FINAL

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El Estero Wastewater Treatment Plant Tertiary Filtration Facility Engineering Assessment and Preliminary Design Services

Tertiary Filtration Facility

Preliminary Design Report

Prepared for:

City of Santa Barbara
735 Anacapa Street
Santa Barbara, CA 93102-1990

Agreement No. 29,977
CDM Smith Project No. 120499-90670

February 19, 2013

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Version:	FINAL	
Prepared For:	Rebecca Bjork, City of Santa Barbara Christopher J. Toth, P.E., City of Santa Barbara	
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Date:	February 19, 2013	

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Abbreviations and Acronyms

A	ampere
ACI	American Concrete Institute
ADM	Aluminum Design Manual
AFY	acre feet per year
AHP	air high pressure
AISC	American Institute of Steel Construction
AL	aluminum
ALP	air low pressure
AM	Assessment Memorandum
ANSI	American National Standards Institute
APCD	Air Pollution Control District
APO	anionic polymer
ASC	antiscalant
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATC	Authority to Construct
AWWA	American Water Works Association
BOD_5	5-day biological oxygen demand
DBC	California Building Code
CA	Cellulose Acetate
$CBOD_5$	Carbonaceous biochemical oxygen demand
CCB	Chlorine Contact Basin
CCT	Chlorine Contact Tank

CCTV	closed circuit television
CDPH	California Department of Public Health
CIP	clean-in-place
CIPR	clean-in-place return
CIT	citric acid
COD	chemical oxygen demand
COP	California Ocean Plan
CPO	cationic polymer
CPT	Cone Penetration Test
CPU	central processing unit
CPVC	Chlorinated Polyvinyl Chloride
CS	chlorine solution
DC	direct current
DI	ductile iron
DIP	ductile iron pipe
DPW	Department of Public Works
EDR	Electrodialysis Reversal
EEWWTP	El Estero Wastewater Treatment Plant
EFM	enhanced flux maintenance
EPA	Environmental Protection Agency
EPDM	ethylene propylene diene monomer
EQ	equalization
FE	filter effluent
ft	foot, feet
FI	filter influent
FRP	fiberglass reinforced plastic
gal	gallon
gfd	gallons per day per square foot

gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
H&SC	Health and Safety Code
HCL	hydrochloric acid
HDPE	high density polyethylene
HMI	Human Machine Interface
HOA	Hand Off Auto
hp	horsepower
HVAC	heating, ventilation, and air conditioning
I&C	Instrumentation and Controls
I&M	inflow and infiltration
I/O	input/output
IBC	International Building Code
ICCES	International Code Council Evaluation Service
ICEA	Insulated Cable Engineers Association
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Fire Code
ISA	International Society of Automation
kV	kilvolt
kVA	kilovolt ampere
kW	kilowatt
lbs/day	pounds per day
LSI	Langelier Saturation Index
max.	maximum
MCC	motor control center
MF	Microfiltration

mg/L	miligramper liter
mgd	million gallons per day
mg/L	milligrams per liter
mL/L	milliliter per liter
min.	minimum
MOPO	Maintenance of Plant Operations
MRP	Master Reclamation Permit
MSL	mean sea level
N/A	not applicable
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NF	Nanofiltration
NFPA	National Fire Protection Association
ng/L	nanograms per liter
No.	number
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelolometric Turbidity Units
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OWS	Operator Workstations
PA	polyamides
PDR	Preliminary Design Report
PLC	programmable logic controller
psf	pounds per square foot
psi	pounds per square inch
PTO	Permit to Operate
PVC	Polyvinyl Chloride

PVDF	Polyvinylidene Fluoride
PWRR	Permeate water recovery rate
RF	reverse filtration
RO	Reverse Osmosis
ROC	RO concentrate
ROF	RO feed
ROFL	RO flush
ROP	RO Permeate
ROWD	Report of Waste Discharge
RTD	Resistance temperature detector
RW	Recycled Water
RWQCB	Regional Water Quality Control Board
SAR	Sodium Adsorption Ratio
SCADA	supervisory control and data acquisition
SCDP	Source Compliance Demonstration Period
SCE	Southern California Edison
scfm	standard cubic feet per minute
SDI	Silt Density Index
SE	secondary effluent
sf	square foot
SHC	sodium hypochlorite
SS	stainless steel
SWRCB	State Water Resources Control Board
TDH	total dynamic head
TDS	Total Dissolved Solids
TM	Technical Memorandum
TN	Total Nitrogen
TOC	Total Organic Carbon

TSS	Total Suspended Solids
TVSS	Transient Voltage Surge Suppression
Typ.	typical
UBC	Uniform Building Code
UF	Ultrafiltration
µg/L	microgram per liter
UL	Underwriters Laboratories
UPS	Uninterruptible Power Supplies
VFD	variable frequency drive
WDR	Waste Discharge Requirements
WQBELs	Water Quality Based Effluent Limitations
WRR	Water Recycling Requirements
WWTP	wastewater treatment plant
XLHDPE	cross-linked high density polyethylene

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Section 1

Filtration TM No.1 – Final Summary Assessment Report on Tertiary Filtration

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Marie Burbano, CDM Smith
Greg Wetterau, CDM Smith

Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design Technical Memorandum (TM) No.1 – Final Summary Assessment Report on Tertiary Filtration*

1.1 Introduction

The City of Santa Barbara (City) has been providing, protecting, and preserving groundwater, drinking water and recycled water for its community for over 150 years. The City has been a leader in water system planning and use of recycled water. Committed to protecting the environment and public health and safety, the City now seeks to sustainably and reliably improve treatment at their El Estero Wastewater Treatment Plant (EEWWTP).

EEWWTP is an 11 mgd wastewater treatment plant that was initially constructed in 1951; the plant has primary sedimentation, secondary processing, tertiary filtration, and disinfection. At EEWWTP, the City produces Title 22 recycled water for 60 to 80 users, according to the 2009 Recycled Water Expansion Assessment. The City is committed to providing recycled water to system users who depend on the reliability of the recycled water system.

In the recent years, the tertiary filter effluent has not been able to reliably meet the required turbidity limit of <2 NTU (nephelometric turbidity units). The influent wastewater is also relatively high in total dissolved solids (TDS), which results in high TDS in the tertiary filter effluent. As a result, the City currently blends tertiary filter effluent with potable water to decrease turbidity and TDS in the recycled water.

In 2012, the City embarked on this project to provide assessment and preliminary design services related to upgrading the existing tertiary filtration system. This project is divided into three tasks.

- **Task I – Assessment** includes the assessment activities and memoranda to determine the path forward for preliminary design.
- **Task II – Filtration Preliminary Design** provides technical memoranda (Filtration TMs) and a preliminary design report (Filtration PDR) for the selected filtration alternative.

- **Task III – Demineralization Preliminary Design** provides technical memoranda (Demineralization TMs) and a preliminary design report (Demineralization PDR) for the selected demineralization alternative.

This TM (Filtration TM No.1) summarizes the six assessment memoranda (AMs) completed as part of Task I – Assessment and is part of Task II – Filtration Preliminary Design. This memorandum also outlines the additional Filtration TMs that will be completed as part of Task II – Filtration Preliminary Design.

Note that there is another TM (Demineralization TM No.1) that will summarize the same details related to Task III – Demineralization Preliminary Design. The purpose of duplicate TMs is to provide independent, stand-alone Preliminary Design reports for filtration and demineralization.

1.2 Summary of Assessment Memoranda

The following is a list of the assessment memoranda (AMs) completed as part of Task I - Assessment.

- AM No.1. Introduction & Project Background
- AM No.2. Recycled Water System Study
- AM No.3. Filtration Alternatives
- AM No.4. Demineralization Alternatives
- AM No.5. Investigation of TDS Sources
- AM No.6. Recycled Water System Hydraulic Analysis

The AMs for Task I addressed both filtration and demineralization, with specific focus on filtration or demineralization as appropriate.

The following sections provide a summary of the evaluations and recommendations provided in the previously completed AMs.

1.2.1 AM No.1 Summary: Introduction and Project Background

AM No.1 provides of list of the AMs associated with the assessment phase of the project and the references and as-built drawings that provide the basis for the AMs, and subsequent technical memoranda and preliminary design report.

1.2.2 AM No.2 Summary: Recycled Water System Study

AM No.2 provides an overview of the existing recycled water system and evaluates future recycled water demands, potential system improvements, and current and future water quality goals.

Currently, recycled water produced by the EEWWTP serves over 400 acres of landscaped areas. These areas include golf courses, parks, schools, and the zoo. Recycled water demand occurs primarily at night with the distribution time occurring between the hours of 9pm and 6am. Though this is an ideal time for irrigation due to the lessened direct human contact, it may also present some issues due to the low influent flow to the treatment plant during the early morning hours.

According to the 2011 Recycled Water Use data, the EEWWTP usage for process water was approximately 258 Acre Feet per Year (AFY). In the City of Santa Barbara Long Term Water Supply Plan, the EEWWTP process water is approximated at 300 AFY. The metered sales to customers was approximately 478 AFY compared with the 800 AFY cited in the City of Santa Barbara Long Term Water Supply Plan. One possible reason for this discrepancy is the particularly high rainfall for the previous water year. The 2010-2011 water year saw 28.49 inches of rain.

The recycled water system, as it is currently, has the capacity to treat and deliver 1,400 AFY (Long Term Water Supply Plan) of recycled water. If the El Estero process water usage totals approximately 300 AFY and the demand from sales to customers is about 800 AFY that would leave approximately 300 AFY of additional capacity.

It is the City of Santa Barbara's policy to require recycled water for irrigation purposes for properties situated along the main recycled water lines. It is also the City's policy to encourage users who are not required to utilize recycled water to do so. Nine potential new recycled water users were identified. The potential users are situated adjacent to the system and would be easy to connect to the system.

In addition to nine identified new users, there is the potential to increase quantities of water used by current customers. These customers would need to be identified by the City from any requests or wishes for additional supply.

Another area for possible expansion is the industrial sector. Currently, the City's recycled water is distributed primarily for irrigation purposes. However, there is a potential for growth in use for businesses such as car washes and laundries in the area.

Lastly, if there is enough capacity for additional customers on the system, there is always the possibility of system expansion. Sixteen potential new users were identified in areas for expansion in Phase I and Phase II. This table also shows possible customers situated near the proposed expansion pipelines. These areas include parks, schools, office complexes, and housing.

1.2.3 AM No.3 Summary: Filtration Alternatives

AM No.3 presents several filtration treatment process alternatives and provides a preliminary analysis to recommend a treatment process to accomplish the desired water quality of the recycled water produced at the EEWWTP.

Recycled water quality criteria and usage are specified in Title 22, Division 4 of the California Code of Regulations (CCR). The EEWWTP produces recycled water that meets the Title 22 criteria for disinfected tertiary recycled water. Depending on the groundwater basin and recycled water usage location, the Regional Water Quality Control Board (RWQCB) can include additional requirements to Title 22. At the EEWWTP, the Central Coast Region of the RWQCB lists the current recycled water requirements in the Waste Discharge Requirements and Master Reclamation Permit Order No. 97-44. Note that Title 22 was written after Order No. 97-44. However, the requirements in Order No. 97-44 are more stringent than Title 22 and, therefore, apply to the EEWWTP. Table 1-1 summarizes the primary water quality requirements for disinfected tertiary recycled water.

Table 1-1: EEWWTP Recycled Water Permit Requirements per Order No. 97-44

Parameter	Requirements
Turbidity [1]	2 NTU (Mean) 5 NTU (Maximum)
Total Non-filterable Residue (Suspended solids)	10 mg/L (Mean) [2] 25 mg/L (Maximum)
Settleable solids	0.1 mL/L (Maximum)
Total dissolved solids	1,500 mg/L (Maximum)
Cadmium	0.01 mg/L (Maximum)
Lead	5.0 mg/L (Maximum)
Total Coliform Most Probable Number (MPN) [3]	2.2 per 100 mL (Average) 23 per 100 mL (Maximum)

Notes:

1. Maximum limit shall not be exceeded more than five percent of the time during any 24-hour period.
2. Compliance shall be determined from the results of the five most recent samples.
3. No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL.

Title 22 provides requirements for both filtered wastewater and disinfected tertiary recycled water. For the purposes of this analysis, the filtered wastewater standards must be met using the filtration alternative selected. Disinfection occurs at El Estero in the chlorine contact basin and onsite storage reservoir. All of the technologies evaluated in AM No.3 meet the Title 22 requirements for filtered wastewater.

The existing filter complex was constructed in 1988 as part of the City's Water Reclamation Project at El Estero. The existing chlorine contact basin and recycled water reservoir were constructed at the same time. The filters are single-media gravity filter type filters with an air/water backwash system.

Existing filter limitations include difficulty to meet effluent turbidity requirements, continuous operational challenges, and operations and maintenance safety concerns. Structural and corrosion problems with the existing filter complex are well documented in the Corrosion Engineering Evaluation Report completed by HAE Engineers in January 2012. These structural and corrosion problems cause operational safety concerns for plant staff. Additionally, one of the greatest challenges to operations is the instrumentation and controls with the existing filter complex. In recent years, the online instrumentation and automated backwashing has not been effective. Access to control instrumentation such as level sensors is limited as well.

Filtration technologies evaluated were as follows.

- Gravity deep bed filters (upgrade existing)
- Upflow continuous backwash media filters
- Cloth or disk filters
- Microfiltration/Ultrafiltration (MF/UF).

Filtration will be prior to any proposed demineralization. For the purposes of the filtration analysis, it is assumed that reverse osmosis (RO) is the preferred alternative for demineralization. For any flow going through the RO, MF pretreatment is highly preferred. For the first four technologies listed (gravity deep bed filters, upflow continuous backwash media filters, cloth or disk filters), a sidestream of MF will be required prior to the RO. For the full MF alternative, no additional sidestream RO pretreatment is required.

In order to evaluate filtration alternatives, criteria were developed and scored during an April 9, 2012 workshop with City staff. The purpose of this workshop was to develop criteria to compare filtration alternatives. The process started with brainstorm to identify list of criteria. The list was narrowed down to the 6 most important criteria. Each meeting attendee then prioritize this list with weights, where 1 = low priority, and 5 = high priority. The weights were averaged and discussed to develop the final criteria and weights, provided in Table 1-2.

Table 1-2: Evaluation Criteria

Criteria	Weight
Increase ease of O&M and safety for plant staff	5
Optimize site layout	3
Minimize recycled water system shutdowns	4
Improved water quality: reduce turbidity & TDS	5
Minimize blending	4
Life-cycle cost	4

Note: 1 = low priority, 5 = high priority

In addition to this evaluation criteria and assessment, capital, operations and maintenance (O&M), and life-cycle cost evaluations were completed to determine the life-cycle cost scores. Table 1-3 summarizes the cost evaluation of the various alternatives.

Table 1-3: Lifecycle Cost Evaluation Summary

	Rehab Existing Filters/ Sidestream MF	Upflow in Existing / Sidestream MF	New Upflow/ Sidestream MF	Disk Filters in Existing/ Sidestream MF	Full MF
Capital Cost	$4.9M	$4.8M	$6.6M	$4.6M	$6.5M
Yearly O&M Cost	$0.08M	$0.08M	$0.08M	$0.08M	$0.1M
20-Year Life-cycle cost	$6.1M	$6M	$7.8M	$5.8M	$7.9M
Life-cycle cost score	4	4	3	4	3

Note: 1 = lowest score or least benefit, 5 = highest score or greatest benefit

Table 1-4 provides the complete filtration assessment scores for each alternative.

Table 1-4: Evaluation Summary

Criteria	Weight	Rehab Existing Filters/ Sidestream MF	Upflow in Existing / Sidestream MF	New Upflow/ Sidestream MF	Disk Filters in Existing/ Sidestream MF	Full MF
O&M and safety	5	3	3	4	4	4
Optimize site layout	3	2	2	3	4	4
Minimize shutdowns	4	3	4	4	3	5
Reduce turbidity & TDS	5	3	4	4	3	5
Minimize blending	4	5	5	5	5	5
Life-cycle cost	4	4	4	3	4	3
Total Weighted Score		84	93	97	95	109

Note: 1 = lowest score or least benefit, 5 = highest score or greatest benefit

Based on the evaluation criteria and filter scores, the full MF alternative is the recommended technology to provide tertiary filtration at the EEWWTP to produce Title 22 recycled water. MF will provide excellent water quality for recycled water users and is a sufficient pretreatment for sidestream RO.

1.2.4 AM No.4 Summary: Demineralization Alternatives

Demineralization is not required to produce Title 22 recycled water at the EEWWTP, but may be provided in the future to further improve the recycled water quality for irrigation users. The following provides a brief summary of the scope of AM No.4. A more detailed summary of AM No.4 is provided in the Demineralization Preliminary Design TM No.1.

AM No.4 identifies and describes four demineralization treatment alternatives:

- Reverse Osmosis (RO)
- Nanofiltration (NF)
- Electrodialysis Reversal (EDR)
- Blending with potable water

AM No.4 evaluates the four demineralization treatment alternatives based on the same evaluation criteria developed for the filtration alternatives. AM No.4 recommends RO as the demineralization treatment alternative for use at the EEWWTP.

1.2.5 AM No.5 Summary: Investigation of TDS Sources

Investigation of TDS sources in the influent to the EEWWTP is part of the Demineralization task. The following provides a brief summary of the scope of AM No.5. A more detailed summary of AM No.5 is provided in the Demineralization Preliminary Design TM No.1.

1.2.6 AM No.6 Summary: Recycled Water System Hydraulic Analysis

AM No.6 provides an evaluation of the existing recycled water distribution system, including the on-site reservoir and transfer pump station at the EEWWTP site and the existing storage reservoirs. An assessment of the existing system is performed to evaluate how to better control recycled water distribution to reliably achieve CT times and to provide better control of the distribution system.

In summary, the El Estero Recycled Water system is currently operating in a batch mode, which produces inconsistent levels of turbidity and which leads to blending the effluent with potable water which leads to inconsistent chlorine residuals and CT Values. Upgrading the recycled water plant with membrane treatment will provide more consistent effluent and give the plant the opportunity to produce continuous and more consistent quality recycled water. The continuous process system will also make it easier to size additional storage tanks to meet future demands.

1.3 Filtration Preliminary Design

The following summarizes the scope of the technical memoranda (TMs) that will provide the basis of the preliminary design.

1.3.1 Filtration Preliminary Design

The following is a list of the filtration TMs to be provided as part of the filtration preliminary design task (Task II).

- Filtration TM No.1 – Final Summary Assessment Report on Tertiary Filtration
  - Summarizes the evaluations and recommendations provided in the Task I AMs
- Filtration TM No.2 – Permitting Requirements and Considerations for Membrane Filtration for Recycled Water
  - Summarizes permitting requirements for the tertiary filtration system
- Filtration TM No.3 – Structural and Geotechnical Design Criteria
  - Summarizes preliminary geotechnical and structural design criteria for the tertiary filtration system
- Filtration TM No.4 – Process Mechanical Design Criteria
  - Summarizes preliminary process mechanical design criteria for the tertiary filtration system
- Filtration TM No.5 – Electrical and Instrumentation and Control Design Criteria
  - Summarizes preliminary electrical and control systems design criteria for the tertiary filtration system
- Filtration TM No.6 – Civil Design Criteria and Demolition and Constructability Considerations
  - Summarizes demolition requirements and evaluates the constructability of the tertiary filtration system
- Filtration TM No.7 – Opinion of Probable Cost of Construction and Implementation Schedule
  - Summarizes opinion of probable cost of construction and implementation schedule for the tertiary filtration system

1.3.2 Demineralization Preliminary Design

Preliminary design of the demineralization system is included under Task III. The following is a list of the demineralization TMs to be provided under Task III.

- Demineralization TM No.1 – Final Summary Assessment Report on Demineralization
- Demineralization TM No.2 – Permitting Requirements and Considerations for Demineralization for Recycled Water
- Demineralization TM No.3 – Structural and Geotechnical Design Criteria
- Demineralization TM No.4 – Process Mechanical Design Criteria
- Demineralization TM No.5 – Electrical and Instrumentation and Control Design Criteria
- Demineralization TM No.6 – Civil Design Criteria and Demolition and Constructability Considerations
- Demineralization TM No.7 – Opinion of Probable Cost of Construction and Implementation Schedule

Section 2

Filtration TM No.2 – Permitting Requirements and Considerations for Membrane Filtration for Recycled Water

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Marie Burbano, CDM Smith
Greg Wetterau, CDM Smith
Evelyn You, CDM Smith
Jason Yoshimura, CDM Smith

Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design Technical Memorandum (TM) No.2 Permitting Requirements and Considerations for Membrane Filtration for Recycled Water*

2.1 Introduction

The purpose of this Technical Memorandum (Filtration TM No.2) is to address California Department of Public Health (CDPH) and Central Coast Region Regional Water Quality Control Board (RWQCB) permitting requirements and considerations associated with the use of tertiary filtration treatment using membrane filtration for recycled water produced at the El Estero Wastewater Treatment Plant (EEWWTP) in the City of Santa Barbara (City).

The City produces filtered disinfected recycled water for non-potable uses. Recently, the recycled water produced by the tertiary filters has not been able to reliably meet the required turbidity limit of <2 Nephelometric Turbidity Units (NTU). Based on total dissolved solids (TDS) and chloride concentrations in the recycled water, the City currently blends with potable water to decrease turbidity and meet voluntary TDS and chloride goals in the recycled water.

As discussed in Assessment Memorandum (AM) No.3 (CDM Smith, June 2012.a), the selected treatment process to provide filtration of the recycled water at the EEWWTP to meet turbidity limits is microfiltration (MF) or ultrafiltration (UF) membrane filtration. The MF and UF membranes provide a physical barrier, resulting in more complete rejection of particles greater than a specified size (on the order of 0.1 µm for MF and on the order of 0.01 µm for UF. Membranes of this kind remove particles down to such small sizes that they both remove pathogens and also particles that adversely affect the aesthetic appearance of the water. Membrane filtration has been successfully employed in the treatment of secondary effluent to make it suitable for reverse osmosis (RO), which is the selected recycled water demineralization process as discussed in AM No.3 (CDM Smith, June 2012.a). It also meets the California Code of Regulations Title 22 filtered wastewater requirements without the use of RO. For the purposes of this TM, membrane filtration and MF/UF will be used interchangeably.

2.1.1 Overview of EEWWTP WDR/MRPs

The City owns a wastewater collection, treatment, and disposal system to provide sewerage service to the City and portions of Santa Barbara County, serving a population of approximately 96,000. The EEWWTP is an 11 million gallon per day (mgd) wastewater treatment plant. It was initially constructed in 1951 and then was updated throughout in the 1970's including a new outfall. The secondary treatment system consists of screening and grinding, aerated grit removal, primary sedimentation, activated sludge stabilization, secondary clarification, disinfection by chlorination, and dechlorination facilities. Treated secondary effluent is discharged through a 8,720-foot ocean outfall to the Pacific Ocean. The outfall terminates in the Santa Barbara Channel in approximately 70-feet of water and provides a minimum initial dilution ratio of 120:1 (seawater: effluent). The wastewater discharge is regulated under National Pollutant Discharge Elimination System (NPDES) Permit (Order No. R3-2010-0011) issued by the RWQCB.

Treated secondary effluent not discharged to the ocean outfall is diverted, prior to the chlorine contact step, to tertiary filters where coagulant and flocculent aids are added. The water is chlorinated, blended with potable water, and used for non-potable water reuse applications (landscape irrigation, construction for dust control and soil compaction, toilet flushing, and EEWWTP process water). Approximately 800 acre-feet per year (AFY) is supplied to reuse customers and 300 AFY is used for EEWWTP process water. The water reuse program is regulated under Waste Discharge Requirements (WDR) and Master Reclamation Permit (MRP) Order No. 97-44.[1] The recycled water/potable water blending is undertaken to meet WDR/MRP turbidity requirements and the City's irrigation water quality goals for chloride (300 mg/L) and total dissolved solids (1,500 mg/L) based on guidance from Ayres and Westcot (1985). Per the Long Term Water Supply Plan (City of Santa Barbara, June 2011), the existing recycled water system has the capacity to treat and deliver 1,400 AFY. The 2009 Water Supply Planning Study showed there was the potential for increased recycled water irrigation use as well as applications for new uses, including car washes and laundries (Carollo, 2009).

The City owns a seawater desalination facility, which is currently not in operation. If operation should commence, the NPDES Permit allows for different volumes of brine to be discharged from the desalination facility to the ocean outfall (3.9 mgd, 4.1 mgd, 9.4 mgd, and up to 12.5 mgd). A minimum initial dilution of 44:1 is provided when brine is discharged. The City has requested the continued coverage of the potential discharge of desalination brine in the NPDES Permit in the event that the desalination facility begins operation.

2.2 Water Recycling Requirements

Water recycling requirements are included in the WDR/MRP as well as the NPDES Permit. The WDR/MRP has no expiration date; the NPDES Permit has an expiration date of May 15, 2015.

2.2.1 Authority for MRPs

In July 1992, section 13523.1 was added to the California Water Code (CWC), authorizing RWQCBs to issue MRPs to a producer and/or distributor of recycled water in lieu of prescribing individual water reuse requirements for a user of recycled water. Section 13523.1 also removed the requirement, except upon written request of a RWQCB, that users file a report with a RWQCB to use recycled water from a producer/distributor for whom a MRP has been issued. Similarly, it exempted any such user of

[1] A WDR/MRP is not needed for in-plant use of recycled water.

recycled water from the requirement to file a report with a RWQCB related to any material change in the character of the recycled water or its use.

2.2.2 EEWWTP 1997 WDR/MRP

2.2.2.1 Approved Uses

The WDR/MRP authorizes two water reuse applications for the use of disinfected filtered recycled water: landscape irrigation and construction (dust control and soil compaction). City staff has interpreted Finding No. 9 in the WDR/MRP to allow for the use of disinfected filtered recycled water for toilet flushing since toilet flushing is an approved use under Title 22 using this type of recycled water. Permit Finding No. 9 states:

"State Department of Health Services' criteria for the use of recycled water are specified in California Code of Regulations Title 22, Chapter 3. The Board has consulted with the State Department of Health Services regarding the regulation of this discharge."

In reviewing this finding, the staff interpretation regarding authorization for toilet flushing may be subject to challenge because:

- Permit findings are not legal obligations or authorities in permits.
- This particular permit finding does not link a specific use (or uses) to the recycled water quality produced by the City.
- There are no provisions in the WDR/MRP that explicitly allow for the use of recycled water for toilet flushing or concomitant CDPH requirements. Title 22, section 60307 allows for the use of disinfected filtered recycled water for toilet flushing. However there are additional requirements in Title 22 (sections 60312 through 60316) that would apply as toilet flushing meets the definition of a dual plumbed system per Title 22 section 60301.250.

The existing toilet flushing uses occur at approved use sites, and thus the use does not violate the WDR/MRP's Discharge Prohibition A.1:

"Discharge to other than approved reclamation areas (see Standard Provision A.6) is prohibited."

Based on this assessment, the WDR/MRP does not allow the use of recycled water for car washing or laundries. The CDPH Title 22 criteria (section 60307) allow the use of disinfected filtered recycled water in commercial car washes (if the recycled water is not heated and the general public is excluded from the washing process) and commercial laundries. To obtain authorization for these uses, as well as toilet flushing, in accordance with the 1984 Standard Permit Provisions for the WDR/MRP (see WDR/MRP Provision D.3), there are two requirements that must be followed:

- "C.7 The 'discharger' **shall file a report of waste discharge or secure a waiver from the Executive Officer at least 120 days** before making any material **change or proposed change** in the character, **location, or volume of the discharge**."
- "C.8 **An engineering report** as specified by Section 60323, Chapter 3, Title 22, of the California Code of Regulations is required, and **written approval** of the Executive Officer must be received by the discharger and user, **before reclaimed water is supplied for any uses and to any users other than those enumerated in this Order.**"

2.2.2.2 Reclamation Specifications

Flow

The WDR/MRP contains a monthly average flow limitation of 4.3 mgd per normal irrigation period (Permit Provision B.1). If the City envisions that future reuse would exceed this limitation, then the WDR/MRP should be amended to increase the flow limitation following the requirements in Standard Provision C.7.

Numeric Limitations

As shown in Table 2-1, Permit Provisions B.2 and B.5 set forth numeric limitations for recycled water based on requirements in Title 22 for the allowed uses (landscape irrigation and construction) using disinfected filtered recycled water. These requirements would also apply for toilet flushing, commercial car washes, and commercial laundries.

Table 2-1: WRD/MRP Numeric Limitations

Parameter	Requirements
Turbidity[1]	2 NTU (Mean) 5 NTU (Maximum)
Total Non-filterable Residue (Suspended Solids)	10 mg/L (Mean)[3] 25 mg/L (Maximum)
Settleable Solids	0.1 mL/L (Maximum)
TDS	1,500 mg/L
Cadmium	0.01 mg/L
Lead	5.0 mg/L
Total Coliform MPN	2.2/100 mL (7-day Median) 23/100 mL (Not to exceed within 30 days)

Notes:

1. Maximum limit shall not be exceeded more than five percent of the time during any 24-hour period.
2. Compliance shall be determined from the results of the five most recent samples.
3. No sample shall exceed a total coliform MPN of 240/100 mL.

If membrane filtration is used in lieu of conventional filtration, then the WDR/MRP should be amended per Standard Provision C.7 to include the Title 22 turbidity limits for MF/UF per section 60301.320(b):

"Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:

1. *0.2 NTU more than 5 percent of the time within a 24-hour period; and*
2. *0.5 NTU at any time."*

Use Area Requirements for Landscape Irrigation and Conformance with the SWRCB Recycled Water Policy[2]

The Recycled Water Policy (RW Policy) was adopted by the SWRCB in February 2009 and became effective in May 2009.[3] The RW Policy was a critical step in creating uniformity in how RWQCBs were individually interpreting and implementing the State Anti-degradation Policy (Resolution 68-16) for landscape irrigation and groundwater recharge projects that use recycled water.

Section 7.a of the RW Policy establishes requirements to address control of incidental runoff from irrigation projects where incidental runoff is defined as unintended small amounts of runoff from sites, such as irrigation over-spray. It is likely that as part of an amendment to the WDR/MRP, the RWQCB would evaluate the WDR/MRP to determine if modifications were necessary to existing provisions or to include new provisions to address the RW Policy requirements. Table 2-2 provides a comparison of the RW Policy requirements, existing WDR/MRP conditions, the City's Water Use Requirements, and provisions in the City's Recycled Water User Agreements.

[2] The WDR/MRP includes use area requirements in Title 22 and are thus not addressed in this TM.
[3] http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf

Table 2-2: Comparison of RW Policy and Existing Use Are Provisions

RW Policy	Existing Provisions	Source	Comment
7.a.(1) Implement an operations and management plan for detection of leaks (such as broken sprinkler heads), and correction within 72 hours of learning of the runoff, or prior to the release of 1,000 gallons, whichever occurs first 7.a.(2) Proper design and aim of sprinkler heads.	Discharge including overspray from irrigation sites or construction sites is prohibited with the exception of insignificant runoff with implementation of good irrigation practices. Precautions must be taken to prevent clogging of spray nozzles, minimize overwatering, and minimize production of runoff. Pipelines must be maintained to prevent leaks. Quarterly recycled water systems inspections to assure proper operation, absence of leaks, etc. Recycled water and spray shall be confined to the authorized use area. Inspection, supervision, and employee training shall be provided by User to assure safe and proper operation of the recycled water system. User should maintain records of inspection and training. The user … shall design, install, construct, provide all work or services, necessary or useful to provide and maintain irrigation … Such modifications include, but are not limited to, sprinkler changes or modifications (including those needed to prevent recycled water from leaving the irrigated area boundaries), quick-coupler modifications or installation, repair of irrigation system leaks …”	WDR/MRP A.2. WDR/MRP B.8. WDR/MRP B.17. City Use Area Requirements City Use Area Requirements City’s Recyled Water User Agreement9.C.(8)	It would seem that the exisiting permit conditions address detection of leaks; it may be necessary for a permit amendment to address the notification requiements in the RW Policy.
7.a.(3) Refraining from application during precipitation events.	Recycled water shall not be used for irrigation during period of extended rainfall and/or runoff.	WDR/MRP B.9.	This is addressed in the existing permit; the City may want to add this to the Use Area Requirements
7.a.(4) Management of ponds containing recycled water such that no discharge occurs unless it is the result of a 25-year, 24-hour storm event or greater, and the RWQCB Executive Officer has been notified of the discharge.	---	---	This may need to be addressed in a permit amendment if sites include ponds.

Section 7.b.(3) of the RW Policy requires priority pollutant monitoring twice per year for landscape irrigation projects except for small disadvantaged communities. The language in the RW Policy is vague and does not specify what has to be monitored (recycled water only, groundwater, etc.). Based on a June 8, 2012 meeting with WateReuse California and SWRCB staff, it appears that the intent of this provision is for priority pollutant monitoring to be required for recycled water only. Groundwater monitoring would only occur on a case-by-case basis if recycled water data indicated that groundwater quality is threatened. In July 2012, WateReuse California submitted comments to the SWRCB with suggested language changes to clarify the intent of the monitoring provisions as part of an ongoing amendment process for the RW Policy. The amendment is not expected to be adopted until early 2013. However, it is likely that the Monitoring and Reporting Program in the WDR/MRP would be modified to include priority pollutant monitoring and possibly other constituents of interest to the RWQCB. The RW Policy amendment is not including monitoring constituents of emerging concern for landscape irrigation projects.

As a note of caution, there are additional provisions in the RW Policy that specifically apply to streamlined permitting (Section 7.c) for landscape irrigation projects, that could be misapplied by the RWQCB even if the City was not pursing a streamlined permitting process. These provisions include:

- Application in amounts and at rates as needed for the landscape (i.e., at agronomic rates and not when the soil is saturated). Each irrigation project shall be subject to an operations and management plan, that may apply to multiple sites, provided to the RWQCB that specifies the agronomic rate(s) and describes a set of reasonably practicable measures to ensure compliance with this requirement, which may include the development of water budgets for use areas, site supervisor training, periodic inspections, tiered rate structures, the use of smart controllers, or other appropriate measures. *Note: some, but not all, of these measures are already being undertaken by the City.*

- Appropriate use of fertilizers that takes into account the nutrient levels in the recycled water. Recycled water producers shall monitor and communicate to the users the nutrient levels in their recycled water.

Another note of caution is warranted about the RWQCB adding or modifying requirements to the WDR/MRP based on provisions that have been included in the SWRCB General Landscape Irrigation Permit (General Permit).[4] Some of the more controversial provisions to be aware of are:

- The direct or indirect discharge from use areas of recycled water to surface waters is prohibited, unless otherwise authorized by an NPDES permit. *Note: this may prohibit even insignificant discharge authorized under the WRD/MRP unless this type of runoff is covered under a Municipal Stormwater NPDES permit.*

- Best management practices presented in Attachment C of the General Permit.

- Users must designate site supervisors with specific responsibilities identified in the General Permit. *Note: the City's Recycled Water User Agreement (Provision 8) largely meets this condition.*

- An operations plan and an irrigation management plan with specific provisions identified in the General Permit.

[4] http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/wq0_2009_0006_general_permit.pdf

- Specific requirements for site supervisor training. *Note: the City's Recycled Water User Agreement (Exhibit B) requires that the user provide training for inspection, supervision, and employees to assure safe and proper operation of the recycled water system.*

2.2.3 Compliance with CWC MPR Requirements

CWC section 13523.1(b) establishes the six conditions that must be included in all MPRs. These conditions have been evaluated in comparison to the 1997 WRD/MRP to identify any potential areas where modifications may be warranted if the WDR/MRP is amended to ensure compliance with the CWC.

- WDRs requirements. These are included in the WDR/MRP.
- A requirement that the permittee comply with the uniform statewide reclamation criteria. *These are included in Standard Provision 6.*
- A requirement that the permittee establish and enforce rules or regulations for reclaimed water users, governing the design and construction of reclaimed water use facilities and the use of reclaimed water. *The WDR/MRP Monitoring and Reporting Program requires the City to provide user guidelines to each Site Supervisor and instructions for implementing the guidelines. Guidelines are included on the City's website5 and in the Recycled Water User Agreements. It is not clear if "guidelines" would entirely satisfy this CWC condition or if the guidelines would have to be formally adopted by the City in some manner.*
- A requirement that the permittee submit a quarterly report summarizing reclaimed water use, including the total amount of reclaimed water supplied, the total number of reclaimed water use sites, and the locations of those sites, including the names of the hydrologic areas underlying the reclaimed water use sites. *The WDR/MRP Monitoring and Reporting Program requires the City to submit monthly reports; however, the reports may not include all of the information included in this CWC condition.*
- A requirement that the permittee conduct periodic inspections of the facilities of the reclaimed water users to monitor compliance by the users with the uniform statewide reclamation criteria and the requirements of the MRP. *The WDR/MRP Monitoring and Reporting Program requires the City to conduct quarterly inspections.*
- Any other requirements determined to be appropriate by the RWQCB. *These are included in the WDR/MRP.*

2.2.4 Recommendations

Based on this evaluation, the following recommendations are offered.

- If at all possible, the City should work with the RWQCB to just amend the existing WDR/MRP to accommodate necessary changes in lieu of a new or substantively revised permit. This seems justified given that the modifications are for the same category of Title 22 recycled water covered by the existing WDR/MRP. This level of effort would save resources for both agencies

[5] http://www.santabarbaraca.gov/NR/rdonlyres/D10F96E1-5E16-4C49-8F79-C2796FE86315/0/RecycledWaterUseRequirements.pdf

and perhaps avoid the inclusion of provisions that have been controversial in other permitting efforts around the State.

- As soon as practicable, the City should submit an Engineering Report to CDPH and RWQCB for the use of recycled water for toilet flushing, an ongoing use not currently authorized in the WDR/MRP. At the appropriate time, based on project planning and implementation, the City should submit an Engineering Report to CDPH and RWQCB for the use of recycled water for car washing and laundries.
- The City should submit a report of waste discharge to the RWQCB to amend the 1997 WDR/MRP to address the conversion to membrane filtration; the use of recycled water for toilet flushing, car washing, and laundries; flow volumes (if necessary); and changes to the Monitoring and Reporting Program. It is recommended that all of these changes should be addressed in one permit action.
- The City should be aware that the RWQCB may need to revise the WDR/MRP to address new provisions in the RW Policy, specifically the notification provisions related to leaking sprinklers and pond management. The City should be cautious of other problematic and/or unwarranted provisions that could end up in a permit amendment.
- Changes to the WDR/MRP may also necessitate changes to the User Guidelines and Recycled Water Agreements. Some additional consideration should be given to the status of the Guidelines to determine if they should be formally adopted to meet the conditions of the CWC for MRPs.

2.3 EEWWTP NPDES Permit Requirements

Backwash from the MF/UF System and neutralized chemical clean-in-place waste will be routed to the EEWWTP headworks for treatment, as described in Section 4. Therefore, there would be no significant change in the discharge to EEWWTP that requires notification to the RWQCB to meet NPDES requirements. In addition, because the MF/UF System is separate from the ocean discharge treatment system, there is no need to notify the RWQCB or modify the NPDES Permit if the membrane filtration system is added to the recycled water system.

However, in reviewing the NPDES Permit, there are several provisions related to the 1997 WRD/MRP that warrant some discussion.

NPDES Permit: Provision IV. Effluent Limitations and Discharge Specifications

"C. Reclamation Specifications

The Discharger shall comply with Waste Discharge Requirements and Master Reclamation WDR/MRP Order No. 97-44 for reclaimed water production and usage. The Discharger shall comply with applicable state and local requirements regarding the production and use of reclaimed wastewater, including requirements of California Water Code (CWC) sections 13500 - 13577 (Water Reclamation) and Department of Health Services (DHS) regulations at title 22, sections 60301 - 60357 of the California Code of Regulations (Water Recycling Criteria)."

Comment: The WRD/MRP requires that the turbidity requirement be met anywhere in the treatment process following filtration. This requirement is currently being attained by blending recycled water with potable water. Based on this provision in the NPDES Permit, this practice could constitute a violation of both the NPDES Permit and WDR/MRP with concomitant civil and criminal liability. It is not necessary to include a water recycling limitation in the NPDES Permit. It should be deleted when the NPDES Permit is next renewed (2015).

Attachment E – Monitoring and Reporting Program: VII. Reclamation Monitoring Requirements

"The Discharger shall comply with Waste Discharge Requirements and Master Reclamation WDR/MRP Order No. 97-44 for reclaimed water production and usage. The Discharger shall comply with applicable State and local monitoring requirements regarding the production and use of reclaimed wastewater, including requirements established by the California Department of Public Health at title 22, sections 60301 - 60357 of the California Code of Regulations, Water Recycling Criteria."

Comment: This provision in the Monitoring and Reporting Program is superfluous and unnecessary. It should be deleted when the NPDES Permit is next renewed (2015).

Attachment F – Fact Sheet: IV.G. Reclamation Specifications

"The Order does not address use of reclaimed wastewater except to require compliance with applicable State and local requirements regarding the production and use of reclaimed wastewater, including those requirements established by the California Department of Public Health at title 22, sections 60301 - 60357 of the California Code of Regulations, Water Recycling Criteria."

Comment: Fact Sheets are now considered part of the "formal" NPDES Permit for purposes of compliance and enforcement. [6] It is not necessary to include a water recycling limitation in the NPDES Permit. It should be deleted when the NPDES Permit is next renewed (2015).

2.4 Santa Barbara County Air Pollution Control District Permits

The U.S. Environmental Protection Agency and the California Air Resources Board have established health-based clean air standards and have given the Santa Barbara County Air Pollution Control District (APCD) the primary authority for controlling air pollution from local stationary sources.

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[6] When the SWRCB shifted to the NPDES permit template, the Fact Sheet became an enforceable part of the permit. Typically, the first page of a permit should include a statement like this signed by the Executive Officer: "I, [name], Executive Officer, do hereby certify that this Order with all attachments is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, [Region] on [date]. Certainly the template was in place when the 2010 Santa Barbara NPDES Permit was adopted; however, the Executive Officer Statement does not conform with the intent of the template: "IT IS HEREBY ORDERED, that Order No. R3-2004-0122 is rescinded upon the effective date of this Order except for enforcement purposes, and, in order to meet the provisions contained in division 7 of the Water Code (commencing with section 13000) and regulations adopted thereunder, and the provisions of the federal Clean Water Act (CWA) and regulations and guidelines adopted thereunder, the Discharger shall comply with the requirements in this Order." However, Finding D. in the NPDES Permit states: "The Fact Sheet (Attachment F), which contains background information and rationale for Order requirements, is hereby incorporated into this Order and constitutes part of the Findings for this Order. Attachments A through F are also incorporated into this Order." Thus, it is expected that the RWQCB would argue that the Fact Sheet is an enforceable part of the permit.

APCD permits may be required for the new chemicals being stored and used as part of the MF/UF System. This is because some chemicals have a tendency to off-gas and air quality permits may be required. The following is a list of all chemicals that will be used for the MF/UF System.

- Aqueous ammonia for chloramination (part of the secondary improvements project)
- Sodium hypochlorite for chloramination and clean-in-place (CIP)
- Citric acid for CIP
- Sodium hydroxide for CIP

Aqueous ammonia has a strong tendency to off-gas. Storage tanks for aqueous ammonia typically require a water bath on the vent to minimize the release of gas into the atmosphere. The City plans to build the aqueous ammonia storage and feed system as part of the secondary improvements project because aqueous ammonia is needed for chloramination of both the Title 22 recycled water and the effluent that is sent to the ocean outfall. The aqueous ammonia will be added to the secondary effluent channel. For the MF/UF System, aqueous ammonia will only need to be added after the planned secondary improvements are completed because, until that time, the secondary process will not fully nitrify and there will be ammonia available in the secondary effluent for the formation of chloramines. During design of the secondary improvements project, it is recommended that the City work with the APCD to obtain permits for the aqueous ammonia storage and feed system. This may be a new permit or a modification to an existing permit at the EEWWTP. The APCD may also allow exemptions to permits, but an APCD review of the design would be required prior to granting an exemption.

Sodium hypochlorite improvements for the MF/UF System include the addition of feed pumps only. The existing on-site sodium hypochlorite storage tanks will be used. No additional permitting from the APCD is expected for the sodium hypochlorite pumps added for the MF/UF System beyond that currently in practice.

Both citric acid and sodium hydroxide storage will be provided in either storage drums or totes with diaphragm metering pumps. These small portable storage containers typically do not require APCD approval.

2.5 Santa Barbara Building Permits

The City of Santa Barbara's Department of Public Works (DPW) oversees residential, commercial and industrial construction within the City. Based on the information provided by DPW, a Planning Commission & Staff Hearing Officer Process is required to apply a building permit for the new EEWWTP improvements. The initial documents needed to be submitted to the Development Application Review Team (DART) include but not limited to the following:

- Master Application Form
- Planning Commission & Staff Hearing Officer Submittal Cover Letter
- Ten Copies of Project Plans
- Photographs of the Project Sites
- Public Notice Requirements

- Hydrology Calculations
- Preliminary Title Report
- Coastal Development Permit Application
- Coastal Development Permit Tenant Notification Instructions
- Coastal Development Permit Tenant Notification Affidavit
- On-Site Posting Instructions
- Hazardous Waste and Substances Requirement

The application forms and checklists downloaded from the City's website are provided in the Appendix C-6. Upon submittal of the building permit application, the City will assign a Case Planner, who will be responsible for coordinating the staff review. During review of the application, additional information and studies may be necessary before the application is determined to be complete and additional processing can occur.

In addition to the building permit and inspections, which will likely be required, several other forms and guidelines may apply to this project, including:

- Project Clearance form
- "As-Built" Construction Plan Submittal Requirements
- Commercial Plan Submittal Requirements
- Interior Demolition Permit Requirements
- Parking Lot Repaving- Restriping Submittal Requirements
- Best Management Practices for Construction Activities
- Access Compliance 2011
- Construction Valuation Form
- Inspection Request form

It is important to coordinate closely with the City's DPW throughout planning and construction to comply with all necessary requirements.

Section 3

Filtration TM No.3 – Geotechnical and Structural Design Criteria

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Leonel Almanzar, CDM Smith
Alan Hahn, CDM Smith
Jeff Woon, CDM Smith

Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design Technical Memorandum (TM) No.3 – Geotechnical and Structural Design Criteria*

3.1 Introduction

This Technical Memorandum No.3 (Filtration TM No.3) provides the structural and geotechnical evaluation for the preliminary design of tertiary filtration facilities at El Estero Wastewater Treatment Plant (EEWWTP) in City of Santa Barbara (City).

3.2 Geotechnical

The following section provides the geotechnical design criteria for the various components of the proposed Membrane Filtration Facility.

3.2.1 Applicable Codes, Standards, and References

The geotechnical and foundation design for the proposed improvement should conform to local engineering practice, soil properties and the minimum requirements of the California Building Code (CBC, 2010), the Standard Specifications for Public Works Construction (Greenbook), and the City standards. The recommended design criteria are based on performance tolerances, such as allowable settlement, as understood to relate to similar structures.

3.2.2 Existing Geotechnical Conditions and Previous Studies

The information presented in this memorandum was based on a review of available data in the site vicinity performed by others as well as published geology maps. A site-specified geotechnical investigation has not been performed at the time of this memo. The following geotechnical reports were provided by the City for the review:

- Staal, Gardner & Dunne, Inc., (1987), "Geotechnical Investigation, Reclaimed Water Project, Santa Barbara Wastewater Treatment Plant, City of Santa Barbara, California," prepared for CH2M Hill California, September.

- Staal, Gardner & Dunne, Inc., (1988), "Report of Pile Driving Observations, Reclaimed Water Project, Santa Barbara Wastewater Treatment Plant, Santa Barbara, California," prepared for CH2M Hill California, Reference C86125, October 19.

The 1987 report consisted of four Cone Penetration Test (CPT) soundings within the plant. CPT-1 was located near the footprint of the existing Filter Complex.

The site and the City of Santa Barbara are located in the western portion of the Transverse Ranges geomorphic province of California. The site is located on a coastal plain, on a small alleviated plain and bounded by the east-west trending Santa Ynez Mountain Range to the north and the Santa Barbara Channel to the south.

3.2.2.1 Subsurface Conditions

Based on the previous investigations, the subsurface conditions at the site consisted of artificial fill overlying Estuarine Deposits and the Older Marine Deposits.

- Artificial Fill – Fill materials were encountered over most of the site in the previous investigation. Fill generally consists of loose to medium dense silty sand and sandy silt with variable amounts of clay, gravel and debris. The fill was likely associated with site development and the original plant construction. Based on the CPT interpretation, fill thickness varies and is estimated to be 8 feet in the vicinity of the existing Filter Complex. Fill thickness ranged from 10 to 16 feet in the vicinity of the chlorine contact basin and the reclaimed water reservoir.

- Estuarine Deposits – Underneath the fill, estuarine deposits consisting of gray, lenticular interlayered, soft to medium stiff silty clay and sandy clay, and loose to medium dense silty and clayey sand with localized sand silt were encountered. The thickness of these deposits ranged from approximately 15 to 50 feet.

- Older Marine Deposits – Older marine deposits consisting of medium dense to dense clayey sand and sandy silt and stiff clay were encountered beneath the estuarine deposits throughout the site. The thickness of the marine deposits is not known.

Previous investigations indicated groundwater ranged from -4 to 5 feet above MSL. A groundwater level of 4 feet MSL was recommended for previous design.

3.2.2.2 Faulting and Seismicity

The project site is situated in a seismically active region. As is the case for most areas of southern California, ground-shaking resulting from earthquakes associated with both nearby and more distant faults is likely to occur during the life of the project.

The site or the City and its sphere of influence are not located within a currently designated State of California, Alquist-Priolo Earthquake Fault Zone (A-P Zone) for the Santa Barbara Quadrangle. The closest state-mapped fault is the Red Mountain Fault in western Ventura County located more than 10 miles from the plant. The San Andreas Fault zone is more than 40 miles northeast of the City.

There are several potentially active faults that pass through the City of Santa Barbara and the surrounding community. The potentially active faults include the La Mesa Fault, More Ranch Fault, Mission Ridge Fault, Lavigia Fault, Lagoon Fault, and the Montecito Fault. During the life of the project, seismic activity associated with active faults in the area may generate moderate to strong ground shaking at the site. It should be noted that the plant site is mapped within an area considered to have high liquefaction potential during a seismic event according to the Environmental Impact Report for the Planned Santa Barbara General Plan Update (AMEC 2010).

3.2.3 Plant Expansion Geotechnical Issues

The artificial fill and the soft estuarine deposits are not suitable for support of structures without the potential to experience detrimental differential settlement. The loose sandy soils are potential susceptible to liquefaction during a seismic event.

The existing Filter Complex is being supported on 12-inch square precast prestressed concrete piles. It is planned to demolish the existing structures to the foundation slab to accommodate the construction of the proposed Membrane Filtration Facility. The existing piles will be re-used for support of the new structures. Based on the proposed layout, the existing piles do not underlie the entire footprint of the proposed facility. It is anticipated that additional pile foundation will be required to supplement existing piles to support the proposed facility. Due to the non-uniform nature of the artificial fill, it is not adequate for support of the miscellaneous containment structure. The miscellaneous structures can be supported on thickened slab/concrete mat bearing on a zone of compacted engineered fill.

3.2.4 Recommended Additional Geotechnical Studies

To provide site specific geotechnical recommendation for final design, we recommend that a boring and/or a CPT be performed in the vicinity of the proposed expansion to obtain subsurface data for foundation design. The supplemental subsurface data will be reviewed to evaluate liquefaction potential based on current seismic criteria, provide foundation design for pile and shallow foundation, and earthwork recommendations for the support of the structures.

3.3 Structural Design Criteria

The following section provides the structural design criteria that will be used for the various components of the proposed Membrane Filtration Facility. These design criteria provide minimum requirements and will be used as a guide in the design and construction of all facilities. Criteria may be modified with approval by the structural engineer where appropriate for specific circumstances. All items noted herein which require approval will be reviewed and approved by the structural engineer for the project.

3.3.1 Applicable Codes, Standards, and References

Although there are many codes, standards, specifications and design aids used by various structural engineers, this section outlines the primary documents that will be used for the structural design phase of the project.

The strength, serviceability, and quality for materials and design procedures will meet the expectations of the following codes, standards, and references:

- 2010 California Building Code (CBC)
- American Society for Testing and Materials (ASTM)
- ACI 318-2008/ACI 318R-2008 -- Building Code Requirements for Structural Concrete, American Concrete Institute (ACI)

- American Society of Civil Engineers (ASCE) 7-2010: Minimum Design Loads for Buildings and Other Structures. American Society of Civil Engineers/Structural Engineer Institute
- Code of Federal Regulations, 29 CFR Part 1910, OSHA
- AWWA D100-2005: Welded Carbon Steel Tanks for Water Storage. American Water Works Association (AWWA)
- AWWA D103-2009: Factory Coated Bolted Carbon Steel Tanks for Water Storage. American Water Works Association (AWWA)
- ADM-2005: Aluminum Design Manual (ADM). The Aluminum Association
- AISC (13th Ed): Steel Construction Manual. American Institute of Steel Construction (AISC)
- Current International Code Council Evaluation Service (ICCES) reports for specific products

3.3.2 Existing Structural Systems

The existing Filter Complex structural system consists of a reinforced concrete tank with multiple levels foundations supported on 12” square concrete piles. The structure was designed to meet the requirements of the 1988 Uniform Building Code (UBC).

The existing Solids Handling Building (SHB) is a reinforced concrete structure with steel roof beams. The structure was designed to meet the requirements of the 1988 Uniform Building Code (UBC). This structure was included in the Structural Assessment report by Coffman Engineers dated December 10, 2012, which indicates that the seismic resisting systems of the SHB are not able to withstand the current loads associated with a design ground motion as required by the 2010 California Building Code (CBC), and that further analysis is required if the structure is to be improved to meet the requirements of the current code.

The proposed modifications of the SHB will not impact or change the main structural system of the building, therefore seismic evaluation of the building to meet new building code is not required as part of the presented building modifications and therefore not discussed in this preliminary report. However, it is recommended that a structural analysis of the building be performed in the future in order to determine the actual response of the structure under new seismic codes and if any seismic retrofit is required in order to provide adequate seismic resistance level of the facility. This scope of work may be included in the Final Design.

3.3.3 Proposed Structural Modifications and Upgrades

The existing Filter Complex structure will be demolished below the foundation slab and new concrete will be added to provide a level surface for the proposed Membrane Filtration Facility. The existing piles will be reviewed for adequacy to resist gravity and lateral loads per the 2010 CBC, and if required, additional piles will be added to provide the capacity required to meet the current building code. In order to provide cover for the new equipment, a new pre-engineered canopy will be attached to the existing concrete foundation.

The work for the Membrane Filtration Facility also consists of adding new compressed air system equipment inside the existing Solids Handling Building. The existing floor slab will be analyzed for the additional equipment loads to ensure conformance to the requirements of the 2010 CBC.

In addition to the modifications to the existing Filter Complex structure and the existing Solids Handling Building, new pile supported slabs will be provided to support new chemicals storage tanks and metering pumps that are outside the plan area of the existing Filter Complex. These tanks will not be covered by a canopy. Additionally, new slabs on grade will be provided outside the existing Solids Handling Building for small secondary containment areas for chemical storage totes and metering pumps.

3.3.4 Materials

3.3.4.1 Concrete

All concrete materials will conform to the requirements of ACI 318. Specific requirements for the project are as follows:

- Class A Concrete: f'c = 2,500 psi for concrete fill, duct encasement, and where noted.
- Class B Concrete: f'c = 3,000 psi where noted (misc. site civil structures).
- Class D Concrete: f'c = 4,000 psi for all structural concrete, unless otherwise noted.
- One inch nominal maximum aggregate size (maximum, for design).
- Reinforcing Steel: ASTM A706 or ASTM A615, Grade 60.

3.3.4.2 Structural Steel

Materials for structural steel will conform to the requirements of Chapter 22 of the CBC. Specific additional requirements for the project are:

- Structural wide-flange shapes: ASTM A992.
- Other structural shapes: ASTM A36.
- Structural plates and bars: ASTM A36 or ASTM A572 Grade 50.
- Structural steel tubes: ASTM A500, Grade B.
- High-strength steel bolts will have a minimum diameter of 5/8 inch and conform to the requirements of ASTM A325, unless noted otherwise.
- Embedded anchor bolts will have a minimum diameter of 3/4 inch and conform to the requirements of ASTM F1554, Grade 36, unless noted otherwise.
- Where stainless steel is required for both dry and wet conditions, Type 316 stainless steel will be used.
- All welding will be designed for electrodes that deposit weld metal with a tensile strength of 70ksi.

3.3.4.3 Aluminum

Aluminum materials will conform to the requirements of the CBC and ADM. Aluminum material will not be used in a submerged condition. Specific requirements for the structural components used on this project are as follows:

- Alloy 6061-T6 for structural shapes and plates.
- Alloy 6063-T6 for extruded aluminum pipe.

Fasteners for aluminum connections will be Type 316 stainless steel with proper dielectric isolation unless otherwise approved.

3.3.4.4 Concrete Anchors

Stainless steel anchors will be used for structural connections to concrete. Type 316 stainless will be used.

3.3.5 Design Loads and Serviceability

3.3.5.1 Scope

All applicable loads and load combinations will be determined as required by the governing code, occupancy, site and environmental effects, equipment and processes. Appropriate load combinations, allowable stresses, load factors and safety factors (as applicable) will be established at the beginning of preliminary design and confirmed at the beginning of final design.

3.3.5.2 Dead Load

Dead loads shall be based on the weight of all fixed construction such as walls, partitions, floors, roofs, cladding, equipment bases and all permanent, non-removable, stationary furnishings.

A uniform collateral load of 10 pounds per square foot (psf) in buildings and 5 psf in canopies will be considered in addition to the dead load of the structure. Weight of all mechanical equipment to be supported by the structure shall be considered if greater than the design collateral load.

3.3.5.3 Live Load

The roof live loads shall be based on the area tributary to the member or element under consideration. The minimum roof live load shall be 20 psf. Floor design live loads are summarized below:

- Process floors, including grating 200 psf;
- Electrical rooms 300 psf; and
- Stairways, corridors, walkways, catwalks 100 psf;

3.3.5.4 Wind Load

Wind load generation shall be based on the following parameters:

- Occupancy Category III;
- Basic Wind Speed = 85 mph (3 second gust);
- Exposure Category C; and
- Wind Importance Factor I = 1.15.

3.3.5.5 Seismic Load

Seismic load generation shall be based on the following earthquake parameters and will be later verified with a Supplemental Geotechnical Report.

Spectral response accelerations follow:

- S_s = 2.097 g;
- S_1 = 0.801 g; and
- Site Class D.

Earthquake spectral response acceleration parameters follow:

- $S_{MS} = F_a * S_s$ = 1.00 * 2.097 = 2.097 g;
- $S_{M1} = F_v * S_1$ = 1.5 * 0.801 = 1.201 g;
- S_{DS} = 2/3 * S_{MS} = 1.398 g;
- S_{D1} = 2/3 * S_{M1} = 0.801 g;
- Seismic Design Category E;
- Occupancy Category III;
- Seismic Importance Factor I_e = 1.25 (structures); and
- Seismic Importance Factor I_p = 1.00 (equipment anchorage).

3.3.5.6 Process Liquid Loads

Design will be performed for liquid loads assuming liquid surface at the maximum working level using normal allowable stresses, or the load factor for a fluid load, as appropriate. In addition, design will be performed assuming the liquid surface at the maximum possible level under surcharge conditions using an increase in allowable stresses, or the load factor for a dead load, without durability factor as appropriate.

Closed liquid containing structures will, whenever possible, be vented to preclude pressurization or depressurization. However, certain structures may experience pressure or vacuum effects due to particular mechanical or process systems, or the malfunction of systems or components. In such cases, design will be performed for the maximum water, air or gas pressure as provided by the mechanical-process discipline in preliminary design.

3.3.5.7 Equipment Loads

Loads from equipment will be considered live loads. The maximum loads and support details for each major piece of equipment will be provided by the discipline designing or specifying it. Final weights of process-mechanical equipment will be established during preliminary design. Preliminary weights of building service equipment (HVAC, plumbing, and electrical) will be established during preliminary design, and confirmed during final design.

In addition to the mechanism's static dead load, design will be performed for other effects, such as those due to operation, maintenance and malfunction. Examples include, but are not limited to, the following:

- Rotating equipment: Design will be performed for moment, torque, and lateral/vertical thrust.

- All equipment: Design will be performed for required maintenance procedures, such as the removal of a large component and the placing of it temporarily on the adjacent structure.

3.3.5.8 Combination of Loads

Design will be performed for combinations of loads, along with appropriate load factors or allowable stresses, in accordance with the governing code[s]. In the absence of specific direction by the code, the most severe distribution, concentration and combination of design loads and forces will be used. These combinations may be limited by practical considerations, such as the following.

- Combination of certain loads will not be considered when the probability of their simultaneous occurrence is negligible. Such loads include wind and seismic on superstructures; and seismic, live load surcharge, and flood on substructures.
- An increase in allowable stress of 33-percent, or a reduced load factor of 0.75, will be applied to the entire load combination where such is permitted for any of the loads considered in the combination.

3.3.5.9 Serviceability

Additional requirements for serviceability will be considered as provided in subsequent sections and referenced standards for specific materials.

3.3.5.9.1 Deflection

Design will be performed to limit deflections to the following. In cases indicated with an asterisk (*), deflection limit will apply to live load effects only. For monorails and cranes, impact need not be included.

- Monorails, including the effects of differential support deflection L/450
- Bridge crane girders L/1000
- Floor plates and gratings* L/360
- Beams, lintels or slabs supporting masonry L/720
  (3/8 inch maximum at windows)
- Roofs without plastered ceilings* L/240
- Roofs with plastered ceilings* L/360
- Floors, steel framed* L/360
- Floors, concrete In accordance with ACI 318
- Floors, wood L/360

3.3.6 Foundation Design

3.3.6.1 Scope

Criteria will be established for the design of structure foundations in coordination with the geotechnical recommendations. Permanent structure foundation elements will be designed to distribute loads to the supporting soil, rock, or piling in accordance with their allowable loads, and to accommodate predicted deformations of the structure caused by settlement or movement of the supporting elements. Piling elements (piles and caissons) will be designed as structural elements to the accommodate stresses generated by the design loads. The design of the transmission of loads from the pilings to the supporting soil or rock will be performed by the geotechnical discipline. Structure foundation elements will be designed to resist effects of groundwater, including buoyancy.

3.3.6.2 Shallow Foundation Support

Design of shallow foundation elements (footings and mats), including excavation and backfill limits and details, will be performed in accordance with the recommendations of the geotechnical report.

To the extent possible, buried piping and ductbanks will be maintained outside the influence zone of the foundation elements. Limits of this zone will be established based on bearing materials' characteristics as documented in the geotechnical report. At a minimum, this zone will be defined by a line extended outward and downward from the bottom corners of a foundation element at a 1 vertical to 1 horizontal slope. A reinforced concrete encasement or other appropriate protection will be provided for any utilities extending into this zone.

3.3.6.3 Deep Foundation Support

Piling will be designed in accordance with the recommendations of the final geotechnical report. Where a transition is required from pile supported to soil supported elements of a structure, design will be performed to accommodate the predicted deformation from such a transition.

Lateral loads to the structures will be resisted by the piling elements, the surrounding elements, or both. Where appropriate, the strain compatibility of the elements will be considered to determine the distribution of the lateral reactions.

3.3.7 Concrete Design

3.3.7.1 Scope

Design of all cast-in-place, site-cast, and precast concrete structures will be performed, except as indicated below. Member sizes, reinforcement, and details will be determined in accordance with the governing code[s].

Design of site concrete work, such as paving, curbing, and sidewalks will be performed by the civil discipline. Design of the following structures and elements will be performed by the fabricator or erector, in accordance with criteria provided in the contract documents.

- Precast site structures, including manholes, vaults, pipe, culverts, and headwalls

3.3.7.2 General Design and Detailing Concepts

3.3.7.2.1 Joints

Design will be performed using the following joint types.

- <u>Isolation joints</u> are formed discontinuities in or between structures which allow movement in any direction. They are not considered to be load-transferring joints. The movement may be due to anticipated settlements, differential deflections, or temperature and shrinkage.

- <u>Expansion joints</u> are formed discontinuities in or between structures that allow movement perpendicular to the plane of the joint only. They are not considered to be load-transferring joints. Most often, this movement is due to both expansive and contractive forces generated by temperature and shrinkage. This movement is accommodated by providing smooth dowels across the joint, debonded on one side. Expansion joints are normally constructed using a joint filler that has sufficient stiffness to maintain its shape during concrete placement, but compresses under the subsequent movement. Keys will not be used in expansion joints. The end surfaces of the elements forming the joint will have face reinforcing to prevent spalling.

- Contraction joints function as a plane of weakness for crack formation to dissipate shrinkage stresses, and are not considered to be load-transferring joints. They may be formed by use of a bond breaker between concrete placements, discontinuing reinforcing steel, forming or sawing a partial depth groove, or by a combination of these methods. Keys will not be used in contraction joints.

- Control joints are a form of contraction joint often used specifically for environmental engineering structures. They are usually not employed as load transferring joints, but do have a limited capacity for load transfer, and can be used as such with caution. A bondbreaker is applied to the joint plane and only 50 percent of the reinforcing steel passes through the joint. Keys will not be used in control joints.

- Construction joints are formed joints between adjacent concrete placements and are designed to be load-transferring joints. Bond between the placements is promoted and reinforcing steel is continuous through the joint so that the section behaves as though it was monolithically constructed. The surface of the first placement will be roughened to promote bond. Keys will not be used unless project requirements dictate and use is approved.

3.3.7.2.2 Layout and Design

The jointing system layout will be determined at the beginning of preliminary design. Joint types, locations, and related criteria will be selected. All joints will go through the entire structure in one plane whenever possible. Staggers and offsets will not be used for expansion, control and contraction joints, and avoided for construction joints unless absolutely necessary.

3.3.7.2.3 Waterstops

Continuous waterstops will be provided in all joints in walls, slabs, and other elements separating the following spaces. Additional installations may be required by special project conditions.

- Between areas of secondary containment and external areas (air or soil)

Waterstops in vertical joints will be extended to 4 inches below the top of the wall, or to the first horizontal joint above the design process liquid or groundwater level, whichever is lower. For horizontal joints at the intersection of walls and slabs, starter walls will be provided as required to avoid interference between the waterstop and horizontal reinforcing. For new construction, waterstops will be ribbed PVC, 9 inches wide with a center bulb at expansion joints and 6 inches wide at control and construction joints.

3.3.7.3 Reinforcement

3.3.7.3.1 Spacing

In general, 6 inches and 12 inches will be used as the basic spaces for detailing on continuous elements such as walls and slabs.

3.3.7.3.2 Splices

Splices in deformed reinforcing bars will be lap splices conforming to ACI 318, unless otherwise indicated. For tension members, full penetration welded splices will be used. In circular tanks designed for ring tension, splice locations will be staggered. Mechanical splicers will be used only in noncritical applications where failure of the splice would not result in structural failure. When used, they will be the threaded-type mechanical splicers.

3.3.7.3.3 Bends

For beams, slabs, joists and similar members, straight longitudinal bars will be used rather than bent longitudinal bars whenever possible.

3.3.7.3.4 Preferred Reinforcing

To the extent possible, the preferred (outermost) reinforcing in continuous members (slabs and walls) within a system will remain consistent even if the spanning direction of the various members within the system varies.

3.3.7.4 Anchors and Embedments

3.3.7.4.1 Anchor Types

Design will be performed using the following anchor types.

- Cast-in anchors are set prior to casting of the concrete. Anchor bolts are the most common type, used in applications such as anchoring of steel columns. Other types include bolts with embedded plates, strap anchors, and headed anchor studs.
- Expansion anchors are generally drilled-in bolts that engage the concrete substrate by using a sloping mandrel to force wedges into the sides of the hole during tightening.
- Adhesive anchors are generally drilled-in bolts that engage the concrete substrate through the chemical bonding by a resin. Reinforcing dowels may also be anchored in this manner.

3.3.7.4.2 Selection

Cast-in anchors generally provide the greatest assurance of adequacy and will be used whenever practical. Cast-in inserts (threaded receptacles set below the concrete surface) will be avoided unless necessary, due to the difficulty of verifying adequate thread engagement. Drilled-in anchors will be used when greater flexibility is required in positioning the anchored elements. Expansion anchors will be used in non-critical applications only and not for tensile or vibratory loads.

3.3.7.4.3 Design

Anchor bolts may be designed using the allowable loads and location restrictions provided in the concrete provisions of the Uniform Building Code. Otherwise, design for allowable loads will be performed by either an analysis that considers the controlling failure mode (including anchor failure, bond failure, and substrate failure), or in accordance with the results of an independent testing program. In determining allowable loads, the effects of anchor spacing, edge distance, and combined loadings will be considered.

3.3.7.5 Systems and Elements

3.3.7.5.1 Elevated Slabs

Structural slabs less than 8 inches in thickness will be designed with a single grid of reinforcing steel; structural slabs 8 inches or greater in thickness will be designed with two grids of reinforcing steel, unless the cover and bar sizes required would result in concrete placement problems.

3.3.7.5.2 Walls

Walls less than 10 inches in thickness will be designed with a single grid of reinforcing steel; walls 10 inches and greater will be designed with two grids. Walls less than 12 inches thick will be restricted to less than 10 feet high for any one placement, to avoid concrete placement and consolidation.

3.3.8 Pre-engineered Metal Structures

Pre-engineered metal building and canopy shall be designed following structural performance technical specification to be provided during detailed design, and additional requirements described herein.

End rigid frames shall be the same as interior rigid frames. No moment transfer shall be provided into the foundation. Framed openings shall be designed to structurally replace the covering and framing displaced.

The design will provide roof and wall bracing systems. Bracings or portal frames shall be designed for controlling wind load or earthquake load combinations and movements. Brace compression flanges of structural members as required by code. Chemical canopy structure lateral load system shall be designed with portal frames to provide unobstructed bay openings.

The size of the prefabricated components and the field connections required for erection shall permit easy assembly and disassembly by means of the building manufacturer's standard fasteners and construction tools. The maximum size of any shop-assembled component of the building shall permit transportation from factory to site by commercial carrier.

Exterior covering shall be minimum 24-gauge galvanized steel conforming to ASTM A653, G90 coating designation, factory color finished.

Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for covering. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or premolded PVC to match configuration of the covering.

Fasteners for Metal Roof and Wall Panels shall be Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels. Exposed wall fasteners shall be factory color finished or provided with plastic color caps to match the covering.

3.3.9 Performance Specification Design

3.3.9.1 Scope

Criteria, standards, quality and submittal requirements will be developed for the design, fabrication, and construction of permanent structures designed by the contractor, subcontractor, manufacturer or vendor.

For the following items, submittals required for review and approval during construction will include complete drawings, material data, and design calculations.

- Pre-engineered Metal Building & Canopies
- Miscellaneous metal systems

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Section 4

Filtration TM No.4 – Process Mechanical Design Criteria

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Marie Burbano, CDM Smith
Evelyn You, CDM Smith
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Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design Technical Memorandum (TM) No.4 –Process Mechanical Design Criteria*

4.1 Introduction

This Technical Memorandum No.4 (Filtration TM No.4) provides the preliminary design for tertiary filtration treatment using membrane filtration for recycled water produced at El Estero Wastewater Treatment Plant (EEWWTP) in City of Santa Barbara (City).

4.2. Design Criteria

This section summarizes the overall design requirements for the filtration system. As discussed in Assessment Memorandum No.3 (CDM Smith. June 2012), the selected treatment process to provide filtration of the recycled water at the EEWWTP is microfiltration (MF) or ultrafiltration (UF) membrane filtration. The MF and UF membranes provide a physical barrier, resulting in more complete rejection of particles greater than a specified size (on the order of 0.1 μm for MF and on the order of 0.01 μm for UF. Membranes of this kind remove particles down to such small sizes that they both remove pathogens and also particles that adversely affect the aesthetic appearance of the water. Membrane filtration has been successfully employed in the treatment of secondary effluent to make it suitable for reverse osmosis (RO), which is the selected recycled water demineralization process as discussed in Assessment Memorandum No.4 (CDM Smith, June 2012). It also meets Title 22 filtered wastewater requirements without the use of RO. For the purposes of this memorandum, membrane filtration and MF/UF will be used interchangeably.

4.2.1 Water Quality Goals

Recycled water quality criteria and usage are specified in Title 22, Division 4 of the California Code of Regulations (CCR). EEWWTP produces recycled water that meets the Title 22 criteria for disinfected tertiary recycled water. Depending on the groundwater basin and recycled water usage location, the Regional Water Quality Control Board (RWQCB) can include additional requirements to Title 22. At EEWWTP, the Central Coast Region of the RWQCB lists the current recycled water requirements in the Waste Discharge Requirements and Master Reclamation Permit Order No. 97-44.

Table 4-1 summarizes the primary water quality requirements for disinfected tertiary recycled water.

Table 4-1: EEWWTP Recycled Water Permit Requirements per Order NO. 97-44

Parameter	Requirements
Turbidity[1]	2 NTU (Mean) 5 NTU (Maximum)
Total Non-filterable Residue (Suspended solids)	10 mg/L (Mean) [2] 25 mg/L (Maximum)
Settleable solids	0.1 mL/L (Maximum)
Total dissolved solids	1,500 mg/L (Maximum)
Cadmium	0.01 mg/L (Maximum)
Lead	5.0 mg/L (Maximum)
Total Coliform Most Probable Number (MPN)[3]	2.2 per 100 mL (7-day Median) 23 per 100 mL (Maximum)

Notes:

1. Maximum limit shall not be exceeded more than five percent of the time during any 24-hour period.
2. Compliance shall be determined from the results of the five most recent samples.
3. No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL.

Title 22 provides requirements for both filtered wastewater and disinfected tertiary recycled water. The filtered wastewater standards have specific requirements for an MF/UF System. Disinfection for recycled water occurs at EEWWTP in the recycled water chlorine contact basin (CCB) and onsite storage reservoir.

Title 22 requirements for filtered wastewater using MF/UF are as follows.

"Filtered wastewater" means an oxidized wastewater that meets the criteria …

(b) Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:

(1) 0.2 NTU more than 5 percent of the time within a 24-hour period; and

(2) 0.5 NTU at any time."

In addition, the MF/UF System provides pretreatment for RO System to reduce the particulate and biological fouling of the RO membranes. The MF/UF System will effectively remove inert particulates, organic particulates, colloidal particulates, pathogenic organisms, bacteria and other particles by the size-exclusion sieve action of the membranes.

Table 4-2 presents the MF/UF filtrate water quality design criteria for the MF/UF System. Note that this table also provides the following source of the requirement for the MF/UF System.

Table 4-2: MF/UF Filtrate Water Quality Design Criteria

Constituent	Design Criteria	Requirement Basis
Turbidity	<0.2 NTU (95% of the time) <0.5 NTU (at any time)	Title 22 requirement for filtered wastewater using MF
Total Non-filterable Residue (Suspended solids)	10 mg/L (Mean) [1] 25 mg/L (Maximum)	Master Reclamation Permit Order No. 97-44
Settleable solids	0.1 mL/L (Maximum)	Master Reclamation Permit Order No. 97-44
Total dissolved solids	1,500 mg/L (Maximum) [2]	Master Reclamation Permit Order No. 97-44
Cadmium	0.01 mg/L (Maximum) [2]	Master Reclamation Permit Order No. 97-44
Lead	5.0 mg/L (Maximum) [2]	Master Reclamation Permit Order No. 97-44

Note:

Compliance shall be determined from the results of the five most recent samples.

MF/UF is not designed to remove TDS, cadmium, or lead. TDS is assumed to be less than 1,500 mg/L, cadmium is assumed to be less than 0.01 mg/L, and lead is expected to be less than 5.0 mg/L in the secondary effluent feeding the MF/UF system.

Although the permit requirements allow up to 25 mg/L of suspended solids, the MF/UF filtrate is not expected to contain any measureable concentration of suspended solids.

The existing disinfection system at the EEWWTP utilizes sodium hypochlorite and existing ammonia in the secondary effluent to generate chloramines. A chlorine contact basin is used to achieve a minimum concentration times time (CT) value of 450 milligram minutes per liter (mg·min/L) per the requirements of Title 22.

As part of the secondary process upgrades currently under design, the disinfection system will continue to use chloramines. The secondary process upgrades will include the addition of an ammonia feed since secondary improvements will result in full nitrification (i.e. removal of the ammonia from the secondary effluent). The planned feed point for the ammonia to the secondary effluent is in the secondary effluent channel, upstream of the split to the MF/UF system. This ammonia feed system is part of the secondary process upgrades and will not be part of the tertiary filtration project scope. If the secondary improvements project is not complete prior to the tertiary filtration project, the plant will continue to have residual ammonia in the secondary effluent. Therefore, a separate ammonia feed system is not needed as part of the tertiary filtration project.

For the condition after the secondary improvements are completed, there will continue to be the ability to dose sodium hypochlorite to the CCBs and reclaimed reservoir. This would be a backup process in case the residual drops too low through the MF/UF System. In that case, it will be important to dose sufficient ammonia at the secondary effluent to generate chloramines.

4.2.2 MF/UF Feed Water Quality

For the MF/UF System design, the feed water quality is based on the quality of the EEWWTP secondary effluent. Currently, the City intends to make improvements to the secondary system from the current non-nitrifying process to a process with full nitrification and partial denitrification. The intent of the secondary improvements is to achieve an improved water quality that will be better for the filtration system. At this time, it is unclear on if the secondary improvements will be completed before or after the construction of the MF/UF System.

For the purposes of this PDR, the MF/UF System design is based on an assumed water quality after the secondary improvements are completed. Table 4-3 provides the assumed secondary effluent quality following secondary improvements that will be used as the design influent to the MF/UF System.

Table 4-3: Assumed Secondary Effluent Quality After Secondary Improvements at EEWWTP

Parameter	Level
Biochemical Oxygen Demand (BOD)	10 mg/L
Total Suspended Solids (TSS)	10 mg/L
Turbidity	<10 NTU
Ammonia	>5 mg/L as N (using ammonia addition to secondary effluent line)

In the event that secondary improvements are not completed prior to the construction of the MF/UF System, the MF/UF System will still be able to operate using the current secondary effluent as a source. Using the current secondary effluent may result in a slightly decreased output of the MF/UF System for the time until the secondary improvements are completed due to a decreased flux rate with a higher influent solids loading. The extent of the decrease in output will depend on the quality of the secondary effluent and the actual flux rate that the MF/UF System is able to achieve. This is expected to be for a short duration (i.e. a few years), and therefore the City decided not to increase the size of the MF/UF System to accommodate this short period of operation.

4.2.3 Facility Sizing

The recycled water demand for the EEWWTP is 1,400 acre-feet per year (AFY) based on discussions with the City as well as the 2011 Long Term Water Supply Plan (City of Santa Barbara, June 2011) and the Urban Water Management Plan (City of Santa Barbara, June 2011). On an average basis, 1,400 AFY results in an annual average daily demand of 1.25 mgd. However, the recycled water demand is not constant throughout the year, with typically higher flows required during the summer peak irrigation season. The 2009 Recycled Water Expansion Assessment (Carollo, August 2009), indicates a maximum monthly demand peaking factor of 2, resulting in a maximum month demand of 2.5 mgd. Assessment Memorandum No.2 provides a detailed analysis of 2011 recycled water demands, including the scale-up to the long-term goal of 1,400 AFY. The results of Assessment Memorandum No.2 projected that the projected recycled water demand in year 2030 will be 2.09 mgd for the daily demand in the peak month, 2.28 mgd for the projected maximum 7-day rolling average, and 3.14 mgd for the daily demand in the peak day, and 2.56 mgd for the projected 99th percentile daily demand. To avoid oversizing the tertiary filtration system, the overall recycled water system is designed to produce 2.5 mgd of recycled water on an average daily basis to meet projected 98th percentile daily recycled water demand for year 2030.

The operations for minimum daily flows through the MF/UF System can be as low as 0.5 mgd or less. To appropriately size an MF/UF System, the full range of minimum to maximum flow may not be feasible because an extensive number of units will be required to provide turndown. For the purpose of this design, the minimum recycled water flow is assumed to be 1 mgd on a daily basis. If the demand is less than 1 mgd, the recycled water system storage can be utilized and the MF/UF System can be shut down for a period of time.

To meet the recycled water demands, it is important to appropriately size the MF/UF System based on the available quantity of secondary effluent. The primary concern for available water for the recycled water system is the ability to meet recycled water demands at night when the influent flows to the EEWWTP are low. Effluent flow data from the EEWWTP for April-May 2011 and July- August 2012 were used to determine the amount of flow available for the recycled water system during these low flow conditions. These months were used since they are typically the higher demand months, instead of the winter months when demand was lower.

The City provided data for the entirety of these two-month durations in 15-minute time intervals. Each interval contained four separate flow measurements, all in million gallons per day: Actual, Average, Minimum, and Maximum. These individual measurements were combined to provide a comprehensive data set for analysis.

The minimum daily flows during April and May 2011 were constant at close to 3.0 mgd. The minimum daily flows for July and August 2012, however, showed a wider variation. Although a consistent trend shows minimum daily flows of approximately 2.5 mgd for the majority of this duration, many days in the first half of July show much lower minimum daily flows. Many of these days had minimum flows of less than 2.1 mgd. On July 7, the flow decreased to below 1.5 mgd, but only for 30 minutes. Because this was only one day and for a short time, this period was considered an outlier and not used as a design condition.

To appropriately size the treatment facilities for these varied flows, it is necessary to estimate an expected minimum flow rate for each hour of the day. Based on the July data on the most extreme days, the design flow condition will include absolute minimum flow rates from 3am until 7:30am and more typical flow rates from 7:30am until 3am the next day.

