Kennedy Jenks

Jacobs

275 Battery Street
Suite 550
San Francisco, California 94111
415-243-2150

4 Embarcadero Center
Suite 3800
San Francisco, California 94111
415-728-0650

Draft Technical Memorandum

MMWD Desalination Supply Study

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REGISTERED PROFESSIONAL ENGINEER
TODD K. REYNOLDS
No. 59630
Exp. 12/31/23
CIVIL
STATE OF CALIFORNIA

Prepared for

MARIN WATER

220 Nellen Avenue
Corte Madera, California 94925

KJ Project No. 2168011.00

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Section 1: Introduction

1.1 Introduction

Marin Municipal Water District's (MMWD, District) watershed has seen historically low rainfall amounts over the period from 2019 through 2021 and the District has implemented water restrictions for the community. To address a potential near-term water supply shortfall if the current drought continues into 2022, and to evaluate future longer-term water supply shortages, MMWD is considering alternatives for supplemental water supply. Alternative water supplies include potential water transfers and a potential temporary or long-term seawater desalination facility.

In 2005 and 2006, MMWD, Kennedy Jenks (KJ) and CH2MHill (now Jacobs) conducted a year-long Seawater Desalination Pilot Program to evaluate and demonstrate the potential for a drought-proof supplemental water supply for Marin. Based on that previous work, MMWD requested that KJ and Jacobs assist them in evaluating the feasibility, capacity, cost and schedule of a potential short-term leased seawater desalination facility to provide supplemental water for Marin in 2022; and to update the costs for a long-term seawater desalination facility.

This technical memorandum describes the overall design parameters and concepts for the two approaches to a supplemental desalination supply. The memo summarizes the availability, capacity, conceptual costs and potential schedule for a short-term (12-month) leased seawater desalination facility with a capacity of approximately 3.6 million gallons per day (mgd). The memo presents conceptual level construction costs and potential schedule for a long-term full-scale 5, 10 and 15-mgd capacity seawater desalination facility. The memo also summarizes discussions with regulators and a potential fast-track project delivery approach for a potential emergency desalination water supply project. In mid-October 2021, MMWD requested that KJ-Jacobs suspend work on the Desalination Supply Study.

1.2 Background

The KJ-Jacobs Seawater Desalination Pilot Program Engineering Report, dated January 26, 2007, (2007 Desal Report) evaluated source and drinking water quality, treatment technologies and facility layouts, brine disposal and environmental aspects for a seawater desalination facility drawing source water from the north San Francisco Bay. The pilot program also provided information to support a project Environmental Impact Report (EIR) which was certified by MMWD in 2007.

The 2007 Desal Report included a conceptual design and costs for a full-scale 5-million gallon-per-day (MGD) desalination facility that was expandable to 15-MGD. The full-scale facility was proposed to be located at the MMWD Pelican Way Storage Site in San Rafael, California. The screened intake was proposed to be located on a reconstructed pier at the Marin Rod and Gun Club near the Richmond-San Rafael Bridge. The concentrate from the facility was proposed to be blended with secondary effluent in the Central Marin Sanitation Agency (CMSA) outfall located near the Pelican Way Storage Site.

This study is based on and builds from the concepts and results from the 2007 Pilot Study and Desal Report.

1.3 Source Water and Treated Water Objectives

The source water for a potential MMWD seawater desalination water supply would be Northern San Francisco Bay water drawn from a screened intake located approximately 5,000 feet out from the shore with a water depth of approximately 8 to 10 feet. The Northern San Francisco Bay is a complex estuarine water body with influences from the Pacific Ocean, fresh water flow from the Sacramento Delta, local rivers, and bay discharges that affect water quality on a daily as well as a seasonal basis.

The general San Francisco Bay source water quality data and treatment objectives pertaining to the operation of the desalination treatment processes are described below. The 2007 Desal Report includes detailed discussions on the occurrence of regulated and non-regulated drinking water constituents and their removal through the desalination treatment process.

1.3.1 Historical San Francisco Bay Source Water Quality

Table 1 below presents general and mineralogical water-quality data for typical Pacific Ocean water, historical maximum levels of constituents in Northern San Francisco Bay (Bay) water, and the water-quality of the Bay water that served as the source water to the pilot plant during the study period. As expected, the pilot plant source water parameters were lower than, but consistent with, Pacific Ocean water-quality parameters. A full-scale SWRO facility must be able to treat the worst-case (highest-salinity) San Francisco Bay water quality that would occur during a prolonged drought, and as represented by the historical maximum values in the table.

Table 1: Historical North San Francisco Bay Source Water Quality

		Typical Pacific Ocean Seawater[a]	Historical North San Francisco Bay Water Quality[b]	2006 Pilot Study Source Water (Bay Water) Quality[c]		
Parameter	**Units**		**Max.**	**Avg.**	**Max.**	**Min.**
TDS	mg/l	34,465	32,000	21,700	29,000	2,500
Conductivity	umhos/cm	–	48,000	39,200	43,500	5,000
Calcium	mg/l	400	371[d]	210	310	71
Magnesium	mg/l	1272	1,181[d]	755	910	580
Sodium	mg/l	10,560	9,805[d]	6,700	8,100	3,300
Potassium	mg/l	380	353[d]	262	350	190
Ammonia	mg/l	0.4	0.4	ND	ND	ND
Barium	mg/l	5	3	5.0	27	0.011
Strontium	mg/l	13	12[d]	2.63	5.9	.004
Bromide	mg/l	–	–	6.9	8.1	6.0
Bicarbonate	mg/l	142	110[d]	101	110	94
Temperature	°C	10	21.7	17	21	10
pH	units	8.2	8.19	7.9	8.3	7.6
Sulfate	mg/l	2,560	2,377[d]	1,533	1,900	1,000
Chloride	mg/l	18,980	17,620	11,000	15,000	2,100
Fluoride	mg/l	1.4	1.3[d]	0.682	0.79	0.5
Boron	mg/l	4.6	4.3[d]	2.3	3.3	1.7

Notes:

(a) From Van der Leeden, et al., 1990, The Water Encyclopedia.
(b) Historical North San Francisco Bay Water Quality Data: 1990 MMWD Pilot Study and USGS data.
(c) On-line and grab samples from March 2005 to April 2006.
(d) Value calculated by taking the ratio of analyte concentration to TDS concentration in typical seawater and multiplying it by the San Francisco Bay TDS historical maximum value for that analyte.

1.3.2 Proposed Finished Water Quality Objectives

The water-quality objectives for the proposed MMWD seawater desalination water supply finished water are shown in Table 2 below. Table 2 also lists important water quality parameters of MMWD's current water sources. The table also lists corrosion control parameter objectives for the finished water to make sure the stabilized desalinated water is compatible with MMWDs current sources.

Table 2: Proposed Finished Water Quality Objectives for the MMWD Desalination Supply

		MMWD Treated Reservoir			Sonoma County Water			Desalination Plant Finished Water Quality Objectives		
Parameter	**Units**	**Avg.**	**Max.**	**Min.**	**Avg.**	**Max.**	**Min.**	**Avg.**	**Max.**	**Min.**
TDS	mg/l	119	136	86	171	186	148	120	180	60
Hardness	mg/l	62	74	52	105	112	96	60	110	50
Alkalinity	mg/l	61	70	49	119	125	110	60	110	50
pH	units	7.8	7.9	7.8	8.1	8.4	7.8	7.9	8.4	7.8
Color	CU	<3	<3	<3	<3	<3	<3	<3	<3	–
TOC	mg/l	1.6	2.4	1.1	0.9	1.2	0.7	<1	1	–
Sodium	mg/l	16	25	11	20	23	16	30	50	10
Chloride	mg/l	27	37	22	8	10	7	50	70	10
Boron	mg/l	<0.05	<0.05	<0.05	0.28	0.26	0.16	0.5	1	–
LSI	–	-0.94	-0.64	-1.29	0.11	0.42	-0.14	0.2	0.4	0.0
RI	–	–	–	–	–	–	–	7	8	6
AI	–	11	11.3	10.8	12	12.2	11.8	11.5	12	11
LNI	–	–	–	–	–	–	–	0.3	0.4	0.25

Notes:

(a) Langlier Saturation Index (LSI); Ryzner Index (RI).
(b) Aggressiveness Index (AI); Larsen Index (LNI).

The general water-quality objectives for the MMWD seawater desalination water supply fall within the range of the water quality parameters for MMWD's current treated reservoir water supply and the imported water from Sonoma County. The total dissolved solids, hardness, alkalinity, color, pH, and corrosion index parameter objectives are based on the goal of providing finished water similar to MMWD's current water supplies with respect to these aesthetic and corrosivity indices.

1.4 Conceptual Desalination Treatment Process

Figure 1 presents a simplified process flow diagram for a potential MMWD desalination facility. The 2007 Desal Report provides more detailed discussions and conceptual design criteria for the desalination facility components. The potential short-term and long-term desalination facilities would include the following treatment processes.

- Passive narrow-slot intake screens
- Source water pre-screens

- Ultrafiltration membrane filters for direct filtration without chemical addition
- Single-pass reverse osmosis membranes operating at ~50% recovery
- Lime stabilization
- Free chlorine disinfection

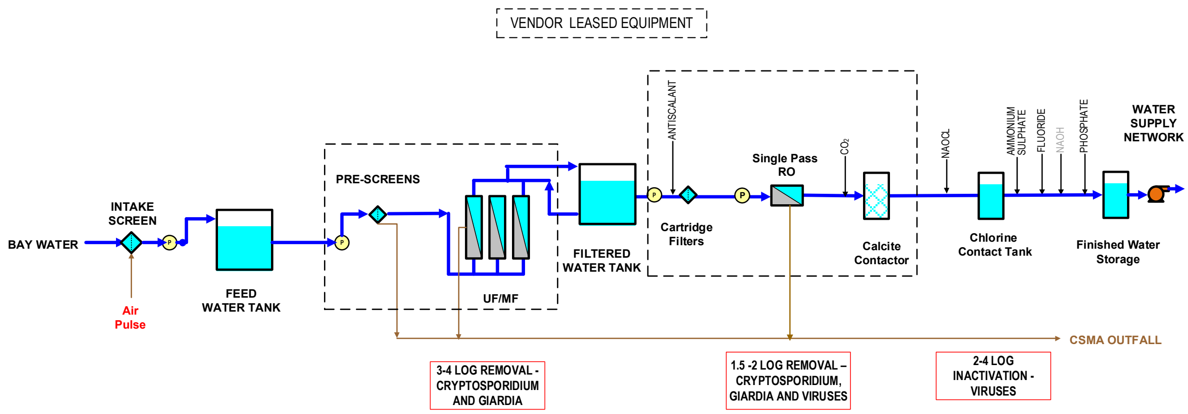

Figure 1: Conceptual Seawater Desalination Process Flow Diagram

1.5 Conceptual Overall Desalination Supply Project Layout

Based on the 2007 Desal Report, a potential short-term leased desalination facility or a long-term full-scale desalination facility could be located at the MMWD's Pelican Way Maintenance Yard facility in San Rafael, CA. The maintenance yard has an area of approximately 6.6 acres. There is an adjacent undeveloped parking area to the northeast of the maintenance yard on Shoreline Parkway. This parking lot site has an area of approximately 1.8 acres. Figure 2 shows a conceptual level overall layout for a potential MMWD desalination supply. The conceptual layout has the following features, which are described in more detail in the following sections related to the short-term leased desalination facility or a long-term full-scale desalination facility:

- The bay water intake would include passive screens located at the same water depth as proposed in 2007, and approximately 5,000-feet from the shoreline adjacent to the MMWD Pelican Way Maintenance Yard. This approach reduces the complexity and costs of a new pier and intake system, as conceived in 2007.

- The intake screens would be connected to an on-shore wet well and pump station via an HDPE pipeline on and under the bay floor.

- The intake pump station would deliver raw water to the treatment facilities located at either or both the maintenance yard and parking lot sites.

- The 3.6 mgd short-term leased desalination facilities require approximately 1.5 acres of space and could be located at either the maintenance yard or parking lot sites.

- The 15-mgd long-term full-scale desalination facilities require approximately 6.5 acres of space and would be located at the maintenance yard and possibly also the parking lot site.

- Treated water from the desalination facilities would be delivered to the MMWD distribution system in San Rafael.

- Brine from the desalination process would be discharged to the Central Marin Sanitation Agency (CMSA) outfall through an existing onshore structure. The brine would blend with water from the CMSA facilities before being discharged to the Bay. The 2007 Desal Report includes detailed discussions on bioassay testing and other studies that were conducted related to the proposed discharge.

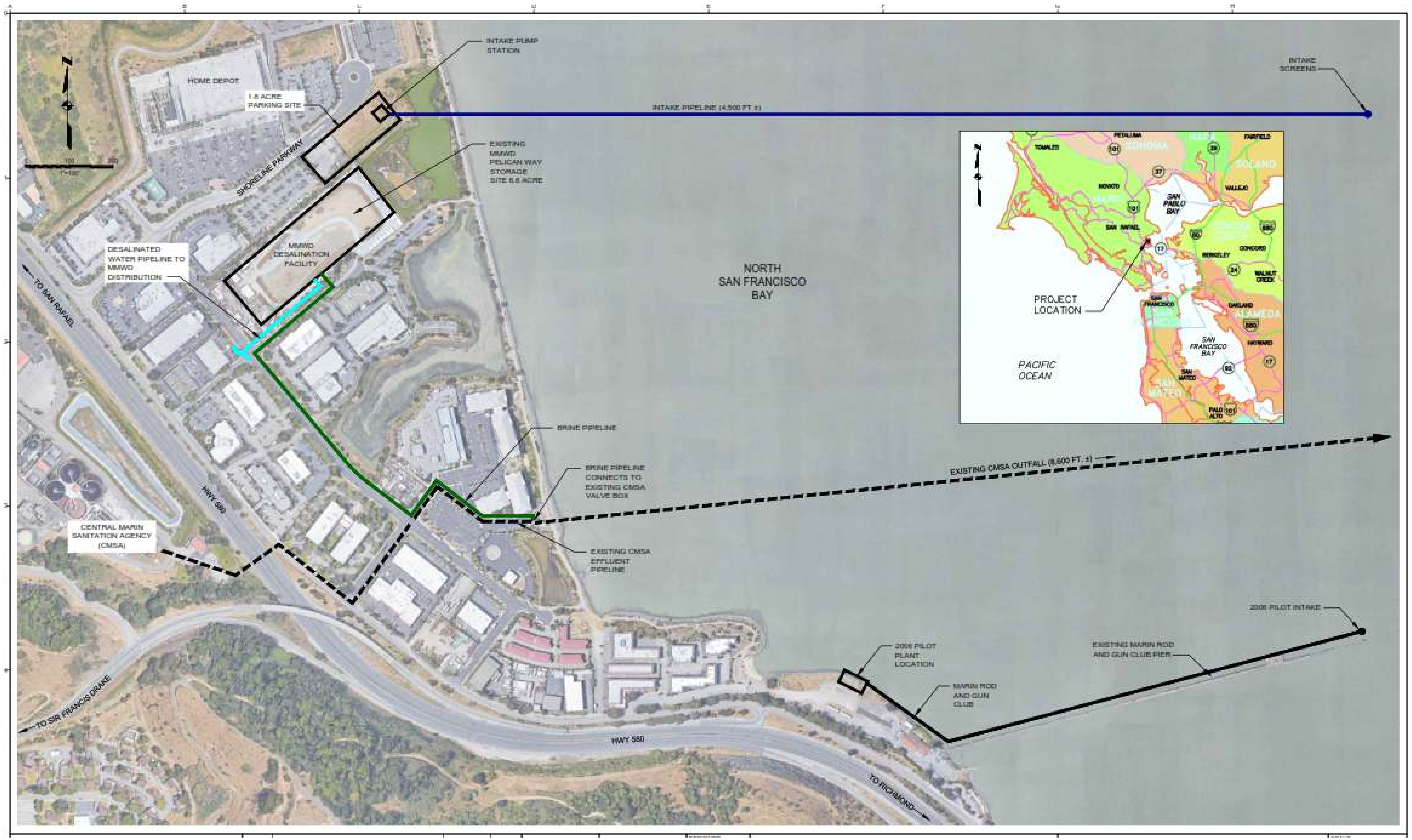

Figure 2: Conceptual Seawater Desalination System Overall Project Layout

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Section 2: Seawater Desalination Alternatives

This section describes the different alternatives evaluated for a MMWD seawater desalination supply and describes the development of opinions of probable project costs for the different alternatives.

2.1 Short-Term Land-Based Desalination System

This MMWD seawater desalination supply alternative could provide a short-term, leased temporary facility to provide supplemental water supply needs associated with the current drought. Elements of this alternative, such as the intake or brine pipeline could be temporary or could be used for potential future long-term facilities. Figure 3 shows an example of a pre-engineered, containerized desalination system.

Figure 3: Example of a Containerized Seawater Desalination System (Osmoflo)

2.1.1 Conceptual Facilities

This approach would provide leased containerized and/or skid-mounted treatment equipment, tanks, electrical infrastructure and pump stations located at the MMWD Pelican Way maintenance yard or parking lot sites in San Rafael, CA. Complete desalination and treatment of the bay water would occur onshore at the Pelican Way Storage Site.

The source water would be provided by barge-mounted or pedestal-mounted intake screens offshore in the North San Francisco Bay. The screens would be located approximately 6-feet above the bay floor in approximately 12-feet of water. An HDPE pipeline would connect the passive intake screens to an on-shore pump station near the Pelican Way maintenance yard.

The treated drinking water (desalted, stabilized and disinfected water) would be pumped from the desal facility into the MMWD distribution system at a connection point along Francisco Boulevard in San Rafael.

The RO concentrate (brine) and backwash water would be conveyed via a HDPE pipeline and connected to an existing shoreline valve box on the CMSA outfall approximately half a mile away from the Pelican Way Storage Site. The brine would blend with the low salinity secondary effluent and be discharged into the San Francisco Bay through the existing CMSA outfall.

Neutralized membrane system cleaning solutions and sanitary wastes would be discharged to the sewer system and treated at the CMSA treatment plant.

2.1.2 Project Delivery Approach

For the leased, land-based containerized equipment approach, it is envisioned that one entity would provide all of the treatment process equipment for a defined period of time with a monthly lease type contract. The Desalination Equipment Entity would be responsible for installing, commissioning and demonstrating that the provided equipment treats the Bay water to meet MMWD-specified drinking water quality and quantity requirements. MMWD would be responsible for operations of the facilities.

MMWD would be responsible for constructing the interfacing systems or support facilities associated with the desalination facility, including preparation of the Pelican Way Storage Site, electric power connection to the treatment and pumping systems, the intake system, the concentrate pipeline and connection to CMSA; and treated water pipeline connection to MMWD distribution.

To help with the project implementation, it is envisioned that MMWD would be responsible for obtaining permits associated with siting and operation of the short-term desalination system. The concept for this land-based short-term desalination supply is similar to the conceptual design of the full-scale facility described in the 2007 Engineering Report and the EIR. The permitting studies conducted in 2007 would be applicable for this alternative.

2.1.3 Potential Equipment Suppliers

Equipment Suppliers such as Suez, Veolia, IDE, Osmoflo, Seven Seas, and others have standard skid-mounted, and in some cases, containerized, pre-filtration, reverse osmosis and water stabilization equipment required for seawater desalination. The systems may be available for lease, depending on availability. These containerized systems are typically small capacity systems with a production capacity of 0.5 to 1.8 mgd.

2.2 Short-Term Ship-Based Desalination System

This MMWD seawater desalination supply alternative could provide a short-term, leased temporary facility to provide supplemental water supply needs associated with the current drought. Figure 4 shows a conceptual picture of an offshore seawater desalination facility on a ship.

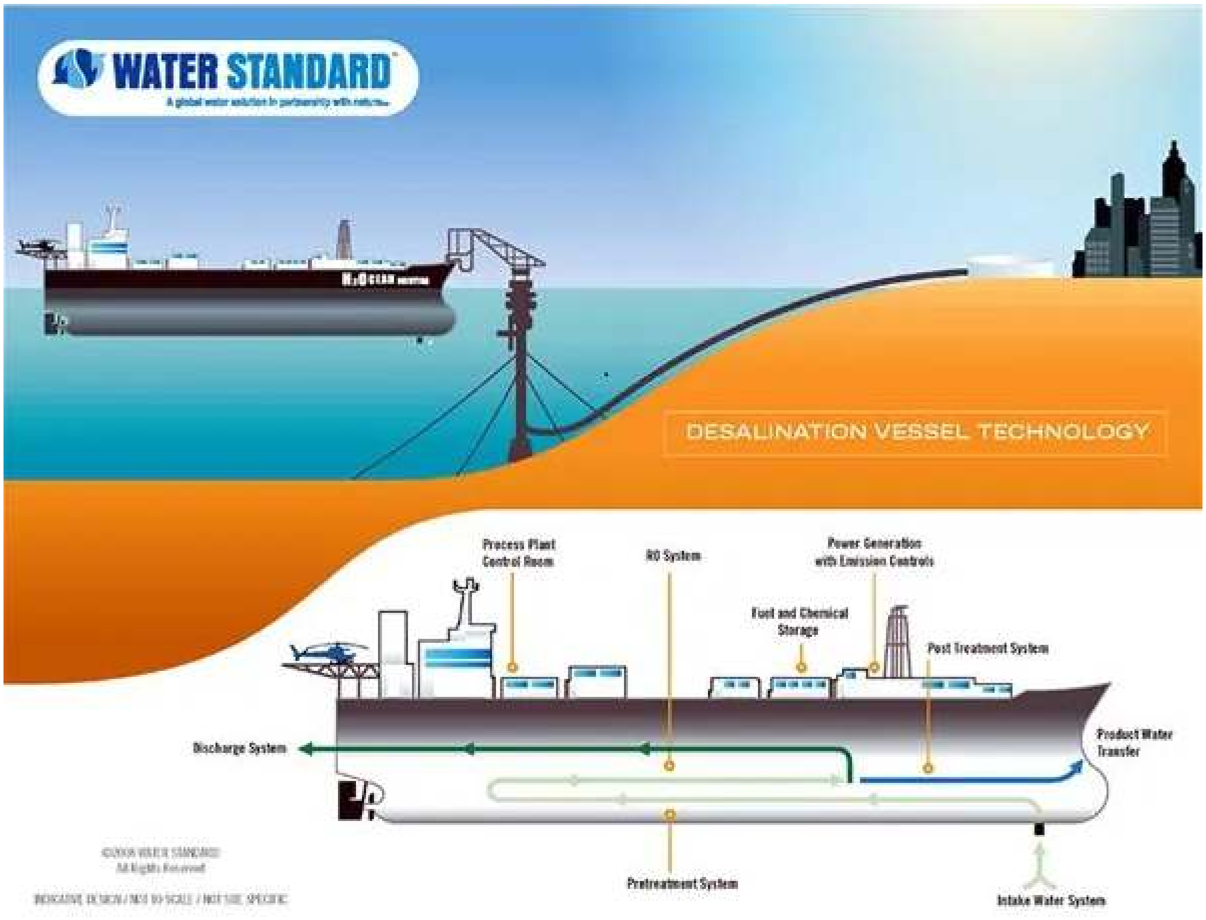

Figure 4: Concept for a Ship-Based Seawater Desalination System (Water Standard)

2.2.1 Conceptual Facilities

The concept of ship or barge-based seawater desalination facilities has been used for potable water production at multiple locations in the Middle-East and are sometimes used for the off-shore (oil and gas) industry.

This approach would provide desalination treatment equipment, tanks, electrical infrastructure and pump stations located on a ship or barge that would be moored in the North San Francisco Bay where there is sufficiently deep water. Bay water would be desalted using treatment systems on the barge, with the desalted water conveyed to shore via a pipeline located along the bottom of the Bay. Stabilization and disinfection could occur on the barge or onshore.

The source (Bay) water would be accessed through an intake screen and pipeline mounted to the ship or from an adjacent dedicated barge.

The fully treated drinking water (desalted, stabilized and disinfected water) would be pumped through an HDPE pipeline to the MMWD Pelican Way Storage Site. The water would be re-pumped into the MMWD distribution system along Francisco Boulevard in San Rafael.

The brine could be discharged directly back into the bay from the barge, although this may be difficult to permit from a regulatory perspective. As an alternative, the brine could be conveyed through an HDPE pipeline from the barge to an on-shore pump station at the Pelican Way Storage Site, and then piped and connected to an existing shoreline valve box on the CMSA outfall approximately half a mile away from the Pelican Way Storage Site. The brine would blend with the low salinity secondary effluent and be discharged into the San Francisco Bay through the existing CMSA outfall.

Treatment wastes, including neutralized membrane cleaning solutions, would need to be transported to shore for disposal.

2.2.2 Project Delivery Approach

For the leased, ship-based containerized equipment approach, it is envisioned that one entity would provide all of the treatment process equipment and operate the ship-based systems for a defined period of time with a monthly “take-or-pay” type contract. The Desalination Equipment Entity would be responsible for installing, commissioning and demonstrating that the provided equipment treats the Bay water to meet MMWD-specified drinking water quality and quantity requirements. The Desalination Equipment Entity would operate the facilities and provide treated water to an on-shore connection point. The price that MMWD would pay would include the costs for equipment leasing and operations.

