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San Elijo Water Reclamation Facility

FINAL Preliminary Design Report
Recycled Water Demineralization Project

December 2009

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K/J Project No. 0987112*00

SAN ELIJO JOINT POWERS AUTHORITY
CARDIFF BY THE SEA, CALIFORNIA

FINAL PRELIMINARY DESIGN REPORT

SAN ELIJO WATER RECLAMATION FACILITY

RECYCLED WATER DEMINERALIZATION PROJECT

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Prepared By:

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Section 1: Executive Summary

1.1 Introduction

The San Elijo Joint Powers Authority (SEJPA) owns and operates a water reclamation facility that includes tertiary filtration of secondary effluent to produce up to 2.48 million gallons per day (MGD) of recycled water. The recycled water currently meets California Title 22 requirements, however, the total dissolved solids (TDS) of the recycled water is increasing and can exceed the SEWRF effluent limit of 1,300 mg/l (daily maximum).

Trussell Technologies prepared a study for SEJPA titled “Conceptual Design of a 0.5 MGD Demineralization Facility”, dated January 2009, (Trussell Study) that recommended a Recycled Water Demineralization (RWD) system process consisting of microfiltration (MF) or ultrafiltration (UF) followed by reverse osmosis (RO) desalination to reduce the TDS of the recycled water. A portion of the San Elijo Water Reclamation Facility’s (SEWRF) secondary effluent will be treated through the RWD system to produce a low TDS water that will be blended with tertiary filtered water to reduce the overall TDS of the recycled water. This project will also increase SEJPA’s Title 22 tertiary filtered water system capacity to 3 MGD.

1.2 Purpose of Report

The purpose of this preliminary design report is to describe the recommended design concepts, components and criteria for the proposed SEJPA RWD Project. The report:

- describes the recommended treatment processes to meet the project objectives,
- provides design criteria and preliminary drawings (civil, architectural, process mechanical, electrical and instrumentation) of the facility
- provides evaluation of cost saving alternatives,
- presents an evaluation of solar power systems that could be incorporated into the project,
- presents preliminary level opinions of project cost, and

The preliminary design engineering report provides the information needed for SEJPA to serve as the basis for the final design of the facilities.

1.3 RWD Feed Water Quality Review

Kennedy/Jenks reviewed source water quality data provided by SEJPA for sampling events from January 2008 through August 2009. Overall, the general source water characteristics of turbidity, suspended solids, total organic carbon (TOC), biological oxygen demand (BOD) and chemical oxygen demand (COD) are typical of a secondary effluent from a well run wastewater treatment facility.

The source water TDS and dissolved minerals, while higher than desired for recycled water use, should not be a challenge for reverse osmosis (RO) desalination. The phosphate levels are relatively low, as are the silica levels in the wastewater. Antiscalant added ahead of the RO will prevent scaling from mineral constituents. The free chlorine that will be added to the source water ahead of the RO will form chloramines which will help to minimize fouling in the MF or UF (MF/UF) and RO systems.

1.4 Treated Water Objectives

The main treatment objective of the RWD is to produce low TDS tertiary treated water to blend with the existing SEWRF effluent to reduce the blended water TDS to less than 1,000 mg/L. Table 1 presents the predicted TDS levels in the recycled water with various flow rates of tertiary filtered water (FW) and RO permeate– either one or two RO units in operation-- for average source water TDS conditions.

Table 1: Predicted Blended Recycled Water TDS

Flow Scenario	FW Flow	FW TDS	RO Permeate Flow	Permeate TDS[a]	Combined Flow	RW Combined TDS
	gpm	mg/L	gpm	mg/L	gpm	mg/L
Minimum (1 RO unit)	400	1,180	175	35	575	835
Average (1 RO unit)	900	1,180	175	35	1,075	995
Average (2 RO units)	900	1,180	350	35	1,250	860
Maximum (2 RO units)	1,750	1,180	350	35	2,100	990

(a) Based on an ESPA2, 75% recovery, 5-year life system, average water temperature.

In addition, the MF/UF treatment processes in the RWD will produce tertiary treated water meeting Title 22 CCR requirements, which can be used to backup or supplement the existing tertiary treatment system, by bypassing the RO process. For example, production of tertiary treated water from the MF/UF systems could be used to maintain recycled water production when the granular media filters are shutdown for maintenance.

1.5 RWD Process Elements

The recommended RWD process is comprised of the following main treatment elements:

- Feed Pumps and Strainers
- MF/UF Filtration
- Filtered Water Break Tank
- RO System
- Chemical Clean In Place Systems
- Washwater Recovery System

The process flow diagram for the RWD is shown in Drawing G1.4. An overview of the complete RWD process is defined in Section 4 of this report.

1.5.1 MF/UF Design Recommendation

Kennedy/Jenks recommends installing two, 470-gpm large capacity MF/UF units to provide pretreatment for the RO systems. This recommendation is based on the following factors:

- **Reliability:** Although an appropriate MF/UF flux rate was selected (20 to 25 gfd), this project did not benefit from pilot testing, thus presenting an unknown that is best addressed with additional MF/UF capacity. Installing the two large capacity MF/UF skids as opposed to the three mid-capacity (235-gpm) units accomplishes this.
- **Redundancy:** The additional MF/UF capacity provides redundancy for maintenance of the SEWRF's DynaSand filters.
- **Operations:** The large capacity units allow for flexibility and ease of operation, and are able to account for variations in feed water quality that the mid-capacity packaged units may not be able to handle.
- **Economics:** The recommended alternative provides the SEJPA with the most economical equipment purchase on a dollar per gallon basis (over 20% less).
- **Expandability:** This alternative allows the RO system to be expanded in the future to be able to produce up to approximately 1 MGD of permeate without further modification to the MF/UF system.

1.5.2 RO Equipment Design Recommendation

Based on the space requirements, the enhanced redundancy and reliability, and the operationally simple approach to matching permeate with recycled water flows, Kennedy/Jenks recommends installing two, 175-gpm RO units, which could be expanded to 350-gpm units based on future demand.

1.6 Proposed RWD Facility Layout

The proposed layout for the RWD system with two large-capacity MF/UF units is shown in Drawing M2.1. The 104-foot length fits abutted up against the existing secondary sedimentation structure. With modifications to the existing paving and landscaped areas continued vehicle access can be maintained to existing areas of the SEWRF.

The RWD facility would have a canopy structure over it to provide sun and rain protection for the equipment and operators. The main process piping would be supported on pipe racks along the walls of the existing secondary clarifier structure at the back of the RWD area. Multiple 4 foot wide access aisles would be provided for equipment maintenance and access.

The equipment would be skid mounted to allow for easy installation and removal of equipment through the open air structure which can be accessed for maintenance from the East and South sides.

1.7 RWD Operational Flexibility

The RWD facility will have operational flexibility to meet the primary project objective of reducing recycled water TDS to below 1,000 mg/l, and also provide other benefits for SEWRF. The RWD operational flexibility would permit:

- Operating at reduced RO permeate flows to match low reuse demand periods to minimize system operating costs.
- Continuing to produce recycled water during periods when the existing media filters are shut down for maintenance.
- Increasing the maximum recycled water capacity of the SEWRF through bypassing the RO and operating the MF/UF system in parallel with the existing media filters.

1.8 Potential Solar Power Facilities

Kennedy/Jenks Consultants has evaluated the use of solar panels as part of the RWD project as a means to effectively offset a portion of SEWRF's energy use. This evaluation, as detailed in the Solar Panel Analysis Technical Memorandum dated October 30, 2009, included the potential for placing solar panels on top of the existing chlorine contact tank (CCT), on top of the proposed RWD System canopy, and on top of the existing recycled water control building. A number of different design considerations were included as part of the system feasibility analysis and are discussed in the technical memorandum.

A financial analysis was also performed for the two system scenarios (Scenario 1 – RWD System canopy only; Scenario 2 – RWD System canopy and chlorine contact tank) based on available estimated solar system costs. During the system lifetime (assumed to be 30 years), neither scenario is projected to pay back the total initial capital investment. After 30 years, Scenario 1 shows a 76% recovery of initial investment, while Scenario 2 shows a 78% recovery. A summary of these results are included in Section 5.2 of this report.

The financial analysis assumes SEJPA would construct and operate the solar units and take advantage of available incentives. An alternative financing approach that involves a third party investor is suggested as an option requiring further analysis that could prove to be financially feasible.

1.9 Opinion of Project Cost

The Engineer's opinion of probable project costs for the SEJPA RWD Project are presented below. The costs were developed based on the preliminary design criteria presented in this report, budgetary quotes from major equipment suppliers, standard costs estimating guidelines and Kennedy/Jenks' engineering experience.

The RWD Project has been developed to a preliminary level and includes an estimated contingency of 18%. The costs estimates also include marks ups for taxes on materials of 8.75%, a 6% markup for general contractor mobilization, and a 15% markup for general contractor overhead and profit. A factor of 14% was added to the opinion of construction cost to cover engineering, construction management and administration for the project.

Table 2 provides a summary of the preliminary level opinion of probable project cost of the SEJPA RWD project evaluated herein.

Table 2: Opinion of Project Cost (Two MF/UF Skids, No Solar Panels)

Description	Materials	Installation	Total
Site Work & Yard Piping	$47,000	$80,000	$127,000
RWD Canopy Structure	$214,000	$162,000	$375,000
Process Equipment	$1,457,000	$155,000	$1,611,000
Process Mechanical & Piping	$48,000	$28,000	$76,000
Electrical And Instrumentation	$250,000	$175,000	$425,000
Subtotal	**$2,016,000**	**$600,000**	**$2,614,000**
Taxes on Materials @ 8.75%			$176,000
Contractor Mobilization @ 6%			$167,000
Contractor Overhead and Profit @ 15%			$419,000
Estimate Contingency @ 18%			$608,000
Estimated Construction Cost			**$3,985,000**
Engineering, Construction Management and Administration @ 14%			$558,000
Estimated Project Cost			**$4,543,000**

Note: In addition to the estimated project cost ($4.5 Million) shown in Table 2, the SEJPA has committed approximately $295,000 to previous efforts related to planning, permitting and financing.

The opinion of construction cost for the Solar system is $270,000 for installation on the new RWD canopy only, or $510,000 for installations on the canopy and the existing chlorine contact basin.

1.10 Potential Funding Opportunities

The SEJPA is seeking a State Revolving Fund (SRF) loan to support the funding of the proposed capital project. A SRF application for the project is currently being prepared, and if the project receives a funding commitment from the State Water Resources Control Board, then SEJPA may have the necessary funds available for construction by or around June 2010.

1.11 Proposed Project Schedule

It is anticipated that the final design of the RWD System will be completed by May 2010 and construction will begin in September 2010. The design and construction schedule provided in Section 9 of this report presents how the project could be completed by June 2011.

Section 2: Source Water Quality and Treatment Objectives

This section presents a summary of the source water quality and the treatment objectives for the RWD system.

2.1 RWD Feed Water Quality Review

Table 3 below presents the average, minimum and maximum water quality of the SEJPA secondary effluent, which will serve as feed water to the RWD system. The source water quality data is primarily based on eighteen sample events from January 2008 through June 2009. Additional water quality sampling for selected constituents was conducted in August 2009.

Table 3: SEJPA Effluent Source Water Quality

Parameter	Units	SEJPA RWD Feed Water Quality[a]		
		Average	Minimum	Maximum
General Physical Constituents				
Temperature	°C	21.6	18.2	26.4
pH	units	7.5	7.3	7.6
BOD – 5[b]	mg/L	10	4	20
CBOD [b]	mg/L	9	4.1	13.9
Turbidity	NTU	8.4	5.0	14.3
Total Suspended Solids (TSS)[b]	mg/L	16	8	25
Total Organic Carbon (TOC)[c]	mg/L	14	13	15
Oil & Grease	mg/L	<5	<5	5.1
General Mineral Constituents				
Total Dissolved Solids (TDS)[d]	mg/L	1,188	940	1,336
Specific Conductance[d]	umhos/cm	1,992	1,535	2,360
Total Alkalinity (as $CaCO_3$)[d]	mg/L	274.5	122.0	339.0
Calcium (Ca)[d]	mg/L	90.5	80.2	108.0
Magnesium (Mg)[d]	mg/L	48.3	40.0	57.2
Sodium (Na)[d]	mg/L	245.9	220.0	270.0
Potassium (K)[d]	mg/L	24.4	21.0	27.0
Ammonia (NH_4)	mg/L	34.2	19.8	50.0
Sulfate (SO_4)[d]	mg/L	277	223	326
Phosphate (PO_4)[c]	mg/L	<1.5	<0.5	4
Chloride (Cl)[d]	mg/L	331	206	398
Fluoride (F)[d]	mg/L	0.36	0.24	0.75
Nitrate (as NO_3)[d]	mg/L	14.2	2.8	84.9
Other Dissolved Inorganic (Metal) Constituents				
Nickel	mg/L	<0.01	<0.01	<0.01

Parameter	Units	SEJPA RWD Feed Water Quality[a]		
		Average	Minimum	Maximum
Arsenic	mg/L	0.02	<0.01	0.02
Aluminum (Al)[c]	mg/L	<0.05	<0.05	<0.05
Barium (Ba)[b]	mg/L	0.028	0.026	0.029
Boron (B)[d]	mg/L	0.45	0.30	0.56
Copper (Cu)	mg/L	0.014	<0.01	0.016
Iron[d]	mg/L	0.175	0.073	0.593
Manganese[d]	mg/L	0.087	0.016	0.110
Selenium	mg/L	<0.01	<0.01	<0.01
Total Silica (SiO2)[c]	mg/L	10.8	10.4	11.3
Strontium (Sr)[e]	mg/L	0.1	-	0.1
Other Dissolved Gaseous Constituents				
Oxygen (O2)	mg/L	4.87	3.25	5.44

(a) Unless noted, data is from eighteen monthly average sample secondary effluent data from January 2008 to June 2009.

(b) Five monthly average sample data from May to August 2009 after improvements made at SEWRF.

(c) Four sample events in August 2009.

(d) Data from tertiary filtered water.

(e) Estimated based on typical wastewater.

General Physical Characteristics

The source water turbidity and suspended solids, typical of a secondary effluent, will need to be filtered out of the water for efficient operation of the RO membrane system. The total organic carbon and oils and grease are relatively low and typical of a well-operated secondary treatment system. The BOD in the secondary effluent has recently improved with modifications to the SEWRF. The BOD and COD levels are typical of a well run wastewater treatment facility.

The proposed MF/UF membrane system will remove the particulate turbidity and suspended solids from the source water. Chlorine will be added ahead of the MF filters to help reduce fouling of the MF filters.

General Mineral Constituents

The source water TDS and dissolved minerals, while higher than desired for recycled water use, should not be a challenge for RO desalination. The phosphate levels are relatively low, as are the silica levels in the wastewater. Antiscalant added ahead of the RO will prevent scaling from mineral constituents. The free chlorine that will be added to the source water ahead of the RO will form chloramines which will help to minimize fouling in the MF and RO systems.

2.2 Regulatory Review

The regulatory conditions for water quality and treatment requirements for reclaimed water in California are governed by the Title 22 California Code of Regulations (CCR). The guidelines for unrestricted urban reuse of recycled water call for membrane filtration to have treated water turbidity not to exceed 0.2 NTU more than 5 percent of the time within a 24-hour period and not to exceed 0.5 NTU at any time. The MF/UF system that would be provided will meet this requirement.

Disinfection requirements for blended permeate and recycled water will be achieved in the existing chlorine contact chamber at the SEJPA RWF.

2.3 Treated Water Objectives

The main treatment objective of the RWD is to produce low TDS tertiary treated water, so that when blended with the existing SEWRF effluent, will produce a blended water with a TDS less than 1,000 mg/L. Table 4 presents the predicted TDS levels in the recycled water with various flow rates of tertiary filtered water (FW) and RO permeate, for average source water TDS conditions.

Table 4: Predicted Blended Recycled Water TDS

Flow Scenario	FW Flow	FW TDS	RO Permeate Flow	Permeate TDS[(a)]	Combined Flow	RW Combined TDS
	gpm	mg/L	gpm	mg/L	gpm	mg/L
Minimum	400	1,180	175	35	575	835
Average (1 RO skid)	900	1,180	175	35	1,075	995
Average (2 RO Skids)	900	1,180	350	35	1,250	860
Maximum	1,750	1,180	350	35	2,100	990

(a) Based on an ESPA2, 75% recovery, 5-year life system, average water temperature.

In addition, the MF/UF treatment processes in the RWD will produce tertiary treated water meeting Title 22 CCR requirements, which can be used to backup or supplement the existing tertiary treatment system, by bypassing the RO process. For example, production of tertiary treated water from the MF/UF systems could be used to maintain recycled water production when the granular media filters are shutdown for maintenance.

2.4 Facility Operations

The recycled water system at the SEWRF is currently manually operated based on recycled water demand and levels in the recycled water storage reservoirs. Facility operators manually set a flow set point for the recycled water filter feed pump station. The filter feed pumps operate to maintain the flow set-point from a flow meter.

The flow range for the variable speed, filter feed pumps is approximately 400 gpm up to 1,750 gpm. In the summer months, the recycled water system is typically operated 24 hrs per day, at varying flow levels. In the winter months, flows are lower and the system may be shut off for short periods.

Kennedy/Jenks proposes the RWD system to have two trains that would each produce 175 gpm of permeate for blending with the recycled water. At low recycled water flow rates, one train would operate to permit better control of the blending ratio and better meet the 1,000 mg/l objective. Additionally, this provides the opportunity to minimize energy use when one unit is not operating. For higher recycled water flow rates, two trains would operate.

Kennedy/Jenks will work with SEJPA to provide an operations strategy that provides flexibility for the RWD operations and helps minimize system operating costs.

Section 3: Evaluation of Treatment Processes

This section describes the evaluation of, and recommendations for, the proposed RWD process and equipment to meet the project objectives. The RWD process is comprised of the following main treatment elements:

- Feed Pumps and Strainers
- MF/UF Filtration
- Filtered Water Break Tank
- RO System
- Chemical Feed Systems
- Clean In Place Systems
- Washwater Recovery System

A brief description of each process element is provided below. Detailed design criteria of the selected project elements are provided at the end of the report.

3.1 RWD Feed Pumps and Strainers

The packaged MF/UF skids require a feed pressure of approximately 10 psi at the inlet flange of the skid. The water enters the skid and typically fills a small source water tank. The skid contains the required pumps, valves, membranes and instrumentation to produce the required capacity of filtered water with pressures suitable to go into an above grade break tank.

Kennedy/Jenks proposes to provide new vertical turbine pumps that would replace the existing non-potable water (NPW) pumps that are no longer in use. The new RWD feed pumps would draw secondary effluent from the existing NPW wet well and pump it to the packaged MF/UF units through new self-cleaning strainers. The strainers would remove particles with approximately 200 microns nominal particle size. These strainers are suitable to protect the membranes from damage by large particles or debris in the water such as leaves or twigs. In some cases, the strainers are part of the MF/UF skid.

The backwash water from the strainers would be sent to the spent washwater sump and returned to the head of the SEWRF.

Chlorine at a dose of 7 to 10 mg/l would be added to the secondary effluent ahead of the MF/UF skids to form chloramines to provide a disinfection residual through the system. This will help to reduce biofouling in the treatment processes. A spare chemical injection point is recommended ahead of the MF/UF system to permit possible future coagulant addition.

3.2 MF/UF Filtration

MF and UF are membrane treatment processes that utilize physical straining to remove particulate matter from water. The typical pore sizes associated with MF (0.1 microns) and UF (0.01 microns) provide an absolute barrier to larger particles and microbes, including bacteria, *Giardia lamblia* cysts, and *Cryptosporidium* oocysts. The small pore sizes allow membrane treatment processes to consistently produce high quality filtered water over a wide range of source water quality and turbidity. For secondary effluent filtration applications, filtrate turbidity is typically on the order of 0.03 NTU.

Membranes come in pressure and immersed system configurations. For the RWD system, both pressure and immersed systems are available as pre-packaged, skid-mounted systems with standard capacities in the range of 200 gpm to 500 gpm. For pressure systems the hollow membrane fibers are enclosed in a pressure housing to form a membrane element. A feed pump pressurizes the source water and it flows through the membrane filter elements and onto the next process. In an immersed membrane configuration, the membrane elements are immersed or submerged in a tank. The source water flows into the tank and then the filtered water is drawn through the membranes with vacuum permeate pumps.

3.2.1 California Department of Public Health Certification

The specified membrane system would be approved as an alternative filtration technology by the California Department of Public Health (CDPH) under the California Surface Water Treatment Rule (CCR, Title 22, Chapter 17, Section 64653(f)) and have demonstrated over 6-log removal of particles. These systems produce water that meets tertiary effluent water quality for recycled water.

3.2.2 Membrane Materials

The recommended membrane material is either polyvinylidene fluoride (PVDF) or polysulfone ether (PES), as both have resistance to exposure to free chlorine and other oxidants. The membrane system and materials would also be compatible with in-line chemical oxidation and potential future coagulation with polyaluminum chlorohydrate (PACl) coagulant.

3.2.3 Membrane System Production

The membrane system production rate is defined as the volume of filtered water produced in a 24-hour period after accounting for any filtered water volumes required for backwashing and/or any chemically enhanced backwashes and enhanced flux maintenance chemical cleaning operations (described below) and taking into account any membrane system downtime for backwashes or the described chemical cleaning operations.

The MF/UF system would need to provide an average of approximately 470 gpm to provide the feed water to the RO systems to produce 350 gpm of permeate.

3.2.4 Membrane System Flux Rate and Capacity

The flux rate of a membrane system is the volume of water that passes through a unit of membrane filter area per unit time. The membrane flux rate is typically described in units of gallons per square foot of membrane area, per day (gfd). Typical flux rates for MF and UF secondary effluent treatment range from 20 to 25 gfd, depending on the type of membrane and the source water quality.

The membrane system capacity is determined by the number of membrane modules or elements in the system (the membrane area) and the system flux rate. For a fixed number of membrane modules, the flux rates can be calculated as "average flux rate," and "instantaneous flux rate." The "average flux rate" is the average production or capacity of the unit divided by the fixed membrane area.

Because the MF/UF units shutdown and stop production to backwash, conduct integrity checks and do maintenance cleans, the units do not operate continuously over a day. Therefore, the system must operate at higher flowrates during the operating period to make up for the lost production during the day. For example, to produce a daily average flowrate of 470 gpm, the MF/UF unit may need to operate at an instantaneous flowrate of 550 to 600 gpm, depending on the specific percentage of shutdown time. The "instantaneous flux rate" is the instantaneous production or capacity of the unit divided by the fixed membrane area.

The membrane system design flux rate provides the specified system production rates at the minimum specified source water temperature, based on treating the specified source water quality. The membrane system design flux rate could be determined during pilot testing or could be conservatively estimated based on operating experience of other facilities on similar waters. The design flux rate is related to the membrane fouling frequency and should be low enough to provide a reasonable period between membrane cleanings.

