements specified in the California Code of Regulations, title 22, section 64554, subdivision (a) prior to implementation of this corrective action. Cal-Am has already begun construction of additional wells (referred to as Extraction Wells #1 and #2) in their system to provide the needed source capacity for meeting system demands in the event that one of their major supply wells is not available. During a meeting on October 16, 2024, Cal-Am staff confirmed that with these new Extraction Wells, they will have sufficient capacity to meet their demands, in the event that one well is taken out of service temporarily (**Appendix M**). Cal-Am had also indicated that they are intending to build two additional extraction wells (referred to as Extraction Wells #3 and #4) and these wells will provide for additional redundancy and source capacity for future system demands.

The PWM Project's Amended and Restated Water Purchase Agreement between M1W, MPWMD, and Cal-Am (executed March 31, 2023; see Appendix O) states "The Company shall be solely responsible for operating and maintain all of its facilities for withdrawal of water." The agreement provides assurance that Cal-Am will provide potable water supply systems to meet its regulatory obligations and its obligations to M1W and MPWMD under the agreement prior to M1W injections into DIW-5 and DIW-6.

6.5.4 Supplement Demand with MCWD Drinking Water Using a System Intertie

A safe interim drinking water source has been secured in the event that one of Cal-Am's Seaside Basin extraction wells in the Santa Margarita aquifer cannot temporarily deliver water to the Cal-Am distribution system and other unimpacted wells are unable to meet the temporary lack of production capacity (for example, before Extraction Well #1 is operational). The existing Potable Water Wheeling Agreement between MCWD and Cal-Am dictates how the existing intertie between their two systems is currently able to operate to allow MCWD to deliver water to Cal-Am on a temporary basis (**Appendix N**). The intertie between MCWD and Cal-Am's systems includes a pressure reducing valve in the pipe that serves both systems and an existing flowmeter to measure flow transferred to Cal-Am's system. The intertie is connected to MCWD's finished water pipeline below General Jim Moore Boulevard. The approximate location of the existing intertie valve and meter (in yellow) is shown in **Figure 6-7**.

Figure 6-7. Location of the MCWD – Cal-Am System Intertie

Conservative modeling of the injection and extraction wells (without ASR well injection) supported by intrinsic and extrinsic tracer studies indicate a minimum travel time of 4 months can be maintained if one of the extraction wells is taken off-line as a result of a water quality excursion in the groundwater. ASR-3 is the extraction well with the largest capacity and a MCWD transfer flow of 500 gpm through the intertie will allow for a temporary shut-down of any of the Cal-Am extraction wells as the capacity of ASR-4 plus the 500 gpm will equal or exceed the capacity of any current extraction well. It has been confirmed by MCWD that they possess the 500 gpm requirement and will make it available to Cal-Am as needed. When EW-1 is operable, the MCWD intertie and use of the alternative wells described above will not be needed (**Appendix M**).

A copy of the Potable Water Wheeling Agreement documenting the agreement for water delivery between MCWD and Cal-Am is available and provided in **Appendix N** and the Amended and Restated Water Purchase Agreement is provided in **Appendix O** documenting Cal-Am's commitment to operations and maintenance of their facilities.

6.6 RESPONSE RETENTION TIME COMPONENTS

6.6.1 Time to Identify Water Quality Problem and Complete Confirmation Sampling

Real-time tracking of critical control points at the AWPF serves to identify early signs of any treatment performance issues. The RRT however is based on the conservative hypothetical scenario – discovering the problem based on water quality results of an acutely toxic parameter that (1) is measured periodically and (2) requires substantial time for the laboratory to analyze and notify M1W of the results. The maximum time that could pass before a problem is identified is the sum of (1) time between sampling events at the PWPS and (2) time estimated by the contracted laboratory to analyze and report the results to M1W. The time passed before a problem is identified varies depending on the acute water quality parameter, which may have different monitoring frequencies and different times for completion of analyses (see **Table 6-4**).

Table 6-4. Routine Monitoring Details for Acute Contaminants in AWPF Product Water

Acute Parameters	Monitoring Frequency	Sample Delivery[a]	Analysis Time	Estimated Notification Time	Total Time to Identify Water Quality Problem[b,c]
Coliform	1/day	n/a	1 day	1 day	3 days
Nitrate[d]	1/week	n/a	8 hours	2 days	10 days
Nitrite[d]	1/week	n/a	8 hours	2 days	10 days

a. Completed by M1W in its in-house laboratory.
b. Total Time = Frequency + Sample Delivery + Analysis Time + Estimated Notification Time.
c. Total Time is rounded up to nearest whole day.
d. Per Title 22 Section 60320.210, a GRRP must collect two total nitrogen samples per week at least three days apart. DDW and the RWQCB approved the change in sampling frequency from twice weekly to weekly in the Revised MRP issued on September 13, 2022.

The laboratory turn-around estimates in **Table 6-4** are conservative (i.e., longer than anticipated) and may be expedited by M1W during time-sensitive situations. If there is a concentration exceedance of an acute parameter, M1W will initiate confirmation sampling at the AWPF. Pursuant to the Title 22 Criteria (Section 60320.212(d)(1)), weekly confirmation samples will be collected until four consecutive weekly results are below the contaminant's MCL. Since the routine sampling schedule already includes weekly samples, a concentration exceedance of these acute parameters does not impact the sampling schedule. To the extent possible, the results for the confirmation samples will be expedited. See **Table 6-5** for timing of expedited turnarounds.

Table 6-5. Estimated Turnarounds for Expedited Assessment of Acute Contaminants

Acute Parameters	Sample Delivery [a]	Analysis Time	Estimated Notification Time	Total Time to Process Expedited Sample[b,c]
Coliform	N/A	1 day	1 day	2 days
Nitrate	N/A	8 hours	8 hours	1 day
Nitrite	N/A	8 hours	8 hours	1 day

Completed by M1W in its in-house laboratory.

a. Total Time = Sample Delivery + Analysis Time + Estimated Notification Time.

b. Total Time is rounded up to nearest whole day.

The total time to identify a water quality problem and complete confirmation sampling is **7 weeks** and is the sum of:

- Longest time elapsed between sample collection (1 week);
- Longest turnaround for routine results (3 days, rounded up to 1 week);
- Time to sampling location (AWPF PWPS) (0 weeks);
- Four consecutive weekly samples showing concentrations below the MCL (4 weeks); and
- Longest turnaround for expedited results (2 days, rounded up to 1 week).

6.6.2 Time to Assess Water Quality Results with DDW and RWQCB

M1W will inform DDW and RWQCB if RRT actions are initiated and will keep the regulators abreast of the findings. After the last set of results are available, the time required for M1W, DDW, and RWQCB to assess the sample results and make decisions regarding the appropriate response(s) is estimated to be **one week**. During that week, M1W will calculate the actual travel time and timeframe of arrival of injected non-compliant water from each injection well to each of the downgradient extraction wells. As discussed in **Section 6.2**, M1W will also keep potentially impacted PWSs apprised of the water quality situation.

6.6.3 Time to Switch to a Safe Interim Drinking Water Supply

The time required to switch to a safe interim drinking water supply after assessing water quality results includes three components. If it is decided that a well will be temporarily shut down in response to a regulatory exceedance due to the Project and an alternative well is used to meet the required capacity, modeling of injection and extraction will be performed using the existing calibrated Watermaster Model to assure that subsurface travel times remain equal to or greater than 4 months. A period of one week would be needed to model the proposed temporary well shut down and the temporary alternative water supply start up scenario.

After modeling results have been obtained, operational decisions that assure subsurface travel times remain greater than four (4) months will be made within one week. From this point, start-up of the alternative well and opening the intertie to receive additional potable water, if needed, will be accomplished in a week. In summary, the steps and duration to procure a safe interim drinking water supply:

- Subsurface travel time modeling (one week);

- Operational decisions regarding how to inject purified water (one week);
- Shift production to available, unimpacted, permitted drinking water wells, if available (1 to 2 weeks)
- Connect the MCWD and Cal-Am drinking water systems to provide additional flow to meet Cal-Am's water supply needs, if needed (one week total)

The total time required for M1W to switch to a safe drinking water supply in the unlikely event that a water quality problem bypasses the multiple fail-safe measures associated with the AWPF and injection facilities is estimated at **4 weeks**.

6.7 RESPONSE RETENTION TIME SUMMARY

The RRT is 3 months is detailed in **Table 6-6** and consists of the time necessary to (1) identify water quality problems and complete confirmation sampling; (2) assess results and make decisions for appropriate responses based on DDW and RWQCB input; and (3) procure safe interim drinking water supply solution (including wellhead treatment), if needed.

Table 6-6. Summary of Response Retention Time

Factors Contributing to RRT	Duration in days[a]	Duration in weeks[b]	Duration in months[c]
#1: Time to identify water quality problem and complete confirmation sampling	40	7	1.63
Longest time between routine sampling frequency	*7*	*1*	*0.23*
Longest turnaround routine sample results	*3*	*1*	*0.23*
Travel time to sampling location	*0*	*0*	*0*
Four consecutive samples less than MCL[d]	*28*	*4*	*0.93*
Longest turnaround for last expedited sample result	*2*	*1*	*0.23*
#2: Time to assess results and make decisions for appropriate responses based on DDW and RWQCB input	7	1	0.23
#3: Time to switch to a safe interim drinking water supply[e]	28	4	0.93
RRT[f]	75	12	2.79

a. All durations rounded up to nearest whole day.
b. All durations rounded up to nearest whole week.
c. All durations rounded up to nearest 100th of a month, assuming 4.29 weeks (30 days) per month.
d. Pursuant to Title 22 Criteria (Section 60320.212(d)(1)), product water samples will be collected after passage of "off-specification" water at monitoring well until four consecutive weekly results are below the contaminant's MCL.
e. Four weeks = reasonable amount of time that certified water distribution specialists and O&M managers at both M1W and MPWMD estimate it will take to evaluate and implement the operational changes.
f. RRT = #1 + #2 + #3

6.8 UNDERGROUND RETENTION TIME ANALYSIS

As described in **Section 5.3**, the underground retention time before injected water reaches a drinking water well varies among the DIWs and varies somewhat over time due to intermittent injection and recovery operations of the downgradient ASR wellfields and other downgradient production wells. Extrinsic tracer studies conducted for purified recycled water injected into DIW-1 and DIW-2 in 2021 were used to calibrate the Watermaster Model, and the recalibrated model was used to evaluate the travel time from each injection well to the closest downgradient production well under a range of operational scenarios. The simulations included conservative assumptions that tended to produce fast travel times between injection and extraction wells. A wide range of assumptions regarding extraction at downgradient drinking water wells (Cal-Am municipal supply wells) were tested, including the addition of two or four new extraction wells. The results showed that a minimum travel time of 4 months was achieved in all scenarios. The two new DIWs (DIW-5, DIW-6) that will be added under the Expanded Project will provide increased flexibility to implement seasonal variations in injection and to allocate injection among the wells to achieve the travel time target. Travel time from DIW-1 to Paralta was the shortest travel time in all of the scenarios. By shifting injection from DIW-1 to the other five DIWs, a minimum travel time of 4.4 months was achieved. With a virus reduction credit of 1.0 per month, an underground retention time of 4 months comfortably exceeds the RRT of 3 months.

The RRT of 3 months is shorter than the fastest estimated underground retention time of 4 months, which will allow response actions to be implemented prior to potential water quality impacts occurring at a downgradient drinking water well.

6.8.1 Travel Times to Monitoring Wells

In compliance with the Title 22 Criteria (Section 60320.226), M1W has constructed MWs to provide timely indication of any water quality problems in the aquifer resulting from injection. The locations of the wells satisfy the following criteria:

- At least one MW is located a) no less than two weeks but no more than six months of travel time from the GRRP, and b) at least 30 days up gradient of the nearest drinking water well;
- A second MW is located between the GRRP and the nearest downgradient drinking water well.

The extrinsic tracer study for DIW-1 and DIW-2 confirmed that wells MW-1AD and MW-2AD satisfy both parts of the first criterion. The t_{10} travel times for the two wells were 58 and 66 days, respectively. Those times equal 8.3 to 9.4 weeks, which is greater than the 2-week minimum and less than the 6-month maximum. Monitoring wells MW-1AD and MW-2AD also satisfy the second criterion, as do monitoring wells MW-1D and MW-2D, as well as an existing well SMTIW MW-1 located near ASR-1 that was used as a monitoring point during the first extrinsic tracer study. MW-1AD and MW-2AD are located between DIW-1 and DIW-2 and Paralta, which is the nearest downgradient drinking water well. MW-1AD and MW-2AD act as sentinels where early monitoring results are collected to help protect the quality of drinking water extracted at Paralta.

For the purpose of implementing actions pursuant to the RRT, MW-1AD and MW-2AD also satisfy the MW needs for DIW-3 and DIW-4. All four wells are injecting into the same aquifer in a geographically small area. The results of the intrinsic and extrinsic tracer studies for DIW-3 and DIW-4 demonstrated the occurrence of preferential flow paths is similar to—or at least not more extreme than—the occurrence in the vicinity of DIW-1 and DIW-2. The water quality of the injected water is also the same. For DIW-3, Paralta is also the nearest downgradient well, but the distance is greater than for DIW-1 and simulations using the calibrated model indicated travel times are longer than from DIW-1 over a range of operational scenarios. For DIW-4, Ord Grove 2 is the nearest downgradient drinking water well. Simulation results indicated that travel times greater than 4.7 months were achieved with a DIW-4 injection rate of 750 gpm. Furthermore, the second extrinsic tracer study showed the model simulates faster travel times between that well pair than were measured using the tracer. For the Project overall, the fastest simulated flow path was always from DIW-1 to Paralta, and wells MW-1AD and MW-2AD fulfill the monitoring requirement for that flow path. In other words, if unexpected events at the RTP or AWPF were to cause off-spec recycled water to be injected into the wells, the two existing MWs would detect that water along its fastest flow path and inform mitigation actions that could be applied to all potentially impacted downgradient drinking water wells.

There are also shallow MWs designed to detect vadose zone injection, but after more than four years of Project operation, no injected water has been positively confirmed to have reached the offsite MWs. The three functioning vadose zone MWs are located next to deep MWs MW-1D, MW-2D, MW-1AD, and MW-2AD. The lack of detection is not surprising given the low rates of injection (20-35 gpm) and the slow rate of downward movement through the vadose zone to the Paso Robles aquifer (estimated to be at least six months). Total travel time to the nearest downgradient well that extracts water from that aquifer (Paralta, which is screened in both aquifers) is estimated to exceed two years.

The sensitive analysis in **Appendix K** reaffirms the DIW-1 to Paralta travel time is the shortest for all well pairs; therefore, this is the only well pair where monitoring wells are appropriate and the correct measure for establishing a minimum travel time and minimum project virus log removal and response retention time.

7 AWPF RECYCLED WATER QUALITY

M1W began operation of the AWPF in 2020 to produce purified water for groundwater injection and irrigation. Annual summary reports for the AWPF and Groundwater Replenishment Project are prepared that summarize production, AWPF influent water quality, and AWPF product water quality. The reports also include a summary of source water flows for the upstream RTP and the groundwater monitoring results downstream of the AWPF. All AWPF product water data presented in this section that reference full-scale facility are from the annual summary reports available on GeoTracker.

The full-scale facility design was informed by a pilot-testing program that was conducted between mid-October 2013 and mid-July 2014, with extensive sampling conducted between December 2013 and June 2014 (Trussell Technologies 2014a, **Appendix B**). The pilot facility treated a flow of 30 gpm of undisinfected RTP secondary effluent with ozonation, MF, and RO. Although an AOP is included in the AWPF, it was not included in the pilot testing and sampling program since design of an AOP system typically does not require a pilot demonstration. Furthermore, sufficient information on AOP treatment efficacy is available from existing GRRPs. The AWPF expansion design utilized the same design goals as the existing full-scale facility regarding water quality and monitoring.

While operating the full-scale facility, PWM Source Waters have been used to supplement the municipal wastewater to meet the growing demands for both potable and non-potable recycled water. Several source water sampling campaigns have been conducted to characterize potential impacts to water quality to ensure water quality parameters do not exceed treatment capabilities. **Table 7-1** summarizes the water quality data from various sampling campaigns for the different source waters. The source water qualities will be discussed for each relevant constituent, where applicable.

Table 7-1. RTP Source Water Quality

Parameter	Units	WW(1)	SIWW(2)	Pond 3(3)	BD(2)	RD(3)
TDS	mg/L	793	1282	863	2003	858
TOC	mg/L	164	295	-	3	-
Ammonia	mg/L (as N)	43	5	0.3	<0.5	0.1
Nitrite	mg/L (as N)	0.1	0.6	< 0.02	0.3	0.2
Nitrate	mg/L (as N)	0.2	5.1	1	66	12
Total N	mg/L (as N)	67.3	25.7	3.6	67	-

(1) WW = municipal wastewater; the data represents the median values from January 2015 through May 2018 without being blended with PWM Source Waters.

(2) SIWW = Salinas Industrial Wastewater; BD = Blanco Drain; the data represent median values from a source water sampling campaign conducted by Trussell Technologies from July 2013 to June 2014 (Trussell 2014b).

(3) Pond 3 = SIWW treated through aerated ponds prior to diversion to RTP; RD = Reclamation Ditch; data represents the median values from composite samples collected and analyzed by M1W from January 2022 through December 2022 and August 2023 through October 2023.

Two pesticides—dieldrin and DDE (a breakdown product of the legacy pesticide DDT)—were detected in low concentrations in the new source waters. Bench tests were conducted in February 2016 to evaluate the removal of these two contaminants through the RTP, ozonation, and MF to ensure compliance with California Ocean Plan water quality objectives for these two contaminants when discharging the RO concentrate through the ocean outfall. Additionally, these pesticides are tested quarterly in the AWPF product water. Results are summarized in **Section 7.5.4** and the complete bench test report is provided in **Appendix H**.

7.1 TOTAL NITROGEN

The Title 22 Criteria include a total nitrogen limit of 10 mg/L in the recycled water or recharge water (before or after injection), where the limit applies to the average of the results of two consecutive samples collected at least three days apart for each week. Since startup in 2020, the AWPF product water has consistently met the total nitrogen limit with a median total nitrogen concentration of 2.3 mg/L and a maximum measured value of 6.6 mg/L. The AWPF influent and product water data are shown in **Figure 7-1** and summarized in **Table 7-2**.

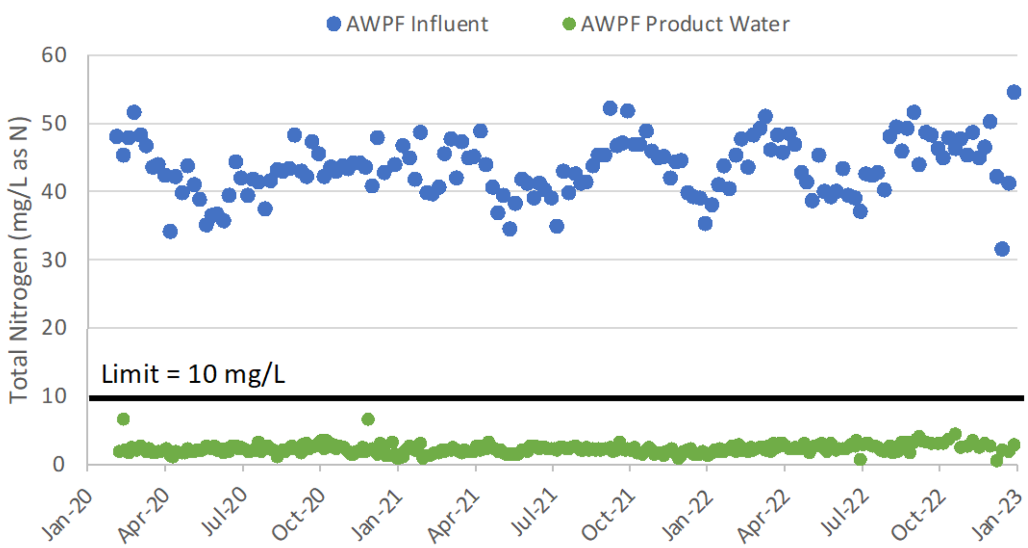

Figure 7-1. Removal of total nitrogen at the AWPF

Table 7-2. Median and Maximum Total Nitrogen Concentrations

Total N	AWPF Influent[(1)], mg/L	AWPF Product Water[(2)], mg/L
Median	44	2.3
Maximum	55	6.6

[(1)]Median and maximum values calculated using weekly 24-hr composite samples collected between January 2020 and December 2022.

[(2)]Median and maximum values calculated using twice-weekly 24-hr composite samples collected between January 2020 and December 2022.

7.2 TOTAL ORGANIC CARBON

Section 60320.218 of the Title 22 Criteria specifies that the TOC concentration in the product water cannot 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 7-1**, the median concentration of TOC in untreated Salinas Industrial Wastewater has a significantly higher TOC concentration. However, the AWPF influent data shown in **Figure 7-2** indicates the TOC concentration in the agricultural wash water is sufficiently reduced through primary and secondary treatment at the RTP and does not significantly impact the TOC concentration entering the AWPF.

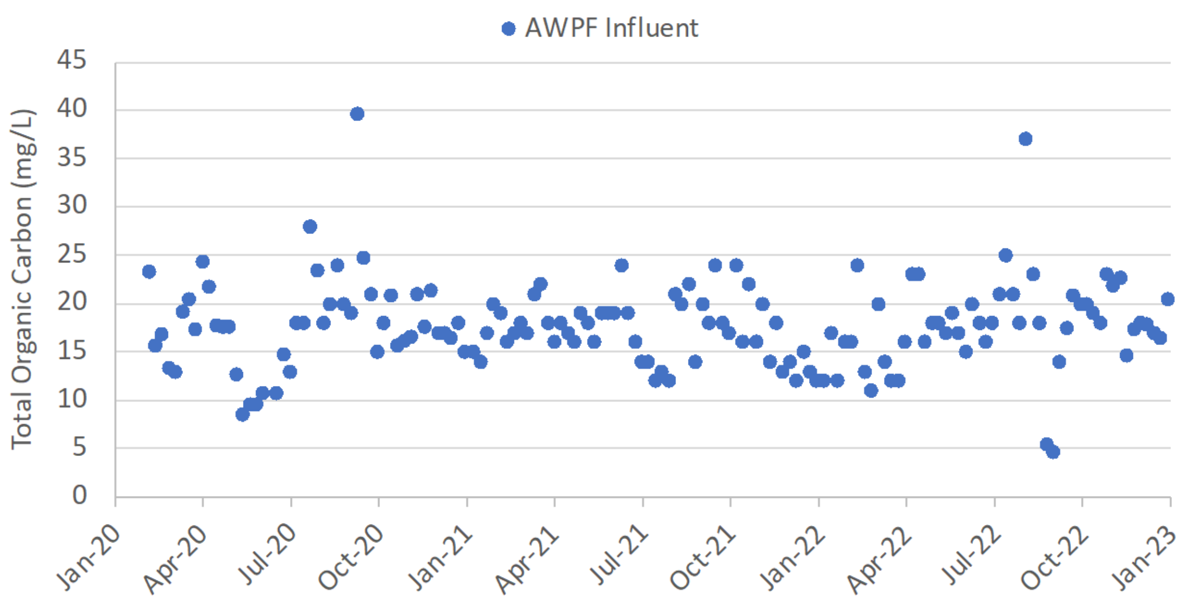

Figure 7-2. TOC Concentrations Entering the AWPF

The RO system is the key unit process in the AWPF that further reduces TOC. The TOC concentrations in the RO permeate are impacted by the ratio of the applied ozone dose to TOC concentration entering the ozone pretreatment process (i.e.., the AWPF influent TOC). As the ozone-to-TOC ratio (O_3:TOC) is increased, the TOC concentration in the RO permeate has been shown to increase slightly. The full-scale ozone dose setpoint was selected based on observations during pilot testing for applied ozone doses spanning from below 10 mg/L up to 20 mg/L.