Design flow conditions were selected to average a total daily recycled water flowrate of 2.5 mgd. First, it was determined that the minimum flow from 3am to 7:30am was 1.5 mgd, as indicated in the graph. Using that as the main constraint, the flow for the remainder of the day (7am to 3am) was increased until a product water of 2.5 mgd on an average basis was achievable. It was important to account for flows that were required from secondary effluent but did not product recycled water, for example MF backwash and RO brine, when determining the secondary effluent flow to the system.

Figure 4-1 shows the measured secondary effluent flow rates for every day in July and August 2012 as well as the design flow conditions. This shows that the design secondary effluent flow will be available on a daily basis for the plant. This also shows that, during the low-flow periods, all of the secondary effluent flow will be used for the recycled water system to meet the 2.5 mgd daily demand. The design secondary effluent flow for normal periods is 3.2 mgd, and low periods is 1.5 mgd, as indicated by the red line in the figure.

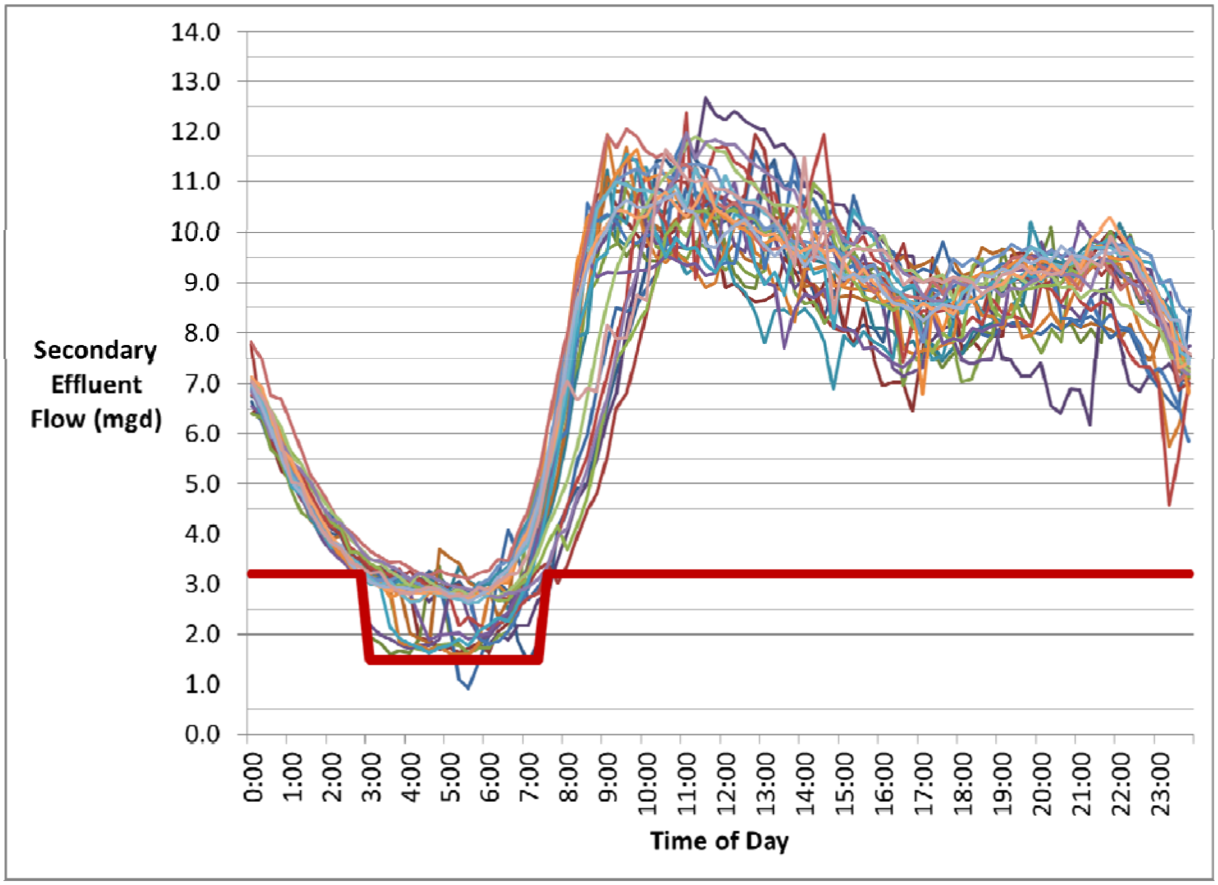

Figure 4-1: July and August Daily Secondary Effluent Flow with Design Flow Conditions in Red

As previously stated, it is important to account for the MF/UF filtrate flow and RO brine flow when sizing the system. Table 4-4 and Figure 4-2 show the design flow conditions through all portions of treatment at the different flow conditions. Using these flows, the combined CCB feed provides 2.5 mgd of recycled water for the system on a daily basis.

Table 4-4: Tertiary System Design Flowrates

	Design Flowrates (mgd)						
Time of Day	Secondary Effluent to MF	Strainer Effluent	Total MF Filtrate	RO Feed Pump Suction	RO Permeate	RO Brine	Combined CCB Feed
3:00 am to 7:30am	1.5	1.5	1.4	1.2	1.0	0.2	1.2
7:30am to 3:00 am	3.2	3.1	3.0	1.2	1.0	0.2	2.8

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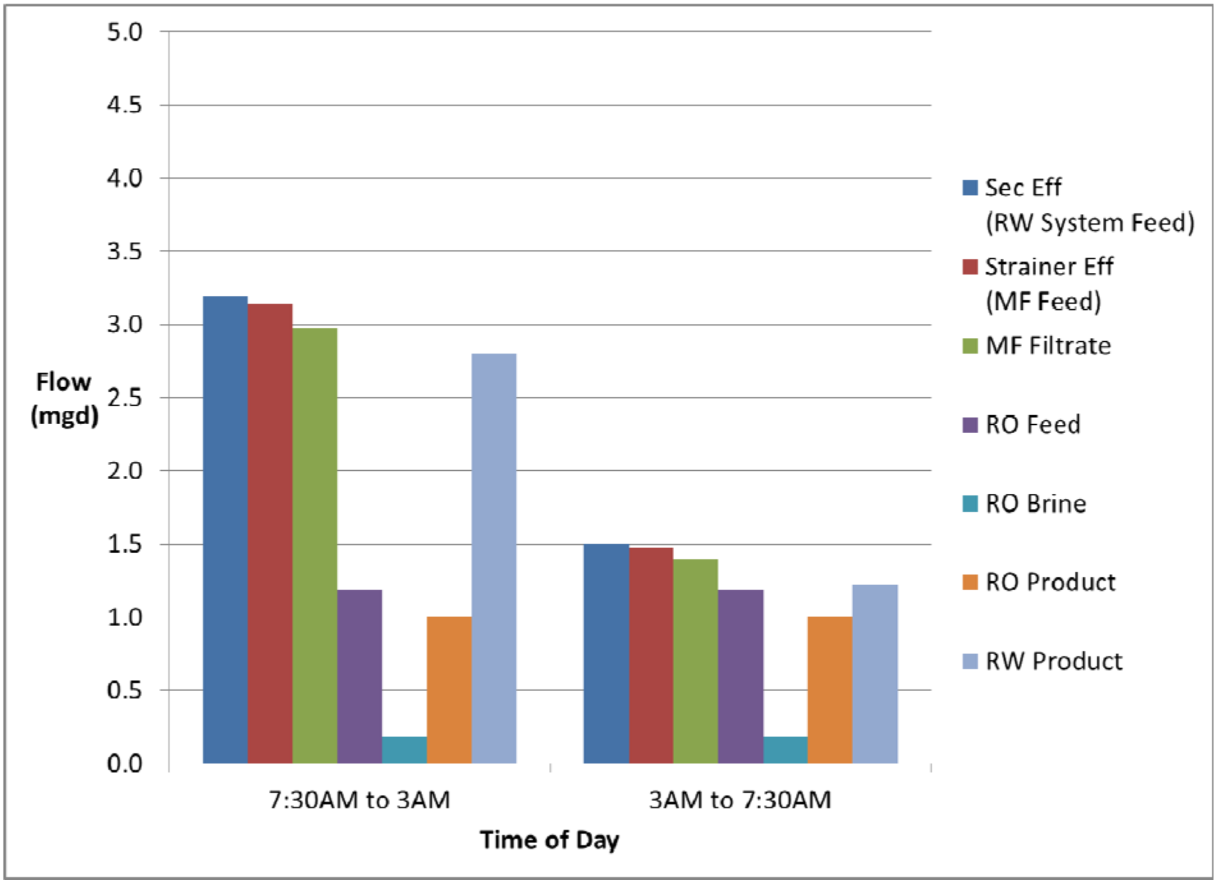

Figure 4-2: Design Flows through the Tertiary System

The MF/UF System is designed to provide an ultimate MF/UF filtrate flow of 3.0 mgd, assuming an overall minimum MF/UF system recovery of 93 percent (95 percent recovery for the MF/UF system and 98 percent recovery for the automatic strainers). This flow will be enough to allow for a RO System to treat a sidestream of the MF/UF filtrate flow to produce 1.0 mgd of RO permeate (1.2 mgd of filtrate is required, based on an RO System recovery of 85 percent). The blended MF/UF filtrate and RO permeate will provide a total recycled water treatment capacity of 2.8 mgd during high flow conditions, and 1.2 mgd during low flow conditions.

The RO System is not required to meet regulatory requirements, so the City may elect to construct only the MF/UF System and construct the RO System in the future. If the RO System is not installed at the same time as the MF/UF System, the MF/UF System may produce less filtrate because the RO brine will not be used.

The control of the MF/UF System to accommodate these flows is provided in Section 4.3.4.3. The existing recycled water storage capacity, and additional storage required to equalize the recycled water flows on-site (e.g., store recycled water produced during the day to be used at night for reuse) is discussed in Assessment Memorandum No.6.

4.3. Treatment Process Description

The AWPF consists of the following treatment components, as shown in Figure G-03B:

- MF/UF Feed Pumps
- Pre-treatment Chemical Addition (chloramination for biofouling control)
- Automatic Strainers
- MF/UF Membranes
- MF/UF Filtrate Tank
- MF/UF System Ancillary Equipment
- MF/UF Backwash System
- MF/UF CIP System
- MF/UF Compressed Air System
- Chemical Facilities

Figure G-03A shows a process flow diagram of the MF/UF system operating without a future RO system. Figure G-03B shows a process flow diagram of the MF/UF system and modified flows when the future RO System will be installed to treat a sidestream of the MF/UF filtrate.

4.3.1 MF/UF Feed Pumps

Feed water for the MF/UF System will be pumped from the secondary effluent line through the MF/UF membranes by the MF/UF feed pumps. Table 4-5 summarizes the design criteria for the MF/UF feed pump.

Table 4-5: MF/UF Feed Pump Design Criteria

Parameter	Criteria
MF/UF Feed Flow	Min = 1.6 mgd Avg = 2.9 mgd Max = 3.1 mgd
Pump Type	Horizontal end suction centrifugal
No. of Pumps	3 (2 duty, 1 standby)
Capacity per Pump	1,074 gpm
TDH	50 psi
Motor Size	50 hp
Drive	VFD

4.3.2 Pre-treatment Chemical Addition

Sodium hypochlorite will be added downstream of the MF/UF feed pumps and upstream of the automatic strainers for chloramination to control the biological fouling of the MF/UF membranes and the future RO membranes. The target combined chlorine concentration (chloramines) is 3 to 5 mg/L.

The chemicals will be flow paced based on the MF/UF feed flow rate and trimmed based on combined chlorine concentration.

Ammonium hydroxide addition is also needed for the formation of chloramines, and included as part of the secondary process improvements, as discussed in Section 4.2.1. If the secondary improvements are not complete prior to the tertiary filtration project, then the secondary treatment plant will not nitrify and the expected secondary effluent ammonia is greater than 4.5 mg/L, sufficient for the formation of chloramines. Table 4-6 summarizes the chemical dose requirements for ammonium hydroxide and sodium hypochlorite.

The design criteria for these chemical systems are described in detail in Section 4.3.6.

Table 4-6: Aqueous Ammonia and Sodium Hypochlorite Doses

Parameter	Criteria
Aqueous Ammonia Doses	
Minimum	2.5 mg/L
Average	3.0 mg/L
Maximum	4.5 mg/L
Sodium Hypochlorite Doses	
Minimum	10.0 mg/L
Average	12.0 mg/L
Maximum	18.0 mg/L

4.3.3 Automatic Strainers

The automatic strainers will be provided immediately upstream of the MF/UF membranes to protect the MF/UF membranes from damage and/or fouling due to larger particles. Automatic strainers are required to meet MF/UF membrane warranty requirements, and thus are typically provided by the membrane manufacturers as part of a complete MF/UF System package. Table 4-7 presents the design criteria for the automatic strainers.

Table 4-7: MF/UF Automatic Strainer Design Criteria

Parameter	Criteria
Type	Auto-Backwash Strainer
No. of Units	2 Duty
Capacity per Unit	1,074 gpm
Screen Pore Size, Minimum	300 microns
Strainer Recovery, Minimum	98%

4.3.4 Microfiltration/Ultrafiltration (MF/UF) System

The MF/UF System is the core process of the filtration system and will be comprised of three MF/UF trains connected in parallel to produce a high quality filtered product, or MF/UF filtrate. The secondary effluent will be chemically conditioned using chloramination and the resultant MF/UF feedwater will be pumped to the MF/UF System for removal of suspended solids. The MF/UF filtrate will then be sent to the MF/UF Filtrate Tank, from which it will overflow to the recycled water chlorine contact basin (CCB) for disinfection and distribution to recycled water users. A portion of the

MF/UF filtrate may pass through RO membranes prior to disinfection for further treatment to remove dissolved constituents for a higher recycled water quality.

This section describes the selection and sizing of the membrane system and components. Critical in this discussion are the determination of feedwater quality and the establishment of treatment goals. These parameters have been defined in Section 4.2. Once these parameters are defined, the basic building blocks of the process, the membrane elements, can be selected and the physical and operational requirements of the specific membrane installation can be determined. These requirements include: MF/UF recovery, number of trains and number membrane modules per train.

It is assumed that future expansion of the Membrane Filtration Facility will not be required. This facility is designed for the projected maximum daily recycled water demand of year 2030.

4.3.4.1 Standardized MF/UF Skid Design versus Preselection

The majority of MF and UF plants today employ proprietary systems with non-uniform element sizing, unique backwashing approaches, and irregular skid configurations, requiring that the membrane system supplier be identified and selected at the beginning of the facility design. This requirement can extend the design process and reduce competitive bidding both during the initial design and in future expansions or plant upgrades. However, the competitive bidding for this type of system can be conducted early in the design process to provide competition.

For this PDR, the proposed MF/UF System utilizes a standardized skid design, which will accommodate membranes by multiple candidate MF/UF membrane manufacturers, to promote competition when selecting the MF/UF System. By employing the standardized skid approach with MF/UF elements that are generally compatible, the elements can be replaced in the future with alternative membranes, allowing for continued competition after the initial facility is constructed. Note that the proposed system does not include all MF/UF manufacturers. Additional details on candidate MF/UF membrane manufacturers that could be considered for utilizing standardized skid design are provided in Section 4.3.4.2.

Two construction schedules are provided in Section 7. One is for the standardized MF/UF skid design and the other is using pre-selection of the MF/UF Manufacturer. The decision on how to proceed should be made based on schedule requirements.

4.3.4.2 Candidate MF/UF System Manufacturers

MF/UF vendors must provide equipment that meets the following minimum qualifications to be considered for use at the EEWWTP:

- Technology and equipment shall have been used for reuse applications in the United States at recycled water treatment facilities of 5.0 mgd capacity or greater
- Technology shall be approved by CDPH for production of tertiary filtered recycled water in accordance with the requirements of Title 22

There are several MF/UF vendors who meet these requirements. Hydranautics offers an MF membrane that provides a higher surface area than other systems; however, the membrane is relatively new and does not yet have a track record. The vendors are summarized in Table 4-8.

Table 4-8: Pressure MF/UF System Candidate Vendors

Parameter	Criteria			
Vendor	Toray	GE	Dow	Pall/Asahi [1]
Membrane Model	HFS-2020	ZeeWeed 1500	SFP-2860	Microza UNA-620A
Membrane Classification	UF	UF	UF	MF
Nominal Pore Size	0.02 µm	0.02 µm	0.03 µm	0.1 µm
Material	Polyvinylidene difluoride (PVDF)	PVDF	PVDF	PVDF
Membrane Area per Module	775 ft^2/module (72 m^2/module)	550 ft^2/module (51 m^2/module)	549 ft^2/module (51 m^2/module)	538 ft^2/module (50 m^2/module)
Flow Direction	Outside-In	Outside-In	Outside-In	Outside-In
Module Dimension – Diameter	8.5 inch	7.0 inch	8.9 inch	6.5 inch
Module Dimension – Length	85.0 inch	75 inch	73.2 inch	85.0 inch

Note:

1. While all Pall MF systems designed/installed in the US utilize Pall's proprietary skid design, Asahi Microza membranes can be utilized in standardized skid configurations.

4.3.4.3 MF/UF System Design Criteria

As stated in Section 4.2.3, the MF/UF System is designed to meet an MF/UF filtrate flow of 3 mgd during high flow periods and 1.4 mgd during low flow periods. This is to meet the daily average flow requirement of 2.5 mgd for the overall recycled water system.

Three skids will be provided for the MF/UF System, with 2 duty skids and 1 redundant skid. Table 4-9 outlines the flows to the MF/UF skids and the RO trains in the different recycled water demands. The MF/UF skids must be operating with at least two units to allow for continuous flow from the system during backwashing. If the minimum flow is less than 1 mgd, system shutdowns will occur.

Table 4-9: MF/UF System and RO System Operation at Different Recycled Water Demand Conditions

Recycled Water Demand	Flow Condition	Skid Operation
Maximum RW demand (Summer Months) – 1.64 mgd (based on Year 2011 RW demand data) to 2.44 mgd (based on Year 2030 projected RW demand data)	Early morning low secondary effluent flow conditions (secondary effluent = 1.5 mgd)	• Operate 2 MF/UF skids at ~ 1.8 mgd total • Operate 1 RO train at 0.5 mgd total • Blend ratio (MF/UF filtrate to RO permeate) is 2:1
	Mid-day max secondary effluent flow conditions (MF feed flow = 3.2 mgd)	• Operate 3 MF/UF skids at ~ 2.98 mgd total • Operate 2 RO trains at 1.0 mgd total • Blend ratio (MF/UF filtrate to RO permeate) is 1.5:1
Minimum RW Demand (Winter Months) – 0.29 mgd (based on Year 2011 RW demand data) to 0.43 mgd (based on Year 2030 projected RW demand data)	All day operating condition (RW demand and production set-point controls are tied) (secondary effluent = 1.26 mgd)	• Operate 2 MF/UF skids at ~ 1.2 mgd • Operate 1 RO train at 0.5 mgd • Blend ratio (MF/UF filtrate to RO permeate) is 1:1

The MF/UF System is configured with a pressurized outside-in configuration. The MF/UF System design criteria utilizing standardized skid design is summarized in Table 4-10.

Table 4-10: MF/UF System Design Criteria

Parameter	Criteria
MF/UF Membranes	
MF/UF Recovery, Minimum	95%
Nominal Pore Size	0.10 µm (MF); 0.02 to 0.08 µm (UF)
Material	PVDF
Type/Fiber Flow Path	Pressurized/Outside-In
Membrane Area Per Module	500 to 840 ft^2 depending on manufacturer (see Table 4-8)
MF/UF System Configuration	
No. of Duty Skids	2
No. of Redundant Skids	1
MF/UF Trains	
Production Capacity per Skid	1 mgd (667 gpm)
Average Design Flux	20 gfd (overall average)
Maximum Design Flux	25 gfd (to account for backwashing)
Maximum Instantaneous Flux with One Skid Offline for Maintenance or Recovery Cleaning	35 gfd
Required Membrane Area per Skid	48,000 sf
Required No. of Membrane Elements per Skid	62 to 96 depending on membrane area per module (see Table 4-8)
Spare Space	15%
Total No. of Membrane Space per Skid [1]	71 to 110 depending on membrane area per module (see Table 4-8)
Operating Flux	
Online factor	88%
Average Flux	20 gfd
Maximum Instantaneous Flux	23±1 gfd
Maximum Instantaneous Flux with One Train Offline	35±1 gfd
Filtration Duration	25 to 30 minutes

4.3.4.4 MF/UF System Design Flux

Since the design of secondary treatment improvements is currently underway, the secondary effluent water representative of future MF/UF feed water quality is currently not available for pilot testing. The assumptions for MF/UF feed water quality are provided in Section 4.2.2. The following conservative design flux rates were used as the basis of design:

- average flux rate of 20 gfd – flux rate based on average daily production
- maximum instantaneous flux of 25 gfd with all skids operational – higher production during normal operation to accommodate filtrate lost during backwashing
- maximum instantaneous flux of 35 gfd with one skid offline for maintenance or recovery cleaning – full design flow will be treated by two trains

These flux rates are conservative when compared to average design flux rates of 26 gfd used at the Water Replenishment District of Southern California's Leo Vander Lans Water Treatment Facility and 30 gfd used at the City of San Diego's Indirect Potable Reuse Demonstration Project Advanced Water Purification Facility.

4.3.5 MF/UF System Ancillary Equipment

The following sections describe the various ancillary systems associated with the MF/UF System.

4.3.5.1 MF/UF Backwash System

The MF/UF filtrate tank is designed to provide backwash water supply to the MF/UF system. The MF/UF filtrate flow will always be more than the RO feed flow, so equalization volume beyond the minimum storage volume required for the RO feed pump is not needed between MF and RO.

Typically, an MF/UF system that is running at a sustainable flux rate can operate with backwash and cleaning intervals that provide a target overall system recovery of greater than 95 percent (i.e., 5 percent of the total flow is used for backwash and cleanings) at a reasonable rate of transmembrane pressure (TMP) increase. Each MF/UF train is expected to backwash approximately every 20 to 30 minutes with no overlap in backwash sequences between trains. Each backwash sequence will last approximately 3.6 minutes. The MF/UF backwash system consists of the following:

- MF/UF filtrate tank to supply MF/UF backwash water
- MF/UF backwash pumps
- Compressed air system to provide process air for air scour (See Section 4.3.5.3)
- Backwash waste line to plant sewer

The MF/UF filtrate tank will provide MF/UF backwash water needed for routine MF/UF System backwash cycles. The tank will also provide the feed water for the RO feed pumps. The MF/UF filtrate tank influent and effluent configuration will differ when operating without the RO system and with the RO system as follows:

- Operating without the RO system:
  - The MF/UF filtrate will be conveyed to the MF/UF filtrate tank with residual pressure from the MF/UF system. The MF/UF filtrate tank fill line (filtrate line from MF/UF skids) will be located at the top of the tank.
  - The tank effluent line leading to the MF/UF backwash pumps will be located at the side bottom side of the tank to provide flooded suction even when the tank is not a full level (during MF backwash).
  - The MF/UF filtrate will overflow out of the tank and flow by gravity to the chlorine contact basin. With this configuration, providing MF/UF filtrate to the MF/UF backwash pumps will have higher priority than sending the water to the chlorine contact basin. Also, by overflowing out of the MF/UF filtrate tank, the line going to the recycled water CCB will have a relatively constant head.
- Operating with the RO system:

- The MF/UF filtrate will be conveyed to the MF/UF filtrate tank with residual pressure from the MF/UF system. The MF/UF filtrate tank fill line (filtrate line from MF/UF skids) will be located at the side bottom of the tank. Another tank fill line will be located at the top of the tank, and RO permeate will overflow out of the RO Flush Tank into the Mf/UF filtrate tank from the top of the tank.
- The RO feed pump suction line will be teed off of the MF/UF filtrate tank fill line. When the MF/UF skids are in filtration mode, the MF/UF filtrate will feed RO feed pump suction and remaining flow will fill the filtrate tank. When MF/UF filtrate flow is less than the RO feed flow (e.g., when only one MF/UF skid is in operation and it goes into backwash) MF/UF filtrate tank will provide feed water to the RO feed pump suction.
- The blend of MF/UF filtrate and RO permeate water will overflow out of the tank and flow by gravity to the chlorine contact basin. With this configuration, providing flow to the RO feed pumps and MF/UF backwash pumps will have higher priority than sending the water to the chlorine contact basin. Also, by overflowing out of the MF/UF filtrate tank, the line going to the recycled water CCB will have a relatively constant head.

Table 4-11 presents the MF/UF filtrate tank design criteria.

Table 4-11: MF/UF Filtrate Tank Design Criteria

Parameter	Criteria
No. of Tanks	1
Nominal Tank Volume	12,000 gal
Diameter	12 ft
Straight Sideshell Height	16.5 ft
Residence Time at Design Flow	5.8 minutes
Type of Tank	HDPE
Tank Color	Black

The MF/UF backwash pumps will be horizontal end suction or vertical in-line centrifugal pumps. Table 4-12 presents the MF/UF backwash pump design criteria.

Table 4-12: MF/UF Backwash Pump Design Criteria

Parameter	Criteria
Pump Type	Horizontal end suction or vertical in-line centrifugal
No. of Pumps	2 (1 duty, 1 standby)
Required Capacity per Pump	1,600 gpm (MF); 1,000 gpm (UF)
TDH	50 psi
Motor Size	50 hp
Drive	Variable speed

Backwash waste from the MF/UF system will be sent to the nearby 42-inch interceptor, and routed to the EEWWTP headworks.

The backwash waste from the MF/UF system cannot be sent direct to the outfall because it would likely violate the NPDES permit limits, especially during low flow periods. The MF/UF system is designed for an overall recovery of 95% recovery. It is assumed that the secondary effluent will have a maximum of 10 mg/L TSS after the improvements. It is also assumed that all the TSS is removed by the MF/UF system, and therefore will be in the backwash waste. Assuming 10 mg/L TSS in the secondary effluent, the backwash waste from the MF/UF system will have 200 mg/L. During low flow periods, nearly all of the secondary effluent will be used for the recycled water system. Therefore, the backwash waste cannot be sent directly to the outfall since it would violate the outfall permit.

The MF/UF backwash flow rate is metered on the backwash supply side. Sample taps could be provided on above grade MF/UF backwash waste pipe. However, the grab samples of MF/UF backwash waste may not be representative of the total composite flow.

4.3.5.2 MF/UF CIP System

Membrane fouling, the accumulation of contaminates on the surface of the membrane material, can significantly impact the operation of a membrane process. When a membrane becomes fouled, operation is compromised due to decreased membrane porosity, decreased hydraulic diameter, and increased effective thickness. In order to prevent fouling, two types of chemical cleaning regimens are typically performed for MF/UF Systems: (1) chemically enhanced backwashes (CEBs) to maintain the day by day membrane permeability, and (2) chemical clean-in-place (CIP) to restore the membrane permeability between phases or when the TMP reaches the terminal value (approximately 35 psi).

CEBs are preventive cleans performed in place at specified regular intervals to maintain the permeability of the membrane at an acceptable level. Typically, CEBs occur once every 1 to 7 days. During these types of cleanings, the membranes will be exposed to chemicals such as sodium hypochlorite, citric acid, and sodium hydroxide for a short period of time (<15 minutes). Other chemicals, including strong acids, may be used depending on the supplier's membrane chemical compatibility and foulants of concern. Chemical concentrations will depend on the severity of the organic or inorganic membrane fouling. Before resuming production, chemical residuals must be flushed out from the membrane modules. Typically, the equipment supplier is responsible for providing input for the optimization of the CEB cleaning regimen. CEBs are automated and can be operator initiated or on a time schedule without operator supervision. Projected staffing requirements are provided in Section 4.6.

CIP cleans are an intensive chemical cleaning used to restore the membrane permeability to pre-fouled conditions. This intensive cleaning are typically performed roughly once every 30 days (40 days maximum) as needed, although longer cleaning intervals may be used if reliable operation is maintained. The chemicals used for recovery cleanings will depend on the severity of the organic or inorganic membrane fouling, and can include sodium hypochlorite, sodium hydroxide, and citric acid or other comparable acids. This cleaning is performed in place, requires a significant soaking or recirculation time (>4 hours), and typically uses higher chemical concentrations than CEBs. CIPs are operator initiated and require operator supervision. Projected staffing requirements are provided in Section 4.6.

The CIP system consists of the following components:

- CEB tank
- CIP tank (to be shared with future RO system)
- CEB/CIP pumps

- Sodium hypochlorite storage and feed system
- Citric acid storage and feed system
- Sodium hydroxide storage and feed system

The CEB and CIP tanks are sized for the MF/UF System is based on an assumption of three volumes required to clean a skid, one volume for the batch chemical solution and two volumes for rinse cycles. The CIP tank is also sized for RO CIP. Table 4-13 presents the CEB and CIP tanks design criteria.

Table 4-13: CEB and CIP Tank Design Criteria

Parameter	Criteria
No. of Tanks	2 (2 duty, 0 standby)
Tank Sizing Requirements	
Required Capacity for MF/UF CIP	1,700 gal (MF); 3,200 gal (UF)
Tank Sizing Calculations	
Required CIP Tank Usable Volume	3,200 gal
Diameter	7 ft
Required Sideshell height	12.5 ft
Required Nominal Tank Volume	3,500 gal
Type of Tank	FRP

The MF/UF CEB/CIP pumps will be horizontal end suction or vertical in-line centrifugal pumps. These common pumps will be shared for both the CEBs and CIPs. Table 4-14 presents the MF/UF CEB/CIP pump design criteria.

Table 4-14: MF/UF CEB/CIP Pump Design Criteria

Parameter	Criteria
Pump Type	Horizontal end suction or vertical in-line centrifugal
No. of Pumps	2 (1 duty, 1 standby)
Required Capacity per Pump	720 gpm (MF); 1,000 gpm (UF)
TDH	50 psi
Motor Size	25 hp (MF); 40 hp (UF)
Drive	Constant speed

CEB and CIP waste from the MF/UF system will be neutralized in the corresponding tanks and then sent to the nearby 42-inch interceptor, and routed to the EEWWTP headworks.

4.3.5.3 MF/UF Compressed Air System

The MF/UF System requires process low pressure air for air scour during membrane backwash, low pressure air for membrane integrity testing, and high pressure control air for the control of automatic control valves that utilize pneumatic actuators. The compressed air system for the MF/UF System will be sized with extra capacity to provide control air for automatic control valves for the future RO System. Table 4-15 presents the compressed air system design criteria.

Table 4-15: Compressed Air System Design Criteria

Parameter	Criteria
No. of Air Compressors	2 (1 duty, 1 standby)
Required Capacity per Air Compressor	TBD
Motor Size	25 hp
No. of Air Receiver Tanks	1 (1 duty, 0 standby)
Required Capacity per Tank	TBD

4.3.6 Chemical Facilities

The chemical systems consist of the following:

- Sodium hypochlorite for chloramination and CIP
- Citric acid for CIP
- Sodium hydroxide for CIP

The primary purpose of chloramination is to prevent biological fouling of the membranes, both to the MF/UF and RO Systems. Chloramines are a disinfectant that will achieve this goal. Free chlorine could also prevent biological fouling, but the RO membrane material cannot tolerate free chlorine, so free chlorine cannot be used. Therefore, chloramination, which is a combination of ammonia and chlorine, will be used for disinfection. These chemical systems are described in detail below.

The recovery clean of the MF/UF membranes is achieved with the following cleans:

- Sodium Hypochlorite, or Sodium Hypochlorite plus Caustic Soda Clean
- Citric Acid Clean

Citric Acid and Sodium Hypochlorite system will be used for RO CIP as well.

4.3.6.1 Aqueous Ammonia

As stated in Section 4.2.1, aqueous ammonia will be added to the secondary effluent line upstream of the MF/UF feed pumps as part of the secondary improvements project. If the secondary improvements project is not complete prior to the tertiary filtration project, the plant will continue to have residual ammonia in the secondary effluent that will be used for chloramine formation.

4.3.6.2 Sodium Hypochlorite

Sodium hypochlorite will be added upstream of the MF/UF feed pumps for chloramination to control the biological fouling of the MF/UF membranes. The chemical will be flow paced based on the MF/UF feed flow rate, and combined chlorine residual or ORP will be monitored to alarm when the measured levels are outside of acceptable range. In addition, sodium hypochlorite will also be used for CIP on an as-needed basis.

Table 4-16 presents the design criteria for the sodium hypochlorite storage and feed system. There are three existing sodium hypochlorite storage tanks in the bulk chemical storage area. Two of three tanks are currently in use. The third tank, which is currently not connected to the system, will be connected as part of this project, and the three tanks will be used in conjunction to provide storage sodium hypochlorite use for effluent disinfection, recycled water disinfection, MF/UF feed chloramination and MF/UF membranes cleaning.

Furthermore, as discussed in Section 4.3.8 below, programming changes will be considered to automate the sodium hypochlorite addition for chlorination and sodium bisulfite addition for dechlorination of the plant effluent to ocean outfall.

Table 4-16: Sodium Hypochlorite Storage and Feed System Design Criteria

Parameter	Criteria
Demand (MF/UF Feed)	
Dose, Minimum	10 mg/L
Dose, Average	12 mg/L
Dose, Maximum	18 mg/L
Storage	
No. of Tanks	3 (existing)
Volume, Each	7,500 gal
Type of Tank	HDPE
Days of Storage, Average Dose	30
Pumps	
No. of Pumps	2 (1 duty, 1 standby)
Pump Type	Diaphragm metering
Flow Range	2.9 to 15.9 gph
Pump Capacity	16.9 gph

4.3.6.3 Citric Acid

Citric acid will be used for the cleaning of the MF/UF membranes. The cleaning requirements are specific to each membrane system vendor. The design of the citric acid system will include either storage drums or totes with a diaphragm metering pump. Although citric acid can be supplied as a dry chemical or as a 20 to 50 percent solution, the MF/UF system is designed around a liquid system for ease of operation. If dry chemical is preferred, the MF/UF filtrate or RO permeate can be used for batching of the citric acid onsite.

4.3.6.4 Sodium Hydroxide

Sodium hydroxide will be used for the cleaning of the MF/UF membranes and neutralization of CIP waste. The cleaning requirements are specific to each membrane system vendor. The design of the sodium hydroxide system will include either storage drums or totes with a diaphragm metering pump. Sodium hydroxide is typically supplied as a 25 to 50 percent solution. A 50 percent sodium hydroxide solution has a relatively high freezing point and must be stored and utilized at temperatures above approximately 55 degrees Fahrenheit, or the storage and handling equipment must be insulated and heat traced. To avoid the need for insulation and heat tracing, use of a 25 percent solution is recommended. The freezing point of the 25 percent solution is -13.9 degrees Fahrenheit.

4.3.7 Process Piping and Valves

The process piping and valves for the MF/UF system will be as shown in Table 4-17:

Table 4-17: Piping and Valves Design Criteria

Parameter	Material	Pressure Rating
Process Piping Upstream of Automatic Strainers	Cement Mortar Lined Ductile Iron or Epoxy Lined Carbon Steel	150 psi
Process Piping Downstream of Automatic Strainers	PVC	150 psi
Process Piping for MF/UF Filtrate	PVC	150 psi
CIP Piping	PVC	150 psi
Sodium Hypochlorite	PVC Schedule 80	150 psi
Citric Acid	PVC Schedule 80	150 psi
Sodium Hydroxide	PVC Schedule 80	150 psi

Process valves will have cast iron bodies, rated for 150 psi. Valves for chemical systems will have PVC bodies, rated for 150 psi.

4.3.8 Miscellaneous Improvements

When the MF/UF system is operated to maximize the recycle water production for reuse, as described in Section 4.3.4.3, there may be times in the early morning hours when all secondary effluent flows will be treated by the MF/UF system, and the secondary effluent flows to Chlorine Contact Tank (CCT) for ocean outfall discharge will be temporarily stopped. To mitigate impacts to the plant effluent chlorination and dechlorination chemical feed systems under these low flow conditions, addition of flow meters on the 48-inch secondary effluent pipe and the 48-inch ocean outfall pipe will be considered during the final design. The CCT influent flow signal will be used for flow pacing the sodium hypochlorite addition for chlorination, and the CCT effluent flow signal will be used for flow pacing the sodium bisulfite addition for dechlorination.

4.4 Membrane Filtration Facility Layout Considerations

The majority of the equipment associated with the MF/UF System, including the MF/UF skids, will be located in the footprint of the existing tertiary filters. It will be necessary to demolish the existing filters in order to install the new MF/UF System. Therefore, during construction of the MF/UF System, the recycled water supply will be from potable water.

4.4.1 Process Connections

The various process headers on the MF/UF skid connect to risers that terminate at the top of the skid. The piping required to convey flows to and from the MF/UF skid connect to these risers.

4.4.2 Preliminary Layout

The MF/UF feed pumps, automatic strainers, MF/UF skids, MF/UF filtrate tank and backwash pumps, CEB and CIP tanks and CEB/CIP pumps, and chemical storage facilities will be located outside in the footprint of the existing tertiary filters. Figure M-01A shows a preliminary layout of the MF System.

The MF/UF system layout shows standardized MF skids with 100-modules, which accommodates Toray, GE, Dow, and Pall/Asahi systems.

4.5 System Reliability and Redundancy

The MF/UF System includes a redundant feed pump, a redundant automatic strainer, and a redundant membrane skid to allow equipment and components to be taken out of service for maintenance or cleaning while still maintaining the ability to produce recycled water at full design capacity. Instrumentation will be provided to protect equipment from damage by shutting down the system when certain conditions, such as high pump discharge pressure, or high transmembrane pressure, occur.

Unlike the main treatment plant processes, the tertiary filtration system is not required to remain online during a power outage as loss of recycled water service does not constitute a public health risk. In addition, recycled water customers can be served with potable water if necessary. Therefore, it is not necessary to connect the MF/UF System to the plant backup power supply.

If the MF/UF System went without power for an extended period of time, the following should be provided.

If the shutdown is shorter than two weeks, the MF/UF membranes should be flushed to sit idle.

If the shutdown is longer than two weeks, the MF/UF membranes should be pickled.

A discussion on temporary power for the MF/UF System is provided in Section 5.

The pipes and equipment are generally designed for a 20-year life. However, the MF/UF membranes typically last five to seven years before requiring replacement. Generally, replacement is required when the production capacities are reduced or membrane recovery cleanings are required more frequently than planned.

4.6 Impacts to Operations and Maintenance Staff Requirements of Proposed Membrane Filtration Facility

In general, the operator time required for daily operation of the MF/UF system will be less than that for the existing filters since the MF/UF system is a more automated and robust treatment system that could handle a wider range of feed water quality than the existing filter system, while reliably producing the desired filtrate water quality. The MF/UF system does not rely on chemical pretreatment to enhance filtration, which will reduce the time and attention required by operators to react to changes in secondary effluent quality. The system will also be programmed to respond automatically to variations in feed flows. Therefore, it will be much less likely that the operators would need to respond to short-term variations in feed flows or feed water quality when operating the MF/UF system, although they would need to be trained to monitor and evaluate the long-term trending of the membrane permeability and other operating parameters to schedule chemical cleanings and plan for membrane replacements.

The staff requirement for equipment maintenance of the MF/UF system will be more than for the existing filters, mainly due to a higher number of pneumatic valves in the MF/UF system and a higher reliance on automation. The individual membrane filters, each containing thousands of membrane fibers, are also more complex than the existing media filters, requiring time and attention to pin broken fibers, replace faulty seal, and investigate integrity failures. Additional training time will be required, as the MF/UF system is a new treatment process for the existing staff and may require a higher degree of training for reliable maintenance.

The impacts to O&M staff requirements for the proposed Membrane Filtration Facility are summarized in Table 4-18.

Table 4-18: Operations and Maintenance Staff Requirements for Membrane Filtration Facility

Activities	Existing Filter System	MF/UF System
Daily Operations		
Normal Operation	Operator needs to respond quickly to variations in feed flows and feed water quality, upsets in coagulant feed, and upsets in filtrate water quality.	Operation is fully automated. Operator response to short-term variations in feed flows and feed water quality is minimal. Operator needs to monitor long-term trending of membrane permeability to plan for membrane cleaning and long-term replacement.
Chemical Cleanings	Not applicable.	Daily CEBs are fully automated, can be initiated on a timer, and do not require operator presence. Monthly CIPs are fully automated as well. However, CIPs are operator initiated and operator presence is highly recommended.
Membrane Fiber Breakage/Pinning	Not applicable.	Operator will be required to pin broken membrane fibers in the event that integrity failures occur. Frequency of membrane fiber breakage varies for all membrane plants (zero to 10 fibers per week is typical).
Filter Media or Membrane Replacement	Filter media replacement as needed.	Membrane replacement typically required once every 5 to 10 years.
Equipment Maintenance	Feed pumps, backwash air blowers, air compressors, coagulant feed system, and valves require routine maintenance.	Feed pumps, automatic strainers, backwash pumps, CIP pumps, CIP tanks and heaters, air compressors, chemical feed systems, and valves require routine maintenance. MF/UF system includes many pneumatic valves on the MF/UF skids that require maintenance.
Training	Periodic training recommended, particularly for new employees.	MF/UF system requires additional operator training. Training is important to familiarize the operators with understanding MF/UF system performance parameters, such as membrane permeability, that would help determine longevity of the membranes and efficiency of operation. Training is also important as proper operation of the MF/UF system will impact performance of the downstream RO system (future).
Summary	--	**Operator time for daily operation of MF/UF system will be less than that for the existing filters.** **Staff requirement for equipment maintenance will be more than that for the existing filters mainly due to higher number of pneumatic valves, instruments, and filter elements in the MF/UF system.** **Training time will be required as MF/UF system is a new treatment process for the existing staff.**

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Section 5

Filtration TM No.5 – Electrical and Instrumentation and Control Design Criteria

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Jane Saulnier, CDM Smith
Brian Young, CDM Smith

Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design Technical Memorandum (TM) No.5 –Electrical and Instrumentation and Controls Design Criteria*

5.1 Introduction

This Technical Memorandum No.5 (Filtration TM No.5) provides the electrical evaluation and instrumentation and controls (I&C) evaluation for the preliminary design of tertiary filtration facilities at El Estero Wastewater Treatment Plant (EEWWTP) in the City of Santa Barbara (City).

5.2 Electrical

The following section provides the electrical design criteria for the various components of the proposed Membrane Filtration Facility.

5.2.1 Applicable Codes, Standards, and References

Electric equipment, materials, and installation will comply with the 2008 National Electrical Code (NEC) and with the latest edition of the following codes and standards:

- National Electrical Safety Code (NESC)
- Occupational Safety and Health Administration (OSHA)
- National Fire Protection Association (NFPA)
- National Electrical Manufacturers Association (NEMA)
- American National Standards Institute (ANSI)
- Insulated Cable Engineers Association (ICEA)
- International Society of Automation (ISA)
- Underwriters Laboratories (UL)
- International Electrical Testing Association (NETA)

- International Building Code (IBC)
- International Fire Code (IFC)
- Model National Energy Code for Buildings
- Institute of Electrical and Electronics Engineers (IEEE)
- NFPA 101 – Life Safety Code

5.2.2 Existing Electrical System

The following description of the existing electrical system is based on drawings and data provided by the City and through a field investigation performed by CDM Smith on August 13, 2012. An existing 12kV Southern California Edison power line serves a 3,750kVA 12kV to 4,160V transformer through a SM-5, 200E fuse in a fusible cutout. The transformer serves and is adjacent to a 4,160V, 1200A "Distribution Panel MS" through a 1200A main circuit breaker. Distribution Panel MS contains utility metering equipment. Five 4,160V substations are fed from Distribution Panel MS as shown in Table 5-1.

Table 5-1: Substations at EEWWTP

Name	Transformer Rating	Bus Rating	Loads Served
Substation A	300 kVA	600 A	MCC-2
Substation B	1500 kVA	2000 A	MCC-1, MCC-8,
Substation C	500 kVA	1000 A	MCC-3A, MCC-3B, MCC-7
Substation D	750 kVA	1200 A	MCC-4, MCC-5, MCC-6, Panel M, MCC-10
Substation E	750 kVA	1200 A	MCC-11

The total peak demand for EEWWTP for the past year has not exceeded 1000kW according to plant staff. Substations B and D are located close to the proposed filtration facility. These two substations were evaluated to determine the preferred power source for the proposed Membrane Filtration Facility.

Substation B is located approximately 150 feet north of the electrical room. An underground duct bank from the substation to the electrical room must be provided, requiring excavation along the existing roadway and grass areas. A clear route is available for the duct bank. The substation appears to have adequate capacity for the proposed loads.

Substation D is located approximately 150 feet south of the electrical room. There is a clear route for exposed overhead conduits from the substation to the electrical room. There is adequate space to route the conduits along the exterior wall of the Solids Handling Building or along the interior wall. The substation appears to have adequate capacity for the proposed loads.

5.2.3 Proposed Electrical Upgrades

Refer to the attached One Line Diagram for the proposed electrical power distribution. Power for the proposed Membrane Filtration Facility may be obtained from Substation B or Substation D. The main substation "MS", substation "B", and substation "D" must all be evaluated to determine the best source for delivering power to the new motor control centers. The selection of the preferred source will be based on several factors:

- Potential future loads on the substations. Based on the locations of the substations and proposed future expansion, it appears that substation D is not likely to be required to serve additional loads in the future. No future loads are anticipated from Substation B but it is more likely than Substation D to be utilized in the future.

- Proximity to the Membrane Filtration Facility electrical room. Both substations are nearly equidistant from the electrical room. Substation D, however, is adjacent to the Solids Handling Building housing the electrical room. This will allow a much less costly method of distributing power from the substation to the electrical room.

- Substation electrical capacity. Substation B has a 1500kVA transformer that is lightly loaded. Substation D has a 750kVA transformer that is also lightly loaded. The proposed filtration system load is 275kVA. A thorough evaluation of the existing loads on both substations must be performed, including recording power metering over several days with documentation of major load operation.

Substation D is the preferred power source but its capacity must be evaluated prior to making a final determination. If it is determined that Substation D does not have adequate capacity for the entire proposed load, the loads may be divided between Substations B and D. The following description includes deriving the power source from either B or D or both.

Refer to the attached load summary spreadsheet for a detailed list of the proposed loads and total load calculation. The proposed loads will be served by a new motor control center in the existing electrical room in the Solids Handling Building. Refer to the attached One Line Diagram drawing for the Filtration System motor control center (MCC). The MCC will be of sufficient electrical capacity and physical size to accommodate future loads equal to 20% of the presently planned load.

Substations D and B, and several other substations, are served from the plant main 4,160V substation “MS”. The main 4,160V substation “MS” must be evaluated to determine the spare capacity to verify that it is adequate for the new loads.

A new low voltage power circuit breaker will be installed in an existing spare space in the substation. Two conduits will be installed from the substation to the MCC. Conduit and wire will exit the substation near the top of the gear and run along the interior of the substation building wall to a junction box. The conduits will exit the building and be installed on a support beam from Substation D building to the Solids Handling Building and then along the exterior wall to the electrical room and into the MCC. Underground duct bank will be required to route power from Substation B to the electrical room in the Solids Handling Building.

The existing electrical equipment in the electrical room, including the MCC and VFDs, will be removed and replaced with new equipment. The existing PLC cabinet (CP-10) in the center of the room will remain in place, and only the I/O associated with the existing filtration system will be removed from this panel. The existing filter systems served by the equipment in the electrical room will be demolished prior to new construction and the electrical equipment does not need to stay in service during construction.

HVAC equipment and miscellaneous small loads will be rated and served at 208V, 3 phase or 120V, 1 phase depending on the load. New HVAC equipment will be served from existing panelboards.

5.2.4 Design Criteria

The following criteria will serve as a guide during the development of the final electrical design.

5.2.4.1 Motor Control Centers (MCC)

A NEMA 12, 480 Volt, 3-phase MCC manufactured by Cutler-Hammer will be provided in the existing electrical room. MCC wiring will be Class II type B. Main horizontal and vertical buses will be copper. MCCs will be equipped with the following:

- Transient Voltage Surge Suppression (TVSS)
- Motor starters, full voltage, for 50hp and below
- Variable frequency drives (VFDs)
- Circuit breakers sized according to the loads they protect per applicable codes
- Digital electrical parameter metering

5.2.4.2 Surge Protection

Surge protection will be provided in the MCC. The surge protective device will be installed on the load side of the main circuit breaker.

5.2.4.3 Wiring Methods

Power conductors will be copper. Conductors shall be 600 Volt, rated 90 degree C, wet location, moisture resistant, flame-retardant, thermosetting insulation, Type XHHW-2, stranded. Control wiring will be copper, 600 Volt, rated 90 degree C, wet location, moisture resistant, flame-retardant, type XHHW-2, stranded. Conductor sizing will be based on 30 degree C ambient temperature, and only allowing the conductor to heat up to 60 degree C (75 degrees C above 1/0AWG), even though the conductor is rated for 90 degrees C. This is to prevent overheating any of the connectors and lugs.

Underground conduits will be direct-buried Rigid Aluminum. Wiring throughout the filtration area may be accomplished utilizing conduit trenches. These are pre-manufactured or cast-in-place underground trenches with an open or closed cover. This allows flexibility when installing and modifying the underground wiring. Wiring trenches with grate covers will be utilized where practical.

Exposed conduits will be Rigid Aluminum in corrosive and non-corrosive areas. Liquid-tight flexible metallic conduit will be used for flexible connections in dry, wet, and damp locations. Enclosures will be specified for environmental areas as indicated in Table 5-2.

Existing conduits are corroded and may not be suitable for pulling in new conductors. Existing conduits will not be reused for new construction.

Table 5-2: Enclosure Design Criteria

Area	NEMA Rating
Indoor Dry	NEMA 12
Indoor Process	NEMA 12

Indoor Corrosive	NEMA 4X 316 SS
Outdoor	NEMA 4X 316 SS
Outdoor Corrosive	NEMA 4X 316 SS

5.2.4.4 Voltage Drop

Conductors will be sized for a maximum voltage drop of 2% for feeder conductors and 3% for branch circuit conductors at full-connected load. Total maximum voltage drop allowed will be 5%.

5.2.4.5 Grounding

The 480 Volt electrical systems neutral will be solidly grounded. The grounding system will include connecting bare copper ground ring, ground rods, and major rebar in foundations, structural steel, and electrical equipment.

Buried #4/0 bare copper ground grid, located 30-inches below grade, with ground rods and a ground test well, will be provided as the grounding electrode system per NFPA 70 (NEC). An equipment grounding conductor sized per the NEC will be provided in each conduit to ground electrical equipment.

The grounding electrode system will have maximum resistance of 5 ohms for the electrical system.

Lightning protection will not be included for the canopy structure.

5.2.4.6Lighting and Illumination

Interior and exterior lighting around the canopy will be provided. The canopy lighting system will be designed in accordance with IES. The lighting system will be designed using the following illumination levels defined in Table 5-3.

Table 5-3: Illumination Levels

Illumination Levels	
Functional Area	Intensity at Floor Level (Footcandles)
Process Area	40
Outdoor equipment areas (pumps, tanks)	1
Outdoor operator areas (valve operation, instrument reading, equipment status, control stations)	5

Under-canopy lighting will consist of high-efficiency high pressure sodium light fixtures.

Exterior lighting will utilize wall pack type fixtures with high-pressure-sodium lamps. Outdoor operator areas and equipment area lighting will be controlled with switches.

Interior and exterior lighting will be operated on 120 Volts.

5.2.4.7 Receptacles

120 Volt receptacles will be provided on the canopy structure every 50 feet or as required.

5.2.4.8 Dry-Type Transformer

Dry type transformers will be energy efficient, three phase 480 Volt delta primary, with four 2-½% full capacity taps below normal, 208/120 Volt wye secondary, 115 degree C rise, 180 degree C insulation, encapsulated copper windings, indoor non-ventilated enclosure, with electrostatic shielding.

5.2.4.9 Panel Boards

The panel boards will be rated for 208/120 Volt, 3 phase, four wire, and 10,000 Amp interrupting capacity and will have solid-grounded neutral rated 100% of phase bus and aluminum buses, and bolt-on type circuit breakers.

5.2.4.10 Variable Frequency Drives

VFDs will be 18 pulse, Altivar 71 manufactured by Schneider Electric. The VFD's harmonics level will be IEEE 519-1992 compliant. The motors controlled by VFDs will be inverter duty, per NEMA MG-1 Parts 30 and 31.

5.2.4.11 Induction Motors

Induction motors will be 208/120 Volt, single phase for fractional horsepower sizes, and 480 Volt, three phase for integral horsepower sizes. Three phase motors will be high efficiency, 1.15 service factor, totally enclosed fan cooled, with thermal cutouts in the winding for VFD driven motors, and anti-condensation heaters, for motors outside above 10hp.

5.2.4.12 Standby Power

Standby power is presently provided to the Distribution Panel MS at 4,160V by a standby generator. The proposed Membrane Filtration Facility is not a critical system and can be shut down during power outages. Equipment that must remain in operation for an orderly shutdown will be connected to standby power.

The Membrane Filtration system will be connected to the plant distribution system and can be operated from the standby power system if desired. For most process equipment the controls will utilize manual start/stop control or PLC control such that during a power outage the equipment will shut down and not restart unless requested to start. Equipment that must remain in operation for an orderly shutdown will be designed to automatically start when standby power or utility source power is restored. The existing standby power system may not have adequate capacity to operate this system depending on the other plant loads operating on standby power.

5.3 Instrumentation and Controls

The following section provides the I&C design criteria for the various components of the proposed Membrane Filtration Facility.

5.3.1 Applicable Codes, Standards, and References

The I&C for the EEWWTP shall be designed in accordance with local and latest industry standards. The following list the primary documents that will be used for design.

- ISA S5.2 Binary Logic Diagrams for Process Operations
- ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

- ISA S5.4, Instrument Loop Diagrams.
- ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
- ISA RP60.3, Human Engineering for Control Centers
- ISA-99, Industrial Automation and Control Systems Security
- National Electrical Manufacturers Association (NEMA)
- NFPA 70, National Electrical Code (NEC).
- NFPA 79, Industrial Control Equipment.
- UL 508 - Industrial Control Equipment - for custom fabricated equipment
- A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

5.3.2 Existing Instrumentation and Control System

The existing filtration system is controlled from the panels CP-10 and LCP-10. The PLC platform is Modicon. The filtration system can be controlled locally at the equipment and monitored from the plant's existing SCADA system. The SCADA Operator Workstations (OWS), which run the Wonderware InTouch software from a tower PC, are located in the Solids Handling Building, Filter Control Room and Distribution Pump Station. In addition to the OWSs, local panel-mounted industrial computers (referred to as the Human Machine Interface, or HMI) also are developed using Wonderware software. The existing plant SCADA system consists of a fiber optic network connecting all area PLCs to a single network. The network communication protocol is Ethernet.

5.3.3 Proposed Instrumentation and Control Upgrades

The existing filtration system will be demolished and replaced with a new Membrane Filtration System. All of the existing I/O shall be removed from its associated control panel. The proposed Membrane Filtration System control panel will be provided with a PLC and associated programming, and integrated into the existing plant SCADA system to be operable remotely from the OWSs and HMIs, and locally through hardwired switches and pushbuttons at each equipment area. The proposed Membrane Filtration System shall match the existing EEWWTP SCADA and equipment tagging standards.

5.3.3.1 Operations and Control Philosophy

The general control philosophy for the Membrane Filtration System is for vendor packaged systems to include a complete control system, including instrumentation, to monitor and control the provided equipment. These individual control systems will be integrated into the plant-wide SCADA network and monitored and controlled from the master facilities controls. The design is intended to meet the following objectives:

- Design the network system to provide a high degree of reliability.
- Provide automation capability (where appropriate) with manual override. The use of automated systems can give operators more operational flexibility.

- Allow the automatic and manual operation of the proposed Membrane Filtration System from the OWSs and from designated areas around the plant.
- Minimize the down time caused by monitoring and control component failures.
- Use the latest available technology to facilitate future expansion or modification.

5.3.4 Design Criteria

The following criteria will serve as a guide during the development of the final design.

5.3.4.1 SCADA Control Architecture

The proposed Membrane Filtration Facility will be incorporated into the existing EEWWTP SCADA system with the use of Modicon Programmable Logic Controllers (PLC). OWS and HMI screens will be developed by the vendor for integration to the existing EEWWTP SCADA screens. An integrator shall incorporate all the MF/UF system screens and remove the demolished filtration system screens from the SCADA system. The screens shall be developed using the version of the existing Wonderware system. The design and integration shall follow the existing EEWWTP SCADA standards.

5.3.4.2 Programmable Logic Controllers

The PLC platform being designed for the new facilities shall be Modicon Quantum PLCs. Each PLC shall utilize the latest CPU processors, communications modules and the latest I/O modules. The PLC shall be programmed with Modicon Unity software.

Input modules will be 24 volts Direct Current (DC) modules only. The output modules will be relay modules used to trigger interposing relays. Analog modules shall be 4-20mA 24VDC isolated input and output channel design. All analog signals exiting buildings to or from devices or instruments shall have transient voltage surge suppression, TVSS, to reduce risk of lightning or power surge conditions.

Vendor supplied PLCs shall have onboard removable memory modules. The memory modules shall hold the processor's program and other vital information. Vendor supplied PLCs shall match the manufacturer of the Plant PLC system.

Individual Uninterruptible Power Supplies (UPS) shall be used for all PLCs and any SCADA network devices. This includes all Ethernet switches and network related equipment. The UPSs should have adequate power reserves to maintain operations for a minimum of 30 minutes. The UPSs must also be able to communicate with the PLC regarding its condition and the condition of the system power input. UPSs shall be provided with maintenance bypass switches for service during operation.

All PLCs should be configured to have a startup procedure in the event that a PLC needs to be shutdown and restarted. The startup program should have either a fixed startup procedure or have retentive values saved from the last known good running condition. Once the PLC has started up, the program should then enter normal operating conditions but the operator should be informed there has been an event.

All PLC Hardware Racks shall have adequate power supplies installed to support a minimum of 25% I/O expansion. PLC panel load calculations should be performed and documented to illustrate adequate power once total I/O count and device count is completed. In addition, there shall be at least 25% spare I/O capacity installed in all PLCs excluding vendor provided PLCs associated with specific equipment.

5.3.4.3 Device and Equipment Communications

Vendor supplied equipment utilizing a PLC shall communicate to the area PLC through a network connection protocol of modbus over Ethernet.

The majority of vendor supplied equipment along with motor control equipment will be specified with the standard option to communicate using modbus over Ethernet. Network switches and associated devices shall be managed where shown in the network block diagram and in the design specifications. The system integrator shall connect all new network communications to the existing SCADA system.

5.3.4.4 SCADA HMI System

New HMIs will be provided and panel mounted to new control panels with PLCs. The HMI will operate on the latest Wonderware SCADA software and communicate with the other distributed control panels at the existing EEWWTP. The new HMI screens will be developed following the existing EEWWTP screens standards. The integrator shall coordinate with EEWWTP to determine existing screens functions. The Membrane Filtration Facility preliminary screens shall be provided to the engineer and EEWWTP for approval before final screen development.

5.3.4.5 Field Devices

The majority of field mounted devices shall be hardwired to the area motor control center (MCC) or PLC. Any device connected to the PLC shall be approved by the PLC manufacturer. Any device installed onto the Ethernet/IP network shall be Ethernet/IP compliant. Failure to follow these recommendations could result in network failures or an incompatible network device.

Local control panels will be used in the proposed Membrane Filtration System. The local control panels will be located close to the equipment. The local control panel will have a Hand Off Auto (HOA) selector switch and other control devices, indicator lights, and push buttons. The HOA selector switch will allow an operator to take manual control of a device or piece of equipment and operate it from that panel manually.

Automated vendor packaged systems shall utilize Ethernet/IP communications where available. If Ethernet/IP is not available, hardwired can be used. The usage of individual UPSs for automation components should be viewed based on operation sensitivity, if a piece of equipment can wait for the Backup emergency power to activate, a UPS is not needed. If a piece of equipment must remain operational through the utility to generator switchover, then a UPS will be required. In general PLCs, Operator workstations and SCADA network equipment switches shall be on UPS power.

The new system field devices using these recommendations will create a network with high reliability, and meet all of the priorities required for this project. Specific field instruments will be defined as part of final design development.

5.3.4.6 PLC Monitoring and Control

Instruments/Equipment/Devices with monitoring and control capability will be tied to the SCADA system, via area PLC, for operator monitoring and control purposes.

Vendor provided PLC packaged control systems shall be tied to the SCADA network via area switches for monitoring and control as required. Vendor provided PLCs shall control the equipment supplied by the vendor and equipment associated with the process potentially supplied by others. The following are some of the typical I/O signals that will be monitored and used to control equipment or systems by SCADA.

- Level Transmitters
- Continuous level monitoring
- PLC calculated high/low level alarm
- PLC calculated high-high/low-low level alarm
- Level Switches
- High/ low level alarms
- High-high/low-low level alarms
- Flow Transmitters (Or Weirs, flumes)
- Continuous flow monitoring
- PLC calculated flow totals
- PLC calculated high/low flow alarms
- Flow Switches
- Flow alarms where applicable
- Pressure Transmitters
- Continuous pressure monitoring
- PLC calculated high/low pressure alarms
- Analyzers (pH, Chlorine, ORP etc.)
- Continuous signal monitoring
- Dry contact high/low level alarm
- PLC calculated high-high/low-low level alarm
- Temperature Transmitters
- Continuous temperature indication
- PLC calculated high/low temperature alarm
- Temperature Switches
- High temperature alarm
- Low temperature alarm
- Open/Close Valve or Gate
- Valve open/close command

- Valve open/close position indication
- Valve in Auto or Remote indication
- Valve fault indication
- Modulating/Flow Control Valve
- Valve position setpoint
- Valve position feedback
- Valve open/close position indication if applicable
- Valve fault indication
- Constant Speed Pumps
- Pump start/stop command
- Pump running indication
- Pump in auto or remote indication
- Pump faulted (General Fault or Multiple Fault Indicators, etc.)
- Variable Speed Pump
- VFD start/stop command
- VFD running indication
- VFD in auto indication
- VFD faulted
- VFD speed setpoint
- VFD speed feedback
- On some motors, motor winding and bearing temperatures

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Section 6

Filtration TM No.6 – Civil Design Criteria and Demolition and Constructability Considerations

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Mike Lin, CDM Smith

Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design Technical Memorandum (TM) No.6 – Civil Design Criteria and Demolition and Constructability Considerations*

6.1 Introduction

This Technical Memorandum No.6 (Filtration TM No.6) provides the civil design criteria, demolition, and constructability evaluation for Membrane Filtration Facilities at El Estero Wastewater Treatment Plant (EEWWTP) in City of Santa Barbara (City).

6.2 Civil

The following section provides the civil design criteria for the various components of the Membrane Filtration Facilities.

6.2.1 Applicable Codes, Standards, and References

The following codes, standards and references apply to the site-civil design for the EEWWTP.

- City of Santa Barbara Public Works Construction Standard Details, as appropriate
- Santa Barbara County Department of Public Works Transportation Division Engineering Design Standards, as appropriate
- California Department of Transportation (CALTRANS) Standard Specifications, Standard Drawings, and Signage Standards, as appropriate
- Standard Plans for Public Works Construction, American Public Works Association – Southern California Chapter and Associated General Contractors of California – Southern California Districts "Greenbook Committee"
- American Society of Mechanical Engineers (ASME)
- American Society of Testing and Materials (ASTM)
- American Water Works Association (AWWA)

- American National Standards Institute (ANSI)
- AWWA M11 Steel Pipe – A guide for Design and Installation
- AWWA M23 PVC Pipe – Design and Installation
- AWWA M55 PE - Pipe Design and Installation
- AWWA M41 - Ductile Iron Pipe and Fittings.
- Staal, Gardner & Dunne, Inc Geotechnical Report dated September 1987

6.2.2 Existing Civil Conditions and Previous Studies

The existing site civil features at the EEWWTP include yard piping, surface drainage, access road, parking, and gates and fences. Buried yard piping at the plant is predominately vitrified clay pipe and reinforced concrete pipe, but also consists of various type of pipe material. The site is graded so that stormwater flows away from the building and is collected by concrete gutters that discharges to a reinforced concrete storm drain system or directly offsite. The storm drain system discharges into a channel located on the east side the plant.

Sanitary waste is collected from the Administration Building, Maintenance Building, and various process areas to a plant sanitary sewer system that connects to the 42-inch diameter interceptor sewer and is conveyed to the Influent Pump Station.

The main access to the plant is through an access gate just off Yanonali St. on the northeast site of the plant. A secondary access gate is located on the southeast side of the plant off Quinientos St. A main access road and various secondary access roads provide vehicular access to the various process areas within the plant.

6.2.3 Proposed Civil Upgrades

The proposed Membrane Filtration Facility and Hydrochloric Acid system will be located within the unpaved area occupied by the existing Filter Complex. A new concrete truck loading pad will be located on the west side of the Hydrochloric Acid system. The concrete truck loading pad will have a sump and a drain line with an isolation valve to capture any potential chemical spills during the chemical delivery and allow storm water runoff to drain into plant influent. New cross gutters will be provided to divert the storm water runoff around the concrete truck loading pad and to the curb and gutter on the west side of the access road. Appendix A, Sheet No. C-01A shows the preliminary site. The existing Filter Complex will be demolished for the proposed Membrane Filtration Facility. Reference Filtration TM No.3 for Structural Requirements.

The proposed citric acid, sodium hydroxide, and antiscalant systems will be located along the west side of the sludge handling building in the existing parking area. The existing sodium hypochlorite storage and feed equipment area will be expanded northward to accommodate 4 new feed pumps. The existing sodium bisulfite storage and feed equipment are will be expanded westward to accommodate 2 new feed pumps.

Yard piping upgrades will include new piping for MF/UF feed, MF/UF filtrate, backwash/CIP (clean-in-place) drainage, drain lines, chemical lines, overflow line to CCT effluent, and potable water line to the CCB influent for chlorine injection. Isolation valves or blind flanges will be provided to allow for connections for the future RO system.

6.2.4 Design Criteria

6.2.4.1 Yard Piping

Yard piping will include MF/UF feed, MF/UF filtrate/RO Bypass, Backwash/CIP drainage, drains, and chemical lines. Design and construction of the yard piping will be coordinated with the design and construction of the proposed Membrane Filtration Facility Structure. Appendix A, Sheet Nos. C-01A, M-01B and M-02A show the preliminary site and site process yard piping for the proposed Membrane Filtration Facility. Buried pipe and fittings will be AWWA Polyvinyl Chloride (PVC) C900/C905, High Density Polypropylene (HDPE), Ductile Iron Pipe (DIP), or 316 Stainless Steel (SS). Where DIP and fittings are used they will be encased in polyethylene in accordance with AWWA C105. Table 6-1 summarizes the preliminary yard piping schedule. Buried pipe will have a minimum cover of four feet. Trenching, backfill, bedding, and compaction will be per the City's standard details and per geotechnical report recommendations. All buried pressure piping will be restrained against thrust using thrust blocks or restrained joints as appropriate. The thrust restraint design will be based on the highest pressure in the pipeline, typically the hydrostatic test pressure.

Chemical lines will be double contained pipes with PVC or Chlorinated Polyvinyl Chloride (CPVC) carrier pipe contain in PVC pipe. Chemical pipes will be direct buried with chemical leak monitoring stations. Where two or more chemical pipes are located in the same route, the chemical pipes may be located in an utilidor.

Table 6-1: Preliminary Yard Piping Schedule

Category	Pipe Material	Nominal Diameter (in)
Secondary Effluent (SE)	PVC/HDPE/DIP	14
Filter Effluent (FE)	PVC/HDPE/SS	12

Staal, Gardner & Dunne, Inc. Geotechnical Report dated September 1987 indicated that the ground water level range from -4 to +5 feet MSL and that ground water levels may rise to near ground surface level for short time periods following heavy precipitation. Buried yard piping will be designed to ensure that it has sufficient ground cover to resist the uplift force from the high ground water.

Leak testing of pipelines will be in accordance with the applicable AWWA and ASTM standards and manuals for the pipe material (e.g. AWWA M23 for PVC/HDPE, AWWA M41 for DIP, AWWA M11 for SS). Hydrostatic test water will be discharged into the plant sewer system at a rate coordinated with plant operations staff.

6.2.4.2 Sanitary Sewer/Drain

New drain lines will be provided to convey Backwash, CIP waste, and drainage from the spill capture area by gravity to an existing sewer manhole by the new Membrane Filter. Sanitary sewer/drain system shall be AWWA PVC C900 SDR 35. Sanitary sewer pipe design criteria are summarized in Table 6-2. Cleanouts will be provided at all junctions or changes in pipe direction or slope/drain.

Table 6-2: Sanitary Sewer/Drain Pipe Design Criteria

Description	Requirement
Minimum Size	4-inch (laterals) 8-inch (mains)
Maximum Velocity at Peak Flow	10 fps
Minimum Velocity at Peak Flow	2 fps
Manning's n-value	0.013
Pipe Material(s)	C900 PVC ASTM D3034 SDR-35 PVC

6.2.4.3 Grading, Paving, and Drainage

The new structures will be located at grade and minimal grading is expected to occur at the site. Any new grading will be limited to the landscaped area around the existing Filter Complex. Minimal impact to the existing site drainage is expected. Where existing drainage path is disrupted (i.e. chemical truck loading area) a new cross gutter will be provided to divert storm water flow around the containment pad and connect to the existing gutter across the roadway.

Pavement design will be per the Staal, Gardner & Dunne, Inc. Geotechnical Report (1987) recommendation. Pavement will be 3-inch asphalt concrete over 6-inch crushed aggregate base. Aggregate base and the upper one foot of subgrade soil will be compacted to 95 percent relative compaction.

6.2.4.4 Landscaping

Landscaping will be provided to restore the disturbed site to existing condition as much as possible. Landscaping will be per City of Santa Barbara Landscape Design Standards for Water Conservation.

6.3 Demolition

The following section provides the demolition design criteria for the various components of the filtration system.

6.3.1 Proposed Demolition

The existing Filter Complex will be demolished down the foundation slab and new concrete will be added to provide a level surface for the proposed Membrane Filtration Facility. Reference Filtration TM No.3 for structural demolition requirements. The existing landscape and a section of the asphalt will be demolished for the construction of the Membrane Filtration Facility, and chemical containment areas for Sodium Hypochlorite Facility additions, Hydrochloric Acid, Citric Acid, and Sodium Hydroxide, and Antiscalant systems. The existing 24-inch FI (Filter Influent) and 24-inch FE (Filter Effluent) will be cut, capped, and protected in place. The existing 18" OF (overflow), 1-inch ALP (air low pressure), 1-inch AHP (air high pressure), 1 ½-inch AL (aluminum) 1 ½-inch CS (chlorine solution), 1-inch APO (anionic polymer), 1-inch CPO (cationic polymer), ½-inch FE, ½"-inch FI, and 4-inch drain will be demolished and removed from site. See Appendix A, Sheet Nos. D-1 through D-3 for preliminary demolition plans and section.

6.4 Constructability

The following section provides a description of constructability issues for the various components of the filtration system.

6.4.1 Maintenance of Plant Operations (MOPO)

The existing filtration system will be taken out of commission for demolition and disconnected from the system for the construction of the new facilities. Potable water will be used in the recycled water system during construction of the proposed Membrane Filtration Facility and the proposed chemical systems. The existing 24-inch FI and 24-inch FE will be cut, and valve off for connection to the proposed Membrane Filtration Facility prior to startup and testing. The existing 18" OF, 1-inch ALP, 1-inch AHP, 1 ½-inch AL, 1 ½-inch CS, 1-inch APO, 1-inch CPO, ½-inch FE, ½"-inch FI, and 4-inch drain will be demolished and removed from site. Table 6-3 summarizes the construction sequence and issues.

Table 6-3: Construction Sequence

Construction Sequence	Comments
Disconnect Filter Complex from system	Filter complex is not required for EEWWTP operations.
Groundwater dewatering	Periodic - depending on construction schedule.
Cut & valve off existing 24-inch FI and 24-inch FE.	Inspect existing pipe for defect and protect in place.
Demolish Filter Complex & construct new Membrane Filtration Facility and associated Chemical systems	Provide potable water for recycled water system.
Connect to system for startup and testing.	Membrane Filtration Facility may be isolated my closing the new isolation valves on the FI and FE pipeline.

High ground water may be encountered during the wet season and will require that dewatering take place during the construction of the proposed Membrane Filtration Facility.

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Section 7

Filtration TM No.7 – Opinion of Probable Cost of Construction and Implementation Schedule

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Greg Wetterau, CDM Smith
Evelyn You, CDM Smith
Kirk Johnson, CDM Smith

Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design Technical Memorandum (TM) No.7 – Opinion of Probable Cost of Construction and Implementation Schedule*

7.1 Introduction

This Technical Memorandum No.7 (Filtration TM No.7) provides the opinion of probable costs and implementation schedule for the construction of Tertiary Filtration Facilities at El Estero Wastewater Treatment Plant (EEWWTP) in City of Santa Barbara (City).

7.2 Opinion of Probable Cost of Construction

The opinion of probable construction costs for the Tertiary Filtration Facilities at EEWWTP is $5,300,000. The break-down of the construction cost estimate is included in Appendix C-5.

The cost estimate includes the following indirect costs and allowances, which are estimated as summarized below based on previous construction project experience:

- Electrical Allowance – Embedded in subtotal of direct cost
- Instrumentation and Control Allowance – Embedded in subtotal of direct cost
- General Conditions – 10.00%
- Building Permits – 1.00%
- Sales tax (Materials, Equipment, and Other) – 7.75%
- Construction Contingency – 25.00%
- Overhead and Profit – 10.00%
- Builders Insurance – 0.20%
- General Liability Insurance – 1.00%

- Bonds – 1.50%
- Escalation (assuming mid-point of construction to be October 2014) – 5.00%

Assuming 15% of construction cost for the cost of engineering design and services during construction, 5% of construction cost for permitting, administration, and legal, the total project cost would be approximately $6,400,000. The opinion of probable cost of construction is summarized in Table 7-1.

Table 7-1: Opinion of Probable Cost of Construction

Item	Cost
MF/UF Facility (including existing Filter Complex demolition, site civil, yard piping, process equipment, electrical improvements, programming upgrades)	**$5.3 Million**
Engineer design and services during construction (15%)	$0.80 Million
Permitting, administration, and legal (5%)	$0.27 Million
Total	**$6.4 Million**

Notes:

1. Does not include costs for new on-site storage reservoir, building upgrades and improvements to Solids Handling Building drainage, automation of existing CCT chlorination and dechlorination chemical feed systems, or upgrades to existing recycled water booster pump station.
2. Does not include construction management costs.

7.3 Implementation Schedule

The projected implementation schedules for the design and construction of the Demineralization Facility without MF/UF vendor preselection and with without MF/UF vendor preselection are presented in Figures 7-1 and 7-2, respectively.

The project schedule without MF/UF vendor preselection estimates 9 months for Final Design, 4 months for Bid Phase, and 20 months for construction. The permitting would require approximately 6 months, including 3 months for CDPH review. The permitting phase would start during 90 percent design.

The project schedule with MF/UF vendor preselection estimates approximately 10 months for MF/UF vendor preselection package preparation, bidding, selection and award, and shop drawings phase. The duration of final design, permitting, general contractor bidding, and construction are expected to be the same as the schedule without MF/UF vendor preselection. Based on the required project schedule, preselection of MF/UF vendor is not recommended for this project.

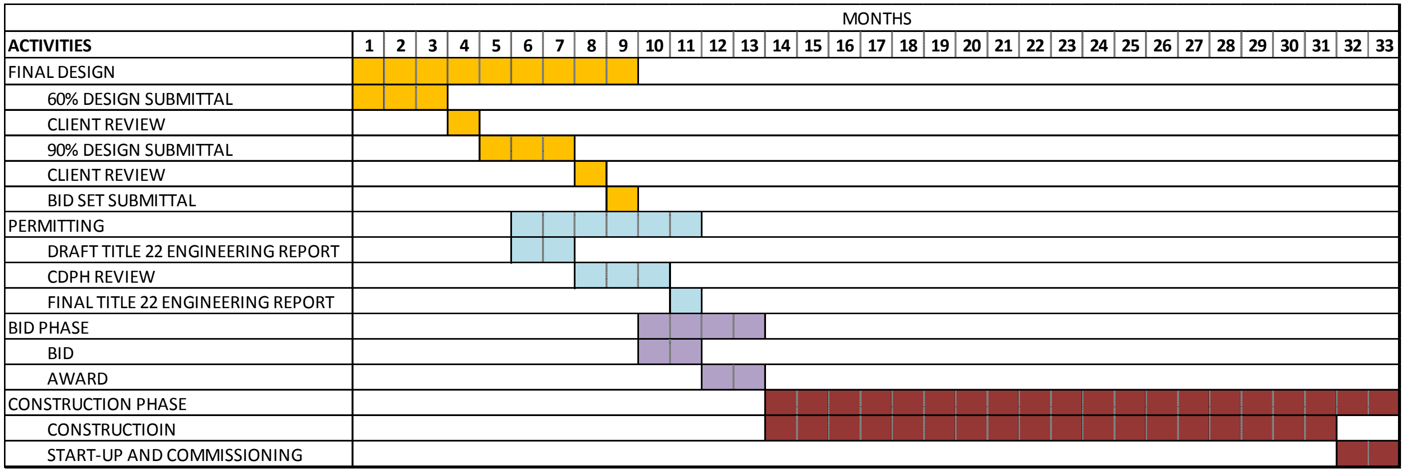

Figure 7-1: Implementation Schedule without MF/UF Vendor Preselection

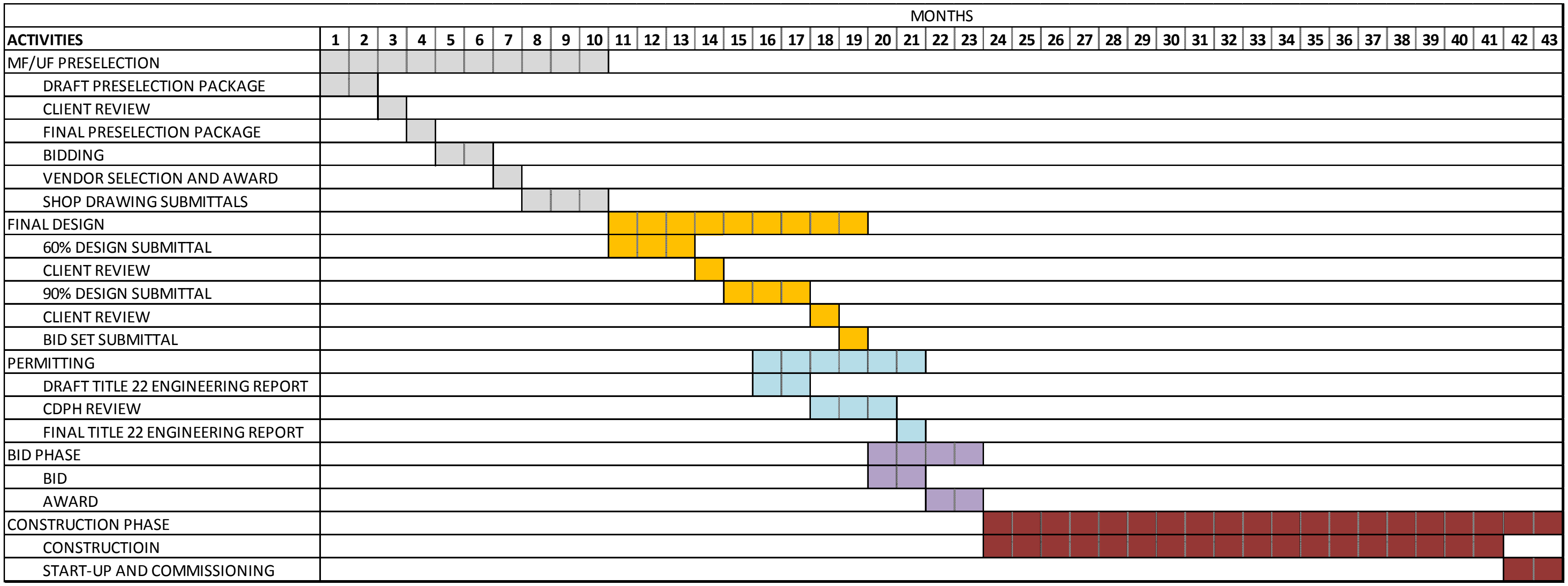

Figure 7-2: Implementation Schedule with MF/UF Vendor Preselection

Appendix A

Preliminary Design Drawings

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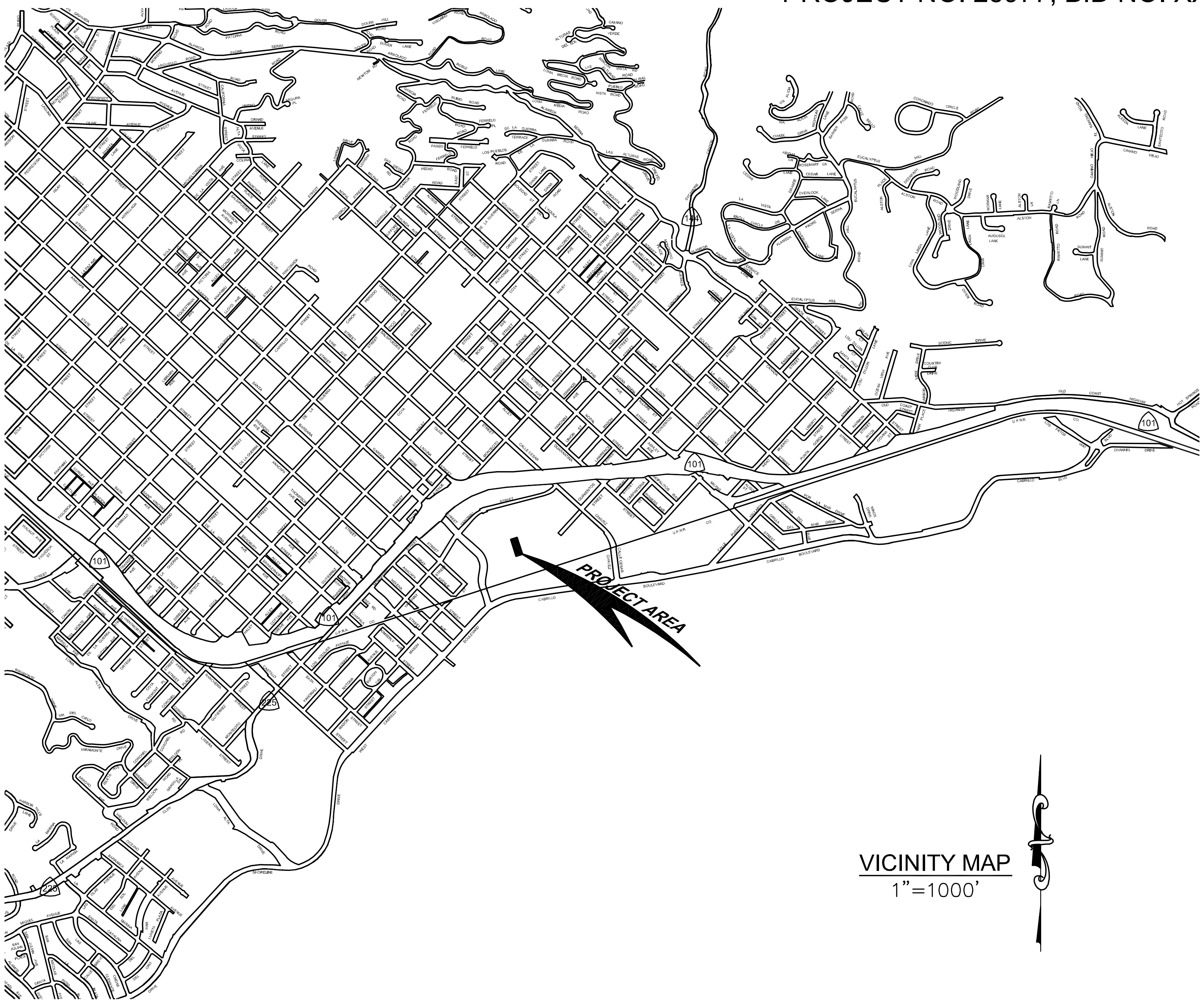
CITY OF SANTA BARBARA

EL ESTERO WASTEWATER TREATMENT PLANT

TERTIARY FILTRATION FACILITY

PROJECT NO. 23977, BID NO. XXXXX

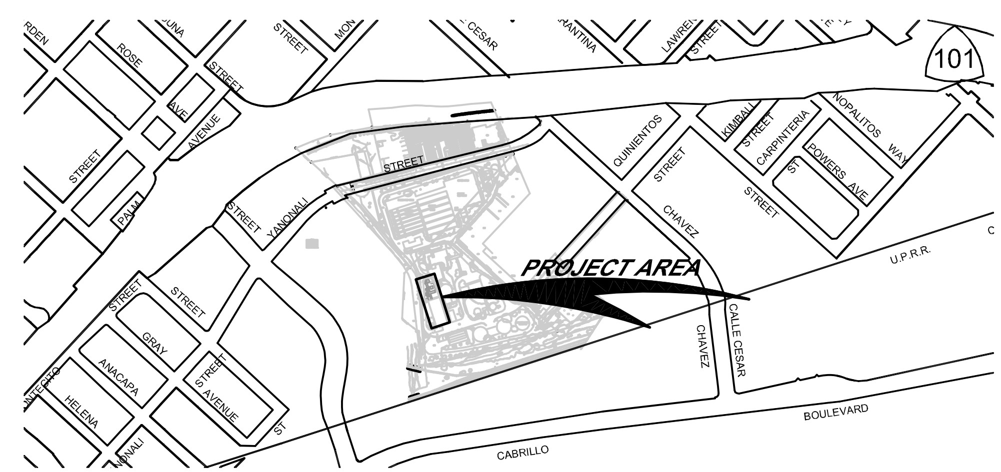


VICINITY MAP
1"=1000'

SHEET INDEX

SHEET #	DRAWING #	TITLE
2	G-01A	COVER SHEET – VICINITY MAP & SHEET INDEX
2	G-02A	GENERAL – ABBREVIATIONS AND LEGEND
3	G-03A	MF/UF SYSTEM – PROCESS FLOW DIAGRAM I
4	G-03B	MF/UF SYSTEM – PROCESS FLOW DIAGRAM II
5	C-01A	MF/UF SYSTEM – SITE AND YARD PIPING PLAN
6	D-01	FILTER COMPLEX – DEMOLITION PLAN I
7	D-02	FILTER COMPLEX – DEMOLITION PLAN II
8	D-03	FILTER COMPLEX – DEMOLITION SECTION
9	M-01A	MF/UF SYSTEM – PLAN I
10	M-02A	MF/UF SYSTEM – PLAN II
11	M-03	MF/UF SYSTEM – SECTIONS
12	E-01	MF/UF SYSTEM – ELECTRICAL SINGLE LINE
13	E-02	MF/UF SYSTEM – ELECTRICAL MCC LAYOUT
14	I-01A	I&C – SYMBOLS, LEGEND & ABBREVIATIONS
15	I-02A	I&C – SYSTEM ARCHITECTURE
16	I-03	FILTER SUPPLY – MODIFICATION
17	I-04	MF/UF SYSTEM – FEED PUMPS AND AUTOMATIC STRAINERS
18	I-05	MF/UF SYSTEM – TYPICAL SKID
19	I-06A	MF/UF SYSTEM – FILTRATE TANK AND BACKWASH PUMPS
20	I-09	CCB & STORAGE RESERVOIR – MODIFICATION
21	I-10A	MF/UF SYSTEM – CEB/CIP SYSTEM
22	I-12A	MF/UF SYSTEM – COMPRESSED AIR SYSTEM
23	I-13	CHEMICAL SYSTEM – SODIUM HYPOCHLORITE
24	I-14A	CHEMICAL SYSTEM – CITRIC ACID
25	I-15A	CHEMICAL SYSTEM – SODIUM HYDROXIDE
26	I-18	FILTRATION – DEMOLITION
27	I-19	CHEMICAL SYSTEM – DEMOLITION

DRAWINGS WITH DRAWING NUMBERS FOLLOWED BY A LETTER 'A' ARE MODIFIED AS PART OF DEMINERALIZATION FACILITY PROJECT.



