APPENDIX D3

Ocean Plan Compliance Assessment

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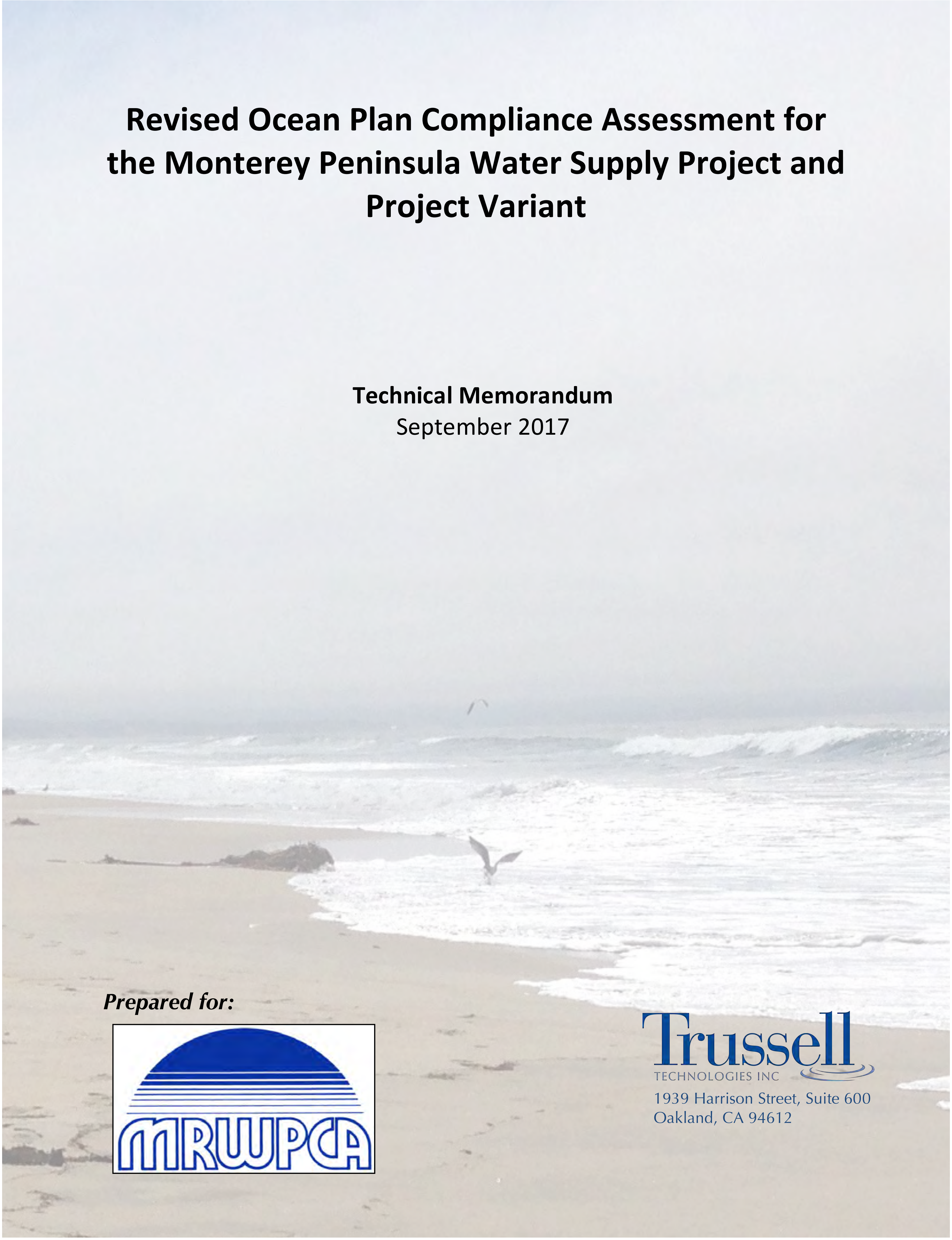

Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

Technical Memorandum
September 2017

Prepared for:

MRWPCA

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Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

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1 Executive Summary

In response to State Water Resources Control Board (SWRCB) Water Rights Orders WR 95-10, WR 2009-0060, and WR 2016-0016, two proposed projects are in development on the Monterey Peninsula to provide potable water to offset pending reductions of Carmel River water diversions: (1) a seawater desalination project known as the **Monterey Peninsula Water Supply Project** (MPWSP), and (2) a groundwater replenishment project known as the **Pure Water Monterey Groundwater Replenishment Project** (GWR Project). The capacity of the MPWSP is dependent on the construction of the GWR Project.

If the GWR Project is not constructed, the MPWSP would entail California American Water ("CalAm") building a seawater desalination facility capable of producing 9.6 million gallons per day (mgd) of drinking water. In the variation of the MPWSP where the GWR Project is constructed, known as the **Monterey Peninsula Water Supply Project Variant** ("Variant"), CalAm would build a smaller desalination facility capable of producing 6.4 mgd of drinking water, and a partnership between the Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) would build an advanced water treatment facility ("AWPF") as part of the GWR Project. This AWPF would be able to produce up to 4,300 acre-feet per year (AFY) (annual average of 3.8 mgd)[1] of highly purified recycled water to enable CalAm to extract 3,500 AFY (annual average of 3.1 mgd) from the Seaside Groundwater Basin for delivery to its customers.

Both the proposed desalination facility and the AWPF would employ reverse osmosis (RO) membranes to purify the waters, and as a result, both projects would produce RO concentrate waste streams that would be disposed through MRWPCA's existing ocean outfall: the brine concentrate from the desalination facility ("Desal Brine"), and the RO concentrate from the AWPF ("GWR Concentrate"). The goal of this technical memorandum (TM) is to analyze whether the discharges from the proposed projects through the existing ocean outfall would comply with the water quality objectives in the SWRCB 2015 Ocean Plan ("Ocean Plan") (SWRCB, 2015a).

The Ocean Plan sets forth numeric and narrative water quality objectives for the ocean with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting. The Regional Water Quality Control Boards utilize these objectives to develop water quality-based effluent limitations for ocean dischargers that have a reasonable potential to exceed the water quality objectives.

When municipal wastewater flows are released from an outfall (typically using specially designed diffusers), the wastewater and ocean water undergo rapid mixing due to the momentum

[1] The AWPF would be capable of producing up to 5 mgd of highly purified recycled water on a daily basis, but production would fluctuate throughout the year, such that the average annual production would be 3.8 mgd (4,300 AFY) in a non-drought year, when adding to the drought reserve.

and buoyancy of the discharge.[2] The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). For rising plumes, the Ocean Plan defines the initial dilution as complete when "the diluting wastewater ceases to rise in the water column and first begins to spread horizontally," (*i.e.*, when the momentum from the discharge has dissipated). For more saline discharges, a sinking plume forms when the discharge is denser than the ambient water (also known as a negatively buoyant plume). In the case of negatively buoyant plumes, the Ocean Plan defines the initial dilution as complete when "the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution."

The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge. The initial dilution occurs in an area known as the zone of initial dilution (ZID). The extent of dilution in the ZID is quantified and referred to as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive effluent limitations in the National Pollutant Discharge Elimination System (NPDES) permit that are applied to a wastewater discharge prior to ocean dilution.

The purpose of this analysis was to assess the ability of the MPWSP and Variant to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the secondary effluent, GWR Concentrate, Desal Brine and hauled waste for these projects. Dr. Philip Roberts, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, conducted modeling of the ocean discharge and estimated D_m values for scenarios involving different flow rates of the proposed projects and different ambient ocean conditions. These ocean modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan.

The estimates of minimum probable dilution (D_m) developed by Dr. Roberts for the MPWSP range from 14.4 to 98, and from 14.4 to 114 for the Variant. These D_m values are substantially lower than what is currently specified in the MRWPCA NPDES permit (145) and those estimated for the GWR Project, which range from 174 to 498 (see Appendix B). As a result of the reduced dilution, some contaminants, which have not traditionally been of concern for discharge through MRWPCA's ocean outfall, are estimated to potentially exceed the Ocean Plan objectives at the edge of the ZID. A summary of the constituents that show potential to exceed the Ocean Plan objectives is provided in Table ES-1 for the MPWSP, and Table ES-2 for the Variant. These constituents can be divided into three categories:

- **Category I -** Insufficient analytical sensitivity to determine compliance: The constituent was not detected above the method reporting limit (MRL) in any of the source waters, but the MRL is not sensitive enough to demonstrate compliance with the Ocean Plan objective.

[2] Municipal wastewater effluent, being low in salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water. GWR Concentrate, whether by itself or mixed with municipal wastewater effluent, is less dense than seawater and also rises (due to buoyancy) while it mixes with ocean water. Desal Brine, depending on the ratio of dilution with GWR Concentrate and municipal wastewater effluent, may be more or less dense than seawater.

- **Category II -** Estimated to be close to exceeding the Ocean Plan objective: The constituent is estimated to be at a concentration between 80% and 100% of the Ocean Plan objective at the edge of the ZID.
- **Category III -** Estimated to exceed the Ocean Plan objective: The constituent is estimated to be at a concentration higher than the Ocean Plan objective at the edge of the ZID.

Table ES-1: Summary of Compliance Conclusions for the MPWSP

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario[f]	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	4	140%
Ammonia			✓	5	102%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]	✓			--	--
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
TCDD Equivalents [e]	✓			--	--
2,4,6-Trichlorophenol	✓			--	--

Notes:
a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.
b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios
c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID
d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification
e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective
f: Flow scenarios are defined in Table 2 and Table 3

Table ES-2: Summary of Compliance Conclusions for the Variant

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario[f]	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	31	189%
Ammonia			✓	30	266%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]		✓		30	94%
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
Bis(2-ethyl-hexyl)phthalate		✓		30	84%
Chlordane			✓	30	199%
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
PCBs			✓	30	169%
TCDD Equivalents [e]			✓	30	131%
Toxaphene			✓	30	126%
2,4,6-Trichlorophenol	✓			--	--

Notes:
a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.
b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios
c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID
d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification
e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective
f: Flow scenarios are defined in Table 2 and Table 3

Based on the data, assumptions, modeling, and analytical methodology presented in this TM, the MPWSP and Variant show a potential to exceed certain Ocean Plan objectives under specific discharge scenarios (see Tables ES-1 and ES-2). In particular, potential issues were identified for the MPWSP and Variant discharge scenarios involving low to moderate secondary effluent flows with Desal Brine: discharges are estimated to exceed or come close to exceeding multiple Ocean Plan objectives, specifically those for cyanide and ammonia for the MPWSP, and cyanide, ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene for the Variant. Ammonia clearly exceeds the Ocean Plan objective and must be resolved for the MPWSP and Variant. When considering a best-case analysis for the Variant, acrylonitrile is estimated to come close to exceeding the Ocean Plan objective, and TCDD equivalents show a potential to exceed the objective. Additional analytical investigation regarding cyanide analysis is recommended to determine if the potential exceedances are representative of actual water quality conditions. Chlordane, PCBs and toxaphene, which were estimated to exceed the objectives for the Variant flow scenarios, were detected at concentrations that are orders of magnitude below detection limits of methods currently used for discharge compliance.

2 Introduction

In response to State Water Resources Control Board (SWRCB) Water Rights Orders WR 95-10, WR 2009-0060, and WR 2016-0016, two proposed projects are in development on the Monterey Peninsula to provide potable water to offset pending reductions of Carmel River water diversions: (1) a seawater desalination project known as the **Monterey Peninsula Water Supply Project** (MPWSP), and (2) a groundwater replenishment project known as the **Pure Water Monterey Groundwater Replenishment Project** (GWR Project). The capacity of the MPWSP is dependent on the construction of the GWR Project.[3]

If the GWR Project is constructed, the MPWSP would entail California American Water ("CalAm") building a seawater desalination facility capable of producing 9.6 million gallons per day (mgd) of drinking water. In the variation of the MPWSP where the GWR Project is constructed, known as the **Monterey Peninsula Water Supply Project Variant** ("Variant"), CalAm would build a smaller desalination facility capable of producing 6.4 mgd of drinking water, and a partnership between the Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) would build an advanced water treatment facility ("AWPF") as part of the GWR Project. This AWPF would be able to produce up to 4,300 acre-feet per year (AFY) (annual average of 3.8 mgd)[4] of highly purified recycled water to enable CalAm to extract 3,500 AFY (annual average of 3.1 mgd) from the Seaside Groundwater Basin for delivery to its customers.

The GWR Project involves treating secondary-treated wastewater (*i.e.*, secondary effluent) from MRWPCA's Regional Treatment Plant (RTP) through the proposed Advanced Water Purification Facility (AWPF) and then injecting up to 3,700 AFY of this highly purified recycled water into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply, and providing up to 600 AFY to Marina Coast Water District for urban landscape irrigation. The GWR Project will also provide additional tertiary recycled water for agricultural irrigation in the northern Salinas Valley as part of the Castroville Seawater Intrusion Project (CSIP). Both the proposed desalination facility and the AWPF would employ reverse osmosis (RO) membranes to purify the waters, and as a result, both projects would produce RO concentrate waste streams that would be disposed through MRWPCA's existing ocean outfall:

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[3] Construction of the GWR Project is expected to begin in September 2018.

[4] The AWPF would be capable of producing up to 5 mgd of highly purified recycled water on a daily basis, but production would fluctuate throughout the year, such that the average annual production would be 3.8 mgd (4,300 AFY) in a non-drought year, when adding to the drought reserve.

the brine concentrate from the desalination facility ("Desal Brine"), and the RO concentrate from the AWPF ("GWR Concentrate").

The goal of this TM is to analyze whether the discharges from the proposed projects through the existing ocean outfall would comply with the numeric water quality objectives in the SWRCB 2015 Ocean Plan ("Ocean Plan") (SWRCB, 2015). A similar assessment of the GWR Project on its own was previously performed (Trussell Tech, 2017, see Appendix B), and so this document provides complementary information focused on the MPWSP and Variant projects.

The original version of this document (Trussell Tech, 2015a) and an addendum report to that document (Trussell Tech, 2015b) were included in both the GWR Project Consolidated Final Environmental Impact Report (CFEIR) and the MPWSP draft Environmental Impact Report (EIR). A second version of this document was updated to include new water quality data and flow scenarios for the MPWSP and Variant to address data gaps noted in the original analyses, and was included in the 2017 MPWSP draft EIR (Trussell Tech, 2016, see Appendix C). The following TM incorporates updates to the 2016 version, including additional water quality data and flow scenarios, and these revisions are discussed in more detail in the following sections.

2.1 Treatment through the Proposed CalAm Desalination Facility

This section describes the proposed treatment train for the MPWSP and Variant desalination facility. Seawater from the Monterey Bay would be extracted through subsurface slant wells beneath the ocean floor and piped to a new CalAm-owned desalination facility. This facility would consist of granular media pressure filters, cartridge filters, a two-pass RO membrane system, RO product-water stabilization (for corrosion control), and disinfection – (Figure 1). The RO process is expected to recover 42 percent of the influent seawater flow as product water, while the remainder of the concentrated influent water becomes the Desal Brine. The MPWSP and Variant product water (desalinated water) would be used for municipal drinking water, while the Desal Brine would be blended with (1) available RTP secondary effluent, (2) brine that is trucked and stored at the RTP, and (3) GWR Concentrate (for the Variant only), and discharged to the ocean through the existing MRWPCA ocean outfall. The volume of Desal Brine is dependent on the project size: 13.98 and 8.99 mgd for the MPWSP and Variant, respectively.

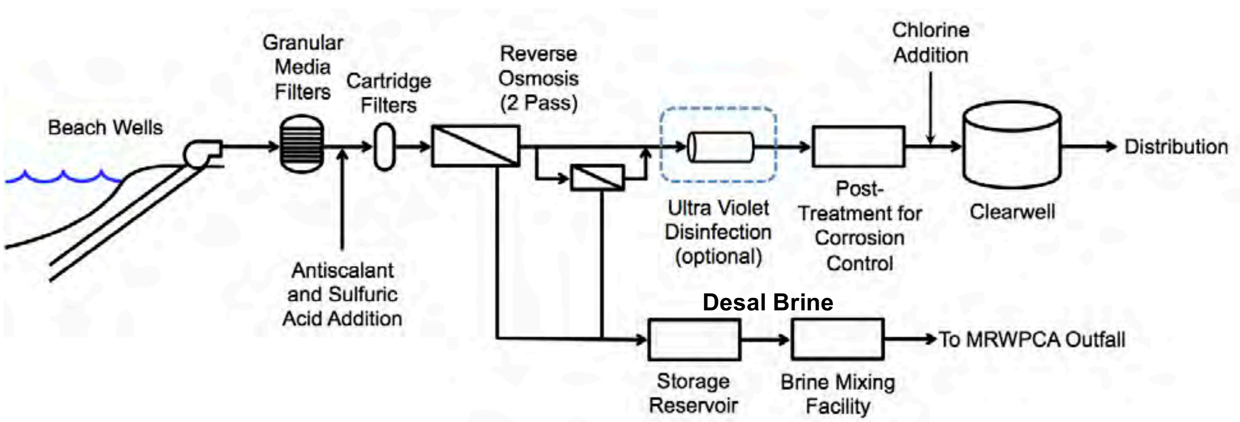

Figure 1 – Schematic of CalAm desalination facilities

2.2 Treatment through the RTP and Proposed AWT Facilities

The existing MRWPCA RTP treatment process includes screening, primary sedimentation, secondary biological treatment through trickling filters, followed by a solids contactor (*i.e.*, bio-flocculation), and clarification (Figure 2). Much of the secondary effluent undergoes tertiary treatment (coagulation, flocculation, granular media filtration, and disinfection) to produce recycled water used for agricultural irrigation. The unused secondary effluent is discharged to the Monterey Bay through the MRWPCA outfall. MRWPCA also accepts trucked brine waste for ocean disposal ("hauled waste"), which is stored in a pond and mixed with secondary effluent prior to being discharged.

The AWPF will include several advanced treatment technologies for purifying the secondary effluent: ozone (O_3), membrane filtration (MF), reverse osmosis (RO), an advanced oxidation process (AOP) using ultraviolet light (UV) and hydrogen peroxide, and finished water stabilization. The Project Partners conducted a pilot-scale study of the planned AWPF ozone, MF, and RO processes from December 2013 through July 2014, successfully demonstrating the ability of the various treatment processes to produce highly-purified recycled water that complies with the California Water Recycling Criteria for Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application (Groundwater Replenishment Regulations) (SWRCB, 2015b) and Central Coast Water Quality Control Plan (Basin Plan) standards, objectives and guidelines for groundwater (CCRWQCB, 2011). After the pilot-scale study, an advanced water purification demonstration facility was built to gain additional experience operating ozone, MF, and RO processes. The new facility also included a UV/hydrogen peroxide AOP and stabilization treatment. The demonstration facility is operated and maintained by MRWPCA.

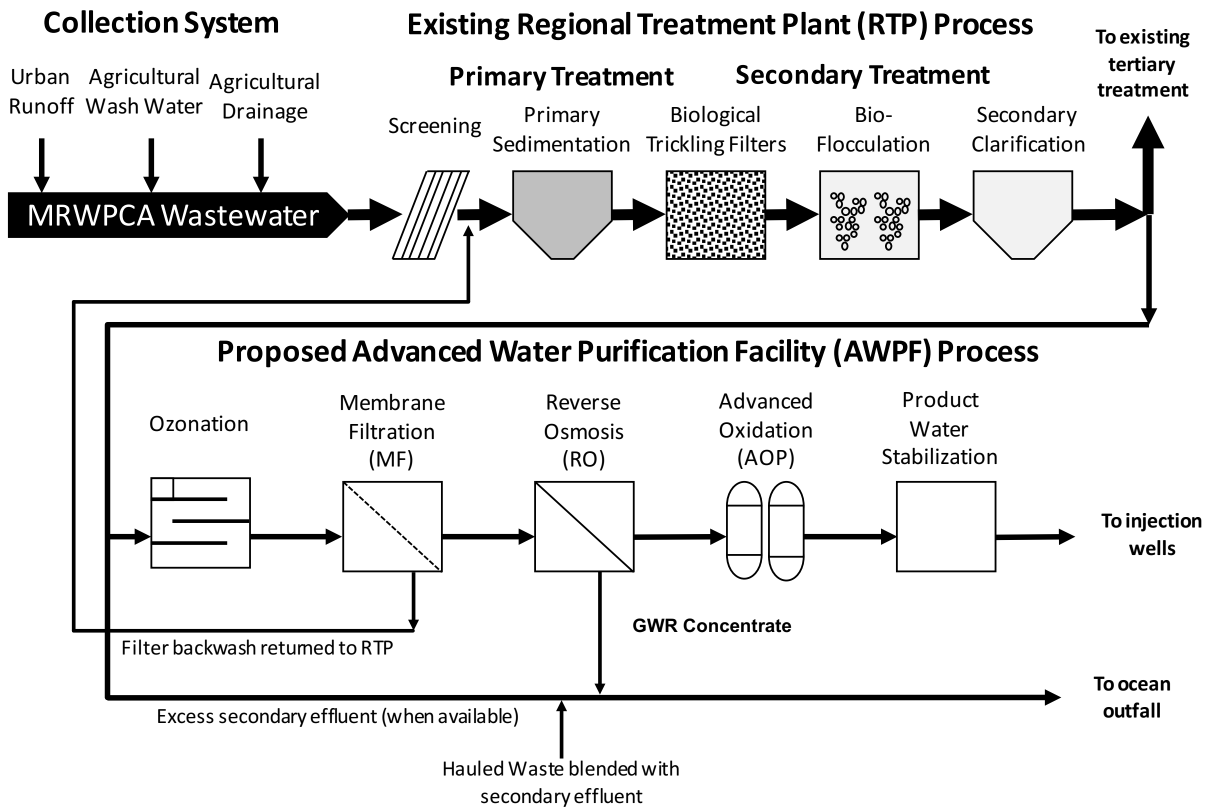

Figure 2 – Schematic of existing MRWPCA RTP and proposed AWPF treatment

2.3 California Ocean Plan

The Ocean Plan sets forth numeric and narrative water quality objectives for the ocean waters with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting (SWRCB, 2015a). The Regional Water Quality Control Boards utilize these objectives to develop water quality-based effluent limitations for ocean dischargers that have a reasonable potential to exceed the water quality objectives.

When municipal wastewater flows are released from an outfall (typically using specially designed diffusers), the wastewater and ocean water undergo rapid mixing due to the momentum and buoyancy of the discharge.[5] The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). For rising plumes, the Ocean Plan defines the initial dilution as complete when "the diluting wastewater ceases to rise in the water column and first begins to spread horizontally," (*i.e.*, when the momentum from the discharge has dissipated). For more saline discharges, a sinking plume forms when the discharge is denser than the ambient water (also known as a negatively buoyant

[5] Municipal wastewater effluent, being low in salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water. GWR Concentrate, whether by itself or mixed with municipal wastewater effluent, is less dense than seawater and also rises (due to buoyancy) while it mixes with ocean water. Desal Brine, depending on the ratio of dilution with GWR Concentrate and municipal wastewater effluent, may be more or less dense than seawater.

plume). In the case of negatively buoyant plumes, the Ocean Plan defines the initial dilution as complete when “the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution.”

The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge. The initial dilution occurs in an area known as the zone of initial dilution (ZID). The extent of dilution in the ZID is quantified and referred to as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive National Pollutant Discharge Elimination System (NPDES) permit limits that are applied to a wastewater discharge prior to ocean dilution.

The current MRWPCA wastewater discharge is governed by NPDES Permit No. CA0048551 (currently implemented as Order No. R3-2014-0013) issued by the Central Coast Regional Water Quality Control Board (“RWQCB”) (CCRWQCB, 2014). Because the existing NPDES permit for the MRWPCA ocean outfall must be amended to discharge Desal Brine, comparing future discharge concentrations to the current NPDES permit limits (that will likely change when the permit is amended) would not be an appropriate metric or threshold for determining whether the proposed projects would have a significant impact on marine water quality. Instead, compliance with the Ocean Plan objectives was selected as an appropriate threshold for determining whether the proposed projects would result in a significant impact requiring mitigation.

Dr. Philip Roberts, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, conducted dilution modeling of the ocean discharge and estimated D_m values for scenarios involving different flow rates of the proposed projects and different ambient ocean conditions. These ocean modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan. Dr. Roberts’ report is included as Appendix D.

2.4 Future Ocean Discharges

A summary schematic of the MPWSP and Variant is presented in Figure 3. For the MPWSP, 23.58 mgd of ocean water (design capacity) would be treated in the desalination facility; an RO recovery of 42% would lead to an MPWSP Desal Brine flow of 13.98 mgd that would be discharged through the outfall. Following periods of plant shutdown, the facility may produce 16.31 mgd of Desal Brine to temporarily boost plant production. Secondary effluent from the RTP would also be discharged through the outfall, although the flow would be variable depending on both the raw wastewater flow and the proportion being processed through the tertiary treatment system at the Salinas Valley Reclamation Plant (SVRP) to produce recycled water for agricultural irrigation. The third and final discharge component is hauled waste that is trucked to the RTP and blended with secondary effluent prior to discharge. The maximum anticipated flow of the hauled waste is 0.03 mgd, and is blended with secondary effluent for a total flow of 0.1 mgd. These three discharge components (Desal Brine, secondary effluent, and hauled waste) would be mixed at the proposed Brine Mixing Facility prior to ocean discharge.

For the Variant, 15.93 mgd of ocean water (design capacity) would be pumped to the desalination facility, and an RO recovery of 42% would result in a Variant Desal Brine flow of

8.99 mgd. Similar to the larger desalination facility, the plant may produce 11.24 mgd of Desal Brine for a short period of time to boost plant production. The Variant would include the GWR Project, which involves the addition of new source waters to the RTP that would alter the water quality of the secondary effluent produced by the RTP. The secondary effluent in the Variant is referred to as "Variant secondary effluent," and would be different in quality from the MPWSP secondary effluent. Under the GWR Project, a portion of the secondary effluent would be fed to the AWPF, and the resultant GWR Concentrate (maximum 1.17 mgd) would be discharged through the outfall. The hauled waste received at the RTP would continue to be mixed with secondary effluent prior to discharge, and so the quality of the blended brine and secondary effluent will change as a result of the change in secondary effluent quality. The hauled waste for the Variant is referred to as "Variant hauled waste." The discharge components for the MPWSP and Variant are summarized in Table 1.

Table 1 – Discharge waters Included in each analysis

Project	Desal Brine	Secondary Effluent	Variant Secondary Effluent	Hauled Waste	Variant Hauled Waste [a]	GWR Concentrate
MPWSP	✓ (13.98 mgd, 16.31 mgd periodically)	✓ (flow varies)		✓ (0.1 mgd)		
Variant	✓ (8.99 mgd, 11.24 mgd periodically)		✓ (flow varies)		✓ (0.1 mgd)	✓ (1.17 mgd)

[a] This is placed in a separate category because it contains Variant secondary effluent.

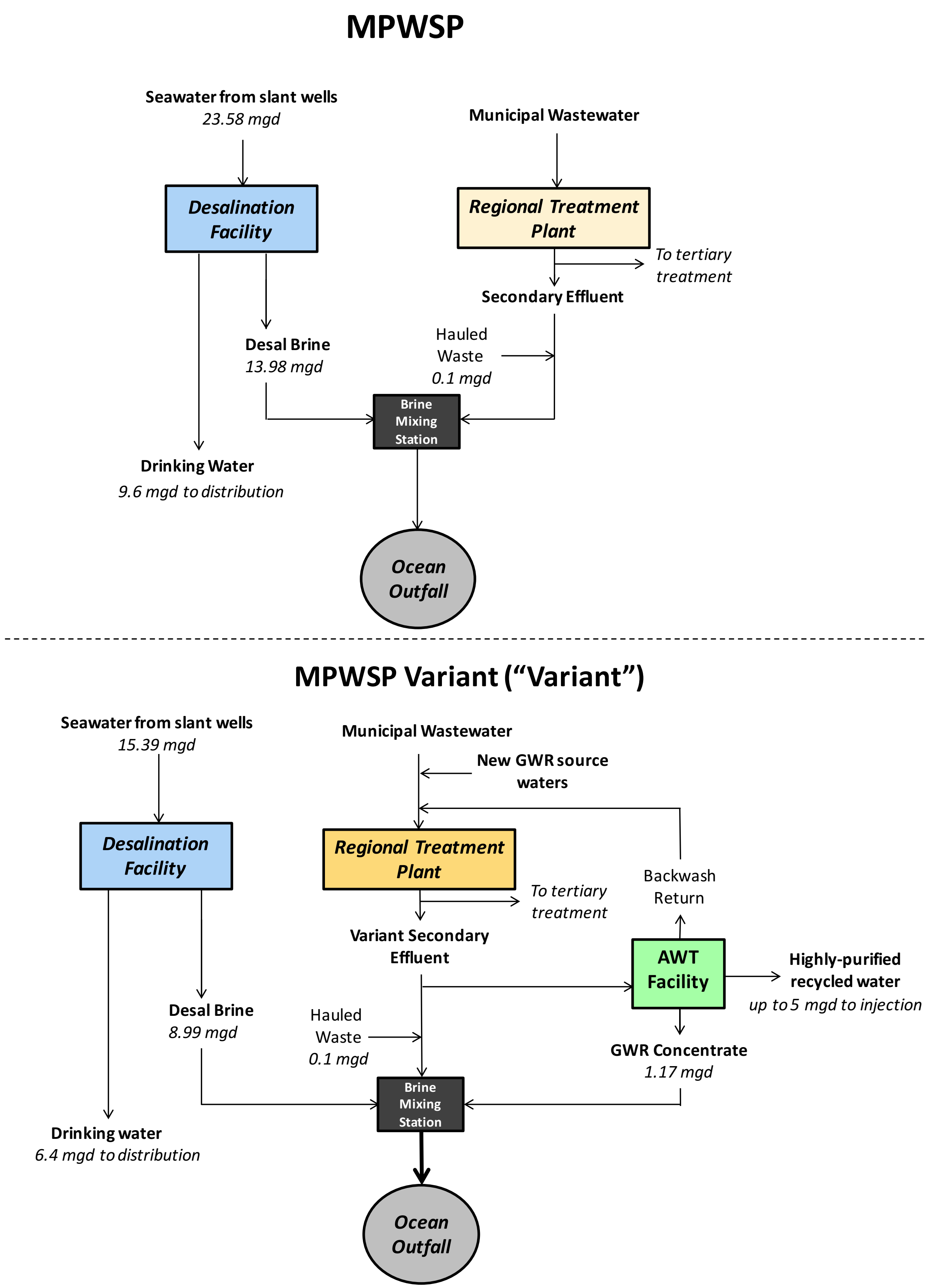

Figure 3 – Flow schematics for the MPWSP and Variant projects (specified flow rates are at design capacity)

2.5 Objective of Technical Memorandum

Trussell Technologies, Inc. ("Trussell Tech") estimated worst-case in-pipe water quality for the various ocean discharge scenarios (*i.e.*, prior to dilution through ocean mixing) for the proposed projects. Dr. Roberts' ocean discharge modeling and the results of the water quality analysis were then used to provide an assessment of whether the proposed projects would consistently meet Ocean Plan water quality objectives. The objective of this TM is to summarize the assumptions, methodology, results and conclusions of the Ocean Plan compliance assessment for the MPWSP and Variant.

3 Methodology for Ocean Plan Compliance Assessment

Water quality data from various sources for the different treatment process influent and waste streams were compiled. Trussell Tech combined these data for different flow scenarios and used ocean modeling results (*i.e.*, D_m values) to assess compliance of different discharge scenarios with the Ocean Plan objectives. This section documents the data sources and provides further detail on the methodology used to perform this analysis. A summary of the methodology is presented in Figure 4.

3.1 Methodology for Determination of Discharge Water Quality

The amounts and combinations of various wastewaters that would be disposed through the MRWPCA outfall will vary depending on the capacity, seasonal and daily flow characteristics, and extent and timing of implementation of the proposed projects.

Detailed discussions about the methods used to determine the discharge water qualities related to the GWR Project were previously discussed and can be found in Appendix B. This previous analysis included water quality estimates of the secondary effluent, Variant secondary effluent, hauled waste, Variant hauled waste, and the GWR Concentrate (*i.e.*, all of the discharges except for the Desal Brine). In the previous analysis, Trussell Tech assumed that the highest observed values for the various Ocean Plan constituents within each type of water flowing to and treated at the RTP, including the AWPF as applicable, to be the worst-case water quality.[6] These same data and assumptions were used in the analysis described in this memorandum. Use of these worst-case water quality concentrations ensures that the analysis in this memorandum is conservative related to the Ocean Plan compliance assessment (and thus, the impact analysis for the MPWSP environmental review processes).

To determine the impact of the MPWSP and Variant, the worst-case water quality of the Desal Brine was estimated using available data from CalAm's temporary test subsurface slant well on the CEMEX mine property in Marina, California. Long-term pumping and water quality sampling from this well began in April 2015.[7] As in the previous Ocean Plan compliance

[6] Except for copper, where instead the median was calculated from the data for each new source water because the maximum values detected seemed to be outliers, and the Ocean Plan objective for copper considered in this assessment is the 6-month median concentration.

[7] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

assessments, the highest observed concentrations in the slant well were used for this Ocean Plan compliance assessment.[8]

The methodology for determining the water quality of the Desal Brine and secondary effluent is further described in this section (the methodology for all other discharge waters can be found in Appendix B). A summary of which discharge waters are considered for both the MPWSP and Variant, and which data sources were used in the determination of the water quality for each discharge stream is shown in Figure 4.

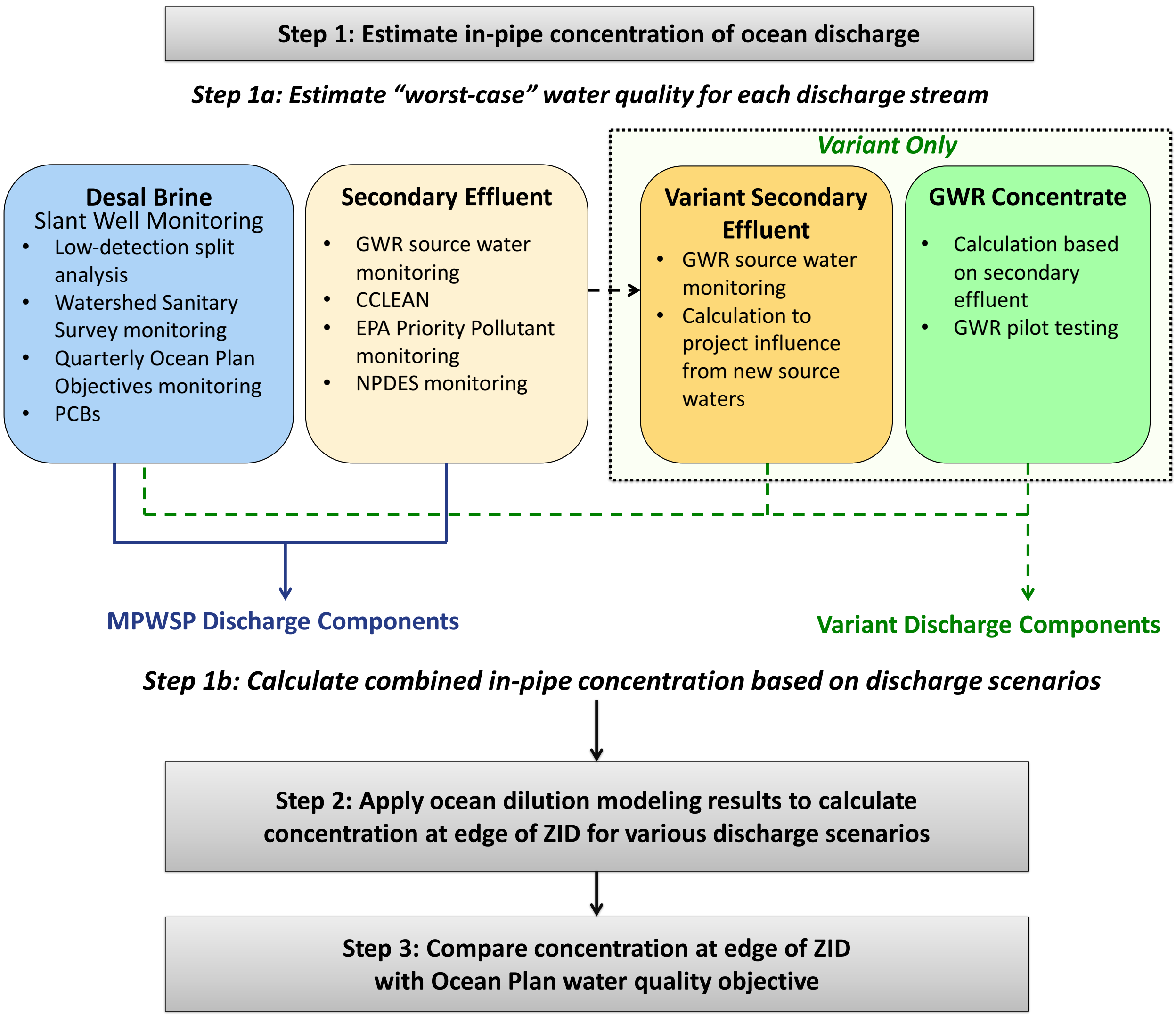

Figure 4 – Logic flow chart for determination of MPWSP and Variant compliance with Ocean Plan objectives.

8 Except for copper, where instead the median was calculated from data from the test slant well because the maximum values detected seemed to be outliers, and the Ocean Plan objective for copper considered in this assessment is the 6-month median concentration.

3.1.1 Secondary Effluent

For the MPWSP, the discharged secondary effluent would not be impacted by additional source waters that would be brought in for the Variant; therefore, the historical secondary effluent quality was used in the analysis. The following sources of data were considered for selecting a secondary effluent concentration for each constituent in the analysis:

- Secondary effluent water quality monitoring conducted for the GWR Project from July 2013 through June 2014.
- MRWPCA RTP historical NPDES compliance water quality data collected semi-annually by MRWPCA (2005- Spring 2017).
- Historical NPDES RTP Priority Pollutant data collected annually by MRWPCA (2004-2016).
- Water quality data collected semi-annually by the Central Coast Long-Term Environmental Assessment Network (CCLEAN) (2008-2016) (CCLEAN, 2014).

The secondary effluent concentration for each constituent selected for the analysis was the maximum reported value from the above sources. In some cases, constituents were not detected (ND); in these cases, the values are reported as ND (<MRL). In cases where the analysis of a constituent was detected but not quantified, the result is also reported as less than the Method Reporting Limit ND (<MRL).[9] Because the actual concentration could be any value equal to or less than the MRL, the conservative approach is to use the value of the MRL for the compliance analysis. For some ND constituents, the MRL exceeds the Ocean Plan objective, and thus no compliance determination can be made.[10] A detailed discussion of the cases where a constituent was reported as less than the MRL is included in the GWR Project TM in Appendix B (Trussell Technologies, 2017).

Cyanide has been detected in the RTP effluent at relatively high levels compared to the discharge requirements. The maximum detected value in the RTP effluent was 81 μg/L.

Several investigations have been conducted into the accuracy of sampling, preservation, and analytical methods for cyanide. These have shown that sample holding time and preservation have a significant impact on measured cyanide concentrations. Pandit et al. (2006) demonstrated that when sodium hydroxide was added to adjust the pH higher than 12, as specified in accepted methods for cyanide measurement in order to preserve the sample, the measured cyanide concentrations were consistently higher than those for samples preserved at pH 10 to 11. They also showed that cyanide levels increased within the recommended holding times of the approved cyanide methods (at pH 12).

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[9] The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (*i.e.*, the lower limit of quantitation). Therefore, acceptable quality control and quality assurance procedures are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the Method Detection Limit (or greater). The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. (40 Code of Federal Regulations Section136 Appendix B).

[10] This phenomenon is common in the implementation of the Ocean Plan where for some constituents, suitable analytical methods are not capable of measuring low enough to quantify the minimum toxicologically relevant concentrations. For these constituents, a discharge is considered compliant if the monitoring results are less than the MRL.

In addition, the 2015 California Ocean Plan specifies the following:

If a discharger can demonstrate to the satisfaction of the Regional Water Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by the approved method in 40 CFR PART 136, as revised May 14, 1999.

Based on the above information, it is recommended that additional cyanide sampling be conducted using different methods (*e.g.*, analysis within 15 minutes with no preservation) to determine if the laboratory method leads to inaccurately high cyanide values. It is also recommended to determine if a method can be performed that distinguishes between weakly and strongly complexed cyanide. Until this is completed, all cyanide concentrations presently available are used in this Ocean Plan compliance assessment.

3.1.2 Desalination Brine

Trussell Tech used the following four sources of data for the Desal Brine water quality assessment:

- A one-time 7-day composite sample from the test slant well with separate analysis of particulate and dissolved phase fractions of constituents using low-detection CCLEAN analysis techniques (February 18-25, 2016). The maximum total concentration was used in this analysis (*i.e.* the sum of the concentration in the particulate and dissolved phase fractions).[11] Of the constituents analyzed with this split phase method,[12] all were detected 100% in the dissolved phase, except PCBs, which were detected 99% in the dissolved phase.
- CalAm Watershed Sanitary Survey monitoring program monthly test slant well sampling water quality results (May 2015 – April 2017).[13]
- Quarterly sampling of the test slant well for constituents specified in the Ocean Plan (November 2015, February, June, and September 2016).
- Test slant well sampling by Geoscience Support Services, Inc. ("Geoscience") every other month for polychlorinated biphenyls (PCBs) (May 2015 – February 2016).[11]

The maximum value observed in any of the data sources was assumed to be the "worst-case" water quality for the raw seawater feeding the desalination facility. If a constituent was ND in all samples, and multiple analysis methods were used with varying MRL values, the highest MRL

[11] Only method detection limits were provided for these results. When a constituent was ND in this dataset, the method detection limit was used for analysis.
[12] Hexachlorobutadiene, hexachlorobenzene, HCH, heptachlor, aldrin, chlordane, DDT, heptachlor epoxide, dieldrin, Endrin, endosulfans, toxaphene, PCBs
[13] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

was assumed for compliance analysis; the exception to this statement is when data were available from the low detection limit 7-day composite sample. For these constituents,[14] the detected value from the low detection analysis was used, even if it was lower than the MRL provided by the standard analysis methods. If the sample results of a constituent reported the concentration as less than the MRL, the MRL was assumed for compliance analysis and the concentration is reported as ND (<MRL) in this TM. Equation 1 was used to calculate a conservative estimate of the Desal Brine concentration (C_{Brine}) for each constituent by using a concentration factor of 1.73, which was calculated assuming complete rejection of the constituent in the feed water (C_{Feed}) and a 42% recovery ($\%_R$) through the seawater RO membranes.

$$C_{Brine} = \frac{C_{Feed}}{1-\%_R} \quad (1)$$

3.1.3 Combined Ocean Discharge Concentrations

Having estimated the worst-case concentrations for each of the discharge components, the combined concentration prior to discharge was determined as a flow-weighted average of the contributions of each of the discharge components appropriate for the MPWSP and Variant.

3.2 Ocean Modeling Methodology

In order to determine Ocean Plan compliance, Trussell Tech used the following information: (1) the in-pipe (*i.e.*, pre-ocean dilution) concentration of a constituent ($C_{in\text{-}pipe}$) that was developed as discussed in the previous section, (2) the minimum probable dilution for the ocean mixing (D_m) for the discharge flow scenarios that were modeled by Dr. Roberts[15] (Roberts, P. J. W, 2017), and (3) the background concentration of the constituent in the ocean ($C_{Background}$) that is specified in Table 3 of the Ocean Plan (SWRCB, 2015b). With this information, the concentration at the edge of the zone of initial dilution (C_{ZID}) was calculated using the following equation:

$$C_{ZID} = \frac{C_{In-pipe} + D_m * C_{Background}}{1 + D_m} \quad (2)$$

The C_{ZID} was then compared to the Ocean Plan water quality objectives[16] in Table 1 of the Ocean Plan (SWRCB, 2015). In this table, there are three categories of objectives: (1)

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[14] Endrin, hexachlorocyclohexane, chlordane, DDT, dieldrin, heptachlor, heptachlor epoxide, hexachlorobutadiene, PCBs, toxaphene.

[15] The Ocean Plan defines dilution differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S - 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Ocean Plan Equation 1.

[16] Note that the Ocean Plan also defines effluent limitations for oil and grease, suspended solids, settleable solids, turbidity, and pH (see Ocean Plan Table 2). These parameters were not evaluated in this assessment. It is assumed that, if necessary, the pH of the water would be adjusted to be within acceptable limits prior to discharge. Oil and grease, suspended solids, settable solids, and turbidity in the GWR Concentrate and Desal Brine would be significantly lower than the secondary effluent. Prior to the AWPF RO treatment process, the process flow would be treated by MF, which will reduce these parameters, and the waste stream from the MF will be returned to RTP

Objectives for Protection of Marine Aquatic Life, (2) Objectives for Protection of Human Health – Non-Carcinogens, and (3) Objectives for Protection of Human Health – Carcinogens. There are also three objectives for each constituent included in the first category (for marine aquatic life): six-month median, daily maximum and instantaneous maximum concentration. For the other two categories, there is one objective: 30-day average concentration. When a constituent had three objectives, the lowest objective, the six-month median, was used to estimate compliance. This approach was taken because the discharge scenarios, discussed in further detail below, could be experienced for six months, and therefore the 6-month median objective would need to be met. For the ammonia objectives (specifically, the total ammonia concentration calculated as the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4), expressed in μg/L as N) the daily maximum and 6-month median objectives were evaluated.

For each discharge scenario, if the C_{ZID} was below the Ocean Plan objective, then it was assumed that the discharge would comply with the Ocean Plan. However, if the C_{ZID} exceeds the Ocean Plan objective, then it was concluded that the discharge scenario could violate the Ocean Plan objective. Note that this approach could not be applied for some constituents, *viz.*, acute toxicity, chronic toxicity, and radioactivity. Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the secondary effluent and GWR Concentrate, and these individual concentrations would comply with the Ocean Plan objectives. Toxicity testing on the seawater was not included in the analysis for this TM; it will be evaluated by another method not discussed in this TM.

Dr. Roberts performed modeling of various discharge scenarios for the MPWSP and Variant that include combinations of Desal Brine, secondary effluent, GWR Concentrate, and hauled waste (Roberts, P. J. W, 2017). Forty-seven scenarios resulting in the worst-case dilution conditions will be presented in this TM. These scenarios assume the maximum flow rates for the GWR Concentrate, Desal Brine and hauled waste, which is a conservative assumption in terms of constituent loading and minimum dilution. Additional flow scenarios were modeled by Dr. Roberts, and can be found in his report (Appendix D).

3.2.1 Ocean Modeling Scenarios

The modeled scenarios are summarized in Tables 2 and 3 for the MPWSP and the Variant, respectively. The Variant discharge scenarios that have no Desal Brine (*i.e.*, Scenarios 21 through 29) have already been analyzed and found to comply with the Ocean Plan (Trussell Tech 2017, see Appendix B); these scenarios are shown in Table 3 for completeness, but for simplicity, the analysis of these scenarios is not repeated in Section 4.

The MPWSP flow scenarios included in this analysis cover the range of potential future discharge compositions, with various secondary effluent flows and Desal Brine flows included. The amount of secondary effluent being discharged is dependent on the demand for recycled water (highest demand, and lowest secondary effluent discharge is experienced during the

headworks. Prior to the Desalination Facility RO treatment process, the process flow would be treated by granular media filters and cartridge filters, which reduce these parameters. The waste stream from the granular media filter would be further treated in gravity thickening basins prior to any discharge of the decant through the ocean outfall. The cartridge filters will be disposed off-site and the solids will not be returned to the process.

summer months), and whether the SVRP is operational. Modeling the minimum secondary effluent flows (*i.e.*, no secondary effluent discharged) provides conditions where the influence of Desal Brine on the ocean discharge water quality is maximized and the discharge plumes are negatively buoyant. The moderate secondary effluent flow scenarios create conditions where the Desal Brine and the secondary effluent have similar levels of influence on the water quality of the ocean discharge, as well as neutrally buoyant discharge plumes. The high secondary effluent flow scenarios provide analysis of the highest expected flows that may be discharged, where the discharge is buoyant.

Table 2 - Modeled flow scenarios for the MPWSP

Flow Scenario No.	Discharge Flows (mgd)		
	Secondary Effluent [a]	Desal Brine	Hauled Waste
MPWSP with Normal Desal Brine Flow			
1	0	13.98	0.1
2	2	13.98	0.1
3	4	13.98	0.1
4	6	13.98	0.1
5	9	13.98	0.1
6	10	13.98	0.1
7	19.78	13.98	0.1
MPWSP with High Desal Brine Flow			
8	0	16.31	0.1
9	2	16.31	0.1
10	7	16.31	0.1
11	8	16.31	0.1
12	10	16.31	0.1
13	12	16.31	0.1
14	16	16.31	0.1

[a] Note that RTP wastewater flows have been declining in recent years as a result of water conservation; while 19.78 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

Similar to the flow scenarios for the MPWSP, Variant flow scenarios were selected to cover the complete range of potential future discharge compositions. These scenarios encompass periods when the AWPF is offline, and/or the desalination plant is offline. They also cover short-term operations with higher Desal Brine discharges when the desalination plant is catching up on production after periods of being offline. All these potential operating conditions were considered with varying amounts of secondary effluent flow, as it is possible that any of these conditions may be experienced during future operations.

Table 3 – Modeled flow scenarios for the Variant

Flow Scenario No.	Discharge Flows (mgd)			
	Secondary Effluent [a]	Desal Brine	GWR Concentrate	Hauled Waste [b]
Variant with AWPF Offline				
15	0	8.99	0	0
16	2	8.99	0	0
17	4	8.99	0	0
18	5.8	8.99	0	0
19	14	8.99	0	0
20	19.78	8.99	0	0
Variant with Desalination Plant Offline				
21	0	0	1.17	0
22	0.4	0	1.17	0
23	0.8	0	1.17	0
24	3	0	1.17	0
25	5	0	1.17	0
26	7	0	1.17	0
27	9	0	1.17	0
28	21	0	1.17	0
29	23.4	0	1.17	0
Variant with Normal Flows				
30	0	8.99	1.17	0
31	2	8.99	1.17	0
32	4	8.99	1.17	0
33	6	8.99	1.17	0
34	11	8.99	1.17	0
35	15.92	8.99	1.17	0
Variant with High Desal Brine Flows and AWPF Offline				
36	0	11.24	0	0
37	3	11.24	0	0
38	5	11.24	0	0
39	9	11.24	0	0
40	12	11.24	0	0
41	16	11.24	0	0
Variant with High Desal Brine Flows				
42	0	11.24	1.17	0
43	1	11.24	1.17	0
44	4	11.24	1.17	0
45	9	11.24	1.17	0
46	12	11.24	1.17	0
47	16	11.24	1.17	0

[a] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 24.7 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.
[b] A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded from the D_m calculation.