During the first year of operation, M1W observed exceedances of TOC in the AWPF product water 24-hour composite samples beginning in June 2020, with results ranging from 0.5 to 0.6 mg/L. M1W observed the upward trend in the AWPF product water composite samples, while no upward trend was observed in AWPF product water grab samples, which were tested for comparison. In addition, TOC concentrations in the RO permeate, measured by an online meter, indicated steady concentrations below 0.25 mg/L. Upon further investigation, M1W staff concluded the elevated TOC concentrations in the composite samples were likely due to contamination and/or biological growth in the sample container during composite sampling. M1W subsequently improved their sampling procedures to add a preservative to the composite container prior to sampling to inhibit biological growth and requested DDW approval to allow the use of an online TOC analyzer at the PWPS for TOC monitoring in the product water. On September 25, 2020, DDW conditionally accepted the proposal to use an online TOC analyzer in lieu of composite samples. M1W has complied with the modified TOC monitoring requirements and has not had any instances of non-compliance since the monitoring transition. **Figure 7-3** shows the AWPF product water TOC from February 2020 through December 2022.

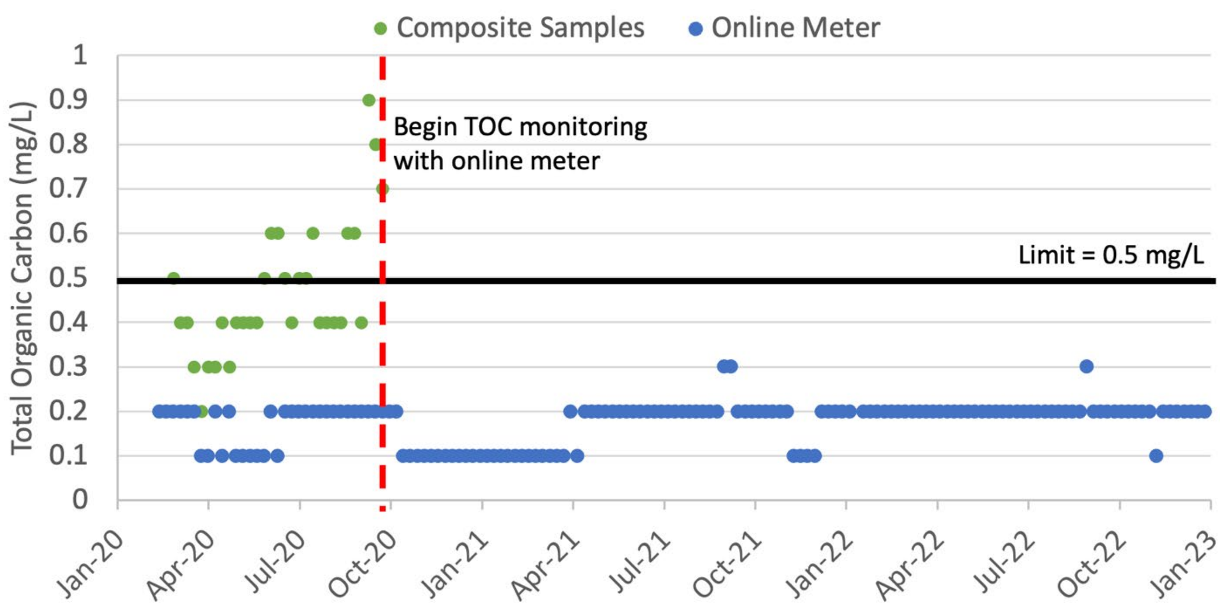

Figure 7-3. TOC concentrations in the AWPF Product Water.

7.3 REGULATED CONSTITUENTS

In accordance with the Title 22 Criteria, the product water must meet primary and secondary drinking water MCLs. A summary of the constituents detected in the AWPF product water with primary and/or secondary MCLs is presented in **Table 7-3**. Thirteen constituents with MCLs were detected in the AWPF product water at least once and none of them exceeded their regulatory limit.

Table 7-3. Constituents with MCLs Detected in Product Water

Constituent	Unit	MCL	Median (Range) [a]
Secondary MCL Consumer Acceptance			
Aluminum	µg/L	50 to 200	34 (32 – 59)
Chloride	mg/L	250	39 (7.59 - 49)
Conductivity	µS/cm	900	210 (57.8 – 795.96)
Sulfate	mg/L	250	0.385 (0.16 – 3.21)
TDS	mg/L	500	110 (45 – 140)
Turbidity	NTU	5	0.1 (0 – 23)
Primary MCL Inorganics			
Aluminum	µg/L	1000	34 (32 – 59)
Chromium	µg/L	50	2[b]
Cyanide	µg/L	150	11.45 (7.9 – 15)
Fluoride	mg/L	2	0.07 (0.06 – 0.09)
Nitrate	mg/L as N	10	0.52 (0.2 – 0.9)
Nitrite	mg/L as N	1	0.1 (0.06 – 0.22)
Nitrate + Nitrite	mg/L as N	10	0.62 (0.22 – 0.86)
Primary MCL Radionuclides			
Combined Radium-226 & Radium-228	pCi/L[c]	5	0.25 (0.038 – 0.95)

a. Median and range calculations exclude non-detects and values reported as detectable not quantifiable (DNQ).
b. Constituent has no range due to only one sample being detectable from February 2020 through December 2022.
c. Picocuries per liter - pCi/L.

7.4 BASIN PLAN OBJECTIVES

For the Seaside Basin, the Central Coastal Basin Plan includes general narrative groundwater objectives for T&O 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 MPN/100 mL; and
- Chemical constituents - groundwater shall not contain chemical concentrations in excess of primary and secondary MCLs.

As previously discussed, the AWPF product water meets all MCLs, the bacterial objective, and the narrative objectives. Based on the data, AWPF product water is also treated to meet the Basin Plan [31].

The Basin Plan also includes guidelines to protect soil productivity, irrigation, and livestock watering. The RO process removes the vast majority of dissolved constituents, including salinity and chloride. One of the Basin Plan guidelines is the Sodium Adsorption Ratio (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 the average quantity of calcium plus magnesium, on an equivalence basis, adjusted for tendency precipitate or dissolve lime (RWQCB, 2011). The cations (calcium, magnesium, and sodium) used to derive an SAR are mostly removed by RO as part of the full-scale AWPF. Calcium and sodium are dosed into the UV/AOP effluent (downstream of the RO process) and maintain a low SAR. The quarterly SAR values in the AWPF product water have ranged from 0.8 to 1.6, compared to the strictest SAR guideline of less than 3.0. The additional sodium hypochlorite for secondary disinfection in conveyance has no noticeable impact on the SAR values).

As discussed in **Section 7.1**, the maximum total nitrogen concentration after secondary treatment at the RTP and treatment at the AWPF was 6.6 mg/L. This concentration includes potential impacts from PWM Source Waters and is below the individual guidelines for ammonia and nitrate.

The Basin Plan includes water quality objectives for drinking water, agricultural use for irrigation supply, and livestock watering. The following demonstrates how the AWPF product water complies with the Basin Plan objectives:

- Of the 21 constituents with objectives, 13 have MCLs that are more stringent than the Basin Plan objectives (aluminum, arsenic, beryllium, cadmium, chromium, fluoride, iron,

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[31] With regards to permitting the Project, it is important to acknowledge what a RWQCB must consider when establishing waste discharge requirements. Per California Water Code Section 13263(a), "[t]he requirements shall implement any relevant water quality control plans that have been adopted, and shall take into consideration the beneficial uses to be protected, the water quality objectives reasonably required for that purpose, other waste discharges, the need to prevent nuisance, and the provisions of Section 13241." WDR requirements should not be performance-based as a means of interpreting Best Practicable Treatment or Control (BPTC) per Resolution 68-16, the Anti-degradation Policy. The application of BPTC does not dictate the application of performance-based limits. As noted in SWRCB Order WQ 2016-0068-DDW (General Waste Reclamation Requirements for Recycled Water Use), BPTC is defined as "a combination of Title 22 and the Regional Water Board Water Quality Control Plans (Basin Plans)." See Finding 29, pg. 9.

lead, manganese, mercury, nickel, nitrate+nitrite, and nitrite). The annual data from AWPF product water for these constituents indicate more than adequate removal and all concentrations are below the MCLs.

- **Copper**. The Basin Plan 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 copper concentration measured in the AWPF product water has been below the MRL of 0.007 mg/L for all monthly samples since startup in February 2020, which is well below the agricultural objectives.
- **Selenium**. The Basin Plan objective for irrigation supply (0.02 mg/L) is more stringent than the drinking water MCL (0.05 mg/L). The selenium concentration measured in the AWPF product water has been below the MRL of 0.0025 mg/L for all monthly samples since startup in February 2020 through December 2022, which is well below the Basin Plan objective.
- **Zinc.** The Basin Plan objective for irrigation supply (2 mg/L) is more stringent than the drinking water MCL (5 mg/L). The zinc concentration measured in the AWPF product water has been below the MRL of 0.023 mg/L for all monthly samples since startup in February 2020 through December 2022, which is well below the Basin Plan objective.
- **Boron**. The Basin Plan includes an agricultural objective for irrigation supply (0.75 mg/L) is more stringent than the drinking water NL of 1 mg/L. The median boron concentration in the AWPF product water from February 2020 through December 2022 was 0.27 mg/L (with a maximum measured value of 0.4 mg/L), which is below the agricultural objective.
- **Vanadium**. The Basin Plan includes an agricultural objective for irrigation supply and livestock monitoring (100 µg/L), which is less stringent than the drinking water NL (50 µg/L). The vanadium concentration in the AWPF product water has been below the MRL of 0.16 µg/L for all monthly samples since startup in February 2020, which is well below the objectives.
- The three remaining agricultural objectives (cobalt, lithium, and molybdenum) do not have regulatory standards or goals. Studies of RO treatment have shown 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).

7.5 OTHER RELEVANT CONSTITUENTS

7.5.1 Endocrine Disrupting Compounds, Pharmaceuticals and Other Chemicals

A panel list of CECs (92 constituents) was measured by Eurofins Eaton Analytical on a monthly basis during pilot testing. The results indicated that ozonation consistently reduced the concentrations of many of the CECs to levels below detection, and the RO removed the remaining CECs to below detection, with only a few exceptions that were expected to be treated by UV/AOP in the full-scale facility. The AWPF product water data has indicated concentrations below respective detection levels for all CECs since startup in February 2020 through December 2022.

7.5.2 Constituents with Notification Levels

During pilot testing, the only constituent measured in the RO permeate above its NL was NDMA. The full-scale UV/AOP process is specifically designed to achieve 1.5-log removal (i.e., 96.8% removal) of NDMA. This level of removal was chosen for design to reduce the NDMA concentration to a conservative target of 1.0 ng/L, which is well below the NL of 10 ng/L. In addition to NDMA removal, the UV/AOP system is designed to achieve a minimum of 0.5 log removal of 1,4-dioxane. **Table 7-4** summarizes the constituent concentrations with NLs detected in the AWPF product water on a quarterly basis since startup in February 2020 through December 2022. All constituent concentrations have consistently been below their respective NL with the exception of one sample of chlorate in October of 2020. The exceedance was promptly addressed with operational changes to reduce the chlorate levels in the AWPF product water and no further exceedances have occurred since October of 2020. The exceedance, prompt response, and return to compliance are shown in **Figure 7-4**.

Table 7-4. Constituents with NLs Detected in the Product Water

Constituent	Unit	Limit	Median (Range)
Boron	mg/L	1 (NL)	0.27 (0.09 – 0.4)
Chlorate	mg/L	0.8 (NL)	0.17 (0.04 – 0.82)[a]
Formaldehyde	µg/L	100 (NL)	24 (10 – 49)
Manganese	µg/L	500 (NL)	2 (1 – 3)

a. The max value in the range exceeded the NL in October 2022, which was promptly addressed with operational changes and no further exceedances have occurred since.

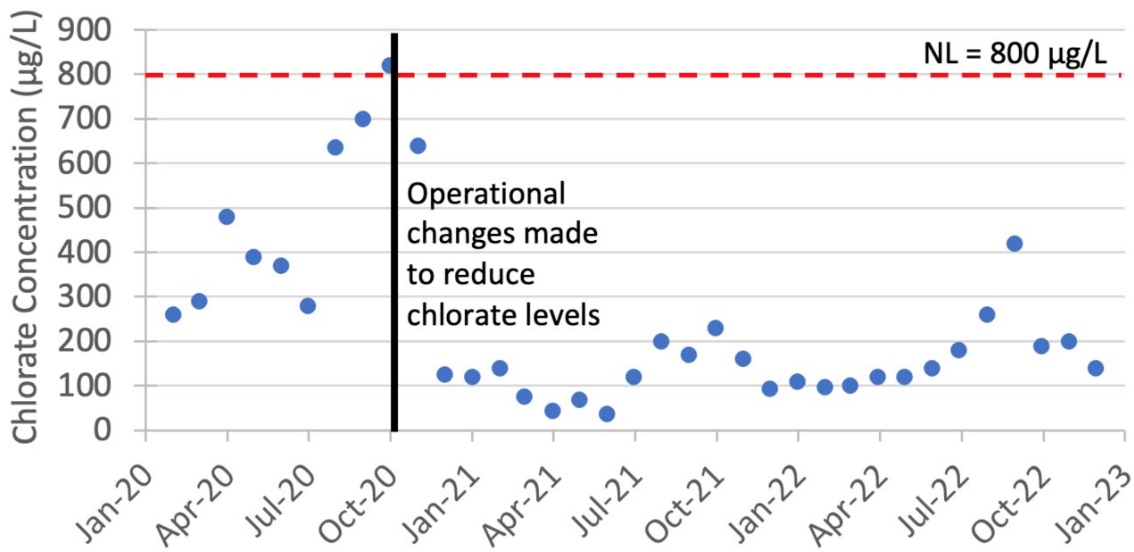


Figure 7-4. Chlorate Concentrations in the AWPF Product Water.

7.5.3 Remaining Priority Pollutants

The Title 22 Criteria require recycled water and groundwater (from downgradient monitoring wells) be monitored for Priority Pollutants (chemicals listed in 40 CFR Part 131.38, "Establishment of numeric criteria for priority toxic pollutants for the State of California") specified by DDW, based on DDW's review of a project's engineering report. All remaining Priority Pollutant concentrations in the AWPF product water have been below detectable levels since startup in February 2020 through December 2022.

7.5.4 Bench Tests for Pesticide Removal

Two persistent legacy pesticides that have been banned for decades but have been detected in low concentrations in samples of Blanco Drain water are dieldrin and DDE (a breakdown product of DDT). The median detected concentration of dieldrin was 17 ng/L, with a range of less than 10 ng/L (below the method detection limit) to 31 ng/L; DDE was detected only once at a concentration of 21 ng/L. Bench tests were conducted in February 2016 evaluating the removal of these two contaminants through the RTP, MF and ozonation in order to ensure compliance with the California Ocean Plan water quality objectives when discharging the RO concentrate through the ocean outfall.

Bench test results showed significant dieldrin and DDx (congeners of DDT, DDE, DDD were all tested) removal through the RTP, ozonation and MF. For dieldrin, 84% removal was seen through the RTP, 44% - 63% removal (depending on ozone dose) was seen through ozonation, and 97% - 98% removal was seen through MF. For DDx, 93% removal was seen through the RTP, 36% - 48% removal was seen through ozonation, and 92% - 94% removal was seen through MF. Overall, 91% to 99.9% dieldrin removal and 96% to 99.8% DDx removal was observed through the RTP, ozonation and filtration. Additional removal of these contaminants through the RO and UV/AOP processes was not evaluated as part of this bench testing.

Quarterly testing of the full-scale AWPF product water has also been conducted since startup in February 2020. All samples through December 2022 have indicated dieldrin concentrations below the MRL of 44 ng/L and DDE concentrations below the MRL of 29 ng/L. Conclusions of these tests were that removal of these contaminants through the RTP alone was sufficient to meet the California Ocean Plan water quality objectives. Removal through the advanced treatment processes in the AWPF offers additional layers of redundancy and robustness to treatment of these contaminants. The complete bench test report is provided in **Appendix H**.

7.6 CONSTITUENTS MONITORED FOR DISINFECTED TERTIARY RECYCLED WATER PRODUCTION

The Title 22 Criteria for disinfected tertiary recycled water requires monitoring of turbidity (< 2 NTU) and total coliform (≤ 2.2 MPN/100 mL) for irrigation with disinfected tertiary recycled water. The treatment steps in the AWPF far exceed the level of treatment required to meet the tertiary recycled water quality goals. In 2022, continuous monitoring showed a maximum daily average turbidity of 0.22 NTU and daily sampling showed undetectable levels of total coliform (< 1 MPN/100 mL).

8 INJECTION OPERATIONS AND MAINTENANCE

The operations plan for injection into the Seaside Groundwater Basin is summarized in this section. A more detailed OOP was submitted to DDW and the RWQCB for review and approval prior to Project startup, and again in January 2022 after the OOP was updated.[32] The OOP contains more specifics on the operation and maintenance of the injection facilities, as well as final approved protocols for groundwater sampling.

8.1 DELIVERY/CONVEYANCE OF PRODUCT WATER TO SEASIDE BASIN

M1W has evaluated the amounts and availability of Project Source Waters and developed estimates of annual deliveries of product water to the Seaside Basin. An average 5,750 AFY is planned for delivery, but monthly amounts will vary based on hydrologic conditions and the status of meeting terms of M1W's agreements to supply recycled water.[33]

Specifically, the Project includes the concept of Operating Reserve and Drought Reserve accounts. During wet and normal precipitation years (when SVRP demand is lower), M1W will continue its existing practice of producing and injecting additional purified recycled water (primarily during October to March) to the Seaside Groundwater Basin for storage in one of the reserve accounts. That stored water can be carried over to provide supplies in future dry or drought years. During dry years, the Project will reduce its deliveries to the Basin during the summer and fall months.[34] If the Project has met the minimum Operating Reserve and additional water is not required for injection to meet the purchase agreement minimums, M1W could reduce the AWPF production to provide more influent for tertiary treatment at the SVRP for delivery to CSIP. During these reduced deliveries to the Seaside Groundwater Basin, potable water can be extracted to meet the project yield for potable supply (5,750 AFY each Fiscal Year after the start date specified in the purchase agreement) by using some or all of the water stored in the Basin during prior years.

For further analysis, these operational guidelines have been translated into potential maximum monthly delivery amounts to the Seaside Basin based on actual hydrologic conditions as discussed in more detail below.

8.2 DELIVERY SCHEDULES AND INJECTION OPERATION

M1W has considered the availability and amounts of source waters, capacity of the AWPF and injection wells, minimum delivery targets, and operational guidelines discussed above in order to develop potential delivery schedules for recharge to the Seaside Basin. Subsurface travel time is one of the considerations for determining injection schedules. The calibrated groundwater model was used to simulate travel times under a variety of Cal-Am and DIW operating

[32] "Operation Optimization Plan, Pure Water Monterey Advanced Water Treatment Facility and Groundwater Replenishment Project," Trussell Technologies, January 2022.

[33] Amended and Restated Water Purchase Agreement, March 31, 2023, as Amended ("Purchase Agreement"). and the Amended and Restated Water Recycling Agreement, November 3, 2015 ("Recycling Agreement").

[34] In accordance with the MPWMD/Cal-Am/M1W purchase agreement, the minimum is 4,600 AFY, assuming the amount of water stored in the basin in prior years is at least 1,150 AF.

conditions. The results showed that there is flexibility in the distribution of injection among the six DIWs while still achieving t_{10} travel times greater than 4 months. For example, the monthly values listed in **Table 8-1** and displayed graphically in **Figure 8-1** met the travel time target for all injection/extraction well pairs in all scenarios representing a range of Cal-Am extraction distributions. For each well, the injection rates are within the physical capacity limit of the well, and total injection is within the seasonal availability of AWPF product water in a maximum-injection year. Note that the total (5,808 AFY) is less than the nominal 5,950 AFY because the amounts in the table are net deep well injection after accounting for backflush cycles. This is not the only feasible set of injection rates. It is simply one set *of many possible sets* that achieved t_{10} travel times to Cal-Am extraction wells greater than 4 months *for all DIWs* in all of the scenarios. Additional discussion is provided in **Appendix F**.

The scenarios for simulating underground travel times all included global conservative assumptions. First, the maximum annual injection volume of 5,950 AFY was used. In dry years when less AWPF water would be produced, annual injection would be smaller and travel times would be uniformly longer. Second, the scenarios all assumed no ASR injection[35] and no availability of upper Carmel Valley water to Cal-Am. ASR injection tends to slow underground travel times, and upper Carmel Valley water decreases Cal-Am extractions from the Seaside Basin, which also slows travel times. Thus, the scenario assumptions were all conservative in that they represent conditions associated with fast travel times.

Table 8-1. Injection Rates for Deep Injection for Groundwater Modeling (Conservative, quickest particle travel time)

Month	Monthly Net Injection (acre-feet)						
	DIW1	DIW2	DIW3	DIW4	DIW5	DIW6	Total
Jan	38.8	51.8	155.1	129.4	157.9	103.5	**636.5**
Feb	35.1	46.8	140.1	116.9	142.6	93.5	**575.0**
Mar	38.8	51.8	155.1	129.4	157.9	103.5	**636.6**
Apr	21.9	29.2	87.5	73.0	89.1	58.4	**359.2**
May	21.7	29.0	86.8	72.4	88.4	57.9	**356.3**
Jun	21.3	28.4	85.2	71.1	86.7	56.9	**349.5**
Jul	21.7	29.0	86.8	72.4	88.4	57.9	**356.3**
Aug	21.7	29.0	86.8	72.4	88.4	57.9	**356.3**
Sep	27.0	36.1	108.0	90.1	109.9	72.1	**443.2**
Oct	31.7	42.2	126.5	105.6	128.8	84.5	**519.4**
Nov	35.6	47.8	142.2	118.7	144.8	95.0	**584.1**
Dec	38.8	51.8	155.1	129.4	157.9	103.5	**636.6**
Total	**354.3**	**472.4**	**1,415.3**	**1,181.0**	**1,440.8**	**944.8**	**5,808.7**

[35] Although the modeling assumes no ASR injection, there has been only one year out of the fourteen (14) years of operating the ASR system when no injection occurred.