MMWD would be responsible for constructing the interfacing systems or support facilities associated with the ship-based desalination facility, including treated water receiving and pumping systems and pipeline connection to MMWD distribution; any preparation of the Pelican Way site; potential concentrate pipeline and connection to CMSA.

To help with the project implementation, it is envisioned that MMWD would be responsible for obtaining permits associated with siting and operation of the ship-based short-term desalination system. The concept for this barge-based short-term desalination facility is different from the facilities described in the 2007 Engineering Report and EIR. The regulatory aspects of the ship or barge-based approach are anticipated to be more challenging than for the shore-based facility.

2.2.3 Potential Equipment Suppliers

Jacobs reached out to several potential suppliers of ship-based desalination systems. There are currently no ship-based desalination systems available for lease. The results of the inquiry regarding ship-based desalination systems is summarized below:

- Water Standard, who was focused on barge-mounted systems, is no longer is this business.

- Bahri, in Saudi, constructed several barge mounted systems, but these are on lease to SWCC (Saline Water Conversion Corporation), and currently not available.
- ACWA Power constructed two 6.9 MGD barge mounted systems in 2008 that were used during a water shortage in Saudi Arabia at that time. We were not able to determine whether these units are still available (or in use) and what their current conditions is.
- Floating Offshore Desalination (FOD) is a recently formed Norwegian company. They are currently looking for clients who are interested in purchasing one or more barge mounted systems, which have an advertised capacity of 20-26 mgd. Their website indicates they can deliver a system in 24 months.

Because a ship-based system would pose more significant permitting challenges than a land-based leased desalination system, and due to the limited availability of these systems, MMWD determined that a ship-based leased desalination system would not be likely to meet their short-term or long-term objectives. Therefore, this alternative was not evaluated further.

2.3 Long-term Full-Scale Desalination System

This MMWD seawater desalination supply alternative could provide supplemental water supply needs associated with near-term and longer-term droughts. Although this alternative would take longer to implement, the capacity is not limited by containerized equipment. A full-scale 15-mgd facility could meet MMWD's longer-term objectives for a supplemental water supply. The facility could be constructed for a smaller initial capacity with the ability to expand in the future.

2.3.1 Conceptual Facilities

Similar to the desalination facilities presented in the 2007 Desal Report, a full scale facility could have an initial capacity of 5-mgd or 10-mgd and be expandable up to 15-MGD. The full-scale facility could be located at the MMWD Pelican Way Site in San Rafael, CA. The screened intake would be offshore with an on-shore pump station near the MMWD Pelican Way Site. The concentrate from the facility is proposed to be blended with secondary effluent in the Central Marin Sanitation Agency (CMSA) outfall.

2.3.2 Project Delivery Approach

For the long-term full-scale desalination facility, the project could be delivered through a traditional Design-Bid-Build (DBB) approach that MMWD uses for other infrastructure projects. The $130M Monterey Pure Water supplemental water supply program components were delivered through a traditional DBB approach.

The project could also be delivered through a Design-Build (DB) or Progressive Design-Build (PDB) delivery method. This project delivery method is now more regularly used in the United States and could offer advantages for reducing the overall program schedule.

Another alternative is Design-Build-Operate (DBO) and Design-Build-Operate-Finance (DBOF). The Carlsbad Desalination Facility in San Diego was delivered through a DBOF contract.

To help with the project implementation, it is envisioned that MMWD would be responsible for obtaining permits associated with siting and operation of the full-scale desalination system. The concept for this long-term desalination supply is the same the full-scale facility described in the 2007 Engineering Report and the EIR. The permitting studies conducted in 2007 would be applicable for this alternative.

2.3.3 Potential Equipment Suppliers

There are a large number of equipment suppliers and contractors that could be competitively bid to supply equipment for a full-scale desalination facility.

2.4 Approach to Cost Estimating

This section describes the KJ-Jacobs Team approach to developing conceptual level opinions of probable project capital cost (construction and lease costs, and associated non-construction costs such as permitting, design and construction support) for the two desalination supply alternatives.

2.4.1 Approach for Short-Term Leased Desalination Equipment

The KJ-Jacobs team prepared a detailed request for information (RFI) for obtaining current availability and cost information from seawater desalination equipment suppliers. The leased desalination equipment RFI included source water quality information, treated water quality requirements, and general process design criteria to ensure that the leased equipment could provide the level of treatment to meet the MMWD objectives. The RFI also requested information on system capacity and system availability for potential installation in 2022 and up to 12-months of equipment leasing. The desalination equipment RFI is provided in Appendix A.

KJ-Jacobs developed a list of ten (10) potential vendors for the supply of leased skid-mounted or containerized seawater desalination equipment. The desalination equipment RFI was sent to the ten vendors in late May and early June of 2021 requesting ability to supply 2 mgd or more of mobile, leased UF, seawater RO and post-treatment systems. KJ-Jacobs received positive responses from three vendors. A summary of the vendor responses is provided in Section 3.

The probable construction costs for the constructed support system facilities for the short-term, leased option were developed based on the costs for a long-term full-scale desalination facility described below. For example, project components such as the intake system and treated water pump station were estimated as a percentage of the full-scale system costs based on the relative capacity of the systems.

2.4.2 Approach for Long-Term Full-Scale Desalination Facilities

The conceptual level opinions of probable capital cost estimates for a potential long-term, full-scale MMWD Seawater Desalination were developed using an in-depth parametric cost estimating model developed by Jacobs. The model, called CPES, includes individual cost modules for each water treatment unit operation. Each module in CPES (e.g., pipeline, pump station, water treatment plant unit process) was developed using standard equipment/process arrangement drawings derived from actual full-scale treatment plant designs that have been constructed and are operational. From the standard general arrangement drawings, physical dimensions and specific components are itemized and tied to design criteria and other user inputs so that the size and layout of the unit operation can be defined. Once the “right sizing” is completed, the model generates quantity take-offs for excavation, concrete, process equipment, mechanical, miscellaneous metals, instrumentation and building materials. A robust construction cost estimate is then generated by applying RS Means unit cost data (updated annually), as well as major process equipment cost algorithms (updated every 3 years based on supplier budget quotes over a range of equipment sizes/capacities) to the quantity take-off information.

Capital cost estimates presented herein were developed based on specific design criteria defined in the 2007 Desal Report and updated for current proposed treatment processes. The use of CPES provides the following benefits:

- increases the accuracy of conceptual cost estimating by calculating quantity take-offs based on the design criteria and applying a unit cost versus the conventional cost-curve approach
- allows more accurate cost estimates to be developed before any design drawings are produced

Although the CPES model typically provides a more accurate project cost than other, more traditional cost curve approaches, the level of accuracy for the capital and operating cost estimates presented below should be considered to represent between a Class 4 and Class 5 estimate with an accuracy in the range of approximately minus 30% to plus 50%, in accordance with standard cost estimating guidelines.

Table 3 below presents a summary of standard cost estimating level description, accuracy and recommended contingencies based on the level of the project. This data was compiled from the Association for the Advancement of Cost Engineering (AACE).

Table 3: Standard AACE Cost Estimating Guidelines

Cost Estimate Class[a]	Project Level Description	Estimate Accuracy Range	Recommended Estimate Contingency
Class 5	Planning	-30 to +50%	30 to 50%
Class 4	Conceptual (1 to 5% Design)	-15 to +30%	25 to 30%
Class 3	Preliminary (10 to 30% Design)	-10 to +20%	15 to 20%
Class 2	Detailed (40 to 70% Design)	-5 to +15%	10 to 15%

Cost Estimate Class[a]	Project Level Description	Estimate Accuracy Range	Recommended Estimate Contingency
Class 1	Final (90 to 100% Design)	-5 to +10%	5 to 10%

Notes:

(a) Association for the Advancement of Cost Engineering, 1997. International Recommended Practices and Standards.

Consistent with the AACE guidelines, the opinions of probable construction costs for the long-term full-scale desalination system and for constructed portions of the short-term, leased options include a 30% contingency. The lease costs for the desalination equipment include a 15% contingency because the equipment components are more defined at this stage.

2.4.3 Materials Assumptions

The process equipment materials used in a seawater desalination facility must be suitable for high salinity water and designed for the appropriate system pressures and conditions. The general construction materials such as for buildings and concrete basins, etc. must also be suitable for a corrosive environment. The cost model incorporated the following materials, approaches and current costs for the capital costs estimate:

- high pressure pumps, valves, piping and fittings – super duplex or super-austenitic "seawater grade" stainless steel
- main process piping – HDPE, fiberglass or PVC
- concrete basins – protective epoxy coatings
- building surfaces – extra protective coatings for the marine environment

The process equipment materials in contact with the seawater and desalted water would also need to be NSF-61 certified, or made of materials that are compatible with drinking water applications, such as stainless steel, PVC, etc. The protective coatings for the pipes, tanks and water containing components would also need to be NSF-61 certified.

Section 3: Short-Term Leased Desalination System

This section summarizes the availability, capacity, conceptual construction costs and potential schedule for a short-term (12-month) leased seawater desalination facility.

3.1 Capacity and Availability of Desalination Equipment for Short-term Lease

The desalination equipment RFI was sent to the ten vendors in late May and early June of 2021 requesting ability to supply 2 mgd or more of mobile, leased UF, seawater RO and post-treatment systems. KJ-Jacobs received positive responses from three vendors. A summary of the vendor responses is provided below.

- **Suez**: Can supply 2-mgd of requested systems by April 2022. The Suez system could consist of three, 0.7-mgd units. Approximate space requirement for the three units is a approximately 100 ft by 300 feet (1 acres).
- **Osmoflo**: Can supply 3.6-mgd of requested systems by April 2022. The Osmoflo system could consist of two, 1.8-mgd units. Approximate space requirement for the two units is approximately 180 ft by 300 feet (1.2 acres).
- **Seven Seas:** Can supply 2-mgd of requested systems by April 2022. The Seven Seas system could consist of four, 0.5-mgd units. Approximate space requirement for the 4 units is approximately 200 ft by 400 feet (1.8 acres).
- **Consolidated Water:** Inventory is limited to two 0.25 mgd SWRO units built by Suez that are 8 years old. Does not meet minimum capacity objectives.
- **Evoqua**: Do have SWRO units in their fleet; but their UF units are not suitable for seawater use.
- **H2O Innovation**: Don’t currently have any leased equipment but would be willing to fabricate. Would require 32 weeks lead time and would require a minimum 2-year lease period**.**
- **Harn RO:** Don’t currently have any leased equipment. They could fabricate but not in the required time frame.
- **IDE:** Don’t currently have any leased equipment available. Could fabricate 1.3-mgd SWRO units but for purchase only.
- **Veolia:** Have mobile UF and RO units; however the RO units appear to be suitable for brackish feeds only (TDS <2000 mg/L).
- **Wigen:** Don’t currently have units for lease. They could fabricate equipment for lease but the capacity would likely be 0.5-mgd to 1-mgd. They could fabricate for purchase with a lead time of 24-30 weeks.

KJ-Jacobs evaluated the submitted information from the three vendors with available equipment (Osmoflo, Suez and Seven Seas). The Osomoflo system had the largest available capacity at approximately 3.6-mgd, the fewest number of units (two), and the lowest conceptual cost of the leased equipment. The Osmoflo system was selected as the basis for determining the conceptual level overall cost for a short-term containerized desalination supply.

3.2 Conceptual Facilities for a Short-term Leased Desalination System

A potential short-term leased desalination facility could be located at or near the MMWD's Pelican Way Maintenance Yard facility in San Rafael, CA. The maintenance yard has an area of approximately 6.6 acres. There is an adjacent undeveloped parking area to the northeast of the maintenance yard on Shoreline Parkway. This parking lot site has an area of approximately 1.8 acres. The 3.6 mgd capacity Osmoflo system requires approximately 1.2 acres; therefore, the short-term leased desalination facility could be sited at either area.

Figure 2 shows a conceptual level overall layout for a potential MMWD desalination supply. The conceptual layout and facilities for a short-term, leased containerized desalination facility are described below.

3.2.1 Intake System

The intake system components for a short-term, leased containerized desalination facility would include:

- Temporary passive screens on a stainless-steel support frame that would located approximately 5,000-feet from the shoreline adjacent to the MMWD Pelican Way Maintenance Yard. The support flame would maintain the intake screens approximately 6-feet above the bay floor and in approximately 8 to 10-feet of water, similar to the screen depths for the 2007 pilot study.
- The screens and support frame would be placed on the bay floor as one unit and could be removed after the facility operating period. Buoys and markers would identify the intake screen area to help protect it from recreational boaters.
- A temporary HDPE pipeline would be installed on the bay floor to connect the passive intake screens to the onshore pump station. A 20-inch to 24-inch pipeline is recommended for the short-term intake.
- The HDPE pipeline could transition to the shore to the north of the wetlands at Shoreline Parkway. A temporary onshore pump station would draw water from the bay and discharge it to a feed water tank for the Osmoflo desalination system.
- An HDPE raw water pipeline would convey source water from the temporary onshore pump station to the desalination equipment, located at either the MMWD maintenance yard or the parking area site.

3.2.2 Leased Desalination Treatment Units

The leased Osmoflo desalination system components are containerized and would be placed on a prepared gravel base at either the MMWD maintenance yard or the parking area site. The Osmoflo units include thirteen containerized units and several tanks. Figure shows a typical layout for the 1.8-mgd Osmoflo containerized desalination unit.

Figure 5: Osmoflo Containerized Seawater Desalination System (1.8 mgd)

3.2.3 Treated Water System

The treated water system components for a short-term, leased containerized desalination facility would include:

- A chlorine disinfection contact tank system to provide disinfection contact time.
- A temporary treated water pump station to boost the finished water into the MMWD distribution system.
- A treated water pipeline to connect the desalination facilities to the MMWD distribution system in San Rafael.

3.2.4 Brine Discharge System

The brine system components for a short-term, leased containerized desalination facility would include:

- Temporary tanks to receive the RO concentrate and membrane filtration backwash water.
- A temporary brine water pump station to pump the discharge water to the CMSA Outfall junction box.
- An HPDE pipeline from the MMWD maintenance yard area to the CMSA outfall junction structure: approximately 2,500 feet long.
- A connection to the CMSA outfall through an existing onshore structure. The brine would blend with water from the CMSA facilities before being discharged to the Bay. The 2007 Desal Report includes detailed discussions on bioassay testing and other studies that were conducted related to the proposed discharge.

3.3 Probable Costs for a Short-term Leased Desalination System

The probable construction and non-construction costs for the short-term leased desalination system is presented in Table 4 below.

Table 4: Probable Costs for a Short-Term Leased Desalination System

MMWD Short-Term Leased Desalination Facility	
SWRO Facility Processes	**3.6 MGD Containerized System**
12 Month Lease of Containerized Desal Equipment	$5,420,000
Shipping, Commissioning & Decommissioning	$2,720,000
MF and RO Membrane Elements	$1,510,000
Subtotal	**$9,650,000**
Contingency on Leased Equipment @ 15%	$1,450,000
Leased Equipment Subtotal	**$11,100,000**
Additional Support Facilities for Containerized Systems	
Intake Screens, Intake Pipeline and Pump Station	$2,880,000
Raw Water Pipe	$130,000
Chlorine Contact Tank	$216,000
Distribution Booster Pumps	$735,000
Treated Water Pipeline to Distribution	$110,000

MMWD Short-Term Leased Desalination Facility	
SWRO Facility Processes	**3.6 MGD Containerized System**
Brine Pump Station	$650,000
Brine Transmission Line	$1,230,000
Subtotal	**$5,950,000**
Additional Project Costs	
Sitework (6%)	$360,000
Specialty Site Electrical Transformers	$800,000
General Yard Electrical (10%)	$600,000
Interconnecting Yard Piping (7%)	$420,000
Additional Instrumentation and Controls (5%)	$300,000
Subtotal of Support Facilities	**$8,430,000**
Contractor Markups on Support Facilities	
Overhead @ 6% on Basic Cost	$510,000
Profit @ 10% on Basic Cost	$840,000
Mob/Bonds/Insurance @ 3% on Basic Cost	$250,000
Subtotal including Contractor Markups	**$10,030,000**
Contingency on Support Facilities @ 30%	$3,010,000
Total Support Facilities Construction Costs	**$13,040,000**
Total of Leased and Support Facilities	**$24,140,000**
Non-Construction Costs	
Permitting @ ~4% on Project Cost	$966,000
Engineering @ 8% on Project Cost	$1,931,000
Services during Construction @ 8% on Project Cost	$1,931,000
Total Desalination Facility Cost including Non-Construction Costs	**$28,968,000**

Probable operating costs for a short-term, leased desalination facilities were estimated from information presented in the 2007 Desal Report and the updated costs for a full-scale facility. The annual operating cost for a 3.6-mgd leased desalination system is approximately $6M to $6.5M for the 12-month lease period.

3.4 Potential Schedule for a Short-term Leased Desalination System

The potential high-level schedule for producing a supplemental water supply from a short-term leased seawater desalination system could be from 12 to 18 months and is presented below.

3.4.1 Leased Equipment Delivery, Commissioning and Startup

As of July 2021, there are two Osmoflo units available and located in the United Arab Emirates (UAE). If MMWD elects to move forward with a short-term leased seawater desalination system, a "hold request" would be placed on the equipment while the lease agreement is being finalized. With the equipment "on hold", MMWD would have a first right of refusal if a counter offer was received to lease the equipment before the lease agreement is finalized.

Following execution of a lease agreement, the potential schedule for delivery, commissioning and startup of the leased equipment provided by Osmoflo is approximately 6 months:

- Preparing the Equipment in UAE for shipping – 1 month
- Shipping from UAE to California – 2 months
- Site Installation – 1 month
- Commissioning and Startup – 1 month
- Contingency – 1 month

3.4.2 Support Facilities Design, Construction and Startup

The site preparation, intake system, treated water system and brine discharge system could be procured through a design-build delivery approach. A potential schedule for design, construction, commissioning and startup of the support facilities provided by MMWD is approximately 12 to 15 months, with some of the elements below occurring in parallel.

- Contracting with a Design-Build Entity – 3 months
- Design of support facilities based on the Osmoflo leased equipment – 3 months
- Site Preparation – 1 month
- Construction of Temporary Intake – 6 months
- Construction of Brine Discharge – 6 months
- Construction of Temporary Treated Water System – 3 months
- Commissioning and Startup – 2 months
- Contingency – 1 month

3.4.3 Obtaining PG&E Power Connection

The 3.6 mgd short-term leased desalination facilities would require up to approximately 3.3 MW of electrical power. Some new PG&E facilities may be needed to deliver that capacity of power to the MMWD maintenance Yard site. A potential schedule for getting power for the proposed facilities is 12 to 18 months, with some of the elements below occurring in parallel.

- Submit a Service Application with PG&E – 1 month
- Design of Site Switchgear – 2 months (Service to the Osmoflo MCC and to the support facilities)
- Typical time for PG&E to make upgrades as required for the service – 12 to 18 months
- Equipment delivery and construction of Electrical Service – 9 months

3.4.4 CEQA and Regulatory Approvals

MMWD certified a California Environmental Quality Act (CEQA) environmental impact report (EIR) for a seawater desalination supply in 2007. This EIR could serve as the basis for an updated EIR for a 3.6 mgd short-term leased desalination facilities. The 2007 Desal Report outlines regulatory permitting requirements for a desalination system including permits for the intake system and brine discharge. Permitting for a 3.6 mgd short-term leased desalination facilities could take significant amount of time; but could be done in parallel with design and procurement of the leased equipment. Permitting is estimated to take 12 months but could take longer.

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Section 4: Long-Term Full-Scale Desalination Supply

This section summarizes the availability, capacity, conceptual construction costs and potential schedule for a long-term, full-scale seawater desalination facility.

4.1 Capacity of a Long-Term Desalination Facility

The long-term, full scale desalination facility could be built to meet MMDW's supplemental water supply needs of 12 to 15-mgd, or more. Similar to the facility described in the 2007 Desal Report, a 15-MGD Facility could be constructed but only provided with 5-mgd capacity desalination equipment. The facility could be expanded up to 10-mgd or 15-mgd by adding additional skid mounted equipment, in the future when needed.

4.2 Conceptual Facilities for a Long-Term Full-Scale Desalination System

A potential long-term full-scale desalination facility could be located at the MMWD's Pelican Way Maintenance Yard facility in San Rafael, CA. The maintenance yard has an area of approximately 6.6 acres. There is an adjacent undeveloped parking area to the northeast of the maintenance yard on Shoreline Parkway. This parking lot site has an area of approximately 1.8 acres. A 15 mgd full-scale facility system requires approximately 6.5 acres; therefore, the full-scale desalination facility could likely require both the maintenance yard and a portion of the parking lot site.

Figure 2 shows a conceptual level overall layout for a potential MMWD desalination supply. The conceptual layout and facilities for a long-term, full-scale desalination facility are described below.

4.2.1 Intake System

The intake system components for a long-term, full-scale desalination facility would include:

- Passive screens on a concrete or stainless-steel support frame that would located approximately 4,500-feet from the shoreline adjacent to the MMWD Pelican Way Maintenance Yard. The support flame would maintain the intake screens approximately 6-feet above the bay floor and in approximately 12-feet of water, similar to the screen depths for the 2007 pilot study.
- The screens and support frame could be placed on the bay floor as one unit and could be accessed for maintenance from a barge or small platform above the intake. Buoys and markers would identify the intake screen area to help protect it from recreational boaters.
- An HDPE pipeline would be installed on the bay floor to connect the passive intake screens to the onshore pump station. A 48-inch pipeline is recommended for the long-term intake.

- An onshore pump station located at the parking lot site would draw water from the bay and pump the water to the pre-treatment systems desalination system. The HDPE pipeline would be connected to the pump station's below-ground wetwell by micro-tunnelling below the shoreline and out into the bay.
- An HDPE raw water pipeline would convey source water from the onshore pump station to the desalination equipment, located at the MMWD maintenance yard.

4.2.2 Full-Scale Desalination Facility

The full-scale desalination facility system components would be constructed in buildings or under canopies at the MMWD maintenance yard. The facilities would be similar to those described in the 2007 Desal Report.

4.2.3 Treated Water System

The treated water system components for a long-term, full-scale desalination facility would include:

- A chlorine disinfection contact tank(s) system to provide disinfection contact time.
- A treated water pump station to boost the finished water into the MMWD distribution system.
- A treated water pipeline to connect the desalination facilities to the MMWD distribution system in San Rafael.

4.2.4 Brine Discharge System

The brine system components for a long-term, full-scale desalination facility would include:

- Tanks to receive the RO concentrate and membrane filtration backwash water.
- A brine water pump station to pump the discharge water to the CMSA Outfall junction box.
- An HPDE pipeline from the MMWD maintenance yard area to the CMSA outfall junction structure: approximately 2,500 feet long.
- A connection to the CMSA outfall through an existing onshore structure. The brine would blend with water from the CMSA facilities before being discharged to the Bay. The 2007 Desal Report includes detailed discussions on bioassay testing and other studies that were conducted related to the proposed discharge.

4.3 Probable Costs for a Long-Term Full-Scale Desalination System

The probable construction and non-construction costs for the short-term leased desalination system is presented in Table 5 below.

Table 5: Probable Construction Costs for Long-Term Desalination Facility

MMWD Long-Term Desalination Facility			
SWRO Facility Processes	**5 MGD, expandable to 15 MGD**	**10 MGD, expandable to 15 MGD**	**15 MGD**
Intake Screens, Intake Pipeline and Pump Station	$7,757,000	$9,770,000	$12,342,000
Raw Water Pipe	$367,000	$367,000	$367,000
Rapid Mix	$1,416,000	$1,895,322	$1,895,322
Strainers, UF Membrane Filters and Building	$8,721,000	$12,993,000	$16,475,000
Filtrate and Backwash Supply Tanks	$202,000	$202,000	$202,000
SWRO Feed Pump Station	$2,941,000	$3,519,000	$3,753,000
1st Pass SWRO and Building Permeate Tank	$16,511,000	$23,912,000	$30,390,000
Chlorine Contact Tank	$716,000	$926,276	$926,276
Distribution Booster Pumps	$2,084,400	$3,885,960	$4,200,000
Treated Water Pipeline to Distribution	$306,000	$306,000	$306,000
Liquid Chemical Facilities	$2,212,000	$2,212,000	$2,212,000
Dry Chemical Facilities	$5,010,000	$5,810,000	$6,620,000
Carbon Dioxide	$962,000	$1,281,000	$1,550,000
Backwash Equalization Basin	$401,000	$401,000	$401,000
Gravity Thickener	$2,229,000	$2,229,000	$2,229,000
Centrifuges	$6,350,000	$6,350,000	$6,350,000
Plant Seismic Piles	$3,000,000	$3,000,000	$3,000,000
Protective Coatings	$1,000,000	$1,000,000	$1,000,000
Brine Pump Station	$2,681,000	$3,533,000	$3,708,000
Brine Transmission Line	$1,643,590	$1,643,590	$1,643,590
O&M Building	$4,943,000	$4,943,000	$4,943,000

MMWD Long-Term Desalination Facility			
SWRO Facility Processes	**5 MGD, expandable to 15 MGD**	**10 MGD, expandable to 15 MGD**	**15 MGD**
Subtotal	**$71,453,000**	**$90,179,000**	**$104,513,000**
Additional Project Costs			
Sitework (6%)	$4,287,180	$5,410,740	$6,270,780
Yard Electrical (10%)	$7,145,300	$9,017,900	$10,451,300
Yard Piping (7%)	$5,001,710	$6,312,530	$7,315,910
Plant Instrumentation and Controls (5%)	$3,572,650	$4,508,950	$5,225,650
Subtotal with Additional Project Costs	**$91,460,000**	**$115,429,000**	**$133,777,000**
Contractor Markups			
Overhead @ 6% on Basic Cost	$5,487,600	$6,925,740	$8,026,620
Profit @ 10% on Basic Cost	$9,146,000	$11,542,900	$13,377,700
Mob/Bonds/Insurance @ 3% on Basic Cost	$2,743,800	$3,462,870	$4,013,310
Subtotal including Contractor Markups	**$108,837,000**	**$137,361,000**	**$159,195,000**
Contingency @ 30%	$27,438,000	$34,628,700	$40,133,100
Total Construction Costs	**$136,275,000**	**$171,990,000**	**$199,328,000**
Non-Construction Costs			
Permitting @ ~1% on Additional project Cost	$915,000	$1,154,000	$1,338,000
Engineering @ 8% on Basic Cost	$7,317,000	$9,234,000	$10,702,000
Services during Construction @ 8% on Basic Cost	$7,317,000	$9,234,000	$10,702,000
Total Desalination Facility Cost including Non-Construction Costs	**$151,824,000**	**$191,612,000**	**$222,070,000**

Probable operating costs for a long-term, full-scale desalination facility were estimated from information presented in the 2007 Desal Report and the updated costs for a full scale facility. The annual operating cost for a 15-mgd full-scale desalination system is approximately $15M to $20M per year.