Kennedy/Jenks recommends specifying an instantaneous flux rate of 20 to 25 gfd for the RWD MF/UF system to minimize cleaning frequency and maximize system reliability with the potential variability of the source water BOD and organics.

3.2.5 Membrane System Recovery Objectives

Membrane System Recovery: Membrane System Recovery is defined as the ratio of the filtered water produced by the system (excluding water used for backwash or cleaning operations) divided by the source water into the membrane system. Kennedy/Jenks recommends a membrane system recovery objective of 95 percent. The membrane system recovery depends on the frequency of backwash, frequency of cleanings, temperature and other factors.

Backwash (reverse filtration, backpulse): Backwash is defined as the periodic use of water and/or air to dislodge and remove solids from the membrane system. Typically, no chemicals are added to the backwash water.

Over time, filtered particulate matter accumulates on the surface of the membrane filters. In order to maintain hydraulic flux, these solids are periodically flushed with the use of reverse-filtration washing or air/water scouring. For average water quality conditions, cleaning events are typically conducted every 15 to 30 minutes.

During a backwash, the MF/UF skid stops production and filtered water is pumped back through the membrane fiber to dislodge the solids. Airwash blowers are also used to help agitate the solids and remove them from the system. The water and solids are drained from the skid and then the unit goes back into production. The backwash event generally lasts for about 2 to 3 minutes and the membrane system spent washwater is produced in relatively small volumes as compared to a granular media filter backwash. Because they are a positive physical barrier, MF filters do not require a filter-to-waste step following a backwash.

Kennedy/Jenks proposes that the spent washwater from the RWD MF/UF system be drained to a below grade sump. This permits efficient backwashing of the units and the sump can be used to capture and return other drains from the RWD processes. The spent washwater would then be pumped to the existing filter backwash sump for return to the head of the primary treatment process at the SEWRF.

3.2.6 Membrane Integrity Validation System

Because the MF/UF system is producing filtrate as pretreatment to RO for recycled water, an automated membrane integrity test is not required. However, the membrane system would include a Membrane Integrity Testing (MIT) System as standard equipment on the skid. Each membrane skid will have an automatic system to directly measure the integrity of the hollow fiber membranes and system o-rings and seals. The system would consist of an automatic air pressure test. The operator would be able to initiate a test at any time during operation to confirm the integrity of the system.

3.3 Comparison of MF/UF Equipment Design Alternatives

There are at least four experienced MF and UF manufacturers that could provide packaged membrane filtration systems for the RWD facility. These membrane system suppliers are Norit, Pall, Siemens/Memcor and GE/Zenon. The manufacturers can provide both MF and/or UF membrane elements for their packaged systems. Both MF and UF membranes will provide a filtered water quality suitable for pretreatment ahead of the RO systems. Kennedy/Jenks recommends specifying both MF and UF membrane classifications for competitive bidding.

The Norit system is a pressurized, “inside-out” configuration where the dirty water is on the inside of the membrane hollow fiber and the filtered water passes through to the outside of the fiber. For secondary effluent, this configuration requires a cross-flow to minimize fouling that can be several times the production rate of the system. This increases the energy requirements of the system. Norit is not recommended for this wastewater application due to the increased energy and intensive cross flow required for operation.

The Pall, Siemens/Memcor and GE/Zenon are all “outside-in” configuration systems where the dirty water is on the outside of the membrane hollow fiber and the filtered water passes through to the inside of the fiber. Pall makes a pressure system. Siemens/Memcor makes both pressure and immersed systems. GE/Zenon makes an immersed system and has just introduced a pressure system. Kennedy/Jenks recommends specifying the "outside-in" configuration for this application because it will have lower energy costs and there are a number of reputable systems for competitive bidding.

For this size of a facility, packaged MF/UF systems are preferred over custom MF/UF systems for the following reasons:

- System components are mounted on pre-engineered skids making installation relatively simple and less costly
- Skid instrumentation and control components are pre-wired and tested making installation relatively simple and less costly
- Manufacturers process and control drawings and submittal information is pre-engineered and standardized, saving costs

The disadvantage to packaged systems is that they come in standardized units with a maximum number of membrane elements. Depending on the number of elements and the desired flux rate, the standard packaged unit may not provide the desired production rate. The recommended number and capacity of the MF/UF systems for the RWD is based on a balance of system capital costs, reliability and redundancy to meet the initial capacity requirements for the project, in addition to flexibility for future expandability.

Kennedy/Jenks sent water quality and preliminary design criteria requirements to various MF and UF manufacturers (Pall, Memcor, Zenon and Norit) to obtain information and budgetary quotes on standard packaged systems for the RWD facility. The section below describes the evaluation and recommendations on the number and capacity of the MF/UF skids.

3.3.1 Number and Capacity of MF/UF Skids

Kennedy/Jenks evaluated several alternatives to meet the initial desired capacity while providing various levels of redundancy, reliability and expandability, including:

1. Two package units with 235-gpm average capacity each: This provides half system capacity redundancy/reliability. Space would be provided for a third unit for future expansion.
2. Three package units with 235-gpm average capacity each: This provides full system capacity redundancy/reliability for the initial production. This option also provides installed capacity for RO expansion and for supplemental tertiary treated water.
3. Two package units with 470-gpm average capacity. This provides full system capacity redundancy/reliability for the initial production. This option provides installed capacity for RO expansion and for supplemental tertiary treated water.
4. Two custom skids with 470-gpm average capacity. This provides full system capacity redundancy/reliability for the initial production and permits a lower flux rate. This option provides installed capacity for RO expansion and for supplemental tertiary treated water.

5. A single package unit with 470-gpm average capacity: This provides no redundancy and is not recommended.

Table 5 summarizes the capacities and approximate footprint requirements for first four MF/UF system alternatives presented above. The MF/UF equipment is based on packaged or custom pressure-type systems from Memcor, Pall and Zenon. The capacities are based on the systems operating with an instantaneous flux rate of 20 to 25 gfd.

Table 5: Comparison of MF/UF System Alternatives

Alternative	1	2	3	4
Type of MF/UF skid system	Mid-Capacity Packaged	Mid-Capacity Packaged	Large Capacity Packaged	Large Capacity Custom
Number of skids	2	3	2	2
Skid Capacity	235 gpm	235 gpm	470 gpm	470 gpm or more
Total Capacity	470 gpm	705 gpm	940 gpm	940 gpm or more
Footprint	25ft L x 26ft W	25ft L x 36ft W	30ft L x 40ft W	30ft L x 40ft W
Budgetary Equipment Costs	$600,000	$850,000	$900,000	>$1,000,000

3.3.2 MF/UF Design Recommendation

Kennedy/Jenks recommends installing two, 470-gpm large capacity MF/UF units (Alternative 3) to provide pretreatment for the RO systems. This recommendation is based on the following factors:

- **Reliability:** Although an appropriate MF/UF flux rate was selected (20 to 25 gfd), this project did not benefit from pilot testing, thus presenting an unknown that is best addressed with additional MF/UF capacity. Installing the two large capacity MF/UF skids as opposed to the three mid-capacity (235-gpm) units accomplishes this.
- **Redundancy:** The additional MF/UF capacity provides redundancy for maintenance of the SEWRF's DynaSand filters.
- **Operations:** The large capacity units allow for flexibility and ease of operation, and are able to account for variations in feed water quality that the mid-capacity packaged units may not be able to handle.
- **Economics:** The recommended alternative provides the SEJPA with the most economical equipment purchase on a dollar per gallon basis (over 20% less).
- **Expandability:** This alternative allows the RO system to be expanded in the future to be able to produce up to approximately 1 MGD of desalted water without further modification to the MF/UF system.

3.4 Filtered Water Break Tank

Kennedy/Jenks recommends providing a break tank between the MF/UF system and the RO systems. This greatly simplifies the operations and controls of the overall process, and more easily permits continuous operation of the RO systems while the MF/UF systems are starting and stopping for backwash and maintenance clean operations. The break tank would be an opaque, HDPE or fiberglass tank that would have an operational storage of approximately 7,000 gallons (the nominal total volume of the tank would be approximately 8,500 gallons) . Initially, this would permit operation of the full RO system capacity with only one MF/UF skid in operation and would allow an MF/UF skid to complete a backwash (approximately 3 minutes), an integrity test (approximately 10 minutes), a maintenance clean (approximately 30 minutes) and a CIP cleaning (approximately 4 hours) without requiring the RO system to shutdown.

However, if the RO system is expanded in the future to its proposed ultimate capacity (1 MGD), this operational storage volume would only permit operation of the full RO system with one MF/UF skid in operation during a backwash and an integrity test (approximately 13 minutes total). During the maintenance clean and CIP cleaning of an MF/UF skid, one of the RO skids would need to be shut down unless a second (or larger) break tank is installed.

Kennedy/Jenks recommends an opaque tank to avoid sunlight stimulated bio-growth in the tank. The chloramine residual in the water should also help to minimize potential bio-growth in the break tank.

3.5 Reverse Osmosis System

3.5.1 RO Feed Pumps

The packaged RO Skids require a feed pressure of approximately 30 to 40 psi at the inlet flange of the skid to move the water through the cartridge filters and to provide a suction pressure for the RO high pressure pumps on the skid. Kennedy/Jenks proposes three RO feed pumps -- two primary and one back up pump -- that would draw water from the Filtrate Break Tank and provide feed water for the RO system. The RO feed pumps would be controlled by the RO system and level in the Filtrate Break Tank.

Antiscalant would be dosed at approximately 2 to 3 mg/l ahead of the RO units to prevent scale formation in the RO membrane system.

When the TDS drops below 1,000 mg/L, the filtered water from the MF/UF units could bypass the RO system and be sent directly from the MF filtrate tank to the chlorine contactor through an RO bypass line. The RO feed pumps would operate on to provide a higher flowrate at a lower required pressure. This bypass feature would be used during RWD system startup and could permit the new MF/UF system to produce recycled water when the existing media filters are shutdown for maintenance.

3.5.2 Reverse Osmosis Skids

RO is a pressure driven membrane separation process that separates TDS and organic molecules from water. With RO, a high TDS source water is pressurized and water then passes through the semi-permeable membrane leaving the salt in the feed water. The RO system produces a low-salt, high quality product water (called permeate) and a concentrated, high-salt stream (called brine).

A packaged RO system typically consists of cartridge filters, high pressure pumps, pressure vessels, spiral-wound membrane elements, and the associated valves, flow meters and instrumentation and controls. The membrane element is the smallest replaceable component. RO membrane elements are loaded into the Pressure Vessels (PV) fabricated mainly from the Reinforced Fiber Glass (FRP). The PVs can be different sizes and lengths to accommodate from one (1) up to eight (8) membrane elements. RO membrane elements have standard diameters of 2.5", 4" and 8" and standard element lengths of 40" and 60". This standardization permits flexibility in designing and operation of the RO system.

Groups of parallel pressure vessels are supported and manifolded together with common piping, valves and instrumentation to form a complete integrated RO unit or skid. The RO unit has independent flow control and is chemically cleaned and operated as a complete unit. Multiple RO units are manifolded together to meet the overall capacity requirements for a system.

RO membranes require pre-treatment ahead of the membranes to protect them from solids and to prevent fouling of the membrane surface. Because the spiral-wound RO membranes cannot be backwashed, suspended solids must be removed from the RO feed water. Even though the RWD will have MF/UF filters as pretreatment to the RO systems, 1- to 5-micron cartridge filters are recommended ahead of the RO system to prevent damage or plugging of the RO membranes. The cartridge filters are standard components of the packaged skid systems. The cartridge filters are replaced periodically based on time or pressure differential.

3.5.3 RO Membrane Materials

Today most of the RO membranes are manufactured from polyamide thin film composites (TFC). The original RO membrane material was Cellulose Acetate (CA). The CA material is resistant to strong oxidants but requires pH control and higher pressures. The TFC material operates at lower pressures and does not require pH control but can be damaged by strong oxidants. Weak oxidants such as chloramines at residual of 3 to 5 mg/l have been successfully used on TFC brackish groundwater and secondary effluent RO systems. Kennedy/Jenks recommends TFC RO membrane elements for the SEWRF RWD facility.

3.5.4 RO Membrane System Capacity

The RO membrane system production rate is defined as the volume of permeate water produced when the system is operating at design recovery, temperature and water quality.

The RO system would be designed to produce 350 gpm of permeate at design conditions. The RO system may produce more or less water, within limitations, if desired by the operator, and if the actual water quality conditions permit.

The RO systems could also be designed for expansion to produce up to 700 gpm by adding more membrane elements onto an existing skid. This would permit relatively easy system expansion within the proposed footprint of the RWD.

3.5.5 RO Membrane System Flux

The flux rate of an RO membrane system is similar to that of MF and UF systems and is specified in gfd. Typical flux rates for RO secondary effluent treatment range is less than or equal to 12 gfd.

The membrane system design flux rate provides the specified system production rates at the minimum specified source water temperature, based on treating the specified source water quality. The membrane system design flux rate could be determined during pilot testing or could be conservatively estimated based on operating experience of other facilities on similar waters. The design flux rate is related to the membrane fouling frequency and should be low enough to provide a reasonable period between membrane cleanings.

Kennedy/Jenks recommends specifying a flux rate of less than 12 gfd for the RWD RO system.

3.5.6 Evaluation of RO System Design Parameters

Kennedy/Jenks evaluated the predicted RO system performance and permeate water quality based on the RWD source water to determine the recommended RO system design parameters. The RO performance and permeate water quality was predicted based on Hydranautics ESPA2 membranes using Hydranautics RO performance modeling software. The modeling was used to evaluate the following design alternatives:

- Membrane element type
- Inter-stage boost energy recovery
- Number of elements per vessel
- System recovery

The following parameters were used in the membrane performance model, unless otherwise noted:

- Maximum source water TDS conditions
- Temperature of 18 deg C. (coldest water temperature)
- Less than 12 gfd flux (for secondary effluent)
- 5-year membrane life

- 7-percent flux decline per year for MF filtered secondary effluent with chloramine residual
- 10-percent salt leakage per year

Table 6 presents the predicted performance of the RWD RO system with different RO System design parameters.

Table 6: Predicted Hydranautics ESPA2 RO Performance

RO System Parameters	Performance Values				
	Run 1	Run 2	Run 3	Run 4	Run 5
Membrane Type	ESPA2	ESPA2	ESPA2	ESPA2	ESPA2
Recovery Rate (%)	75	75	75	80	80
Interstage ERD Boost of 20 psi	N	Y	Y	N	Y
Number of elements in a vessel	6	6	7	6	6
RO Feed Pressure, psi	159	152	156	160	153
Permeate TDS, mg/l	39.4	37.7	40.1	46.5	44.1
Brine TDS, mg/l	5,480	5,485	5,470	6,820	6,820
Concentrate LSI	1.93	1.93	1.93	2.2	2.2
Concentrate Stiff & Davis Saturation Index	1.68	1.68	1.68	1.88	1.88

3.5.6.1 RO Membrane Type

Kennedy/Jenks recommends designing the RWD RO system around the Hydranautics ESPA2 to achieve the lower permeate TDS levels of approximately 40 to 50 mg/l. While the ESPA1 and other lower energy RO elements provide greater flow at lower pressures, the permeate TDS would be more than double the TDS of the ESPA2 elements and is not low enough to meet the project objectives.

3.5.6.2 RO Membrane Element Test Unit

Kennedy/Jenks understands that SEJPA has purchased some ESPA2 RO elements from the secondary membrane market for use at the RWD. This can be an effective strategy to reduce the costs of an RO system that is treating secondary effluent for recycled water. For example, RO membranes that no longer meet drinking water treatment objectives could still be suitable for the RWD treatment objectives. Kennedy/Jenks recommends that SEJPA use the secondary ESPA2 elements and purchase some new ESPA2 elements, as needed, for the RWD RO system.

To use the secondary market RO elements, it would be beneficial to know the relative performance of the elements before loading them into the RO system. The elements can be tested with a small single element test unit. This is a service that can be provided by the RO element suppliers. The SEJPA could also consider purchase of a small single element test unit to do the testing themselves. This approach may be more cost effective for evaluating larger numbers of elements over time.

The proposed RO units for the SEJPA RWD could each hold 54 RO elements for a total of 108 elements.

SEJPA could work with the membrane supplier to test the initial set of secondary elements for the project in conjunction with purchase of some new elements. Kennedy/Jenks contacted Hydranautics regarding the budgetary costs of perform testing of secondary elements. The cost on a per element basis drops with the increased number of elements for testing. The budgetary cost for 1 element is $200. For 50 elements the cost would be $6,000 ($120 per element). For 100 elements the testing cost would be $8,000 ($80 per element).

Assuming the cost of a new 8-inch RO element is $800, the cost for the SEJPA RO unit elements would be approximately $86,000. The cost of testing the secondary elements (assuming SEJPA has 100 elements) is only about 10-percent of the cost of new elements.

Hydranuatics also provided information on a single element test unit that they use. A listing of design criteria and unit components is provided in the table below.

Table 7: Single Element Test Unit Design Parameters

Parameter	Value
Design Conditions:	
Permeate Flow	7.3 gpm
Feed/Reject Flow	48.6 / 41.6 gpm
Temperature	77 F
Recovery	15 percent
Array	Single Element
Test Elements:	
Quantity	1
Size	8 inches
Type	TFC
Elements Housing:	
Quantity	1
Type	FRP
Elements per Housing	1
Pressure	300 psid
Pump:	
Quantity	1
Flow	48.6 gpm
Pressure	130 psi
Type	Centrifugal Multistage
Valves & Piping:	
High Pressure Piping, Size/Type	316SS Tubing 1½ inch
Permeate/Feed/Reject Piping,	Sch 80 PVC 1" 1½" 1½"

Parameter	Value
Size/Type	
Valves line size	to match the piping
Service Inlet	1
Manual Rate Set Valve, pump discharge	1
Automatic/Manual on the reject flow	1
CIP Connections	Not Required
Operation:	Manual
Instrumentation:	
Pressure Gauges, psi - rate control valve/feed/permeate/reject/pump	5
Flow Indication, gpm - recycle/permeate/reject	3
Temperature, degree F, pump suction	1

The reported budgetary cost of the single element test unit is $25,000 to $30,000. This may be a cost effective investment depending on the frequency of membrane replacement for the RWD and the cost of used RO membrane elements on the secondary market.

3.5.6.3 Energy Recovery in the RO System

The brine exiting the RO system contains pressure energy that can be recovered. Energy recovery devices (ERD) such as reverse running pumps can convert the pressure energy from the brine into pressure energy to help reduce the feed pressure requirements for the RO.

Runs 1 and 2, and 4 and 5, in Table 6 above compare an RO system without and with energy recovery, respectively. In Runs 2 and 5, an inter-stage boost ERD provides an estimated 20 psi boost to the second stage feed. This helps to reduce the feed pressure to the RO and improves the permeate water quality, as compared to runs 1 and 4.

The use of ERD systems on relatively low-pressure brackish water RO systems, such as the RWD RO system is becoming more common. However, the relatively small capacity of the RWD RO systems and the added complexity of an ERD for a low capacity system are not generally suitable for adding an ERD. The relatively small energy savings from the ERD for this application do not justify the additional cost and complexity of the ERD.

Kennedy/Jenks does not recommend an ERD for the small capacity RO units for the RWD project.

3.5.6.4 Number of Elements in the RO Pressure Vessel

For larger RO systems, many designers are placing up to seven or eight membrane elements in a pressure vessel. This permits design of the system with fewer pressure vessels and provides for a slightly lower flux rate, as compared to a system with 6 elements in a pressure vessel. This primarily helps reduce the capital cost of the system. However, the 7-element PV system has a slightly higher feed pressure and slightly worse feed water quality than the 6-element PV system, for similar conditions. Runs 2 and 3 in Table 6 above compare a 6-element PV system and a 7-element PV system, respectively.

Because the capacity of the RWD RO systems is relatively small and standard packaged systems are typically designed around a 6-element PV system, Kennedy/Jenks does not believe there would be significant cost savings with a 7-element PV system and recommends designing around the a 6-element PV system.

3.5.6.5 RO System Recovery

The recovery of an RO system is defined as the volume of permeate divided by the feed to the RO system. To increase the recovery of the overall process, the brine from a first stage of RO elements is fed to a second stage of RO elements. In some cases, the brine from the second stage can also be fed to a third stage. The higher the recovery, the more permeate is produced, and less brine is generated.

As the recovery increases, scaling in the membranes can occur without proper pretreatment. The Langlier Saturation Index (LSI) and Stiff & Davis Saturation Index (SDSI) are indicators of the likelihood of scaling due to the increasing concentration of the ions in the brine concentrate stream. Antiscalants and acid can be added to the RO feed water to prevent scale formation. The objective for the RWD RO design is to operate at as high a recovery as possible without needing to add acid.

Runs 2 and 5 compare a two-stage RO system with 75-percent recovery and 80-percent recovery, respectively. The system with 80-percent recovery has a slightly higher pressure and slightly worse water quality, than the 75-percent recovery system. However, to produce 350 gpm, the 80-percent recovery uses only 438 gpm, whereas the 75-percent recovery system uses 467 gpm. This may be an important factor to maximize recycled water production at the SEWRF.

Typical packaged RO skids can vary the system recovery only by approximately 5-percent. This is because they often have a fixed flow orifice plate brine control system. However, with a motorized control valve on or ERD on the brine system, the recovery variation could be greater, perhaps up to 20 to 30-percent.

Kennedy/Jenks recommends designing the RO system to produce the 350 gpm of permeate at 75-percent recovery. This provides for the required production at a conservative recovery. However, Kennedy/Jenks also recommends specifying that the RO system be able to operate with the ability to go up to 80-percent recovery or down to approximately 50-percent recovery. This would provide system flexibility and permit the system to produce less permeate at lower energy during periods of low recycled water demand.

3.5.6.6 RO System Fouling

The nature and rapidity of fouling experienced by RO systems operated on secondary effluent depends on many factors, most notably source water quality and the type of treatment the source water is provided (pretreatment) prior to RO processing. The typical frequency of CIP cleaning for RO facilities is generally two to three times per year (every 4 to 6 months) where feed water pretreatment is satisfactory. Some RO facilities perform cleanings less frequently while other facilities clean more often depending upon the level of foulants present and the ability of the pretreatment to adequately reduce or manage these foulants.

RO membrane fouling is a function of four primary factors:

1. Scaling and depositions - precipitation of sparingly soluble salts.
2. Particulate fouling - accumulation of particulate inorganic and particulate organic matter.
3. Bio-fouling - attachment and growth of microbes and microorganisms.
4. Organic fouling - deposition of colloidal and dissolved organics.

For the RWD, an appropriate RO system design recovery and an antiscalant scale inhibitor would be used to control scaling (factor #1). The mineral constituents of concern for scaling at the RWD include: calcium sulfate, barium sulfate, strontium sulfate and silica. The recovery for the RWD RO system (75 to 80-percent) would be specified to maintain the LSI below 2.5 and the SDSI below 1.9, as well as the concentration percentages of the above sparingly soluble salts below the limits recommended for the RO elements. Antiscalants would also be used to prevent scaling. The silica levels in the source water are relatively low and the concentration factor at 80-percent does not exceed the limit.