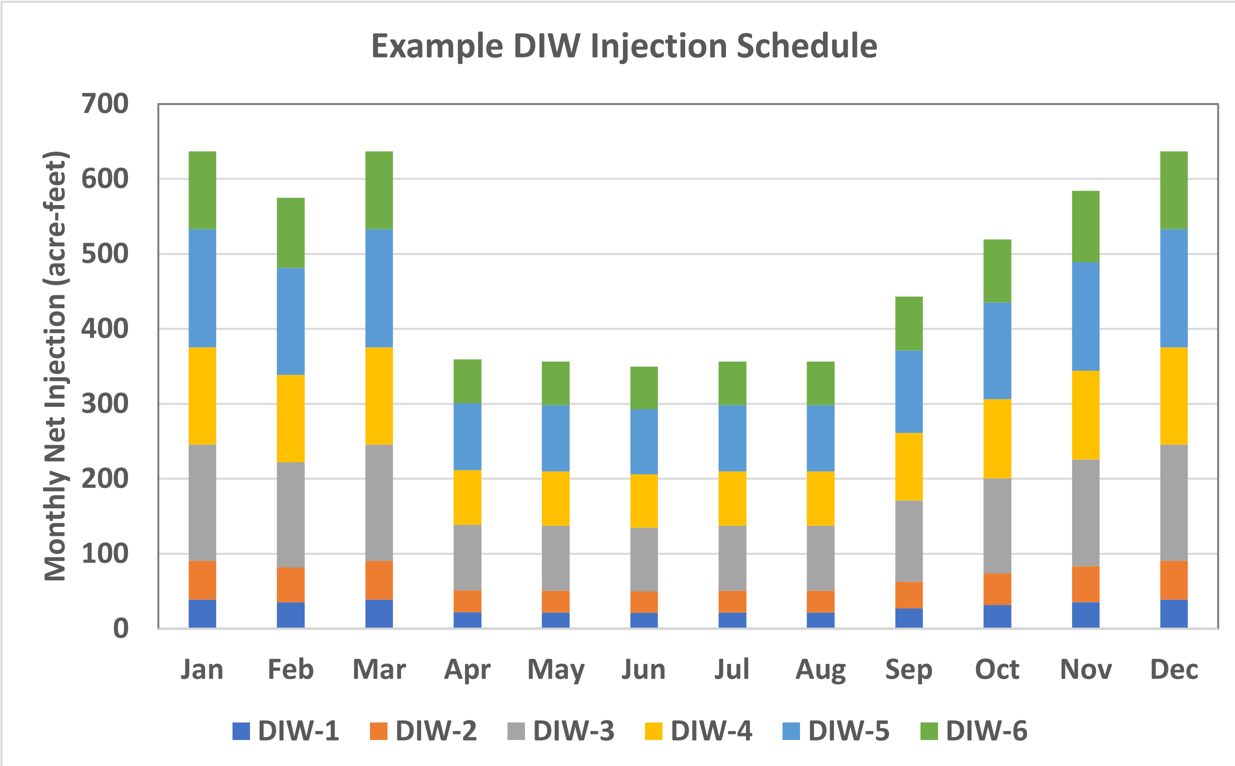


Figure 8-1. Monthly Net Injection Rates for DIWs in All Scenarios

8.3 INJECTION WELL OPERATION

The Project includes four existing DIWs (DIW-1, DIW-2, DIW-3, and DIW-4), two existing VZWs (VZW-1B[36] and VZW-2) and the backflush percolation basin near DIW-4. The Expanded Project will add DIW-5, DIW-6, and another backflush percolation basin located between those wells. This Engineering Report describes the coordinated operation of all facilities.

8.3.1 Deep Injection Wells

Injection into each DIW is continuous except for brief periods of backflushing to maintain the specific injection capacity of the well. Continuous injection tends to gradually clog the aquifer in the immediate vicinity of the well with trace amounts of solids in the injected water, entrained air, or biofouling. This material can be dislodged and removed if the well is periodically pumped as an extraction well at a rate higher than the rate of injection. Standard practice is to backflush at twice the injection rate. Early experience with DIW-1 and DIW-2 confirmed that backflushing at rates roughly equal to the injection rate led to long-term declines in injection capacity. All of the DIWs are now backflushed at twice the injection rate. Weekly backflushing for 2 hours has proven to be adequate to prevent chronic declines in injection capacity at DIW-1 through DIW-4.

[36] The original VZW-1 was not successfully drilled to target depth using the auger method and the borehole was abandoned. VZW-1A was drilled using the reverse rotary method (similar to VZW-2) adjacent to the abandoned VZW-1 borehole. VZW-1A experienced a collapse during construction and was replaced with VZW-1B.

With these durations and proportions, net injection into the Santa Margarita Aquifer is 97.6 percent of the gross injection volume.

Constraints on the physical injection capacities of the DIWs include aquifer transmissivity, well specific capacity, available vertical room for drawdown during backflushing and “draw-up” during injection, pump capacity for backflushing, and the need to backflush at twice the injection rate. The limiting factor varies among the wells. For example, the relatively shallow depth of the Santa Margarita Aquifer at DIW-2 limits the vertical range available for drawdown and draw-up. At DIW-3, the injection capacity is limited by the size of the pump and motor for backflushing. The physical injection capacities are discussed in **Section 3.4**.

All of the DIWs are instrumented with sensors that monitor flow, pressure and water levels. Injection at DIW-1, DIW-2 and DIW-4 typically occurs under a pressure of 40-80 pounds per square inch provided by the supply pipeline (at DIW-3 pressures range from 10 to 40 psi). The pump in the well does not operate during injection. A downhole flow-control valve regulates flow reaching the top of the well screen to ensure that water maintains positive pressure throughout its journey down the well. A pressure transducer monitors water levels every few minutes. That information is relayed to a control center at the AWPF via a SCADA system. Alarms are set to alert personnel to excessively high or low water levels in the well, which indicate some type of malfunction. The SCADA data are reviewed weekly to look for long-term trends that might indicate problems with the well. In particular, data are reviewed to ensure that each backflush cycle returns the specific injection capacity to its value at the end of the previous backflush cycle.

Actual monthly injection volumes for each DIW are less than the physical capacity of the well and are selected to achieve the target annual production volume while optimizing the life of the well and maintaining more than 4 months underground retention time even in years with no ASR injection and maximum possible use of the nearest down gradient extraction wells. Simulations of Project operational scenarios described in detail in **Section 5.3** demonstrate that t_{10} travel times greater than 4 months can be met using the injection schedule in **Section 8.2** (**Table 8-1**) under a wide range of assumptions regarding Cal-Am extraction. The single injection schedule is not unique; variations are also feasible. The point is that a change in Cal-Am extraction distribution generally does not require a compensating change in injection distribution to maintain a t_{10} travel time greater than 4 months for all of the DIWs. In the future, if Cal-Am chooses to shift its production from Paralta, ASR-3, and/or ASR-4 to new, larger capacity, dedicated extraction wells to the north (i.e., EW-1, EW-2, EW-3, and/or EW-4), then the minimum underground retention/travel time (DIW-1 to Paralta) and other travel times will also increase.

8.3.2 Vadose Zone Wells

The two vadose zone injection wells were installed at approximately the same time as DIW-1 and DIW-2. They were initially expected to inject nearly a third as much water as those two deep injection wells (over 200 gpm), but in practice VZW-1B and VZW-2 have only been capable of sustained injection at 35 and 20 gpm, respectively. Because they are screened in the unsaturated (vadose) zone, they cannot be backflushed. Instead, they are simply operated under continuous injection at a combined rate of 55 gpm, which provides annual recharge of 89 AFY to the Paso Robles Aquifer.

8.4 INJECTION SUPPORT FACILITIES

Injection support facilities are described in **Section 3.4**. Information is summarized below with additional components relating to system operation.

8.4.1 Product Water Supply Pipelines and Electrical Service

The product water is transmitted via the conveyance pipeline to the injection wellfield. There, the pipeline connects to a local 18- to 20-in diameter product water supply line to deliver water to the injection wells. This local water supply line was constructed along the length of the Injection Facilities area in phases, to support the phasing of injection wells. Deep injection wells DIW-1 through DIW-4 are tied into the local water supply line by 12-in diameter feed lines and also to a 12-in pipeline that feeds into backflush pipeline to the backflush basin. Injection and backflush pumping is controlled downhole by a flow-control valve. The vadose zone wells are connected to the 18-in water supply line by a 6-in diameter feed line. Vadose zone wells are not connected to the backflush line.

An electrical duct bank is connected to an electrical cabinet, constructed at each well site. Electrical equipment includes a main electrical power supply cabinet required for Pacific Gas and Electric (PG&E) power supply, a transformer and motor controls.

Connection to the PG&E circuit is an underground feed from a pole along General Jim Moore Boulevard. The well motors are operated with a variable frequency drive (VFD).

8.4.2 Backflush Basins

The first backflush basin is located next to DIW-4 and has a storage volume of approximately 2.1 AF. Discharge water is pumped to the backflush basin from each of the four deep injection wells via a 16-inch backflush pipeline. In the operational scenario simulations described in **Section 5.3**, the weekly volume of backflush water from DIW-1 through DIW-4 in winter (when injection and backflush rates are at their seasonal maximum) was 1.2 acre-feet. The first backflush basin has proven capable of percolating that rate of inflow. A second backflush basin will be constructed between wells DIW-5 and DIW-6 as part of the Expanded Project and will percolate the backflush water from DIW-5 and DIW-6. Its construction and operation will be similar to the first backflush basin, except it will have two cells, or compartments, to allow it to accept backflush water even while one side is being maintained. Since start-up of DIW-3 and DIW-4, the first backflush basin has not had an observable percolation capacity decline. However, the second backflush basin may require rehabilitation (scraping and ripping) if percolation capacity is less than required for backflushes.

8.5 OPERATIONS PLAN

Injection occurs on a mostly continual basis, controlled by the O&M schedules of the AWPF. An average of 5,750 AFY will be injected into the Seaside Groundwater Basin for downgradient recovery using existing drinking water extraction wells. During normal and wet periods, up to 5,950 AFY may be injected to replenish the Drought and Operating Reserve account balances. After subtracting backflush volumes, net injection for the deep (Santa Margarita Aquifer) will be 5,540 AFY in normal years and 5,810 AFY in years when reserves are being replenished. This magnitude of supplemental recharge to the Seaside Groundwater Basin will allow the reduction in Cal-Am's Carmel River diversions mandated by the Cease and Desist Order and extraction of Seaside Groundwater Basin native groundwater mandated by the Basin adjudication. For comparison, Cal-Am's allocation of Seaside Groundwater Basin native groundwater yield is only 1,474 AFY under the Basin adjudication ruling, with a required in lieu recharge reduction of 700 AFY for 25 years. A detailed description of the plans to operate and maintain the Injection Facilities is presented in the OOP for the Project.

9 HYDROGEOLOGIC SETTING

Physical characteristics of the Seaside Groundwater Basin and management of groundwater in the Basin were extensively described in the April 2019 Engineering Report. A summary is provided here that highlights Basin characteristics most relevant to groundwater flow directions near the Project, underground residence times of injected water, and effects of Project operation on water levels and storage.

9.1 LOCATION OF PROJECT WITHIN THE BASIN

The Seaside Groundwater Basin is adjacent to Monterey Bay (to the west) and bounded by the Monterey Subbasin of the Salinas Valley Basin to the north and east and by impermeable bedrock to the south. Boundaries of the Seaside Groundwater Basin and of subareas within it are shown in **Figure 9-1**. The Project is located in the north-central part of the Basin, close to the boundary between the Northern Coastal and Northern Inland Subareas. The boundary between those two subareas is based on land use, not hydrogeology. The Northern Coastal Subarea is largely urbanized and includes the Cities of Seaside and Sand City. The Northern Inland Subarea consists of lands within the former Fort Ord that were used as a firing range decades ago. Because of the likely presence of unexploded ordnance buried in soils, the Northern Inland Subarea is completely undeveloped and covered with natural coastal scrub vegetation. Project facilities are all at the western edge of the Northern Inland Subarea, where remedial procedures have been implemented to remove any explosive hazards.

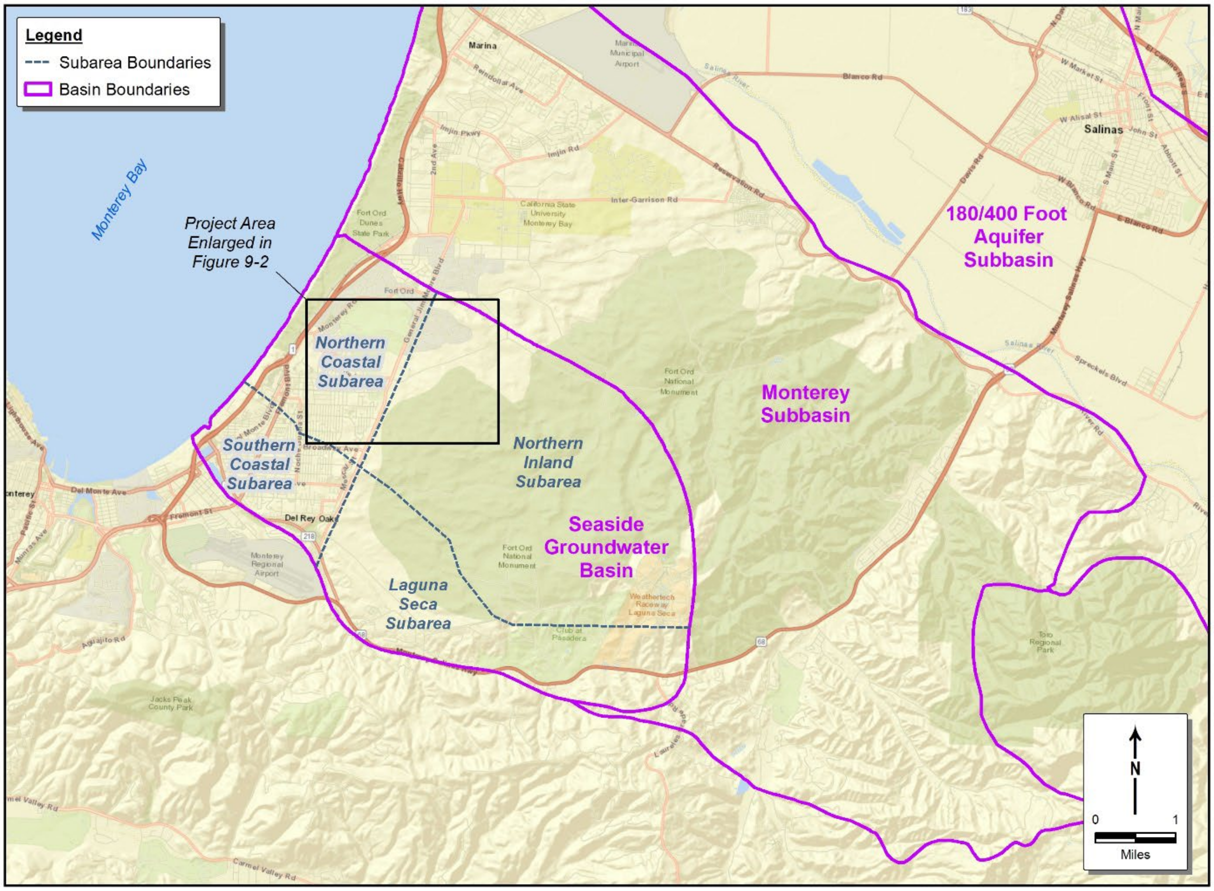


Figure 9-1. Boundaries of the Seaside Groundwater Basin

The Basin boundary closest to the Project area is the northern boundary, which is simply a flow divide between pumping centers to the north and south (Yates et al, 2005). Its location is poorly defined because there are few wells in that area, and the location can shift due to changes in pumping on either side. This boundary was scrutinized in model results out of concern that injection at DIW-5 and DIW-6 might create a water-level mound that would allow some of the injected water to flow north into the Monterey Subbasin.

The ocean boundary is of great concern for Seaside Groundwater Basin management overall because of the risk of seawater intrusion. Basin deposits extend offshore beneath Monterey Bay, and water levels near pumping centers and at the coastline are below sea level, at least in the Santa Margarita Aquifer. However, Project injection wells and the municipal supply wells that recover the injected water are all 1.5 miles or more from the coast. Together, the ASR and PWM projects roughly double the amount of recharge to the Northern Inland and Northern Coastal Subareas. In contrast, Cal-Am extraction is expected to gradually increase over the next 10 years to decades as demand increases and additional extraction well capacity is installed (MPWMD 2022). Therefore, average annual injection is expected to outpace average annual extraction for the first several decades of Project operation. By design, this surplus will raise water levels in the Santa Margarita Aquifer toward and possibly to the protective groundwater elevations that would reliably prevent seawater intrusion.

The internal boundary between the Northern and Southern Coastal Subareas and between the Northern Inland and Laguna Seca Subareas is defined by geologic structures that create partial barriers to groundwater flow. Those are described in **Section 9.2**.

9.2 AQUIFERS AND STRUCTURE

The general stratigraphy in the northern part of the Seaside Groundwater Basin consists of three major formations stacked on top of one another. **Figure 9-2** shows geologic features near the Project area, including the location of the section line used to prepare the hydrogeologic cross section shown in **Figure 9-3**. The Aromas Sand is the shallowest formation and is 200-300 ft thick in the Project area. The Aromas Sand is almost entirely above the water table in the vicinity of the Project area. The vadose zone injection wells inject water into the Aromas Sand for percolation down to the underlying Tertiary and Quaternary continental deposits, which in this report are referred to as the Paso Robles Aquifer, consistent with customary local terminology. The Paso Robles Aquifer is an unconfined aquifer, a thinly-layered sequence of sands, silts and clays. Its thickness in the Project area ranges from approximately 150 ft over the crest of the anticline to approximately 450 ft near the sites for DIW-5 and DIW-6.

Beneath the Paso Robles Aquifer is the Santa Margarita Sandstone, referred to here as the Santa Margarita Aquifer. It is an older (Miocene-Pliocene) marine sandstone approximately 200 ft thick with generally increasing amounts of fine-grained material present toward the lower part of the formation. It is confined by a heavily cemented layer at the top of the sandstone. Because of its texture, the hydraulic conductivity of the Santa Margarita Aquifer is approximately three times greater than that of the Paso Robles Aquifer (Yates et al, 2005). Because of its marine origin, however, its water quality is poorer (higher total dissolved solids).

Underlying all of these formations is the relatively impermeable Monterey Formation of Miocene age. It consists of shales that store and yield much smaller quantities of groundwater to wells than the overlying formations do. Thus, it is considered “bedrock” that underlies the Basin and also forms its southern boundary.

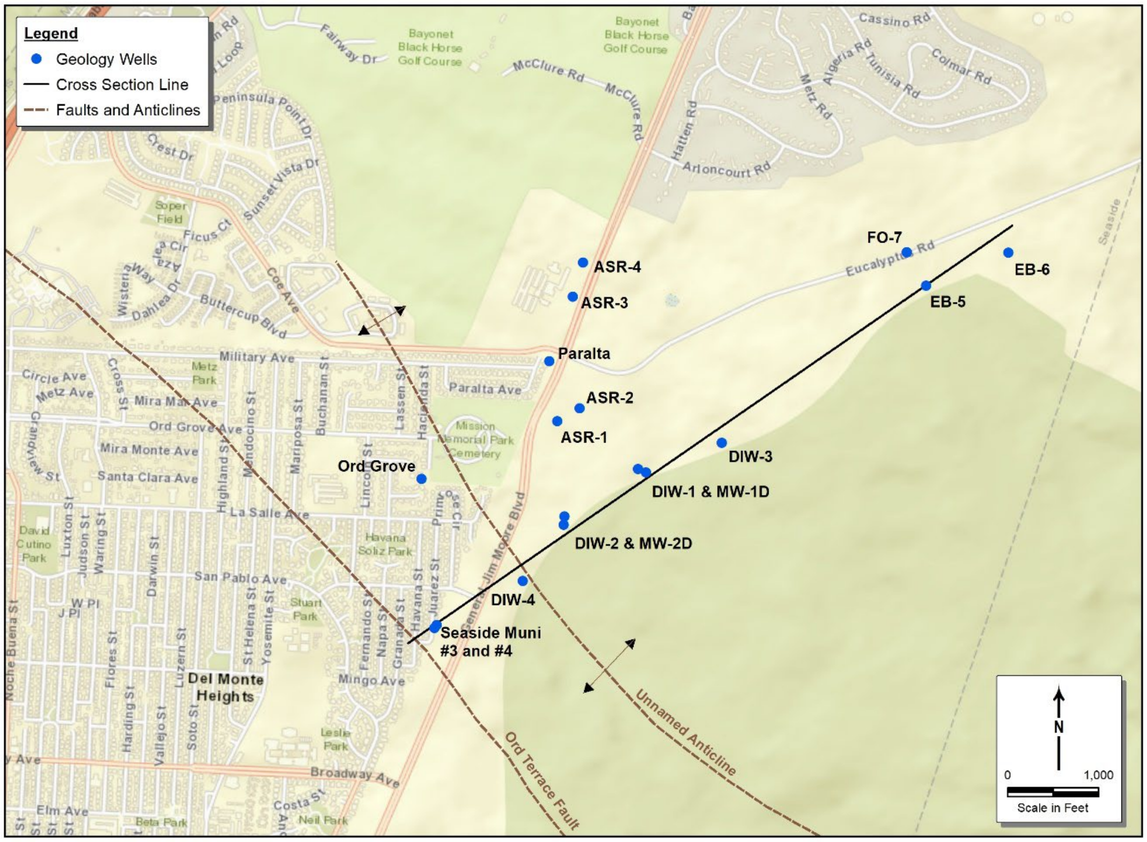


Figure 9-2. Geologic Features near the Project Area

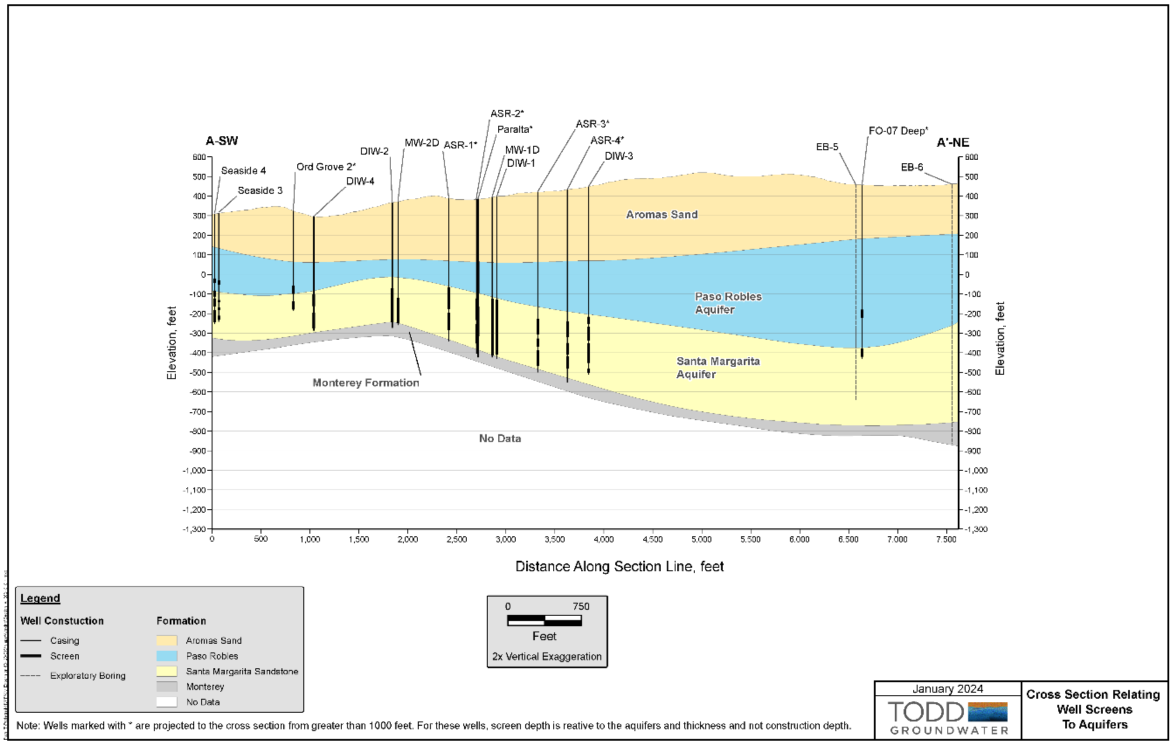


Figure 9-3. Hydrogeologic Cross Section A-A'

One geologic structure that might affect groundwater flow in the Project area is an unnamed anticline the crest of which is parallel to and slightly northeast of the line between DIW-4 and Ord Grove 2 (Clark and others, 1997). Because of the folding, the Santa Margarita Aquifer is thinner and shallower near the crest of the anticline, which decrease transmissivity and also reduce the vertical range of water levels available for draw-up during injection and drawdown during backflushing. It is for these reasons that the physical capacity of DIW-2 (located near the crest) is smaller than the capacities of the other DIWs.