4.4 Probable Schedule for a Long-Term Full-Scale Desalination System

The potential schedule for producing a supplemental water supply from a long-term full-scale seawater desalination system could be from 36 to 48 months and is presented below.

4.4.1 Desalination Facilities Design, Construction and Startup

The site preparation, intake system, full-scale desalination facilities, treated water system and brine discharge system could be procured through a traditional design-bid-build or through a design-build delivery approach. A potential schedule for design, construction, commissioning and startup of the support facilities provided by MMWD is approximately 36 to 48 months, with some of the elements below occurring in parallel.

- Contracting with a Design-Build Entity – 4 months
- Design of desalination facilities – 12 months
- Equipment procurement and delivery times – 12 months
- Construction of full-scale facilities – 24 months
- Commissioning and Startup – 3 months
- Contingency – 1 month

4.4.2 Obtaining PG&E Power Connection

The 15 mgd short-term leased desalination facilities would require up to approximately 15 MW of electrical power. It is likely that new PG&E facilities would be needed to deliver that capacity of power to the MMWD Maintenance Yard site. A potential schedule for getting power for the proposed facilities is 18 to 24 months, with some of the elements below occurring in parallel.

- Submit a Service Application with PG&E – 1 month
- Design of Site Switchgear – 6 months
- Typical time for PG&E to make upgrades as required for the service – 18 to 24 months
- Equipment procurement and delivery times for Electrical Service – 12 months

4.4.3 CEQA and Regulatory Approvals

MMWD certified a California Environmental Quality Act (CEQA) environmental impact report (EIR) for a seawater desalination supply in 2007. This EIR could serve as the basis for an updated EIR for a 15 mgd long-term full-scale desalination facilities. The 2007 Desal Report outlines regulatory permitting requirements for a desalination system including permits for the intake system and brine discharge. Permitting for 15-mgd desalination facilities could take significant amount of time; but could be done in parallel with design and procurement of the leased equipment. Permitting is estimated to take 12 months but could take longer.

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Section 5: Potential Emergency Desalination Supply

The initial results of the MMWD Desalination Supply Study (sections 1 through 4 above) were presented to the MMWD Board in July 2021. At that time, even with conservation efforts of 20 to 25-percent reduction in water use, and depending on the winter rainy season, the District's reservoirs were projected to drop from ~30% to below 10% by the summer of 2022. MMWD requested that KJ-Jacobs continue investigating a leased or purchased containerized desalination system, start initial discussion with regulatory agencies, and develop a project delivery approach and more detailed schedule to delivery an emergency desalination water supply by the summer or fall of 2022.

5.1 Potential Emergency Desalination Facilities

Based on the evaluations above, the emergency desalination project was anticipated to contain the following elements:

- The bay water intake would include temporary passive screens with mechanical brushing to meet current best-available technology. The screens would be located in similar water depth as proposed in 2007, and approximately 5,000-feet from the shoreline adjacent to the MMWD Pelican Way Maintenance Yard. Conceptual drawings of the intake screen system are provided in Appendix A.

- The intake screens would be connected to an on-shore pump station via a temporary 36-inch HDPE pipeline placed on the bay floor and anchored with concrete blocks.

- The intake pump station would be a temporary skid or slab mounted system and deliver raw water to the treatment facilities.

- Suez and Osmoflo containerized seawater desalination systems would be leased or purchased. These could provide up to 5.4 MGD of desalinated and stabilized water by the summer or fall of 2022. Technical information on the Osmoflo desalination system is provided in Appendix A.

- Ancillary systems including UV disinfection, calcite stabilization, chlorine disinfection, and intermediate pump stations and tanks would be provided.

- The stabilized water would be disinfected with a post-treatment system to produce treated water that meets DDW Surface Water Treatment requirements.

- Treated water from the emergency desalination facilities would be delivered to the MMWD 1-MG tank and pump station that is being constructed at the Pelican Way site. This pump station would pump the treated water into the MMWD distribution system.

- Brine and backwash water from the desalination process would be discharged to the Central Marin Sanitation Agency (CMSA) outfall through an existing onshore valve box structure. The brine would blend with water from the CMSA facilities before being discharged to the Bay. The 2007 Desal Report and EIR include detailed discussions on bioassay testing and other studies that were conducted related to the proposed discharge.

- The brine would be conveyed through a 30-inch PVC or HDPE pipeline that would be constructed in the public right of way from the Pelican Way site down to the existing CMSA onshore connection structure for the submarine outfall.

- Power for the facilities would initially be provided by engine generators, until PG&E power could be obtained. Containerized switchgear and transformers would be provided, as required for the desalination equipment.

5.2 Permitting Discussions with Regulatory Agencies

MMWD certified an EIR for a 5 to 15 MGD Desalination Facility in 2007. Extensive environmental studies were conducted at that time that showed that the produced water was safe and that the intake entrainment and brine discharge with CMSA effluent did not create a significant impact to the Bay. These studies were used to discuss the potential emergency desalination project with the regulators in anticipation of applying for permits for the project.

Kennedy Jenks reached out to regulatory agencies and setup virtual meetings to hold initial discussions regarding permitting for the potential emergency desalination project. Agencies that were contacted include:

- SWRCB Division of Drinking Water (DDW)
- U.S. Army Corps of Engineers (Corps)
- Regional Water Quality Control Board (RWQCB) for the NPDES and 401 Water Quality Certification
- San Francisco Bay Conservation and Development Commission (BCDC)
- State Lands Commission
- California Department of Fish and Wildlife (CDFW)
- National Marine Fisheries

The KJ-Jacobs team and MMWD Staff prepared powerpoint presentations on the potential emergency desalination project and presented to the SWRCB DDW Staff in September 2021 and to an interagency group (the Marin Projects Committee) in early October 2021. The presentation slides for these meetings are provided in Appendix B.

Based on initial discussion with MMWD and regulatory agencies such as the Regional Water Quality Control Board, the Army Corps of Engineers, and the State Water Resources Control Board, Division of Drinking Water, because of the emergency nature of this project, the typical permitting process may not be possible. The regulatory agencies indicated that an alternative permitting approach may be possible, where MMWD would consult with the regulators and potentially submit the applications for the various permits in parallel with the construction and potential operation of the facilities.

5.3 Project Delivery Approach and Schedule

In discussion with MMWD Staff, to provide an emergency desalination water supply by MMWD's objective of July 2022 (dependent on final equipment delivery schedules), KJ-Jacobs proposed a two-phase Design-Build project delivery approach for the emergency desalination project.

Phase 1: 10% Design and Permitting Support

- KJ-Jacobs would prepare 10% design drawings, criteria and performance requirements to obtain prices and delivery schedules from equipment and material suppliers.
- KJ-Jacobs would develop a preliminary overall project estimated cost for the construction and delivery of the project.
- KJ-Jacobs would support MMWD with initial communications and studies for the permitting of the project.

Phase 2: Develop GMP, Procurement, Construction and Startup

- Jacobs-KJ would work with sub-contractors to prepare a Phase 2 Design-Build Guaranteed Maximum Price (GMP) for MMWD approval under a Design-Build Contract.
- Jacobs-KJ would order the equipment and materials for the project. (MMWD could also directly issue purchase orders for equipment).
- Jacobs-KJ would support MMWD with communications and studies for the permitting of the project.
- Jacobs-KJ would work with sub-contractors to construct the facilities and startup the desalination system.

The Emergency Desalination Project could be delivered through three design-build packages with specialty design teams and contractors focused on each package:

- Desalination and Ancillary Facilities at Pelican Way site
- Intake Screens and Pipeline
- Brine Pipeline and CMSA Connection

These packages would be designed, constructed and started-up in parallel to meet the aggressive project schedule. The packages could be delivered under one single overall Design-Build contract or through separate contracts.

The MMWD Emergency Desalination Project Overall Project schedule, included in Appendix C, shows the parallel nature and task inter-relationships for a fast-track project delivery.

5.4 Project Study Suspension

On 18 October 2021, MMWD Staff requested that the KJ-Jacobs team suspend further work on the Emergency Desalination Water Supply. The MMWD Board directed MMWD Staff to focus on the conservation and pipeline water supply alternatives to address the District's supplemental water supply needs.

Appendix A: Desalination Equipment Information

A-1: Request for Information on Leased Desalination Equipment

A-2: Technical Brochure on the Osmoflo Containerized Desalination Systems

A-3: Conceptual Layouts and Drawings of an ISI Screened Intake System

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Jacobs

4 Embarcadero Center
Suite 3800
San Francisco, CA 94111
United States
T +1.415.356.2040
F +1.415.356.2055
www.jacobs.com

Subject	Request for Information	**Project Name**	MMWD Emergency Desalination System
Attention	[Vendor Contact and Company]		
From	Jacobs		
Date	May 17, 2021		
Copies to	Marin Municipal Water District Kennedy Jenks		

1. Introduction and Project Description

This request for information is for the supply of a membrane filtration (microfiltration/ultrafiltration [MF/UF]), seawater reverse osmosis (SWRO) and remineralization (post-treatment) system for a 2.0 (+/- 0.5) mgd emergency desalination system (EDS) for the Marin Municipal Water District (MMWD). MMWD is located in Marin County, California, just north of San Francisco. The intent is for MMWD to lease trailer mounted, containerized, or otherwise easy to install and commission equipment to enable rapid production of drinking water to MMWD's customers.

The information requested herein is required to provide MMWD and their consulting engineers with sufficient data to prepare budget, schedule, and site design tasks needed to evaluate the EDS as a supplemental water supply and to provide conceptual layouts of the site and related infrastructure.

1.1 Project and Infrastructure Status

If MMWD elects to move forward with the EDS, the following should be noted in terms of existing infrastructure and permitting status:

- A new intake and pumping system will be constructed to supply raw seawater (bay water) to the vendor supplied equipment from Northern San Francisco Bay.
- The RO concentrate, along with backwash (waste) waters from strainers and MF/UF, will be disposed to an existing outfall.
- It is planned that MMWD would supply seawater to the leased desalination system as well as connection points for the off take of the remineralized RO permeate and RO brine, such that all equipment related to the MF/UF, RO and remineralization systems would be provided by Lessor.

MMWD and their engineers would be responsible for design and implementation of a chlorine disinfection system for the remineralized permeate prior to distribution.

- A Draft EIR and related studies were developed to permit a permanent desalination facility. As such, it is anticipated that MMWD will have the ability to apply for the necessary permits to install and operate the ESD to supply drinking water during drought conditions.

1.2 Source Water and Product Water Quality Goals and RO System Design

The intent of the EDS is to utilize a single pass RO system to minimize the footprint of the RO system as well as its operating complexity. Table 1 provides the quality of the source water (San Francisco Bay water and desal plant feedwater) as well as design feedwater, permeate, and post-treated water quality, for the purposes of guiding selection and sizing of the leased equipment. Based on this information, we request that the Vendor confirm that their RO system design can meet the target permeate quality requirements with a single-pass system.

As the basis for proposing a single-pass RO system, Jacobs has performed RO ‘projections’ using IMSDesign™. Table 2 provides the projected permeate quality, along with feed pressure, for projections performed using both low energy and high rejection elements at minimum and maximum temperatures; and at the following design conditions: year 1 membrane life, 40% recovery and 8 gfd,. The design values are considered typical for most mobile SWRO systems. The tabulated information indicates that with the use of high rejection RO elements, the target permeate quality can be achieved over the range of anticipated feed water temperatures. Should the temperature decline to 10 deg C, feed pressure could approach 800 psig, which may, for some leased systems, represent the maximum allowable feed pressure.

As is indicated in subsequent sections, given the less-than-seawater salinity of the Bay, we believe that a higher recovery can be achieved with the leased RO system and have specified a minimum recovery of 45%. We request that the Vendor confirm whether this recovery can be achieved, and if not under all Design Feedwater conditions listed in Table 1, please indicate which conditions would represent exceptions.

Table 1 – Summary of Design Water Quality Values

		Historical North San Francisco Bay	From Pilot Study (at Intake Location)	Design Feedwater	Target Permeate	Target Finished Water
Parameter	**units**	**Maximum**	**Maximum**	**Design Values**		
TDS	mg/l	32,000	29,000	29,000	<150	<250
Conductivity	uS/cm	48,000	43,500	43,500		
Calcium	mg/l	371	310	310	<1	15-20
Magnesium	mg/l	1,181	910	910		

Sodium	mg/l	9,805	8,100	9150	<50	<50
Potassium	mg/l	353	350	350		
Ammonia	mg/l	0.4	ND	0.36		
Barium	mg/l	3	27	2.7		
Strontium	mg/l	12	5.9	11		
Bromide	mg/l	–	-	55	<0.5	<0.5
Bicarbonate	mg/l	110	110	110	1	40-50
Chloride	mg/l	17,620	15,000	16,000	<75	<80
Sulfate		2,377	1,900	2,100		
Fluoride	mg/l	1.3	0.79	1.2	<0.1	
Boron	mg/l	4.3	3.3	3.9	<0.8	<0.8
pH	units	8.19	8.3	8.2	6.5	7.8-7.9
LSI	--				-7.91	-0.9 to -1.2
Temperature	deg C	22	21	10-21	Same as source design	7.8-7.9
Turbidity	NTU	-	9-30 (dry season)	15	<0.1	

Table 2. SWRO Permeate Water Quality and Feed Pressure Projections (Membrane Age: 1 year)

		Low Energy SWRO Membranes (SWC5 or equal)		High Rejection SWRO Membranes (SCW4 or equal)	
Parameter	**Units**	**Temp: 10oC**	**Temp: 22oC**	**Temp: 10oC**	**Temp: 22oC**
Feed Pressure	psi	675	603	775	660
TDS	mg/l	100	160	70	115
Sodium	mg/l	34	58	25	42
Bromide	mg/l	0.33	0.64	0.18	0.35

pH	units	6.4	6.6	6.3	6.5
Chloride	mg/l	55	90	40	65
Boron	mg/l	0.4	0.8	0.25	0.5

2. Schedule

2.1 Leasing period

The duration for which MMWD would lease the Vendor-supplied equipment cannot be predicted with reasonable accuracy as it will depend on the duration of the drought that is currently occurring in northern California. For the purposes of this RFI, the lease duration is assumed to be 12 months. Equipment availability and leasing cost should be provided based on this leasing period. In the event that MMWD requires the use of Vendor-provided equipment beyond the 12-month period, vendor shall confirm MMWD's right to such an extension and provide pricing for additional 6-and 12-month lease periods.

Should MMWD choose to contract with the Vendor for the equipment described in the Scope of Supply, Vendor shall indicate what form of commitment is required by MMWD, prior to lease execution, to ensure that the equipment will be reserved for MMWD's use.

2.2 Lease start date

For the purposes of this RFI, the Vendor shall assume a lease start date of April 30, 2022.

2.3 Equipment delivery and operation

For the purposes of this RFI, and based on the assumed lease start date, the Vendor shall indicate at what date their equipment can be delivered to site and the anticipated duration between delivery and equipment operation. Vendor shall be responsible for installation of all plumbing, electrical and I&C connections between the UF and RO systems and between the RO and remineralization systems unless specifically stated otherwise, in which case Vendor shall provide drawings and instructions for such exempted installation. MMWD will contract with a 3rd-party contractor to install equipment not associated with Vendor-supplied systems.

3. Leasing Costs

Vendor to provide the monthly cost for lease of the equipment described in Section 4 and for the periods stated in Section 2.

Vendor shall indicate when the first lease payment is due (e.g, first production of desalinated water meeting Finished Water quality goal) and whether a deposit or other initial payment is required between the date of lease execution and first lease payment. Vendor shall also indicate whether any penalty payment will be assessed if MMWD should decide to cancel the lease prior to the end of the lease period.

4. Scope of Supply

The MF/UF and SWRO vendor scope of the supply shall include the following equipment and services:

- MF/UF system
- SWRO system
- Remineralization system
- Support during equipment installation, commissioning, startup and operator training

4.1 MF/UF system

The MF/UF system shall include, in addition to the membrane valves and module racks, all required ancillary equipment for a complete operating system, including pre-strainers, backwash water storage and pumping, cleaning system to perform maintenance cleans and CIPs, direct integrity test system, and HMI/PLC. The PLC shall automatically control all MF/UF system functions except start of CIP, which will be operator initiated. The CIP system should also be designed to add chemicals to neutralize the spent cleaning solutions to achieve a pH of 6 to 9 and a zero free chlorine residual.

4.2 SWRO system

The SWRO system shall include the following: low pressure forwarding pumps, cartridge filters, high pressure pumps, RO racks and all associated piping, valving, instrumentation, controls and HMI/PLC. The system shall also include a CIP system to perform chemical cleaning of the RO elements, including tank (with mixer), tank heater, recirculation pump, cartridge filter and piping/hoses for recirculation of cleaning solution between tank and RO pressure vessels. The CIP system should also be designed to add chemicals to neutralize the spent cleaning solutions to achieve a pH of 6 to 9.

4.3 Remineralization system

The remineralization system shall include a carbon dioxide (CO_2) system and a calcite contractor. The CO_2 shall comprise a pressurized CO2 storage tank, vaporizer/vapor heater, CO_2 regulator and diffuser. The system shall be sized to deliver a CO_2 dose of between 10 to 30 mg/L to the RO permeate upstream of the calcite contactor. A means of mixing the CO2 in the permeate shall be provided (e.g., static mixer).

The calcite contactor shall include all components necessary for a fully functioning system, including a means to easily load limestone into the contactor vessel. All wetted components of the contactor vessel shall be constructed of corrosion resistant materials (e.g., rubber-lined carbon steel). The contactor shall be designed with sufficient bed depth and empty bed contact time to achieve the desired Finished Water quality based on the quality of permeate produced by the RO system.

4.4 Installation, Startup and Training

The supplier of this equipment shall install, startup and commission their systems and provide training to MMWD operations staff or their contracted operations provider.

4.5 Optional Services and Equipment

Optional services that will be considered by the District include:

- Operations of the facility. Please provide a monthly operations quotation assuming an operations period for the following periods:
  - 12 months (base lease period)
  - Additional 6 months following base lease period
  - Additional 12 months following base lease period
- List number of CA state certified operators and their level of certification that would be provided for system operation.

MMWD may have an interest in a Lease-to-Purchase option should the lease period extend beyond a certain point. Please indicate whether a Lease-to-Purchase option is available. If so, additional details (e.g., buyout table showing purchase price vs. duration of lease would be requested.

4.6 Additional

We anticipate that the MF/UF, SWRO and remineralization equipment will be supplied as separate, standalone systems. If the Vendor cannot supply all components specified for each system, such as the CO2 system for remineralization, please indicate as such so that the non-supplied equipment can be supplied by others.

Also indicate deviations from, or exceptions to, the above scope of supply, including services associated with system installation, commissioning, start-up and operation. Such information is important to enable MMWD and their engineers to determine and account for necessary design factors to implement design, construction, and operations. Note: please confirm if you can supply each separate treatment process, item or service and provide notes for deviations, addition, or other information that is important for MMWD or their consulting engineers to know.

If the vendor cannot supply systems that produce the desired 2.0 mgd of RO permeate (treating the design source water quality at the target permeate quality), provide the requested information and pricing for a lesser capacity system, but not less than 1.5 mgd. If the vendor can supply more than 2.0 mgd of RO permeate, please provide the requested information and pricing for the higher capacity system and what the maximum capacity that can be supplied. Should the vendor be able to supply a system having a capacity >1.5 and <2 mgd, please indicate is additional capacity can be supply at a future date and what that date would be.

4.7 Equipment Requirements

4.7.1 MF/UF system

The pretreatment systems shall utilize MF or UF hollow fiber membrane (preferably trailer mounted) that can produce sufficient pretreated water to continuously produce 2.0 mgd of permeate while operating 24 hours a day and 7 days per week and that achieves the permeate quality requirements in Table 1.1 assuming the source water quality in Table 1.1. List the supplier, number and quantity of membrane modules. Include a description of how many trains are included, their design flow rates, pressures, and other standard design criteria.

The pretreatment system shall include an auto-backwashing strainer, CIP and backwash systems, chemical dosing systems, CIP neutralization tanks and other ancillary equipment for “plug and play” operations with the SWRO equipment.

Sample specifications and information to be included are as follows:

MF/UF System Characteristics			
Capacity	Influent: 5.5 mgd; specify number of trailers or units	Effluent: 4.5 mgd; specify number of trailers or units	
No. of Racks	List number of racks comprising the system		
MF/UF	Include total modules and membrane model/type, number of modules per trailer/unit and per train (subset of modules for a single backwash)		
Pre-filter	100-micron auto-backwashing strainer (or similar) and confirm suitability for seawater use		
Feedwater Operation Limits	List salinity range	List temperature range	List average and maximum turbidity limits
Design Pressures (psi)	List typical design pressures for seawater inlet, filtered water outlet, backwash outlet, waste drain outlet and others as applicable		
Backwash	List max flow rate per unit (e.g., 440 gpm); specify backwash type (e.g., intermittent in a two-phase air/water mixture); specify design frequency and duration assuming 15 NTU average		
Instrumentation	List online inlet and outlet instruments as applicable (e.g., flow, pressure, temp., turbidity, & conductivity		
PLC/HMI	Describe PLC and controls (e.g., Allen-Bradley PLC with touchscreen HMI)		
Compliance	List equipment certifications as applicable (e.g., CE, UL)		
Connection size & type	List as applicable (e.g., Inlet, outlet, backwash outlet, waste drain outlet, CIP waste outlet, CIP/BW Tank Overflow, pressure safety valve outlet)		
Electrical Service & Breaker Size	List design info (e.g., 480 VAC, 60 Hz, 3 Phase; and breaker size for each trailer/unit)		

Dimensions, Weight	List per trailer/unit (e.g., 40 ft x 8 ft x 9.5 ft. tall; 42,000 lbs)
Average Noise Level	List average noise level (e.g., 78 dB)

4.7.2 SWRO

List the supplier, number and quantity of SWRO membrane elements to be supplied with each are system. Include a RO software projection for the proposed element model using the element manufacturers software. Provided projections for year 0 and year 1 membrane life for feedwater temperatures of 10 and 21 deg C.

The SWRO systems shall include low pressure transfer pump, 5.0-micron cartridge filters, high pressure feed pump, RO vessels, energy recovery device, CIP system and permeate flush system for plug and play operation. If RO feedwater tank and forwarding pumps are not being supplied, please provide storage volume and pump flow and TDH requirements. Likewise of RO permeate storage tank for RO system flushing is not being provided, please indicate required volume.

List the volumes and specifications and wetted materials of construction for all instrumentation, and equipment. Please provide an estimated footprint for the SWRO system and be prepared to provide additional information including exact dimensions, weight, and similar information needed information for site design, planning, and integration with District control and remote operating systems.

Sample specifications and information to be included are as follows:

SWRO System Characteristics	
Capacity	List design inlet and outlet flow rates at 45% recovery including flows per unit
Number of Trains	List number of trains comprising the system
SWRO Units	Describe SWRO units (e.g.,15 Pressure Vessels with 7 SWRO elements per vessel, single-stage, single pass configuration with high pressure pump and energy recovery device make and model numbers)
Pre-filter	List number and size of pre-filters included (e.g., 5-micron nominal, X number of 30-inch housings and 70 x-inch dia. filters per housing) and confirm suitability with seawater.
Feedwater Design Limits	List design range for temperature, turbidity, SDI, TDS and other values as applicable
Pressure (psi)	List inlet out outlet design pressures as applicable
CIP System	Provide system description and tank volume

Instrumentation	List online inlet and outlet instruments as applicable (e.g., flow, pressure, pH, ORP, temp., turbidity, & conductivity)
PLC/HMI	Describe PLC and controls (e.g., Allen-Bradley PLC with touchscreen HMI)
Connection size & type	List as applicable (e.g., Inlet, concentrate out, permeate, waste drain outlet, CIP waste outlet, permeate off-spec, pressure safety valve outlet, etc.)
Electrical Service & Breaker Size	List design info per container/unit (e.g., 480 VAC, 60 Hz, 3 Phase; breaker size and estimate of amps at max load)
Dimensions, Operating Weight	List per container/unit: 40 ft x 8 ft x 8 ft. 6-inches tall; and approximate weight during operations
Average Noise Level	List average noise level in dB

4.7.3 Remineralization

The remineralization system shall include storage tanks, carbon dioxide system. calcite contactor(s), and chemical dosing systems to achieve the finished water quality shown in Table 1.1.