PROJECT LOCATION MAP
1"=500'

PRELIMINARY DESIGN DRAWINGS

JANUARY 2013

CDM SMITH PROJECT NO. 120499-90670

FUND MANAGER DATE

SUPERVISING CIVIL ENGINEER DATE

CDM Smith
523 West Sixth Street
Suite 400
Los Angeles, CA. 90014
Tel: 213-457-2200

PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION

APPROVED: CITY ENGINEER DATE ORIGINAL SIGNED DATE

DESIGN EY
DRAWN CB
CHECKED RC

PRELIMINARY DESIGN

NO. DATE APPROVED REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY

COVER SHEET

VICINITY MAP & SHEET INDEX

PBW. NO. -

BID NO. - SHT. DES. -

DWG. NO. G-01A

SHT. - OF -

GENERAL ABBREVIATIONS

A	AB	ANCHOR BOLT
	ABAN	ABANDONED
	AC	ASPHALTIC CONCRETE OR ASPHALT
	ADH	ADHESIVE
	AFF	ABOVE FINISHED FLOOR
	AG	ABOVE GRADE
	AHS	AIR HOSE STATION
	ALT	ALTERNATE
	ALY	ALLOY
	AMT	AMOUNT
	ANOD	ANODIZED
	AP	ACCESS PANEL
	APPROX	APPROXIMATE
	AR	AIR RELEASE VALVE
	ARCH	ARCHITECTURAL
	ARD	ACID RESISTANT DRAIN
	ARRGT	ARRANGEMENT
	ARV	AIR RELIEF VALVE
	ASSY	ASSEMBLY
	ASTM	AMERICAN INSTITUTE OF TESTING AND MATERIALS
	AT	AIR TIGHT
	AUTO	AUTOMATIC
	AUX	AUXILIARY
	AVAR, AV/AR	AIR VACUUM RELIEF/ AIR RELEASE VALVE
	AVE	AVENUE
	AVG	AVERAGE
	AWG	AMERICAN WIRE GAUGE
	AWWA	AMERICAN WATER WORKS ASSOCIATION
B	B	BEND
	B&B	BELL AND BELL
	B&F	BELL AND FLANGE
	B&S	BELL AND SPIGOT, GENERIC
	BC	BEGINNING OF CURVE
	BET	BETWEEN
	BF	BLIND FLANGE
	BFV	BUTTERFLY VALVE
	BHP	BRAKE HORSE POWER
	BIT	BITUMINOUS
	BLDG	BUILDING
	BLVD	BOULEVARD
	BM	BENCH MARK
	BO	BLOW OFF
	BOT	BOTTOM
	BP	BELT PRESS
	BRG	BEARING
	BRK	BRICK
	BT	BENT
	BV	BALL VALVE
C	C	CIVIL
	C TO C	CENTER TO CENTER
	CAJ	CAULKED JOINT
	CAL/OSHA	CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION
	CAT	CATALOG
	CB	CATCH BASIN
	CEB	CHEMICAL ENHANCED BACKWASH
	CEM	CEMENT
	CENT	CENTRIFUGAL
	CF	CENTRIFUGE
	CFM	CUBIC FEET PER MINUTE
	CFS	CUBIC FEET PER SECOND
	CG	CENTER OF GRAVITY
	CHAM	CHAMFER
	CHEM	CHEMICAL
	CHKD	CHECKERED
	CIR	CIRCLE
	℄	CENTER LINE
	CL2G	CHLORINE GAS
	CL2S	CHLORINE SOLUTION
	CLG	CEILING
	CLKG	CAULKING
	CLR	CLEARANCE
	CM	CENTIMETER
	CML	CONCRETE MORTAR LINED
	CMU	CONCRETE MASONRY UNIT
	CO	CLEAN OUT
	COL	COLUMN
	COMB	COMBINATION
	COMP	COMPANION
	CONC	CONCRETE, CONCENTRATED
	CONN	CONNECTION
	CONST	CONSTRUCTION
	CONT	CONTINUOUS, CONTINUE
	CONTR	CONTRACTOR OR CONTRACT
	COORD	COORDINATE
	COR	CORRUGATED
	CORR	CORRIDOR
	CP	CONTROL POINT
	CPLG	COUPLING
	CRE	CORROSION RESISTANT
	CRS	COURSES
	CSK	COUNTER SINK
	CSTG	CASTING
	CTR	CENTER
	CV	CHECK VALVE
	CZP	CANAL ZONE PIPE
D	DBL	DOUBLE
	DCO	DANDY CLEANOUT
	DEF	DEFLECTION
	DEMO	DEMOLITION
	DEPT	DEPARTMENT
	DET	DETAIL
	DIA	DIAMETER
	DIAG	DIAGONAL
	DIAP	DIAPHRAGM
	DIM	DIMENSION
	DIR	DIRECTION
	DISCH	DISCHARGE
	DIST	DISTANCE
	DWG	DRAWING
E	E	EAST, EASTERLY, EASTING
	E TO E	END TO END
	EA	EACH
	ECC	ECCENTRIC
	EF	EACH FACE
	EG	EXISTING GRADE
	ELEC	ELECTRICAL
	ELEV	ELEVATION
	ELL	ELBOW
	EMERG	EMERGENCY
	ENG	ENGINEER
	EP	EDGE OF PAVEMENT
	EPXL	EPOXY LINED
	EQ	EQUAL
	EQUIP	EQUIPMENT
	EVWD	EAST VALLEY WATER DISTRICT
	EW	EACH WAY
	EWU	EYE WASH UNIT
	EXH	EXHAUST
	EXIST	EXISTING
	EXP	EXPANSION
	EXP JT	EXPANSION JOINT
	EXT	EXTERNAL
F	F	FAHRENHEIT
	FA	FLANGE ADAPTER
	FAB	FABRICATED
	FC	FLEXIBLE COUPLING OR CONNECTION, FERRIC CHLORIDE
	FCV	AUTOMATIC CONTROL VALVE
	FD	FLOOR DRAIN
	FDN	FOUNDATION
	FE	FLOW ELEMENT
	FF	FINISH FLOOR
	FG	FINISHED GRADE
	FH	FIRE HYDRANT
	FHV	FIRE HOSE VALVE
	FIN	FINISHED
	FIT	FLOW INDICATING TRANSMITTER
	FL	FLUSH
	FLG	FLANGE
	FLEX	FLEXIBLE
	FLR	FLOOR
	FLGD	FLANGED
	FLV	FLAP VALVE
	FM	FORCE MAIN
	FPM	FEET PER MINUTE
	FPS	FEET PER SECOND
	FS	FLOW SWITCH, FINISHED SURFACE
	FSF	FERRIC SULFATE
	FT	FEET
	FV	AUTOMATIC VALVE
	FZP	FOOTHILL ZONE PIPE
G	G	GROUND, GAS
	GA	GAUGE, GAGE
	GAC	GRANULAR ACTIVATED CARBON
	GAL	GALLON
	GALV	GALVANIZE, GALVANIZED (HOT DIPPED)
	GLV	GLOBE VALVE
	GPM	GALLONS PER MINUTE
	GR	GRADE
	GRTG	GRATING
	GV	GATE VALVE
	GVL	GRAVEL
H	H	HIGH
	HB	HOSE BIBB
	HD	HEAVY DUTY
	HDR	HEADER
	HDW	HARDWARE
	HEV	HOSE END VALVE
	HGL	HYDRAULIC GRADE LINE
	HGR	HANGER
	HGT	HEIGHT
	HH	HANDHOLE
	HORIZ	HORIZONTAL
	HP	HORSEPOWER
	HRT	HIGH POINT
	HRL	HANDRAIL
	HS	HIGH STRENGTH
	HV	HAND VALVE
	HVAC	HEATING, VENTILATING AND AIR CONDITIONING
	HVY	HEAVY
	HWL	HIGH WATER LEVEL
	HYD	HYDRAULIC
	HZ	HERTZ
I	IC	INSPECTION CHAMBER
	ID	INTERNAL DIAMETER
	IE	INVERT ELEVATION
	IF	INSIDE FACE
	IN	INCH
	INS	INSULATION, INSULATE
	INSTA	INSTANTANEOUS
	INSTR	INSTRUMENTATION, INSTRUMENT
	INT	INTERIOR
	INV	INVERT
	IPS	IRON PIPE SIZE
J	JT	JOINT
L	L	LITER, LENGTH, LEFT
	LAB	LABORATORY
	LAT	LATERAL
	LF	LINEAR FEET
	LB	POUND
	LG	LONG
	LH	LEFT HAND
	LLWL	LOW LOW WATER LEVEL
	LONG	LONGITUDINAL
	LPT	LOW POINT
	LR	LONG RADIUS
	LWL	LOW WATER LEVEL
M	M	MOTOR
	MAN	MANUAL
	MAS	MASONRY
	MATL	MATERIAL
	MAX	MAXIMUM
	MCC	MOTOR CONTROL CENTER
	MECH	MECHANICAL
	MED	MEDIUM
	MEZZ	MEZZANINE
	MFR	MANUFACTURER
	MGD	MILLION GALLONS PER DAY
	MH	MANHOLE
	MHS	METAL HOSE
	MHT	MEAN HIGH TIDE
	MHW	MEAN HIGH WATER
	MIN	MINIMUM
	MISC	MISCELLANEOUS
	MJ	MECHANICAL JOINT
	MLT	MEAN LOW TIDE
	MLW	MEAN LOW WATER
	MO	MASONRY OPENING
	MSL	MEAN SEA LEVEL
	MTD	MOUNTED
	MTL	METAL
N	N	NORTH, NORTHERLY, NORTHING
	NAD83	NORTH AMERICAN DATUM 1983
	NAT	NATURAL
	NAVD29	NORTH AMERICAN VERTICAL DATUM 1929
	NC	AMERICAN NATIONAL COARSE THREAD
	NC	NORMALLY CLOSED
	NF	AMERICAN NATIONAL FINE THREAD
	NIC	NOT IN CONTRACT
	NO.	NUMBER
	NO	NORMALLY OPEN
	NOM	NOMINAL
	NPDES	NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
	NPSF	AMERICAN NATIONAL STRAIGHT PIPE THREADS FOR DRY SEAL PRESSURE JOINTS
	NPT	AMERICAN NATIONAL TAPER PIPE THREAD
	NTS	NOT TO SCALE
	NV	NEEDLE VALVE
O	O TO O	OUT TO OUT
	O/C	ON CENTER
	OD	OUTSIDE DIAMETER
	OED	OPEN END OR OPEN EQUIPMENT DRAIN
	OF	OUTSIDE FACE
	OFF	OFFSET
	OPNG	OPENING
	OPP	OPPOSITE
	OR	OUTSIDE RADIUS
	OS&Y	OUTSIDE STEM AND YOKE
	OSHA	OCCUPATIONAL SAFETY AND HEATH ASSOCIATION
	OVHD	OVERHEAD
P	P	PUMP, PUMPING
	P&ID	PROCESS AND INSTRUMENTATION DIAGRAM
	PACL	POLYALUMINUM CHLORIDE
	PB	PULLBOX
	PC	POINT OF CURVATURE
	PCC	PORTLAND CEMENT CONCRETE
	PCHV	PINCH VALVE
	PE	PRESSURE ELEMENT, POLYETHYLENE
	PFP	PLATE AND FRAME PRESS
	PH	POTHOLE
	PI	PRESSURE INDICATOR, POINT OF INTERSECTION
	PIT	PRESSURE INDICATING TRANSMITTER
	PL	PLATE, PROPERTY LINE
	PLMG	PLUMBING
	PV	PLUG VALVE
	PLYWD	PLYWOOD
	PM	POTASSIUM PERMANGANATE
	PN	PNEUMATIC
	PO4	ORTHOPHOSPHATE
	PP	POWER POLE
	PPM	PARTS PER MILLION
	PR	PAIR
	PRV	PRESSURE REGULATING VALVE
	PS	PRESSURE SWITCH, PIPE SUPPORT
	PSF	POUNDS PER SQ. FOOT
	PSI	POUNDS PER SQUARE INCH
	PSV	PRESSURE SAFETY VALVE
	PT	POINT OF TANGENCY
	PTD	PAINTED
	PVMT	PAVEMENT
Q	Q	FLOW
	QTY	QUANTITY
R	R	RISERS, RADIUS
	R/RT	RIGHT
	R&R	REMOVE AND RECONSTRUCT
	RAD	RADIUS
	RD	ROAD
	RD	ROOF DRAIN
	RED	REDUCER
	REF	REFERENCE
	REHAB	REHABILITATION
	REINF	REINFORCING
	REQ'D	REQUIRED
	REST'D	RESTRAINED
	RESIL	RESILIENT
	RGH	ROUGH
	RH	RIGHT HAND
	RJ	RESTRAINED JOINT
	RLG	RAILING
	RM	ROOM
	RND	ROUND
	RO	ROUGH OPENING
	RPBP	REDUCED PRESSURE BACK FLOW PREVENTER
	RPM	REVOLUTION PER MINUTE
	RST	REINFORCING STEEL
	RUB	RUBBER
S	S	SOUTH, SLOPE
	SA	SHOCK ABSORBER
	SAN	SANITARY
	SBCO	SAN BERNARDINO COUNTY
	SCD	SCREWED
	SCE	SOUTHERN CALIFORNIA EDISON
	SCH	SCHEDULE
	SCR	SCREW
	SCRN	SCREEN, SCREENING
	SD	STORM DRAIN
	SEC	SECONDARY, SECONDS, SECTION
	SF	SQUARE FEET
	SG	SLIDE GATE
	SHT	SHEET
	SHTG	SHEETING
	SIM	SIMILAR
	SLG	SLUICE GATE
	SLNT	SEALANT
	SLV	SLEEVE
	SM	SHEET METAL
	SMH	SEWER MANHOLE
	SP	STATIC PRESSURE
	SP	STAND PIPE
	SPEC	SPECIFICATION, SPECIFIED
	SPPWC	STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION
	SPR	SPRINKLER
	SQ	SQUARE
	SR	SHORT RADIUS
	SS	STAINLESS STEEL, SANITARY SEWER
	SSK	SERVICE SINK
	SSPWC	STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION
	ST	STREET
	STA	STATION
	STD	STANDARD
	STG	STORAGE
	STIFF	STIFFENER
	STL	STEEL, GENERAL
	STR	STRAIGHT
	STRUCT	STRUCTURE, STRUCTURAL
	SUB	SUBMERGED
	SUC	SUCTION
	SUPT	SUPERINTENDENT
	SURF	SURFACE
	SUSP	SUSPENDED
	SW	SOCKET WELDED
	SYM	SYMMETRICAL
T	T	TREADS
	T&B	TOP AND BOTTOM
	TDH	TOTAL DYNAMIC HEAD
	TE	TEMPERATURE ELEMENT
	TEL	TELEPHONE
	TEMP	TEMPERATURE
	TES	THROUGH EXISTING SLAB
	TEW	THROUGH EXISTING WALL
	TF	TOP FACE
	THK	THICK
	THRD	THREADED, THREAD
	TI	TEMPERATURE INDICATOR
	TIT	TEMPERATURE INDICATING TRANSMITTER
	TK	TANK
	TOC	TOP OF CONCRETE
	TOS	TOP OF STEEL
	TOW	TOP OF WALL
	TPG	TOPPING
	TYP	TYPICAL
U	U/S	UNDERSIDE
	UG	UNDERGROUND
	UL	UNDERWRITERS LABORATORY
	UNK	UNKNOWN
	UNO	UNLESS NOTED OTHERWISE
	US/USA	UNITED STATES, UNDERGROUND SERVICE ALERT
	USC&GS	UNITED STATES COAST AND GEODETIC SURVEY
	UTIL	UTILITY
	UZP	UPPER ZONE PIPE
V	V	VALVE, VOLTS
	VAC	VACUUM
	VB	VALVE BOX
	VE	VIBRATION ELIMINATOR
	VERT	VERTICAL
	VF	VACUUM FILTER
	VOL	VOLUME
	VTR	VENT THROUGH ROOF
	VT	VENT
W	W	WEST, WIDE
	W/	WITH
	W/A	WHERE APPLICABLE
	W/O	WITHOUT
	WATCH	WORK AREA TRAFFIC CONTROL HANDBOOK
	WC	WATER CLOSET
	WD	WOOD
	WGT	WEIGHT
	WH	WALL HYDRANT
	WHS	WASH HOSE STATION
	WL	WATER LEVEL
	WP	WEATHER PROOF
	WS	WATER SURFACE, WATER STOP
	WT	WATERTIGHT, WEIGHT
	WWF	WELDED WIRE FABRIC
	WV	WATER VALVE
X	X HVY	EXTRA HEAVY
	X STR	EXTRA STRONG
	XP	EXPLOSION PROOF
Y	YH	YARD HYDRANT
	ø	DIAMETER
	@	AT
	△	DELTA

DRAWING, SECTION AND DETAIL TITLES

SUBTITLE OR DESCRIPTION (AS REQ'D)
PLAN
1/4" = 1'-0" — SCALE

SUBTITLE OR DESCRIPTION (AS REQ'D)
ELEVATION
1/4" = 1'-0"

SECTION 3/4" = 1'-0" — (1 / S-6) — SECTION NUMBER; SHEET WHERE SECTION CUT IS TAKEN *

DETAIL 3/4" = 1'-0" — (A / A-3) — DETAIL LETTER; SHEET WHERE DETAIL IS TAKEN *

SCHEMATIC 3/4" = 1'-0" — (1 / M-6) — SCHEMATIC NUMBER; SHEET WHERE SCHEMATIC IS TAKEN *

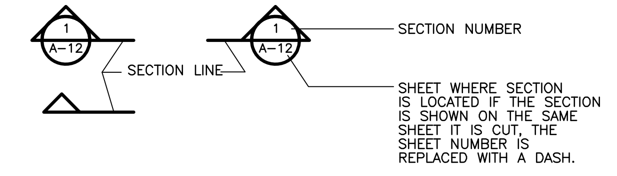
DIAGRAM 3/4" = 1'-0" — (1 / I-6) — DIAGRAM NUMBER; SHEET WHERE DIAGRAM IS TAKEN *

* IF SECTION, DETAIL, SCHEMATIC OR DIAGRAM IS DRAWN ON THE SAME SHEET THAT IT IS TAKEN FROM, SHEET NUMBER IS REPLACED WITH A HYPHEN. IF THE SECTION IS REFERENCED ON MULTIPLE SHEETS, THE SHEET NUMBER SHOWN INDICATES THE FIRST SHEET THE SECTION IS TAKEN FROM.

UNDERGROUND UTILITIES AGENCIES:

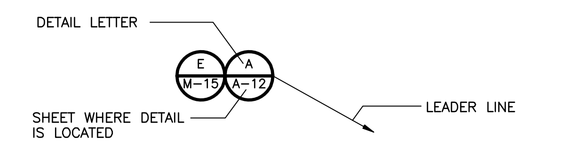
ELECTRIC	**SOUTHERN CALIFORNIA EDISON** CONTACT NAME: CONTACT PHONE NO:
GAS	**SOUTHERN CALIFORNIA GAS COMPANY** CONTACT NAME: CONTACT PHONE NO:
TELEPHONE	**–** CONTACT NAME: CONTACT PHONE NO:
WATER	**CITY OF SANTA BARBARA** CONTACT PHONE NO: (805) 564–5413
SEWER	**CITY OF SANTA BARBARA** CONTACT PHONE NO: (805) 564–5413
STORM DRAIN	**CITY OF SANTA BARBARA** CONTACT PHONE NO: (805) 897–2658

SECTION CUT SYMBOLS



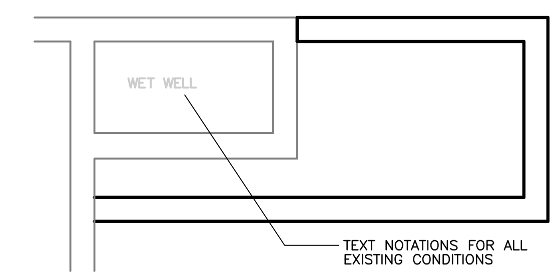
WHEN REFERENCING A SECTION IN A NOTE, 1/M–1 FORMAT INSTEAD OF THE BUBBLE CAN BE USED

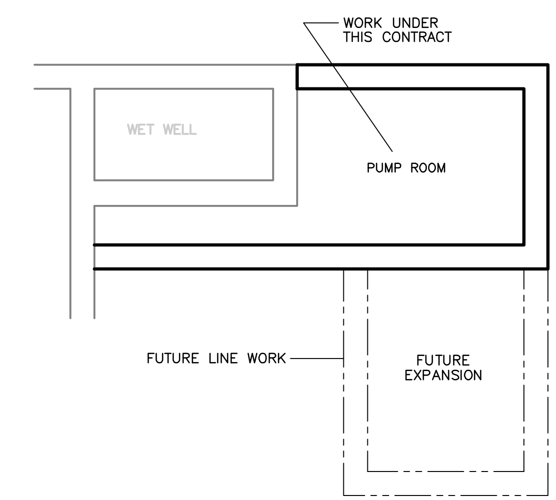
DETAIL CALL OUT SYMBOLS



WHERE A NOTE IS REQUIRED FOR CLARITY, A/M–12 FORMAT IN THE NOTE INSTEAD OF BUBBLE IS USED. IF MULTIPLE DETAILS REFER TO THE SAME AREA OF THE DRAWING, THE BUBBLES ARE STACKED SIDE BY SIDE.

EXISTING OR FUTURE CONDITION DESIGNATION





CDM Smith
523 West Sixth Street
Suite 400
Los Angeles, CA. 90014
Tel: 213-457-2200

APPROVED:
CITY ENGINEER
DATE
ORIGINAL SIGNED DATE

DESIGN	EY
DRAWN	CB
CHECKED	DC

PRELIMINARY DESIGN

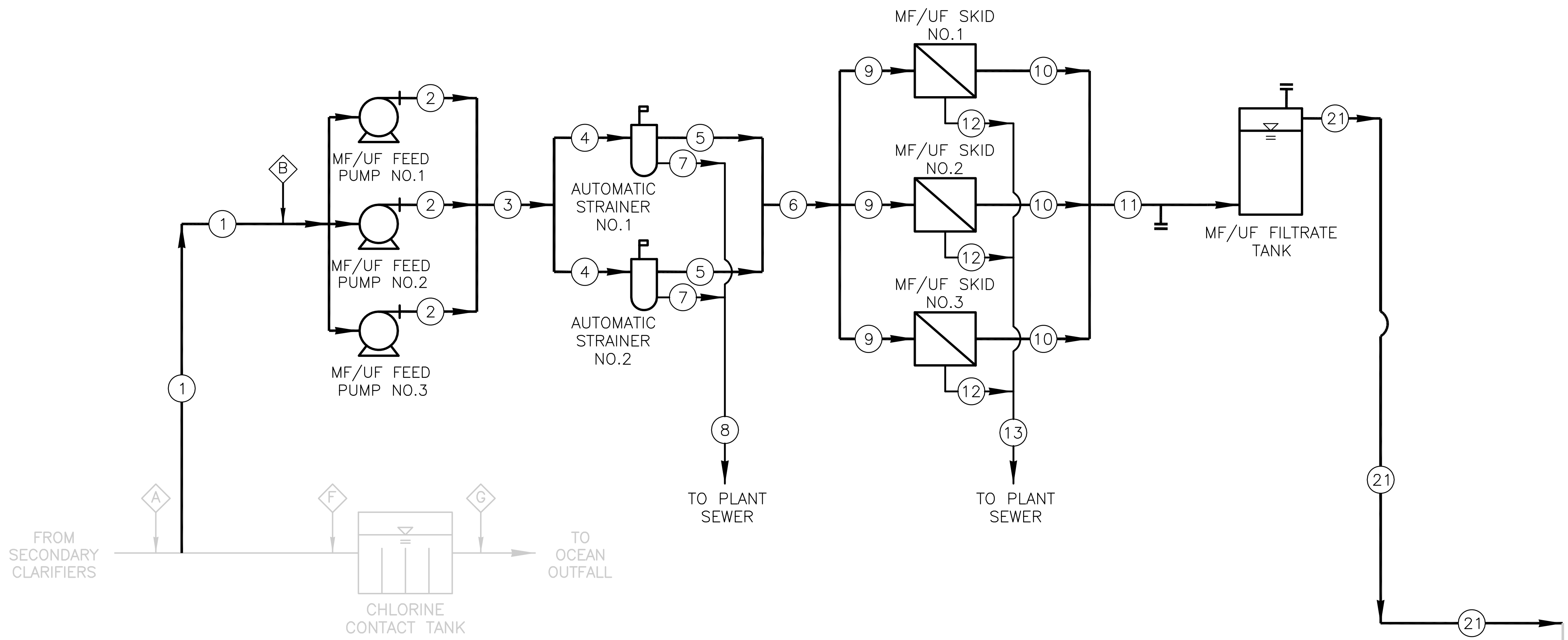
NO.	DATE	APPROVED	REVISIONS

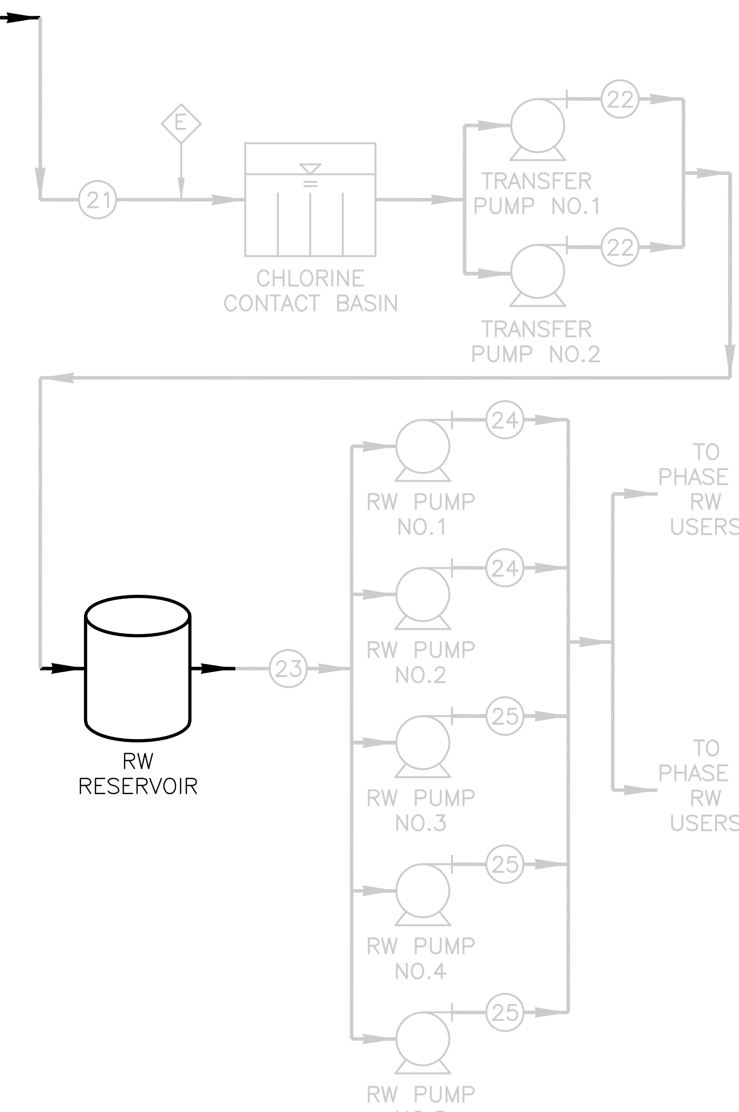
EL ESTERO WWTP TERTIARY FILTRATION FACILITY

GENERAL

ABBREVIATIONS AND LEGEND

PBW. NO.	–
BID NO.	–
SHT. DES.	–
DWG. NO.	G-02A
SHT.	– OF –





	SECONDARY EFFLUENT TO MF/UF	MF/UF FEED PUMP DISCHARGE PER UNIT	TOTAL STRAINER FEED	STRAINER FEED PER UNIT	STRAINER EFFLUENT PER UNIT	TOTAL MF/UF FEED	STRAINER BACKWASH PER UNIT (INTERMITTENT)	TOTAL STRAINER BACKWASH (INTERMITTENT)	MF/UF FEED PER SKID	MF/UF FILTRATE PER SKID	TOTAL MF/UF FILTRATE	MF/UF BACKWASH WASTE PER SKID (INTERMITTENT)	TOTAL MF/UF BACKWASH WASTE (INTERMITTENT)	TOTAL CCB FEED	CCB TRANSFER PUMP DISCHARGE	TOTAL RECYCLED WATER DEMAND	RW PUMP WITH VFD DISCHARGE (INTERMITTENT)	RW PUMP CONSTANT SPEED DISCHARGE (INTERMITTENT)	RO CONCENTRATE PER TRAIN	AMMONIUM HYDROXIDE	SODIUM HYPOCHLORITE	HYDROCHLORIC ACID	ANTISCALANT	SODIUM HYPOCHLORITE	SODIUM HYPOCHLORITE	SODIUM BISULFITE
PROCESS STREAM ID	1	2	3	4	5	6	7	8	9	10	11	12	13	21	22	23	24	25	CHEMICAL ID	A	B	C	D	E	F	G
DESIGN PARAMETERS																										
RECOVERY					98%						95%								CHEM DOSE, AVG. (mg/L)	EXIST	12.0	43.0	3.0	EXIST	EXIST	EXIST
TSS REJECTION											99.9%								CHEM DOSE, MAX. (mg/L)	EXIST	18.0	47.0	5.0	EXIST	EXIST	EXIST
SALT REJECTION																										
FLOWS																										
DESIGN FLOW (mgd)[a]	2.69	1.34	2.69	1.34	1.32	2.63	0.03	0.05	0.88	0.83	2.50	0.04	0.13	2.50	2.50	2.50	0.46	1.02								
DESIGN FLOW (gpm)	1,860	930	1,860	930	910	1,830	20	40	610	580	1,740	30	90	1,740	1,740	1,740	320	710								
MINIMUM FLOW (mgd)[b]	1.07	0.54	1.07	0.54	0.53	1.05	0.01	0.02	1.05	1.00	1.00	0.05	0.05	1.00	1.00	0.43	0.43	0.00								
MINIMUM FLOW (gpm)	750	370	750	370	370	730	0	0	730	690	690	0	0	690	690	300	300	0								
MAXIMUM FLOW (mgd)[c]	3.22	1.61	3.22	1.61	1.58	3.16	0.03	0.06	1.05	1.00	3.00	0.05	0.16	3.00	3.00	3.60	1.56	1.02								
MAXIMUM FLOW (gpm)	2,240	1,120	2,240	1,120	1,100	2,190	448	448	730	690	2,080	1,500	1,500	2,080	2,080	2,500	1,080	710								
PRESSURES																										
PRESSURE, AVG. (psi)	2	27	27	27	23	23	0	0	23	9	9	0	0	3.3	EXIST	EXIST	EXIST	EXIST								
PRESSURE, MAX (psi)	3	62	62	62	53	53	0	0	53	9	9	0	0	3.3	EXIST	EXIST	EXIST	EXIST								
CONSTITUENTS																										
pH, AVG	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	pH	12.0	12.3	<1.0	2-4	12.3	12.3	4.8-5.2
pH, MAX	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1								
TSS, AVG (mg/L)	10	10	10	10	10	10			10	0.01	0.01			0.01	0.01	0.01	0.01	0.01								
TSS, MAX (mg/L)	10	10	10	10	10	10			10	0.01	0.01			0.01	0.01	0.01	0.01	0.01								
TURBIDITY, AVG (NTU)	<10	<10	<10	<10	<10	<10			<10	<2	<2			<2	<2	<2	<2	<2								
TURBIDITY, MAX (NTU)	<10	<10	<10	<10	<10	<10			<10	<2	<2			<2	<2	<2	<2	<2								
TDS, AVG (mg/L)	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254.0	1,254.0	1,254.0	1,254.0								
TDS, MAX (mg/L)	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614.0	1,614.0	1,614.0	1,614.0								
TOTAL CHLORINE, AVG (mg/L)	0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5								
TOTAL CHLORINE, MAX (mg/L)	0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0								

NOTES:

a) DESIGN FLOWS ARE EQUIVALENT OF MAXIMUM DAILY RECYCLED WATER DEMAND IN YEAR 2030.

b) MINIMUM FLOWS ARE EQUIVALENT OF THE MINIMUM FLOWS AT WHICH THE MF/UF AND RO SYSTEMS CAN BE OPERATED (ONE MF/UF SKID and ONE RO TRAIN).

c) MAXIMUM FLOWS ARE EQUIVALENT OF SYSTEM DESIGN CAPACITY (CAPACITY WITH ALL MF/UF SKIDS AND ALL RO TRAINS ONLINE 24 HRS/DAY).

CDM Smith
523 West Sixth Street
Suite 400
Los Angeles, CA. 90014
Tel: 213-457-2200

APPROVED: CITY ENGINEER DATE
ORIGINAL SIGNED DATE

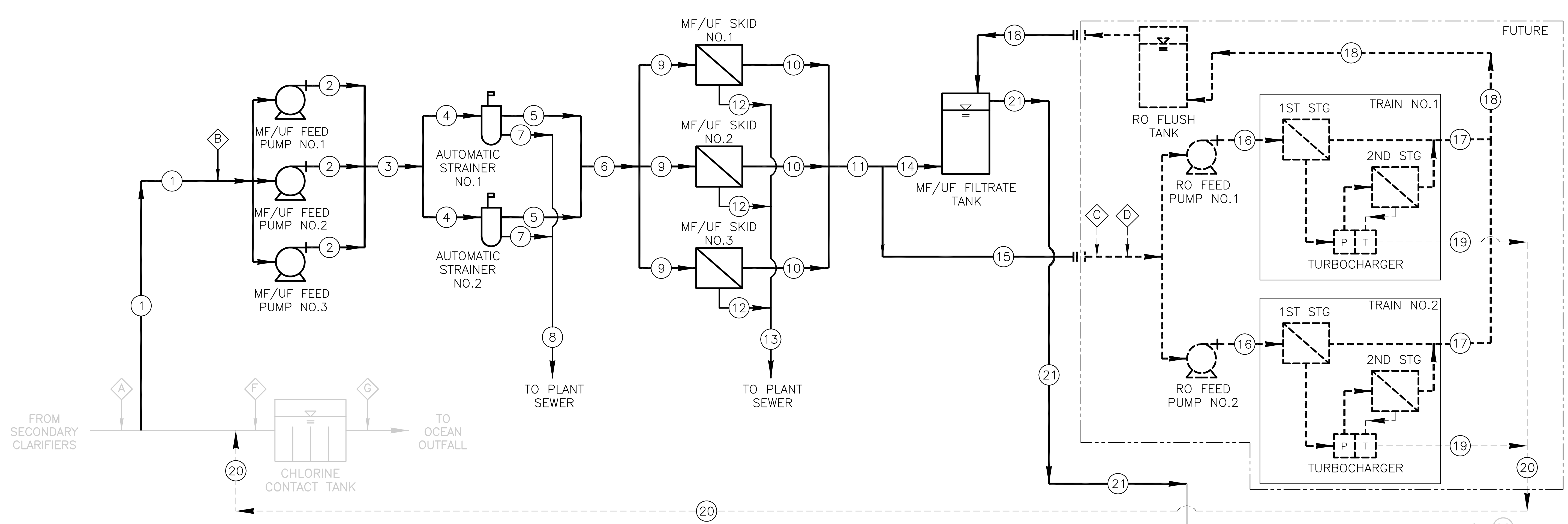
DESIGN EY
DRAWN CB
CHECKED DC

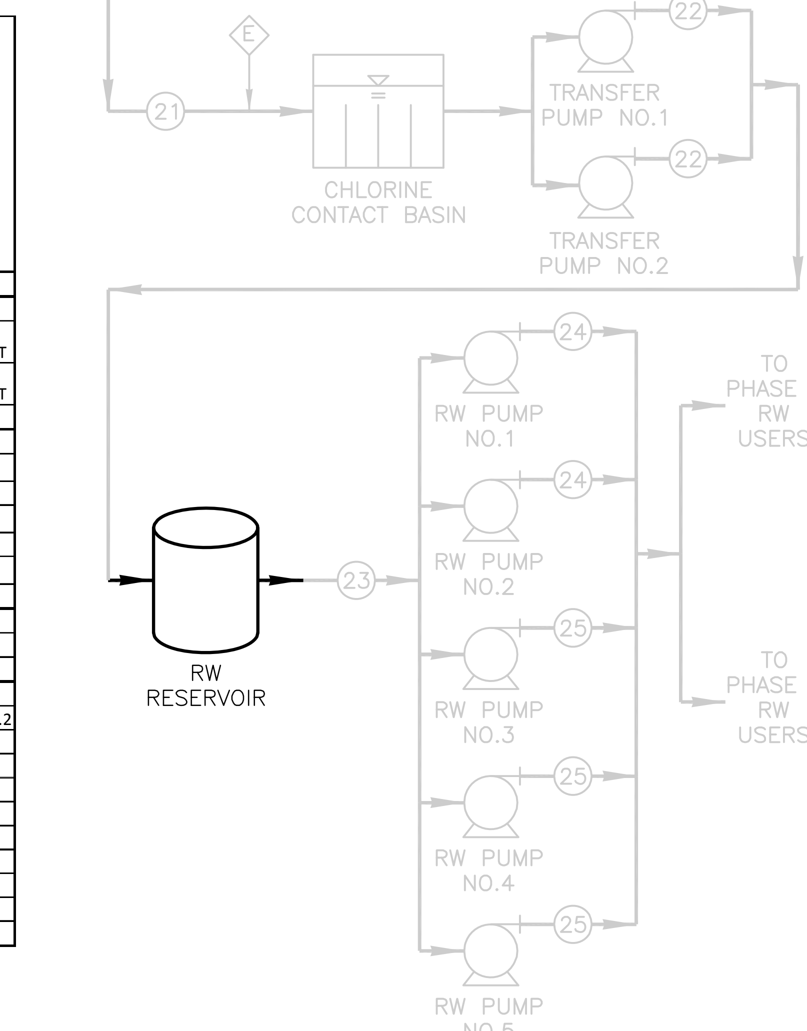
PRELIMINARY DESIGN

NO. DATE APPROVED REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY
MF/UF SYSTEM
PROCESS FLOW DIAGRAM I

PBW. NO. -
BID NO. - SHT. DES. -
G-03A
DWG. NO.
SHT. - OF -





	SECONDARY EFFLUENT TO MF/UF	MF/UF FEED PUMP DISCHARGE	TOTAL STRAINER FEED	STRAINER FEED PER UNIT	STRAINER EFFLUENT PER UNIT	TOTAL MF/UF FEED	STRAINER BACKWASH PER UNIT (INTERMITTENT)	TOTAL STRAINER BACKWASH (INTERMITTENT)	MF/UF FEED PER SKID	MF/UF FILTRATE PER SKID	TOTAL MF/UF FILTRATE	MF/UF BACKWASH WASTE PER SKID (INTERMITTENT)	TOTAL MF/UF BACKWASH WASTE (INTERMITTENT)	RO BYPASS	TOTAL RO FEED	RO FEED PER TRAIN	RO PERMEATE PER TRAIN	TOTAL RO PERMEATE	RO CONCENTRATE PER TRAIN	TOTAL RO CONCENTRATE	TOTAL CCB FEED	CCB TRANSFER PUMP DISCHARGE	TOTAL RECYCLED WATER DEMAND	RW PUMP WITH VFD DISCHARGE (INTERMITTENT)	RW PUMP CONSSTANT SPEED DISCHARGE (INTERMITTENT)		AMMONIUM HYDROXIDE	SODIUM HYPOCHLORITE	HYDROCHLORIC ACID	ANTISCALANT	SODIUM HYPOCHLORITE	SODIUM HYPOCHLORITE	SODIUM BISULFITE
PROCESS STREAM ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	CHEMICAL ID	A	B	C	D	E	F	G
DESIGN PARAMETERS																																	
RECOVERY					98%						95%						85%									CHEM DOSE, AVG. (mg/L)	EXIST	12.0	43.0	3.0	EXIST	EXIST	EXIST
TSS REJECTION											99.9%															CHEM DOSE, MAX. (mg/L)	EXIST	18.0	47.0	5.0	EXIST	EXIST	EXIST
SALT REJECTION																	97%																
FLOWS																																	
DESIGN FLOW (mgd)[a]	2.87	1.44	2.87	1.44	1.41	2.82	0.03	0.06	0.94	0.89	2.68	0.05	0.14	1.50	1.18	0.59	0.50	1.00	0.09	0.18	2.50	2.50	2.50	0.46	1.02								
DESIGN FLOW (gpm)	2,000	1,000	2,000	1,000	980	1,960	20	40	650	620	1,860	30	100	1,040	820	410	350	690	60	120	1,740	1,740	1,740	320	710								
MINIMUM FLOW (mgd)[b]	1.07	0.54	1.07	0.54	0.53	1.05	0.01	0.02	1.05	1.00	1.00	0.05	0.05	0.41	0.59	0.59	0.50	0.50	0.09	0.09	0.91	0.91	0.43	0.43	0.00								
MINIMUM FLOW (gpm)	750	370	750	370	370	730	0	0	730	690	690	0	0	290	410	410	350	350	60	60	630	630	300	300	0								
MAXIMUM FLOW (mgd)[c]	3.22	1.61	3.22	1.61	1.58	3.16	0.03	0.06	1.05	1.00	3.00	0.05	0.16	1.82	1.18	0.59	0.50	1.00	0.09	0.18	2.82	2.82	3.60	1.56	1.02								
MAXIMUM FLOW (gpm)	2,240	1,120	2,240	1,120	1,100	2,190	479	479	730	690	2,080	1,500	1,500	1,270	820	410	350	690	60	120	1,960	1,960	2,500	1,080	710								
PRESSURES																																	
PRESSURE, AVG. (psi)	2	27	27	27	23	23	0	0	23	9	9	0	0	3.3	3.3	155	9	9	10	10	9	EXIST	EXIST	EXIST	EXIST								
PRESSURE, MAX (psi)	3	62	62	62	53	53	0	0	53	9	9	0	0	3.3	3.3	298	9	9	10	10	9	EXIST	EXIST	EXIST	EXIST								
CONSTITUENTS																																	
pH, AVG	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.0	7.0	5.5	5.5	7.7	7.7	7.0	7.0	7.0	7.0	7.0	pH	12.0	12.3	<1.0	2-4	12.3	12.3	4.8-5.2
pH, MAX	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	7.0	7.0	5.7	5.7	7.8	7.8	7.2	7.2	7.2	7.2	7.2								
TSS, AVG (mg/L)	10	10	10	10	10	10			10	0.01	0.01			0.01	0.01	0.01	0.00	0.00			0.01	0.01	0.01	0.01	0.01								
TSS, MAX (mg/L)	10	10	10	10	10	10			10	0.01	0.01			0.01	0.01	0.01	0.00	0.00			0.01	0.01	0.01	0.01	0.01								
TURBIDITY, AVG (NTU)	<10	<10	<10	<10	<10	<10			<10	<2	<2			<2	<2	<2	0.00	0.00			<2	<2	<2	<2	<2								
TURBIDITY, MAX (NTU)	<10	<10	<10	<10	<10	<10			<10	<2	<2			<2	<2	<2	0.00	0.00			<2	<2	<2	<2	<2								
TDS, AVG (mg/L)	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	1,254	38	38	8,147	8,147	767	767	767	767	767								
TDS, MAX (mg/L)	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	1,614	48	48	10,486	10,486	988	988	988	988	988								
TOTAL CHLORINE, AVG (mg/L)	0	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.0	3.0	3.5	3.5	3.3	3.3	3.3	3.3	3.3								
TOTAL CHLORINE, MAX (mg/L)	0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.5	3.5	4.0	4.0	3.8	3.8	3.8	3.8	3.8								

NOTES:

a) DESIGN FLOWS ARE EQUIVALENT OF MAXIMUM DAILY RECYCLED WATER DEMAND IN YEAR 2030.

b) MINIMUM FLOWS ARE EQUIVALENT OF THE MINIMUM FLOWS AT WHICH THE MF/UF AND RO SYSTEMS CAN BE OPERATED (ONE MF/UF SKID and ONE RO TRAIN).

c) MAXIMUM FLOWS ARE EQUIVALENT OF SYSTEM DESIGN CAPACITY (CAPACITY WITH ALL MF/UF SKIDS AND ALL RO TRAINS ONLINE 24 HRS/DAY).

CDM Smith
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Tel: 213-457-2200

DESIGN EY
DRAWN CB
CHECKED DC

PRELIMINARY DESIGN

APPROVED:
CITY ENGINEER DATE
ORIGINAL SIGNED DATE

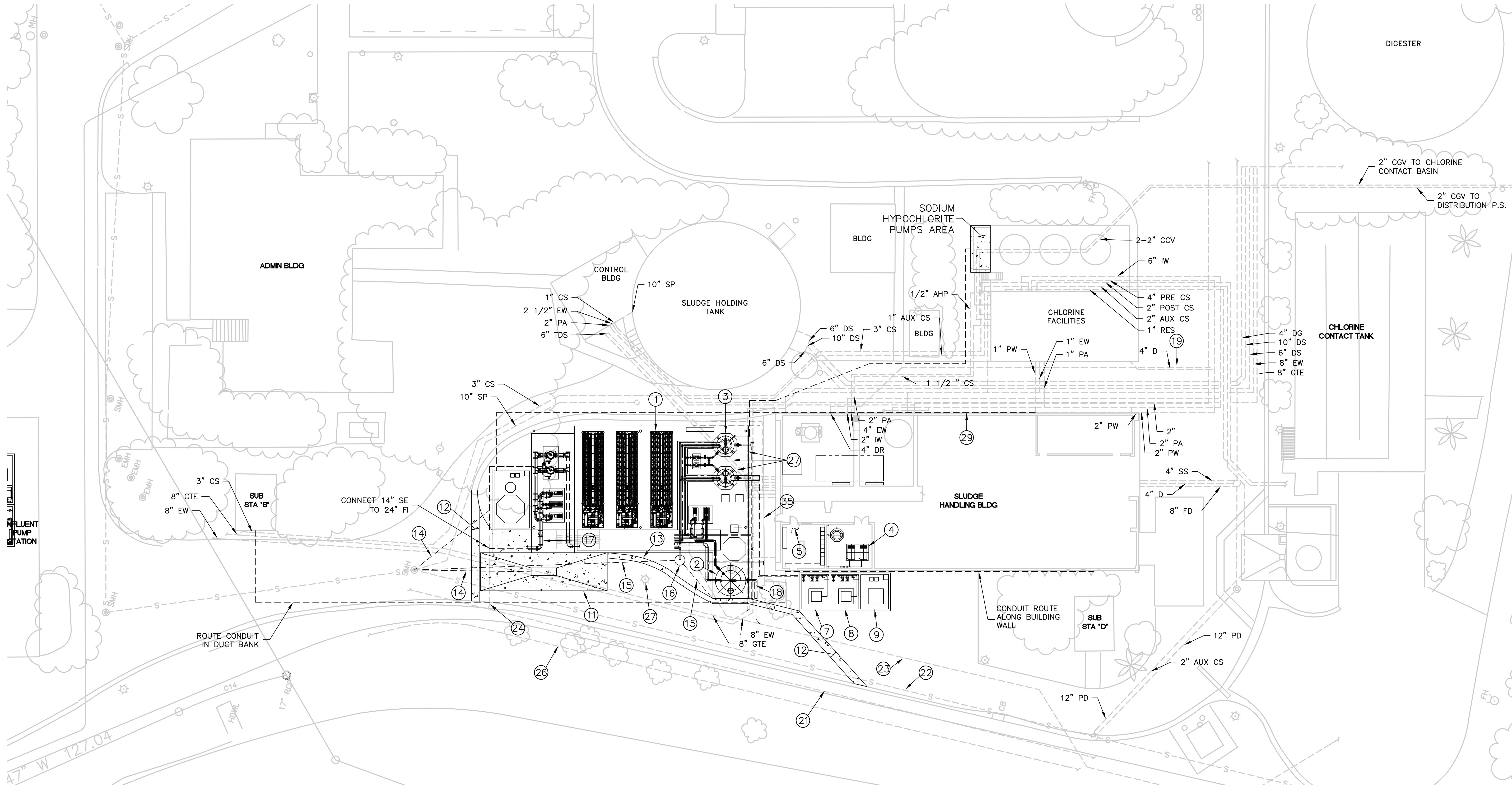
NO. DATE APPROVED REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM

PROCESS FLOW DIAGRAM II

- PBW. NO.
- BID NO. - SHT. DES.
G-03B DWG. NO.
SHT. - OF -



NOTES:

1. MF/UF FACILITY
2. MF/UF FILTRATE TANK
3. CIP TANK
4. COMPRESSED AIR SYSTEM
5. ELECTRICAL/CONTROL ROOM
7. CITRIC ACID SYSTEM CONTAINMENT PAD
8. SODIUM HYDROXIDE SYSTEM CONTAINMENT PAD
9. ANTISCALANT SYSTEM CONTAINMENT PAD
10. HYDROCHLORIC ACID SYSTEM CONTAINMENT PAD
11. CHEMICAL TRUCK CONCRETE UNLOADING PAD
12. CROSS GUTTER
13. CURB AND GUTTER
14. 4" DRAIN
15. 8" DRAIN (REROUTED AROUND EXPANDED SLAB)
16. 48" DIA SMH
17. 14" SE
18. 12" FILTRATE OVERFLOW/BYPASS (BYP)
21. (EXIST) 48" LAND OUTFALL
22. (EXIST) 42" INTERCEPTOR
23. (EXIST) 24" FE
24. (EXIST) 24" FI
25. DEMOLISHED AND REMOVE
26. (EXIST) BRINE LINE
27. RELOCATE
29. 2" PW
35. LIMITS OF SIDEWALK DEMOLITION

SITE PLAN
1"=20'

NOTE:
THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON THESE PLANS WERE OBTAINED BY A SEARCH OF AVAILABLE RECORDS, AND THE ACCURACY OR COMPLETENESS OF THE UTILITIES ON THE DRAWINGS IS NOT GUARANTEED. THESE LOCATIONS ARE APPROXIMATE AND SHALL BE CONFIRMED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION, SO THAT ANY NECESSARY ADJUSTMENT CAN BE MADE IN ALIGNMENT AND/OR GRADE OF THE PROPOSED IMPROVEMENT. THE CONTRACTOR SHALL REPORT ALL DISCREPANCIES TO THE ENGINEER PRIOR TO THE COMMENCEMENT OF WORK. COMMENCEMENT OF WORK SHALL CONSTITUTE FULL ACCEPTANCE OF EXISTING SITE CONDITIONS. ANY DISCREPANCIES FOUND OR ANY DETAILS NOT SHOWN ON THE DRAWINGS SHALL BE RECORDED ON THE AS-BUILTS AND REPORTED TO THE ENGINEER. THE CONTRACTOR IS REQUIRED TO TAKE DUE PRECAUTIONARY MEASURE TO PROTECT ANY UTILITY LINES SHOWN AND ANY OTHER LINES NOT OF RECORD OR NOT SHOWN ON THESE PLANS.

1" = 20'
10 0 20

CDM Smith
523 West Sixth Street
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Los Angeles, CA. 90014
Tel: 213-457-2200

APPROVED: CITY ENGINEER DATE
ORIGINAL SIGNED DATE

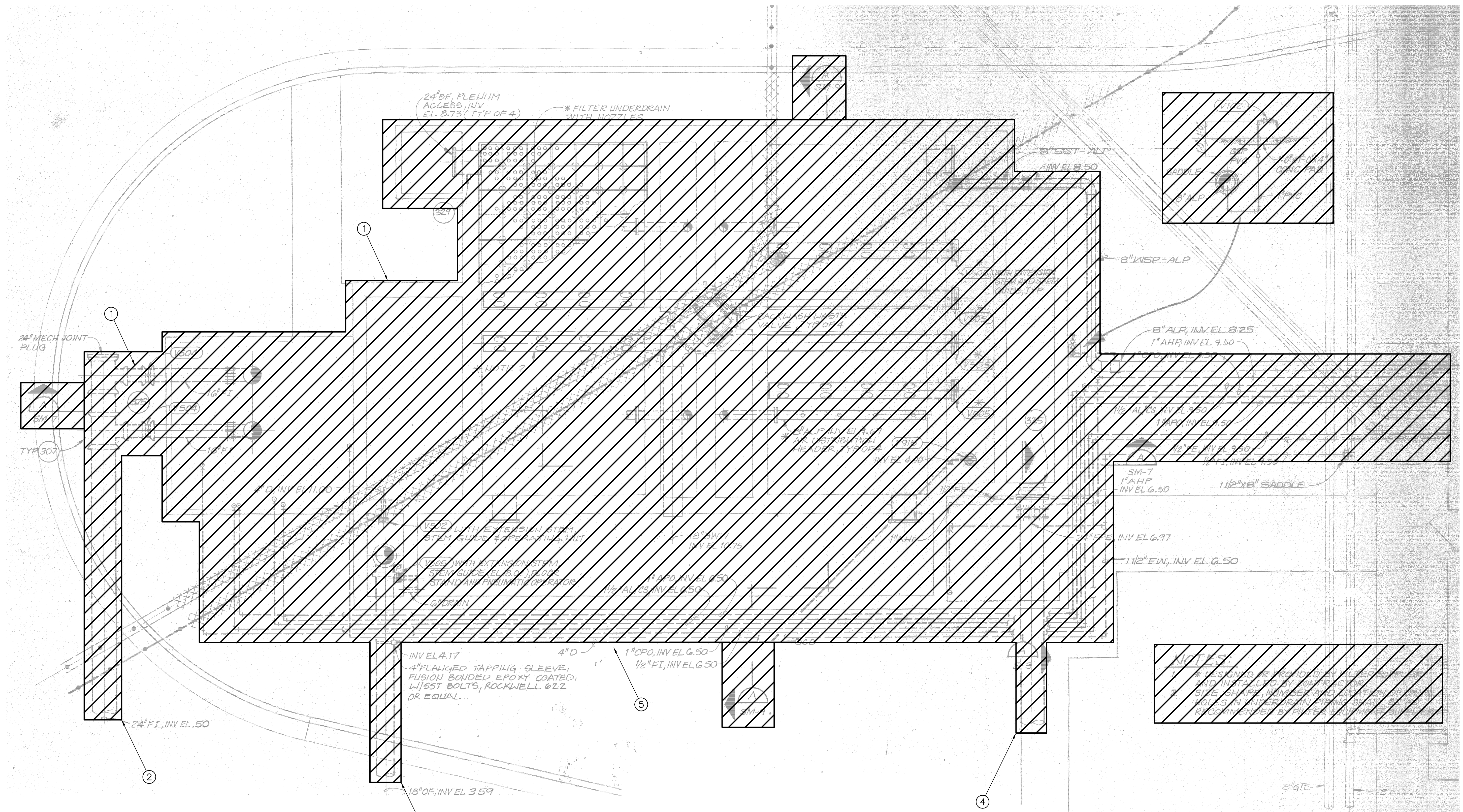
DESIGN ML
DRAWN JH
CHECKED RC

PRELIMINARY DESIGN

NO. | DATE | APPROVED | REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY
MF/UF SYSTEM
SITE AND YARD PIPING PLAN

- PBW. NO.
- BID NO. - SHT. DES.
C-01A DWG. NO.
SHT. - OF -



NOTES:

1. (EXIST) FILTER TANK AND EQUIPMENT – DEMO
2. (EXIST) FILTER FEED PIPING – DEMO
3. (EXIST) FILTER OVERFLOW PIPING – DEMO
4. (EXIST) FILTER EFFLUENT PIPING – DEMO
5. (EXIST) CHEMICAL PIPING – DEMO

FILTER COMPLEX DEMOLITION

PLAN

1/4" = 1'-0"

1/4" = 1'- 0"

2 1 0 2 4

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Los Angeles, CA. 90014
Tel: 213-457-2200

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EL ESTERO WWTP TERTIARY FILTRATION FACILITY

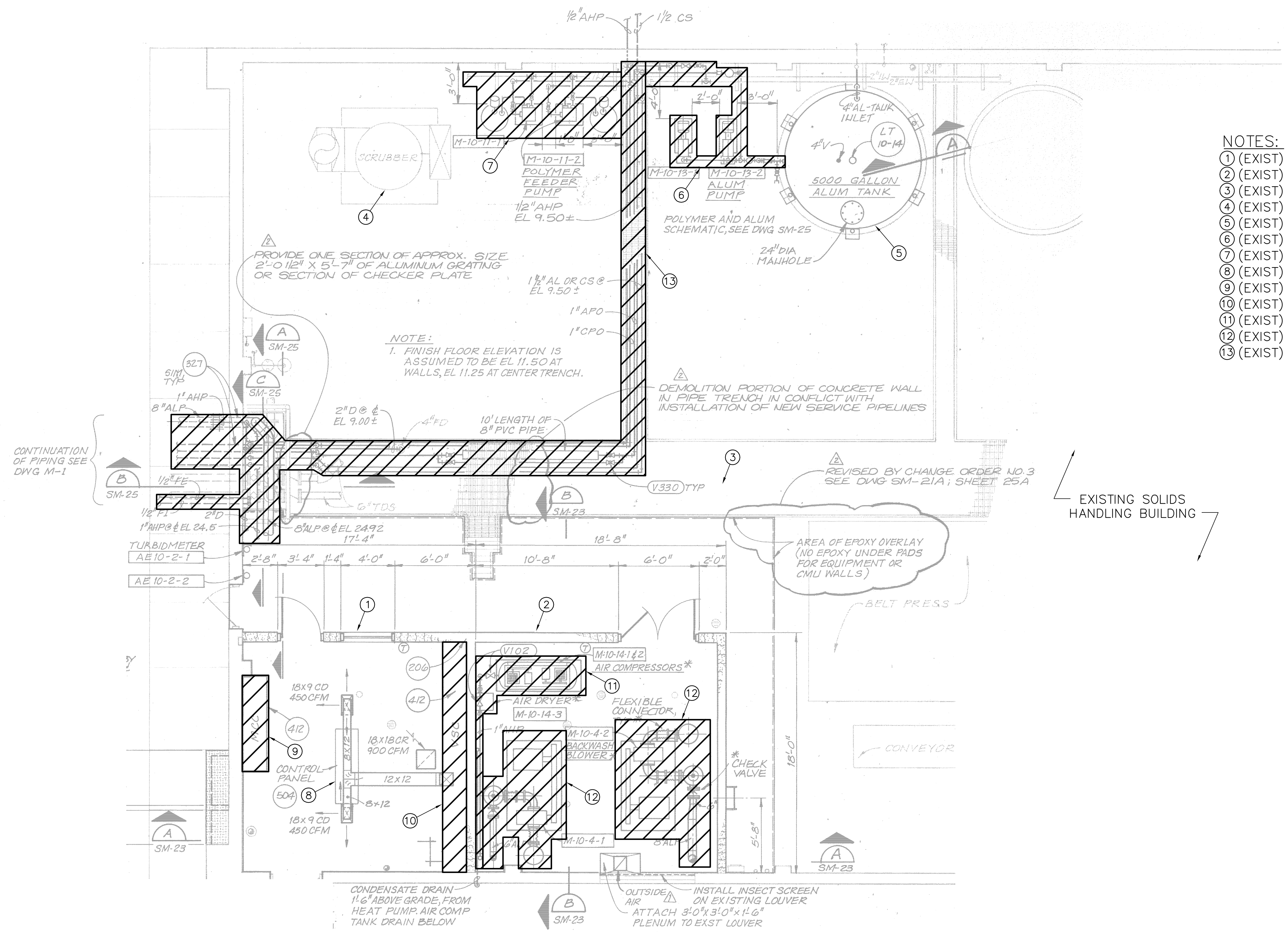
FILTER COMPLEX
DEMOLITION PLAN I

PBW. NO. -

BID NO. - SHT. DES. -

DWG. NO. D-01

SHT. - OF -



NOTES:

1. (EXIST) ELECTRICAL ROOM
2. (EXIST) AIR SCRUBBER/BLOWER ROOM
3. (EXIST) PIPE TRENCH
4. (EXIST) AIR SCRUBBER – PROTECT IN PLACE
5. (EXIST) FERROUS SULFATE TANK – PROTECT IN PLACE
6. (EXIST) ALUM PUMPS AND PIPING – DEMO
7. (EXIST) POLYMER SYSTEM AND PIPING – DEMO
8. (EXIST) CONTROL PANEL – PROTECT IN PLACE
9. (EXIST) MCC – DEMO
10. (EXIST) VSC – DEMO
11. (EXIST) AIR COMPRESSOR AND RECEIVER – DEMO
12. (EXIST) BLOWERS – DEMO
13. (EXIST) CHEMICAL PIPING – DEMO

EXISTING SOLIDS HANDLING BUILDING

FILTER COMPLEX DEMOLITION

PLAN

1/4" = 1'-0"

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FILTER COMPLEX

DEMOLITION PLAN II

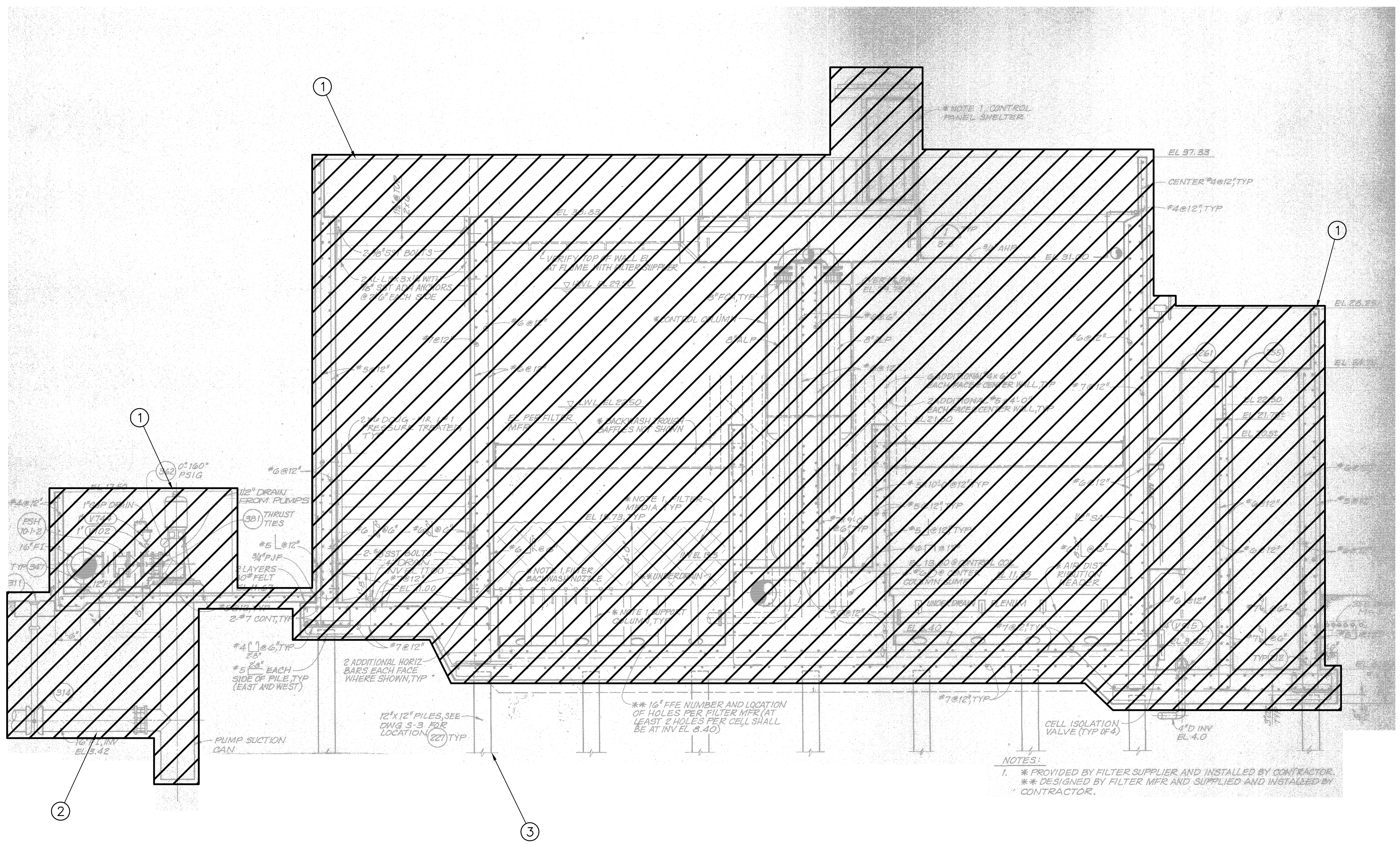
PBW. NO. -

BID NO. - SHT. DES. -

D-02

DWG. NO.

SHT. - OF -



NOTES:

1. (EXIST) FILTER TANK AND EQUIPMENT – DEMO
2. (EXIST) FILTER FEED PIPING – DEMO
3. (EXIST) STRUCTURAL PILE – PROTECT IN PLACE

FILTER COMPLEX DEMOLITION

SECTION 1
1/4" = 1'-0" D-01

1/4" = 1'- 0"
2 1 0 2 4

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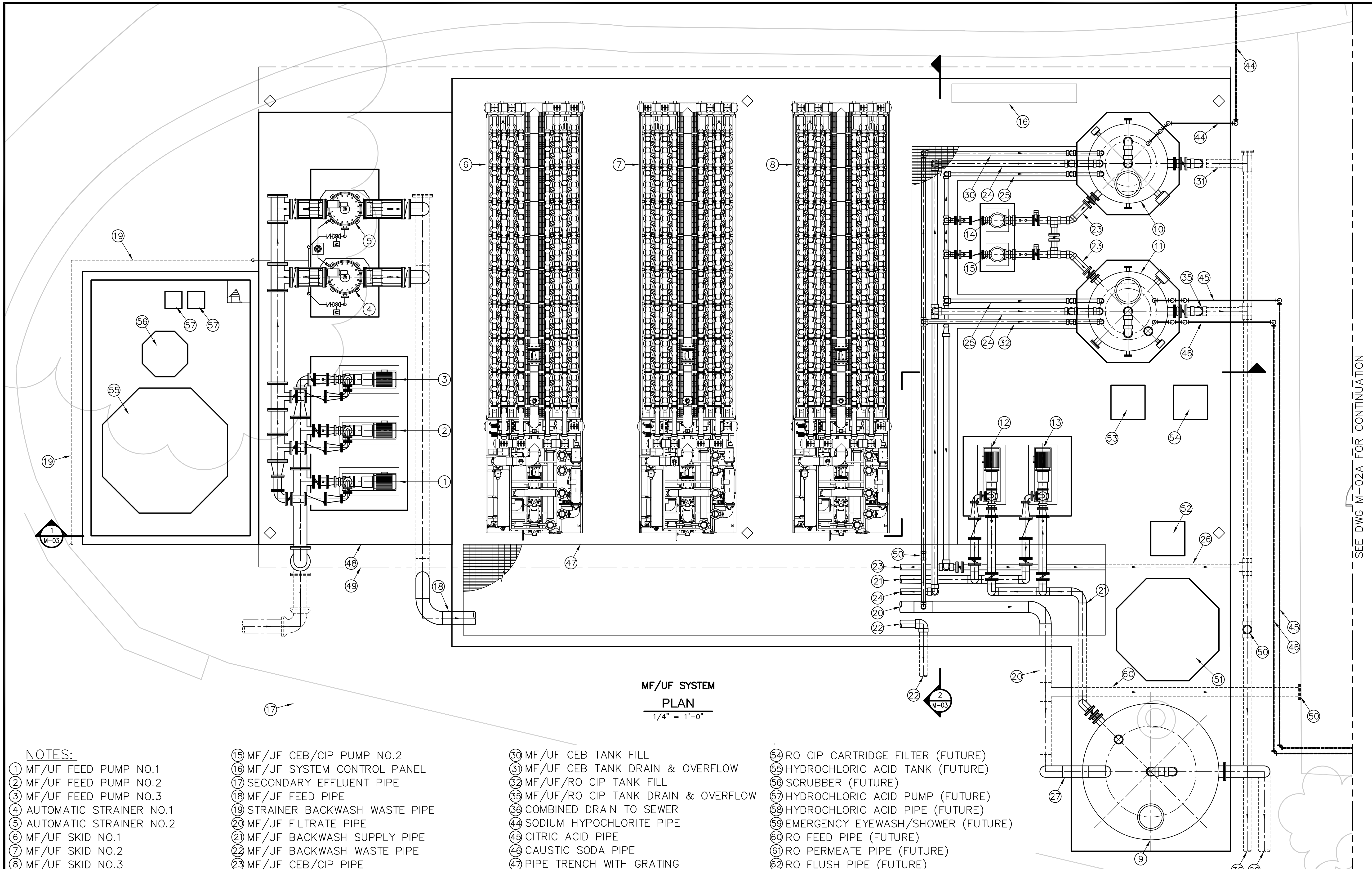
NO.	DATE	APPROVED	REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY

FILTER COMPLEX DEMOLITION SECTION

PBW. NO. -
BID NO. -
SHT. DES. -
D-03
DWG. NO.
SHT. - OF -



NOTES:

1. MF/UF FEED PUMP NO.1
2. MF/UF FEED PUMP NO.2
3. MF/UF FEED PUMP NO.3
4. AUTOMATIC STRAINER NO.1
5. AUTOMATIC STRAINER NO.2
6. MF/UF SKID NO.1
7. MF/UF SKID NO.2
8. MF/UF SKID NO.3
9. MF/UF FILTRATE TANK
10. MF/UF CEB TANK
11. MF/UF/RO CIP TANK
12. MF/UF BACKWASH PUMP NO.1
13. MF/UF BACKWASH PUMP NO.2
14. MF/UF CEB/CIP PUMP NO.1
15. MF/UF CEB/CIP PUMP NO.2
16. MF/UF SYSTEM CONTROL PANEL
17. SECONDARY EFFLUENT PIPE
18. MF/UF FEED PIPE
19. STRAINER BACKWASH WASTE PIPE
20. MF/UF FILTRATE PIPE
21. MF/UF BACKWASH SUPPLY PIPE
22. MF/UF BACKWASH WASTE PIPE
23. MF/UF CEB/CIP PIPE
24. MF/UF CEB/CIP RETURN PIPE
25. MF/UF CEB/CIP RECIRCULATION PIPE
26. MF/UF CEB/CIP WASTE PIPE
27. MF/UF FILTRATE TANK FILL (TOP & SIDE)
28. MF/UF FILTRATE TANK OVERFLOW TO CCB
29. MF/UF FILTRATE OVERFLOW TO DRAIN
30. MF/UF CEB TANK FILL
31. MF/UF CEB TANK DRAIN & OVERFLOW
32. MF/UF/RO CIP TANK FILL
35. MF/UF/RO CIP TANK DRAIN & OVERFLOW
36. COMBINED DRAIN TO SEWER
44. SODIUM HYPOCHLORITE PIPE
45. CITRIC ACID PIPE
46. CAUSTIC SODA PIPE
47. PIPE TRENCH WITH GRATING
48. LIMITS OF FOUNDATION
49. LIMITS OF CANOPY
50. BLIND FLANGE
51. RO FLUSH TANK (FUTURE)
52. RO FLUSH PUMP (FUTURE)
53. RO CIP PUMP (FUTURE)
54. RO CIP CARTRIDGE FILTER (FUTURE)
55. HYDROCHLORIC ACID TANK (FUTURE)
56. SCRUBBER (FUTURE)
57. HYDROCHLORIC ACID PUMP (FUTURE)
58. HYDROCHLORIC ACID PIPE (FUTURE)
59. EMERGENCY EYEWASH/SHOWER (FUTURE)
60. RO FEED PIPE (FUTURE)
61. RO PERMEATE PIPE (FUTURE)
62. RO FLUSH PIPE (FUTURE)
63. RO FLUSH TANK OVERFLOW PIPE (FUTURE)
64. RO FLUSH TANK DRAIN PIPE (FUTURE)
65. RO CIP PIPE (FUTURE)
66. RO CIP RETURN PIPE (FUTURE)
67. RO CIP RECIRCULATION PIPE (FUTURE)
68. RO CONCENTRATE PIPE (FUTURE)

1/4" = 1'-0"

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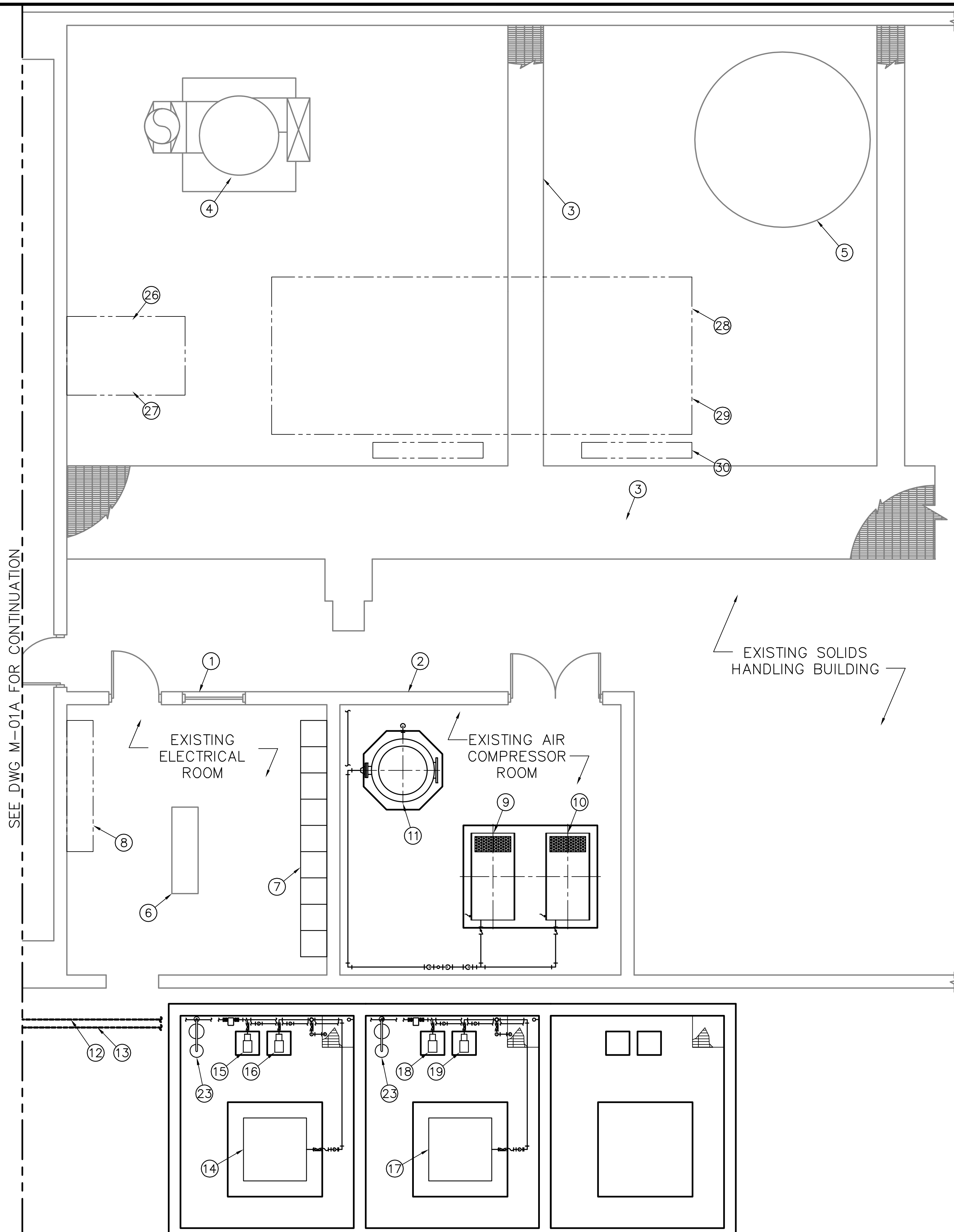
EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM
PLAN I

PBW. NO.
BID NO. SHT. DES.
M-01A
DWG. NO.
SHT. - OF -



MF/UF SYSTEM

PLAN

1/4" = 1'-0"

1/4" = 1'- 0"

NOTES:

1. (EXIST) ELECTRICAL ROOM
2. (EXIST) AIR SCRUBBER/BLOWER ROOM
3. (EXIST) PIPE TRENCH
4. (EXIST) AIR SCRUBBER – PROTECT IN PLACE
5. (EXIST) FERROUS SULFATE TANK – PROTECT IN PLACE
6. (EXIST) CONTROL PANEL – REMOVE EXIST FILTER I/O AND PROTECT IN PLACE
7. MF SYSTEM MCC
8. RO SYSTEM MCC (FUTURE)
9. AIR COMPRESSOR NO.1
10. AIR COMPRESSOR NO.2
11. AIR RECEIVER
12. CITRIC ACID PIPE
13. SODIUM HYDROXIDE PIPE
14. CITRIC ACID TOTE
15. CITRIC ACID FEED PUMP NO.1
16. CITRIC ACID FEED PUMP NO.2
17. SODIUM HYDROXIDE TOTE
18. SODIUM HYDROXIDE FEED PUMP NO.1
19. SODIUM HYDROXIDE FEED PUMP NO.2
23. EMERGENCY EYEWASH/SHOWER
26. RO FEED PUMP NO.1 (FUTURE)
27. RO FEED PUMP NO.2 (FUTURE)
28. RO TRAIN NO.1 (FUTURE)
29. RO TRAIN NO.2 (FUTURE)
30. RO SYSTEM CONTROL PANEL (FUTURE)

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EL ESTERO WWTP TERTIARY FILTRATION FACILITY

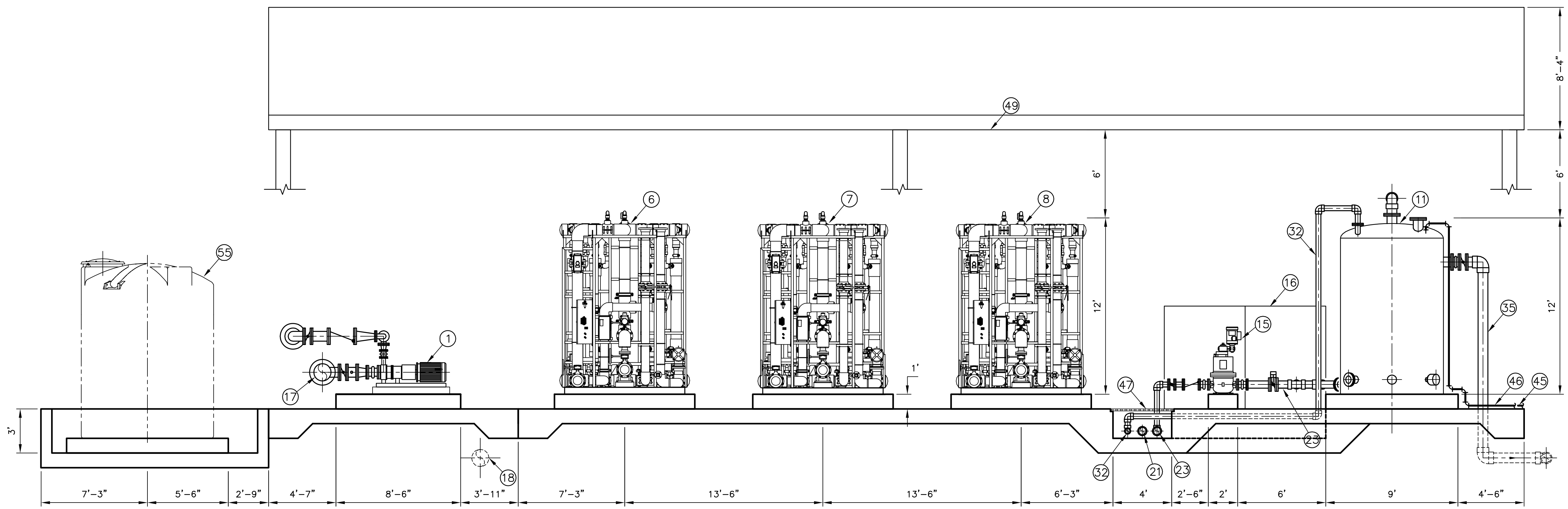
MF/UF SYSTEM
PLAN II

- PBW. NO.