The anticline or related faulting may be responsible for creating a partial barrier to groundwater flow across it, but evidence is mixed. Pumping from wells on either side does not affect water levels in wells on the opposite side, and Ord Grove 2 has never seen water quality effects of Carmel Valley water injected at ASR-1 and ASR-2 after 15 years of ASR operation. However, when the anticline was represented in the groundwater flow model as an impermeable flow boundary, it excessively constrained the spread of water injected at DIW-4. This resulted in excessively fast simulated travel times from DIW-4 to Ord Grove 2 compared to actual travel times observed during the extrinsic tracer study. The assumed partial flow barrier was subsequently removed from the model, and the revised simulated travel times more closely matched travel times measured by an extrinsic tracer study.

The Ord Terrace Fault is parallel to and southwest of the anticline. It significantly offsets bedrock and the larger Laguna Seca Anticline, but it does not appear to impede groundwater flow in the Paso Robles and Santa Margarita Aquifers (Yates et al, 2005).

9.3 GROUNDWATER PRODUCTION

Groundwater pumping from the Basin has changed significantly since 1995 due to changes in water rights. In 1995, Cal-Am received a Cease and Desist Order from the SWRCB requiring it to drastically reduce the amount of water it produced from wells in the Carmel Valley. Cal-Am's initial response was to increase production from its wells in the Seaside Basin. However, the Seaside Groundwater Basin was not able to absorb the increase, which led to an adjudication of Basin water rights in 2005. Since then, the focus of Cal-Am, MPWMD, and M1W has been on providing supplemental recharge to the Basin to support the water needs of Cal-Am and other Basin users. The ASR and PWM Projects both function to provide the necessary additional recharge.

Cal-Am achieved full compliance with the terms of the Cease and Desist Order beginning in January 2022. Consequently, groundwater withdrawals since then are most indicative of current and near-term future pumping. For example, in water year 2023, Cal-Am produced 5,802 AF, of which 1,466 AF was its allocation of "natural safe yield", 110 AF was carry-over production allowance from 2022, 806 AF was water derived from ASR recharge, and 3,458 AF was water derived from Project injection (Seaside Basin Watermaster, 2023). Pumping by others in the Northern Coastal Subarea was much smaller. Of the ten additional users registered with the Watermaster, only four were active and produced a combined total of 233 AF. Of that, 41 AF was for irrigation of the Seaside municipal golf courses (Bayonet and Blackhorse). The Existing Project now delivers recycled water to the golf course as of early 2023.

In water year 2023, approximately 83 percent of withdrawals from the Coastal and Northern Inland Subareas was from the Santa Margarita Aquifer (including all recovered ASR and PWM water). Seasonal variations in pumping are relatively small compared to typical patterns in California because the water is for municipal use in a cool climate. Seasonal variations in water use have generally been within +/- 20 percent of annual average use. However, SWRCB Water Rights Order 98-04 requires greater production from the Seaside Basin during summer months to protect the Carmel River, which contributes to seasonality of pumping.

All groundwater withdrawals in the Seaside Basin are regulated by the Seaside Basin Watermaster under the terms of the water rights adjudication in 2006. Production allowances are assigned to each user granting them a fraction of the "natural safe yield" of the Basin. However, supplemental recharge including water injected by the Project is not subject to the adjudication. Instead, withdrawal of that water is specified under the terms of a water purchase agreement between M1W, MPWMD, and Cal-Am.

9.4 WATER LEVELS AND FLOW DIRECTIONS

At the Basin scale, regional groundwater flow is from inland areas toward the coast. There are very few wells in the Northern Inland Subarea, but projection of water level gradients suggested that water levels slope from approximately 150 ft above sea level at the inland edge of the Northern Inland Subarea to near sea level at the Monterey Bay coastline (Yates and others, 2005). Superimposed on the regional gradient are depressions in the potentiometric (water level) surface in areas of concentrated pumping. In both the Paso Robles and Santa Margarita Aquifers, the major pumping depression is typically centered around the Luzern, Ord Grove and Paralta Wells. The depression is evident in the contours of groundwater elevation in the Santa Margarita Aquifer in October 2022 shown in **Figure 9-4**. Those water levels are from the fall season of a very dry year and consequently represent the low end of the recent range of water levels. Water levels were approximately 40 ft below sea level near the center of the trough. Because of the confined groundwater conditions (and associated low storativity) in the Santa Margarita Aquifer, drawdown from pumping spreads out over a large area. For example, water levels were approximately 25 ft below sea level at the coastline, creating a situation that could induce seawater intrusion. However, coastal wells are sampled by MPWMD and the Watermaster to detect seawater intrusion, and to date no evidence of intrusion has been detected.

Figure 9-5 shows contours of groundwater elevation in the Santa Margarita Aquifer for April 2023, near the end of an exceptionally wet winter. Water levels were approximately 15 ft higher than in October 2022 near the center of the pumping trough and approximately 10 ft higher at the coastline. The large rise in water levels during the 6 months between the contour dates was due to the normal seasonal decrease in municipal pumping combined with an above-average amount of injection of Carmel Valley water at the ASR wells. Eventual construction of Cal-Am's planned new extraction wells EW-1 through EW-4 will tend to extend the Santa Margarita Aquifer pumping trough to the north along General Jim Moore Boulevard.

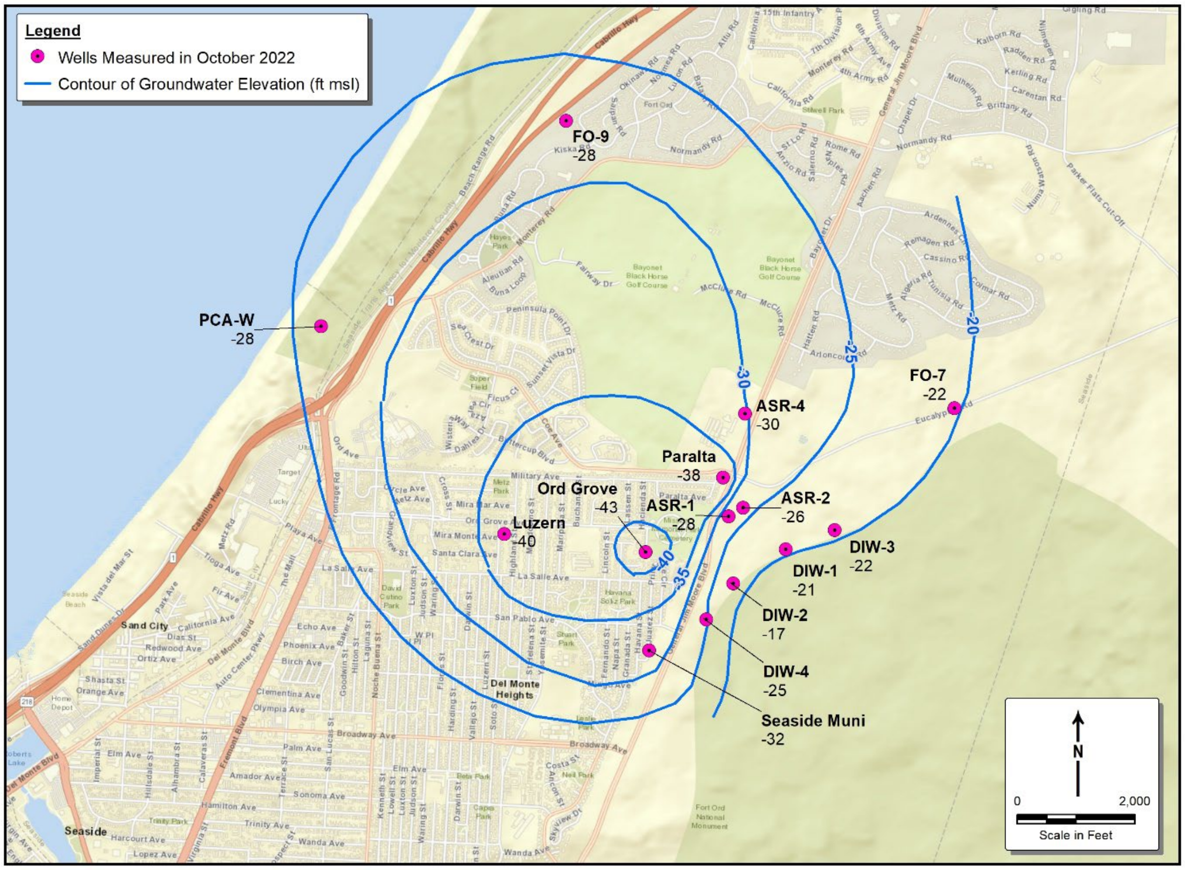


Figure 9-4. Water Level Contours, Santa Margarita Aquifer, October 2022

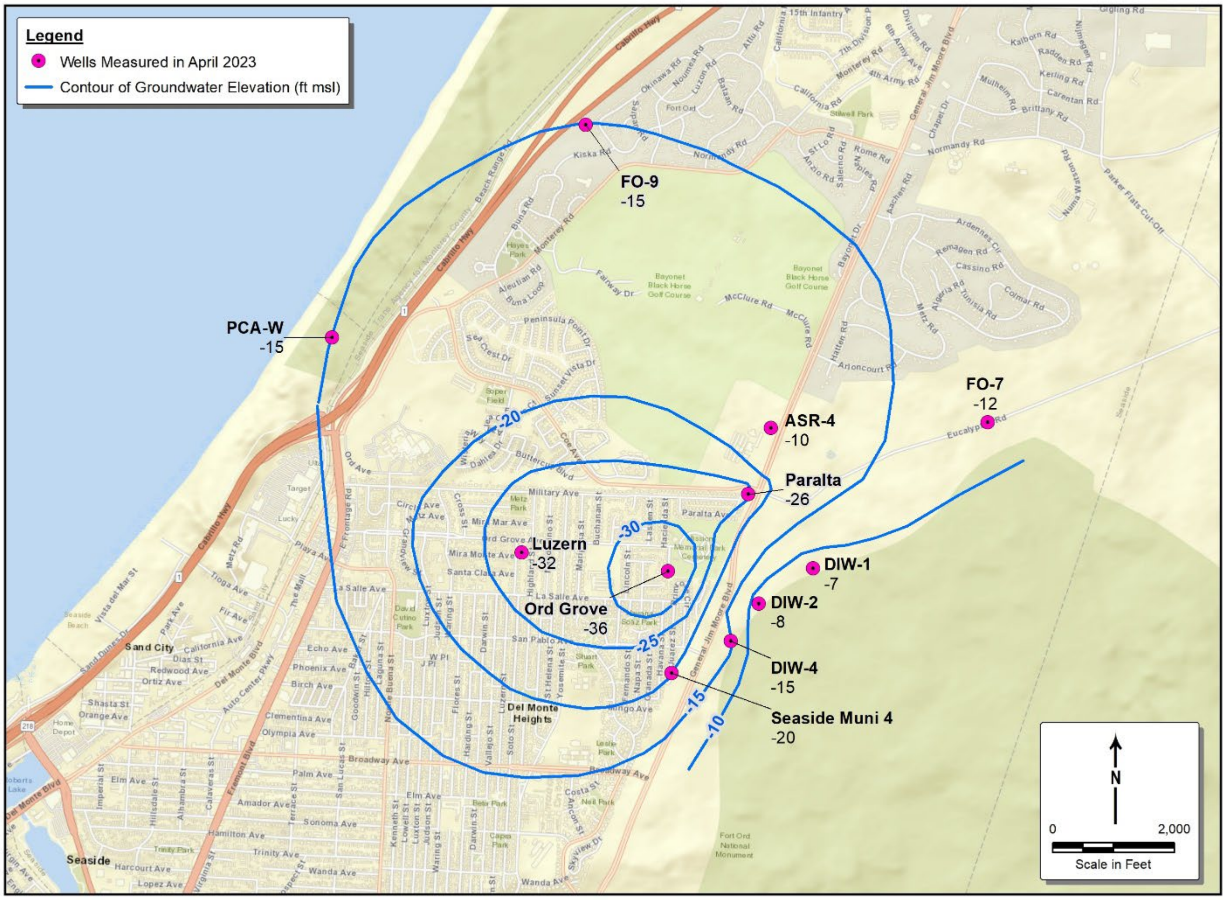


Figure 9-5. Water Level Contours, Santa Margarita Aquifer, April 2023

Recent seasonal trends in groundwater levels in Santa Margarita Aquifer wells can be seen in the hydrographs for 2021-2013 in **Figure 9-6**. For a historical context, hydrographs of water levels in the Paralta test well and FO7 Shallow and Deep wells during 1994-2014 are shown in **Figure 9-7**. In the early 1990s, water levels in the Paralta well were mostly in the 0-12 ft above mean sea level range (ft msl). Cal-Am increased production from its Seaside Basin wells (including Paralta) beginning in 1995, when Water Rights Order 95-10 was adopted by the State Water Resources Control Board requiring Cal-Am to decrease its production from the Carmel Valley. Seasonal water-level fluctuations increased to approximately 20 ft, and a long-term declining trend set in. By 2005, water levels had dropped to 0 to -20 ft msl. An adjudication of Basin groundwater rights in 2006 led to a reduction in pumping by all Basin users, which initiated a gradual rise in water levels to -1 to -12 ft msl by 2014. Jumping ahead to 2022 and 2023, Paralta water levels are now lower, in the -20 to -40 ft msl range.

At the FO-7 monitoring well cluster—4,100 ft east of Paralta—water levels in the deep (Santa Margarita Aquifer) well followed the same pattern as Paralta during 1994-2014. Although there is no extraction well nearby, drawdown from the Paralta well and other large Santa Margarita Aquifer production wells spread out over a large area because of the confined conditions in that aquifer. However, there has been more water level recovery at FO7 than at Paralta since 2014. Water levels were -18 to -28 ft msl in 2013-2014 and rose to -12 to -22 ft msl in 2023.

The hydrographs for 2022-2023 (**Figure 9-6**) show the combined effects of seasonal changes in extraction and seasonal patterns of ASR injection. The effect of DIW and ASR injection can be seen in the hydrographs for DIW-1 through DIW-4. There was a substantial increase in water levels in all four of those wells during winter 2023. DIW injection was varying seasonally, from approximately 250 AF/month in summer 2022 to approximately 400 AF/month in winter 2023 and back to 250 AF/month in summer 2023. Combined injection at ASR-1 and ASR-2 averaged 111 AF/month during January-April 2023 thanks to unusually high flows in the Carmel River. Cal-Am extraction did not follow a typical seasonal water demand pattern between October 2022 and April 2023. Extraction from all Cal-Am wells fluctuated within a range of roughly 370-620 AF/month. The water level rise from October 2022 to April 2023 was approximately 30 ft at DIW-1, which is closest to the injection at ASR-1 and ASR-2. The seasonal rise decreased to approximately 20 ft at DIW-2 and DIW-3 and approximately 15 ft at DIW-4, correlating with distance from the ASR wells. In general, higher water levels in DIWs provide additional available drawdown for backflushing, which in some DIWs enables higher injection rates.

Near the coast, water levels rose by approximately 10 feet from October to April (PCA-W Deep and FO-9 Deep). This further confirms that the effects of extraction and injection in the Project area extend to the coast.

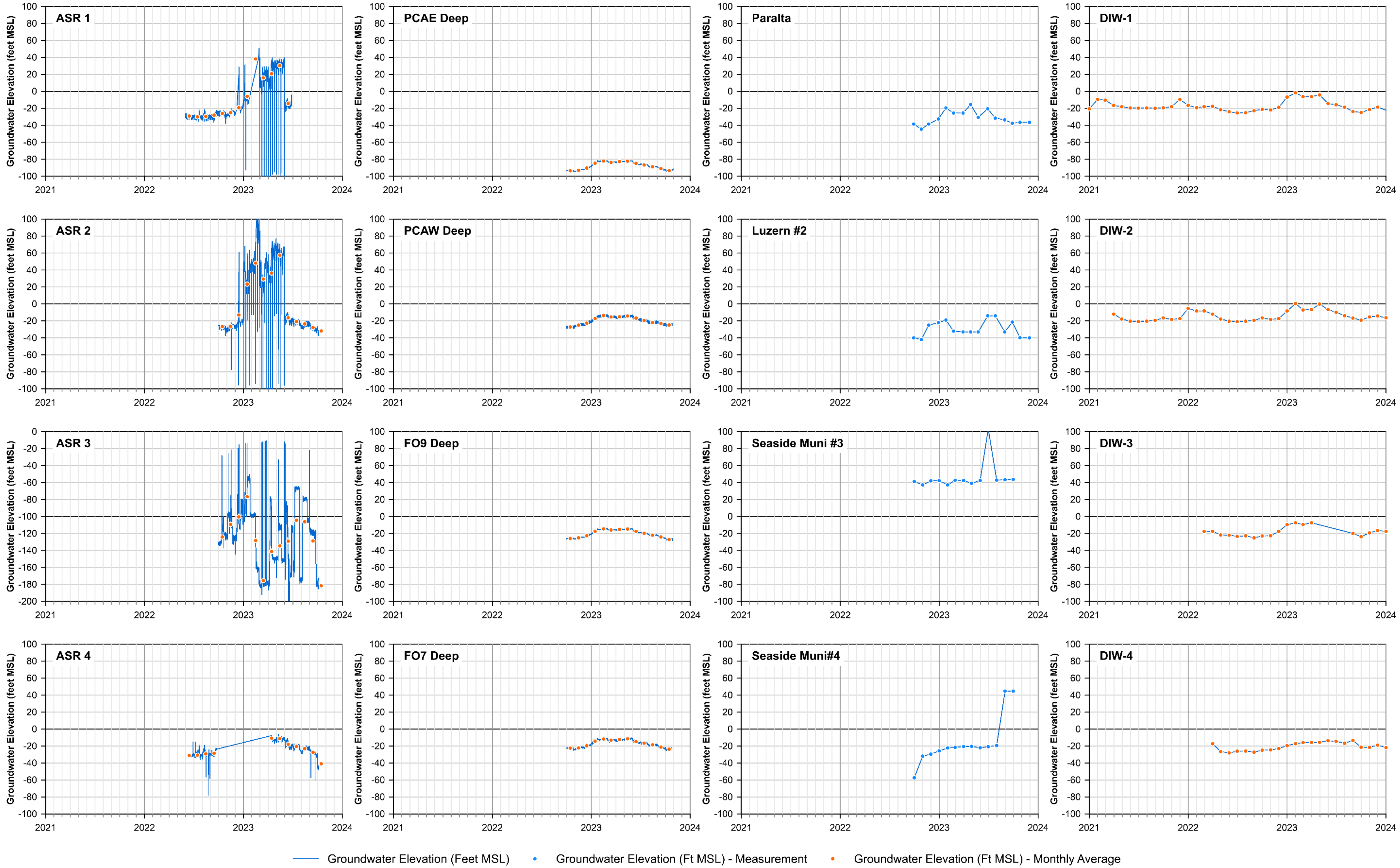


Figure 9-6. Santa Margarita Aquifer Water Levels, 2021-2023

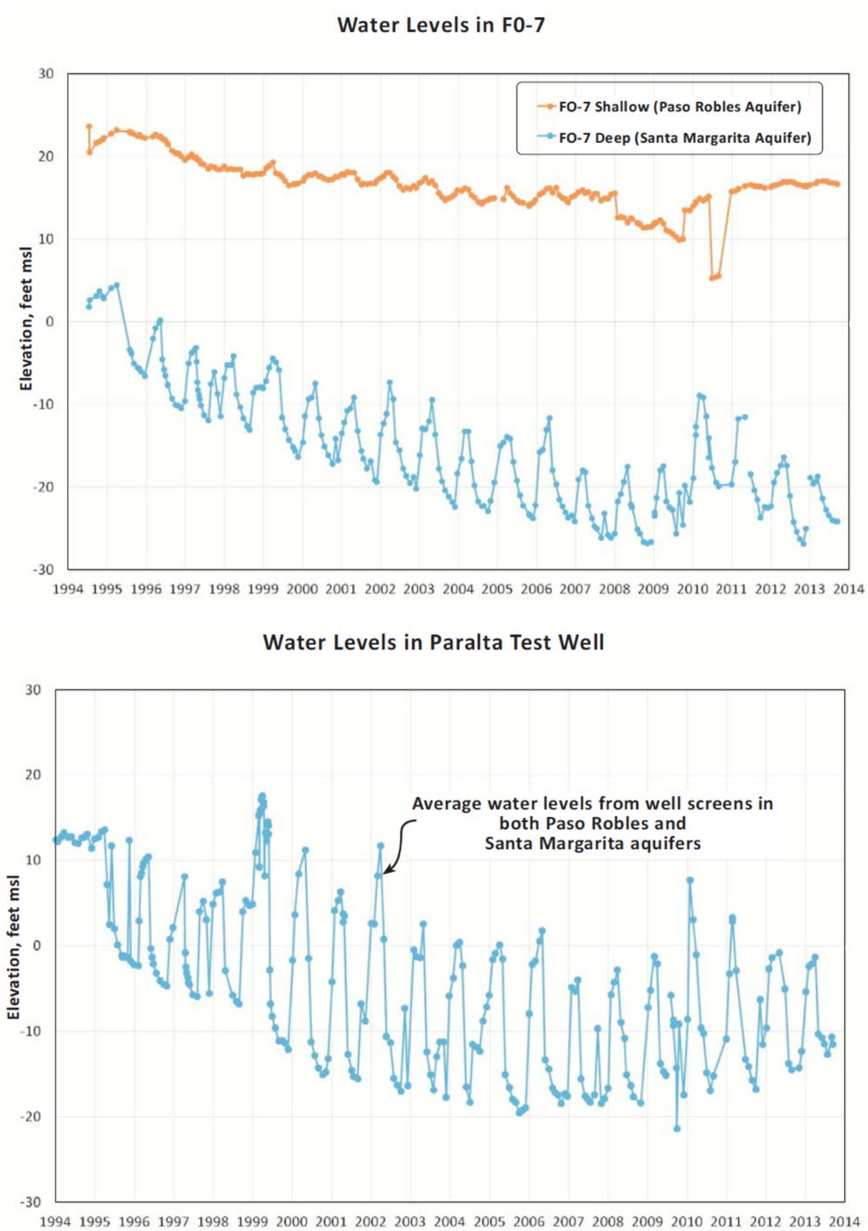


Figure 9-7. Water Levels in Project Area, 1994-2014

9.5 WATER BALANCE

Groundwater budgets provide a useful context for evaluating the Project. They demonstrate the magnitude and importance of the additional yield provided by the project and also point to potential effects on boundary flows. **Table 9-1** presents the average annual pre-Project water budget for the combined Northern Coastal and Northern Inland Subareas. Combining these subareas is appropriate because all recharge in the Northern Inland Subarea flows into the Northern Coastal Subarea or to Project and ASR wells near the subarea boundary.

Details regarding the data and estimation methods for the flows were presented in the 2019 Engineering Report. Key features of the budget include:

- Essentially all-natural recharge is from deep percolation of rainfall beneath the root zone. This has been estimated to average approximately 2 inches per year in undeveloped areas (Yates and others, 2005).
- There are no surface streams in the budget area and, hence, no groundwater recharge or discharge involving streams.
- The water table is too deep to support direct use of groundwater by plants.
- 98 percent of outflow during the budget period was to wells. That means there is very little outflow that could be captured by increasing groundwater pumping in strategic locations.
- The budget includes 100 AFY of subsurface inflow from offshore areas and a 203 AFY deficit that could eventually translate into increased inflow from offshore areas.
- ASR well recharge averaged 15 percent of total recharge during the budget period, which represents a significant boost in local yield.