Sample specifications and information to be included are as follows:

Calcite contactors and dosing systems typically provided with rentals	
Capacity	2.0 mgd +/- to match SWRO permeate capacity with added n+1 redundancy
Calcium addition	Calcite contactors to add approximately 33 to 50 mg/l CaCO3*. Include no. of units and design capacity per unit.
CO_2 Dosing	Equipment to dose approximately 10 to 30 mg/l of CO_2*
Instrumentation and Controls	Describe general control scheme
Connection size & type	Provide if known or add note if additional details needed
Electrical Service & Breaker Size	Provide if known or add note if additional details needed

Dimensions, Weight	Provide if known or add note if additional details needed
Other dosing systems	Provide basic details on other chemical dosing systems available via rental and chemical compatibility for free chlorine, aqueous ammonia, phosphate-based corrosion inhibitor and fluorosilicic acid

***Vendor shall confirm $CaCO_3$ and CO_2 doses to meet target finished water requirements (e.g., calcium, alkalinity, pH and LSI).

DESAL NOW

Emergency Water Solutions

7MLD Seawater Desalination Plant

OSMOFLO

World class desalination

Portable containerised Seawater desalination plant that produces up to 7,000 m^3/day of RO product water.

Osmoflo's rental fleet comprising of desalination and wastewater equipment is strategically located globally for rapid deployment. With the largest global fleet of emergency water treatment equipment in a range of sizes and technologies, Osmoflo have a solution to meet your temporary water and wastewater treatment requirements.

DESAL NOW has capacity to take on emergency desalinated water requirements for industry anywhere on the planet.

DESAL NOW fleet includes 7MLD modularised systems that can be setup to produce desalinated water from 7 to 28 MLD that suits the client's needs.

Each 7MLD comprises of a seawater intake pumping system with robust two pass pre-screening system prior to containerised ultrafiltration units. The seawater reverse osmosis unit comprises of an LP pumping container with an energy recovery device to optimise the energy required for seawater desalination. The remineralisation system is available as an option should there be a need for WHO potable water standards.

Standard Features

- Rapid deployment plug and play system
- Completely containerised solution that requires minimal site work
- Site installation & start-up can be undertaken on fast track basis subject to intake and outfall being in place along with any local government authority approvals
- Easy increase or decrease in capacity requirements via 7MLD modularised systems
- Main process equipment - UF & RO, along with ancillary components for operation - Pumps, strainers, compressors & blowers are all containerised which are interchangeable between 7MLD systems
- Robust pre-filtration with automated self-cleaning strainers
- Instrumentation with PLANT CONNECT function
- 2 weeks FOB dispatch

Optional Features

- Additional pre and post treatment to suit feed and product water requirements
- Calcite filter for pH correction & potable water application
- Plant Connect and remote monitoring support
- Full or partial operation and maintenance support
- Ship mounting ability
- Diesel generated power supply

Actual Plant Photos

Overall Plant View

Intake Pump & Strainer Container

UF Container

LP Pump & ERD Container

High Pressure Pump

(R→L) HP Pump, LP&ERD Container, RO Containers, Calcite Filter

Calcite Filter & Product Transfer Pump

MCC Container

Technical Specifications

Specifications	
TDS	35,000 mg/L to 45,000 mg/L
SDI	< 10
Recovery/Rejection	35 – 45 % / 98%
pH	4 – 10
Temperature	20 – 40 ^{0}C
Power Supply	11 kV, 50Hz, 3 phase

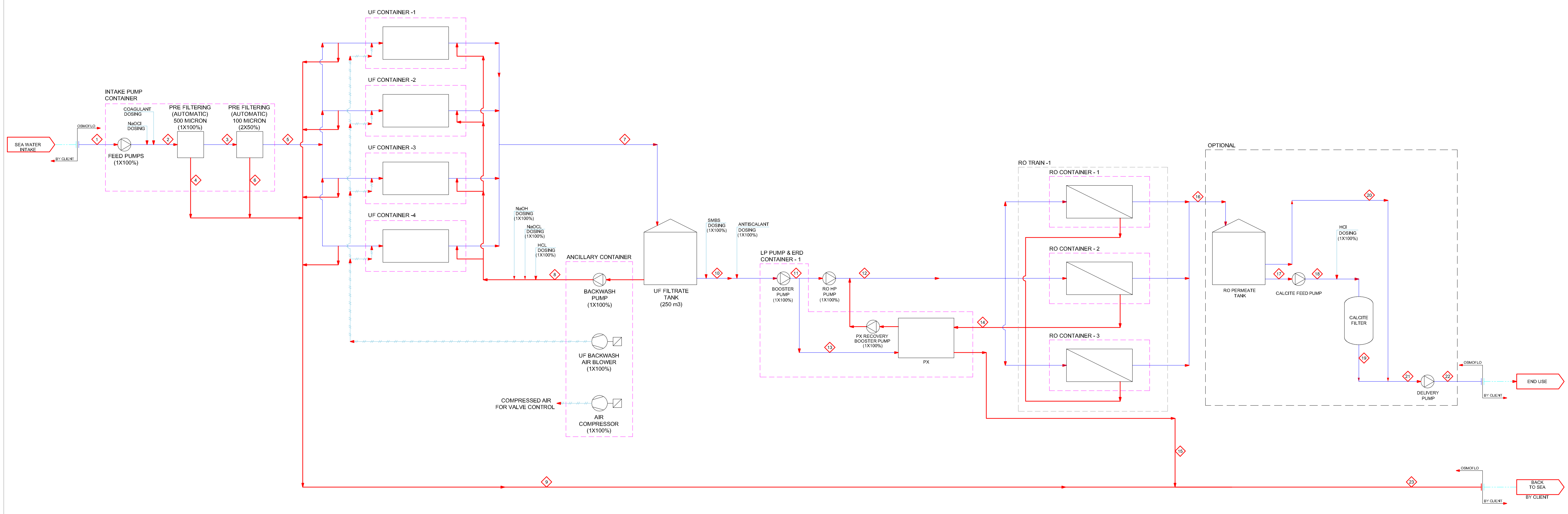
Equipment Detail (Each 7 MLD System)

1 x 20' Seawater Pump Container	
1 x Feed Pump	Horizontal Centrifugal Pump, Sulzer A44-200LM HP
1 x Motor (Feed Pump)	ABB, 132 kW, 690 VAC, Drive – VFD
1 x 500 micron Strainers	Self-cleaning auto-backwashable strainers
1 x Motor (500 Micron Strainer)	ABB, 0.5 kW, 415 VAC, Drive – DOL
2 x 100 micron Strainers	Self-cleaning auto-backwashable strainers
2 x Motor (100 Micron Strainers)	ABB, 0.35 kW, 415 VAC, Drive – DOL
4 x 40' UF Containers	
4 x UF Skids	66 DOW UF modules per skid (Total 264 UF modules), Skid piping & Instrumentation
1 x 40' SWRO Feed & ERD Container	
1 x SWRO LP Pump	Horizontal Centrifugal Pump, Sulzer A44-150
1 x Motor (SWRO LP Pump)	ABB, 200 kW, 690 VAC, Drive - VFD
1 x PX Booster Pump	Vertical Centrifugal Pump, Union
1 x Motor (PX Booster Pump)	ABB, 55 kW, 415 VAC, Drive - VFD
1 x Energy Recovery System	Pressure exchanger system from ERI
1 x SWRO HP Pump Skid	
1 x SWRO HP Pump	Horizontal Centrifugal Pump, Sulzer MBN 100-300 / 6stage
1 x Motor (SWRO HP Pump)	ABB, 710 kW, 11 kV, Drive - DOL
3 x 40' SWRO Containers	
3 x SWRO Skids	7 elements long x 31 pressure vessels per skid (Total 651 RO membranes), Skid piping & Instrumentation

1 x 40' Ancillary Container	
1 x UF Backwash Pump	Horizontal Centrifugal Pump, Sulzer A41-200
1 x Motor (UF Backwash Pump)	ABB, 45 kW, 415 VAC, Drive - VFD
1 x UF CIP Pump	Vertical Inline Pump, Grundfos CRN64-1
1 x Motor (UF CIP Pump)	ABB, 15 kW, 415 VAC, Drive - VFD
1 x Permeate Service General Pump	Vertical Inline Pump, Grundfos CRN64-1
1 x Motor (Permeate Service General Pump)	ABB, 15 kW, 415 VAC, Drive - VFD
1 x RO CIP/Flush Pump	Horizontal Centrifugal Pump, Sulzer A33-125
1 x Motor (RO CIP/Flush Pump)	ABB, 55 kW, 415 VAC, Drive - DOL
1 x UF Air Blower	Roots twin lobe, Gardner Denver OR Equal
1 x Motor (UF Air Blower)	ABB, 37 kW, 415 VAC, Drive - VFD
1 x Air compressor	Positive Displacement Reciprocating, Atlas copco OR Equal
1 x Motor (Air compressor)	ABB, 15 kW, 415 VAC, Drive - DOL
3 x CEB Chemical Dosing System	Air Operated Diaphragm Pumps, Sandpiper or Equal 200 Ltrs. Dosing Tanks with Bunds
6 x Chemical Dosing Pumps	Electronic Metering Pump, 0.3 kW, 240 VAC, Grundfos OR Equal 200 Ltrs. Dosing Tanks with Bunds
1 x 40' MCC container with	
MV Switchgear	11 kV Switchgear
LV Switchgear	690 V & 415 V Switchgear
Control System	Allen Bradley/Siemens Control System
Ancillary Items	
1 x Product Water Pump	Horizontal Centrifugal Pump, Sulzer MBN100-300/2
1 x Motor (Product Water Pump)	ABB, 315 kW, 690 VAC, Drive – VFD
1 x 40' Operator Container	
1 x 11 kV to 690 V SDT	
1 x 11 kV to 415 V SDT	
1 x skidded 4 mtr diameter CALCITE filter with access platform	
1 x All interconnecting pipe work and cables with overhead pipe / cable rack	

ITEM	TAG	DESCRIPTION	Operation Mode	Operation Range	Detail	Power Supply	Installed Drives (kW)	INSTALLED LOAD Proj Current (A)	Current Draw R (A)	Current Draw W (A)	Current Draw B (A)	NORMAL OPERATION Duty %	Current Draw R (A)	Current Draw W (A)	Current Draw B (A)	CIP OF UF/RO Duty %	Current Draw R (A)	Current Draw W (A)	Current Draw B (A)	kW CONSUMPTION Hours of operation per day	KWh/day
		Electrical Power Schedule - 7 MLD (1.58 MIGD) UF/RO Plant					**Rev. PA**														
		11kV/690V/400V Distribution																			
		Intake System																			
1		Seawater Intake Pump-1	Auto/ Man/ Off	VFD	LV-MCC-1	690 VAC	132	213.0	213.0	213.0	213.0	100	213.0	213.0	213.0					24	3168.0
2		500 Micron Strainer-1 Motor	Auto/ Man/ Off	DOL		400 VAC	0.5	0.8	0.8	0.8	0.8	100	0.8	0.8	0.8					24	12.0
3		100 Micron Strainer-1 Motor	Auto/ Man/ Off	DOL		400 VAC	0.35	0.6	0.6	0.6	0.6	100	0.6	0.6	0.6					24	8.4
4		100 Micron Strainer-2 Motor	Auto/ Man/ Off	DOL		400 VAC	0.35	0.6	0.6	0.6	0.6	100	0.6	0.6	0.6					24	8.4
		Single Phase Loads																			
5		Sodium Hypochlorite Dosing Pump-1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							24	7.2
6		Coagulant Dosing Pump-1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							24	7.2
		Ultrafiltration System																			
7		UF Backwash Pump-1	Auto/ Man/ Off	VFD	LV-MCC-3	400 VAC	45	72.0	72.0	72.0	72.0	100	72.0	72.0	72.0					8	360.0
8		UF CIP Pump	Auto/ Man/ Off	DOL	LV-MCC-4	400 VAC	11	18.4	18.4	18.4	18.4	0				100	18.4	18.4	18.4	24	0.0
9		CIP Tank Filling Pump	Auto/ Man/ Off	DOL	LV-MCC-4	400 VAC	10	14.3	14.3	14.3	14.3	0				100	14.3	14.3	14.3	24	0.0
10		UF Air Blower-1	Auto/ Man/ Off	VFD		400 VAC	37	61.0	61.0	61.0	61.0	100	61.0	61.0	61.0	100	61.0	61.0	61.0	4	148.0
11		UF Air Compressor-1	Auto/ Man/ Off	DOL	LV-MCC-4	400 VAC	15	24.7	24.7	24.7	24.7	100	24.7	24.7	24.7	100	24.7	24.7	24.7	24	360.0
12		Air Compressor Heating Element	Auto/ Man/ Off	DOL		400 VAC	0.8	1.5	1.5	1.5	1.5	100	1.5	1.5	1.5	100	1.5	1.5	1.5	24	19.2
		Single Phase Loads																			
13		UF Backwash NaOCl Dosing Pump-1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							0.5	0.2
14		UF CEB HCl Dosing Pump-1	Air Operated			230 VAC	0.3	1.3	1.3			0								0	0.0
15		UF CEB NaOCl Dosing Pump-1	Air Operated			230 VAC	0.3	1.3	1.3			0								0	0.0
16		UF CEB NaOH Dosing Pump-1	Air Operated			230 VAC	0.3	1.3	1.3			0								0	0.0
17		SMBS Dosing Pump -1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							24	7.2
		RO Booster Pump Container-1																			
18		RO Booster LP Pump-1	Auto/ Man/ Off	VFD	LV-MCC-1	690 VAC	200	320.0	320.0	320.0	320.0	100	320.0	320.0	320.0					24	4800.0
19		PX-Booster Pump-1	Auto/ Man/ Off	VFD	LV-MCC-3	400 VAC	55	91.5	91.5	91.5	91.5	100	91.5	91.5	91.5					24	1320.0
		Single Phase Loads																			
20		Antiscalant Dosing Pump - 1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							24	7.2
		Miscellaneous Plant Equipments																			
21		RO High Pressure Pump-1	Auto/ Man/ Off	DOL	MV-DP	11000 VAC	710	588.0	588.0	588.0	588.0	100	588.0	588.0	588.0					24	17040.0
22		Product Water Transfer Pump-1	Auto/ Man/ Off	VFD	LV-MCC-1	690 VAC	315	498.0	498.0	498.0	498.0	100	498.0	498.0	498.0					16	5040.0
23		RO CIP/Flush Pump-1	Auto/ Man/ Off	DOL	LV-MCC-3	400 VAC	55	91.5	91.5	91.5	91.5	0				100	91.5	91.5	91.5	0	0.0
23		Permeate Service General Pump	Auto/ Man/ Off	DOL		400 VAC	15	24.7	24.7	24.7	24.7	0				100	24.7	24.7	24.7	0	0.0
24		CIP Heater	Auto/ Man/ Off	DOL		400 VAC	30	49.6	49.6	49.6	49.6	0				100	49.6	49.6	49.6	0	0.0
25		Miscellaneous Plant Equipments	Auto/ Man/ Off	DOL		400 VAC	5	7.0	7.0	7.0	7.0	100	7.0	7.0	7.0	100	7.0	7.0	7.0	0	0.0
		Single Phase Loads																			
26		Calcite Feed HCl Dosing Pump - 1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							24	7.2
27		Delivery NaOH Dosing Pump - 1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							24	7.2
28		Delivery NaOCl Dosing Pump - 1	Auto/ Man/ Off	DOL		230 VAC	0.3	1.3	1.3			100	1.3							24	7.2
29		Air Conditioner-1 - MCC Container	Auto/ Man/ Off	DOL		230 VAC	2	8.7			8.7	100			8.7					24	48.0
30		Air Conditioner-2 - MCC Container	Auto/ Man/ Off	DOL		230 VAC	2	8.7			8.7	100			8.7					24	48.0
31		Air Conditioner-1 - Operator Station & Control Room Container	Auto/ Man/ Off	DOL		230 VAC	2	8.7			8.7	100			8.7					24	48.0
32		Air Conditioner-2 - Operator Station & Control Room Container	Auto/ Man/ Off	DOL		230 VAC	2	8.7			8.7	100			8.7					24	48.0
33		Miscellaneous Plant Equipments	Auto/ Man/ Off	DOL		230 VAC	5	21.7	21.7			100	21.7							24	120.0
									2113.2	2077.1	2111.9		1910.8	1878.6	1913.4		292.7	292.7	292.7		
	TOTALS						**1653.3kW**		**2113.2 A**				**1913.4 A**				**292.7 A**				**32646.55**

	kWhr/day	32646.6
	m^3/day	7000
Approx power consumed for 7000m3/day product	kWhr/m^3	**4.66**



Node/Stream		01	02	03	04	05	06	07	08	09	10	11
Description	Unit	Seawater Intake Pump Suction	Seawater Intake Pump to 500 Micron Strainer Inlet	500 Micron Strainer Outlet to 100 Micron Strainer Inlet	500 Micron Strainer Drain	100 Micron Strainer Outlet to UF	100 Micron Strainer Drain	UF Filtrate to Filtrate Tank	UF Backwash	UF Backwash Waste	RO Booster Pumps Suction	RO Booster LP Pump Discharge
Normal Flow	m^3/h	683.2	683.2	681.1	2.0	679.1	2.0	679.1	505.0		679.1	679.1
Peak Instantaneous Flow	m^3/h	767.6	767.6	765.3	-	763.0	-	763	-	-	-	-
Normal Flow	MLD	16.4	16.4	16.3	0.0	16.3	0.0	18.3	-	2.0	16.3	16.3
Normal Flow	MIGD	3.61	3.61	3.60	0.01	3.59	0.01	4.03	-	0.44	3.59	3.59
Pressure	kPag	Flooded	350	300	200	250	200	100	200	100	Flooded	200 - 800
Operating frequency		Continuous	Continuous	Continuous	Intermittent	Continuous	Intermittent	Continuous	Intermittent	Intermittent	Continuous	Continuous
Run Hours Per Day	h	24	24	24	24	24	24	24	0.8	0.8	24	24
Temperature	^0C	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35

Node/Stream	12	13	14	15	16	17	18	19	20	21	22	23
Description	RO HP Pump Discharge	RO Booster LP Pump to PX	RO Reject to PX	PX LP Outlet to Outfall	RO Permeate to permeate storage tank	Calcite feed pump suction	Calcite feed pump Delivery	Calcite filter outlet	Bypass to calcite filter	Delivery pump suction	Delivery pump discharge	Total Plant Waste
Normal Flow	292.0	387.1	387.1	387.1	292.0	58.4	58.4	58.4	233.6	292.0	292.0	391.2
Peak Instantaneous Flow	-	-	-	-	-	-	-	-	-	-	-	475.1
Normal Flow	7.0	9.3	9.3	9.3	7.0	1.4	1.4	1.4	5.6	7.0	7.0	11.4
Normal Flow	1.54	2.04	2.04	2.04	1.54	0.31	0.31	0.31	1.23	1.54	1.54	2.51
Pressure	6500	200 - 800	6300	100	300	Flooded	400	300 - 350	Flooded	300	4000	100
Operating frequency	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Run Hours Per Day	24	24	24	24	24	24	24	24	24	24	24	24
Temperature	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35	20 - 35

PROCESS FLOW DIAGRAM LINES

PROCESS LINE
SUB PROCESS LINES
CLIENT LINE
AIR

NOTES:
1. PRODUCT WATER TANK AND PUMPS CAN BE LOCATED BASED ON REAL ESTATE AVAILABILITY AND / OR DEPENDING UPON CLIENT REQUIREMENT
2. PRODUCT WATER QUALITY, QUANTITY, PLANT RECOVERIES ARE SUBJECT TO CHANGE BASED ON THE FEED WATER PARAMETERS.

REVISION DETAILS

ISSUE	DATE	DSN NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
PA	07/12/2015	PRELIMINARY	KPB	SP	SP	BW
PB	19/12/2015	PRELIMINARY	YNP	SP	SP	BW

TERMINATION POINTS

TP #	DESCRIPTION	SIZE	CONNECTION TYPE

OSMOFLO

JOB No OPP0xxx

OSMOFLO PTY LTD
382 Diment Road. Burton. SA 5110. ABN 39 050 952 175
Phone (08) 8282 9700 Fax (08) 8280 3015 Web: www.osmoflo.com

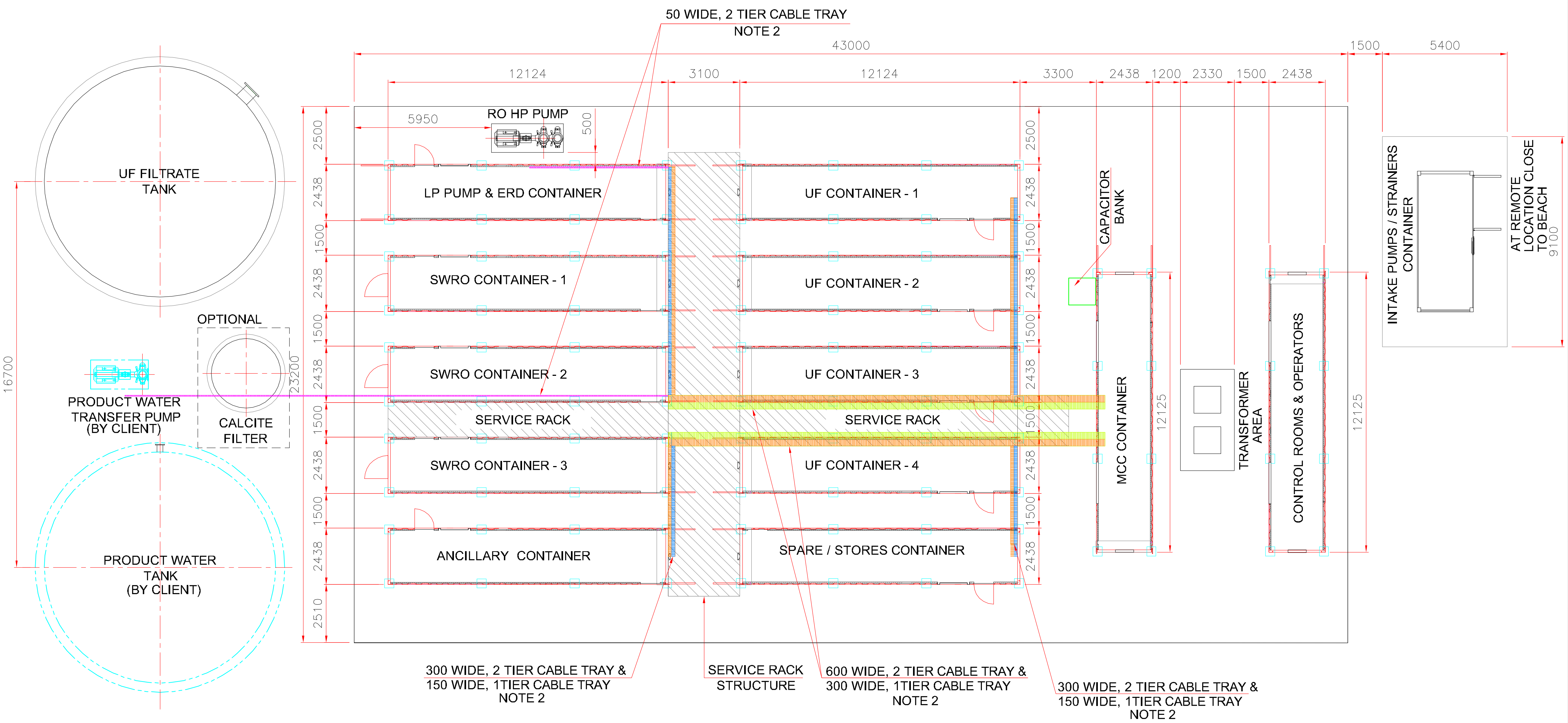
DRAWN	KPB
CHECKED	SP
APPROVED	BW

TITLE
PROCESS FLOW DIAGRAM FOR 7 MLD UF/RO PLANT

CLIENT -

DRAWING No OPP0xxxx-0001-PB

DRAWING STANDARD AS1100 | DO NOT SCALE | SHEET No 1 OF 1



REVISION DETAILS

ISSUE	DATE	DSN NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
PA	07/12/2015	PRELIMINARY	YNP	SP	SP	BW

NOTES:
1) THERE WILL BE A MINIMUM OF 8 BLOCKS PER 40' CONTAINER WITH SUITABLE PACKING OR SHIM MATERIAL TO ENSURE +/- 2MM CONTAINER FLOOR LEVEL.
2) THE MINIMUM ELEVATION BETWEEN THE CABLE TRAY TIERS SHOULD BE 300mm.