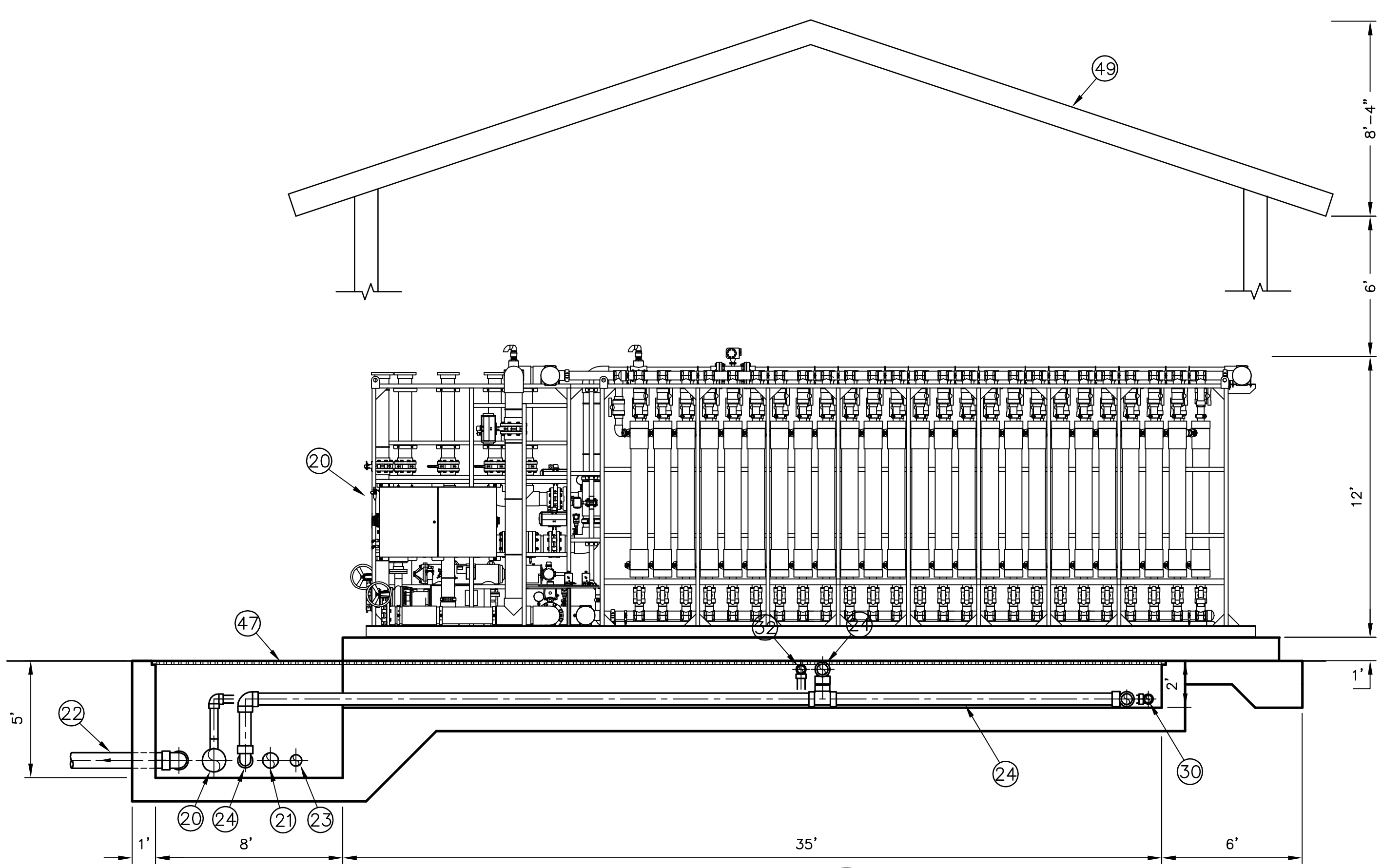
- BID NO. | - SHT. DES.

M-02A DWG. NO.

SHT. - OF -



SECTION 1
1/4" = 1'-0"
M-01A



SECTION 2
1/4" = 1'-0"
M-01A

NOTES:

1. MF/UF FEED PUMP NO.1
6. MF/UF SKID NO.1
7. MF/UF SKID NO.2
8. MF/UF SKID NO.3
11. MF/UF/RO CIP TANK
15. MF/UF CEB/CIP PUMP NO.2
16. MF/UF SYSTEM CONTROL PANEL
17. SECONDARY EFFLUENT PIPE
18. MF/UF FEED PIPE
19. STRAINER BACKWASH WASTE PIPE
20. MF/UF FILTRATE PIPE
21. MF/UF BACKWASH SUPPLY PIPE
22. MF/UF BACKWASH WASTE PIPE
23. MF/UF CEB/CIP PIPE
24. MF/UF CEB/CIP RETURN PIPE
25. MF/UF CEB/CIP RECIRCULATION PIPE
26. MF/UF CEB/CIP WASTE PIPE
32. MF/UF/RO CIP TANK FILL
35. MF/UF/RO CIP TANK DRAIN & OVERFLOW
36. COMBINED DRAIN TO SEWER
45. CITRIC ACID PIPE
46. CAUSTIC SODA PIPE
47. PIPE TRENCH WITH GRATING
49. CANOPY
55. HYDROCHLORIC ACID TANK (FUTURE)

1/4" = 1'- 0"
2 1 0 2 4

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NO.	DATE	APPROVED	REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM SECTIONS

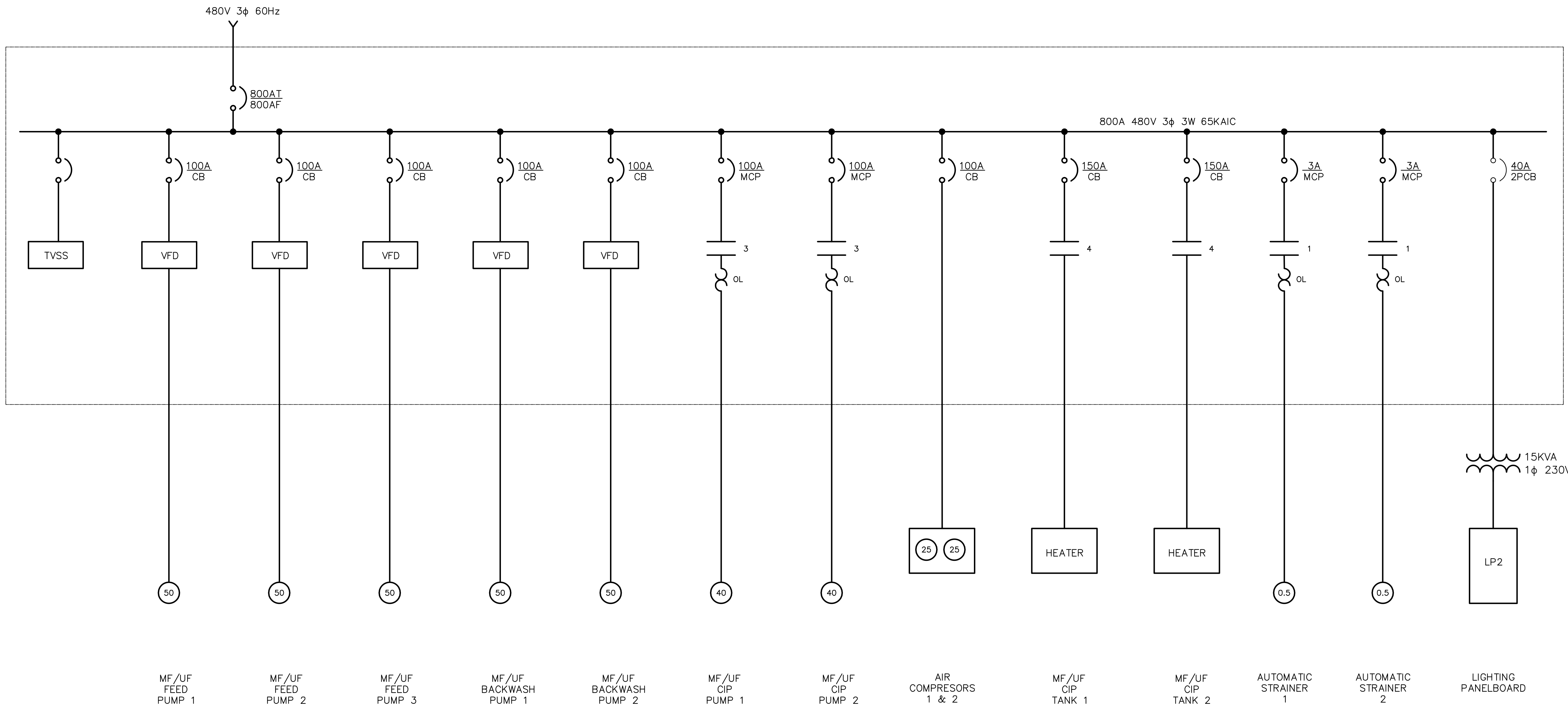
PBW. NO.

BID NO. SHT. DES.

M-03

DWG. NO.

SHT. - OF -



MF/UF SYSTEM – MCC
DIAGRAM 1
NTS –

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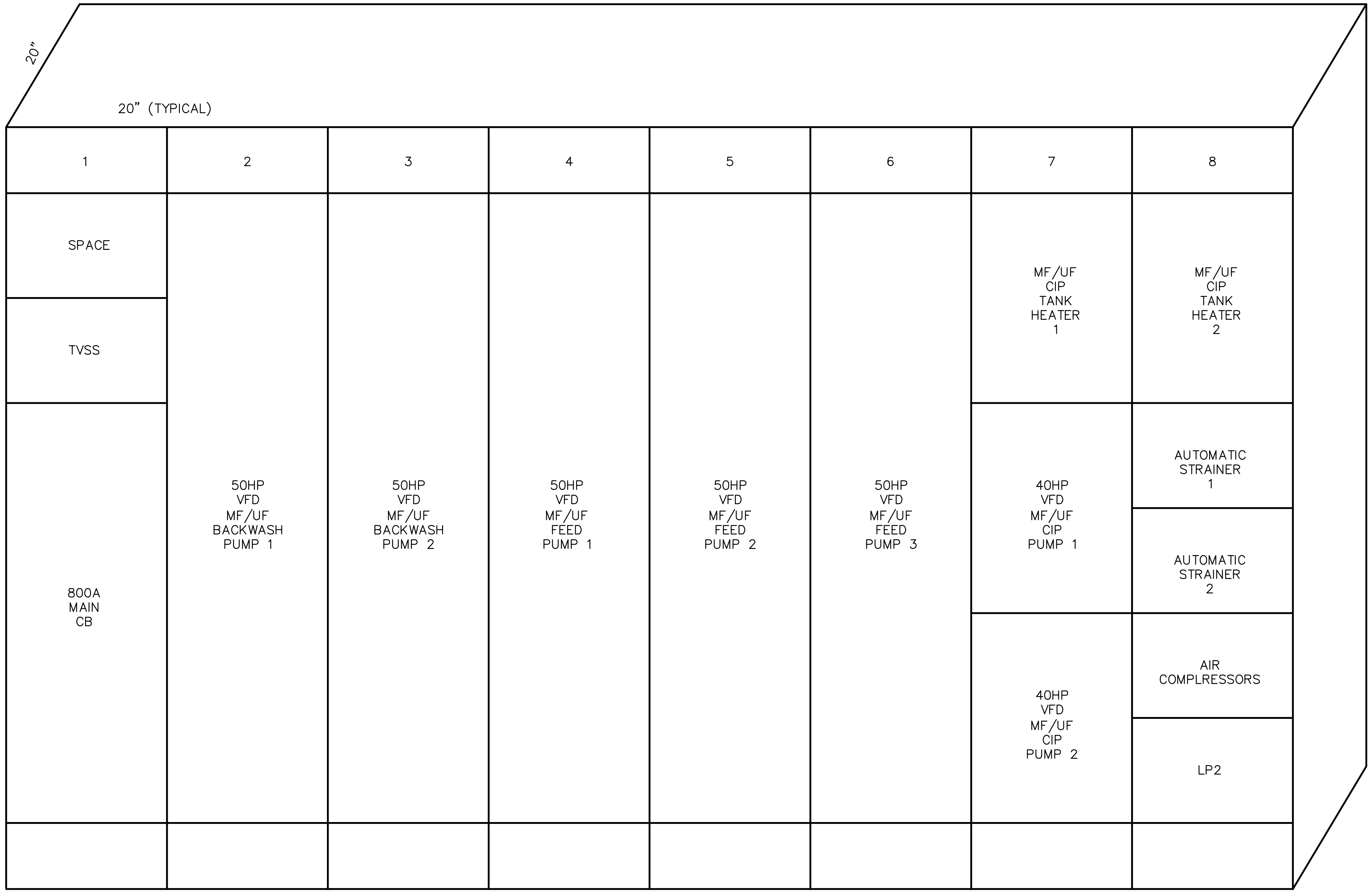
REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY
MF/UF SYSTEM
ELECTRICAL SINGLE LINE

PBW. NO. -
BID NO. -
SHT. DES. -
DWG. NO. E-01
SHT. - OF -



MF/UF SYSTEM – MCC

ELEVATION

NTS

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NO. DATE APPROVED REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM

ELECTRICAL MCC LAYOUT

PBW. NO. -
BID NO. - SHT. DES. -
DWG. NO. E-02
SHT. - OF -

INSTRUMENT IDENTIFICATION

EXAMPLE SYMBOLS

- FIRST LETTER(S)
- SUCCEEDING LETTER(S)
- CLARIFYING ABBREVIATIONS
- BB
- FIT L-1
- DIVISION SUPPLIED BY
- SUFFIX (USED WHEN THERE ARE MULTIPLE DEVICES WITH THE SAME UNIT NUMBER)
- LOOP NUMBER

DIGITAL SYSTEM INTERFACES

- ▲ ANALOG INPUT
- ▼ ANALOG OUTPUT
- △x DISCRETE INPUT
- ▽x DISCRETE OUTPUT

WHERE X=
- A = ALARM
- M = MAINTAINED
- K = MOMENTARY
- S = STATUS
- L = LATCHED

TRANSDUCERS

- A ANALOG
- D DIGITAL
- E VOLTAGE
- F FREQUENCY
- H HYDRAULIC
- I CURRENT
- P PNEUMATIC
- PF PULSE FREQUENCY
- PD PULSE DURATION
- R RESISTANCE

GENERAL INSTRUMENT OR FUNCTION SYMBOLS

- FIELD MOUNTED
- PANEL MOUNTED (OPERATOR ACCESSIBLE)
- YL PILOT LIGHT
- HS OO ON-OFF HAND SWITCH MAINTAINED CONTACT SWITCH (CONTROLLED DEVICE WILL RESTART ON RETURN OF POWER AFTER POWER FAILURE).
- HS SS STOP-START HAND SWITCH MOMENTARY CONTACT SWITCHES (CONTROLLED DEVICE WILL NOT RESTART ON RETURN OF POWER AFTER POWER FAILURE).

INSTRUMENTATION IDENTIFICATION LETTERS

LETTER	FIRST-LETTER: PROCESS OR INITIATING VARIABLE	FIRST-LETTER: MODIFIER	SUCCEEDING-LETTERS: READOUT OR PASSIVE FUNCTION	SUCCEEDING-LETTERS: OUTPUT FUNCTION	SUCCEEDING-LETTERS: MODIFIER
A	ANALYSIS (+)		ALARM		
B	BURNER, COMBUSTION			CLOSED, STOP, DECREASE	
C				CONTROL	
D	DENSITY (S.G) (1)	DIFFERENTIAL		OPEN, START, INCREASE	
E	VOLTAGE		PRIMARY ELEMENT (SENSOR)		
F	FLOW RATE	RATIO (FRACTION)			FAIL
G			GLASS, GAUGE VIEWING DEVICE	GATE	
H	HAND (MANUAL)				HIGH (OPENED)
!	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW (CLOSED)
M	MOTION, MOTOR	MOMENTARY		MOTOR	MIDDLE, INTERMEDIATE
N	TORQUE				ON, OPERATE
O			ORIFICE, RESTRICTION		OVERLOAD
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION	PUMP	
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD OR PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED (+)	X AXIS	UNCLASSIFIED (+)	UNCLASSIFIED (+)	UNCLASSIFIED (+)
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVE, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.

INTERFACE SYMBOLS

- A = SOURCE DRAWING NO.
- X = TO OR FROM TEXT
- Y = TO OR FROM TEXT CONTINUATION
- B/L = BOUNDARY LIMIT (SOURCE/DESTINATION OUTSIDE OF CONTRACT SCOPE)

VALVE SYMBOLS

- GATE
- KNIFE GATE
- BUTTERFLY
- BALL
- VEE- BALL
- SEAT PORT ECCENTRIC PLUG
- DIAPHRAGM
- NEEDLE
- CHECK
- BACKFLOW PREVENTER
- ROTARY
- GLOBE VALVE
- PLUG VALVE
- DOUBLE DOOR CHECK VALVE
- BALL CHECK VALVE
- PRV XX-XXXX BACK PRESSURE VALVE
- AIR VALVE
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- REGULATED SIDE PRESSURE CONTROL
- MULTI-PORT VALVES (GATE VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN.) ARROWS INDICATE FLOW PATTERN. SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- ANGLE GATE
- TELESCOPE
- SAMPLE
- MUD
- ELECTRONIC CONTROL VALVE (ARROW INDICATES CHECK VALVE FUNCTION)
- S PRESSURE REGULATING VALVE

GATE SYMBOLS

- SLUICE GATE
- SLIDE GATE
- WEIR GATE
- STOP LOG

ACTUATOR SYMBOLS

- XX PNEUMATIC DIAPHRAM SPRING-OPPOSED SINGLE OR DOUBLE ACTING
- CYLINDER, SINGLE ACTING SPRING OPPOSED WITHOUT POSITIONER OR PILOT.
- CYLINDER, DOUBLE ACTING, WITHOUT POSITIONER OR PILOT.
- EXAMPLE OF CYLINDER WITH POSITIONER
- ANY CYLINDER THAT IS ASSEMBLED WITH A PILOT SO THAT ASSEMBLY IS ACTUATED BY ONE CONTROLLED INPUT. PILOT MAY BE POSITIONER, SOLINOID VALVE, SIGNAL CONVERTER ETC
- VALVE POSITIONER
- M XX ELECTRIC MOTOR
- E/H XX ELECTROHYDRAULIC
- DIAPHRAGM, DIFFERENTIAL PRESSURE
- S XX SOLENOID
- H XX HYDRAULIC

NOTE: ON LOSS OF PRIMARY POWER (PNEUMATIC, ELECTRICAL OR HYDRAULIC)

- XX: FO = FAIL OPEN
- FC = FAIL CLOSED
- BLANK = FAIL TO LAST POSITION

PRIMARY ELEMENT SYMBOLS

- M ELECTROMAGNETIC FLOWMETER
- X PROPELLER OR TURBINE METER
- PARSHALL FLUME
- ORIFICE PLATE
- FLOW TUBE
- PITOT-STATIC
- FI ROTAMETER
- LEVEL (BUBBLER TUBE)
- LEVEL SWITCH (FLOAT)
- ULTRASONIC LEVEL SENSOR
- RADAR LEVEL SENSOR
- SUBMERSIBLE PRESSURE TRANSDUCER

LINE LEGEND

- PROCESS (CLOSED CONDUIT, DASHED LINE INDICATES ALTERNATE FLOW STREAM)
- EXISTING PROCESS
- BUILDING OR FACILITY BOUNDARY
- PACKAGE SYSTEM EQUIPMENT BOUNDARY
- ELECTRICAL CABLE
- VENDOR SUPPLIED CABLE
- PNEUMATIC SIGNAL
- FILLED SYSTEM SIGNAL
- HYDRAULIC SYSTEM SIGNAL
- ETHERNET CABLE
- RADIO SIGNAL
- FO FIBER OPTIC CABLE

MISCELLANEOUS SYMBOLS

- BLIND FLANGE
- CAP
- REDUCER
- STRAINER
- FLEXIBLE CONNECTION
- AIR GAP
- V VENT TO ATMOSPHERE
- DIAPHRAGM OR ANNULAR SEAL
- ANNULAR DIAPHRAGM SEAL
- RUPTURE DISK (PRESSURE)
- RUPTURE DISK (VACUUM)
- PIG INSERT POINT
- OR PIG CATCH POINT
- F FLUSHING CONNECTION
- HOSE ADAPTER
- S SEAL WATER SET
- SIGHT GLASS
- A SELF CONTAINED AIR SUPPLY
- SD D COMPOSITE SAMPLER (DIPPER TYPE)
- SS COMPOSITE SAMPLER (SUCTION TYPE)
- IN-LINE SILENCER
- FILTER
- T DRIP TRAP
- FLAME TRAP
- 120V 120 VOLT, 60 HZ POWER
- 480V 480 VOLT, 3 PHASE, 60 HZ POWER
- PLUG
- RECEPTACLE
- FFLCPLLLX PANEL CONTINUED ON SAME OR OTHER DRAWING
- PANEL OUTLINE
- PANEL NAME
- I OR I INTERLOCK. SEE CONTROL DIAGRAMS OR DESCRIPTIONS
- X PURGE SET X: W = WATER, A = AIR
- SEE
- XX AIR SET XX= SUPPLY PRESSURE IN PSIG.
- J JUNCTION BOX
- M ELECTRIC MOTOR
- HORN
- PULSATION DAMPENER
- CALIBRATION COLUMN
- SIGHT GLASS
- STATIC MIXER
- MIXER

PUMP AND COMPRESSOR SYMBOLS

NOTE: XX: AS ADJUSTABLE SPEED
- CS CONSTANT SPEED (SINGLE SPEED)
- CS-2 CONSTANT SPEED (TWO SPEED)

- XX CENTRIFUGAL PUMP (DRY PIT)
- XX CENTRIFUGAL WET PIT SUBMERSIBLE PUMP OR TURBINE PUMP
- M VERTICAL TURBINE PUMP
- XX SUBMERSIBLE SUMP PUMP
- XX RECIPROCATING OR METERING PUMP (POSITIVE DISPLACEMENT)
- XX DIAPHRAGM PUMP
- XX PROGRESSIVE CAVITY PUMP
- VACUUM PUMP
- ROTARY PUMP
- XX GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- SCREW PUMP
- XX COMPRESSOR (CENTRIFUGAL)
- XX BLOWER OR FAN (CENTRIFUGAL)
- INJECTOR

ABBREVIATIONS

GENERAL

- AC ALTERNATING CURRENT
- AM AUTO-MANUAL
- CAM COMPUTER-AUTO-MANUAL
- CL_2 FREE CHLORINE RESIDUAL
- CM COMPUTER-MANUAL
- COD CHEMICAL OXYGEN DEMAND
- CP-X CONTROL PANEL NO. X
- DC DIRECT CURRENT
- DO DISSOLVED OXYGEN
- FO FIBER OPTIC
- FR FORWARD-REVERSE
- HMI HUMAN MACHINE INTERFACE
- HOA HAND-OFF-AUTO
- HOR HAND-OFF-REMOTE
- ISR INTRINSICALLY SAFE RELAY
- LA LOCAL-AUTO
- LCP LOCAL CONTROL PANEL
- LEL LOWER EXPLOSIVE LIMIT
- LOR LOCAL-OFF-REMOTE
- LOS LOCKOUT STOP
- LR LOCAL-REMOTE
- MA MANUAL-AUTO
- MCC-X MOTOR CONTROL CENTER NO. X
- OAC OPEN-AUTO-CLOSE
- OC OPEN-CLOSE (D)
- OCR OPEN-CLOSE-REMOTE
- OCA OPEN-CLOSE-AUTO
- OIT OPERATOR INTERFACE TERMINAL
- OO ON-OFF
- OOA ON-OFF-AUTO
- OOR ON-OFF-REMOTE
- ORP OXIDATION REDUCTION POTENTIAL
- OSC OPEN-STOP-CLOSE
- OWS OPERATOR WORKSTATION
- PLC PROGRAMMABLE LOGIC CONTROLLER
- RIO REMOTE I/O UNIT
- RTU REMOTE TELEMETRY UNIT
- SCADA SUPERVISORY CONTROL AND DATA ACQUISITION
- SS START-STOP
- SVP SOLENOID VALVE PANEL
- TCL_2 TOTAL CHLORINE RESIDUAL
- TOC TOTAL ORGANIC CARBON
- TURB TURBIDITY
- VFD VARIABLE FREQUENCY DRIVE

PROCESS FLOW STREAMS

- AA AQUEOUS AMMONIA
- ASC ANTISCALANT
- BWS BACKWASH WATER SUPPLY
- BWW BACKWASH WASTE
- BYP BYPASS
- CA COMPRESSED AIR
- CEB CHEMICALLY ENHANCED BACKWASH
- CIP CLEAN-IN-PLACE
- CIPR CIP RETURN
- CIPW CIP WASTE
- CIT CITRIC ACID
- CS CAUSTIC SODA, SODIUM HYDROXIDE
- D DRAIN, DRAIN WATER
- FDW MEMBRANE FEED WATER
- FLT MEMBRANE FILTRATE WATER
- HCL HYDROCHLORIC ACID
- IW INDUSTRIAL WATER
- OF OVERFLOW
- PW POTABLE WATER
- ROC RO CONCENTRATE
- ROF RO FEED
- ROFL RO FLUSH
- ROP RO PERMEATE
- RW RECLAIMED WATER
- SA SAMPLE
- SS SANITARY SEWER
- SBS SODIUM BISULFITE
- SD STORM DRAIN
- SCE SECONDARY EFFLUENT
- SHC SODIUM HYPOCHLORITE
- TE TERTIARY EFFLUENT
- V VENT

PIPE MATERIALS

- BS BLACK STEEL PIPE
- CI CASTE IRON
- CU COPPER
- CPVC CHLORINATED POLYVINYL CHLORIDE
- DI DUCTILE IRON
- DIGL DUCTILE IRON GLASS LINED
- FRP FIBERGLASS REINFORCED PLASTIC
- GS GALVANIZED STEEL
- HDPE HIGH DENSITY POLYETHYLENE
- PE POLYETHYLENE
- PCCP PRESTRESSED CONCRETE CYLINDER PIPE
- PP POLYPROPYLENE
- PPSTL POLYPROPYLENE LINED STEEL
- PVC POLYVINYL CHLORIDE
- RC REINFORCED CONCRETE
- RUB SEWER PIPE RUBBER
- SS STAINLESS STEEL
- STL STEEL

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Tel: 213-457-2200

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DESIGN EY
DRAWN CB
CHECKED DC

PRELIMINARY DESIGN

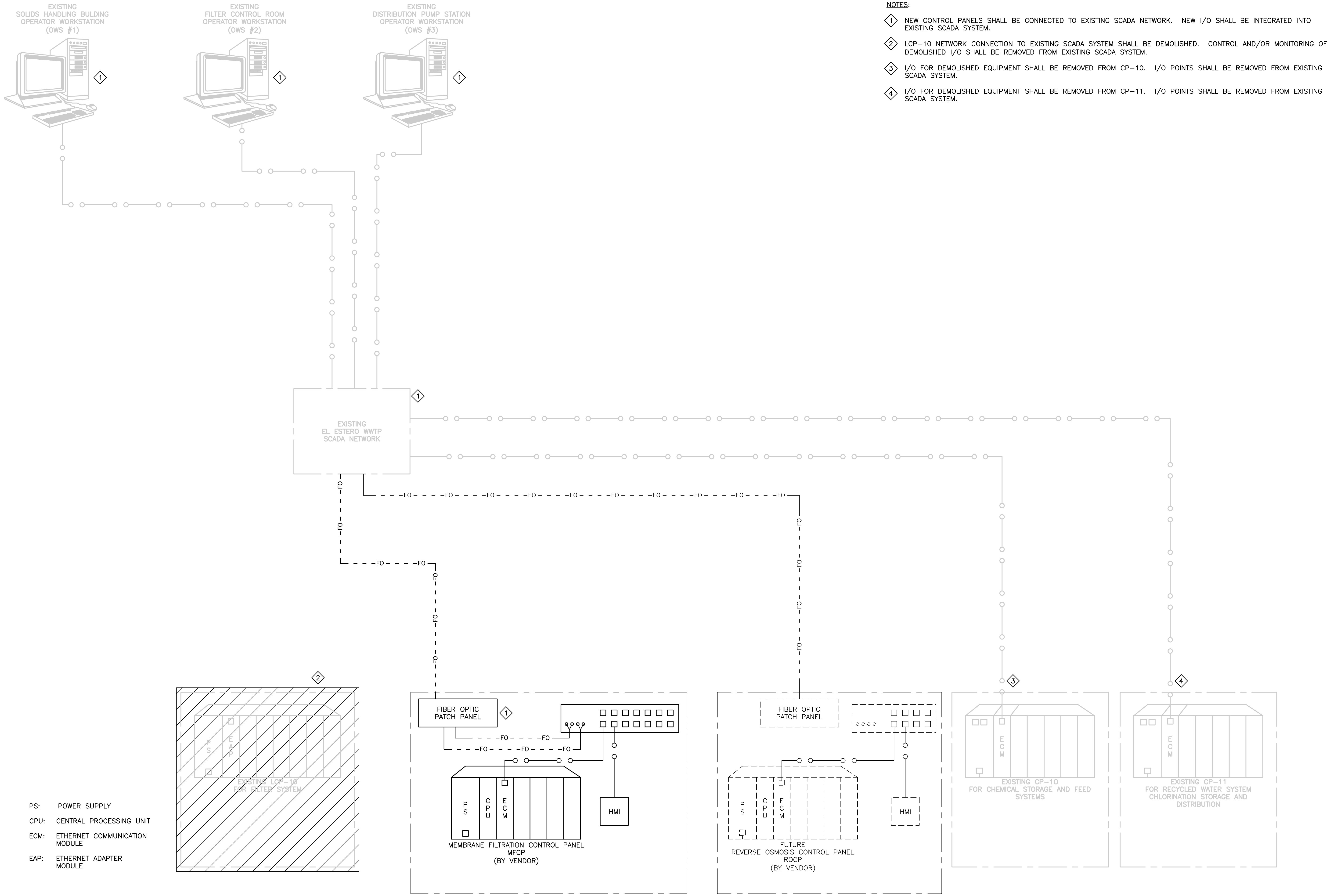
REVISIONS: NO. | DATE | APPROVED

EL ESTERO WWTP TERTIARY FILTRATION FACILITY
I&C
SYMBOLS, LEGEND, & ABBREVIATIONS

PBW. NO. -
BID NO. - | SHT. DES. -
DWG. NO. I-01A
SHT. - OF -

NOTES:

1. NEW CONTROL PANELS SHALL BE CONNECTED TO EXISTING SCADA NETWORK. NEW I/O SHALL BE INTEGRATED INTO EXISTING SCADA SYSTEM.
2. LCP-10 NETWORK CONNECTION TO EXISTING SCADA SYSTEM SHALL BE DEMOLISHED. CONTROL AND/OR MONITORING OF DEMOLISHED I/O SHALL BE REMOVED FROM EXISTING SCADA SYSTEM.
3. I/O FOR DEMOLISHED EQUIPMENT SHALL BE REMOVED FROM CP-10. I/O POINTS SHALL BE REMOVED FROM EXISTING SCADA SYSTEM.
4. I/O FOR DEMOLISHED EQUIPMENT SHALL BE REMOVED FROM CP-11. I/O POINTS SHALL BE REMOVED FROM EXISTING SCADA SYSTEM.



PS: POWER SUPPLY
CPU: CENTRAL PROCESSING UNIT
ECM: ETHERNET COMMUNICATION MODULE
EAP: ETHERNET ADAPTER MODULE

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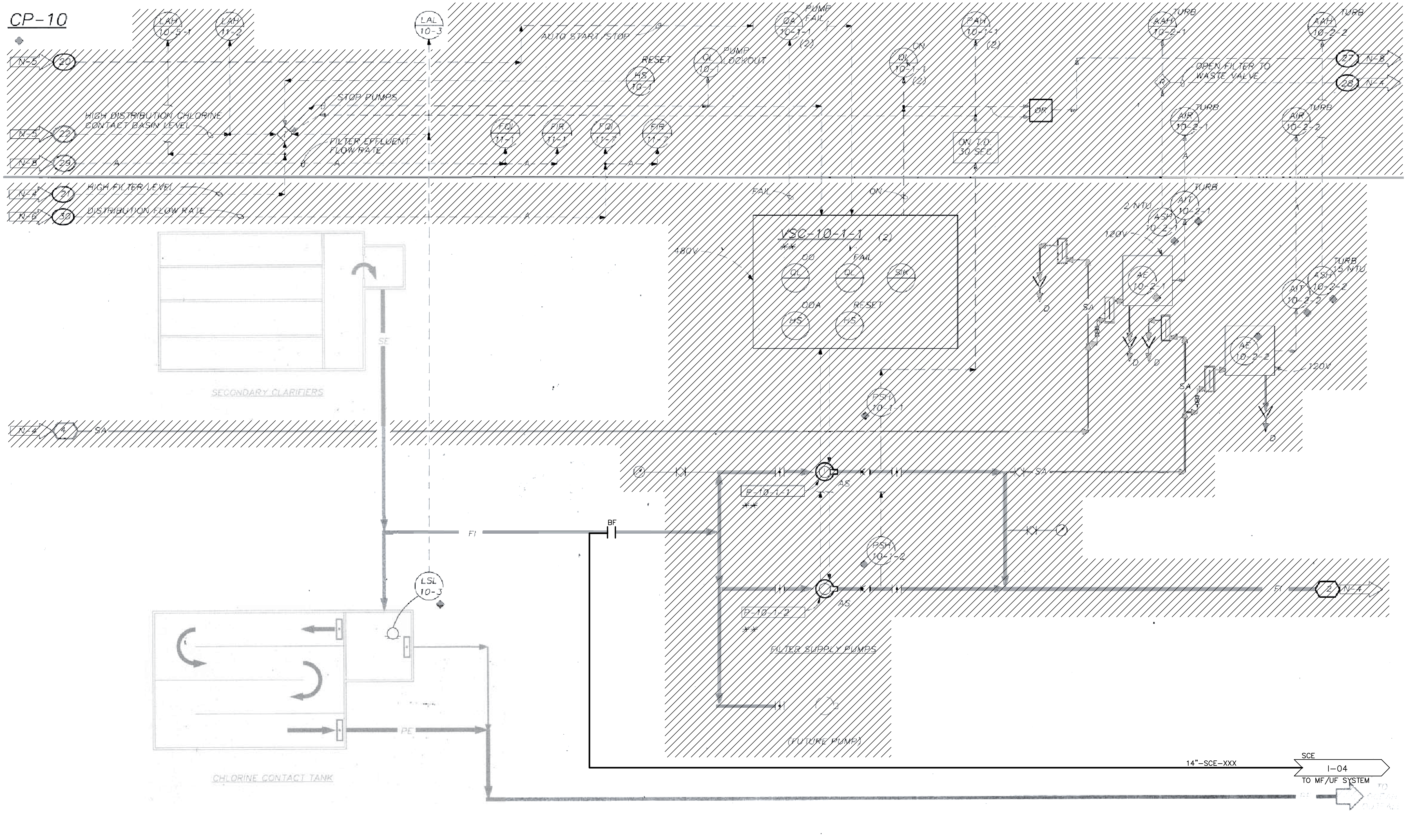
EL ESTERO WWTP TERTIARY FILTRATION FACILITY

I&C
SYSTEM ARCHITECTURE

PBW. NO.
BID NO. SHT. DES.
I-02A
DWG. NO.
SHT. – OF –



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EL ESTERO WWTP TERTIARY FILTRATION FACILITY

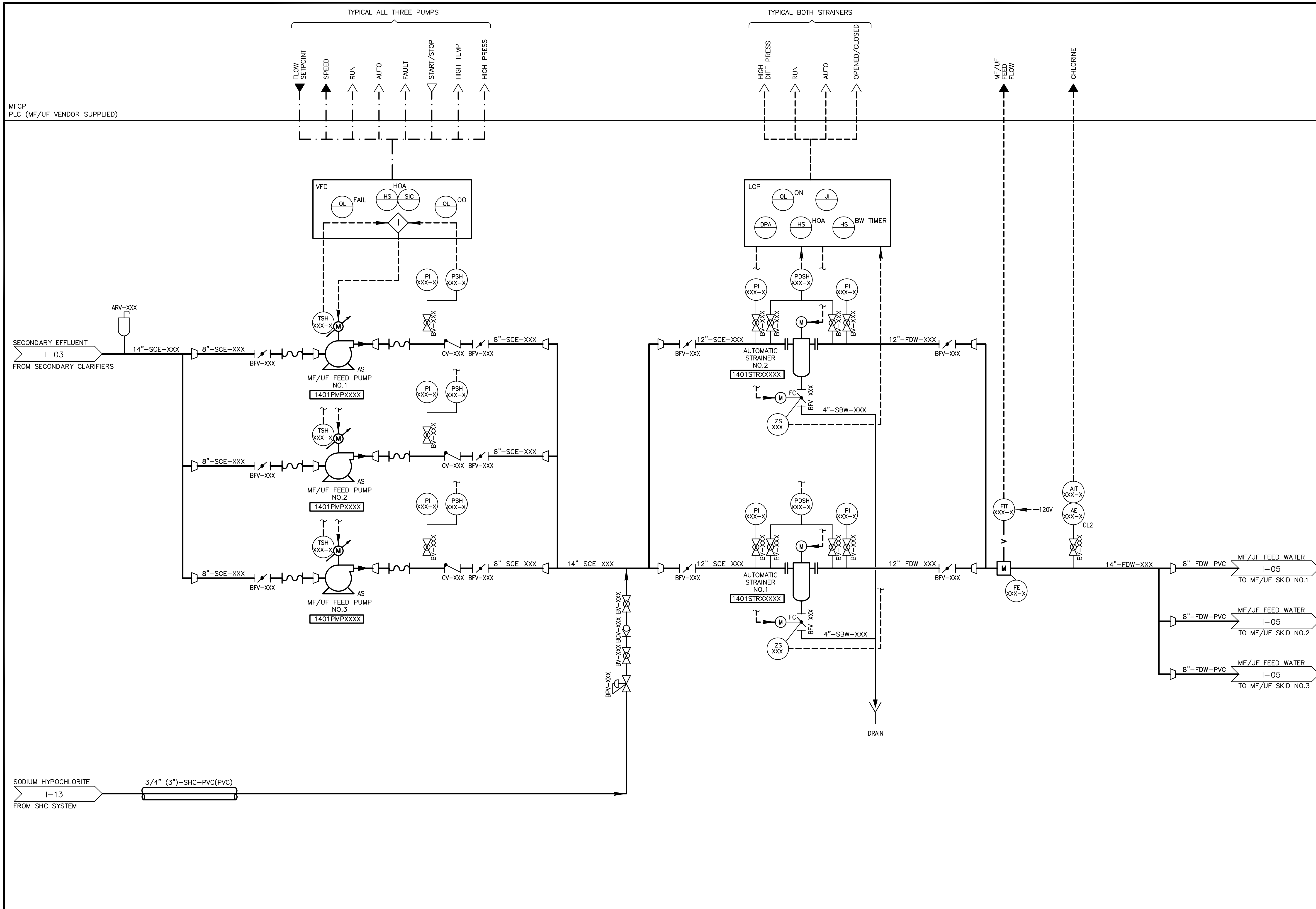
FILTER SUPPLY MODIFICATION

PBW. NO.

BID NO. | SHT. DES.

I-03
DWG. NO.

SHT. – OF –



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EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM

FEED PUMPS AND AUTOMATIC STRAINERS

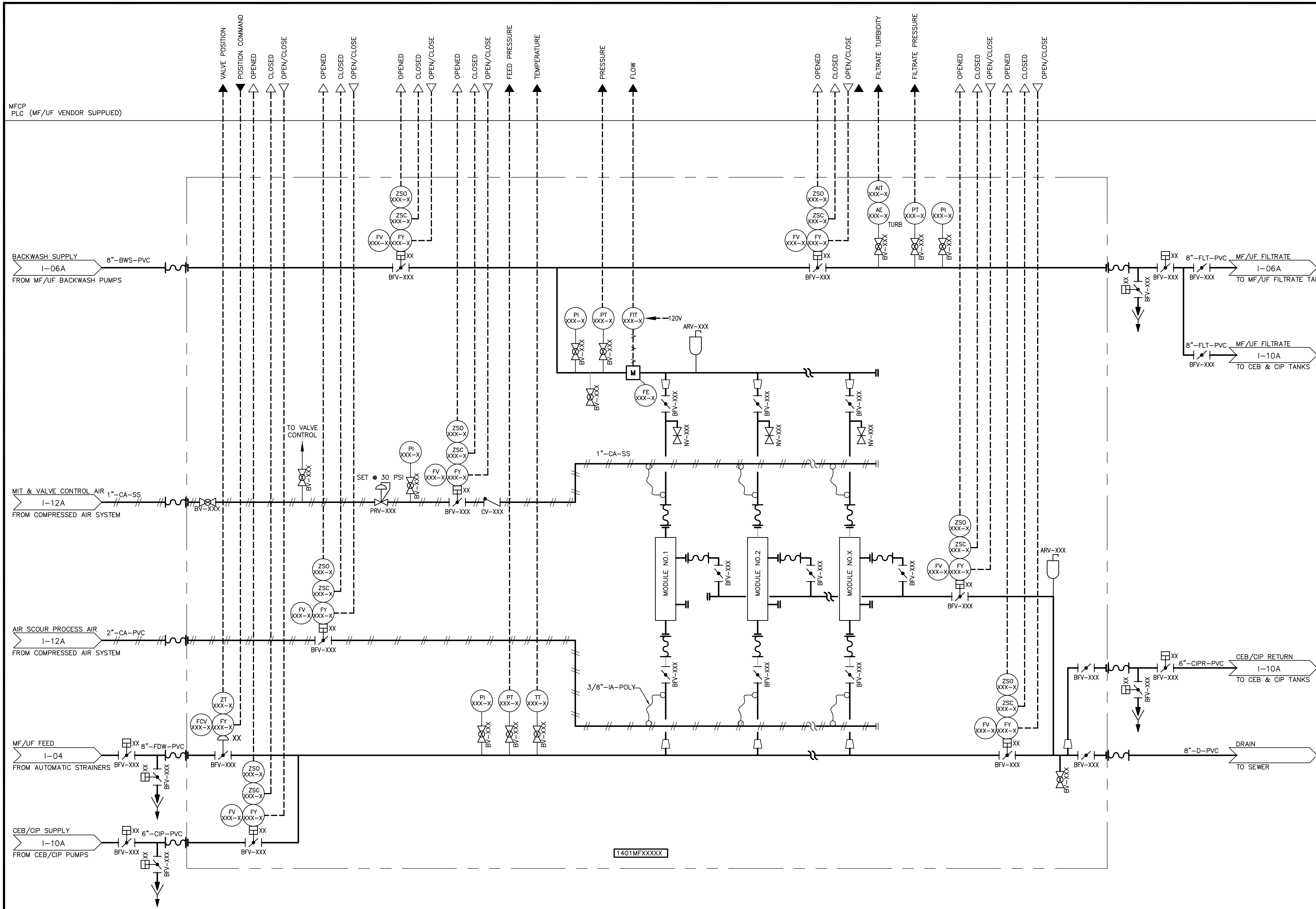
PBW. NO. -

BID NO. -

SHT. DES. -

DWG. NO. I-04

SHT. - OF -



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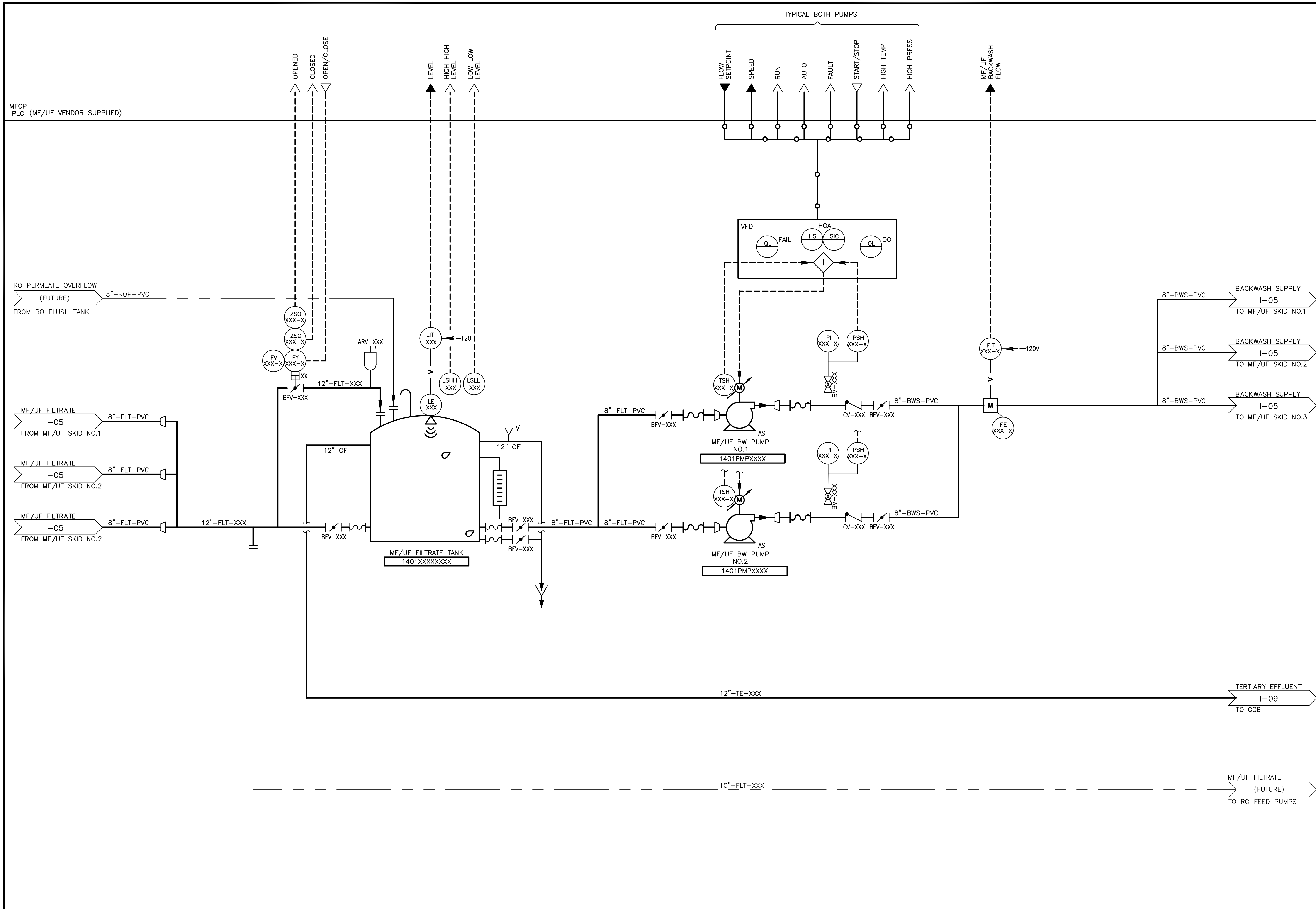
MF/UF SYSTEM TYPICAL SKID

PBW. NO. -
BID NO. -
SHT. DES. -
DWG. NO. I-05
SHT. - OF -



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PRELIMINARY DESIGN

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EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM

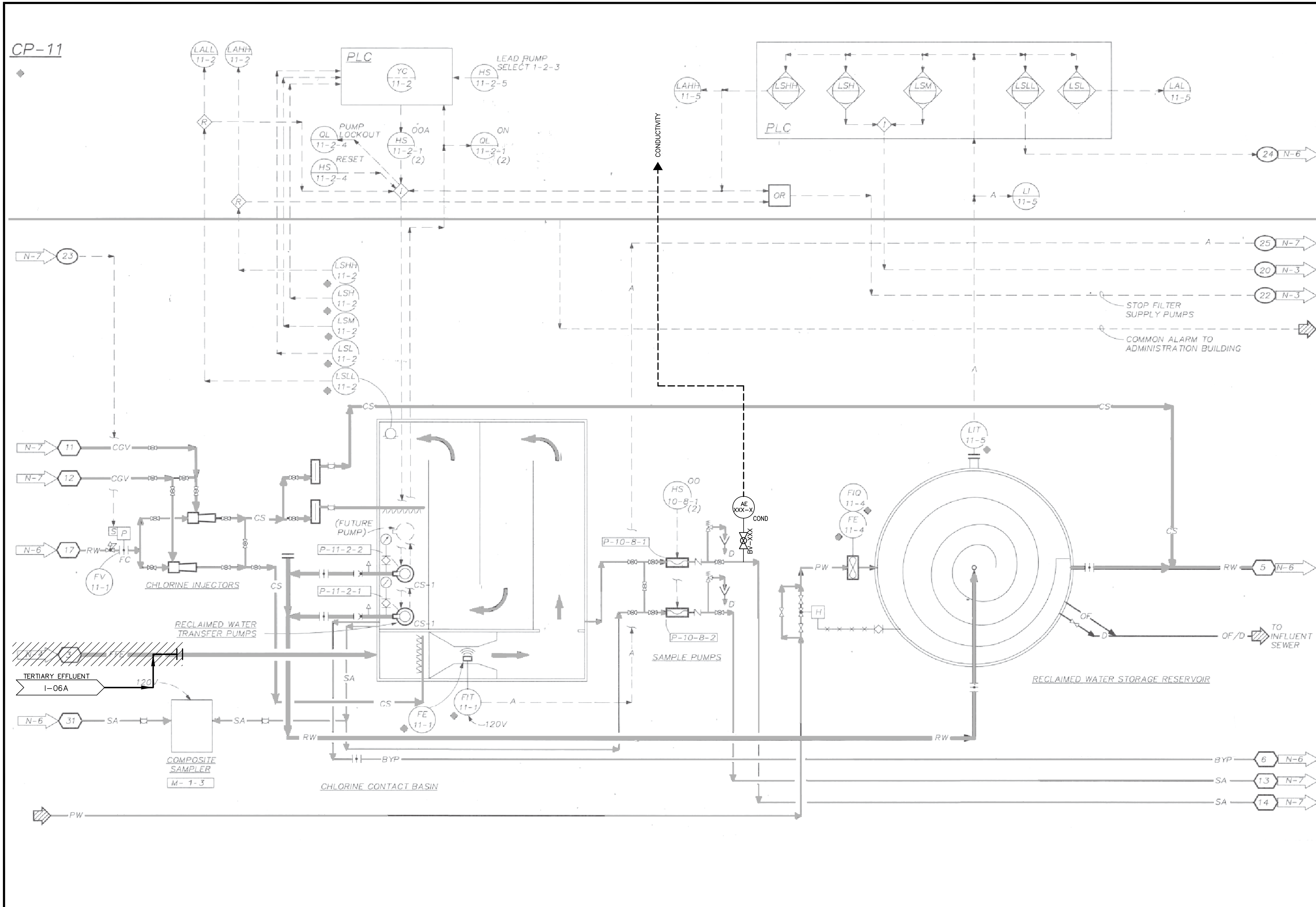
FILTRATE TANK AND BACKWASH PUMPS

PBW. NO. -

BID NO. - SHT. DES. -

I-06A
DWG. NO.

SHT. – OF –



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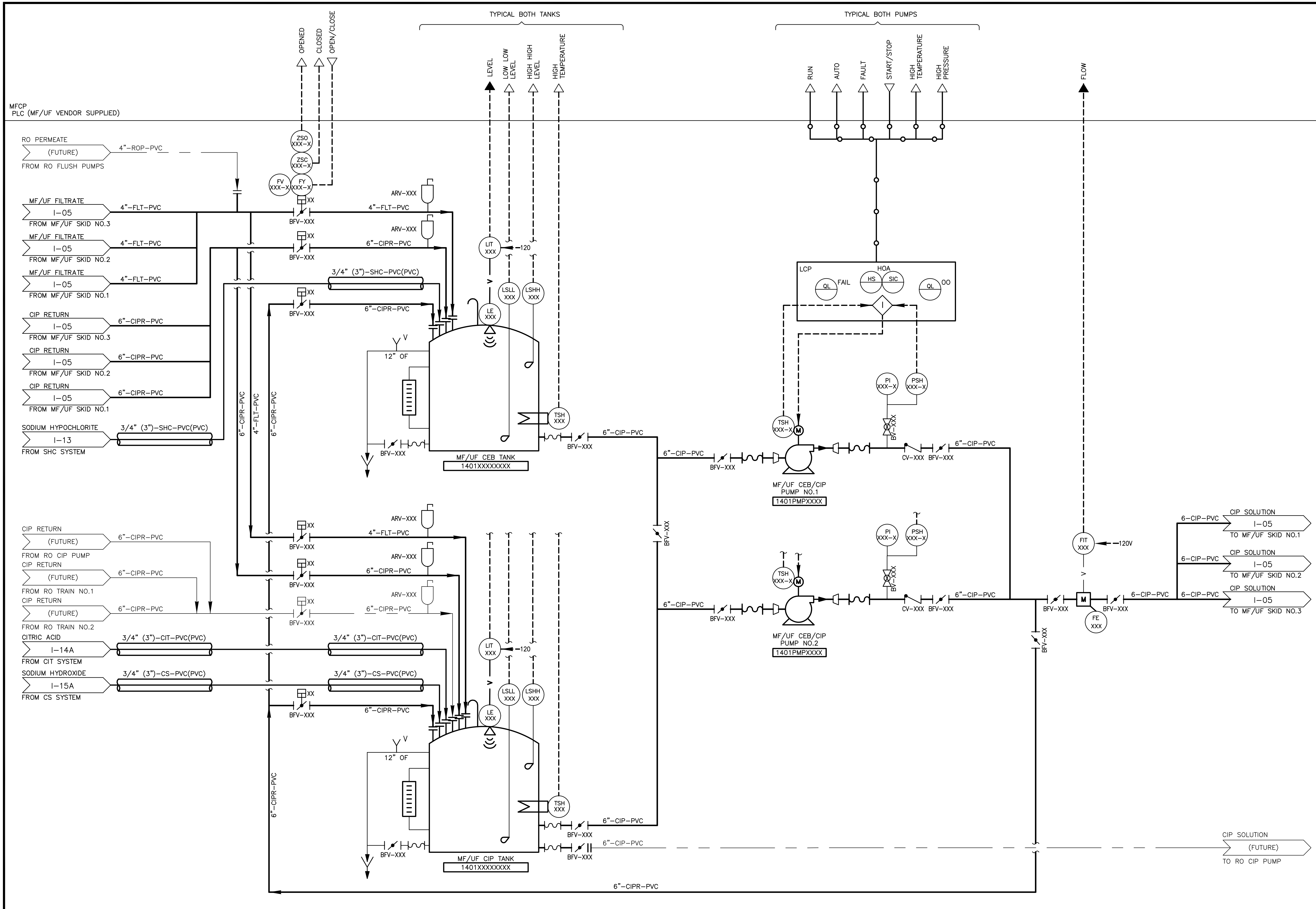
CHECKED DC

PRELIMINARY DESIGN

NO.	DATE	APPROVED	REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY
CCB & STORAGE RESERVOIR MODIFICATION

PBW. NO.
BID NO. SHT. DES.
I-09
DWG. NO.
SHT. – OF –



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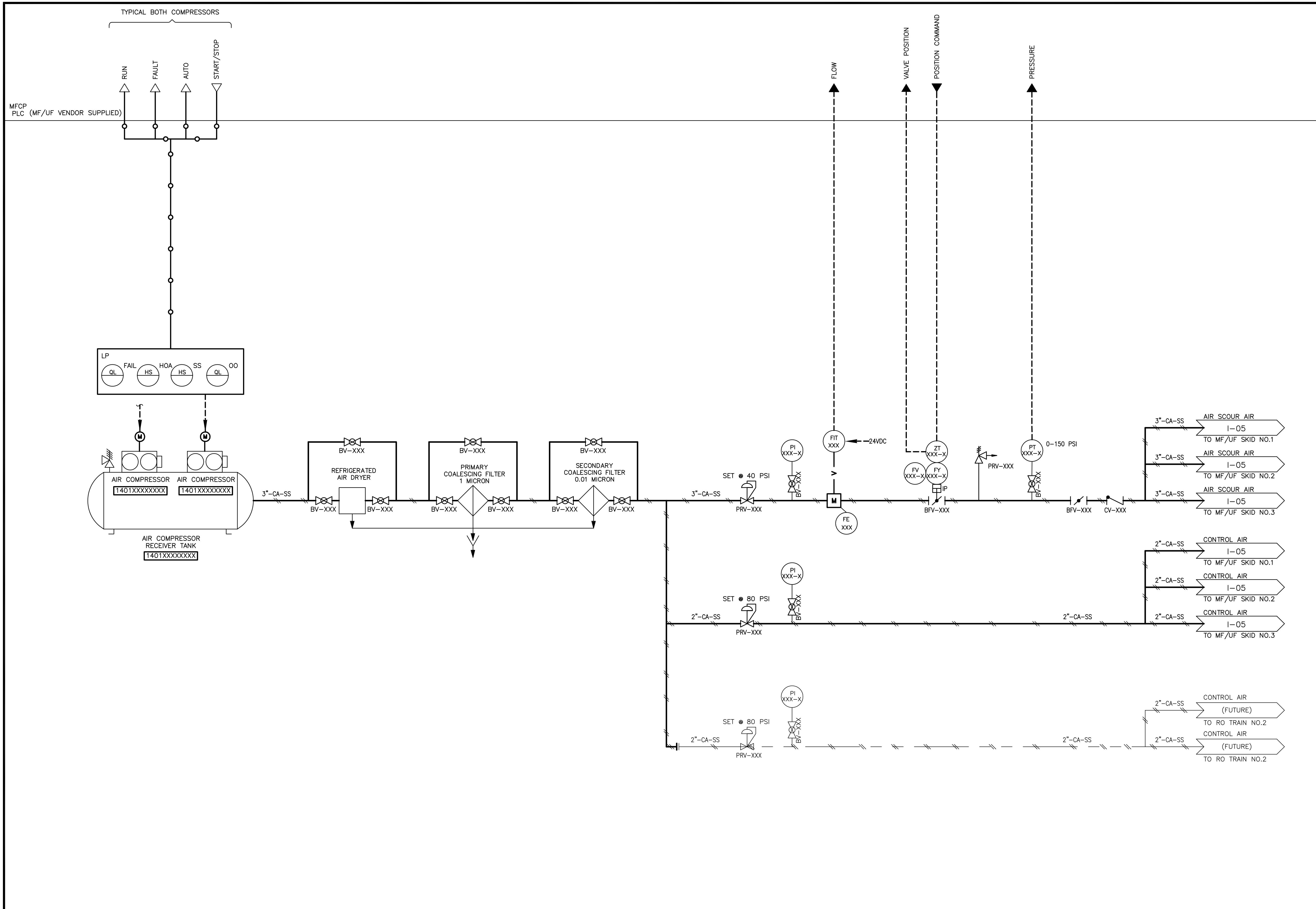
EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM
CEB/CIP SYSTEM

PBW. NO. -
BID NO. -
SHT. DES. -
DWG. NO. I-10A
SHT. - OF -



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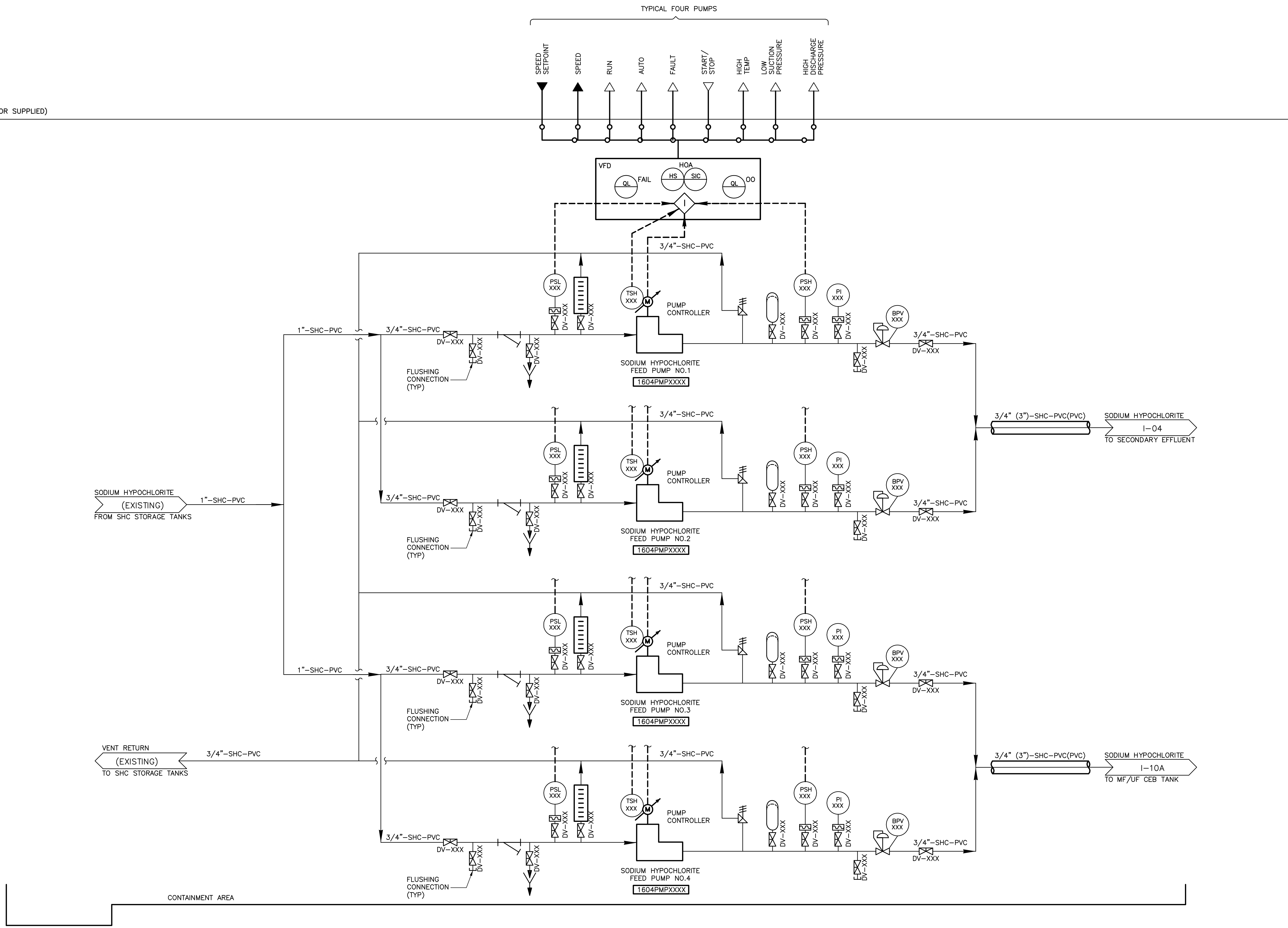
EL ESTERO WWTP TERTIARY FILTRATION FACILITY

MF/UF SYSTEM

COMPRESSED AIR SYSTEM

PBW. NO. -
BID NO. -
SHT. DES. -
DWG. NO. I-12A
SHT. – OF –



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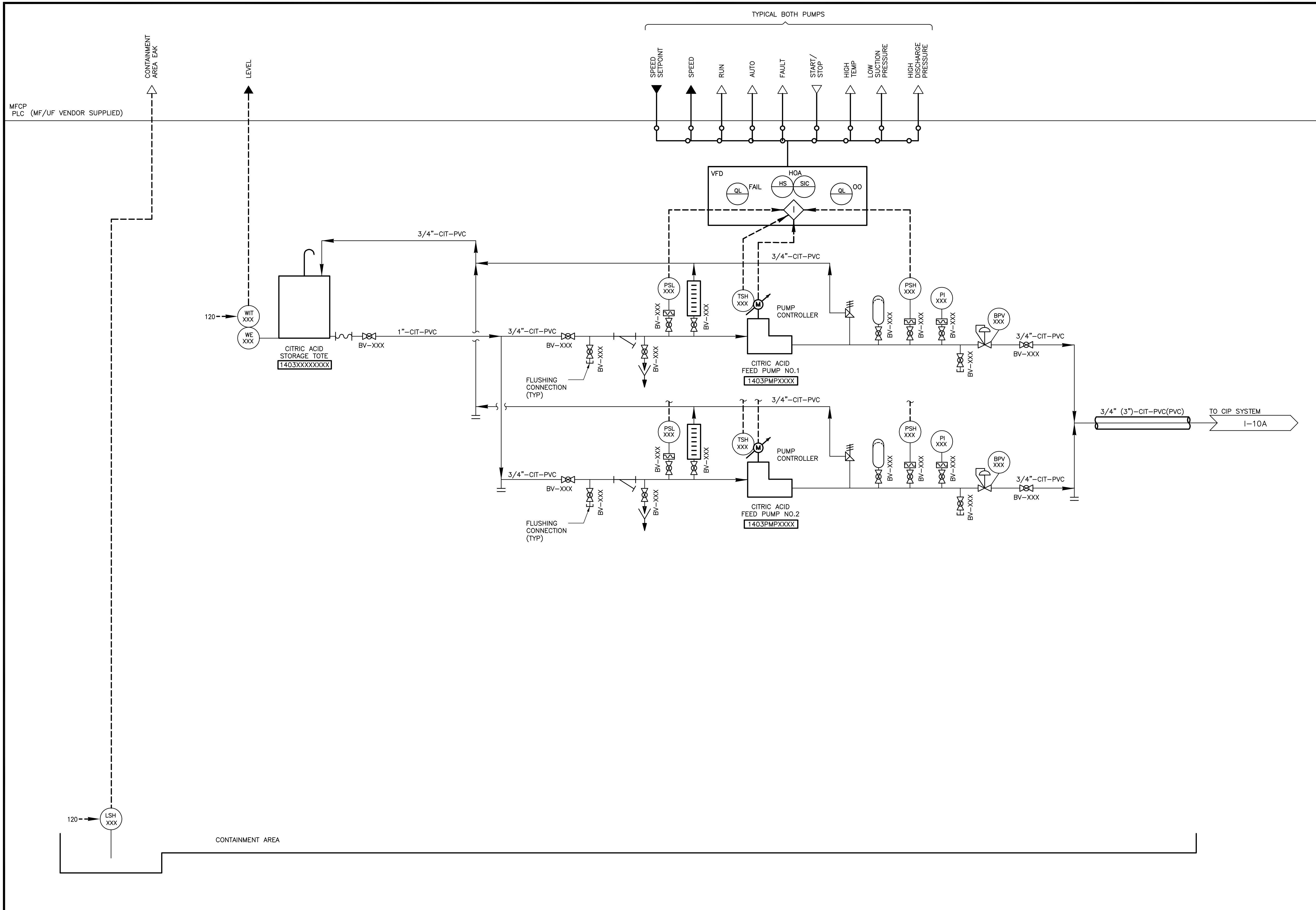
EL ESTERO WWTP TERTIARY FILTRATION FACILITY
CHEMICAL SYSTEM
SODIUM HYPOCHLORITE

PBW. NO. -
BID NO. -
SHT. DES. -
DWG. NO. I-13
SHT. - OF -



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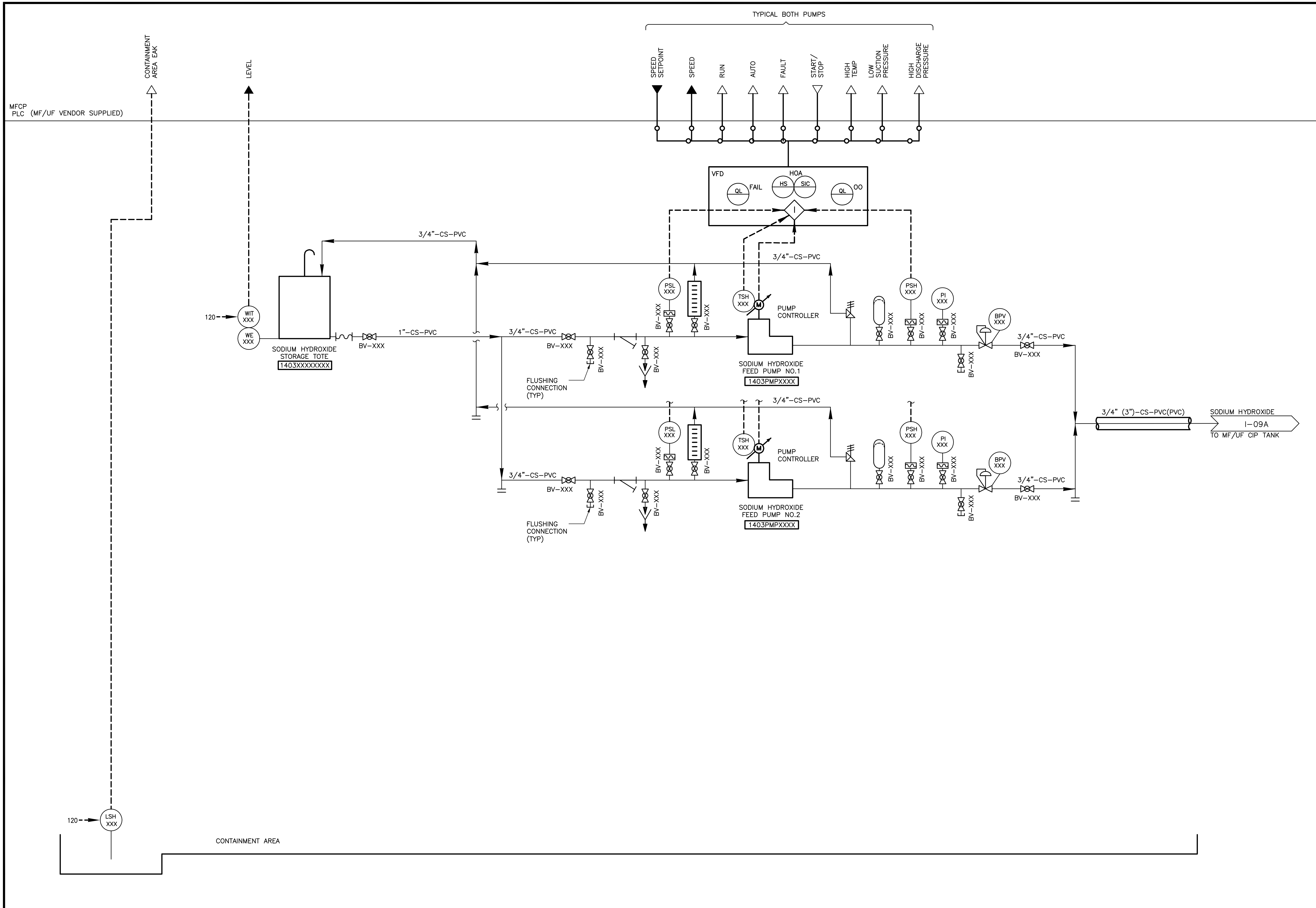
EL ESTERO WWTP TERTIARY FILTRATION FACILITY

CHEMICAL SYSTEM

CITRIC ACID

- PBW. NO.	
- BID NO.	- SHT. DES.
I-14A DWG. NO.	
SHT. - OF -	



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NO.	DATE	APPROVED

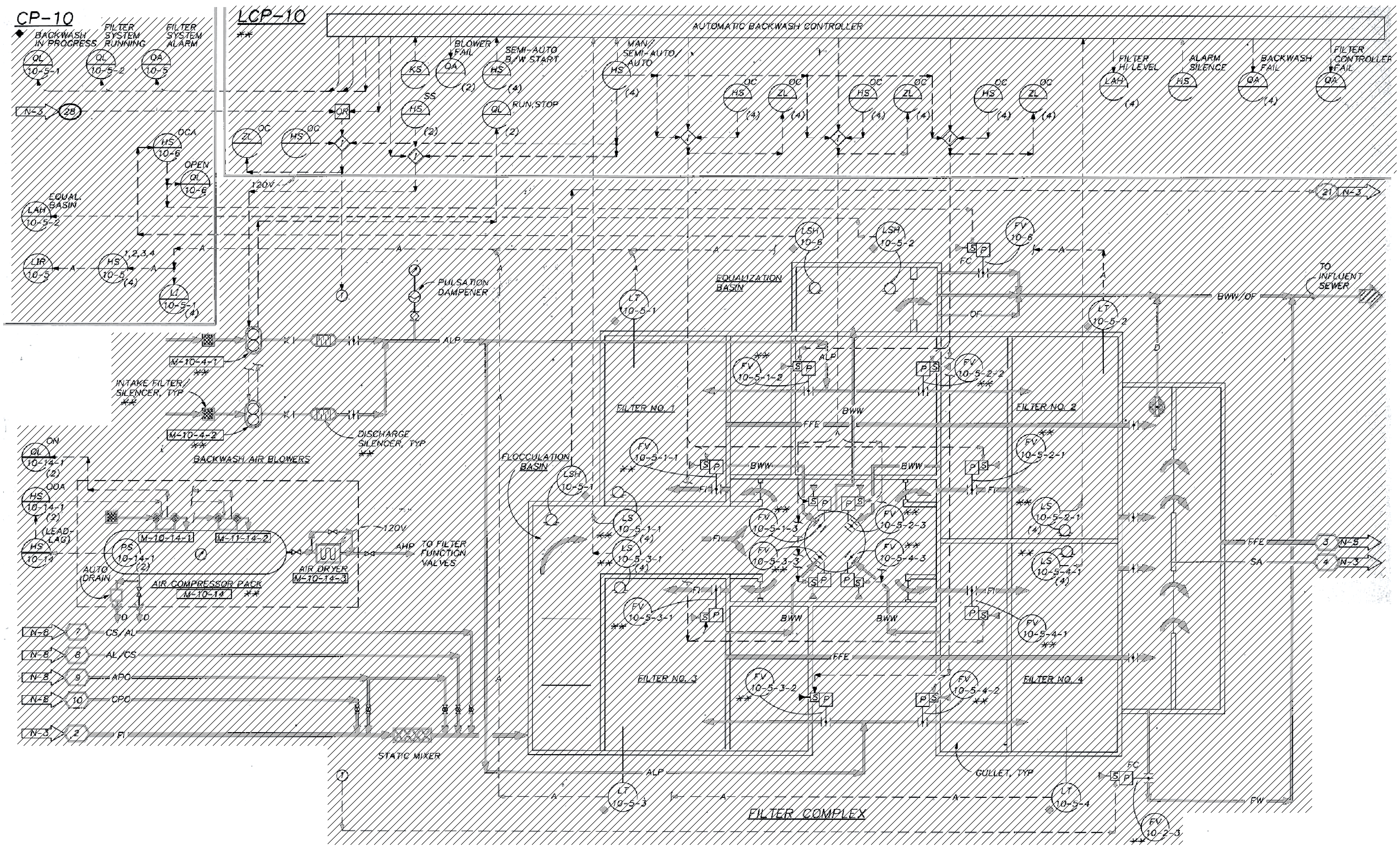
REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY
CHEMICAL SYSTEM
SODIUM HYDROXIDE

- PBW. NO.
- BID NO.
- SHT. DES.

I-15A
DWG. NO.

SHT. – OF –



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PRELIMINARY DESIGN

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CITY ENGINEER

DATE

ORIGINAL SIGNED DATE

REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY

FILTRATION DEMOLITION

PBW. NO.

BID NO. SHT. DES.

I-18

DWG. NO.

SHT. – OF –

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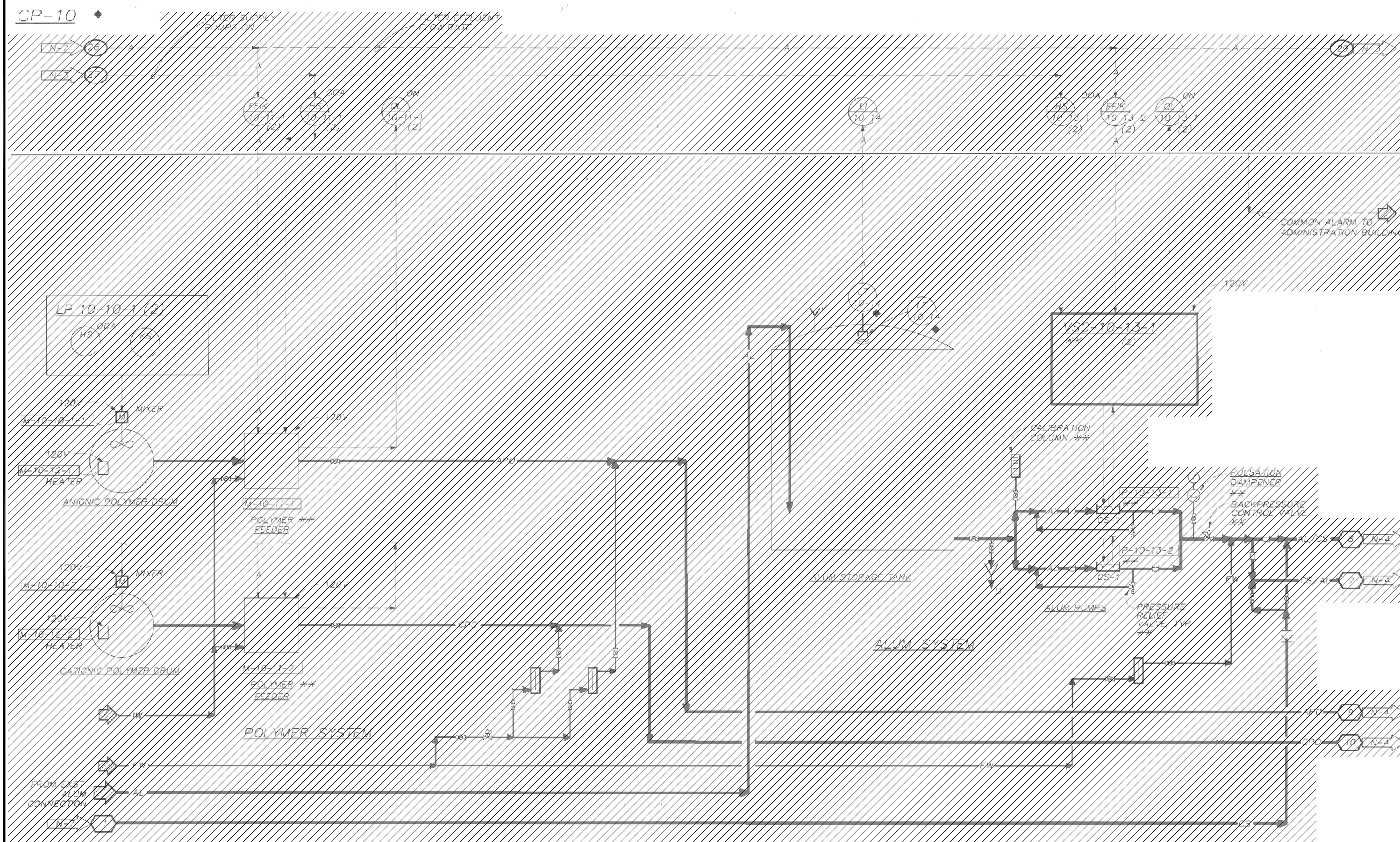

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PRELIMINARY DESIGN

NO.	DATE	APPROVED	REVISIONS

EL ESTERO WWTP TERTIARY FILTRATION FACILITY

CHEMICAL SYSTEM

DEMOLITION

PBW. NO.