Operation of the Project will dominate the water budget. The average injection of 5,750 AFY will exceed the combined total of all other sources of recharge. Groundwater extraction at nearby Cal-Am wells will continue to create a local closed cell with high groundwater turnover. Cal-Am extraction is expected to increase gradually over the next couple of decades, during which time average annual injection (ASR and PWM) is expected to exceed average annual extraction. This is expected to raise water levels in the vicinity of those projects, which could slightly increase groundwater outflow across the northern inland Basin boundary, depending on water levels on the opposite side. Any increase in outflow across the northern inland boundary would be of native groundwater, not injected PWM water. Higher water levels could also reduce landward flow from offshore areas.

Table 9-1. Groundwater Budget for Northern Coastal and Northern Inland Subareas of the Seaside Groundwater Basin

Water Balance Component	Average Annual Pre-Project Flow (acre-feet/year)[1]
INFLOWS	
Rainfall	1,596
Irrigation Deep Percolation	546
Pipe Leaks	488
ASR Recharge	625
Inflow from Southern Coastal Subarea	790
Inflow from offshore	100
Total Inflow	***4,145***
OUTFLOWS	
Wells	4,278
Outflow to offshore	70
Total outflow	***4,348***
STORAGE CHANGE	
Inflows - Outflows	***-203***

Notes:

[1] Values are averages for 2008-2012 except subsurface inflows (2003-2007) and pipe leaks (2011-2012).

9.6 WATER QUALITY

Groundwater quality in the Project area was extensively studied during the Project design phase and documented in the 2019 Engineering Report. The pre-Project water quality patterns revealed by that work are summarized briefly here. Effects of Project operation on groundwater quality since injection commenced in March 2020 are described in **Section 11**.

Pre-Project water quality studies documented in the 2019 Engineering Report presented major-ion comparisons among local wells and the results of testing for contaminants. In general, wells screened in the Paso Robles Aquifer showed lower concentrations than wells screened in the Santa Margarita Aquifer for all major ions, especially calcium, chloride, HCO_3^-, magnesium, and sulfate. Groundwater in both aquifers ranged from neutral-type to sodium-potassium-type (for cations) and bicarbonate-carbonate-type, to neutral-type, to chloride-type (for anions). Compared to the Santa Margarita Aquifer samples, most of the groundwater samples from the Paso Robles wells exhibited a more sodium-chloride (saline) signature, even though that aquifer had a lower overall total dissolved solids concentration.

The pre-Project studies also included sampling three Paso Robles Aquifer wells and three Santa Margarita Aquifer in the Project area for 275 constituents that could pose water quality concerns. No exceedances of primary drinking water maximum contaminant levels (MCLs) were recorded in any of the wells with turbidity values of 10 NTU or less. Two wells with elevated turbidity had concentrations of some metals that were above the MCLs, but those concentrations were clearly associated with the turbidity.

Groundwater samples were also analyzed for contaminants remaining from historical use of the Northern Inland subarea as a firing range for military training. That included 17 explosive compounds (nitroaromatics and nitramines), beryllium and lead. The results demonstrated that groundwater has not been impacted locally from explosives associated with former Fort Ord activities.

Laboratory analyses of the samples from the six study wells included CECs. As defined in the Recycled Water Policy, CECs are chemicals in personal care products, pharmaceuticals including antibiotics, antimicrobials, agricultural and household chemicals, hormones, food additives, transformation products and inorganic constituents. These chemicals are commonly detected in trace amounts in surface water, wastewater, recycled water, and groundwater and have been added to the monitoring requirements for any project involving groundwater replenishment using recycled water. As part of the Title 22 Criteria for GRRP projects, a Project Sponsor must recommend CECs for monitoring in product water and groundwater. The pre-Project study analyzed six candidate CECs: 17-*β*-estradiol, caffeine, NDMA, triclosan, N,N-diethyl-meta-toluamide (DEET) and sucralose. Only NDMA, caffeine and DEET were detected, each in only one or two wells and at concentrations in the low parts per trillion (ng/L). None of the CECs currently have MCLs for drinking water. For NDMA, the current NL is 10 ng/L.

10 DOWNGRADIENT EXTRACTION WELLS

Wells downgradient of the Project's injection wells include aquifer storage and recovery (ASR) wells owned by MPWMD and Cal-Am municipal supply wells. Cal-Am has plans to construct four additional municipal wells to the north of the existing group of ASR and municipal wells. Most of the wells are screened entirely in the Santa Margarita Aquifer, but a few are also screened in the overlying Paso Robles Aquifer. Extraction from these wells for municipal supply constitutes the largest and most concentrated pumping stress in the Seaside Groundwater Basin and creates a local depression or "pumping trough" in the Santa Margarita Aquifer water-level surface. Locally, the gradient toward the pumping trough adds to the larger seaward basin-wide gradient to produce the gradient that moves water from the Project injection wells to the extraction wells. The locations of all of the relevant wells can be seen in **Figures 3-9a** and **3-9b**. The depths and capacities of the wells are listed in **Table 10-1**.

10.1 ASR WELLS

The MPWMD ASR facilities consist of shallow extraction wells next to the Carmel River, a pipeline to convey the water to a treatment plant that brings the water quality up to potable standards, and four ASR wells that inject the water into the Santa Margarita Aquifer. Operation of the Carmel Valley wells is limited to periods when flow in the Carmel River exceeds a specified threshold. In practice, this occurs primarily during the winter. In its 14 year operational history, the ASR project operated to inject water into the Seaside Groundwater Basin in all but one year (2014) as shown in **Table 10-1,** which lists the annual amounts of ASR injection from 2010 to 2023.

Two of the four ASR wells (ASR-1 and ASR-2) are located approximately midway between DIW-1 and DIW-2 and the Paralta well. ASR-1 was formerly used for both injection and extraction—which is typical for ASR operation—but extraction for municipal supply was discontinued in 2021. Intrinsic tracer study results indicated the underground travel time from DIW-1 could fall under the minimum of 2 months if PWM injection and Cal-Am extraction were to increase as planned to meet water supply needs for the Monterey Peninsula under the Cease and Desist Order. ASR-2 has always been used exclusively for injection. The other two ASR wells are located near General Jim Moore Boulevard north of the Paralta well. Well ASR-3 was used for injection and is currently operated by Cal-Am as a municipal supply well. Well ASR-4 was exclusively an injection well until 2023, when it was approved for use as a municipal supply well. Similar to ASR-3, it is now used solely as a municipal supply well. With the loss of ASR-1 as a supply well, Cal-Am now extracts substantial quantities from ASR-3 and plans to start extractions from ASR-4 in 2024. The ASR wells are all screened exclusively in the Santa Margarita Aquifer.

Monitoring of water levels in the Northern Coastal and Northern Inland Subareas has shown that injection at the ASR wells raises water levels in the Santa Margarita Aquifer over a wide area. Within approximately 500 feet of ASR-1 and ASR-2, water levels rise by 10 feet or more. The rise decreases exponentially with distance, to 1 foot or less at Highway 1 and ~0 feet at sentinel wells near the coastline.

Table 10-1. Injection and Recovery Volumes, ASR Project

Water Year	ASR Injection (AFY)	ASR Recovery (AFY)
2010	1,111	1,111
2011	1,117	1,117
2012	131	131
2013	294	513
2014	0	0
2015	215	0
2016	699	493
2017	2,345	1,182
2018	530	1,499
2019	417	744
2020	916	434
2021	66	0
2022	71	0
2023	1,656	806
Total	9,566	8,030

10.2 CAL-AM AND SEASIDE MUNICIPAL WELLS

Cal-Am's most heavily used supply wells are also the ones closest to Project DIWs. The Paralta well is located 1,630 ft northwest of DIW-1. It is screened in both the Paso Robles and Santa Margarita Aquifers. The two aquifers have different water qualities; Paso Robles water fresher than Santa Margarita water. Based on ratios of chloride and total dissolved solids concentrations, it appears that 60-70 percent of Paralta production is from the Santa Margarita Aquifer. The Ord Grove 2 well is located 1,600 ft northwest of DIW-4. It is also a dual-aquifer well, and a similar ion ratio approach indicated that 58-80 percent of the water is from the Santa Margarita Aquifer. ASR-3 is currently the well used most heavily by Cal-Am and accounted for 36 percent of total Cal-Am production from the Seaside Groundwater Basin in 2022. ASR-3 is 2,300 ft from DIW-3, which is the upgradient Project well. ASR-4 is located 390 ft north of ASR-3 and received regulatory approval for use as a municipal supply well in 2023. It is expected to begin actively contributing to Cal-Am supply in 2024. Cal-Am's other existing wells (Luzern, Playa #3 and Plumas #4) are all far to the west and south of the primary supply wells and produce relatively small amounts of water mostly from the Paso Robles Aquifer. Injected water would not flow to those distant wells, because it would be captured by closer, higher producing wells, so travel time estimates are not needed.

Cal-Am plans to install four additional extraction wells, all completed in the Santa Margarita Aquifer. EW-1 and EW-2 would be approximately 600 ft north of ASR-4 along General Jim Moore Boulevard. They would contribute to pumping trough drawdown in that vicinity, but injected project water arriving from DIW-3 would tend to be intercepted by ASR-3 and ASR-4 before reaching those wells. EW-3 and EW-4 would be located another 2,650-3,250 ft farther north along General Jim Moore Boulevard. The upgradient Project injection wells for that well pair would be DIW-5 and DIW-6.

Extraction from Cal-Am's wells in the Seaside Groundwater Basin evolved over the past 18 years as Cal-Am came into compliance with the terms of the Cease and Desist order limiting its exports from the Carmel Valley. Full compliance was achieved beginning in January 2022, and production data since then are used as the basis for estimating future Cal-Am extraction. Monthly production by well during calendar year 2022 is shown in **Figure 10-1**. Cal-Am production totaled 5,639 AF in 2022. In the scenario simulations described in **Section 5.3** production was 5,850 AFY, reflecting conservative (low) assumptions regarding availability of upper Carmel Valley and other water supplies.

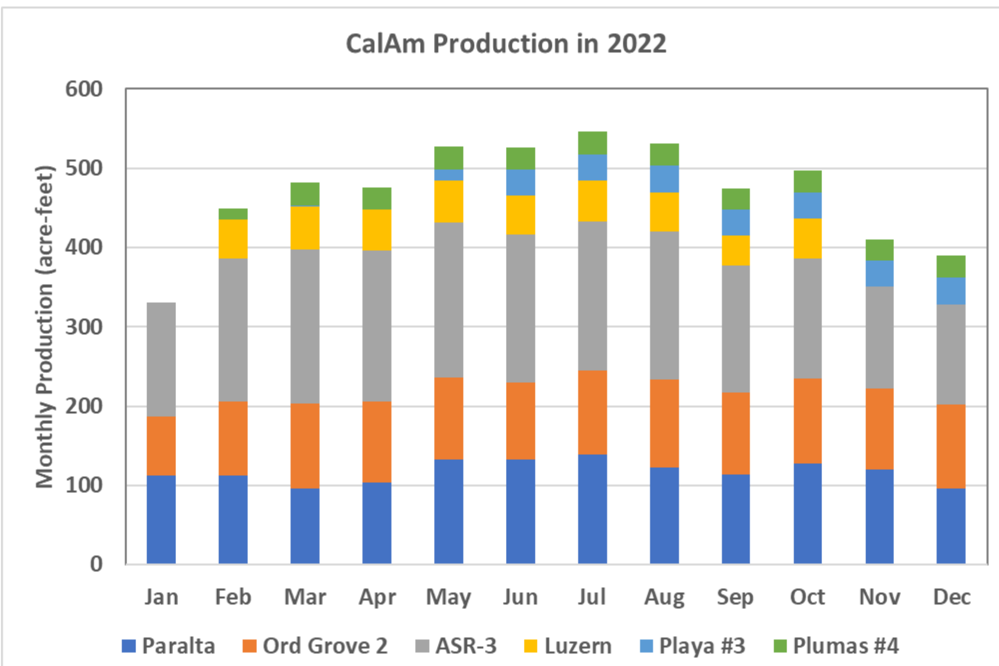


Figure 10-1. Monthly Production from Cal-Am Wells in 2022

Seaside Muni #4 is geographically close to DIW-4 but it is not in the downgradient direction (see **Figures 3-9a** and **3-9b** for well locations). It produced 157 AFY during 2022-2023, mostly from the Paso Robles Aquifer. A few other production wells are located in the vicinity of the Project but either produce exclusively from the Paso Robles Aquifer or are used only for non-potable purposes. These include the Mission Memorial Park well and the Reservoir Well.

10.3 CLOSEST DRINKING WATER SUPPLY WELL

Title 22 Criteria (Section 60320.224), the minimum travel time for injected water (before reaching the nearest drinking water well) must be greater than the RRT. For the Project, the RRT is 3 months and the minimum underground retention time is 4 months (see **Sections 5** and **6** for details).

Tracer studies and modeling have confirmed that the nearest downgradient drinking water well is the Paralta well receiving injected water from DIW-1. For the other DIWs, different municipal wells are downgradient, but the distances and travel times are greater. The closest downgradient drinking water well to each DIW is listed in **Table 10-2**. Simulations of Project operation described in **Section 5** and **Appendix F** demonstrated the Project can readily achieve an underground retention time of at least 4 months for all of the DIWs under a range of assumptions regarding Cal-Am extraction rates and locations.

Table 10-2. Closest Drinking Water Wells to Injection Wells

Project Wells[a]	Target Aquifer	Closest Downgradient Production Well	Approximate Distance (feet)
DIW-1	Santa Margarita	Paralta	1,630
DIW-2	Santa Margarita	Paralta	1,807
DIW-3	Santa Margarita	ASR-3	2,350
DIW-4	Santa Margarita	Ord Grove 2	1,600
DIW-5	Santa Margarita	Cal-Am EW 3 and 4[b]	3,800
DIW-6	Santa Margarita	Cal-Am EW 3 and 4[b]	4,100

a. VZWs are not shown due to the low injection rates and long travel times.
b. Planned Cal-Am extraction wells.

10.4 PRIMARY CONTROL ZONE BOUNDARY

As required by the Title 22 Criteria (Section 60320.200(e)(2)), a zone of controlled drinking water well construction (primary control zone) must be delineated around the Project injection wells based on the longest of the travel times for pathogen control or RRT. The intent is to ensure no new drinking water wells are constructed within this control zone and to prevent travel times shorter than required for effective pathogen credit or to respond to injection of off-specification water. The shortest simulated t_{10} underground retention time between any Project injection well and the nearest downgradient drinking water well for the operational scenario described in **Section 5.3** was 4.4 months. To allow for additional operational flexibility, a log virus removal credit of 4.0 months for underground retention time is being requested for the Project. As described in **Section 6.7**, the RRT is 3 months. Accordingly, a primary control zone representing the longest distance covered in 4 months for each injection well was used to delineate the primary control zone for each aquifer. The primary zone for the Santa Margarita Aquifer will be the areas encompassed by the red inner dashed lines in **Figure 10-2**. The primary control zone was delineated as the outer envelope of all particle tracks (converted from t_{peak} to t_{10} travel distances) at travel times of 4 months or less from all simulated scenarios.

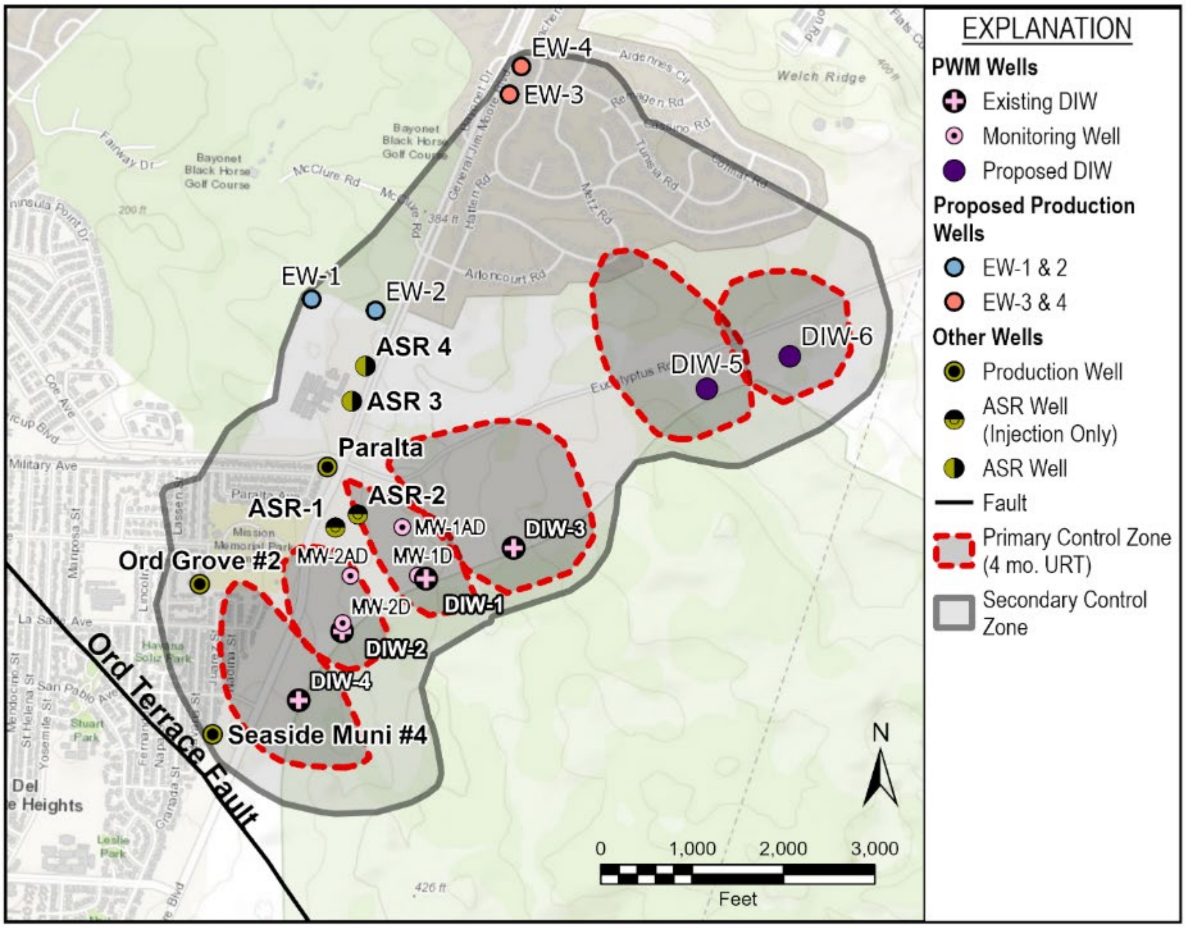


Figure 10-2. Boundaries of the Primary and Secondary Control Zones

A primary control zone was not developed for the Paso Robles Aquifer because the injection capacities of the vadose zone wells have proven to be far smaller than initially anticipated (20-35 gpm versus 500 gpm). At such low rates of injection, the geologic materials between the well screen and the water table in the underlying Paso Robles Aquifer are assumed to remain unsaturated. Unsaturated flow is relatively slow, and the time required to percolate through the 200 ft of unsaturated zone beneath the well would easily be over an order of magnitude greater than the 4 months of credited t_{10} travel time applicable to the Santa Margarita Aquifer.

Pending DDW acceptance of this Engineering Report, the revised primary control zone boundary will be presented to the MPWMD Board for an update to its drinking water well construction ordinance and will go into effect when approved by the MPWMD Board.

10.5 SECONDARY CONTROL ZONE BOUNDARY

As required by the Title 22 Criteria (Section 60320.200(e)(3)), a secondary control zone must be delineated around the injection wells representing a zone of potential controlled drinking water well construction requiring further study prior to a production well being installed. Conceptually, it is the area near enough to the primary control zone that a new well might accelerate the movement of water from the injection wells and locally expand the primary control zone. Modeling for the Project has shown municipal wells have noticeable individual and cumulative effects on groundwater flow patterns and rates. The secondary control zone was delineated based on considerations of particle traces and locations where new wells could impact Project operations. Any new well within the envelope connecting Ord Grove #2, Paralta, ASR-3, EW-1 and EW-4 could affect the extent of the primary control zone, even if it did not pull the primary control zone all the way to the new well. Section 60320.200(e)(3) states the purpose of the secondary control zone is to identify locations where new pumping could alter travel times, "thereby requiring further study and potential mitigating activities prior to drinking water well construction." The secondary control zone is the gray-shaded region bounded by a gray line in **Figure 10-2**. Any proposal to install a new well within the secondary control zone would require additional study. Pending DDW acceptance of this Engineering Report, the secondary control zone boundary will also be presented to the MPWMD Board to be included in the updated drinking water well construction ordinance.

The Title 22 Criteria also require the map to show all drinking water and project-related monitoring wells within a 2-year t_{10} travel time. The wells shown in **Figure 10-2** are those wells.

11 GROUNDWATER RECHARGE IMPACTS

Project operation could potentially affect groundwater levels, storage and quality. For each of these conditions, the effects observed since Project operation began in March 2020 and anticipated effects of implementing the Expansion Project are described below.

11.1 IMPACTS ON GROUNDWATER LEVELS

Injection into vadose zone wells VZW-1B and VZW-2 has been only 35 gpm and 20 gpm, respectively, since nearly the start of project operations. The water percolates down through the unsaturated zone to reach the water table near the top of the Paso Robles Aquifer. This could result in a small, localized mound in the water table. Applying the Theis well function (Theis, 1935) with aquifer characteristics of the top 100 ft of the Paso Robles Aquifer suggests the mound would be 2-3 ft high after one year of operation at a radial distance of 10 ft, diminishing to less than 1 ft at distances greater than 200 ft.

Injection into the DIWs is relatively continuous and probably manifests as groundwater levels that are higher than they would have been without injection by a fairly stable increment. The magnitude of the increment can be estimated by the water-level response to injection at ASR wells. During January to May 2023, ASR-1 and ASR-2 injected a total of 1,619 AF of water into the Santa Margarita Aquifer near DIW-1 and DIW-2. Water levels rose by 50-60 ft at those wells during the injection period. The effect decreased with distance to a rise of approximately 6 feet at a distance of 1,000 ft and approximately 1 foot at Highway 1 (Lear, 2024). Project wells DIW-1 through DIW-4 injected a similar amount of water during that period (1,767 AF), so the general magnitude of water level response would have been similar. The primary difference is that Project injection was ongoing before and after the January-May period, whereas ASR injection was only during that period. Over the next several decades, ASR injection and Project injection are expected to gradually raise water levels throughout the Northern Inland and Northern Coastal Subareas, as explained in **Section 11.2**.

11.2 IMPACTS ON GROUNDWATER STORAGE

The groundwater budget of the combined Northern Inland and Northern Coastal Subareas of the Seaside Groundwater Basin is described in Section 9.5. Including the Expanded Project, total Project injection would average 5,750 AFY, which would more than double the pre-Project average annual recharge. Cal-Am extraction is expected to gradually increase over the next 10 years to decades as demand increases and additional extraction well capacity is installed. Initially, however, average annual is expected to outpace the increase in extraction. Together, ASR and PWM injection are expected to increase basin storage by tens of thousands of acre-feet over the next several decades. In any case, the existing PWM Project and Expanded Project operations accelerate groundwater turnover between the injection and extraction wells relative to pre-project conditions, regardless of whether storage is increasing.