MF/UF pretreatment systems would be employed to control fouling caused by accumulation of inorganic/organic particulate matter (factor #2). Cartridge filters on the RO system will also remove particles before the RO system.

Biofouling (factor #3) would be managed through chloramination of the pretreatment systems, including filtrate tanks and piping, and RO system, as well as reduction in bacterial concentrations through MF/UF filtration.

Fouling from dissolved and colloidal organics that could pass through the pretreatment system (factor #4) would be controlled through designing the RO with moderate flux rates and through periodic chemical clean-in-place (CIP) cleanings. The constituents of concern for organic and colloidal fouling include dissolved organic carbon (DOC) and colloidal calcium phosphate. The levels of these constituents in the source water are relatively low and should be manageable for the RWD operations.

CIPs would be conducted to remove inorganic scaling and organic materials from the membrane surface and element feed spacer using two general chemical regimes: acidic solutions, which are formulated to solubilize precipitated salts, and alkaline solutions, which are formulated to remove inert inorganic material as well as organic and biological matter.

The extent to which RO membrane fouling occurs and the resultant changes in RO performance that fouling causes is evaluated using the following:

- Normalized permeate flow (NPF), which measures the change in resistance of water flow through the RO membrane.
- Normalized salt passage (NSP), which measures the change in resistance to salt (conductivity) flow through the membrane.
- Normalized differential pressure (DPN), which measures the degree of accumulation of material in the feed/brine spacer.

The operating data from the RWD units would be “normalized” through the above performance parameters to account for the effects of variations in feedwater temperature and salinity as well as membrane flux and recovery that would otherwise mask changes caused by fouling. The normalization equations from the membrane supplier’s performace program would used to normalize the data and track the performance and fouling trends of the operating RO systems.

3.5.7 Recommended Number of RO Desalination Units

The recommended number and capacity of the RO systems for the RWD is based on a balance of system capital costs, and reliability and redundancy to meet the capacity requirements for the project. Kennedy/Jenks sent water quality and preliminary design criteria information to various RO system manufacturers and obtained information on standard packaged RO systems for the RWD facility. Kennedy/Jenks also obtained budgetary equipment costs for the manufacturers packaged systems.

Kennedy/Jenks evaluated several alternatives to meet the desired capacity while providing various levels of redundancy and reliability, including:

1. A single 350-gpm RO unit: This provides no redundancy, although spare parts can be maintained as on-shelf spares to minimize system downtime. Reducing system permeate capacity when recycled water demands are low is more complicated with a single system.
2. Two, 175-gpm RO units: This provides half system capacity redundancy/reliability, and provides a simple means for reducing permeate flow when recycled water demands are low.
3. Three, 175-gpm RO units: This provides full system redundancy/reliability and provides a simple means for reducing permeate flow when recycled water demands are low. However, this redundancy may not be worth the additional cost and space requirements.
4. Two, 175-gpm RO units, expandable up to 350-gpm: This provides half system capacity redundancy/reliability, and provides a simple means for reducing permeate flow when recycled water demands are low. This also provides the opportunity to expand based on future demand.

Table 8 presents a summary and approximate footprint requirements for the different RO system alternatives presented above.

Table 8: Comparison of RO System Alternatives

Alternative	1	2	3	4
Type of RO skid system	Mid-Capacity Packaged, Not Expandable	Mid-Capacity Packaged, Not Expandable	Mid-Capacity Packaged, Not Expandable	Mid-Capacity Packaged, Expandable
Number of skids	1	2	3	2
Capacity of skid(1)	350 gpm	175 gpm	175 gpm	175 (350) gpm
Total Capacity of skids(1)	350 gpm	350 gpm	525 gpm	350 (700) gpm
Footprint	24ft x 15ft	24ft x 26ft	24ft x 36ft	24ft x 26ft
Budgetary Equipment Cost	$350,000	$400,000	$600,000	$500,000

(1) Additional membranes would be added to existing skid to increase production to future value in parenthesis.

3.5.8 RO Equipment Design Recommendation

Based on the space requirements, the enhanced redundancy and reliability, and the operationally simple approach to matching permeate with recycled water flows, Kennedy/Jenks recommends installing two, 175-gpm RO units, which could be expanded to 350-gpm units based on future demand (Alternative 4).

The ability to shut down one of the RO units to better control the blending ratio to meet the water quality objectives could save approximately $8,750 per year in operating costs. This savings is based on being able to run only one, 175-gpm capacity RO unit for approximately half the year with an assumed energy cost of $0.125 per kWhr.

3.6 Chemical Clean in Place Systems

3.6.1 MF/UF Membrane Cleaning

A MF/UF membrane cleaning system will be provided as part of the SEWRF's RWD system. Membrane system cleaning operations and recommended target cleaning frequency objectives for this system are defined as:

A. Chemically Enhanced Backwash (CEB): A CEB is defined as a procedure in which a cleaning chemical (typically hypochlorite) is periodically introduced to the backwash water to provide a shock cleaning. The chlorine concentration in the backwash water may be 10 to 20 mg/l. This is typically done if the feed water is not chlorinated.

B. Maintenance Clean (MC or Enhanced MC): A MC is defined as a procedure in which cleaning chemicals (typically hypochlorite or citric acid) are introduced to the membrane unit and the membrane unit is soaked for a short period to help reduce the rate of membrane fouling. The MC typically does not exceed approximately 30 minutes from initiation to completion. The MC would be fully automated. After the washing period is completed, the unit would be automatically returned to filtration service. MC is further described as the use of any chemical that:

1. Does not change the pH from a value between 6.0 and 9.0 pH units.
2. Involves free chlorine at concentrations up to approximately 100 mg/l.

The recommended MC objective would be to occur no more than once in 3 days of operation.

C. Clean-In-Place Chemical Clean (CIP) (Recovery Clean): A CIP is defined as a procedure in which the membrane systems are cleaned with chemical solutions (typically 2-percent hypochlorite or citric acid) for an extended period of time to restore the membrane permeability to clean-membrane trans-membrane pressure (TMP) levels. The CIP chemical clean is defined as greater than 60 minutes from initiation until completion and typically requires 6 to 8 hours to complete. The CIP chemical clean would be operator initiated and automated to the maximum practical extent.

The recommended objective for the CIP cleaning frequency is to occur no more than once in 30 days of operation.

The MF/UF system would have a packaged MC/CIP skid with a tank, pumps that would be used to perform automated maintenance cleans and manually initiated CIP cleanings for the MF/UF skids. Potable water or RO permeate would be used as make-up water for the cleaning solutions. MC and CIP cleaning solutions of citric acid are used to dissolve iron, manganese or calcium carbonate scales. Sodium hypochlorite solutions are used to remove organic foulants. The cleaning solutions are batched, and the cleaning chemicals are circulated through an off-line, isolated membrane unit for several hours. The membranes are then rinsed before being brought back in service.

For larger systems, the spent cleaning solutions are often neutralized to a pH between 6 and 9 and then discharged to the sanitary sewer or back to the head of the primary treatment process. For the SEJPA RWD, the spent CIP cleaning solution will be relatively small at approximately 500 gallons per CIP event per unit. This small volume should not require neutralization with additional chemicals, but rather would be neutralized by blending with the backwash water from the new MF filters and the plants existing tertiary filters as is it returned to the head of the primary process at the SEWRF. The spent cleaning solution would be drained to the backwash water sump. The diluted spent cleaning solution would then be pumped to the existing filter backwash sump for return to the head of the primary treatment process at the SEWRF.

3.6.2 RO Membrane Cleaning

RO Membrane system cleaning operations and recommended target cleaning frequency objectives are described below. Unlike MF/UF membranes, RO systems are not backwashed.

A. Clean-In-Place Chemical Clean (CIP) (Recovery Clean): A CIP is defined as a procedure in which the RO membrane systems are cleaned with chemical solutions (typically 2-percent caustic, citric acid or detergent solution) for an extended period of time to restore the membrane permeability and performance. The cleaning solution is often heated to improve effectiveness. The CIP chemical clean typically requires 3 to 4 hours to complete. The CIP chemical clean would be operator initiated and automated to the maximum practical extent.

   The recommended objective for the RO CIP cleaning frequency is to occur no more than once in 4 months of operation or less often.

The RO system would have a packaged CIP skid with a tank, pumps that would be used to perform manually initiated CIP cleanings for the RO skids. RO permeate would be used as make-up water for the cleaning solutions. CIP cleaning solutions of citric acid are used to dissolve iron, manganese or calcium carbonate scales. Caustic and detergent solutions are used to remove organic foulants. The cleaning solutions are batched, and the cleaning chemicals are circulated through an off-line, isolated membrane unit for several hours. The membranes are then rinsed before being brought back in service. Similar to the MF/UF system, the RO system spent cleaning solutions would be discharged to the spent washwater sump for dilution and returned to the head of the SEWRF via the DynaSand filter spent backwash water sump.

The RO CIP system would also serve as a permeate flushing system. When an RO unit shuts down, RO permeate would be flushed through the system to displace the secondary effluent feed water and minimize fouling and bio-growth in the RO membranes. Also, following a CIP, the RO system would perform a system flush to waste to remove any residual cleaning solution. This flush water would be directed to the spent washwater system.

3.7 Washwater Recovery System

The washwater recovery system would consist of a wet well sized to accept waste flows from backwashes and membrane cleanings. The wet well would be used as a pump station with duty and standby pumps to pump washwater to the head of the wastewater treatment system. The wet well would serve as a detention basin to allow dilution of chemical cleaning solution with neutral washwater to neutralize the pH of chemical cleaning waste. CIP solution waste would be approximately 500 gallons and the wet well would be approximately 4,000 gallons which would allow for a dilution of conservatively 6 to 1 of neutral backwash water to waste CIP solution.

The pumps in the wet well would be controlled by level. When the wet well reaches a certain level the pumps would turn on and drain the wet well. The system would be fully automated.

When cleaning the RO membranes with a detergent, there could be a significant amount of foam that will be generated in the RO CIP tank. This detergent foam would be washed out of the CIP tank and into solution with a hose and discharged to the wet well.

Section 4: Proposed RWD Facility

4.1 Process Flow

The process flow diagram for the RWD is shown in Drawing G1.4. The secondary effluent feed flow to the RWD would be directed from the existing Secondary Effluent Diversion Chamber to the existing non-potable water wet well through an existing 18-inch pipe. New RWD feed pumps would lift the secondary effluent to the MF/UF membrane skids. The MF/UF filtered water would flow into a Filtered Water Break Tank. The MF/UF treated water in the break tank would meet Title 22 tertiary treated water requirements.

From the break tank the water would be pumped through RO membranes to remove TDS to meet the treated water objectives for the project. Filtered water can also be pumped directly to the recycled water chlorine contact tank, bypassing the RO. Ancillary to the main treatment train are chemical feed systems and Clean in Place Skids which are used to mix and dose chemical solutions through the MF/UF and RO systems periodically to keep the membranes clean.

4.2 Process Hydraulics

The hydraulic profile for the RWD is shown in Drawing G1.5. The hydraulic profile was calculated at a maximum future flow to produce up to 1 MGD of RO permeate. The secondary effluent feed flow to the RWD would flow by gravity from the existing Secondary Effluent Diversion Chamber to the existing non-potable water wet well through an existing 18-inch pipe. The headloss through this pipeline is minimal due to the low flow velocities in the pipe. An existing weir in the Filtered Water Pump Station maintains the water level in the existing Secondary Effluent Diversion Chamber at a minimum of 28.33 feet.

The flow through the RWD will be accomplished by pumping through the process units as shown in G1.5. The RO permeate will flow with residual pressure from the RO pumps to a free discharge into the existing recycled water chlorine rapid mix chamber. The RO brine will flow with residual pressure from the RO pumps to a free discharge into the existing effluent outfall pump station.

4.3 RWD Facility

4.3.1 Layout

The proposed layout for the RWD system with two large-capacity MF/UF units is shown in Drawing M2.1. The 104-foot length fits abutted up against the existing secondary sedimentation structure. With modifications to the existing paving and landscaped areas continued vehicle access can be maintained to existing areas of the SEWRF.

The RWD facility would have a canopy structure over it to provide sun and rain protection for the equipment and operators. The main process piping would be supported on pipe racks along the wall of the existing secondary clarifier structure at the back of the RWD area.

Multiple 4 foot wide access aisles would be provided for equipment maintenance and access.

The equipment would be skid mounted to allow for easy installation and removal of equipment through the open air structure which can be accessed for maintenance from the East and South sides. To add or remove the filtered water break tank behind the structural cross-bracing, temporary bracing would be provided in an adjacent bay during the work. This would permit removing the normal bracing to access the equipment.

4.3.2 Chemical Storage

Chemical storage in the RWD area would be accommodated by using 300 gallon tote bins and 55 gallon drums which are delivered full of chemical as a container and therefore do not require chemical transfer piping to convey chemical from a bulk delivery truck. The totes and drums would be stored on top of secondary containment basins and would be located at the edges of the concrete slab to allow a fork lift to place the totes or drums on the secondary containment basins. Chemicals which would be stored include:

- Antiscalant (330 gallon Tote): Injected at the feed to the RO units to inhibit scaling.
- Caustic Soda (55 gallon drum): RO system CIP.
- Citric Acid (55 gallon drum): Used for MF/UF and RO CIP.
- Hypochlorite (55 gallon drum): Filled from storage and used for MF/UF CIP

Sodium hypochlorite would be stored in the existing storage tank located approximately 2000 ft north of the RWD facility. New package feed pumps would be located at the existing hypochlorite storage area and would dose to the process to create chloramines for biofouling control. A transfer pump would be provided to fill the 55-gallon drum of hypochlorite used for MF/UF maintenance cleanings and CIPs.

Caustic Soda and Hypochlorite are basic chemicals and are non-compatible with Citric Acid and antiscalant chemicals. The chemical storage areas are shown separated from each other to avoid potential exothermic reactions which could occur if these two chemicals were to mix.

4.3.3 Site Piping and Utilities

New site piping and utilities outside of the main RWD layout for the project would include:

- 1-inch double contained Hypochlorite feed pipeline from existing storage tank to within the RWD process area to be used for chloramination and cleaning of the MF/UF. May be able to use existing 1-inch pipeline that runs from the existing chemical storage tank to the existing non-potable water pump station (adjacent to the secondary sedimentation basins).
- 3-inch spent washwater pipeline from washwater wet well to the existing filter backwash sump.

- 8-inch RO permeate to Chlorine Contact Box.
- 4-inch brine pipeline from the RO units to the manhole feeding the ocean outfall pump station.
- Electrical and control wiring and conduits

The Site Plan (Sheet C1.3) and the Electrical Site Plan (Sheet E1.3) show the proposed routing of the RWD system piping and conduits.

4.4 Civil Site Improvements

As shown in the Site Plan (Sheet C1.3), the civil site work for the RWD system will include the following:

- Saw cutting and asphalt removal.
- Removal of trees and landscaped areas.
- Re-grading of area adjacent to the secondary clarifiers in order to construct a new concrete pad for the RWD system equipment.
- Re-grading of driveway and area surrounding the RWD system.
- Relocation of a site features (light pole, bollards, etc.).
- Trenching for installation of pipelines and utilities associated with the RWD system.
- Paving and resurfacing driveway and pipeline trenches.
- Potential modification to existing electrical and communication vaults to match proposed grade.

4.5 Permitting and CEQA

4.5.1 RWD Permitting Requirements

The SEWRF currently operates in accordance with the following two permits issued by the Regional Water Quality Control Board, San Diego (Regional Board):

- Order No. 2000-10 Master Recycled Water Permit for the Production and Purveyance of Recycled Water for San Elijo joint Powers Authority, San Dieguito Water District, Santa Fe Irrigation District, and City of Del Mar. (Order No. 2000-10)
- Order No. R9—2005-0100, NPDES No. CA0107999 Waste Discharge Requirements for the San Elijo Joint Powers Authority, San Elijo Water Reclamation Facility Discharge to the Pacific Ocean via the San Elijo Ocean Outfall. (Oder No. R9-2005-0100)

The treatment and distribution of recycled water must comply with Order No. 2000-10. The order prohibits the distribution of effluent that does not comply with certain numeric values including TDS (annual average and maximum day values of 1200 mg/l and 1300 mg/l, respectively). As noted previously, the proposed RWD has been developed in response to effluent concentrations that have exceeded effluent limitations.

The order also limits the distribution of recycled water to a maximum 30-day average dry weather flow of 2.48 million gallons per day (MGD) unless waste discharge requirements are obtained for a larger flow. Recycle water must also comply with disinfected tertiary provisions in State of California Title 22 Code of Regulations.

The proposed RWD improvements would allow SEJPA to produce up to 3.0 MDG of recycled water meeting Title 22 disinfected tertiary provisions. Prior to the production and distribution of flows greater than 2.48 MGD, the following process must be completed:

- Submit a Report of Waste Discharge to the Regional Board requesting the increase in recycled water flow from 2.48 to 3.0 MGD.
- Work with Regional Board staff to resolve questions; once resolved, the Regional Board issues a letter indicating the report has been found to be complete.
- Review and comment on the draft Order No. 2000-10 amendment prior to completion by the Regional Board staff. Should the Regional board staff decide to issue a new order, provide comments prior to the completion of the draft order.
- Attend Regional Board hearing and respond to Board member questions.
- After the amendment or new order is adopted, complete required technical documents and obtain approvals
    - Complete and submit an engineer's report certifying the new process design and compliance with effluent limits.
    - Complete and submit an updated Title 22 engineers report. Coordinate this report with the California Department of Public Heath (CDPH).

The processing of an amendment (or new order) will take about 6-8 months to complete. The Report of Waste Discharge should be submitted during the design period. The engineers and Title 22 reports should be completed during construction and scheduled to allow the delivery of recycled water using the RWD equipment once construction and startup has been completed.

Order R9-2005-0100 provides effluent limits for the discharge of effluent through the San Elijo ocean outfall. The RWD project can be implemented without an amendment to this order if effluent limits are met. The worst case ocean discharge condition would occur during periods when ocean discharge is limited to 100% concentrate from the proposed RO system. An evaluation of such a discharge has been completed; the predicted concentration of constituents were found to below effluent limits as summarized on Table 9.

Table 9: NPDES Effluent Limits Concentrate Comparison

Parameter	Units	Effluent Limit(1)	2008 Results	Concentrate(2)	2009 Results	Concentrate(2)
Aresnic	μg/L	6,900	0.504	2.016	<10.0	<40.0
Cadmium	μg/L	950	ND	<1.0		
Chromium, Hexavalent	μg/L	1,900	ND	<1.0		
Copper	μg/L	2,400	0.404	1.616	<10.0	<40.0
Lead	μg/L	1,900	0.151	0.604		
Mercury	μg/L	38	ND	<1.0		
Nickel	μg/L	4,800	ND	<1.0	<10.0	<40.0
Selenium	μg/L	14,000	ND	<1.0	<10.0	<40.0
Silver	μg/L	630	ND	<1.0		
Zinc	μg/L	17,000	0.933	3.732		
Cyanide	μg/L	950	1.009	4.036		

(1) RWQCB Region 9, Order No. R9-2005-0100, NPDES No. CA0107999, Table 8
(2) Concentration of constituents in RO brine is about 4 times that of the RO feed water at 75% recovery. If ND is reported in the effluent, the concentation in the RO reject should not exceed detection limit (assume < 1.0 μg/l).

4.5.2 California Environmental Quality Act (CEQA) Compliance

The proposed RWD requires completion of environmental documentation and adoption by the SEJPA Board of Directors. The documentation is being completed in a separate document.

Section 5: Electrical and Solar Panel Review

5.1 Electrical Review

5.1.1 Metering Switchboard

The existing MS-2 metering switchboard is served by SDG&E and is rated at 1600 amps. Seven months of SDG&E bills were reviewed by the SEJPA staff and the results are tabulated below to show that this switchboard has not exceeded 566 amps (assuming a 0.85 p.f.) in demand during that period.

Table 10: Historical SDG&E Bills From 2009

	Maximum On-Peak Demand (KW)	Maximum Demand (KW)
December	303	384
January	312	377
February	366	366
March	375	392.6
April	398	385
May	391	391
June	375	389.1

$$\text{Maximum Demand Current} = \frac{P}{\sqrt{3} * V * \text{COS}\theta}$$

Where,

P = 400,000 W (Note: The SDG&E maximum On-Peak Demand is 398 KW based on historical data)
V = 480 V
$\text{COS}\theta$ = 0.85

The new RWD load will be added to this service, via MCC-L, and is expected to initially be approximately 371 amps. The ultimate RWD load after future build out is expected to be approximately 483 amps. Adding the 483 amps to 566 amps, the total load on existing MS-2 will be approximately 1049 amps. Since MS-2 is rated for 1600 amps, the metering switchboard will support the additional load of the RWD system and still have about 34% reserve capacity.

5.1.2 Power Requirements

Power for the RWD system will come from MS-2 via MCC-L located in the Reclaimed Water Electrical Building. The total connected load on MCC-L is approximately 713 amps. The load is split between two 700 amp breakers that feed the motor control center. A bus tie separates the connected load which is approximately 318 amps on one breaker and approximately 395 amps on the other breaker. Accordingly, MCC-L can absorb the 483 amp RWD load addition as long as the load is split evenly between both breakers. Since the connected load on one breaker could reach 625 amps, we recommend changing the trip plugs on both breakers to 800 amps. See drawing E1.2 for MCC-L modifications.

Motor control center MCC-L will feed a new motor control center MCC-M located at the RWD Facility. The new outdoor NEMA 3R motor control center will be approximately 91"H x 167"W x 36"D. The motor control will include three 30 hp VFDs, two 3 hp FVNR motor starters, seven feeder breakers, and a 120/240V panelboard. The single-line diagram for MCC-M is shown on Drawing E1.3.

Four existing 20 hp NPW pumps will be replaced with four 10 hp RWD Source Water Pumps. Since the NPW pumps are currently powered from MCC-G, the new VFDs for the RWD Source Water Pumps will be located in MCC-G. The conduit system between MCC-G and the existing NPT wetwell is to be reused for the RWD Source Water Pumps. See drawing E1.4 for MCC-G modifications...

5.1.3 Telemetry Requirements

Status and alarm signals from the RWD facility will be conveyed to the existing RW-LCP located in the electrical room. The RW-LCP will communicate with the RWD Main Control Panel via a fiber optic data link. Using a fiber optic data link eliminates the need for adding hardwired I/O to the existing RW-LCP.

Status and alarm signals from the RWD Source Water Pump VFDs will be routed to the existing RAS/WAS-LCP located in the Blower RAS/WAS electrical room. The RAS/WAS-LCP will monitor and control the RWD Source Water Pump VFDs as shown on the P&IDs. The new I/O connected to the RAS/WAS-LCP may require changes to the existing PLC which will be determined during the design phase of the project.