3.2.2 Ocean Modeling Assumptions

Dr. Roberts documented the modeling assumptions and results in a TM (Roberts, P. J. W., 2017, Appendix D). Changes incorporated into this modeling work compared to the work produced in 2016 included (a) modification to the outfall end gate to include one 6-inch Tideflex valve instead of an open end, (b) analysis of all worst-case ocean conditions, and (c) additional flow scenarios incorporating higher brine discharge flows. The modeling assumptions were specific to ambient ocean conditions: Davidson (November to March), Upwelling (April to August), and Oceanic (September to October).[17] In order to conservatively demonstrate Ocean Plan compliance, the lowest D_m from the applicable ocean conditions was used for each flow scenario. For all scenarios, the ocean modeling was performed assuming all 129 operational diffuser ports were open.

Three methods were used when modeling the ocean mixing: (1) the Cederwall formula (for neutral and negatively buoyant plumes only), (2) the mathematical model UM_3 in the United States Environmental Protection Agency's (EPA's) Visual Plume suite, and (3) the NRFIELD model (for positively buoyant plumes only), also from the EPA's Visual Plume suite (Roberts, P. J. W., 2017). When results were provided from both Cederwall and UM_3, the minimum estimated D_m value was used in this analysis; when results were provided from both UM_3 and NRFIELD, the D_m value estimated with the UM_3 model was selected for consistency, such that all dilution results for buoyant discharges used for this analysis were determined using the same model.

4 Ocean Plan Compliance Results

4.1 Water Quality of Combined Discharge

As described above, the first step in the Ocean Plan compliance analysis was to estimate the worst-case water quality for the future wastewater discharge components (*viz.*, Desal Brine, secondary effluent, hauled waste and GWR Concentrate). The estimated water quality for each type of discharge is provided in Table 4. Specific assumptions and data sources for each constituent are documented in the Table 4 footnotes.

Table 4 – Estimated worst-case water quality for the various discharge waters

Constituent	Units	Desal Brine	Secondary Effluent		Hauled Waste		GWR Concentrate	Footnotes
			MPWSP	*Variant*	*MPWSP*	*Variant*		
Ocean Plan water quality objectives for protection of marine aquatic life								
Arsenic	μg/L	17.2	45	45	45	45	12	2,6,16,21
Cadmium	μg/L	5.0	1	1.2	1	1.2	6.5	1,7,15,21
Chromium (Hexavalent)	μg/L	ND(<0.03)	ND(<2)	2.5	130	130	13	3,7,15,21

[17] Note that these ranges assign the transitional months to the ocean condition that is typically more restrictive at relevant discharge flows.

Constituent	Units	Desal Brine	Secondary Effluent MPWSP	Secondary Effluent Variant	Hauled Waste MPWSP	Hauled Waste Variant	GWR Concentrate	Footnotes
Copper	µg/L	0.5	11	11	39	39	58	1,7,15,21,28
Lead	µg/L	ND(<0.5)	0.11	2.69	0.76	2.69	14.2	1,7,15,21
Mercury	µg/L	0.414	0.019	0.085	0.044	0.085	0.510	1,10,16,21
Nickel	µg/L	11.0	5.2	12.2	5.2	12.2	64	1,7,15,21
Selenium	µg/L	8.4	4	6.4	75	75	34	1,7,15,21
Silver	µg/L	0.50	0.14	0.77	0.14	0.77	4.05	1,10,15,21
Zinc	µg/L	9.5	20	57.5	170	170	303	1,7,15,21
Cyanide	µg/L	ND(<8.6)	81	89.7	81	89.7	143	1,7,16,17,21
Total Chlorine Residual	µg/L	--	ND(<200)	ND(<200)	ND(<200)	ND(<200)	ND(<200)	5
Ammonia (as N) 6-mo median	µg/L	143.1	42,900	42,900	42,900	42,900	225,789	1,6,15,21,27
Ammonia (as N) daily max	µg/L	143.1	49,000	49,000	49,000	49,000	257,895	1,6,15,21,27
Acute Toxicity	TUa	--	2.3	2.3	2.3	2.3	0.77	1,12,16,17,24
Chronic Toxicity	TUc	--	40	40	80	40	100	1,12,16,17,24
Phenolic Compounds (non-chlorinated)	µg/L	ND(<86.2)	69	69	69	69	363	1,6,14,15,23,2526
Chlorinated Phenolics	µg/L	ND(<34.5)	ND(<20)	ND(<20)	ND(<20)	ND(<20)	ND(<20)	3,9,18,23,25,26
Endosulfan	µg/L	ND(<3.4E-6)	0.015	0.046	0.015	0.046	0.24	1,10,14,15,22,25
Endrin	µg/L	ND(<1.6E-6)	0.000112	0.000112	0.000112	0.000112	0.00059	4,8,15,22
HCH (Hexachlorocyclohexane)	µg/L	0.000043	0.036	0.059	0.036	0.059	0.312	1,10,14,15,22, 25
Radioactivity (Gross Beta)	pCi/L	ND(<5.17)	32	32	307	307	34.8	1,6,12,16,17,23
Radioactivity (Gross Alpha)	pCi/L	22.4	18	18	457	457	14.4	1,6,12,16,17,23
Objectives for protection of human health - noncarcinogens								
Acrolein	µg/L	ND(<3.4)	ND(<5)	8.3	ND(<5)	8.3	44	3,7,15,23
Antimony	µg/L	0.21	0.65	0.78	0.65	0.78	4.1	1,7,15,21
Bis (2-chloroethoxy) methane	µg/L	ND(<16.7)	ND(<0.5)	ND(<4.0)	ND(<0.5)	ND(<4.0)	ND(<1)	3,9,18,23
Bis (2-chloroisopropyl) ether	µg/L	ND(<16.7)	ND(<0.5)	ND(<4.0)	ND(<0.5)	ND(<4.0)	ND(<1)	3,9,18,23
Chlorobenzene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Chromium (III)	µg/L	17	3.0	6.9	87	87	36	2,7,15,21
Di-n-butyl phthalate	µg/L	ND(<16.7)	ND(<5)	ND(<7)	ND(<5)	ND(<7)	ND(<1)	3,9,18,23
Dichlorobenzenes	µg/L	ND(<0.9)	1.6	1.6	1.6	1.6	8.4	1,10,15,21
Diethyl phthalate	µg/L	ND(<0.9)	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<1)	3,9,18,23
Dimethyl phthalate	µg/L	ND(<0.9)	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.5)	3,9,18,23
4,6-dinitro-2-methylphenol	µg/L	ND(<84.5)	ND(<0.5)	ND(<19)	ND(<0.5)	ND(<19)	ND(<5)	3,9,18,23
2,4-dinitrophenol	µg/L	ND(<86.2)	ND(<0.5)	ND(<9)	ND(<0.5)	ND(<9)	ND(<5)	3,9,18,23
Ethylbenzene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Fluoranthene	µg/L	ND(<0.2)	0.00684	0.00684	0.00684	0.00684	0.0360	4,8,15,23
Hexachlorocyclopentadiene	µg/L	ND(<0.09)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.05)	3,9,18,23
Nitrobenzene	µg/L	ND(<41.4)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<1)	3,9,18,23
Thallium	µg/L	ND(<0.1)	ND(<0.5)	0.68	ND(<0.5)	0.68	3.6	3,7,15,21
Toluene	µg/L	ND(<0.9)	0.47	0.48	0.47	0.48	2.5	1,10,15,21
Tributyltin	µg/L	ND(<0.08)	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.02)	3,13,18,23
1,1,1-trichloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Objectives for protection of human health - carcinogens								
Acrylonitrile	µg/L	ND(<3.4)	ND(<2)	2.5	ND(<2)	2.5	13	3,7,15,23
Aldrin	µg/L	ND(<6.7E-5)	ND(<0.005)	ND(<0.007)	ND(<0.005)	ND(<0.007)	ND(<0.01)	3,9,18,23
Benzene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Benzidine	µg/L	ND(<86.2)	ND(<0.5)	ND(<18.6)	ND(<0.5)	ND(<18.6)	ND(<0.05)	3,9,18,23
Beryllium	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.68)	0.0052	0.0052	ND(<0.5)	3,9,17,18,21
Bis(2-chloroethyl)ether	µg/L	ND(<41.4)	ND(<0.5)	ND(<4.0)	ND(<0.5)	ND(<4.0)	ND(<1)	3,9,18,23
Bis(2-ethyl-hexyl)phthalate	µg/L	ND(<1.0)	78	78	78	78	411	2,6,15,23
Carbon tetrachloride	µg/L	ND(<0.9)	ND(<0.5)	0.50	ND(<0.5)	0.50	2.66	3,7,15,21
Chlordane	µg/L	1.45E-5	0.00122	0.00122	0.00122	0.00122	0.0064	4,8,14,15,22,25
Chlorodibromomethane	µg/L	ND(<0.9)	ND(<0.5)	2.2	ND(<0.5)	2.2	12	3,7,15,21
Chloroform	µg/L	ND(<0.9)	2	34	2	34	180	2,7,15,21
DDT	µg/L	1.7E-6	0.001	0.001	0.001	0.001	0.0003	4,7,14,19,22,25
1,4-dichlorobenzene	µg/L	ND(<0.9)	1.6	1.6	1.6	1.6	8.4	1,6,15,21
3,3-dichlorobenzidine	µg/L	ND(<86)	ND(<0.03)	ND(<18)	ND(<0.03)	ND(<18)	ND(<2)	3,9,18,23
1,2-dichloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1-dichloroethylene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	0.5	0.5	ND(<0.5)	3,9,18,21
Dichlorobromomethane	µg/L	ND(<0.9)	ND(<0.5)	2.4	ND(<0.5)	2.4	12	3,7,15,21
Dichloromethane	µg/L	ND(<0.9)	0.88	0.88	0.88	0.88	4.6	1,7,15,21
1,3-dichloropropene	µg/L	ND(<0.9)	ND(<0.5)	0.56	ND(<0.5)	0.56	3.0	3,7,15,21

Constituent	Units	Desal Brine	Secondary Effluent		Hauled Waste		GWR Concentrate	Footnotes
			MPWSP	*Variant*	*MPWSP*	*Variant*		
Dieldrin	µg/L	4.7E-5	0.0007	0.0015	0.0007	0.0015	0.0001	4,7,19,22
2,4-dinitrotoluene	µg/L	ND(<0.2)	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.1)	3,9,18,23
1,2-diphenylhydrazine	µg/L	ND(<16.7)	ND(<0.5)	ND(<4)	ND(<0.5)	ND(<4)	ND(<1)	3,9,18,23
Halomethanes	µg/L	ND(<0.9)	0.54	1.3	0.73	1.3	6.9	2,7,14,15,21
Heptachlor	µg/L	ND(<6.9E-7)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	2,9,18,22
Heptachlor epoxide	µg/L	ND(<1.6E-6)	0.000088	0.000088	0.000088	0.000088	0.000463	4,8,15,22
Hexachlorobenzene	µg/L	ND (<6.5E-5)	0.000078	0.000078	0.000078	0.000078	0.000411	4,8,15,22
Hexachlorobutadiene	µg/L	ND(<3.4E-7)	0.000009	0.000009	0.000009	0.000009	0.000047	4,8,15,22
Hexachloroethane	µg/L	ND(<16.7)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<0.5)	3,9,18,23
Isophorone	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,23
N-Nitrosodimethylamine	µg/L	ND(<0.003)	0.017	0.086	0.017	0.086	0.150	2,7,16,17,23
N-Nitrosodi-N-Propylamine	µg/L	ND(<0.003)	0.076	0.076	0.076	0.076	0.019	2,6,16,17,23
N-Nitrosodiphenylamine	µg/L	ND(<16.7)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<1)	3,9,18,23
PAHs	µg/L	2.2E-3	0.04	0.04	0.04	0.04	0.21	4,7,14,15,22,25
PCBs	µg/L	0.00013	0.00068	0.00068	0.00068	0.00068	0.00357	4,8,14,15,22,25
TCDD Equivalents	µg/L	ND (<2.5E-5)	1.37E-7	1.39E-7	1.37E-7	1.39E-7	7.29E-7	4,7,13,14,15,23, 25
1,1,2,2-tetrachloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Tetrachloroethylene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Toxaphene	µg/L	3.97E-5	0.0071	0.0071	0.0071	0.0071	0.0373	4,8,15,22
Trichloroethylene	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1,2-trichloroethane	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
2,4,6-trichlorophenol	µg/L	ND(<16.7)	ND(<0.5)	ND(<2.1)	ND(<0.5)	ND(<2.1)	ND(<1)	3,9,18,23
Vinyl chloride	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21

Table 4 Footnotes:

MPWSP Secondary Effluent and Hauled Waste

[1] The value reported is based on MRWPCA historical data.

[2] The value reported is based on secondary effluent data collected during the GWR Project source water monitoring programs (not impacted by the proposed new source waters), and are representative of future water quality under the MPWSP scenario.

[3] The MRL provided represents the Maximum Reported Value in Table F-3 of MRWPCA's current NPDES permit. There are two exceptions to this statement: (1) the maximum reported value for hexavalent chromium was disregarded as it was the concentration measured in the hauled waste, not the secondary effluent (2) chlorinated phenolics was not included in Table F-3, and so the MRL provided is the reported value from MRWPCA's priority pollutant monitoring.

Total Chlorine Residual

[5] For all waters, it is assumed that dechlorination will be provided such that the total chlorine residual will be below detection.

Variant Secondary Effluent and Hauled Waste

[6] Existing RTP effluent exceeds concentrations observed in other proposed source waters; the value reported is the existing secondary effluent value.

[7] The proposed new source waters may increase the secondary effluent concentration; the value reported is based on estimated source water blends.

[8] RTP effluent value is based on CCLEAN data; no other source waters were considered due to MRL differences.

[9] MRL provided represents the maximum flow-weighted MRL based on the blend of source waters.

[10] The only water with a detected concentration was the RTP effluent, however the flow-weighted concentration increases due to higher MRLs for the proposed new source waters.

[11] Additional source water data are not available; the reported value is for RTP effluent.

[12] Calculation of the flow-weighted concentration was not feasible due to constituent. The maximum observed value is reported.

[13] Agricultural Wash Water data are based on an aerated sample, instead of a raw water sample.

[14] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.

GWR Concentrate Data
[15] The value presented represents a calculated value assuming no removal prior to RO, complete rejection through RO membrane, and an 81% RO recovery.
[16] The value represents the maximum value observed during the pilot testing study.
[17] The calculated value for the AWPF data (described in note 15) was not used in the analysis because it was not considered representative. It is expected that the value would increase as a result of treatment through the AWPF (*e.g.* formation of N-Nitrosodimethylamine as a disinfection by-product), or that it will not concentrate linearly through the RO (*e.g.* toxicity and radioactivity).
[18] The MRL provided represents the limit from the source water and pilot testing monitoring programs.
[19] The value presented represents a calculated value assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, 36% and 44% removal through ozone for DDT and dieldrin, respectively, 92% and 97% removal through MF for DDT and dieldrin, respectively, recycling of the MF backwash to the RTP, complete rejection through the RO membrane, and an 81% RO recovery. The assumed removals are based on results from ozone bench-scale testing of Blanco Drain water blended with secondary effluent and low detection sampling through the RTP.
[20] Footnote not used

Desal Brine Data
[21] The value reported is based on test slant well data collected through the Watershed Sanitary Survey.
[22] The value reported is based on data from the one-time 7-day composite sample from the test slant well. If ND, the method detection limit was used for the analysis instead of the MRL. MRLs were not available for this data set.
[23] The value reported is based on data from the test slant well collected through the quarterly Ocean Plan constituents monitoring.
[24] Acute and chronic toxicity have not been measured or estimated
[25] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.
[26] Chlorinated phenolic compounds is the sum of the following: 4-chloro-3-methylphenol, 2-chlorophenol, pentachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol. Non-chlorinated phenolic compounds is the sum of the following: 2,4-dimethylphenol, 4,6-Dinitro-2-methylphenol, 2,4-dinitrophenol, 2-methylphenol, 4-methylphenol, 2-nitrophenol, 4-nitrophenol, and phenol.

General
[27] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[28] The value reported for the Variant secondary effluent was calculated using the median of the data collected for the new source waters and is an estimate of the potential increase in concentration of the secondary effluent based on estimated source water blends. The value reported for the Desal Brine was calculated with the median of the data collected from the test slant well and assuming a 42% recovery through the RO. The median values were used because the maximum values detected in both sources appear to be outliers, and because the Ocean Plan objective is a 6-month median concentration, it is reasonable to use the median value detected from these source waters.

4.2 Ocean Modeling Results

The resulting estimates of minimum probable dilution (D_m) for each discharge scenario are presented in Tables 5 and 6 (Roberts, P. J. W., 2017). For discharge scenarios that were modeled with more than one modeling method, the lowest D_m (*i.e.*, most conservative) is reported in the tables below. For the MPWSP, the flow scenarios in which little or no secondary effluent was discharged (Scenarios 1, 2, 8, and 9) resulted in the lowest D_m values as a result of the discharge plume being negatively buoyant. At higher secondary effluent flows, the discharge plume would be positively buoyant, resulting in an increased D_m, as evidenced in Scenarios 7 and 14. The same trend was observed for Variant scenarios.

The estimates of minimum probable dilution (D_m) for the MPWSP range from 14.4 to 98, and 14.4 to 114 for the Variant. These D_m values are substantially lower than what is currently specified in the MRWPCA NPDES permit (145) and those estimated for the GWR Project, which range from 174 to 498 (see Appendix B). As a result of the reduced dilution, some contaminants, which have not traditionally been of concern for discharge through MRWPCA's ocean outfall, are estimated to potentially exceed the Ocean Plan objectives at the edge of the ZID.

Table 5 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for MPWSP

Flow Scenario No.	Ocean Condition	Discharge flows (mgd)			D_m [b]
		Secondary Effluent [a]	Desal Brine	Hauled Waste	
MPWSP with Normal Desal Brine Flow					
1	Davidson	0	13.98	0.1	14.4
2	Davidson	2	13.98	0.1	15.8
3	Davidson	4	13.98	0.1	17.8
4	Davidson	6	13.98	0.1	20.9
5	Davidson	9	13.98	0.1	26.7
6	Upwelling	10	13.98	0.1	38.2
7	Upwelling	19.78	13.98	0.1	98
MPWSP with High Desal Brine Flow					
8	Davidson	0	16.31	0.1	14.5
9	Davidson	2	16.31	0.1	15.7
10	Davidson	7	16.31	0.1	21.8
11	Davidson	8	16.31	0.1	23.5
12	Davidson	10	16.31	0.1	29.2
13	Davidson	12	16.31	0.1	43.9
14	Oceanic	16	16.31	0.1	87

[a] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.
[b] Several models were used to estimate the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. The Ocean Plan defines dilution differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S - 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

Table 6 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for Variant

Flow Scenario No.	Ocean Condition	Discharge flows (mgd)				D_m [c]
		Secondary Effluent [a]	Desal Brine	GWR Concentrate	Hauled Waste [b]	
Variant with AWPF Offline						
15	Davidson	0	8.99	0	0	15.7
16	Davidson	2	8.99	0	0	16.4
17	Davidson	4	8.99	0	0	19.9
18	Davidson	5.8	8.99	0	0	28.4
19	Upwelling	14	8.99	0	0	109.0
20	Upwelling	19.78	8.99	0	0	117.0
Variant with Normal Flows						
30	Davidson	0	8.99	1.17	0	15.5
31	Davidson	2	8.99	1.17	0	17.7
32	Davidson	4	8.99	1.17	0	23.8
33	Davidson	6	8.99	1.17	0	67.5
34	Upwelling	11	8.99	1.17	0	106.0
35	Upwelling	15.92	8.99	1.17	0	114.0
Variant with High Desal Brine Flows and AWPF Offline						
36	Davidson	0	11.24	0	0	14.4
37	Davidson	3	11.24	0	0	17.1
38	Davidson	5	11.24	0	0	20.5
39	Upwelling	9	11.24	0	0	90.0
40	Oceanic	12	11.24	0	0	94.0
41	Upwelling	16	11.24	0	0	102.0
Variant with High Desal Brine Flows						
42	Davidson	0	11.24	1.17	0	15.2
43	Davidson	1	11.24	1.17	0	16.0
44	Davidson	4	11.24	1.17	0	20.8
45	Upwelling	9	11.24	1.17	0	90.0
46	Upwelling	12	11.24	1.17	0	97.0
47	Upwelling	16	11.24	1.17	0	104

[a] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.
[b] Hauled waste was not included in the modeling of MPWSP flow scenarios; however, the change in both flow and TDS from the addition of hauled waste is less than 1% and thus is expected to have a negligible impact on the modeled D_m.
[c] Several models were used to estimate the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. The Ocean Plan defines dilution differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S – 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

4.3 Ocean Plan Compliance Results

The flow-weighted in-pipe concentration for each constituent was calculated for each modeled discharge scenario using the water quality presented in Table 4 and the discharge flows presented in Tables 2 and 3. The in-pipe concentration was then used to calculate the concentration at the edge of the ZID using the D_m values presented in Tables 5 and 6. The resulting concentrations for each constituent in each scenario were compared to the Ocean Plan objectives to assess compliance. The estimated concentrations for the 47 flow scenarios (14 for the MPWSP and 33 for the Variant) for all constituents are presented as concentrations at the edge of the ZID (Appendix A, Table A1 and A3) and as a percentage of the Ocean Plan objective (Appendix A, Table A2 and A4).

Some constituents were estimated to potentially exceed or come close to exceeding the Ocean Plan water quality objectives for the MPWSP and Variant; however, some of these constituents were never detected above the MRL in any of the source waters, but the MRLs are higher than the Ocean Plan objective. Due to this insufficient analytical sensitivity, no compliance conclusion can be drawn for these constituents. This is a common occurrence for ocean discharges since the MRL of the approved compliance analysis method is higher than the Ocean Plan objective for certain constituents.

Of the constituents detected in the source waters, two (cyanide and ammonia) were identified as having potential to exceed the Ocean Plan objective in the MPWSP, and eight (cyanide, ammonia, acrylonitrile, beryllium, chlordane, PCBs, TCDD equivalents, and toxaphene) were identified as having potential to exceed the Ocean Plan objective in the Variant. Within this Variant subset of eight constituents, acrylonitrile, beryllium and TCDD equivalents were detected in some of the source waters, but not in the others. For these analyses, the MRLs themselves were above the Ocean Plan objective. To assess the blended concentrations for these constituents, a value of zero was assumed for any sources when the concentration was below the MRL.[18] This approach is a "best-case" scenario because it assumes the lowest possible concentration—namely, a value of zero—for any constituent below the reporting limit. This approach is still useful, however, to bracket the analysis and assess the potential for Ocean Plan compliance issues under best-case conditions. Through this method, TCDD equivalents continues to show potential to exceed the Ocean Plan objective for the Variant. The estimated concentration of acrylonitrile[19] and beryllium at the edge of the ZID is less than the Ocean Plan objective and therefore did not show exceedances through this "best-case" analysis. However, because this is only a partial analysis (a special case), it is not possible to draw conclusions on whether acrylonitrile and beryllium will comply with the Ocean Plan during actual conditions.

The constituents that may exceed the Ocean Plan objective, or come close to exceeding the objective, are shown at their estimated concentration at the edge of the ZID in Table 7 for the MPWSP and Table 8 for the Variant, and as the concentration at the edge of the ZID as a

[18] Additionally, the Ocean Plan states that for constituents that are made up of an aggregate of constituents, a concentration of 0 can be assumed for the individual constituents that are not detected above the MRL, such as TCDD equivalents.

[19] Acrylonitrile was only detected in one potential source water for the Variant. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant.

percentage of the Ocean Plan objective in Table 9 and 10 for the MPWSP and Variant, respectively. The "best-case" scenario compliance assessment results for acrylonitrile and TCDD equivalents are also included in these tables.

Table 7 – Estimated concentrations at the edge of the ZID for Ocean Plan constituents of concern in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Cyanide	µg/L	1	0.6	1.1	1.3	1.4	1.3	1.0	0.5	0.6	1.0	1.3	1.3	1.2	0.9	0.5
Ammonia (as N) – 6-mo median [b]	µg/L	600	29	341	523	600	614	461	255	26	301	575	585	546	409	243
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																
Acrylonitrile [c d]	µg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	4	0.1	0.7	1.0	1.1	1.1	0.8	0.5	0.1	0.6	1.1	1.1	1.0	0.8	0.4
Chlordane	µg/L	2.3E-05	1.5E-06	1.0E-05	1.5E-05	1.7E-05	1.8E-05	1.3E-05	7.3E-06	1.4E-06	9.1E-06	1.7E-05	1.7E-05	1.6E-05	1.2E-05	6.9E-06
PCBs	µg/L	1.9E-05	8.9E-06	1.2E-05	1.4E-05	1.4E-05	1.3E-05	9.2E-06	4.6E-06	8.8E-06	1.2E-05	1.3E-05	1.3E-05	1.1E-05	8.1E-06	4.6E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6.3E-11	1.1E-09	1.7E-09	1.9E-09	1.9E-09	1.5E-09	8.1E-10	5.4E-11	9.4E-10	1.8E-09	1.9E-09	1.7E-09	1.3E-09	7.7E-10
Toxaphene [e]	µg/L	2.1E-04	5.8E-06	5.7E-05	8.7E-05	1.0E-04	1.0E-04	7.6E-05	4.2E-05	5.3E-06	5.1E-05	9.6E-05	9.7E-05	9.1E-05	6.8E-05	4.0E-05

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 8 – Estimated concentrations at the edge of the ZID for Ocean Plan constituents of concern in the Variant [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Cyanide	µg/L	1	0.6	1.4	1.6	1.4	0.5	0.5	1.5	1.9	1.7	0.7	0.5	0.6	0.6	1.4	1.6	0.5	0.5	0.5	1.3	1.6	1.8	0.6	0.6	0.6
Ammonia (as N) – 6-mo median [b]	µg/L	600	39	474	648	581	239	251	1593	1551	1248	473	326	316	34	519	627	212	235	246	1333	1363	1227	335	327	320
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c d]	µg/L	0.1	0.002	0.03	0.04	0.03	0.01	0.01	0.1	0.1	0.1	0.03	0.02	0.02	0.001	0.03	0.04	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
Bis(2-ethyl-hexyl)phthalate	µg/L	4	0.1	0.9	1.2	1.1	0.4	0.5	2.9	2.9	2.3	0.9	0.6	0.6	0.1	1.0	1.2	0.4	0.4	0.5	2.5	2.5	2.3	0.6	0.6	0.6
Chlordane	µg/L	2.3E-05	2E-06	1E-05	2E-05	2E-05	7E-06	7E-06	5E-05	4E-05	4E-05	1E-05	9E-06	9E-06	2E-06	2E-05	2E-05	6E-06	7E-06	7E-06	4E-05	4E-05	4E-05	1E-05	9E-06	9E-06
PCBs	µg/L	1.9E-05	9E-06	1E-05	1E-05	1E-05	4E-06	4E-06	3E-05	3E-05	2E-05	9E-06	6E-06	5E-06	9E-06	1E-05	1E-05	4E-06	4E-06	4E-06	3E-05	3E-05	2E-05	6E-06	6E-06	6E-06
TCDD Equivalents [d]	µg/L	3.9E-09	1E-10	2E-09	2E-09	2E-09	8E-10	8E-10	5E-09	5E-09	4E-09	2E-09	1E-09	1E-09	8E-11	2E-09	2E-09	7E-10	8E-10	8E-10	4E-09	4E-09	4E-09	1E-09	1E-09	1E-09
Toxaphene [e]	µg/L	2.1E-04	7E-06	8E-05	1E-04	1E-04	4E-05	4E-05	3E-04	3E-04	2E-04	8E-05	5E-05	5E-05	7E-06	9E-05	1E-04	4E-05	4E-05	4E-05	2E-04	2E-04	2E-04	6E-05	5E-05	5E-05

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 9 – Estimated concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Cyanide	µg/L	1	59%	108%	133%	140%	134%	99%	52%	58%	101%	134%	133%	120%	88%	51%
Ammonia (as N) – 6-mo median [b]	µg/L	600	5%	57%	87%	100%	102%	77%	43%	4%	50%	96%	97%	91%	68%	40%
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																
Acrylonitrile [c d]	µg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	4	3%	19%	28%	32%	32%	24%	13%	3%	17%	31%	31%	29%	22%	13%
Chlordane	µg/L	2.3E-05	6%	44%	66%	75%	77%	57%	32%	6%	39%	72%	73%	68%	51%	30%
PCBs	µg/L	1.9E-05	47%	64%	72%	72%	66%	49%	24%	46%	61%	69%	67%	60%	43%	24%
TCDD Equivalents [d]	µg/L	3.9E-09	2%	27%	42%	49%	50%	38%	21%	1%	24%	47%	48%	44%	33%	20%
Toxaphene [e]	µg/L	2.1E-04	3%	27%	42%	47%	48%	36%	20%	3%	24%	45%	46%	43%	32%	19%

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 10 – Estimated concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the Variant [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Cyanide	µg/L	1	61%	138%	163%	139%	53%	55%	150%	189%	173%	71%	55%	56%	61%	144%	158%	49%	53%	55%	135%	158%	176%	55%	56%	57%
Ammonia (as N) – 6-mo median [b]	µg/L	600	7%	79%	108%	97%	40%	42%	266%	258%	208%	79%	54%	53%	6%	86%	105%	35%	39%	41%	222%	227%	205%	56%	54%	53%
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c d]	µg/L	0.1	2%	28%	38%	34%	14%	14%	94%	92%	74%	28%	19%	19%	1%	30%	37%	13%	14%	15%	79%	81%	73%	20%	19%	19%
Bis(2-ethyl-hexyl)phthalate	µg/L	4	3%	26%	34%	31%	12%	13%	84%	81%	65%	25%	17%	17%	3%	28%	33%	11%	12%	13%	70%	72%	64%	18%	17%	17%
Chlordane	µg/L	2.3E-05	8%	60%	81%	72%	30%	31%	199%	193%	155%	59%	40%	39%	7%	66%	79%	26%	29%	30%	167%	170%	153%	42%	40%	40%
PCBs	µg/L	1.9E-05	47%	71%	77%	63%	22%	23%	169%	156%	121%	45%	30%	28%	47%	73%	74%	22%	23%	23%	149%	147%	124%	32%	30%	29%
TCDD Equivalents [d]	µg/L	3.9E-09	2%	39%	53%	48%	20%	21%	131%	128%	103%	39%	27%	26%	2%	42%	52%	17%	19%	20%	110%	112%	101%	28%	27%	26%
Toxaphene [e]	µg/L	2.1E-04	4%	38%	51%	46%	19%	20%	126%	122%	98%	37%	26%	25%	3%	41%	50%	17%	19%	19%	105%	108%	97%	26%	26%	25%

a: Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, beryllium did not exceed the Ocean Plan objective and therefore was not included in Tables 7 through 10.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Potential issues for cyanide and ammonia compliance were identified to occur when there is no, or relatively low secondary effluent flow mixed with hauled waste and Desal Brine, as in MPWSP Scenarios 2-6 and 9-13. Potential issues were also identified to occur when there is little or no secondary effluent flow discharged for the Variant Project, as in Variant Scenarios 16-18, 30-32, 37, 38, and 42-44. The constituents of interest related to these scenarios are cyanide, ammonia, acrylonitrile, bis(2-ethyl-hexyl)phthalate, chlordane, PCBs, TCDD equivalents, and toxaphene. Ammonia is expected to be the constituent with the highest exceedance, being 2.66 times the Ocean Plan objective in flow scenario 30 (0 mgd secondary effluent with hauled waste, 1.17 mgd GWR Concentrate and 8.99 mgd Desal Brine). This scenario is problematic because constituents that have relatively high loadings in the secondary effluent are concentrated in the GWR Concentrate. This scenario assumes the GWR Concentrate flow is much smaller than the Desal Brine flow, such that the resulting discharge plume is negatively buoyant and achieves poor ocean dilution.

Chlordane, PCBs, and toxaphene were only detected when analyzed with low-detection methods, which have far greater sensitivity than standard methods. These results were used to investigate potential to exceed Ocean Plan objectives because these objectives are orders of magnitude below detection limits of methods currently used for discharge compliance.

5 Conclusions

The purpose of this analysis was to assess the ability of the MPWSP and Variant to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the secondary effluent, GWR Concentrate, Desal Brine and hauled waste for these projects. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and scenario. A summary of the constituents that show potential to exceed the Ocean Plan objectives is provided in Table 11 for the MPWSP and Table 12 for the Variant. These constituents can be divided into three categories:

- **Category I -** Insufficient analytical sensitivity to determine compliance: The constituent was not detected above the MRL in any of the source waters, but the MRL is not sensitive enough to demonstrate compliance with the Ocean Plan objective.
- **Category II -** Estimated to be close to exceeding the Ocean Plan objective: The constituent is estimated to be at a concentration between 80% and 100% of the Ocean Plan objective at the edge of the ZID.
- **Category III -** Estimated to exceed the Ocean Plan objective: The constituent is estimated to be at a concentration higher than the Ocean Plan objective at the edge of the ZID.

Table 11: Summary of Compliance Conclusions for the MPWSP

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	4	140%
Ammonia			✓	5	102%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]	✓			--	--
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
TCDD Equivalents [e]	✓			--	--
2,4,6-Trichlorophenol	✓			--	--

Notes:
a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.
b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios
c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID
d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification
e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective

Table 12: Summary of Compliance Conclusions for the Variant

	Category I [a]	Category II [b]	Category III [c]	Worst Case Exceedance	
Constituent	Compliance Determination Not Possible	Estimated to be Close to Exceeding Objective	Estimated to Exceed Objective	Flow Scenario	Estimated Percentage of Objective at edge of ZID
Cyanide [d]			✓	31	189%
Ammonia			✓	30	266%
Chlorinated Phenolics	✓			--	--
2,4-Dinitrophenol	✓			--	--
Tributyltin	✓			--	--
Acrylonitrile [e]		✓		30	94%
Aldrin	✓			--	--
Benzidine	✓			--	--
Beryllium [e]	✓			--	--
Bis(2-chloroethyl)ether	✓			--	--
Bis(2-ethyl-hexyl)phthalate		✓		30	84%
Chlordane			✓	30	199%
3,3-Dichlorobenzidine	✓			--	--
1,2-Diphenylhydrazine (azobenzene)	✓			--	--
Heptachlor	✓			--	--
PCBs			✓	30	169%
TCDD Equivalents [e]			✓	30	131%
Toxaphene			✓	30	126%
2,4,6-Trichlorophenol	✓			--	--

Notes:
a: ND in all sources, but MRL higher than Ocean Plan objective and therefore unable to demonstrate compliance. Exceptions are: MRL for 2,4-dinitrophenol was less than objective in secondary effluent and MRL for heptachlor was less than objective in slant well.
b: Concentration of constituent at the edge of the ZID is estimated to be between 80% and 100% of the Ocean Plan objective for some scenarios
c: Concentration of constituent is estimated to be > 100% of the Ocean Plan objective for some scenarios at the edge of the ZID
d: Issues with approved analytical methods may have resulted in erroneously high cyanide quantification
e: Only a best-case scenario could be evaluated, where a value of 0 was assumed when the constituent was ND and the MRL was larger than the Ocean Plan objective

Based on the data, assumptions, modeling, and analytical methodology presented in this TM, the MPWSP and Variant show a potential to exceed certain Ocean Plan objectives under specific discharge scenarios (see Tables 11 and 12). In particular, potential issues were identified for the MPWSP and Variant flow scenarios involving low to moderate secondary effluent flows with Desal Brine. Under these conditions, discharges are estimated to exceed or come close to exceeding multiple Ocean Plan objectives, specifically those for cyanide and ammonia for the MPWSP, and cyanide, ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene for the

Variant. Ammonia clearly exceeds the Ocean Plan objective and must be resolved for the MPWSP and Variant. When considering a best-case analysis for the Variant, acrylonitrile comes close to exceeding the Ocean Plan objective, and TCDD equivalents show a potential to exceed the objective. Additional analytical investigation regarding cyanide analysis is recommended to determine if the potential exceedances are representative of actual water quality conditions. Chlordane, PCBs and toxaphene, which were estimated to exceed the objectives for Variant flow scenarios, were detected at concentrations that are orders of magnitude below detection limits of methods currently used for discharge compliance.

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Appendix A

Table A1 – Complete list of estimated concentrations of Ocean Plan constituents at the edge of the ZID for the MPWSP

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Arsenic	µg/L	8	3.9	4.1	4.1	4.0	3.9	3.7	3.3	3.9	4.0	4.0	4.0	3.8	3.6	3.3
Cadmium	µg/L	1	0.3	0.3	0.2	0.2	0.1	0.1	0.03	0.3	0.3	0.2	0.1	0.1	0.1	0.03
Chromium (Hexavalent)	µg/L	2	0.06	0.06	0.06	0.06	0.05	0.04	0.02	0.05	0.06	0.05	0.05	0.04	0.03	0.02
Copper	µg/L	3	1.9	2.0	2.1	2.1	2.1	2.1	2.0	1.9	2.0	2.1	2.1	2.1	2.1	2.0
Lead	µg/L	2	0.03	0.03	0.02	0.02	0.01	0.01	0.003	0.03	0.03	0.02	0.02	0.01	0.01	0.004
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.002	0.03	0.02	0.01	0.01	0.01	0.01	0.003
Nickel	µg/L	5	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.7	0.6	0.4	0.4	0.3	0.2	0.1
Selenium	µg/L	15	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0.6	0.5	0.3	0.3	0.2	0.2	0.1
Silver	µg/L	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Zinc	µg/L	20	8.2	8.2	8.2	8.2	8.2	8.2	8.1	8.2	8.2	8.2	8.2	8.2	8.1	8.1
Cyanide	µg/L	1	0.6	1.1	1.3	1.4	1.3	1.0	0.5	0.6	1.0	1.3	1.3	1.2	0.9	0.5
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	29	341	523	600	614	461	255	26	301	575	585	546	409	243
Ammonia (as N) - Daily Max	µg/L	2,400	32	388	597	684	701	526	291	28	342	656	668	623	467	277
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	5.6	5.0	4.4	3.7	2.9	2.0	0.8	5.6	5.0	3.6	3.3	2.6	1.8	0.9
Chlorinated Phenolics [b]	µg/L	1	<2.2	<1.9	<1.7	<1.4	<1.0	<0.7	<0.3	<2.2	<2.0	<1.3	<1.2	<1.0	<0.6	<0.3
Endosulfan	µg/L	0.009	7E-06	1E-04	2E-04	2E-04	2E-04	2E-04	9E-05	6E-06	1E-04	2E-04	2E-04	2E-04	1E-04	8E-05
Endrin	µg/L	0.002	2E-07	1E-06	1E-06	2E-06	2E-06	1E-06	7E-07	1E-07	8E-07	2E-06	2E-06	1E-06	1E-06	6E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	2E-05	3E-04	4E-04	5E-04	5E-04	4E-04	2E-04	2E-05	2E-04	5E-04	5E-04	5E-04	3E-04	2E-04
Radioactivity (Gross Beta) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Objectives for protection of human health – non carcinogens – 30-day average limit																
Acrolein	µg/L	220	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.04	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.05
Antimony	µg/L	1200	0.01	0.02	0.02	0.02	0.01	0.01	0.005	0.01	0.02	0.01	0.01	0.01	0.01	0.005
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Chlorobenzene	µg/L	570	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Chromium (III)	µg/L	190000	1.2	0.9	0.8	0.6	0.4	0.3	0.1	1.1	1.0	0.6	0.5	0.4	0.3	0.1
Di-n-butyl phthalate	µg/L	3500	<1.1	<0.9	<0.7	<0.6	<0.4	<0.3	<0.1	<1.1	<0.9	<0.6	<0.5	<0.4	<0.3	<0.1
Dichlorobenzenes	µg/L	5100	0.1	0.1	0.1	0.05	0.04	0.03	0.01	0.1	0.1	0.05	0.05	0.04	0.03	0.01
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.03	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.03
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.1	<0.05	<0.03	<0.02	<0.1	<0.1	<0.1	<0.1	<0.04	<0.03	<0.02
4,6-dinitro-2-methylphenol	µg/L	220	<5.4	<4.4	<3.5	<2.7	<1.9	<1.3	<0.4	<5.4	<4.5	<2.6	<2.3	<1.7	<1.1	<0.5

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
2,4-Dinitrophenol [b]	µg/L	4.0	<5.6	<4.5	<3.6	<2.7	<1.9	<1.3	<0.4	<5.5	<4.6	<2.6	<2.4	<1.8	<1.1	<0.5
Ethylbenzene	µg/L	4100	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Fluoranthene	µg/L	15	0.01	0.01	0.01	0.01	0.004	0.003	0.001	0.01	0.01	0.01	0.005	0.004	0.002	0.001
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003
Nitrobenzene	µg/L	4.9	<2.7	<2.1	<1.7	<1.3	<0.9	<0.6	<0.2	<2.7	<2.2	<1.3	<1.1	<0.9	<0.5	<0.2
Thallium	µg/L	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003
Toluene	µg/L	85000	0.06	0.05	0.04	0.03	0.03	0.02	0.01	0.06	0.05	0.03	0.03	0.02	0.02	0.01
Tributyltin [b]	µg/L	0.0014	<0.005	<0.005	<0.004	<0.003	<0.003	<0.002	<0.001	<0.005	<0.005	<0.003	<0.003	<0.002	<0.002	<0.001
1,1,1-Trichloroethane	µg/L	540000	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																
Acrylonitrile [c d]	µg/L	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aldrin [b]	µg/L	0.000022	<7E-06	<4E-05	<6E-05	<7E-05	<7E-05	<5E-05	<3E-05	<6E-06	<4E-05	<7E-05	<7E-05	<6E-05	<5E-05	<3E-05
Benzene	µg/L	5.9	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Benzidine [b]	µg/L	0.000069	<5.6	<4.5	<3.6	<2.7	<1.9	<1.3	<0.4	<5.5	<4.6	<2.6	<2.4	<1.8	<1.1	<0.5
Beryllium [d]	µg/L	0.033	2E-06	2E-06	2E-06	1E-06	8E-07	6E-07	2E-07	2E-06	2E-06	1E-06	9E-07	7E-07	4E-07	2E-07
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.7	<2.1	<1.7	<1.3	<0.9	<0.6	<0.2	<2.7	<2.2	<1.3	<1.1	<0.9	<0.5	<0.2
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.7	1.0	1.1	1.1	0.8	0.5	0.1	0.6	1.1	1.1	1.0	0.8	0.4
Carbon tetrachloride	µg/L	0.90	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Chlordane	µg/L	0.000023	1E-06	1E-05	2E-05	2E-05	2E-05	1E-05	7E-06	1E-06	9E-06	2E-05	2E-05	2E-05	1E-05	7E-06
Chlorodibromomethane	µg/L	8.6	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Chloroform	µg/L	130	0.1	0.1	0.1	0.1	0.05	0.03	0.02	0.1	0.1	0.1	0.1	0.04	0.03	0.02
DDT	µg/L	0.00017	6E-07	8E-06	1E-05	1E-05	1E-05	1E-05	6E-06	5E-07	7E-06	1E-05	1E-05	1E-05	1E-05	6E-06
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.05	0.04	0.03	0.01	0.1	0.1	0.05	0.05	0.04	0.03	0.01
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.6	<4.5	<3.5	<2.7	<1.9	<1.3	<0.4	<5.5	<4.6	<2.6	<2.4	<1.8	<1.1	<0.5
1,2-Dichloroethane	µg/L	28	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
1,1-Dichloroethylene	µg/L	0.9	0.06	0.05	0.04	0.03	0.03	0.02	0.01	0.06	0.05	0.03	0.03	0.02	0.02	0.01
Dichlorobromomethane	µg/L	6.2	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Dichloromethane	µg/L	450	0.06	0.05	0.05	0.04	0.03	0.02	0.01	0.06	0.05	0.04	0.04	0.03	0.02	0.01
1,3-dichloropropene	µg/L	8.9	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Dieldrin	µg/L	0.00004	3E-06	8E-06	1E-05	1E-05	1E-05	8E-06	4E-06	3E-06	7E-06	1E-05	1E-05	9E-06	7E-06	4E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.02	<0.03	<0.03	<0.03	<0.02	<0.01	<0.01	<0.02	<0.03	<0.03	<0.03	<0.02	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Halomethanes	µg/L	130	0.1	0.05	0.04	0.03	0.03	0.02	0.01	0.1	0.05	0.03	0.03	0.02	0.02	0.01
Heptachlor [b]	µg/L	0.00005	<5E-06	<8E-05	<1E-04	<1E-04	<1E-04	<1E-04	<6E-05	<4E-06	<7E-05	<1E-04	<1E-04	<1E-04	<9E-05	<6E-05
Heptachlor Epoxide	µg/L	0.00002	1E-07	8E-07	1E-06	1E-06	1E-06	1E-06	5E-07	1E-07	7E-07	1E-06	1E-06	1E-06	9E-07	5E-07
Hexachlorobenzene	µg/L	0.00021	4E-06	4E-06	4E-06	3E-06	3E-06	2E-06	7E-07	4E-06	4E-06	3E-06	3E-06	2E-06	2E-06	8E-07
Hexachlorobutadiene	µg/L	14	3E-08	9E-08	1E-07	1E-07	1E-07	1E-07	5E-08	3E-08	8E-08	1E-07	1E-07	1E-07	9E-08	5E-08
Hexachloroethane	µg/L	2.5	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Isophorone	µg/L	730	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
N-Nitrosodimethylamine	µg/L	7.3	0.0002	0.0003	0.0003	0.0003	0.0003	0.0002	0.0001	0.0002	0.0003	0.0003	0.0003	0.0003	0.0002	0.0001
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.001	0.001	0.0005	0.0003	0.001	0.001	0.001	0.001	0.001	0.0004

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
N-Nitrosodiphenylamine	µg/L	2.5	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
PAHs	µg/L	0.0088	0.0002	0.0004	0.0005	0.0006	0.0005	0.0004	0.0002	0.0002	0.0004	0.0005	0.0005	0.0005	0.0004	0.0002
PCBs	µg/L	0.000019	9E-06	1E-05	1E-05	1E-05	1E-05	9E-06	5E-06	9E-06	1E-05	1E-05	1E-05	1E-05	8E-06	5E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6E-11	1E-09	2E-09	2E-09	2E-09	1E-09	8E-10	5E-11	9E-10	2E-09	2E-09	2E-09	1E-09	8E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.06	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.06	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Tetrachloroethylene	µg/L	2.0	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
Toxaphene [e]	µg/L	2.1E-04	6E-06	6E-05	9E-05	1E-04	1E-04	8E-05	4E-05	5E-06	5E-05	1E-04	1E-04	9E-05	7E-05	4E-05
Trichloroethylene	µg/L	27	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.05	<0.04	<0.03	<0.03	<0.02	<0.01	<0.1	<0.05	<0.03	<0.03	<0.02	<0.02	<0.01
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.1	<0.9	<0.7	<0.5	<0.4	<0.3	<0.1	<1.1	<0.9	<0.5	<0.5	<0.3	<0.2	<0.1
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.03	<0.02	<0.02	<0.01	<0.01	<0.03	<0.03	<0.02	<0.02	<0.02	<0.01	<0.01

a: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent.

b: All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.

d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.

e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A2 – Complete list of estimated concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Objectives for protection of marine aquatic life - 6-month median limit																
Arsenic	µg/L	8	49%	51%	51%	50%	49%	46%	41%	49%	51%	50%	49%	48%	45%	41%
Cadmium	µg/L	1	32%	27%	22%	17%	12%	8%	3%	32%	27%	17%	15%	11%	7%	3%
Chromium (Hexavalent)	µg/L	2	3%	3%	3%	3%	2%	2%	1%	3%	3%	3%	2%	2%	1%	1%
Copper	µg/L	3	64%	67%	69%	69%	70%	69%	68%	64%	66%	69%	70%	70%	69%	68%
Lead	µg/L	2	2%	1%	1%	1%	1%	0.4%	0.1%	2%	1%	1%	1%	1%	0.4%	0.2%
Mercury	µg/L	0.04	68%	55%	44%	35%	25%	17%	6%	68%	56%	33%	30%	23%	15%	7%
Nickel	µg/L	5	14%	12%	10%	8%	6%	4%	2%	14%	12%	8%	7%	6%	4%	2%
Selenium	µg/L	15	4%	3%	3%	2%	2%	1%	0.4%	4%	3%	2%	2%	2%	1%	0.5%
Silver	µg/L	0.7	26%	25%	25%	24%	24%	24%	23%	26%	25%	24%	24%	24%	23%	23%
Zinc	µg/L	20	41%	41%	41%	41%	41%	41%	40%	41%	41%	41%	41%	41%	41%	40%
Cyanide	µg/L	1	59%	108%	133%	140%	134%	99%	52%	58%	101%	134%	133%	120%	88%	51%
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	5%	57%	87%	100%	102%	77%	43%	4%	50%	96%	97%	91%	68%	40%
Ammonia (as N) - Daily Max	µg/L	2,400	1%	16%	25%	29%	29%	22%	12%	1%	14%	27%	28%	26%	19%	12%
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	19%	17%	15%	12%	10%	7%	3%	19%	17%	12%	11%	9%	6%	3%
Chlorinated Phenolics [b]	µg/L	1	--	--	--	--	--	<72%	<26%	--	--	--	--	--	<63%	<31%
Endosulfan	µg/L	0.009	0.1%	1%	2%	2%	2%	2%	1%	0.1%	1%	2%	2%	2%	2%	1%
Endrin	µg/L	0.002	0.01%	0.05%	0.1%	0.1%	0.1%	0.1%	0.03%	0.01%	0.04%	0.08%	0.08%	0.07%	0.05%	0.03%
HCH (Hexachlorocyclohexane)	µg/L	0.004	0.5%	7%	11%	13%	13%	10%	5%	0.4%	6%	12%	12%	11%	9%	5%
Radioactivity (Gross Beta) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pCi/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Objectives for protection of human health – non carcinogens – 30-day average limit																
Acrolein	µg/L	220	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.05%	<0.02%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.04%	<0.02%
Antimony	µg/L	1200	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Bis (2-chloroethoxy) methane	µg/L	4.4	<25%	<20%	<16%	<12%	<8%	<6%	<2%	<24%	<20%	<12%	<11%	<8%	<5%	<2%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.1%	<0.1%	<0.1%	<0.04%	<0.03%	<0.02%	<0.01%	<0.1%	<0.1%	<0.04%	<0.04%	<0.03%	<0.02%	<0.01%
Chlorobenzene	µg/L	570	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.03%	<0.03%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<2%	<1%	<1%	<1%	<0.2%	<2%	<2%	<1%	<1%	<1%	<0.5%	<0.2%
2,4-Dinitrophenol [b]	µg/L	4.0	--	--	--	<69%	<47%	<32%	<9%	--	--	<66%	<59%	<44%	<28%	<12%
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.05%	0.04%	0.03%	0.02%	0.01%	0.1%	0.1%	0.04%	0.03%	0.02%	0.02%	0.01%