11.3 IMPACTS ON GROUNDWATER QUALITY

The beneficial effects of PWM injection were rapidly evident in nearby monitoring wells. **Figure 11-1** shows specific conductance measured in Project monitoring wells during the first 16 months following the start of injection in March 2020. The specific conductance of AWPF averaged 107 µS/cm until October 10, 2020, when a change in the chemical used for corrosion control increased it to around 185 µS/cm. Water in all of the deep monitoring wells (upper plot) shifted to a mixed composition consisting almost entirely of AWPF water. Specific conductance in MW-2D began declining 4 days after the start of injection, and in MW-1D the decline began on day 11 (Todd Groundwater, 2020). Specific conductance continued declining over the following two months, reaching a steady value of around 220 µS/cm in both wells by the end of June 2020. This represents a blend of approximately 87 percent AWPF water and 13 percent native groundwater.

The offsite deep monitoring wells also experienced declines in specific conductance, and as expected, the shift was later and more gradual. At MW-2AD, the shift was complete by November 2020 except for a temporary rebound in late December when DIW-2 was taken off-line for rehabilitation. At MW-1AD, the shift was not complete until around July 2021. The longer time frame was attributed to the location of this well off the direct flow path between DIW-1 and Paralta. The additional time required for transverse dispersion caused the delayed arrival. The equilibrated specific conductance was approximately 280 µS/cm at both wells, representing a blend containing 83-87 percent AWPF water and 13-17 percent native groundwater.

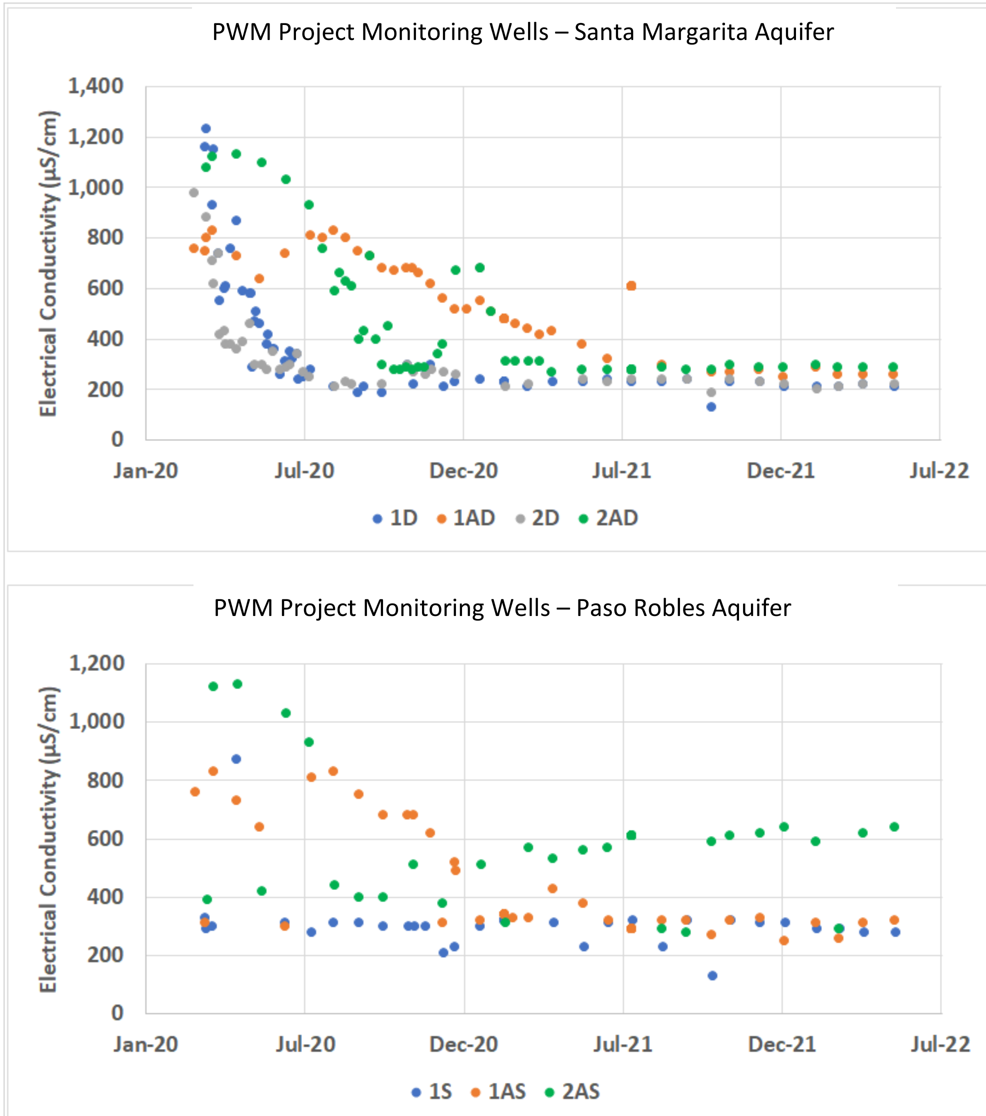


Figure 11-1. Electrical Conductivity in Project Monitoring Wells, 2020-2022

The trends in Paso Robles Aquifer water quality (lower plot) are more likely due to above-average rainfall recharge in 2019 than either ASR or Project injection. It has been observed that the effect of rainfall recharge in wet years on Paso Robles water levels is typically delayed by 6 months or more as water percolates downward through the unsaturated Aromas Formation to reach the water table (Lear, 2024). Thus, dilution from 2019 rainfall recharge could plausibly have caused the general decrease in specific conductance observed in the shallow monitoring wells during 2020. Injection of AWPF water into vadose zone wells VZW-1B and VZW-2 would not likely have caused the decrease because their injection rates are so low (35 and 20 gpm) and two of the monitored wells are approximately 600 ft away. The ASR wells do not inject into the Paso Robles Aquifer and could not be a plausible cause of the changes in specific conductance.

Injection of AWPF at the DIWs should also noticeably decrease the dissolved solids concentration at downgradient municipal supply wells, as indicated by a decrease in specific conductance. Indeed, that effect has become apparent at most of the wells. **Figure 11-2** shows specific conductance measured at the Ord Grove 2, Seaside Muni #4, Paralta, and ASR-3 wells, along with the specific conductance of the purified recycled water. For historical context, the upper plot shows data since 2000. The lower plot expands the data for 2022-2023. DIW-3 began injecting in mid-March 2022, and specific conductance at ASR-3 began declining around the beginning of January 2023, approximately 9.5 months later. DIW-4 began injecting in early April 2022, and specific conductance at Ord Grove 2 similarly began declining around the middle of January 2023, approximately 9.5 months later. Ignoring occasional high outliers (measurement errors), the data for Seaside Muni #4 show no trend, consistent with modeling results that showed it outside the path of flow from DIW-4.

In contrast to the other municipal wells, Paralta began experiencing a prominent increasing trend in specific conductance beginning in mid-January 2023. The timing and direction of this change suggest that Carmel Valley groundwater injected at ASR-1 and ASR-2 began displacing AWPF water that had been arriving from DIW-1 and DIW-2. Prior to the increase, Paralta specific conductance was near the very bottom of its historical range. This was likely due to the introduction of Project water beginning in March 2020. Carmel Valley groundwater has a higher specific conductance than AWPF water, so if it replaced AWPF water upgradient of Paralta, the specific conductance at Paralta would increase. There was a substantial amount of ASR injection in winter 2023, commencing approximately one month before the start of the rising trend in specific conductance at Paralta. As a result, the direction and timing of the trend are consistent with the expected effects of ASR injection.

The high variability of Paralta specific conductance during 2005-2020 is likely due to ASR operation, which periodically injected Carmel Valley water with a specific conductance around 490-530 µS/cm. Prior to the start of ASR operations around 2007, Paralta specific conductance was mostly greater than 900 µS/cm. From 2007-2020 it fluctuated in the 490-900 µS/cm range, consistent with variable mixing of Carmel Valley water and native groundwater. The lower values common since 2020 (400-450 µS/cm) are almost certainly due to injection of AWPF water at DIW-1 and DIW-2. Thus, operation of the Project has decreased groundwater salinity at the Paralta by approximately 50 percent.

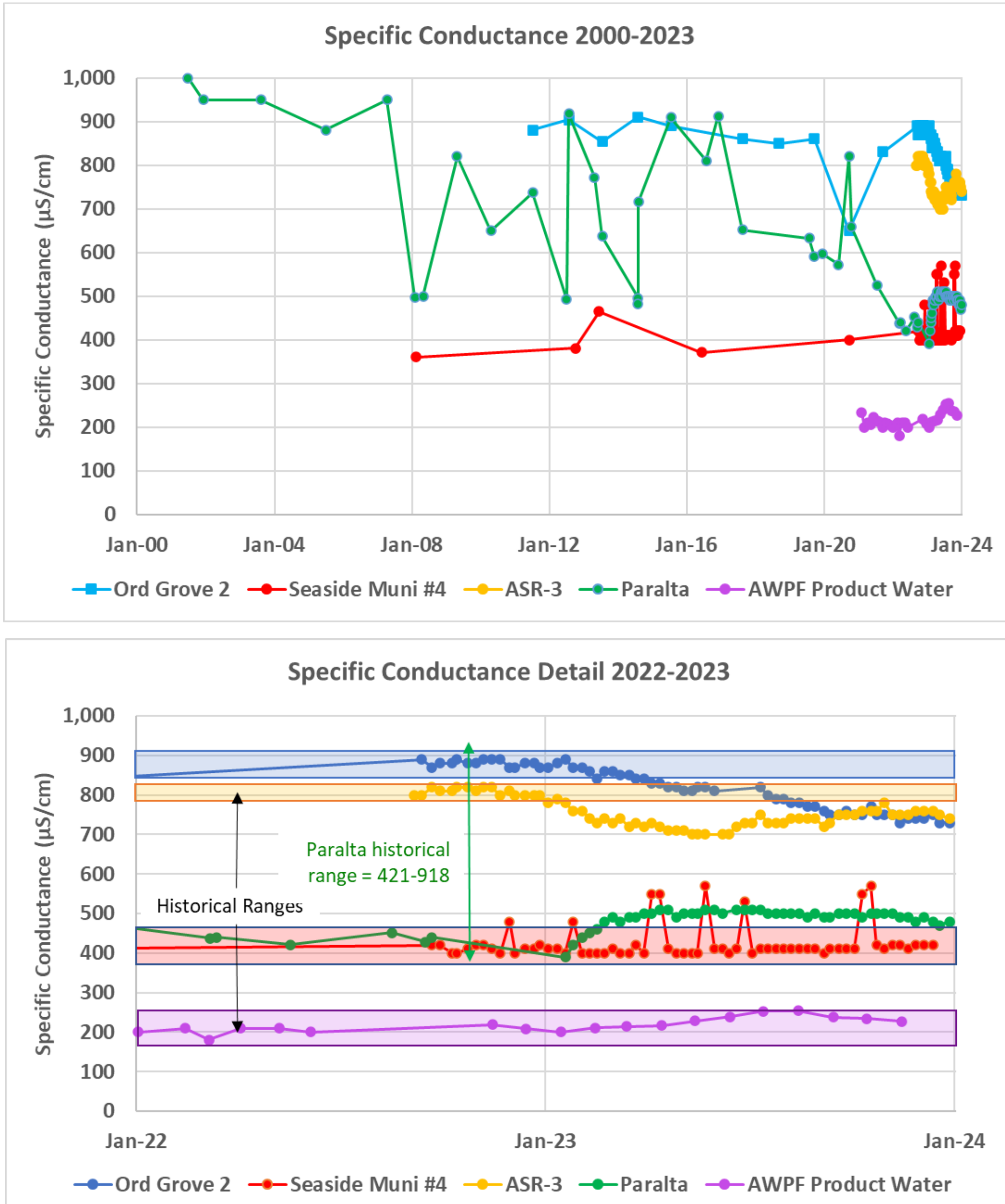


Figure 11-2. Specific Conductance in Municipal Supply Wells, 2000-2023

In some cases, injection of a new type of water into an aquifer can mobilize naturally occurring metals that are normally bound to solid particles in the aquifer matrix. This occurred at monitoring well MW-2D located 70 ft from DIW-2. Injection into DIW-2 commenced in March 2020, at which time the arsenic concentration in MW-2D was below the detection limit of 1 µg/L. The arsenic concentration began steadily rising, reaching a peak of 16 µg/L in June 2020. It then steadily declined back to below the detection limit by September 2020. A subsequent investigation evaluated three geochemical reactions that could potentially release arsenic into solution, and one reaction was consistent with all aspects of the data (Fendorf, 2022). That reaction consists of oxidation of pyrite (iron sulfide) containing trace amounts of arsenic. The injected AWPF water is more oxygenated than native groundwater, so oxidation of pyrite is plausible. The reaction would convert As^{+3} to As^{+5} (which is more soluble) and release it into solution. However, the same process would oxidize iron in the pyrite from a ferrous to ferric state. As^{+5} adsorbs strongly to hydrous ferric oxide (HFO) in aquifers, and the newly-liberated arsenic was thus re-sequestered into the solid phase by adsorption to HFO. These two processes played out over 6 months.

The arsenic investigation also considered whether a “reductive dissolution rebound” might occur if a DIW were taken off-line for any reason, temporarily halting the inflow of oxygenated water. The conclusion was that this risk would diminish over time because oxygenated conditions also lead to oxidation of organic carbon (mostly in microbial biomass) and flush it away from the vicinity of the well. That carbon would be the substrate needed to convert arsenic back from its +5 state to a +3 state. Thus, future releases of arsenic into solution are not expected to occur and would in any case be smaller than the observed initial release.

11.4 RECYCLED WATER CONTRIBUTION

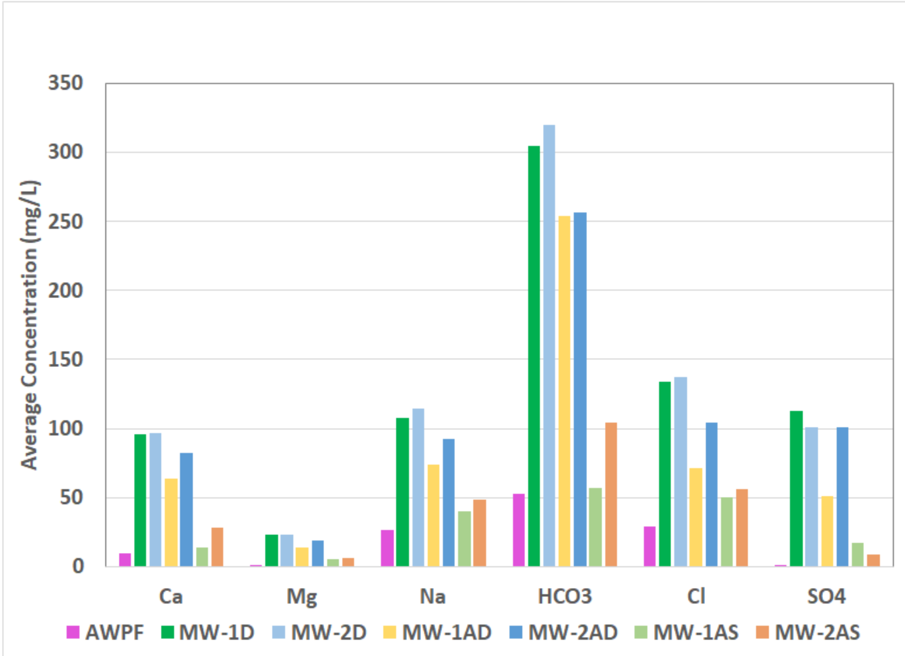
Title 22 (Section 60320.216) specifies the maximum percentage of recycled water allowed in groundwater basin areas downgradient of a GRRP. For the Project, the maximum allowed RWC is 100 percent because of the high level of treatment of the recycled water prior to injection. Data from the intrinsic tracer study for DIW-1 and DIW-2 showed the measured specific conductance at monitoring wells MW-1AD and MW-2AD (approximately 1,100 ft from the DIWs) stabilized at a blend of 83-87 percent injected water and 13-17 percent native groundwater after the first 3 months of Project operation. This percentage probably decreases with distance downgradient, but theoretically it would increase to 100 percent over time. Except for nitrate, product water is of higher quality than groundwater with respect to mineral content and will actually improve overall groundwater quality locally.

11.5 ANTI-DEGRADATION ASSESSMENT

As discussed in **Section 2**, the State Anti-degradation Policy was adopted to maintain high quality water resources to the maximum extent possible, especially when the quality of the water is higher than established by adopted policies. In this case, the purified recycled water has lower concentrations of all major ions than the pre-Project baseline concentrations measured at the Project monitoring wells (**Figure 11-3**). The AWPF product water samples were taken after the switch to calcium chloride plus sodium hydroxide for chemical stabilization (corrosion control) of the product water. The monitoring well samples were all collected in 2018-2019, prior to Project start-up. Total organic carbon was also lower in AWPF water. Specific conductance (not shown) averages around 185 µS/cm in AWPF product water versus 733-1,131 µS/cm in the deep monitoring wells and 304-412 µS/cm in the shallow monitoring wells. Pesticides and pesticide breakdown products were not present in AWPF water at the laboratory detection limits.

The only constituent that is higher in AWPF product water than in most pre-Project groundwater samples is nitrogen (nitrate plus nitrite). A concentration of 0.62 mg/L was measured in the product water whereas it was not detected in four of the six monitoring wells. Concentrations in MW-1AD and MW-2AS were 0.47 mg/L and 0.81 mg/L, respectively. The AWPF concentration is only 6 percent of the drinking water MCL, so it does not pose a risk to health. However, it represents a small use of assimilative capacity. In situations where the ambient concentration of a water quality constituent is below the Basin Plan objective for that constituent, the difference is the assimilative capacity. The Basin Plan objective for nitrate is the drinking water primary MCL of 10 mg/L as N. The average pre-Project concentration in the monitoring wells was 0.24 mg/L if the non-detect values are assumed to equal half the detection limit. The assimilative capacity equals 10 mg/L minus 0.24 mg/L, or 9.76 mg/L. Over the long term, the project could increase the concentration by 0.38 mg/L, to 0.62 mg/L. This increase would equal 3.9 percent of the available assimilative capacity for nitrate in the area affected by injection of Project water. However, the affected area is only 6.6 percent of the total Seaside Groundwater Basin area, based on the extent of the 2-year travel time secondary Zone of Controlled Drinking Water Wells (**Section 10**). Thus, at the scale of the Basin, the Project would consume 0.3 percent of the nitrate available assimilative capacity. This is acceptable because:

- It is less than the 10 percent maximum allowed for a single project,
- The resulting nitrate concentration would be much less than half the primary MCL, which is the recommended maximum for salt and nutrient management planning,
- The advanced treatment process at the AWPF constitutes the best available treatment method, and
- The large increase in local water supplies created by the Project vastly outweighs the small increase in nitrate in terms of the overall economic benefit to the people of California.



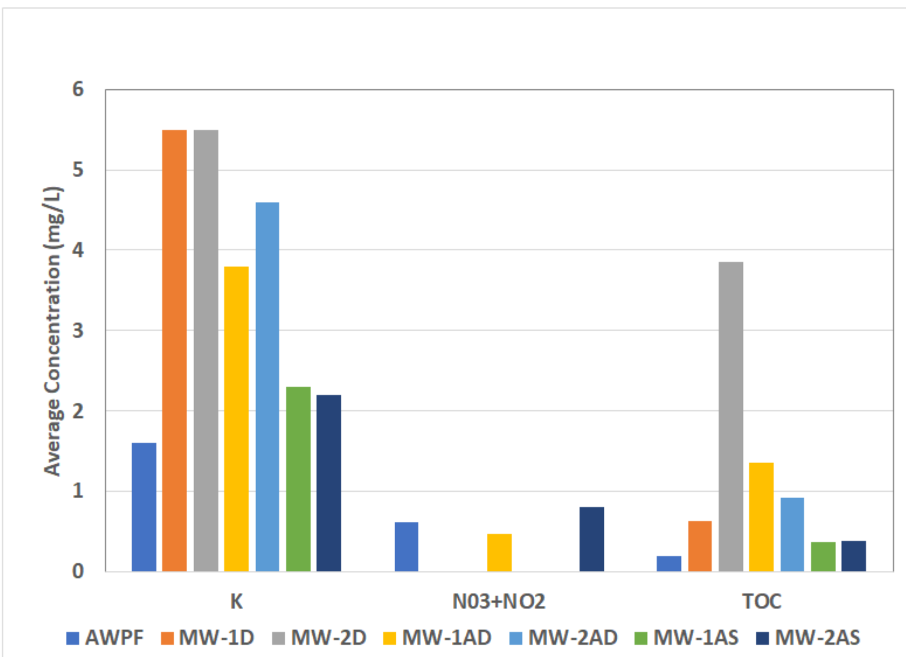


Figure 11-3. Comparison of AWPF Product Water and Pre-Project Groundwater Quality

12 MONITORING AND REPORTING PROGRAM

The Project's MRP is prescribed by the WDR/WRR and was most recently revised in September 2022 (MRP No. R3-2020-0122, revised September 13, 2022). The revised MRP includes reduced sampling frequencies for select constituents, updated requirements for chloramine monitoring, and clarity on the time period over which annual injection volume limits are based (i.e., WY versus calendar year).

For reference, the revised MRP covers the following requirements.

- Monitoring Locations, General Provisions, and Reporting Overview
- AWPF Influent Quality
- RO Performance
- AOP Performance
- Pathogenic Microorganism Reduction
- CECs
- Product Water Quality
- Groundwater Quality
- Project Compliance Reports

12.1 MONITORING LOCATIONS, GENERAL PROVISIONS, AND REPORTING OVERVIEW

The MRP includes the following monitoring locations:

- Influent to the AWPF
    - At a location, before clarified secondary effluent enters the ozone pre-treatment system of the AWPF
- Prior to RO (MF effluent)
    - At a location where all membrane filtration effluent streams are combined prior to RO treatment
- After RO (influent to AOP)
    - At a location after RO treatment where all RO effluent streams are combined prior to AOP treatment
- AWPF Recycled Water
    - At a location downstream of the last chemical injection point and prior to well injection
- Groundwater MWs (ID#s)
    - MW-2D, MW-2AD, MW-2AS, MW-1D, MW-1S, MW-1AD, MW-1AS

M1W ensures proper sampling and analyses by:

- Use of a laboratory that is DDW-approved, RWQCB-approved, SWRCB-approved or Environmental Laboratory Accreditation Program (ELAP)-certified for analyses of regulated constituents.

- Use of drinking water analytical methods for constituents with MCLs that are DDW-approved, as described in 40 CFR Part 141:
- Analytical methods will be selected with MRLs lower than prescribed limitations or goals when practicable and feasible.
- Calibration curves will be developed that include the MRL (or equivalent if there is a different treatment of samples relative to calibration standards) to avoid extrapolation beyond the lowest point of the calibration curve.
- Allowable hold time limits as specified in 40 CFR Part 141 will be observed.
- All Quality Assurance/Quality Control (QA/QC) analyses will be completed on the same day samples are analyzed.
- Selection of the best available method for chemicals specified in the Title 22 Criteria without primary and secondary MCLs (listed in order of preference):
- Drinking water method or waste-water method.
- DDW-recommended methods.
- Most sensitive of the USEPA approved methods.
- Most sensitive of the methods available from scientific literature and commercial laboratory (requires DDW-approval and RWQCB notification).
- A method developed by the laboratory (requires DDW review/approval and RWQCB notification).
- Perform sample dilutions to obtain a range of values between 1 and 800 for bacteria analyses.
- Use of analytical methods that achieve SWRCB-specified MRLs for CEC monitoring required by the Recycled Water Policy.
- Following the required schedule and frequency for routine monitoring.
- Quarterly monitoring should be conducted in the following periods: January-March, April-June, July-September, and October-December.
- Semi-annual monitoring of product water should be conducted in two intervals: January-June and July-December.
- Semi-annual monitoring of groundwater should be conducted in two intervals: January-June and July-December.
- Should M1W need to deviate from these specified months, the RWQCB will be notified of the deviation and the reason for it.
- Providing analytical results in the monitoring report submitted in accordance with the MRP for the Project.
- Notifying PWS, owners of small water systems, and other active production wells having downgradient sources potentially affected by the Project or within a 10-year travel time from the Project shall be notified by direct mail and/or electronic mail of the availability of the annual report. Other parties interested in receiving copies of the reports must notify M1W in writing to be notified when the reports are available.