It is assumed that San Elijo staff will provide PLC programming, OIT screen development, and central system programming.

5.2 Solar Panel Review

Kennedy/Jenks Consultants has evaluated the use of solar panels as part of the Advanced Water Treatment (RWD) project as a means to effectively offset a portion of SEWRF's energy use. This evaluation, as detailed in the Solar Panel Analysis Technical Memorandum dated October 30, 2009, included the potential for placing solar panels on top of the existing chlorine contact tank (CCT), on top of the proposed RWD System canopy, and on top of the existing recycled water control building. A number of different design considerations were included as part of the system feasibility analysis and are discussed in the technical memorandum.

A financial analysis was performed for the two system scenarios (Scenario 1 – RWD System canopy only; Scenario 2 – RWD System canopy and chlorine contact tank) based on the assumptions and considerations stated in the technical memorandum. During the system lifetime (assumed to be 30 years), neither scenario is projected to pay back the total initial capital investment. After 30 years, Scenario 1 shows a 76% recovery of initial investment, while Scenario 2 shows a 78% recovery. Table 11 provides a summary of the financial analysis of the project lifetime for each scenario.

The system capital costs range between $6.50~$9.00 per watt, which is inclusive of engineering, materials and installation. This range is based on the best installation cost estimates available. PV module prices are currently $4.40 per watt (per http://www.solarbuzz.com), however, engineering and installation costs can range from $2.00 ~ $4.50 per watt. The variation in this price range is dependent upon various factors regarding the specific installation. These factors include size of system (economies of scale), physical location, new versus existing structure, and rooftop challenges (i.e. equipment, penetrations, slope). Based on the factors specific to the proposed scenarios, including the size and suitability of rooftop installation, the proposed system cost is estimated at $7.50 per watt. This estimate is confirmed with the cost of a similar size system on a recent project.

Table 11: Solar Cost Analysis

Project Life (30-Year) Totals:	Scenario 1 (36 kW)	Scenario 2 (68 kW)
Capital Purchase:		
Materials and installation cost (1)	**($270,000)**	**($510,000)**
Energy Savings:		
Energy Savings	**$159,162**	**$300,639**
O&M Costs:		
Insurance (0.05% of Capital Investment)	**($4,050)**	**($7,650)**
Maintenance Expense – Annual (starting in Year 6)	**($17,079)**	**($25,618)**
Maintenance Expense - Inverter Replacements	**($50,400)**	**($95,200)**
Incentives:		
REC Value	**$33,122**	**$62,564**
Carbon Credit Value	**$6,044**	**$11,417**
PBI Payments	**$79,430**	**$150,035**
Return on Initial Capital Expenditure (2009 Dollars)	**($63,770)**	**($113,813)**

(1) The cost includes the photo-voltaic panels, fixed-tilt solar arrays (south-facing, angled at 32-degrees, inverters, wiring, engineering, installation, utility grid interconnect, warranty, 5-years of maintenance, and 5-years of performance monitoring and reporting service (required for the Performance Based Incentive).

The evaluation performed in the technical memorandum analyzed the case of public ownership of the solar panel system. Based on the financial analysis, direct purchase and ownership by SEJPA of the solar panel system does not appear to be favorable in either scenario. This is due to the projected estimate that the initial capital investment will never be recovered. The solar panel system would likely have to be replaced before ever reaching the point at which the SEJPA would break even on their initial investment.

Many incentives for the development and implementation of solar panel systems have been initiated by state and federal legislation. The goal of the legislation is to encourage the widespread growth of renewable energy generation by offering incentives to make projects feasible. However, in this specific case, the incentives offered do not bridge the gap and make public ownership economically favorable.

Therefore, in order to make the solar panel system a more feasible alternative energy option, it is recommended that the SEJPA seek alternate financing options. Alternative options for financing solar panel systems include: public-private partnerships, power-purchase-agreements, and tax-free municipal lease. The first two options offer advantages including the eligibility to take advantage of the federal tax credits and incentives in addition to the state rebates. Evaluating alternate financing options is recommended if the SEJPA would like to further pursue a solar panel system as alternative energy option.

Section 6: Canopy Structure Code Review

6.1 Project Description

The project involves improvements to the SEWRF. The project includes the design of a 0.5 MGD RWD facility to complement the existing 2.48 mgd tertiary treatment system. The upgrades include the construction of a new open air canopy structure.

6.2 Proposed New Structures

This review addresses the following new construction:

- New RWD facility canopy structure.

6.3 Codes Used by the SEJPA

The SEJPA is a self reviewing agency and the RWD is not subject to reviews by the local City building officials.

This Preliminary Code Review is developed using the adopted California Building Code (CBC) 2007 edition which is based on the 2006 IBC. The CBC is used for all building design requirements (including referenced NEC sections), and supersedes National Fire Protection Association (NFPA) requirements in all areas. As a general rule, the NFPA requirements are used for electrical design and for items that are not addressed in the IBC.

- California Building Code (CBC), 2007, includes energy conservation requirements
- National Electrical Code (NEC), 2005
- Uniform Plumbing Code (UPC), 2006
- Uniform Mechanical Code (UMC), 2006
- California Fire Code (CFC), 2007
- CAL-OSHA (California Occupational Safety and Health) primarily governs access to non-building related processes where no hazardous materials are involved.

6.4 Essential versus Non-Essential Facility

Section 1602 of the CBC defines an Essential Facility as a building or other structure that is intended to remain operational in the event of an extreme environmental loading from flood, wind, snow or earthquake. Designating a building or other structure as an Essential Facility is a performance objective that means that the building will have minimal damage following extreme environmental loading that would interrupt the operation of the facility. By assigning a building or other structure an Essential Facility occupancy category the code requires that the environmental design loads be increased on the structure to result in a building with the strength or the ductility to resist the extreme loading.

The Essential Facility occupancy category is typically reserved for hospitals, fire and police stations, emergency shelters or emergency preparedness, communication and operation centers, and water treatment facilities required to maintain water pressure for fire suppression. This doesn't mean that the buildings or other structures at a Water Reclamation Facility couldn't be assigned this occupancy category, but generally the Essential Facility category is reserved for buildings that have functions as listed above.

Consequently, the proposed new structure for this project will not be categorized as Essential Facilities. The structure will be designed to resist environmental loading from flood, wind, snow or earthquakes based on the performance objective that damage to the structure represents a substantial hazard to human life in the event of failure. The structure, however, may not remain operational after a major environmental event.

6.5 New RWD Structure Summary

The new RWD canopy structure will house up to three (3) MF Units, RO Booster Pumps, two (2) RO Units, an Air Compressor, MCC panel, two (2) Clean-in-place skids, Chemical Feed Pumps, an Antiscalant tote bin, Caustic Soda drum, Citric Acid drum, Hypochlorite drum and up to two (2) FW Tanks.

Salient features of the RWD structure are as follows:

- The footprint of the concrete pad is approximately 3,536 square feet on a single floor.
- The canopy structure will be constructed of a concrete slab, Open Structural Steel Framing, and a shed steel roof framing covered with a standing seam metal roof and potential and optional Solar Voltaic Panels.
- The structure will not be mechanically heated or ventilated.
- Two 7,600 gallon process water tanks, the process equipment, chemical totes and drums and CIP tanks will be housed within the open structure.

6.6 Zoning Requirement Issues

Local zoning regulations and ordinances, including regulations related to building setbacks, noise, landscaping, exterior lighting, and parking, are not included in this code summary.

6.7 Building Code Review (Life-Safety)

6.7.1 New RWD Structure

- **Floor Area:** 3,536 SF total. The proposed structure is limited to the Concrete pad, structural frame and metal roof with optional solar voltaic panels.
- **Height:** One story, 21 feet at the highest point actual. Allowable 2 stories, 55 feet.

- **Construction Type:** CBC Type II-B, constructed of non-combustible, non-fire rated materials.
- **Occupancy Group:** Groups F-1. CBC paragraph 306.2 defines F-1 as occupancies consisting of moderate-hazard industrial functions.
- **Calculated Occupant Load:** At 300 square feet per person for storage and mechanical areas per Table 1004.1.1 of the CBC the occupant load of the RWD Structure is 12.
- **Chemicals Stored and/or Used:**
    - Sodium Hypochlorite at 12.5% concentration is a hazardous corrosive. Sodium Hypochlorite is primarily stored in another location and will be piped to the RWD.
    - One 55 gallon drum of Sodium Hypochlorite, 12.5% solution. Sodium Hypochlorite is limited to 500 gallons indoor use and storage.
    - One 55 gallon drum of Citric Acid. Citric Acid is a non-hazardous irritant with no limitation on indoor use and storage.
    - One 55 gallon drum of Caustic Soda, 25% solution. Caustic Soda is limited to 500 gallons indoor use and storage.
    - One 300 gallon tote bin of Antiscalant. Antiscalant is a non-hazardous irritant with no limitation on indoor use and storage.
- **Spill Control and Secondary Containment**: Paragraph 2704.2.1 of the California Fire Code establishes the requirements for spill control for hazardous material liquids. Paragraph 2704.2.2 establishes the requirements for secondary containment. Although the quantities used and stored are below the maximum exempted amounts, spill control and secondary containment will be provided as a means of preventing the potential release of hazardous materials to storm drains and water courses referenced in paragraph 2703.3 of the California Fire Code. Floors shall be liquid-tight, sloped, recessed, curbed, or designed with sumps or collection systems to contain spillage. Double containment piping will be provided for the Caustic Soda and the Hypochlorite.
- **Chemical Separation:** The treatment chemicals are not compatible and require separate containment. The code requires 20 feet of separation between the secondary containment of incompatible chemicals.
- **Fire Sprinklers:** Not required, not a hazardous occupancy
- **Accessibility:** The structure is not normally occupied. Mechanical and equipment rooms are not required to be accessible per CBC 1103B.1 exception 1.

6.7.2 General Code Requirements

- **Exterior walls:** None
- **Occupancy separations:** None
- **Exits required:** 200 foot maximum travel distance to exit area.

- **Insulation:** Not required
- **Ventilation:** Code requires that all buildings be ventilated naturally or by mechanical means per CBC 1203.4 or the UMC. Natural ventilation requires operable windows or louvers with a free area of at least 1/20th of the floor area of the room or area.
- The RWD Structure will be fresh air ventilated in conformance with the California Fire Code at one cubic foot per minute (CFM) per square foot (sq. ft) of floor area.
- **Identification Signs:**
  - Tanks and tote bins shall bear hazard identification signs per CFC 2703.
  - Additional signs are required at entrances to locations where hazardous materials are stored.
  - No smoking signs shall be provided within 25 feet of outdoor storage areas.
- **Safety Features:**
  - Fire extinguishers are required per the California Fire Code.
  - Emergency eyewash/shower stations with tepid water are recommended for the chemical storage area.
- **Security:** Storage areas shall be secured against unauthorized entry. This is accomplished by the RWD being inside the secured SEWRF.
- **Hydrant Fire flow Requirement**: 1,500 gpm minimum and a maximum of 250 feet from each building.
- **Building Insulation:** The structure does not require insulation per requirements contained in the California Building Code.
- **Electrical:** Electrical design shall comply with the NEC. A minimum of 42-inch clearance be maintained in front of the electrical panels.
- **Industrial Safety:** The design shall comply with the CAL-OSHA safety requirements and guidelines. This will primarily affect safety features for equipment, access to equipment, underground vaults or tanks, and safety signage.
- **Accessibility:** The structure is not normally occupied. Mechanical and equipment rooms are not required to be accessible per CBC 1103B.1 exception 1.

Section 7: Architectural Alternatives Comparison

This section describes two options developed for the architectural design of the canopy structure. Option 1 is a canopy structure with the minimum amount of architectural elements, while Option 2 includes some perforated stainless steel metal panels to provide some screening of the structure. Drawing A2.2 illustrated the differences between these two options in terms of aesthetics.

7.1 Basic Canopy Structure

The canopy structure shown in Option -1 is a basic one story open air, pre-engineered metal structure on a concrete building pad with a roof canopy. The structure is approximately 20'-0" high. The steel columns at the front are protected with a 3'-6" high concrete encasement. The back of the structure faces an existing 3'-6" high concrete wall with a continuous guard rail. The roof canopy is a shed style roof with a slope of 2:12. The roof system is a prefinished standing seam metal roof with the ability to support an array of photovoltaic solar roof panels sloping towards the south.

The structure is open and the equipment arranged on the concrete pad in a way that allows a minimum of 3'-6" access to the pieces of equipment. Properties surrounding the building will primarily view the roof canopy with the solar panels which screen the view of the equipment.

7.2 Canopy Structure with Screening

The canopy structure shown in Option – 2 is also a one story open air, pre-engineered metal building on a concrete building pad with a roof canopy. Similar to Option 1, this structure is approximately 20'-0" high. The steel columns at the front are protected with a 3'-6" high concrete encasement. The back of the structure faces an existing 3'-6" high concrete wall with a continuous guard rail. The roof canopy is a shed style roof with a slope of 2:12. The roof system is a prefinished standing seam metal roof with the ability to support an array of photovoltaic solar roof panels sloping towards the south.

The structure is open and the equipment is arranged on the concrete pad in a way that allows a minimum of 3'-6" access between equipment. This Option includes perforated stainless steel screen panels on the front and the back of the structure in an effort to further screen the view of equipment from adjacent properties. The screening enhances the aesthetics of the structure but does not impede access to the process equipment.

The additional screening adds approximately $20,000 dollars (markups included) to the project cost of the basic canopy alternative.

Section 8: Structural Design Requirements and Criteria

The following structural design requirements will be utilized for the design of new treatment facilities as a part of the RWD Project for SEJPA.

The RWD facilities are anticipated to be contained within a steel roof canopy structure set on a slab-on-grade concrete foundation. The steel structure is anticipated to be a rigid steel frame in one direction and a braced frame in the other direction. We anticipate that this will be pre-engineered building, provided by a third party building manufacturer.

8.1 General Design Requirements

This section prescribes structural design requirements applicable to all buildings and treatment structures for the proposed treatment improvements.

Buildings and treatment structures, including elements of these structures, may be designed utilizing allowable stress design, strength design, or load and resistance factor design. Allowable stress design is a method of proportioning structural elements such that computed stresses produced in the elements by the allowable stress load combinations do not exceed specified allowable stresses (also called working stress design). Strength design is a method of proportioning structural elements such that the computed forces produced in the elements by the factored load combinations do not exceed the factored element strength. The term “strength design” is used in the design of concrete and masonry structures. Load and Resistance Factor Design (LRFD) is a method of proportioning structural elements using load and resistance factors such that no applicable limit state is reached when the structure is subjected to all appropriate load combinations. The term LRFD is used in the design of steel and wood structures.

8.2 Codes and Standards

The building codes and standards listed below may be utilized in the design of buildings and treatment structures or elements of these structures.

a) 2007 California Building Code, Title 24, Part 2, Volume 2, International Code Council and California Building Standards Commission, 2006

b) 2006 International Building Code, Volume 1, Administrative, Fire- and Life-Safety, and Field Inspection Provisions, International Code Council, 2006. (as referenced in the 2007 CBC)

c) 2006 International Building Code, Volume 2, Structural Engineering Design Provisions, International Code Council, 2006. (as referenced in the 2007 CBC)

d) Minimum Design Loads for Buildings and Other Structures, ASCE Standard, ANSI/ASCE 7-05, Revision of ASCE 7-02, American Society of Civil Engineers, 2005.

e) Standard Specifications for Highway Bridges, Fifteenth Edition, American Association of State Highway and Transportation Officials, Inc., 1992.

f) Building Code Requirements for Reinforced Concrete (ACI 318-05) and Commentary (ACI 318R-05), American Concrete Institute.

g) Manual of Steel Construction, Specification for Structural Steel Buildings with Commentary, Allowable Stress Design and LRFD, American Institute of Steel Construction, Inc., Thirteenth Edition, 2005.

h) North American Specification for the Design of Cold-Formed Steel Structural Members, AISI/COS/NASPEC 2004, American Iron and Steel Institute, 2004 Edition.

8.3 Design Loads

a) Dead Loads: Dead loads shall consist of the weight of all materials and fixed equipment incorporated into the building or other structure.

b) Live Loads: Live loads are those loads produced by the use and occupancy of the building or structure and do not include dead load, construction load, or environmental loads such as wind load, snow load, rain load, earthquake load or flood load. Floors shall be designed for the unit loads in the table below.

Table 12: Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads

Occupancy or Use	Uniform (psf)	Concentrated (lbs)
Handrails, guardrails, and grab bars	50	200
Offices	50	2,000
Roofs (uniform load subject to reduction for area and pitch)	20	2,000
Sidewalks, vehicular driveways	250	8,000
Stairs and exit-ways	100	300/tread
Light manufacturing or storage warehouse	125	2,000
Heavy manufacturing or storage warehouse	250	3,000

For additional loads not indicated in Table 12, design for the unit loads will be as set forth in ASCE 7-05, Table 4-1. Concrete floor slabs-on-grade should not be less than those given for heavy manufacturing or storage warehouse; 250 psf uniform load and 3,000 pound concentrated load except in areas where vehicles may access and then the concentrated load should be increased to 8,000 pounds. Floor live loads in equipment rooms, pump rooms, electrical rooms, and areas where equipment may be moved to various locations should be not less than those given for light manufacturing or storage warehouse; 125 pounds per square foot (psf) uniform load and 2,000 pound concentrated load. Live loads for grated and plated areas should equal or exceed the corresponding floor live load for the given area. Access hatches should equal or exceed the corresponding floor live load for the given area.

Vehicle loads shall be in accordance with the latest edition of the AASHTO Standard Specifications for Highway Bridges. All vehicle accessible areas will be designed to resist HS-20 loading.

c) Snow Loads: Not applicable.

d) Wind Loads: Buildings and treatment structures less than 60 feet in height should be designed in accordance with ASCE 7-05 Chapter 6 for wind effects based on the following factors:

Table 13: Wind Load Design Requirements and Criteria

Description of Coefficient	Coefficient
Exposure (flat and generally open terrain)	C
Basic wind speed, mph	85
Wind Importance Factor	I_W = 1.15

e) Earthquake Loads: Buildings and treatment structures will be designed to resist the effects of earthquake ground motions in accordance with adopted building codes and national standards for non-building structures. The purpose of the earthquake provisions in building codes is primarily to safeguard against major structural failures and loss of life, not to limit damage or maintain function. The design basis ground motion utilized in the design of the buildings and treatment structures is that ground motion that has a 10 percent chance of being exceeded in 50 years. The design of new buildings and the earthquake forces shall be determined considering seismic zoning, site characteristics, occupancy, configuration, structural system and building height. Seismic load design requirements and criteria are summarized in the table below:

Table 14: Seismic Load Design Requirements and Criteria

Description of Coefficient	Coefficient
Occupancy Category	III
Seismic Importance Factor, S_S	1.25
Seismic Importance Factor, S_1	1.50
Soil Profile	Se (assumed)
Soil Coefficient F_A	1.0
Soil Coefficient F_v	1.5
Seismic Coefficient, S_{DS}	.908
Seismic Coefficient, S_{D1}	.512
Seismic Design Category	E
Overstrength and Ductility Coefficient, R	5.0
Seismic Amplification Factor, Ω	2.5

f) Other Minimum Loads: In addition to the loads listed above, buildings and non-building structures will be designed to resist other loads including fluid pressures, hydrostatic uplift, lateral soil pressures, ponding loads, and self-straining forces.

8.4 Structural Tests and Inspections

Structural tests and inspections shall be provided for certain types of work. The drawings and the technical specifications will provide detailed information on the quality assurance and testing and inspection requirements for different materials in the shop and in the field.

a) Special Inspections: Special inspections for certain materials of construction or procedures will be provided as noted on the Special Inspection and Testing Schedule on the Structural Drawings.

b) Structural Observation: Structural observation by the engineer of record shall be provided for all new construction for buildings and non-building structures in Seismic Design Category D, E or F when facilities are in occupancy category, III or IV, or when designated by the engineer of record or the local building official.

8.5 Foundations and Retaining Walls

It is recommended that a geotechnical investigation be conducted prior to final design in order to confirm our understanding that the site is underlain by a substantial amount of structural fill. The foundations would then be designed in accordance with the information provided by this geotechnical investigation. We expect that at-grade or shallow footings will be sufficient for the project, and do not anticipate any significant settlement.

8.6 Concrete Structures

Concrete structures shall be designed in accordance with Chapter 19 of the IBC and Building Code Requirements for Reinforced Concrete (ACI 318-05) published by the American Concrete Institute. Different types of concrete may be utilized where different compressive strengths are required or where different performance requirements are required of the mix design. In general, one or more of the following mix designs may be utilized for concrete building and treatment structure construction:

Table 15: Concrete Mix Design Types

Concrete Type	A	B	C	D	E
Specified 28-Day Compressive Strength (lb/in2)	4,000	4,500	4,000	4,500	2,500
Maximum Coarse Aggregate Size (in)	1	1-1/2	1	1	1
Air Content at Point of Placement (%)	6	5-1/2	1	4-1/2	1
Maximum Water-Cementitious Material Ratio	0.45	0.40	0.50	0.45	0.55
Minimum Cementitious Material Content (lb/yd3)	570	590	570	570	510
Maximum 28-Day Drying Shrinkage (%)	0.05	0.05	--	--	--

Type A and B concretes are typically utilized for non-building liquid-containing structures. Type A concrete is for normal sanitary exposure where crack width is intended to be limited to 0.01 inches. Type B concrete is for severe sanitary exposure where crack width is intended to be limited to 0.0085 inches. Type C and D concretes are typically utilized for buildings. Type C concrete is a basic building concrete. Type D concrete is concrete for severe weather conditions with significant freezing and thawing. Type E concrete will be used when strength and durability are not requirements such as for sidewalks, curbs, bollards and other non-structural concrete. We anticipate utilizing Type C concrete for the building foundation and Type E concrete for additional site improvements

The building foundation will be designed with bar cover provided over reinforcing steel meeting or exceeding the requirements of ACI 318.

8.7 Steel Buildings and Structures

Steel buildings and non-building structures shall be designed in accordance with Chapter 22 of the IBC and the Manual of Steel Construction, Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design and the Manual of Steel Construction, Load and Resistance Factor Design Specification for Structural Steel Buildings.

Prefabricated metal buildings shall be designed in accordance with the requirements published by the Metal Building Manufacturer's Association. Prefabricated metal buildings shall be designed and provided by the Contractor. The design, submittal and review of the metal buildings shall be deferred submittals in accordance with the building codes.

Cold-formed steel buildings and structures shall be designed in accordance with Division VII of Chapter 22 of the IBC and the North American Specification for the Design of Cold-Formed Steel Structural Members published by the American Iron and Steel Institute.