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.02%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<54%	<44%	<35%	<27%	<19%	<13%	<4%	<54%	<45%	<26%	<23%	<17%	<11%	<5%
Thallium	µg/L	2	<0.3%	<0.4%	<0.5%	<0.5%	<0.5%	<0.3%	<0.2%	<0.3%	<0.4%	<0.5%	<0.5%	<0.4%	<0.3%	<0.2%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [b]	µg/L	0.0014	--	--	--	--	--	--	<46%	--	--	--	--	--	--	<54%
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health - carcinogens - 30-day average limit [c,d]																
Acrylonitrile [c,d]	µg/L	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aldrin [b]	µg/L	0.000022	<30%	--	--	--	--	--	--	<28%	--	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<1%	<0.4%	<0.3%	<0.1%	<1%	<1%	<1%	<1%	<0.4%	<0.3%	<0.1%
Benzidine [b]	µg/L	0.000069	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium [d]	µg/L	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-chloroethyl)ether [b]	µg/L	0.045	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	19%	28%	32%	32%	24%	13%	3%	17%	31%	31%	29%	22%	13%
Carbon tetrachloride	µg/L	0.90	<6%	<5%	<5%	<4%	<3%	<2%	<1%	<6%	<5%	<4%	<3%	<3%	<2%	<1%
Chlordane	µg/L	0.000023	6%	44%	66%	75%	77%	57%	32%	6%	39%	72%	73%	68%	51%	30%
Chlorodibromomethane	µg/L	8.6	<1%	<1%	<0.5%	<0.4%	<0.3%	<0.2%	<0.1%	<1%	<1%	<0.4%	<0.4%	<0.3%	<0.2%	<0.1%
Chloroform	µg/L	130	0.04%	0.05%	0.05%	0.04%	0.04%	0.03%	0.01%	0.04%	0.05%	0.04%	0.04%	0.03%	0.02%	0.01%
DDT	µg/L	0.00017	0.3%	5%	7%	8%	8%	6%	3%	0.3%	4%	8%	8%	7%	6%	3%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.3%	0.3%	0.3%	0.3%	0.2%	0.1%	0.1%
3,3-Dichlorobenzidine [b]	µg/L	0.0081	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.1%	<0.03%
1,1-Dichloroethylene	µg/L	0.9	6%	5%	5%	4%	3%	2%	1%	6%	5%	4%	3%	3%	2%	1%
Dichlorobromomethane	µg/L	6.2	<1%	<1%	<1%	<1%	<0.4%	<0.3%	<0.1%	<1%	<1%	<1%	<0.5%	<0.4%	<0.3%	<0.1%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%
1,3-dichloropropene	µg/L	8.9	<1%	<1%	<0.5%	<0.4%	<0.3%	<0.2%	<0.1%	<1%	<1%	<0.4%	<0.3%	<0.3%	<0.2%	<0.1%
Dieldrin	µg/L	0.00004	8%	19%	25%	27%	27%	20%	10%	8%	18%	26%	26%	24%	17%	10%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<1%	<1%	<0.5%	<0.5%	<1%	<1%	<1%	<1%	<1%	<0.5%
1,2-Diphenylhydrazine [b]	µg/L	0.16	--	--	--	--	--	--	<45%	--	--	--	--	--	--	<62%
Halomethanes	µg/L	130	0.04%	0.04%	0.03%	0.03%	0.02%	0.01%	0.01%	0.04%	0.04%	0.03%	0.02%	0.02%	0.01%	0.01%
Heptachlor [b]	µg/L	0.00005	<9%	--	--	--	--	--	--	<8%	--	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	4%	6%	6%	6%	5%	3%	1%	3%	6%	6%	6%	4%	3%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	2%	1%	1%	0.3%	2%	2%	1%	1%	1%	1%	0.4%
Hexachlorobutadiene	µg/L	14	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Hexachloroethane	µg/L	2.5	<43%	<35%	<28%	<22%	<15%	<10%	<3%	<43%	<36%	<21%	<19%	<14%	<9%	<4%
Isophorone	µg/L	730	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodimethylamine	µg/L	7.3	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.2%	0.3%	0.3%	0.3%	0.2%	0.1%	0.1%	0.2%	0.3%	0.3%	0.3%	0.2%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<43%	<35%	<28%	<22%	<15%	<10%	<3%	<43%	<36%	<21%	<19%	<14%	<9%	<4%
PAHs	µg/L	0.0088	2%	4%	6%	6%	6%	5%	2%	2%	4%	6%	6%	6%	4%	2%
PCBs	µg/L	0.000019	47%	64%	72%	72%	66%	49%	24%	46%	61%	69%	67%	60%	43%	24%

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario													
			MPWSP							MPWSP with High Desal Brine Flows						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
TCDD Equivalents [d]	µg/L	3.9E-09	2%	27%	42%	49%	50%	38%	21%	1%	24%	47%	48%	44%	33%	20%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<1%	<1%	<0.3%	<2%	<2%	<1%	<1%	<1%	<1%	<0.3%
Tetrachloroethylene	µg/L	2.0	<3%	<2%	<2%	<2%	<1%	<1%	<0.3%	<3%	<2%	<2%	<2%	<1%	<1%	<0.4%
Toxaphene [e]	µg/L	2.1E-04	3%	27%	42%	47%	48%	36%	20%	3%	24%	45%	46%	43%	32%	19%
Trichloroethylene	µg/L	27	<0.2%	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.1%	<0.1%	<0.1%	<0.03%
1,1,2-Trichloroethane	µg/L	9.4	<1%	<1%	<0.4%	<0.4%	<0.3%	<0.2%	<0.1%	<1%	<1%	<0.4%	<0.3%	<0.3%	<0.2%	<0.1%
2,4,6-Trichlorophenol [b]	µg/L	0.29	--	--	--	--	--	--	<25%	--	--	--	--	--	<75%	<34%
Vinyl chloride	µg/L	36	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.04%	<0.01%	<0.1%	<0.1%	<0.1%	<0.1%	<0.05%	<0.03%	<0.02%

a: Note that if the percentage was determined to be less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the constituent was estimated to be 0.000001% of the objective, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

b: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.

c: All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.

e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A3 – Complete list of estimated concentrations of Ocean Plan constituents at the edge of the ZID for the Variant

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Arsenic	µg/L	8	3.9	4.1	4.1	3.9	3.3	3.3	3.8	4.0	3.9	3.4	3.3	3.3	3.9	4.1	4.1	3.3	3.3	3.3	3.9	3.9	4.0	3.3	3.3	3.3
Cadmium	µg/L	1	0.3	0.2	0.2	0.1	0.02	0.02	0.3	0.2	0.2	0.1	0.03	0.02	0.3	0.2	0.2	0.04	0.03	0.03	0.3	0.3	0.2	0.04	0.03	0.03
Chromium (Hexavalent)	µg/L	2	0.09	0.09	0.09	0.06	0.02	0.02	0.17	0.15	0.11	0.04	0.02	0.02	0.08	0.08	0.07	0.02	0.02	0.02	0.14	0.14	0.11	0.03	0.02	0.02
Copper	µg/L	3	1.9	2.0	2.1	2.1	2.0	2.0	2.3	2.3	2.3	2.1	2.1	2.1	1.9	2.1	2.1	2.0	2.0	2.0	2.3	2.3	2.2	2.1	2.1	2.1
Lead	µg/L	2	0.03	0.05	0.06	0.05	0.02	0.02	0.13	0.12	0.09	0.03	0.02	0.02	0.03	0.05	0.06	0.02	0.02	0.02	0.11	0.11	0.09	0.02	0.02	0.02
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.002	0.002	0.03	0.02	0.01	0.005	0.003	0.002	0.03	0.02	0.01	0.003	0.003	0.003	0.03	0.02	0.02	0.004	0.003	0.003
Nickel	µg/L	5	0.7	0.6	0.5	0.4	0.1	0.1	1.0	0.9	0.6	0.2	0.1	0.1	0.7	0.6	0.5	0.1	0.1	0.1	1.0	0.9	0.7	0.2	0.1	0.1
Selenium	µg/L	15	0.6	0.5	0.4	0.3	0.1	0.1	0.7	0.6	0.4	0.1	0.1	0.1	0.6	0.5	0.4	0.1	0.1	0.1	0.7	0.6	0.5	0.1	0.1	0.1
Silver	µg/L	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Zinc	µg/L	20	8.2	8.7	8.8	8.7	8.3	8.3	10.2	10.1	9.6	8.6	8.4	8.4	8.2	8.7	8.8	8.3	8.3	8.3	9.9	9.9	9.6	8.4	8.4	8.4
Cyanide	µg/L	1	0.6	1.4	1.6	1.4	0.5	0.5	1.5	1.9	1.7	0.7	0.5	0.6	0.6	1.4	1.6	0.5	0.5	0.5	1.3	1.6	1.8	0.6	0.6	0.6
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	39	474	648	581	239	251	1593	1551	1248	473	326	316	34	519	627	212	235	246	1333	1363	1227	335	327	320
Ammonia (as N) - Daily Max	µg/L	2,400	43	540	739	663	273	286	1819	1771	1425	540	372	361	37	591	716	242	268	281	1521	1555	1401	383	373	365
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	5.5	4.8	3.9	2.7	0.7	0.6	7.1	5.9	4.2	1.5	0.9	0.8	5.6	4.6	3.8	0.9	0.8	0.7	6.9	6.4	4.7	1.0	0.9	0.8
Chlorinated Phenolics [b]	µg/L	1	<2.2	<1.8	<1.4	<1.0	<0.2	<0.2	<2.0	<1.6	<1.2	<0.4	<0.2	<0.2	<2.2	<1.7	<1.4	<0.3	<0.3	<0.3	<2.0	<1.9	<1.4	<0.3	<0.3	<0.2
Endosulfan	µg/L	0.009	3E-05	5E-04	7E-04	6E-04	3E-04	3E-04	2E-03	2E-03	1E-03	5E-04	3E-04	3E-04	3E-05	5E-04	7E-04	2E-04	3E-04	3E-04	1E-03	1E-03	1E-03	4E-04	3E-04	3E-04
Endrin	µg/L	0.002	2E-07	1E-06	2E-06	2E-06	6E-07	7E-07	4E-06	4E-06	3E-06	1E-06	9E-07	8E-07	2E-07	1E-06	2E-06	6E-07	6E-07	6E-07	4E-06	4E-06	3E-06	9E-07	9E-07	8E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	4E-05	6E-04	9E-04	8E-04	3E-04	3E-04	2E-03	2E-03	2E-03	7E-04	5E-04	4E-04	4E-05	7E-04	9E-04	3E-04	3E-04	3E-04	2E-03	2E-03	2E-03	5E-04	5E-04	4E-04
Radioactivity (Gross Beta) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of human health – non carcinogens – 30-day average limit																										
Acrolein	µg/L	220	0.2	0.3	0.2	0.2	0.1	0.1	0.5	0.4	0.3	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.4	0.4	0.3	0.1	0.1	0.1
Antimony	µg/L	1200	0.01	0.02	0.02	0.01	0.01	0.01	0.04	0.04	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.04	0.03	0.03	0.01	0.01	0.01
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.6	<0.1	<0.1	<0.1
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.6	<0.1	<0.1	<0.1
Chlorobenzene	µg/L	570	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Chromium (III)	µg/L	190000	1.1	0.9	0.7	0.5	0.1	0.1	1.2	1.0	0.7	0.2	0.1	0.1	1.2	0.9	0.7	0.1	0.1	0.1	1.2	1.1	0.8	0.2	0.1	0.1
Di-n-butyl phthalate	µg/L	3500	<1.1	<0.9	<0.7	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.9	<0.6	<0.1	<0.1	<0.1
Dichlorobenzenes	µg/L	5100	0.1	0.1	0.1	0.04	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.01	0.1	0.1	0.1	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.03	<0.03	<0.1	<0.1	<0.1	<0.04	<0.03	<0.03	<0.1	<0.1	<0.1	<0.03	<0.03	<0.03	<0.1	<0.1	<0.1	<0.03	<0.03	<0.03
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.04	<0.01	<0.01	<0.1	<0.1	<0.05	<0.02	<0.01	<0.01	<0.1	<0.1	<0.1	<0.02	<0.02	<0.01	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01
4,6-dinitro-2-methylphenol	µg/L	220	<5.3	<4.1	<3.1	<2.0	<0.4	<0.3	<4.5	<3.5	<2.4	<0.8	<0.4	<0.4	<5.4	<3.9	<3.0	<0.6	<0.5	<0.4	<4.7	<4.2	<2.9	<0.6	<0.5	<0.4
2,4-Dinitrophenol [b]	µg/L	4.0	<5.4	<4.1	<3.0	<1.9	<0.4	<0.3	<4.6	<3.5	<2.3	<0.8	<0.4	<0.3	<5.6	<3.8	<2.9	<0.6	<0.5	<0.4	<4.8	<4.3	<2.8	<0.5	<0.5	<0.4
Ethylbenzene	µg/L	4100	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Fluoranthene	µg/L	15	0.01	0.01	0.01	0.004	0.001	0.001	0.01	0.01	0.005	0.001	0.001	0.001	0.01	0.01	0.01	0.001	0.001	0.001	0.01	0.01	0.01	0.001	0.001	0.001
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.003	<0.003	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003
Nitrobenzene	µg/L	4.9	<2.6	<2.0	<1.4	<0.9	<0.2	<0.1	<2.2	<1.6	<1.1	<0.3	<0.2	<0.1	<2.7	<1.8	<1.4	<0.3	<0.2	<0.2	<2.3	<2.0	<1.3	<0.2	<0.2	<0.2
Thallium	µg/L	2	0.01	0.01	0.01	0.01	0.004	0.004	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.004	0.004	0.004	0.03	0.03	0.02	0.01	0.01	0.01
Toluene	µg/L	85000	0.05	0.05	0.04	0.02	0.01	0.01	0.06	0.05	0.04	0.01	0.01	0.01	0.06	0.04	0.03	0.01	0.01	0.01	0.06	0.06	0.04	0.01	0.01	0.01
Tributyltin [b]	µg/L	0.0014	<0.005	<0.004	<0.003	<0.002	<0.001	<0.001	<0.005	<0.004	<0.003	<0.001	<0.001	<0.001	<0.005	<0.004	<0.003	<0.001	<0.001	<0.001	<0.005	<0.004	<0.003	<0.001	<0.001	<0.001
1,1,1-Trichloroethane	µg/L	540000	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c]	µg/L	0.10	0.002	0.03	0.04	0.03	0.01	0.01	0.1	0.1	0.1	0.03	0.02	0.02	0.001	0.03	0.04	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
Aldrin [b]	µg/L	0.000022	<9E-06	<8E-05	<1E-04	<1E-04	<4E-05	<4E-05	<8E-05	<1E-04	<1E-04	<5E-05	<4E-05	<4E-05	<8E-06	<9E-05	<1E-04	<3E-05	<4E-05	<4E-05	<6E-05	<9E-05	<1E-04	<4E-05	<4E-05	<4E-05
Benzene	µg/L	5.9	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Benzidine [b]	µg/L	0.000069	<5.4	<4.2	<3.1	<2.0	<0.4	<0.3	<4.6	<3.6	<2.4	<0.8	<0.4	<0.4	<5.6	<4.0	<3.0	<0.6	<0.5	<0.5	<4.8	<4.3	<2.9	<0.6	<0.5	<0.4
Beryllium [c]	µg/L	0.033	4E-06	3E-06	2E-06	1E-06	2E-07	4E-07	3E-06	2E-06	1E-06	5E-07	2E-07	2E-07	3E-06	2E-06	1E-06	3E-07	2E-07	2E-07	3E-06	2E-06	1E-06	3E-07	2E-07	2E-07
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.6	<2.0	<1.4	<0.9	<0.2	<0.1	<2.2	<1.7	<1.1	<0.4	<0.2	<0.1	<2.7	<1.8	<1.4	<0.3	<0.2	<0.2	<2.3	<2.0	<1.3	<0.3	<0.2	<0.2
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.9	1.2	1.1	0.4	0.5	2.9	2.9	2.3	0.9	0.6	0.6	0.1	1.0	1.2	0.4	0.4	0.5	2.5	2.5	2.3	0.6	0.6	0.6
Carbon tetrachloride	µg/L	0.90	0.05	0.05	0.04	0.02	0.01	0.01	0.06	0.05	0.04	0.01	0.01	0.01	0.06	0.04	0.03	0.01	0.01	0.01	0.06	0.06	0.04	0.01	0.01	0.01
Chlordane	µg/L	0.000023	2E-06	1E-05	2E-05	2E-05	7E-06	7E-06	5E-05	4E-05	4E-05	1E-05	9E-06	9E-06	2E-06	2E-05	2E-05	6E-06	7E-06	7E-06	4E-05	4E-05	4E-05	1E-05	9E-06	9E-06
Chlorodibromo-methane	µg/L	8.6	0.1	0.1	0.1	0.05	0.02	0.02	0.1	0.1	0.1	0.03	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02
Chloroform	µg/L	130	0.1	0.4	0.5	0.5	0.2	0.2	1.3	1.3	1.0	0.4	0.3	0.3	0.1	0.4	0.5	0.2	0.2	0.2	1.1	1.1	1.0	0.3	0.3	0.3

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
DDT	µg/L	0.00017	8E-07	1E-05	1E-05	1E-05	5E-06	6E-06	2E-06	1E-05	1E-05	6E-06	5E-06	5E-06	7E-07	1E-05	1E-05	5E-06	5E-06	6E-06	2E-06	6E-06	1E-05	5E-06	5E-06	5E-06
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.04	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.01	0.1	0.1	0.1	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.02	0.02
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.4	<4.2	<3.1	<2.0	<0.4	<0.3	<4.6	<3.6	<2.4	<0.8	<0.4	<0.4	<5.6	<4.0	<3.0	<0.6	<0.5	<0.4	<4.8	<4.3	<2.9	<0.6	<0.5	<0.4
1,2-Dichloroethane	µg/L	28	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
1,1-Dichloroethylene	µg/L	0.9	0.05	0.05	0.04	0.02	0.01	0.01	0.05	0.04	0.03	0.01	0.01	0.01	0.06	0.04	0.03	0.01	0.01	0.01	0.05	0.05	0.03	0.01	0.01	0.01
Dichlorobromo-methane	µg/L	6.2	0.1	0.1	0.1	0.05	0.02	0.02	0.1	0.1	0.1	0.03	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02	0.1	0.1	0.1	0.02	0.02	0.02
Dichloromethane	µg/L	450	0.05	0.05	0.04	0.03	0.01	0.01	0.08	0.07	0.05	0.02	0.01	0.01	0.06	0.05	0.04	0.01	0.01	0.01	0.07	0.07	0.05	0.01	0.01	0.01
1,3-dichloropropene	µg/L	8.9	0.05	0.05	0.04	0.03	0.01	0.01	0.07	0.05	0.04	0.01	0.01	0.01	0.06	0.04	0.04	0.01	0.01	0.01	0.07	0.06	0.04	0.01	0.01	0.01
Dieldrin	µg/L	0.00004	4E-06	2E-05	2E-05	2E-05	9E-06	9E-06	4E-06	2E-05	2E-05	9E-06	8E-06	8E-06	4E-06	2E-05	2E-05	8E-06	9E-06	9E-06	4E-06	1E-05	2E-05	7E-06	8E-06	8E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.03	<0.04	<0.03	<0.01	<0.01	<0.01	<0.03	<0.03	<0.01	<0.01	<0.01	<0.01	<0.03	<0.03	<0.01	<0.01	<0.01	<0.01	<0.02	<0.03	<0.01	<0.01	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.2	<0.1	<0.1	<1.1	<0.8	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.6	<0.1	<0.1	<0.1
Halomethanes	µg/L	130	0.1	0.1	0.05	0.04	0.01	0.01	0.1	0.1	0.1	0.02	0.01	0.01	0.1	0.1	0.05	0.01	0.01	0.01	0.1	0.1	0.1	0.02	0.01	0.01
Heptachlor [b]	µg/L	0.00005	<7E-06	<1E-04	<1E-04	<1E-04	<6E-05	<6E-05	<8E-05	<1E-04	<1E-04	<7E-05	<5E-05	<6E-05	<6E-06	<1E-04	<1E-04	<5E-05	<5E-05	<6E-05	<6E-05	<1E-04	<1E-04	<5E-05	<6E-05	<6E-05
Heptachlor Epoxide	µg/L	0.00002	2E-07	1E-06	1E-06	1E-06	5E-07	5E-07	3E-06	3E-06	3E-06	1E-06	7E-07	7E-07	2E-07	1E-06	1E-06	4E-07	5E-07	5E-07	3E-06	3E-06	3E-06	7E-07	7E-07	7E-07
Hexachlorobenzene	µg/L	0.00021	4E-06	4E-06	3E-06	2E-06	7E-07	6E-07	6E-06	5E-06	4E-06	1E-06	8E-07	8E-07	4E-06	4E-06	3E-06	8E-07	8E-07	7E-07	6E-06	6E-06	4E-06	1E-06	9E-07	8E-07
Hexachlorobutadiene	µg/L	14	3E-08	1E-07	1E-07	1E-07	5E-08	5E-08	4E-07	3E-07	3E-07	1E-07	7E-08	7E-08	3E-08	1E-07	1E-07	5E-08	5E-08	5E-08	3E-07	3E-07	3E-07	7E-08	7E-08	7E-08
Hexachloroethane	µg/L	2.5	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.1	<0.1	<0.1	<1.1	<0.7	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.5	<0.1	<0.1	<0.1
Isophorone	µg/L	730	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
N-Nitrosodimethylamine	µg/L	7.3	0.0003	0.001	0.001	0.001	0.0005	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.0003	0.001	0.001	0.0004	0.0005	0.001	0.001	0.001	0.002	0.001	0.001	0.001
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.0004	0.001	0.0004	0.001	0.001	0.0005	0.0004	0.0004	0.0003	0.001	0.001	0.0004	0.0004	0.0004	0.0003	0.001	0.001	0.0004	0.0004	0.0004
N-Nitrosodiphenylamine	µg/L	2.5	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.1	<0.1	<0.1	<1.1	<0.7	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.5	<0.1	<0.1	<0.1
PAHs	µg/L	0.0088	0.0002	0.0005	0.0007	0.0006	0.0002	0.0002	0.0016	0.0015	0.0012	0.0005	0.0003	0.0003	0.0002	0.0006	0.0007	0.0002	0.0002	0.0002	0.0014	0.0014	0.0012	0.0003	0.0003	0.0003
PCBs	µg/L	0.000019	9E-06	1E-05	1E-05	1E-05	4E-06	4E-06	3E-05	3E-05	2E-05	9E-06	6E-06	5E-06	9E-06	1E-05	1E-05	4E-06	4E-06	4E-06	3E-05	3E-05	2E-05	6E-06	6E-06	6E-06
TCDD Equivalents [c]	µg/L	3.9E-09	1E-10	2E-09	2E-09	2E-09	8E-10	8E-10	5E-09	5E-09	4E-09	2E-09	1E-09	1E-09	8E-11	2E-09	2E-09	7E-10	8E-10	8E-10	4E-09	4E-09	4E-09	1E-09	1E-09	1E-09
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.05	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.06	<0.04	<0.03	<0.01	<0.01	<0.01	<0.05	<0.05	<0.03	<0.01	<0.01	<0.01
Tetrachloroethylene	µg/L	2.0	<0.1	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.05	<0.03	<0.01	<0.01	<0.01
Toxaphene [e]	µg/L	2.1E-04	7E-06	8E-05	1E-04	1E-04	4E-05	4E-05	3E-04	3E-04	2E-04	8E-05	5E-05	5E-05	7E-06	9E-05	1E-04	4E-05	4E-05	4E-05	2E-04	2E-04	2E-04	6E-05	5E-05	5E-05
Trichloroethylene	µg/L	27	<0.1	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.05	<0.03	<0.01	<0.01	<0.01
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.05	<0.04	<0.02	<0.01	<0.01	<0.05	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.04	<0.03	<0.01	<0.01	<0.01	<0.1	<0.05	<0.03	<0.01	<0.01	<0.01
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.1	<0.8	<0.6	<0.4	<0.1	<0.1	<0.9	<0.7	<0.5	<0.1	<0.1	<0.1	<1.1	<0.7	<0.6	<0.1	<0.1	<0.1	<0.9	<0.8	<0.5	<0.1	<0.1	<0.1
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.02	<0.02	<0.005	<0.01	<0.03	<0.03	<0.02	<0.01	<0.005	<0.004	<0.03	<0.03	<0.02	<0.01	<0.01	<0.005	<0.03	<0.03	<0.02	<0.01	<0.01	<0.005

a: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent.
b: All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
c: Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A4 – Complete list of estimated concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of marine aquatic life - 6-month median limit																										
Arsenic	µg/L	8	49%	52%	51%	48%	41%	41%	48%	50%	48%	42%	41%	41%	49%	51%	51%	41%	41%	41%	48%	49%	49%	41%	41%	41%
Cadmium	µg/L	1	32%	25%	18%	12%	2%	2%	31%	24%	16%	5%	3%	2%	32%	23%	18%	4%	3%	3%	32%	28%	19%	4%	3%	3%
Chromium (Hexavalent)	µg/L	2	5%	5%	4%	3%	1%	1%	8%	7%	5%	2%	1%	1%	4%	4%	4%	1%	1%	1%	7%	7%	5%	1%	1%	1%
Copper	µg/L	3	64%	68%	70%	70%	68%	68%	78%	77%	75%	70%	69%	69%	64%	68%	70%	68%	68%	68%	75%	76%	75%	69%	69%	69%
Lead	µg/L	2	2%	3%	3%	2%	1%	1%	6%	6%	5%	2%	1%	1%	2%	3%	3%	1%	1%	1%	6%	6%	5%	1%	1%	1%
Mercury	µg/L	0.04	66%	52%	38%	25%	6%	5%	65%	50%	34%	12%	7%	6%	68%	49%	37%	9%	8%	7%	66%	59%	40%	9%	8%	7%
Nickel	µg/L	5	14%	13%	11%	8%	2%	2%	21%	17%	13%	4%	3%	2%	14%	12%	11%	3%	2%	2%	20%	18%	14%	3%	3%	3%
Selenium	µg/L	15	4%	3%	3%	2%	0.5%	0.4%	5%	4%	3%	1%	1%	0%	4%	3%	3%	1%	1%	0.5%	5%	4%	3%	1%	1%	1%
Silver	µg/L	0.7	26%	26%	26%	25%	24%	23%	29%	28%	27%	24%	24%	24%	26%	26%	26%	24%	24%	24%	29%	28%	27%	24%	24%	24%
Zinc	µg/L	20	41%	43%	44%	44%	41%	41%	51%	50%	48%	43%	42%	42%	41%	43%	44%	41%	41%	41%	49%	49%	48%	42%	42%	42%
Cyanide	µg/L	1	61%	138%	163%	139%	53%	55%	150%	189%	173%	71%	55%	56%	61%	144%	158%	49%	53%	55%	135%	158%	176%	55%	56%	57%
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	7%	79%	108%	97%	40%	42%	266%	258%	208%	79%	54%	53%	6%	86%	105%	35%	39%	41%	222%	227%	205%	56%	54%	53%
Ammonia (as N) - Daily Max	µg/L	2,400	2%	22%	31%	28%	11%	12%	76%	74%	59%	23%	16%	15%	2%	25%	30%	10%	11%	12%	63%	65%	58%	16%	16%	15%
Acute Toxicity [a]	TUa	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chronic Toxicity [a]	TUc	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenolic Compounds (non-chlorinated)	µg/L	30	18%	16%	13%	9%	2%	2%	24%	20%	14%	5%	3%	3%	19%	15%	13%	3%	3%	2%	23%	21%	16%	3%	3%	3%
Chlorinated Phenolics [b]	µg/L	1	--	--	--	--	<23%	<21%	--	--	--	<41%	<24%	<22%	--	--	--	<31%	<28%	<25%	--	--	--	<30%	<27%	<24%
Endosulfan	µg/L	0.009	0.4%	6%	8%	7%	3%	3%	19%	18%	15%	6%	4%	4%	0%	6%	7%	3%	3%	3%	16%	16%	15%	4%	4%	4%
Endrin	µg/L	0.002	0.01%	0.1%	0.1%	0.1%	0.03%	0.03%	0.2%	0.2%	0.2%	0.1%	0.04%	0.04%	0.01%	0.1%	0.1%	0.03%	0.03%	0.03%	0.2%	0.2%	0.2%	0.04%	0.04%	0.04%
HCH (Hexachlorocyclohexane)	µg/L	0.004	1%	16%	22%	20%	8%	9%	55%	53%	43%	16%	11%	11%	1%	18%	22%	7%	8%	8%	46%	47%	42%	12%	11%	11%
Radioactivity (Gross Beta) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Radioactivity (Gross Alpha) [a]	pci/L	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario: Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Objectives for protection of human health – non carcinogens – 30-day average limit																										
Acrolein	µg/L	220	0.1%	0.1%	0.1%	0.1%	0.03%	0.03%	0.2%	0.2%	0.1%	0.1%	0.03%	0.03%	0.1%	0.1%	0.1%	0.03%	0.03%	0.03%	0.2%	0.2%	0.2%	0.04%	0.04%	0.03%
Antimony	µg/L	1200	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Bis (2-chloroethoxy) methane	µg/L	4.4	<24%	<19%	<14%	<9%	<2%	<2%	<20%	<16%	<11%	<4%	<2%	<2%	<25%	<18%	<13%	<3%	<2%	<2%	<21%	<19%	<13%	<3%	<2%	<2%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.1%	<0.1%	<0.1%	<0.03%	<0.01%	<0.01%	<0.1%	<0.1%	<0.04%	<0.01%	<0.01%	<0.01%	<0.1%	<0.1%	<0.05%	<0.01%	<0.01%	<0.01%	<0.1%	<0.1%	<0.05%	<0.01%	<0.01%	<0.01%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.03%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.03%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<1%	<1%	<0.2%	<0.2%	<2%	<2%	<1%	<0.4%	<0.2%	<0.2%	<2%	<2%	<1%	<0.3%	<0.2%	<0.2%	<2%	<2%	<1%	<0.3%	<0.2%	<0.2%
2,4-Dinitrophenol [b]	µg/L	4.0	--	--	<74%	<47%	<9%	<7%	--	--	<58%	<19%	<10%	<8%	--	--	<72%	<14%	<12%	<10%	--	--	<70%	<14%	<11%	<9%
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.04%	0.02%	<0.01%	<0.01%	0.1%	0.05%	0.03%	0.01%	<0.01%	<0.01%	0.1%	0.1%	0.04%	0.01%	0.01%	<0.01%	0.1%	0.1%	0.04%	0.01%	0.01%	<0.01%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<53%	<40%	<28%	<18%	<3%	<2%	<45%	<34%	<22%	<7%	<4%	<3%	<54%	<37%	<28%	<5%	<5%	<4%	<47%	<42%	<27%	<5%	<4%	<3%
Thallium	µg/L	2	0.3%	1%	1%	1%	0.2%	0.2%	1%	1%	1%	0.4%	0.3%	0.3%	0.3%	1%	1%	0.2%	0.2%	0.2%	1%	1%	1%	0.3%	0.3%	0.3%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [b]	µg/L	0.0014	--	--	--	--	<41%	<36%	--	--	--	<69%	<42%	<37%	--	--	--	<53%	<49%	<44%	--	--	--	<51%	<46%	<42%
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health - carcinogens - 30-day average limit [c d]																										
Acrylonitrile [c]	µg/L	0.10	2%	28%	38%	34%	14%	14%	94%	92%	74%	28%	19%	19%	1%	30%	37%	13%	14%	15%	79%	81%	73%	20%	19%	19%
Aldrin [b]	µg/L	0.000022	<41%	--	--	--	--	--	--	--	--	--	--	--	<38%	--	--	--	--	--	--	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<0.4%	<0.1%	<0.1%	<1%	<1%	<0.5%	<0.2%	<0.1%	<0.1%	<1%	<1%	<1%	<0.1%	<0.1%	<0.1%	<1%	<1%	<1%	<0.1%	<0.1%	<0.1%
Benzidine [b]	µg/L	0.000069	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium [c]	µg/L	0.033	0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	0.01 %	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Bis(2-chloroethyl)ether [b]	µg/L	0.045	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	26%	34%	31%	12%	13%	84%	81%	65%	25%	17%	17%	3%	28%	33%	11%	12%	13%	70%	72%	64%	18%	17%	17%
Carbon tetrachloride	µg/L	0.90	6%	5%	4%	3%	1%	1%	7%	6%	4%	1%	1%	1%	6%	5%	4%	1%	1%	1%	7%	6%	5%	1%	1%	1%
Chlordane	µg/L	0.000023	8%	60%	81%	72%	30%	31%	199%	193%	155%	59%	40%	39%	7%	66%	79%	26%	29%	30%	167%	170%	153%	42%	40%	40%
Chlorodibromo-methane	µg/L	8.6	1%	1%	1%	1%	0.2%	0.2%	1%	1%	1%	0.4%	0.2%	0.2%	1%	1%	1%	0.2%	0.2%	0.2%	1%	1%	1%	0.3%	0.2%	0.2%
Chloroform	µg/L	130	0.1%	0.3%	0.4%	0.4%	0.1%	0.2%	1%	1%	1%	0.3%	0.2%	0.2%	0.1%	0.3%	0.4%	0.1%	0.1%	0.2%	1%	1%	1%	0.2%	0.2%	0.2%

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Flow Scenario																							
			Variant with GWR Offline						Variant with Normal Flows						Variant with High Desal Brine Flows and GWR Offline						Variant with High Desal Brine Flows					
			15	16	17	18	19	20	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
DDT	µg/L	0.00017	0.5%	6%	9%	8%	3%	3%	1%	6%	7%	3%	3%	3%	0.4%	7%	8%	3%	3%	3%	1%	4%	7%	3%	3%	3%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.2%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%	0.3%	0.3%	0.3%	0.1%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%
3,3-Dichlorobenzidine [b]	µg/L	0.0081	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.1%	<0.1%	<0.02%	<0.02%	<0.2%	<0.1%	<0.1%	<0.04%	<0.02%	<0.02%	<0.2%	<0.2%	<0.1%	<0.03%	<0.03%	<0.02%	<0.2%	<0.2%	<0.1%	<0.03%	<0.02%	<0.02%
1,1-Dichloroethylene	µg/L	0.9	6%	5%	4%	3%	1%	1%	6%	5%	3%	1%	1%	1%	6%	5%	4%	1%	1%	1%	6%	5%	4%	1%	1%	1%
Dichlorobromo-methane	µg/L	6.2	1%	1%	1%	1%	0.3%	0.3%	2%	2%	1%	1%	0.3%	0.3%	1%	1%	1%	0.3%	0.3%	0.3%	2%	2%	2%	0.4%	0.4%	0.3%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	0.02%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	0.01%	<0.01%	<0.01%	<0.01%	0.02%	0.02%	0.01%	<0.01%	<0.01%	<0.01%
1,3-dichloropropene	µg/L	8.9	1%	1%	0.4%	0.3%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%	1%	0.5%	0.4%	0.1%	0.1%	0.1%	1%	1%	0.5%	0.1%	0.1%	0.1%
Dieldrin	µg/L	0.00004	10%	47%	61%	53%	21%	22%	11%	41%	48%	22%	19%	21%	10%	50%	59%	19%	21%	22%	10%	26%	48%	18%	20%	21%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<0.5%	<1%	<0.4%	<1%	<1%	<0.5%	<0.4%	<0.4%	<0.5%	<1%	<1%	<0.4%	<0.5%	<0.5%	<0.4%	<1%	<1%	<0.4%	<0.4%	<0.4%
1,2-Diphenylhydrazine [b]	µg/L	0.16	--	--	--	--	<51%	<42%	--	--	--	--	<54%	<45%	--	--	--	<76%	<67%	<56%	--	--	--	<72%	<62%	<53%
Halomethanes	µg/L	130	0.04%	0.04%	0.04%	0.03%	0.01%	0.01%	0.1%	0.1%	0.05%	0.02%	0.01%	0.01%	0.04%	0.04%	0.04%	0.01%	0.01%	0.01%	0.1%	0.1%	0.05%	0.01%	0.01%	0.01%
Heptachlor [b]	µg/L	0.00005	<14%	--	--	--	--	--	--	--	--	--	--	--	<12%	--	--	--	--	--	--	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	5%	7%	6%	2%	3%	17%	16%	13%	5%	3%	3%	1%	6%	7%	2%	2%	3%	14%	14%	13%	3%	3%	3%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	1%	0.3%	0.3%	3%	3%	2%	1%	0.4%	0.4%	2%	2%	2%	0.4%	0.4%	0.3%	3%	3%	2%	0.5%	0.4%	0.4%
Hexachlorobutadiene	µg/L	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	µg/L	2.5	<42%	<32%	<23%	<15%	<3%	<2%	<36%	<27%	<18%	<6%	<3%	<2%	<43%	<30%	<23%	<4%	<4%	<3%	<37%	<33%	<22%	<4%	<4%	<3%
Isophorone	µg/L	730	<0.01%	<0.01%	--	--	--	--	<0.01%	<0.01%	--	--	--	--	<0.01%	<0.01%	--	--	--	--	<0.01%	<0.01%	--	--	--	--
N-Nitrosodimethylamine	µg/L	7.3	--	0.01%	0.02%	0.02%	0.01%	0.01%	0.02%	0.02%	0.02%	0.01%	0.01%	0.01%	--	0.02%	0.02%	0.01%	0.01%	0.01%	0.02%	0.02%	0.02%	0.01%	0.01%	0.01%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.3%	0.3%	0.3%	0.1%	0.1%	0.1%	0.2%	0.3%	0.1%	0.1%	0.1%	0.1%	0.3%	0.3%	0.1%	0.1%	0.1%	0.1%	0.2%	0.3%	0.1%	0.1%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<42%	<32%	<23%	<15%	<3%	<2%	<36%	<27%	<18%	<6%	<3%	<2%	<43%	<30%	<23%	<4%	<4%	<3%	<37%	<33%	<22%	<4%	<4%	<3%
PAHs	µg/L	0.0088	2%	6%	8%	7%	3%	3%	18%	18%	14%	5%	4%	3%	2%	7%	7%	2%	3%	3%	16%	16%	14%	4%	4%	4%
PCBs	µg/L	0.000019	47%	71%	77%	63%	22%	23%	169%	156%	121%	45%	30%	28%	47%	73%	74%	22%	23%	23%	149%	147%	124%	32%	30%	29%
TCDD Equivalents [c]	µg/L	3.9E-09	2%	39%	53%	48%	20%	21%	131%	128%	103%	39%	27%	26%	2%	42%	52%	17%	19%	20%	110%	112%	101%	28%	27%	26%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<0.3%	<0.2%	<2%	<2%	<1%	<0.4%	<0.3%	<0.2%	<2%	<2%	<2%	<0.3%	<0.3%	<0.3%	<2%	<2%	<1%	<0.3%	<0.3%	<0.3%
Tetrachloroethylene	µg/L	2.0	3%	2%	2%	1%	0.3%	0.3%	2%	2%	1%	1%	0.3%	0.3%	3%	2%	2%	0.4%	0.4%	0.3%	3%	2%	2%	0.4%	0.3%	0.3%
Toxaphene [e]	µg/L	2.1E-04	4%	38%	51%	46%	19%	20%	126%	122%	98%	37%	26%	25%	3%	41%	50%	17%	19%	19%	105%	108%	97%	26%	26%	25%
Trichloroethylene	µg/L	27	0.2%	0.2%	0.1%	0.1%	0.02%	0.02%	0.2%	0.2%	0.1%	0.04%	0.02%	0.02%	0.2%	0.2%	0.1%	0.03%	0.03%	0.02%	0.2%	0.2%	0.1%	0.03%	0.03%	0.02%
1,1,2-Trichloroethane	µg/L	9.4	1%	0.5%	0.4%	0.3%	0.1%	0.1%	1%	0.4%	0.3%	0.1%	0.1%	0.1%	1%	0.5%	0.4%	0.1%	0.1%	0.1%	1%	1%	0.4%	0.1%	0.1%	0.1%
2,4,6-Trichlorophenol [b]	µg/L	0.29	--	--	--	--	25%	20%	--	--	--	51%	27%	21%	--	--	--	39%	33%	27%	--	--	--	37%	31%	26%
Vinyl chloride	µg/L	36	0.1%	0.1%	0.1%	0.05%	0.01%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%	0.01%

a: Note that if the percentage was determined to be less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the constituent was estimated to be 0.000001% of the objective, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
b: Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.
c: All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
d: Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time.
e: Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Appendix B

Trussell Technologies, Inc (Trussell Tech), 2017. "Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project." *Technical Memorandum prepared for MRWPCA and MPWMD*. September.

Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project

Technical Memorandum
September 2017

Prepared for:

Partners for Pure Water Solutions
MRWPCA
Monterey Peninsula Water Management District

Trussell Technologies Inc
1939 Harrison Street, Suite 600
Oakland, CA 94612

Ocean Plan Compliance Assessment for the Pure Water Monterey Groundwater Replenishment Project

Technical Memorandum

Pure Water Monterey
A Groundwater Replenishment Project

September 2017

Prepared By:

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1 Executive Summary

Monterey Regional Water Pollution Control Agency (MRWPCA) and the Monterey Peninsula Water Management District ("Project Partners") are implementing the Pure Water Monterey Groundwater Replenishment Project ("Project"). The Project involves treating secondary effluent from MRWPCA's Regional Treatment Plant (RTP) through the proposed Advanced Water Purification Facility (AWPF) and then injecting this highly purified recycled water into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply. The Project will also provide additional tertiary recycled water for agricultural irrigation in the northern Salinas Valley as part of the Castroville Seawater Intrusion Project (CSIP). A waste stream, the reverse osmosis concentrate ("RO concentrate"), will be generated by the AWPF and discharged through the existing MRWPCA ocean outfall, which currently discharges secondary effluent from the RTP. The goal of this technical memorandum is to analyze whether discharge of the Project's RO concentrate to the Pacific Ocean (Monterey Bay) through the existing outfall would comply with numeric water quality objectives in the California Ocean Plan to protect marine aquatic life and human health.

The California Ocean Plan sets forth numeric and narrative water quality objectives for ocean waters with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting (SWRCB, 2015). For typical wastewater discharges, when released from an outfall, the wastewater and ocean water undergo rapid mixing due to the momentum and buoyancy of the discharge. The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge into the ocean. The initial dilution occurs in an area known as the zone of initial dilution (ZID), and the Ocean Plan objectives are to be met at the edge of the ZID. The extent of dilution in the ZID is quantified as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive NPDES permit limits that are applied to a wastewater discharge prior to ocean dilution.

Trussell Technologies, Inc. (Trussell Tech) estimated worst-case in-pipe discharge water quality (*i.e.*, prior to being discharged through the outfall and diluted in the ocean) for the Project and used the dilution modeling results determined by Dr. Philip Roberts to provide an assessment of whether the Project would consistently meet Ocean Plan water quality objectives. The resulting concentrations for each constituent in each scenario were compared to its minimum Ocean Plan objective to assess compliance. The estimated concentrations for eight different flow scenarios are presented in the following technical memorandum (TM) (Tables 3 and 4). None of the constituents are expected to exceed their Ocean Plan objective[1]. Ammonia is estimated to reach a concentration closest to its minimum objective, with the highest estimated concentration at the edge of the ZID at 71% of the objective.

[1] Aldrin, benzidine, 3,3-dichlorobenzidine and heptachlor were not detected in any source waters, however their MRLs are greater than the Ocean Plan objective. Therefore, no percentages are presented Table 4 as no compliance conclusions can be drawn for these constituents. This is a common occurrence for ocean discharges since the MRL is higher than the Ocean Plan objective for some constituents.

The purpose of the analysis documented in this TM was to assess the ability of the Project to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the RTP secondary effluent, RO concentrate, and hauled waste (blended with secondary effluent) for the Project. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and discharge scenario. Compliance assessments could not be made for selected constituents due to analytical limitations, but this is a common occurrence for these Ocean Plan constituents. Based on the data, assumptions, modeling, and analytical methodology presented in this technical memorandum, the Project will comply with all numeric Ocean Plan objectives.

2 Introduction

Monterey Regional Water Pollution Control Agency (MRWPCA) and the Monterey Peninsula Water Management District ("Project Partners") are in the process of implementing the Pure Water Monterey Groundwater Replenishment Project ("Project"). The Project involves treating secondary effluent from MRWPCA's Regional Treatment Plant (RTP) through the proposed Advanced Water Purification Facility (AWPF) and then injecting this highly purified recycled water into the Seaside Groundwater Basin, with subsequent withdrawal for use as a municipal water supply. The Project will also provide additional tertiary recycled water for agricultural irrigation in the northern Salinas Valley as part of the Castroville Seawater Intrusion Project (CSIP). A waste stream, the reverse osmosis concentrate ("RO concentrate"), will be generated by the AWPF and discharged through the existing MRWPCA ocean outfall, which currently discharges secondary effluent from the RTP. The goal of this technical memorandum is to analyze whether discharge of the Project's RO concentrate to the Pacific Ocean (Monterey Bay) through the existing outfall would comply with numeric water quality objectives in the California Ocean Plan to protect marine aquatic life and human health.

The original version of this document (Trussell Technologies, 2015b) and an addendum report to that document (Trussell Technologies, 2015c) was included in the Project's Consolidated Final Environmental Impact Report (CFEIR). This version has been updated to reflect an increase in capacity of the AWPF to produce more product water and thus more RO concentrate. In addition, new water quality data have been included since the original analysis (including years 2012 – 2017), and the ocean dilution modeling has correspondingly been revised. Further details regarding these updates are included in the following sections.

2.1 Treatment through the RTP and AWPF

The existing RTP treatment process includes screening, primary sedimentation, secondary biological treatment through trickling filters (TFs), followed by a solids contactor (*i.e.*, bio-flocculation), and then clarification (Figure 1). Much of the secondary effluent undergoes tertiary treatment (coagulation, flocculation, granular media filtration and disinfection) to produce recycled water used for agricultural irrigation. The unused secondary effluent is discharged to the Monterey Bay through an existing ocean outfall. The RTP also accepts trucked brine waste ("hauled waste") for ocean disposal, which is stored in a pond and mixed with secondary effluent prior to being discharged.

The AWPF will include several advanced treatment technologies for purifying the secondary effluent water: ozone (O_3), membrane filtration (MF), reverse osmosis (RO), an advanced oxidation process (AOP) using ultraviolet light (UV) and hydrogen peroxide, and finished water stabilization. The Project Partners conducted a pilot-scale study of the ozone, MF, and RO processes of the AWPF from December 2013 through July 2014, successfully demonstrating the ability of the various treatment processes to produce highly-purified recycled water that complies with the California Water Recycling Criteria for Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application (Groundwater Replenishment Regulations) (SWRCB, 2014) and Central Coast Water Quality Control Plan (Basin Plan) standards, objectives and guidelines for groundwater (CCWQCB, 2011). After the pilot-scale study, an advanced water purification demonstration facility was built to gain additional experience operating ozone, MF, and RO processes; the new facility also includes a UV/hydrogen peroxide AOP and stabilization treatment. The demonstration facility is operated and maintained by MRWPCA.