Reports produced to comply with requirements in the WDR/WRR, at a minimum, include:

- Analytical results;
- Location of each sampling station where representative samples are obtained, including a map, at a scale of 1-in equals 1200 ft or less, that clearly identifies the locations of all

injection wells, project monitoring wells, and production wells;

- Analytical test methods used and the corresponding MRLs;
- Name(s) of the laboratory that conducted the analyses;
- Copy of the laboratory ELAP certification;
- QA/QC information, including documentation of the chain of custody; and,
- MCL, NL, response level, DDW condition, or Recycled Water Discharge Limit.

12.2 AWPF INFLUENT QUALITY MONITORING

AWPF influent is secondary-treated effluent from the RTP. The AWPF influent meets Title 22 Section 60320.201 requirements that specify the use of oxidized wastewater (a term defined in Title 22 Section 60301.650). RTP effluent is currently monitored in accordance with requirements specified in the NPDES permit. One of the routinely measured parameters is $CBOD_5$, which can serve as an indication of oxidized effluent. To date, all samples have consistently met effluent limits for $CBOD_5$, and the highest reported daily maximum value was 42 mg/L in December 2016 (below the 85 mg/L daily maximum effluent limit), when the solids contact was bypassed for maintenance. The influent sampling station is located before secondary treated water enters the AWPF and prior to hypochlorite addition. The date and time of sampling are reported with the analytical values determined.

12.3 RO PERFORMANCE MONITORING

Per the Title 22 Criteria, M1W is required to use indicators and/or surrogates to evaluate AWPF unit process performance. To satisfy Title 22 Section 60320.201(b), RO feed and permeate, including the permeate of each train and stage, are monitored continuously for EC using online meters. EC is a surrogate that serves to monitor performance of the RO treatment process and provides an early warning of compromised integrity. Critical, alarm, and shutdown setpoints are described in **Section 13** and further detailed in the OOP.

Reporting the effectiveness of the RO process is in accordance with Title 22 Sections 60320.201(g) and (h). Within 60 days after the initial twelve months of full-scale operations, M1W submitted a report to DDW and RWQCB regarding RO performance based on EC LRV and any accounts of process failure(s) based on critical, alarm, and shutdown setpoints and corresponding corrective action(s) taken. Additionally, each quarter for the duration of the Project operation, M1W provides the percentage of results that did not meet the EC operational limits. Since monitoring is continuous, daily averages are used for computation. If the frequency of exceedance is greater than 10%, M1W submits a report (within 45 days after the end of the quarter) to DDW and RWQCB that explains the corrective action(s) planned or taken to reduce the percentage to less than 10%. As needed, M1W consults with DDW and if required, develops and implements an alternative monitoring plan approved by DDW.

12.4 AOP PERFORMANCE MONITORING

Monitoring and reporting the effectiveness of the AOP process (UV/H_2O_2) is conducted in accordance with Title 22 Sections 60320.201(e) and (h). Within 60 days after the initial twelve months of full-scale operations, the M1W submitted a report to DDW and RWQCB regarding AOP performance based on selected surrogate(s) and/or operational parameter(s) during demonstration testing, as well as a description of any process failure(s) and corresponding corrective action(s) taken. Additionally, each quarter for the duration of the replenishment operation, M1W calculates the percentage of results that did not meet the selected surrogate or operational parameter's operative limits to ensure AOP performance. If monitoring is continuous using online analyzers, daily averages are used for computation. If the frequency of exceedance is greater than 10%, M1W submits a report (within 45 days after the end of the quarter) to DDW and RWQCB that explains the corrective action(s) planned or taken to reduce the percentage to less than 10%. As needed, M1W consults with DDW and if required, develops and implements an alternative monitoring plan approved by DDW.

12.5 PATHOGENIC MICROORGANISM REDUCTION MONITORING

To satisfy on-going compliance for pathogenic microorganism control at the AWPF per Title 22 Section 60320.208(c), M1W administers and monitors MF PDTs, EC reduction through RO, and UV and H_2O_2 dose delivered through AOP. M1W conducts the monitoring specified in **Table 12-1** and reports the results for each unit process in the compliance monitoring reports.

Table 12-1. Pathogenic Microorganism Control Compliance Monitoring

Unit Process	Integrity Measure	Monitoring Frequency	Reporting	
			Pass	*Assumption*
MF	Pressure decay LRV and filtrate turbidity	Once every 24 hours of operation and continuous[c]	≥4.0[a] log ≤0.2 NTU[e]	MF is providing credited log reductions
RO	Strontium, TOC, or EC LRV reduction[b]	Grab and continuous[c]	≥1.0 log	RO is providing credited log reductions
AOP	Calculated UV dose[d]	Continuous[c]	≥300 mJ/cm^2	AOP is providing credited log reductions

a. Pressure decay rate value with an ending pressure that provides a resolution of 3 microns or less.
b. Daily EC reduction = -log(ECRO Permeate/ECRO Feed). More information on the three-surrogate approach for integrity monitoring is provided in Section 5.
c. Since monitoring is continuous using online analyzers, daily averages are used for computation.
d. The UV reactor outputs a calculated UV Dose using online measurements of AOP feed flow rate, UV transmittance, and UV intensity. The dose equation or validation report will be provided after performance testing during start-up. A UV dose of 236 mJ/cm2 is estimated for 6 log removal of enteric virus based on USEPA UV doses required for log removals of 4 and less; accordingly, 300 mJ/cm2 is proposed as a conservative target for pathogen control.
e. Less than or equal to 0.2 nephelometric turbidity units (NTU) 95% of the time within a 24-hour period and less than 0.5 NTU at any time.

The log reduction achieved through the entire system is determined each day and reported as "yes" if required log reductions were achieved or "no" if not achieved. If any of the three components (MF, RO, and AOP) do not pass, response measures specified in Title 22 Sections 60320.208(h) and (i) are launched. Within 24 hours of becoming aware of the issue, M1W immediately investigates potential cause(s) and takes corrective action(s). DDW and RWQCB are notified immediately if the AWPF fails to meet pathogen reduction criteria longer than four consecutive hours, or more than a total of eight hours during any seven-day period. Failures of shorter duration will be reported to the RWQCB no later than 10 days after the month in which failure occurred. If the calculated overall log reduction drops below 10-logs for enteric virus, or 8-logs for *Giardia* cysts or *Cryptosporidium* oocysts, M1W will immediately notify DDW and RWQCB, and discontinue application of product water for injection, unless directed otherwise by DDW or RWQCB.

12.6 CONSTITUENTS OF EMERGING CONCERN (CECS)

Section 3 of the MRP includes the CEC monitoring requirements, including sampling frequencies and locations (prior to RO, prior to AOP, product water. If a change in sampling location is needed, M1W must request approval from the RWQCB prior to implementing the change.

M1W is following the three-phased monitoring approach for the health-based and performance indicator CECs based on the Recycled Water Policy and prescribed in the MRP. The indicator CECs include the constituents listed in the Recycled Water Policy and additional constituents specified by DDW.

- Initial assessment monitoring phase conducted for one year with quarterly sampling.
- The baseline monitoring phase conducted for three years with quarterly sampling, except where more frequent monitoring is necessary to respond to a concern. The standard operation monitoring phase conducted with semi-annual or annual sampling, except where more frequent monitoring is necessary to respond to a concern.
- For all monitoring phases, should a CEC indicator not be present at sufficient concentrations to use for performance assessments, M1W consults with DDW and RWQCB on other potential options.
- After each sampling event for health-based CEC’s, M1W conducts the evaluation prescribed in the MRP and implements appropriate response actions. If a health-based CEC also has a NL or a MCL pursuant to Title 22 (Sections 60320.212, 60320.220, and 60320), the more frequent monitoring requirements in Title 22 govern the sampling, regardless of the phase.

M1W is following the three-phased monitoring approach for the CEC performance surrogates based on the Recycled Water Policy and prescribed in the MRP. The prescribed surrogates are EC, UV Absorbance, and TOC.

- Initial assessment monitoring phase conducted for one year with more frequent monitoring during months 1 to 3 and decreased frequency during months 4 to 12.
- The baseline monitoring phase conducted at a frequency determined by the RWQCB based on operational performance determined during the initial assessment monitoring phase.
- The standard operation monitoring phase conducted at a frequency determined by the RWQCB based on the results of previous phases and associated operational performance.

M1W is following the three-phased approach for bioanalytical screening based on the Recycled Water Policy and prescribed in the MRP. The prescribed bioanalytical screening tools are Estrogen receptor-α and Aryl hydrocarbon receptor.

- Initial assessment monitoring phase conducted for three years with quarterly sampling.
- Baseline monitoring phase conducted for one year with quarterly sampling.
- The standard operation monitoring phase conducted with semi-annual or annual sampling, except where more frequent monitoring is necessary to respond to a concern.

After each sampling event for the bioanalytical screening tools, M1W conducts the evaluation prescribed in the MRP and implements appropriate response actions.

12.7 PRODUCT WATER – WATER QUALITY COMPLIANCE

Product water is monitored for compliance purposes to ensure protection of public health and the groundwater beneficial uses. Process control parameters are also monitored to facilitate operations of the AWPF (see discussion in **Section 13**). For regulatory compliance, the product water is monitored for the compliance parameters defined in the Title 22 Criteria and the WDR/WRR:

- Coliform bacteria
- Total nitrogen
- Regulated contaminants and physical characteristics
- TOC
- Additional monitoring requirements
- Priority Pollutants
- DDW-specified chemicals based on review of Engineering Report, affected groundwater basin, and source control assessments
- Recycled Water Policy health-based CECs
- Basin Plan water quality objectives
- Acutely toxic parameters monitored as a part of RRT response process

After the first full year of monitoring, M1W compiled results and submitted a revised monitoring program to DDW and the RWQCB for review and approval. The current product water monitoring program is available in the MRP.

12.8 GROUNDWATER MONITORING

Groundwater monitoring is conducted to demonstrate ongoing project performance and to comply with Title 22 Criteria, Basin Plan groundwater objectives, and applicable state policies regarding the protection of groundwater quality. The groundwater monitoring program includes:

- Operating at least one downgradient well with groundwater travel times (underground retention time) no less than two weeks and no more than six months from the injection wells (well also has to be greater than 30 days travel time from the nearest drinking water source).
- Operating an additional downgradient well between the Injection Facilities and the nearest downgradient potable water supply (in addition to the downgradient monitoring well used to demonstrate retention time).
- Monitoring groundwater levels and water quality with well design allowing for sample collection from each aquifer that receives recycled water.

The MWs are also used to collect data as part of the tracer studies conducted to identify underground retention time for application to the pathogen reduction credit and the prescribed RRT for the Project.

12.8.1 Monitoring Well Locations and Design

To comply with the recycled water recharge regulations and account for anticipated variable flowpaths to the nearest drinking water wells, M1W installed four MW clusters to monitor the two aquifers receiving injection. As shown in **Figures 3-9a** and **3-9b**, the monitoring wells are located between the injection wells (DIWs and VZWs) and the nearest drinking water wells to the west and northwest of the Injection Well Field. Each MW cluster consists of a shallow MW screened in the Paso Robles Aquifer (designated with the letter "S") and a deep MW screened in the Santa Margarita Aquifer (designated by the letter "D"). MW Cluster 1 (i.e., MW-1S and MW-1D) was installed in 2017 during Phase 1 construction, while the three other monitoring well clusters (MW-2D, MW-1AS/1AD, and MW-2AS/2AD) were installed and developed in 2018/2019 during Phase 2 construction. MW-2S was abandoned because the well was found to be excessively shallow and sandy. Water quality samples are collected and analyzed for a comprehensive list of parameters and frequencies as specified in the WDR/WRR.

12.9 PROJECT COMPLIANCE REPORTS

Analytical data are submitted electronically by the laboratory to DDW's database by the 10^{th} day of the following month in which analyses were completed. Monthly and quarterly data are also submitted via electronic deliverable format to the CIWQS and Geotracker databases. Summaries of operational concerns that address changes in reporting conditions, including influent, recycled water, and groundwater monitoring results, are provided as PDF files.

Annual reports are prepared by a properly qualified engineer registered and licensed in the State of California and experienced in the field of wastewater treatment, and include, at a minimum, the information listed below. M1W notifies all downgradient public water systems and drinking water well owners of annual report availability by direct mail or electronic mail.[37]

1. Summary of the makeup of source waters (municipal wastewater, agricultural wash water, Blanco Drain, and Reclamation Ditch) entering the RTP. At a minimum, the summary includes include a discussion on:

- The priority source of water usage for the period reported and the basis for the priority;
- Monthly volume for each source water type; and
- An evaluation of which demand scenario best fits the volumes observed during the reporting period (drought, Normal/Wet Full Reserve, Normal/Wet Building Reserve).

2. Tabular and graphical summaries of the monitoring data obtained during the previous year;

[37] Public water systems and drinking water well owners with downgradient sources potentially affected by the recharge project and within ten years groundwater travel time from the Project injection wells.

3. A summary of compliance status during the previous year;
4. Any non-compliance during the reporting year with a description of:
   - The date, duration, and nature of the violation;
   - A summary of corrective actions and/or suspensions of subsurface application of recycled water resulting from a violation; and
   - If uncorrected, a schedule for and summary of all pending and completed remedial actions;
5. Any detections of monitored chemicals or contaminants, and any observed trends in the MWs;
6. Information pertaining to the vertical and horizontal migration of the recharge water plume;
7. Title 22 drinking water quality data for the nearest drinking water supply well (Paralta only);
8. A description of any changes in the operation of any unit processes or facilities;
9. The estimated quantity and quality of recycled water to be utilized for the next calendar year;
10. A list of the analytical methods used for each test and associated laboratory QA/QC procedures. The report will identify the laboratories used to monitor compliance, their status of certification, and provide a summary of proficiency test;
11. A list of current operating personnel, their responsibilities and their corresponding grade of certification;
12. A summary of monitoring reports, reporting and trend analysis, to describe the changes in water quality and contrast them to background measurements for all constituents exceeding MCLs or where concentration trends increase after the addition of recycled water. As needed, a specific description of any studies or investigation made to identify the source, fate and transport path of constituents which exceeded MCLs at the MW;
13. A summary of coordination activities with MCWD on the operation and maintenance of the conveyance pipeline and Blackhorse Reservoir necessary for protection of the product water for injection (M1W is kept informed of the status of testing and maintenance of the backflow preventer on the conveyance pipeline, occurrence of backflow incidents (if any), and maintenance activities of the Blackhorse Reservoir); and
14. Annual volume of the AWPF product water injected into the Seaside Basin (based on California WY, which is October 1 to September 30).

Per the Title 22 Criteria (Section 60320.228(b)), every five years from the date of approval of the Engineering Report, M1W is required to update the Engineering Report and submit it to DDW and RWQCB. This Engineering Report for the Expanded Project meets the requirements for a five-year update.

13 GENERAL OPERATIONS PLAN

The AWPF is equipped with modern control and monitoring equipment, which facilitates operation of the facility by highly trained operations staff to produce a water supply that is reliably protective of public health. Standby equipment is included, as needed, to facilitate both planned and unplanned service of equipment. An OOP was developed for the facility that details Standard Operating Procedures (SOPs) and compliance and optimization activities. An overview of the AWPF operations plan features is described in this section. If the product water does not meet permit requirements, pathogen performance, or advanced treatment criteria based on online monitoring parameters (*e.g.*, conductivity removal through RO, UV dose) and other critical control points (*e.g.,* MF DIT), the product water is returned to the RTP headworks, or pumped to the SVRP.

In accordance with Title 22 (Section 60320.200(g)) and the WDR/WRR, prior to operations of the Expanded Project, M1W will demonstrate that all expansion process equipment has been installed and can be operated to meet their intended function by undertaking actions including, but not limited to, the following:

- Develop a Startup/Commissioning Plan to verify the correct installation of equipment and document proper performance for equipment,
- Collect manufacturers' standard factory tests and results (e.g., MF membrane pathogen removal testing, RO conductivity removal testing),
- Perform tests of all newly installed equipment to verify proper installations and functionalities,
- Perform partial and complete startups and shutdowns of partial process treatment trains and the whole AWPF,
- Perform complete simulations of major and critical alarms, and
- Conduct startup and performance evaluation.

13.1 RTP AND AWPF SYSTEM CONTROLS AND RELIABILITY

13.1.1 Controls

M1W employs a virtualized server/client SCADA system. The AWPF is integrated into this system to allow for control and monitoring by M1W. The SCADA system is under one Factorytalk Directory and is part of a Microsoft domain. Redundant Human-machine Interface (HMI) servers and FactoryTalk Alarm and Event (FTAE) servers, where the operators interface with the system, share a pair of redundant RSLinx data servers. The RSLinx data servers provide PLC data and alarms to the HMI servers and Factorytalk Historian, which records and saves the data.

Each process area (RTP, Pump Stations, SVRP, and CSIP) has a master ControlLogix PLC and the RTP includes a redundant PLC. These master PLCs act as gateways between other PLCs and remote input and output (I/O) to the M1W SCADA and M1W Historian database software systems.

The local PLCs at the AWPF control the unit processes to meet operational setpoints, trigger alarms when thresholds are passed that require operator intervention, and shutdown down unit processes that threaten the safety of equipment, operators, or public health. These local PLCs feed into a master Project PLC, which feed into the existing SCADA network.

13.1.2 Redundancy

This section describes how each unit process is designed with some levels of redundancy based on typical operational downtime and anticipated maintenance activities. The specific AWPF design criteria, as they relate to redundancy, are summarized in more detail in **Section 3**.

Ozone system. The ozone system is included in the AWPF process train to reduce MF fouling and to reduce the concentration of CECs and pesticides in product water and RO concentrate discharged to the ocean. The ozone system inactivates pathogens; however, currently no regulatory credit is being sought for this inactivation as it is not required to meet the Title 22 pathogen LRVs (i.e., the AWPF can produce a product that is protective of public health when the ozone system is offline, as sufficient pathogen inactivation is obtained in downstream processes: MF, RO, UV/AOP, and travel time in the conveyance pipeline and aquifer). MF fouling will temporarily increase when the ozone system is offline; however, fouling will return to low levels when the ozone system is brought back online and cleans are used to remove foulants from extended ozone system downtime. Accordingly, the ozone system has not been designed with the same level of redundancy as the other treatment processes that are required for pathogen removal credits.

Standby LOX tanks, vaporizers, ozone generators, nitrogen boost systems, and ozone destructs rarely fail and due to the permissible ozone system downtime, they are not included. Spare parts are held onsite to facilitate rapid repair of systems that require service. Four sidestream injection lines are included in the design, which allow for continued ozone injection if an injection line requires service, albeit at a lower transfer efficiency.

The design ozone dose was selected after pilot testing ozone pre-treatment for a thermally induced phase separation (TIPS) PVDF low-pressure membrane, and the design ozone dose has been confirmed with operation of the full-scale facility. The design ozone dose accounts for differences in water quality and transfer efficiency between pilot testing and the AWPF. Given that the ozone dose was conservatively selected for poor water quality (high in nitrite and TOC) and the maximum expected flow, the ozone system is able to address a wide spectrum of feed water conditions.

MF system. The MF system design allows for one standby block of membranes at peak flow while maintaining the design flux. This standby block can be brought online when one of the other blocks is removed from service for maintenance or a CIP. The design flux was based on pilot testing and operation of the full-scale facility, which allows operation with reasonable time between CIPs. Blocks of MF modules may be periodically removed from service for routine backflushes (e.g., every 15 minutes) and daily cleans; the MF system includes flow equalization upstream (MF feed tank) and downstream (MF filtrate tank) to allow the upstream and downstream processes (ozone and RO, respectively) to operate at constant flow during these regular backflushes and daily cleans, and the MF system flux was designed to meet the target, average MF system flowrate, despite temporarily suspensions in production during the regular backflushes and periodic cleans. A standby automatic pre-strainer and a duplex compressed air system are also included to reduce downtime associated with automatic strainer and air compressor maintenance. The alarms and standby block of membranes meet the Water Recycling Criteria reliability requirements for filtration.

RO system. The RO system does not include a standby train for CIP events; rather, the offline time associated with RO CIP events was incorporated into the AWPF design offline factor and 6.5 mgd of design flow and 7.6 mgd of peak flow capacity. The CIP interval for the full-scale facility has been approximately every 3 months at the design RO recovery. The cartridge filters will be upsized to handle the increased production capacity.

UV/AOP system. The UV/AOP system includes at least one redundant reactor at peak flows, which is brought online if a duty reactor alarms out of service or if one is taken offline for service. The design UV dose is based on conservative 1,4-dioxane removal requirements and a conservative effluent NDMA goal. The NDMA removal goal was based on observed RO permeate NDMA concentrations during pilot testing and the minimum removal has been validated with quarterly AWPF product water NDMA monitoring since startup in 2020. The UV dose required to meet these goals achieves significantly greater pathogen inactivation than the process is granted credit. The alarms and standby train meet the reliability guidelines provided in the NWRI UV Guidelines.

Product water stabilization. Product water stabilization consists of decarbonation and chemical addition. Calcium chloride and sodium hydroxide are injected to add calcium and alkalinity. Sodium hypochlorite and ammonium sulfate are added to generate chloramines to prevent biological regrowth in the conveyance pipeline and to obtain LRV credits, when needed. The decarbonator includes a redundant blower to minimize downtime associated with regular blower maintenance. A standby decarbonator is not required, as they rarely require removal from service for maintenance.

Chemical feed systems and pumps. Standby chemical feed metering pumps and water pumps are provided to minimize downtown and to ensure reliability of disinfection systems (e.g., UV/AOP).

Power supply. The RTP has a 21 kilovolt (kV) primary service. The 21 kV medium voltage switchgear has a main breaker and 2 x knife disconnect switches that supply a redundant set of 21 kV to 480 volts alternating current (VAC) transformers. During normal operation the A or B side transformer is selected. The A and B transformers feed 2 x 4000 ampere (A) 480 VAC main breakers. A 1500 kW emergency standby transformer supplies power to the RTP during a PG&E power loss. There are 3 x 580 kW 480 VAC cogeneration units powered by a biogas and natural gas blend. During normal operations 2 x 580 kW cogeneration units are in operation. The RTP administration building has a critical load emergency generator on an Automatic Transfer Switch (ATS) to supply power to the control room and server room if the RTP 1500 kW generator fails. The SVRP has a separate 21 kV service that is not connected to the RTP.

The AWPF power is supplied through an existing 21 kV PG&E utility connection and a pending connection with the ReGen Monterey power generation facilities. The system components include a utility service, transformers, and switchgears. The major electrical loads are from the influent pumping, ozone generator, MF and RO feed water pumping, UV reactors, and product water pumping. The AWPF electrical service was originally designed for expansion to 6.5 mgd and additional electrical loads are being added to increase the AWPF peak capacity to 7.6 mgd. The additional electrical loads do not exceed the capacity of the existing switchgears, so no additional switchgears are required for the AWPF expansion. The increased electrical loads will require additional breakers for the following components being added: source water pump, ozone injection pump, MF feed pump, MF auto-strainer control panel, building supply fans, RO transfer pump, UV reactors, waste equalization pump, lighting, and a product water pump.