8.8 Seismic Anchorage design

Anchorage of Equipment is referenced in the IBC from Chapter 13 of ASCE 7-05. In accordance with this standard, design of equipment attachment is required for higher risk seismic areas (Seismic Design Categories D, E and F) for the following pieces of equipment:

- Any equipment with a component importance factor I_P greater than 1.0. This includes all equipment necessary for storage or distribution of fire water and all equipment related to the handling of hazardous materials and any fire suppression systems.
- Any equipment without flexible connections to associated piping ductwork or conduits
- Any equipment weighing more than 400 lbs
- Any equipment mounted more than 4 feet above the floor and weighing more than 20 lbs, or 5 lb/ft for distribution systems.

In areas of moderate seismic risk, (Seismic Design Category C) the following Components must be anchored:

- Any equipment with a component importance factor Ip of greater than 1.0. This includes all equipment necessary for storage or distribution of fire water and all equipment related to the handling of hazardous materials and any fire suppression systems.

In areas of lower seismic risk (Seismic Design Category B), only anchorage of Architectural components (not equipment) with a component importance factor IP of greater than 1.0 is required. No equipment anchorage is required in Seismic Design Category B or A

All equipment shall be certified by the manufacturer as having been designed to internally resist seismic loading.

Section 9: Opinion of Probable Construction Cost and Schedule

The Engineer's opinion of probable construction costs for the SEJPA RWD Project are presented below. The costs were developed based on the preliminary design criteria above, budgetary quotes from major equipment suppliers, standard costs estimating guidelines and Kennedy/Jenks' engineering experience.

Table 16 below presents a summary of standard cost estimating level descriptions, accuracy and recommended contingencies based on the development level of the project. This data was compiled from the Association for the Advancement of Cost Engineering (AACE).

Table 16: 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%
Class 1	Final (90 to 100% Design)	-5 to +10%	5 to 10%

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

The RWD Project has been developed to a preliminary level, with preliminary design criteria, preliminary layouts and a basic understanding of site conditions and limitations. Therefore, the level of accuracy for the capital and operating cost estimates presented should be considered to represent a Class 3 estimate. An estimated contingency of 18%, reflecting that used with a good quality Class 3 estimate, was applied to the opinion of probable construction cost.

The costs estimates also include marks ups for taxes on materials of 8.75%, a 6% markup for general contractor mobilization, and a 15% markup for general contractor overhead and profit. A factor of 14% was added to the opinion of construction cost to cover engineering, construction management and administration for the project.

Table 17 provides a summary of the preliminary level opinion of probable project cost of the SEJPA RWD project evaluated herein.

Table 17: Opinion of Project Cost (Two MF/UF Skids, No Solar Panels)

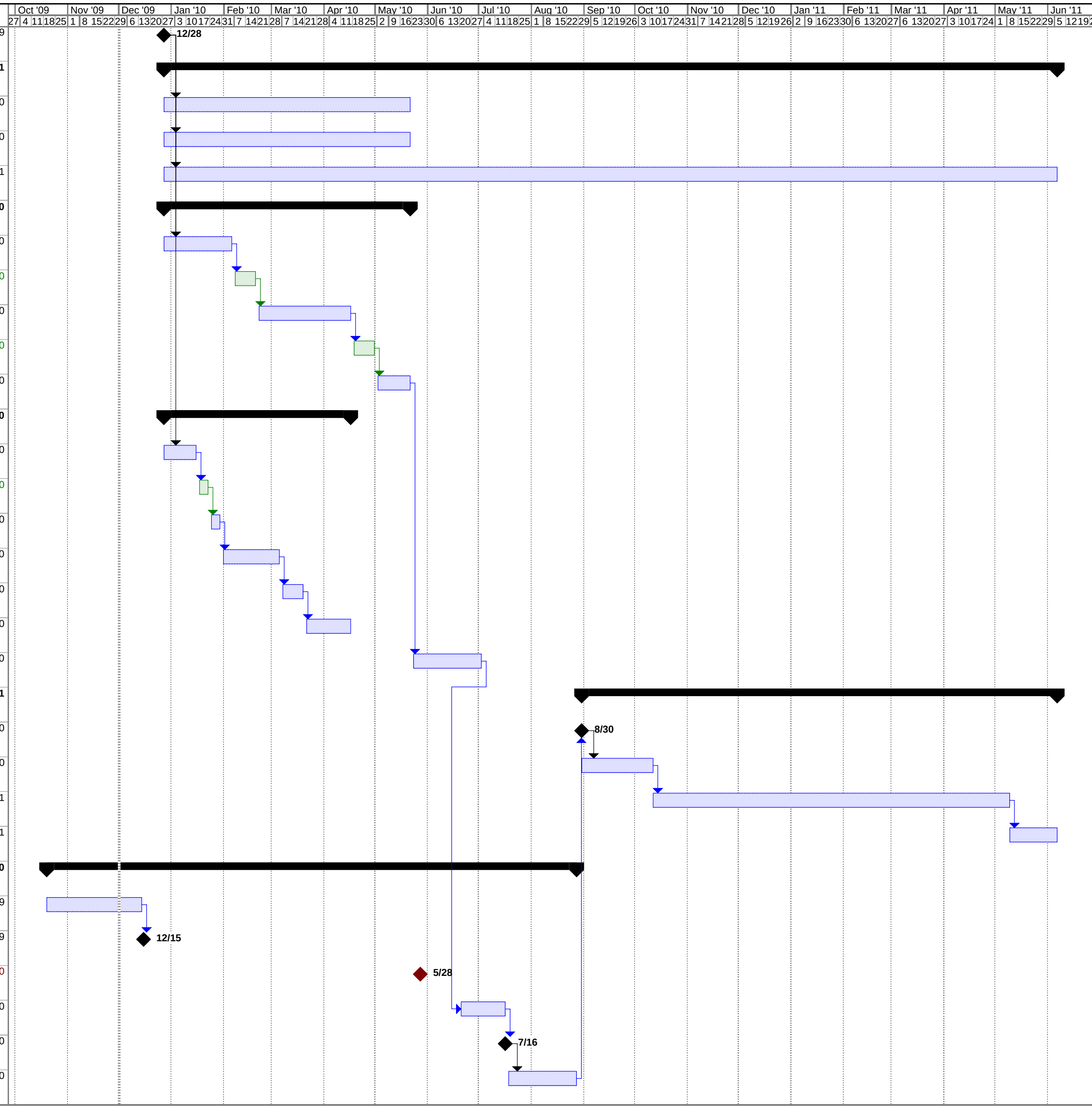
Description	Materials	Installation	Total
Site Work & Yard Piping	$47,000	$80,000	$127,000
RWD Canopy Structure	$214,000	$162,000	$375,000
Process Equipment	$1,457,000	$155,000	$1,611,000
Process Mechanical & Piping	$48,000	$28,000	$76,000
Electrical And Instrumentation	$250,000	$175,000	$425,000
Subtotal	**$2,016,000**	**$600,000**	**$2,614,000**
Taxes on Materials @ 8.75%			$176,000
Contractor Mobilization @ 6%			$167,000
Contractor Overhead and Profit @ 15%			$419,000
Estimate Contingency @ 18%			$608,000
Estimated Construction Cost			**$3,985,000**
Engineering, Construction Management and Administration @ 14%			$558,000
Estimated Project Cost			**$4,543,000**

Note: In addition to the estimated project cost ($4.5 Million) shown in Table 17, the SEJPA has committed approximately $295,000 to previous efforts related to planning, permitting and financing.

It is anticipated that the final design of the RWD System will be completed by May 2010 and construction will begin in September 2010. Per the attached design and construction schedule, the project is estimated to be completed by June 2011.

San Elijo Joint Powers Authority
Recycled Water Demineralization Project
Final Design & Construction Schedule
(Updated: December 1, 2009)

ID	Task Name	Duration	Start	Finish
1	Notice to Proceed	0 days	Mon 12/28/09	Mon 12/28/09
2	**Task 1 - Project Management**	**376 days**	**Mon 12/28/09**	**Mon 6/6/11**
3	1.1 Project Meetings & Workshops	105 days	Mon 12/28/09	Fri 5/21/10
4	1.2 Quality Control/Quality Assurance	105 days	Mon 12/28/09	Fri 5/21/10
5	1.3 Project Management	376 days	Mon 12/28/09	Mon 6/6/11
6	**Task 2 - Final Design**	**105 days**	**Mon 12/28/09**	**Fri 5/21/10**
7	5.1 50% Design	30 days	Mon 12/28/09	Fri 2/5/10
8	San Elijo JPA Review	10 days	Mon 2/8/10	Fri 2/19/10
9	5.2 90% Design	40 days	Mon 2/22/10	Fri 4/16/10
10	San Elijo JPA Review	10 days	Mon 4/19/10	Fri 4/30/10
11	5.3 Final Design	15 days	Mon 5/3/10	Fri 5/21/10
12	**Task 3 - Membrane Pre-Selection**	**80 days**	**Mon 12/28/09**	**Fri 4/16/10**
13	Prepare Draft Pre-Selection Package	15 days	Mon 12/28/09	Fri 1/15/10
14	SEJPA Review	5 days	Mon 1/18/10	Fri 1/22/10
15	Prepare Final Pre-Selection Package	5 days	Mon 1/25/10	Fri 1/29/10
16	Bid Period	25 days	Mon 2/1/10	Fri 3/5/10
17	Bid Evaluation and Award	10 days	Mon 3/8/10	Fri 3/19/10
18	Shop Drawing Review	20 days	Mon 3/22/10	Fri 4/16/10
19	Task 4 - AWT System Bidding	30 days	Mon 5/24/10	Fri 7/2/10
20	**Task 5 - Construction**	**200 days**	**Mon 8/30/10**	**Mon 6/6/11**
21	NTP	0 days	Mon 8/30/10	Mon 8/30/10
22	Mobilization	30 days	Tue 8/31/10	Mon 10/11/10
23	Construction	150 days	Tue 10/12/10	Mon 5/9/11
24	Startup & Commissioning	20 days	Tue 5/10/11	Mon 6/6/11
25	**Task 6 - SRF Funding**	**224 days**	**Tue 10/20/09**	**Fri 8/27/10**
26	Prepare SRF Application Part 1	40 days	Tue 10/20/09	Mon 12/14/09
27	Submit Application Part 1	0 days	Tue 12/15/09	Tue 12/15/09
28	SRF Priority List (Estimated)	0 days	Fri 5/28/10	Fri 5/28/10
29	Prepare Application Part 2	20 days	Mon 6/21/10	Fri 7/16/10
30	Submit Application Part 2	0 days	Fri 7/16/10	Fri 7/16/10
31	Execute Financing Agreement	30 days	Mon 7/19/10	Fri 8/27/10



Project: RW AWT SRF Schedule 0813
Date: Tue 12/1/09

Task | Split | Progress | Milestone | Summary | Client Review

Section 10: Tabulated Design Criteria

The proposed preliminary design criteria for the RWD system presented in Table 18 below. A process flow schematic for the RWD system is shown in Drawing G1.5.

Table 18: RWD Plant Preliminary Design Criteria

	Unit	Initial Value	Future Value
TERTIARY TREATMENT FLOW RATES			
Maximum Product Water	gpm	1800 (2.6 MGD)	1800 (2.6 MGD)
Average Product Water	gpm	900 (1.3 MGD)	900 (1.3 MGD)
Minimum Product Water	gpm	400 (0.58 MGD)	400 (0.58 MGD)
RWD TREATMENT FLOW RATES			
Maximum Feed Water	gpm	1,120 (1.6 MGD)	1,120 (1.6 MGD)
Average Feed Water	gpm	560 (0.81 MGD)	560 (0.81 MGD)
Maximum MF Production	gpm	940 (1.4 MGD)	940 (1.4 MGD)
Average MF Production	gpm	470 (0.68 MGD)	470 (0.68 MGD)
Maximum RO Product Water	gpm	350 (0.5 MGD)	700 (1.0 MGD)
Average RO Product Water	gpm	175 (0.25 MGD)	350 (0.5 MGD)
SECONDARY EFFLUENT SOURCE WATER [1]			
Minimum Design Temperature	°C	15	15
Total Disolved Solids	mg/L	1,200	1,200
TERTIARY TREATED WATER OBJECTIVES			
Blended Tertiary Effluent Total Disolved Solids	mg/L	<1,000	<1,000
RWD RO Permeate TDS	mg/L	~40	~40
RWD FEED PUMPS			
Maximum Source Water Flow	gpm	1,120	1,120
Average Source Water Flow	gpm	560	560
Process Pumps	number	3	3
Standby Pumps	number	1	1
Pump Max Capacity (each)	gpm @ TDH	380 @ 40	380 @ 40
Pump Design Capacity (each)	gpm @ TDH	280 @ 35	280 @ 35
Motor	HP	10	10
Speed Control	type	VFD	VFD
STRAINERS (PART OF MF SKID)			
Process Units	number	2	2

	Unit	Initial Value	Future Value
Flow Range (Each)	gpm	260-530	260-530
Nominal Particle Size Removal	microns	200	200
Backwash Approach	--	Secondary Effluent	Secondary Effluent
Minimum Backwash Pressure	psi	35	35
Approx. Backwash Volume per Unit Wash	gal	20	20
Approx. Total Backwash Volume	gpd	960	1920
Strainer Materials	--	Stainless Steel	Stainless Steel
PACKAGED MF SYSTEM			
MF Production for RO Feed (Total)	gpm	470	940
MF Production for RW Maximum (Total)	gpm	940	940
MF Instantaneous Feed (Total)	gpm	1,120	1,120
Primary Process Units	number	1	2
Redundant Units	number	1	0
Membrane Classification	--	MF/UF	MF/UF
Packaged Membrane System Type	--	Pressure	Pressure
Hollow Fiber Flow Configuration	--	Outside-In	Outside-In
Membrane Material	--	PVDF	PVDF
Design Capacity, Each	gpm	470	470
Minimum System Recovery	%	95	95
System Instantaneous Flux Rate at Design Capacity	gfd	20 to 25	20 to 25
MF SYSTEM BACKWASH			
Backwash Frequency	minutes	25 to 30	25 to 30
Backwash Source	--	Air and Filtered Water	Air and Filtered Water
Approx. Backwash Volume per Unit Wash	gal	500	500
Approx. Daily Backwash Volume at Max Flow	gpd	48,000	72,000
MF SYSTEM CLEAN-IN-PLACE (CIP)			
Maintenance Clean Frequency	days	3	3
CIP Frequency	days	> 30	> 30
Typical CIP Chemicals and Storage	--		
12.5% Sodium Hypochlorite	gal	55	55
Citric Acid	gal	55	55
Waste/Flush Volume per CIP per Unit	gal	500	500
MF FILTRATE TANK			
Quantity	number	1	1

	Unit	Initial Value	Future Value
Operational Capacity to supply 2 RO	gal	7,000	7,000
Approx. HRT with 1 MF unit offline	min	Unlimited	15
RO BOOSTER PUMPS			
Maximum RO Feed Water Flow	gpm	470	940
Average RO Feed Water Flow	gpm	235	470
RO Feed Pressure	psi	40	40
RO Bypass Flow	gpm	940	940
RO Bypass Flow Pressure	psi	5	5
Process Pumps	number	2	2
Standby Pumps	number	1	1
Pump Design Capacity (each)	gpm @ TDH	235 @ 95	470 @ 95
Bypass Capacity	gpm @ TDH	940 @ 25	940 @ 25
Motor	HP	15	30
Speed Control	type	VFD	VFD
RO SYSTEM			
Maximum Product Flow (Total, 2 units)	gpm	350 (0.5 MGD)	700 (1.0 MGD)
Average Product Flow (Total, 1 unit)	gpm	175 (0.25 MGD)	350 (0.25 MGD)
Maximum Feed Flow @ 75% Recovery (2 units)	gpm	466 (0.67 MGD)	932 (1.34 MGD)
Average Feed Flow @ 75% Recovery (1 unit)	gpm	233 (0.34 MGD)	466 (0.67 MGD)
Brine Flow (Max @ 75%)	gpm	117	234
RO Process Skids	number	2	2
Design Flux Rate	gfd	<12	<12
Design Recovery	%	75	75
Permeate Capacity per Skid - maximum	gpm	175	350
RO Membrane Array	--	2 Stage	2 Stage
RO Membrane Material	--	TFC	TFC
RO Membrane Element Diameter	inches	8	8
Nominal Cartridge Filter Rating	micron	5	5
Approximate Antiscalant Dose	mg/l	3.0	3.0
RO SYSTEM CLEAN-IN-PLACE (CIP)			
CIP Frequency	months	> 3	> 3
Typical CIP Chemicals and Storage	--		
Caustic Soda	gal	55	55
Citric Acid	gal	55	55
Surfactant	gal	None	None
Waste/Flush Volume per CIP per Unit	gal	500	500

	Unit	Initial Value	Future Value
RWD SPENT WASHWATER PUMP STATION			
Design Instantaneous Volume to Sump at Max Flow (1 Strainer + 2 UF Unit Backwashes)	gal	1000	1000
Typical Backwash Volume per Day at Max Flow (Strainer + UF)	gal	48,000	72,000
Maximum Washwater Flowrate	gpm	25	50
Backwash Wet Well Volume	gal	4000	4000
Return Water Pumps (Lead and Standby)	number	2	2
Pump Type	--	Submerged	Submerged
Capacity (each pump)	gpm @ TDH ft	60 gpm @ 20 ft	60 gpm @ 20 ft
Motor	HP	3	3
Speed Control	type	fixed	fixed
HYPOCHLORITE			
Process Water Flow (Min/Avg/Max)	gpm	560 / 560 / 1120	560 / 560 / 1120
Dosage (Min/Avg/Max) (Solution)	mg/l	7 / 10 / 10	7 / 10 / 10
Use - Min/Avg/Max	ppd	47 / 67 / 133	47 / 67 / 133
Chemical Solution Conc. (Solution)	lbs/gal	0.92	0.92
Metering Pumps			
Number of Pumps (Lead and Standby)	-	2	2
Pump Capacity - Min/Avg/Max	gph	2.1 / 3.0 / 6.0	2.1 / 3.0 / 6.0
Pump Capacity - Min/Avg/Max	mL/min	133 / 191 / 381	133 / 191 / 381
Storage Tank			
Type	-	(E) Chem Storage Tank	(E) Chem Storage Tank
Number	-	1	1
Operational Capacity	gallons	2,000	2,000
Max Use	gal/day	57	57
Supply at Avg Use	days	>30	>30
ANTISCALANT			
Process Water Flow (Min/Avg/Max)	gpm	470 / 470 / 940	470 / 470 / 940
Dosage (Min/Avg/Max) (Solution)	mg/l	2 / 3 / 3	2 / 3 / 3
Use - Min/Avg/Max	ppd	11 / 17 / 34	11 / 17 / 34
Chemical Solution Conc. (Solution)	lbs/gal	9.2	9.2
Metering Pumps			
Number of Pumps (Lead and Standby)	-	2	2
Pump Capacity - Min/Avg/Max	gph	0.05 / 0.08 / 0.15	0.05 / 0.08 / 0.15
Pump Capacity - Min/Avg/Max	mL/min	3.2 / 4.8 / 10	3.2 / 4.8 / 10
Storage Tank			

	Unit	Initial Value	Future Value
Type	-	Tote	Tote
Number	-	1	1
Operational Capacity (Each)	gallons	250	250
Overall (Nominal) Capacity (Each)	gallons	330	330
Supply at Avg./Max. Use	days	30 / 15	30 / 15

Section 11: Preliminary Design Drawings

The preliminary design report includes preliminary drawings to present portions of the project design in conceptual form, to allow review of the project by SEJPA Staff and to facilitate developing the opinion of probable project cost. The drawings included herein are:

General
Drawing G1.4: RWD Facility Process Flow Schematic
Drawing G1.5: RWD Facility Hydraulic Profile

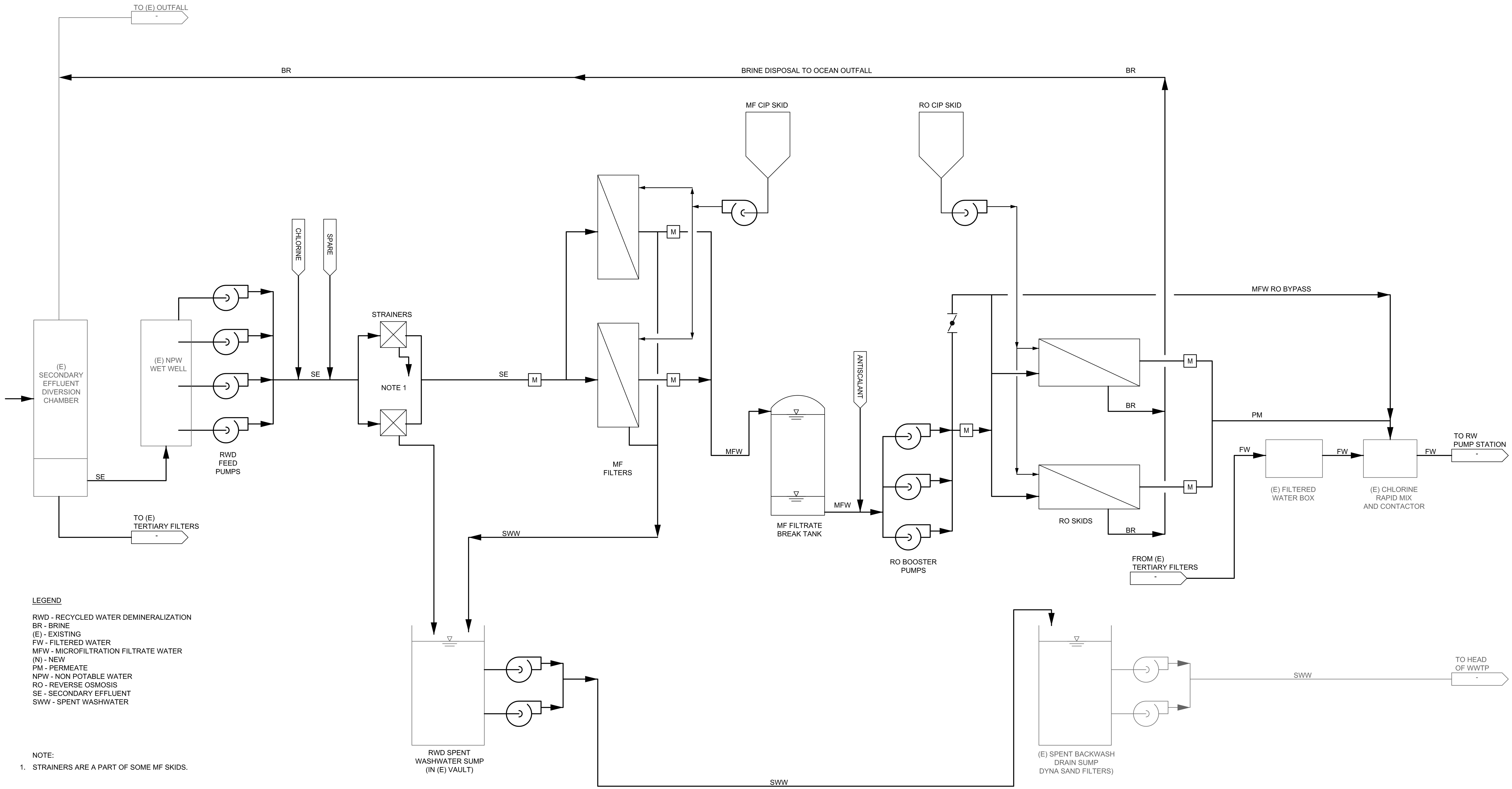
Civil
Drawing C1.3: RWD Facility Site Plan