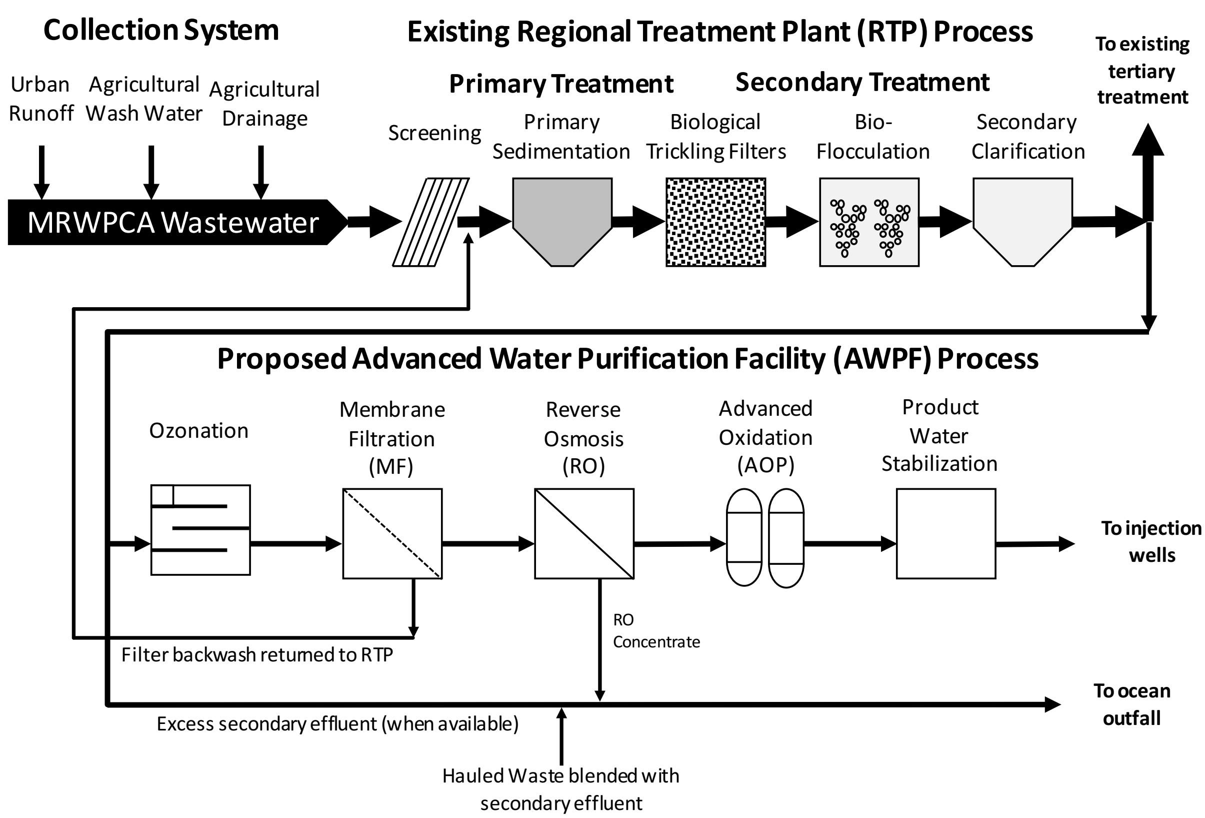

Figure 1 – Simplified diagram of existing MRWPCA RTP and Future AWPF treatment processes

Reverse osmosis is an excellent removal process, separating out most dissolved constituents from the recycled water. The dissolved constituents removed through RO are concentrated into a waste stream known as the RO concentrate. Unlike the waste from the MF, the RO concentrate cannot be recycled back to the RTP headworks and would be discharged through the existing ocean outfall. Discharges through the outfall are subject to National Pollution Discharge Elimination System (NPDES) permitting based on requirements specified in the California State Water Resources Control Board 2015 Ocean Plan ("Ocean Plan") (SWRCB, 2015). Monitoring of the RO concentrate was conducted during the Project's pilot-scale study.

2.2 California Ocean Plan

The California Ocean Plan sets forth numeric and narrative water quality objectives for ocean waters with the intent of protecting the ocean's beneficial uses, which include recreation, aesthetics, navigation, fishing, mariculture, areas of special biological significance, rare and endangered species, habitat, fish migration, fish spawning, and shellfish harvesting (SWRCB, 2015). For typical wastewater discharges, when released from an outfall, the wastewater and ocean water undergo rapid mixing due to the momentum and buoyancy of the discharge.[2] The mixing that occurs in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). The numeric Ocean Plan objectives are to be met after the initial dilution of the discharge into the ocean. The initial dilution occurs in an area known as the zone of initial dilution (ZID), and the Ocean Plan objectives are to be met at the edge of the ZID. The extent of dilution in the ZID is quantified as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive NPDES permit limits that are applied to a wastewater discharge prior to ocean dilution.

The current RTP wastewater discharge is governed by Order No. R3-2014-0013 (NPDES permit No. CA0048551) issued by the Central Coast Regional Water Quality Control Board (RWQCB). Because the current NPDES permit for the existing ocean outfall must be amended to include RO concentrate in the waste discharge, comparing future discharge concentrations to current NPDES permit limits would not be an appropriate metric or threshold for determining whether the Project would have a significant impact on marine water quality. Instead, compliance with the Ocean Plan objectives was selected as an appropriate threshold for determining whether the Project would result in a significant impact requiring mitigation. Dilution modeling of the Project's ocean discharge was conducted by Dr. Philip Roberts
, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, to determine D_m values for the various discharge scenarios at different ambient ocean conditions. The dilution modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan.

2.3 Objective of Technical Memorandum

Trussell Technologies, Inc. (Trussell Tech) estimated worst-case in-pipe discharge water quality (*i.e.*, prior to being discharged through the outfall and diluted in the ocean) for the Project and used the dilution modeling results determined by Dr. Roberts to provide an assessment of whether the Project would consistently meet Ocean Plan water quality objectives. The purpose of this technical memorandum (TM) is to summarize the assumptions, methodology, results and conclusions of the Ocean Plan compliance assessment.

3 Methodology for Ocean Plan Compliance Assessment

To analyze impacts due to ocean discharge of RO concentrate, the Project technical team (Trussell Tech with MRWPCA staff) conducted a thorough water quality and flow characterization of the current secondary effluent and the new sources of water to be diverted

[2] Municipal wastewater effluent, being low in salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water.

into the wastewater collection system. After primary and secondary treatment, this effluent will be used as influent to the AWPF. The team collected all available water quality data for secondary effluent and water quality monitoring results for the Project's new source waters through a one-year monitoring program conducted from July 2013 to June 2014. The new source waters included in the monitoring program were agricultural wash water, and waters from the Blanco Drain, Lake El Estero, and Tembladero Slough. Regular monthly and quarterly sampling was carried out for the RTP secondary effluent, agricultural wash water, and Blanco Drain drainage water. Limited sampling of stormwater from Lake El Estero was performed due to seasonal availability, and there was one sampling event for the Tembladero Slough drainage water. Additional data from routine monitoring of the Reclamation Ditch and Salinas Urban Stormwater Runoff was also incorporated into the analysis (for years 2012 to 2017).

Lake El Estero and the Tembladero Slough are no longer included as new source waters for the Project, and so the monitoring data for those source waters were not included in this analysis. For the Reclamation Ditch, water quality data related to the Ocean Plan were only available for ammonia, copper, zinc, arsenic, cadmium, lead, nickel, and total phenols. For the remaining constituents identified in the Ocean Plan, the concentrations in the Reclamation Ditch waters were conservatively assumed to be the higher of either the Blanco Drain or Tembladero Slough concentrations.

Using the full suite of data, the team estimated the future worst-case water quality of the combined ocean discharge. With the results of dilution modeling, concentrations at the edge of the ZID were estimated to determine the ability of the Project to comply with the Ocean Plan objectives. The purpose of this section is to outline the methodology used to make this determination. A summary of the methodology is presented in Figure 2.

3.1 Methodology for Determination of Discharge Water Quality

Water quality data for three types of discharge waters were used to estimate the future combined water quality in the ocean outfall discharge under Project conditions: (1) the RTP secondary effluent, (2) hauled waste (discussed in Section 3.1.3), and (3) the Project RO concentrate. First, Trussell Tech estimated the potential influence of the new source waters (*e.g.*, agricultural wash water, stormwater and agricultural drainage waters) on the worst-case water quality for each of the three types of discharge water. The volumetric contribution of each new source water will change under the different flow scenarios that can occur under the Project. MRWPCA staff worked with Schaaf and Wheeler consultants to estimate the available volume of source waters for each month of the different types of operational years for the Project (Andrew Sterbenz, Schaaf and Wheeler, June 05, 2017). The monthly flows for each source water were estimated for three types of operational years: (1) wet/normal years where a drought reserve is being built, (2) wet/normal years where the drought reserve has been met, and (3) a drought year. All the different flow scenarios were considered in developing the assumed worst-case concentrations for the Ocean Plan constituents in the secondary effluent. This conservative approach used the highest observed concentrations from all data sources for each source water in the analysis[3].

Cyanide has been detected in the RTP effluent and other new source waters (Agricultural Wash Water and the Blanco Drain) at relatively high levels compared to the discharge requirements. The maximum detected value in the RTP effluent was 81 µg/L; the maximum seen in the Agricultural Wash Water and the Blanco Drain was 89 µg/L and 127 µg/L, respectively.

Several investigations have been conducted into the accuracy of sampling, preservation, and analytical methods for cyanide. These have shown that sample holding time and preservation have a significant impact on measured cyanide concentrations. Pandit et al. (2006) demonstrated that when sodium hydroxide was added to adjust the pH higher than 12, as specified in accepted methods for cyanide measurement in order to preserve the sample, the measured cyanide concentrations were consistently higher than those for samples preserved at pH 10 to 11. Pandit et al. also showed that cyanide levels increased within the recommended holding times of the approved cyanide methods (at pH 12).

In addition, the 2015 California Ocean Plan specifies the following:

If a discharger can demonstrate to the satisfaction of the Regional Water Board (subject to EPA approval) that an analytical method is available to reliably distinguish between strongly and weakly complexed cyanide, effluent limitations for cyanide may be met by the combined measurement of free cyanide, simple alkali metal cyanides, and weakly complexed organometallic cyanide complexes. In order for the analytical method to be acceptable, the recovery of free cyanide from metal complexes must be comparable to that achieved by the approved method in 40 CFR PART 136, as revised May 14, 1999.

Based on the above information, it is recommended that additional cyanide sampling be conducted using different methods (*e.g.,* analysis within 15 minutes with no preservation) to determine if the current laboratory method leads to inaccurately high cyanide values. It is also recommended to determine if a method can be performed that distinguishes between weakly and strongly complexed cyanide. Until this evaluation is completed, all cyanide concentrations presently available are used in this Ocean Plan compliance assessment.

It was also assumed that no constituent removal occurred through the RTP when considering the new source waters, and so the concentration detected through the source water monitoring program was used to calculate the concentration in the RTP secondary effluent. The exceptions to this statement are dieldrin and DDT. RTP sampling and bench-scale testing were conducted for these constituents to determine removal through the RTP, ozone and MF processes. The minimum removal through the RTP and ozone process was observed to be 91% and 96% for dieldrin and DDT, respectively (Trussell Tech, 2016b). The MF process was observed to remove

[3] The exception to this statement is copper. The median copper concentration was used to estimate the water quality impact of the additional source waters, as the maximum values detected appear to be outliers. Additionally, the minimum Ocean Plan objective for copper is a 6-month median value, and so it is reasonable to use the median value detected from the new source waters to estimate compliance.

a minimum of 97% and 92% for dieldrin and DDT, respectively (Trussell Tech, 2016b). However, the MF system only removes the constituents from the RO concentrate, as the MF backwash water is returned to the RTP headworks.

Once the estimated worst-case water quality was determined for the RTP secondary effluent, these values were used in estimating the worst-case water qualities for the hauled waste and the RO concentrate, as appropriate. The methodology for each type of water is further described in the following sections.

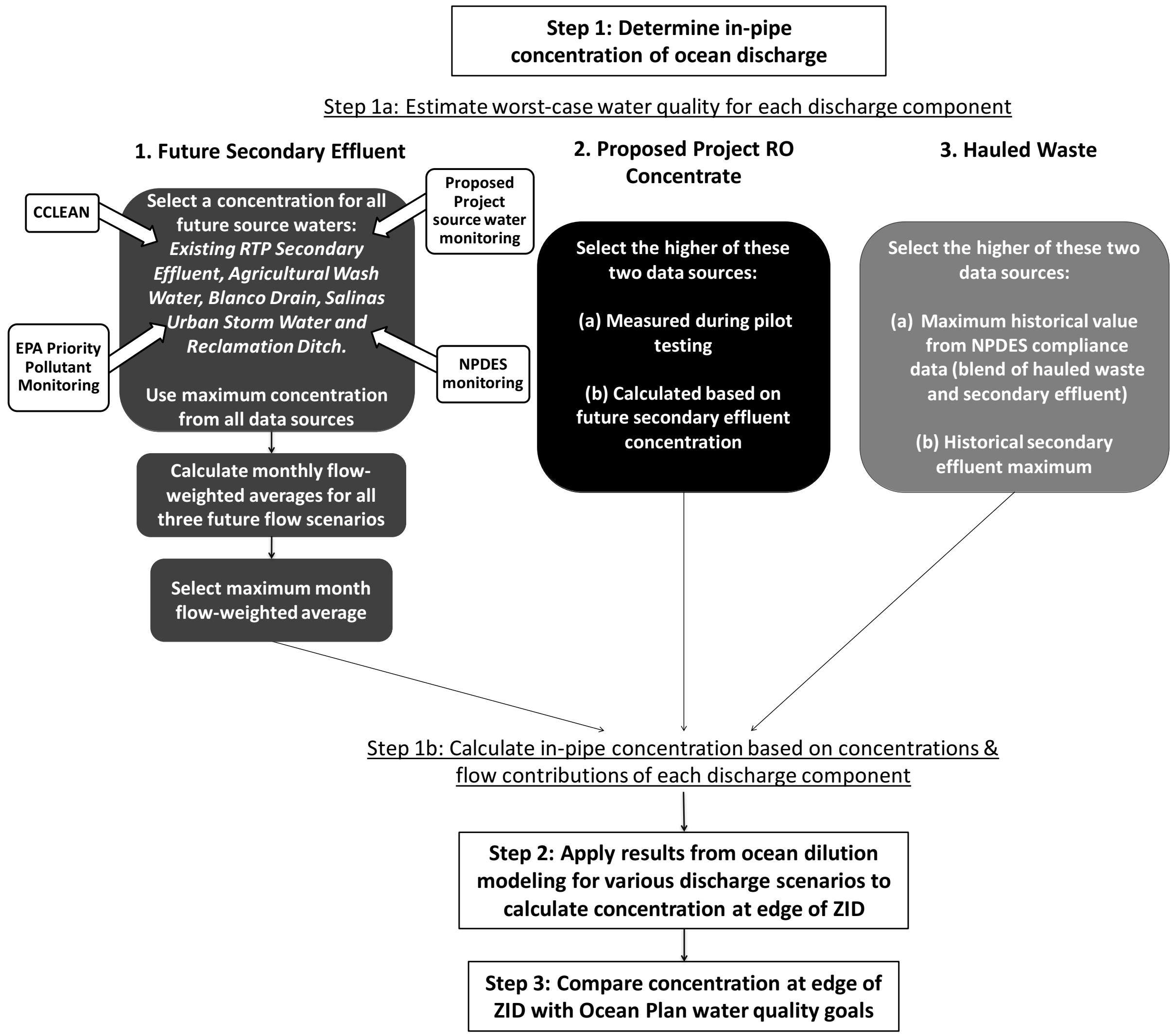

Figure 2 – Logic flow-chart for determination of project compliance with the Ocean Plan objectives

3.1.1 Future Secondary Effluent

The Project involves bringing new source waters into the RTP, and so the water quality of those source waters, as well as the existing secondary effluent, was taken into account to estimate the water quality of the future secondary effluent. Although the new source waters will be brought into the RTP influent, it was assumed that no removal of constituents occurred through the RTP when calculating the secondary effluent concentration (except dieldrin and DDT, as described in the previous section). The following sources of data were considered for selecting an existing secondary effluent concentration for each constituent in the analysis:

- Source water monitoring conducted for the Project from July 2013 through June 2014
- NPDES storm water discharge monitoring for the City of Salinas (2012 – 2017) and the Salinas Industrial Ponds (2017)
- RTP historical NPDES compliance data collected semi-annually by MRWPCA (2005-Spring 2017)
- Historical NPDES RTP Priority Pollutant data collected annually by MRWPCA (2004-2016)
- Data collected semi-annually by the Central Coast Long-Term Environmental Assessment Network (CCLEAN) (2008-2016)

The existing secondary effluent concentration for each constituent selected for the analysis was the maximum reported value from the above sources.

Limited data sources were available for several of the new source waters (*i.e.*, agricultural wash water, Blanco Drain, and the Reclamation Ditch). Agricultural wash water and Blanco Drain water quality data was collected during the source water monitoring conducted for the Project. NPDES storm water discharge monitoring for the City of Salinas (2012 – 2017) and Salinas Industrial Ponds monitoring (2017) provided additional data for the Reclamation Ditch and the agricultural wash water. For these new source waters, the maximum observed concentration was selected for Ocean Plan compliance analysis.[4]

Source water flows used for calculation of blended future secondary effluent concentrations were taken from the three projected operational conditions prepared by MRWPCA: (a) normal/wet year, building reserve, (b) normal/wet year, full reserve, and (c) drought year. For each constituent, a total of 36 future concentrations were calculated – 12 months of the year for the three projected future source water flow contributions. Of these concentrations, the maximum monthly flow-weighted concentration was selected for each constituent to be used for the Ocean Plan compliance analysis.

When a constituent could not be quantified or was not detected, it was reported as less than the Method Reporting Limit (<MRL).[5] Because the actual concentration could be any value equal to or less than the MRL, the conservative approach is to use the value of the MRL in the flow-

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[4] Except for copper, where instead the median was calculated from the data for each new source water because the maximum values detected seemed to be outliers, and the Ocean Plan objective for copper considered in this assessment is the 6-month median concentration.

[5] The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (*i.e.*, the lower limit of quantitation). Therefore, acceptable quality control and quality assurance procedures are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the Method Detection Limit (or greater). The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. (40 Code of Federal Regulations Section136 Appendix B).

weighting calculations. In some cases, constituents were not detected above the MRL in any of the source waters, so the concentrations for these constituents were reported as ND (<MRL) in this TM. In cases where the analysis of a constituent was detected but was not quantifiable, the results were also reported in this TM as less than the Method Reporting Limit, ND (<MRL). For some non-detected constituents, the MRL exceeds the Ocean Plan objective, and thus no compliance determination could be made.[6]

The following approaches were used for addressing the cases where a constituent was reported as less than the MRL:

- **Aggregate constituents with multiple congeners or sub-components:** Some Ocean Plan constituents are a combination of multiple congeners or sub-components (*e.g.*, chlordane, PAHs, PCBs, and TCDD equivalents, among others). Per the Ocean Plan, if individual congeners or sub-components are below the MRL, they are assumed to be zero for the purposes of calculating the aggregate parameter.
- **Combining different types of waters:** The same approach was used for both combining different source waters (*i.e.*, estimating future secondary effluent concentrations based on a flow-weighted average of source water contributions) and for combining the different discharge components (*i.e.*, RTP secondary effluent, hauled waste, and RO concentrate). For each constituent:
  - ***When all waters had maximum values reported above the MRL*:** The flow-weighted average of the maximum detected concentrations was used when all waters had values reported above the MRL.
  - ***When some or all waters had maximum values reported as less than the MRL*:**
    - When the MRL was at least two orders of magnitude greater (*i.e.*, at least 100 times greater) than the highest detected value from the other waters, the waters with maximum concentrations below the MRL were ignored. This case is exclusive to times when CCLEAN data were reported as detections for the RTP secondary effluent, and all the other source waters were below the MRL[7] (*i.e.*, hexachlorobutadiene was detected at a concentration of 9.0×10^{-6} μg/L in the secondary effluent via CCLEAN, and the MRL of all other source waters was 0.5 μg/L). The analytical methods used for CCLEAN can detect concentrations many orders of magnitude below the detection limits for traditional methods, and thus to include the MRL value from the other methods would overshadow the CCLEAN data. Additionally, in cases where the traditional analytical method had an MRL greater than the Ocean Plan objective, performing the analysis using the high MRL from the non-CCLEAN methods would result in an inability to make a compliance determination for these constituents.

[6] This phenomenon is common in the implementation of the Ocean Plan where for some constituents, suitable analytical methods are not capable of measuring low enough to quantify the minimum toxicologically relevant concentrations. For these constituents, a discharge is considered compliant if the monitoring results are less than the MRL.

[7] Specifically, this case applies to endrin, fluoranthene, chlordane, heptachlor epoxide, hexachlorobenzene, hexachlorobutadiene, PCBs, and toxaphene.

- When the MRL was less than two orders of magnitude greater (*i.e.*, less than 100 times greater) than the highest detected value from the other waters, the constituents were reported as less than the MRL and were assumed to have a concentration equal to the MRL for the purposes of calculating a flow-weighted average (*i.e.*, mercury was detected in the secondary effluent at a concentration of 0.019 µg/L, but was not detected in any other source waters, where the MRL was 0.2 µg/L).

3.1.2 GWR RO Concentrate

Two potential worst-case estimates of constituent concentrations were available for assessing the Project's RO concentrate:

- Measured in the concentrate during pilot testing
- Calculated from the blended future secondary effluent concentration, using the following treatment assumptions[8]:
  - No removal prior to the RO process (*i.e.*, no removal through the RTP or AWPF ozone or MF), except for dieldrin and DDT
  - 81% RO recovery (*i.e.*, of the water feeding into the RO system, 81% is product water, also known as permeate, and 19% is the RO concentrate)
  - Complete rejection of each constituent by the RO membrane (i.e., 100% of the constituent is in the RO concentrate)

The higher of these two values was selected as the final concentration of the RO concentrate for all constituents, except as noted in the Table 1 footnotes.

3.1.3 Hauled Waste

Currently, small volumes of brine are trucked to the RTP and blended with secondary effluent in a brine pond. The blended waste from this pond ("hauled waste") is then discharged along with the secondary effluent bound for ocean discharge (when there is excess secondary effluent to discharge). For the Project, the hauled waste will be discharged with both secondary effluent and RO concentrate (see Figure 1). The point where the hauled waste is added to the ocean discharge water is downstream of the AWPF intake, and thus will not impact the quality of the Project product water or the RO concentrate. Currently, all sampling of the hauled waste takes place after dilution by secondary effluent in the brine pond, so the data represent a mix of secondary effluent and brine water. It is appropriate to use these data for the hauled waste quality since the practice of diluting with secondary effluent will continue in the future. Two potential values were available for the hauled waste constituent concentrations:

- Historical NPDES compliance data collected semi-annually by MRWPCA (2005-Spring 2017) of hauled waste water diluted with existing secondary effluent
- Calculated future secondary effluent constituent concentrations, as previously described.

The higher of these two values was selected for all constituents; because the hauled waste is diluted by secondary effluent prior to discharge, it is also appropriate to use future secondary effluent concentrations to represent the concentration within the hauled waste. Even if a

[8] Based on the treatment assumptions, the RO concentrate would equal 5.3 times the AWPF influent (*i.e.*, blended future secondary effluent) concentration.

constituent was not present in the hauled waste, if it was present in the secondary effluent it would be present in the combined discharge.

3.1.4 Combined Ocean Discharge Concentrations

Having calculated the worst-case future concentrations for each of the three discharge components (i.e., secondary effluent, RO concentrate, blended hauled waste), the combined concentration prior to discharge was determined as a flow-weighted average of the contributions of each of these three discharge components. Depending on drought conditions and water usage for agricultural irrigation, the amount of secondary effluent discharged to the ocean will vary. A range of potential discharge scenarios was considered to encompass the worst-case water quality conditions of the combined discharge, as described in Section 4.2.

3.2 Ocean Modeling and Ocean Plan Compliance Analysis Methodology

In order to determine Ocean Plan compliance, Trussell Tech used the following information: (1) the in-pipe concentration (*i.e.*, pre-ocean dilution) of a constituent ($C_{in\text{-}pipe}$) that was calculated as discussed in the previous section, (2) the minimum probable dilution for ocean mixing (D_m) for the relevant discharge flow scenarios that was modeled by Dr. Roberts[9] (Roberts, P. J. W, 2017), and (3) the background concentration of the constituent in the ocean ($C_{Background}$) that is specified in the Ocean Plan's "Table 3." With this information, the concentration at the edge of the zone of initial dilution (C_{ZID}) was calculated using the following equation:

$$C_{ZID} = \frac{C_{In-pipe} + D_m * C_{Background}}{1 + D_m} \quad (1)$$

The C_{ZID} was then compared to the Ocean Plan objectives[10] in the Ocean Plan's "Table 1" (SWRCB, 2015). As described previously, the in-pipe concentration was estimated as a flow-weighted average of the future secondary effluent, Project RO concentrate, and hauled waste with the concentrations determined as discussed above. The D_m values for various flow scenarios were determined by modeling. Note that this approach could not be applied for some constituents (*e.g.*, acute toxicity, chronic toxicity, and radioactivity[11]).

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[9] The Ocean Plan defines D_m differently than Dr. Roberts. Dr. Roberts provided results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S – 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

[10] Note that the Ocean Plan (see Ocean Plan Table 2) also defines effluent limitations for oil and grease, suspended solids, settable solids, turbidity, and pH. These parameters were not evaluated in this assessment. It is assumed that, if necessary, the pH of the water would be adjusted to be within acceptable limits prior to discharge; the current AWPF design does not include to ability to change the RO concentrate pH because pilot testing and RO performance modeling indicated it was not necessary. Oil and grease, suspended solids, settable solids, and turbidity in the RO concentrate would be significantly lower than the secondary effluent. Prior to the RO treatment, the process flow would be treated by MF, which will reduce these parameters, and the waste stream from the MF will be returned to RTP headworks.

[11] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives (Trussell

Two methods were used when modeling the ocean mixing: (1) the mathematical model UM_3 in the United States Environmental Protection Agency's (EPA's) Visual Plume suite, and (2) the NRFIELD model (for positively buoyant plumes only), also from the EPA's Visual Plume suite (Roberts, P. J. W., 2017). When results were provided from both methods, the D_m value estimated with the UM_3 model was selected for consistency, such that all dilution results used for this analysis were determined using the same model.

Dr. Roberts documented the dilution modeling assumptions and results in a technical memorandum (Roberts, P. J. W., 2017, Appendix A). Additional analysis assumptions were made as follows:

- **Flow**: A sensitivity analysis of the relationship between D_m and flow rate was performed for the various discharge types. The greatest D_m sensitivity to flow changes was determined to be from variations in the RTP secondary effluent flow. To simplify the analysis, the flow scenarios used in the compliance analysis only considered the maximum flows for the hauled waste and the RO concentrate because these flows result in the lowest D_m, thus making the analysis conservative. The flows considered for each discharge type are as follows:
  - ***Secondary effluent*:** a range of conditions was modeled that reflect realistic future discharge scenarios (minimum flow, moderate flow, and maximum flow).
  - ***Project RO concentrate*:** 1.17 million gallons per day (mgd), which would be the resulting RO concentrate flow when the AWPF is producing 5.0 mgd of highly-purified recycled water (corresponding AWPF influent is 6.86 mgd of RTP secondary effluent). Although the AWPF will not be operated at this influent flowrate year-round, this is the highest potential RO concentrate flow and therefore the most conservative assessment.
  - ***Hauled waste:*** A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded when determining the D_m value. However, the impact of hauled waste on assumed in-pipe water quality was still assessed. A hauled waste flow of 0.03 mgd blended with secondary effluent for a total flow of 0.1 mgd was used for calculating the in-pipe concentrations of each constituent.
- **Total Dissolved Solids (TDS)**: the greatest dilution is achieved when the salinity of the discharge water is lower and the most different from the ambient ocean salinity; therefore, the most conservative TDS will be the highest (*i.e.*, closest to ambient salinity) of:
  - ***Secondary effluent:*** 1,100 milligram per liter (mg/L), which is the maximum expected future TDS, taking into account the flow contribution of each source water and the maximum observed TDS value from each source water

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Technologies, 2015c and 2016a). Current discharges of the secondary effluent and hauled waste are monitored semiannually for acute toxicity, chronic toxicity, and radioactivity per the existing NPDES permit. See section 4.4.

  - ***Project RO concentrate*:** 5,800 mg/L, which is the maximum expected future TDS based on the maximum expected future secondary effluent TDS and the RO treatment assumptions listed in the section above (*i.e.* in a drought year).
- **Ocean salinity**: 33,340 mg/L – 33,890 mg/L, depending on the ocean condition
- **Temperature**:
  - ***Secondary effluent*:** 20˚C
  - ***Project RO concentrate***: 20˚C

An additional consideration of the ocean dilution modeling is the variation in ocean conditions throughout the year. Three conditions were modeled for all flow scenarios: Davidson (December to February), Upwelling (March to September), and Oceanic (October to November)[12]. To conservatively demonstrate Ocean Plan compliance, the lowest D_m from the applicable ocean conditions was used for each flow scenario.

Ocean dilution modeling covered the range of potential operating conditions, and the results showed that Ocean Plan compliance would be achieved when considering all potential secondary effluent flowrates. To simplify the calculation and presentation of these results, representative flowrate ranges were chosen. To select the representative flow scenarios for compliance assessment, the balance between in-pipe dilution and dilution through the outfall was considered. In general, higher secondary effluent flows discharged to the ocean would provide dilution of the Project RO concentrate; however, greater dilution due to ocean water mixing would be provided at lower wastewater discharge flows. The balance of these influences was considered in determining compliance under the eight representative discharge conditions that are described in Section 4.2 for the Project.

4 Ocean Plan Compliance Results

4.1 Water Quality of Combined Discharge

As described above, the first step in the Ocean Plan compliance analysis was to estimate the worst-case water quality for each of the three future discharge components: future RTP effluent, Project RO concentrate, and blended hauled waste. A summary of the estimated water qualities of these components is given in Table 1. Additional considerations and assumptions for each constituent are documented in the Table 1 notes section.

Table 1 – Summary of estimated worst-case water quality for the three waste streams that would be discharged through the ocean outfall

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Ocean Plan water quality objectives for protection of marine aquatic life					
Arsenic	µg/L	45	45	12	1,12
Cadmium	µg/L	1.2	1.2	6.5	2,11
Chromium (Hexavalent)	µg/L	2.5	130	13	2,11

[12] Note that these ranges assign the transitional months (March, September, and November) to the ocean condition that is typically more restrictive at relevant discharge flows.

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Copper	µg/L	11	39	58	2,11,17
Lead	µg/L	2.69	2.69	14.2	2,11
Mercury	µg/L	0.085	0.085	0.510	5,12
Nickel	µg/L	12.2	12.2	64	2,11
Selenium	µg/L	6.4	75	34	2,11
Silver	µg/L	0.77	0.77	4.05	5,11
Zinc	µg/L	57.5	170	303	2,11
Cyanide	µg/L	89.7	89.7	143	2,12,13
Total Chlorine Residual	µg/L	ND(<200)	ND(<200)	ND(<200)	10
Ammonia (as N), 6-month median	µg/L	42,900	42,900	225,789	1,11,18
Ammonia (as N), daily maximum	µg/L	49,000	49,000	257,895	1,11,18
Acute Toxicity	TUa	2.3	2.3	0.77	7,12,13
Chronic Toxicity	TUc	40	40	100	7,12,13
Phenolic Compounds (non-chlorinated)	µg/L	69	69	363	1,9,11
Chlorinated Phenolics	µg/L	ND(<20)	ND(<20)	ND(<20)	4,14
Endosulfan	µg/L	0.046	0.046	0.24	5,9,11
Endrin	µg/L	0.000112	0.000112	0.00059	3,11
HCH (Hexachlorocyclohexane)	µg/L	0.059	0.059	0.312	5,9,11
Radioactivity (Gross Beta)	pCi/L	32	307	34.8	1,7,12,13
Radioactivity (Gross Alpha)	pCi/L	18	457	14.4	1,7,12,13
Objectives for protection of human health - noncarcinogens					
Acrolein	µg/L	8.3	8.3	44	2,11
Antimony	µg/L	0.78	0.78	4.1	2 ,11
Bis (2-chloroethoxy) methane	µg/L	ND(<4.0)	ND(<4.0)	ND(<1)	4,14
Bis (2-chloroisopropyl) ether	µg/L	ND(<4.0)	ND(<4.0)	ND(<1)	4,14
Chlorobenzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Chromium (III)	µg/L	6.9	87	36	2,11
Di-n-butyl phthalate	µg/L	ND(<7)	ND(<7)	ND(<1)	4,14
Dichlorobenzenes	µg/L	1.6	1.6	8	5,11
Diethyl phthalate	µg/L	ND(<5)	ND(<5)	ND(<1)	4,14
Dimethyl phthalate	µg/L	ND(<2)	ND(<2)	ND(<0.5)	4,14
4,6-dinitro-2-methylphenol	µg/L	ND(<19)	ND(<19)	ND(<5)	4,14
2,4-dinitrophenol	µg/L	ND(<9)	ND(<9)	ND(<5)	4,14
Ethylbenzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Fluoranthene	µg/L	0.00684	0.00684	0.0360	3,11
Hexachlorocyclopentadiene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.05)	4,14
Nitrobenzene	µg/L	ND(<2.1)	ND(<2.1)	ND(<1)	4,14
Thallium	µg/L	0.68	0.68	3.6	2,11
Toluene	µg/L	0.48	0.48	2.5	5,11
Tributyltin	µg/L	ND(<0.05)	ND(<0.05)	ND(<0.02)	8,14
1,1,1-trichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Objectives for protection of human health - carcinogens					
Acrylonitrile	µg/L	2.5	2.5	13	2,11
Aldrin	µg/L	ND(<0.007)	ND(<0.007)	ND(<0.01)	4,14
Benzene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Benzidine	µg/L	ND(<18.6)	ND(<18.6)	ND(<0.05)	4,14
Beryllium	µg/L	ND(<0.68)	0.0052	ND(<0.5)	4,14
Bis(2-chloroethyl)ether	µg/L	ND(<4.0)	ND(<4.0)	ND(<1)	4,14
Bis(2-ethyl-hexyl)phthalate	µg/L	78	78	411	1,11
Carbon tetrachloride	µg/L	0.50	0.50	2.66	2,11
Chlordane	µg/L	0.00122	0.00122	0.0064	3,9,11
Chlorodibromomethane	µg/L	2.2	2.2	12	2,11

Constituent	Units	Secondary Effluent	Hauled Waste	RO Concentrate	Notes
Chloroform	µg/L	34	34	180	2,11
DDT	µg/L	0.001	0.001	0.0003	2,9,11,15
1,4-dichlorobenzene	µg/L	1.6	1.6	8.4	1,11
3,3-dichlorobenzidine	µg/L	ND(<18)	ND(<18)	ND(<2)	4,14
1,2-dichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
1,1-dichloroethylene	µg/L	ND(<0.5)	0.5	ND(<0.5)	4,14
Dichlorobromomethane	µg/L	2.4	2.4	12	2,11
Dichloromethane (methylenechloride)	µg/L	0.88	0.88	4.6	2,11
1,3-dichloropropene	µg/L	0.56	0.56	3.0	2,11
Dieldrin	µg/L	0.0015	0.0015	0.0001	2,11,15
2,4-dinitrotoluene	µg/L	ND(<2)	ND(<2)	ND(<0.1)	4,14
1,2-diphenylhydrazine (azobenzene)	µg/L	ND(<4)	ND(<4)	ND(<1)	4,14
Halomethanes	µg/L	1.3	1.3	6.9	2,9,11
Heptachlor	µg/L	ND(<0.01)	ND(<0.01)	ND(<0.01)	4,14
Heptachlor epoxide	µg/L	0.000088	0.000088	0.000463	3,11
Hexachlorobenzene	µg/L	0.000078	0.000078	0.000411	3,11
Hexachlorobutadiene	µg/L	0.000009	0.000009	0.000047	3,11
Hexachloroethane	µg/L	ND(<2.1)	ND(<2.1)	ND(<0.5)	4,14
Isophorone	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
N-Nitrosodimethylamine	µg/L	0.086	0.086	0.150	2,12,13
N-Nitrosodi-N-Propylamine	µg/L	0.076	0.076	0.019	1,12,13
N-Nitrosodiphenylamine	µg/L	ND(<2.1)	ND(<2.1)	ND(<1)	4,14
PAHs	µg/L	0.04	0.04	0.21	2,9,11
PCBs	µg/L	0.00068	0.00068	0.00357	3,9,11
TCDD Equivalents	µg/L	1.39E-7	1.39E-7	7.29E-7	2,8,9,11
1,1,2,2-tetrachloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Tetrachloroethylene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
Toxaphene	µg/L	0.0071	0.0071	0.0373	3,11
Trichloroethylene	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
1,1,2-trichloroethane	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14
2,4,6-trichlorophenol	µg/L	ND(<2.1)	ND(<2.1)	ND(<1)	4,14
Vinyl chloride	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	4,14

Table 1 Notes:

RTP Effluent and Hauled Waste Data

[1] Existing RTP effluent exceeds concentrations observed in other proposed source waters; the value reported is the existing secondary effluent value.

[2] The proposed new source waters may increase the secondary effluent concentration; the value reported is based on estimated source water blends.

[3] RTP effluent value is based on CCLEAN data; no other source waters were considered due to MRL differences.

[4] MRL provided represents the maximum flow-weighted MRL based on the blend of source waters.

[5] The only water with a detected concentration was the RTP effluent, however the flow-weighted concentration increases due to higher MRLs for the proposed new source waters.

[6] Additional source water data are not available; the reported value is for RTP effluent.

[7] Calculation of the flow-weighted concentration was not feasible due to the constituent, and so the maximum observed value is reported.

[8] Agricultural Wash Water data are based on an aerated sample, instead of a raw water sample.

[9] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.

[10] For all waters, dechlorination will be provided when needed such that the total chlorine residual will be below detection.

RO Concentrate Data

[11] The value presented represents a calculated value assuming no removal prior to RO, complete rejection through RO membrane, and an 81% RO recovery.

[12] The value represents the maximum value observed during the pilot testing study.

[13] The calculated value for the RO concentrate data (described in note 11) was not used in the analysis because it was not considered representative. It is expected that the value would increase as a result of treatment through the AWPF (*e.g.* formation of N-Nitrosodimethylamine as a disinfection by-product), or that it will not concentrate linearly through the RO (*e.g.* toxicity and radioactivity).

[14] The MRL provided represents the limit from the source water and pilot testing monitoring programs.

[15] The value presented represents a calculated value assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, 36% and 44% removal through ozone for DDT and dieldrin, respectively, 92% and 97% removal through MF for DDT and dieldrin, respectively, recycling of the MF backwash to the RTP, complete rejection through the RO membrane, and an 81% RO recovery. The assumed removals are based on results from ozone bench-scale testing of Blanco Drain water blended with secondary effluent and low detection sampling through the RTP.

General

[16] Footnote not used

[17] The value reported for the secondary effluent was calculated using the median of the data collected for the new source waters and is an estimate of the potential increase in concentration of the secondary effluent based on estimated source water blends. The median value was used because the maximum values detected in new source waters appear to be outliers, and because the Ocean Plan objective is a 6-month median concentration, it is reasonable to use the median value detected from these source waters.

[18] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).

4.2 Ocean Modeling Results

Dr. Roberts performed dilution modeling of various discharge scenarios that included combinations of RTP secondary effluent, hauled waste, and Project RO concentrate (Appendix A, Table C3). Year-round compliance with the Ocean Plan objectives was assessed through the evaluation of eight representative discharge scenarios covering the expected range of secondary effluent discharge flows. All scenarios assume the maximum flow rates for the RO concentrate and hauled waste, which is a conservative assumption in terms of constituent loading and minimum dilution.

To assess potential future discharge compositions, various secondary effluent flow rates were included in this analysis. These scenarios encompass the range of operating conditions that is expected to occur for the Project, as well as the best- and worse-case ocean dilution conditions. The eight scenarios used for the compliance assessment, in terms of secondary effluent flow rates to be discharged with the other waste streams, are shown in Table 2, and include:

- **Minimum Wastewater Flow (Upwelling) – Scenario 1:** the maximum influence of the Project RO concentrate on the ocean discharge (*i.e.*, no secondary effluent discharged). The Upwelling ocean condition was used since it represents the worst-case dilution for this flow scenario.
- **Low Wastewater Flow (Upwelling) – Scenarios 2-3:** significant influence of the Project RO concentrate on the ocean discharge (*i.e.*, minimal secondary effluent discharged). The

Upwelling ocean condition was used as it represents the worst-case dilution for this flow scenario.

- **Moderate Wastewater Flow (Upwelling) – Scenarios 4-7:** conditions with a moderate wastewater flow when the Project RO concentrate has a greater influence on the in-pipe water quality than in Scenario 8, but where the ocean dilution (D_m) is reduced due to the higher overall discharge flow (*i.e.*, compared to Scenarios 1-3). The Upwelling ocean condition was used as it represents the worst-case dilution for these scenarios.
- **High Wastewater Flow (Upwelling) – Scenario 8:** the highest expected flow that will be discharged. The Upwelling ocean condition was used as it represents the worst-case dilution for this flow scenario.

Table 2 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis

No.	Discharge Scenario (Ocean Condition)	Flows (mgd)			D_m
		Secondary Effluent	RO Concentrate	Blended Hauled Waste[1]	
1	Minimum wastewater flow (Upwelling)	0	1.17	0	498
2	Low wastewater flow (Upwelling)	0.4	1.17	0	460
3	Low Wastewater Flow (Upwelling)	0.6	1.17	0	442
4	Moderate wastewater flow (Upwelling)	2	1.17	0	358
5	Moderate wastewater flow (Upwelling)	4	1.17	0	299
6	Moderate wastewater flow (Upwelling)	4.5	1.17	0	289
7	Moderate wastewater flow (Upwelling)	5	1.17	0	281
8	High wastewater flow (Upwelling)	23.4	1.17	0	174

[1]A sensitivity analysis was conducted to determine the impacts of hauled waste on the modeled D_m results. It was concluded that neither the flow nor TDS from the addition of hauled waste had a significant impact on the modeled D_m result, and was therefore excluded from the D_m calculation.

4.3 Ocean Plan Compliance Results

The flow-weighted in-pipe concentration for each constituent was calculated for each modeled discharge scenario using the water quality presented in Table 1 and the flows presented in Table 2. The in-pipe concentration was then used to calculate the concentration at the edge of the ZID using the D_m values presented in Table 2[13]. The resulting concentrations for each constituent in each scenario were compared to the Ocean Plan objective to assess compliance. The estimated concentrations for all eight flow scenarios are presented as concentrations at the edge of the ZID

[13] The Ocean Plan defines D_m differently than Dr. Roberts. Dr. Roberts provided dilution results defined as S = [total volume of a sample]/[volume of effluent contained in the sample]. The D_m referenced in Equation 1 of the California Ocean Plan is defined as $D_m = S – 1$. A value of 1 was subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

(Table 3) and as a percentage of the Ocean Plan objective (Table 4). As shown, none of the constituents are expected to exceed their Ocean Plan objective[14]. Ammonia is estimated to reach a concentration closest to its objective, where it is 71% of the objective in Scenario 1.

Table 3 – Estimated concentrations of Ocean Plan constituents at the edge of the ZID

Constituent	Units	Ocean Plan Objective	Estimated Concentrations at Edge of ZID by Discharge Scenario							
			1	2	3	4	5	6	7	8
Objectives for protection of marine aquatic life										
Arsenic	µg/L	8	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.2
Cadmium	µg/L	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chromium (Hexavalent)	µg/L	2	0.04	0.04	0.04	0.03	0.02	0.02	0.02	0.02
Copper	µg/L	3	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Lead	µg/L	2	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mercury	µg/L	0.04	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	µg/L	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Selenium	µg/L	15	0.1	0.1	0.1	0.05	0.05	0.05	0.04	0.05
Silver	µg/L	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Zinc	µg/L	20	8.6	8.5	8.5	8.4	8.4	8.3	8.3	8.4
Cyanide	µg/L	1	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	424	371	355	302	278	276	273	295
Ammonia (as N) - Daily Max	µg/L	2,400	484	424	406	345	318	315	312	337
Acute Toxicity[a]	TUa	0.3								
Chronic Toxicity[a]	TUc	1								
Phenolic Compounds (non-chlorinated)	µg/L	30	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.5
Chlorinated Phenolics	µg/L	1	0.04	0.04	0.05	0.1	0.1	0.1	0.1	0.1
Endosulfan	µg/L	0.009	4.5E-04	4.0E-04	3.8E-04	3.2E-04	3.0E-04	3.0E-04	2.9E-04	3.2E-04
Endrin	µg/L	0.002	1.1E-06	9.7E-07	9.3E-07	7.9E-07	7.3E-07	7.2E-07	7.1E-07	7.7E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	5.9E-04	5.1E-04	4.9E-04	4.2E-04	3.9E-04	3.8E-04	3.8E-04	4.1E-04
Radioactivity (Gross Beta)[a]	pci/L	–								
Radioactivity (Gross Alpha)[a]	pci/L	–								
Objectives for protection of human health - noncarcinogens										
Acrolein	µg/L	220	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Antimony	µg/L	1200	0.01	0.01	0.01	0.01	0.01	0.005	0.005	0.01
Bis (2-chloroethoxy) methane	µg/L	4.4	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Chlorobenzene	µg/L	570	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Chromium (III)	µg/L	190000	0.1	0.1	0.1	0.06	0.05	0.05	0.05	0.05
Di-n-butyl phthalate	µg/L	3500	<0.003	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	<0.04
Dichlorobenzenes	µg/L	5100	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Diethyl phthalate	µg/L	33000	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02	<0.03

[14] Aldrin, benzidine, 3,3-dichlorobenzidine and heptachlor were not detected in any source waters, however their MRLs are greater than the Ocean Plan objective. Therefore, no percentages are presented Table 4 as no compliance conclusions can be drawn for these constituents. This is a common occurrence for ocean discharges since the MRL is higher than the ocean plan objective for some constituents.