OSMOFLO

JOB No OPP0xxx

DRAWN YNP
CHECKED SP
APPROVED BW

OSMOFLO PTY LTD
382 Diment Road, Burton, SA 5110. ABN 39 050 952 175
Phone (08) 8282 9700 Fax (08) 8280 3015 Web: www.osmoflo.com

TITLE SITE LAYOUT FOR 7 MLD UF / RO PLANT

CLIENT -

DRAWING No OPP0xxx-2000-PA

DRAWING STANDARD AS1100 | SCALE NTS | SHEET No 1 OF 1

International

Dubai

Oman

Chile

India

Singapore

Business Partners

Malaysia

Thailand

Australia

Main Facility
382 Diment Road, Burton, South Australia 5110
+61 8 8282 9700
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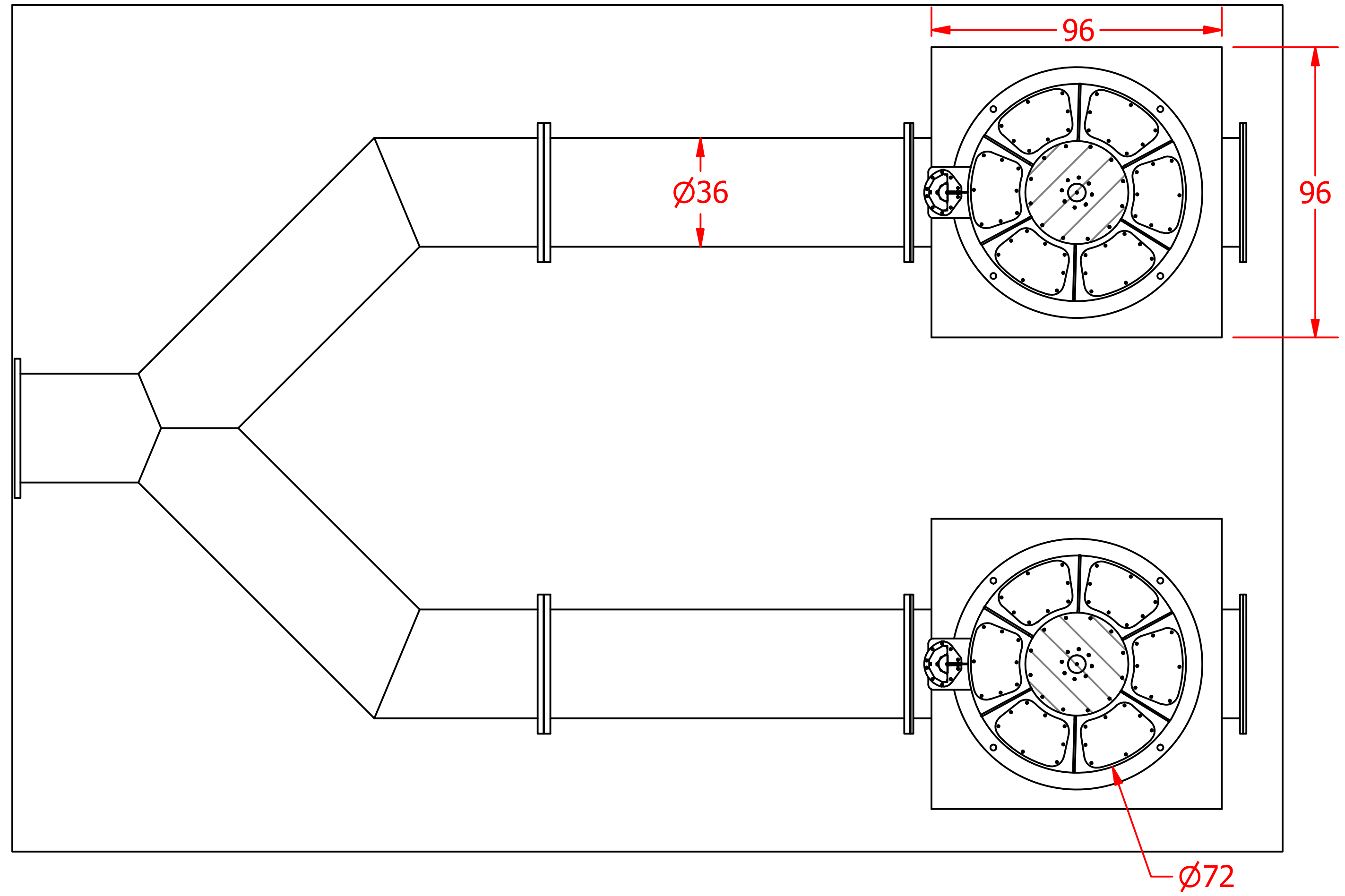
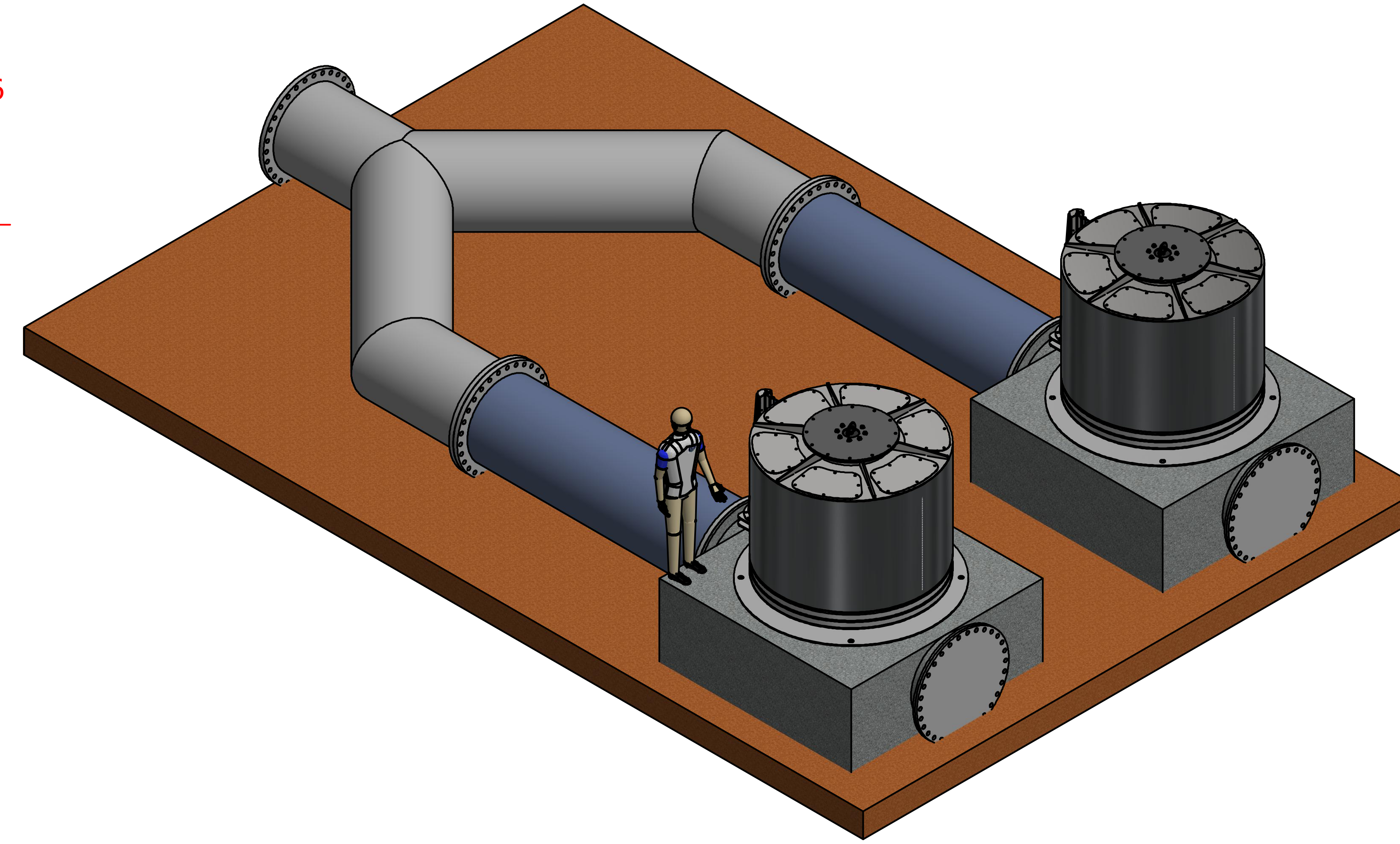
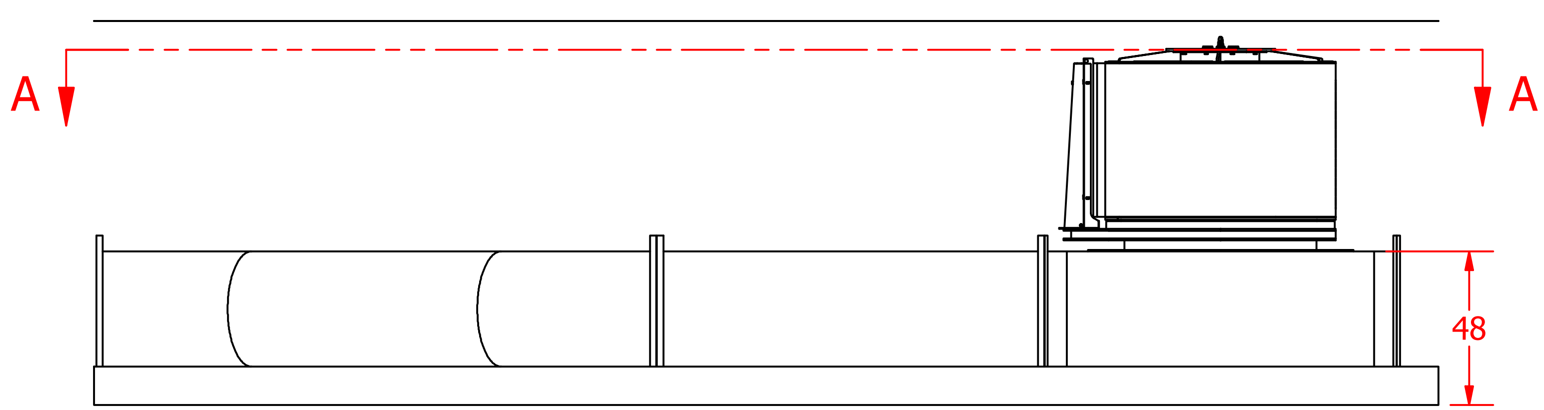
World class desalination

NOT FOR CONSTRUCTION

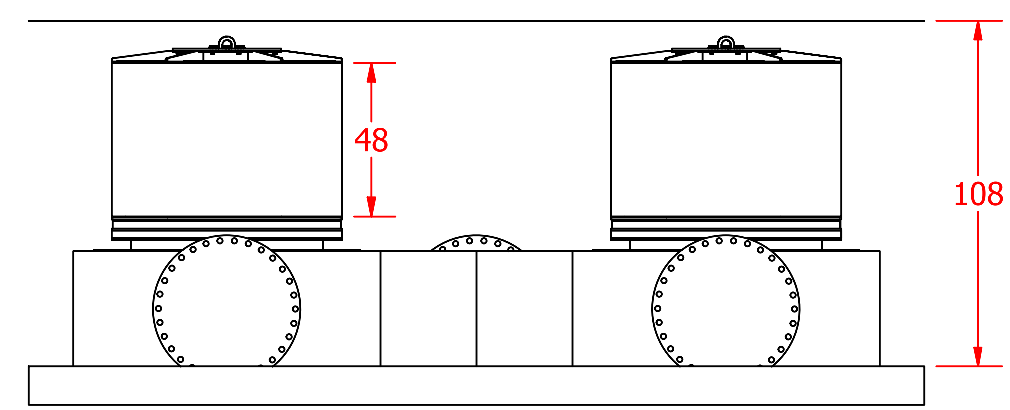


SECTION A-A





SIDE VIEW



END VIEW

REV	DESCRIPTION	DATE	APPROVED
ALL DIMENSIONS IN INCHES UNLESS NOTED			

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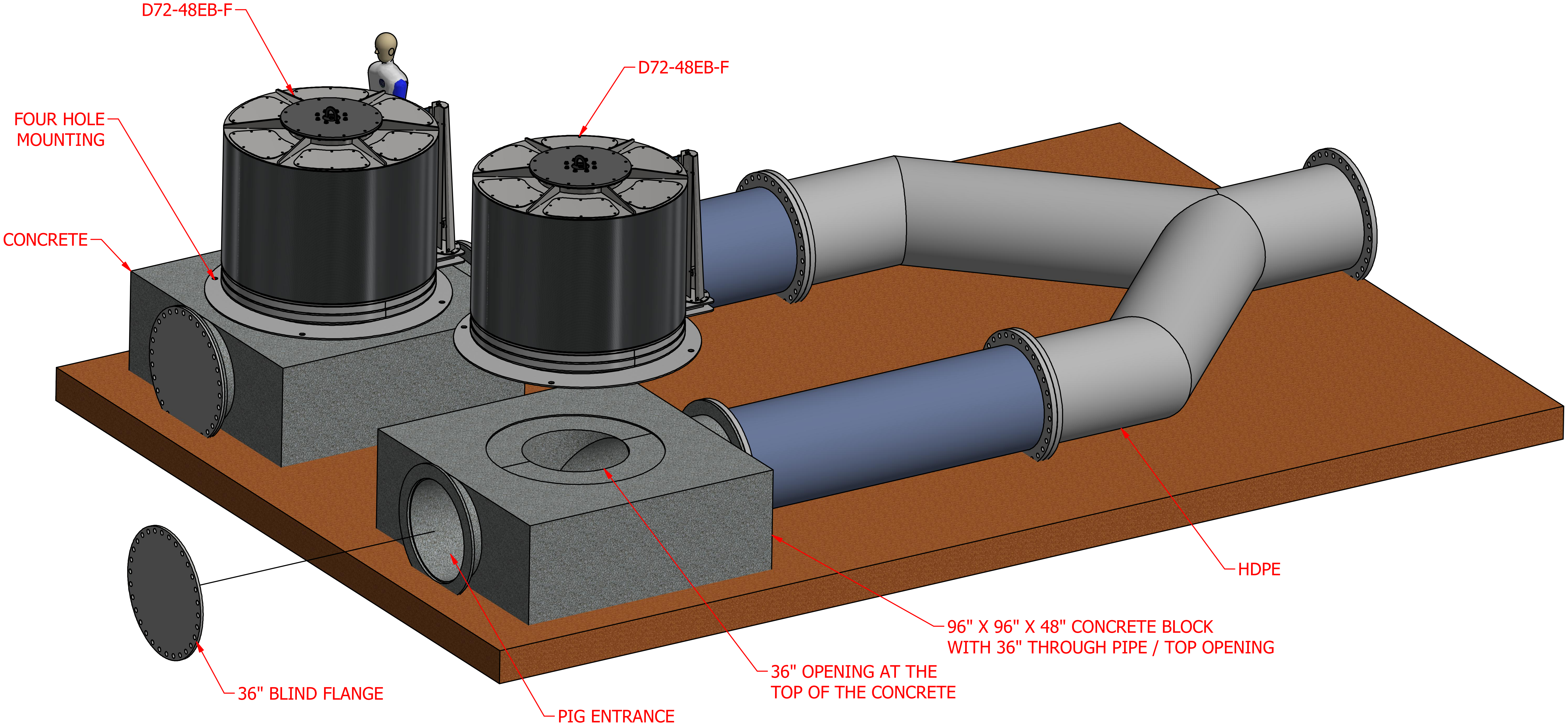
STANDARD TOLERANCES
Fractional Dimensions ± 1/32
Decimal Dimensions ± 0.005

www.intakescreensinc.com
CA C.L. 796197
ISI Intake Screens, Inc.
8417 River Road - Sacramento, California 95832
(916) 665-2727 (916) 665-2729 FAX

DATE 10/14/2021 APP'D BY RUSSELL BERRY IV DRAWN BY JACOB CHAPIN "B" SHEET SCALE	PROJECT MARIN	DESCRIPTION DUAL D72-48EB-F SCREEN ASSEMBLY MATERIAL LAYOUT.	DRAWING NUMBER MARIN MASS 69476.3 lbmass	SHEET NUMBER 1 of 3



ISOMETRIC VIEW

ALL DIMENSIONS IN INCHES UNLESS NOTED			
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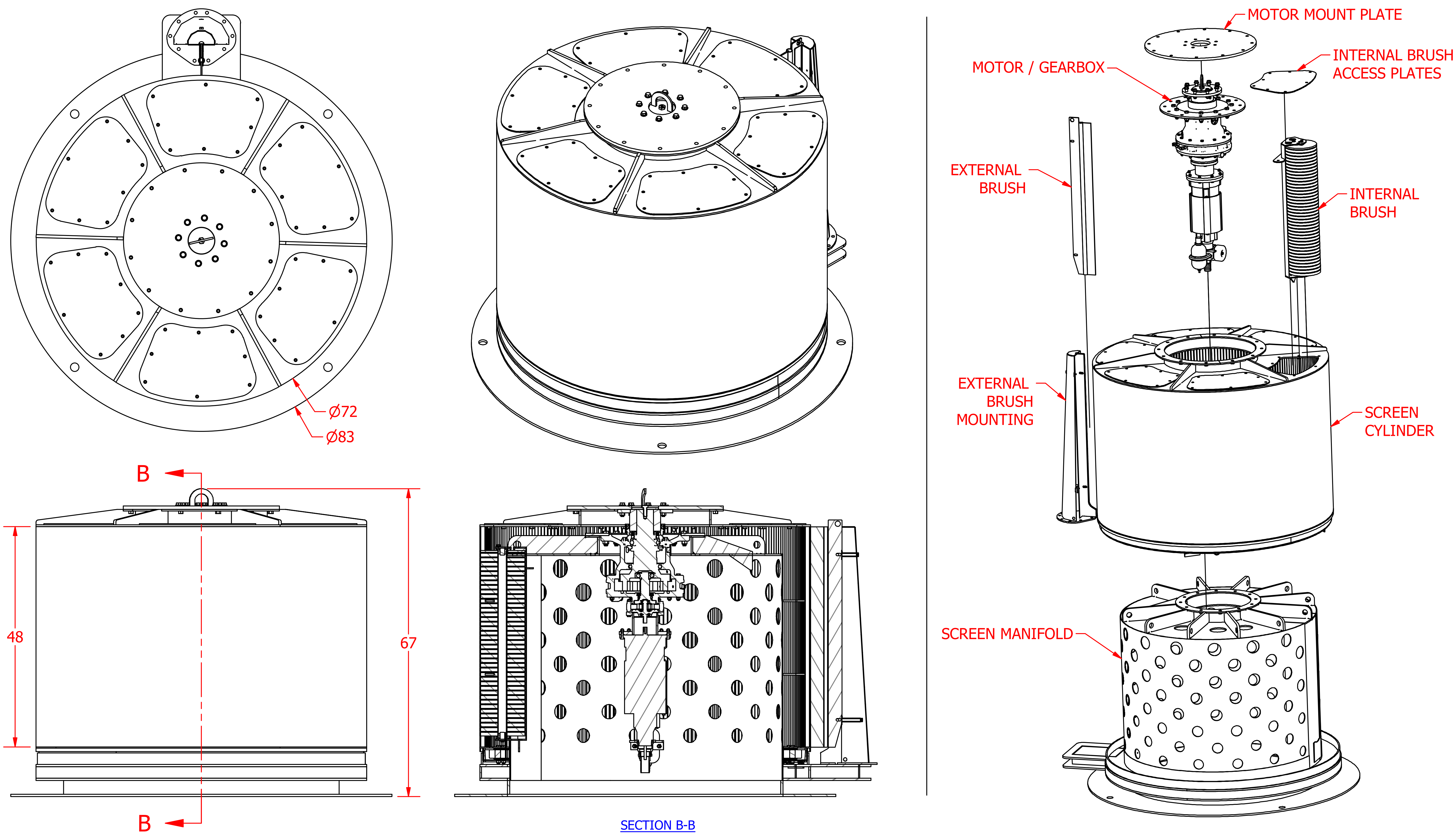
(916) 665-2727 (916) 665-2729 FAX

DATE	10/14/2021
APP'D BY	RUSSELL BERRY IV
DRAWN BY	JACOB CHAPIN
"B" SHEET SCALE	
PROJECT	MARIN
DESCRIPTION	DUAL D72-48EB-F SCREEN ASSEMBLY
MATERIAL	LAYOUT.
DRAWING NUMBER	MARIN
MASS	69476.3 lbmass
SHEET NUMBER	2 of 3



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8417 River Road - Sacramento, California 95832
(916) 665-2727 (916) 665-2729 FAX

DATE	10/14/2021
APP'D BY	RUSSELL BERRY IV
DRAWN BY	JACOB CHAPIN
"B" SHEET SCALE	
PROJECT	MARIN
DESCRIPTION	SCREEN
MATERIAL	ASSEMBLY
DRAWING NUMBER	D72-48EB-F
MASS	4352.6 lbmass
SHEET NUMBER	3 of 3

Appendix B: Presentations to Regulators

B-1: Presentation to the California Division of Drinking Water (DDW).

B-2: Presentation to the Marin Projects Committee (Inter-Agency Group of Regulators).

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Potential Emergency Desal Supply

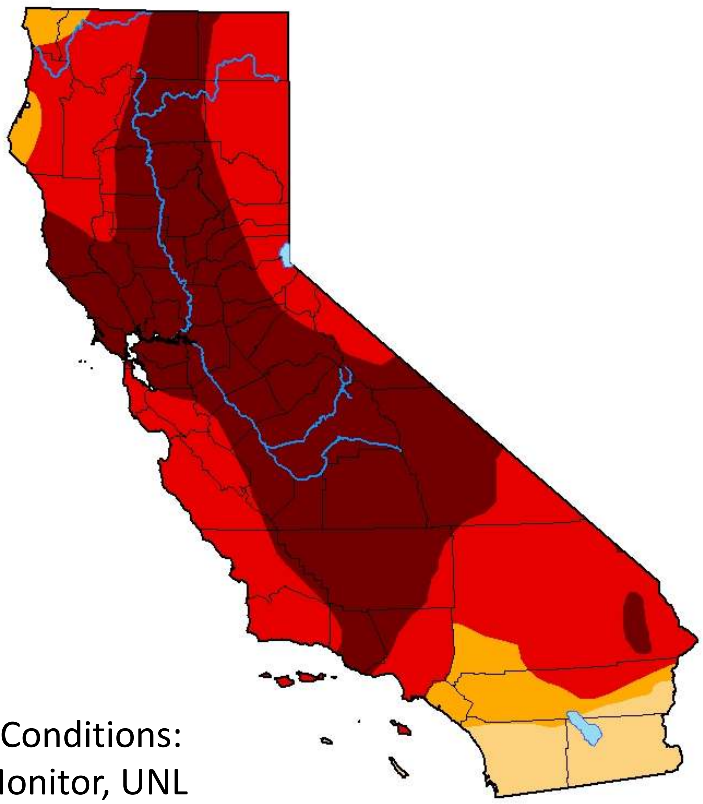
DDW Informational Meeting

28 September 2021

Informational Meeting Agenda

- California Drought and MMWD Water Supply
- Potential Water Supply Alternatives
- Potential Emergency Desalination Facility
- Previous Studies for 2007 Desalination Project
- Questions and Discussion

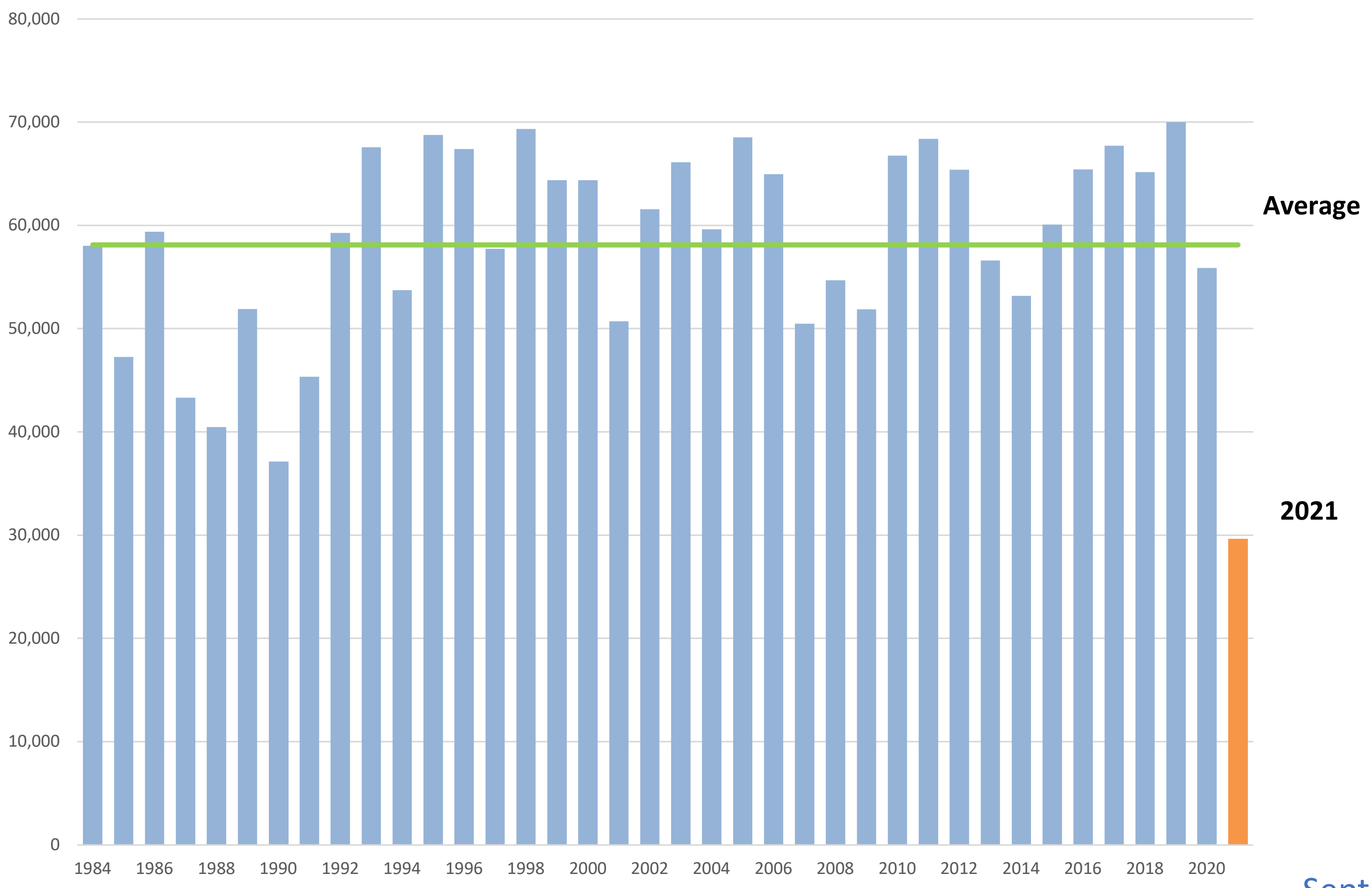
Droughts and Temperature Rise are having an Increasing Impact on California Water Supplies