BID NO. SHT. DES.

I-19

DWG. NO.

SHT. – OF –

Appendix B

Assessment Memos

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Appendix B-1: AM No.1 Introduction & Project Background

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Marie Burbano, CDM Smith
Greg Wetterau, CDM Smith

Date: *June 4, 2012*

Subject: *Assessment Memorandum (AM) No. 1 – Introduction and Project Overview*

Introduction

The City of Santa Barbara (City) has been providing, protecting, and preserving groundwater, drinking water and recycled water for its community for over 150 years. The City has been a leader in water system planning and use of recycled water. Committed to protecting the environment and public health and safety, the City now seeks to sustainably and reliably improve treatment at their El Estero Wastewater Treatment Plant (El Estero).

El Estero is an 11 mgd wastewater treatment plant that was initially constructed in 1951; the plant has primary sedimentation, secondary processing, tertiary filtration, and disinfection. As part of El Estero, the City produces Title 22 recycled water for 60 to 80 users, according to the 2009 Recycled Water Expansion Assessment. The City is committed to providing recycled water to system users who depend on the reliability of the recycled water system.

Recently, the water produced by the tertiary filters has not been able to reliably meet the required turbidity limit of <2 NTU (nephelometric turbidity units). The influent wastewater is also relatively high in total dissolved solids (TDS). As a result, the City currently blends with potable water to decrease turbidity and TDS in the recycled water. A planned improvement to the secondary treatment system will likely improve secondary effluent turbidity, making the secondary effluent more amenable to filtration. However, the aging infrastructure of the filters may still require rehabilitation, retrofit or possibly replacement. When planning filtration improvements, the issue of reducing TDS and chloride levels should also be considered, as TDS varies greatly between the potable water system (averaging 574 mg/L) and the wastewater treatment plant effluent (1350 mg/L TDS). This increase of more than 700 mg/L TDS is likely a combination of water softeners and seawater or groundwater infiltration.

In 2012, the City embarked on a project to provide assessment and pre-design services related to upgrading the existing tertiary filtration system.

Project Overview

This project is divided into three tasks. Task I – Assessment includes the assessment activities and memoranda to determine the path forward for pre-design. Task II – Filtration Pre-Design provides technical memoranda and a pre-design report (PDR) for the selected filtration alternative. Task III – Demineralization Pre-Design provides technical memoranda and a pre-design report (PDR) for the selected demineralization alternative. The following is a list of the assessment memoranda (AMs) provided as part of Task I.

- AM No. 1. Introduction & Project Background
- AM No. 2. Recycled Water System Study
- AM No. 3. Filtration Alternatives
- AM No. 4. Demineralization Alternatives
- AM No. 5. Investigation of TDS Sources
- AM No. 6. Recycled Water System Hydraulic Analysis

The technical memoranda and components of the PDRs for Tasks II and III will be described in Technical Memorandum No. 1 for each task.

Reference Documents

In preparation for the assessment memoranda, technical memoranda, and pre-design report (PDR), CDM Smith reviewed numerous document and as-built information received from plant staff. This section lists and describes those documents received.

Reports, Studies, and Data

The following is a list of reports, studies, and data received and reviewed.

1. City of Santa Barbara Water Conservation Technical Analysis (Maddaus Water Management, F, 1961, 10_TechnicalMemorandum_FINAL_10-20-2010x.pdf) – Evaluates water conservation programs and estimates associated cost savings.

2. Operation Manual for Santa Barbara Water Reclamation System (1989, 11_Recl-O&M-ElesteroWWTP1989.pdf) – Describes equipment operation for plant reclamation system including startup/shutdown procedures and includes facility layout drawings and P&IDs.

3. City of Santa Barbara Reclaimed Water System Distribution Map (Carollo Engineers, 13_EEWTP-Schematic-of-Recycled-Water-System.pdf) – Schematic of distribution piping that includes facility and hydraulic/flow information, also includes recommendations for upgrades and expansion.

4. City of Santa Barbara Long Term Water Supply Plan (City of Santa Barbara, 2011, 14_Long_Term_Water_Supply_Plan.CityofSB.2011.Final.pdf) – Discusses existing and future water sources for the City.

5. Reclamation System Demand Projections (14_System_Demand_Projections.LTWSP.Figure_8.pdf) – Chart showing demand projections through 2030.

6. Water Supply Planning Study (Carollo Engineers, 2009, 14_Water_Supply_Planning_Study.Final.Carollo_Engrs.August_2009.pdf) – Describes historical, current and predicted conditions of City's water supply sources.

7. Cater Treatment Plant 2011 Annual Water Quality Summary (2_Cater Raw - 2011.pdf) – Lists influent water quality concentrations for typical parameters such as pH, nitrogen, TDS, turbidity and coliforms. Lists approximately 40 parameters.

8. Cater Treatment Plant 2011 Annual Water Quality Summary (2_Cater Tap - 2011.pdf) – Same as Item No. 7 but for treated effluent.

9. Industrial User Forms (3_Appendix-A_%202011_Industrial_Users.pdf) – Provides discharge water quality data (mostly metals) for eight industrial users.

10. El Estero 2011 Monthly Water Quality Data Tables (3_ElEstero-Influent_Data_2011.pdf) – Monthly water quality and constituent removal data for plant influent, primary clarifier effluent, plant effluent and reclaim water discharge.

11. El Estero 2012 Monthly Water Quality Data Tables (3_ElEstero-Influent_Data_Jan-Feb_2012.pdf) Same as Item No. 10 but for the first two months of 2012 only.

12. CCTV Test Reports (National Plant Services Inc, 2011, 4_CCTV Results - 100 E Cabrillo Blvd.pdf) – CCTV test reports for sewer pipelines along one street in the City's service area showing pipeline defects.

13. City Collection System Map (5_Collection-System-within-2500-ft-of-ocean.pdf) – GIS map displaying collection system infrastructure within 2,500 feet of Pacific Ocean.

14. City Drinking Water Infrastructure Map (6_DW-Water_Facilities_Map_April-2011_SBAR%20City.pdf) – Map showing the following facility locations: water sources, pressure zones, transmission mains, storage facilities, pressure reducing stations, and sampling locations.

15. Instructions for obtaining ground water quality (6_FW_http_waterdata.usgs.gov_ca_nwis_dvstat_referred.pdf) – Email correspondence

indicating how to obtain USGS groundwater quality information near Santa Barbara downtown.

16. Ground Water Quality 2010 Summary Data (6_Groundwater Annual Summary 2010.pdf) – Lists concentrations of approximately 45 parameters grouped into four areas – Alameda, San Roque, Los Robles, and Hope.

17. Hourly Conductivity/TDS/Flow Data(7_CONDUCTIVITY-MAY02 -THRU-MAY_2007.XLS) – Data for approximately twelve days in April 2007. Location is unclear.

18. Influent TDS Data (7_Influent-TDS-Data2008.pdf) Handwritten TDS data for approximately 6 days in May 2008.

19. Influent TDS Data (7_INFLUENT-TDS-STUDY-MAY2008.xls) – Data from Item No. 18 input into an excel spreadsheet.

20. Salinity/Chloride/Sodium Data (7_Sal031203.xls) – Data for five samples collected in 2003.

21. EEWWTP BioWin Modeling Report (Brown and Caldwell, 2010, 8_Item-8-BC_Predicted_WQ.pdf) – Includes model calibration and validation description and results.

22. Customer Recycled Water 2011 Usage Spreadsheet (Copy of 2011.Monthly_Recycled_Water_Final.xlsx) – Lists individual customer recycled water usage by month and includes a chart showing blend ratios of recycled/potable water.

23. EEWWTP Secondary Clarifier Effluent Annual Data Summaries (PFE2006.pdf) – Includes monthly data for approximately 40 parameters. Data is provided in excel and pdf documents for 2006 through 2011. Document names typical for each year.

24. EEWWTP Reclaim Distribution Water Annual Data Summaries (RECL2006.pdf) – Includes monthly data for approximately 40 parameters. Data is provided in excel and pdf documents for 2006 through 2011. Document names typical for each year.

25. Reclamation Quarterly Reports to Regional Water Quality Control Board (Reclamation Qrtly Rpt_QRT 1 - CY 2011.pdf) – Reports for Quarters 1, 3 and 4 in 2011 that include reclaim water and filter effluent information such as flow, turbidity, coliforms, solids, chlorine application and permit violations. Document names typical for each quarter.

26. EEWWTP 1997 Master Reclamation Permit (Regional Water Quality Control Board, 1997, sb city reclamation permit.pdf) – Includes water quality limits and monitoring requirements, dated 1997. The following file is a repeat document: sbcityreclpermit9744_.pdf

27. EEWWTP 1990 Master Reclamation Permit (Regional Water Quality Control Board, 1990, sbcityreclpermit90103_.pdf) – Includes water quality limits and monitoring requirements, dated 1990.

28. EEWWTP Tertiary Filter Memoranda (Carollo Engineers, 2009, CarolloTertiaryFilterMemorandaCY2009.pdf) – Several reports describing existing filter performance and optimization recommendations.

29. EEWWTP 2010 Ocean Discharge NPDES Permit (Regional Water Quality Control Board, 2010, 2010_0011_el_estero.pdf) Includes water quality limits and monitoring requirements for ocean discharge.

30. EEWWTP 2010 Ocean Discharge NPDES Permit City Comments (City of Santa Barbara, 2010, att_2.pdf) – Lists City comments to Item No. 29 NPDES permit.

31. EEWWTP 1999 Ocean Discharge NPDES Permit (Regional Water Quality Control Board, 1999, edc_att8.pdf) - Includes water quality limits and monitoring requirements for ocean discharge.

32. City of Santa Barbara Water Quality Monitoring Program Report (City of Santa Barbara, 2006, FiveYearWaterQualityReportMarch2007.pdf) – Describes contaminants of concern, sample locations and results from water quality testing.

33. EEWWTP Process Air and Activated Sludge Report (Brown and Caldwell, 2011, I04770_EEWWTP FINAL Report_9Sept2011_Compiled_Dbl Side Print.pdf) – Describes testing and modeling efforts and recommends a solution to resolving variable performance of secondary treatment system.

34. EEWWTP 2004 Ocean Discharge NPDES Permit Letter (Regional Water Quality Control Board, 2004, item10_staff_rpt.pdf) - Includes water quality limits and monitoring requirements for ocean discharge.

35. City of Santa Barbara Recycled Water Expansion Assessment (2009, Recycled Water Expansion Assessment.pdf) – Describes existing recycled water infrastructure and customers and potential expansion.

36. EEWWTP Tertiary Filter Rehab Report (Carollo Engineers, 2008, Tertiary Filter Rehab Project. Final Report.Carollo.July 2008.pdf) – Describes alternatives for improving filter performance including rehab of existing filters, micro-filtration and upflow sand filters.

37. Geotechnical Investigation Reclaimed Water Project (Stall, Gardner & Dunne, Inc./CH2M Hill, 1987, Geotechnical Report for Tertiary.pdf) – Geotechnical report for the reclaimed water expansion project.

38. Pile Driving for Tertiary Technical Memorandum (Stall, Gardner & Dunne, Inc./CH2M Hill, 1988, Pile Driving for Tertiary.pdf) – Report of pile driving observations for the reclaimed water expansion project.

As-Built Drawings

The following page provides a list of reports, studies, and data received and reviewed. Additionally, the following as-builts are expected to be received shortly.

Santa Barbara El Estero WWTP Tertiary Filtration Facility Project
As-Built Drawings

Name of Project	Design Level	No. of Dwgs	Date	Designed By	File Name
Santa Barbara Wastewater Treatment Plant - Contract I	As-Built	24	Jun-1974	Engineering - Science, Inc.	Contract%20I%20Plans%20for%20Preliminary%20Site%20Work%20and%20Foundation%20Preparation_%20Pages%201-12.pdf, Contract%20I%20Plans%20for%20Preliminary%20Site%20Work%20and%20Foundation%20Preparation_Pages%2013-24.pdf
Santa Barbara Wastewater Treatment Plant - Contract III Electrical	As-Built	64	Jul-1974	Engineering - Science, Inc.	Contract%20III%20Electrical%20Drawings%20.pdf
Santa Barbara Wastewater Treatment Plant	As-Built	4	3/15/1976	Buyco Engineering Services	Schematic%20Diagrams%20and%20Panel%20Layouts%20(3_15_1976).pdf
Santa Barbara Wastewater Treatment Plant	As-Built	4	6/7/1976	Buyco Engineering Services	Control%20Building%20Plan%2C%20Control%20Panels%2C%20Electrical%20Power%20Plan%20(1997).pdf
Santa Barbara Wastewater Treatment Plant - Contract III Structural	As-Built	67	11/28/1977	Engineering - Science, Inc.	Contract III _ S-1-S19A.pdf Contract%20III%20_%20S-21-S47.pdf Contract%20III%20_%20S-48-S-70.pdf
Santa Barbara Wastewater Treatment Plant - Contract III Mechanical	As-Built	65	2/21/1978	Engineering - Science, Inc.	Contract III Mechanical.pdf
Santa Barbara Wastewater Treatment Plant - Contract III General and Civil	As-Built	29	8/10/1978	Engineering - Science, Inc.	Contract%20III%20General%20and%20Civil%20Drawings.pdf
Santa Barbara Wastewater Treatment Plant	As-Built	18	2/23/1979	Buyco Engineering Services	Control%20Panels%20(1996).pdf
City of Santa Barbara Water Reclamation Project Treatment Systems	As-Built	86	10/13/1989	CH2M Hill	Water%20Reclamation%20Project_Pages%201-44%20(Record%201989).pdf, Water%20Reclamation%20Project_Pages%2045-88%20(Record%201989).pdf
City of Santa Barbara Plan & Profile Pipeline Corridor		1	2/26/1991	Pennfield & Smith Engineers	Plan%20%26%20Profile%20Pipeline%20Corridor%20(2_26_1991).pdf
City of Santa Barbara Plan & Profile Pipeline Corridor		1	4/10/1991	Pennfield & Smith Engineers	Plan%20%26%20Profile%20Pipeline%20Corridor%20(4_10_1991)%20.pdf
City of Santa Barbara Alternative Water Supply Seawater RO Desalting Plant	Preliminary	12	5/18/1991	Ionics	Seawater%20RO%20Desalting%20Plant%20(1991).pdf
City of Santa Barbara Water Reclamation Project		3	5/28/1991	Fenner Engineering Inc.	Santa%20Barbara%20Water%20Reclamation%20Project%20(1991).pdf
City of Santa Barbara Temporary Emergency Desalination Plant Offsite Pipeline Improvements	Approved for Construction	14	9/3/1991	Pennfield & Smith Engineers	%20Temporary%20Emergency%20Desalination%20Plant%20.pdf
City of Santa Barbara Temporary Emergency Desalination Plant Offsite Pipeline Improvements - Brine Water Line Dischrage Structure Detail	Approved for Construction	1	10/22/1991	Pennfield & Smith Engineers	Brine%20Water%20Line%20Discharge%20Structure%20Details.pdf
City of Santa Barbara Primary Sludge Line Replacement Project		9	5/19/1992	Pennfield & Smith Engineers	Primary%20Sludge%20Line%20Replacement%20Project%20.pdf
City of Santa Barbara Temporary Emergency Desalination Plant Offsite Pipeline Improvements	As-Built	15	2/5/1993	Pennfield & Smith Engineers	Temporary%20Emergency%20Desalination%20Plant%20Offsite%20Pipeline%20Improvements%20.pdf
City of Santa Barbara El Estero Waste Water Treatment Plant Process Water Backup Pump Station		3	7/9/1993	Pennfield & Smith Engineers	Process%20Water%20Backup%20Pump%20Station%20.pdf
Santa Barbara Wastewater Treatment Plant	As-Built	13	1/16/1997	Buyco Engineering Services	Master%20Control%20Panel%20(1_1997).pdf
Santa Barbara Wastewater Treatment Plant	As-Built	1	4/6/1998	Buyco Engineering Services	Electrical%20Power%20Plan%20(4_6_1998).pdf
City of Santa Barbara El Estero Wastewater Treatment Plant - Secondary Processes and Tertiary Filter Upgrades	90%	21	2004	Carollo Engineers	Secondary%20Process%20%26%20Tertiary%20Filter%20Upgrades%20(90%25%20Submittal)%20.pdf
City of Santa Barbara El Estero Wastewater Treatment Plant - Primary and Secondary Clarifiers, Aeration Basins and Filter Rehabilitation		20	5/18/2005	Carollo Engineers	Primary%20and%20Secondary%20Clarifiers%2C%20Aeration%20Basins%20and%20Filter%20Rehabilitation%20(5_18_2005).pdf

Appendix B-2: AM No.2 Recycled Water System Study

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In association with

Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Jamie Harlan, MNS Engineers*
Don Cutler, CDM Smith
Evelyn You, CDM Smith

Date: *February 19, 2013*

Subject: *Assessment Memorandum (AM) No. 2 – Recycled Water System Study*

Purpose and Background

The purpose of this assessment memorandum (AM) is to evaluate key existing and future recycled water system characteristics at the City of Santa Barbara's El Estero Wastewater Treatment Plant (EEWWTP) and to develop a design basis for process flow rates and treatment requirements to be considered in the development of improvements to the recycled water system. The information presented herein includes an evaluation of the existing and future recycled water demands, recycled water production capacities, and existing recycled water quality goals.

Recycled Water System Overview

Construction of EEWWTP, located at 520 East Yanonali Street, Santa Barbara, CA 93103, was completed in 1979, including secondary treatment processes. EEWWTP was upgraded with the addition of a tertiary treatment processes and water reclamation facility in 1991. The Santa Barbara Water Recycled Water System was developed in two phases. Phase I construction, completed in July of 1989, included the recycled water treatment facilities, plant storage, plant pumping facilities, and approximately 5.2 miles of pipeline. Phase II construction, completed in May 1991, included the remainder of the pipeline, a large storage tank under the municipal golf course, a booster pump station, and a pump station at the storage tank.

Recycled water is produced by taking effluent that has already undergone primary and secondary treatment and directing it through tertiary filters. After tertiary filtration and disinfection, the recycled water can be used for many reuse purposes. Appropriate uses for the City's recycled water include irrigation, supply for impoundment (lakes/ponds), supply for cooling or air conditioning, and other uses. Some examples of other uses include, but are not limited to, toilet flushing, industrial process water, mixing concrete, and dust control on roads. By using recycled water for these tasks, potable water supplies may be maximized.

Facilities

The recycled water production and distribution system facilities are described in AM6 – Recycled Water System Hydraulic Analysis.

Recycled Water Regulations

The City of Santa Barbara adheres to the California Code of Regulations' Recycled Water guidelines (Titles 17 and 22) for its Recycled Water Program. The City's recycled water system is also operated and managed according to the Regional Water Quality Control Board Order No. 97-44, Master Reclamation Permit for the City of Santa Barbara, Producer/User and Primary Producer/User of Recycled Water. The NPDES Permit for El Estero Wastewater Treatment Plant Waste Discharge Requirements for the City of Santa Barbara El Estero Wastewater Treatment Facility was adopted by the Regional Water Quality Control Board and became effective on May 13, 2010.

Table 1 summarizes the recycled water regulations that currently influence and control the operations of EEWWTP.

Table 1 Recycled Water Regulations Applicable to EEWWTP

Entity	Regulations	
California Department of Public Health	Title 17 Division 1	State Department of Health Services, Chapter 5. Sanitation (Environmental)
	Title 22 Division 4	Environmental Health
	Health and Safety Code Division 6	Sanitary Districts
	Water Code Division 6	Conservation, Development, and Utilization of State Water Resources
	Water Code Division 7	Water Quality
Regional Water Quality Control Board	Order No. 97-44	General Permit Master Reclamation Permit for the City of Santa Barbara
	Order No. R3-2010-0011 NPDES No. CA0048143	NPDES Permit for El Estero Wastewater Treatment Plant Waste Discharge Requirements for the City of Santa Barbara El Estero Wastewater Treatment Facility
California Recycled Water Policy	Resolution No. 2009-0011	Adoption of a Policy for Water Quality Control for Recycled Water
State Water Resources Control Board	Order No. 2009-0006-DWQ	General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water
City of Santa Barbara	Recycled Water Program and Policies	See Policy Statement

The City of Santa Barbara Recycled Water Program and Policies are as follows:

"California Water Law (Title 22) regulates recycled water use. The law states that the following uses are approved for tertiary treated recycled water (City's recycled water):

Irrigation of: food crops, orchards, all landscaping (residential, commercial and public), and pasture for animals.

Supply for impoundment (lakes/ponds): nonrestricted recreational impoundments (swimming allowed), fish hatcheries, and landscape impoundments.

Supply for cooling or air conditioning: industrial or commercial cooling or air conditioning with cooling tower, evaporative condenser, or spraying that creates a mist

Other uses: flushing toilets and urinals, priming drain traps, industrial process water that may contact workers, structural and nonstructural fire fighting, decorative fountains, commercial laundries, consolidation of backfill material around potable water pipelines, artificial snow making, industrial boiler feed, soil compaction, mixing concrete, dust control on roads and streets, flushing sanitary sewers, and cleaning roads, sidewalks and outdoor work areas.

The City's policy (and State law) is to require recycled water for irrigation for: multiple family developments, developments with common area irrigated lots, and commercial developments that are adjacent to the recycled water main line. (City Municipal Code 14.23.010-14.23.030.) The City's policy is to encourage but not require all other uses. Single family residential parcels adjacent to the recycled water main line are not required but are encouraged to use recycled water on their sites.

There are plan specifications that must be followed for recycled water, a user agreement that must be recorded and other review requirements that all sites must go through before the recycled water meter is issued."

California's Recycled Water Policy may have an effect on EEWWTP and its future operations. Table 2 summarizes the various elements of the State Recycled Water Policy.

Table 2 State Recycled Water Policy Requirements Applicable to EEWWTP

Entity	Regulations	Requirements
State Recycled Water Policy	Mandate for the Use of Recycled Water	The State Water Board has mandated that the state will have an increase the use of recycled water in California by 200,000 AFY by the year 2020 and by an additional 300,000 AFY by 2030.
	Salt/Nutrient Management Plans	It is the state's goal to have a salt/nutrient management plan for all groundwater basin/sub-basin in the state.
	Landscape Irrigation Projects	The goals of this section are to control incidental runoff and to streamline the permitting process for recycled water projects. This streamlining process will be accomplished by creating consistent criteria.
	Recycled Water Groundwater Recharge Projects	This is a potential use for recycled water that would be examined on a site specific basis and would vary project to project.
	Anti-degradation	The goal of this section is to ensure that the state waterways are regulated to obtain optimum water quality.
	Emerging Constituents/Chemicals of Emerging Concern	This policy results in the research and examination of CECs. The state hopes to research and develop analytical methods to determine potential environmental and public health impacts of CECs.
	Incentives for the Use of Recycled Water	Funding – The State Water Board has a goal of providing funding for the salt/nutrient management plans, recycled water projects, and stormwater recharge projects. Stormwater – The Board strongly encourages water purveyors to provide financial incentives for water recycling and stormwater recharge and reuse projects as well as encouraging the Regional Water Boards to require less stringent monitoring and regulatory requirements for stormwater treatment and use projects than for projects involving untreated stormwater discharges. TMDLs – The Regional Water Boards will assign waste load allocations in such a way that gives an incentive for more water recycling.

Existing and Future Recycled Water Demands

According to the City's 2011 Long Term Water Supply Plan, the City's recycled water system has the capacity to treat and deliver 1,400 AFY of recycled water. The EEWWTP process water usage is approximately 300 AFY, and the current connected recycled demand from sales to customers is approximately 800 AFY, which leaves approximately 300 AFY of capacity for new recycled water customers.

The historical recycled water demand data is presented in Table 3.

Table 3 Historical Recycled Water Demand

Average Annual Demand	2003	2004	2005	2006	2007	2011	Average Peaking Factor
Total Annual Demands (AFY)	702	824	710	656	846	942	
Average Day Demand (mgd)	0.63	0.74	0.63	0.59	0.76	0.84	
Month with Minimum Demand	Jan	Mar	Mar	Apr	Jan	Feb	
Minimum Month (acre-feet)	8.9	17.2	5.9	7.6	25.7	35.8	
Minimum Month (mgd)	0.10	0.19	0.06	0.08	0.28	0.42	
Minimum Month Peaking Factor	0.1	0.2	0.1	0.1	0.3	0.5	0.25
Month with Maximum Demand	Sept	Aug	Jul	Jul	Aug	May	
Maximum Month (acre-feet)	131	123	117	117	127	131	
Maximum Month (mgd)	1.43	1.33	1.27	1.27	1.38	1.38	
Maximum Month Peaking Factor	2.2	1.8	2.0	2.1	1.8	1.6	1.95

According to the 2011 Recycled Water Use data, EEWWTP usage of total recycled water (reclaimed water plus potable water blend) was approximately 942 Acre Feet per Year (AFY) for the 2011 calendar year. The monthly distribution of the recycled water demand for year 2011 is shown in Figure 1. The monthly recycled water demand peaking factors, based on year 2011 data, are shown in Figure 2.

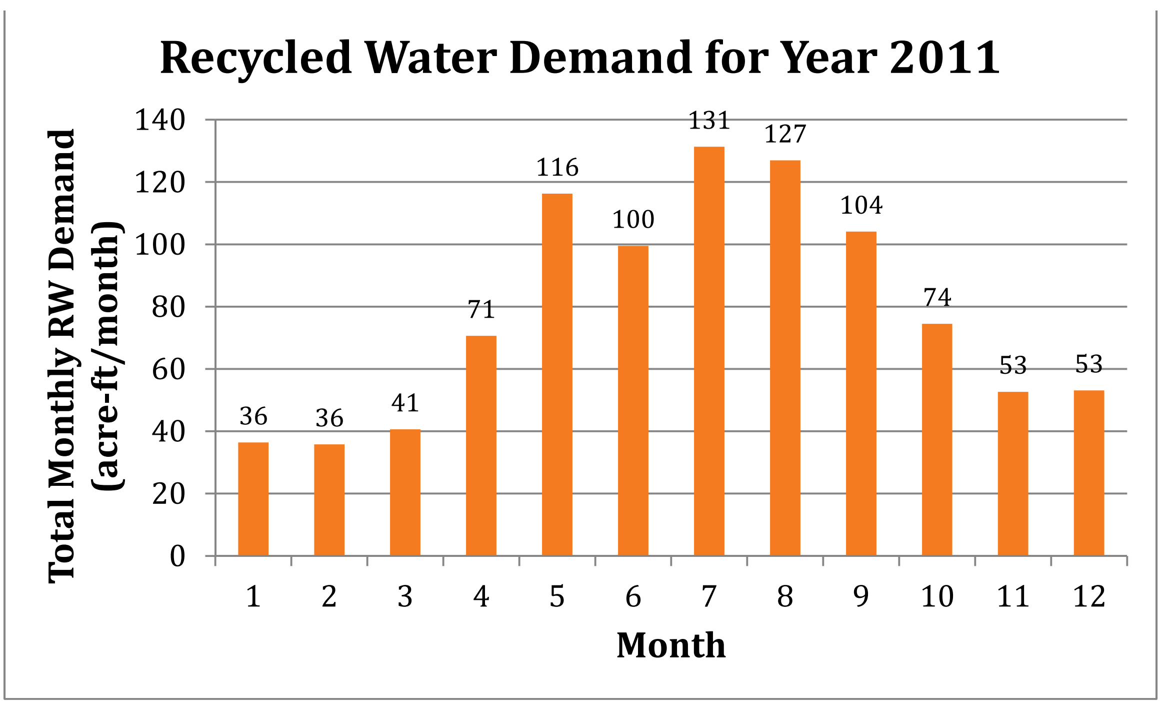

Figure 1
Monthly Recycled Water Demand for Year 2011

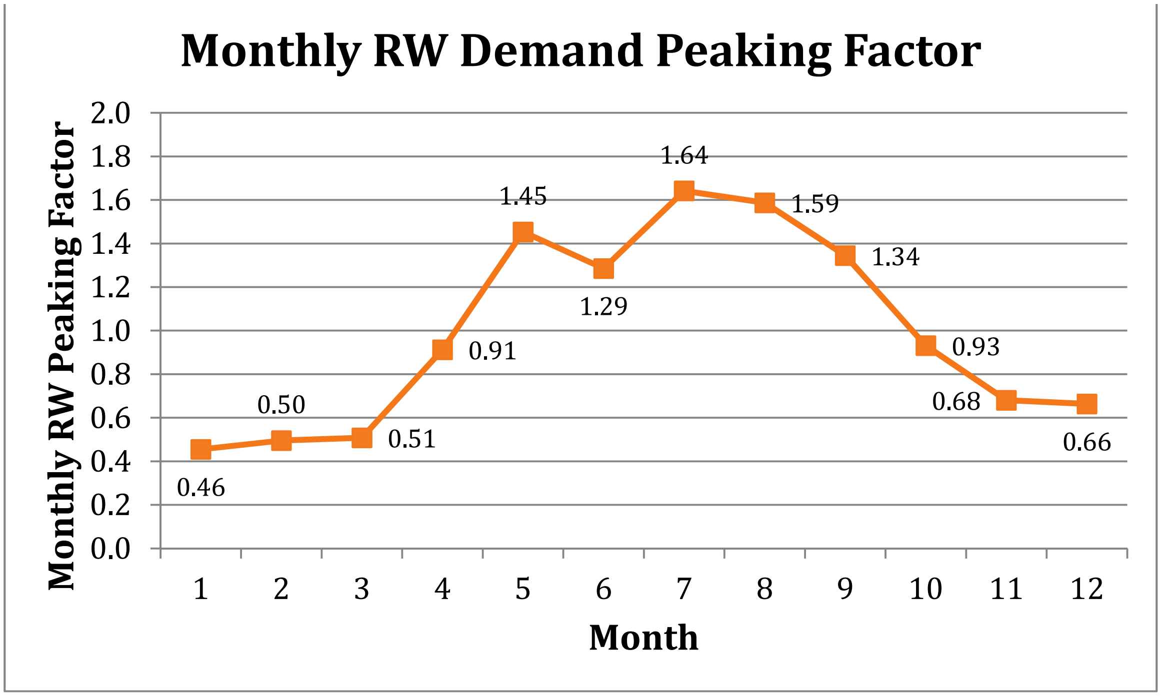

Figure 2
Monthly Recycled Water Demand Peaking Factor Based on 2011 Data

Table 3 shows the actual and projected recycled water sales.

Table 3 Actual and Projected Recycled Water Demand

Average Annual Demand	Actual 2005	Actual 2010	Actual 2011	Projected 2015	Projected 2020	Projected 2025	Projected 2030
EEWWTP Usage for Process Water (AFY) [1]	300	300	300	300	300	300	300
Connected Recycled Water Customers							
# of Accounts	76	84	N/A	99	114	129	144
Usage (AFY)	718	697	642	875	950	1,025	1,100
Total Recycled Water Demand (AFY)	1,020	997	942	1,180	1,250	1,330	1,400

Notes:

1. Estimated Value

Existing Recycled Water Users

Currently recycled water produced by EEWWTP serves over 400 acres of landscaped areas. These areas include golf courses, parks, schools, and the zoo. The list of the current metered recycled water users can be found in Attachment A.

Potential New Recycled Water Users

It is the City's policy to require recycled water for irrigation purposes for properties situated along the main recycled water lines. These properties include multiple family developments, developments with common area irrigated lots, and commercial developments (City Municipal Code 14.23.010-14.23.030.) It is also the City's policy to encourage users who are not required to utilize recycled water to do so.

The potential new recycled water users located adjacent to existing recycled water distribution pipelines are summarized in Table 4. The City has recently reached out to the Santa Barbara Cemetery and the 23-acre Clark Estate, both situated along East Cabrillo Boulevard.

Table 4 Potential New Users – Pipeline Adjacent

Potential User	Address
City of Santa Barbara Cemetery	901 Channel Drive
Clark Estate	Situated Adjacent to the Above
Harbor View Inn	22 W. Cabrillo Blvd.
The Armory	700 E Canon Perdido
Mission Terrace Convalescent	623 Junipero St.
Santa Barbara Community College	Restroom Facilities
West Beach Inn	306 West Cabrillo Boulevard
Best Western Beachside Inn	336 West Cabrillo Boulevard
Santa Barbara Convalescent Hospital	2225 De La Vina Street

In addition to adding new recycled water users, there is also the potential to increase quantities of recycled water used by current customers. The City would need to identify these customers based on any requests or wishes for additional supply from the recycled water customers.

Another area for possible recycled water expansion is industrial use. Currently, the City's recycled water is distributed primarily for irrigation purposes. However, there is a potential for growth in use for businesses such as car washes and laundries in the area.

Lastly, if there is enough capacity, there is always the possibility for expansion of the recycled water distribution system. Table 5 shows potential areas for expansion in Phase I and Phase II, and possible customers situated near the proposed expansion pipelines. These areas include parks, schools, office complexes, and housing. Any system expansion would need further analysis including a system model.

Table 5 Potential Areas for Recycled Water Expansion

Area	Proposed Expansion Pipeline	Potential New Customers
Phase I	State Street or Santa Barbara Street	Plaza De Vera Cruz
		Anacapa School
		Sunken Gardens
		City and County Offices
		Alameda Park
		Alice Keck Park Gardens
		Santa Barbara Public Library
		Santa Barbara Assisted Living
Phase II	Meigs Road / Carillo St.	Arroyo Hondo Park
		Hilda McIntyre Ray Park
	San Roque Road	San Roque Park
		Stevens Park
	State Street	Rocky Nook Park
		Santa Barbara Museum of Natural History
		San Roque High School
		Several Hotels Along Upper State Street

Required Recycled Water Production Capacity

According to the City's 2011 Long Term Water Supply Plan, the recycled water system as it is currently configured has the capacity to treat and deliver approximately 1,400 acre feet per year (AFY) of recycled water. Current demand is 800 AFY plus 300 AFY of onsite process water used at EEWWTP, which leaves 300 AFY additional capacity for addition of future recycled water customers. To achieve the goals set forth in the City's 2011 Long Term Water Supply Plan and the Urban Water Management Plan, use of 1,400 AFY is the goal in this study.

Applying the peaking factors shown in Figure 2, the projected monthly recycled water demand for years 2015, 2020, 2025 and 2030 are summarized in Table 6. Also applying the minimum month peaking factor of 0.25 and maximum month peaking factor of 1.95, based on the historical recycled water demand data (See Table 3), the minimum and maximum month recycled demands are also projected. As shown in Table 6, the minimum month recycled water demand could be as low as 0.26 mgd (Year 2015) and the maximum month demand could be as high as 2.44 mgd (Year 2030). Based on this information, and considering the City's goal of minimizing potable water blending, the recycled water treatment system at EEWWTP will be sized for 2.5 mgd capacity.

Table 6 Historical Recycled Water Demand

Recycled Water Demand	Monthly Peaking Factor	2011	2015	2020	2025	2030
Average Annual Demand (AFY)		942	1180	1250	1330	1400
Average Annual Demand (mgd)		0.84	1.05	1.12	1.19	1.25
January	0.46	0.39	0.48	0.51	0.55	0.57
February	0.5	0.42	0.53	0.56	0.59	0.62
March	0.51	0.43	0.54	0.57	0.61	0.64
April	0.91	0.76	0.96	1.01	1.08	1.14
May	1.45	1.22	1.53	1.62	1.72	1.81
June	1.29	1.08	1.36	1.44	1.53	1.61
July	1.64	1.38	1.73	1.83	1.95	2.05
August	1.59	1.34	1.67	1.77	1.89	1.99
September	1.34	1.13	1.41	1.49	1.59	1.67
October	0.93	0.78	0.98	1.04	1.10	1.16
November	0.68	0.57	0.72	0.76	0.81	0.85
December	0.66	0.55	0.69	0.74	0.78	0.82
Minimum Month Demand	0.25	0.21	0.26	0.28	0.30	0.31
Maximum Month Demand	1.95	1.64	2.05	2.17	2.31	2.44

To meet the recycled water demands, it is important to appropriately size the recycled water treatment system based on the available quantity of secondary effluent. The primary concern for available water for the recycled water system is the ability to meet recycled water demands at night when the influent flows to the EEWWTP are low. Effluent flow data from the EEWWTP for April-May 2011 and July- August 2012 were used to determine the amount of flow available for the recycled water system during these low flow conditions. These months were used since they are typically the higher demand months, instead of the winter months when demand was lower.

The City provided data for the entirety of these two-month durations in 15-minute time intervals. Each interval contained four separate flow measurements, all in million gallons per day: Actual, Average, Minimum, and Maximum. These individual measurements were combined to provide a comprehensive data set for analysis.

The minimum daily flows during April and May 2011 were constant at close to 3.0 mgd. The minimum daily flows for July and August 2012, however, showed a wider variation. Although a consistent trend shows minimum daily flows of approximately 2.5 mgd for the majority of this duration, many days in the first half of July show much lower minimum daily flows. Many of these days had minimum flows of less than 2.1 mgd. On July 7, the flow decreased to below 1.5 mgd, but only for 30 minutes. Because this was only one day and for a short time, this period was considered an outlier and not used as a design condition.

To appropriately size the treatment facilities for these varied flows, it is necessary to estimate an expected minimum flow rate for each hour of the day. Based on the July data on the most extreme days, the design flow condition will include absolute minimum flow rates from 3am until 7:30am and more typical flow rates from 7:30am until 3am the next day.

Design flow conditions were selected to average a total daily recycled water flowrate of 2.5 mgd. First, it was determined that the minimum flow from 3am to 7:30am was 1.5 mgd, as indicated in the graph. Using that as the main constraint, the flow for the remainder of the day (7am to 3am) was increased until a product water of 2.5 mgd on an average basis was achievable. It was important to account for flows that were required from secondary effluent but did not produce recycled water, for example microfiltration/ultrafiltration (MF/UF) backwash and reverse osmosis (RO) brine, when determining the secondary effluent flow to the system.

Figure 3 shows the measured second effluent flow rates for every day in July and August 2012 as well as the design flow conditions. This shows that the design secondary effluent flow will be available on a daily basis for the plant. This also shows that, during the low-flow periods, all of the secondary effluent flow will be used for the recycled water system to meet the 2.5 mgd daily demand. The design secondary effluent flow for normal periods is 3.2 mgd, and low periods is 1.5 mgd, as indicated by the red line in the figure.

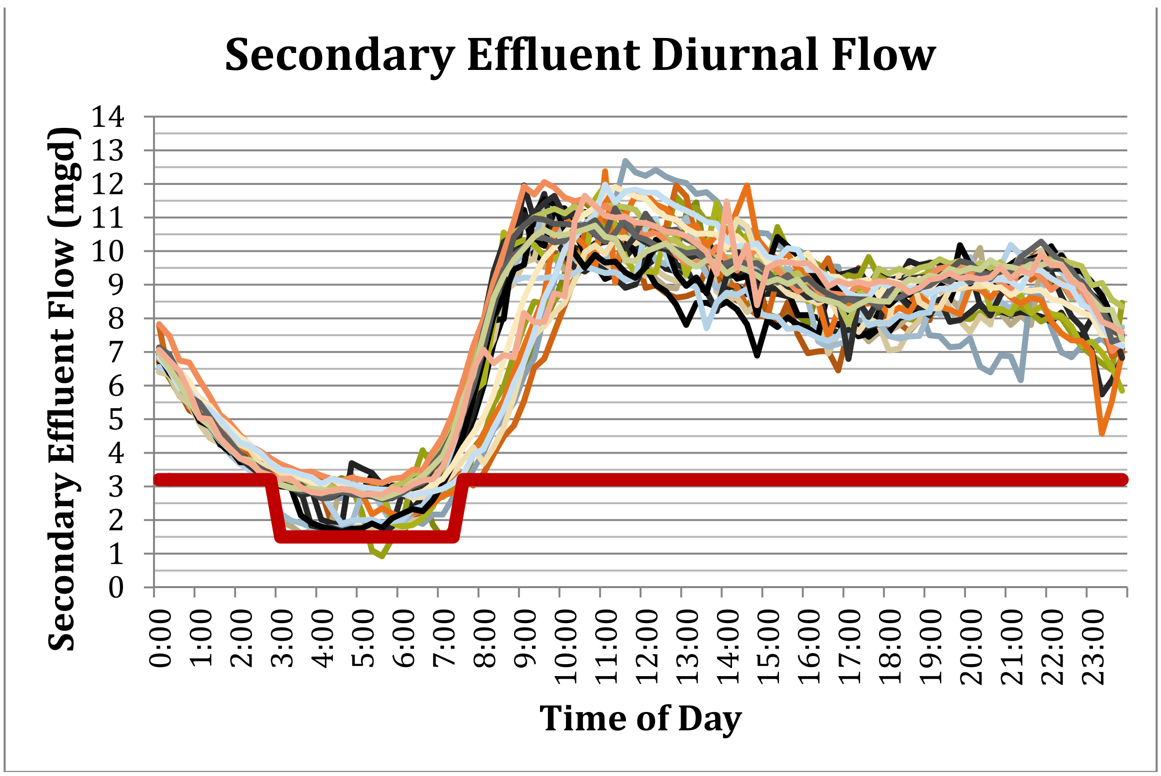

Figure 2
July and August 2011 Daily Secondary Effluent Flow with Design Flow Conditions in Red

Existing Facility Produced Water Quality and Future Water Quality Goals

Current Water Quality

California Code of Regulations' Recycled Water guidelines (Titles 17 and 22) are followed by the City of Santa Barbara's Recycled Water Program. The City's recycled water system is also operated and managed according to the Regional Water Quality Control Board Order No. 97-44, Master Reclamation Permit for the City of Santa Barbara, Producer/User and Primary Producer/User of Recycled Water. The NPDES Permit for EEWWTP Waste Discharge Requirements was adopted by the Regional Water Quality Control Board and became effective on May 13, 2010.

The City of Santa Barbara follows Monitoring and Reporting Program No. 97-44 as set forth in their Master Reclamation Permit.

Table 7 Reclaimed Water Monitoring Requirements

Constituent	Units	Type of Sample	Minimum Sampling and Analyzing Frequency
Daily Flow Volume[1]	gpd[2]	Metered	Daily
Maximum Daily Flow[1]	gpd[2]	Metered	Monthly
Mean Daily Flow[1]	gpd[2]	Calculated	Monthly
Turbidity[3]	NTU	Metered	Continuous
Chlorine Residual[4,3]	mg/L	Metered	Continuous
Total Coliform Organisms	MPN/100mL	Grab	Daily
Settleable Solids	mL/L	Grab	Daily
pH	pH Units	Grab	Daily
Total Non-Filterable Residue (Suspended Solids)	mg/L	24-hr Composite	Five days per week
Total Dissolved Solids	mg/L	Grab	Quarterly (Jan, Apr, Jul, Oct)
Cadmium	mg/L	24-hr Composite	Semi-annually (Apr, Oct)
Lead	mg/L	24-hr Composite	Semi-annually (Apr, Oct)

1. Flow shall be metered at the distribution system pump station to provide a record of the quantity of reclaimed water used each day (per normal irrigation period).
2. Report daily maximum and daily mean valued. In reporting turbidity, the amount of time that NTU limitation was exceeded each day shall be reported. Turbidity samples may be obtained anywhere in the treatment process following filtration.
3. Report daily maximum and daily minimum values before discharge and at the end of the chlorine contact chamber. Compliance shall be determined by daily minimum values measured within the chlorine contact zone at the end of the chlorine contact chamber.
4. Monitor at the distribution system pump station.

Permit Reclamation Specifications

Daily flow (per normal irrigation period) averaged over each month shall not exceed 4.3 million gallons.

Recycled Water shall not contain constituents in excess of the following:

Table 8 Reclaimed Water Quality Requirements

Constituent	Unit of Measurement	Mean	Maximum
Turbidity	NTU	2	5
Total Non-Filterable Residue (Suspended solids)	mg/L	10	25
Settleable Solids	mL/L		0.1
Total Dissolved Solids	mg/L		1500
Cadmium	mg/L		0.01
Lead	mg/L		5

The Median concentration of total coliform bacteria in the disinfected effluent shall not exceed a Most Probable Number (MPN) of 2.2 per 100 milliliters, utilizing the bacteriological results of the last seven days for which analyses have been completed, and the MPN shall not exceed 23 per 100 mL in more than one sample in any 30-day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL.

The filtered wastewater must be disinfected by a chlorine disinfection process that provides a CT (chlorine concentration times modal contact time) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on a peak dry weather flow. Contact time shall be determined using the volume of the chlorine contact chamber and the 600,000 gallon storage tank at the EEWWTP.

Reclamation Quarterly Reports

Quarterly reclamation reports are produced as required by the California Regional Water Quality Control Board.

It was reported to the California Regional Water Quality Board that in Quarter 3 of 2011 (July, August and September) there was a violation at the plant. Contact Time and Total Coliform Bacteria were the offending parameters. Reclamation Quarterly Report: Quarter 3 – CY 2011 states that these parameters were violated on two occasions each. The explanation given for the cause of the violations is as follows:

> "The CT value <450 mg-min/L violations occurred when the filter was not producing recycle water at desired levels and potable water was used to fill the reservoir. Potable water has low chlorine residual which results in low CT values. The violation of the 23 MPN100ml daily maximum was caused by the utilization of potable water with low chlorine residual in conjunction with a low volume filter production."

The corrective action taken by EEWWTP and the City of Santa Barbara was to issue a request for proposal to study the tertiary treatment facilities. This request for proposal resulted in this current study being performed by CDM Smith.

Current water quality tables and graphs may be found in Attachment B. Graphs display the minimum, average, and maximum values of each constituent for the years 2006 to 2011.

Future Water Quality Goals

The two main parameters that prompted this particular study are the chlorine contact time and the total coliform bacteria. It is a goal to meet the requirements as set forth in the Master Reclamation Permit.

In the Long Term Water Supply Plan mineral reduction is addressed. The City desires to achieve a mineral content that is suitable for irrigation purposes. It has been a goal of the City to not allow more than 300 mg/L of chloride during the irrigation season. The maximum Total Dissolved Solids (TDS) as required by the general permit is 1,500 mg/L. Though 1,500mg/L is the upper limit of TDS, the city averaged 951.7 mg/L from 2006 to 2011. In 2011 the TDS averaged 692 mg/L.

One goal of the City is to reduce potable water mixing. In order to achieve its turbidity and mineral requirements, potable water is often blended with the recycled water. In recent years the blend water proportion has been increasing. Figure 4 shows the ten-year history of blend proportions. According to the Long Term Water Supply, issues with the Secondary Process began in 2004 in conjunction with the Secondary Process issues.

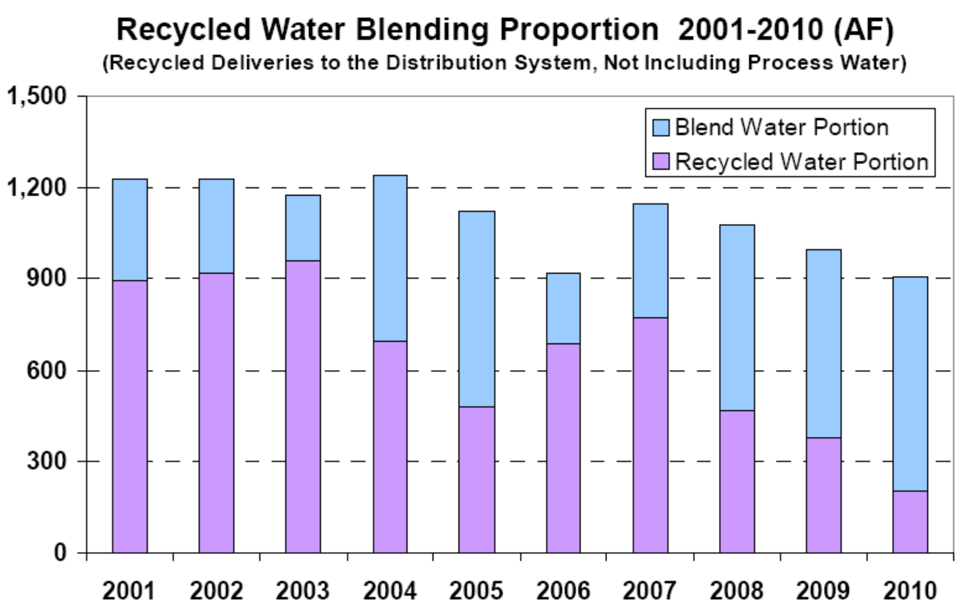

Figure 4
Recycled Water Blending Proportion 2001-2010 (AF)

The water produced by the tertiary filters has not been consistent in meeting the turbidity requirements of less than 2 NTU. If the City wishes to reach its turbidity requirement of less than 2 NTU without blending, other treatment options must be examined.

Utilizing potable water in this heightened capacity can be very expensive. Also, by eliminating potable water from this process, the City will be even closer to achieving the 20 by 2020 mandate.

Other draft legislation includes the creation of Salt/Nutrient Management Plans and examination of Constituents of Emerging Concern (CEC) as mentioned in the discussion of the State Recycled Water Policy.

ATTACHMENT A
Recycled Water Customers

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Recycled Water Users	Address
Cottage Hospital	OAK PARK LN & JUNIPERO ST
Oak Pak Restrooms	600 W. JUNIPERO
900 Old Coast Highway, CALTRANS	900 OLD COAST HIGHWAY
Dwight Murphy Restroom, City of SB	501 NINOS
Dwight Murphy Fill Station, CALTRANS	501 NINOS DR
Sycamore Creek, CALTRANS	501 NINOS DR
Arroyo Burro Creek, City of SB, Creeks	2931 CLIFF DR
Marbourg, N. Quarantia St.	119 N QUARANTINA
801 Shoreline Drive (Ledbetter Beach Parks Restroom)	801 SHORELINE
1100 Shoreline Drive	1100 SHORELINE DRIVE
SPRINT PCS	2800 CLIFF DR
NMC Parking	2 N CALLE CESAR CHAVEZ
Villa Del Mar Condos	214 E. YANONALI STREET
Breamar Lift Station	3500 MCCAW
Reclaimed Reservoir Yard 46321496	400 ALAN RD
Marborg Industries (Union St.)	709 UNION AVE
SPRINT PCS - Las Positas Rd.	1500 LAS POSITAS
Garden Street Restroom	11 GARDEN STREET IRRGATION
Marborg Industries (Chemical Toilets)	23 N QUARANTINA
Shoreline Beach Cafe (toilets)	801 SHORELINE DR
MacKenzie Park Restroom	3111 STATE ST
Caltrans (San Marcos Pass)	540 W. PUEBLO
Wastewater Vactor #667	
11 Garden Street Irrigation	11 GARDEN STREET
Caltrans (Quarantina)	2 N. QUARANTINA ST
Palm Park Expansion Restroom	325 E CABRILLO BLVD
Palm Park Expansion Irrigation	325 E CABRILLO BLVD
Sea Landing	501 SHORELINE DR
Rockhar Mini-Storage	3650 CALLE REAL
Palm Park Restroom (East)	620 E CABRILLO BLVD
1 State Street Restroom	1 STATE STREET
Wastewater Vactor #669	
Wastewater Vactor #668	
Shoreline Condominiums	222 MEIGS RD
Earl Warren Showgrounds	3402 CALLE REAL
Val Verde - Torino Road	3790 TORINO RD
Val Verde 1315357	900 CALLE DE LOS AMIGOS
Washington School	290 LIGHTHOUSE RD
La Mesa Park	259 MEIGS RD
Hidden Valley Park	901 CALLE DE LOS AMIGOS
Monroe School	431 FLORA VISTA DR
Arroyo Burro Beach	2981 CLIFF DR
MacKenzie Lawn Bowling	3111 STATE ST
MacKenzie Park	3111 STATE ST
Oak Park	600 W ALAMAR

La Cumbre Junior High	2257 MODOC RD
Los Positas Park	1298 LAS POSITAS
Municipal Golf Course	3333 MCCAW AVE
Caltrans (Los Positas)	0 JUNIPERO ST
Samarkand	2250 SAMARKAND DR
Pilgrim Terrace Co-op Homes	649 PILGRIM TERRACE DR
Pilgrim Terrace Park	651 PILGRIM TERRACE DR
Adams School	2701 LAS POSITAS
Boys Club	632 E. CANON PERDIDO
El Escorial	625 POR LA MAR CIRCLE
City College Main Campus	721 CLIFF DR
City College West Campus	721 CLIFF DR
Lash Water Truck 1214830	
Bird Refuge	1100 E. CABRILLO BLVD
Water Truck - Parks Dept #562 (Active)	
Ortega Park	604 E ORTEGA ST
Santa Barbara Zoo (042837)	500 NINOS DR
Santa Barbara Zoo (1520839)	500 NINOS DR
Palm Park (West) - Irrigation	1 STATE STREET
Municipal Tennis Courts	1414 PARK PL
Santa Barbara Jr High (South)	721 E COTA
Santa Barbara High School	700 E ANAPAMU
Shoreline Park (East)	1201 SHORELINE DR
DoubleTree Inn (Formerly "Red Lion Inn")	633 E CABRILLO
Shoreline Median	601 SHORELINE DR
Dwight Murphy Field	501 NINOS
Cabrillo Ball Field	800 CALLE PUERTO VALLARTA
Palm Park (East)	400 E CABRILLO BLVD
Palm Park (Middle) San Bar St parking lot	200 E CABRILLO BLVD
Harbor Lot / Marina 2	401 SHORELINE DR
Leadbetter Beack	803 SHORELINE DR
Shoreline Park (West)	1235 SHORELINE PARK
Pershing / Plaza Del Mar	131 CASTILLO ST
Housing Authority of - Meigs Rd.	219 MEIGS RD
Housing Authority - Elise Wy.	1934 ELISE WAY
Santa Barbara Jr. High (North)	721 E COTA
Montecito Country Club	920 SUMMIT RD
INSITUFORM, INC-WATER TRUCK	
MONTECITO SANITARY DIST. (no meter)	1042 MONTE CRISTO LN
VENCO SWEEPING 2"	
VENCO SWEEPING 3"	
ALLBRETT, LOYRS-Steam Clearer	956 MIRAMONTE DR
99 GARDEN STREET MEDIAN	99 GARDEN STREET MEDIAN
15 GARDEN ST PARKING LOT	15 GARDEN ST PARKING LOT

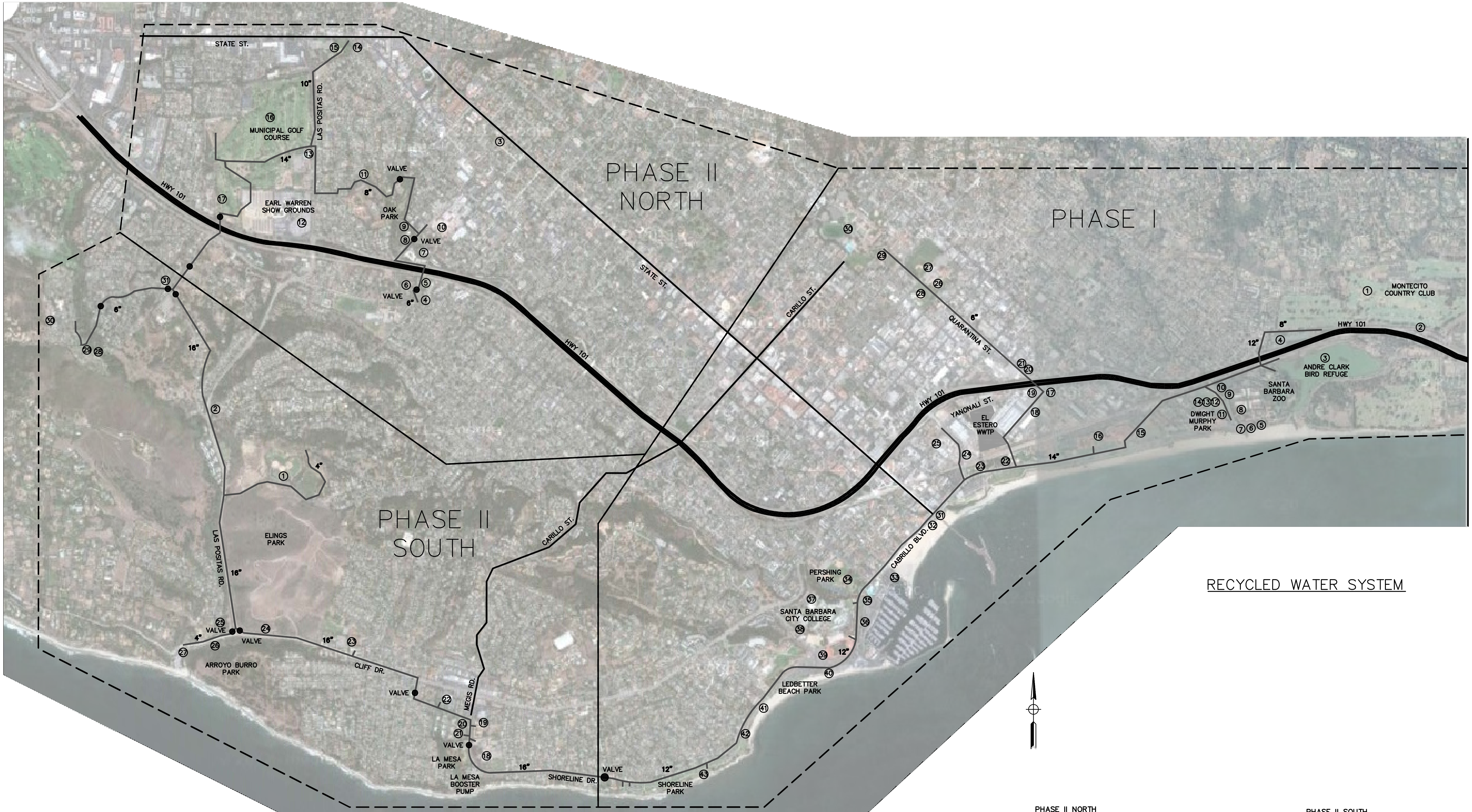
			CITY OF SANTA BARBARA 2011 RECYCLED WATER USE														- ACRE FEET -		
Mtr Cnt	Recycled Water Users	Acct #	Jan	Feb	Mar	1ST_QTR	Apr	May	Jun	2ND_QTR	Jul	Aug	Sep	3RD_QTR	Oct	Nov	Dec	4TH_QTR	YTD
1	Cottage Hospital / Oak Park Ln & Junipero St	111464				**0.000**				**0.000**			0.002	**0.002**	0.000	0.000	0.000	**0.000**	**0.002**
2	Oak Pak Restrooms (600 W. Junipero)	111345				**0.000**	0.011	0.016	0.018	**0.046**	0.000	0.055	0.005	**0.060**	0.011	0.014	0.014	**0.039**	**0.145**
3	900 Old Coast Highway, CALTRANS	111296	0.030	0.023	0.025	**0.078**	0.053	0.000	0.282	**0.335**	0.046	0.002	0.007	**0.055**	0.000	0.000	0.000	**0.000**	**0.468**
4	501 Ninos Drive, City of SB	111128	0.021	0.025	0.018	**0.064**	0.032	0.030	0.030	**0.092**	0.021	0.044	0.009	**0.073**	0.028	0.030	0.030	**0.087**	**0.317**
5	501 Ninos Drive, CALTRANS	111076	0.034	0.037	0.076	**0.147**	0.131	0.126	0.177	**0.434**	0.218	0.386	0.011	**0.615**	0.266	0.126	0.126	**0.519**	**1.715**
6	501 Ninos Drive, CALTRANS	111075	0.000	0.000	0.000	**0.000**	0.000	0.000	0.340	**0.340**	0.000	0.000	0.014	**0.014**	0.014	0.011	0.011	**0.037**	**0.390**
7	2931 Cliff Dr., City of SB, Creeks	109949	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.016	**0.016**	0.000	0.000	0.000	**0.000**	**0.016**
8	MARBOURG N.QUARANTINA ST.	109796	0.002	0.055	0.016	**0.073**	0.037	0.179	0.227	**0.443**	0.207	0.253	0.018	**0.478**	0.163	0.147	0.147	**0.457**	**1.451**
9	801 SHORELINE DRIVE (LEDBETTER BEACH PARKS REST ROOM)	109522	0.060	0.085	0.055	**0.200**	0.094	0.023	0.000	**0.117**	0.000	0.110	0.021	**0.131**	0.046	0.032	0.032	**0.110**	**0.558**
10	1100 SHORELINE DRIVE	108941	0.000	0.000	0.002	**0.002**	0.000	0.266	0.381	**0.647**	0.337	0.000	0.023	**0.360**	0.170	0.021	0.021	**0.211**	**1.221**
11	SPRINT PCS - CLIFF DR	108868	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.025	**0.025**	0.000	0.000	0.000	**0.000**	**0.025**
12	NMC PARKING - N CALLE CESAR CHAVEZ	108859	0.000	0.023	0.000	**0.023**	0.007	0.046	0.037	**0.090**	0.041	0.076	0.028	**0.145**	0.018	0.000	0.000	**0.018**	**0.275**
13	214 E. YANONALI STREET	108724	0.016	0.067	0.028	**0.110**	0.094	0.152	0.149	**0.395**	0.135	0.319	0.030	**0.484**	0.140	0.115	0.115	**0.370**	**1.359**
14	BREAMAR LIFT STATION	108723	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.032	**0.032**	0.000	0.000	0.000	**0.000**	**0.032**
15	RECLAIMED RESERVIOR YARD 46321496	108717	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.034	**0.034**	0.002	0.005	0.005	**0.011**	**0.046**
16	MARBORG INDUSTRIES (UNION ST)	108694	0.000	0.000	0.000	**0.000**	0.000	0.000	0.044	**0.044**	0.000	0.000	0.037	**0.037**	0.005	0.000	0.000	**0.005**	**0.085**
17	SPRINT PCS - LAS POSITAS RD.	108122	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.039	**0.039**	0.000	0.000	0.000	**0.000**	**0.039**
18	GARDEN STREET RESTROOM	107568	0.092	0.096	0.071	**0.259**	0.115	0.103	0.149	**0.367**	0.122	0.220	0.041	**0.383**	0.133	0.106	0.106	**0.344**	**1.354**
19	MARBORG INDUSTRIES	107466	0.000	0.014	0.018	**0.032**	0.018	0.016	0.016	**0.051**	0.016	0.034	0.044	**0.094**	0.025	0.025	0.025	**0.076**	**0.253**
20	SHORELINE BEACH CAFÉ (toilets)	107293	0.011	0.021	0.014	**0.046**	0.018	0.028	0.023	**0.069**	0.025	0.057	0.046	**0.129**	0.023	0.011	0.011	**0.046**	**0.289**
21	MACKENZIE PARK RESTROOM	107169	0.002	0.002	0.005	**0.009**	0.005	0.005		**0.009**	0.009	0.018	0.048	**0.076**	0.002	0.002	0.002	**0.007**	**0.101**
22	CAL TRANS (San Marcos Pass)	107133	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.051	**0.051**	0.000	0.000	0.000	**0.000**	**0.051**
23	WASTEWATER VACTOR #667	106842	0.000	0.021	0.005	**0.025**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.053	**0.053**	0.000	0.000	0.000	**0.000**	**0.078**
24	11 GARDEN STREET IRRGATION	106403	0.000	0.005	0.028	**0.032**	0.000	0.002	0.000	**0.002**	0.000	0.011	0.055	**0.067**	0.246	0.076	0.076	**0.397**	**0.498**
25	CAL TRANS (QUARANTINA)	106264	0.025	0.000	0.000	**0.025**	0.000	0.000	0.211	**0.211**	0.574	1.628	0.057	**2.259**	0.078	0.055	0.055	**0.188**	**2.684**
26	PALM PARK EXPANSION RESTROOM	106249	0.000	0.000	0.080	**0.080**	0.090	0.087	0.115	**0.292**	0.115	0.253	0.060	**0.427**	0.129	0.163	0.163	**0.455**	**1.253**
27	PALM PARK EXPANSION IRRGATION	106248	0.000	0.028	0.005	**0.032**	0.018	0.496	0.432	**0.946**	0.436	1.015	0.062	**1.513**	0.184	0.170	0.170	**0.523**	**3.014**
28	SEA LANDING	106175	0.000	0.000	0.000	**0.000**	0.014	0.032	0.071	**0.117**	0.062	0.083	0.064	**0.209**	0.055	0.041	0.041	**0.138**	**0.464**
29	ROCKHAR MINI-STORAGE	105547	0.000	0.016	0.000	**0.016**	0.005	0.005	0.002	**0.011**	0.023	0.016	0.067	**0.106**	0.000	0.028	0.028	**0.055**	**0.188**
30	PALM PARK RESTROOM (EAST)	105463	0.108	0.133	0.103	**0.344**	0.140	0.225	0.092	**0.457**	0.090	0.000	0.069	**0.158**	0.087	0.076	0.076	**0.239**	**1.198**
31	1 STATE STREET RESTROOM	105462	0.092	0.110	0.067	**0.269**	0.124	0.115	0.158	**0.397**	0.140	0.321	0.071	**0.533**	0.179	0.103	0.103	**0.386**	**1.584**
32	WASTEWATER VACTOR #669	105159	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.073	**0.073**	0.000	0.000	0.000	**0.000**	**0.073**
33	WASTEWATER VACTOR #668	104973	0.000	0.000	0.000	**0.000**	0.000	0.000		**0.000**	0.000	0.000	0.076	**0.076**	0.000	0.000	0.000	**0.000**	**0.076**
34	SHORELINE CONDOMINIUMS	104857	0.000	0.000	0.000	**0.000**	0.000	0.055	0.073	**0.129**	0.067	0.119	0.078	**0.264**	0.076	0.057	0.057	**0.191**	**0.583**
35	EARL WARREN SHOWGROUNDS	104757	0.064	0.147	0.163	**0.374**	0.140	0.225	0.271	**0.636**	0.174	0.473	0.080	**0.728**	0.253	0.223	0.223	**0.698**	**2.436**
36	VAL VERDE - Torino Road	104711	0.450	0.266	0.271	**0.987**	0.170	0.932	0.700	**1.802**	0.836	1.382	0.083	**2.300**	1.058	0.693	0.693	**2.445**	**7.534**
37	VAL VERDE 1315357	104710	0.737	0.902	0.882	**2.521**	1.765	2.068	3.655	**7.489**	2.029	4.105	0.085	**6.219**	3.287	2.126	2.126	**7.539**	**23.767**
38	WASHINGTON SCHOOL	104709	0.099	0.126	0.117	**0.342**	0.170	0.271	0.877	**1.318**	0.604	0.769	0.087	**1.460**	0.422	0.305	0.305	**1.033**	**4.153**
39	LA MESA PARK	104708	0.000	0.005	0.000	**0.005**	0.000	0.197	0.181	**0.379**	0.030	0.698	0.090	**0.817**	0.181	0.000	0.000	**0.181**	**1.382**
40	HIDDEN VALLEY PARK	104707	0.000	0.000	0.000	**0.000**	0.000	0.021	0.039	**0.060**	0.096	0.161	0.092	**0.349**	0.076	0.023	0.023	**0.122**	**0.530**
41	MONROE SCHOOL	104706	0.046	0.246	0.354	**0.645**	0.103	0.383	0.673	**1.159**	0.950	1.396	0.094	**2.440**	1.095	0.280	0.280	**1.655**	**5.900**
42	ARROYO BURRO BEACH	104704	0.014	0.000	0.021	**0.034**	0.053	0.083	0.112	**0.248**	0.069	0.161	0.096	**0.326**	0.227	0.053	0.053	**0.333**	**0.941**
43	MACKENZIE LAWN BOWLING	104696	0.000	0.000	0.000	**0.000**	0.000	0.000		**0.000**	0.106	0.048	0.099	**0.253**	0.044	0.046	0.046	**0.135**	**0.388**
44	MACKENZIE PARK	104679	0.000	0.028	0.021	**0.048**	0.025	0.840	0.882	**1.747**	0.466	0.808	0.101	**1.375**	0.255	0.204	0.204	**0.663**	**3.834**
45	OAK PARK	104678	0.000	0.007	0.005	**0.011**	0.009	0.220	0.411	**0.640**	0.197	0.544	0.103	**0.845**	0.119	0.025	0.025	**0.170**	**1.667**
46	LA CUMBRE JUNIOR HIGH	104677	0.126	0.976	0.262	**1.364**	2.215	0.000	2.860	**5.076**	1.508	3.407	0.106	**5.021**	0.301	1.393	1.393	**3.088**	**14.548**

47	LOS POSITAS PARK	104676	0.140	1.364	0.317	**1.820**	0.149	1.295	3.425	**4.869**	2.606	6.956	0.108	**9.669**	2.778	2.185	2.185	**7.149**	**23.508**
48	MUNICIPAL GOLF COURSE	104660	0.452	3.524	1.097	**5.073**	3.124	13.228	15.078	**31.430**	8.462	24.940	0.110	**33.512**	9.325	8.184	8.184	**25.693**	**95.709**
49	CAL TRANS (Los Positas)	104659	0.558	0.388	0.372	**1.318**	0.450	0.367	0.803	**1.621**	1.315	1.534	0.112	**2.961**	1.196	0.611	0.611	**2.417**	**8.317**
50	SAMARKAND	104658	0.073	0.067	0.085	**0.225**	0.184	0.230	0.223	**0.636**	0.213	0.354	0.115	**0.682**	0.191	0.133	0.133	**0.457**	**2.000**
51	PILGRIM TERRACE COOP HOMES	104657	0.138	0.110	0.122	**0.370**	0.124	0.101	0.122	**0.347**	0.133	0.292	0.117	**0.542**	0.085	0.122	0.122	**0.328**	**1.586**
52	PILGRIM TERRACE PARK	104614	0.000	0.000	0.000	**0.000**	0.000	0.000	0.083	**0.083**	0.168	0.207	0.119	**0.494**	0.103	0.041	0.041	**0.186**	**0.762**
53	ADAMS SCHOOL	104582	0.213	0.230	0.021	**0.464**	0.236	0.448	0.498	**1.182**	0.172	0.661	0.122	**0.955**	0.360	0.200	0.200	**0.760**	**3.361**
54	BOYS CLUB	104190	0.032	0.080	0.044	**0.156**	0.014	0.315	0.071	**0.399**	0.092	0.468	0.124	**0.684**	0.126	0.108	0.108	**0.342**	**1.582**
55	EL ESCORIAL	104180	0.039	0.269	0.147	**0.455**	0.232	0.528	0.620	**1.380**	0.434	0.886	0.126	**1.446**	0.510	0.916	0.916	**2.342**	**5.622**
56	CITY COLLEGE MAIN CAMPUS	104092	0.181	0.654	0.383	**1.219**	0.556	1.713	1.834	**4.102**	1.977	2.851	0.129	**4.956**	1.591	1.201	1.201	**3.992**	**14.270**
57	CITY COLLEGE WEST CAMPUS	104091	0.149	0.730	0.363	**1.242**	0.613	2.229	2.746	**5.588**	1.405	3.889	0.131	**5.425**	0.000	3.124	3.124	**6.249**	**18.503**
58	LASH WATER TRUCK 1214830	103695	0.000	0.000	0.007	**0.007**	0.007	0.000	0.005	**0.011**	0.018	0.044	0.133	**0.195**				**0.000**	**0.213**
59	BIRD REFUGE	103642	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.135	**0.135**	0.000	0.000	0.000	**0.000**	**0.135**
60	WATER TRUCK-Parks Dept #562 (Active)	103624				**0.000**		0.000	0.948	**0.948**	0.115	0.000	0.138	**0.253**				**0.000**	**1.201**
61	ORTEGA PARK	103446	0.000	0.007	0.002	**0.009**	0.018	0.546	0.654	**1.219**	0.443	0.921	0.140	**1.504**	0.310	0.184	0.184	**0.677**	**3.409**
62	SANTA BARBARA ZOO (042837)	103390	0.243	0.292	0.213	**0.748**	0.434	0.579	0.487	**1.499**	1.026	0.916	0.142	**2.084**	0.505	0.588	0.588	**1.680**	**6.012**
63	SANTA BARBARA ZOO (1520839)	103389	0.326	0.395	0.292	**1.012**	0.590	0.792	0.670	**2.052**	1.125	1.540	0.145	**2.810**	0.691	0.808	0.808	**2.307**	**8.182**
64	PALM PARK (WEST)- Irrigation	103387	0.005	0.051	0.007	**0.062**	0.030	0.083	0.122	**0.234**	0.119	0.239	0.147	**0.505**	0.067	0.060	0.060	**0.186**	**0.987**
65	MUNICIPAL TENNIS COURTS	103386	0.011	0.000	0.000	**0.011**	0.018	0.014	0.051	**0.083**	0.028	0.009	0.149	**0.186**	0.016	0.039	0.039	**0.094**	**0.374**
66	SANTA BARBARA JR HIGH (SOUTH)	103385	0.016	0.000	0.000	**0.016**	0.000	0.273	0.301	**0.574**	0.312	0.879	0.152	**1.343**	0.457	0.328	0.328	**1.113**	**3.046**
67	SANTA BARBARA HIGH SCHOOL	103384	0.730	0.473	0.386	**1.589**	1.331	2.546	2.553	**6.430**	1.954	4.562	0.154	**6.669**	1.754	1.453	1.453	**4.660**	**19.348**
68	SHORELINE PARK (EAST)	103383	0.000	0.000	0.000	**0.000**	0.000	0.051	0.434	**0.484**	0.500	1.527	0.156	**2.183**	0.188	0.000	0.000	**0.188**	**2.856**
69	RED LION INN	101874	0.315	0.872	0.519	**1.706**	1.111	3.423	2.449	**6.983**	2.493	3.726	0.158	**6.377**	1.837	1.045	1.045	**3.926**	**18.992**
70	SHORELINE MEDIAN	101144	0.000	0.000	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.000	0.161	**0.161**	0.000	0.000	0.000	**0.000**	**0.161**
71	DWIGHT MURPHY	100341	0.002	0.094	0.000	**0.096**	0.000	1.090	1.054	**2.144**	0.728	1.520	0.163	**2.410**	0.372	0.324	0.324	**1.019**	**5.670**
72	CABRILLO BALL FIELD	021591	0.000	0.007	0.000	**0.007**	0.002	0.840	0.764	**1.607**	0.425	1.290	0.165	**1.880**	0.507	0.223	0.223	**0.953**	**4.447**
73	PALM PARK (EAST)	021588	0.000	0.021	0.073	**0.094**	0.085	1.814	3.180	**5.078**	0.000	0.000	0.168	**0.168**	1.251	0.223	0.223	**1.697**	**7.036**
74	PALM PARK (MIDDLE)San Bar St parking lot	021585	0.000	0.002	0.002	**0.005**	0.002	0.259	0.370	**0.631**	0.344	0.581	0.170	**1.095**	0.253	0.046	0.046	**0.344**	**2.075**
75	HARBOR LOT/MARINA 2	021577	0.000	0.002	0.005	**0.007**	0.028	0.168	0.434	**0.629**	0.000	1.240	0.172	**1.412**	0.266	0.064	0.064	**0.395**	**2.443**
76	LEADBETTER BEACH	021566	0.000	0.002	0.005	**0.007**	0.005	0.301	0.301	**0.606**	0.441	0.654	0.174	**1.270**	0.186	0.009	0.009	**0.204**	**2.087**
77	SHORELINE PARK (WEST)	021563	0.000	0.000	0.000	**0.000**	0.000	0.083	0.611	**0.693**	0.618	1.646	0.177	**2.440**	0.197	0.000	0.000	**0.197**	**3.331**
78	PERSHING/PLAZA DEL MAR	021548	0.062	0.200	0.280	**0.542**	0.438	1.371	1.233	**3.042**	0.937	2.165	0.179	**3.281**	0.546	0.533	0.533	**1.612**	**8.476**
79	HOUSING AUTHORITY OF - MEIGS RD	018368	0.000	0.034	0.048	**0.083**	0.064	0.073	0.110	**0.248**	0.112	0.168	0.181	**0.461**	0.197	0.133	0.133	**0.464**	**1.256**
80	HOUSING AUTHORITY - ELISE WY	018324	0.000	0.011	0.007	**0.018**	0.011	0.044	0.062	**0.117**	0.067	0.085	0.184	**0.335**	0.053	0.025	0.025	**0.103**	**0.574**
81	SANTA BARBARA JR HIGH (NORTH)	000051	0.087	1.109	0.236	**1.433**	0.987	1.391	1.793	**4.171**	2.394	3.749	0.186	**6.329**	1.646	0.650	0.650	**2.945**	**14.878**
82	MONTECITO COUNTRY CLUB	000034	1.074	1.274	0.716	**3.065**	2.305	13.558	14.382	**30.246**	13.753	27.557	0.188	**41.499**	15.204	3.375	3.375	**21.954**	**96.763**
83	INSITUFORM, INC-WATER TRUCK (Finaled)	110299				**0.000**				**0.000**				**0.000**				**0.000**	**0.000**
84	MONTECITO SANITARY DIST. (no meter)	108007				**0.000**				**0.000**				**0.000**				**0.000**	**0.000**
85	VENCO SWEEPING 2" (Finaled)	107988				**0.000**				**0.000**				**0.000**				**0.000**	**0.000**
86	VENCO SWEEPING 3" (Finaled)	107975				**0.000**				**0.000**				**0.000**				**0.000**	**0.000**
87	ALLBRETT, LOYRS-Steam Clearer (Finaled)	107549				**0.000**				**0.000**				**0.000**				**0.000**	**0.000**
88	99 GARDEN STREET MEDIAN (Finaled)	106434				**0.000**				**0.000**				**0.000**				**0.000**	**0.000**
89	15 GARDEN ST PARKING LOT (Finaled)	021584				**0.000**				**0.000**				**0.000**				**0.000**	**0.000**
	Total Billed Recycled Water Usage:		**6.878**	**15.723**	**8.457**	**31.058**	**18.806**	**56.997**	**72.158**	**147.961**	**54.679**	**117.025**	**7.812**	**179.516**	**52.167**	**33.719**	**33.719**	**119.605**	**478.140**

Monthly Readings:

From:		Prior Ending Read	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
EEWTP	Filter Production (gallons)		2,556,000	2,357,000	2,848	682,000	665,000	3,664,000	6,132,000	7,544,000	13,314,000	4,514,000	6,005,000	3,111,000
EEWTP	El Estero Usage [Process Water] (gallons)		7,318,432	5,605,512	6,643,652	6,054,312	6,841,956	6,290,680	7,488,976	7,708,888	6,934,708	7,280,284	7,985,648	7,890,652
EEWTP	Blending Water Usage - at EEWTP (gallons)		9,563,875	9,859,228	10,797,811	22,321,106	37,966,684	29,002,190	36,791,606	33,830,723	20,458,832	19,698,448	11,324,172	13,855,291
EEWTP	Metered Distribution Flow at EEWTP (gallons)		11,862,000	11,662,000	12,936,000	23,017,999	37,885,000	32,425,000	42,795,000	41,367,000	33,918,000	24,274,000	17,162,000	17,300,000
EEWTP	Theoretical (Calc'd) Distribution Flow (gallons)		12,119,875	12,216,228	13,645,811	23,003,106	38,631,684	32,666,190	42,923,606	41,374,723	33,772,832	24,212,448	17,329,172	16,966,291
DIST.	Blending Water @ Golf Course Tank (HCF)	23,600	23,600	23,600	23,600	23,600	23,600	23,600	23,600	23,600	23,600	23,600	23,600	23,600

Summary Information in Acre-Feet:	JAN	FEB	MAR	1st QTR	APR	MAY	JUN	2nd QTR	JUL	AUG	SEP	3rd QTR	OCT	NOV	DEC	4th QTR	TOTAL
Filter Production	7.84	7.23	0.01	15.09	2.09	2.04	11.24	15.38	18.82	23.15	40.86	82.83	13.85	18.43	9.55	41.83	155.12
Blending Water @ EEWTP	29.35	30.26	33.14	92.74	68.50	116.52	89.00	274.02	112.91	103.82	62.79	279.52	60.45	34.75	42.52	137.73	784.01
Metered Distribution Flow @ EEWTP	36.40	35.79	39.70	111.89	70.64	116.27	99.51	286.41	131.33	126.95	104.09	362.38	74.49	52.67	53.09	180.25	940.94
Potable/Blending Water Added @ Golf Course Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Metered Water to Distribution (EEWTP + Golf Course)	36.40	35.79	39.70	111.89	70.64	116.27	99.51	286.41	131.33	126.95	104.09	362.38	74.49	52.67	53.09	180.25	940.94
Total Blending Water (EEWTP + Golf Course)	29.35	30.26	33.14	92.74	68.50	116.52	89.00	274.02	112.91	103.82	62.79	279.52	60.45	34.75	42.52	137.73	784.01
Percent Blend Water	81%	85%	83%	83%	97%	100%	89%	96%	86%	82%	60%	77%	81%	66%	80%	76%	83%
Total El Estero Usage [Process Water]	22.46	17.20	20.39	60.05	18.58	21.00	19.31	58.88	22.98	23.66	21.28	67.92	22.34	24.51	24.22	71.07	257.92
Net Production to Distribution System	13.94	18.59	19.31	51.84	52.06	95.27	80.20	227.53	108.35	103.29	82.81	294.45	52.15	28.16	28.88	109.19	683.01
Metered Sales to Customers	6.878	15.723	8.457	31.06	18.806	56.997	72.158	147.96	54.679	117.025	7.812	179.52	52.167	33.719	33.719	119.61	478.14



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1. MONTECITO COUNTRY CLUB
2. CALTRANS (900 OLD COAST HWY)
3. BIRD REFUGE (1100 E. CABRILLO BLVD.)
4. MUNICIPAL TENNIS COURTS (1414 PARK PL.)
5. PALM PARK RESTROOM (EAST) (620 E CABRILLO BLVD)
6. PALM PARK (EAST) (400 E CABRILLO BLVD)
7. PALM PARK (MIDDLE) SAN BAR ST PARKING LOT (200 E CABRILLO BLVD)
8. EL ESCORIAL (625 POR LA MAR CIR)
9. SANTA BARBARA ZOO (500 NINOS DR.)
10. SANTA BARBARA ZOO (500 NINOS DR.)
11. SYCAMORE CREEK, CALTRANS (501 NINOS DR)
12. DWIGHT MURPHY FILL STATION, CALTRANS (501 NINOS DR)
13. DWIGHT MURPHY RESTROOM(501 NINOS DR)
14. DWIGHT MURPHY FIELD (501 NINOS DR)

PHASE I CONTINUED

15. CABRILLO BALL FIELD (800 CALLE PUERTO VALLARTA)
16. FESS PARKER'S DOUBLE TREE INN (633 E. CABRILLO BLVD)
17. CALTRANS (QUARANTINA) (2 N QUARANTINA ST)
18. NMC PARKING (2 N. CALLE CESAR CHAVEZ
19. MARBORG INDUSTRIES (CHEMICAL TOILETS) (23 N QUARANTINA ST)
20. MARBOURG (N QUARANTINA ST) (119 N QUARANTINA ST)
21. MARBORG INDUSTRIES (UNION STREET) (709 UNION ST)
22. PALM PARK EXPANSION RESTROOM (325 E. CABRILLO BLVD)
23. PALM PARK EXPANSION IRRIGATION (325 E. CABRILLO BLVD)
24. 11 GARDEN STREET IRRIGATION (11 GARDEN ST)
25. 214 E YANONALI ST (VILLAS DEL MAR) (214 E YANONALI ST)
26. SANTA BARBARA JR HIGH (SOUTH) (721 E COTA ST)
27. SANTA BARBARA JR. HIGH (NORTH) (721 E COTA ST)
28. ORTEGA PARK (604 E ORTEGA ST)

PHASE I CONTINUED

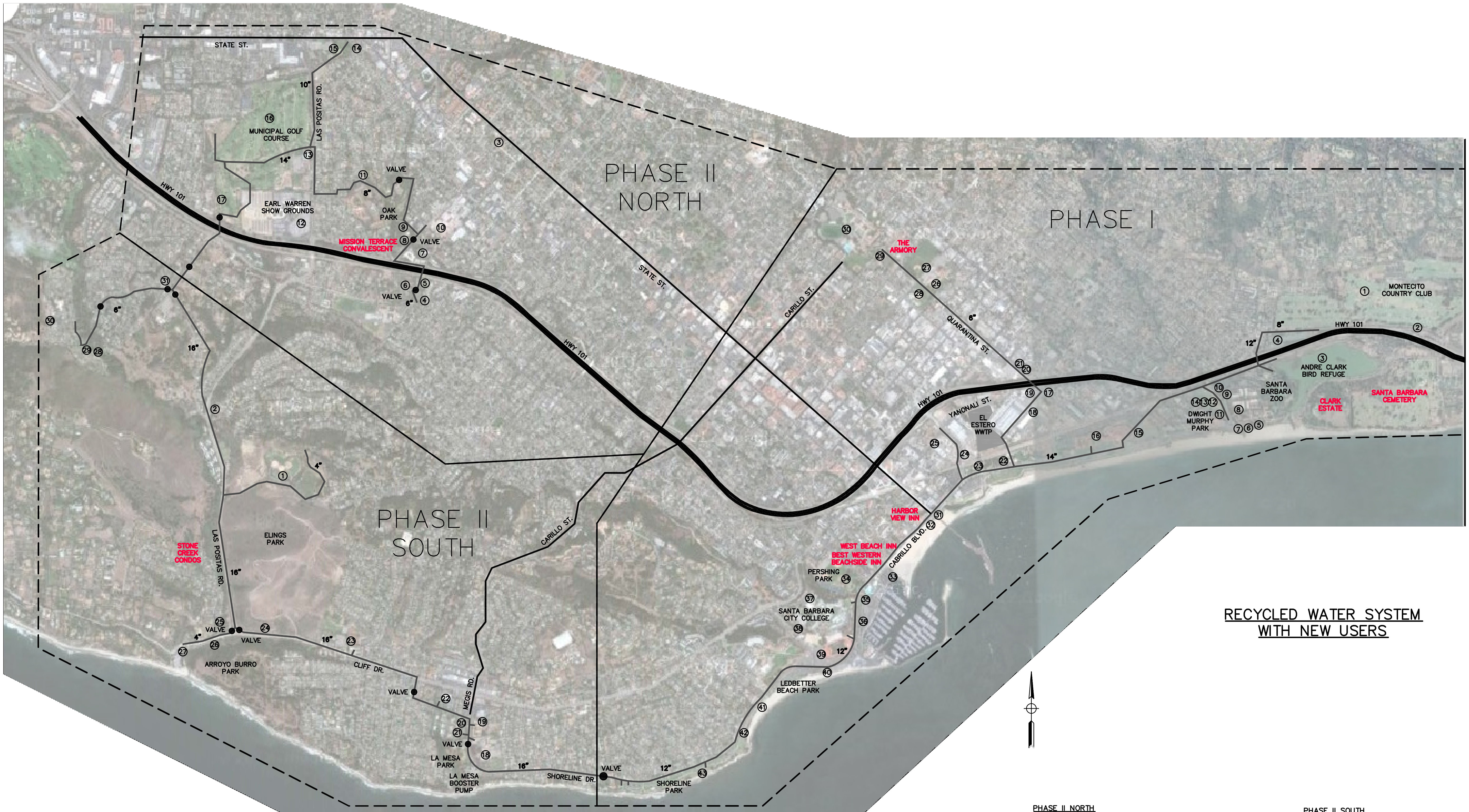
29. BOYS & GIRLS CLUB 632 E. CANON PERDIDO ST.)
30. SANTA BARBARA HIGH SCHOOL (700 E. ANAPAMU ST.
31. 1 STATE STREET RESTROOM (1 STATE STREET)
32. PALM PARK (WEST) – IRRIGATION (1 STATE STREET)
33. HARBOR LOT / MARINA 2 (401 SHORELINE DR.)
34. PERSHING / PLAZA DEL MAR (131 CASTILLO ST.)
35. SEA LANDING (501 SHORELINE DR.)
36. SHORELINE MEDIAN (601 SHORELINE DR.)
37. CITY COLLEGE MAIN CAMPUS (721 CLIFF DR.)
38. CITY COLLEGE WEST CAMPUS (721 CLIFF DR.)
39. LEADBETTER BEACH (803 SHORELINE DR.)
40. SHORELINE BEACH CAFE (TOILETS) (801 SHORELINE DR.)
41. 1100 SHORELINE DR (1100 SHORELINE DR)
42. SHORELINE PARK (EAST) (1201 SHORELINE DR.)
43. SHORELINE PARK (WEST) (1235 SHORELINE DR.)