Constituent	Units	Ocean Plan Objective	Estimated Concentrations at Edge of ZID by Discharge Scenario							
			1	2	3	4	5	6	7	8
Dimethyl phthalate	µg/L	820000	<0.001	<0.002	<0.002	<0.00	<0.01	<0.01	<0.01	<0.01
4,6-dinitro-2-methylphenol	µg/L	220	<0.01	<0.02	<0.02	<0.04	<0.1	<0.1	<0.1	<0.1
2,4-Dinitrophenol	µg/L	4.0	<0.01	<0.01	<0.01	<0.02	<0.03	<0.03	<0.03	<0.05
Ethylbenzene	µg/L	4100	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Fluoranthene	µg/L	15	6.8E-05	5.9E-05	5.7E-05	4.8E-05	4.4E-05	4.4E-05	4.4E-05	4.7E-05
Hexachlorocyclopentadiene	µg/L	58	<0.0002	<0.0004	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.003
Nitrobenzene	µg/L	4.9	<0.002	<0.003	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01
Thallium	µg/L	2	0.01	0.01	0.01	0.005	0.004	0.004	0.004	0.005
Toluene	µg/L	85000	0.005	0.004	0.004	0.003	0.003	0.003	0.003	0.003
Tributyltin	µg/L	0.0014	<4.5E-05	<6.3E-05	<7.0E-05	<1.1E-04	<1.4E-04	<1.5E-04	<1.6E-04	<2.8E-04
1,1,1-Trichloroethane	µg/L	540000	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Objectives for protection of human health - carcinogens										
Acrylonitrile	µg/L	0.10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Aldrin[b]	µg/L	0.000022	<2.0E-05	<2.0E-05	<2.0E-05	<2.2E-05	<2.6E-05	<2.6E-05	<2.7E-05	<4.1E-05
Benzene	µg/L	5.9	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Benzidine[b]	µg/L	0.000069	<0.003	<0.01	<0.02	<0.03	<0.0	<0.1	<0.1	<0.1
Beryllium	µg/L	0.033	0.0009	0.0011	0.0012	0.0017	0.0021	0.0022	0.0023	0.0038
Bis(2-chloroethyl)ether	µg/L	0.045	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.8	0.7	0.6	0.5	0.5	0.5	0.5	0.5
Carbon tetrachloride	µg/L	0.90	0.00	0.004	0.004	0.004	0.003	0.003	0.003	0.003
Chlordane	µg/L	0.000023	1.2E-05	1.1E-05	1.0E-05	8.5E-06	7.9E-06	7.8E-06	7.7E-06	8.3E-06
Chlorodibromomethane	µg/L	8.6	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02
Chloroform	µg/L	130	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
DDT	µg/L	0.00017	6.3E-07	1.0E-06	1.2E-06	2.0E-06	2.7E-06	2.8E-06	3.0E-06	5.3E-06
1,4-Dichlorobenzene	µg/L	18	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
3,3-Dichlorobenzidine[b]	µg/L	0.0081	<0.01	<0.01	<0.02	<0.03	<0.05	<0.1	<0.1	<0.1
1,2-Dichloroethane	µg/L	28	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
1,1-Dichloroethylene	µg/L	0.9	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.003
Dichlorobromomethane	µg/L	6.2	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Dichloromethane (methylenechloride)	µg/L	450	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,3-dichloropropene	µg/L	8.9	0.01	0.005	0.005	0.004	0.004	0.004	0.004	0.004
Dieldrin	µg/L	0.00004	4.9E-07	1.2E-06	1.5E-06	2.8E-06	4.0E-06	4.3E-06	4.5E-06	8.3E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.001	<0.001	<0.002	<0.004	<0.01	<0.01	<0.01	<0.01
1,2-Diphenylhydrazine (azobenzene)	µg/L	0.16	<0.002	<0.004	<0.005	<0.01	<0.01	<0.01	<0.01	<0.02
Halomethanes	µg/L	130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Heptachlor[b]	µg/L	0.00005	<2.0E-05	<2.2E-05	<2.3E-05	<2.8E-05	<3.3E-05	<3.4E-05	<3.5E-05	<5.7E-05
Heptachlor Epoxide	µg/L	0.00002	8.7E-07	7.6E-07	7.3E-07	6.2E-07	5.7E-07	5.7E-07	5.6E-07	6.0E-07
Hexachlorobenzene	µg/L	0.00021	7.7E-07	6.7E-07	6.5E-07	5.5E-07	5.1E-07	5.0E-07	5.0E-07	5.4E-07
Hexachlorobutadiene	µg/L	14	8.9E-08	7.8E-08	7.5E-08	6.3E-08	5.8E-08	5.8E-08	5.7E-08	6.2E-08
Hexachloroethane	µg/L	2.5	<0.001	<0.002	<0.003	<0.004	<0.01	<0.01	<0.01	<0.01
Isophorone	µg/L	730	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
N-Nitrosodimethylamine	µg/L	7.3	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0005
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.00005	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0004
N-Nitrosodiphenylamine	µg/L	2.5	<0.002	<0.003	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01
PAHs	µg/L	0.0088	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
PCBs	µg/L	0.000019	6.7E-06	5.9E-06	5.6E-06	4.8E-06	4.4E-06	4.4E-06	4.3E-06	4.7E-06
TCDD Equivalents	µg/L	3.9E-09	1.4E-09	1.2E-09	1.1E-09	9.7E-10	9.0E-10	8.9E-10	8.8E-10	9.5E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Tetrachloroethylene	µg/L	2.0	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
Toxaphene	µg/L	2.1E-04	7.0E-05	6.1E-05	5.9E-05	5.0E-05	4.6E-05	4.6E-05	4.5E-05	4.9E-05
Trichloroethylene	µg/L	27	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
1,1,2-Trichloroethane	µg/L	9.4	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003
2,4,6-Trichlorophenol	µg/L	0.29	<0.002	<0.003	<0.003	<0.005	<0.01	<0.01	<0.01	<0.01
Vinyl chloride	µg/L	36	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.003

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituents. These constituents were measured individually for the secondary effluent and RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives.
[b] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

Table 4 – Estimated concentrations of all COP constituents, expressed as percent of Ocean Plan Objective

Constituent	Units	Ocean Plan Objective	Estimated Percentage of Ocean Plan Objective at Edge of ZID by Discharge Scenario[c]							
			1	2	3	4	5	6	7	8
Objectives for protection of marine aquatic life										
Arsenic	µg/L	8	38%	38%	38%	39%	39%	39%	39%	40%
Cadmium	µg/L	1	1%	1%	1%	1%	1%	1%	1%	1%
Chromium (Hexavalent)	µg/L	2	2%	2%	2%	1%	1%	1%	1%	1%
Copper	µg/L	3	70%	70%	70%	69%	69%	69%	69%	69%
Lead	µg/L	2	1%	1%	1%	1%	1%	1%	1%	1%
Mercury	µg/L	0.04	4%	3%	3%	3%	3%	3%	3%	3%
Nickel	µg/L	5	2%	2%	2%	2%	2%	2%	2%	2%
Selenium	µg/L	15	0.5%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%
Silver	µg/L	0.7	24%	24%	24%	24%	23%	23%	23%	23%
Zinc	µg/L	20	43%	42%	42%	42%	42%	42%	42%	42%
Cyanide	µg/L	1	28%	28%	28%	30%	34%	35%	35%	53%
Total Chlorine Residual	µg/L	2	--	--	--	--	--	--	--	--
Ammonia (as N) - 6-mo median	µg/L	600	71%	62%	59%	50%	46%	46%	46%	49%
Ammonia (as N) - Daily Max	µg/L	2,400	20%	18%	17%	14%	13%	13%	13%	14%
Acute Toxicity[a]	TUa	0.3								
Chronic Toxicity[a]	TUc	1								
Phenolic Compounds (non-chlorinated)	µg/L	30	2%	2%	2%	2%	1%	1%	1%	2%
Chlorinated Phenolics	µg/L	1	4%	4%	5%	6%	7%	7%	7%	11%
Endosulfan	µg/L	0.009	5%	4%	4%	4%	3%	3%	3%	4%
Endrin	µg/L	0.002	0.1%	0.05%	0.05%	0.04%	0.04%	0.04%	0.04%	0.04%
HCH (Hexachlorocyclohexane)	µg/L	0.004	15%	13%	12%	10%	10%	10%	9%	10%
Radioactivity (Gross Beta)[a]	pci/L	–								
Radioactivity (Gross Alpha)[a]	pci/L	–								
Objectives for protection of human health - noncarcinogens										
Acrolein	µg/L	220	0.04%	0.03%	0.03%	0.03%	0.02%	0.02%	0.02%	0.03%
Antimony	µg/L	1200	0.001%	0.001%	0.001%	0.0005%	0.0004%	0.0004%	0.000%	0.000%
Bis (2-chloroethoxy) methane	µg/L	4.4	<0.1%	<0.1%	<0.1%	<0.2%	<0.3%	<0.3%	<0.3%	<0.5%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Di-n-butyl phthalate	µg/L	3500	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.02%	<0.03%	<0.0%
2,4-Dinitrophenol	µg/L	4.0	<0.3%	<0.3%	<0.4%	<1%	<1%	<1%	<1%	<1%
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<0.04%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.2%
Thallium	µg/L	2	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin	µg/L	0.0014	<3%	<4%	<5%	<8%	<10%	<11%	<11%	<20%
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health - carcinogens										

Constituent	Units	Ocean Plan Objective	Estimated Percentage of Ocean Plan Objective at Edge of ZID by Discharge Scenario[c]							
			1	2	3	4	5	6	7	8
Acrylonitrile	µg/L	0.10	25%	21%	21%	17%	16%	16%	16%	17%
Aldrin[b]	µg/L	0.000022	--	--	--	--	--	--	--	--
Benzene	µg/L	5.9	<0.02%	<0.02%	<0.02%	<0.02%	<0.03%	<0.03%	<0.03%	<0.0%
Benzidine[b]	µg/L	0.000069	--	--	--	--	--	--	--	--
Beryllium	µg/L	0.033	3%	3%	4%	5%	6%	7%	7%	12%
Bis(2-chloroethyl)ether	µg/L	0.045	<5%	<9%	<11%	<18%	<24%	<26%	<27%	<49%
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	22%	19%	18%	16%	14%	14%	14%	15%
Carbon tetrachloride	µg/L	0.90	1%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%
Chlordane	µg/L	0.000023	52%	46%	44%	37%	34%	34%	34%	36%
Chlorodibromomethane	µg/L	8.6	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Chloroform	µg/L	130	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
DDT	µg/L	0.00017	0.4%	1%	1%	1%	2%	2%	2%	3%
1,4-Dichlorobenzene	µg/L	18	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
3,3-Dichlorobenzidine[b]	µg/L	0.0081	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.01%	<0.01%	<0.01%	<0.01%	0.01%	0.01%	0.01%	0.01%
1,1-Dichloroethylene	µg/L	0.9	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.3%
Dichlorobromomethane	µg/L	6.2	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.3%
Dichloromethane (methylenechloride)	µg/L	450	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
1,3-dichloropropene	µg/L	8.9	0.1%	0.1%	0.1%	0.04%	0.04%	0.04%	0.04%	0.04%
Dieldrin	µg/L	0.00004	1%	3%	4%	7%	10%	11%	11%	21%
2,4-Dinitrotoluene	µg/L	2.6	<0.02%	<0.1%	<0.1%	<0.1%	<0.2%	<0.2%	<0.2%	<0.4%
1,2-Diphenylhydrazine (azobenzene)	µg/L	0.16	<2%	<3%	<3%	<5%	<7%	<7%	<8%	<14%
Halomethanes	µg/L	130	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Heptachlor[b]	µg/L	0.00005	<40%	<43%	<45%	<56%	<67%	<69%	<71%	--
Heptachlor Epoxide	µg/L	0.00002	4%	4%	4%	3%	3%	3%	3%	3%
Hexachlorobenzene	µg/L	0.00021	0.4%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.3%
Hexachlorobutadiene	µg/L	14	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Hexachloroethane	µg/L	2.5	<0.05%	<0.1%	<0.1%	<0.2%	<0.2%	<0.2%	<0.3%	<0.5%
Isophorone	µg/L	730	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodimethylamine	µg/L	7.3	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	0.01%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.01%	0.02%	0.02%	0.0%	0.1%	0.1%	0.1%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<0.1%	<0.1%	<0.1%	<0.2%	<0.3%	<0.3%	<0.3%	<0%
PAHs	µg/L	0.0088	5%	4%	4%	3%	3%	3%	3%	3%
PCBs	µg/L	0.000019	35%	31%	30%	25%	23%	23%	23%	25%
TCDD Equivalents	µg/L	3.9E-09	35%	31%	29%	25%	23%	23%	23%	24%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.04%	<0.05%	<0.05%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Tetrachloroethylene	µg/L	2.0	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Toxaphene	µg/L	2.1E-04	33%	29%	28%	24%	22%	22%	21%	23%
Trichloroethylene	µg/L	27	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
1,1,2-Trichloroethane	µg/L	9.4	<0.01%	<0.01%	<0.01%	<0.01%	<0.02%	<0.02%	<0.02%	<0.03%
2,4,6-Trichlorophenol	µg/L	0.29	<1%	<1%	<1%	<2%	<2%	<2%	<2%	<4%
Vinyl chloride	µg/L	36	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituents. These constituents were measured individually for the secondary effluent and RO concentrate, and these individual concentrations would comply with the Ocean Plan objectives (see Section 4.4).

[b] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

[c] Note that if the percentage was determined to be less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the constituent was estimated to be 0.000001% of the objective, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

4.4 Toxicity

The NPDES permit includes daily maximum effluent limitations for acute and chronic toxicity that are based on the current allowable D_m of 145. The acute toxicity effluent limitation is 4.7 TUa (acute toxicity units) and the chronic toxicity effluent limitation is 150 TUc (chronic toxicity units). The permit requires that toxicity testing be conducted twice per year, with one sample collected during the wet season when the discharge is primarily secondary effluent and once during the dry season when the discharge is primarily trucked brine waste. The MRWPCA ocean discharge has consistently complied with these toxicity limits (CCRWQCB, 2014).

Toxicity testing of RO concentrate generated by the pilot testing was conducted in support of the Project (Trussell Technologies, 2015). On April 9, 2014, a sample of RO concentrate was sent to Pacific EcoRisk for acute and chronic toxicity analysis. Based on these results (RO concentrate values presented in Table 1), the Project concentrate requires a minimum D_m of 16:1 and 99:1 for acute and chronic toxicity, respectively, to meet the Ocean Plan objectives. These D_m values were compared to estimated D_m values for the discharge of RO concentrate only from the Project's full-scale AWPF and the discharge of RO concentrate combined with secondary effluent from the RTP. The minimum dilution modeled for the various Project discharge scenarios was 174:1, which is when the secondary effluent discharge is at the highest expected flow for future discharges. Given that the lowest expected D_m value for the various Project ocean discharge scenarios is greater than the required dilution factor for compliance with the Ocean Plan toxicity objectives, this sample illustrates that the discharge scenarios would comply with Ocean Plan objectives.

5 Conclusions

The purpose of the analysis documented in this technical memorandum was to assess the ability of the Project to comply with the numeric Ocean Plan water quality objectives. Trussell Tech used a conservative approach to estimate the water qualities of the RTP secondary effluent, RO concentrate, and hauled waste (blended with secondary effluent) for the Project. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and scenario. Compliance assessments could not be made for select constituents, as noted, due to analytical limitations, but this is a common occurrence for these Ocean Plan constituents. Based on the data, assumptions, modeling, and analytical methodology presented in this technical memorandum, the Project would comply with all Ocean Plan objectives.

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Appendix C

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DRAFT Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

Technical Memorandum
July 2016

Prepared for:

MRWPCA

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DRAFT Revised Ocean Plan Compliance Assessment for the Monterey Peninsula Water Supply Project and Project Variant

Technical Memorandum

Pure Water Monterey
A Groundwater Replenishment Project

July 2016

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Table of Contents

1 Introduction

In response to State Water Resources Control Board (SWRCB) Water Rights Orders WR 95-10 and WR 2009-0060, two proposed projects are in development on the Monterey Peninsula to provide potable water to offset pending reductions of Carmel River water diversions: (1) a seawater desalination project known as the **Monterey Peninsula Water Supply Project** (MPWSP), and (2) a groundwater replenishment project known as the **Pure Water Monterey Groundwater Replenishment Project** (GWR Project). The capacity of the MPWSP is dependent on whether the GWR Project is constructed.

If the GWR Project is not constructed, the MPWSP would entail California American Water ("CalAm") building a seawater desalination facility capable of producing 9.6 million gallons per day (mgd) of drinking water. In a variation of that project where the GWR Project is constructed, known as the **Monterey Peninsula Water Supply Project Variant** ("Variant"), CalAm would build a smaller desalination facility capable of producing 6.4 mgd of drinking water, and a partnership between the Monterey Peninsula Water Management District (MPWMD) and the Monterey Regional Water Pollution Control Agency (MRWPCA) would build an advanced water treatment facility ("AWT Facility") capable of producing up to 3,700 acre-feet per year (AFY) (3.3 mgd)[1] of highly purified recycled water to enable CalAm to extract 3,500 AFY (3.1 mgd) from the Seaside Groundwater Basin for delivery to their customers (the AWT Facility is part of the GWR Project).

The AWT Facility would purify secondary-treated wastewater (*i.e.*, secondary effluent) from MRWPCA's Regional Treatment Plant (RTP), and this highly purified recycled water would be injected into the Seaside Groundwater Basin and later extracted for municipal water supplies. Both the proposed desalination facility and the proposed AWT Facility would employ reverse osmosis (RO) membranes to purify the waters, and as a result, both projects would produce RO concentrate waste streams that would be disposed through the existing MRWPCA ocean outfall: the brine concentrate from the desalination facility ("Desal Brine"), and the RO concentrate from the AWT Facility ("GWR Concentrate").

The goal of this technical memorandum is to analyze whether the discharges from the proposed projects through the existing ocean outfall would impact marine water quality, and thus, human health, marine biological resources, or beneficial uses of the receiving waters. A similar assessment of the GWR Project on its own was previously performed (Trussell Technologies, 2015, see Appendix B), and so this document provides complementary information focused on the MPWSP and the Variant projects.

The original version of this document (Trussell Technologies, 2015b) and an addendum report to that document (Trussell Technologies, 2015c) were included in both the GWR Project Consolidated Final Environmental Impact Report (CFEIR) and the MPWSP draft Environmental Impact Report (EIR). This version has been updated to include new water quality data and flow

[1] One million gallons per day is equal to 1,121 acre-feet per year. The AWT Facility would be capable of producing up to 4 mgd of highly purified recycled water on a daily basis, but production would fluctuate throughout the year, such that the average annual production would be 3.3 mgd (3,700 AFY) in a non-drought year.

scenarios for the MPWSP and Variant to address data gaps noted in the original analyses (2015b and 2015c).

1.1 Treatment through the Proposed CalAm Desalination Facility

This section describes the proposed treatment train for the MPWSP and Variant desalination facility. Seawater from the Monterey Bay would be extracted through subsurface slant wells beneath the ocean floor and piped to a new CalAm-owned desalination facility. This facility would consist of granular media pressure filters, cartridge filters, a two-pass RO membrane system, RO product-water stabilization (for corrosion control), and disinfection (Figure 1). The RO process is expected to recover 42 percent of the influent seawater flow as product water, while the remainder of the concentrated influent water becomes the Desal Brine. The MPWSP and Variant product water (desalinated water) would be used for municipal drinking water, while the Desal Brine would be blended with (1) available RTP secondary effluent, (2) brine that is trucked and stored at the RTP, and (3) GWR Concentrate (for the Variant only), and discharged to the ocean through the existing MRWPCA ocean outfall. The volume of Desal Brine is dependent on the project size: 13.98 and 8.99 mgd for the MPWSP and Variant, respectively.

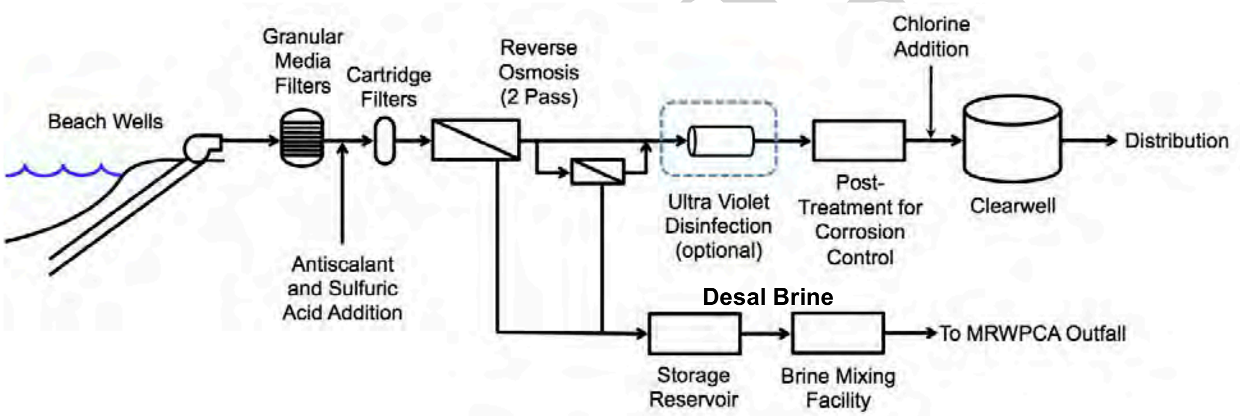


Figure 1 – Schematic of CalAm desalination facilities

1.2 Treatment through the RTP and Proposed AWT Facilities

The existing MRWPCA RTP treatment process includes screening, primary sedimentation, secondary biological treatment through trickling filters followed by a solids contactor (*i.e.*, bio-flocculation), and clarification (Figure 2). Much of the secondary effluent undergoes tertiary treatment (granular media filtration and disinfection) to produce recycled water used for agricultural irrigation. The unused secondary effluent is discharged to the Monterey Bay through the MRWPCA outfall. MRWPCA also accepts trucked brine waste for ocean disposal ("hauled brine"), which is stored in a pond and mixed with secondary effluent for disposal.

The proposed AWT Facility would include several advanced treatment technologies for purifying the secondary effluent: ozone (O_3), biologically active filtration (BAF) (this is an optional unit process), membrane filtration (MF), RO, and an advanced oxidation process (AOP) using ultraviolet light ("UV") and hydrogen peroxide. MRWPCA and the MPWMD conducted a pilot-scale study of the ozone, MF, and RO components of the AWT Facility from December 2013 through July 2014, successfully demonstrating the ability of the various treatment processes to produce highly purified recycled water that complies with the California

Groundwater Replenishment Water Recycling Criteria ("Groundwater Replenishment Regulations"),[2] the SWRCB's Anti-degradation and Recycled Water Policies,[3] and the Water Quality Control Plan for the Central Coastal Basin (Basin Plan)[4] standards, objectives and guidelines for groundwater. Water quality monitoring of the concentrate from the RO was also conducted during the pilot-scale study.

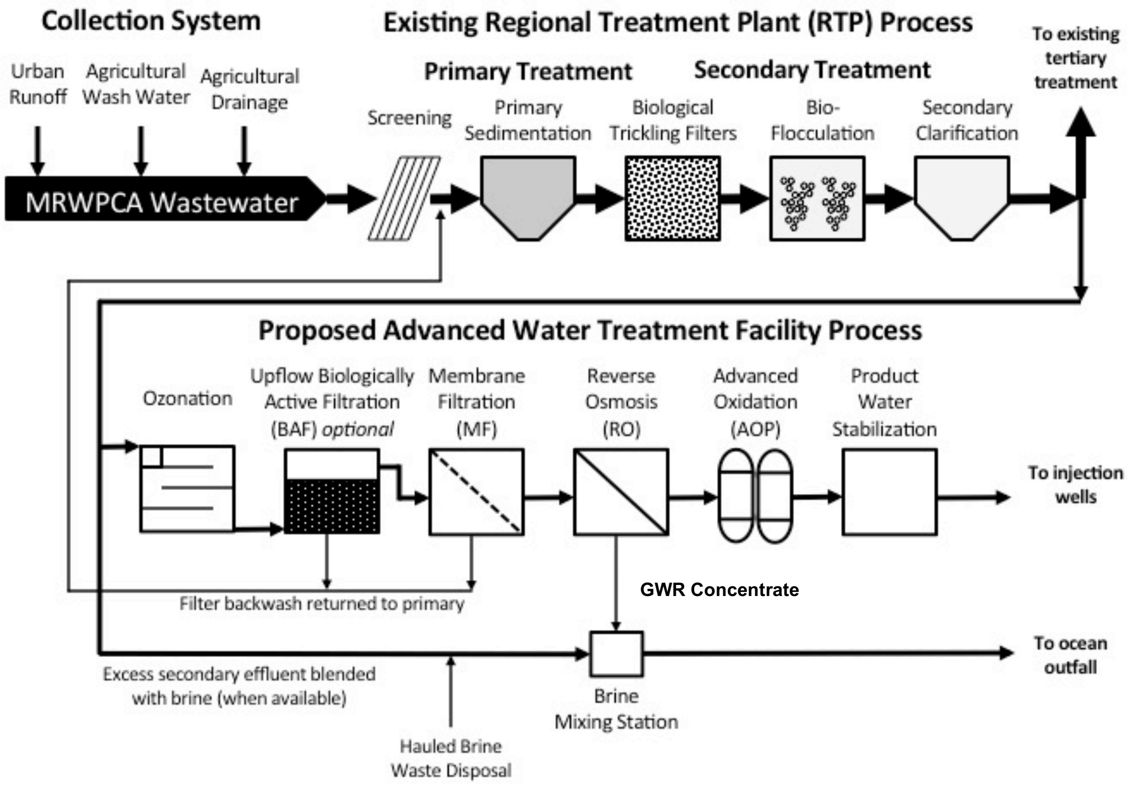


Figure 2 – Schematic of existing MRWPCA RTP and proposed AWT Facility treatment

1.3 California Ocean Plan

The SWRCB 2012 Ocean Plan ("Ocean Plan") sets forth water quality objectives for the ocean with the intent of preserving the quality of the ocean water for beneficial uses, including the protection of both human and aquatic ecosystem health (SWRCB, 2012). Regional Water Quality Control Boards utilize these objectives to develop water quality-based effluent limitations for ocean dischargers that have a reasonable potential to exceed the water quality objectives.

When municipal wastewater flows are released from an outfall, the wastewater and ocean water undergo rapid mixing due to the momentum (from specially designed diffusers) and buoyancy of

[2] SWRCB (2014) Water Recycling Criteria. Title 22, Division 4, Chapter 3, California Code of Regulations.

[3] See http://www.swrcb.ca.gov/plans_policies/

[4] See http://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs/basin_plan_2011.pdf

the discharge.[5] The mixing occurring in the rising plume is affected by the buoyancy and momentum of the discharge, a process referred to as initial dilution (NRC, 1993). For rising plumes, the Ocean Plan defines the initial dilution as complete when "the diluting wastewater ceases to rise in the water column and first begins to spread horizontally," (*i.e.*, when the momentum from the discharge has dissipated). For more saline discharges, a sinking plume can form when the discharge is denser than the ambient water (also known as a negatively buoyant plume). In the case of negatively buoyant plumes, the Ocean Plan defines the initial dilution as complete when "the momentum induced velocity of the discharge ceases to produce significant mixing of the waste, or the diluting plume reaches a fixed distance from the discharge to be specified by the Regional Board, whichever results in the lower estimate for initial dilution."

The Ocean Plan objectives are to be met after the initial dilution of the discharge. The initial dilution occurs in an area known as the zone of initial dilution (ZID). The extent of dilution in the ZID is quantified and referred to as the minimum probable initial dilution (D_m). The water quality objectives established in the Ocean Plan are adjusted by the D_m to derive the National Pollutant Discharge Elimination System (NPDES) permit limits for a wastewater discharge prior to ocean dilution.

The current MRWPCA wastewater discharge is governed by NPDES permit R3-2014-0013 issued by the Central Coast Regional Water Quality Control Board ("RWQCB"). Because the existing NPDES permit for the MRWPCA ocean outfall must be amended to discharge Desal Brine, comparing future discharge concentrations to the current NPDES permit limits (that will likely change when the permit is amended) would not be an appropriate metric or threshold for determining whether the proposed projects would have a significant impact on marine water quality. Instead, compliance with the Ocean Plan objectives was selected as an appropriate threshold for determining whether or not the proposed projects would result in a significant impact requiring mitigation.

Dr. Philip Roberts, a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, conducted modeling of the ocean discharge and estimated D_m values for scenarios involving different flows of the proposed projects and different ambient ocean conditions. These ocean modeling results were combined with projected discharge water quality to assess compliance with the Ocean Plan.

1.4 Future Ocean Discharges

A summary schematic of the MPWSP and Variant is presented in Figure 3. For the MPWSP, 23.58 mgd of ocean water (design capacity) would be treated in the desalination facility; an RO recovery of 42% would lead to an MPWSP Desal Brine flow of 13.98 mgd that would be discharged through the outfall. Secondary effluent from the RTP would also be discharged through the outfall, although the flow would be variable depending on both the raw wastewater flow and the proportion being processed through the tertiary treatment system at the Salinas Valley Reclamation Plant (SVRP) to produce recycled water for agricultural irrigation. The third

[5] Municipal wastewater effluent, being effectively fresh water in terms of salinity, is less dense than seawater and thus rises (due to buoyancy) while it mixes with ocean water. GWR Concentrate, whether by itself or mixed with municipal wastewater effluent, is less dense than seawater and also rises (due to buoyancy) while it mixes with ocean water.

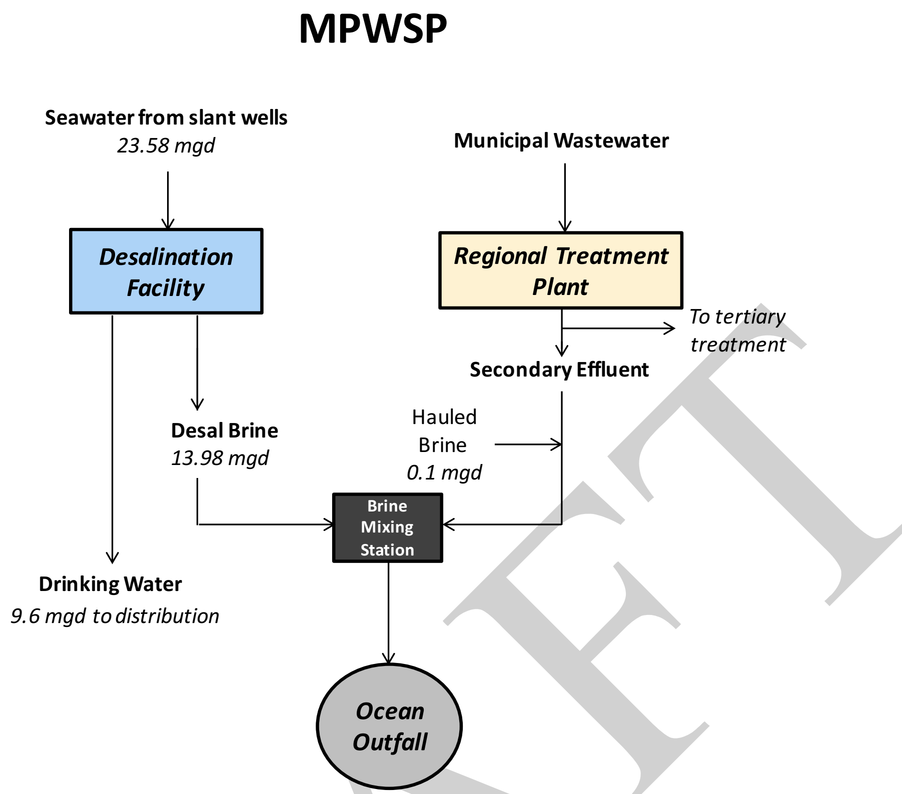
and final discharge component is hauled brine that is trucked to the RTP and blended with secondary effluent prior to discharge. The maximum anticipated flow of this stream is 0.1 mgd (blend of brine and secondary effluent). These three discharge components (Desal Brine, secondary effluent, and hauled brine) would be mixed at the proposed Brine Mixing Facility prior to ocean discharge.

For the Variant, 15.93 mgd of ocean water (design capacity) would be pumped to the desalination facility, and an RO recovery of 42% would result in a Variant Desal Brine flow of 8.99 mgd. The Variant would include the GWR Project, which involves the addition of new source waters to the RTP that would alter the water quality of the secondary effluent produced by the RTP. The secondary effluent in the Variant is referred to as "Variant secondary effluent," and would be different in quality from the MPWSP secondary effluent. Under the GWR Project, a portion of the secondary effluent would be fed to the AWT Facility, and the resultant GWR Concentrate (maximum 0.94 mgd) would be discharged through the outfall. The hauled brine received at the RTP would continue to be blended with secondary effluent prior to discharge, the quality of the blended brine and secondary effluent will change as a result of the change in secondary effluent quality; the hauled brine for the Variant is referred to as "Variant hauled brine." The discharge components for the MPWSP and Variant are summarized in Table 1.

Table 1 – Discharge waters Included in each analysis

Project	Desal Brine	Secondary Effluent	Variant Secondary Effluent	Hauled Brine	Variant Hauled Brine [a]	GWR Concentrate
MPWSP	✓ (13.98 mgd)	✓ (flow varies)		✓ (0.1 mgd)		
Variant	✓ (8.99 mgd)		✓ (flow varies)		✓ (0.1 mgd)	✓ (0.94 mgd)

[a] This is placed in a separate category because it contains Variant secondary effluent.



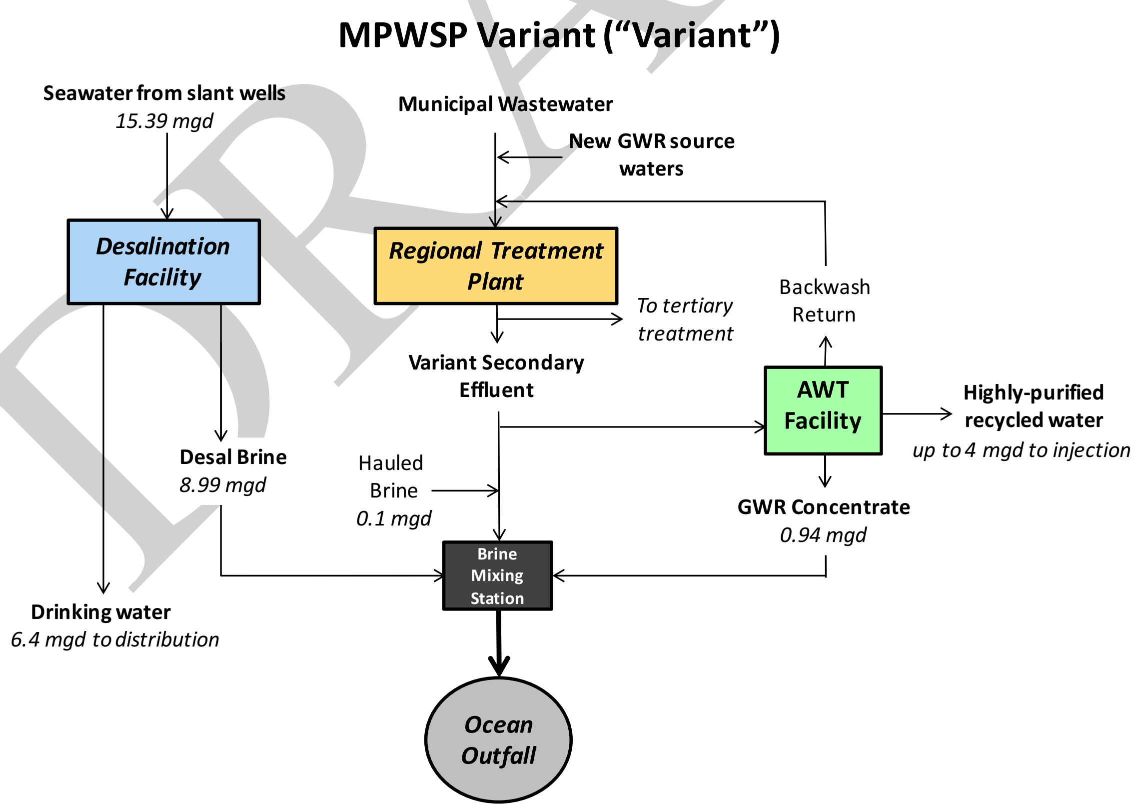


Figure 3 – Flow schematics for the MPWSP and Variant projects (specified flow rates are at design capacity)

1.5 Objective of Technical Memorandum

Trussell Technologies, Inc. ("Trussell Tech") estimated worst-case in-pipe water quality for the various ocean discharge scenarios (*i.e.*, prior to dilution through ocean mixing) for the proposed projects. Dr. Roberts' ocean discharge modeling and the results of the water quality analysis were then used to provide an assessment of whether the proposed projects would consistently meet Ocean Plan water quality objectives. The objective of this technical memorandum is to summarize the assumptions, methodology, results and conclusions of the Ocean Plan compliance assessment for the MPWSP and Variant.

2 Methodology for Ocean Plan Compliance Assessment

Water quality data from various sources for the different treatment process influent and waste streams were compiled. Trussell Tech combined these data for different flow scenarios and used ocean modeling results (*i.e.*, D_m values) to assess compliance of different discharge scenarios with the Ocean Plan objectives. This section documents the data sources and provides further detail on the methodology used to perform this analysis. A summary of the methodology is presented in Figure 4.

2.1 Methodology for Determination of Discharge Water Quality

The amounts and combinations of various wastewaters that would be disposed through the MRWPCA outfall will vary depending on the capacity, seasonal and daily flow characteristics, and extent and timing of implementation of the proposed projects.

Detailed discussions about the methods used to determine the discharge water qualities related to the GWR Project were previously discussed and can be found in Appendix B. This previous analysis included water quality estimates of the secondary effluent, Variant secondary effluent, hauled brine, Variant hauled brine, and the GWR Concentrate (*i.e.*, all of the discharges except for the Desal Brine). In the previous analysis, Trussell Tech assumed that the highest observed values for the various Ocean Plan constituents within each type of water flowing to and treated at the RTP, including the AWT Facility as applicable, to be the worst-case water quality.[6] These same data and assumptions were used in the analysis described in this memorandum. Use of these worst-case water quality concentrations ensures that the analysis in this memorandum is conservative related to the Ocean Plan compliance assessment (and thus, the impact analysis for the MPWSP environmental review processes).

To determine the impact of the MPWSP and Variant, the worst-case water quality of the Desal Brine was estimated using available data from CalAm's temporary test subsurface slant well on the CEMEX mine property in Marina, California. Long-term pumping and water quality

[6] The exception to this statement is cyanide. In mid-2011, Monterey Bay Analytical Service (MBAS) began performing the cyanide analysis on the RTP secondary effluent, at which time the reported values increased by an order of magnitude. Because no operational or source water composition changes took place at this time that would result in such an increase, it is reasonable to conclude the increase is an artifact of the change in analysis method and therefore the results were questionable. Therefore, although the cyanide concentrations reported by MBAS are presented, they are not used in the analysis for evaluating compliance with the Ocean Plan objectives.

sampling from this well began in April 2015.[7] As in the previous Ocean Plan compliance assessments, the highest observed concentrations in the slant well were used for this Ocean Plan compliance assessment.

The methodology for determining the water quality of the Desal Brine and secondary effluent is further described in this section (the methodology for all other discharge waters can be found in Appendix B). A summary of which discharge waters are considered for both the MPWSP and Variant, and which data sources were used in the determination of the water quality for each discharge stream is shown in Figure 4.

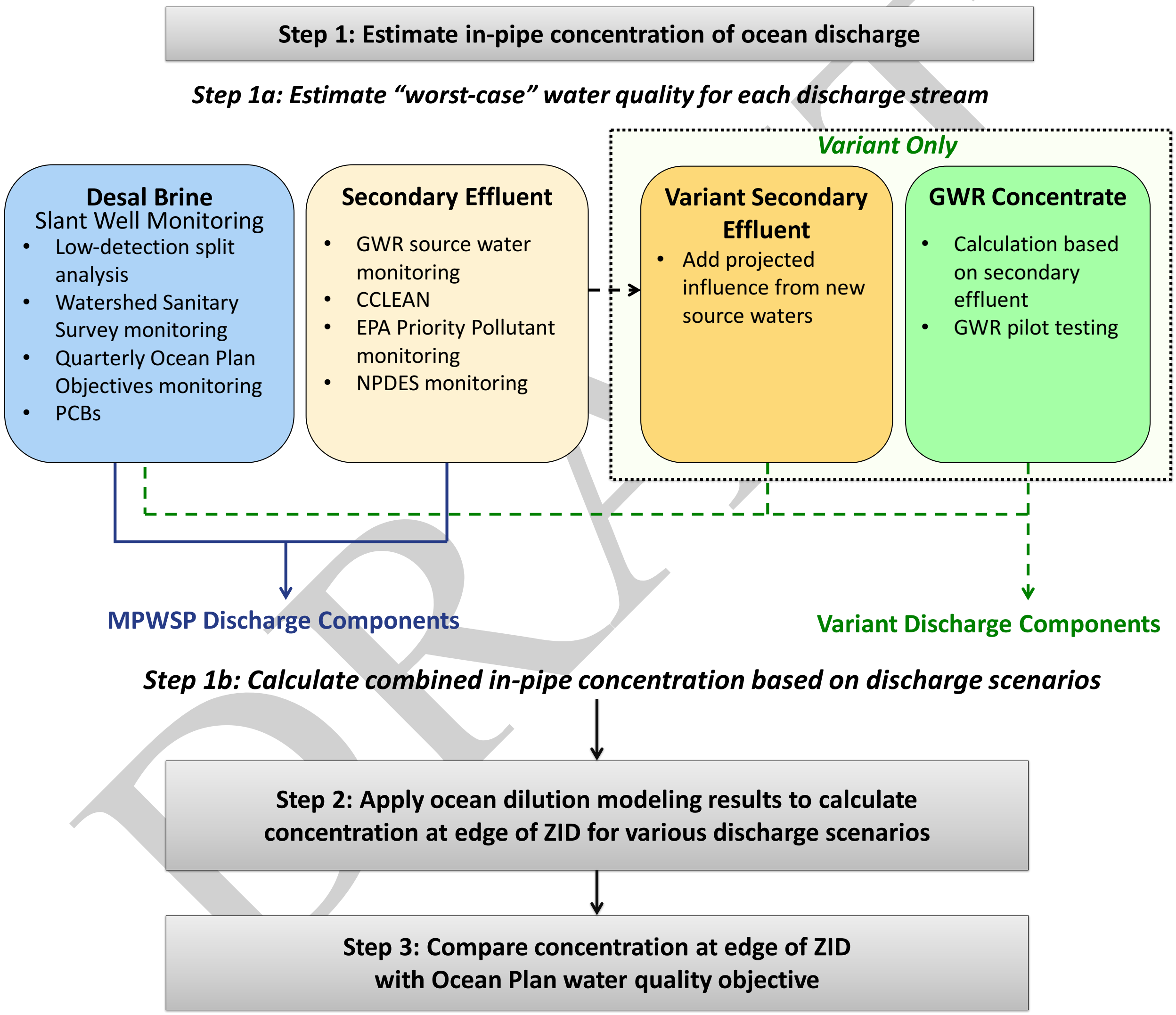


Figure 4 – Logic flow chart for determination of MPWSP and Variant compliance with Ocean Plan objectives.

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[7] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

2.1.1 Secondary Effluent

For the MPWSP, the discharged secondary effluent would not be impacted by additional source waters that would be brought in for the Variant; therefore, the historical secondary effluent quality was used in the analysis. The following sources of data were considered for selecting a secondary effluent concentration for each constituent in the analysis:

- Secondary effluent water quality monitoring conducted for the GWR Project from July 2013 through June 2014.
- Historical NPDES compliance water quality data collected semi-annually by MRWPCA (2005-2014).
- Historical Priority Pollutant data collected annually by MRWPCA (2004-2014).
- Water quality data collected by the Central Coast Long-Term Environmental Assessment Network (CCLEAN) (2008-2015).

The secondary effluent concentration for each constituent selected for the analysis was the maximum reported value from the above sources. In some cases, constituents were not detected (ND) in any of the source waters; in these cases, the values are reported as ND(<MRL). In cases where the analysis of a constituent that was detected but not quantified, the result is reported as less than the Method Reporting Limit ND(<MRL).[8] Because the actual concentration could be any value equal to or less than the MRL, the conservative approach is to use the value of the MRL. For some ND constituents, the MRL exceeds the Ocean Plan objective, and thus no compliance determination can be made.[9] A detailed discussion of the cases where a constituent was reported as less than the MRL is included in the GWR Project technical memorandum in Appendix B (Trussell Technologies, 2015a).

2.1.2 Desalination Brine

Trussell Tech used the following four sources of data for the Desal Brine water quality assessment:

- A one-time 7-day composite sample from the test slant well with separate analysis of particulate and dissolved phase fractions of constituents using low-detection CCLEAN analysis techniques (February 18-25, 2016). The maximum total concentration was used in this analysis (*i.e.* the sum of the concentration in the particulate and dissolved phase

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[8] The lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (*i.e.*, the lower limit of quantitation). Therefore, acceptable quality control and quality assurance procedures are calibrated to the MRL, or lower. To take into account day-to-day fluctuations in instrument sensitivity, analyst performance, and other factors, the MRL is established at three times the Method Detection Limit (or greater). The Method Detection Limit is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. (40 Code of Federal Regulations Section136 Appendix B).

[9] This phenomenon is common in the implementation of the Ocean Plan where for some constituents, suitable analytical methods are not capable of measuring low enough to quantify the minimum toxicologically relevant concentrations. For these constituents, a discharge is considered compliant if the monitoring results are less than the MRL.

fractions).[10] Of the constituents analyzed with this split phase method,[11] all were detected 100% in the dissolved phase, except PCBs, which were detected 99% in the dissolved phase.

- CalAm Watershed Sanitary Survey monitoring program monthly test slant well sampling water quality results (May 2015 – February 2016).[12]
- Quarterly sampling of the test slant well for constituents specified in the Ocean Plan (November 2015 and February 2016).
- Test slant well sampling by Geoscience Support Services, Inc. ("Geoscience") every other month for polychlorinated biphenyls (PCBs) (May 2015 – February 2016).[11]

The maximum value observed in any of the data sources was assumed to be the "worst-case" water quality for the raw seawater feeding the desalination facility. If a constituent was ND in all samples, and multiple analysis methods were used with varying MRL values, the highest MRL was assumed for compliance analysis; the exception to this statement is when data was available from the low detection limit 7-day composite sample. As for the secondary effluent water quality, if the sample results of a constituent reported the concentration as less than the MRL, the MRL was assumed for compliance analysis and the concentration is reported as ND(<MRL) in this TM. Equation 1 was used to calculate a conservative estimate of the Desal Brine concentration (C_{Brine}) for each constituent by using a concentration factor of 1.73, which was calculated assuming complete rejection of the constituent in the feed water (C_{Feed}) and a 42 percent recovery ($\%_R$) through the seawater RO membranes.

$$C_{Brine} = \frac{C_{Feed}}{1 - \%_R} \quad (1)$$

The original Technical Memorandum (TM) (Trussell Technologies, 2015b) noted that no data were available for several Ocean Plan constituents. For constituents that lacked Desal Brine data, a concentration of zero was assumed for the previous analysis, such that the partial influence of the other discharge streams could still be assessed. Thus, a complete "worst-case" assessment for these constituents was not previously possible. The updated analysis discussed in this TM includes data for all of the constituents where no data were previously available, except for toxicity, which will be discussed in Section 2.2.

2.1.3 Combined Ocean Discharge Concentrations

Having estimated the worst-case concentrations for each of the discharge components, the combined concentration prior to discharge was determined as a flow-weighted average of the contributions of each of the discharge components appropriate for the MPWSP and Variant.

[10] Only method detection limits were provided for these results. When a constituent was ND in this dataset, the method detection limit was used for analysis.
[11] Hexachlorobutadiene, hexachlorobenzene, HCH, heptachlor, Aldrin, chlordane, DDT, heptachlor epoxide, dieldrin, Endrin, endosulfans, toxaphene, PCBs
[12] The well was shut down on June 5, 2015 to assess regional trends in aquifer water levels and resumed pumping October 27, 2015. The well was shut down again between March 4, 2016 and May 2, 2016 for discharge line repairs. No water quality data were collected during shutdown periods.

2.2 Ocean Modeling Methodology

In order to determine Ocean Plan compliance, Trussell Tech used the following information: (1) the in-pipe (*i.e.*, pre-ocean dilution) concentration of a constituent ($C_{in\text{-}pipe}$) that was developed as discussed in the previous section, (2) the minimum probable dilution for the ocean mixing (D_m) for the discharge flow scenarios that were modeled by Dr. Roberts[13] (Roberts, P. J. W, 2016), and (3) the background concentration of the constituent in the ocean ($C_{Background}$) that is specified in Table 3 of the Ocean Plan (SWRCB, 2012). With this information, the concentration at the edge of the zone of initial dilution (C_{ZID}) was calculated using the following equation:

$$C_{ZID} = \frac{C_{In-pipe} + D_m * C_{Background}}{1 + D_m} \qquad (2)$$

The C_{ZID} was then compared to the Ocean Plan water quality objectives[14] in Table 1 of the Ocean Plan (SWRCB, 2012). In this table, there are three categories of objectives: (1) Objectives for Protection of Marine Aquatic Life, (2) Objectives for Protection of Human Health – Non-Carcinogens, and (3) Objectives for Protection of Human Health – Carcinogens. There are three objectives for each constituent included in the first category (for marine aquatic life): six-month median, daily maximum and instantaneous maximum concentration. For the other two categories, there is one objective: 30-day average concentration. When a constituent had three objectives, the lowest objective, the six-month median, was used to estimate compliance. This approach was taken because the discharge scenarios, discussed in further detail below, could be experienced for six months, and therefore the 6-month median objective would need to be met. For the ammonia objectives (specifically, the total ammonia concentration calculated as the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4), expressed in µg/L as N) the daily maximum and 6-month median objectives were evaluated.

For each discharge scenario, if the C_{ZID} was below the Ocean Plan objective, then it was assumed that the discharge would comply with the Ocean Plan. However, if the C_{ZID} exceeds the Ocean Plan objective, then it was concluded that the discharge scenario could violate the Ocean Plan objective. Note that this approach could not be applied for some constituents, *viz.*, acute toxicity, chronic toxicity, and radioactivity. Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based on the nature of the constituents. These constituents were measured individually for the secondary effluent and GWR Concentrate, and these individual concentrations would comply with the Ocean Plan

[13] The Ocean Plan defines D_m differently than Dr. Roberts. A value of 1 must be subtracted from the dilution estimates provided by Dr. Roberts prior to using Equation 1.

[14] Note that the Ocean Plan also defines effluent limitations for oil and grease, suspended solids, settleable solids, turbidity, and pH (see Ocean Plan Table 2). These parameters were not evaluated in this assessment. It is assumed that, if necessary, the pH of the water would be adjusted to be within acceptable limits prior to discharge. Oil and grease, suspended solids, settable solids, and turbidity in the GWR Concentrate and Desal Brine would be significantly lower than the secondary effluent. Prior to the AWT Facility RO treatment process, the process flow would be treated by MF, which will reduce these parameters, and the waste stream from the MF will be returned to RTP headworks. Prior to the Desalination Facility RO treatment process, the process flow would be treated by granular media filters and cartridge filters, which reduce these parameters. The waste stream from the granular media filter would be further treated in gravity thickening basins prior to any discharge of the decant through the ocean outfall. The cartridge filters will be disposed off-site and the solids will not be returned to the process.

objectives. Toxicity testing on the seawater was not included in the analysis for this TM; it will be evaluated by another method not discussed in this TM.

Dr. Roberts performed modeling of 16 discharge scenarios for the MPWSP and Variant that include combinations of Desal Brine, secondary effluent, GWR Concentrate, and hauled brine (Roberts, P. J. W, 2016). All scenarios assume the maximum flow rates for the GWR Concentrate, Desal Brine and hauled brine, which is a conservative assumption in terms of constituent loading and minimum dilution.

2.2.1 Ocean Modeling Scenarios

The modeled scenarios are summarized in Tables 2 and 3 for the MPWSP and the Variant, respectively. The baseline MPWSP discharge scenario in Table 2 that has no Desal Brine (*i.e.* Scenario 1) is shown for completeness, but will not be analyzed in this TM as this flow scenario would fall under MRWPCA's existing NPDES permit, for which a D_m value is already established. The Variant discharge scenarios that have no Desal Brine (*i.e.* Scenarios 11 through 15) have already been analyzed and found to comply with the Ocean Plan (Trussell Tech 2015, see Appendix B); these scenarios are shown in Table 3 for completeness, but for simplicity, the analysis of these scenarios is not repeated in Section 3.

Table 2 - Modeled flow scenarios for the MPWSP

No.	Discharge Scenario	Discharge Flows (mgd)		
		Secondary Effluent	Desal Brine	Hauled Brine [a]
1	Baseline - high secondary effluent [b]	19.78	0	0.1
2	Desal Brine with no secondary effluent	0	13.98	0.1
3	Desal Brine with low secondary effluent	1	13.98	0.1
4	Desal Brine with low secondary effluent	2	13.98	0.1
5	Desal Brine with moderate secondary effluent	9	13.98	0.1
6	Desal Brine with high secondary effluent [b]	19.78	13.98	0.1

[a] Hauled brine was not included in the modeling of MPWSP flow scenarios; however, the change in both flow and TDS from the addition of hauled brine is less then 1% and thus is expected to have a negligible impact on the modeled D_m.
[b] Note that RTP wastewater flows have been declining in recent years as a result of water conservation; while 19.78 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

MPWSP Flow Scenarios:

(1) **Baseline – high secondary effluent:** The baseline flow scenario with no Desal Brine. This scenario represents times when the desalination facility is offline, the demand for recycled water is lowest (*e.g.*, during winter months), and the SVRP is not operational.

(2) **Desal Brine with no secondary effluent:** The maximum influence of the Desal Brine on the overall discharge (*i.e.*, no secondary effluent discharged). This scenario would be representative of conditions when demand for recycled water is highest (*e.g.*,

during summer months), and all of the RTP secondary effluent is recycled through the SVRP for agricultural irrigation.

(3-4) **Desal Brine with low secondary effluent:** Desal Brine discharged with a relatively low amount of secondary effluent, resulting in a negatively buoyant plume. This scenario represents times when demand for recycled water is high, but there is excess secondary effluent that is discharged to the ocean.

(5) **Desal Brine with moderate secondary effluent:** Desal Brine discharged with a relatively moderate secondary effluent flow that results in a plume with slightly negative buoyancy. This scenario would be representative of conditions when demand for recycled water is low, and there is excess secondary effluent that is discharged to the ocean.

(6) **Desal Brine with high secondary effluent:** Desal Brine discharged with a relatively high amount of secondary effluent, resulting in a positively buoyant plume. This scenario would be representative of conditions when demand for recycled water is lowest (*e.g.*, during winter months), and the SVRP is not operational.