June 2021 Drought Conditions:
From US Drought Monitor, UNL

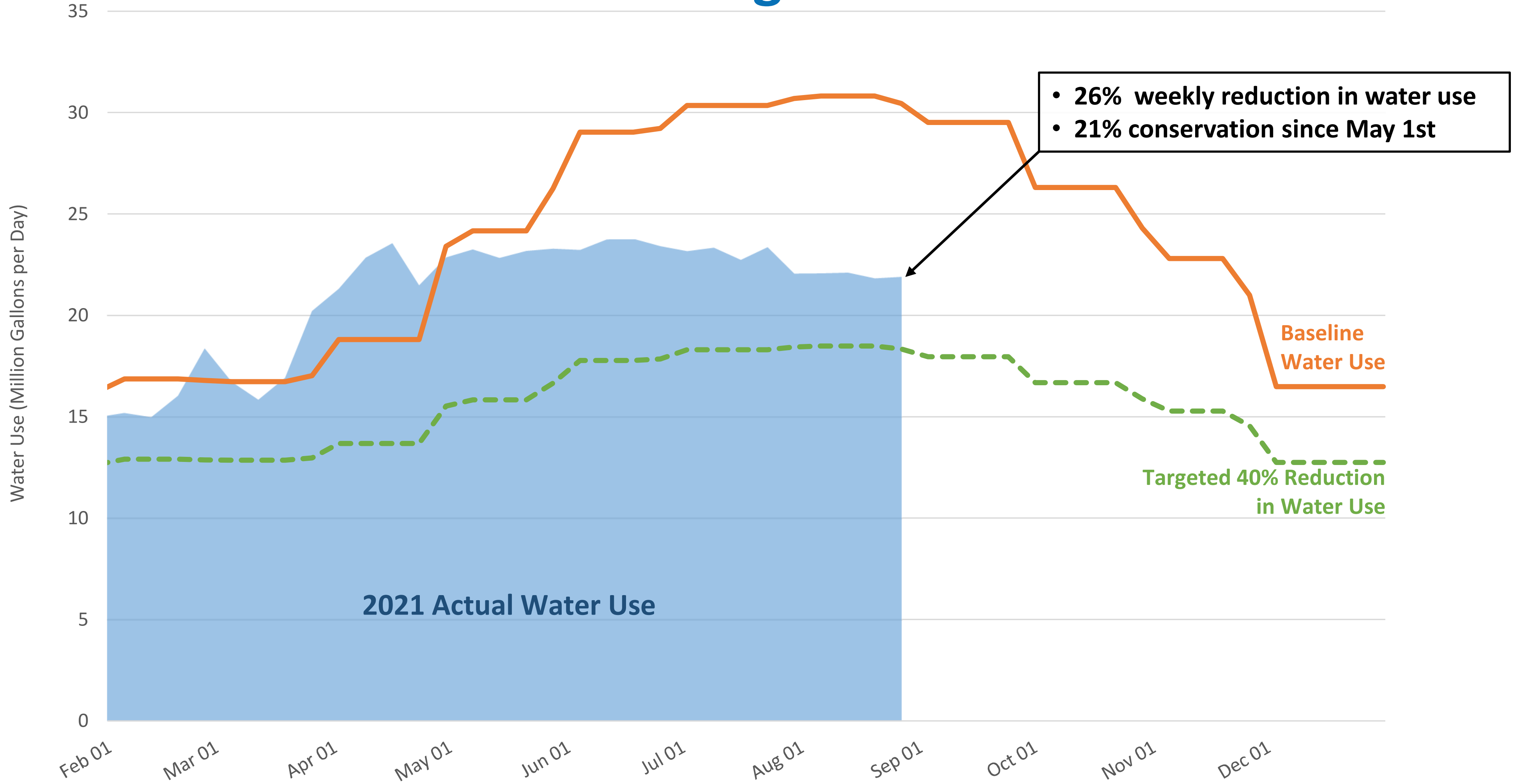
- More evaporation and transpiration
- Dry ground soaks up more water – less runoff
- Less water makes it into Reservoirs

Historical MMWD Total Reservoir Storage

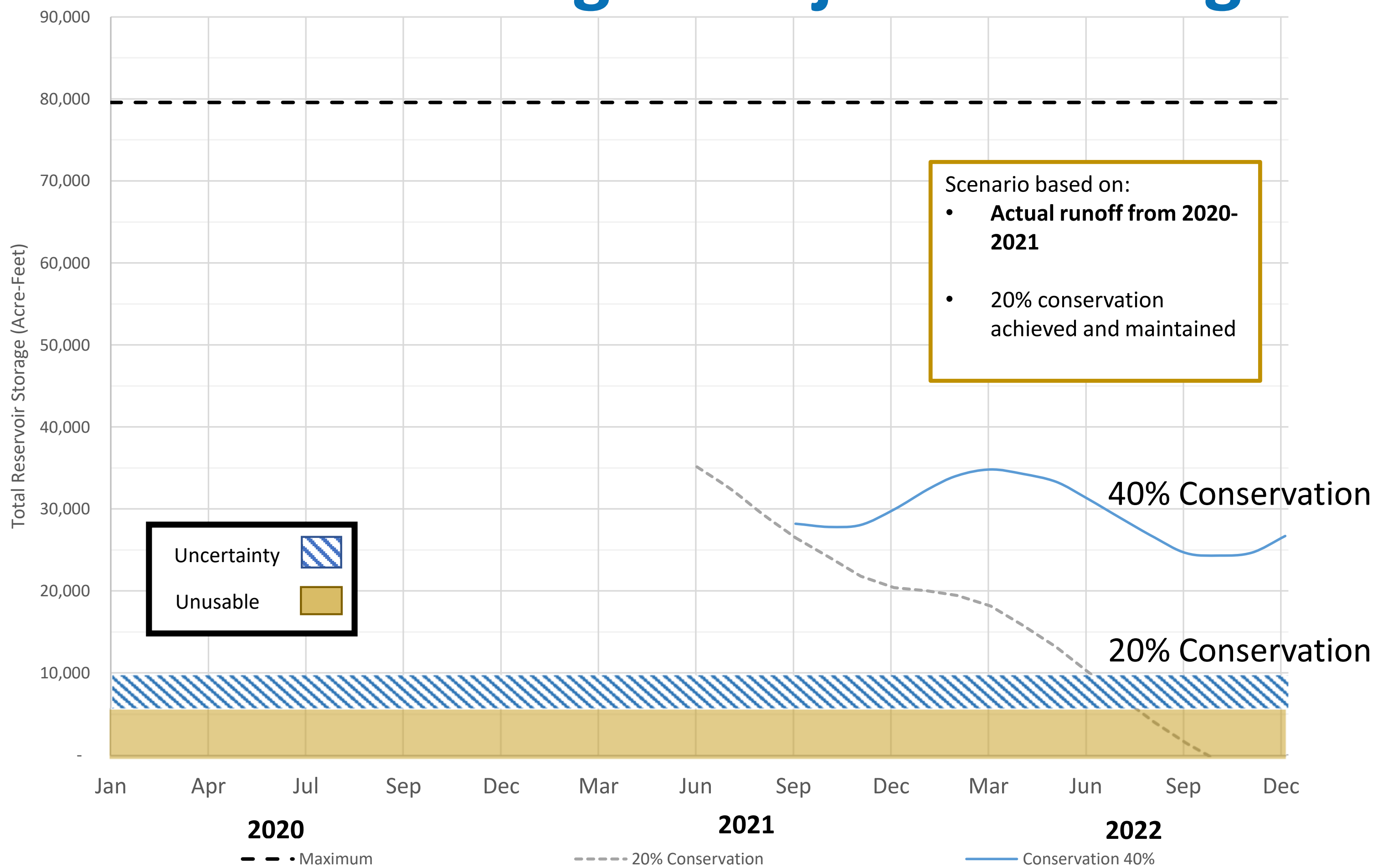


September 2021

MMWD Actual vs. Targeted Water Use



MMWD Drought Project Planning



MMWD Emergency Water Supply Alternatives

Water Conservation and Supply alternatives are being evaluated for availability, capacity, cost, schedule and permit requirements

Plan A – Work to achieve 40% Conservation.

Plan B - Pipeline on the Richmond-San Rafael Bridge similar to 1976-1977 Drought.

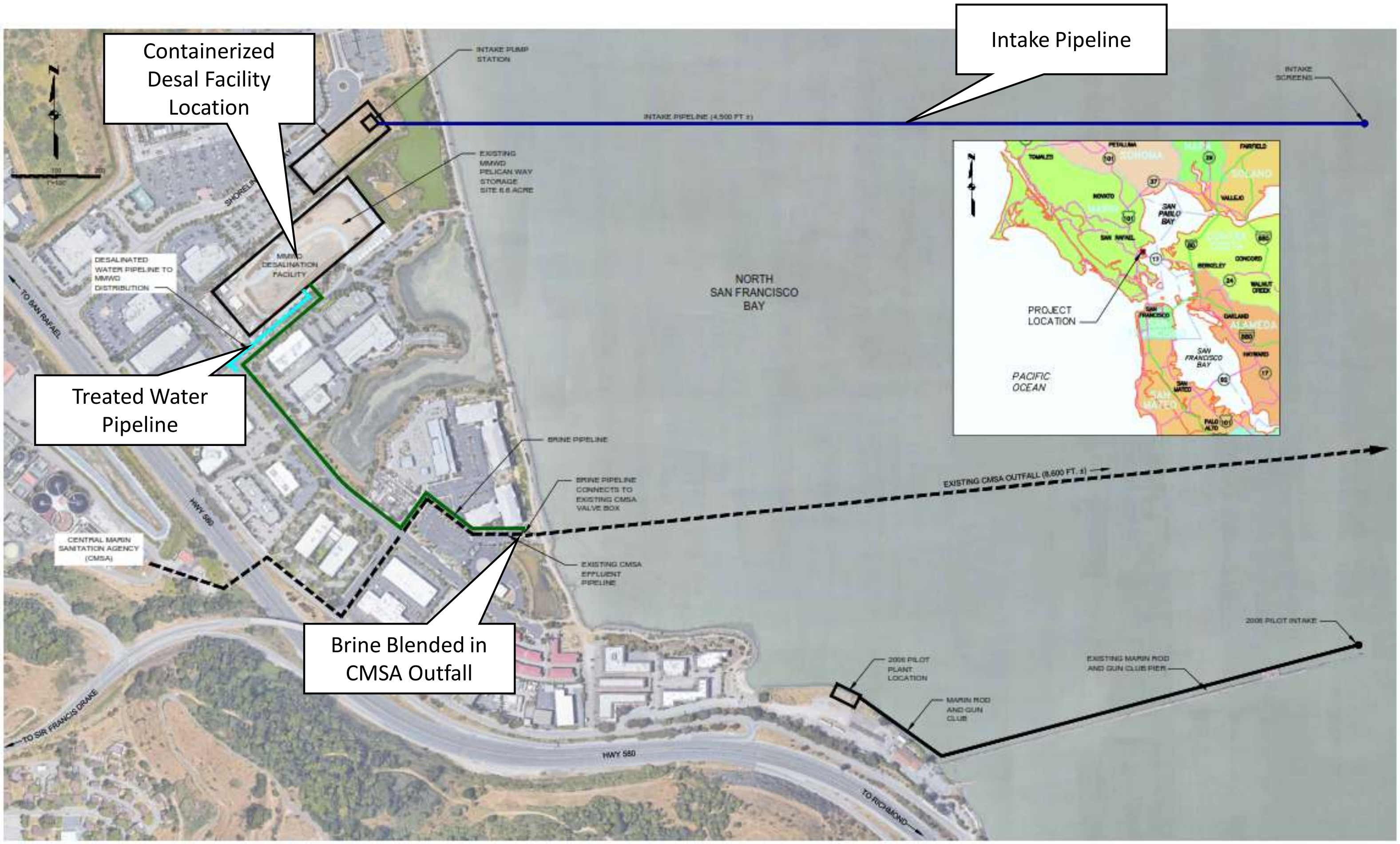
Plan C - Temporary Desalination System similar to project pilot studied in 2005 and 2006.

MMWD Emergency Desalination Supply Project

Proposed Project Description and Location:

- Located at MMWD Pelican Way Maintenance Yard
  - 125 Pelican Way, San Rafael CA (37.95 N – 122.49 W)
- Use containerized desalination equipment
- Facility would produce 5.4 MGD of drinking water
- Screened Intake in San Rafael Bay: ~14.4 MGD
- Brine discharge blended in CMSA Outfall: ~9 MGD
- ~ 9 to 10 months to procure, deliver, install and startup

Conceptual Emergency Desalination Project Layout

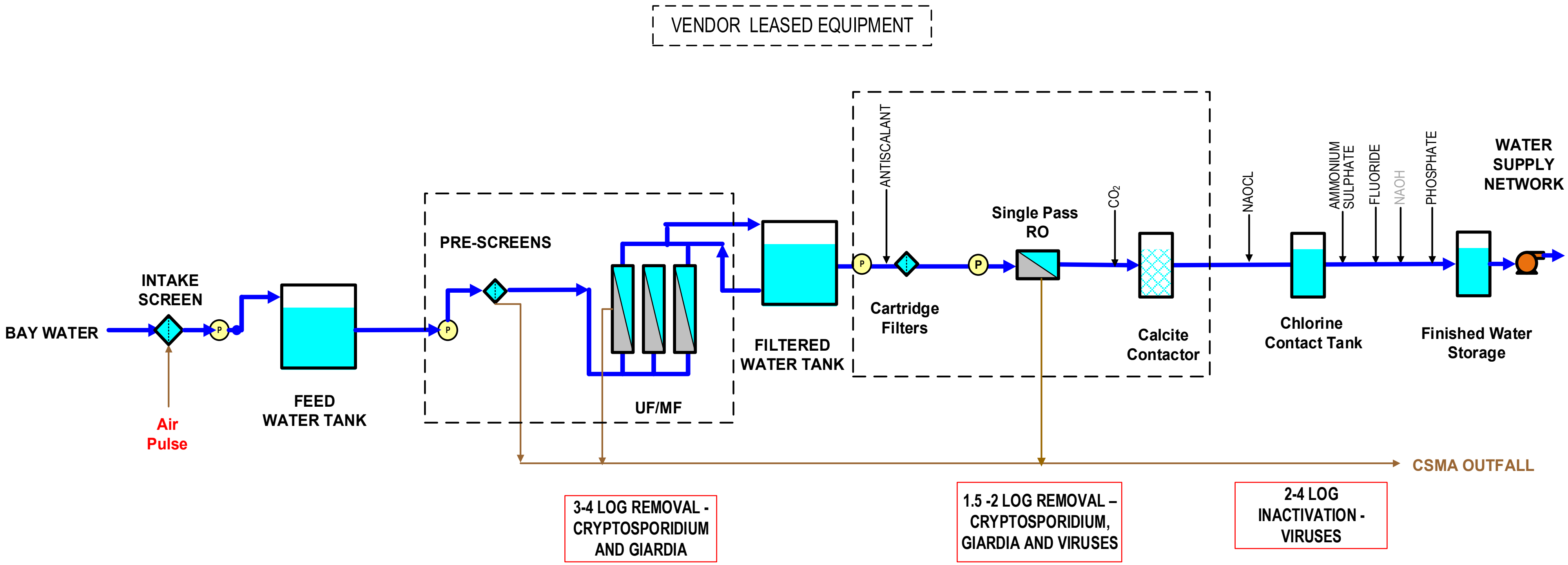


Containerized 1.8 MGD Seawater Desal System

- Australian Desal Supplier
- Containerized and pre-engineered
- 3 Units could provide 5.4 MGD
- Similar size to Desal Project studied for 2007 EIR
- ~ 9 months to deliver, install and startup

Containerized 1.8 MGD Seawater Desal System

Emergency Desal System Process Flow Diagram



MMWD provides supporting facilities (Intake, Brine, TW Tank)

2005-2006 MMWD Desal Pilot Program provided data that can be used to evaluate an Emergency Desal System

- Demonstrated technology and that desal water is safe
- Conducted environmental studies to support EIR
- Informed customers on the program and technology
- MMWD certified an EIR for a 5-MGD to 15-MGD Desalination Project in 2007

2006 Pilot Showed Desalinated water is safe

- Testing of Bay and Desal Water:
  - 126 regulated compounds
  - 538 voluntary (non-regulated) compounds
  - 253 voluntary additional compounds analyzed at ultra-low levels
  - E-Screen assay

- Used over **6,000 data points** to evaluate water quality and treatment performance

Source Water data from the 2006 Desal Pilot Study and Report

		Typical Pacific Ocean Seawater[(a)]	Historical North San Francisco Bay Water Quality[(b)]	2006 Pilot Study Source Water (Bay Water) Quality[(c)]		
Parameter	units		Max.	Avg.	Max.	Min.
TDS	mg/l	34,465	32,000	21,700	29,000	2,500
Conductivity	umhos/cm	–	48,000	39,200	43,500	5,000
Calcium	mg/l	400	371[(d)]	210	310	71
Magnesium	mg/l	1272	1,181[(d)]	755	910	580
Sodium	mg/l	10,560	9,805[(d)]	6,700	8,100	3,300
Potassium	mg/l	380	353[(d)]	262	350	190
Ammonia	mg/l	0.4	0.4	ND	ND	ND
Barium	mg/l	5	3	5.0	27	0.011
Strontium	mg/l	13	12[(d)]	2.63	5.9	.004
Bromide	mg/l	–	–	6.9	8.1	6.0
Bicarbonate	mg/l	142	110[(d)]	101	110	94
Temperature	°C	10	21.7	17	21	10
pH	units	8.2	8.19	7.9	8.3	7.6
Sulfate	mg/l	2,560	2,377[(d)]	1,533	1,900	1,000
Chloride	mg/l	18,980	17,620	11,000	15,000	2,100
Fluoride	mg/l	1.4	1.3[(d)]	0.682	0.79	0.5
Boron	mg/l	4.6	4.3[(d)]	2.3	3.3	1.7

From a Source Water Sanitary Survey Perspective: What is "SF Bay Water"?

- Ocean Water
- Delta Water
- Local Municipal and Industrial Discharge Water
- Storm Water Runoff

We propose to treat SF Bay Water as an impaired water source and provide 5-log Giardia, Crypto. and 6-log virus removal and inactivation.

- MF: 4-log *Giardia* and *Cryptosporidium* removal
- RO: 2-log *Giardia* and *Cryptosporidium* removal
- Free Chlorine: 6-log virus and 0.5-log *Giardia* inactivation

2006 Desalinated Water Quality Results

Detailed List of Constituent Sample Results Available

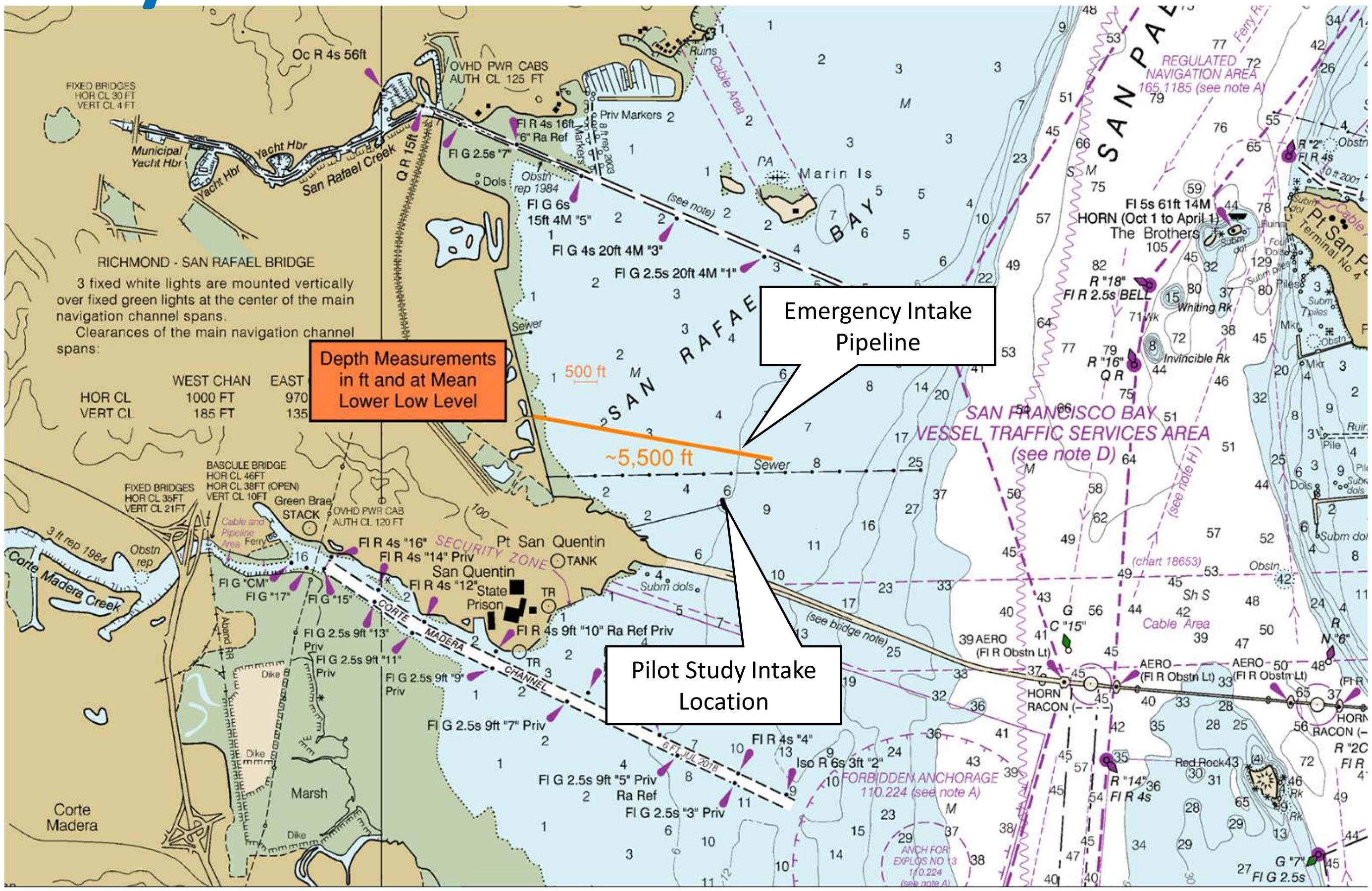
Constituents	Maximum Contaminant Level (MCL)[a]	SF Bay Water[a]	Desalinated Water[a]	Existing MMWD Sources[a]
Sodium	N/A	7,100	21	18 – 20
Chloride	250[b]	12,000	20	8 – 21
Total Organic Carbon (TOC)	2[c]	0.86	ND	1 – 2
Boron	1[d]	2.3	0.2	ND – 0.28
Ethylene Dibromide	0.00005	0.00002[e]	ND	ND
Mercury	0.002	ND	ND	ND

a - ppm
b – Federal Secondary (aesthetic) Standard
c – based on MMWD source water quality
d – CA DHS notification level

Desal Water would be Stabilized to Match Existing MMWD Sources for Corrosion Control