Architectural
Drawing A2.1: RWD Facility Plan
Drawing A2.2: RWD Facility Exterior Elevations Options 1 and 2

Mechanical
Drawing M2.1: RWD Facility Process Plan

Electrical
Drawing E1.1: RWD Facility Electrical Site Plan
Drawing E1.2: RWD Facility MCC-L Single Line Diagram
Drawing E1.3: RWD Facility MCC-M Single Line Diagram
Drawing E1.4: RWD Facility MCC-G Single Line Diagram

P&IDs
Drawing I1.1: Instrumentation Legend and Abbreviations
Drawing I1.2: SCADA Block Diagram
Drawing I1.3: Process and Instrumentation Diagram RWD Membrane Pretreatment System
Drawing I1.4: Process and Instrumentation Diagram RWD RO Treatment System
Drawing I1.5: Process and Instrumentation Diagram MF/UF and RO CIP System
Drawing I1.6: Process and Instrumentation Diagram Spent Washwater System



LEGEND

RWD - RECYCLED WATER DEMINERALIZATION
BR - BRINE
(E) - EXISTING
FW - FILTERED WATER
MFW - MICROFILTRATION FILTRATE WATER
(N) - NEW
PM - PERMEATE
NPW - NON POTABLE WATER
RO - REVERSE OSMOSIS
SE - SECONDARY EFFLUENT
SWW - SPENT WASHWATER

NOTE:

1. STRAINERS ARE A PART OF SOME MF SKIDS.

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NO.	REVISION	DATE	BY

SCALES

0 1"

0 25mm

IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

REGISTERED PROFESSIONAL ENGINEER TODD K. REYNOLDS No. C59630 Exp. 12/31/09 CIVIL STATE OF CALIFORNIA

DESIGNED PDT

DRAWN JL

CHECKED TKR

SAN ELIJO JOINT POWERS AUTHORITY

SAN ELIJO WATER RECLAMATION FACILITY

RECYCLED WATER DEMINERALIZATION PROJECT PRELIMINARY DESIGN REPORT

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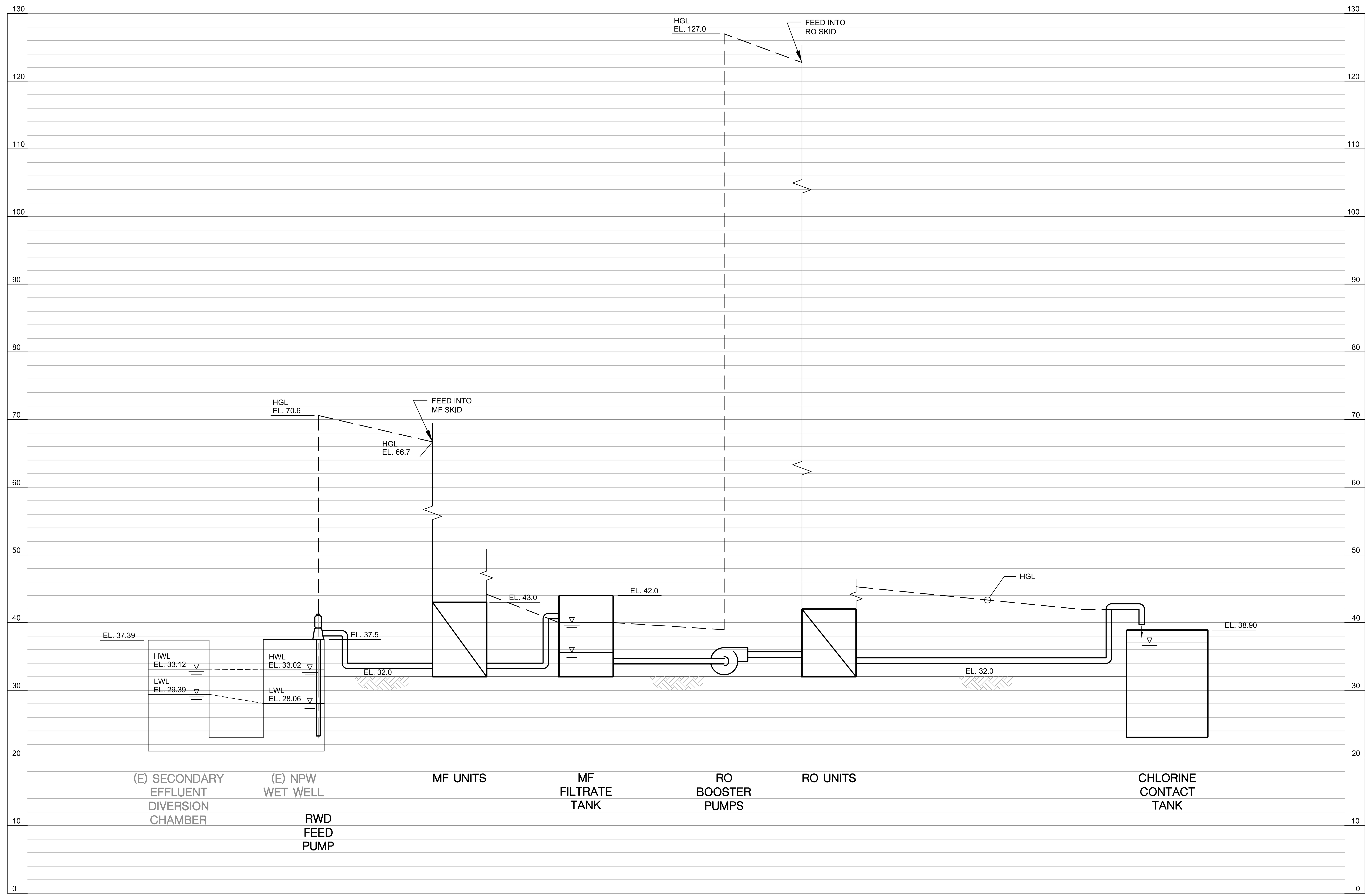
RWD FACILITY PROCESS FLOW SCHEMATIC

FILE NAME 098711_00-G1_4

JOB NO. 0987112.00

DATE DECEMBER 2009

SHEET G 1.4 OF X



NOTE:

1. HGL IS SHOWN FOR FUTURE MAX FLOW OF 700 GPM PERMEATE.

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SCALES

0 — 1"

0 — 25mm

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RWD FACILITY HYDRAULIC PROFILE

FILE NAME 0987112_00-G1_5

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SHEET G 1.5 OF X

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SITE PLAN

0 10 20 30

1"=20'

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0 — 25mm

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REGISTERED PROFESSIONAL ENGINEER
COREY B. YOUNG
No. C 69577
EXP. 06-30-10
CIVIL
STATE OF CALIFORNIA

DESIGNED CBY

DRAWN LMM

CHECKED MAT

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RWD FACILITY
SITE PLAN

FILE NAME 0987112_00-C1_3

JOB NO. 0987112.00

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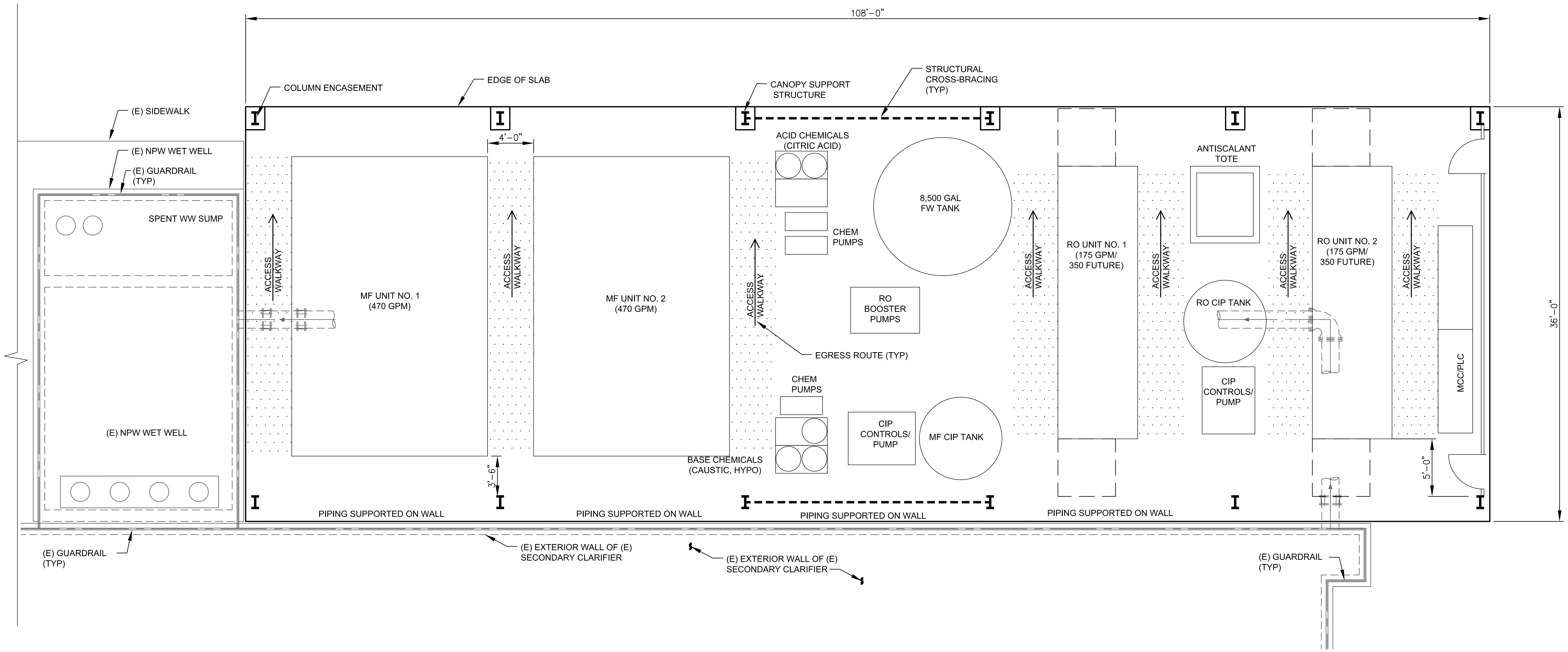
SHEET C1.3 OF X



PLAN

0 4 8

3/16"=1'-0"

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SCALES

0 1"

0 25mm

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LICENSED ARCHITECT
WILLIAM G. RAMROTH
C-9594
REN. 7/31/11
STATE OF CALIFORNIA

DESIGNED HLV

DRAWN HLV

CHECKED WGR

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RWD FACILITY PLAN

FILE NAME 0987112_00-A2_1

JOB NO. 0987112.00

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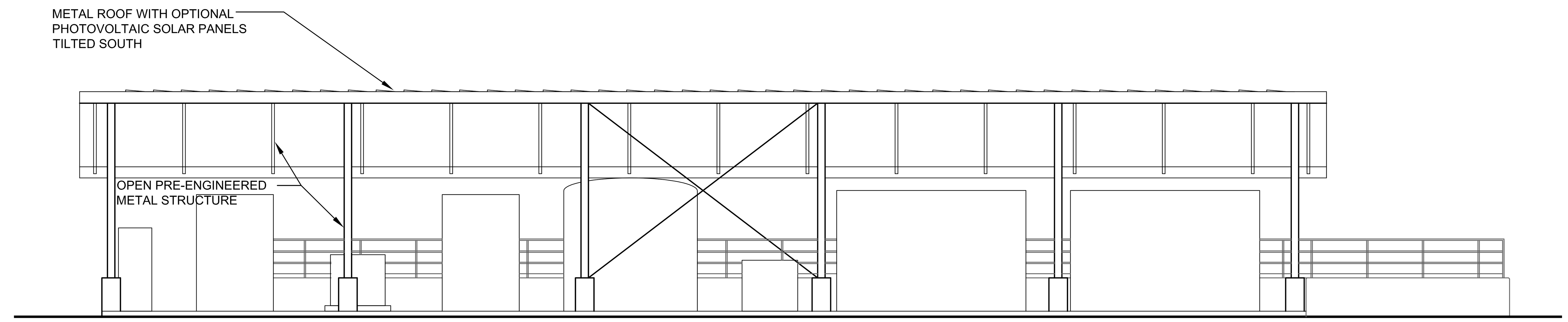
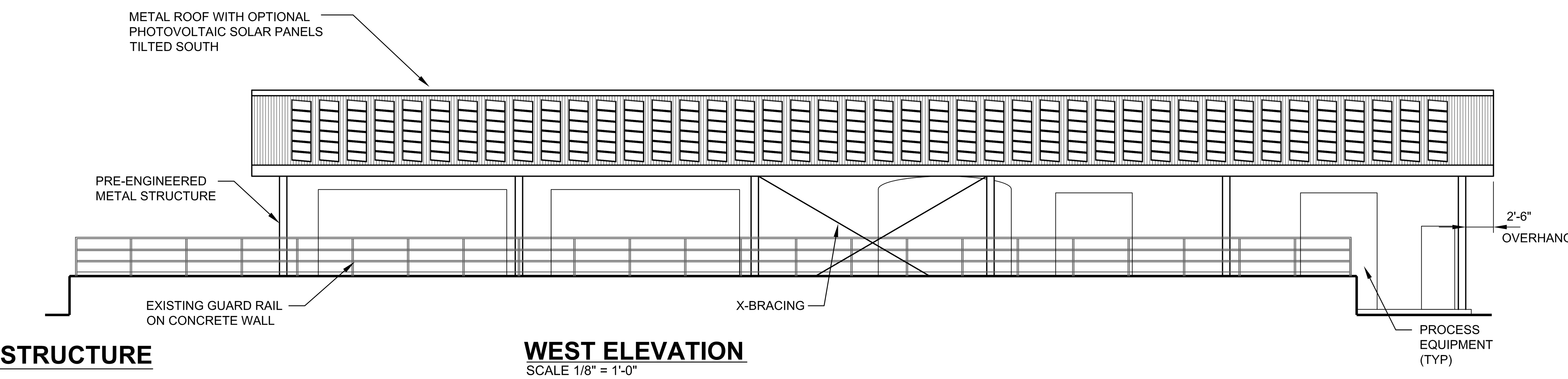
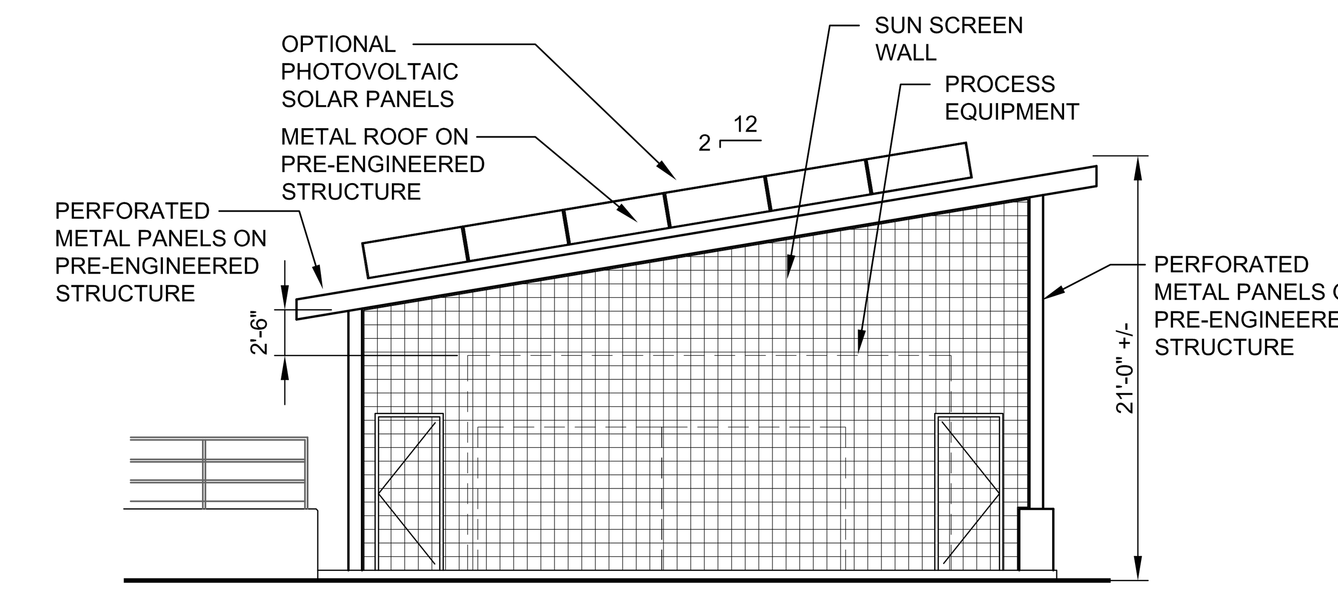
SHEET **A2.1** OF X



EAST ELEVATION
SCALE 1/8" = 1'-0"

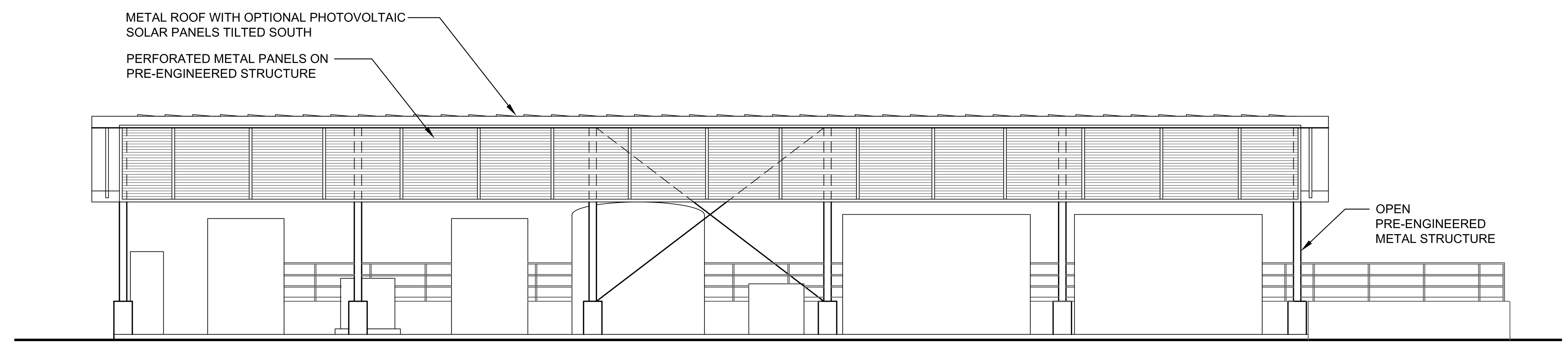




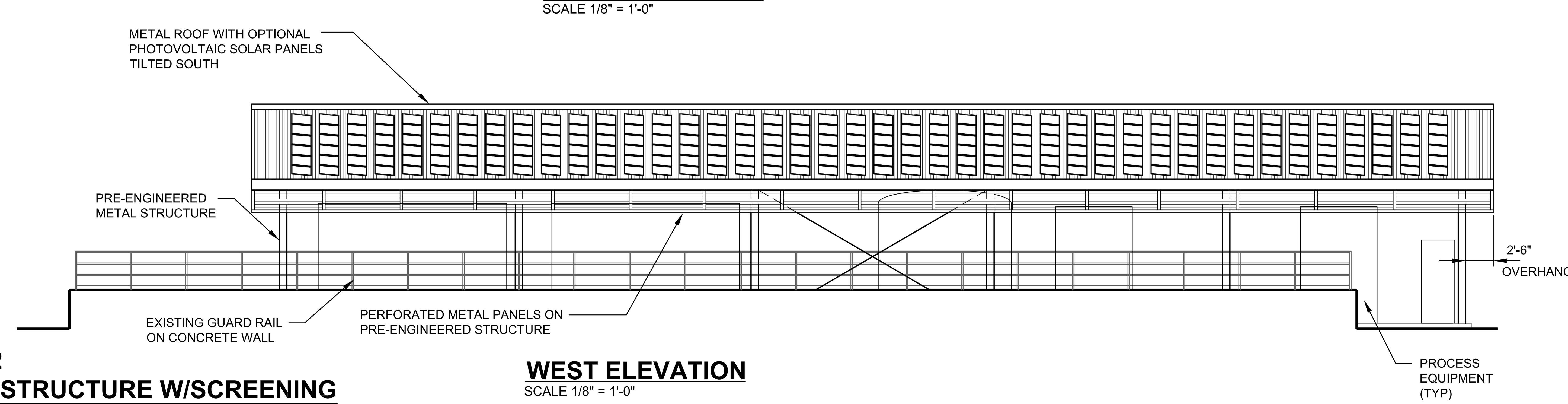
OPTION 1
CANOPY STRUCTURE

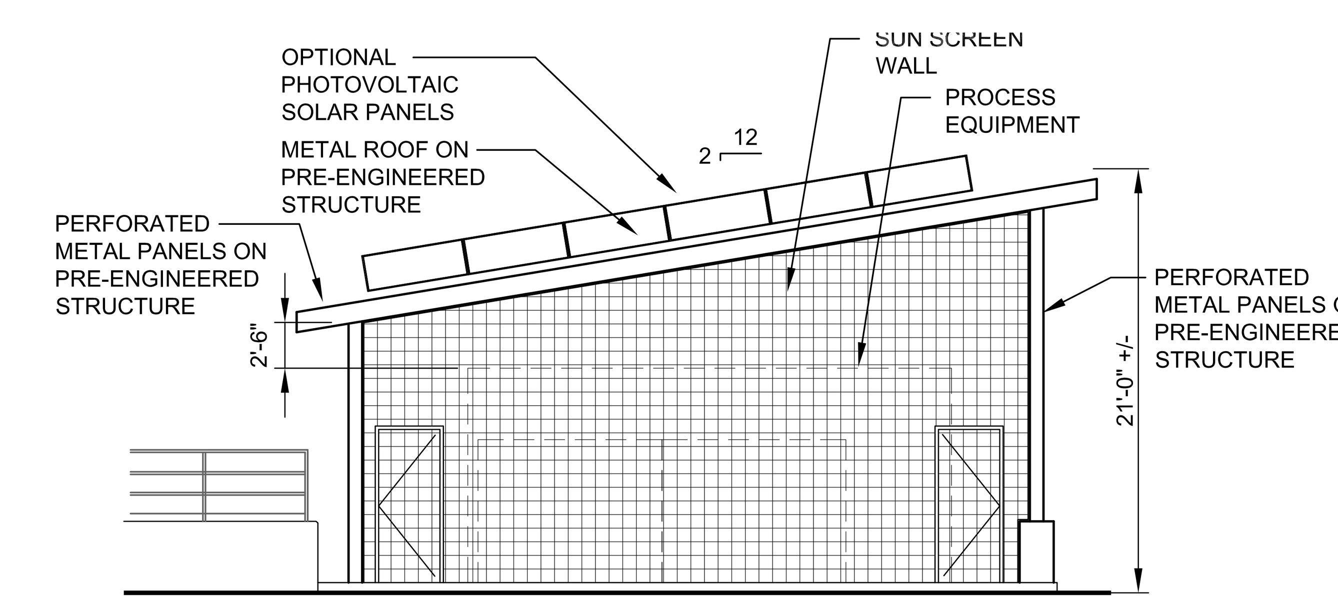
WEST ELEVATION
SCALE 1/8" = 1'-0"