Table 3 – Modeled flow scenarios for the Variant

No.	Discharge Scenario	Discharge Flows (mgd)			
		Secondary Effluent	Desal Brine	GWR Concentrate	Hauled Brine [a]
1	Desal Brine only	0	8.99	0	0.1
2	Desal Brine with low secondary effluent	1	8.99	0	0.1
3	Desal Brine with low secondary effluent	2	8.99	0	0.1
4	Desal Brine with moderate secondary effluent	5.8	8.99	0	0.1
5	Desal Brine with high secondary effluent [b]	19.78	8.99	0	0.1
6	Desal Brine with GWR Concentrate and no secondary effluent	0	8.99	0.94	0.1
7	Desal Brine with GWR Concentrate and low secondary effluent	1	8.99	0.94	0.1
8	Desal Brine with GWR Concentrate and low secondary effluent	3	8.99	0.94	0.1
9	Desal Brine with GWR Concentrate and moderate secondary effluent	5.3	8.99	0.94	0.1
10	Desal Brine with GWR Concentrate and high secondary effluent	15.92	8.99	0.94	0.1
11	RTP design capacity with GWR Concentrate [c]	24.7	0	0.94	0.1
12	RTP capacity with GWR Concentrate with current port configuration [c]	23.7	0	0.94	0.1
13	Minimum secondary effluent flow with GWR Concentrate [c]	0	0	0.94	0.1
14	Minimum secondary effluent flow with GWR Concentrate during Davidson oceanic conditions [c]	0.4	0	0.94	0.1
15	Moderate secondary effluent flow with GWR concentrate [c]	3	0	0.94	0.1

[a] Hauled brine was not included in the modeling of Variant scenarios involving discharge of desalination brine. However, the change in both flow and TDS from the addition of hauled brine is less than 1% and thus is expected to have a negligible impact on the modeled D_m.
[b] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.
[c] Scenarios 11 through 15 were analyzed as part of a previous analysis (see Appendix B), and based on the documented assumptions, the GWR Concentrate would comply with the Ocean Plan objectives; therefore, these scenarios are not discussed further in this memorandum.

Variant Flow Scenarios:

(1) **Desal Brine only:** Desal Brine discharged without secondary effluent or GWR Concentrate. This scenario would be representative of conditions when the smaller (6.4 mgd) desalination facility is in operation, but the AWT Facility is not operating

(*e.g.*, offline for maintenance), and all of the secondary effluent is recycled through the SVRP (*e.g.*, during high irrigation water demand summer months).

(2-3) **Desal Brine with low secondary effluent:** Desal Brine discharged with low secondary effluent flow, but no GWR Concentrate, which results in a negatively buoyant plume. This scenario would be representative of times when the smaller desalination facility is in operation, but the AWT Facility is not operating (*e.g.* offline for maintenance), and most of the secondary effluent is recycled through the SVRP (*e.g.*, during high irrigation water demand summer months).

(4) **Desal Brine with moderate secondary effluent:** Desal Brine discharged with a relatively moderate flow of secondary effluent, but no GWR concentrate, which results in a plume with slightly negative buoyancy. This scenario represents times when demand for recycled water is low (*e.g.*, during winter months), and the AWT Facility is not operating.

(5) **Desal Brine with high secondary effluent:** Desal Brine discharged with a relatively high flow of secondary effluent, but no GWR concentrate, resulting in a positively buoyant plume. This scenario would be representative of conditions when demand for recycled water is lowest (*e.g.*, during winter months), and neither the SVRP nor the AWT Facility are operational.

(6) **Desal Brine with GWR Concentrate and no secondary effluent:** Desal Brine discharged with GWR Concentrate and no secondary effluent. This scenario would be representative of the condition where both the desalination facility and the AWT Facility are in operation, and there is the highest demand for recycled water through the SVRP (*e.g.*, during summer months).

(7-8) **Desal Brine with GWR Concentrate and low secondary effluent:** Desal Brine discharged with low secondary effluent flow and GWR Concentrate, which results in a negatively buoyant plume. This scenario would be representative of times when both the desalination facility and the AWT Facility are in operation, and most of the secondary effluent is recycled through the SVRP (*e.g.*, during high irrigation water demand summer months).

(9) **Desal Brine with GWR Concentrate and moderate secondary effluent:** Desal Brine discharged with GWR Concentrate and a relatively moderate secondary effluent flow that results in a plume with slightly negative buoyancy. This scenario represents times when both the desalination facility and the AWT Facility are operating, but demand for recycled water is low and there is excess secondary effluent discharged to the ocean.

(10) **Desal Brine with GWR Concentrate and high secondary effluent:** Desal Brine discharged with GWR Concentrate and a relatively high flow of secondary effluent. The reduction of secondary effluent flow between Scenario 5 and this scenario is a result of the AWT Facility operation. This would be a typical discharge scenario when there is no demand for tertiary recycled water (*e.g.*, during winter months).

(11-15) **Variant conditions with no Desal Brine contribution**: These scenarios represent a range of conditions that would exist when the CalAm desalination facilities were offline for any reason. These conditions were previously evaluated (Trussell Tech, 2015) and thus are not discussed further in this technical memorandum.

2.2.2 Ocean Modeling Assumptions

Dr. Roberts documented the modeling assumptions and results in a technical memorandum (Roberts, P. J. W., 2016). The modeling assumptions were specific to ambient oceanic conditions: Davidson (November to March), Upwelling (April to August), and Oceanic (September to October).[15] In order to conservatively demonstrate Ocean Plan compliance, the lowest D_m from the applicable ocean conditions was used for each flow scenario. For all scenarios, the ocean modeling was performed assuming all 129 operational diffuser ports were open.

Three methods were used when modeling the ocean mixing: (1) the Cederwall formula (for neutral and negatively buoyant plumes only), (2) the mathematical model UM_3 in the United States Environmental Protection Agency's (EPA's) Visual Plume suite, and (3) the NRFIELD model (for positively buoyant plumes only), also from the EPA's Visual Plume suite (Roberts, P. J. W., 2016). When results were provided from multiple methods, the minimum predicted D_m value was used in this analysis as a conservative approach.

3 Ocean Plan Compliance Results

3.1 Water Quality of Combined Discharge

As described above, the first step in the Ocean Plan compliance analysis was to estimate the worst-case water quality for the future wastewater discharge components (*viz.*, Desal Brine, secondary effluent, hauled brine and GWR Concentrate). The estimated water quality for each type of discharge is provided in Table 4. The Desal Brine water quality previously assumed in Trussell Technologies, 2015b is also included in Table 4 for reference ("Previous Desal Brine"); only the updated Desal Brine water quality was used in this analysis ("Updated Desal Brine"). Specific assumptions and data sources for each constituent are documented in the Table 4 footnotes.

Table 4 – Estimated worst-case water quality for the various discharge waters

Constituent	Units	Updated Desal Brine	Previous Desal Brine	Secondary Effluent		Hauled Brine		GWR Concentrate	Footnotes
				MPWSP	*Variant*	*MPWSP*	*Variant*		
Objectives for protection of marine aquatic life – 6-month median limit									
Arsenic	μg/L	17.2	37.9	45	45	45	45	12	2,6,16,21
Cadmium	μg/L	5.0	7.9	1	1.2	1	1.2	6.4	1,7,15,21
Chromium (Hexavalent)	μg/L	ND(<0.03)	–	ND(<2)	2.7	130	130	14	3,7,15,21
Copper	μg/L	0.5	3.07	10	10.5	39	39	55	1,7,15,21,28
Lead	μg/L	ND(<0.5)	6.4	ND(<0.5)	0.82	0.76	0.82	4.3	1,3,7,15,21
Mercury	μg/L	0.414	ND(<0.3)	0.019	0.089	0.044	0.089	0.510	1,10,16,21
Nickel	μg/L	11.0	ND(<8.6)	5.2	13.1	5.2	13.1	69	1,7,15,21
Selenium	μg/L	ND(<0.09)	55.2	3	6.5	75	75	34	2,7,15,21
Silver	μg/L	0.50	0.064	ND(<0.19)	ND(<1.59)	ND(<0.19)	ND(<1.59)	ND(<0.19)	3,9,18,21
Zinc	μg/L	9.5	ND(<35)	20	48.4	20	48.4	255	1,7,15,21
Cyanide (MBAS data)	μg/L	--	--	81	89.5	81	89.5	143	1,7,16,20
Cyanide	μg/L	ND(<8.6)	ND(<8.6)	7.2	7.2	46	46	38	1,11,15,20,21
Total Chlorine Residual	μg/L	--	ND(<200)	ND(<200)	ND(<200)	ND(<200)	ND(<200)	ND(<200)	5
Ammonia (as N) 6-mo median	μg/L	143.1	ND(<86.2)	36,400	36,400	36,400	36,400	191,579	1,6,15,21,27

[15] Note that these ranges assign the transitional months to the ocean condition that is typically more restrictive at relevant discharge flows.

Constituent	Units	Updated Desal Brine	Previous Desal Brine	Secondary Effluent		Hauled Brine		GWR Concentrate	Footnotes
				MPWSP	*Variant*	*MPWSP*	*Variant*		
Ammonia (as N) daily max	µg/L	143.1	ND(<86.2)	49,000	49,000	49,000	49,000	257,895	1,6,15,21,27
Acute Toxicity	TUa	--	–	2.3	2.3	2.3	2.3	0.77	1,12,16,17,24
Chronic Toxicity	TUc	--	–	40	40	80	40	100	1,12,16,17,24
Phenolic Compounds (non-chlorinated)	µg/L	ND(<86.2)	–	69	69	69	69	363	1,6,14,15,23,25 26
Chlorinated Phenolics	µg/L	ND(<34.5)	–	ND(<20)	ND(<20)	ND(<20)	ND(<20)	ND(<20)	3,9,18,23,25,26
Endosulfan	µg/L	ND(<3.4E-6)	6.7E-05	0.015	0.048	0.015	0.048	0.25	1,10,14,15,22,25
Endrin	µg/L	ND(<1.6E-6)	2.8E-05	0.000079	0.000079	0.000079	0.000079	0.00042	4,8,15,22
HCH (Hexachlorocyclohexane)	µg/L	0.000043	0.00068	0.034	0.060	0.034	0.060	0.314	1,15,22,25
Radioactivity (Gross Beta)	pCi/L	ND(<5.17)	–	32	32	307	307	34.8	1,6,12,16,17,23
Radioactivity (Gross Alpha)	pCi/L	22.4	–	18	18	457	457	14.4	1,6,12,16,17,23
Objectives for protection of human health – non carcinogens – 30-day average limit									
Acrolein	µg/L	ND(<3.4)	–	ND(<5)	9.0	ND(<5)	9.0	47	3,7,15,23
Antimony	µg/L	0.19	16.6	0.65	0.79	0.65	0.79	4.1	1,6,15,21
Bis (2-chloroethoxy) methane	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Bis (2-chloroisopropyl) ether	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Chlorobenzene	µg/L	ND(<0.9)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Chromium (III)	µg/L	17	106.9	3.0	7.3	87	87	38	2,6,15,21
Di-n-butyl phthalate	µg/L	ND(<16.7)	–	ND(<5)	ND(<7)	ND(<5)	ND(<7)	ND(<1)	3,9,18,23
Dichlorobenzenes	µg/L	ND(<0.9)	–	1.6	1.6	1.6	1.6	8	1,6,15,21
Diethyl phthalate	µg/L	ND(<0.9)	–	ND(<5)	ND(<5)	ND(<5)	ND(<5)	ND(<1)	3,9,18,23
Dimethyl phthalate	µg/L	ND(<0.9)	–	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.5)	3,9,18,23
4,6-dinitro-2-methylphenol	µg/L	ND(<84.5)	–	ND(<0.5)	ND(<20)	ND(<0.5)	ND(<20)	ND(<5)	3,9,18,23
2,4-dinitrophenol	µg/L	ND(<86.2)	–	ND(<0.5)	ND(<13)	ND(<0.5)	ND(<13)	ND(<5)	3,9,18,23
Ethylbenzene	µg/L	ND(<0.9)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Fluoranthene	µg/L	ND(<0.2)	0.0019	0.00654	0.00654	0.00654	0.00654	0.03442	4,9,18,23
Hexachlorocyclopentadiene	µg/L	ND(<0.09)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.05)	3,9,18,23
Nitrobenzene	µg/L	ND(<41.4)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<1)	3,9,18,23
Thallium	µg/L	ND(<0.1)	ND(<1.7)	ND(<0.5)	0.69	ND(<0.5)	0.69	3.7	3,7,15,21
Toluene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Tributyltin	µg/L	ND(<0.08)	–	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.05)	ND(<0.02)	3,13,18,23
1,1,1-trichloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Objectives for protection of human health – carcinogens – 30-day average limit									
Acrylonitrile	µg/L	ND(<3.4)	–	ND(<2)	2.5	ND(<2)	2.5	13	3,7,15,23
Aldrin	µg/L	ND(<6.7E-5)	–	ND(<0.005)	ND(<0.007)	ND(<0.005)	ND(<0.007)	ND(<0.01)	3,9,18,23
Benzene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Benzidine	µg/L	ND(<86.2)	–	ND(<0.5)	ND(<19.8)	ND(<0.5)	ND(<19.8)	ND(<0.05)	3,9,18,23
Beryllium	µg/L	ND(<0.9)	ND(<1.7)	ND(<0.5)	ND(<0.69)	0.0052	0.0052	ND(<0.5)	3,9,17,18,21
Bis(2-chloroethyl)ether	µg/L	ND(<41.4)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Bis(2-ethyl-hexyl)phthalate	µg/L	ND(<1.0)	ND(<1.0)	78	78	78	78	411	2,6,15,23
Carbon tetrachloride	µg/L	ND(<0.9)	ND(<0.5)	ND(<0.5)	0.50	ND(<0.5)	0.50	2.66	3,7,15,21
Chlordane	µg/L	1.45E-5	0.0002	0.00068	0.00068	0.00068	0.00068	0.0036	4,8,14,15,22,25
Chlorodibromomethane	µg/L	ND(<0.9)	–	ND(<0.5)	2.4	ND(<0.5)	2.4	13	3,7,15,21
Chloroform	µg/L	ND(<0.9)	–	2	39	2	39	204	2,7,15,21
DDT	µg/L	1.7E-6	0.00055	0.0001	0.0001	0.0012	0.0012	0.006	4,7,14,19,22,25
1,4-dichlorobenzene	µg/L	ND(<0.9)	ND(<0.9)	1.6	1.6	1.6	1.6	8.4	1,6,15,21
3,3-dichlorobenzidine	µg/L	ND(<86.2)	–	ND(<0.025)	ND(<19)	ND(<0.025)	ND(<19)	ND(<2)	3,9,18,23
1,2-dichloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1-dichloroethylene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	0.5	0.5	ND(<0.5)	3,9,18,21
Dichlorobromomethane	µg/L	ND(<0.9)	–	ND(<0.5)	2.6	ND(<0.5)	2.6	14	3,7,15,21
Dichloromethane	µg/L	ND(<0.9)	ND(<0.9)	0.55	0.64	0.55	0.64	3.4	1,7,15,21
1,3-dichloropropene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	0.56	ND(<0.5)	0.56	3.0	3,7,15,21
Dieldrin	µg/L	4.7E-5	8.8E-05	0.0001	0.0001	0.0006	0.0006	0.0033	4,7,19,22
2,4-dinitrotoluene	µg/L	ND(<0.2)	–	ND(<2)	ND(<2)	ND(<2)	ND(<2)	ND(<0.1)	3,9,18,23
1,2-diphenylhydrazine	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<4.2)	ND(<0.5)	ND(<4.2)	ND(<1)	3,9,18,23
Halomethanes	µg/L	ND(<0.9)	–	0.54	1.4	0.73	1.4	7.5	2,7,14,15,21
Heptachlor	µg/L	ND(<6.9E-7)	8.6E-06	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	ND(<0.01)	3,9,18,22
Heptachlor epoxide	µg/L	ND(<1.6E-6)	ND(<0.02)	0.000079	0.000079	0.000079	0.000079	0.000416	4,8,15,22
Hexachlorobenzene	µg/L	ND (<6.5E-5)	ND(<0.09)	0.000078	0.000078	0.000078	0.000078	0.000411	4,8,15,22,23
Hexachlorobutadiene	µg/L	ND(<3.4E-7)	–	0.000009	0.000009	0.000009	0.000009	0.000047	4,8,15,22
Hexachloroethane	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<0.5)	3,9,18,23
Isophorone	µg/L	ND(<0.9)	–	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,23
N-Nitrosodimethylamine	µg/L	ND(<0.003)	ND(<0.003)	0.017	0.096	0.017	0.096	0.150	2,7,16,17,23

Constituent	Units	Updated Desal Brine	Previous Desal Brine	Secondary Effluent		Hauled Brine		GWR Concentrate	Footnotes
				MPWSP	Variant	MPWSP	Variant		
N-Nitrosodi-N-Propylamine	µg/L	ND(<0.003)	ND(<0.003)	0.076	0.076	0.076	0.076	0.019	2,6,16,17,23
N-Nitrosodiphenylamine	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<1)	3,9,18,23
PAHs	µg/L	2.2E-3	0.012	0.03	0.03	0.03	0.03	0.19	4,8,14,15,22,25
PCBs	µg/L	0.00013	0.002	0.00068	0.00068	0.00068	0.00068	0.00357	4,8,14,15,22,25
TCDD Equivalents	µg/L	ND (<2.5E-5)	–	1.37E-7	1.42E-7	1.37E-7	1.42E-7	7.46E-7	4,13,14,15,23,25
1,1,2,2-tetrachloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Tetrachloroethylene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
Toxaphene	µg/L	3.97E-5	ND(<0.0013)	0.0071	0.0071	0.0071	0.0071	0.0373	4,8,15,22
Trichloroethylene	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
1,1,2-trichloroethane	µg/L	ND(<0.9)	ND(<0.9)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21
2,4,6-trichlorophenol	µg/L	ND(<16.7)	–	ND(<0.5)	ND(<2.3)	ND(<0.5)	ND(<2.3)	ND(<1)	3,9,18,23
Vinyl chloride	µg/L	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	ND(<0.5)	3,9,18,21

Table 4 Footnotes:

MPWSP Secondary Effluent and Hauled Brine

[1] The value reported is based on MRWPCA historical data.
[2] The value reported is based on secondary effluent data collected during the GWR Project source water monitoring programs (not impacted by the proposed new source waters), and are representative of future water quality under the MPWSP scenario.
[3] The MRL provided represents the limit from NPDES monitoring data for secondary effluent and hauled waste. In cases where constituents had varying MRLs, in general, the lowest MRL is reported.
[4] RTP effluent value presented based on CCLEAN data.

Total Chlorine Residual

[5] For all waters, it is assumed that dechlorination will be provided such that the total chlorine residual will be below detection.

Variant Secondary Effluent and Hauled Brine

[6] Existing RTP effluent exceeds concentrations observed in other proposed source waters; the value reported is the existing secondary effluent value.
[7] The proposed new source waters may increase the secondary effluent concentration; the value reported is based on predicted source water blends.
[8] RTP effluent value is based on CCLEAN data; no other source waters were considered due to MRL differences.
[9] MRL provided represents the maximum flow-weighted MRL based on the blend of source waters.
[10] The only water with a detected concentration was the RTP effluent, however the flow-weighted concentration increases due to higher MRLs for the proposed new source waters.
[11] Additional source water data are not available; the reported value is for RTP effluent.
[12] Calculation of the flow-weighted concentration was not feasible due to constituent. The maximum observed value is reported.
[13] Agricultural Wash Water data are based on an aerated sample, instead of a raw water sample.
[14] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.

GWR Concentrate Data

[15] The value presented represents a calculated value assuming no removal prior to RO, complete rejection through RO membrane, and an 81% RO recovery.
[16] The value represents the maximum value observed during the pilot testing study.
[17] The calculated value for the AWT Facility data (described in note 15) was not used in the analysis because it was not considered representative. It is expected that the value would increase as a result of treatment through the AWT Facility (*e.g.* formation of N-Nitrosodimethylamine as a disinfection by-product), or that it will not concentrate linearly through the RO (*e.g.* toxicity and radioactivity).
[18] The MRL provided represents the limit from the source water and pilot testing monitoring programs.

[19] The value presented represents a calculated value assuming 93% and 84% removal through primary and secondary treatment for DDT and dieldrin, respectively, and 36% and 44% removal through ozone for DDT and dieldrin, respectively, complete rejection through the RO membrane, and an 81% RO recovery. The assumed removals are based on results from ozone bench-scale testing of Blanco Drain water blended with secondary effluent and low detection sampling through the RTP.

Cyanide Data
[20] In mid-2011, MBAS began performing the cyanide analysis on the RTP effluent, at which time the reported values increased by an order of magnitude. Because no operational or source water composition changes took place at this time that would result in such an increase, it is reasonable to conclude the increase is an artifact of the change in analysis method and therefore questionable. Therefore, the cyanide values as measured by MBAS are listed separately from other cyanide values, and the MBAS data were not be used in the analysis for evaluating compliance with the Ocean Plan objectives.

Desal Brine Data
[21] The value reported is based on test slant well data collected through the Watershed Sanitary Survey.
[22] The value reported is based on data from the one-time 7-day composite sample from the test slant well. If ND, the method detection limit was used for the analysis instead of the MRL. MRLs were not available for this data set.
[23] The value reported is based on data from the test slant well collected through the quarterly Ocean Plan constituents monitoring.
[24] Acute and chronic toxicity have not been measured or estimated
[25] This value in the Ocean Plan is an aggregate of several congeners or compounds. Per the approach described in the Ocean Plan, for cases where the individual congeners/compounds were less than the MRL, a value of 0 is assumed in calculating the aggregate value.
[26] Chlorinated phenolic compounds is the sum of the following: 4-chloro-3-methylphenol, 2-chlorophenol, pentachlorophenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol. Non-chlorinated phenolic compounds is the sum of the following: 2,4-dimethylphenol, 4,6-Dinitro-2-methylphenol, 2,4-dinitrophenol, 2-methylphenol, 4-methylphenol, 2-nitrophenol, 4-nitrophenol, and phenol.

General
[27] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[28] The value reported for the Variant secondary effluent was calculated using the median of the data collected for the new source waters and is an estimate of the potential increase in concentration of the secondary effluent based on predicted source water blends. The value reported for the Desal Brine was calculated with the median of the data collected from the test slant well and assuming a 42% recovery through the RO. The median values were used because the maximum values detected in both sources appear to be outliers, and because the Ocean Plan objective is a 6-month median concentration, it is reasonable to use the median value detected from these source waters.

3.2 Ocean Modeling Results

The estimated minimum probable dilution (D_m) for each discharge scenario is presented in Tables 5 and 6 (Roberts, P. J. W., 2016). For discharge scenarios that were modeled with more than one modeling method, the lowest D_m (*i.e.*, most conservative) is reported in the tables below. For the MPWSP, the flow scenarios in which little or no secondary effluent was discharged (Scenarios 2, 3 and 4) resulted in the lowest D_m values as a result of the discharge plume being negatively buoyant. At higher secondary effluent flows, the discharge plume would be positively buoyant, resulting in an increased D_m, as evidenced in Scenario 6. The same trend was observed for Variant scenarios.

Table 5 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for MPWSP

No.	Discharge Scenario (Ocean Condition)	Discharge flows (mgd)			D_m [b]
		Secondary effluent	Desal Brine	Hauled brine [a]	
2	Desal Brine with no secondary effluent	0	13.98	0.1	14.6
3	Desal Brine with low secondary effluent	1	13.98	0.1	15.2
4	Desal Brine with low secondary effluent	2	13.98	0.1	16.0
5	Desal Brine with moderate secondary effluent	9	13.98	0.1	34.3
6	Desal Brine with high secondary effluent [c]	19.78	13.98	0.1	153

[a] Hauled brine was not included in the modeling of MPWSP flow scenarios; however, the change in both flow and TDS from the addition of hauled brine is less than 1% and thus is expected to have a negligible impact on the modeled D_m.

[b] Several models were used to predict the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. A value of 1 has also been subtracted from Dr. Roberts' values to take into account the different definition of dilution/D_m provided by Dr. Roberts versus the Ocean Plan.

[c] Note that RTP wastewater flows have been declining in recent years as a result of conservation; while 19.68 mgd is higher than current RTP wastewater flows, this is expected to be a conservative scenario with respect to ocean modeling, compared to using the current wastewater flows of 16 to 18 mgd.

Table 6 – Flow scenarios and modeled D_m values used for Ocean Plan compliance analysis for Variant

No.	Discharge Scenario	Discharge Flows (mgd)				D_m [b]
		Secondary Effluent	Desal Brine	GWR Concentrate	Hauled Brine [a]	
1	Desal Brine only	0	8.99	0	0.1	14.9
2	Desal Brine with low secondary effluent	1	8.99	0	0.1	15.7
3	Desal Brine with low secondary effluent	2	8.99	0	0.1	16.7
4	Desal Brine with moderate secondary effluent	5.8	8.99	0	0.1	31.5
5	Desal Brine with high secondary effluent [b]	19.78	8.99	0	0.1	104
6	Desal Brine with GWR Concentrate and no secondary effluent	0	8.99	0.94	0.1	15.6
7	Desal Brine with GWR Concentrate and low secondary effluent	1	8.99	0.94	0.1	16.4
8	Desal Brine with GWR Concentrate and low secondary effluent	3	8.99	0.94	0.1	20.3
9	Desal Brine with GWR Concentrate and moderate secondary effluent	5.3	8.99	0.94	0.1	54.4
10	Desal Brine with GWR Concentrate and high secondary effluent	15.92	8.99	0.94	0.1	194

[a] Hauled brine was not included in the modeling of Variant scenarios involving discharge of desalination brine. However, the change in both flow and TDS from the addition of hauled brine is less than 1% and thus is expected to have a negligible impact on the modeled D_m.
[b] Several models were used to predict the minimal probable dilution value (UM_3, Cederwall for neutral and negatively buoyant plumes, and NRFIELD for buoyant plumes). Values included here are the model results (D_m values) that resulted in the lowest D_m. A value of 1 has also been subtracted from Dr. Roberts' values to take into account the different definition of dilution/D_m provided by Dr. Roberts versus the Ocean Plan.

3.3 Ocean Plan Compliance Results

The flow-weighted in-pipe concentration for each constituent was calculated for each modeled discharge scenario using the water quality presented in Table 4 and the discharge flows presented in Tables 2 and 3. The in-pipe concentration was then used to calculate the concentration at the edge of the ZID using the D_m values presented in Tables 5 and 6. The resulting concentrations for each constituent in each scenario were compared to the Ocean Plan objectives to assess compliance. The estimated concentrations for the 15 flow scenarios (5 for the MPWSP and 10 for the Variant) for all constituents are presented as concentrations at the edge of the ZID (Appendix A, Table A1 and A3) and as a percentage of the Ocean Plan objective (Appendix A, Table A2 and A4).

It was identified that some constituents are estimated to exceed the Ocean Plan objective for some discharge scenarios. Seventeen[16] constituents were highlighted to potentially exceed the Ocean Plan water quality objectives; however, ten[17] of these constituents were never detected above the MRL in any of the source waters, and the MRLs are higher than the Ocean Plan objective.[18] Due to this insufficient analytical sensitivity, no compliance conclusion can be drawn for these constituents. This is a typical occurrence for ocean discharges since the MRL of the approved compliance analysis method is higher than the Ocean Plan objective for certain constituents.

Of the constituents detected in the source waters, seven were identified as having potential to exceed the Ocean Plan objective in the Variant. Within this subset, acrylonitrile, beryllium and TCDD equivalents were detected in some of the source waters, but not in the others. For these analyses, the MRLs themselves were above the Ocean Plan objective. To assess the blended concentrations for these constituents, a value of zero was assumed for any sources when the concentration was below the MRL.[19] This approach is a “best-case” scenario because it assumes the lowest possible concentration—namely, a value of zero—for any constituent below the reporting limit. This approach is still useful, however, to bracket the analysis and assess the potential for Ocean Plan compliance issues under best-case conditions. Through this method, TCDD equivalents shows potential to exceed the Ocean Plan objective for the Variant. The predicted concentration of acrylonitrile[20] and beryllium at the edge of the ZID is less than the Ocean Plan objective and therefore did not show exceedances through this “best-case” analysis.

A list of the constituents that may exceed the Ocean Plan are shown at their estimated concentration at the edge of the ZID in Table 7 for the MPWSP and Table 8 for the Variant, and as the concentration at the edge of the ZID as a percentage of the Ocean Plan objective in Table 9 and 10 for the MPWSP and Variant, respectively. The “best-case” scenario compliance assessment results for TCDD equivalents is also included in these tables.

[16] Ammonia, chlorinated phenolics, 2,4-dinitrophenol, tributyltin, acrylonitrile, aldrin, benzidine, beryllium, bis(2-chloroethyl)ether, chlordane, 3,3-dichlorobenzidine, 1,2-diphenylhydrazine, heptachlor, PCBs, TCDD equivalents, toxaphene, 2,4,6-trichlorophenol

[17] Chlorinated phenolics, 2,4-dinitrophenol, tributyltin, aldrin, benzidine, bis(2-chloroethyl)ether, 3,3-dichlorobenzidine, 1,2-diphenylhydrazine, heptachlor, 2,4,6-trichlorophenol

[18] The exceptions to this statement are: 2,4-dinitrophenol was ND in the MPWSP Secondary Effluent, and this MRL is lower than the Ocean Plan objective (*i.e.*, MRL = 0.5 ug/L versus 4 ug/L = objective); heptachlor was not detected above the MRL in the slant well, and this MRL is lower than the Ocean Plan objective (*i.e.*, MRL = 0.00000069 ug/L versus 0.00005 ug/L).

[19] Additionally, the Ocean Plan states that for constituents that are made up of an aggregate of constituents, a concentration of 0 can be assumed for the individual constituents that are not detected above the MRL, such as TCDD equivalents.

[20] Acrylonitrile was only detected in one potential source water for the Variant. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant.

Table 7 – Predicted concentrations at the edge of the ZID for Ocean Plan constituents of concern in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Ammonia (as N) – 6-mo median [b]	µg/L	600	25.7	172.1	287	409.0	139.2
Objectives for protection of human health - carcinogens - 30-day average limit [c d]							
Chlordane	µg/L	2.3E-05	1.23E-06	3.91E-06	6.00E-06	7.89E-06	2.65E-06
PCBs	µg/L	1.9E-05	8.76E-06	1.07E-05	1.20E-05	9.86E-06	2.94E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6.23E-11	6.17E-10	1.05E-09	1.53E-09	5.22E-10
Toxaphene [e]	µg/L	2.1E-04	5.75E-06	3.42E-05	5.65E-05	7.99E-05	2.71E-05

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[c] Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 8 – Predicted concentrations at the edge of the ZID for Ocean Plan constituents of concern in the Variant [a]

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Ammonia (as N) – 6-mo median [b]	µg/L	600	34	245	396	446	239	1111	1154	1060	445	151
Objectives for protection of human health - carcinogens - 30-day average limit [c]												
Chlordane	µg/L	2.3E-05	1.37E-6	5.24E-6	7.98E-6	8.61E-6	4.53E-6	2.15E-5	2.22E-5	2.03E-5	8.49E-6	2.86E-6
PCBs	µg/L	1.9E-05	8.72E-6	1.15E-5	1.33E-5	1.07E-5	4.85E-6	2.77E-5	2.76E-5	2.40E-5	9.68E-6	3.05E-6
TCDD Equivalents [c]	µg/L	3.9E-09	9.81E-11	9.26E-10	1.52E-9	1.73E-9	9.30E-10	4.30E-9	4.47E-9	4.11E-9	1.73E-9	5.87E-10
Toxaphene [d]	µg/L	2.1E-04	7.37E-6	4.84E-5	7.77E-5	8.72E-5	4.66E-5	2.17E-4	2.25E-4	2.07E-4	8.68E-5	2.94E-5

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[c] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[d] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 9 – Predicted concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the MPWSP [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Ammonia (as N) – 6-mo median [b]	µg/L	600	4%	29%	48%	68%	23%
Objectives for protection of human health – carcinogens – 30-day average limit [c d]							
Chlordane	µg/L	2.3E-05	5%	17%	26%	34%	12%
PCBs	µg/L	1.9E-05	46%	56%	63%	52%	15%
TCDD Equivalents [d]	µg/L	3.9E-09	2%	16%	27%	39%	13%
Toxaphene [e]	µg/L	2.1E-04	3%	16%	27%	38%	13%

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[c] Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.
[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table 10 – Predicted concentrations at the edge of the ZID expressed as percentage of Ocean Plan Objective for constituents of in the Variant [a]

Constituent	Units	Ocean Plan Objective	Est. Percentage of Ocean Plan objective at Edge of ZID by Scenario									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Ammonia (as N) – 6-mo median [b]	µg/L	600	5.7%	41%	66%	74%	40%	185%	192%	177%	74%	25%
Objectives for protection of human health - carcinogens - 30-day average limit [c]												
Chlordane	µg/L	2.3E-05	6%	23%	35%	37%	20%	94%	97%	88%	37%	12%
PCBs	µg/L	1.9E-05	46%	61%	70%	57%	26%	146%	145%	126%	51%	16%
TCDD Equivalents [c]	µg/L	3.9E-09	3%	24%	39%	44%	24%	110%	115%	105%	44%	15%
Toxaphene [d]	µg/L	2.1E-04	4%	23%	37%	42%	22%	103%	107%	99%	41%	14%

[a] Shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.
[b] Ammonia (as N) represents the total ammonia concentration, *i.e.* the sum of unionized ammonia (NH_3) and ionized ammonia (NH_4).
[c] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[d] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Potential issues were identified to occur when there is no, or relatively low, secondary effluent flow mixed with hauled brine, GWR Concentrate and Desal Brine, as in Variant Scenarios 6, 7 and 8. The constituents of interest related to these scenarios are ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene. Ammonia is expected to be the constituent with the highest exceedance, being 1.92 times the Ocean Plan objective in Scenario 7 (1 mgd secondary effluent with hauled brine, GWR Concentrate and Desal Brine). This scenario is problematic because constituents that have relatively high loadings in the secondary effluent are concentrated in the GWR Concentrate. This scenario assumes the GWR Concentrate flow is much smaller than the Desal Brine flow, such that the resulting discharge plume is negatively buoyant and achieves poor ocean dilution. Based on this analysis, Scenarios 6, 7 and 8 have been identified as having constituents that may exceed the Ocean Plan objective.

Chlordane, PCBs, and toxaphene were only detected when analyzed with low-detection methods, which have far greater sensitivity than standard methods. These results were used to investigate potential to exceed Ocean Plan objectives because these objectives are orders of magnitude below detection limits of methods currently used for discharge compliance.

4 Conclusions

The purpose of this analysis was to assess the ability of the MPWSP and Variant to comply with the Ocean Plan objectives. Trussell Tech used a conservative approach to estimate the water qualities of the secondary effluent, GWR Concentrate, Desal Brine and hauled brine for these projects. These water quality data were then combined for various discharge scenarios, and a concentration at the edge of the ZID was calculated for each constituent and scenario. Seventeen constituents showed potential to exceed the Ocean Plan objectives. These constituents can be divided into three categories:

- Detected concentrations exceed Ocean Plan objectives (Category I): four constituents were detected in all source waters and the blended concentration at the edge of the ZID exceeded the Ocean Plan objective
- Insufficient analytical sensitivity to determine compliance (Category II): ten constituents were not detected above the MRL in any of the source waters, but the MRL was not sensitive enough to demonstrate compliance with the Ocean Plan objective
- Combination of Categories I and II: discharge blends contain sources with exceedances of Ocean Plan objectives (Category I) and sources whose compliance is indeterminate (Category II).

Based on the data, assumptions, modeling, and analytical methodology presented in this technical memorandum, the Variant shows a potential to exceed certain Ocean Plan objectives under specific discharge scenarios. In particular, potential issues were identified for the Variant discharge scenarios involving low secondary effluent flows with Desal Brine and GWR Concentrate: discharges are predicted to exceed or come close to exceeding multiple Ocean Plan objectives, specifically those for ammonia, chlordane, PCBs, TCDD equivalents, and toxaphene. Ammonia clearly exceeds the Ocean Plan objective and must be resolved for the Variant. TCDD equivalents shows a potential to exceed the Ocean Plan objective through a best-case analysis. Chlordane, PCBs and toxaphene, which were predicted to exceed the objectives, were detected at concentrations that are orders of magnitude below detection limits of methods currently used for discharge compliance.

5 References

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Appendix A

Table A1 – Complete list of predicted concentrations of Ocean Plan constituents at the edge of the ZID for the MPWSP

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Arsenic	µg/L	8	3.9	4.0	4.1	3.7	3.2
Cadmium	µg/L	1	0.3	0.3	0.3	0.1	0.02
Chromium (Hexavalent)	µg/L	2	0.1	0.1	0.1	0.04	0.01
Copper	µg/L	3	1.9	2.0	2.0	2.1	2.0
Lead	µg/L	2	0.03	0.03	0.03	0.01	0.003
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.002
Nickel	µg/L	5	0.7	0.7	0.6	0.2	0.05
Selenium	µg/L	15	0.04	0.05	0.05	0.04	0.01
Silver	µg/L	0.7	0.2	<0.2	<0.2	<0.2	<0.2
Zinc	µg/L	20	8.1	8.1	8.2	8.2	8.0
Cyanide	µg/L	1	0.6	0.5	0.5	0.2	0.1
Total Chlorine Residual	µg/L	2	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	25.7	172.1	287	409.0	139.2
Ammonia (as N) - Daily Max	µg/L	2,400	31.4	228.8	384	549.8	187.2
Acute Toxicity [a]	TUa	0.3					
Chronic Toxicity [a]	TUc	1					
Phenolic Compounds (non-chlorinated)	µg/L	30	5.5	5.2	4.9	2.2	0.5
Chlorinated Phenolics [b]	µg/L	1	<2.20	<2.06	<1.92	<0.82	<0.17
Endosulfan	µg/L	0.009	7.05E-06	6.77E-05	1.15E-04	1.68E-04	5.72E-05
Endrin	µg/L	0.002	1.35E-07	4.45E-07	6.86E-07	9.09E-07	3.05E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	1.82E-05	1.56E-04	2.63E-04	3.81E-04	1.30E-04
Radioactivity (Gross Beta) [a]	pCi/L	0.0					
Radioactivity (Gross Alpha) [a]	pCi/L	0.0					
Objectives for protection of human health – non carcinogens – 30-day average limit							
Acrolein	µg/L	220	<0.2	<0.2	<0.2	<0.1	<0.03
Antimony	µg/L	1200	0.01	0.01	0.01	0.01	0.003
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.1	<1.0	<0.9	<0.3	<0.05
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.1	<1.0	<0.9	<0.3	<0.05
Chlorobenzene	µg/L	570	<0.1	<0.1	<0.05	<0.02	<0.004
Chromium (III)	µg/L	190000	1.1	1.0	0.9	0.3	0.1
Di-n-butyl phthalate	µg/L	3500	<1.1	<1.0	<0.9	<0.3	<0.1
Dichlorobenzenes	µg/L	5100	<0.1	0.1	0.1	0.03	0.01
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.02
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.04	<0.01
4,6-dinitro-2-methylphenol	µg/L	220	<5.4	<4.8	<4.3	<1.5	<0.2
2,4-Dinitrophenol [b]	µg/L	4.0	<5.5	<4.9	<4.4	<1.5	<0.2
Ethylbenzene	µg/L	4100	<0.1	<0.1	<0.05	<0.02	<0.004
Fluoranthene	µg/L	15	<0.01	0.01	0.01	0.003	0.0005
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.002
Nitrobenzene	µg/L	4.9	<2.6	<2.4	<2.1	<0.7	<0.1
Thallium	µg/L	2	<0.01	<0.01	<0.01	<0.01	<0.002
Toluene	µg/L	85000	<0.06	<0.05	<0.05	<0.02	<0.004
Tributyltin [b]	µg/L	0.0014	<0.01	<0.005	<0.005	<0.002	<0.0004
1,1,1-Trichloroethane	µg/L	540000	<0.1	<0.1	<0.05	<0.02	<0.004
Objectives for protection of human health – carcinogens – 30-day average limit							
Acrylonitrile [c,d]	µg/L	0.10	--	--	--	--	--
Aldrin [b]	µg/L	0.000022	<6.51E-06	<2.63E-05	<4.18E-05	<5.70E-05	<1.92E-05

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario				
			MPWSP				
			2	3	4	5	6
Benzene	µg/L	5.9	<0.1	<0.1	<0.05	<0.02	<0.004
Benzidine [b]	µg/L	0.000069	<5.5	<4.9	<4.4	<1.5	<0.2
Beryllium [d]	µg/L	0.033	2.38E-6	2.14E-6	1.91E-6	6.41E-7	1.00E-7
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.6	<2.4	<2.1	<0.7	<0.1
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.4	0.7	0.9	0.3
Carbon tetrachloride	µg/L	0.90	<0.1	<0.1	<0.05	<0.02	<0.004
Chlordane	µg/L	0.000023	1.23E-6	3.91E-6	6.00E-6	7.89E-6	2.65E-6
Chlorodibromomethane	µg/L	8.6	<0.1	<0.1	<0.05	<0.02	<0.004
Chloroform	µg/L	130	0.1	0.1	0.1	0.04	0.01
DDT	µg/L	0.00017	1.53E-7	5.28E-7	8.21E-7	1.09E-6	3.68E-7
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.03	0.01
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.5	<4.9	<4.4	<1.5	<0.2
1,2-Dichloroethane	µg/L	28	<0.1	<0.1	<0.05	<0.02	<0.004
1,1-Dichloroethylene	µg/L	0.9	0.1	0.1	0.05	0.02	0.004
Dichlorobromomethane	µg/L	6.2	<0.1	<0.1	<0.05	<0.02	<0.004
Dichloromethane	µg/L	450	<0.1	0.1	0.05	0.02	0.004
1,3-dichloropropene	µg/L	8.9	<0.1	<0.1	<0.05	<0.02	<0.004
Dieldrin	µg/L	0.00004	3.01E-6	3.15E-6	3.21E-6	2.01E-6	5.37E-7
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.02	<0.02	<0.03	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.1	<1.0	<0.9	<0.3	<0.05
Halomethanes	µg/L	130	0.1	0.1	0.05	0.02	0.004
Heptachlor [b]	µg/L	0.00005	<4.60E-06	<4.51E-05	<7.69E-05	<1.12E-04	<3.81E-05
Heptachlor Epoxide	µg/L	0.00002	1.35E-07	4.45E-07	6.86E-07	9.09E-07	3.05E-07
Hexachlorobenzene	µg/L	0.00021	4.18E-06	4.08E-06	3.93E-06	1.99E-06	4.72E-07
Hexachlorobutadiene	µg/L	14	2.60E-08	6.03E-08	8.68E-08	1.06E-07	3.52E-08
Hexachloroethane	µg/L	2.5	<1.1	<1.0	<0.9	<0.3	<0.05
Isophorone	µg/L	730	<0.1	<0.1	<0.05	<0.02	<0.004
N-Nitrosodimethylamine	µg/L	7.3	0.0002	0.0003	0.0003	0.0002	0.0001
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.0003
N-Nitrosodiphenylamine	µg/L	2.5	<1.1	<1.0	<0.9	<0.3	<0.05
PAHs	µg/L	0.0088	1.51E-04	2.48E-04	3.23E-04	3.45E-04	1.11E-04
PCBs	µg/L	0.000019	8.76E-06	1.07E-05	1.20E-05	9.86E-06	2.94E-06
TCDD Equivalents [d]	µg/L	3.9E-09	6.23E-11	6.17E-10	1.05E-09	1.53E-09	5.22E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.1	<0.1	<0.05	<0.02	<0.004
Tetrachloroethylene	µg/L	2.0	<0.1	<0.1	<0.05	<0.02	<0.004
Toxaphene [e]	µg/L	2.1E-04	5.75E-06	3.42E-05	5.65E-05	7.99E-05	2.71E-05
Trichloroethylene	µg/L	27	<0.1	<0.1	<0.05	<0.02	<0.004
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.1	<0.05	<0.02	<0.004
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.1	<1.0	<0.9	<0.3	<0.05
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.03	<0.01	<0.003

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent.

[b] All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

[c] Acrylonitrile was only detected in one potential source water for the Variant Project. It was not detected in any potential source waters for the MPWSP Project; therefore, a compliance determination cannot be made for the MPWSP Project and only partial determination can be made for the Variant Project.

[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance

determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A2 – Complete list of predicted concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]				
			MPWSP				
			2	3	4	5	6
Objectives for protection of marine aquatic life - 6-month median limit							
Arsenic	µg/L	8	49%	50%	51%	46%	40%
Cadmium	µg/L	1	32%	29%	26%	10%	2%
Chromium (Hexavalent)	µg/L	2	3%	3%	3%	2%	1%
Copper	µg/L	3	64%	65%	67%	69%	68%
Lead	µg/L	2	2%	2%	2%	1%	0.2%
Mercury	µg/L	0.04	67%	61%	54%	20%	4%
Nickel	µg/L	5	14%	13%	12%	5%	1%
Selenium	µg/L	15	0.3%	0.3%	0.4%	0.3%	0.1%
Silver	µg/L	0.7	26%	<26%	<25%	<24%	<23%
Zinc	µg/L	20	40%	41%	41%	41%	40%
Cyanide	µg/L	1	57%	54%	51%	23%	5%
Total Chlorine Residual	µg/L	2	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	4%	29%	48%	68%	23%
Ammonia (as N) - Daily Max	µg/L	2,400	1%	10%	16%	23%	8%
Acute Toxicity [b]	TUa	0.3					
Chronic Toxicity [b]	TUc	1					
Phenolic Compounds (non-chlorinated)	µg/L	30	18%	17%	16%	7%	2%
Chlorinated Phenolics [c]	µg/L	1	--	--	--	--	--
Endosulfan	µg/L	0.009	0.1%	1%	1%	2%	1%
Endrin	µg/L	0.002	0.01%	0.02%	0.03%	0.05%	0.02%
HCH (Hexachlorocyclohexane)	µg/L	0.004	0.5%	4%	7%	10%	3%
Radioactivity (Gross Beta) [b]	pci/L	0.0					
Radioactivity (Gross Alpha) [b]	pci/L	0.0					
Objectives for protection of human health – non carcinogens – 30-day average limit							
Acrolein	µg/L	220	<0.1%	<0.1%	<0.1%	<0.1%	<0.01%
Antimony	µg/L	1200	0.0010%	0.0011%	0.0012%	0.0009%	0.0002%
Bis (2-chloroethoxy) methane	µg/L	4.4	<24%	<22%	<20%	<7%	<1%
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.09%	<0.08%	<0.07%	<0.02%	<0.01%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Chromium (III)	µg/L	190000	0.0006%	0.0005%	0.0005%	0.0002%	0.00003%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.03%	<0.03%	<0.01%	<0.01%
Dichlorobenzenes	µg/L	5100	0.001%	0.001%	0.001%	0.001%	0.0002%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<2%	<1%	<0.1%
2,4-Dinitrophenol [c]	µg/L	4.0	--	--	--	--	--
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.1%	0.02%	0.003%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<54%	<48%	<43%	<15%	<2%
Thallium	µg/L	2	<0.3%	<0.4%	<0.4%	<0.4%	<0.1%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [c]	µg/L	0.0014	--	--	--	--	--
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]				
			MPWSP				
			2	3	4	5	6
Objectives for protection of human health – carcinogens – 30-day average limit							
Acrylonitrile [d e]	µg/L	0.10	--	--	--	--	--
Aldrin [c]	µg/L	0.000022	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<0.3%	<0.1%
Benzidine [c]	µg/L	0.000069	--	--	--	--	--
Beryllium [e]	µg/L	0.033	0%	0%	0%	0%	0%
Bis(2-chloroethyl)ether [c]	µg/L	0.045	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	12%	19%	25%	9%
Carbon tetrachloride	µg/L	0.90	<6%	<6%	<5%	<2%	<0.5%
Chlordane	µg/L	0.000023	5%	17%	26%	34%	12%
Chlorodibromomethane	µg/L	8.6	<1%	<1%	<1%	<0.2%	<0.05%
Chloroform	µg/L	130	0.04%	0.04%	0.05%	0.03%	0.01%
DDT	µg/L	0.00017	0.09%	0.31%	0.48%	0.64%	0.22%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.2%	0.05%
3,3-Dichlorobenzidine [c]	µg/L	0.0081	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%
1,1-Dichloroethylene	µg/L	0.9	6%	6%	5%	2%	0.5%
Dichlorobromomethane	µg/L	6.2	<1%	<1%	<1%	<0.3%	<0.1%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.005%	0.001%
1,3-dichloropropene	µg/L	8.9	<1%	<1%	<1%	<0.2%	<0.05%
Dieldrin	µg/L	0.00004	8%	8%	8%	5%	1%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<0.3%
1,2-Diphenylhydrazine [c]	µg/L	0.16	--	--	--	--	--
Halomethanes	µg/L	130	0.04%	0.04%	0.04%	0.02%	0.003%
Heptachlor [c]	µg/L	0.00005	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	2%	3%	5%	2%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	1%	0.2%
Hexachlorobutadiene	µg/L	14	1.86E-7%	4.30E-7%	6.20E-7%	7.60E-7%	2.52E-7%
Hexachloroethane	µg/L	2.5	<43%	<38%	<35%	<12%	<2%
Isophorone	µg/L	730	<0.008%	<0.007%	<0.007%	<0.003%	<0.001%
N-Nitrosodimethylamine	µg/L	7.3	0.003%	0.004%	0.004%	0.003%	0.001%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.1%	0.2%	0.2%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<43%	<38%	<34%	<12%	<2%
PAHs	µg/L	0.0088	2%	3%	4%	4%	1%
PCBs	µg/L	0.000019	46%	56%	63%	52%	15%
TCDD Equivalents [e]	µg/L	3.9E-09	2%	16%	27%	38%	13%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<0.2%
Tetrachloroethylene	µg/L	2.0	<3%	<3%	<2%	<1%	<0.2%
Toxaphene [e]	µg/L	2.1E-04	3%	16%	27%	38%	13%
Trichloroethylene	µg/L	27	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%
1,1,2-Trichloroethane	µg/L	9.4	<1%	<1%	<1%	<0.2%	<0.04%
2,4,6-Trichlorophenol [c]	µg/L	0.29	--	--	--	--	--
Vinyl chloride	µg/L	36	<0.1%	<0.1%	<0.1%	<0.04%	<0.01%

[a] Note that if the percentage as determined by using the MRL was less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the MRL indicated the value was <0.000001%, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

[b] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.