PHASE II NORTH

1. LOS POSITAS PARK (1298 LAS POSITAS RD.)
2. SPRINT PCS – LAS POSITAS (1500 LAS POSITAS RD.)
3. CALTRANS (LOS POSITAS) (0 W. JUNIPERO ST.)
4. LA CUMBRE JUNIOR HIGH (2257 MODOC RD.)
5. PILGRIM TERRACE PARK (651 PILGRIM TERRACE DR.)
6. PILGRIM TERRACE CO-OP HOMES (649 PILGRIM TERRACE DR.)
7. CALTRANS (SAN MARCOS PASS) (540 W. PUEBLO ST.
8. OAK PARK RESTROOMS (600 W. JUNIPERO ST.)
9. OAK PARK (600 W. ALAMAR AVE.
10. COTTAGE HOSPITAL (OAK PARK LN. & JUNIPERO ST.)
11. SAMARKAND (2250 SAMARKAND DR)
12. EARL WARREN SHOWGROUNDS (3402 CALLE REAL)
13. ADAMS SCHOOL (2701 LAS POSITAS RD.)
14. MACKENZIE PARK RESTROOM (3111 STATE ST.)
15. MACKENZIE PARK (3111 STATE ST.)
16. MUNICIPAL GOLF COURSE (3333 MCCAW AVE.)
17. ROCKHAR MINI-STORAGE (3650 CALLE REAL)

PHASE II SOUTH

18. WASHINGTON SCHOOL (290 LIGHTHOUSE RD.)
19. SHORELINE CONDOMINIUMS (222 MEIGS RD.)
20. LA MESA PARK (259 MEIGS RD)
21. HOUSING AUTHORITY – MEIGS (219 MEIGS RD.)
22. HOUSING AUTHORITY – ELISE (1934 ELISE WY)
23. MONROE SCHOOL (431 FLORA VISTA DR.)
24. SPRINT PCS (2800 CLIFF DR.)
25. RECLAIMED RESERVOIR YARD 46321496 (400 ALAN RD.
26. ARROYO BURRO CREEK, CITY OF SB, CREEKS (2931 CLIFF DR.)
27. ARROYO BURRO BEACH (2981 CLIFF DR.)
28. HIDDEN VALLEY PARK (900 CALLE DE LOS AMIGOS)
29. VAL VERDE 1315357 (900 CALLE DE LOS AMIGOS)
30. VAL VERDE – TORINO ROAD (3790 TORINO DR.)
31. BREAMAR LIFT STATION (3500 MCCAW)



RECYCLED WATER SYSTEM WITH NEW USERS

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CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT
WATER RESOURCES DIVISION LABORATORY
MONITORING AND REPORTING PROGRAM NO. 90-103

EL ESTERO WWTP RECLAIMED DISTRIBUTION WATER ANNUAL SUMMARY 2006

EPA METHODS	PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MIN	MAX	AVG
600/8-78-017	Total Coliform Bacteria, MPN/100 mL (7-Day Median)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
310.1	Alkalinity (as CaCO3)	208	217	250	248	214	251	251	274	266	252	314	215	208	314	247
Calc.	Bicarbonate (HCO3)	253.76	264.74	305	302.56	261.08	306.22	306.22	334.28	324.52	307.44	383.08	262.3	253.76	383.08	301
215.2	Calcium (Ca)	93.7	96.1	91.3	105	103	103.3	108.1	99.3	93.7	96.4	95.8	94.5	91.3	108.1	98.4
130.2	Total Hardness (CaCO3)	426	414	412	462	450	444	435	452	450	459	437	428	412	462	439
375.4	Sulfate (SO4)	295	284	278	297	276	277	293	276	306	308	322	321	276	322	294
407A	Chloride (Cl)	290	298	261	267	192	157	296	285	260	337	336	290	157	337	272
352.1	Nitrate as Nitrogen (NO3-N)	7.43	6.49	6.25	9.48	2.37	1.32	2.56	5.28	2.2	5.57	2.34	1.2	1.2	9.48	4.4
354.1	Nitrite as Nitrogen (NO2-N)	0.73	1.29	0.55	<0.5	<0.1	<0.1	1.06	1.48	1.3	1.35	0.94	1.56	<0.1	1.56	0.9
300	Fluoride (F)	0.42	0.36	0.3	0.4	0.27	0.18	0.39	0.26	0.6	0.4	0.44	0.42	0.18	0.6	0.37
300	Bromide (Br)	0.54	0.52	0.34	0.41	0.18	<0.1	0.64	0.63	0.9	0.49	0.43	0.85	<0.1	0.9	0.5
350.3	Ammonia as Nitrogen	6.57	<1.0	16	7.81	4.65	7.94	13.9	10.8	14.8	16.1	25.8	24.6	<1.0	25.8	12.5
330.2.3	Chlorine Residual - Total*	3.7	4.12	4.12	3.35	4.71	5.9	8.15	6.18	5.87	4.79	5.03	4.77	3.35	8.15	5.06
160.2	Total Suspended Solids (TSS)*	2.4	1.1	1.5	1.8	2	1.6	1.7	6.53	1.5	2	2.72	2.01	1.1	6.53	2.2
160.1	Total Dissolved Solids (TDS)	1202	1286	1130	1323	1234	926	1247	1280	1168	1316	1200	822	822	1323	1178
150.1	pH, Units	7.87	8.08	7.77	7.67	7.99	7.99	8.33	7.97	8	8.09	8.13	8.17	7.67	8.33	8.01
110.2	Color, apparent unfiltered	25	15	13	17	18	8	17	25	17	21	18	7	7	25	16.8
120.1	Conductivity (EC), umhos/cm	1916	1610	1840	1954	1946	1502	1700	2340	2005	2340	2190	1130	1130	2340	1873
180.1	Turbidity, NTUs	2.71	1.52	2.03	2.09	2.55	1.65	1.71	1.97	1.67	2.06	3.7	1.05	1.05	3.7	2.06
365.2	Phosphorous (P)	0.52	0.5	0.98	1.5	1.4	0.77	1.4	1.7	1.2	0.79	0.59	0.31	0.31	1.7	0.97
212.3	Boron (B)	0.57	0.45	0.51	0.6	0.66	0.47	0.54	0.6	0.62	0.71	0.62	0.56	0.45	0.71	0.58
273.1	Sodium (Na)	152	129	188	190	191	125	175	240	190	236	204	95	95	240	176
258.1	Potassium (K)	21.3	18.7	27.6	28.6	28.1	16.8	23.7	34.7	27.4	33.4	30.2	9.82	9.82	34.7	25.0
242.1	Magnesium (Mg)	46.4	51.4	49.6	44.6	49.8	46	48.2	54.6	52.8	54.4	48.2	47	44.6	54.6	49.4
Calc.	Sodium Absorption Ratio (SAR)	3.21	2.64	3.93	3.91	3.87	3	3.52	4.8	3.89	4.76	4.24	1.99	1.99	4.8	3.65
Calc.	Adjusted Sodium Absorption Ratio (SARa)	7.44	6.29	10.07	9.43	9.04	7	8.51	11.77	9.42	11.58	10.61	4.72	4.72	11.77	8.82
206.2	Arsenic (As)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
213.1	Cadmium (Cd)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
218.1	Chromium (Cr)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
220.1	Copper (Cu)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
236.1	Iron (Fe)	0.24	0.11	0.12	0.13	0.26	0.26	0.14	0.14	0.1	0.1	0.44	0.11	0.1	0.44	0.2
239.2	Lead (Pb)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
245.1	Mercury (Hg)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
246.2	Molybdenum (Mo)	0.004	0.003	0.008	0.011	0.001	<0.001	0.003	0.005	0.004	0.006	0.006	0.003	<0.001	0.011	0.005
249.1	Nickel (Ni)	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
270.2	Selenium (Se)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
272.1	Silver (Ag)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
289.1	Zinc (Zn)	0.02	0.03	0.03	0.03	0.04	<0.02	<0.02	0.03	0.04	0.03	0.022	<0.02	<0.02	0.04	0.03

* Monthly Average

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CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT
WATER RESOURCES DIVISION LABORATORY
MONITORING AND REPORTING PROGRAM NO. 90-103

EL ESTERO WWTP RECLAIMED DISTRIBUTION WATER ANNUAL SUMMARY 2007

EPA METHODS	PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MIN	MAX	AVG
600/8-78-017	Total Coliform Bacteria, MPN/100 mL (7-Day Median)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
310.1	Alkalinity (as CaCO3)	279	298	374	314	293	271	293	278	273	273	270	268	268	374	290
Calc.	Bicarbonate (HCO3)	340	364	456	383	357	331	357	339	333	333	329	327	327	456	354
215.2	Calcium (Ca)	95.3	91.7	97.7	96.9	90.1	88.6	97.1	96.4	95.5	85.7	88.9	94.2	85.7	97.7	93.2
130.2	Total Hardness (CaCO3)	425	427	440	449	398	425	433	421	436	428	440	438	398	449	430
375.4	Sulfate (SO4)	278	285	308	299	263	276	274	269	300	292	291	292	263	308	286
407A	Chloride (Cl)	175	267	291	279	203	231	246	78.7	328	260	289	320	78.7	328	247
352.1	Nitrate as Nitrogen (NO3-N)	0.47	0.76	0.65	0.43	0.24	1.24	0.27	0.31	0.48	2.65	0.92	2.51	0.24	2.65	0.91
354.1	Nitrite as Nitrogen (NO2-N)	<0.1	<0.1	0.67	0.57	0.14	2.92	0.79	0.82	3.09	1.36	1.66	2.80	<0.1	3.09	1.3
300	Fluoride (F)	0.37	0.40	0.57	0.62	0.54	2.04	0.40	0.36	0.38	0.50	0.42	0.41	0.36	2.04	0.58
300	Bromide (Br)	0.38	0.74	0.76	0.35	0.31	3.00	0.58	0.43	0.81	1.06	0.85	0.45	0.31	3.00	0.81
350.3	Ammonia as Nitrogen	17.8	23.7	27.9	29.4	22.9	21.8	22.1	15.7	22.6	17.2	24.8	19.6	15.7	29.4	22.1
330.2.3	Chlorine Residual - Total*	4.85	6.45	6.88	5.69	7.68	5.64	6.25	6.45	5.75	6.15	6.32	5.61	4.85	7.68	6.14
160.2	Total Suspended Solids (TSS)*	1.94	2.03	2.04	1.48	1.58	1.84	2.15	2.77	2.8	1.97	2.46	2.	1.48	2.8	2.09
160.1	Total Dissolved Solids (TDS)	1041	1054	1226	1127	1021	1028	1316	1505	1184	1209	1192	1249	1021	1505	1179
150.1	pH, Units	8.10	8.00	8.05	7.73	7.68	8.15	7.71	8.26	7.59	8.01	8.01	8.12	7.59	8.26	7.95
110.2	Color, apparent unfiltered	16	16	28	13	14	11	17	18	18	23	18	20	11	28	17.7
120.1	Conductivity (EC), umhos/cm	1771	1897	2030	1943	1761	1639	1933	1881	2070	2050	1876	2100	1639	2100	1913
180.1	Turbidity, NTUs	3.55	3.37	2.58	2.51	3.22	2.23	2.36	2.40	1.64	2.47	2.76	1.81	1.64	3.55	2.58
365.2	Phosphorous (P)	0.43	0.53	0.31	0.71	0.46	0.41	0.90	2.1	0.32	1.1	0.52	0.49	0.31	2.1	0.69
212.3	Boron (B)	0.57	0.49	0.69	0.73	0.45	0.41	0.62	0.53	0.76	0.78	0.54	0.42	0.41	0.78	0.58
273.1	Sodium (Na)	144	141	211	198	127	147	160.6	181.2	173.2	196	167	180	127	211	169
258.1	Potassium (K)	23.0	26.2	26.7	32.4	19.4	20.6	2.604	22.60	24.60	30.26	23.3	29.2	2.604	32.4	23.4
242.1	Magnesium (Mg)	40.8	35.0	51.0	44.0	39.8	42.6	44.4	43.6	42.0	43.6	43.8	41.4	35.0	51.0	42.7
Calc.	Sodium Absorption Ratio (SAR)	3.11	3.18	4.31	4.19	2.80	3.21	3.39	3.85	3.72	4.30	3.62	3.89	2.80	4.31	3.63
Calc.	Adjusted Sodium Absorption Ratio (SARa)	7.59	7.75	11.15	10.43	6.88	7.77	8.37	9.38	9.01	10.33	8.75	9.37	6.88	11.15	8.90
206.2	Arsenic (As)	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0021	0.0016	<0.001	0.0021	0.001
213.1	Cadmium (Cd)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0001	<0.0001	<0.01	0.009
218.1	Chromium (Cr)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.0018	0.0018	<0.02	0.018
220.1	Copper (Cu)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	<0.01	<0.01	0.0044	0.0044	0.011	0.010
236.1	Iron (Fe)	0.21	0.081	0.153	0.184	0.253	0.165	0.191	0.140	0.181	0.197	0.178	0.140	0.081	0.253	0.173
239.2	Lead (Pb)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0056	<0.0001	<0.0001	0.0056	0.001
245.1	Mercury (Hg)	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
246.2	Molybdenum (Mo)	0.005	0.007	0.005	0.0047	<0.001	<0.001	0.005	0.003	0.002	0.006	0.0108	0.0081	<0.001	0.0108	0.005
249.1	Nickel (Ni)	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.0056	0.0056	<0.06	0.055
270.2	Selenium (Se)	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.0040	0.0032	<0.001	0.0040	0.001
272.1	Silver (Ag)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	0.0012	0.0012	0.013	0.010
289.1	Zinc (Zn)	<0.02	0.027	<0.02	<0.02	0.024	<0.02	<0.02	0.254	0.303	0.321	0.429	0.0230	<0.02	0.429	0.12

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CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT

WATER RESOURCES DIVISION LABORATORY

MONITORING AND REPORTING PROGRAM NO. 90-103

EL ESTERO WWTP RECLAIMED DISTRIBUTION WATER ANNUAL SUMMARY 2008

EPA METHODS	PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MIN	MAX	AVG
600/8-78-017	Total Coliform Bacteria, MPN/100 mL (7-Day Median)	<1.1	<1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	<1.1	<1.1	1.1	1.1
310.1	Alkalinity (as CaCO3)	242	272	179	199	248	199	179	232	218	211	300	264	179	300	229
Calc.	Bicarbonate (HCO3)	295	332	218	243	303	243	218	283	266	257	366	322	218	366	279
215.2	Calcium (Ca)	91.8	95.3	84.1	98.5	97.7	104.9	90.5	86.9	88.1	88.9	101	100	84.1	104.9	94.0
130.2	Total Hardness (CaCO3)	419	406	355	420	420	433	402	374	378	376	452	472	355	472	409
375.4	Sulfate (SO4)	293	267	226	260	276	270	239	265	232	237	290	301	226	301	263
407A	Chloride (Cl)	257	249	186	58.1	250	27.9	168	162	142	58.6	188	195	27.9	257	162
352.1	Nitrate as Nitrogen (NO3-N)	3.36	2.48	5.24	1.20	4.12	0.24	1.38	0.69	0.92	0.42	1.79	2.81	0.24	5.24	2.05
354.1	Nitrite as Nitrogen (NO2-N)	0.83	1.33	<0.1	0.26	1.21	<0.1	<0.1	<0.1	<0.1	<0.1	1.63	0.39	<0.1	1.63	0.5
300	Fluoride (F)	0.40	0.42	0.37	0.33	0.41	0.32	0.37	0.32	0.26	0.26	0.29	0.42	0.26	0.42	0.35
300	Bromide (Br)	0.26	0.40	<0.1	<0.1	0.49	<0.10	0.62	0.37	0.15	<0.1	0.68	0.34	<0.1	0.68	0.3
350.3	Ammonia as Nitrogen	12.1	19.5	0.888	1.7	10.7	0.22	4.91	5.0	3.68	1.8	12.5	9.8	0.22	19.5	6.90
330.2.3	Chlorine Residual - Total*	3.7	3.82	4.38	3.91	4.43	3.71	3.06	2.96	2.49	2.69	3.01	4.32	2.49	4.43	3.54
160.2	Total Suspended Solids (TSS)*	1.58	1.5	1.3	1.17	1.24	1.19	1.19	1.22	2.	1.36	1.58	2.35	1.17	2.35	1.47
160.1	Total Dissolved Solids (TDS)	1123	1088	906	794	1008	720	892	926	941	766	1068	1040	720	1123	939
150.1	pH, Units	7.96	7.97	8.16	8.19	8.17	8.24	8.05	8.10	8.13	8.23	8.21	7.85	7.85	8.24	8.11
110.2	Color, apparent unfiltered	20	17	7	8	13	5	10	8	11	7	12	13	5	20	10.9
120.1	Conductivity (EC), umhos/cm	1869	1895	1443	1219	1337	860	1279	1342	1290	1264	1883	1860	860	1895	1462
180.1	Turbidity, NTUs	3.57	2.84	2.07	1.44	1.85	0.64	1.48	1.55	1.24	1.04	0.91	1.80	0.64	3.57	1.70
365.2	Phosphorous (P)	0.54	0.46	0.32	0.30	0.49	0.10	0.38	0.22	0.24	0.22	<1.0	0.40	0.40	<1.0	0.39
212.3	Boron (B)	0.50	0.52	0.36	0.43	0.62	0.50	0.44	0.39	0.48	0.41	0.62	0.60	0.36	0.62	0.49
273.1	Sodium (Na)	199	184	130	77.2	145	60.8	115	121.8	114	80.4	143	160	60.8	199	128
258.1	Potassium (K)	25.1	29.5	17.2	11.6	22.7	4.84	17.3	15.4	15.2	10.4	21.2	22.4	4.84	29.5	17.7
242.1	Magnesium (Mg)	46.2	42.0	32.4	34.4	40.2	39.2	41.2	39.6	40.4	35.4	44.2	49.2	32.4	49.2	40.4
Calc.	Sodium Absorption Ratio (SAR)	4.23	3.95	3.05	1.71	3.12	1.29	2.52	2.72	2.52	1.82	2.99	3.27	1.29	4.23	2.77
Calc.	Adjusted Sodium Absorption Ratio (SARa)	10.03	9.56	6.69	3.94	7.47	3.01	5.67	6.38	5.87	4.21	7.45	8.02	3.01	10.03	6.53
206.2	Arsenic (As)	2.0	<0.2	<0.2	3.8	7.8	<1.0	<0.2	1.8	1.6	1.5	2.2	1.5	<0.2	7.8	2.0
213.1	Cadmium (Cd)	<0.2	<0.2	<0.2	<0.2	<1.0	<1.0	<0.2	<1.0	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
218.1	Chromium (Cr)	1.8	16.2	14.7	2.0	19.4	<1.0	10.9	15.9	8.3	11.6	<1.0	1.4	<1.0	19.4	8.7
220.1	Copper (Cu)	5.5	6.3	4.1	4.7	3.0	2.0	2.6	<1.0	<0.2	3.1	3.5	3.4	<0.2	6.3	3.3
236.1	Iron (Fe)	290	0.120	78	46	91	39	94	73	106	77	100	85	0.120	290	89.9
239.2	Lead (Pb)	<0.2	<0.2	<0.2	<0.2	<1.0	<1.0	<0.2	<1.0	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
245.1	Mercury (Hg)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
246.2	Molybdenum (Mo)	10.1	11.0	6.1	5.7	8.1	5.2	8.2	6.6	5.8	6.6	7.9	7.3	5.2	11.0	7.4
249.1	Nickel (Ni)	6.5	6.5	5.3	5.1	6.2	3.1	5.0	4.1	3.0	3.7	3.8	4.5	3.0	6.5	4.7
270.2	Selenium (Se)	3.8	3.9	3.3	12.9	<1.0	<1.0	2.5	2.1	2.2	1.1	1.6	<1.0	<1.0	12.9	3.0
272.1	Silver (Ag)	<0.2	4.1	1.3	<0.2	1.0	14.4	3.6	<1.0	15.7	<1.0	2.6	1.5	<1.0	15.7	3.9
289.1	Zinc (Zn)	31.8	26.5	20.8	14.6	21.8	14.0	12.6	8.8	1.6	12.6	18.8	31.3	1.6	31.8	17.9

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600/8-78-017	Total Coliform Bacteria, MPN/100 mL (7-Day Median)	<1.1	<1.1	<1.1	1.1	1.1	1.1	1.1	1.2	1.1	1.1	1.1	<1.1	<1.1	1.2	1.1
310.1	Alkalinity (as CaCO3)	241	230	192	245	194	214	211	190	214	216	181	187	181	245	210
Calc.	Bicarbonate (HCO3)	294	281	234	299	237	261	257	232	261	264	221	228	221	299	256
215.2	Calcium (Ca)	102	91.3	92.5	101	95.3	90.5	100	101	95.3	92.9	83.3	85.7	83.3	102	94.2
130.2	Total Hardness (CaCO3)	441	386	400	456	402	428	444	438	450	430	378	392	378	456	420
375.4	Sulfate (SO4)	297	238	237	337	257	290	278	335	293	305	263	267	237	337	283
407A	Chloride (Cl)	213	170	242	256	68.1	185	82.0	134	286	144	87.1	89.6	68.1	286	163
352.1	Nitrate as Nitrogen (NO3-N)	21.3	2.09	5.87	2.65	0.66	2.67	0.95	2.46	0.55	1.15	0.90	0.45	0.45	21.3	3.48
354.1	Nitrite as Nitrogen (NO2-N)	0.30	<0.1	<0.1	0.79	0.17	0.67	0.22	4.66	0.56	5.33	1.40	0.54	<0.1	5.33	1.2
300	Fluoride (F)	0.63	0.55	0.58	0.57	0.42	0.48	0.40	0.52	0.54	0.43	0.45	0.43	0.40	0.63	0.50
300	Bromide (Br)	0.25	<0.1	<0.1	<0.1	<0.1	0.30	<0.1	<0.1	0.19	<0.1	<0.1	0.13	<0.1	0.30	0.1
350.3	Ammonia as Nitrogen	8.9	8.2	2.7	11.3	0.7	8.0	3.50	3.4	5.7	5.5	1.0	4.1	0.7	11.3	5.3
330.2.3	Chlorine Residual - Total*	4.16	4.12	3.33	3.31	3.35	2.67	3.16	2.37	2.67	1.83	1.57	2.42	1.57	4.16	2.91
160.2	Total Suspended Solids (TSS)*	1.74	1.72	1.76	1.9	1.85	2.48	2.39	2.67	2.78	2.46	2.19	2.15	1.72	2.78	2.17
160.1	Total Dissolved Solids (TDS)	982	898	1069	1090	702	878	981	904	1,020	925	730	751	702	1090	911
150.1	pH, Units	7.86	8.09	7.53	7.88	8.23	8.04	7.85	7.92	7.84	7.55	7.86	7.66	7.53	8.23	7.86
110.2	Color, apparent unfiltered	8	12	12	13	7	11	17	14	7	14	<5	7	<5	17	10.6
120.1	Conductivity (EC), umhos/cm	1770	1597	1828	1776	1031	1376	1528	1302	1479	1461	1075	1157	1031	1828	1448
180.1	Turbidity, NTUs	1.79	2.24	1.96	2.68	0.82	1.18	1.83	2.08	5.12	1.81	0.89	1.24	0.82	5.12	1.97
365.2	Phosphorous (P)	0.29	0.34	0.43	0.39	0.03	0.41	0.35	0.16	0.45	0.47	<0.1	0.20	<0.1	0.47	0.3
212.3	Boron (B)	0.55	0.38	0.41	0.49	0.38	0.44	0.46	0.36	0.48	0.49	0.34	0.34	0.34	0.55	0.43
273.1	Sodium (Na)	132	129	174	143	59.2	81.6	128	100	137	129	77.4	91.8	59.2	174	115
258.1	Potassium (K)	18.5	16.3	21.5	18.8	6.12	9.42	17.2	12.6	17.3	15.6	7.8	9.26	6.12	21.5	14.2
242.1	Magnesium (Mg)	42.8	41.8	40.4	40.2	35.6	38.4	42.8	41.8	46.0	44.4	39.0	43.2	35.6	46.0	41.4
Calc.	Sodium Absorption Ratio (SAR)	2.77	2.81	3.80	3.04	1.31	1.81	2.70	2.11	2.88	2.76	1.75	2.02	1.31	3.80	2.48
Calc.	Adjusted Sodium Absorption Ratio (SARa)	6.65	6.62	8.58	7.29	3.02	4.22	6.31	4.87	6.76	6.45	3.94	4.59	3.02	8.58	5.78
206.2	Arsenic (As)	2.0	2.0	<15.0	2.0	1.4	1.3	2.0	1.9	2.6	2.0	1.8	1.9	1.3	<15.0	3.0
213.1	Cadmium (Cd)	<1.0	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	1.3
218.1	Chromium (Cr)	<1.0	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	2.6	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	1.5
220.1	Copper (Cu)	21.5	2.9	<5.0	3.4	2.1	1.5	2.8	3.9	3.1	1.6	3.9	4.6	1.5	21.5	4.7
236.1	Iron (Fe)	146	73	121	70	48	51	104	81	146	120	60	83	48	146	91.9
239.2	Lead (Pb)	<1.0	<1.0	<5.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<5.0	1.3
245.1	Mercury (Hg)	<0.02	<0.2	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	0.2
246.2	Molybdenum (Mo)	7.2	8.2	9.8	7.7	7.0	6.8	8.7	8.6	8.8	8.7	8.4	8.3	6.8	9.8	8.2
249.1	Nickel (Ni)	3.6	2.9	<5.0	3.7	2.9	4.2	4.1	5.2	4.3	2.9	<1.0	3.3	<1.0	5.2	3.6
270.2	Selenium (Se)	1.5	2.2	<15.0	2.1	1.8	2.4	2.5	1.8	2.1	2.0	<1.0	3.3	<1.0	<15.0	3.1
272.1	Silver (Ag)	1.6	0.7	<5.0	2.0	<1.0	1.3	12.7	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	12.7	2.5
289.1	Zinc (Zn)	21.5	17.0	12.8	17.9	12.7	21.0	16.3	30.6	21.7	13.8	16.1	30.4	12.7	30.6	19.3

* Monthly Average
All units are in mg/L unless otherwise indicated.
All Inorganic Trace Metals are in ug/L

CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT

WATER RESOURCES DIVISION LABORATORY

MONITORING AND REPORTING PROGRAM NO. 90-103

EL ESTERO WWTP RECLAIMED DISTRIBUTION WATER ANNUAL SUMMARY 2010

EPA METHODS	PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MIN	MAX	AVG
600/8-78-017	Total Coliform Bacteria, MPN/100 mL (7-Day Median)	<1.1	<1.1	1.1	<1.1	<1.1	<1.1	1.1	1.1	1.3	1.1	<1.1	<1.1	<1.1	1.3	1.1
310.1	Alkalinity (as CaCO3)	176	183	228	217	193	208	253	265	218	222	200	191	176	265	213
Calc.	Bicarbonate (HCO3)	215	223	278	265	235	254	309	323	266	271	244	233	215	323	260
215.2	Calcium (Ca)	83.3	83.3	82.9	98.1	87.3	96.1	93.3	99.3	93.7	104	82.5	80.1	80.1	104	90.3
130.2	Total Hardness (CaCO3)	382	386	373	424	386	430	418	454	412	440	372	370	370	454	404
375.4	Sulfate (SO4)	287	261	320	267	249	273	265	330	257	285	253	250	249	330	275
407A	Chloride (Cl)	209	207	247	139	47.2	76.9	85	168	63.5	58.9	153	307	47.2	307	147
352.1	Nitrate as Nitrogen (NO3-N)	2.42	5.23	2.02	0.61	0.14	<0.1	0.13	0.26	0.12	0.15	0.35	4.56	<0.1	5.23	1.3
354.1	Nitrite as Nitrogen (NO2-N)	0.69	0.60	0.71	0.26	<0.1	0.11	<0.1	<0.1	<0.1	<0.1	0.38	0.39	<0.1	0.71	0.3
300	Fluoride (F)	0.60	0.62	0.89	0.44	0.39	0.35	0.38	0.70	0.32	0.75	0.90	0.68	0.32	0.90	0.59
300	Bromide (Br)	0.27	<0.1	<0.1	0.18	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.33	0.91	<0.1	0.91	0.2
350.3	Ammonia as Nitrogen	9.16	4.77	7.65	6.91	2.99	4.94	5.12	11.2	1.68	5.09	3.95	11.5	1.68	11.5	6.25
330.2.3	Chlorine Residual - Total*	2.25	1.8	2.89	3.85	2.76	2.71	3.48	3.3	1.38	2.94	2.92	4.	1.38	4.	2.86
160.2	Total Suspended Solids (TSS)*	2.09	1.85	2.15	1.88	1.19	1.22	1.26	1.55	1.35	1.45	1.33	1.7	1.19	2.15	1.59
160.1	Total Dissolved Solids (TDS)	847	904	920	876	642	738	870	976	759	750	710	736	642	976	811
150.1	pH, Units	7.44	7.52	8.03	8.12	8.02	8.17	7.95	7.89	7.84	8.14	7.88	7.73	7.44	8.17	7.89
110.2	Color, apparent unfiltered	8	13	18	<5	<5	7	17	17	7	6	7	8	<5	18	10
120.1	Conductivity (EC), umhos/cm	1311	1421	1509	1349	919	1101	1600	1667	1153	1105	1099	1207	919	1667	1287
180.1	Turbidity, NTUs	1.43	1.71	2.72	1.94	0.47	0.72	2.52	1.47	0.97	0.98	1.71	1.36	0.47	2.72	1.50
365.2	Phosphorous (P)	<0.10	0.400	<0.100	0.284	0.11	0.11	0.1	<0.1	0.2	0.2	0.3	0.3	<0.1	0.400	0.2
212.3	Boron (B)	0.40	0.37	0.39	0.39	0.32	0.38	0.4	0.5	0.4	0.5	0.4	0.4	0.32	0.5	0.40
273.1	Sodium (Na)	114	119	151	104	48.4	64.0	149	150	78.4	70.2	82.4	98.6	48.4	151	102
258.1	Potassium (K)	13.3	14.4	17.7	11.3	3.80	5.78	19.4	18.5	9.08	6.60	8.50	11.8	3.80	19.4	11.7
242.1	Magnesium (Mg)	40.6	40.0	40.6	43.2	33.6	40.4	45.0	47.4	38.2	47.0	42.8	38.4	33.6	47.4	41.4
Calc.	Sodium Absorption Ratio (SAR)	2.56	2.68	3.40	2.20	1.12	1.38	3.17	3.10	1.72	1.43	1.83	2.27	1.12	3.40	2.24
Calc.	Adjusted Sodium Absorption Ratio (SARa)	5.70	6.00	7.88	5.19	2.53	3.24	7.63	7.58	4.05	3.45	4.22	5.10	2.53	7.88	5.21
206.2	Arsenic (As)	<1.0	6.1	2.4	1.3	<1.0	<1.0	1.3	2.0	<15.0	1.6	1.4	1.3	1.3	<15.0	3.0
213.1	Cadmium (Cd)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<10.0	1.8
218.1	Chromium (Cr)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10.0	<1.0	<1.0	1.2	<1.0	<10.0	1.8
220.1	Copper (Cu)	3.3	2.8	6.5	4.4	3.9	1.5	6.3	7.2	<10.0	3.1	3.4	11.2	3.1	11.2	5.3
236.1	Iron (Fe)	60	81	170	71	35	114	210	100	<100	92	192	136	92	210	113
239.2	Lead (Pb)	4.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5.4	<10.0	<1.0	<1.0	<1.0	<1.0	<10.0	2.4
245.1	Mercury (Hg)	<0.2	<30	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2	<0.2	<30	2.7
246.2	Molybdenum (Mo)	8.5	7.5	8.2	6.0	6.2	5.6	6.3	6.0	<10.0	6.9	8.0	8.3	6.9	<10.0	7.3
249.1	Nickel (Ni)	3.2	4.1	5.4	3.5	2.8	2.0	4.7	4.5	<10.0	3.8	3.4	2.0	2.0	<10.0	4.1
270.2	Selenium (Se)	2.5	<1.0	2.3	<1.0	<1.0	1.6	1.7	1.9	<15.0	1.6	1.3	2.6	1.3	<15.0	2.8
272.1	Silver (Ag)	1.3	0.2	0.5	<1.0	1.7	1.7	<1.0	11.2	<5.0	<1.0	4.7	3.8	<1.0	11.2	2.8
289.1	Zinc (Zn)	15.2	18.7	25.1	23.1	11.0	25.8	24.6	20.2	17.1	13.7	17.4	29.8	11.0	29.8	20.1

* Monthly Average

All units are in mg/L unless otherwise indicated.

All Inorganic Trace Metals are in ug/L

CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT

WATER RESOURCES DIVISION LABORATORY

MONITORING AND REPORTING PROGRAM NO. 90-103

EL ESTERO WWTP RECLAIMED DISTRIBUTION WATER ANNUAL SUMMARY 2011

EPA METHODS	PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MIN	MAX	AVG
600/8-78-017	Total Coliform Bacteria, MPN/100 mL (7-Day Median)	<1.1	1.1	1.1	<1.1	<1.1	1.1	1.1	1.1	1.2	1.1	1.2	1.1	<1.1	1.2	1.1
310.1	Alkalinity (as CaCO3)	215	180	229	180	181	188	201	220	284	211	233	260	180	284	215
Calc.	Bicarbonate (HCO3)	262	220	279	220	221	229	245	268	346	257	284	317	220	346	262
215.2	Calcium (Ca)	84.9	84.5	90.9	85.7	81.7	82.6	94.5	92.1	96.1	97.7	86.5	88.5	81.7	97.7	88.8
130.2	Total Hardness (CaCO3)	418	364	387	354	348	356	402	411	438	410	374	404	348	438	389
375.4	Sulfate (SO4)	234	216	234	203	201	219	232	241	264	274	229	285	201	285	236
407A	Chloride (Cl)	82.8	37.2	63	20.6	34.9	17.9	43.1	31.6	113	42.2	42.2	144	17.9	144	56.0
352.1	Nitrate as Nitrogen (NO3-N)	0.17	<0.1	0.19	<0.1	0.14	<0.1	0.12	<0.1	0.21	0.15	0.15	2.27	<0.1	2.27	0.3
354.1	Nitrite as Nitrogen (NO2-N)	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.26	<0.1	<0.1	2.44	<0.1	2.44	0.3
300	Fluoride (F)	0.43	0.32	0.40	0.33	0.61	0.33	0.31	0.38	0.39	0.39	0.39	0.47	0.31	0.61	0.40
300	Bromide (Br)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
350.3	Ammonia as Nitrogen	6.15	<0.1	6.34	<0.1	<0.1	<2	<1	<2	8.35	<0.1	8.96	10.1	<0.1	10.1	3.8
330.2.3	Chlorine Residual - Total*	3.71	4.99	4.	4.15	2.23	2.47	1.98	2.79	1.85	2.04	1.94	2.75	1.85	4.99	2.91
160.2	Total Suspended Solids (TSS)*	1.46	1.08	1.16	1.03	1.	1.09	1.17	1.26	1.91	1.46	1.45	1.33	1.	1.91	1.28
160.1	Total Dissolved Solids (TDS)	732	587	803	540	514	547	627	677	938	692	739	910	514	938	692
150.1	pH, Units	7.93	8.22	8.11	8.16	8.32	8.29	8.07	8.08	7.95	8.08	7.96	8.07	7.93	8.32	8.10
110.2	Color, apparent unfiltered	6	<5	8	<5	<5	<5	<5	<5	16	<5	7	17	<5	17	7
120.1	Conductivity (EC), umhos/cm	1101	803	1183	815	805	8.16	999	1108	1279	953	1133	1565	8.16	1565	979
180.1	Turbidity, NTUs	1.32	0.47	1.53	0.37	0.21	0.21	0.42	0.46	1.57	0.29	0.83	1.62	0.21	1.62	0.78
365.2	Phosphorous (P)	0.3	<0.1	0.15	0.57	0.35	0.51	<0.10	<0.10	0.54	0.11	0.16	0.35	<0.10	0.57	0.28
212.3	Boron (B)	0.3	0.3	0.396	0.292	0.336	0.340	0.373	0.436	0.532	0.392	0.371	0.548	0.292	0.548	0.385
273.1	Sodium (Na)	105	62.8	112	44.8	41.6	42.4	48.4	57.6	136	62.4	94.0	157	41.6	157	80.3
258.1	Potassium (K)	12.5	4.20	13.3	2.84	2.94	3.26	3.88	6.30	17.2	3.78	10.3	17.4	2.84	17.4	8.16
242.1	Magnesium (Mg)	37.4	35.0	40.8	31.2	34.0	33.6	3.56	37.4	44.8	47.6	40.6	46.6	3.56	47.6	36.0
Calc.	Sodium Absorption Ratio (SAR)	2.39	1.45	2.45	1.05	0.98	0.99	1.33	1.28	2.87	1.29	2.09	3.36	0.98	3.36	1.79
Calc.	Adjusted Sodium Absorption Ratio (SARa)	5.50	3.23	5.78	2.34	2.17	9.34	12.49	12.02	27.00	12.17	19.64	31.60	2.17	31.60	11.9
206.2	Arsenic (As)	1.2	1.0	20.9	<1.0	18.7	1.1	4.3	4.9	1.6	12.7	1.2	1.6	<1.0	20.9	5.9
213.1	Cadmium (Cd)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
218.1	Chromium (Cr)	<1.0	<1.0	<1.0	<1.0	2.1	<1.0	1.4	1.8	<1.0	3.2	<1.0	<1.0	<1.0	3.2	1.4
220.1	Copper (Cu)	<5.0	10.6	3.6	<5.0	7.4	5.1	5.1	5.1	10.1	<5.0	7.2	5.4	<5.0	10.6	6.2
236.1	Iron (Fe)	131	68	135	<30	<30	<30	87	98	181	<30	77	150	<30	181	87.3
239.2	Lead (Pb)	<1.0	<1.0	2.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.8	1.2
245.1	Mercury (Hg)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
246.2	Molybdenum (Mo)	7.6	7.4	7.3	5.7	5.7	6.0	6.2	5.2	7.1	4.9	6.5	7.7	4.9	7.7	6.4
249.1	Nickel (Ni)	2.7	3.0	3.9	2.9	2.8	3.0	3.5	2.4	3.4	3.0	3.1	4.1	2.4	4.1	3.2
270.2	Selenium (Se)	2.2	2.0	<1.0	1.0	1.4	1.7	2.2	1.1	1.7	<1.0	<1.0	1.7	<1.0	2.2	1.5
272.1	Silver (Ag)	<1.0	1.1	8.5	6.1	2.6	10.9	17.5	<1.0	5.0	3.1	13.2	1.8	<1.0	17.5	6.0
289.1	Zinc (Zn)	31.9	10.5	16.3	17.2	15.7	16.6	13.0	10.8	16.4	9.3	7.3	23.1	7.3	31.9	15.7

* Monthly Average

All units are in mg/L unless otherwise indicated.

All Inorganic Trace Metals are in ug/L

CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT								
WATER RESOURCES DIVISION LABORATORY								
MONITORING AND REPORTING PROGRAM NO. 90-103								
Minimum								
EPA METHODS		**PARAMETER**	2006	2007	2008	2009	2010	2011
600/8-		Total Coliform Bacteria,	1.1	1.1	<1.1	<1.1	<1.1	<1.1
78-017		MPN/100 mL (7-Day Median)	0	0	242	0	0	0
310.1		Alkalinity (as CaCO3)	208	268	179	181	176	180
Calc.		Bicarbonate (HCO3)	253.76	327	218	221	215	220
215.2		Calcium (Ca)	91.3	85.7	84.1	83.3	80.1	81.7
130.2		Total Hardness (CaCO3)	412	398	355	378	370	348
375.4		Sulfate (SO4)	276	263	226	237	249	201
407A		Chloride (Cl)	157	78.7	27.9	68.1	47.2	17.9
352.1		Nitrate as Nitrogen (NO3-N)	1.2	0.24	0.24	0.45	<0.1	<0.1
354.1		Nitrite as Nitrogen (NO2-N)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
300		Fluoride (F)	0.18	0.36	0.26	0.40	0.32	0.31
300		Bromide (Br)	<0.1	0.31	<0.1	<0.1	<0.1	<0.1
350.3		Ammonia as Nitrogen	<1.0	15.7	0.22	0.7	1.68	<0.1
330.2.3		Chlorine Residual - Total*	3.35	4.85	2.49	1.57	1.38	1.85
160.2		Total Suspended Solids (TSS)*	1.1	1.48	1.17	1.72	1.19	1.
160.1		Total Dissolved Solids (TDS)	822	1021	720	702	642	514
150.1		pH, Units	7.67	7.59	7.85	7.53	7.44	7.93
110.2		Color, apparent unfiltered	7	11	5	<5	<5	<5
120.1		Conductivity (EC), umhos/cm	1130	1639	860	1031	919	8.16
180.1		Turbidity, NTUs	1.05	1.64	0.64	0.82	0.47	0.21
365.2		Phosphorous (P)	0.31	0.31	0.40	<0.1	<0.1	<0.10
212.3		Boron (B)	0.45	0.41	0.36	0.34	0.32	0.292
273.1		Sodium (Na)	95	127	60.8	59.2	48.4	41.6
258.1		Potassium (K)	9.82	2.604	4.84	6.12	3.80	2.84
242.1		Magnesium (Mg)	44.6	35.0	32.4	35.6	33.6	3.56
Calc.		Sodium Absorption Ratio (SAR)	1.99	2.80	1.29	1.31	1.12	0.98
Calc.		Adjusted Sodium Absorption Ratio (SARa)	4.72	6.88	3.01	3.02	2.53	2.17
			0	0	0	0	0	0
206.2		Arsenic (As)	<0.001	<0.001	<0.2	1.3	1.3	<1.0
213.1		Cadmium (Cd)	<0.01	<0.0001	<1.0	<1.0	<1.0	<1.0
218.1		Chromium (Cr)	<0.02	0.0018	<1.0	<1.0	<1.0	<1.0
220.1		Copper (Cu)	<0.01	0.0044	<0.2	1.5	3.1	<5.0
236.1		Iron (Fe)	0.1	0.081	0.120	48	92	<30
239.2		Lead (Pb)	<0.001	<0.0001	<1.0	<1.0	<1.0	<1.0
245.1		Mercury (Hg)	<0.0002	<0.0002	<0.2	<0.2	<0.2	<0.2
246.2		Molybdenum (Mo)	<0.001	<0.001	5.2	6.8	6.9	4.9
249.1		Nickel (Ni)	<0.06	0.0056	3.0	<1.0	2.0	2.4
270.2		Selenium (Se)	<0.001	<0.001	<1.0	<1.0	1.3	<1.0
272.1		Silver (Ag)	<0.01	0.0012	<1.0	<1.0	<1.0	<1.0
289.1		Zinc (Zn)	<0.02	<0.02	1.6	12.7	11.0	7.3
* Monthly Average								
All units are in mg/L unless otherwise indicated.								
All Inorganic Trace Metals are in ug/L								

CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT								
WATER RESOURCES DIVISION LABORATORY								
MONITORING AND REPORTING PROGRAM NO. 90-103								
Average								
EPA METHODS		**PARAMETER**	2006	2007	2008	2009	2010	2011
600/8-		Total Coliform Bacteria,	1.1	1.1	1.1	1.1	1.1	1.1
78-017		MPN/100 mL (7-Day Median)	0	0	242	0	0	0
310.1		Alkalinity (as CaCO3)	247	290	229	210	213	215
Calc.		Bicarbonate (HCO3)	301	354	279	256	260	262
215.2		Calcium (Ca)	98.4	93.2	94.0	94.2	90.3	88.8
130.2		Total Hardness (CaCO3)	439	430	409	420	404	389
375.4		Sulfate (SO4)	294	286	263	283	275	236
407A		Chloride (Cl)	272	247	162	163	147	56
352.1		Nitrate as Nitrogen (NO3-N)	4.4	0.91	2.05	3.48	1.3	0.3
354.1		Nitrite as Nitrogen (NO2-N)	0.9	1.3	0.5	1.2	0.3	0.3
300		Fluoride (F)	0.37	0.58	0.35	0.50	0.59	0.40
300		Bromide (Br)	0.5	0.81	0.3	0.1	0.2	<0.1
350.3		Ammonia as Nitrogen	12.5	22.1	6.90	5.3	6.25	3.8
330.2.3		Chlorine Residual - Total*	5.06	6.14	3.54	2.91	2.86	2.91
160.2		Total Suspended Solids (TSS)*	2.2	2.09	1.47	2.17	1.59	1.28
160.1		Total Dissolved Solids (TDS)	1178	1179	939	911	811	692
150.1		pH, Units	8.01	7.95	8.11	7.86	7.89	8.14
110.2		Color, apparent unfiltered	16.8	17.7	10.9	10.6	10	7
120.1		Conductivity (EC), umhos/cm	1873	1913	1462	1448	1287	979
180.1		Turbidity, NTUs	2.06	2.58	1.7	1.97	1.5	0.78
365.2		Phosphorous (P)	0.97	0.69	0.39	0.3	0.2	0.28
212.3		Boron (B)	0.58	0.58	0.49	0.43	0.40	0.385
273.1		Sodium (Na)	176	169	128	115	102	80.3
258.1		Potassium (K)	25.0	23.4	17.7	14.2	11.7	8.16
242.1		Magnesium (Mg)	49.4	42.7	40.4	41.4	41.4	36.0
Calc.		Sodium Absorption Ratio (SAR)	3.65	3.63	2.77	2.48	2.24	1.79
Calc.		Adjusted Sodium Absorption Ratio (SARa)	8.82	8.90	6.53	5.78	5.21	11.9
206.2		Arsenic (As)	<0.001	0.001	2.0	3.0	3.0	5.9
213.1		Cadmium (Cd)	<0.01	0.009	<1.0	1.3	1.8	<1.0
218.1		Chromium (Cr)	<0.02	0.018	8.7	1.5	1.8	1.4
220.1		Copper (Cu)	<0.01	0.010	3.3	4.7	5.3	6.2
236.1		Iron (Fe)	0.2	0.173	89.9	91.9	113	87.3
239.2		Lead (Pb)	<0.001	0.001	<1.0	1.3	2.4	1.2
245.1		Mercury (Hg)	<0.0002	<0.0002	<0.2	0.2	2.7	<0.2
246.2		Molybdenum (Mo)	0.005	0.005	7.4	8.2	7.3	6.4
249.1		Nickel (Ni)	<0.06	0.055	4.7	3.6	4.1	3.2
270.2		Selenium (Se)	<0.001	0.001	3.0	3.1	2.8	1.5
272.1		Silver (Ag)	<0.01	0.010	3.9	2.5	2.8	6.0
289.1		Zinc (Zn)	0.03	0.12	17.9	19.3	20.1	15.7
* Monthly Average								
All units are in mg/L unless otherwise indicated.								
All Inorganic Trace Metals are in ug/L								

CITY OF SANTA BARBARA - PUBLIC WORKS DEPARTMENT								
WATER RESOURCES DIVISION LABORATORY								
MONITORING AND REPORTING PROGRAM NO. 90-103								
Maximum								
EPA METHODS		**PARAMETER**	2006	2007	2008	2009	2010	2011
600/8-		Total Coliform Bacteria,	1.1	1.1	1.1	1.2	1.3	1.2
78-017		MPN/100 mL (7-Day Median)	0	0	242	0	0	0
310.1		Alkalinity (as CaCO3)	314	374	300	245	265	284
Calc.		Bicarbonate (HCO3)	383.08	456	366	299	323	346
215.2		Calcium (Ca)	108.1	97.7	104.9	102	104	97.7
130.2		Total Hardness (CaCO3)	462	449	472	456	454	438
375.4		Sulfate (SO4)	322	308	301	337	330	285
407A		Chloride (Cl)	337	328	257	286	307	144
352.1		Nitrate as Nitrogen (NO3-N)	9.48	2.65	5.24	21.3	5.23	2.27
354.1		Nitrite as Nitrogen (NO2-N)	1.56	3.09	1.63	5.33	0.71	2.44
300		Fluoride (F)	0.6	2.04	0.42	0.63	0.90	0.61
300		Bromide (Br)	0.9	3.00	0.68	0.30	0.91	<0.1
350.3		Ammonia as Nitrogen	25.8	29.4	19.5	11.3	11.5	10.1
330.2.3		Chlorine Residual - Total*	8.15	7.68	4.43	4.16	4	4.99
160.2		Total Suspended Solids (TSS)*	6.53	2.8	2.35	2.78	2.15	1.91
160.1		Total Dissolved Solids (TDS)	1323	1505	1123	1090	976	938
150.1		pH, Units	8.33	8.26	8.24	8.23	8.17	8.32
110.2		Color, apparent unfiltered	25	28	20	17	18	17
120.1		Conductivity (EC), umhos/cm	2340	2100	1895	1828	1667	1565
180.1		Turbidity, NTUs	3.7	3.55	3.57	5.12	2.72	1.62
365.2		Phosphorous (P)	1.7	2.1	<1.0	0.47	0.400	0.57
212.3		Boron (B)	0.71	0.78	0.62	0.55	0.5	0.548
273.1		Sodium (Na)	240	211	199	174	151	157
258.1		Potassium (K)	34.7	32.4	29.5	21.5	19.4	17.4
242.1		Magnesium (Mg)	54.6	51.0	49.2	46.0	47.4	47.6
Calc.		Sodium Absorption Ratio (SAR)	4.8	4.31	4.23	3.80	3.40	3.36
Calc.		Adjusted Sodium Absorption Ratio (SARa)	11.77	11.15	10.03	8.58	7.88	31.60
206.2		Arsenic (As)	<0.001	0.0021	7.8	<15.0	<15.0	20.9
213.1		Cadmium (Cd)	<0.01	<0.01	<1.0	<5.0	<10.0	<1.0
218.1		Chromium (Cr)	<0.02	<0.02	19.4	<5.0	<10.0	3.2
220.1		Copper (Cu)	<0.01	0.011	6.3	21.5	11.2	10.6
236.1		Iron (Fe)	0.44	0.253	290	146	210	181
239.2		Lead (Pb)	<0.001	0.0056	<1.0	<5.0	<10.0	2.8
245.1		Mercury (Hg)	<0.0002	<0.0002	<0.2	<0.5	<30	<0.2
246.2		Molybdenum (Mo)	0.011	0.0108	11.0	9.8	<10.0	7.7
249.1		Nickel (Ni)	<0.06	<0.06	6.5	5.2	<10.0	4.1
270.2		Selenium (Se)	<0.001	0.0040	12.9	<15.0	<15.0	2.2
272.1		Silver (Ag)	<0.01	0.013	15.7	12.7	11.2	17.5
289.1		Zinc (Zn)	0.04	0.429	31.8	30.6	29.8	31.9
* Monthly Average								
All units are in mg/L unless otherwise indicated.								
All Inorganic Trace Metals are in ug/L								

ATTACHMENT B
Historical Water Quality

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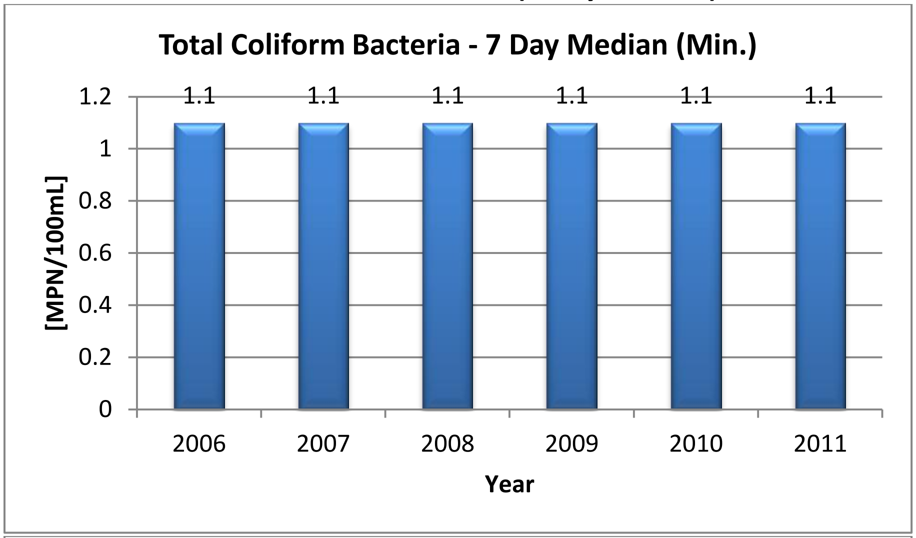
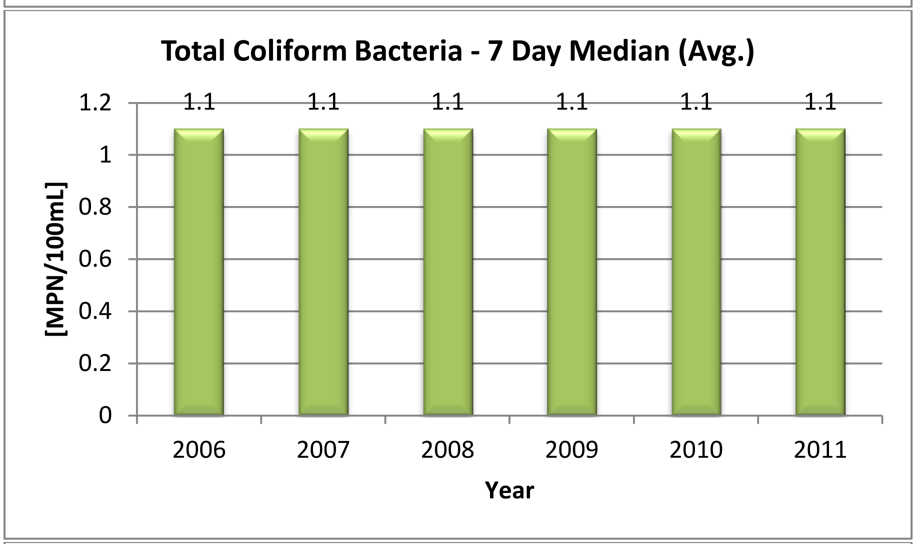
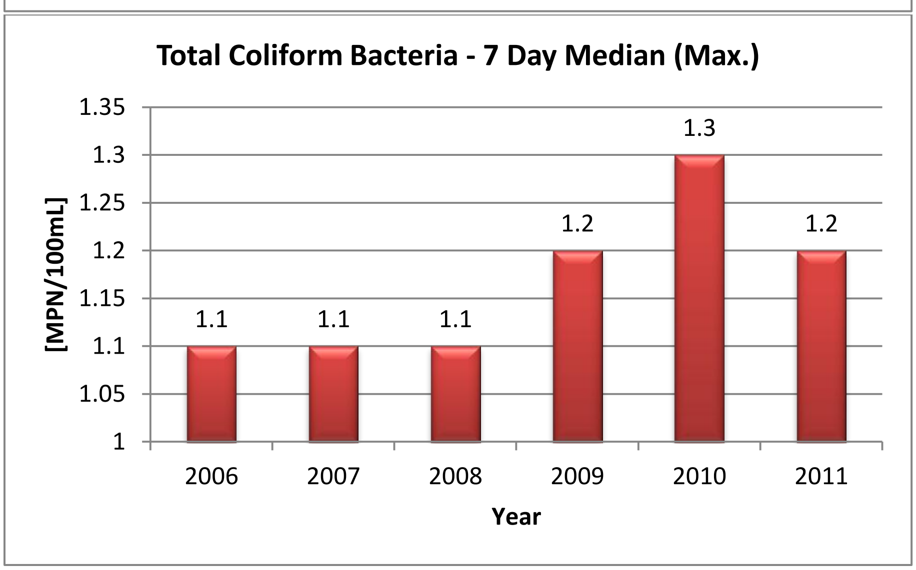
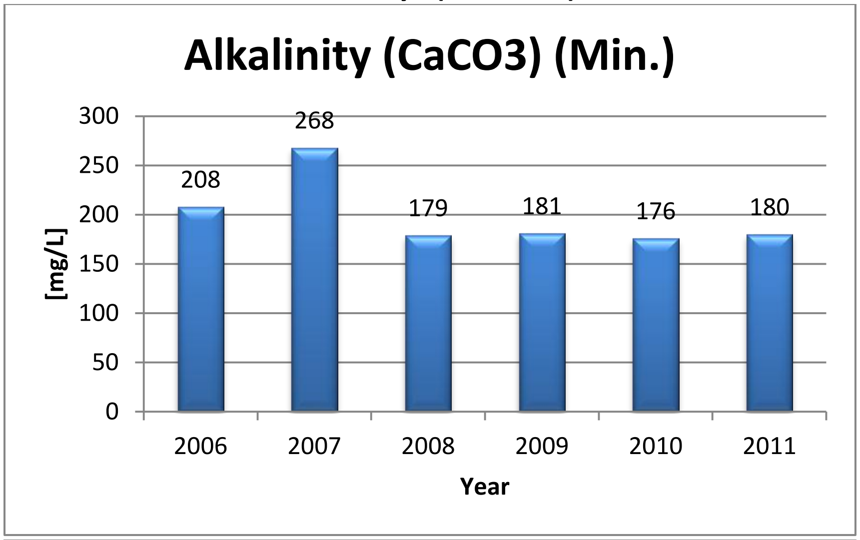
Total Coliform Bacteria (7 Day Median)

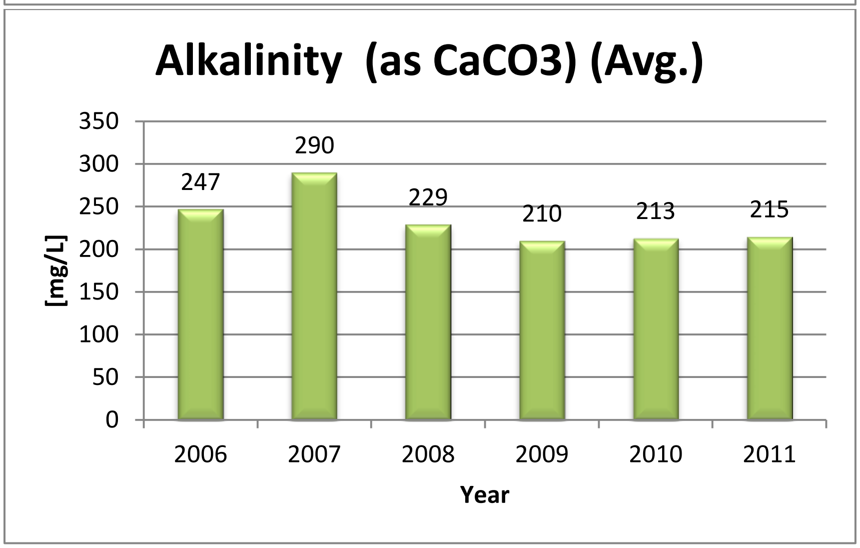


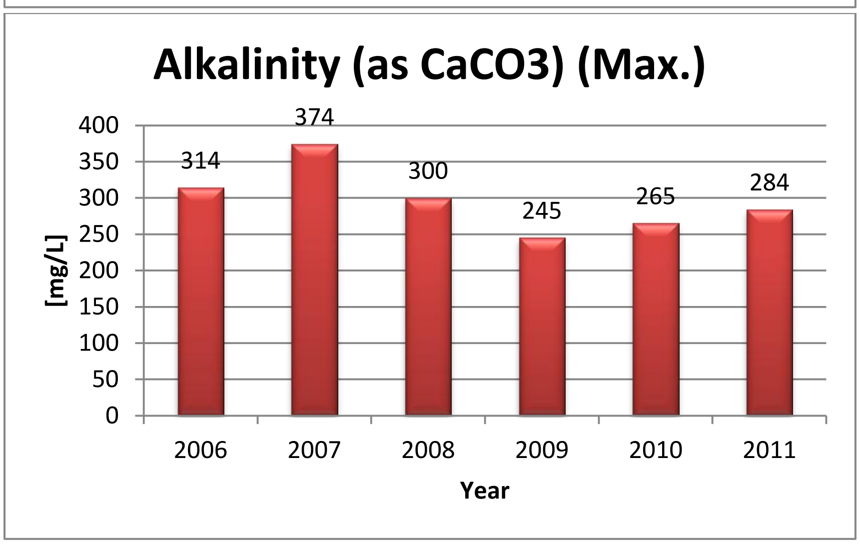




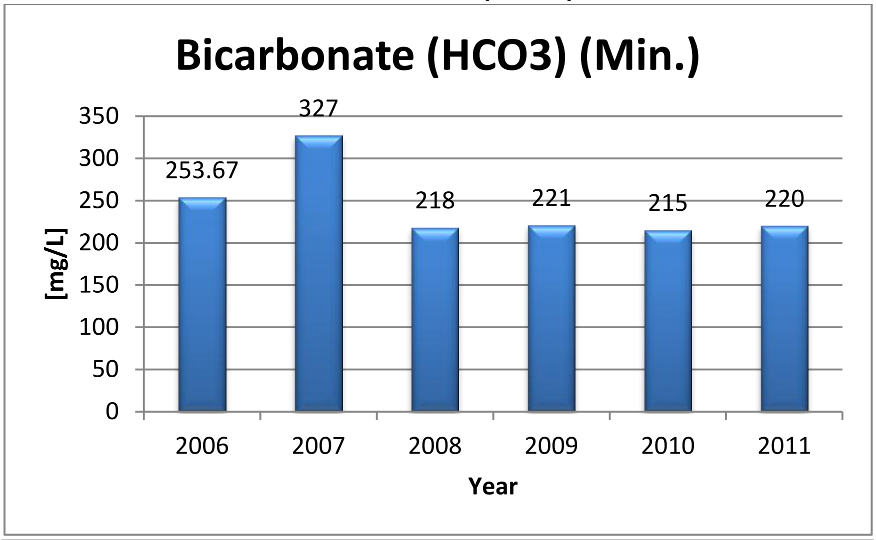
Alkalinity (as CaCO3)

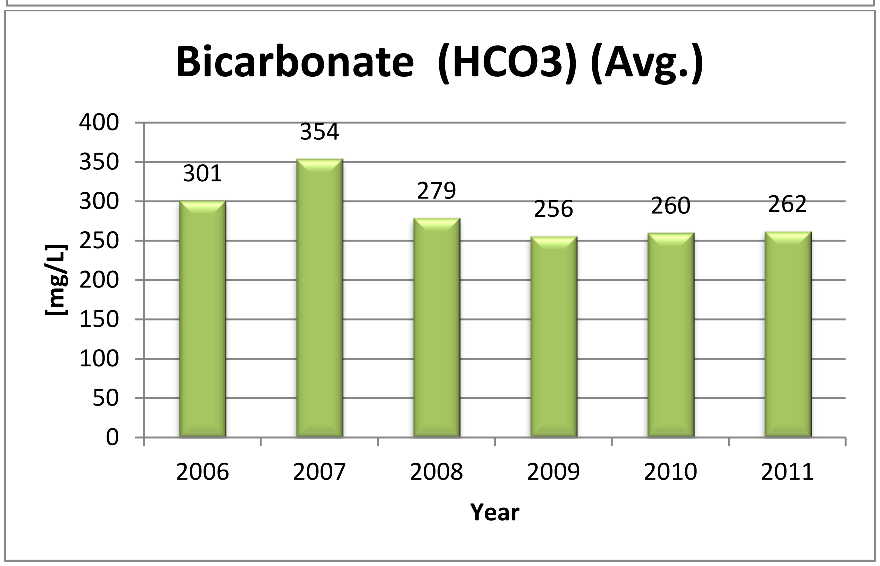


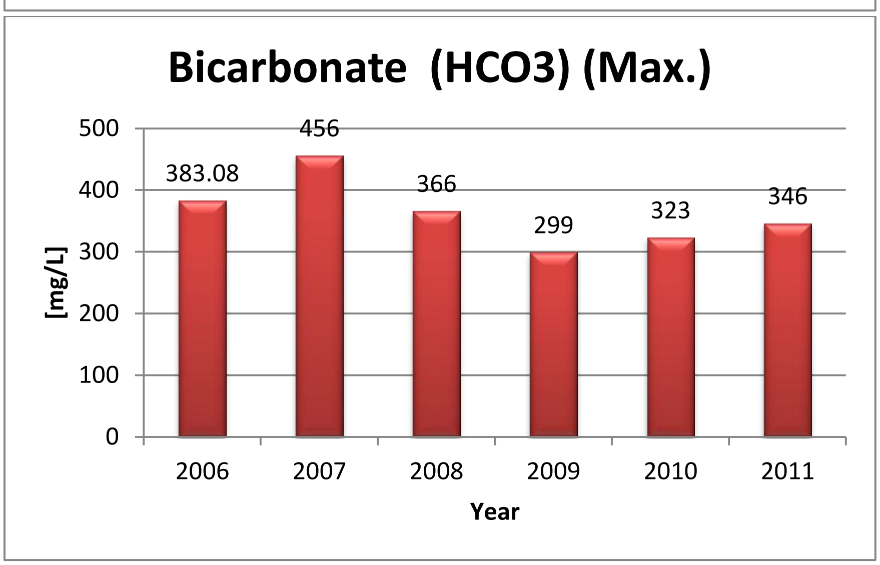




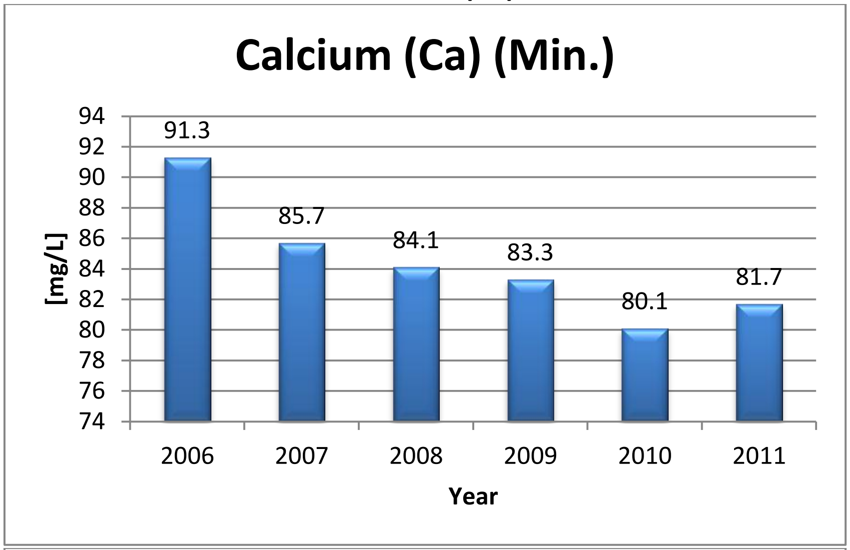
Bicarbonate (HCO3)

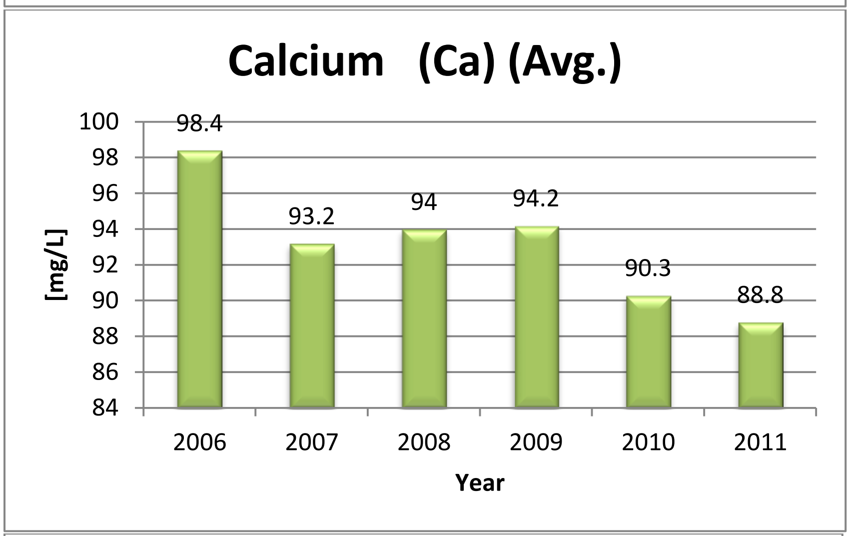


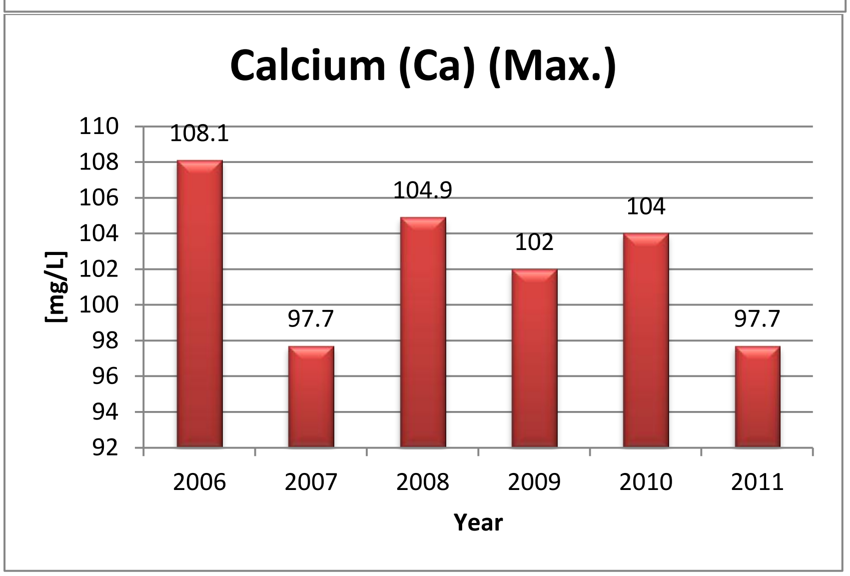




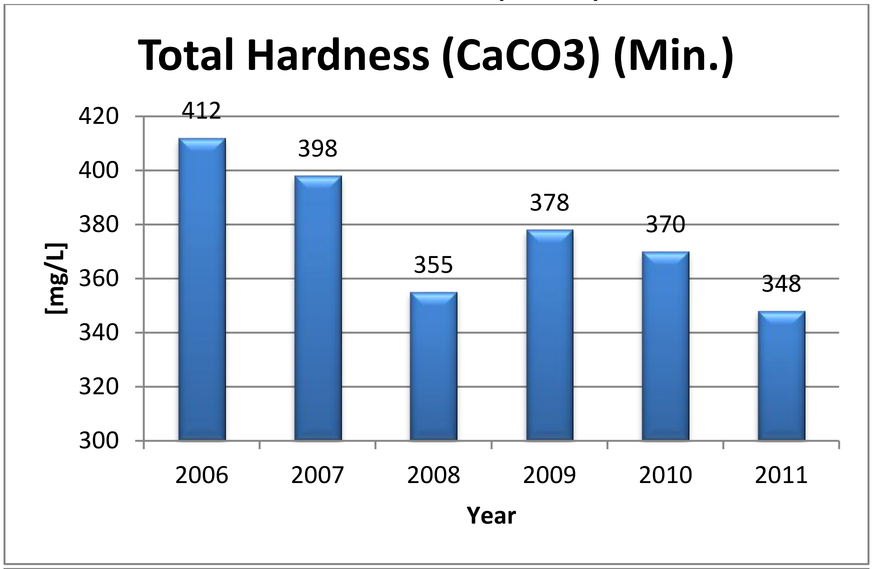
Calcium (Ca)

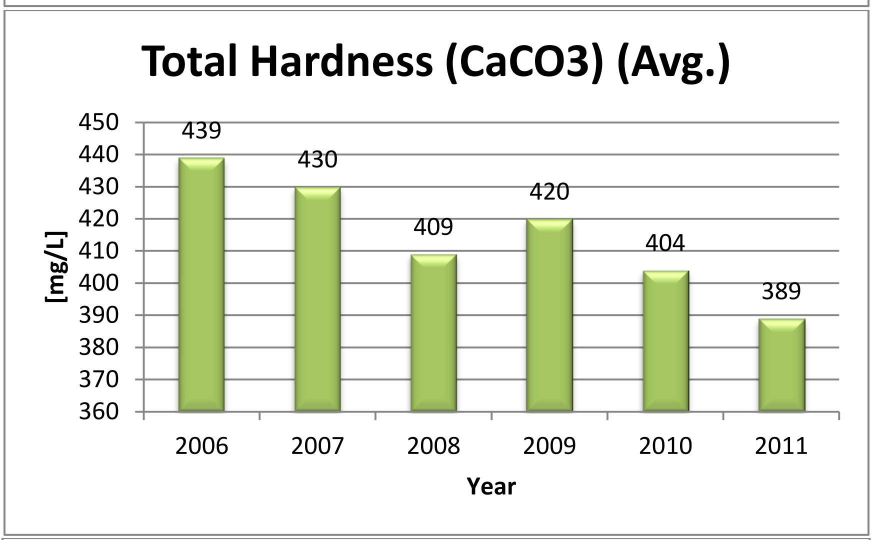

Calcium (Ca) (Min.)
[mg/L]
94
92
90
88
86
84
82
80
78
76
74
91.3
85.7
84.1
83.3
80.1
81.7
2006
2007
2008
2009
2010
2011
Year

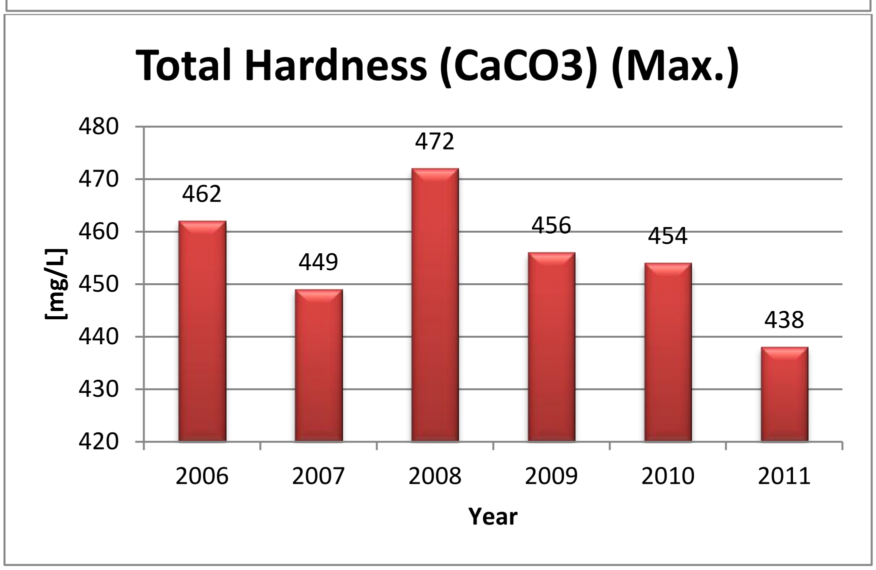

Calcium (Ca) (Avg.)
[mg/L]
100
98
96
94
92
90
88
86
84
98.4
93.2
94
94.2
90.3
88.8
2006
2007
2008
2009
2010
2011
Year