To reduce the frequency of power outages: (1) M1W is assisting ReGen with implementing a project to connect the AWPF to the adjacent landfill biogas electricity generator, and (2) M1W has programmed the purchase of backup power generation into its CIP to prevent the AWPF from shutting down during regional power outages in the event that landfill biogas electricity is not available.

RTP. The upstream RTP process includes bar screens (1/4 inch), aerated grit removal, primary clarification (five clarifiers, with scum removal), CEPT facilities (ferric chloride), trickling filters towers (six towers, five currently used; synthetic media), bio-flocculation basins (also known as solids contact basins), and secondary clarification (six clarifiers with scum removal), as well as solids handling facilities (gravity thickener, dissolve air flotation thickener, anaerobic digesters, screw presses, sludge drying beds, and sludge lagoons), all with an average dry weather and ultimate peak wet weather flow of 29.6 and 81 mgd, respectively. The average dry weather flow to the RTP will not exceed the permitted capacity of the RTP with the addition of maximum amount of PWM Source Waters potentially available (the predicted flows range from 19 to 29.6 mgd, with an average flow of 24 mgd and a maximum flow of 29.6 mgd, where capacity is only reached for the month of June under extreme conditions of low municipal wastewater and high recycled water demands). Unused secondary effluent is discharged through an ocean outfall with RO concentrate. The reliability features of the RTP meet the Water Recycling Criteria reliability requirements for primary treatment, biological treatment, and secondary sedimentation by having alarms and multiple treatment units capable of treating the entire flow with one unit not in operation. In addition, a long-term disposal option is available through the ocean outfall.

Flow control and residuals. Operation of the AWPF benefits from diverting a constant flow of secondary effluent from the larger secondary effluent flow that goes to either the SVRP or the ocean outfall, thereby avoiding the operational challenges associated with variable flowrates. The AWPF diverts secondary effluent from a diversion structure located downstream of the secondary clarifier effluent channel and upstream of SVRP influent pump station diversion. Operation of the AWPF also benefits from being able to discharge waste flows (also known as recycle streams) back to the RTP headworks, thus decreasing the potential negative impact that could occur from recycled streams being handled at the AWPF. Recycle streams are returned to the RTP headworks. RO concentrate is discharged to the ocean outfall.

13.1.3 Robustness

Several treatment processes are included in the AWPF and these processes, as well as the travel time in the aquifer, provide treatment through a variety of mechanisms. Given that contaminant removal efficiency is largely impacted by the treatment mechanism (*e.g.*, some contaminants are readily removed through RO, such as bromate, while others require UV/AOP to meet product water quality goals and requirements, such as NDMA), including a variety of treatment mechanisms facilitates the removal of a wide range of constituents.

The addition of ozone upstream of MF not only reduces MF fouling, but also provides additional robustness by adding a new oxidation step into the treatment train, which can both inactivate pathogens and oxidize CECs. **Table 13-1** summarizes the treatment mechanisms achieved through the AWPF and the groundwater aquifer. **Table 13-2** summarizes the impact of the major processes on constituents of concern.

Table 13-1. AWPF and Aquifer Treatment Process Robustness through Multiple Treatment Mechanisms

Process	Biological Oxidation	Sorption	Chemical Oxidation	Physical Removal	Physical Degradation
RTP (primary & secondary)	✓	✓		✓ (Sed[a])	
Chloramination			✓		
Ozone			✓		
MF				✓	
RO				✓	
UV/AOP			✓		✓ (Photolysis)
Decarbonator				✓ (Stripping)	
Aquifer	✓	✓		✓	✓ (Hydrolysis)

a. Sedimentation.

Table 13-2. AWPF and Aquifer Treatment Barriers

Process	Chemical Constituents				Pathogenic Microorganisms			
	Nitrogen	TOC	DPBs	Inorganics	CECs	Bacteria	Viruses	Protozoa
RTP (primary & secondary)	✓	✓		✓	✓	✓	✓	✓
Ozone					✓	✓	✓	✓
MF		✓		✓[a]		✓	✓	✓
RO	✓	✓	✓	✓	✓	✓	✓	✓
UV/AOP	✓		✓		✓	✓	✓	✓
Conveyance (Chloramination)						✓	✓	✓
Aquifer						✓	✓	✓

a. Particulate inorganics (*e.g.*, iron and manganese)

13.1.4 Resiliency and Integrity Monitoring

The Project has multiple resiliency elements beginning with M1W's pretreatment, source control program, and efficacy of the RTP treatment processes to protect the feed water coming into the AWPF. Other features include monitoring of the AWPF treatment processes, AWPF product water quality, and product water total chlorine at the injection well head to ensure all systems are performing as expected and that the AWPF is reliably producing a water that is protective of public health. Monitoring consists of grab samples, composite samples, and online instrumentation. The treatment processes have alarm setpoints, which alert the attention of M1W staff and trigger shutdown processes when necessary. M1W staff also regularly review monitoring results and verify instrument readings. When monitoring results pass thresholds or alarm setpoints, staff respond according to the OOP and SOPs.

Monitoring of the AWPF performance requires monitoring of surrogates that indicate the removal of pathogenic microorganisms and that demonstrate AOP performance. Pathogen microorganism removal credit is claimed for three treatment processes: MF, RO, and UV/AOP. In addition, pathogen credit is claimed for time spent in the conveyance pipeline and the aquifer following treatment in the AWPF. The AOP requirement to remove 1,4-dioxane and the M1W goal to achieve 1.5 log removal of NDMA result in a UV/AOP process that achieves significantly greater log removal than the maximum credited unit process removal of 6 logs per pathogen or pathogen class (enteric virus, *Cryptosporidium* oocysts, *Giardia* cysts). Thus, ensuring that the AOP requirements are met ensures that the UV/AOP process meets its log removal requirements. Preliminary surrogates, critical control point target setpoints, example low and high alarm setpoints, and corrective actions are shown in **Table 13-3**. These setpoints are preliminary and may be modified, as needed, in the OOP.

Table 13-3. Preliminary Treatment Surrogates, Alarms and Example Corrective Actions in Response to Treatment Failures

Process	Parameter(s)	Monitoring Frequency	Target Setpoint	Alarm Low	Alarm High	Example Corrective Actions
MF	Pressure decay LRV and turbidity	Minimum of 1 per day and continuous	LRV = N/A[a] Turb = N/A	LRV = 4 log Turb = N/A	LRV = N/A Instant. Turb = 0.5 [b] Avg Turb = 0.2 [b]	Confirm results. Remove modules from service upon failure. Assess fiber breakage. Isolate, repair or replace module.
RO	Surrogate LRV[c]	Strontium = Grab samples once every 24 hours TOC and Conductivity = Continuous (at least 1 measurement every 15 minutes)	N/A[a]	1 log	--	Monitor individual RO trains. Verify analyzer accuracy. Remove train(s) from service upon failure. Conduct vessel probing.
UV/AOP	Calculated UV dose[d]	Continuous (at least 1 measurement every 15 minutes)	Variable (1,600 mJ/cm^2 design dose)	300 mJ/cm^2	--	Remove reactor from service. Check and replace lamps or ballasts as needed. Check and recalibrate sensors as needed. Check H_2O_2 dosing system.
	H_2O_2 dose		Variable (5.5 mg/L design dose)	2.2 mg/L	7.0 mg/L	

a. If the overall AWPF pathogen reduction falls below 12/10/10, the SCADA system will alarm and notify the Operators to investigate potential causes and take corrective actions. If the AWPF fails to meet the pathogen reduction requirement for a period longer than 4 consecutive hours, or more than 8 hours in any 7-day period, then M1W shall notify DDW and the Regional Water Quality Control Board (RWQCB) immediately. If the overall AWPF pathogen reduction falls below 10/8/8, the system will immediately and automatically enter recirculation mode.

b. Less than or equal to 0.2 NTU 95% of the time within a 24-hour time period and less than 0.5 NTU all the time

c. Surrogate parameters used for determining pathogen LRV are strontium, TOC, and conductivity.

d. The UV reactor outputs a calculated UV Dose using online measurements of AOP feed flow rate, UV transmittance, and UV intensity. The dose equation established during performance testing is provided in the UV/AOP Section of the Operation Optimization Plan (OOP).

If any critical failure occurs, the SCADA system will alarm and immediately reduce AWPF production to the setpoint of 2 mgd and place the AWPF into recirculation mode, which stops delivery of purified water to the AWPF product water conveyance pipeline. Once in recirculation mode, UV/AOP product water is diverted back to the MF feed tank, where the water circulates through the MF system, RO system, UV/AOP system, and back to the MF feed tank. Soon after recirculation mode is initiated, the feed flow into the AWPF Source Water Pump Station is automatically reduced to maintain the appropriate operating range in the MF feed tank. This allows the M1W Operators the opportunity to investigate and repair the cause of the critical failure. If system repair requires too much time, the AWPF can be placed into Standby or Offline Mode. Should any off-specification water flow past the recirculation point (just prior to the post treatment decarbonator) and into the PWPS, the off-specification water can be pumped to the SVRP Pond bypassing the conveyance pipeline. Depending on the nature of the failure, M1W must immediately notify DDW and the RWQCB, in accordance with Title 22 Criteria.

As discussed previously, TOC, total nitrogen, constituents with MCLs, lead, copper, Priority Pollutants, constituents with NLs, and indicator compounds indicative of pharmaceuticals, endocrine disrupting chemicals, personal care products, constituents regulated through source control, and other indicators of municipal wastewater are monitored in the RO permeate or a downstream location prior to injection into the aquifer to verify product water quality and are also monitored upstream as necessary to verify removal performance. M1W staff will review results and take corrective actions as necessary, which may include modifying treatment processes, removing units from service, or other actions as needed to improve performance.

In addition to the monitoring described above and in **Section 12**, other process and water quality parameters are regularly monitored to support operation of the AWPF. These parameters include levels (*e.g.*, chemical levels), flow rates, pressures, speeds (*e.g.*, pump motor speeds), residuals, concentrations, setpoints, and positions (*e.g.*, valve positions) for both the treatment processes and support systems. Parameters are monitored through manual readings, on-line data, and laboratory analysis. Example water quality parameters include chloramine residual, ambient ozone concentration, ozone gas concentration, dissolved ozone residual, nitrite, ORP, pH, turbidity, and temperature. A final list of parameters that support operation of the AWPF is detailed in the O&M Manual and SOPs. Responses, based on monitoring results, may include the removal of processes from service, investigation of unusual results, and modification of treatment process setpoints to adapt to changing conditions.

Pathogenic microorganism concentration reduction failure. As discussed in **Section 12**, the log reductions achieved through the entire system are determined each day and reported as “yes” if required log reductions were achieved or “no” if not achieved. If all three components (MF, RO, and AOP) do not pass, response measures specified in Title 22 Sections 60320.208(h) and (i) are launched. Within 24 hours of becoming aware of the issue, M1W will immediately investigate potential cause(s) and take corrective action(s). DDW and RWQCB are notified immediately if the AWPF fails to meet pathogen reduction criteria longer than four consecutive hours, or more than a total of eight hours during any seven-day period. Failures of shorter duration are reported to the RWQCB no later than ten days after the month in which failure occurred. If the calculated overall log reduction drops below 10-logs for enteric virus, or 8-logs for *Giardia* cysts or *Cryptosporidium* oocysts, M1W will immediately notify DDW and RWQCB, and discontinue application of product water for injection, unless directed otherwise by DDW or RWQCB.

Nitrogen Compounds, Regulated Contaminants and Action Levels, NLs, TOC, Additional Chemicals, and CECs. Information on response actions including monitoring, investigations, and suspension of product water for injection for each of these contaminant categories is presented in **Section 12**. Regular water quality sample collection and online monitoring is conducted at the RTP for process control, which includes turbidity, TSS, BOD (soluble and total $CBOD_5$, and BOD_5), dissolved organic carbon, TSS, volatile suspended solids, ammonia, pH, temperature, dissolved oxygen and flow at various locations in the RTP. This regular monitoring facilitates control of RTP treatment processes.

The RTP has alarms to indicate issues with the primary and secondary facilities, including power failure, unusual water quality, and mechanical failures. The alarm devices are connected to uninterruptible power supplies (UPSs) so that they continue to work in a power failure. All alarms result in an audible alarm in the control room. The control room operator is a Grade III operator or higher or is being supervised by a Grade III or higher operator on site. The control room is staffed 24 hours per day every day. Depending on the nature of the alarm, the control room operator can address the issue individually, call in on-call personnel to address the issue; or call the Chief Operator and/or managers. All alarms are recorded and printed, and those records are maintained on paper and electronically. Alarms for the AWPF will also be routed to the control room.

13.2 TRAINING

13.2.1 O&M Manuals and SOPs

Training and O&M manuals are provided by the engineering firm responsible for the 100% design of the AWPF, which includes training by the Original Equipment Manufacturers (OEMs) that provide equipment for the AWPF (for example, ozonation training is conducted by the ozone system supplier). O&M manuals are included in the M1W Electronic O&M Manual, which is currently in production for all facilities located at the RTP site. The O&M manuals include process descriptions, control descriptions, design criteria, routine duties, start-up and shut-down SOPs, alarms, an emergency response plan, operation and maintenance staffing plans, contact information, water quality sampling and testing plans, and equipment specifications for each section of the facility.

Training includes hands-on instruction for each component of the facility. M1W staff generate additional, internal SOPs to facilitate routine tasks, as needed. A select group of operators were initially assigned to the AWPF to quickly develop expertise on the AWPF unit processes. Additionally, operators are cycled through the AWPF to both ensure a broad range of expertise is available to support the AWPF and to facilitate an understanding of how the RTP treatment and the AWPF performance are interlinked. In addition to operating the RTP to meet ocean discharge requirements and provide a suitable influent to the SVRP, M1W operates the RTP to provide a suitable influent to the AWPF.

M1W has developed a web-based O&M Manual for the RTP, which provides easy access to graphics, photos, safety considerations, design criteria, general descriptions, major equipment, control strategies, alarms, P&IDs, SOPs, daily checklists, maintenance schedules, and troubleshooting information for each of the processes (*e.g.*, headworks, primary clarification). General information is also included, such as SCADA screens, reports, organizational charts, and emergency SOPs. A screenshot of an example page on the website is shown in **Figure 13-1**.

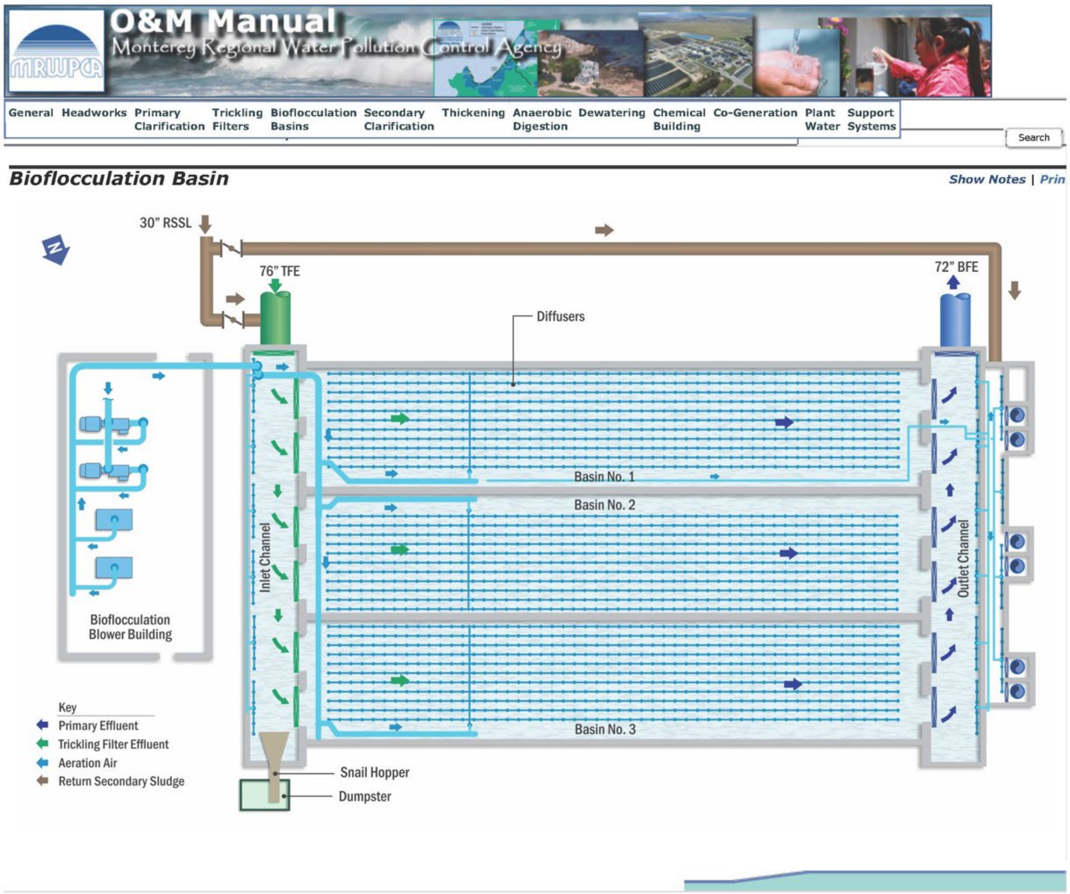


Figure 13-1.Screenshot of M1W's web-based RTP O&M manual. Bioflocculation graphic shown; clicking on components opens windows with photos and equipment lists.

The AWPF operators are certified through the Wastewater Operator Certification Program of the SWRCB Office of Operator Certification. For potable reuse treatment facilities, DDW requests operators have advanced water treatment (AWT) certifications. M1W AWPF operators are certified through the advanced water treatment operator certification program. M1W AWPF operators are required to participate in the reuse operator training and certification programs.

13.2.2 Demonstration Facility

M1W currently maintains and operates an AWPF Demonstration Facility. This facility has pilot-scale treatment equipment that represent the full-scale AWPF equipment. The demonstration facility treatment steps are pre-straining, chloramination, ozonation, MF, RO, UV/AOP, and product water stabilization. The demonstration facility has a UV/AOP effluent flow rate of 15 gpm, with a product water stabilization sidestream flowrate of approximately 1 gpm.

The demonstration facility receives secondary effluent from a submerged pump in the secondary clarifier effluent channel. Coarse strainers are used at the demonstration facility to remove snails that could clog pilot-scale equipment. Following straining, sodium hypochlorite is dosed to form chloramines. Following chloramination, the water travels through the ozone, MF, RO, and UV/AOP treatment process skids. After the skids, a sidestream flows through the product water tasting equipment, which includes chemical stabilization via a calcite filter, a cartridge filter, a small UV reactor, and a chiller. The ozone, MF, RO, and UV/AOP treatment skids are automated with PLC control and alarms. These skids, pretreatment equipment (chloramination) and post-treatment equipment are integrated through a master PLC, with interlocks.

In the operating the Demonstration Facility, the operators measure several water quality parameters, including critical control points, critical operating points, and constituents in the product water (see **Appendix J** for Demonstration Facility water quality monitoring schedules and operator checklists). Critical control point monitoring includes MF DIT LRV, RO electrical conductivity LRV, estimated UV/AOP 1,4-dioxane and NDMA removal calculations (based on UVT, UV intensity, and H_2O_2 pump speed), UV/AOP H_2O_2 residual, UVT, and UV power. Critical operating points include secondary effluent nitrite and TOC, ozone system dissolved ozone residual, chloramine residual, MF transmembrane pressure and total coliform removal, RO feed pH and anti-scalant flow, and stabilized pH and conductivity, as well as chemical levels, flows, pressures and meter verification. Product water quality monitoring includes TOC and total nitrogen.

The Demonstration Facility equipment and the control system mirror the design for the full-scale AWPF. M1W staff develop expertise through operation of the Demonstration Facility equipment, which is invaluable for operation and control of the full-scale AWPF.

13.3 PREVENTIVE MAINTENANCE PROGRAM FOR TREATMENT FACILITIES

The M1W Maintenance Department’s mission is to effectively and efficiently maintain all equipment so that it remains in a safe, reliable, and well-maintained condition for its internal and external customers.

13.3.1 Graduated Preventative Maintenance Program

The emphasis of the maintenance program is preventive rather than reactive maintenance. A strong preventive maintenance program effectively reduces overall maintenance costs by decreasing the number of, and the high cost of unpredictable repairs caused by reactive maintenance. M1W uses a graduated preventative maintenance (PM) program that is based on the manufacturer’s recommendations and modified based on their experience and their local environment. These PM practices maximize useful life, are cost efficient over the life of the asset, and ensures their assets remain in serviceable operating condition.

Maintenance schedules are developed for each asset, based upon usage and manufacturer’s recommendations. Each asset has PM tasks categorized as Weekly, Monthly, Semi-Annual or Annual, which include regular inspections. In addition, many assets also have “real-time” SCADA condition monitoring installed and are subject to daily physical operational checks. All of these data are monitored and tracked within the Agency Computerized Maintenance Management System (CMMS) program.

To assure optimum benefits, M1W continually reviews its maintenance practices to identify potential improvements to the program.

13.3.2 Reliability Centered Maintenance

M1W has conducted a failure modes effects analysis in order to develop a condition-based maintenance monitoring plan, which is tied into their process plan, for reliability centered maintenance. This asset management plan prioritizes maintenance based on maintaining reliability in the system and takes into account cascading effects that lack of maintenance could have on process performance.

13.4 OPERATIONAL STRATEGIES AND CONTINGENCY PLANS

M1W staff follow the SOPs, O&M manuals, and the OOP for operation of the AWPF. The SOPs, O&M manuals, and OOP include plans for normal operation, maintenance, cleanings, equipment failures, power outages, source water control upsets, RTP upsets or changes in performance, AWPF upsets or changes in performance, and challenges with conveyance, injection and extraction.

The RTP includes a biological secondary process, comprised of non-nitrifying trickling filters, bioflocculation (solids contact), and clarification. While the secondary process is typically stable, unforeseen upsets may occur which could impact the quality of feed water to the AWPF. Occasionally an upset or change in raw water quality requires elevated coagulant doses at the SVRP to reach filter effluent turbidity goals. The ozone system further provides pre-treatment to improve MF filterability during poor water quality events.

The RTP trickling filters are operated for BOD removal; however, partial nitrification can occur in the trickling filters under certain conditions. This partial nitrification can result in a nitrite residual in the secondary effluent, which exerts an ozone demand. The ozone system is designed for an elevated concentration of nitrite, and RTP operation can be adjusted to minimize nitrite formation, if necessary.

In the event of a power failure, a backup power system is used to properly shutdown the AWPF and maintain power to key facilities, such as PLCs. If the AWPF shuts down (e.g., water quality shutdown alarm, power failure), secondary effluent that would otherwise go to the AWPF is diverted to the SVRP facilities if sufficient capacity and demand is available, or the ocean outfall. In the event that AWPF product water quality fails to meet regulatory requirements, M1W will respond as described above and in accordance with the Title 22 Criteria. These responses may include repeat sampling, notification to DDW and the RWQCB, and suspension of production. If production is suspended, the AWPF will either be placed into recirculation mode while Operators investigate the source of the critical failure and make necessary adjustments or repairs, or the off-specification water will be returned to the RTP headworks or pumped to SVRP. In recirculation mode, AWPF production is reduced and the UV/AOP system effluent is diverted back to the MF feed tank for repeat treatment through the MF, RO and UV systems; water from the MF feed tank can be diverted (as needed) to the Waste Equalization Pump Station, where water is returned to the RTP headworks. If off-specification water is sent to the aquifer before production can be suspended, then the steps described in **Section 6** are followed to ensure a safe interim drinking water supply (e.g., monitoring, management, using an intertie with adjacent, connected public water system). An extensive Contingency Plan was developed and included in the OOP for the AWPF.

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