[c] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A3 – Complete list of predicted concentrations of Ocean Plan constituents at the edge of the ZID for the Variant

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Arsenic	µg/L	8	3.9	4.0	4.1	3.8	3.3	3.8	4.0	4.0	3.4	3.2
Cadmium	µg/L	1	0.3	0.3	0.2	0.1	0.02	0.3	0.3	0.2	0.1	0.01
Chromium (Hexavalent)	µg/L	2	0.09	0.09	0.09	0.06	0.02	0.16	0.2	0.1	0.05	0.01
Copper	µg/L	3	1.9	2.0	2.0	2.1	2.1	2.2	2.3	2.2	2.1	2.0
Lead	µg/L	2	0.03	0.03	0.03	0.02	0.01	0.1	0.05	0.04	0.02	0.004
Mercury	µg/L	0.04	0.03	0.02	0.02	0.01	0.002	0.03	0.02	0.02	0.01	0.002
Nickel	µg/L	5	0.7	0.7	0.6	0.4	0.1	1.0	0.9	0.7	0.3	0.1
Selenium	µg/L	15	0.1	0.1	0.1	0.1	0.05	0.2	0.2	0.2	0.1	0.03
Silver	µg/L	0.7	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Zinc	µg/L	20	8.1	8.3	8.5	8.5	8.3	9.5	9.5	9.3	8.5	8.2
Cyanide	µg/L	1	0.6	0.6	0.5	0.3	0.1	0.7	0.7	0.5	0.2	0.05
Total Chlorine Residual	µg/L	2	–	–	–	–	–	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	34	245	396	446	239	1111	1154	1060	445	151
Ammonia (as N) - Daily Max	µg/L	2,400	43	328	531	600	322	1493	1551	1425	598	203
Acute Toxicity [a]	TUa	0.3										
Chronic Toxicity [a]	TUc	1										
Phenolic Compounds (non-chlorinated)	µg/L	30	5.4	5.0	4.7	2.4	0.7	6.7	6.2	4.8	1.8	0.4
Chlorinated Phenolics [b]	µg/L	1	<2.2	<2.0	<1.8	<0.9	<0.2	<2.0	<1.8	<1.4	<0.5	<0.1
Endosulfan	µg/L	0.009	3.3E-05	3.1E-04	5.1E-04	5.9E-04	3.2E-04	1.5E-03	1.4E-03	1.4E-03	5.9E-04	2.0E-04
Endrin	µg/L	0.002	1.5E-07	6.0E-07	9.2E-07	9.9E-07	5.2E-07	2.5E-06	2.6E-06	2.3E-06	9.8E-07	3.3E-07
HCH (Hexachlorocyclohexane)	µg/L	0.004	4.4E-05	3.9E-04	6.4E-04	7.3E-04	3.9E-04	1.8E-03	1.9E-03	1.7E-03	7.3E-04	2.5E-04
Radioactivity (Gross Beta) [a]	pci/L	0.0										
Radioactivity (Gross Alpha) [a]	pci/L	0.0										
Objectives for protection of human health – non carcinogens – 30-day average limit												
Acrolein	µg/L	220	0.2	0.2	0.3	0.2	0.1	0.5	0.4	0.4	0.1	0.04
Antimony	µg/L	1200	0.01	0.02	0.02	0.01	0.01	0.03	0.03	0.03	0.01	0.004
Bis (2-chloroethoxy) methane	µg/L	4.4	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Bis (2-chloroisopropyl) ether	µg/L	1200	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Chlorobenzene	µg/L	570	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Chromium (III)	µg/L	190000	1.1	1.0	0.9	0.4	0.1	1.2	1.1	0.8	0.3	0.1
Di-n-butyl phthalate	µg/L	3500	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.1
Dichlorobenzenes	µg/L	5100	0.1	0.1	0.1	0.04	0.01	0.1	0.1	0.1	0.03	0.01
Diethyl phthalate	µg/L	33000	<0.1	<0.1	<0.1	<0.1	<0.04	<0.1	<0.1	<0.1	<0.04	<0.02
Dimethyl phthalate	µg/L	820000	<0.1	<0.1	<0.1	<0.04	<0.02	<0.1	<0.1	<0.05	<0.02	<0.01

Constituent	Units	Ocean Plan Objective	Estimated Concentration at Edge of ZID by Scenario									
			Variant									
			1	2	3	4	5	6	7	8	9	10
4,6-dinitro-2-methylphenol	µg/L	220	<5.3	<4.6	<4.1	<1.8	<0.4	<4.6	<4.1	<3.0	<1.0	<0.2
2,4-Dinitrophenol [b]	µg/L	4.0	<5.4	<4.7	<4.1	<1.8	<0.3	<4.7	<4.1	<3.0	<1.0	<0.2
Ethylbenzene	µg/L	4100	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Fluoranthene	µg/L	15	0.01	0.01	0.01	0.003	0.001	0.01	0.01	0.01	0.002	0.0003
Hexachlorocyclopentadiene	µg/L	58	<0.01	<0.01	<0.01	<0.01	<0.004	<0.01	<0.01	<0.01	<0.004	<0.002
Nitrobenzene	µg/L	4.9	<2.6	<2.2	<1.9	<0.8	<0.1	<2.2	<2.0	<1.4	<0.5	<0.1
Thallium	µg/L	2	0.01	0.01	0.01	0.01	0.005	0.03	0.03	0.02	0.01	0.003
Toluene	µg/L	85000	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Tributyltin [b]	µg/L	0.0014	<0.01	<0.005	<0.004	<0.002	<0.001	<0.005	<0.004	<0.003	<0.001	<0.0003
1,1,1-Trichloroethane	µg/L	540000	<0.05	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Objectives for protection of human health – carcinogens – 30-day average limit												
Acrylonitrile [c]	µg/L	0.10	0.001	0.007	0.011	0.012	0.007	0.034	0.035	0.031	0.013	0.004
Aldrin [b]	µg/L	0.000022	<9.0E-06	<4.9E-05	<7.8E-05	<8.7E-05	<4.6E-05	<6.4E-05	<9.2E-05	<1.1E-04	<5.6E-05	<2.4E-05
Benzene	µg/L	5.9	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Benzidine [b]	µg/L	0.000069	<5.4	<4.7	<4.2	<1.8	<0.4	<4.7	<4.2	<3.0	<1.0	<0.2
Beryllium [c]	µg/L	0.033	3.61E-6	3.10E-6	2.66E-6	1.08E-6	1.72E-7	3.14E-6	2.72E-6	1.88E-6	6.15E-7	1.03E-7
Bis(2-chloroethyl)ether [b]	µg/L	0.045	<2.6	<2.2	<1.9	<0.8	<0.2	<2.2	<2.0	<1.4	<0.5	<0.1
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	0.1	0.6	0.9	1.0	0.5	2.4	2.5	2.3	1.0	0.3
Carbon tetrachloride	µg/L	0.90	0.1	0.05	0.04	0.02	0.01	0.1	0.1	0.04	0.02	0.004
Chlordane	µg/L	0.000023	1.4E-06	5.2E-06	8.0E-06	8.6E-06	4.5E-06	2.2E-05	2.2E-05	2.0E-05	8.5E-06	2.9E-06
Chlorodibromomethane	µg/L	8.6	0.1	0.1	0.1	0.05	0.02	0.1	0.1	0.1	0.04	0.01
Chloroform	µg/L	130	0.1	0.3	0.5	0.5	0.3	1.2	1.3	1.2	0.5	0.2
DDT	µg/L	0.00017	9.6E-07	8.1E-06	1.3E-05	1.5E-05	8.1E-06	3.7E-05	3.9E-05	3.6E-05	1.5E-05	5.1E-06
1,4-Dichlorobenzene	µg/L	18	0.1	0.1	0.1	0.04	0.01	0.1	0.1	0.1	0.03	0.01
3,3-Dichlorobenzidine [b]	µg/L	0.0081	<5.4	<4.7	<4.2	<1.8	<0.4	<4.7	<4.2	<3.0	<1.0	<0.2
1,2-Dichloroethane	µg/L	28	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
1,1-Dichloroethylene	µg/L	0.9	0.1	0.05	0.04	0.02	0.01	0.05	0.05	0.04	0.01	0.003
Dichlorobromomethane	µg/L	6.2	0.1	0.1	0.1	0.05	0.02	0.1	0.1	0.1	0.04	0.01
Dichloromethane	µg/L	450	0.1	0.05	0.05	0.02	0.01	0.1	0.1	0.05	0.02	0.004
1,3-dichloropropene	µg/L	8.9	0.1	0.05	0.05	0.02	0.01	0.1	0.1	0.04	0.02	0.004
Dieldrin	µg/L	0.00004	3.3E-06	6.6E-06	8.8E-06	8.5E-06	4.2E-06	2.1E-05	2.2E-05	2.0E-05	8.1E-06	2.7E-06
2,4-Dinitrotoluene	µg/L	2.6	<0.01	<0.02	<0.03	<0.03	<0.01	<0.01	<0.02	<0.03	<0.01	<0.01
1,2-Diphenylhydrazine [b]	µg/L	0.16	<1.0	<0.9	<0.8	<0.4	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Halomethanes	µg/L	130	0.1	0.1	0.1	0.03	0.01	0.1	0.1	0.1	0.03	0.01
Heptachlor [b]	µg/L	0.00005	<7.0E-6	<6.5E-5	<1.1E-4	<1.2E-4	<6.6E-05	<6.3E-05	<1.1E-04	<1.5E-04	<7.5E-05	<3.4E-05
Heptachlor Epoxide	µg/L	0.00002	1.5E-7	6.0E-7	9.2E-7	9.9E-7	5.2E-7	2.5E-6	2.6E-6	2.3E-6	9.8E-7	3.3E-7
Hexachlorobenzene	µg/L	0.00021	4.1E-6	4.0E-6	3.8E-6	2.2E-6	7.0E-7	5.9E-6	5.5E-6	4.4E-6	1.6E-6	4.4E-7
Hexachlorobutadiene	µg/L	14	2.8E-8	7.7E-8	1.1E-7	1.2E-7	6.0E-8	2.9E-7	3.0E-7	2.7E-7	1.1E-7	3.8E-8
Hexachloroethane	µg/L	2.5	<1.0	<0.9	<0.8	<0.3	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Isophorone	µg/L	730	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
N-Nitrosodimethylamine	µg/L	7.3	0.0003	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.0003
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.0003	0.001	0.001	0.001	0.001	0.0003	0.001	0.001	0.001	0.0003
N-Nitrosodiphenylamine	µg/L	2.5	<1.0	<0.9	<0.8	<0.3	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
PAHs	µg/L	0.0088	0.0002	0.0003	0.0004	0.0004	0.0002	0.0012	0.0012	0.0010	0.0004	0.0001
PCBs	µg/L	0.000019	8.7E-6	1.2E-5	1.3E-5	1.1E-5	4.8E-6	2.8E-5	2.8E-5	2.4E-5	9.7E-6	3.0E-6
TCDD Equivalents [c]	µg/L	3.9E-09	9.8E-11	9.3E-10	1.5E-9	1.7E-9	9.3E-10	4.3E-9	4.5E-9	4.1E-9	1.7E-9	5.9E-10
1,1,2,2-Tetrachloroethane	µg/L	2.3	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Tetrachloroethylene	µg/L	2.0	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
Toxaphene [e]	µg/L	2.1E-04	7.4E-06	4.8E-05	7.8E-05	8.7E-05	4.7E-05	2.2E-04	2.3E-04	2.1E-04	8.7E-05	2.9E-05
Trichloroethylene	µg/L	27	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
1,1,2-Trichloroethane	µg/L	9.4	<0.1	<0.05	<0.04	<0.02	<0.01	<0.05	<0.05	<0.04	<0.01	<0.003
2,4,6-Trichlorophenol [b]	µg/L	0.29	<1.0	<0.9	<0.8	<0.3	<0.1	<0.9	<0.8	<0.6	<0.2	<0.04
Vinyl chloride	µg/L	36	<0.03	<0.03	<0.03	<0.02	<0.005	<0.03	<0.03	<0.02	<0.01	<0.003

[a] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.
[b] All observed values from some data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.
[c] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.
[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Table A4 – Complete list of predicted concentrations at the edge of the ZID expressed as a percentage of Ocean Plan[a]

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Objectives for protection of marine aquatic life - 6-month median limit												
Arsenic	µg/L	8	49%	50%	51%	47%	41%	48%	49%	50%	43%	39%
Cadmium	µg/L	1	31%	27%	24%	11%	2%	31%	27%	20%	7%	1%
Chromium (Hexavalent)	µg/L	2	5%	5%	5%	3%	1%	8%	8%	6%	2%	1%
Copper	µg/L	3	64%	66%	68%	69%	68%	75%	75%	75%	70%	68%
Lead	µg/L	2	2%	2%	2%	1%	0.3%	3%	2%	2%	1%	0.2%
Mercury	µg/L	0.04	66%	58%	51%	23%	6%	64%	57%	42%	15%	4%
Nickel	µg/L	5	14%	13%	13%	7%	2%	20%	19%	15%	6%	1%
Selenium	µg/L	15	0.4%	1%	1%	1%	0.3%	2%	2%	1%	1%	0.2%
Silver	µg/L	0.7	26%	<27%	<27%	<26%	<24%	<26%	<26%	<27%	<25%	<24%
Zinc	µg/L	20	41%	42%	43%	43%	41%	47%	48%	47%	43%	41%
Cyanide	µg/L	1	57%	53%	49%	26%	7%	71%	65%	50%	18%	5%
Total Chlorine Residual	µg/L	2	–	–	–	–	–	–	–	–	–	–
Ammonia (as N) - 6-mo median	µg/L	600	6%	41%	66%	74%	40%	185%	192%	177%	74%	25%
Ammonia (as N) - Daily Max	µg/L	2,400	2%	14%	22%	25%	13%	62%	65%	59%	25%	8%
Acute Toxicity [b]	TUa	0.3										
Chronic Toxicity [b]	TUc	1										
Phenolic Compounds (non-chlorinated)	µg/L	30	<18%	<17%	<16%	<8%	<2%	<22%	<21%	<16%	<6%	<1%
Chlorinated Phenolics [c]	µg/L	1	--	--	--	--	--	--	--	--	--	--
Endosulfan	µg/L	0.009	0.4%	3%	6%	7%	4%	16%	17%	15%	7%	2%
Endrin	µg/L	0.002	0.01%	0.03%	0.05%	0.05%	0.03%	0.1%	0.1%	0.1%	0.05%	0.02%
HCH (Hexachlorocyclohexane)	µg/L	0.004	1%	10%	16%	18%	10%	45%	47%	43%	18%	6%
Radioactivity (Gross Beta) [b]	pci/L	0.0										
Radioactivity (Gross Alpha) [b]	pci/L	0.0										
Objectives for protection of human health – non carcinogens – 30-day average limit												
Acrolein	µg/L	220	0.1%	0.1%	0.1%	0.1%	0.03%	0.2%	0.2%	0.2%	0.1%	0.02%
Antimony	µg/L	1200	0.001%	0.001%	0.001%	0.001%	0.0005%	0.003%	0.003%	0.002%	0.001%	0.0003%
Bis (2-chloroethoxy) methane	µg/L	4.4	<24%	<21%	<18%	<8%	<2%	<21%	<18%	<13%	<5%	<1%

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]									
			Variant									
			1	2	3	4	5	6	7	8	9	10
Bis (2-chloroisopropyl) ether	µg/L	1200	<0.1%	<0.1%	<0.1%	<0.03%	<0.01%	<0.1%	<0.1%	<0.05%	<0.02%	<0.004%
Chlorobenzene	µg/L	570	<0.01%	<0.01%	<0.01%	<0.004%	<0.001%	<0.01%	<0.01%	<0.01%	<0.002%	<0.001%
Chromium (III)	µg/L	190000	0.001%	0.001%	0.0005%	0.0002%	0.0001%	0.001%	0.001%	0.0004%	0.0001%	0.00003%
Di-n-butyl phthalate	µg/L	3500	<0.03%	<0.03%	<0.02%	<0.01%	<0.003%	<0.03%	<0.02%	<0.02%	<0.01%	<0.001%
Dichlorobenzenes	µg/L	5100	0.001%	0.001%	0.001%	0.001%	0.0003%	0.002%	0.002%	0.001%	0.001%	0.0002%
Diethyl phthalate	µg/L	33000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Dimethyl phthalate	µg/L	820000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
4,6-dinitro-2-methylphenol	µg/L	220	<2%	<2%	<2%	<1%	<0.2%	<2%	<2%	<1%	<0.5%	<0.1%
2,4-Dinitrophenol [c]	µg/L	4.0	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	µg/L	4100	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Fluoranthene	µg/L	15	0.1%	0.1%	0.1%	0.02%	0.004%	0.1%	0.1%	0.04%	0.01%	0.002%
Hexachlorocyclopentadiene	µg/L	58	<0.01%	<0.01%	<0.02%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Nitrobenzene	µg/L	4.9	<53%	<45%	<39%	<16%	<3%	<46%	<40%	<28%	<9%	<2%
Thallium	µg/L	2	0.3%	0.5%	1%	0.5%	0.2%	1%	1%	1%	0.5%	0.2%
Toluene	µg/L	85000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Tributyltin [c]	µg/L	0.0014	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	µg/L	540000	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
Objectives for protection of human health – carcinogens – 30-day average limit												
Acrylonitrile [d]	µg/L	0.10	1%	7%	11%	12%	7%	34%	35%	31%	13%	4%
Aldrin [c]	µg/L	0.000022	--	--	--	--	--	--	--	--	--	--
Benzene	µg/L	5.9	<1%	<1%	<1%	<0.4%	<0.1%	<1%	<1%	<1%	<0.2%	<0.1%
Benzidine [c]	µg/L	0.000069	--	--	--	--	--	--	--	--	--	--
Beryllium [d]	µg/L	0.033	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bis(2-chloroethyl)ether [c]	µg/L	0.045	--	--	--	--	--	--	--	--	--	--
Bis(2-ethyl-hexyl)phthalate	µg/L	3.5	3%	16%	25%	28%	15%	69%	72%	66%	27%	9%
Carbon tetrachloride	µg/L	0.90	6%	5%	5%	2%	1%	7%	6%	5%	2%	0.4%
Chlordane	µg/L	0.000023	6%	23%	35%	37%	20%	94%	97%	88%	37%	12%
Chlorodibromomethane	µg/L	8.6	1%	1%	1%	0.5%	0.2%	1%	1%	1%	0.4%	0.1%
Chloroform	µg/L	130	0.1%	0.2%	0.3%	0.4%	0.2%	1%	1%	1%	0.4%	0.1%
DDT	µg/L	0.00017	1%	5%	8%	9%	5%	22%	23%	21%	9%	3%
1,4-Dichlorobenzene	µg/L	18	0.3%	0.3%	0.3%	0.2%	0.1%	1%	0.5%	0.4%	0.2%	0.05%
3,3-Dichlorobenzidine [c]	µg/L	0.0081	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	µg/L	28	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.05%	<0.01%
1,1-Dichloroethylene	µg/L	0.9	6%	5%	5%	2%	1%	6%	5%	4%	1%	0.4%
Dichlorobromomethane	µg/L	6.2	1%	1%	1%	1%	0.3%	2%	2%	2%	1%	0.2%
Dichloromethane	µg/L	450	0.01%	0.01%	0.01%	0.005%	0.002%	0.01%	0.01%	0.01%	0.004%	0.001%
1,3-dichloropropene	µg/L	8.9	1%	1%	1%	0.3%	0.1%	1%	1%	0.5%	0.2%	0.04%
Dieldrin	µg/L	0.00004	8%	16%	22%	21%	11%	54%	55%	49%	20%	7%
2,4-Dinitrotoluene	µg/L	2.6	<0.5%	<1%	<1%	<1%	<1%	<0.4%	<1%	<1%	<1%	<0.3%
1,2-Diphenylhydrazine [c]	µg/L	0.16	--	--	--	--	--	--	--	--	--	--
Halomethanes	µg/L	130	0.04%	0.04%	0.04%	0.03%	0.01%	0.1%	0.1%	0.1%	0.02%	0.01%
Heptachlor [c]	µg/L	0.00005	--	--	--	--	--	--	--	--	--	--
Heptachlor Epoxide	µg/L	0.00002	1%	3%	5%	5%	3%	12%	13%	12%	5%	2%
Hexachlorobenzene	µg/L	0.00021	2%	2%	2%	1%	0.3%	3%	3%	2%	1%	0.2%
Hexachlorobutadiene	µg/L	14	2E-7%	6E-7%	8E-7%	8E-7%	4E-7%	2E-6%	2E-6%	2E-6%	8E-7%	3E-7%
Hexachloroethane	µg/L	2.5	<42%	<36%	<32%	<14%	<3%	<36%	<32%	<23%	<8%	<1%
Isophorone	µg/L	730	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
N-Nitrosodimethylamine	µg/L	7.3	0.004%	0.01%	0.02%	0.01%	0.01%	0.01%	0.02%	0.02%	0.01%	0.005%
N-Nitrosodi-N-Propylamine	µg/L	0.38	0.1%	0.2%	0.3%	0.3%	0.1%	0.1%	0.2%	0.3%	0.1%	0.1%
N-Nitrosodiphenylamine	µg/L	2.5	<42%	<36%	<32%	<14%	<3%	<36%	<32%	<23%	<8%	<1%

Constituent	Units	Ocean Plan Objective	Percentage of Ocean Plan Objective at Edge of ZID by Scenario [a]									
			Variant									
			1	2	3	4	5	6	7	8	9	10
PAHs	µg/L	0.0088	2%	3%	4%	4%	2%	14%	14%	12%	5%	1%
PCBs	µg/L	0.000019	46%	61%	70%	57%	26%	146%	145%	126%	51%	16%
TCDD Equivalents [d]	µg/L	3.9E-09	3%	24%	39%	44%	24%	110%	115%	105%	44%	15%
1,1,2,2-Tetrachloroethane	µg/L	2.3	<2%	<2%	<2%	<1%	<0.3%	<2%	<2%	<2%	<1%	<0.1%
Tetrachloroethylene	µg/L	2.0	<3%	<2%	<2%	<1%	<0.3%	<2%	<2%	<2%	<1%	<0.2%
Toxaphene [e]	µg/L	2.1E-04	4%	23%	37%	42%	22%	103%	107%	99%	41%	14%
Trichloroethylene	µg/L	27	<0.2%	<0.2%	<0.2%	<0.1%	<0.02%	<0.2%	<0.2%	<0.1%	<0.05%	<0.01%
1,1,2-Trichloroethane	µg/L	9.4	<1%	<1%	<0.5%	<0.2%	<0.1%	<1%	<0.5%	<0.4%	<0.1%	<0.03%
2,4,6-Trichlorophenol [c]	µg/L	0.29	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	µg/L	36	<0.1%	<0.1%	<0.1%	<0.04%	<0.01%	<0.1%	<0.1%	<0.1%	<0.03%	<0.01%

[a] Note that if the percentage as determined by using the MRL was less than 0.01 percent, then a minimum value is shown as "<0.01%" (*e.g.*, if the MRL indicated the value was <0.000001%, for simplicity, it is displayed as <0.01%). Also, shading indicates constituent is expected to be greater than 80 percent (orange shading) or exceed (red shading) the ocean plan objective for that discharge scenario.

[b] Calculating flow-weighted averages for toxicity (acute and chronic) and radioactivity (gross beta and gross alpha) is not appropriate based the nature of the constituent. These constituents were measured individually for the secondary effluent and GWR concentrate, and these individual concentrations would comply with the Ocean Plan objectives.

[c] All observed values from all data sources were below the MRL, and the flow-weighted average of the MRLs is higher than the Ocean Plan objective. No compliance conclusions can be drawn for these constituents.

[d] Acrylonitrile, beryllium and TCDD equivalents represent a special case; they were detected in some source waters, but were also not detected above the MRL in others, and the MRL values are above the Ocean Plan objectives. For these constituents, a value of 0 was assumed when it was not detected in a source water and the MRL was above the Ocean Plan objective. This assumption was made to show there is potential for the constituent to exceed the Ocean Plan objective in some flow scenarios, but there is not enough information to provide a complete compliance determination at this time. When only the detected values were considered, acrylonitrile and beryllium did not exceed the Ocean Plan objective by 80% or more and therefore were not included in Tables 7 through 10.

[e] Toxaphene was only detected using the low-detection techniques of the CCLEAN program. It was detected once (09/2011) out of 12 samples collected from the secondary effluent from 2010 through 2015, and during the 7-day composite sample from the test slant well.

Appendix D

Roberts, P. J. W, 2017. "Modeling Brine Disposal into Monterey Bay – Supplement." *Technical Memorandum to Environmental Science Associates (ESA)*. 22 September.

Modeling Brine Disposal into Monterey Bay – Supplement

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Final Report

Prepared for
ESA | Environmental Science Associates
San Francisco, California

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Contents

EXECUTIVE SUMMARY

Additional dilution simulations are presented for the disposal of brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. The report is a supplement to Roberts (2016) and addresses new flow scenarios and other issues that have been raised.

It has been suggested to replace the opening in the end gate of the diffuser with a check valve. A 6-inch valve was proposed, and analyses of the internal hydraulics of the diffuser and outfall were conducted. The check valve had minimal effect on the flow distribution between the diffuser ports and minimal effect on head loss. The flow from the end gate was reduced slightly and the exit velocity considerably increased. The effect of the valve orientation on dilution of brine discharges was investigated. It was found that any upward angle greater than about 20° would result in dilutions that meet the BMZ salinity requirements. The optimum angle to maximize dilution is 60°.

Dilutions were computed for all new flow scenarios assuming the 6-inch check valve was installed in the end gate.

The effect of currents on the brine jets was addressed. Dilutions were predicted using the mathematical model UM3 for the pure brine discharges for various anticipated current speeds. Jets discharging into the currents were bent back and dilutions were increased by the current. Jets discharging with the current were swept downstream and impacted the seabed farther from the diffuser. All dilutions with currents were greater than those with zero current, and all impact points were well within the BMZ.

It has been suggested to orient the nozzles along the diffuser upwards (from their present horizontal angles) to increase the dilution of dense effluents. This would decrease the dilution of buoyant effluents, however. Dilutions were predicted for dense and buoyant effluents. For dense effluents, increasing the nozzle angle increased dilution considerably; for buoyant effluents, the dilutions reduced slightly.

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1. Introduction

It is proposed to dispose of the brine concentrate resulting from reverse osmosis (RO) seawater desalination into Monterey Bay, California. Discharge will be through an existing outfall and diffuser usually used for domestic wastewater disposal. Because of varying flow scenarios, the effluent and its composition vary from pure secondary effluent to pure brine. Sixteen scenarios, with flows ranging from 9.0 to 33.8 mgd (million gallons per day) and densities from 998.8 to 1045.2 kg/m^3, were previously analyzed in Roberts (2016). The internal hydraulics of the outfall and diffuser were computed and dilutions predicted for flow scenarios resulting in buoyant and dense effluents. It was found that, for all dense discharge conditions, the salinity requirements in the new California Ocean Plan were met within the BMZ (Brine Mixing Zone).

Since that report was completed, new flow scenarios have been proposed that include higher volumes of brine and GWR effluent, the inclusion of hauled brine, and situations where the desalination plant is offline. It has been requested to analyze dilutions for many more flow combinations for typical and variant cases. And it is proposed to replace the opening in the diffuser's end gate, which allows some brine to be released at a low velocity and therefore low dilution, with a check valve that would increase the exit velocity and therefore increase dilution. The check valve would be angled upwards, further increasing dilution. Finally, it has been suggested to replace the horizontal 4-inch check valves along the diffuser with upwardly oriented valves that would increase the dilution of dense effluents.

The specific tasks addressed in this report are:

- Analyze internal hydraulics accounting for the effect of the new proposed end gate check valve;
- Compute dilutions for new scenarios with dense and buoyant flow effluents accounting for the effect of the valve;
- Assess the effects of currents on dense discharges;
- Compute the dilution of dense discharges from the end gate;
- Analyze the effect of varying the nozzle angle on the dilution of dense and buoyant effluents.

2. MODELING SCENARIOS

2.1 Introduction

To address the additional concerns and issues that have been raised, the revised dilution analyses will include the following:

- **End-Gate**: The outfall hydraulics will be revised assuming the end-gate has been replaced with one Tideflex valve. The assumed end-gate configuration may be modified depending on the California Ocean Plan (COP) compliance analysis results.
- **Effluent Water Quality:** The salinity and temperature of the secondary effluent and GWR effluent shall remain unchanged from prior analyses presented in the 2017 Draft EIR/EIS.
- **Ocean Conditions**: Dilution analyses shall incorporate conditions related to the ocean seasons consistent with previous analyses. Worst-case conditions shall be assessed and presented.
- **Mitigation:** Preliminary assessments of the impact of diffuser nozzle orientation on dilution of dense and buoyant effluents will be made.
- **Currents:** The effects of currents on the advection and dispersion of dense effluents will be assessed.

All revised discharge scenarios will incorporate consideration of a modified end-gate on outfall diffuser hydraulics and dilution.

Model analyses will be done for typical and high brine discharge scenarios with a range of secondary and GWR effluent flows. Modeling the highest RO concentrate flow expected follows the conservative approach previously used on COP compliance evaluations for this project. Also, scenarios involving high flows of secondary effluent will be assessed for typical operations of the Variant both with and without GWR effluent. In addition, it has been requested that discharge scenarios where brine is absent be included in dilution model analyses to cover times when the desalination plant is offline.

2.2 Environmental and Discharge Conditions

In the previous report, Roberts (2016), oceanographic measurements obtained near the diffuser were discussed. Traditionally, three oceanic seasons have been defined in Monterey Bay: Upwelling (March-September), Oceanic (September-November), and Davidson (November-March). Density profiles were averaged by season to obtain representative profiles for the dilution simulations. The profiles are shown in Figure 1 and are tabulated in Appendix A. The salinities and temperatures near the depth of the diffuser were averaged seasonally as summarized in Table 1.

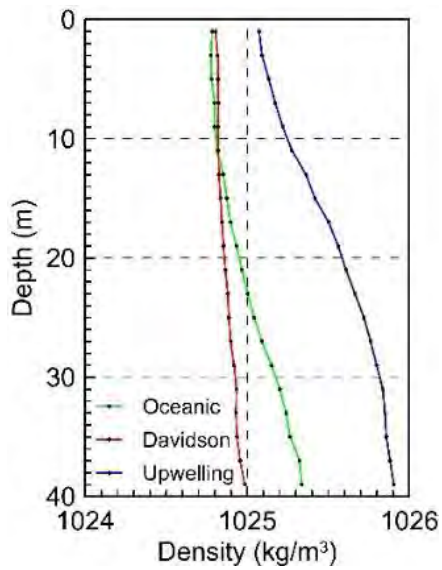


Figure 1. Seasonally averaged density profiles used for dilution simulations.

Table 1. Seasonally Averaged Properties at Diffuser Depth

Season	Temperature (°C)	Salinity (ppt)	Density (kg/m^3)
Davidson	14.46	33.34	1024.8
Upwelling	11.48	33.89	1025.8
Oceanic	13.68	33.57	1025.1

The assumed constituent properties are summarized in Table 2.

Table 2. Assumed Properties of Effluent Constituents

Constituent	Temperature (°C)	Salinity (ppt)	Density (kg/m^3)
Secondary effluent	20.0	0.80	998.8
Brine	9.9	58.23	1045.2
GWR	20.0	5.80	1002.6
Hauled brine	20.0	40.00	1028.6

2.3 Discharge Scenarios

Following publication of the 2017 MPWSP Draft EIR/EIS, the MRWPCA commented on several concerns related to the impact analysis regarding Ocean Plan and NPDES compliance. Specifically, discharge scenarios involving higher volumes of desalination brine (following a shut down for repair or routine maintenance) had not been assessed. Also, it was requested that higher resolution model analysis be conducted for scenarios involving low and moderate flows of secondary effluent for all project alternatives. Additionally, the MRWPCA requested that increased GWR effluent flows be assessed as part of planning for an increased capacity PWM project. Finally, it was requested that hauled brine be included in the dilution analysis for the Proposed Project.

It is proposed that revised model analysis be completed for typical and high brine discharge scenarios with secondary effluent flows ranging from 0 to 10 mgd and with the inclusion of hauled brine. Additionally, scenarios involving high flows of secondary effluent (15 and 19.78 mgd) will be assessed for typical operations. In addition, MPWPCA has requested that discharge scenarios where brine is absent be included in dilution model analyses to cover times when the desal plant is offline and to revise dilution model estimates based on the modified end-gate which may alter the outfall diffuser hydraulics.

Table 3 details the revised discharge scenarios for dilution model analysis of the Proposed Project (full size desalination facility and no implementation of GWR/PWM).

Table 4 details revised discharge scenarios for dilution model analysis of the Variant (MPWSP Alternative, reduced capacity desalination facility with PWM/GWR).

Table 3. Modeled Discharge Scenarios – Project (no GWR)

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
T1	SE Only	0.00	19.78	0	0.1	19.88	1.00	999.0
T2	Brine only	13.98	0.00	0	0.1	14.08	58.10	1045.1
T3	Brine + Low SE	13.98	1.00	0	0.1	15.08	54.30	1042.0
T4	Brine + Low SE	13.98	2.00	0	0.1	16.08	50.97	1039.4
T5	Brine + Low SE	13.98	3.00	0	0.1	17.08	48.04	1037.0
T6	Brine + Low SE	13.98	4.00	0	0.1	18.08	45.42	1034.9
T7	Brine + Moderate SE	13.98	5.00	0	0.1	19.08	43.08	1033.0
T8	Brine + Moderate SE	13.98	6.00	0	0.1	20.08	40.98	1031.3
T9	Brine + Moderate SE	13.98	7.00	0	0.1	21.08	39.07	1029.7
T10	Brine + Moderate SE	13.98	8.00	0	0.1	22.08	37.34	1028.3
T11	Brine + Moderate SE	13.98	9.00	0	0.1	23.08	35.76	1027.1
T12	Brine + High SE	13.98	10.00	0	0.1	24.08	34.30	1025.9
T13	Brine + High SE	13.98	15.00	0	0.1	29.08	28.54	1021.2
T14	Brine + High SE	13.98	19.78	0	0.1	33.86	24.63	1018.1
T15	High Brine only	16.31	0.00	0	0.1	16.41	58.12	1045.1
T16	High Brine + Low SE	16.31	1.00	0	0.1	17.41	54.83	1042.5
T17	High Brine + Low SE	16.31	2.00	0	0.1	18.41	51.89	1040.1
T18	High Brine + Low SE	16.31	3.00	0	0.1	19.41	49.26	1038.0
T19	High Brine + Low SE	16.31	4.00	0	0.1	20.41	46.89	1036.1
T20	High Brine + Moderate SE	16.31	5.00	0	0.1	21.41	44.73	1034.3

Table 4. Modeled Discharge Scenarios – Variant

Case ID	Scenario	Constituent Flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
V1	Brine only	8.99	0.00	0	0.0	8.99	58.23	1045.2
V2	Brine + Low SE	8.99	1.00	0	0.0	9.99	52.48	1040.6
V3	Brine + Low SE	8.99	2.00	0	0.0	10.99	47.78	1036.8
V4	Brine + Low SE	8.99	3.00	0	0.0	11.99	43.86	1033.6
V5	Brine + Low SE	8.99	4.00	0	0.0	12.99	40.55	1030.9
V6	Brine + Moderate SE	8.99	5.00	0	0.0	13.99	37.70	1028.6
V7	Brine + Moderate SE	8.99	5.80	0	0.0	14.79	35.71	1027.0
V8	Brine + Moderate SE	8.99	7.00	0	0.0	15.99	33.09	1024.9
V9	Brine + High SE	8.99	14.00	0	0.0	22.99	23.26	1017.0
V10	Brine + High SE	8.99	19.78	0	0.0	28.77	18.75	1013.3
V11	GWR Only	0.00	0.00	1.17	0.0	1.17	5.80	1002.6
V12	Low SE + GWR	0.00	0.40	1.17	0.0	1.57	4.53	1001.6
V13	Low SE + GWR	0.00	3.00	1.17	0.0	4.17	2.20	999.9
V14	High SE + GWR	0.00	23.70	1.17	0.0	24.87	1.04	999.0
V15	High SE + GWR	0.00	24.70	1.17	0.0	25.87	1.03	999.0
V16	Brine + High GWR only	8.99	0.00	1.17	0.0	10.16	52.19	1040.3
V17	Brine + High GWR + Low SE	8.99	1.00	1.17	0.0	11.16	47.59	1036.6
V18	Brine + High GWR + Low SE	8.99	2.00	1.17	0.0	12.16	43.74	1033.5
V19	Brine + High GWR + Low SE	8.99	3.00	1.17	0.0	13.16	40.48	1030.9
V20	Brine + High GWR + Low SE	8.99	4.00	1.17	0.0	14.16	37.67	1028.6
V21	Brine + High GWR + Moderate SE	8.99	5.00	1.17	0.0	15.16	35.24	1026.6
V22	Brine + High GWR + Moderate SE	8.99	5.30	1.17	0.0	15.46	34.57	1026.1
V23	Brine + High GWR + Moderate SE	8.99	6.00	1.17	0.0	16.16	33.11	1024.9
V24	Brine + High GWR + Moderate SE	8.99	7.00	1.17	0.0	17.16	31.23	1023.4
V25	Brine + High GWR + High SE	8.99	11.00	1.17	0.0	21.16	25.48	1018.7
V26	Brine + High GWR + High SE	8.99	15.92	1.17	0.0	26.08	20.82	1015.0
V27	Brine + Low GWR only	8.99	0.00	0.94	0.0	9.93	53.27	1041.2
V28	Brine + Low GWR + Low SE	8.99	1.00	0.94	0.0	10.93	48.47	1037.3
V29	Brine + Low GWR + Low SE	8.99	3.00	0.94	0.0	12.93	41.09	1031.4
V30	Brine + Low GWR + Moderate SE	8.99	5.30	0.94	0.0	15.23	35.01	1026.4
V31	Brine + Low GWR + High SE	8.99	15.92	0.94	0.0	25.85	20.95	1015.1
V32	High Brine only	11.24	0.00	0.00	0.0	11.24	58.23	1045.2
V33	High Brine + Low SE	11.24	0.50	0.00	0.0	11.74	55.78	1043.3
V34	High Brine + Low SE	11.24	1.00	0.00	0.0	12.24	53.54	1041.4
V35	High Brine + Low SE	11.24	2.00	0.00	0.0	13.24	49.55	1038.2
V36	High Brine + Low SE	11.24	3.00	0.00	0.0	14.24	46.13	1035.5
V37	High Brine + Low SE	11.24	4.00	0.00	0.0	15.24	43.16	1033.0
V38	High Brine + Moderate (5) SE	11.24	5.00	0.00	0.0	16.24	40.55	1030.9
V39	High Brine + GWR only	11.24	0.00	1.17	0.0	12.41	53.29	1041.2
V40	High Brine + GWR + Low SE	11.24	0.50	1.17	0.0	12.91	51.25	1039.6
V41	High Brine + GWR + Low SE	11.24	1.00	1.17	0.0	13.41	49.37	1038.0
V42	High Brine + GWR + Low SE	11.24	2.00	1.17	0.0	14.41	46.00	1035.3
V43	High Brine + GWR + Low SE	11.24	3.00	1.17	0.0	15.41	43.07	1033.0
V44	High Brine + GWR + Low SE	11.24	4.00	1.17	0.0	16.41	40.49	1030.9
V45	High Brine + GWR + Moderate SE	11.24	5.00	1.17	0.0	17.41	38.21	1029.0

3. Outfall Hydraulics

3.1 Introduction

The outfall and diffuser is described in Roberts (2016) (see Figure 1 in that report) as follows:

The Monterey Regional Water Pollution Control Agency (MRWPCA) outfall at Marina conveys the effluent to the Pacific Ocean to a depth of about 100 ft below Mean Sea Level (MSL). The ocean segment extends a distance of 9,892 ft from the Beach Junction Structure (BJS). Beyond this there is a diffuser section 1,406 ft long. The outfall pipe consists of a 60-inch internal diameter (ID) reinforced concrete pipe (RCP), and the diffuser consists of 480 ft of 60-inch RCP with a single taper to 840 ft of 48-inch ID. The diffuser has 171 ports of two-inch diameter: 65 in the 60-inch section and 106 in the 48-inch section. The ports discharge horizontally alternately from both sides of the diffuser at a spacing of 16 ft on each side except for one port in the taper section that discharges vertically for air release. The 42 ports closest to shore are presently closed, so there are 129 open ports distributed over a length of approximately 1024 ft. The 129 open ports are fitted with four inch Tideflex "duckbill" check valves (the four inch refers to the flange size not the valve opening). The valves open as the flow through them increases so the cross-sectional area is variable. The end gate has an opening at the bottom about two inches high. The hydraulic characteristics of the four-inch valves and the procedure to compute the flow distribution in the diffuser with the end gate opening was detailed in Roberts (2016) Appendix A.

It is proposed to replace the end gate opening with a Tideflex check valve. A suitable valve is a 6 inch Tideflex check valve, Hydraulic Code 355. The hydraulic characteristics of this valve are shown in Figure 2.

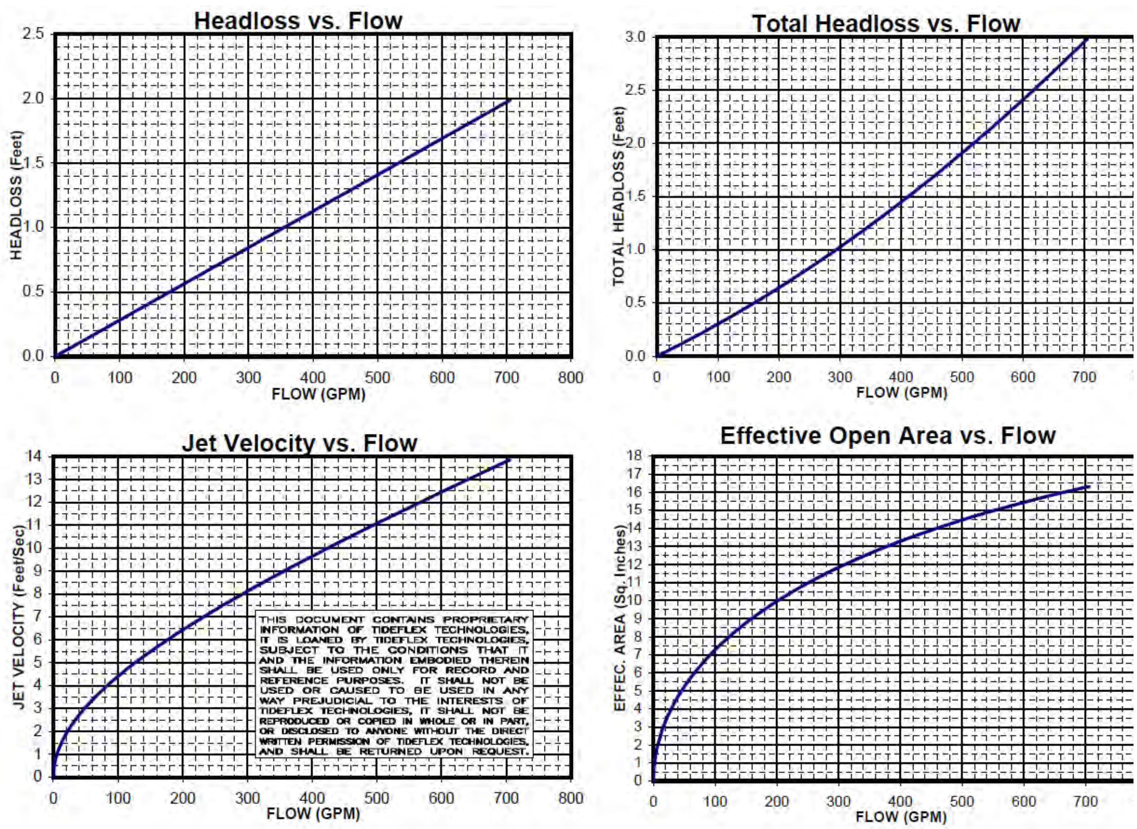


Figure 2. Characteristics of 6-inch TideFlex check valve Hydraulic Code 355.

The same methodology to compute the internal hydraulics as outlined in Roberts (2016) was used. For the purposes of the hydraulic computations, the relationship between the total head loss across the valve, E' and the flow Q of Figure 2 was approximated by:

$$Q = -28.24E'^2 + 319.8E' \qquad (1)$$

The calculation procedure followed that in Roberts (2016) except that the open end gate relationship was replaced by Eq. 1.

Typical flow variations with and without the end gate valve are shown in Figure 3. This shows Case T1, mostly secondary effluent with a total flow of 19.88 mgd, density 999.0 kg/m^3, and case T2, almost pure brine with a flow of 14.08 mgd, density 1045.1 kg/m^3. The flow distributions with and without the Tideflex valve are virtually indistinguishable. The flow exiting from the end gate is reduced slightly from 4% to 3% of the total for T1 and from 5% to 4% for T2. The velocity from the end gate is increased significantly by the check valve, from 6.7 to 10.7 ft/s for T1 and from 6.1 to 9.7 ft/s for T2. The additional total head loss through the outfall due to the check valve is negligible, about 0.01 ft.

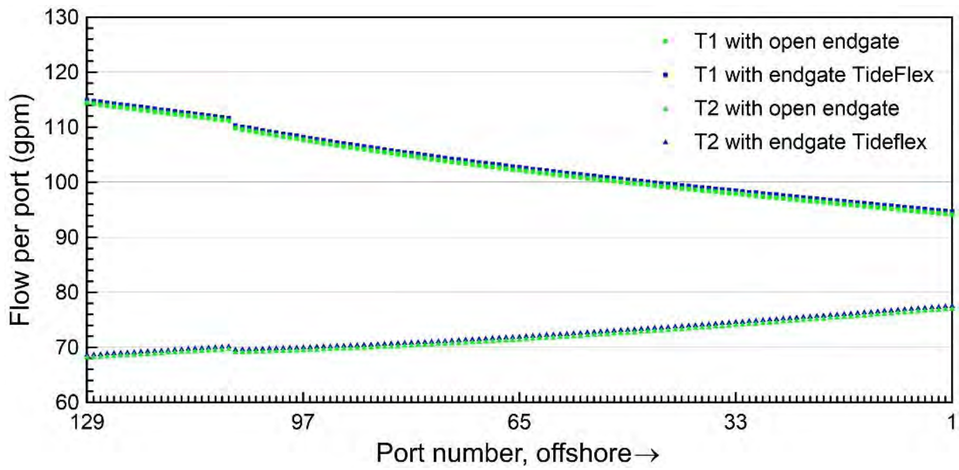


Figure 3. Typical port flow distributions with and without the endgate check valve for cases T1 and T2.

3.2 Effect of End Gate Valve on Dilution

The end gate check valve decreases the flow from the end gate and increases the flow from the two-inch ports. The dilution calculations later in this report assume the check valve is in place. To assess the effect of the valve on dilution from the main diffuser, dilutions were calculated for cases T1 and T2.

For T1, the total flow through the two-inch ports increased from 19.1 to 19.2 mgd (0.5%) and the port diameter increased from 2.00 to 2.01 inches. This had no effect on dilution (when rounded to a whole number).

For T2, the total flow through the two-inch ports increased from 13.4 to 13.5 mgd (0.8%) and the port diameter was unchanged at 1.84 inches. This had no effect on dilution (when rounded to a whole number).

4. Dense Discharge Dilution

4.1 Introduction

The calculation procedure was similar to that in Roberts (2016), where dilutions were predicted by two methods. First was the semi-empirical equation due to Cederwall (1968) (Eq. 3 in Roberts, 2016):

$$\frac{S_i}{F_j} = 0.54\left(0.66 + 0.38\frac{z}{dF_j}\right)^{5/3} \tag{2}$$

where S_i is the impact dilution, F_j the jet densimetric Froude number, and z the height of the nozzle above the seabed. Second, the dilution and trajectories of the jets were predicted by UM3, a Lagrangian entrainment model in the mathematical modeling suite Visual Plumes (Frick et al. 2003, Frick 2004, and Frick and Roberts 2016).

First, the internal hydraulics program was run to determine the flow variation along the diffuser. Dilutions were then computed for the flow and equivalent nozzle diameter for the innermost and outermost nozzles and the lowest dilution chosen. Worst-case oceanic conditions were assumed, which corresponds to the lowest oceanic density, the "Davidson" condition (Table 1), i.e. salinity = 33.34 ppt, density = 1024.8 kg/m^3.

4.2 Results

The results for the Project scenarios (Table 3) are summarized in Table 5, and for the Variant (Table 4) in Table 6. For large density differences, the Cederwall equation gives the lowest dilutions but as the effluent density approaches the ambient density, UM3 gives lower dilutions. To be conservative, the lowest of the two model predictions was chosen, as shown in last columns of Tables 5 and 6. The increase in dilution from the impact point to the edge of the BMZ was assumed to be 20% as discussed in Roberts (2016).

All dense discharges meet the Ocean Plan requirement of a 2 ppt increment in salinity at the edge of the BMZ.