Calcium (Ca) (Max.)
[mg/L]
110
108
106
104
102
100
98
96
94
92
108.1
97.7
104.9
102
104
97.7
2006
2007
2008
2009
2010
2011
Year

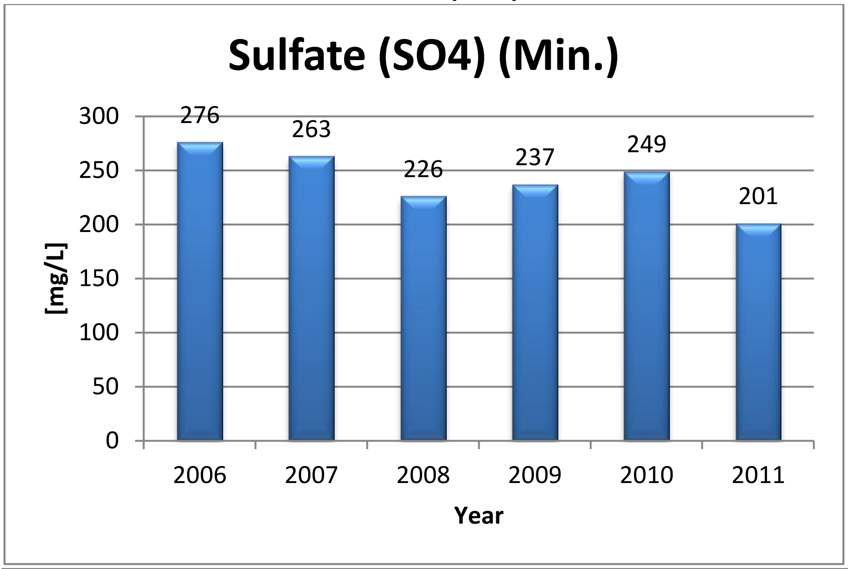
Total Hardness (CaCO3)



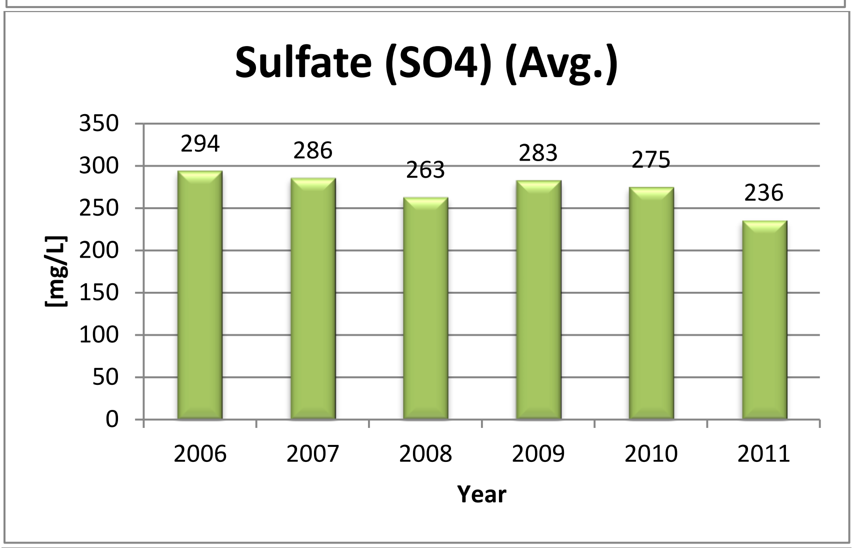




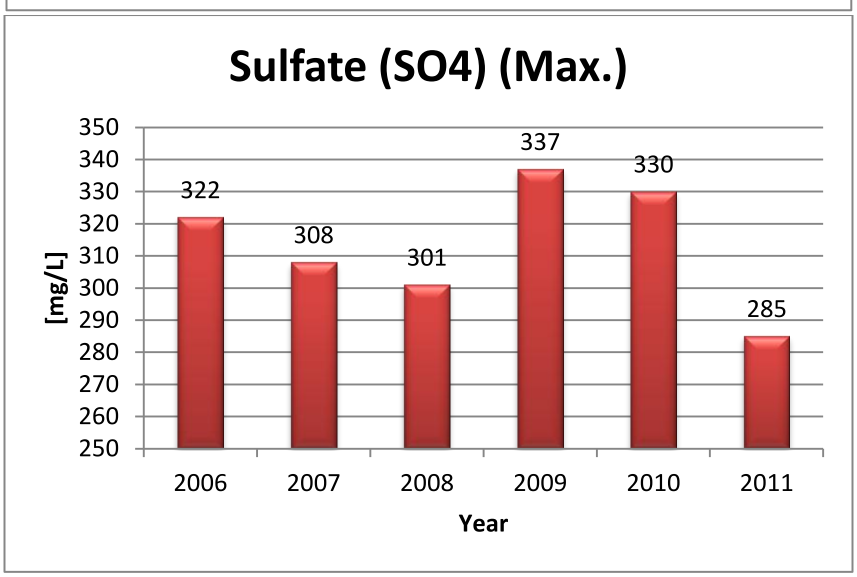
Sulfate (SO4)



Sulfate (SO4) (Min.)
[mg/L]
Year
300
250
200
150
100
50
0
276
263
226
237
249
201
2006
2007
2008
2009
2010
2011

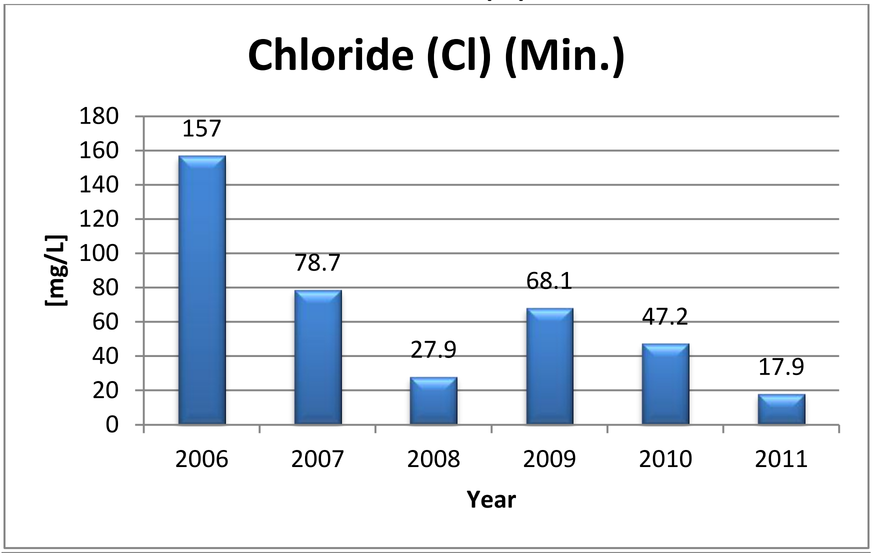


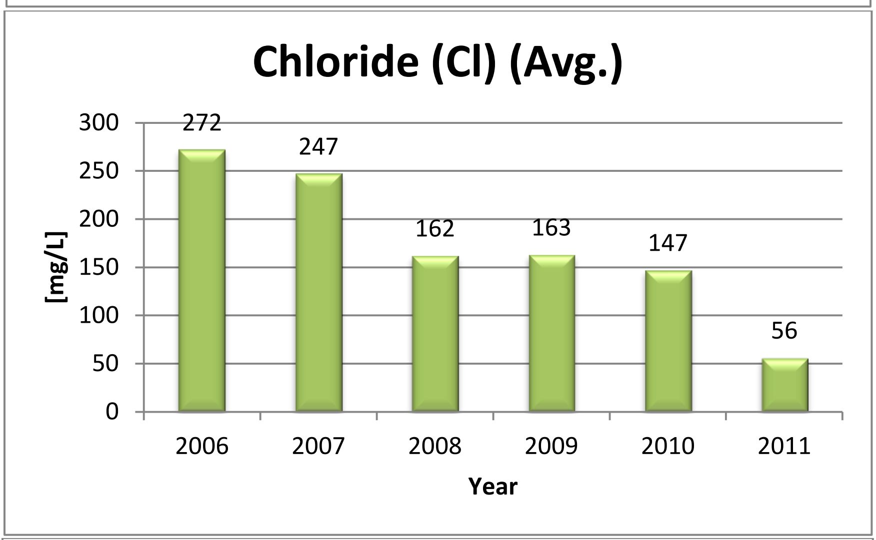
Sulfate (SO4) (Avg.)
[mg/L]
Year
350
300
250
200
150
100
50
0
294
286
263
283
275
236
2006
2007
2008
2009
2010
2011

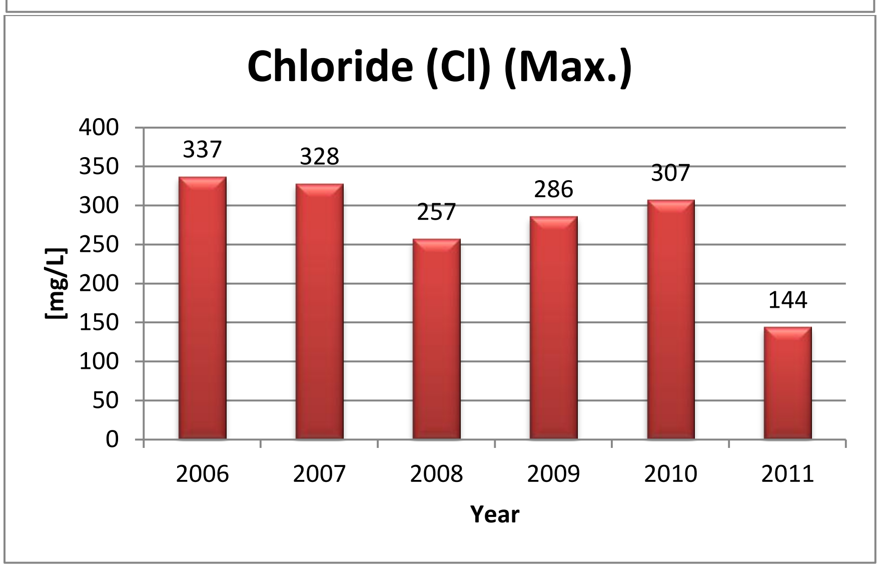


Sulfate (SO4) (Max.)
[mg/L]
Year
350
340
330
320
310
300
290
280
270
260
250
322
308
301
337
330
285
2006
2007
2008
2009
2010
2011

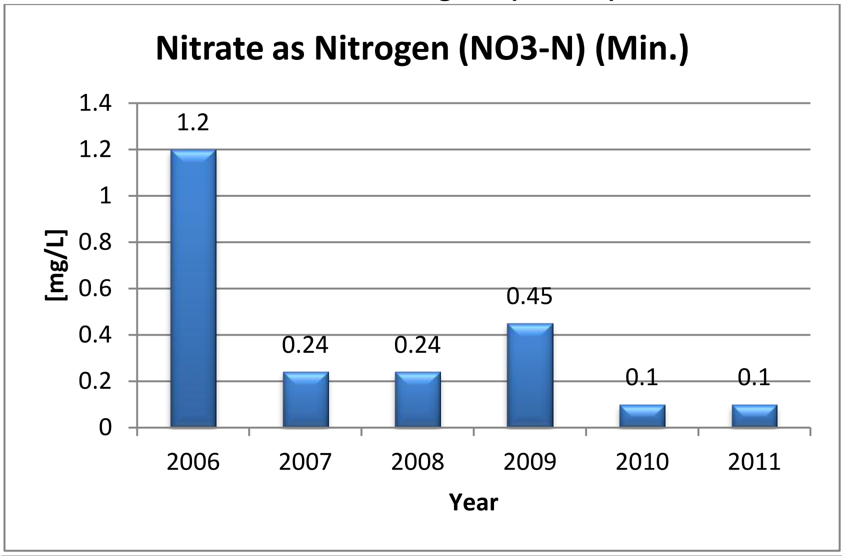
Chloride (Cl)

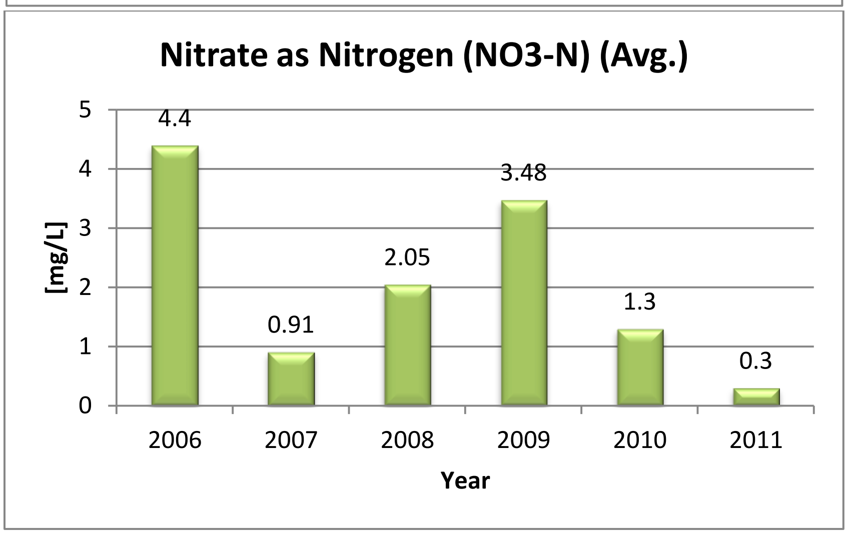

Chloride (Cl) (Min.)
180
160
140
120
100
80
60
40
20
0
[mg/L]
157
78.7
27.9
68.1
47.2
17.9
2006
2007
2008
2009
2010
2011
Year

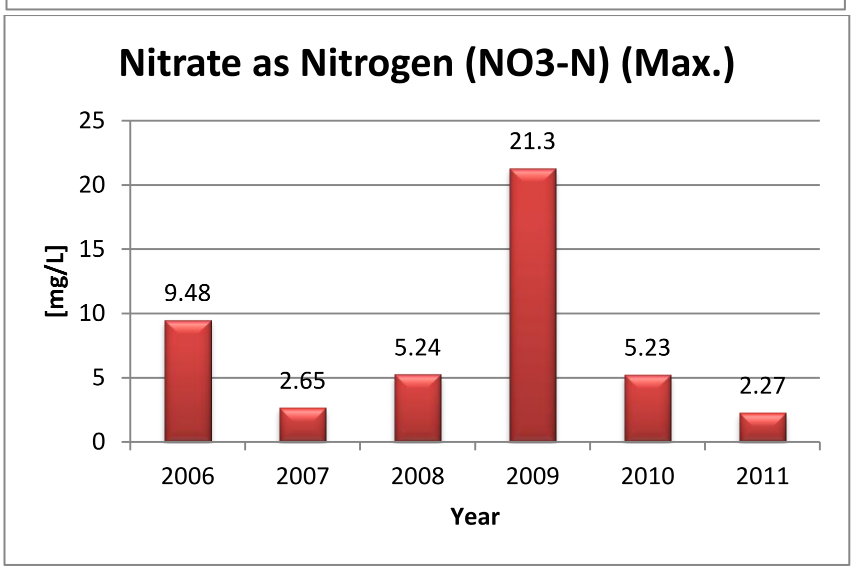

Chloride (Cl) (Avg.)
300
250
200
150
100
50
0
[mg/L]
272
247
162
163
147
56
2006
2007
2008
2009
2010
2011
Year


Chloride (Cl) (Max.)
400
350
300
250
200
150
100
50
0
[mg/L]
337
328
257
286
307
144
2006
2007
2008
2009
2010
2011
Year

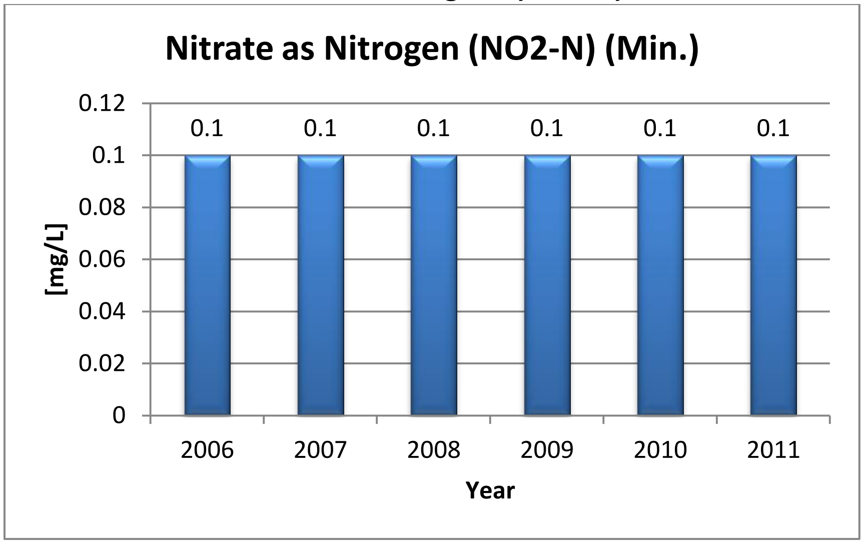
Nitrate as Nitrogen (NO3-N)

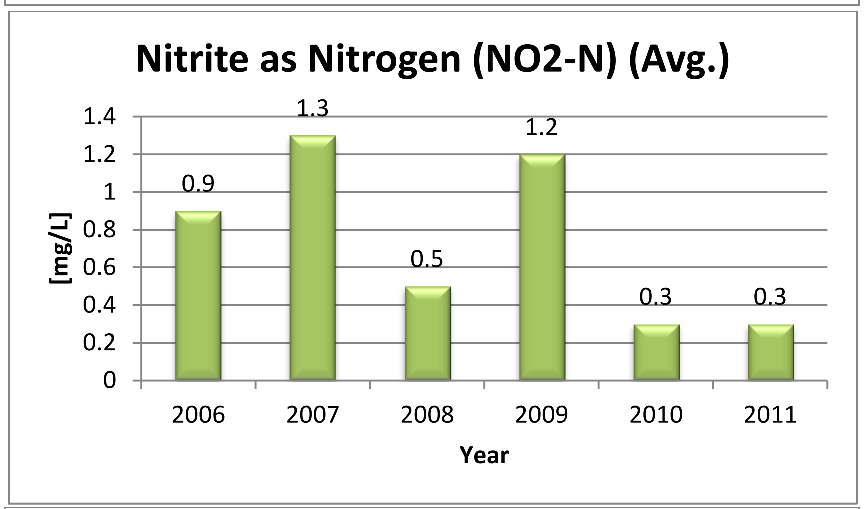


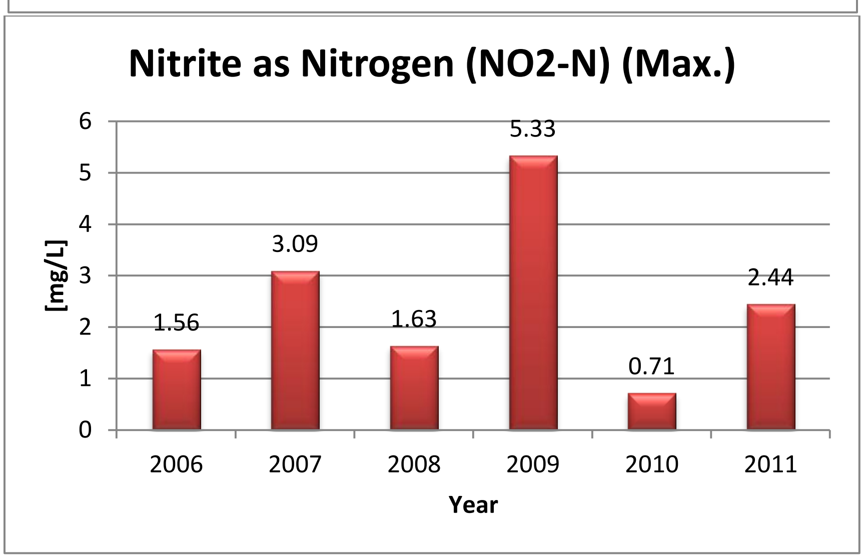




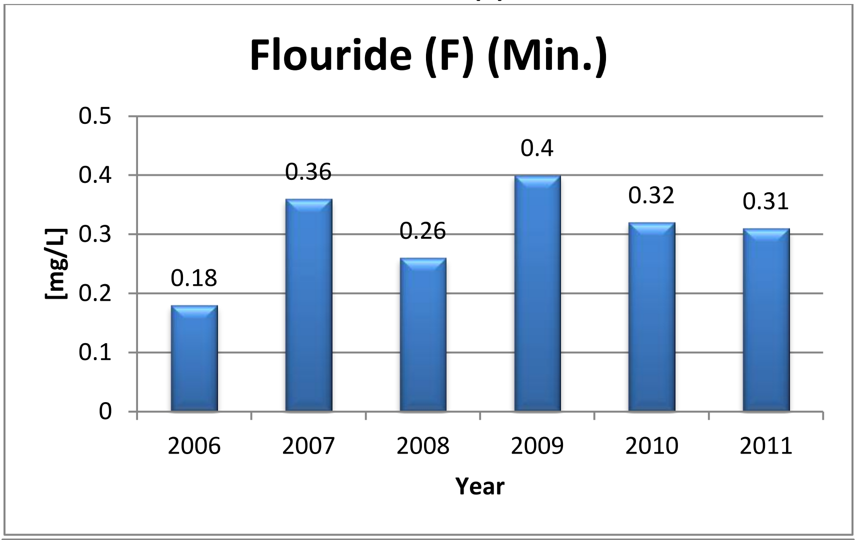
Nitrite as Nitrogen (NO2-N)



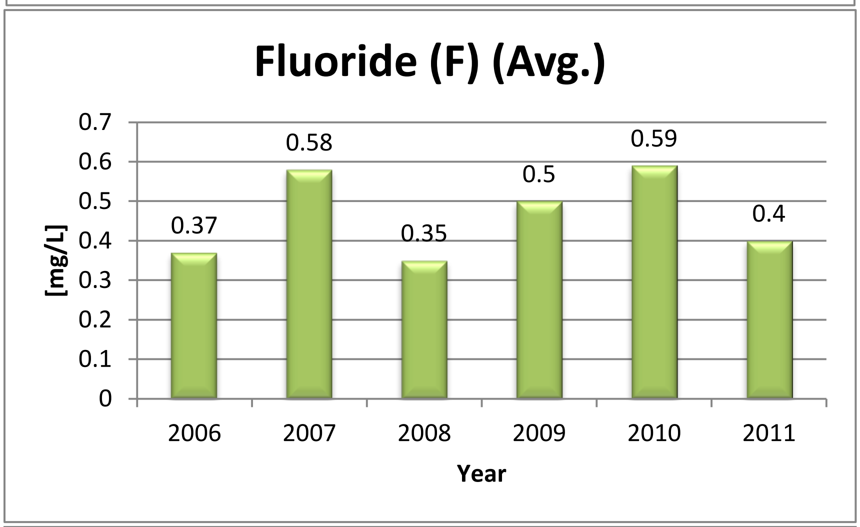




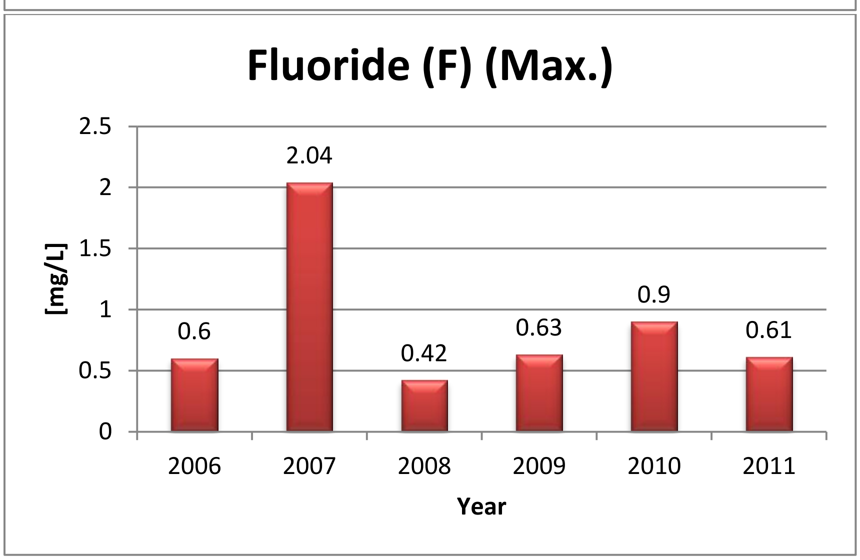
Fluoride (F)



Flouride (F) (Min.)
[mg/L]
0.5
0.4
0.3
0.2
0.1
0
0.18
0.36
0.26
0.4
0.32
0.31
2006
2007
2008
2009
2010
2011
Year

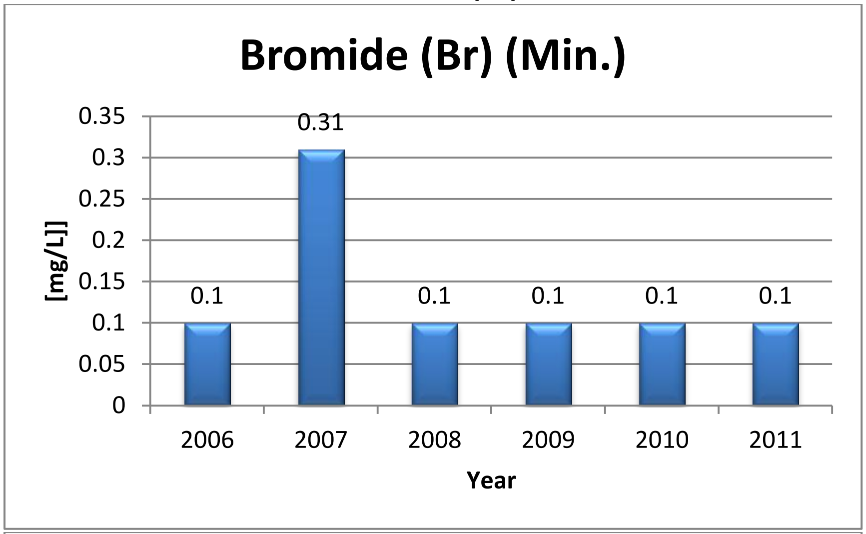


Fluoride (F) (Avg.)
[mg/L]
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.37
0.58
0.35
0.5
0.59
0.4
2006
2007
2008
2009
2010
2011
Year

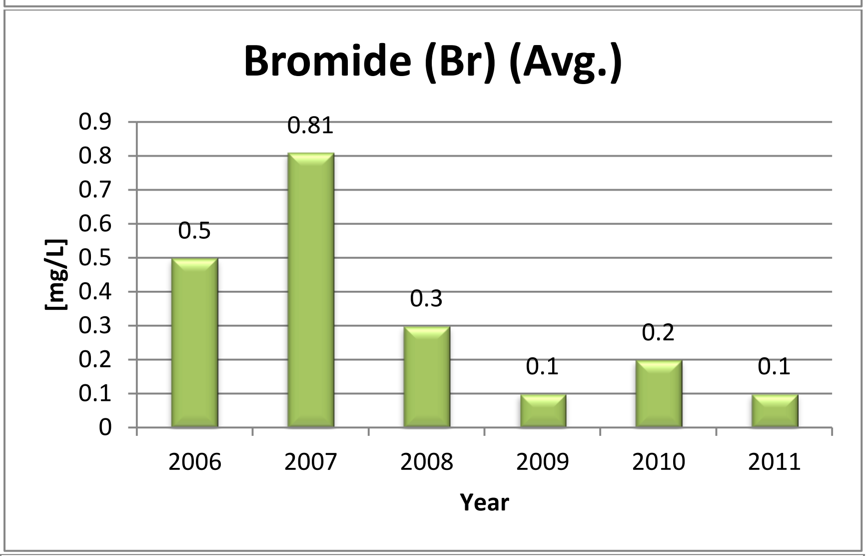


Fluoride (F) (Max.)
[mg/L]
2.5
2
1.5
1
0.5
0
0.6
2.04
0.42
0.63
0.9
0.61
2006
2007
2008
2009
2010
2011
Year

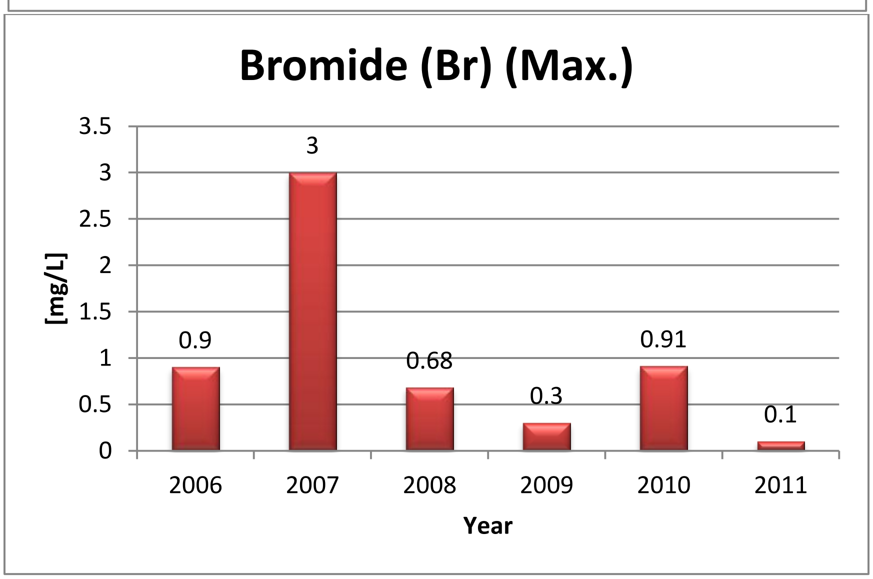
Bromide (Br)



Bromide (Br) (Min.)
[mg/L]
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.1
0.31
0.1
0.1
0.1
0.1
2006
2007
2008
2009
2010
2011
Year

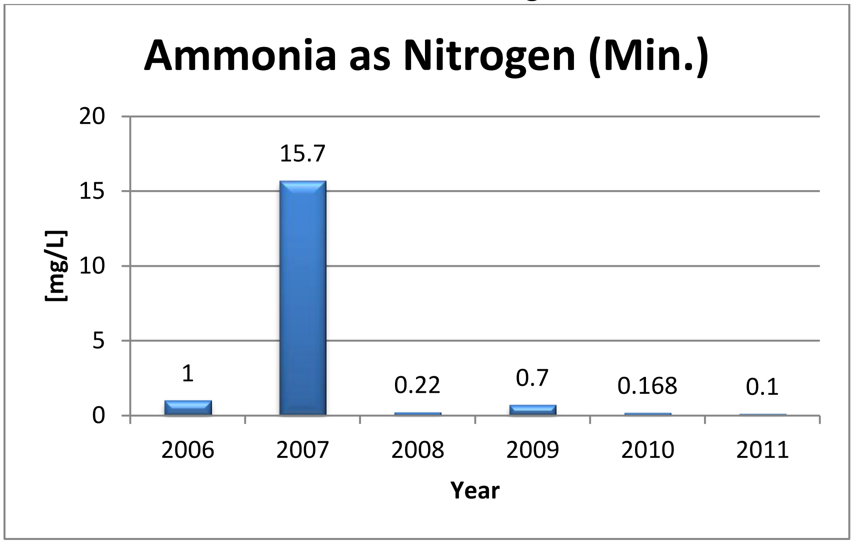


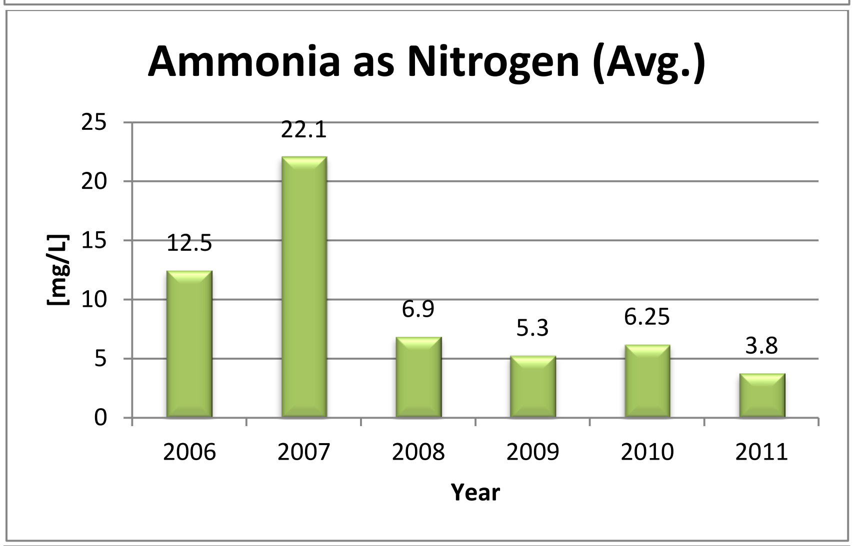
Bromide (Br) (Avg.)
[mg/L]
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.5
0.81
0.3
0.1
0.2
0.1
2006
2007
2008
2009
2010
2011
Year

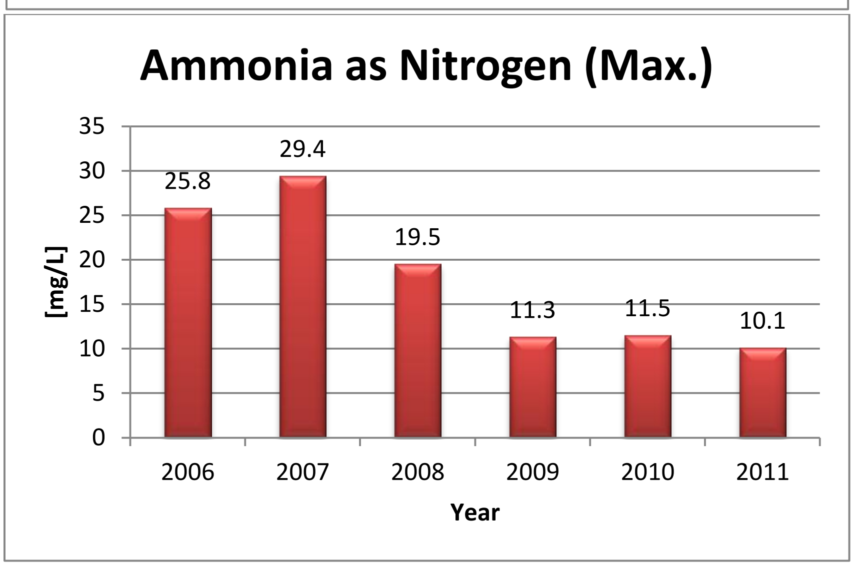


Bromide (Br) (Max.)
[mg/L]
3.5
3
2.5
2
1.5
1
0.5
0
0.9
3
0.68
0.3
0.91
0.1
2006
2007
2008
2009
2010
2011
Year

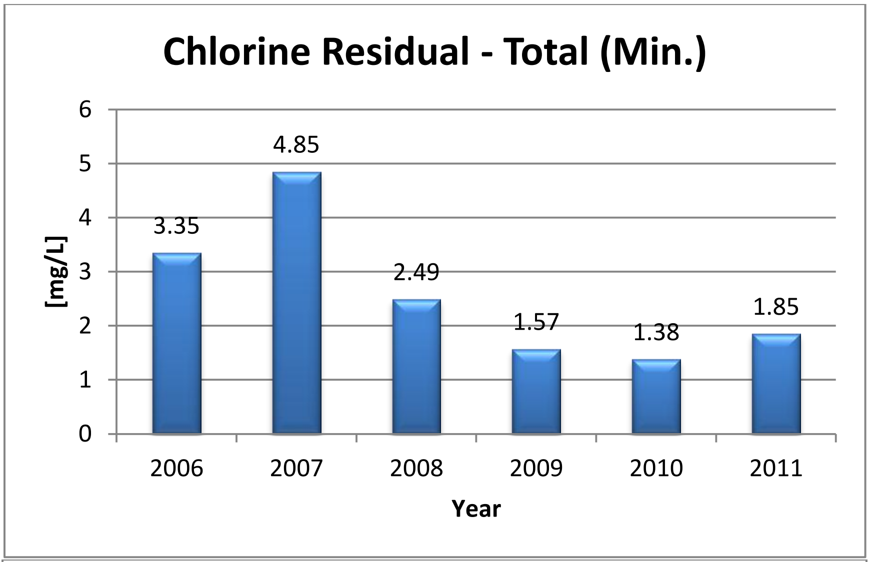
Ammonia as Nitrogen

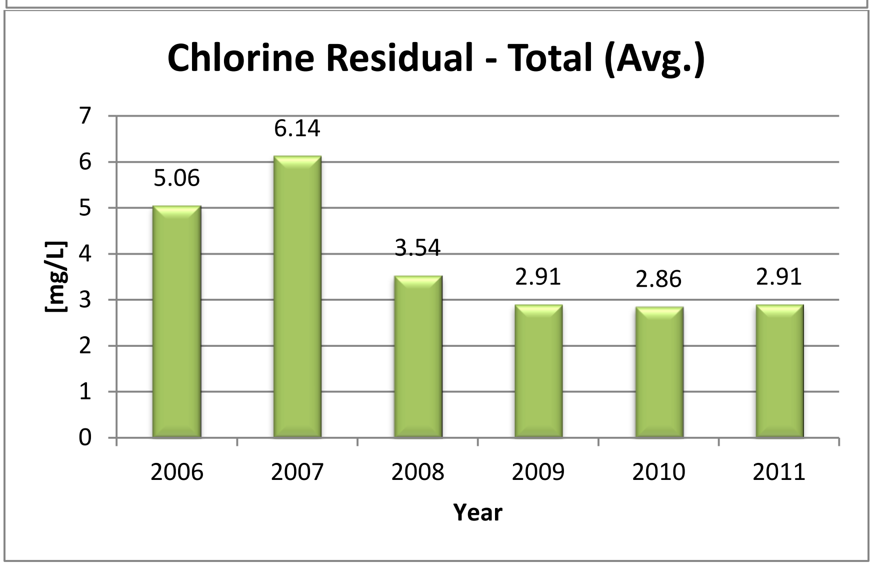


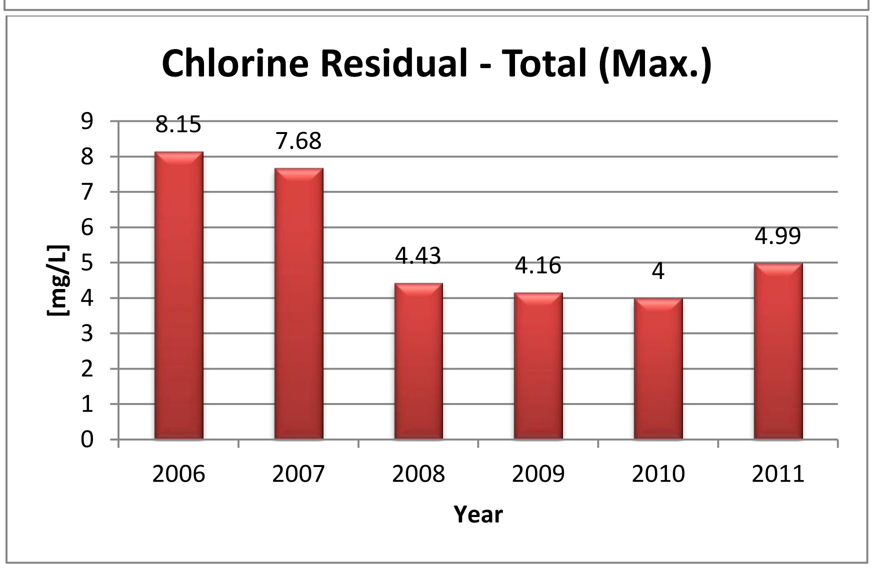




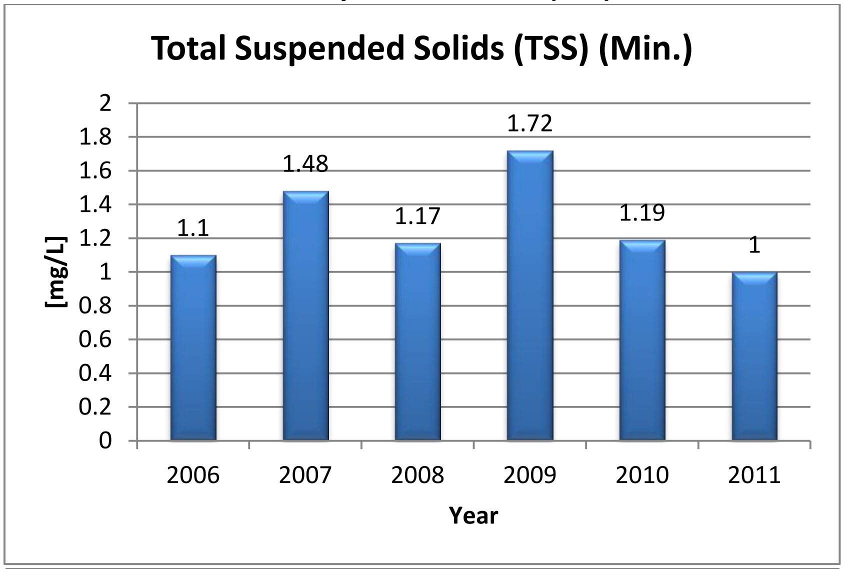
Chlorine Residual - Total*

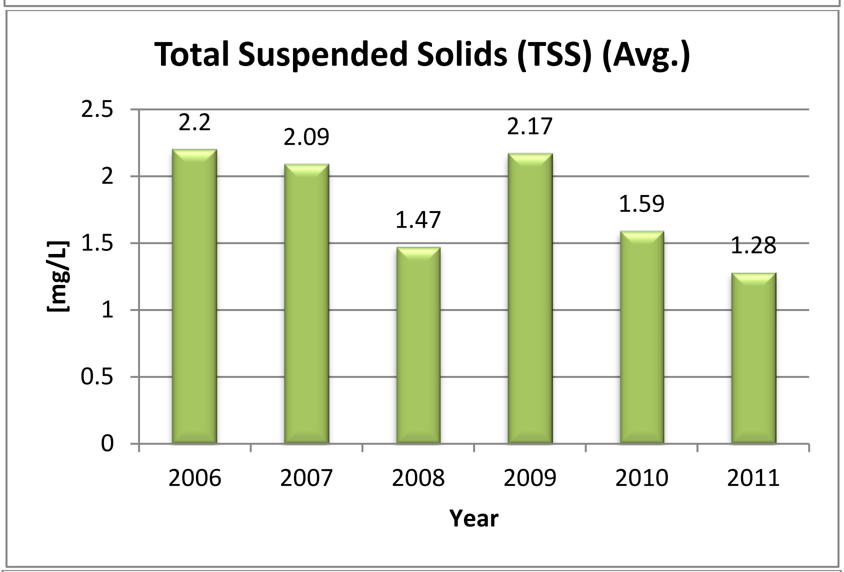


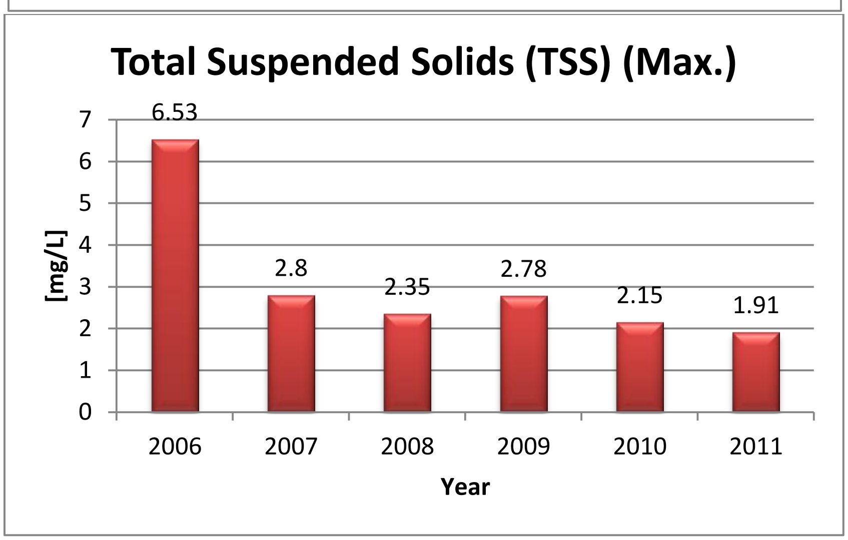




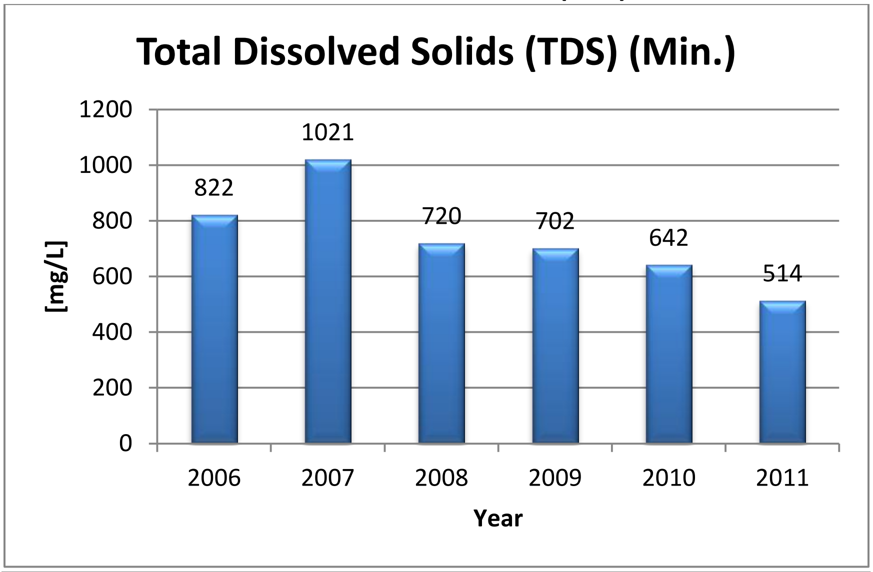
Total Suspended Solids (TSS)*

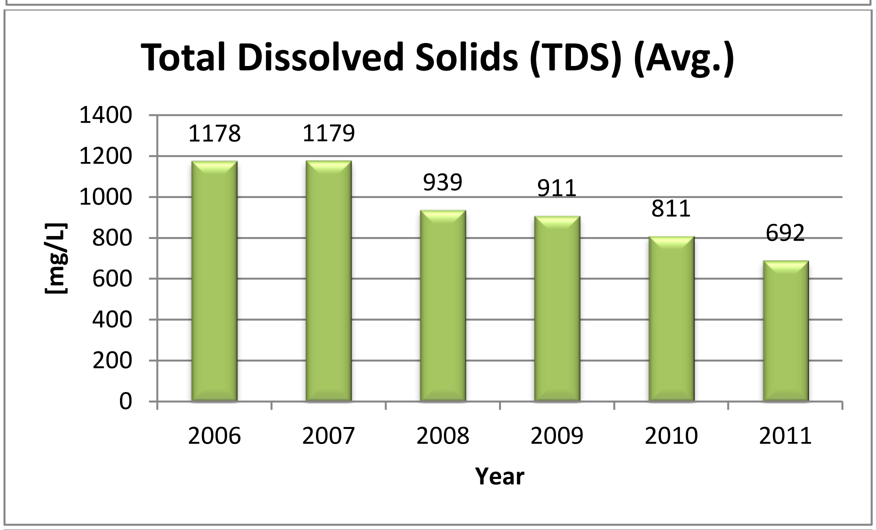


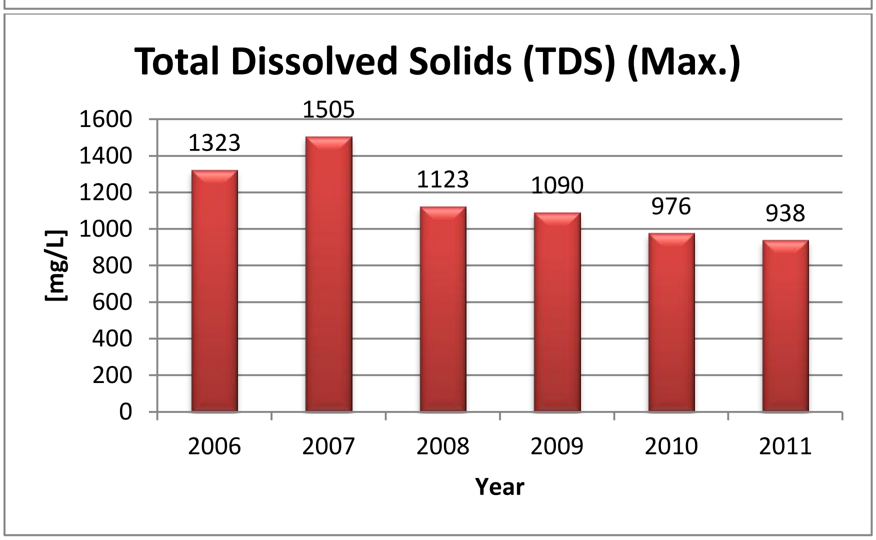




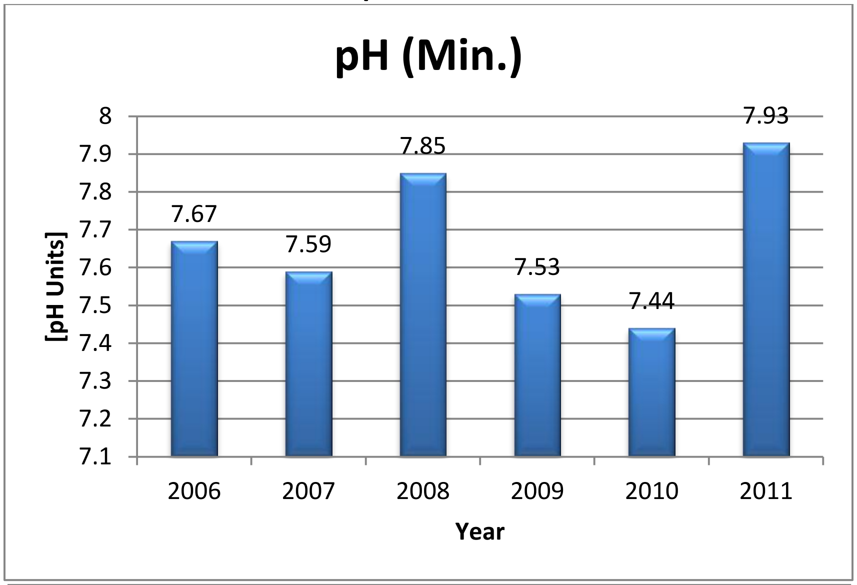
Total Dissolved Solids (TDS)

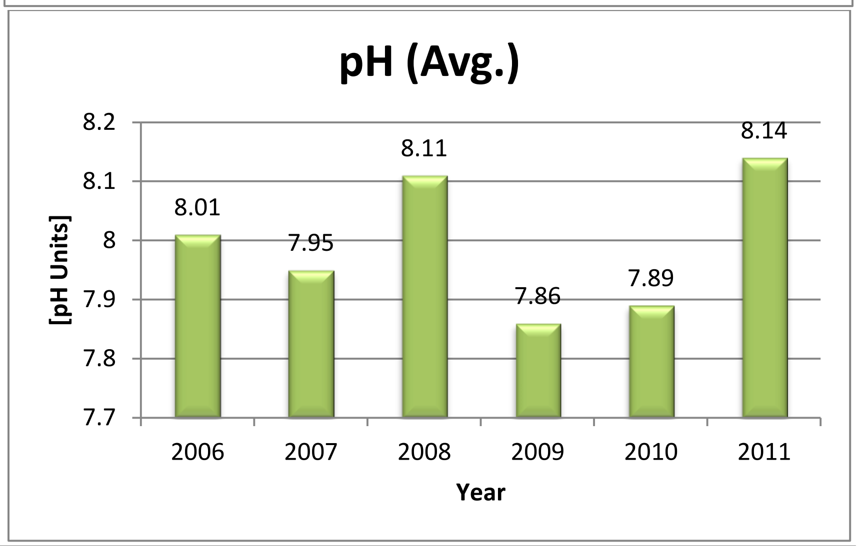


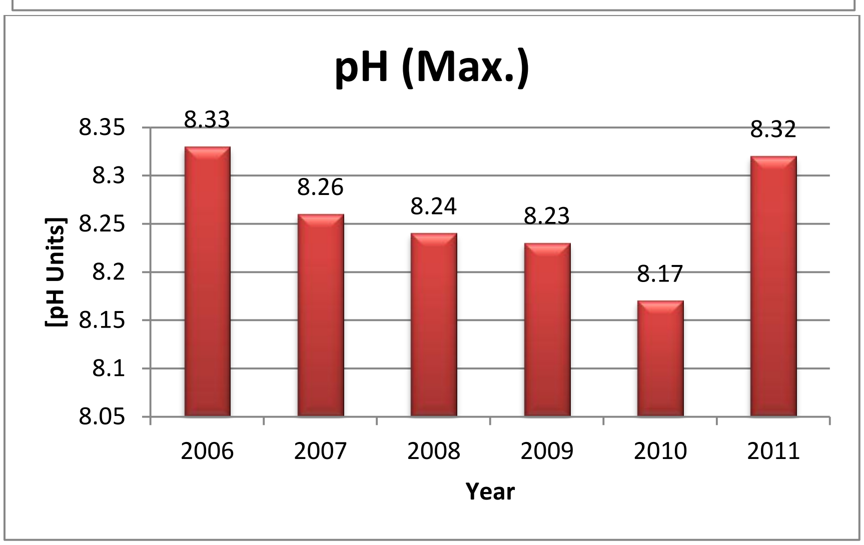




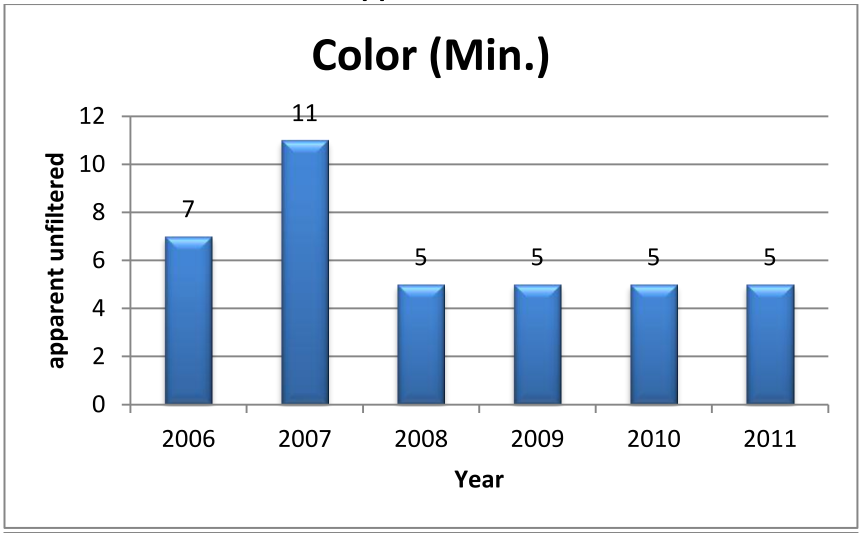
pH, Units

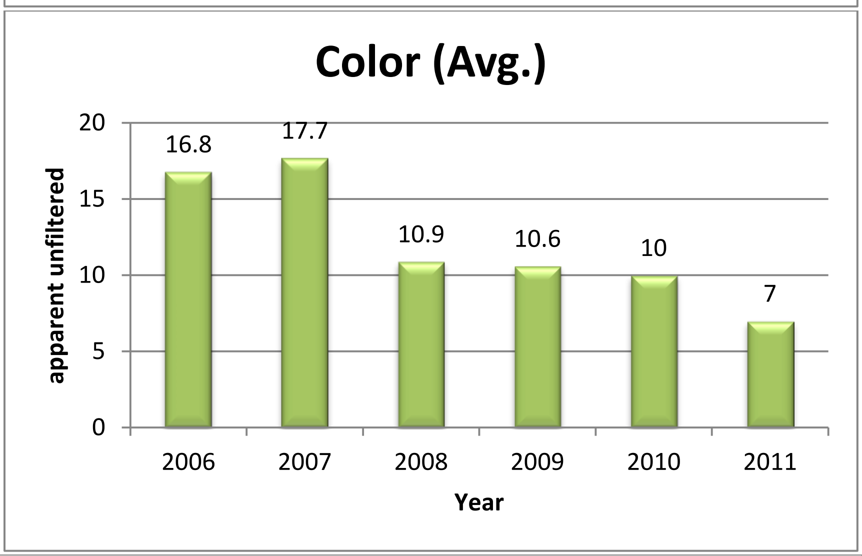

pH (Min.)
8
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
[pH Units]
7.67
7.59
7.85
7.53
7.44
7.93
2006
2007
2008
2009
2010
2011
Year

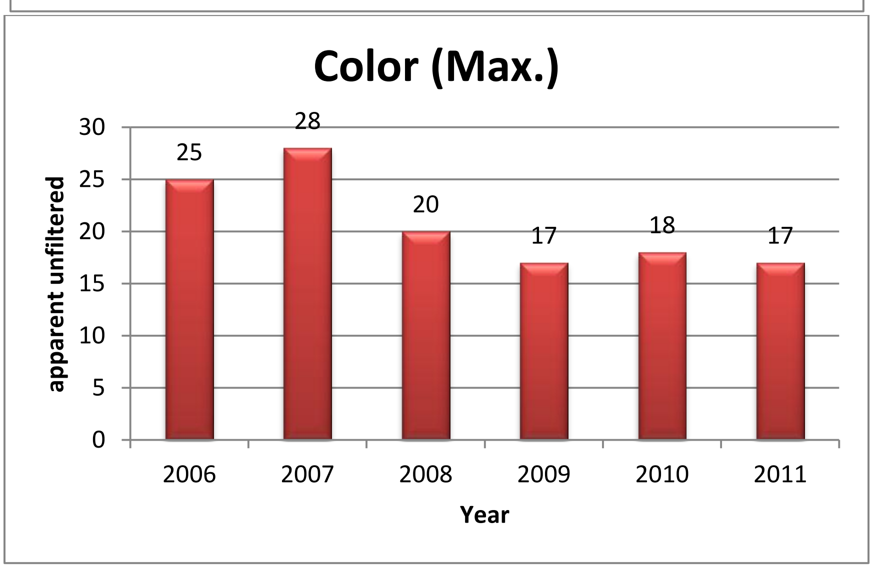

pH (Avg.)
8.2
8.1
8
7.9
7.8
7.7
[pH Units]
8.01
7.95
8.11
7.86
7.89
8.14
2006
2007
2008
2009
2010
2011
Year


pH (Max.)
8.35
8.3
8.25
8.2
8.15
8.1
8.05
[pH Units]
8.33
8.26
8.24
8.23
8.17
8.32
2006
2007
2008
2009
2010
2011
Year

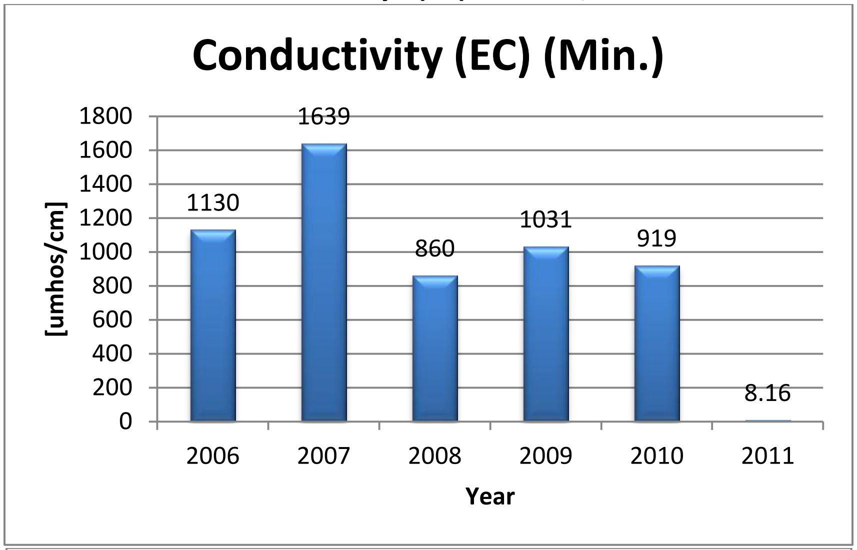
Color, apparent unfiltered

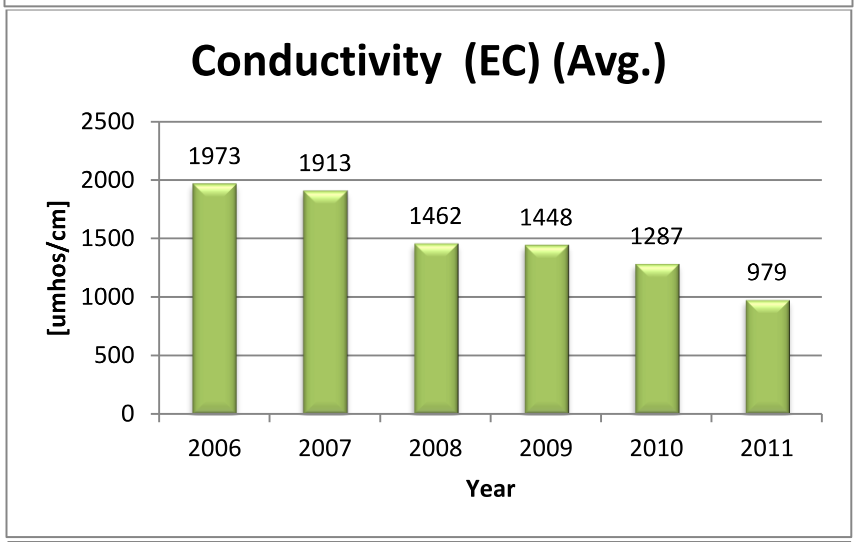


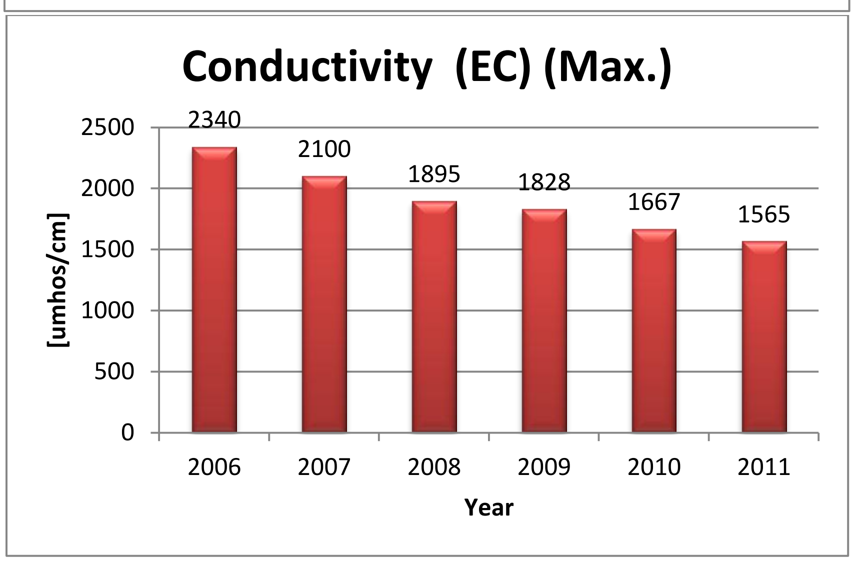




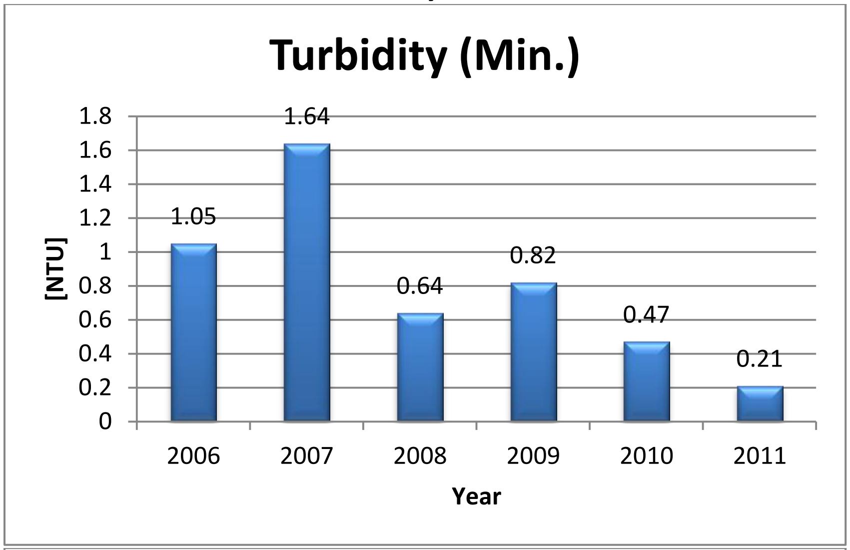
Conductivity (EC), umhos/cm

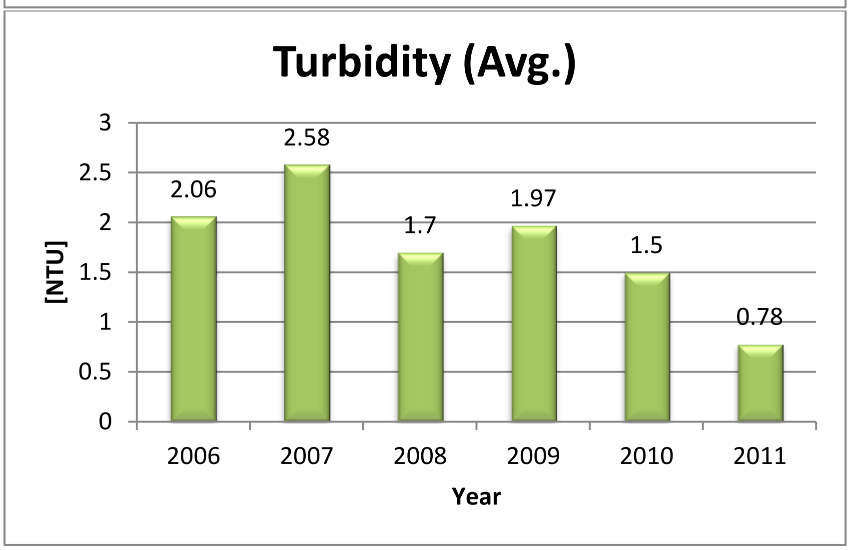


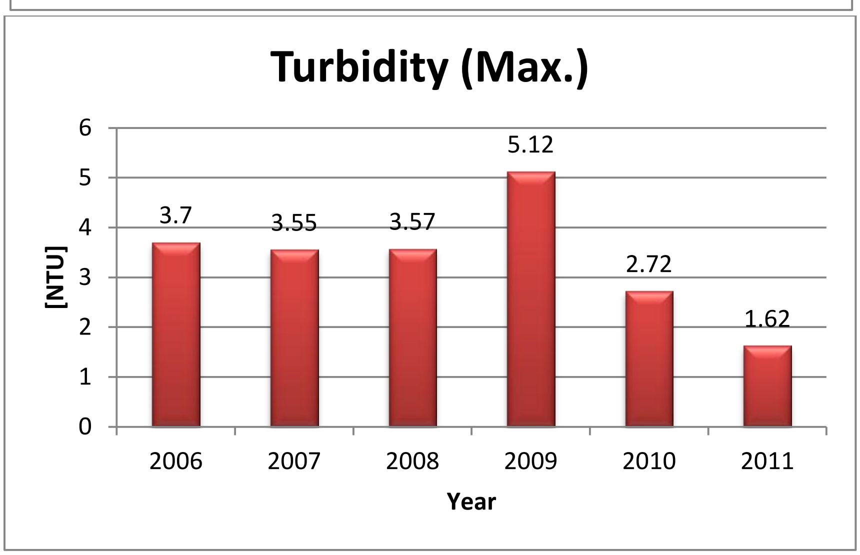




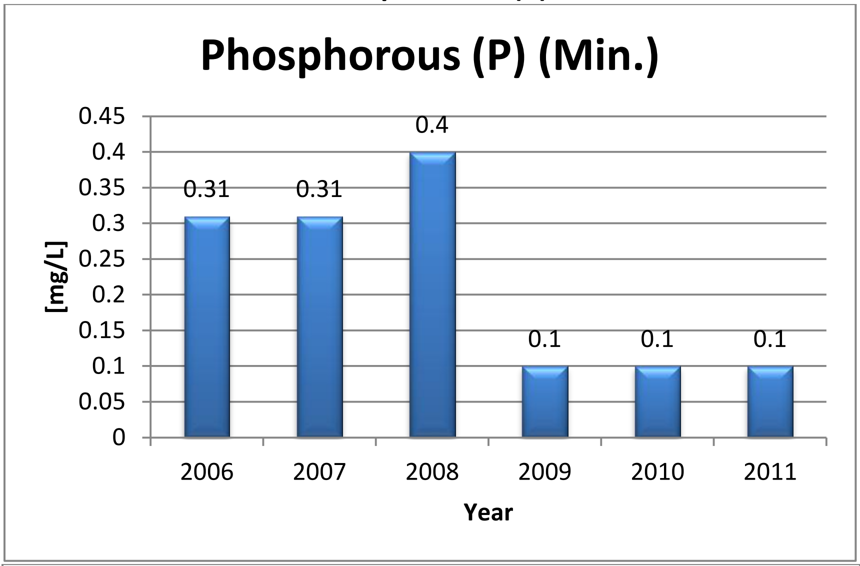
Turbidity, NTUs

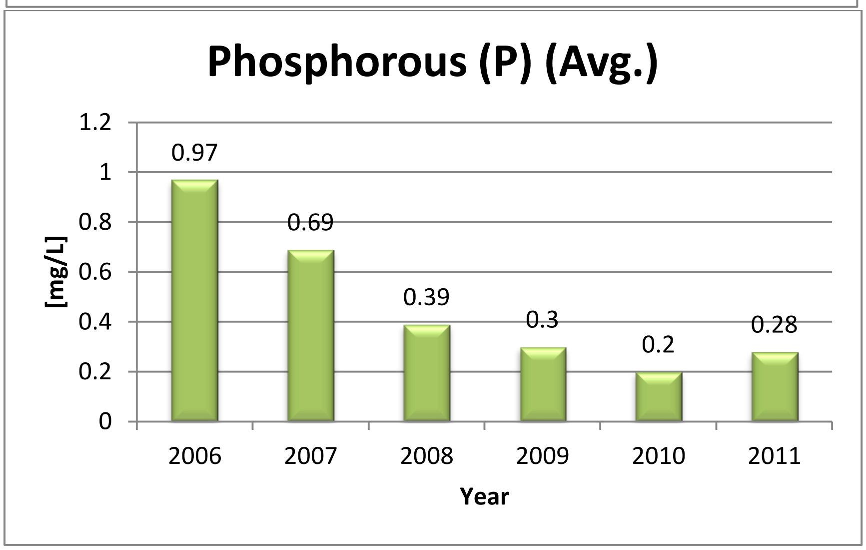


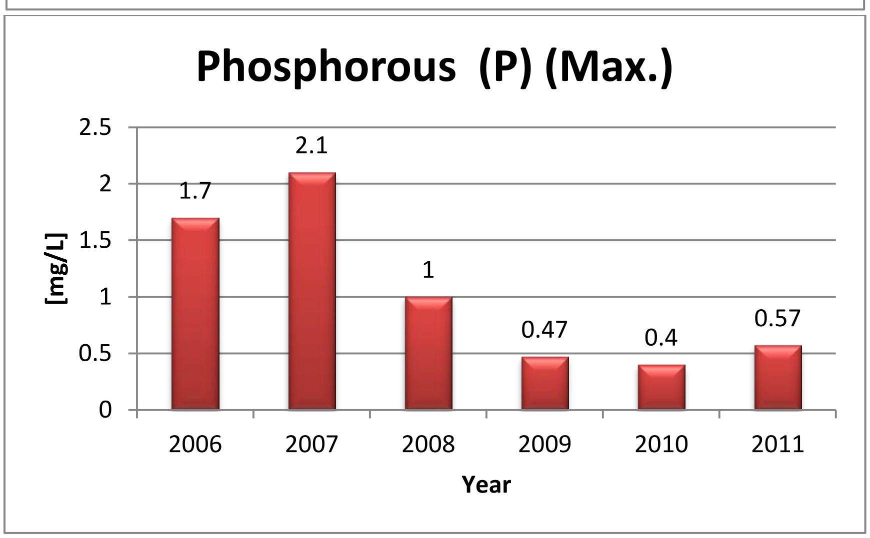




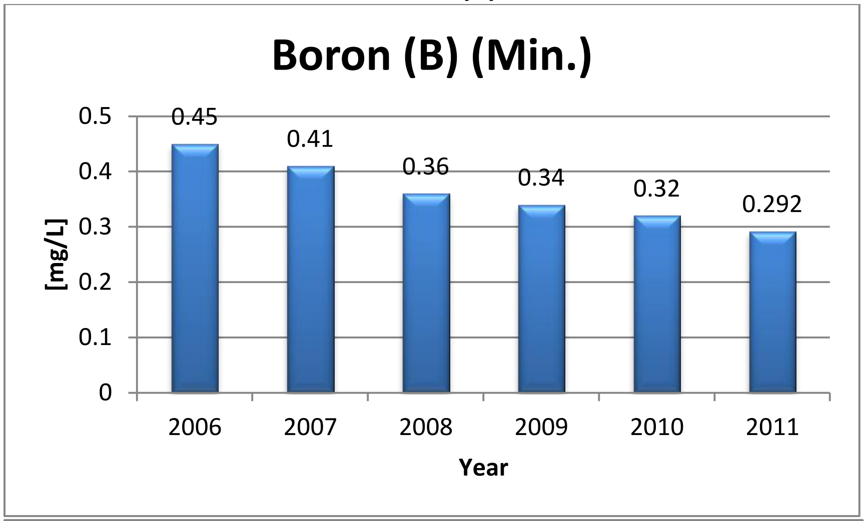
Phosphorous (P)



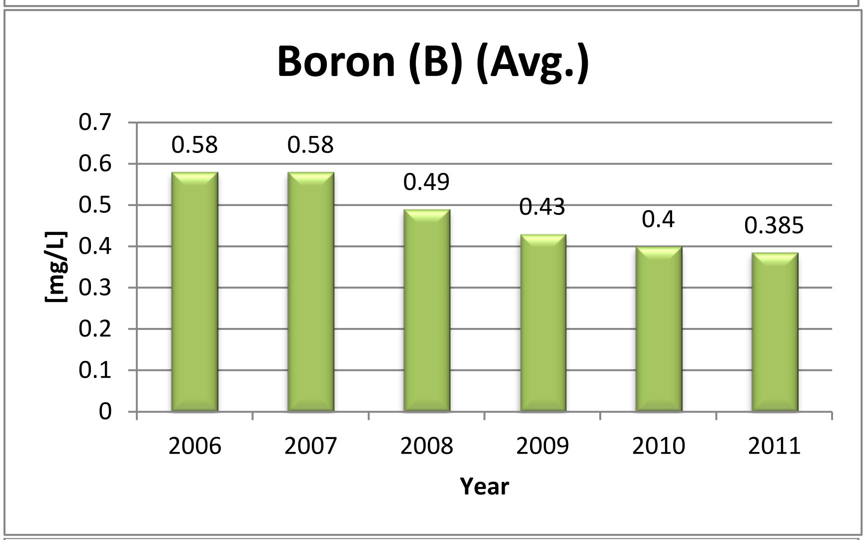




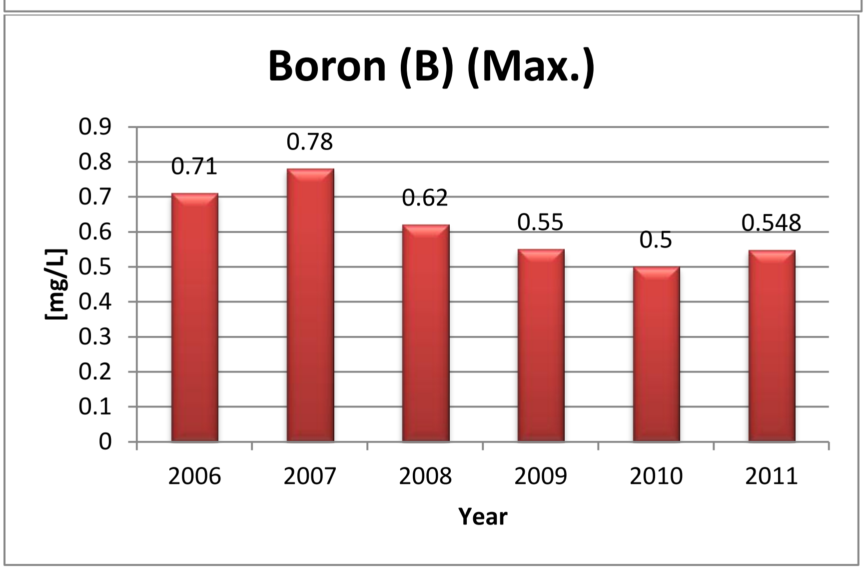
Boron (B)



Boron (B) (Min.)
0.5
0.4
0.3
0.2
0.1
0
[mg/L]
0.45
0.41
0.36
0.34
0.32
0.292
2006
2007
2008
2009
2010
2011
Year

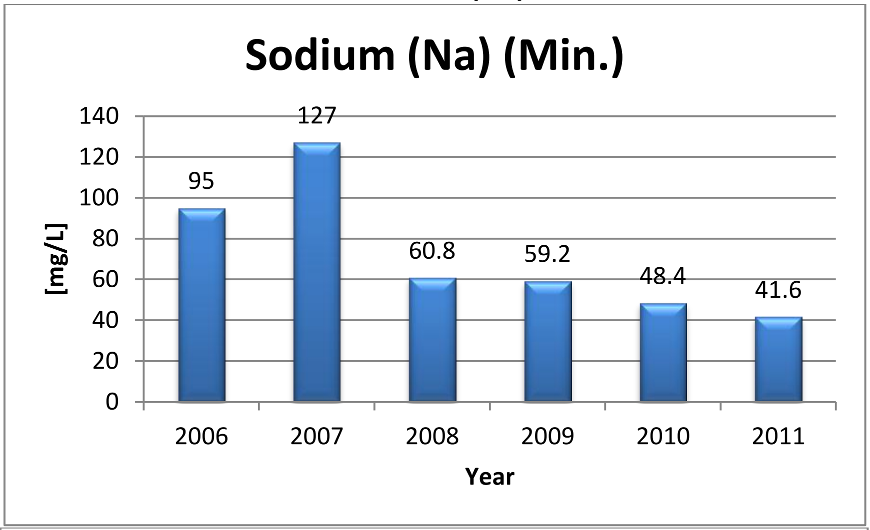


Boron (B) (Avg.)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
[mg/L]
0.58
0.58
0.49
0.43
0.4
0.385
2006
2007
2008
2009
2010
2011
Year

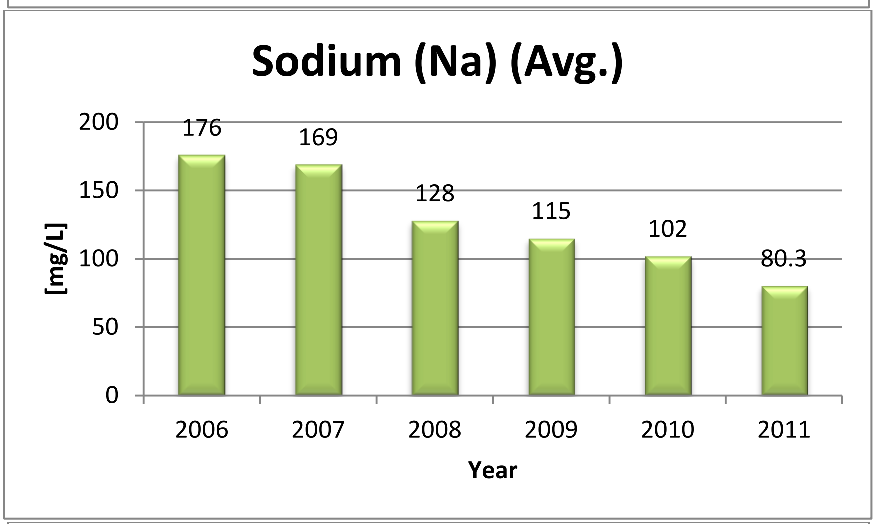


Boron (B) (Max.)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
[mg/L]
0.71
0.78
0.62
0.55
0.5
0.548
2006
2007
2008
2009
2010
2011
Year