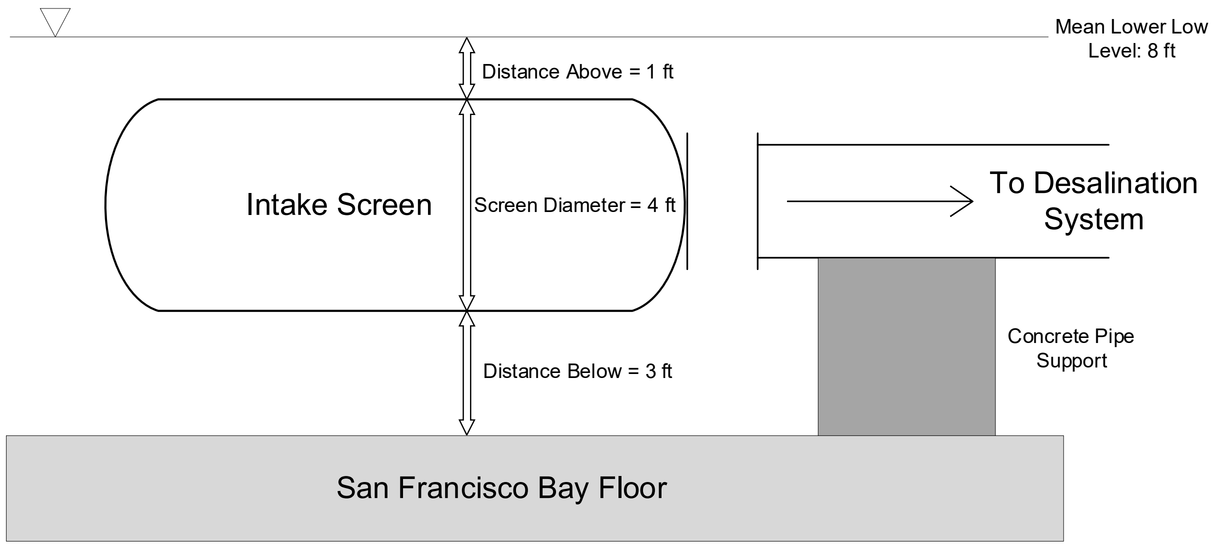
		MMWD Treated Reservoir			Sonoma County Water			Desalination Plant Finished Water Quality Objectives		
Parameter	**units**	**Avg.**	**Max.**	**Min.**	**Avg.**	**Max.**	**Min.**	**Avg.**	**Max.**	**Min.**
TDS	mg/l	119	136	86	171	186	148	120	180	60
Hardness	mg/l	62	74	52	105	112	96	60	110	50
Alkalinity	mg/l	61	70	49	119	125	110	60	110	50
pH	units	7.8	7.9	7.8	8.1	8.4	7.8	7.9	8.4	7.8
Color	CU	<3	<3	<3	<3	<3	<3	<3	<3	–
TOC	mg/l	1.6	2.4	1.1	0.9	1.2	0.7	<1	1	–
Sodium	mg/l	16	25	11	20	23	16	30	50	10
Chloride	mg/l	27	37	22	8	10	7	50	70	10
Boron	mg/l	<0.05	<0.05	<0.05	0.28	0.26	0.16	0.5	1	–
LSI	–	-0.94	-0.64	-1.29	0.11	0.42	-0.14	0.2	0.4	0.0
RI	–	–	–	–	–	–	–	7	8	6
AI	–	11	11.3	10.8	12	12.2	11.8	11.5	12	11
LNI	–	–	–	–	–	–	–	0.3	0.4	0.25

Temporary Intake would be near location of 2006 pilot study intake



Passive Intake Screens would Minimize Entrainment and Entrapment

- Two screens
- 1-mm screen slot size
- <0.5 fps velocity
- 316-SS
- Automatic brush mechanisms



2006 Pilot Study Activities and Studies that supported the 2007 Desal Project EIR

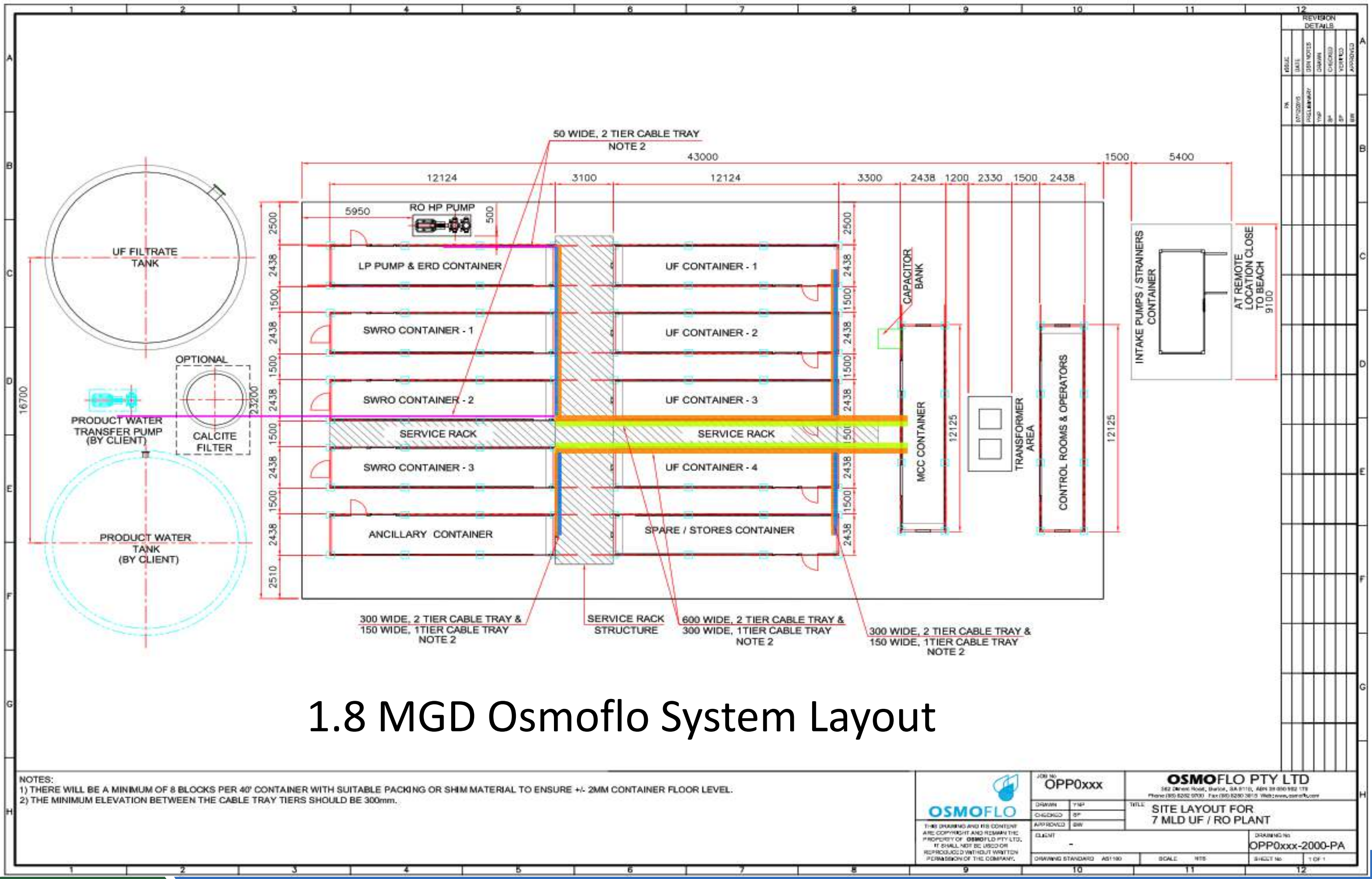
- Agency Meetings/Coordination
- Fisheries Studies
- Intake Entrainment Studies (Pilot Plant)
- Outfall Dilution Modeling
- Discharge Water Quality and Bioassay Testing (Pilot Plant)

Next Steps for Temporary Desal Supply

- Discuss permitting options with Regulatory Agencies
  - RWQCB
  - BCDC
  - Army Corps
  - Fish and Wildlife
- Continue developing as a “Plan C” option for emergency water supply
- Secure Desal Equipment (?)

Emergency Desal Supply Questions?

Three 1.8 MGD Systems would require ~2 Acres



1.8 MGD Osmoflo System Layout

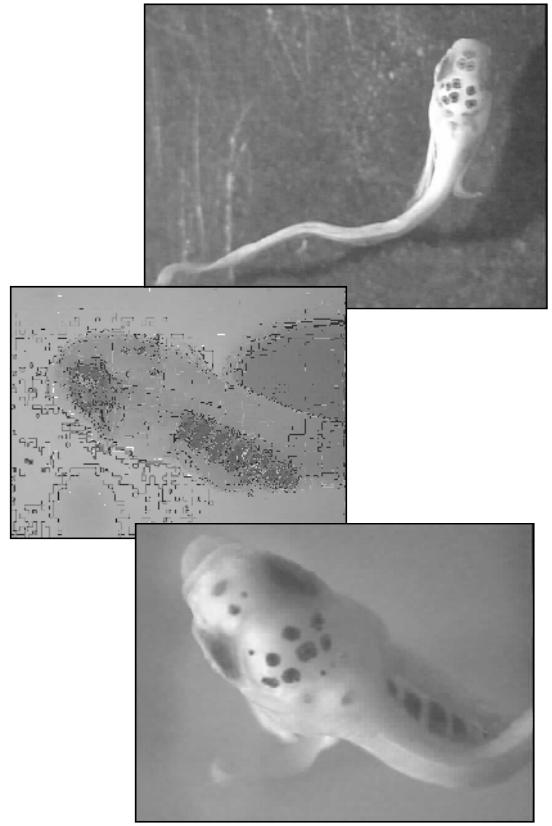
Proposed Screening for Emergency Intake System

- Proposed to meet current Federal, State & Ocean Plan criteria for fish protection
  - 1-mm openings
  - <0.5 fps velocity
- More protective than 2006 Intake Screens
- In ~7 to 8 ft water at low-low tide
- Buoys or markers for small boat safety

2006 Pilot Facility Intake Screen:
3/32-inch wedge-wire screen

2006 Pilot Plant Entrainment Study

- Coordinated with CDFW and NMFS
- Bay fish sampling and feedwater sampling
- Direct measurement of species composition, seasonal distribution, and densities of:
  - Ichthyoplanton (larval fish and eggs)
  - Crab (*Cancer* spp.)
  - Shrimp (*Crangon* spp.)
  - Oyster
- 2006 Study evaluated impacts for 30 mgd intake
- Temporary Desal would be ~14.4 mgd intake



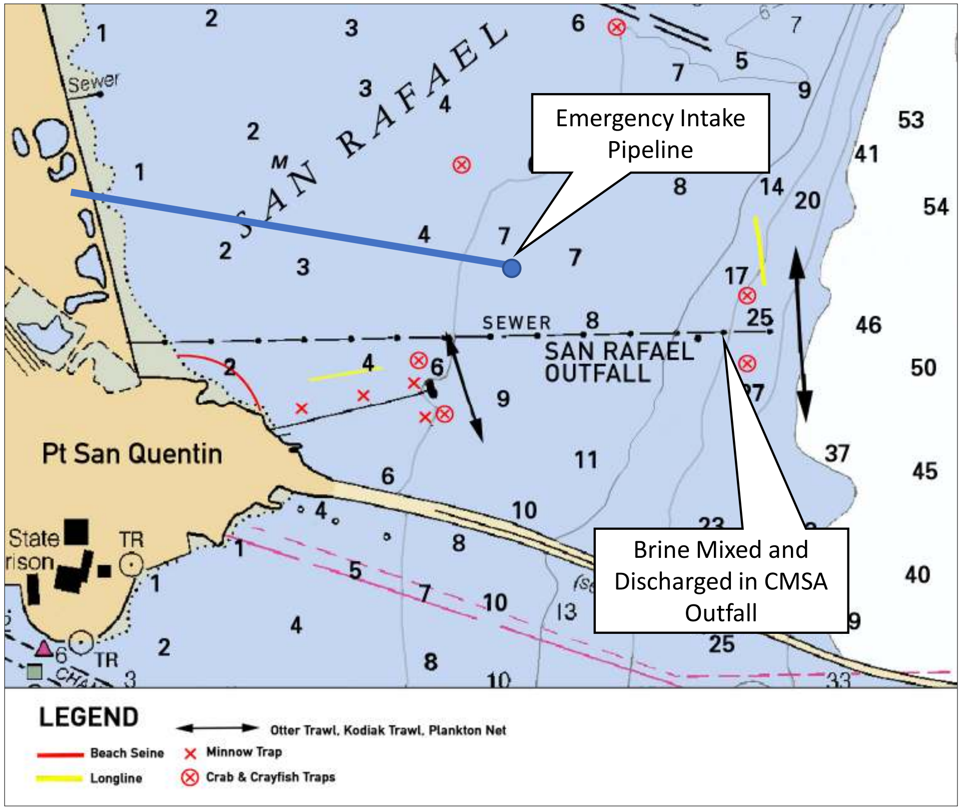
MMWD Pilot Plant Entrainment Study

- One-year program (July 2005 – June 2006)
- Samples collected twice per month
- Day/night sampling
- Ichthyoplankton sampling year round
- Macroinvertebrate sampling for 6 months
  - Finer mesh netting
- Study designed in consultation with NOAA Fisheries and CDFG

EIR Appendix C –Facility Intake Effects

- 2006 Intake Study conclusions
  - Low diversity of larvae in northern SF Bay
    - Pacific herring larvae approximately 98%
    - Extremely low numbers of post-zoeal *Crangon* spp. shrimp
  - Low potential impacts to most abundant target species' source water population
    - Larval entrainment impacts to fisheries were orders of magnitude below the levels set by fishery management practice to maintain sustainable yields
    - Not a significant impact

2006 Pilot modeled and tested brine discharge impacts with CMSA Outfall



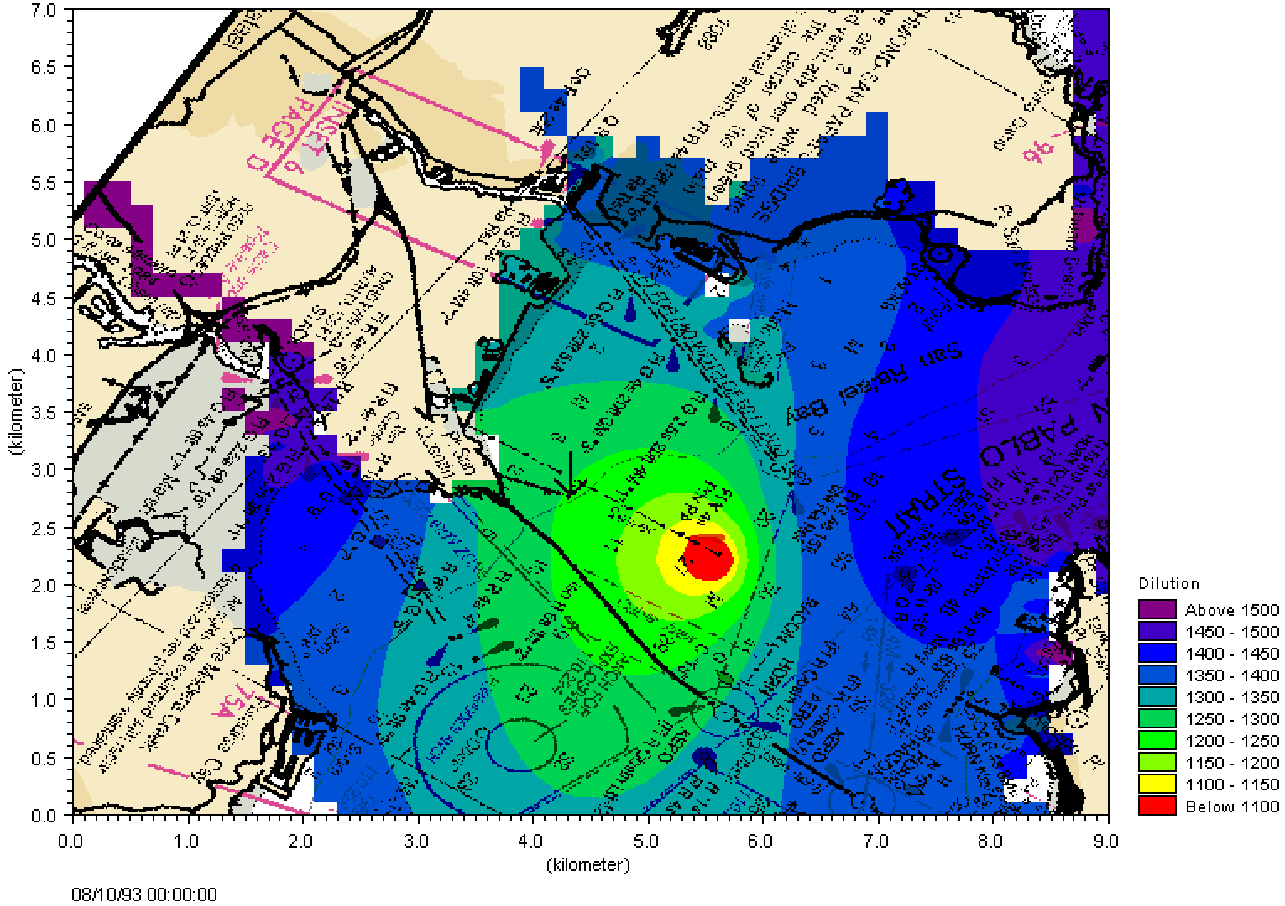
EIR Appendix F – Brine Disposal Evaluation

- USEPA Visual Plumes (VP) mixing zone model used in combination of Monte Carlo statistical approach
- CMSA Effluent/Brine concentrations < NPDES permit limits (Except for ammonia, not related to Desal brine)
  - Desal Brine flow of 15 mgd
  - CMSA Flow of 7 mgd (typical dry weather flow)
  - 1,050 foot diffuser of 84” buried pipe
  - 176 risers for 2 to 40 mgd

Near and Far Field Dilution Analysis was Conducted for 2007 Desal EIR

- Used peer reviewed model of the Bay based on the MIKE 21 model developed by the Danish Hydraulics Institute.
- 2006 Inputs: Brine flow of 15 MGD, CMSA wastewater flow of 7 MGD
  - Temporary Brine flow would only be ~9 MGD.
- Model run for August conditions
- Minimum dilution in San Rafael Bay varies from 1100 to 1500.

Initial Mixing Zone from Far Field Dilution Analysis



2006 Pilot Bioassay Testing of Brine to support the EIR

- Bioassay testing of the brine discharge
  - Both acute and chronic testing
- Toxicity testing of the pretreatment solids

Extensive bioassays conducted to evaluate impact of brine effluent

- Acute bioassays
  - Mysid Shrimp
  - Topsmelt
  - Marine Algae
- Chronic bioassays (growth and reproduction)
  - Marine Giant Kelp
  - Bay Mussel
  - Inland Silverside
  - Opossum Shrimp
  - Marine Diatom

Desal brine mixed with CMSA Effluent does not adversely impact the health of Bay

- Brine mixed with CMSA effluent
  - No significant effects in acute or chronic bioassay testing
  - Bioassay results were similar to CMSA effluent results with no brine addition

EIR Appendix F – Brine Disposal Evaluation

- Ambient SF Bay concentrations are > water quality criteria (WQC) for dieldrin, heptachlor epoxide, PCBs, and dioxin.
- Therefore, RO concentrate estimated to be > WQC for dieldrin, heptachlor epoxide, PCBs, and dioxin because ambient SF Bay concentrations are > WQC
- After initial dilution at diffuser, concentrations estimated to be similar to ambient SF Bay water

Potential Mitigations for Temporary Project

- Remove piles and components from decayed portions of Marin Rod and Gun Club pier.
- Support bay restoration projects with the SFSU Romberg-Tiburon Estuary and Ocean Science Center.
- Other ideas

2007 Adopted EIR Special Studies

- App A – Scoping Report
- App B – Engineering Report for Pilot Program
- **App C – Facility Intake Effects**
- App D - Special Status Species
- App E - Cultural Resources
- **App F – Brine Disposal Evaluation**
- App G – Land Use
- App H – Alternative Energy Scenario
- App I - Mitigation Monitoring Reporting Program

EIR – App I Summary of Applicable MMRP

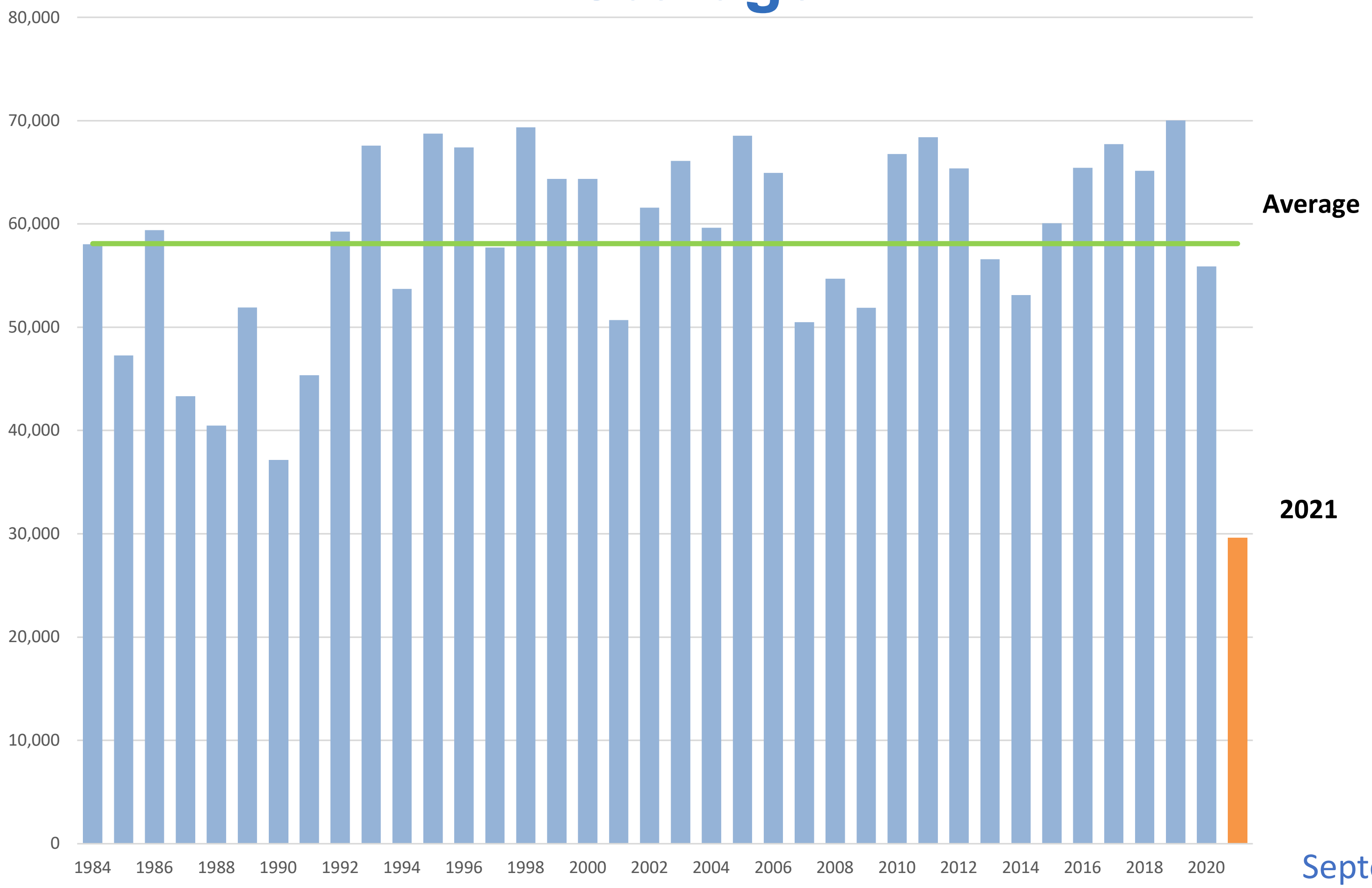
- 4-2.1 (a) and (b) Follow BAAQMD Control Measures
- 4-3.9(a)Consult with NOAA Fisheries esp re special status species (e.g. chinook salmon, steelhead and green sturgeon)
- 4-5.7 – Conduct grading and construction activity to minimize runoff
- 4-7.8 Design to mitigate impacts of future tsunami
- 4-9.3 –Powered equipment to be equipped with mufflers and located away from sensitive noise receptors and designate noise disturbance coordinator