Table 5. Summary of Dilution Simulations for Dense Effluent Scenarios – Project (no GWR)

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt
T2	14.08	58.10	1045.1	77.8	1.88	9.0	28.5	15.4	16.2	10.2	15.4	1.61	18.5	1.34
T3	15.08	54.30	1042.0	82.8	1.91	9.3	31.6	16.0	16.1	10.4	16.0	1.31	19.2	1.09
T4	16.08	50.97	1039.4	80.8	1.89	9.2	34.5	16.8	17.6	11.6	16.8	1.05	20.1	0.88
T5	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	17.7	18.5	12.7	17.7	0.83	21.2	0.69
T6	18.08	45.42	1034.9	91.6	1.95	9.8	43.4	18.8	19.5	13.8	18.8	0.64	22.5	0.54
T7	19.08	43.08	1033.0	97.1	1.98	10.1	49.2	20.1	20.9	15.3	20.1	0.48	24.2	0.40
T8	20.08	40.98	1031.3	103.1	2.01	10.4	56.5	21.9	22.2	16.8	21.9	0.35	26.3	0.29
T9	21.08	39.07	1029.7	108.7	2.02	10.9	67.4	24.8	24.9	19.2	24.8	0.23	29.7	0.19
T10	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	28.2	27.5	21.9	27.5	0.15	33.0	0.12
T11	23.08	35.76	1027.1	119.8	2.07	11.4	103.3	34.2	27.7	22.3	27.7	0.09	33.2	0.07
T12	24.08	34.30	1025.9	125.3	2.10	11.6	150.4	46.7	39.2	33.0	39.2	0.02	47.0	0.02
T15	16.41	58.12	1045.1	82.4	1.90	9.3	29.3	15.5	16.3	10.5	15.5	1.60	18.6	1.33
T16	17.41	54.83	1042.5	87.8	1.93	9.6	32.3	16.1	16.9	11.3	16.1	1.34	19.3	1.11
T17	18.41	51.89	1040.1	93.3	1.96	9.9	35.4	16.7	17.5	12.1	16.7	1.11	20.1	0.92
T18	19.41	49.26	1038.0	98.7	1.99	10.2	38.9	17.5	18.4	13.1	17.5	0.91	21.0	0.76
T19	20.41	46.89	1036.1	104.8	2.01	10.6	43.6	18.6	19.3	14.2	18.6	0.73	22.3	0.61
T20	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	19.6	20.4	15.4	19.6	0.58	23.6	0.48

Table 6. Summary of Dilution Simulations for Dense Effluent Scenarios – Variant

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m³)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
V1	9.0	58.23	1045.2	51.6	1.68	7.5	23.9	15.7	16.0	8.6	15.7	1.59	18.8	1.32
V2	10.0	52.48	1040.6	55.8	1.72	7.7	28.9	16.3	16.9	9.6	16.3	1.17	19.6	0.98
V3	11.0	47.78	1036.8	54.9	1.71	7.7	33.1	17.4	18.1	10.5	17.4	0.83	20.8	0.69
V4	12.0	43.86	1033.6	61.5	1.76	8.1	40.3	18.8	19.8	12.4	18.8	0.56	22.6	0.47
V5	13.0	40.55	1030.9	67.3	1.81	8.4	49.2	20.9	21.6	14.4	20.9	0.35	25.0	0.29
V6	14.0	37.70	1028.6	73.4	1.85	8.8	64.3	24.6	24.9	17.5	24.6	0.18	29.5	0.15
V7	14.8	35.71	1027.0	76.8	1.87	9.0	86.0	30.3	29.4	21.4	29.4	0.08	35.3	0.07
V8	16.0	33.09	1024.9	76.3	1.87	8.9	382.9	110.2	67.6	51.4	67.6	0.00	81.1	0.00
V16	10.2	52.19	1040.3	56.8	1.72	7.8	29.7	16.5	17.3	9.9	16.5	1.14	19.8	0.95
V17	11.2	47.59	1036.6	56.1	1.72	7.8	33.6	17.4	18.3	10.8	17.4	0.82	20.9	0.68
V18	12.2	43.74	1033.5	63.5	1.79	8.1	40.1	18.7	19.3	12.3	18.7	0.56	22.4	0.46
V19	13.2	40.48	1030.9	68.3	1.81	8.5	50.3	21.1	21.8	14.5	21.1	0.34	25.4	0.28
V20	14.2	37.67	1028.6	73.8	1.85	8.8	65.0	24.8	24.9	17.5	24.8	0.17	29.8	0.15
V21	15.2	35.24	1026.6	80.9	1.89	9.3	97.2	33.2	31.7	23.5	31.7	0.06	38.0	0.05
V22	15.5	34.57	1026.1	79.8	1.89	9.1	114.2	37.7	34.3	25.6	34.3	0.04	41.2	0.03
V23	16.2	33.11	1024.9	83.3	1.91	9.3	395.8	113.5	68.5	53.5	68.5	0.00	82.2	0.00
V27	9.9	53.27	1041.2	55.3	1.71	7.7	28.5	16.3	16.9	9.5	16.3	1.22	19.6	1.02

Table 6. Summary of Dilution Simulations for Dense Effluent Scenarios – Variant

Case ID	Effluent conditions			Port conditions				Predictions						
								Cederwall	UM3		At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
V28	10.9	48.47	1037.3	59.3	1.75	7.9	33.1	17.1	17.8	10.7	17.1	0.88	20.6	0.74
V29	12.9	41.09	1031.4	67.0	1.80	8.5	48.1	20.6	21.1	13.9	20.6	0.38	24.7	0.31
V30	15.2	35.01	1026.4	78.3	1.88	9.1	100.6	34.1	32.6	24.1	32.6	0.05	39.1	0.04
V32	11.2	58.23	1045.2	63.3	1.78	8.2	26.5	15.4	16.1	9.3	15.4	1.61	18.5	1.34
V33	11.7	55.78	1043.3	57.1	1.73	7.8	27.0	15.8	16.5	9.2	15.8	1.42	19.0	1.18
V34	12.2	53.54	1041.4	67.3	1.81	8.4	29.9	16.1	16.8	10.3	16.1	1.26	19.3	1.05
V35	13.2	49.55	1038.2	66.4	1.80	8.4	33.3	16.9	17.8	11.0	16.9	0.96	20.3	0.80
V36	14.2	46.13	1035.5	72.7	1.84	8.8	38.8	18.1	19.0	12.4	18.1	0.71	21.7	0.59
V37	15.2	43.16	1033.0	78.9	1.88	9.1	45.3	19.6	20.3	13.9	19.6	0.50	23.5	0.42
V38	16.2	40.55	1030.9	85.0	1.92	9.4	53.7	21.5	22.0	15.8	21.5	0.33	25.9	0.28
V39	12.4	53.29	1041.2	61.5	1.76	8.1	29.5	16.2	17.0	10.0	16.2	1.23	19.5	1.02
V40	12.9	51.25	1039.6	64.5	1.79	8.2	31.3	16.5	17.3	10.5	16.5	1.09	19.8	0.91
V41	13.4	49.37	1038.0	67.6	1.81	8.4	33.7	17.0	17.8	11.1	17.0	0.95	20.4	0.79
V42	14.4	46.00	1035.3	73.9	1.85	8.8	39.1	18.1	18.8	12.4	18.1	0.70	21.7	0.58
V43	15.4	43.07	1033.0	80.0	1.89	9.2	45.6	19.6	20.2	14.0	19.6	0.50	23.5	0.41
V44	16.4	40.49	1030.9	85.8	1.92	9.5	54.4	21.7	22.3	16.0	21.8	0.33	26.1	0.27
V45	17.4	38.21	1029.0	90.3	1.95	9.7	66.0	24.7	24.7	18.4	24.7	0.20	29.6	0.16

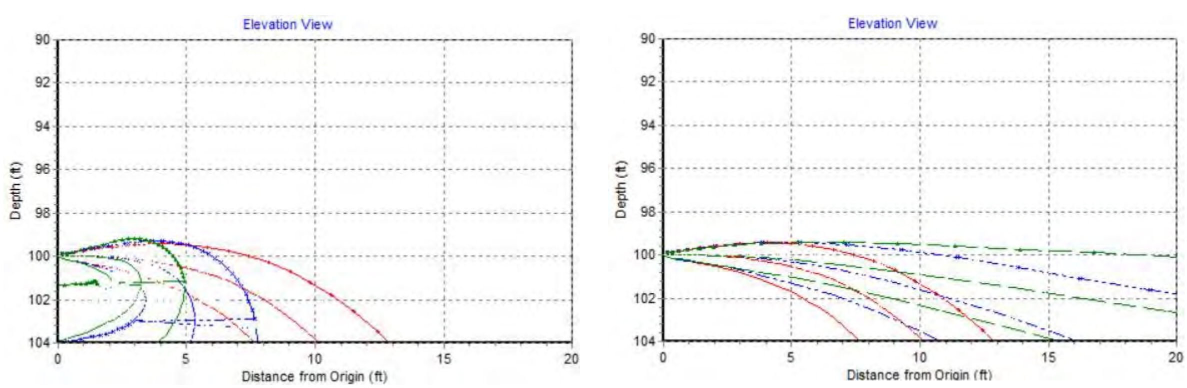
4.3 Effect of Currents

The effect of currents on the dynamics of dense jets has been questioned. All simulations have been done with zero current speed, as this is usually the worst case that results in lowest dilutions. According to the Research Activity Panel of the Monterey Bay National Marine Sanctuary, currents in the vicinity of the diffuser are commonly 5 to 10 cm/s and can reach 20 cm/s.

The effect of currents on dense jets is determined by the dimensionless parameter $u_r F_j$ (Gungor and Roberts 2009) where $u_r = u_a/u$ is the ratio of the ambient current speed, u_a, to the jet velocity, u. If $u_r F_j \ll 1$ the current does not significantly affect the jet; if $u_r F_j \gg 1$ the jet will be significantly deflected by the current and dilution increases significantly. Gungor and Roberts (2009) investigated the effects of currents on vertical dense jets; experiments on multiport diffusers with 60° nozzles were reported by Abessi and Roberts (2017).

There are no known experiments on horizontal dense jets in flowing currents so we investigated the phenomenon using the UM3 model in Visual Plumes. We simulated the pure brine case, T2 (Table 3) at current speeds of zero, 5, 10, and 20 cm/s. Because of the orientation of the MRWPCA diffuser (see Figure 1 of Roberts 2016) the predominant current direction is expected to be perpendicular to the diffuser axis. The nozzles are perpendicular to the diffuser, so the current direction relative to the individual jets is either counter-flow (jets directly opposing the current), or co-flow (jets in the same direction as the currents.

UM3 was run for all cases. Screen shots of the jet trajectories for counter- and co-flowing jets are shown in Figure 4.



a) Counter-flow   b) Co-flow

Figure 4. Screen shots of UM3 simulations of dense jet trajectories (Case T2) in counter- and co-flowing currents. Red: zero current; Blue: 10 cm/s; Green: 20 cm/s.

In counter flowing currents, the jets are bent backwards and impact the seabed closer to the diffuser. In co-flowing currents, the jets are advected downstream and impact the seabed farther from the diffuser. The numerical results are summarized in Table 7.

Table 7. UM3 Simulations of Case T2 with Current

Current	Counter-flow		Co-flow	
Speed (cm/s)	Dilution	Impact distance (ft)	Dilution	Impact distance (ft)
0	16.2	10	16.2	10
5	17.3	8	22.6	13
10	18.9	5	38.4	16
20	32.6	0	78.0	27

It can be seen that the effect of the currents is to increase dilution compared to the zero current case. The maximum impact distance from the diffuser occurs with co-flowing currents and increases as the current speed increases. In this case, the maximum impact distance (for u_a = 20 cm/s) is 27 ft (8.2 m). Clearly, this is much less than the distance to the edge of the BMZ (100 m) so we conclude that neglecting the effect of currents is indeed conservative, and the Ocean Plan regulations will be met for all anticipated currents.

4.4 Dilution of End Gate Check Valve

As discussed in Section 3, it has been proposed to replace the opening in the end gate with a 6-inch Tideflex check valve. We simulated the dilution of this valve for various nozzle angles for the worst case of pure brine, T2 (Table 3). The flow distributions along the diffuser for this case were shown in Figure 3. The exit velocity from the end gate check valve is 9.7 ft/s and the equivalent round diameter is 4.1 inches, yielding a densimetric Froude number, F_j = 20.7.

The effect of nozzle angle on the dilution of dense jets is discussed in Section 6.2. Using Figure 6, the impact dilutions for various angles were calculated. The results are summarized in Table 8.

The corresponding dilution for the main diffuser nozzles is 15.4 (Table 5). It is therefore apparent that any nozzle angle greater than about 20° will result in dilutions greater than the main diffuser and will meet the BMZ requirements. Dilution is maximized for a 60° nozzle.

Table 8. Effect of Nozzle Angle on Impact Dilution for Flow from End Gate Check Valve for Case T2 (14.08 mgd, 1045.1 kg/m^3).

Nozzle angle (Degrees)	Impact dilution
0	8.9
10	12.3
20	18.9
30	25.6
40	31.6
50	35.7
60	36.9

5. Buoyant Discharge Dilution

5.1 Introduction

The same procedures and models discussed in Roberts (2016) were used except that all three seasonal profiles were used for each flow scenario to determine the worst-case condition. Inspection of Tables 3 and 4 show that there are 14 cases of buoyant discharges, i.e., the effluent density is less than the receiving water density. Three are for the Project and 11 for the Variant. Two models in the US EPA modeling suite Visual Plumes were used: NRFIELD and UM3. Zero current speed was assumed in all cases.

5.2 Results

The following procedure was used: The internal hydraulics program was first run for each scenario and the average diameter and flow for each nozzle was obtained. UM3 and NRFIELD were then run for each oceanic season.

As was observed in Roberts (2016), for very buoyant cases, the average dilution predicted by UM3 is close to the minimum (centerline) dilution predicted by NRFIELD. They diverge as the effluent becomes only slightly buoyant (i.e. the effluent density approaches the ambient density), with UM3 dilutions being considerably higher.

NRFIELD is based on experiments conducted for parameters typical of domestic wastewater discharges into coastal waters and estuaries. For this situation, dilution and mixing are mainly dependent on the source buoyancy flux with momentum flux playing a minor role. As the effluent density approaches the background density, buoyancy becomes less important and the mixing becomes dominated by momentum. In that situation, NRFIELD continues to give predictions but issues a warning that "The results are extrapolated" when the parameters are outside the range of the original experiments. Table 9 summarizes the results; NRFIELD predictions are only given when they fall within the experimental range on which it is based.

The plume behavior depends strongly on the shape of the density profile (Figure 1) but dilutions are generally very high. The Upwelling profile always gives deepest submergence and lowest dilutions. The plumes are always submerged with the Upwelling and Oceanic profiles but some plumes surface with the weak Davidson stratification. Dilutions are very high for surfacing plumes, up to 842 (Case V12) when the flow is very low.

Table 9. Summary of Dilution Simulations for Buoyant Effluent Scenarios – Project and Variant

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height (centerline) (ft)	Minimum dilution	Rise height (centerline) (ft)	Rise height (top) (ft)
T1	Upwelling	19.88	1.00	999.0	103.7	2.01	10.5	27.9	188	57	179	41	57
	Davidson								327	100	349	100	100
	Oceanic								239	80	238	50	72
T13	Upwelling	29.08	28.54	1021.2	151.6	2.18	13.0	80.6	93	28			
	Davidson								127	57			
	Oceanic								94	27			
T14	Upwelling	33.86	24.63	1018.1	176.4	2.25	14.2	66.7	99	36			
	Davidson								147	76			
	Oceanic								104	41			
V9	Upwelling	22.99	23.26	1017.0	119.6	2.10	11.1	50.3	110	37			
	Davidson								172	75			
	Oceanic								116	42			
V10	Upwelling	28.77	18.75	1013.3	149.9	2.18	12.9	48.3	118	44	100	39	41
	Davidson								202	96	215	97	100
	Oceanic								132	58	134	57	59
V11	Upwelling	1.17	5.80	1002.6	6.5	0.71	5.3	25.4	495	30			
	Davidson								974	48			
	Oceanic								549	35			
V12	Upwelling	1.57	4.53	1001.6	8.4	0.81	5.2	23.1	457	31	385	25	32
	Davidson								842	50	652	33	45
	Oceanic								520	37	460	28	36

Table 9. Summary of Dilution Simulations for Buoyant Effluent Scenarios – Project and Variant

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height (centerline) (ft)	Minimum dilution	Rise height (centerline) (ft)	Rise height (top) (ft)
V13	Upwelling	4.17	2.20	999.9	21.7	1.24	5.8	19.9	324	39	301	30	40
	Davidson								547	66	687	51	74
	Oceanic								376	47	378	35	47
V14	Upwelling	24.87	1.04	999.0	129.6	2.11	11.9	30.9	174	60	165	56	59
	Davidson								290	100	301	67	100
	Oceanic								223	86	235	55	81
V15	Upwelling	25.87	1.03	999.0	134.8	2.13	12.1	31.4	172	60	163	57	59
	Davidson								281	100	293	67	100
	Oceanic								221	87	232	56	82
V24	Upwelling	17.16	31.23	1023.4	89.3	1.94	9.7	87.3	91	20			
	Davidson								131	46			
	Oceanic								91	18			
V25	Upwelling	21.16	25.48	1018.7	109.8	2.03	10.9	56.2	107	33			
	Davidson								159	65			
	Oceanic								111	37			
V26	Upwelling	26.08	20.82	1015.0	135.6	2.13	12.2	49.7	115	41			
	Davidson								191	89			
	Oceanic								124	49			
V31	Upwelling	25.85	20.95	1015.1	134.4	2.13	12.1	49.5	115	41			
	Davidson								191	89			
	Oceanic								124	49			

6. DILUTION MITIGATION – EFFECT OF NOZZLE ANGLE

6.1 Introduction

Orienting the nozzles upwards from horizontal will increase the dilution of brine mixtures that are more dense than the receiving water. For buoyant effluents, it will decrease dilution slightly. In this section, we investigate the effect on dilution of varying nozzle orientations for dense and buoyant effluents.

6.2 Dense Effluents

The effect of nozzle angle on dense jets has been recently investigated by Abessi and Roberts (2015). Figure 5 shows central plane tracer concentrations (inverse of dilution) obtained by laser-induced fluorescence for dense jets with angles ranging from 15° to 85°. For very shallow angles, e.g. 15°, the jet impacts the bed quickly, reducing dilution. For steep angles, e.g. 85°, the trajectory is also truncated and the jet falls back on itself, which also reduces dilution.

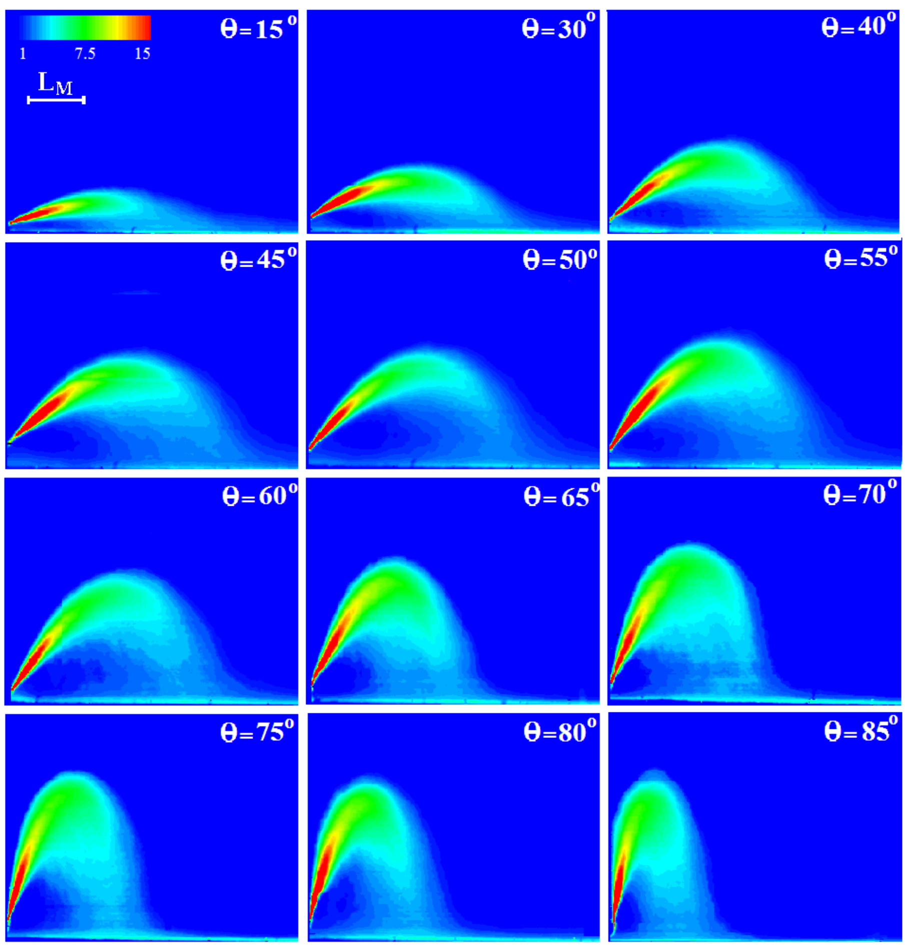


Figure 5. Central plane tracer concentrations for dense jets at various nozzle angles from 15° to 85°. After Abessi and Roberts (2015).

The optimum angle for dilution is 60°. This is illustrated by Figure 6, which shows the variation with nozzle angle on normalized impact dilution (S_i/F_j) and near field dilution (S_n/F_j) for single jets.

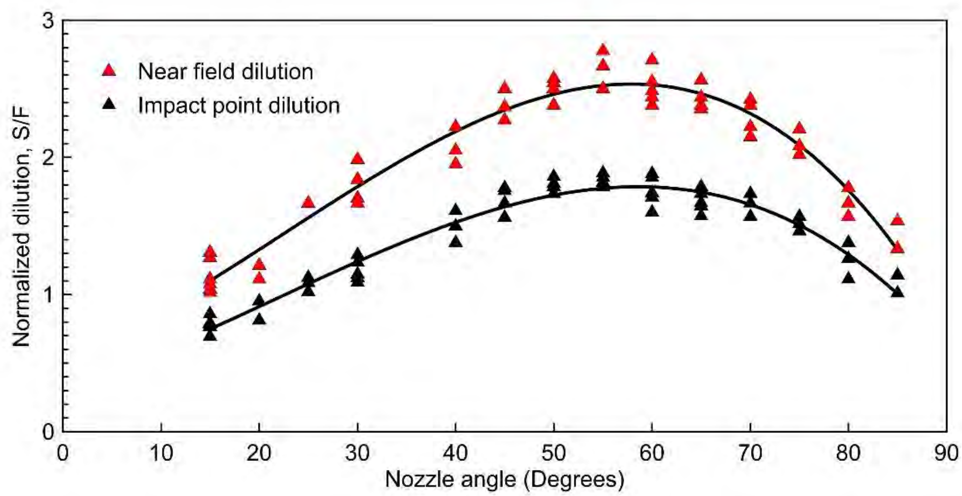


Figure 6. Effect of nozzle angle on normalized dilution of dense jets. After Abessi and Roberts (2015).

Impact dilutions were computed for the "worst-case" of brine only (T2, for conditions, see Table 3) using Figure 6. The results are tabulated in Table 10 and plotted in Figure 7. The effect of the height of the nozzle above the seabed, z, is determined by the dimensionless parameter z/dF_j, where d is the nozzle diameter. For Monterey, the nozzles are four feet above the seabed, so for case T2 we have $z/dF_j \approx 0.93$. The experiments of Abessi and Roberts were done with nozzles closer to the bed, with h/dF_j ranging from 0.12 to 0.39, so actual dilutions are expected to be higher than predicted in Table 10.

Dilution calculations with UM3 are also shown for completeness with other simulations. However, it is known that UM3 considerably underestimates dilutions for inclined jets (Palomar et al. 2012), therefore only the Abessi and Roberts results are used.

Table 10. Effect of Nozzle Angle on Dense Jets Case T2.
(for conditions, see Table 3)

Case ID	Nozzle angle	Dilution predictions				At impact		At BMZ	
		Cederwall	Abessi and Roberts (2015a)		UM3	Dilution	Salinity increment	Dilution	Salinity increment
	(deg)	Impact	Impact	Near field	Impact		(ppt)		(ppt)
T2	0	15.4	-	-	16.1	15.4	1.61	18.5	1.34
	10	-	16.9	25.2	18.7	16.9	1.47	20.3	1.22
	20	-	25.9	37.8	20.9	25.9	0.95	31.1	0.80
	30	-	35.3	50.8	22.8	35.3	0.70	42.3	0.59
	40	-	43.4	62.3	24.3	43.4	0.57	52.1	0.48
	50	-	49.0	70.0	24.5	49.0	0.50	58.9	0.42
	60	-	50.7	71.9	24.4	50.7	0.49	60.9	0.41

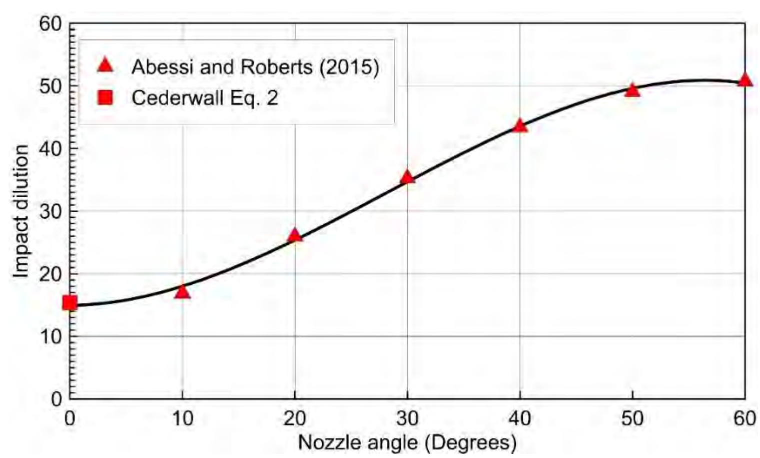


Figure 7. Effect of nozzle angle on dilution of dense jets, case T2.

Increasing the angle from horizontal (0°) to 60° increases dilution considerably, from 15 to 51. A 30° angle more than doubles the dilution compared to the horizontal jets.

The dilution at the BMZ is computed as 120% of the impact dilution. Note that in Table 10 the increase in dilution from the impact point to the end of the near field is more than 20%. This result, however, is for a single jet, and the increase for merged jets is less than this, and is conservatively assumed to be 20%, as explained in Roberts (2016).

6.3 Buoyant Effluents

Diffusers for buoyant effluents are usually designed with horizontal nozzles to maximize the length of the jet trajectory up to the terminal rise height, and therefore maximize dilution. Inclining the nozzles upwards will usually reduce dilution, although for very buoyant discharges in deep water the effect may be minimal. This is because the dynamics are then buoyancy dominated and the effect of momentum flux and therefore nozzle orientation is unimportant.

For very buoyant discharges, NRFIELD is the preferred model. NRFIELD, however, assumes the nozzles to be horizontal, so UM3 was used to assess the effect of nozzle orientation.

Simulations were run with UM3 for selected cases to bracket the expected results. The chosen cases were for the project scenarios (Table 3): T1 (mainly pure secondary effluent) and T13 (brine plus high secondary effluent). The latter case is only slightly buoyant and resulted in the lowest dilution of the buoyant cases. The simulations were run only for the oceanic conditions that gave the highest dilutions (Upwelling) and lowest dilutions (Davidson).

The results are summarized in Table 11 and plotted in Figure 8.

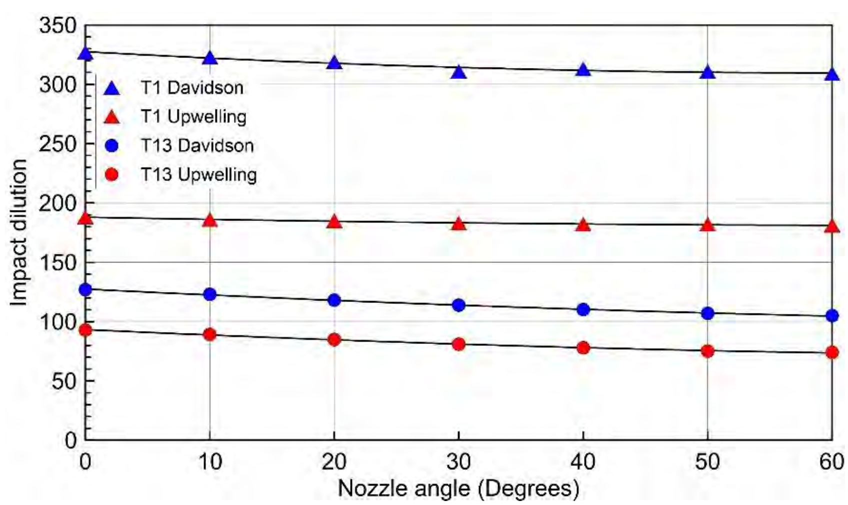


Figure 8. Effect of nozzle angle on dilution for selected buoyant discharge scenarios.

The results are insensitive to nozzle angle, especially for the very buoyant case of mainly pure secondary effluent (T1). Changing the nozzles from horizontal to 60° for the Davidson condition reduces dilution from 327 to 309, and for Upwelling condition from 188 to 181. For case T13 the corresponding reductions are from 127 to 105 and from 93 to 75. The percentage reductions for T13 are greater due to the increased effect of momentum flux, and therefore nozzle angle. More modest changes in orientation result in lesser effect; for a 30° nozzle the dilution reductions range from 3 to 13%.

Table 11. Effect of nozzle Angle on Dilution for Selected Buoyant Effluent Scenarios

Case ID	Oceanic Season	Effluent conditions			Nozzle angle	UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density	(deg)	Average dilution	Rise height (centerline) (ft)
T1	Upwelling	19.88	1.00	999.0	0	188	57
					10	186	58
					20	185	58
					30	183	59
					40	182	60
					50	182	61
					60	181	61
T1	Davidson	19.88	1.00	999.0	0	327	100
					10	323	100
					20	319	100
					30	311	100
					40	313	100
					50	311	100
					60	309	100
T13	Upwelling	29.08	28.54	1021.2	0	93	28
					10	89	29
					20	85	30
					30	81	31
					40	78	33
					50	75	35
					60	74	37
T13	Davidson	29.08	28.54	1021.2	0	127	57
					10	123	57
					20	118	57
					30	114	58
					40	110	60
					50	107	61
					60	105	63

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APPENDIX A. DENSITY PROFILES

The seasonally averaged density profiles assumed for modeling purposes are summarized below.

Depth (m)	Density (kg/m^3)		
	Upwelling	Davidson	Oceanic
1	1025.1	1024.8	1024.8
3	1025.1	1024.8	1024.8
5	1025.1	1024.8	1024.8
7	1025.2	1024.8	1024.8
9	1025.2	1024.8	1024.8
11	1025.3	1024.8	1024.8
13	1025.4	1024.8	1024.9
15	1025.4	1024.8	1024.9
17	1025.5	1024.8	1024.9
19	1025.6	1024.9	1024.9
21	1025.6	1024.9	1025.0
23	1025.7	1024.9	1025.0
25	1025.7	1024.9	1025.0
27	1025.8	1024.9	1025.1
29	1025.8	1024.9	1025.1
31	1025.8	1024.9	1025.2
33	1025.9	1024.9	1025.2
35	1025.9	1024.9	1025.3

APPENDIX B. ADDITIONAL SCENARIOS

In a memorandum from Trussell Technologies, Inc. dated July 21, 2017, dilution simulations for some additional scenarios were requested. They were contained in table 9 of that memo, which is reproduced below.

Table 9 –Proposed Flow Scenarios for Additional Modeling

No.	RTP Secondary Effluent	Hauled Waste	GWR Concentrate	Desal Brine	Ocean Condition[1]
MPWSP with high Desal Brine flow					
1	6	0	--	16.31	All
2	7	0	--	16.31	All
3	8	0	--	16.31	All
4	9	0	--	16.31	All
5	10	0	--	16.31	All
6	12	0	--	16.31	All
7	14	0	--	16.31	All
8	16	0	--	16.31	All
Variant with Desal Off					
9	8	0	1.17	0	All
Variant with GWR Concentrate off and high Desal Brine flow					
10	6	0	--	11.24	All
11	7	0	--	11.24	All
12	8	0	--	11.24	All
13	9	0	--	11.24	All
14	10	0	--	11.24	All
15	12	0	--	11.24	All
16	14	0	--	11.24	All
17	16	0	--	11.24	All
Variant with high Desal Brine flow					
18	6	0	1.17	11.24	All
19	7	0	1.17	11.24	All
20	8	0	1.17	11.24	All
21	9	0	1.17	11.24	All
22	10	0	1.17	11.24	All
23	12	0	1.17	11.24	All
24	14	0	1.17	11.24	All
25	16	0	1.17	11.24	All

1: All ocean conditions should be modeled when using the UM3 and NRFIELD models. For dense plumes that are modeled with Cederwall and UM3, the worst-case ocean condition should be used.

The flow conditions for these additional scenarios are summarized in Table B1. Dilutions were simulated according to the same procedures as outlined in Sections 4 and 5. The results for dense discharges are summarized in Table B2 and for buoyant discharges in Table B3.

Table B1. Additional Modeled Discharge Scenarios

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
AT1	MPWSP with high desal brine flow	16.31	6.00	0.00	0.0	22.31	42.78	1032.7
AT2		16.31	7.00	0.00	0.0	23.31	40.98	1031.3
AT3		16.31	8.00	0.00	0.0	24.31	39.33	1030.0
AT4		16.31	9.00	0.00	0.0	25.31	37.81	1028.7
AT5		16.31	10.00	0.00	0.0	26.31	36.40	1027.6
AT6		16.31	12.00	0.00	0.0	28.31	33.89	1025.6
AT7		16.31	14.00	0.00	0.0	30.31	31.70	1023.8
AT8		16.31	16.00	0.00	0.0	32.31	29.79	1022.2
AV9	Variant with desal off	0.00	8.00	1.17	0.0	9.17	1.44	999.3
AV10	Variant with GWR concentrate off and high desal brine flow	11.24	6.00	0.00	0.0	17.24	38.24	1029.1
AV11		11.24	7.00	0.00	0.0	18.24	36.19	1027.4
AV12		11.24	8.00	0.00	0.0	19.24	34.35	1025.9
AV13		11.24	9.00	0.00	0.0	20.24	32.69	1024.6
AV14		11.24	10.00	0.00	0.0	21.24	31.19	1023.4
AV15		11.24	12.00	0.00	0.0	23.24	28.58	1021.3
AV16		11.24	14.00	0.00	0.0	25.24	26.38	1019.5
AV17		11.24	16.00	0.00	0.0	27.24	24.50	1018.0
AV18	Variant with high desal brine flow	11.24	6.00	1.17	0.0	18.41	36.18	1027.4
AV19		11.24	7.00	1.17	0.0	19.41	34.36	1025.9
AV20		11.24	8.00	1.17	0.0	20.41	32.71	1024.6
AV21		11.24	9.00	1.17	0.0	21.41	31.22	1023.4
AV22		11.24	10.00	1.17	0.0	22.41	29.87	1022.3
AV23		11.24	12.00	1.17	0.0	24.41	27.48	1020.4
AV24		11.24	14.00	1.17	0.0	26.41	25.46	1018.7
AV25		11.24	16.00	1.17	0.0	28.41	23.73	1017.3

Table B2. Summary of Dilution Simulations for Dense Additional Scenarios

Case ID	Effluent conditions			Port conditions				Predictions			At impact (ZID)		At BMZ	
	Flow (mgd)	Salinity (ppt)	Density (kg/m3)	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Dilution	Dilution	Impact distance (ft)	Dilution	Salinity increment (ppt)	Dilution	Salinity increment (ppt)
AT1	22.3	42.78	1032.7	116.0	2.06	11.2	57.9	22.1	21.4	16.6	21.4	0.42	25.7	0.35
AT2	23.3	40.98	1031.3	120.7	2.08	11.4	60.7	22.8	22.8	18.1	22.8	0.34	27.4	0.28
AT3	24.3	39.33	1030.0	125.5	2.10	11.6	69.2	25.0	24.5	19.8	24.5	0.24	29.4	0.20
AT4	25.3	37.81	1028.7	130.3	2.11	12.0	81.4	28.2	27.2	22.3	27.2	0.16	32.6	0.14
AT5	26.3	36.40	1027.6	135.1	2.13	12.2	97.8	32.5	30.2	25.3	30.2	0.10	36.2	0.08
AT6	28.3	33.89	1025.6	144.7	2.16	12.7	195.3	58.6	44.9	39.0	44.9	0.01	53.9	0.01
AV10	17.2	38.24	1029.1	89.4	1.94	9.7	66.0	24.7	24.6	18.2	24.6	0.20	29.5	0.17
AV11	18.2	36.19	1027.4	93.6	1.96	10.0	86.1	30.0	28.8	22.0	28.8	0.10	34.6	0.08
AV12	19.2	34.35	1025.9	98.4	1.99	10.2	133.0	42.4	37.4	29.7	37.4	0.03	44.9	0.02
AV18	18.4	36.18	1027.4	94.7	1.97	10.0	86.4	30.0	28.7	22.0	28.7	0.10	34.4	0.08
AV19	19.4	34.36	1025.9	99.5	1.99	10.3	135.0	42.9	37.6	29.8	37.6	0.03	45.1	0.02

Table B3. Summary of Dilution Simulations for Buoyant Additional Scenarios

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height centerline (ft)	Minimum dilution	Rise height centerline (ft)	Rise height top (ft)
AT7	Upwelling	30.31	31.70	1023.8	157.8	2.20	13.3	123.3	88	19			
	Davidson								120	45			
	Oceanic								90	17			
AT8	Upwelling	32.31	29.79	1022.2	179.2	2.26	14.3	98.6	90	26			
	Davidson								118	53			
	Oceanic								88	23			
AV9	Upwelling	9.17	1.44	999.3	55.9	1.72	7.7	22.4	244	48	234	35	48
	Davidson								467	100	584	67	100
	Oceanic								309	66	315	42	60
AV13	Upwelling	20.24	32.69	1024.6	108.9	2.03	10.8	133.6	91	17			
	Davidson								100	15			
	Oceanic								138	41			
AV14	Upwelling	21.24	31.19	1023.4	114.9	2.06	11.1	96.5	88	20			
	Davidson								124	47			
	Oceanic								88	18			
AV15	Upwelling	23.24	28.58	1021.3	126.9	2.08	12.0	76.2	96	28			
	Davidson								133	55			
	Oceanic								95	26			
AV16	Upwelling	25.24	26.38	1019.5	138.7	2.11	12.7	68.1	100	32			
	Davidson								144	64			
	Oceanic								104	35			
AV17	Upwelling	27.24	24.50	1018.0	151.1	2.15	13.4	63.6	103	36			
	Davidson								155	73			
	Oceanic								109	41			

Table B3. Summary of Dilution Simulations for Buoyant Additional Scenarios

Case ID	Season	Effluent conditions			Port conditions				UM3 simulations		NRFIELD simulations		
		Flow (mgd)	Salinity (ppt)	Density	Flow (gpm)	Diam. (inch)	Velocity (ft/s)	Froude no.	Average dilution	Rise height centerline (ft)	Minimum dilution	Rise height centerline (ft)	Rise height top (ft)
AV20	Upwelling	20.41	32.71	1024.6	110.1	2.02	11.0	136.9	92	17			
	Davidson								139	41			
	Oceanic								101	15			
AV21	Upwelling	21.41	31.22	1023.4	116.1	2.02	11.6	102.6	91	20			
	Davidson								126	64			
	Oceanic								91	18			
AV22	Upwelling	22.41	29.87	1022.3	116.4	2.06	11.2	81.3	93	24			
	Davidson								128	51			
	Oceanic								90	21			
AV23	Upwelling	24.41	27.48	1020.4	134.0	2.10	12.4	71.8	98	30			
	Davidson								138	59			
	Oceanic								101	31			
AV24	Upwelling	26.41	25.46	1018.7	145.8	2.14	13.0	65.4	101	34			
	Davidson								149	68			
	Oceanic								106	38			
AV25	Upwelling	28.4	23.73	1017.3	157.6	2.17	13.7	62.3	105	37			
	Davidson								161	78			
	Oceanic								110	43			

APPENDIX C. EFFECT OF NOZZLE ANGLE ON DILUTION

In order to further investigate the effect of nozzle angle on dilution for various scenarios, additional model runs were undertaken for horizontal and 60° nozzles. Most were previously analyzed cases, whose flow properties are given in Tables 3 and 4. Table C1 summarizes the properties of the new cases.

Dilutions were simulated according to the same procedures as outlined in Sections 4 and 5. Table C2 summarizes the results for dense discharges. For the buoyant cases, only Upwelling and Davidson conditions were run to bracket the expected results. Because NRFIELD only allows for horizontal nozzles, only results for UM3 are shown in Table C3.

Table C1. Further Modeled Discharge Scenarios

Case ID	Scenario	Constituent flows (mgd)				Combined effluent		
		Brine	Secondary effluent	GWR	Hauled brine	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)
1	GWR only	0.00	0.00	1.17	0.0	1.17	5.80	1002.6
5		0.00	0.40	1.17	0.0	1.57	4.53	1001.6
7		0.00	0.60	1.17	0.0	1.77	4.11	1001.3
12		0.00	2.00	1.17	0.0	3.17	2.65	1000.2
16		0.00	4.00	1.17	0.0	5.17	1.93	999.7
17		0.00	4.50	1.17	0.0	5.67	1.83	999.6
18		0.00	5.00	1.17	0.0	6.17	1.75	999.5
32		0.00	23.40	1.17	0.0	24.57	1.04	999.0
New	Variant with normal flows and GWR offline	8.99	10.00	0.00	0.0	18.99	27.99	1020.8
New2		8.99	6.50	1.17	0.0	16.66	32.14	1024.1
New3		8.99	7.00	1.17	0.0	17.16	31.23	1023.4

Table C2. Summary of Dilution Simulations for Dense Scenarios

		Effluent conditions			Port conditions				Impact dilution predictions			At impact (ZID)		AT BMZ	
Case ID	Nozzle angle (deg)	Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (in.)	Velocity (ft/s)	Froude no.	Cederwall	Abessi & Roberts 2015a	UM3	Dilution	Salinity incr-ement (ppt)	Dilution	Salinity incr-ement (ppt)
T5	0	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	17.7	-	18.5	17.7	0.83	21.2	0.69
	60	17.08	48.04	1037.0	86.2	1.92	9.6	38.6	-	68.9	-	68.9	0.21	82.6	0.18
T10	0	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	28.2	-	27.5	27.5	0.15	33.0	0.12
	60	22.08	37.34	1028.3	114.2	2.05	11.1	80.6	-	143.7	-	143.7	0.03	172.4	0.02
T20	0	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	19.6	-	20.4	19.6	0.58	23.6	0.48
	60	21.41	44.73	1034.3	110.3	2.04	10.8	48.1	-	85.7	-	85.7	0.13	102.8	0.11
AT6	0	28.31	33.89	1025.6	144.7	2.16	12.7	194.0	58.3	-	44.9	44.9	0.01	53.9	0.01
	60	28.31	33.89	1025.6	144.7	2.16	12.7	194.0	-	345.6	-	345.6	0.00	414.8	0.00
V2	0	9.99	52.48	1040.6	55.8	1.72	7.7	28.9	16.3	-	16.9	16.3	1.17	19.6	0.98
	60	9.99	52.48	1040.6	55.8	1.72	7.7	28.9	-	51.5	-	51.5	0.37	61.9	0.31
V4	0	11.99	43.86	1033.6	61.5	1.76	8.1	40.3	18.8	-	19.8	18.8	0.56	22.6	0.47
	60	11.99	43.86	1033.6	61.5	1.76	8.1	40.3	-	71.8	-	71.8	0.15	86.1	0.12
V6	0	13.99	37.70	1028.6	73.4	1.85	8.8	64.3	24.6	-	24.9	24.6	0.18	29.5	0.15
	60	13.99	37.70	1028.6	73.4	1.85	8.8	64.3	-	114.6	-	114.6	0.04	137.5	0.03
V8	0	15.99	33.09	1024.9	76.3	1.87	8.9	382.9	110.2	-	67.6	67.6	0.00	81.1	0.00
	60	15.99	33.09	1024.9	76.3	1.87	8.9	382.9	-	682.3	-	682.3	0.00	818.8	0.00
V16	0	10.16	52.19	1040.3	56.8	1.72	7.8	29.7	16.5	-	17.3	16.5	1.14	19.8	0.95
	60	10.16	52.19	1040.3	56.8	1.72	7.8	29.7	-	52.9	-	52.9	0.36	63.5	0.30
V17	0	11.16	47.59	1036.6	56.1	1.72	7.8	33.6	17.4	-	18.3	17.4	0.82	20.9	0.68
	60	11.16	47.59	1036.6	56.1	1.72	7.8	33.6	-	59.9	-	59.9	0.24	71.9	0.20
V19	0	13.16	40.48	1030.9	68.3	1.81	8.5	50.3	21.1	-	21.8	21.1	0.34	25.4	0.28
	60	13.16	40.48	1030.9	68.3	1.81	8.5	50.3	-	89.6	-	89.6	0.08	107.6	0.07
V22	0	15.46	34.57	1026.1	79.8	1.89	9.1	114.2	37.7	-	34.3	34.3	0.04	41.2	0.03
	60	15.46	34.57	1026.1	79.8	1.89	9.1	114.2	-	203.5	-	203.5	0.01	244.2	0.01
V23	0	16.16	33.11	1024.9	83.3	1.91	9.3	395.8	113.5	-	68.5	68.5	0.00	82.2	0.00
	60	16.16	33.11	1024.9	83.3	1.91	9.3	395.8	-	705.4	-	705.4	0.00	846.5	0.00

Table C2. Summary of Dilution Simulations for Dense Scenarios

Case ID	Nozzle angle (deg)	Effluent conditions			Port conditions				Impact dilution predictions			At impact (ZID)		AT BMZ	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Flow (gpm)	Diam. (in.)	Velocity (ft/s)	Froude no.	Cederwall	Abessi & Roberts 2015a	UM3	Dilution	Salinity incr-ement (ppt)	Dilution	Salinity incr-ement (ppt)
V32	0	11.24	58.23	1045.2	63.3	1.78	8.2	26.5	15.4	-	16.1	15.4	1.61	18.5	1.34
	60	11.24	58.23	1045.2	63.3	1.78	8.2	26.5	-	47.2	-	47.2	0.53	56.6	0.44
V36	0	14.24	46.13	1035.5	72.7	1.84	8.8	38.8	18.1	-	19.0	18.1	0.71	21.7	0.59
	60	14.24	46.13	1035.5	72.7	1.84	8.8	38.8	-	69.1	-	69.1	0.19	82.9	0.15
AV10	0	17.24	38.24	1029.1	89.4	1.94	9.7	65.9	24.7	-	27.5	24.7	0.20	29.6	0.17
	60	17.24	38.24	1029.1	89.4	1.94	9.7	65.9	-	117.4	-	117.4	0.04	140.9	0.03
AV12	0	19.24	34.35	1025.9	98.4	1.99	10.2	132.4	42.2	-	37.4	37.4	0.03	44.9	0.02
	60	19.24	34.35	1025.9	98.4	1.99	10.2	132.4	-	235.9	-	235.9	0.00	283.1	0.00
V39	0	12.41	53.29	1041.2	61.5	1.76	8.1	29.5	16.2	-	17.0	16.2	1.23	19.5	1.02
	60	12.41	53.29	1041.2	61.5	1.76	8.1	29.5	-	52.6	-	52.6	0.38	63.1	0.32
V43	0	15.41	43.07	1033.0	80.0	1.89	9.2	45.6	19.6	-	20.2	19.6	0.50	23.5	0.41
	60	15.41	43.07	1033.0	80.0	1.89	9.2	45.6	-	81.2	-	81.2	0.12	97.5	0.10
V45	0	17.41	38.21	1029.0	90.3	1.95	9.7	66.0	24.7	-	18.4	18.4	0.26	22.1	0.22
	60	17.41	38.21	1029.0	90.3	1.95	9.7	66.0	-	117.7	-	117.7	0.04	141.2	0.03
AV19	0	19.41	34.36	1025.9	99.5	1.99	10.3	134.4	42.8	-	37.6	37.6	0.03	45.1	0.02
	60	19.41	34.36	1025.9	99.5	1.99	10.3	134.4	-	239.4	-	239.4	0.00	287.3	0.00

Table C3. Summary of Dilution Simulations for Buoyant Further Scenarios

Case ID	Season	Effluent conditions			Port conditions					UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Nozzle angle (deg)	Flow (gpm)	Diam. (inch)	Velocity (ft/s	Froude no.	Average dilution	Rise height (centerline) (ft)
New	Upwelling	18.99	27.99	1020.8	0	98.5	1.99	10.2	62.8	101	28
					60					82	34
	Davidson				0					145	55
					60					123	58
V25	Upwelling	21.16	25.48	1018.7	0	109.8	2.03	10.9	56.2	107	33
					60					91	39
	Davidson				0					159	65
					60					141	70
AV14	Upwelling	21.24	31.19	1023.4	0	114.9	2.06	11.1	96.5	88	20
					60					66	28
	Davidson				0					124	47
					60					94	49
AV21	Upwelling	21.41	31.22	1023.4	0	116.1	2.02	11.6	102.6	91	20
					60					68	30
	Davidson				0					126	64
					60					96	49
1	Upwelling	1.17	5.80	1002.6	0	6.8	0.71	5.5	26.6	499	29
					60					488	30
	Davidson				0					987	S
					60					949	S
5	Upwelling	1.57	4.53	1001.6	0	8.1	0.79	5.3	23.7	461	31
					60					447	32
	Davidson				0					853	50
					60					817	50
7	Upwelling	1.77	4.11	1001.3	0	9.3	0.85	5.3	22.6	443	32
					60					428	33
	Davidson				0					800	S
					60					768	S

Table C3. Summary of Dilution Simulations for Buoyant Further Scenarios

Case ID	Season	Effluent conditions			Port conditions					UM3 simulations	
		Flow (mgd)	Salinity (ppt)	Density (kg/m^3)	Nozzle angle (deg)	Flow (gpm)	Diam. (inch)	Velocity (ft/s	Froude no.	Average dilution	Rise height (centerline) (ft)
12	Upwelling	3.17	2.65	1000.2	0	16.5	1.11	5.5	20.1	359	36
					60					347	37
	Davidson				0					609	59
					60					586	59
16	Upwelling	5.17	1.93	999.7	0	26.9	1.35	6.0	19.9	300	51
					60					291	41
	Davidson				0					517	S
					60					507	S
17	Upwelling	5.67	1.83	999.6	0	29.6	1.40	6.2	19.9	290	S
					60					282	S
	Davidson				0					509	S
					60					504	S
18	Upwelling	6.17	1.75	999.5	0	32.3	1.44	6.4	20.2	282	S
					60					274	S
	Davidson				0					506	S
					60					510	S
32	Upwelling	24.57	1.04	999.0	0	128.0	2.10	11.9	30.9	175	S
					60					168	S
	Davidson				0					291	S
					60					276	S
New2	Upwelling	16.66	32.14	1024.1	0	86.1	1.92	9.5	103.5	92	18
					60					65	26
	Davidson				0					131	43
					60					95	46
New3	Upwelling	17.16	31.23	1023.4	0	89.0	1.94	9.7	87.0	91	20
					60					69	29
	Davidson				0					131	46
					60					102	48