SOUTH ELEVATION
SCALE 1/8" = 1'-0"



EAST ELEVATION
SCALE 1/8" = 1'-0"





OPTION 2
CANOPY STRUCTURE W/SCREENING

WEST ELEVATION
SCALE 1/8" = 1'-0"

SOUTH ELEVATION
SCALE 1/8" = 1'-0"

0 4' 8' 16'
SCALE 1/8" = 1'-0"

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SCALES
0 — 1"
0 — 25mm
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LICENSED ARCHITECT
WILLIAM G. RAMROTH
C-9594
REN. 7/31/11
STATE OF CALIFORNIA

DESIGNED HLV
DRAWN HLV
CHECKED WGR

SAN ELIJO JOINT POWERS AUTHORITY
SAN ELIJO WATER RECLAMATION FACILITY
RECYCLED WATER DEMINERALIZATION PROJECT
PRELIMINARY DESIGN REPORT

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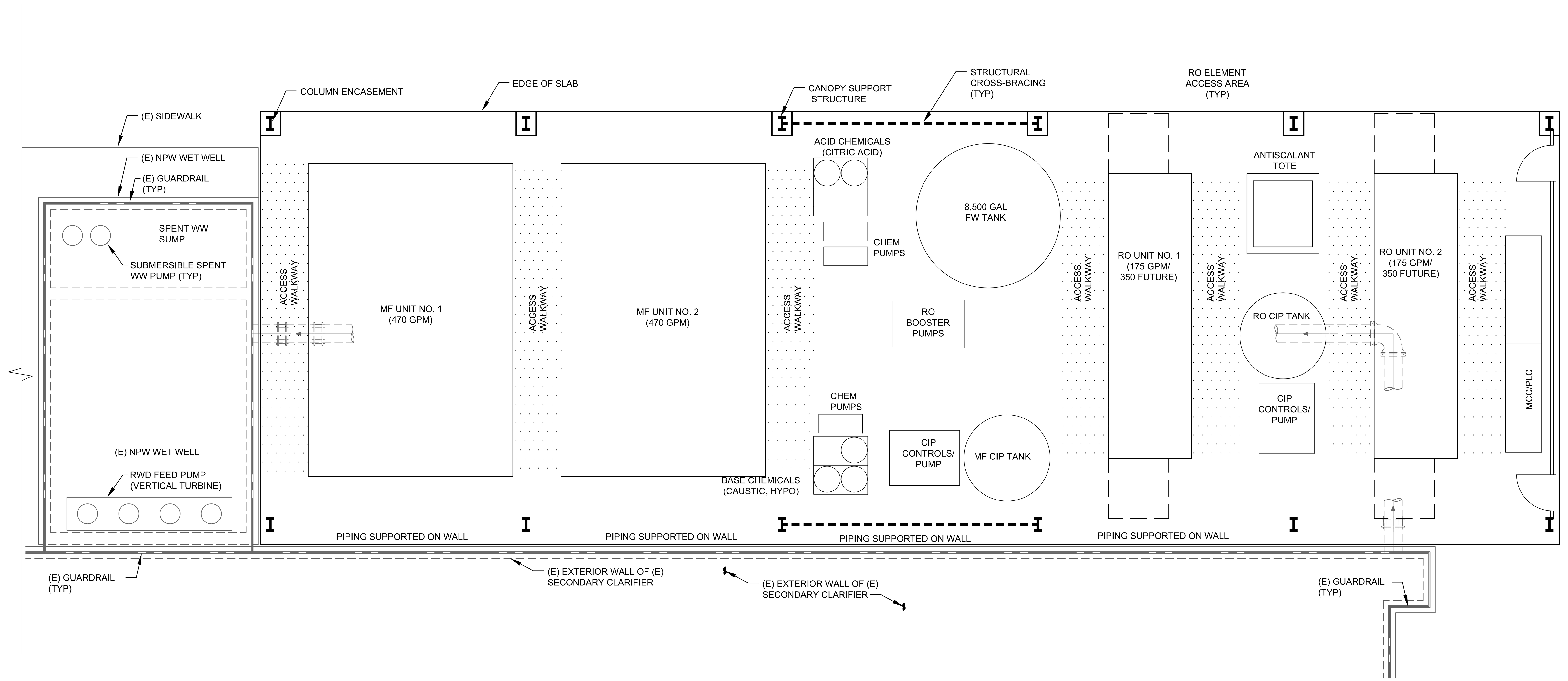
RWD FACILITY
EXTERIOR ELEVATIONS
OPTIONS 1 AND 2

FILE NAME 0987112_00-A2_2
JOB NO. 0987112.00
DATE DECEMBER 2009
SHEET A2.2 OF X



PLAN

0 4 8

3/16"=1'-0"

USE OF DOCUMENTS

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SCALES

0 1"

0 25mm

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DRAWN HLV

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RWD FACILITY
PROCESS PLAN

FILE NAME 0987112_00-M_1

JOB NO. 0987112.00

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0 — 25mm

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REGISTERED PROFESSIONAL ENGINEER
JOSEPH M. MORAES
No. E11023
Exp. 6/30/11
ELECTRICAL
STATE OF CALIFORNIA

DESIGNED JMM

DRAWN CAD

CHECKED JMM

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RWD FACILITY
ELECTRICAL SITE PLAN

FILE NAME 0987112_00-E1_1

JOB NO. 0987112.00

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SHEET E1.1 OF X

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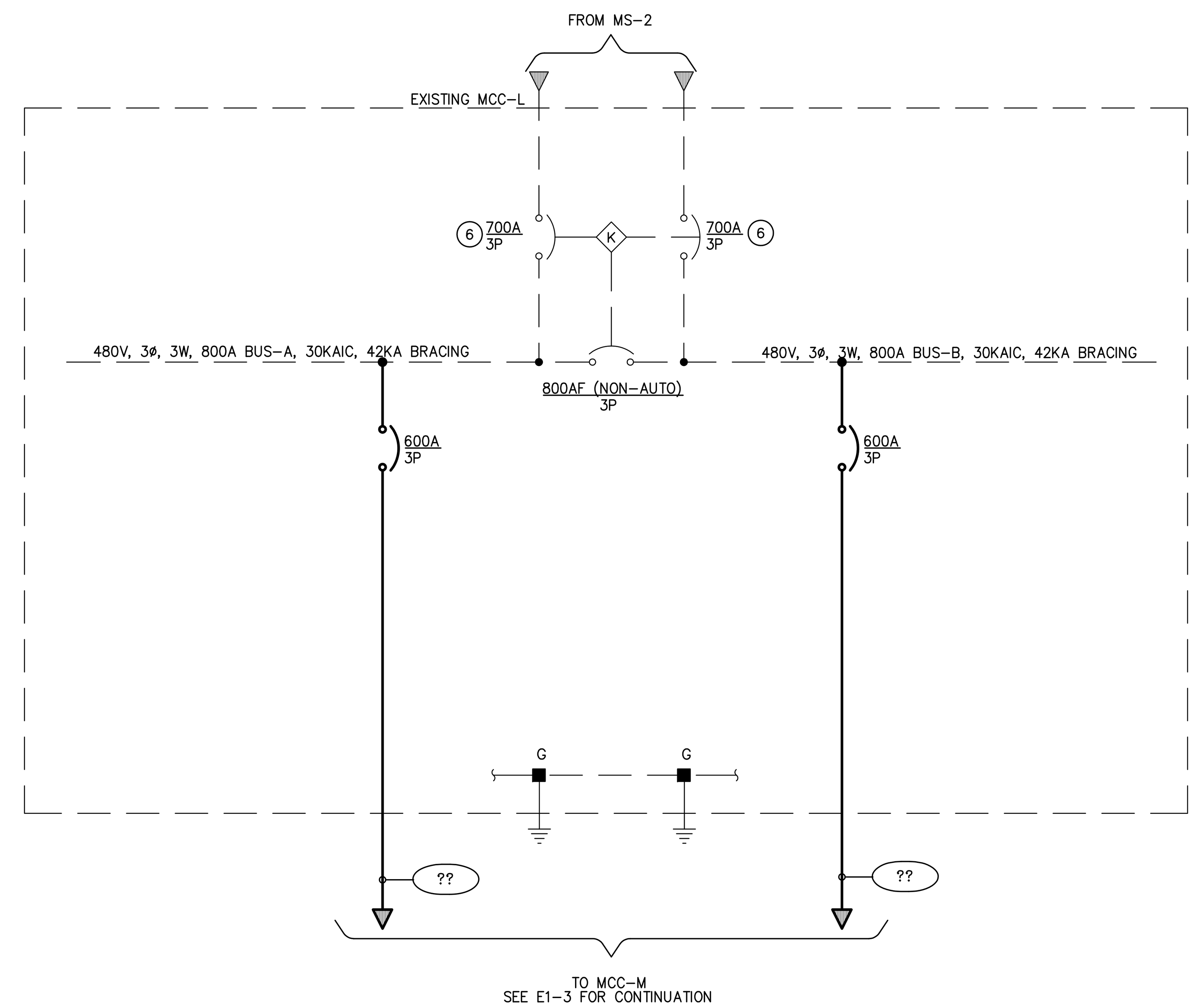


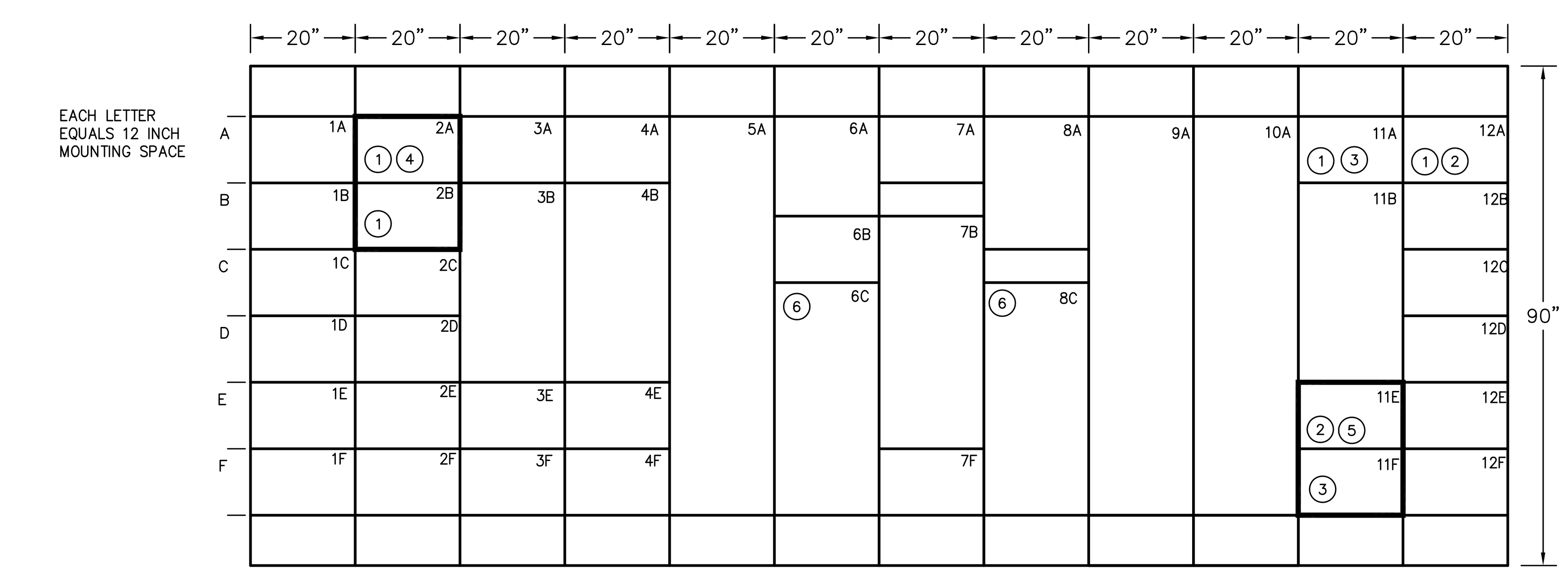
LEGEND

EXISTING

NEW

NOTES:

1. REMOVE MCC-L BUCKETS IN THE FOLLOWING LOCATIONS: 2A, 2B, 11A, AND 12A. RETURN USED EQUIPMENT TO SAN ELIJO JPA.
2. RELOCATE STARTER FOR RAPID MIXER FROM LOCATION 11E TO LOCATION 12A.
3. RELOCATE CAPACITOR FOR RECLAIMED WATER PUMP NO. 2 FROM LOCATION 11F TO LOCATION 11A.
4. PROVIDE 600A FEEDER BREAKER IN MCC-L LOCATION 2A FOR MCC-M BUS A. PROVIDE CUSTOM ENGRAVING WITH EQUIPMENT NAME AND NUMBER. MATCH EXISTING MCC ENGRAVINGS.
5. PROVIDE 600A FEEDER BREAKER IN MCC-L LOCATION 11E FOR MCC-M BUS B. PROVIDE CUSTOM ENGRAVING WITH EQUIPMENT NAME AND NUMBER. MATCH EXISTING MCC ENGRAVINGS.
6. REPLACE 700 AMP TRIP PLUG WITH AN 800 AMP TRIP PLUG.



A / E1-2 EXISTING MCC-L ELEVATION

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0 — 25mm

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PRELIMINARY DESIGN REPORT

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RWD FACILITY
MCC-L SINGLE LINE DIAGRAM

FILE NAME 0987112_00-E1_2

JOB NO. 0987112.00

DATE DECEMBER 2009

SHEET E1.2 OF X

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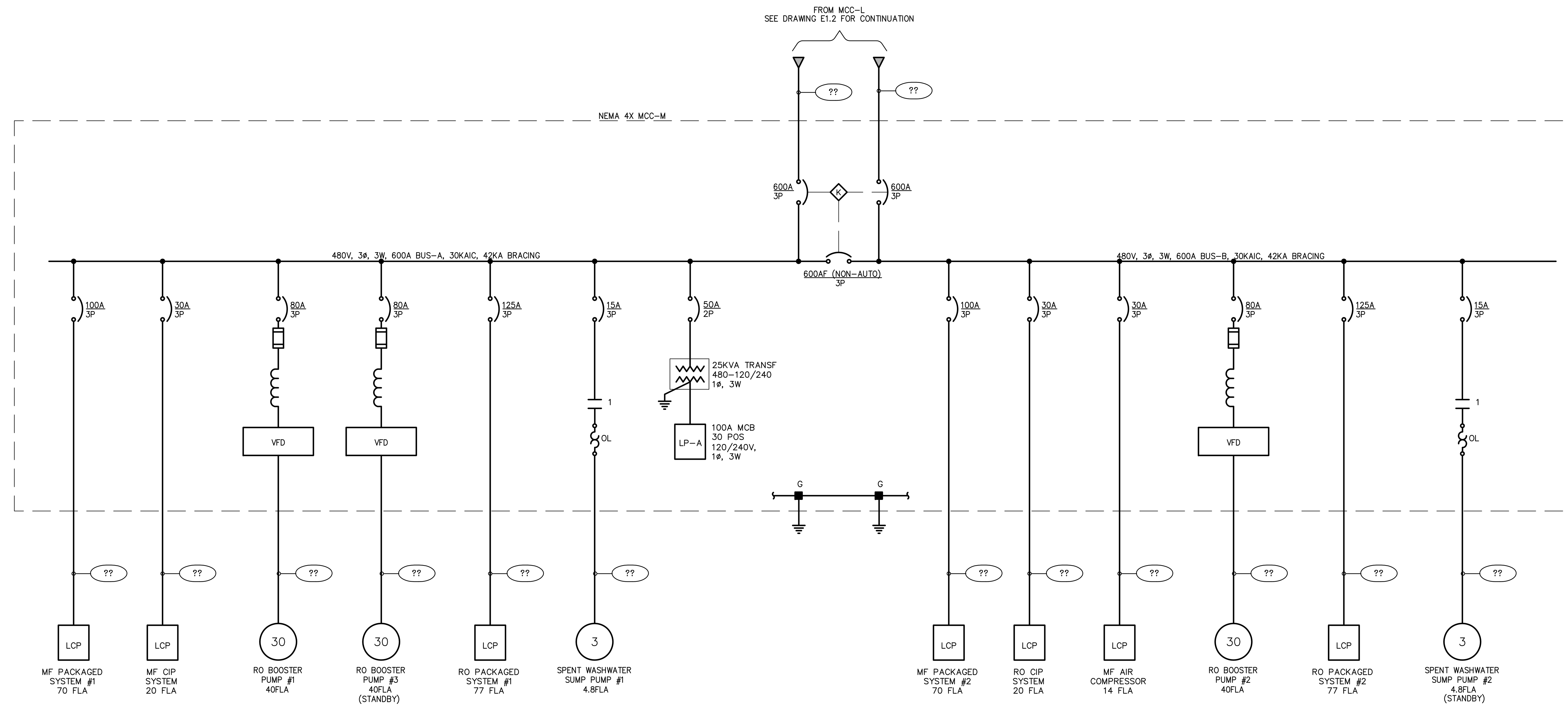
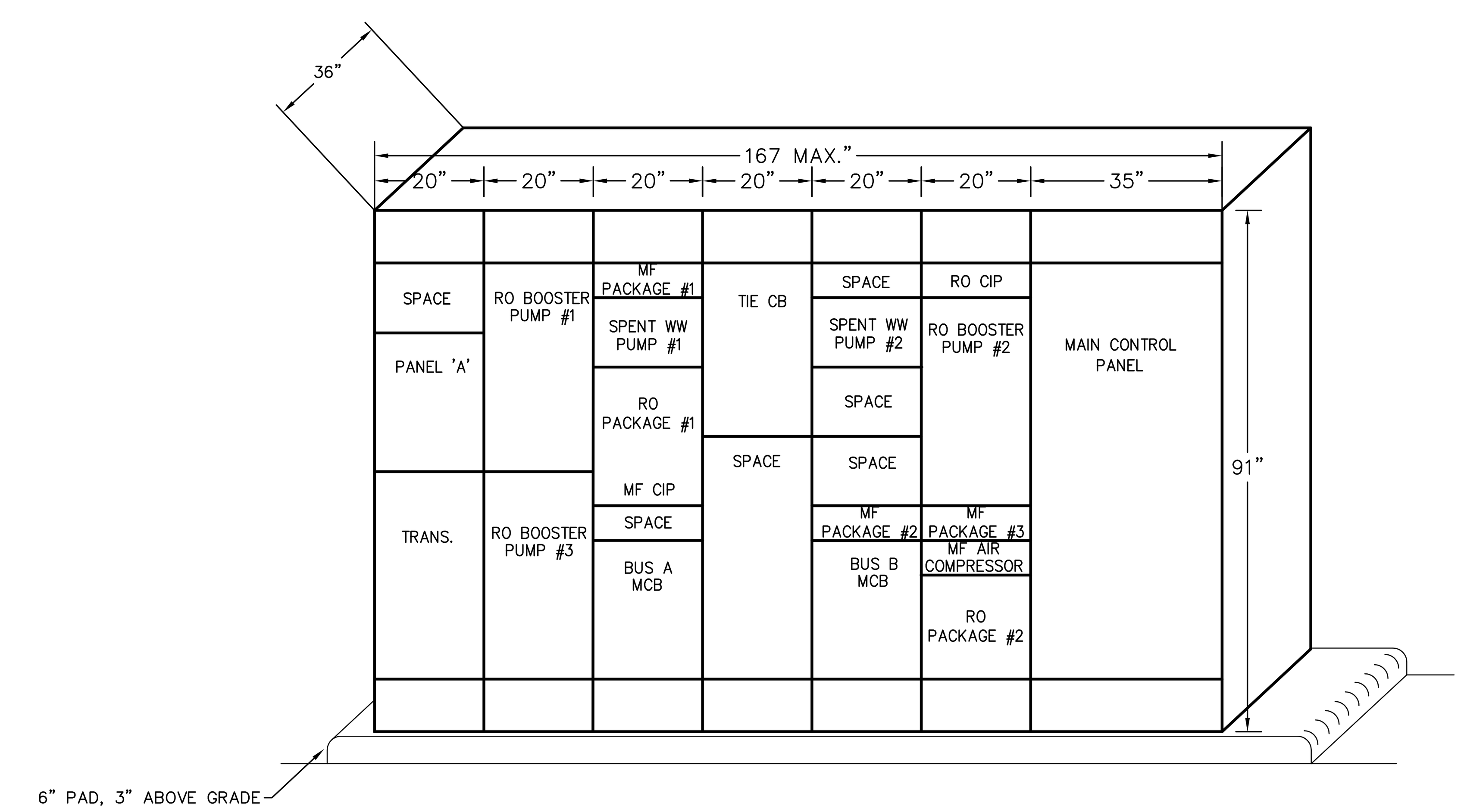


MCC-M BUS-A LOAD CALC	
MF PACKAGE #1	70A
MF CIP	20A
RO PUMP #1	40A
RO PUMP #3 (STBY)	0A
RO PACKAGE #1	77A
SPENT WW PUMP #1	4.8A
PANEL A	30A
25% LARGEST MOTOR	10A
	251.8A @480V,3ø

MCC-M BUS-B LOAD CALC	
MF PACKAGE #2	70A
RO CIP	20A
AIR COMPRESSOR	14A
RO PUMP #2	40A
RO PACKAGE #2	77A
SPENT WW PUMP #2 (STBY)	0A
25% LARGEST MOTOR	10A
	231.0A @480V,3ø



A E1-3 NEMA 3R STAINLESS STEEL MCC-M ELEVATION

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SAN ELIJO WATER RECLAMATION FACILITY