Potential Emergency Desal Supply Project

Marin Project Coordination Meeting

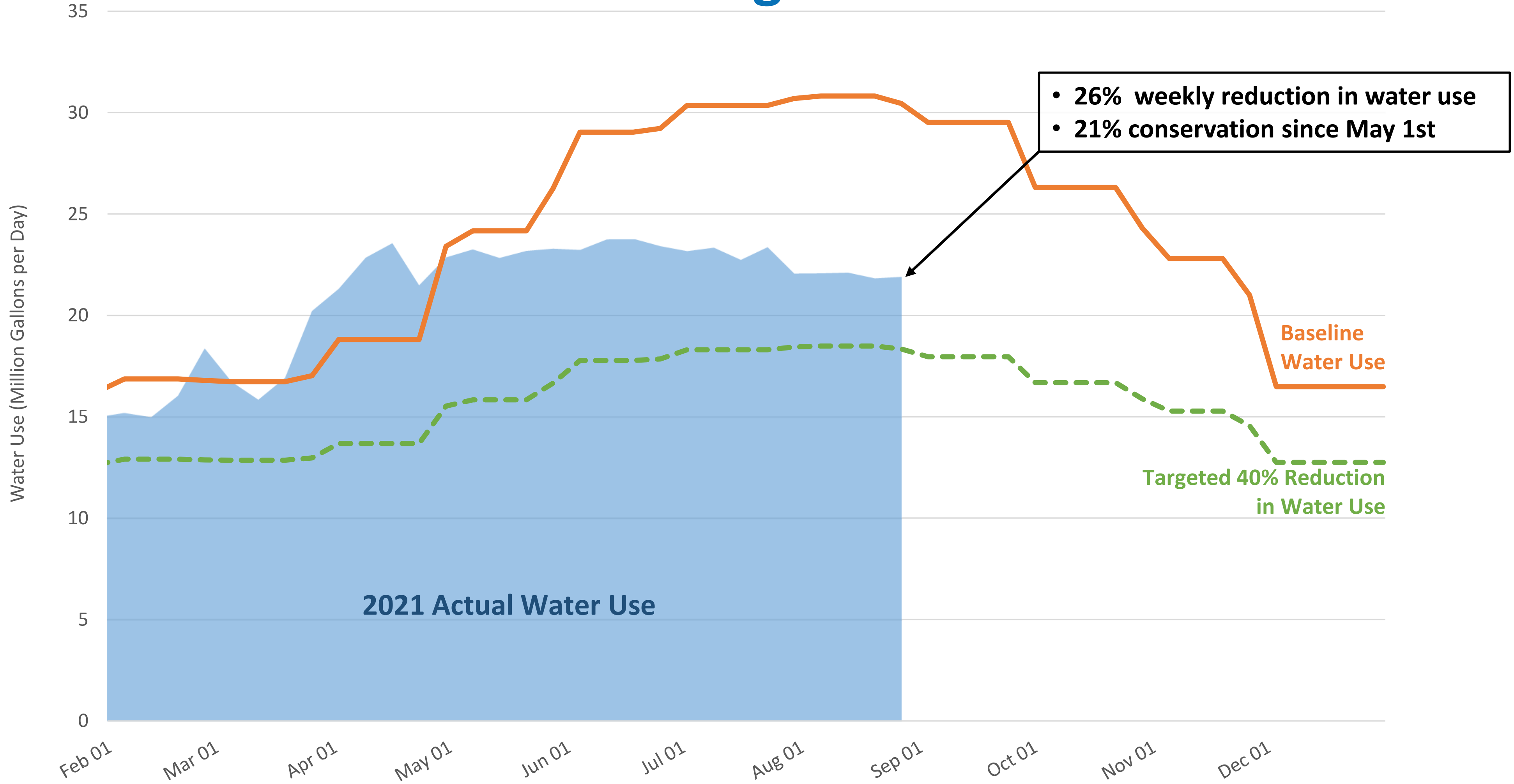
07 October 2021

Severe Drought has Impacted MMWD Total Reservoir Storage

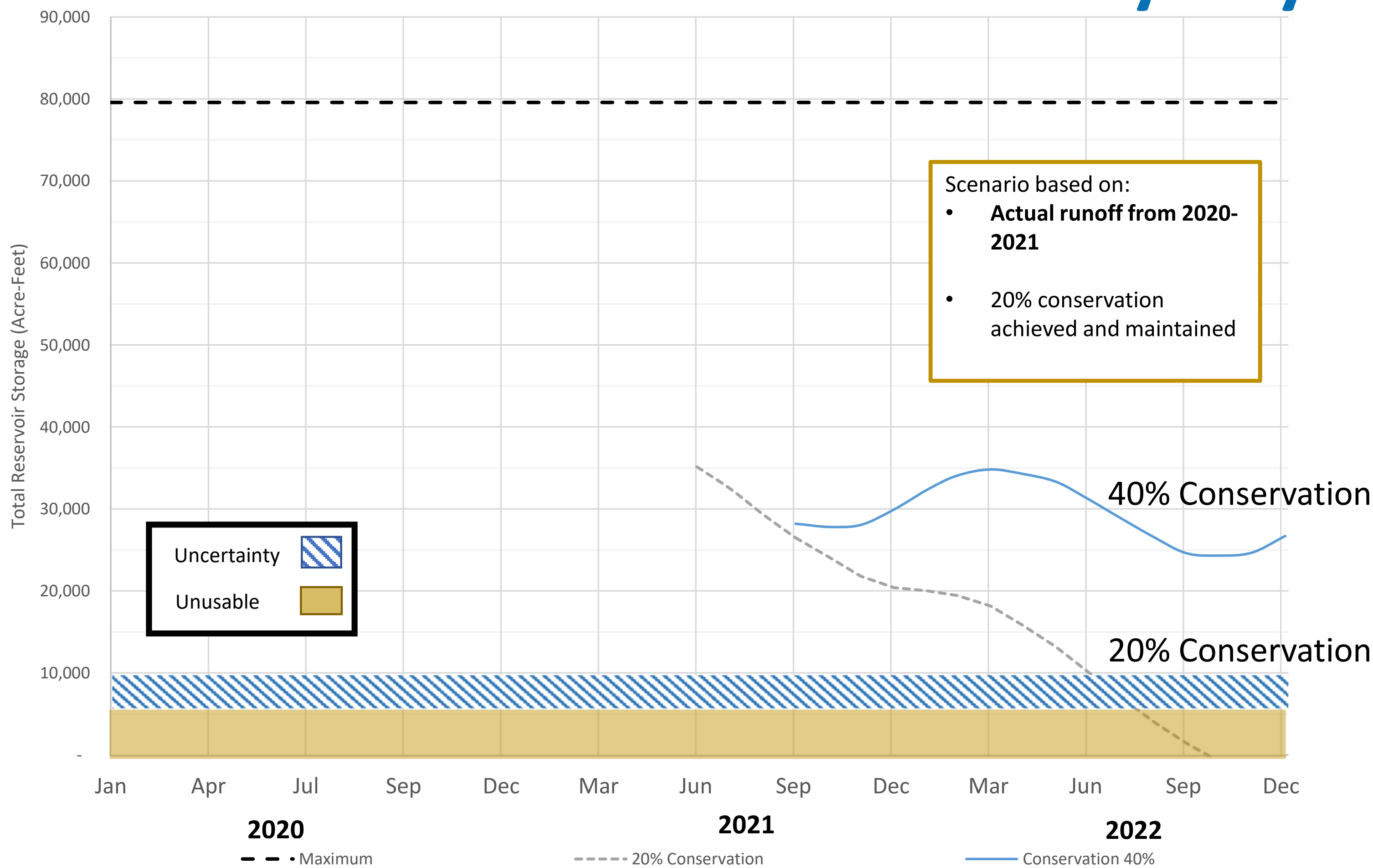


September 2021

MMWD Actual vs. Targeted Water Use



MMWD Reservoirs could be Unusable by July 2022



MMWD Emergency Water Supply Alternatives

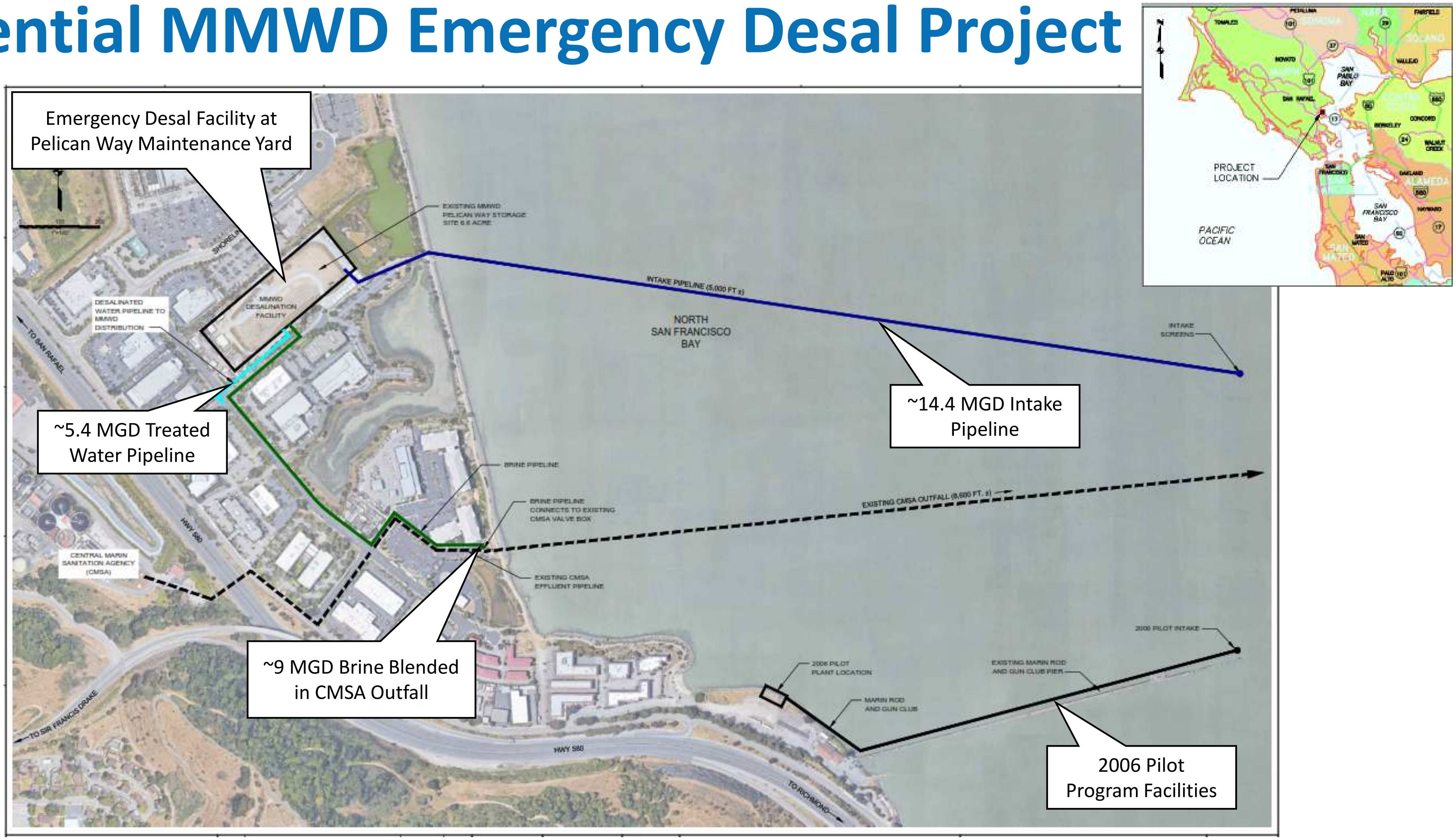
Water Conservation and Supply alternatives are being evaluated for availability, capacity, cost, schedule and permit requirements

Plan A – Work to achieve 40% Conservation.

Plan B - Pipeline on the Richmond-San Rafael Bridge similar to 1976-1977 Drought.

Plan C - Temporary Desalination System similar to project pilot studied in 2005 and 2006.

Potential MMWD Emergency Desal Project



Temporary Containerized Seawater Desal System

- 5.4 MGD drinking water
- Similar size to Desal Project in 2007 EIR
- Containerized and pre-engineered
- ~ 9 months to deliver, install and startup

2005-2006 MMWD Desal Pilot Program provides data that can be used to evaluate an Emergency Desal System

- Demonstrated technology and that desal water is safe
- Conducted environmental studies to support 2007 EIR
- Informed customers on the program and technology
- MMWD certified an EIR for a 5-MGD to 15-MGD Desalination Project in 2007

2007 Adopted EIR Special Studies

- App A – Scoping Report
- App B – Engineering Report for Pilot Program
- **App C – Facility Intake Effects**
- App D - Special Status Species
- App E - Cultural Resources
- **App F – Brine Disposal Evaluation**
- App G – Land Use
- App H – Alternative Energy Scenario
- App I - Mitigation Monitoring Reporting Program

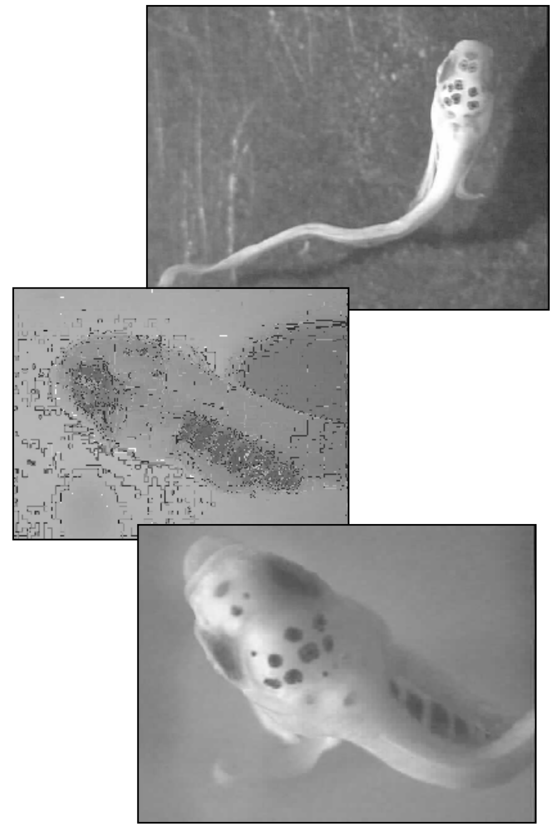
Proposed Emergency Intake System

- 36-inch HDPE - ~5,000 ft laid on Bay floor with concrete anchor blocks
- Screens to meet current Ocean Plan criteria for fish protection
  - 1-mm openings
  - <0.5 fps velocity
  - Brush cleaning system
- In ~7 to 8 ft water at low-low tide
- Buoys or markers for small boat safety

2006 Pilot Facility Intake Screen:
3/32-inch wedge-wire screen

2006 Pilot Plant Entrainment Study

- Coordinated with CDFW and NMFS
- Bay fish sampling and feedwater sampling
- Direct measurement of species composition, seasonal distribution, and densities of:
  - Ichthyoplanton (larval fish and eggs)
  - Crab (*Cancer* spp.)
  - Shrimp (*Crangon* spp.)
  - Oyster
- 2006 Study evaluated impacts for 30 mgd intake
- Temporary Desal would be ~14.4 mgd intake



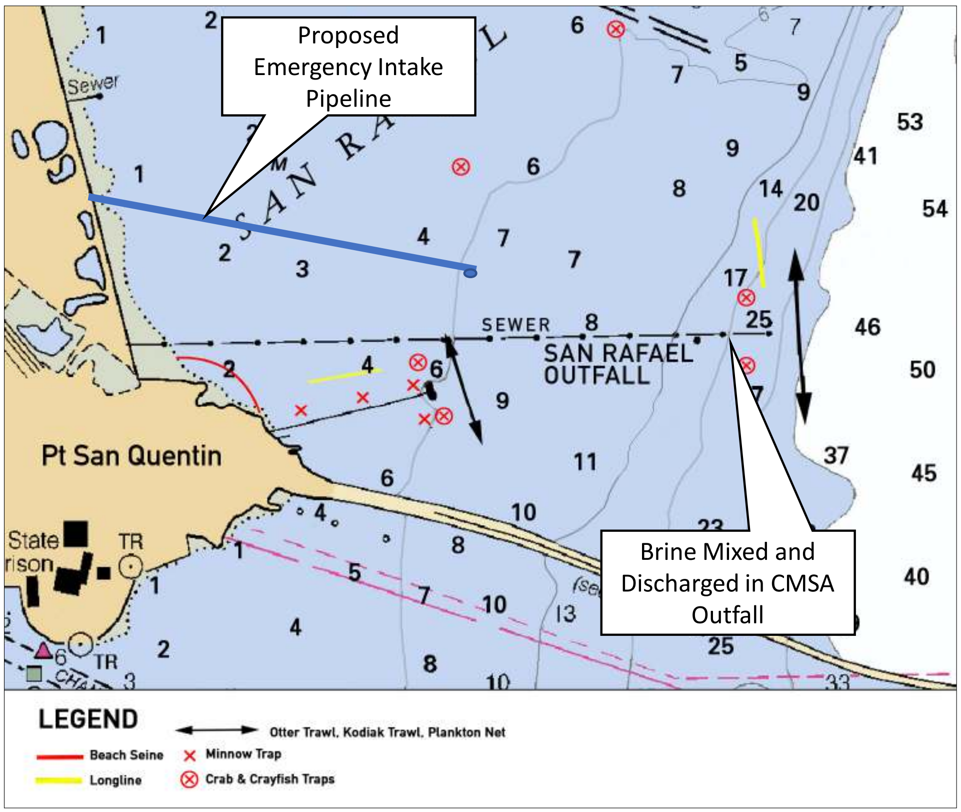
MMWD Pilot Plant Entrainment Study

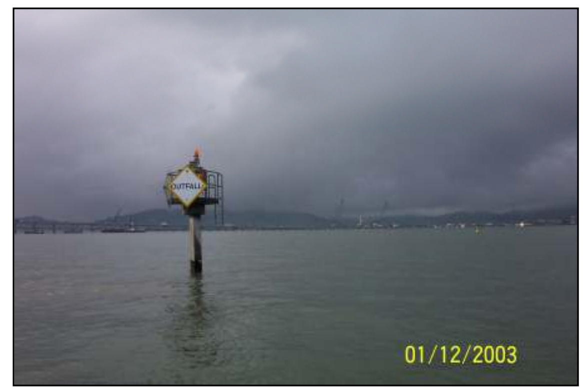
- One-year program (July 2005 – June 2006)
- Samples collected twice per month
- Day/night sampling
- Ichthyoplankton sampling year round
- Macroinvertebrate sampling for 6 months
  - Finer mesh netting
- Study designed in consultation with NOAA Fisheries and CDFG

EIR Appendix C –Facility Intake Effects

- 2006 Intake Study conclusions
  - Low diversity of larvae in northern SF Bay
    - Pacific herring larvae approximately 98%
    - Extremely low numbers of post-zoeal *Crangon* spp. shrimp
  - Low potential impacts to most abundant target species' source water population
    - Larval entrainment impacts to fisheries were orders of magnitude below the levels set by fishery management practice to maintain sustainable yields
    - Not a significant impact

2006 Pilot modeled and tested brine discharge impacts with CMSA Outfall





Near and Far Field Dilution Analysis was Conducted for 2007 Desal EIR (App. F)

- Used peer reviewed model of the Bay based on the MIKE 21 model developed by the Danish Hydraulics Institute.
- 2006 Inputs: Brine flow of 15 MGD, CMSA wastewater flow of 7 MGD
  - Temporary Brine flow would only be ~9 MGD.
- Model run for worst-case August conditions
- Achieved minimum dilution requirements

2006 Pilot Bioassay Testing Results (App. F)

- Tested different blend ratios including high Brine concentration levels
  - No significant effects in acute or chronic bioassay testing
  - Bioassay results were similar to CMSA effluent results with no brine addition

Potential Mitigations for Emergency Project

- Remove piles and components from decayed portions of Marin Rod and Gun Club pier.
- Support bay restoration projects with the SFSU Romberg-Tiburon Estuary and Ocean Science Center.
- Other ideas

Next Steps for Temporary Desal Supply

- Continue to discuss permitting options with Regulatory Agencies
  - RWQCB
  - BCDC
  - Army Corps
  - Fish and Wildlife
- Continue developing as a “Plan C” option for emergency water supply

Emergency Desal Supply Discussion

Appendix C: Emergency Desal Project Schedule

C-1: MMWD Emergency Desal Project – Draft Overall Project Schedule

MMWD Emergency Desal Project - Draft Overall Project Schedule

ID	Task Name	Start
1	**Key Project Activities and Gateways**	**Tue 10/12/21**
2	Develop DB Phase 1 Scope and Fee	Tue 10/12/21
3	Submit DB Phase 1 Scope and Fee	Thu 10/21/21
4	MMWD Review	Thu 10/21/21
5	MMWD Board Mtg	Tue 11/2/21
6	Phase 1 Contract Exectution	Wed 11/3/21
7	Phase 1 NTP	Tue 11/9/21
8	Concept Development	Thu 11/11/21
9	Concept Presentation	Mon 11/22/21
10	MMWD Concept Agreement	Wed 11/24/21
11	Major Equipment Pricing	Wed 11/10/21
12	Major Equip MMWD Review	Mon 12/13/21
13	MMWD Major Equip Pricing Agreement	Mon 12/20/21
14	Develop DB Phase 2 EMP	Mon 11/22/21
15	Develop Phase 2 DB Contract	Mon 11/22/21
16	Submit DB Phase 2 EMP and DB Contract	Mon 1/10/22
17	MMWD Review	Tue 1/11/22
18	DB Phase 2 NTP	Mon 1/17/22
19	**Desalination Plant Package**	
20	**Desal Equipment**	**Tue 11/9/21**
21	Confirm Desal Supplier	Tue 11/9/21
22	MMWD Issues PO	Mon 11/15/21
23	Prepare to ship	Mon 11/15/21
24	Ship to US	Mon 1/10/22
25	Deliver to site	Mon 4/11/22
26	Equipment at site	Thu 6/2/22
27	30% Design of Ancillary Syst	Wed 11/10/21
28	Major Equip Pricing	Wed 11/10/21
29	MMWD Authorize Equip Purchase	Mon 12/20/21
30	Order Pump Stations, Tanks, etc	Tue 12/21/21
31	Equipment Delivery	Mon 1/3/22
32	Equipment Installation	Sun 3/20/22
33	Interconnect Desal	Sun 5/22/22
34	Startup desal equipment	Tue 7/5/22
35	Produce Water	Mon 8/1/22
36	**MF/RO Elements**	**Wed 11/10/21**
37	Design Spec	Wed 11/10/21
38	Request and Recieve Bids	Sun 11/14/21

MMWD Emergency Desal Project - Draft Overall Project Schedule

ID	Task Name	Start
39	Purchase Order	Tue 12/21/21
40	Deliver MF/RO	Sun 12/26/21
41	Install MF/RO Elements	Sun 5/15/22
42	**Stabilization and UV Disinfect**	**Wed 11/10/21**
43	Design Spec	Wed 11/10/21
44	Request and Receive Bids	Mon 11/15/21
45	Purchase Orders	Tue 12/21/21
46	Deliver Calcite Contactors	Sun 1/9/22
47	Deliver UV Reactors	Sun 1/16/22
48	Install Stabilization and UV Disinfection	Sun 5/22/22
49	**Power**	**Wed 11/10/21**
50	30% Design	Wed 11/10/21
51	Equipment Pricing	Mon 11/15/21
52	Order Switchgear / Transormers	Tue 12/21/21
53	Order Generators	Tue 12/21/21
54	Deliver Generators and Switchgear	Tue 1/11/22
55	Generators at Site	Sun 5/15/22
56	Complete Wiring	Sun 5/8/22
57	Energize System	Sun 6/5/22
58	Power Available	Thu 6/30/22
59	**Site Prep Design and GMP**	**Mon 11/15/21**
60	Geotech	Mon 11/15/21
61	Survey	Mon 11/15/21
62	Design	Sun 12/5/21
63	Contractor Mobilize and order materials	Sun 1/23/22
64	**Site Prep Materials and Const**	**Sun 1/23/22**
65	Site Prep and Grading	Sun 1/23/22
66	Delivery of Rock	Sun 2/27/22
67	Place and Compact Base Ro	Sun 4/17/22
68	Site Ready	Wed 6/1/22
69	Equipment Delivery	Wed 6/1/22
70		
71	**Brine Pipeline Package**	**Tue 11/9/21**
72	Design Build P1 Contract	Tue 11/9/21
73	Utility Location	Mon 11/15/21
74	Geotech	Mon 11/15/21
75	Survey & Title Reports	Mon 11/15/21
76	Design	Sun 11/28/21
77	Equip Pricing	Mon 11/15/21
78	MMWD Authorizes Equip	Mon 12/20/21

ID	Task Name	Start
79	Procure Misc Material	Tue 12/21/21
80	Mobilize Contractor	Mon 1/24/22
81	**Brine Pipeline Materials and Construction**	**Wed 11/10/21**
82	Specify Pipe	Wed 11/10/21
83	Request + Receive Bids for I	Sun 11/14/21
84	Order Pipe	Tue 12/21/21
85	Deliver Pipe	Mon 12/27/21
86	Construct Brine Pipe	Mon 2/21/22
87	Connect to CMSA	Sun 5/8/22
88	RWQCB Permission for Discharge	Wed 6/15/22
89	Startup Desal	Sun 7/10/22
90	Produce Water	Mon 8/1/22
91		
92	**Intake Package**	**Tue 11/9/21**
93	Design Build Contract	Tue 11/9/21
94	Survey	Mon 11/15/21
95	Develop Intake GMP	Mon 11/15/21
96	MMWD Authorize Purchase	Mon 12/20/21
97	Design	Sun 11/28/21
98	Issue Design Package	Sun 12/26/21
99	Procure Misc Materials	Sun 12/26/21
100	Contractor Mobilize	Sun 1/9/22
101	**Intake Screens Materials and Constr.**	**Wed 11/10/21**
102	Design Screens	Wed 11/10/21
103	Request and Receive Bids	Mon 11/22/21
104	Sign P.O. For Screens	Tue 12/21/21
105	Deliver Screens	Mon 1/3/22
106	Install Screens	Mon 5/23/22
107	Startup Intake	Sun 6/5/22
108	Startup Desal Equipment	Sun 6/26/22
109	Produce Water	Mon 8/1/22
110	**Intake Pipeline Materials and Constr.**	**Wed 11/10/21**
111	Design Pipe	Wed 11/10/21
112	Request and Receive Bid	Wed 11/24/21
113	Sign P.O. For Pipe	Tue 12/21/21
114	Deliver HDPE Pipe	Mon 1/3/22
115	ACOE Permission for Intake	Tue 3/1/22
116	Install Intake Pipeline	Mon 3/7/22
117	Ready for Screen Installatio	Mon 5/23/22