RECYCLED WATER DEMINERALIZATION PROJECT
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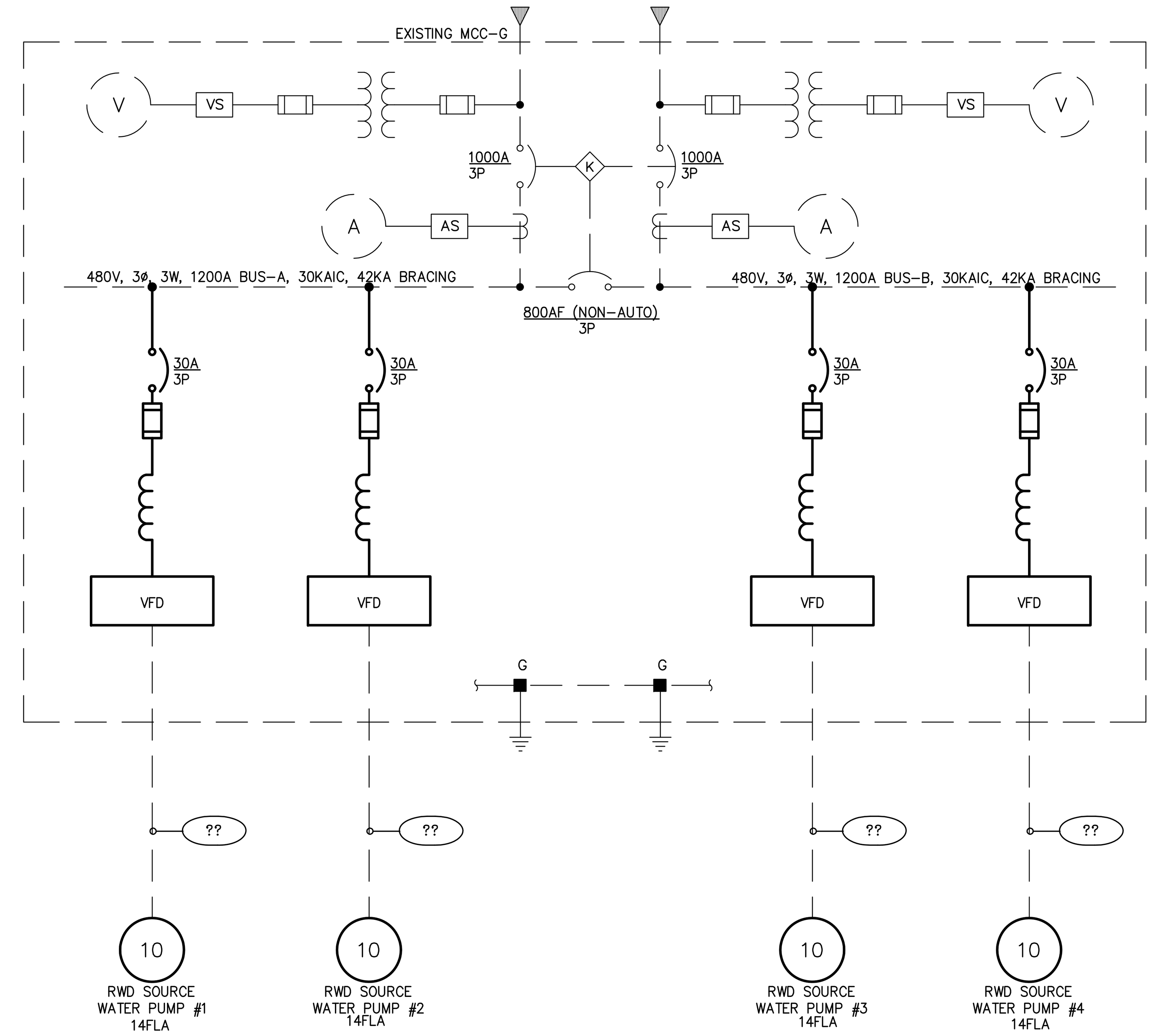
RWD FACILITY
MCC-M SINGLE LINE DIAGRAM

FILE NAME 0987112_00-E1_3
JOB NO. 0987112.00
DATE DECEMBER 2009
SHEET **E1.3** OF X

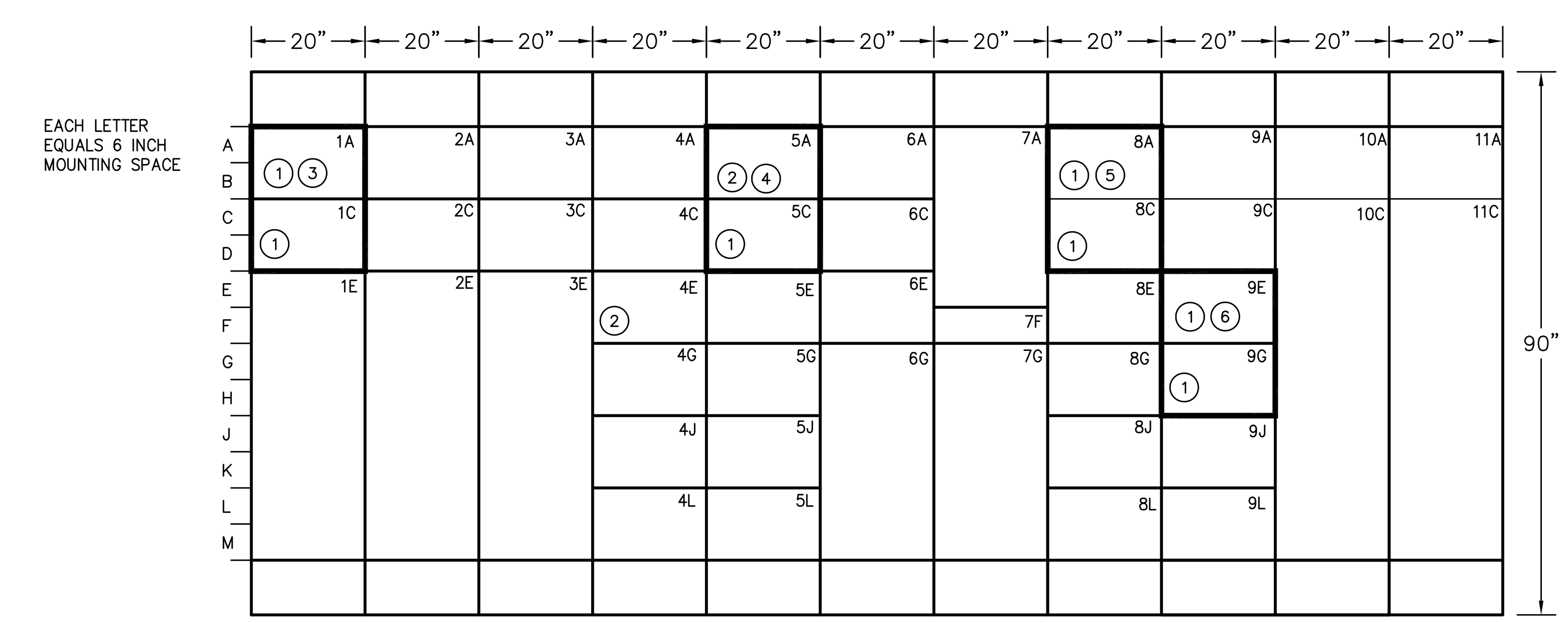


LEGEND

- - - EXISTING
——— NEW

NOTES:

1. REMOVE MCC-G BUCKETS IN THE FOLLOWING LOCATIONS: 1A, 1C, 4E, 5C, 8A, 8C, 9E, AND 9G. RETURN USED EQUIPMENT TO SAN ELIJO JPA.
2. RELOCATE STARTER FOR EXHAUST FAN EF-5 FROM LOCATION 5A TO LOCATION 4E.
3. PROVIDE VFD IN MCC-G LOCATION 1A FOR RWD SOURCE WATER PUMP #1. PROVIDE CUSTOM ENGRAVING WITH EQUIPMENT NAME AND NUMBER. MATCH EXISTING MCC ENGRAVINGS.
4. PROVIDE VFD IN MCC-G LOCATION 5A FOR RWD SOURCE WATER PUMP #2. PROVIDE CUSTOM ENGRAVING WITH EQUIPMENT NAME AND NUMBER. MATCH EXISTING MCC ENGRAVINGS.
5. PROVIDE VFD IN MCC-G LOCATION 8A FOR RWD SOURCE WATER PUMP #3. PROVIDE CUSTOM ENGRAVING WITH EQUIPMENT NAME AND NUMBER. MATCH EXISTING MCC ENGRAVINGS.
6. PROVIDE VFD IN MCC-G LOCATION 9E FOR RWD SOURCE WATER PUMP #4. PROVIDE CUSTOM ENGRAVING WITH EQUIPMENT NAME AND NUMBER. MATCH EXISTING MCC ENGRAVINGS.



A / E1-4 EXISTING MCC-G ELEVATION

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(760) 431-7177

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0 — 25mm

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REGISTERED PROFESSIONAL ENGINEER
JOSEPH M. MORAES
No. E11023
Exp. 6/30/11
ELECTRICAL
STATE OF CALIFORNIA

DESIGNED JMM
DRAWN CAD
CHECKED JMM

SAN ELIJO JOINT POWERS AUTHORITY
SAN ELIJO WATER RECLAMATION FACILITY
RECYCLED WATER DEMINERALIZATION PROJECT
PRELIMINARY DESIGN REPORT

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RWD FACILITY
MCC-G SINGLE LINE DIAGRAM

FILE NAME 0987112_00-E1_4
JOB NO. 0987112.00
DATE DECEMBER 2009
SHEET **E1.4** OF X

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INSTRUMENT SYMBOL IDENTIFIERS

J-3, J-1, J-2, J-4, J-5, J-6

- J-1: IDENTIFICATION LETTERS (SEE TABLE BELOW)
- J-2: LOOP NUMBER
- J-3: VENDOR DESIGNATOR (NOTE 3)
- J-4: FUNCTION BLOCK (SEE TABLE BELOW)
- J-5: PANEL NUMBER
- J-6: HANDSWITCH DESIGNATOR (SEE BELOW)

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE			CONTROL	CLOSED
D	DENSITY	DIFFERENTIAL	DAMPER		
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY	SWITCH		
T	TEMPERATURE			TRANSMIT	
U	MULTI VARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, OR LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

GENERAL INSTRUMENT OR FUNCTION SYMBOLS	FIELD MOUNTED	PRIMARY LOCATION ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION ACCESSIBLE TO OPERATOR	NORMALLY INACCESSIBLE OR BEHIND THE PANEL
DISCRETE INSTRUMENTS				
SHARED DISPLAY, SHARED CONTROL				
COMPUTER FUNCTION				
PROGRAMMABLE LOGIC CONTROL				

J-4 FUNCTION BLOCK DESIGNATORS

- SUMMING
- DIFFERENCE
- INTEGRAL
- DERIVATIVE
- MULTIPLYING
- DIVIDING
- CONVERT:
- ROOT EXTRACTION
- SQUARE ROOT
- EXPONENTIAL
- HIGH SELECTING
- LOW SELECTING
- BIAS
- F(X) NONLINEAR OR UNSPECIFIED FUNCTION

* E - VOLTAGE; I - CURRENT; P - PNEUMATIC; A - ANALOG; B - BINARY; H - HYDRAULIC; O - ELECTROMAGNETIC, SONIC; R - RESISTANCE (ELECT); D - DIGITAL

J-6 HANDSWITCH DESIGNATORS

HOA	HAND-OFF-AUTO	LR	LOCAL-REMOTE
HOR	HAND-OFF-REMOTE	OC	OPEN-CLOSE
F-R	FORWARD-REVERSE	OCA	OPEN-CLOSE-AUTO
1-0	ON-OFF	A/M	AUTO-MANUAL

INSTRUMENT SERVICES

- AS — INSTRUMENT AIR SUPPLY (NOTE 4)
- ES — 120 VAC ELECTRICAL SERVICE (DIFFERENT VOLTAGES ARE SPECIFICALLY NOTED)

PLC INPUT/OUTPUT

- DISCRETE INPUT
- ANALOG INPUT
- DISCRETE OUTPUT
- ANALOG OUTPUT

FLOW PRIMARY ELEMENTS

- ORIFICE PLATE
- SINGLE PORT PITOT TUBE OR PITOT-VENTURI TUBE
- VENTURI TUBE
- AVERAGING PITOT TUBE
- FLUME
- WEIR
- TURBINE OR PROPELLER-TYPE PRIMARY ELEMENT
- THERMAL MASS FLOWMETER
- POSITIVE DISPLACEMENT TYPE FLOW TOTALIZING INDICATOR
- VORTEX SENSOR
- TARGET TYPE SENSOR
- FLOW NOZZLE
- MAGNETIC FLOWMETER
- SONIC FLOWMETER
- ROTAMETER
- ROTAMETER WITH INTEGRAL VALVE

LINES

- MAIN PROCESS
- SECONDARY PROCESS
- I - 2 / A: REFERENCES LEAVING SHEET; LINE CONTINUATION; TO DRAWING REFERENCE
- A / I - 3: REFERENCES ENTERING SHEET; FROM DRAWING REFERENCE; LINE CONTINUATION
- 24" BW: PIPE SYSTEM; PIPE SIZE IN INCHES
- ELECTRICAL SIGNAL
- SOFTWARE OR DATALINK
- PNEUMATIC
- HYDRAULIC
- CAPILLARY TUBE
- ELECTROMAGNETIC OR SONIC (GUIDED)

MECHANICAL — OR — ELECTRICAL

CONNECTED

NOT CONNECTED

VALVES

- GATE VALVE
- GLOBE VALVE
- PLUG VALVE
- CHECK VALVE
- PINCH VALVE
- DIAPHRAGM VALVE
- BUTTERFLY VALVE
- BALL VALVE
- NEEDLE VALVE
- PLUG (COCK)
- PRESSURE REDUCING REGULATING VALVE, SELF-CONTAINED
- BACK PRESSURE REGULATING VALVE, SELF-CONTAINED
- PRESSURE REDUCING REGULATOR WITH EXTERNAL PRESSURE TAP
- 3-WAY VALVE
- 4-WAY VALVE
- ANGLE VALVE
- PRESSURE RELIEF VALVE
- * FC = FAIL CLOSED; FO = FAIL OPEN; LC = LOCKED CLOSED; LO = LOCKED OPEN
- CLOSED DURING NORMAL OPERATION
- SHADING INDICATES PORT TO BE CLOSED DURING NORMAL OPERATION. DOT INDICATES PORT TO BE CLOSED DURING ALTERNATE OPERATION.

VALVE OPERATORS

- DIAPHRAGM
- DIAPHRAGM PRESSURE BALANCED
- M — MOTOR
- CYLINDER OPERATOR
- S — SOLENOID
- SV — SOLENOID VALVE

TYPICAL CONNECTION

- IN-LINE DEVICE
- DIRECT CONNECTION TO PROCESS
- TEMPERATURE ELEMENT WITH WELL
- RADIATION OR SONIC SENSING
- FILLED SYSTEM, DIAPHRAGM SEAL CONNECTION

MISCELLANEOUS

- FLANGE
- UNION
- Y STRAINER
- FLOW STRAIGHTENING VANE
- TEE
- SCREWED CAP
- WELDED CAP
- BLIND FLANGE
- REDUCER
- HB — HOSE BIBB CONNECTION
- EXPANSION JOINT
- FLEXIBLE COUPLING
- FLANGED COUPLING ADAPTER
- SLUICE GATE OR SLIDE GATE
- DRAIN
- DIAPHRAGM SEAL
- RUPTURE DISK, PRESSURE
- RUPTURE DISK, VACUUM
- P — PURGE
- THERMOMETER WELL
- CALIBRATION CYLINDER
- PULSATION DAMPER
- AIR RELIEF VALVE
- AIR RELEASE
- LEVEL PROBE
- CHEMICAL DIFFUSER
- STATIC MIXER
- EDUCTOR/INJECTOR
- INTERLOCK. NUMBER IS THE CROSS REFERENCE TO A SPECIFIC ELEMENTARY DIAGRAM OR TO A SPECIFIC CONTROL STRATEGY DESCRIBED IN THE SPECS
- * AV - AIR VALVE; F - FILTER; T - TRAP; FH - FIRE HYDRANT
- WATER LINE
- GRAVITY FLOW

EQUIPMENT

- MIXER
- VERTICAL TURBINE PUMP
- SUBMERSIBLE PUMP
- PUMP BLOWER
- PUMP
- METERING PUMP
- PUMP PROGRESSIVE CAVITY
- ROTARY PUMP
- PERISTALTIC PUMP

NOTES:

1. THIS IS A GENERALIZED LEGEND SHEET.
2. SEE ALSO ISA S5.1, S5.3 AND S7.3.
3. INSTRUMENTS MARKED WITH AN ASTERISK ARE FURNISHED WITH THE EQUIPMENT.
4. REFER TO ISA RP7.7 FOR INSTRUMENT AIR QUALITY STANDARDS.

NO.	REVISION	DATE	BY

SCALES: 0 — 1"; 0 — 25mm. IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

REGISTERED PROFESSIONAL ENGINEER TONY L WAKIM No. 7021 Exp. 12/31/09 CONTROL SYSTEM STATE OF CALIFORNIA

DESIGNED PDT · DRAWN JL · CHECKED TIW

SAN ELIJO JOINT POWERS AUTHORITY
SAN ELIJO WATER RECLAMATION FACILITY

RECYCLED WATER DEMINERALIZATION PROJECT PRELIMINARY DESIGN REPORT

Kennedy/Jenks Consultants©
10920 VIA FRONTERA, SUITE 110, SAN DIEGO, CA 92127

INSTRUMENTATION LEGEND AND ABBREVIATIONS

FILE NAME 0987112_00-I1_1 · JOB NO. 0987112.00 · DATE DECEMBER 2009 · SHEET I 1.1 OF X

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\\Sfocad\caddwgs\2009\0987112.00_SEJPA\0987112_00-I1_2.dwg MIKE MARX 11/24/2009 11:18 AM

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SCADA BLOCK DIAGRAM

FILE NAME 0987112_00-I1_2
JOB NO. 0987112.00
DATE DECEMBER 2009
SHEET I 1.2 OF X

* SUPPLIED BY EQUIPMENT MANUFACTURER

NOTES:

1. PROCESS PIPING SHALL BE PVC UNLESS OTHERWISE NOTED.
2. ALL WORK IS NEW UNLESS OTHERWISE NOTED.
3. STRAINER IS PART OF MF SKID FOR SOME MANUFACTURERS.

MIKE MARX 11/24/2009 11:22 AM

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PROCESS AND INSTRUMENTATION DIAGRAM
RWD MEMBRANE PRETREATMENT SYSTEM

FILE NAME 0987112_00-I1_3
JOB NO. 0987112.00
DATE DECEMBER 2009
SHEET I 1.3 OF X

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SCALES

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PROCESS AND INSTRUMENTATION DIAGRAM RWD RO TREATMENT SYSTEM

FILE NAME 0987112_00-I1_4

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PROCESS AND INSTRUMENTATION DIAGRAM
MF/UF AND RO CIP SYSTEM

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JOB NO. 0987112.00

DATE DECEMBER 2009

SHEET **I 1.5** OF X

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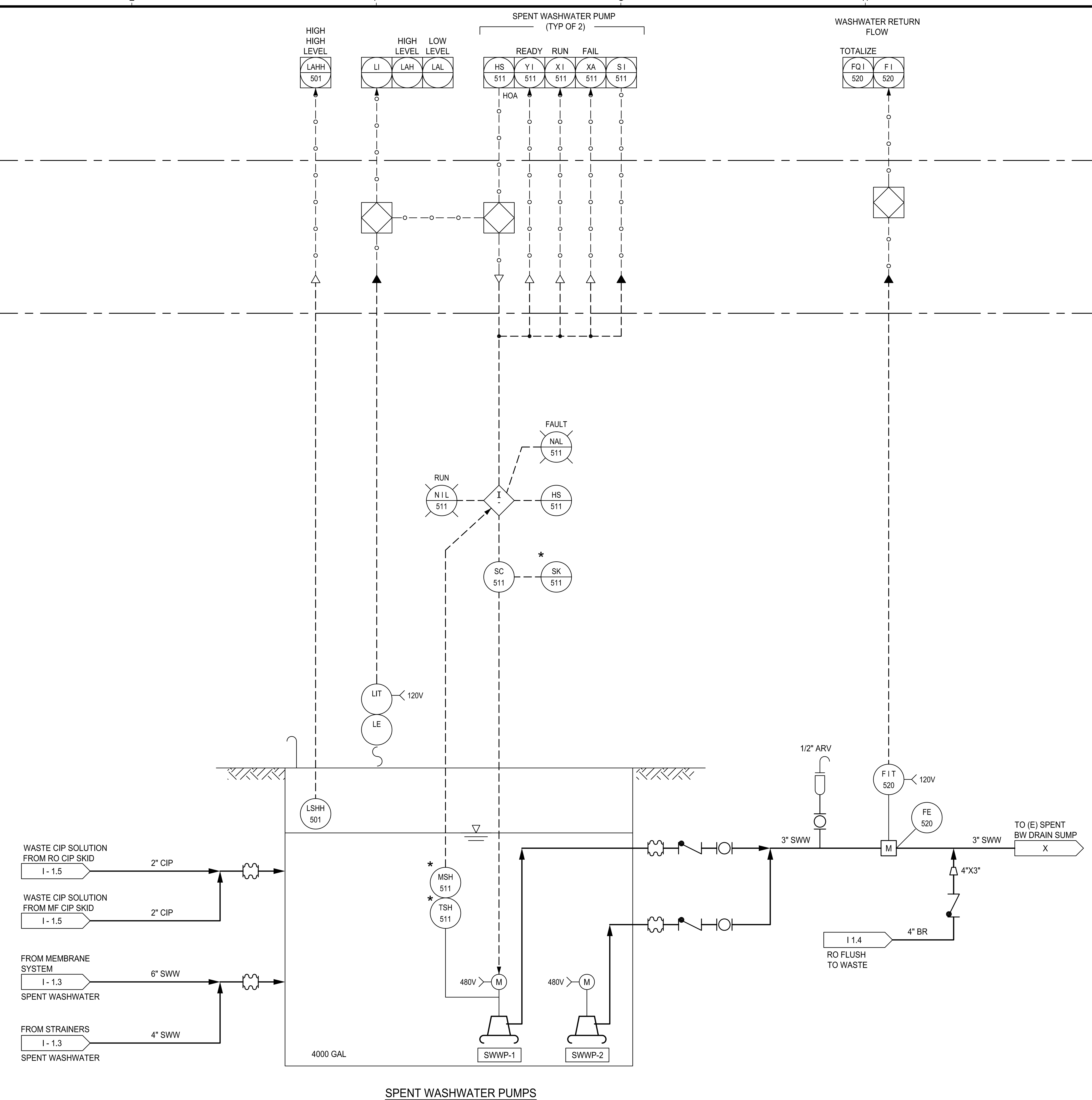

NOTE:

1. PROVIDE PVC FOR PROCESS PIPING UNLESS OTHERWISE NOTED.

* SUPPLIED BY EQUIPMENT MANUFACTURER

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PROCESS AND INSTRUMENTATION DIAGRAM SPENT WASHWATER SYSTEM

FILE NAME 0987112._00-I1_6

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DATE DECEMBER 2009

SHEET I 1.6 OF X