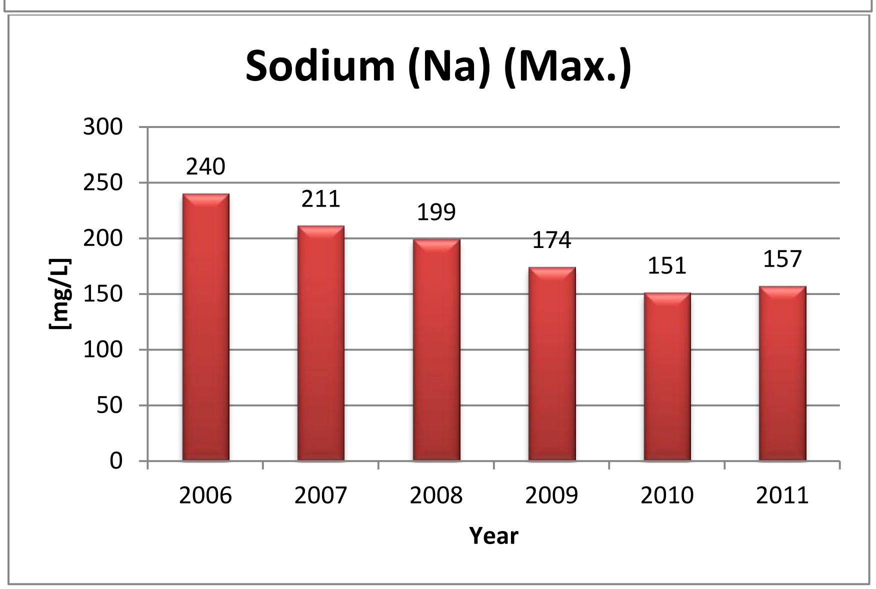
Sodium (Na)



Sodium (Na) (Min.)
[mg/L]
140
120
100
80
60
40
20
0
95
127
60.8
59.2
48.4
41.6
2006
2007
2008
2009
2010
2011
Year

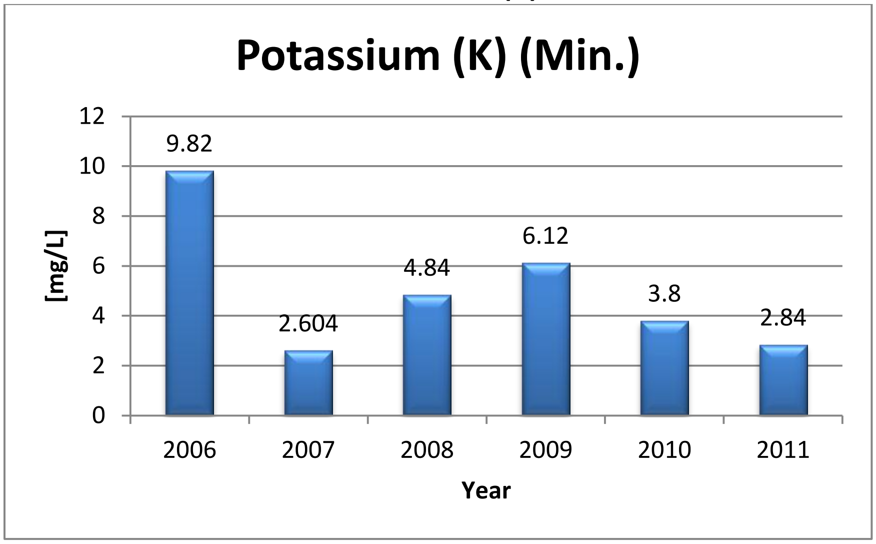


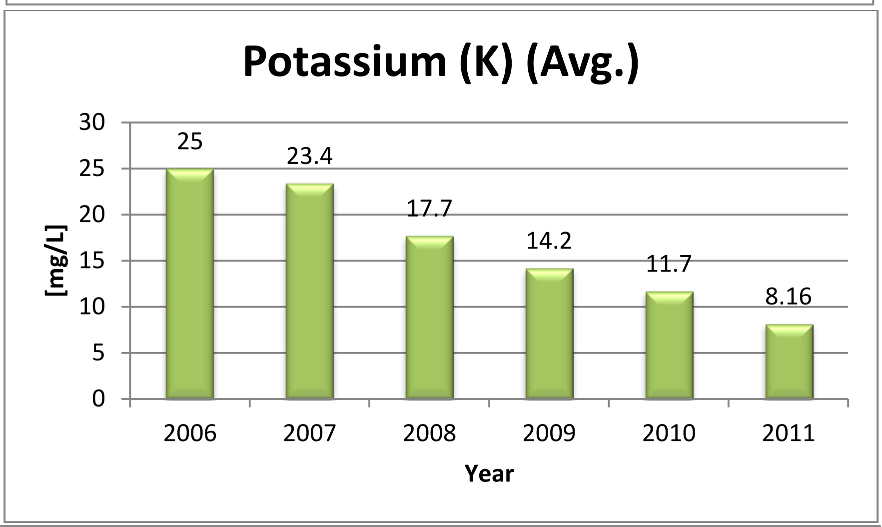
Sodium (Na) (Avg.)
[mg/L]
200
150
100
50
0
176
169
128
115
102
80.3
2006
2007
2008
2009
2010
2011
Year

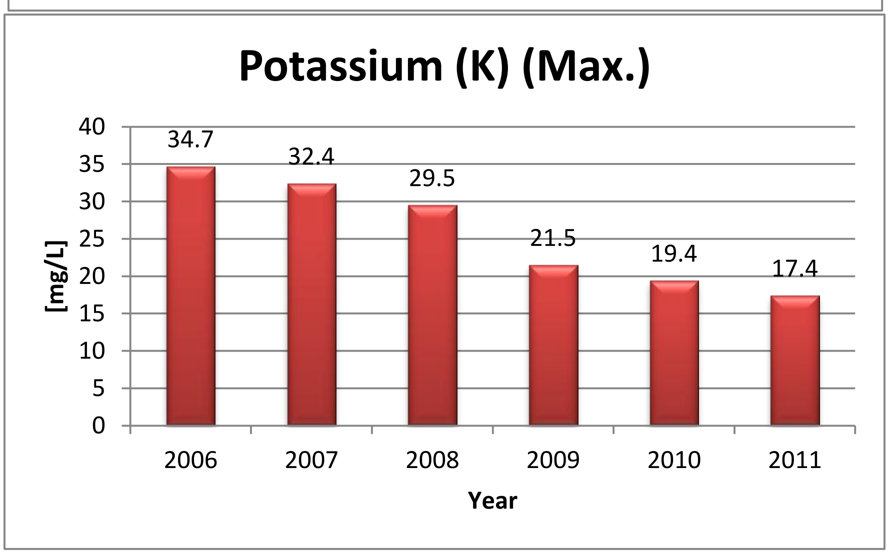


Sodium (Na) (Max.)
[mg/L]
300
250
200
150
100
50
0
240
211
199
174
151
157
2006
2007
2008
2009
2010
2011
Year

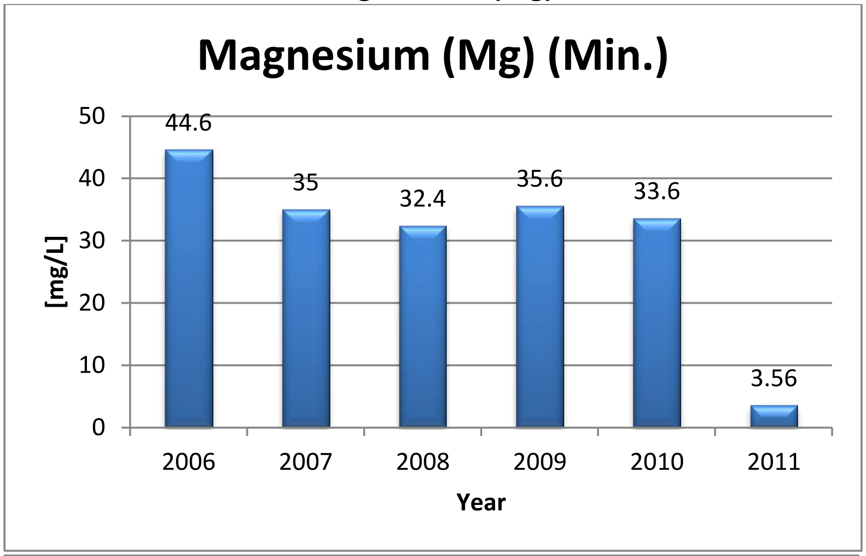
Potassium (K)

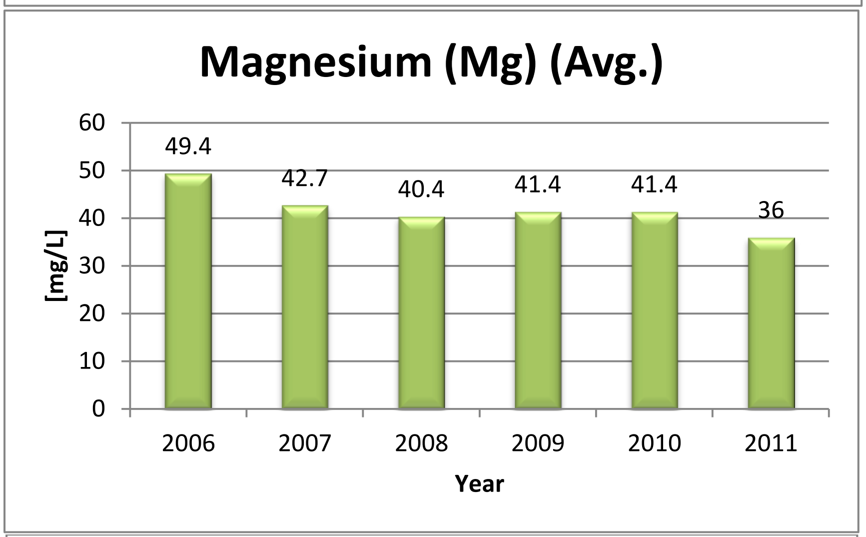

Potassium (K) (Min.)
[mg/L]
12
10
8
6
4
2
0
9.82
2.604
4.84
6.12
3.8
2.84
2006
2007
2008
2009
2010
2011
Year

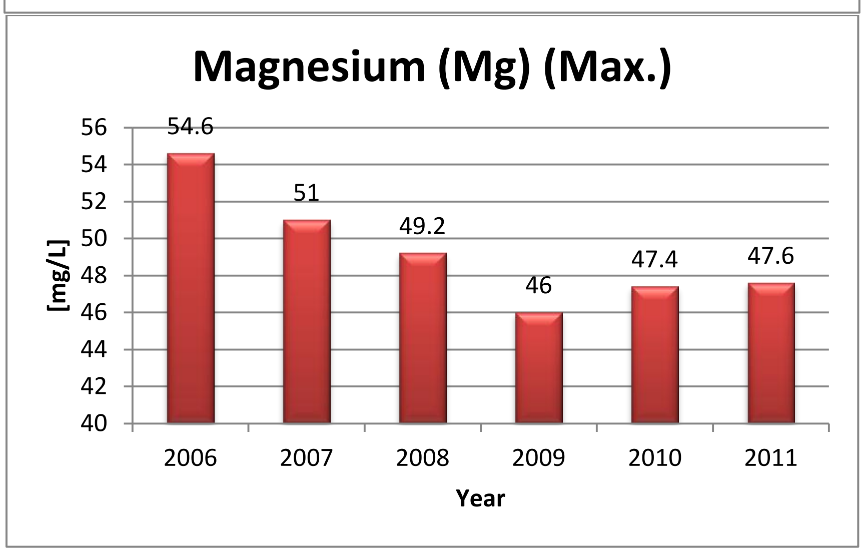

Potassium (K) (Avg.)
[mg/L]
30
25
20
15
10
5
0
25
23.4
17.7
14.2
11.7
8.16
2006
2007
2008
2009
2010
2011
Year


Potassium (K) (Max.)
[mg/L]
40
35
30
25
20
15
10
5
0
34.7
32.4
29.5
21.5
19.4
17.4
2006
2007
2008
2009
2010
2011
Year

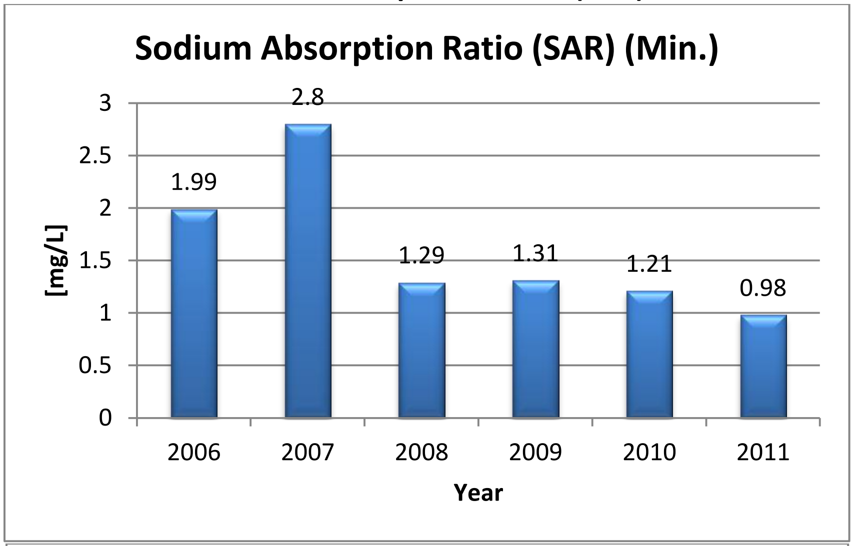
Magnesium (Mg)

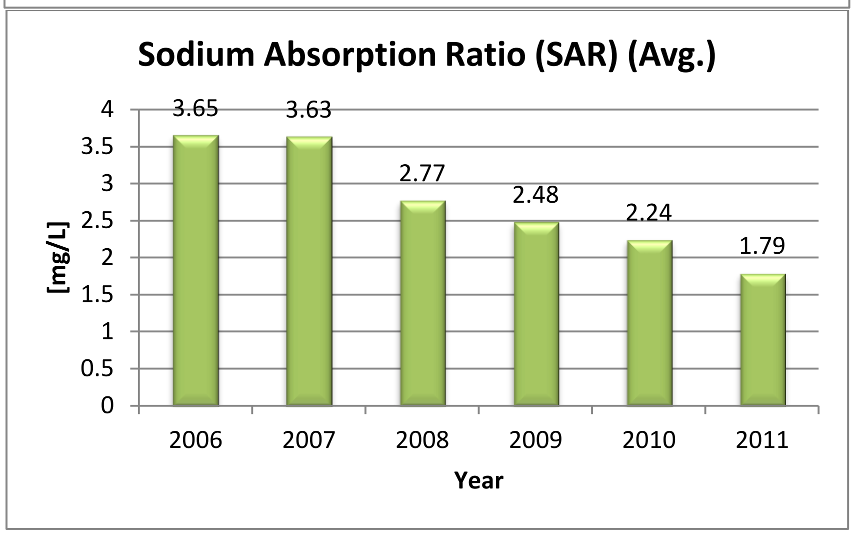


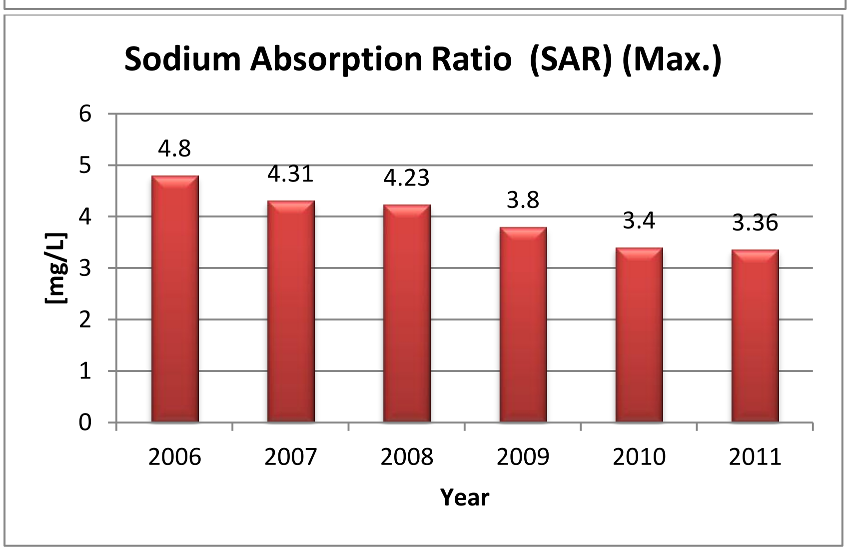




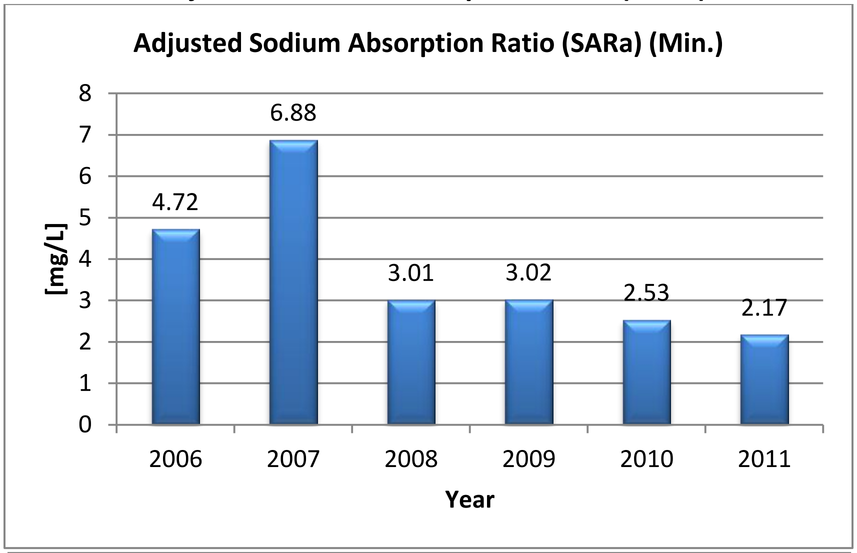
Sodium Absorption Ratio (SAR)

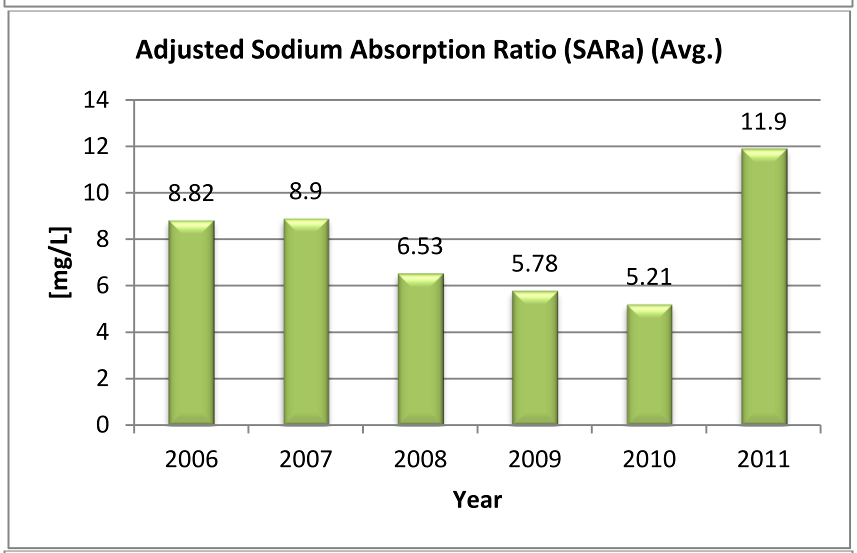


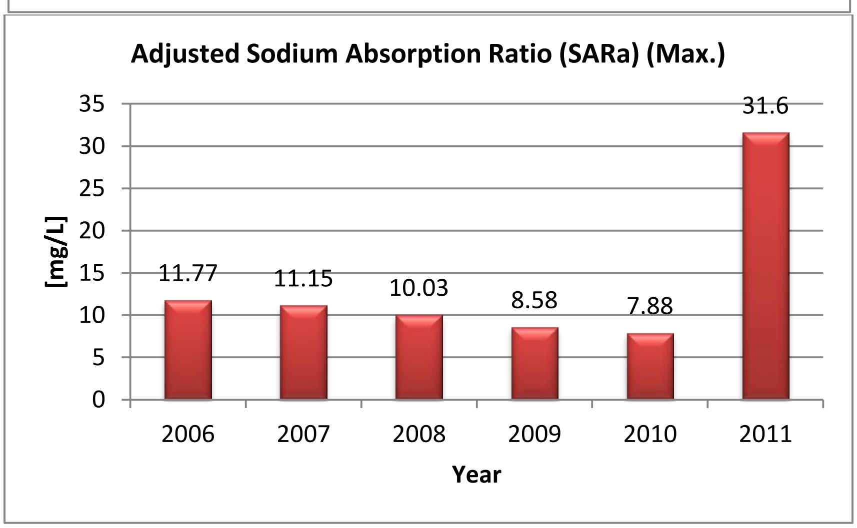




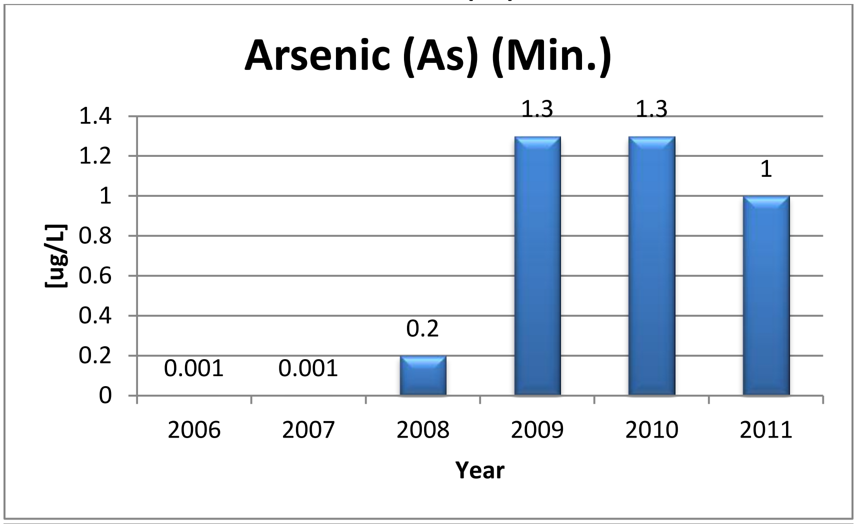
Adjusted Sodium Absorption Ratio (SARa)

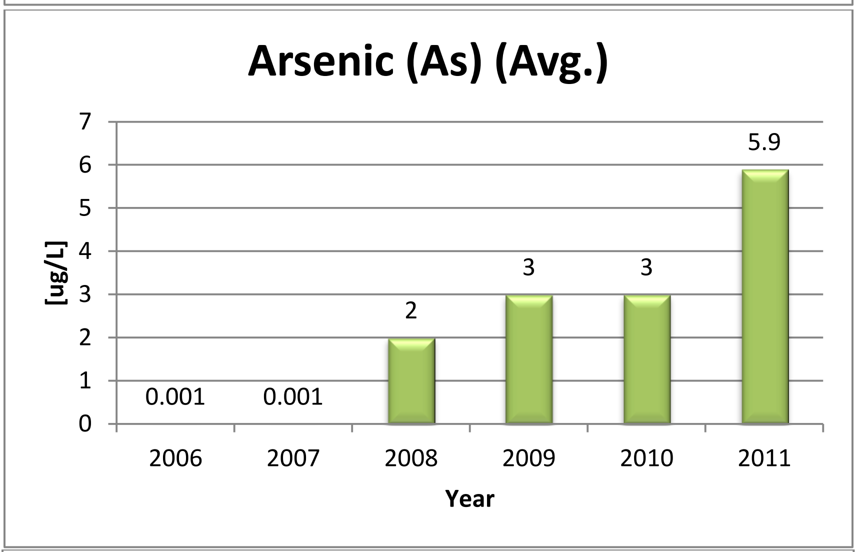


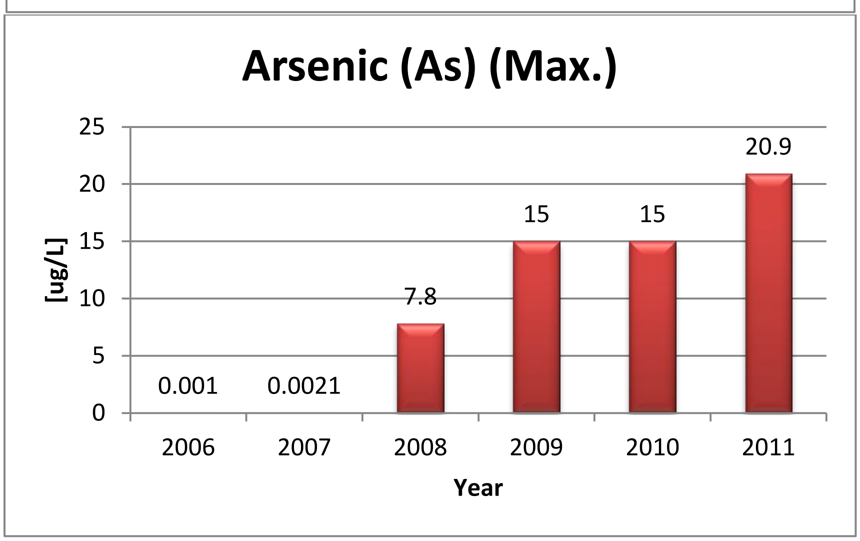




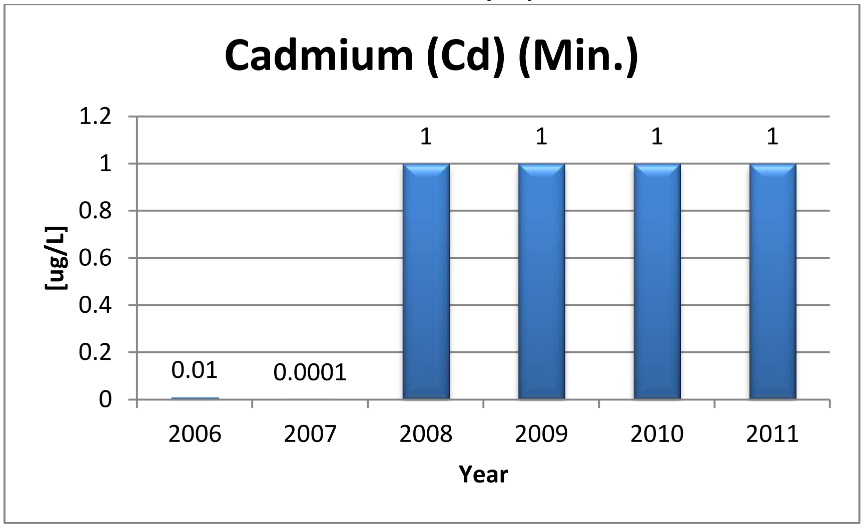
Arsenic (As)

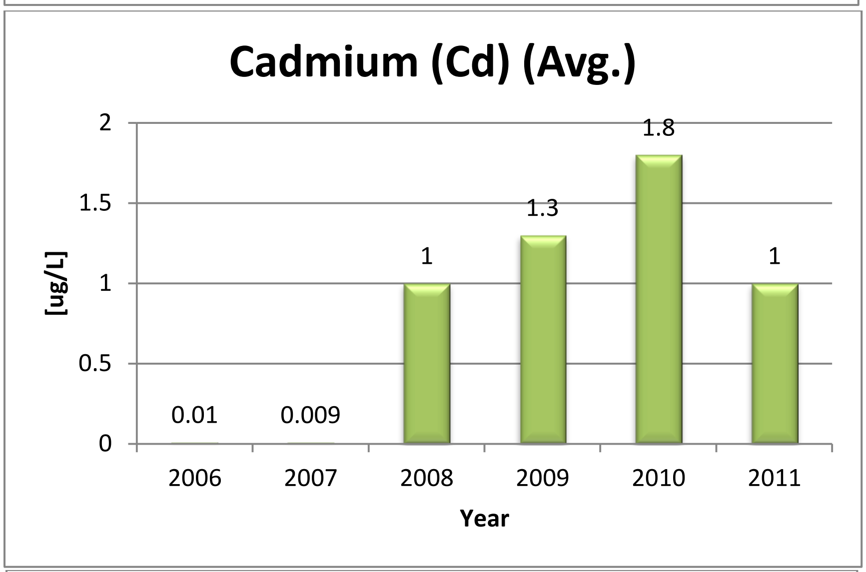

Arsenic (As) (Min.)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
[ug/L]
0.001
0.001
0.2
1.3
1.3
1
2006
2007
2008
2009
2010
2011
Year

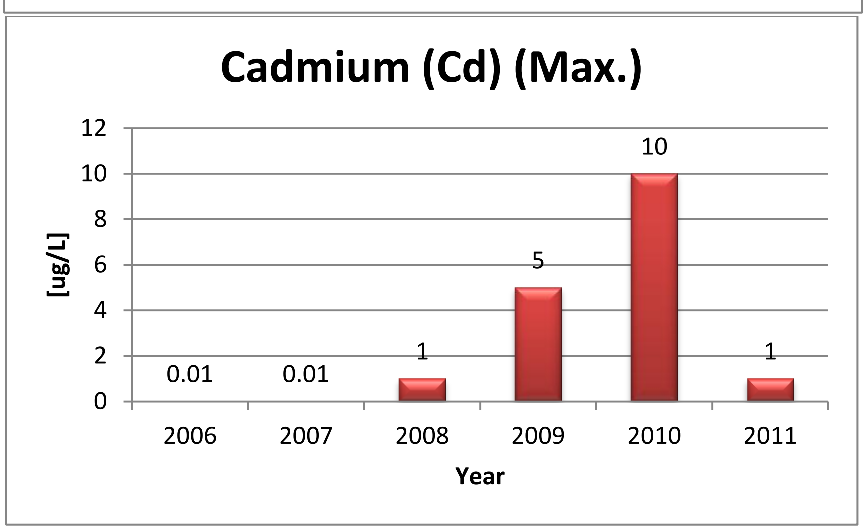

Arsenic (As) (Avg.)
7
6
5
4
3
2
1
0
[ug/L]
0.001
0.001
2
3
3
5.9
2006
2007
2008
2009
2010
2011
Year


Arsenic (As) (Max.)
25
20
15
10
5
0
[ug/L]
0.001
0.0021
7.8
15
15
20.9
2006
2007
2008
2009
2010
2011
Year

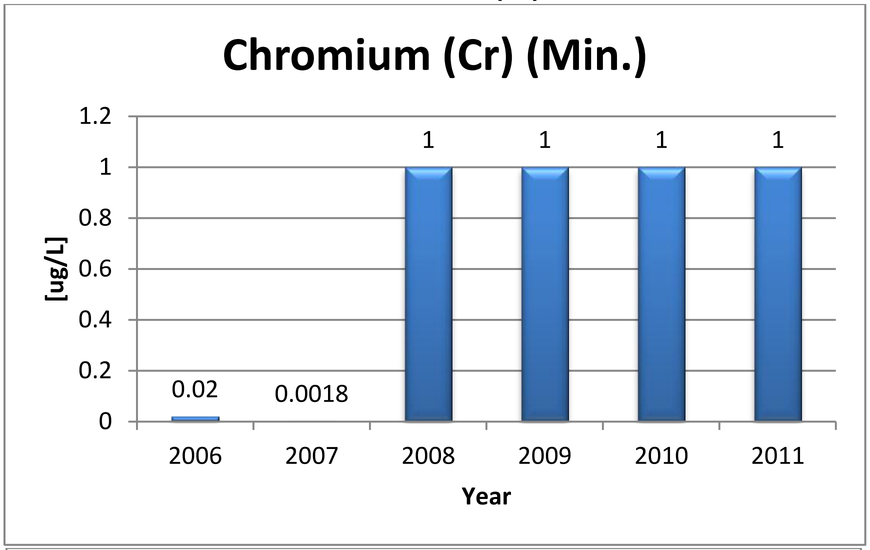
Cadmium (Cd)

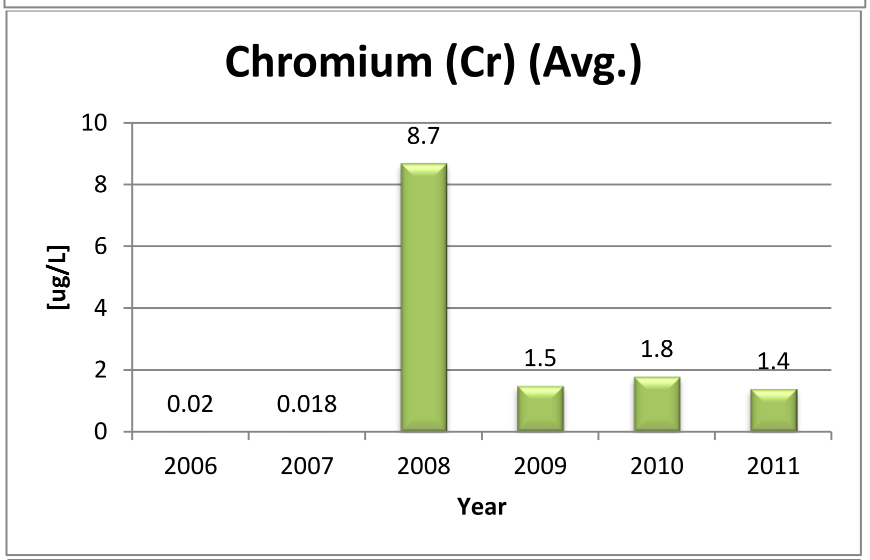

Cadmium (Cd) (Min.)
1.2
1
0.8
0.6
0.4
0.2
0
[ug/L]
1
1
1
1
0.01
0.0001
2006
2007
2008
2009
2010
2011
Year

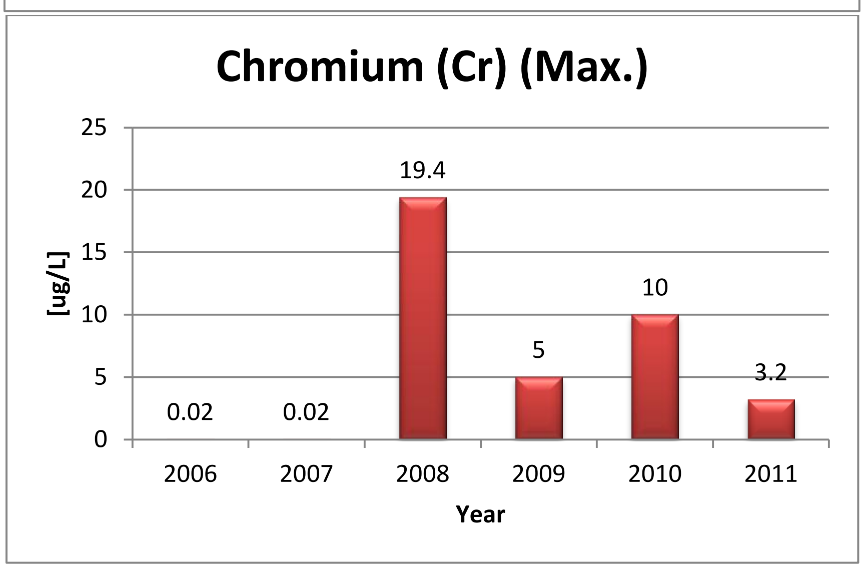

Cadmium (Cd) (Avg.)
2
1.5
1
0.5
0
[ug/L]
1.8
1.3
1
1
0.01
0.009
2006
2007
2008
2009
2010
2011
Year


Cadmium (Cd) (Max.)
12
10
8
6
4
2
0
[ug/L]
10
5
1
1
0.01
0.01
2006
2007
2008
2009
2010
2011
Year

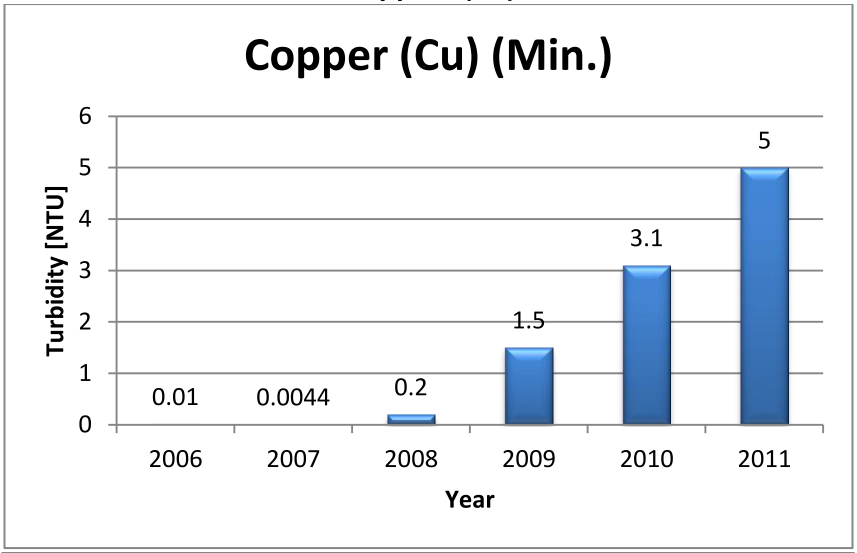
Chromium (Cr)

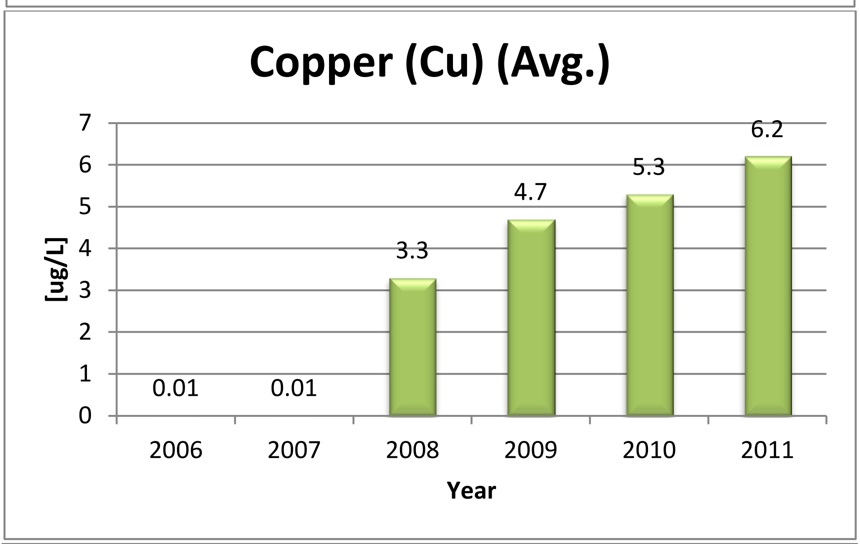

Chromium (Cr) (Min.)
1.2
1
0.8
0.6
0.4
0.2
0
[ug/L]
0.02
0.0018
1
1
1
1
2006
2007
2008
2009
2010
2011
Year

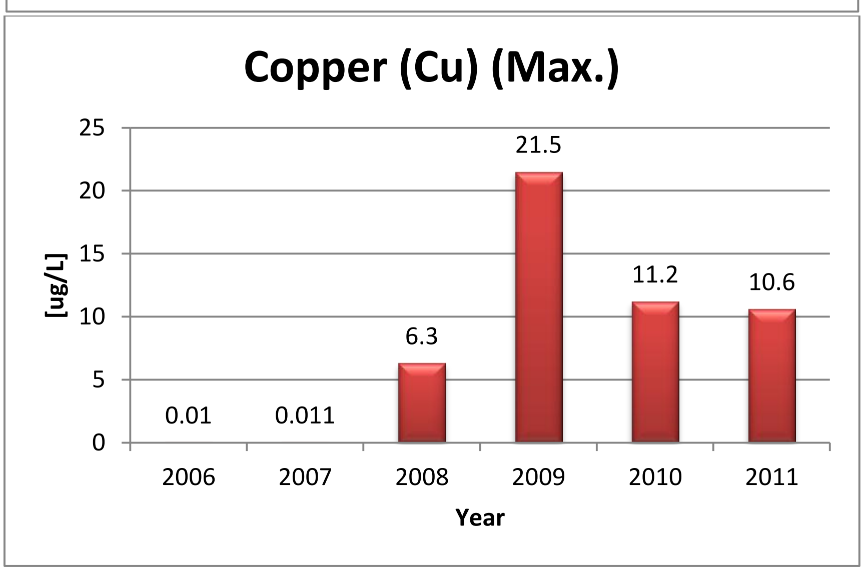

Chromium (Cr) (Avg.)
10
8
6
4
2
0
[ug/L]
0.02
0.018
8.7
1.5
1.8
1.4
2006
2007
2008
2009
2010
2011
Year


Chromium (Cr) (Max.)
25
20
15
10
5
0
[ug/L]
0.02
0.02
19.4
5
10
3.2
2006
2007
2008
2009
2010
2011
Year

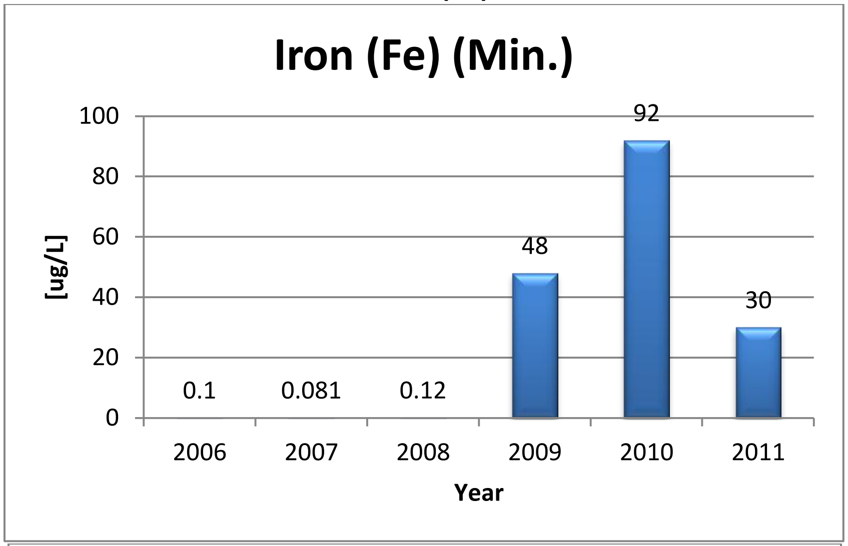
Copper (Cu)

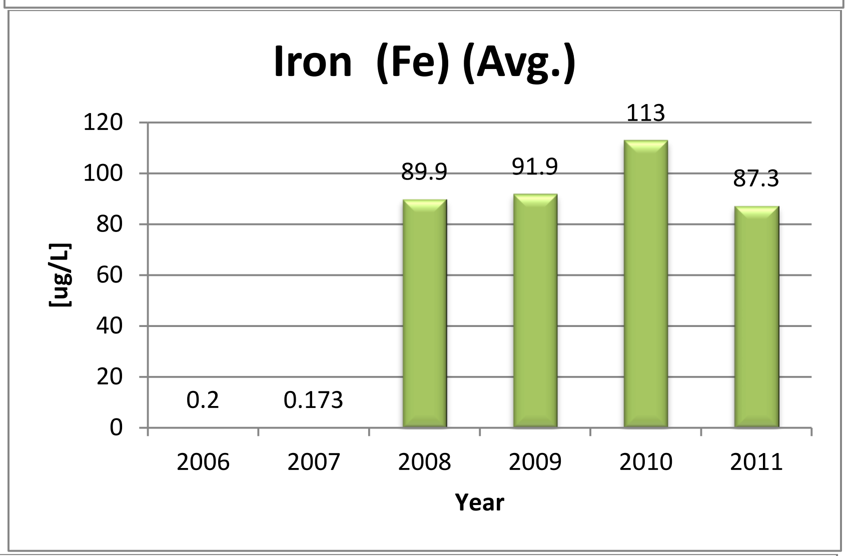

Copper (Cu) (Min.)
Turbidity [NTU]
6
5
4
3
2
1
0
0.01
0.0044
0.2
1.5
3.1
5
2006
2007
2008
2009
2010
2011
Year

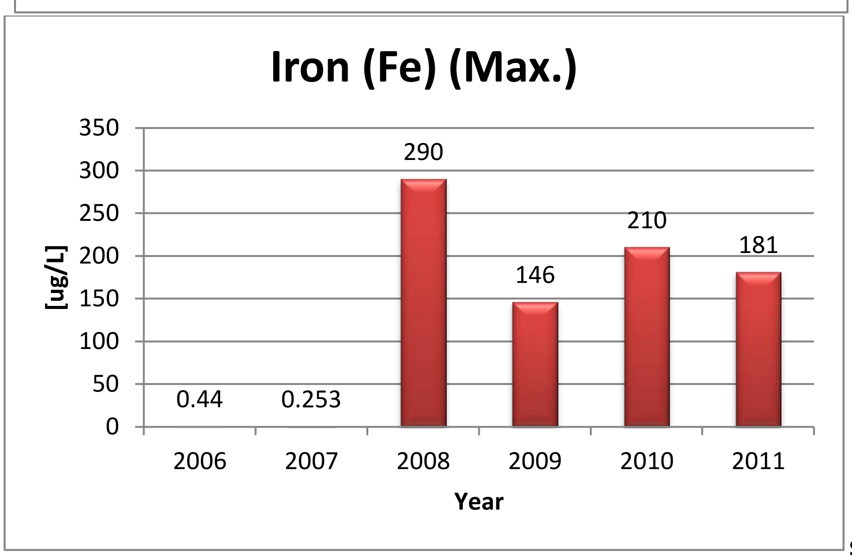

Copper (Cu) (Avg.)
[ug/L]
7
6
5
4
3
2
1
0
0.01
0.01
3.3
4.7
5.3
6.2
2006
2007
2008
2009
2010
2011
Year


Copper (Cu) (Max.)
[ug/L]
25
20
15
10
5
0
0.01
0.011
6.3
21.5
11.2
10.6
2006
2007
2008
2009
2010
2011
Year

Iron (Fe)

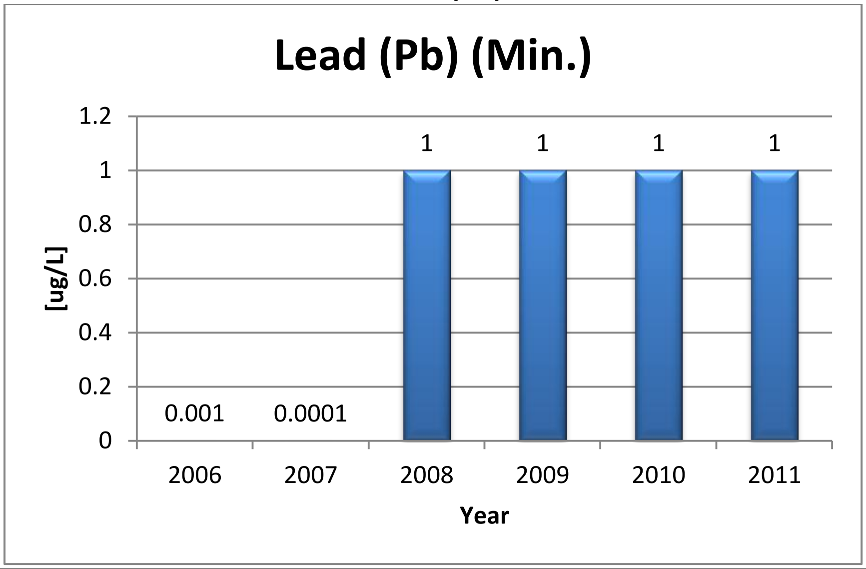

Iron (Fe) (Min.)
[ug/L]
100
80
60
40
20
0
0.1
0.081
0.12
48
92
30
2006
2007
2008
2009
2010
2011
Year


Iron (Fe) (Avg.)
[ug/L]
120
100
80
60
40
20
0
0.2
0.173
89.9
91.9
113
87.3
2006
2007
2008
2009
2010
2011
Year

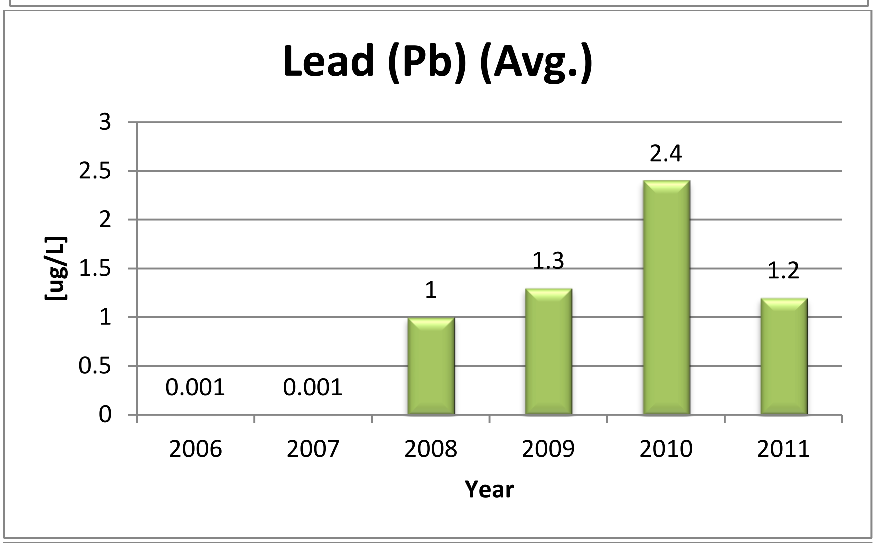

Iron (Fe) (Max.)
[ug/L]
350
300
250
200
150
100
50
0
0.44
0.253
290
146
210
181
2006
2007
2008
2009
2010
2011
Year

s

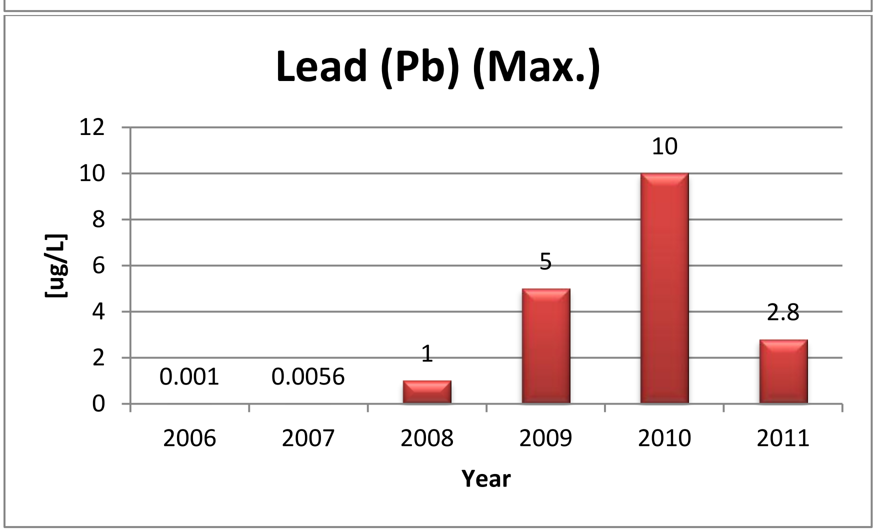
Lead (Pb)



Lead (Pb) (Min.)
1.2
1
0.8
0.6
0.4
0.2
0
[ug/L]
0.001
0.0001
1
1
1
1
2006
2007
2008
2009
2010
2011
Year

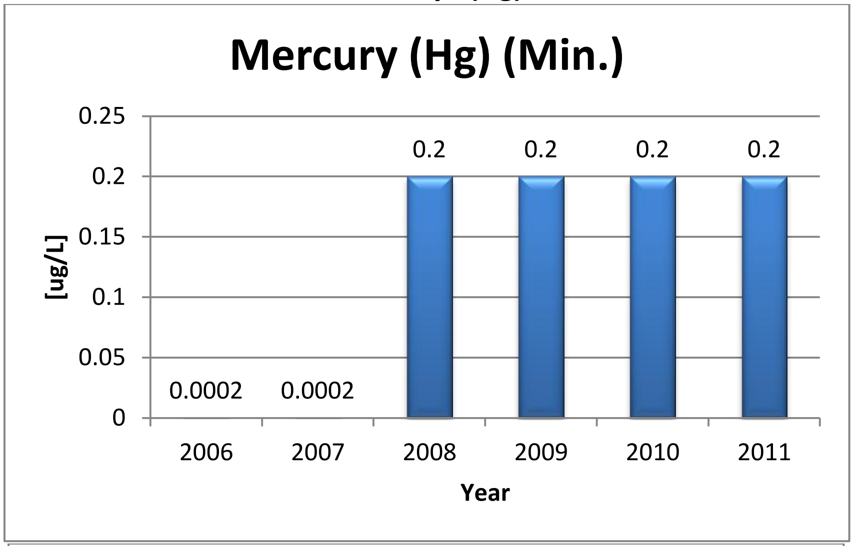


Lead (Pb) (Avg.)
3
2.5
2
1.5
1
0.5
0
[ug/L]
0.001
0.001
1
1.3
2.4
1.2
2006
2007
2008
2009
2010
2011
Year



Lead (Pb) (Max.)
12
10
8
6
4
2
0
[ug/L]
0.001
0.0056
1
5
10
2.8
2006
2007
2008
2009
2010
2011
Year

Mercury (Hg)


Mercury (Hg) (Min.)
0.25
0.2
0.15
0.1
0.05
0
[ug/L]
0.0002
0.0002
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0.2
0.2
0.2
2006
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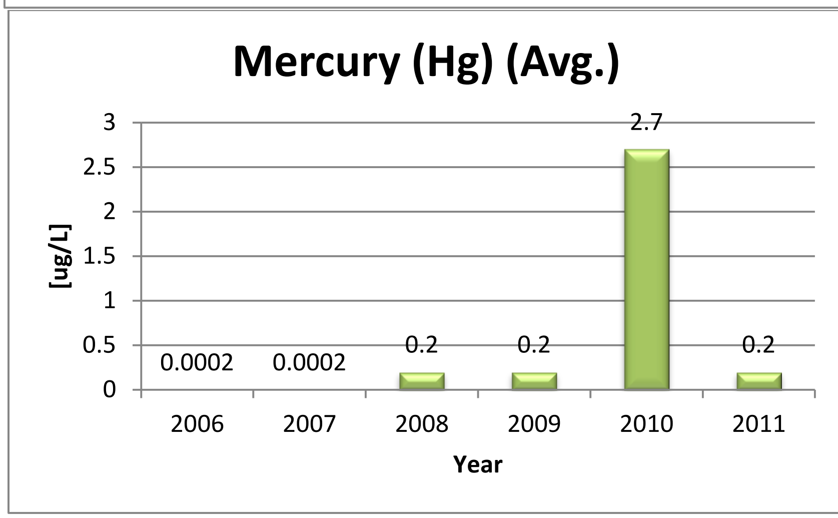
2008
2009
2010
2011
Year


Mercury (Hg) (Avg.)
3
2.5
2
1.5
1
0.5
0
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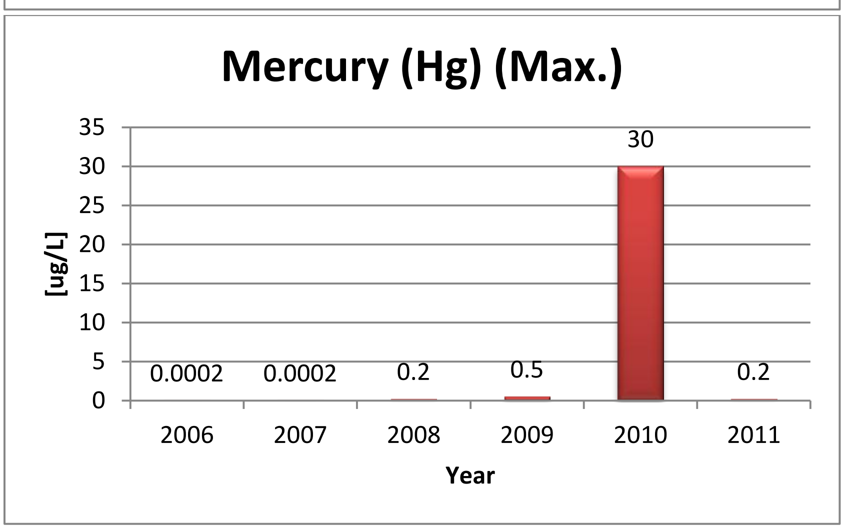
0.2
0.2
2.7
0.2
2006
2007
2008
2009
2010
2011
Year


Mercury (Hg) (Max.)
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30
25
20
15
10
5
0
[ug/L]
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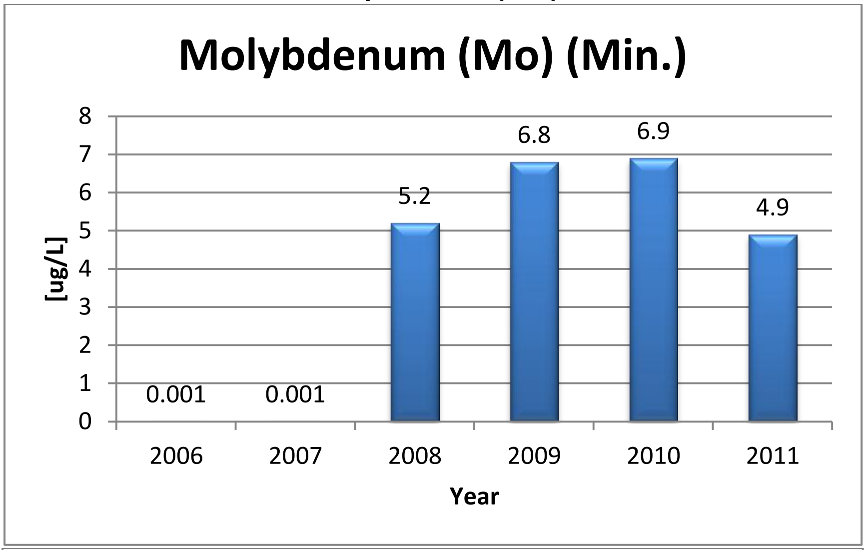
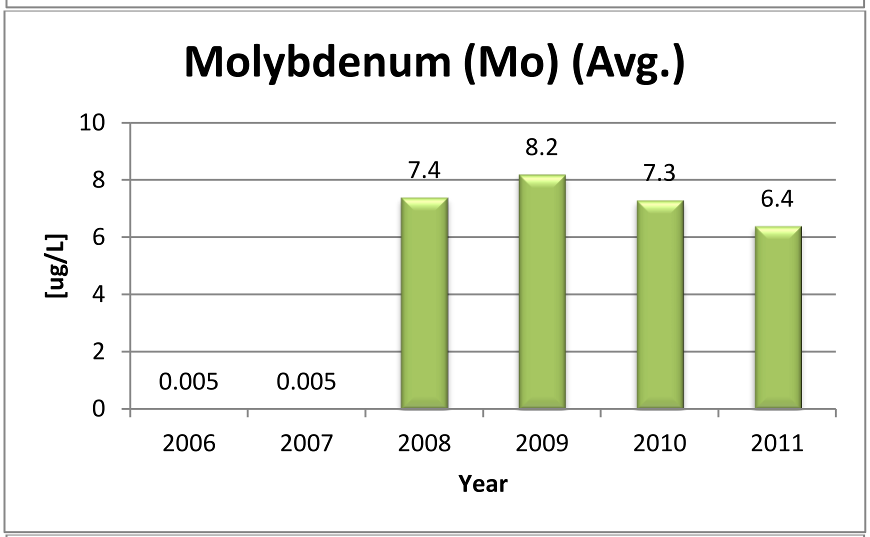
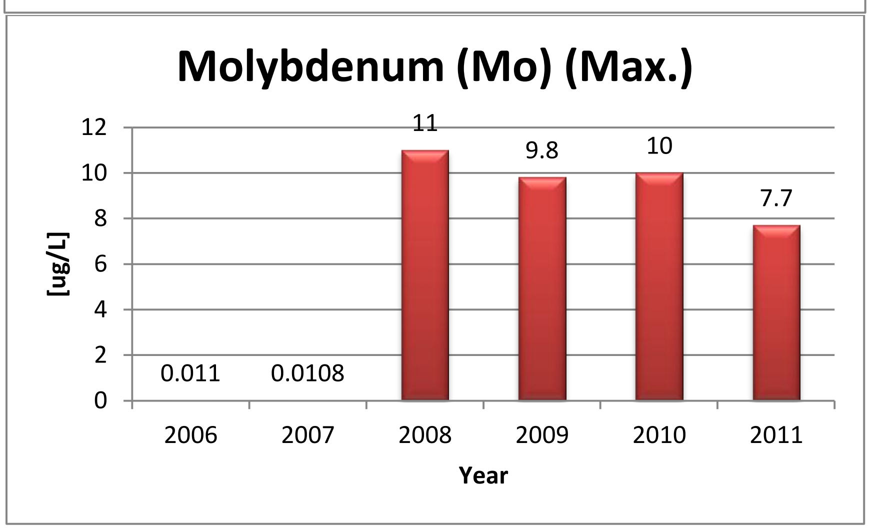
0.0002
0.2
0.5
30
0.2
2006
2007
2008
2009
2010
2011
Year

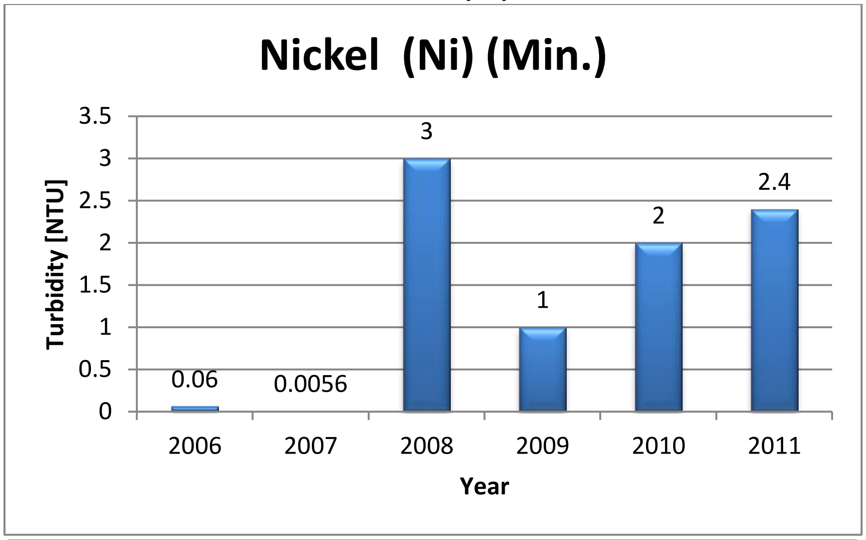
Molybdenum (Mo)

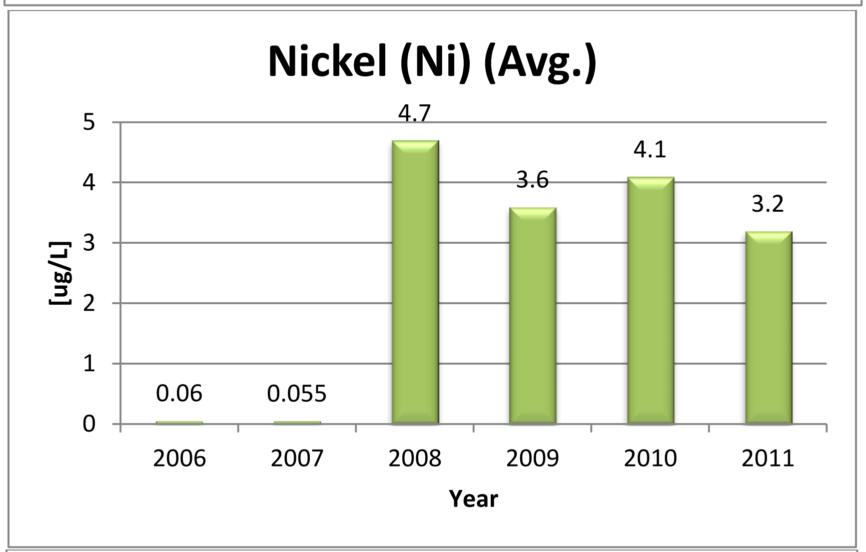


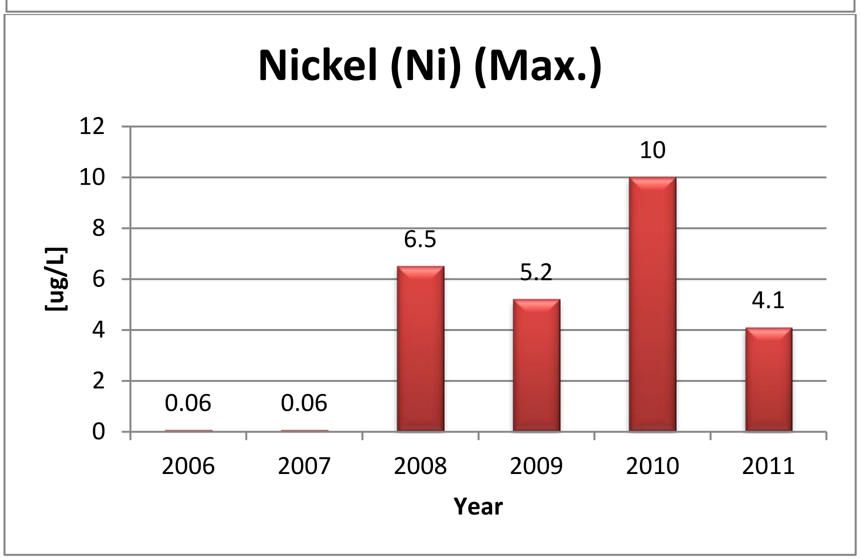




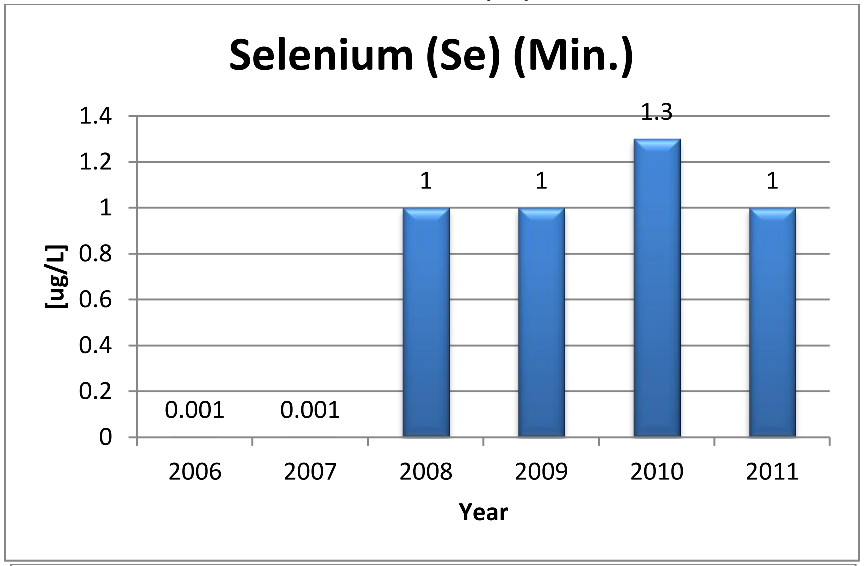
Nickel (Ni)

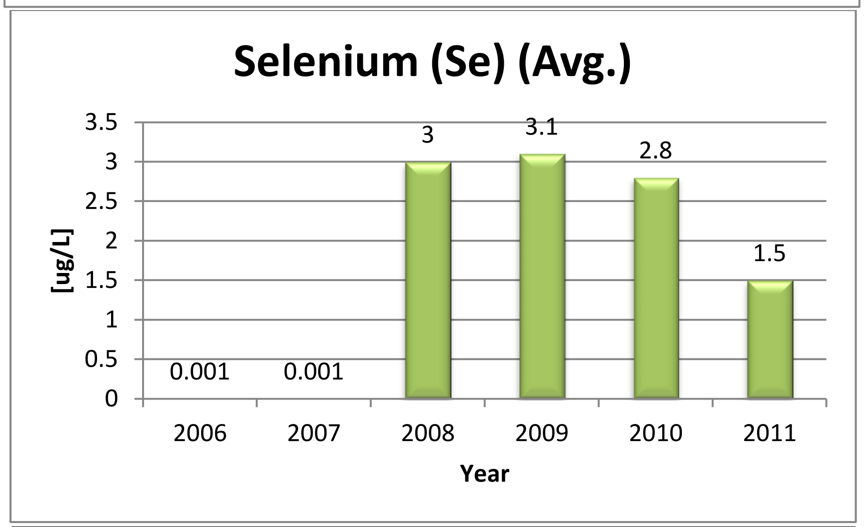

Nickel (Ni) (Min.)
Turbidity [NTU]
3.5
3
2.5
2
1.5
1
0.5
0
0.06
0.0056
3
1
2
2.4
2006
2007
2008
2009
2010
2011
Year

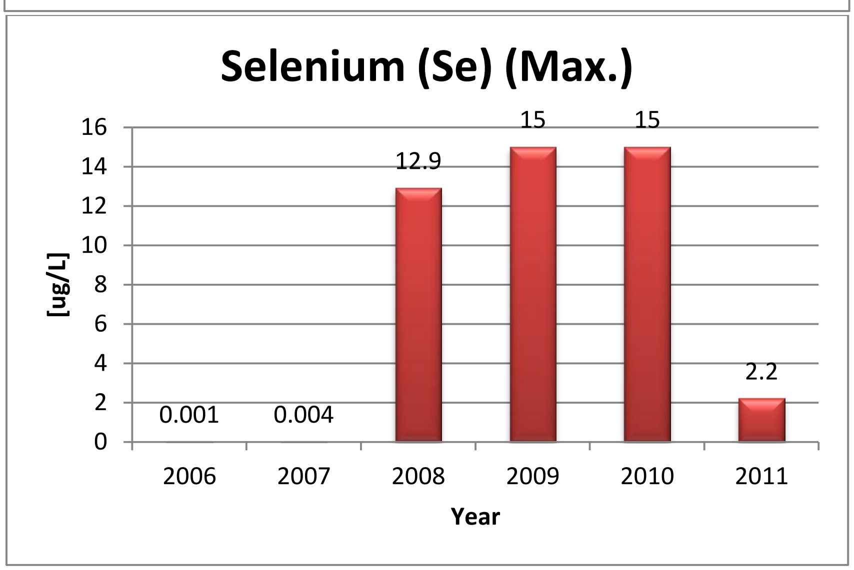

Nickel (Ni) (Avg.)
[ug/L]
5
4
3
2
1
0
0.06
0.055
4.7
3.6
4.1
3.2
2006
2007
2008
2009
2010
2011
Year


Nickel (Ni) (Max.)
[ug/L]
12
10
8
6
4
2
0
0.06
0.06
6.5
5.2
10
4.1
2006
2007
2008
2009
2010
2011
Year

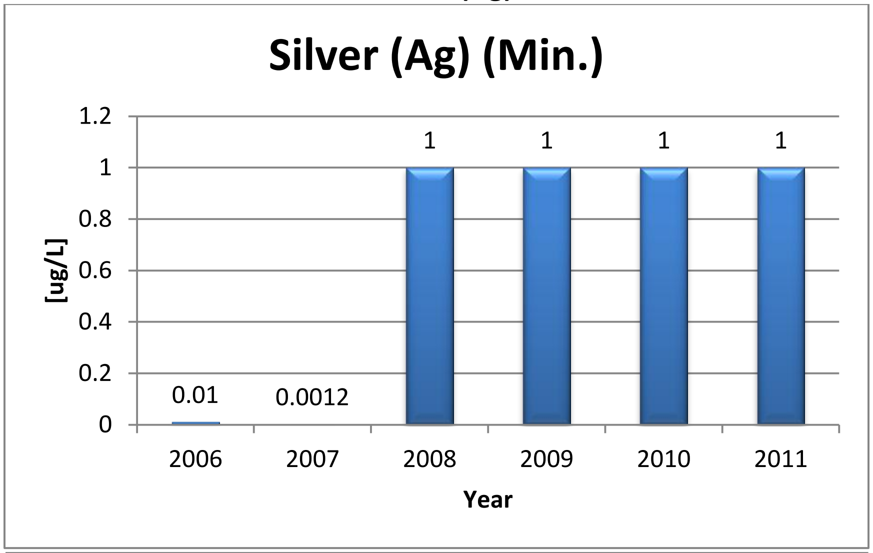
Selenium (Se)


Selenium (Se) (Min.)
[ug/L]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.001
0.001
1
1
1.3
1
2006
2007
2008
2009
2010
2011
Year

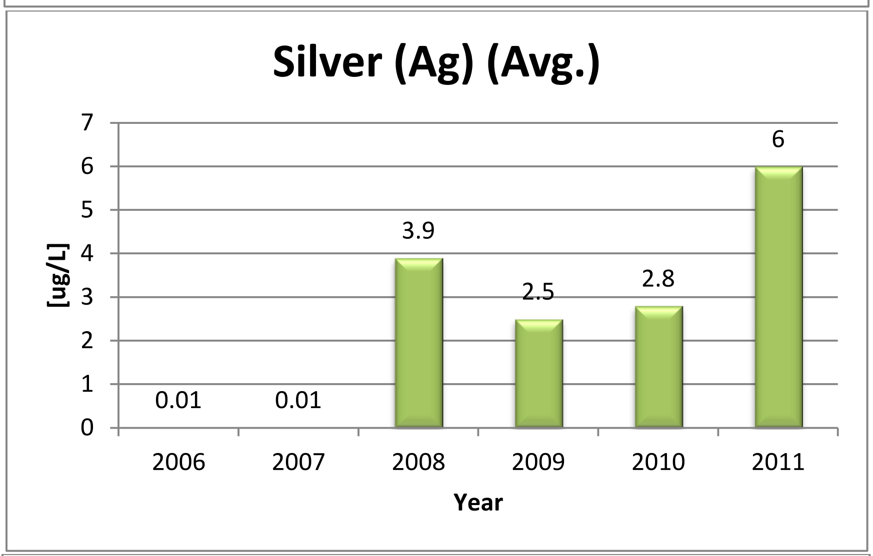

Selenium (Se) (Avg.)
[ug/L]
3.5
3
2.5
2
1.5
1
0.5
0
0.001
0.001
3
3.1
2.8
1.5
2006
2007
2008
2009
2010
2011
Year


Selenium (Se) (Max.)
[ug/L]
16
14
12
10
8
6
4
2
0
0.001
0.004
12.9
15
15
2.2
2006
2007
2008
2009
2010
2011
Year

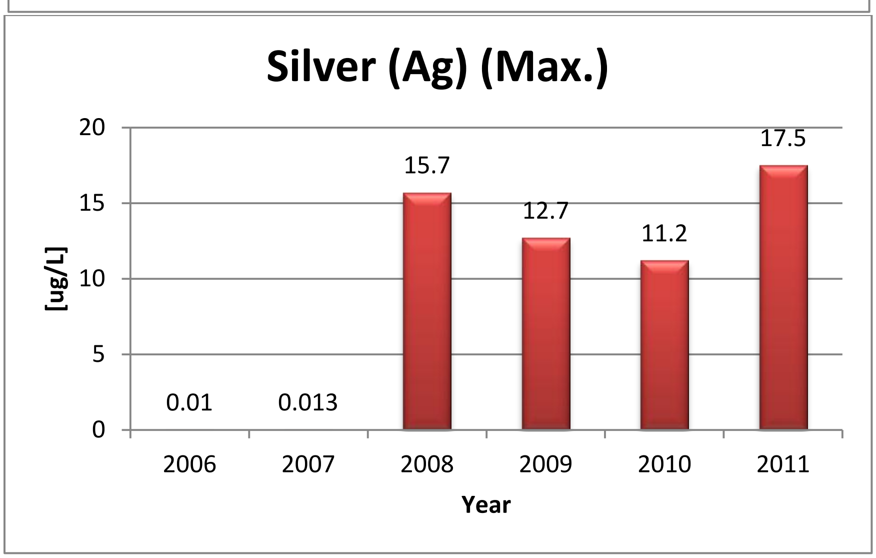
Silver (Ag)



Silver (Ag) (Min.)
1.2
1
0.8
0.6
0.4
0.2
0
[ug/L]
0.01
0.0012
1
1
1
1
2006
2007
2008
2009
2010
2011
Year

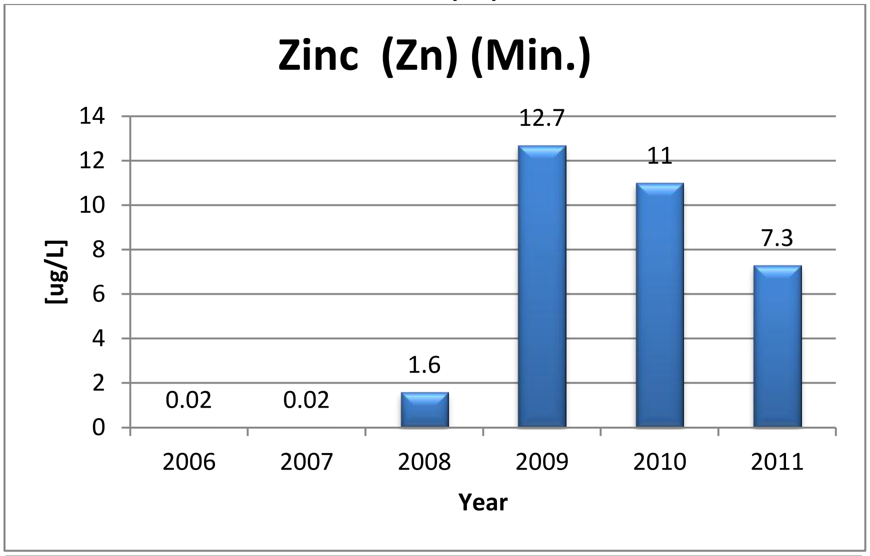


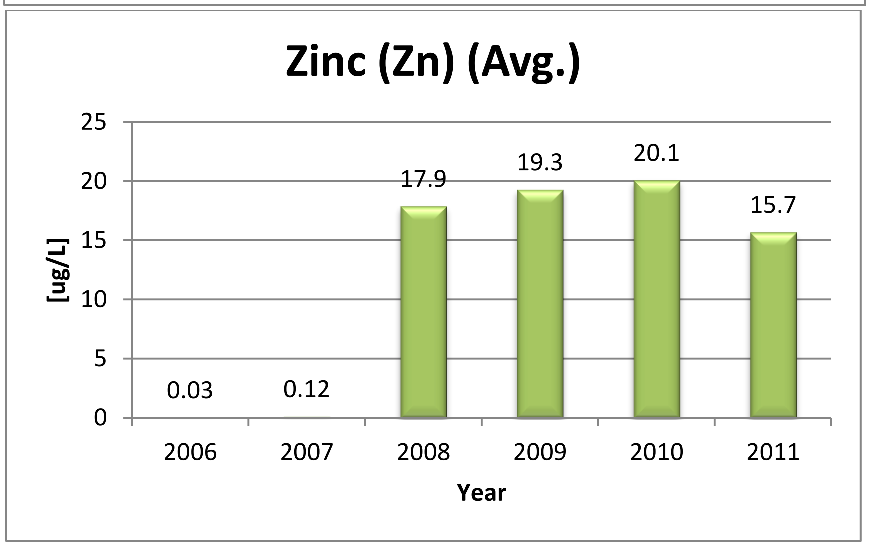
Silver (Ag) (Avg.)
7
6
5
4
3
2
1
0
[ug/L]
0.01
0.01
3.9
2.5
2.8
6
2006
2007
2008
2009
2010
2011
Year

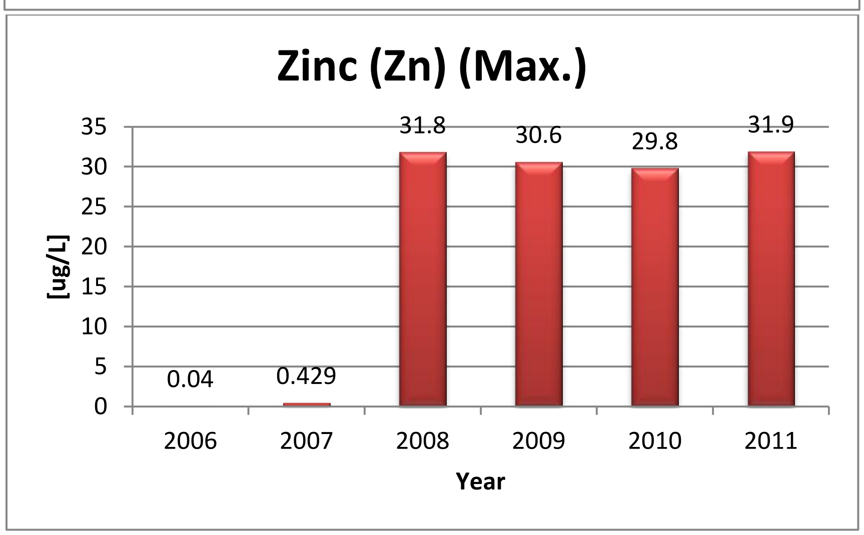


Silver (Ag) (Max.)
20
15
10
5
0
[ug/L]
0.01
0.013
15.7
12.7
11.2
17.5
2006
2007
2008
2009
2010
2011
Year

Zinc (Zn)


Zinc (Zn) (Min.)
[ug/L]
0
2
4
6
8
10
12
14
0.02
0.02
1.6
12.7
11
7.3
2006
2007
2008
2009
2010
2011
Year


Zinc (Zn) (Avg.)
[ug/L]
0
5
10
15
20
25
0.03
0.12
17.9
19.3
20.1
15.7
2006
2007
2008
2009
2010
2011
Year


Zinc (Zn) (Max.)
[ug/L]
0
5
10
15
20
25
30
35
0.04
0.429
31.8
30.6
29.8
31.9
2006
2007
2008
2009
2010
2011
Year

Appendix B-3: AM No.3 Filtration Alternatives

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Marie Burbano, CDM Smith

Date: *June 4, 2012*

Subject: *Assessment Memorandum (AM) No. 3 – Filtration Alternatives*

Purpose and Background

This technical memorandum (TM) evaluates treatment process alternatives for the filtration of recycled water produced at the City of Santa Barbara's El Estero Wastewater Treatment Plant (El Estero).

The purpose of this memorandum is to present several filtration treatment process alternatives and provide a preliminary analysis to recommend a treatment process to accomplish the desired water quality of the recycled water produced at El Estero. The treatment processes that are considered in this evaluation are gravity deep bed filters, upflow continuous backwash media filters, cloth or disk filters, and microfiltration (MF). The recommended treatment process will be further developed during the preliminary design phase.

For all capital cost estimates, the following allowances have been included.

- 15% for engineering design and services during construction
- 5% for permitting, administration, and legal

For the life-cycle cost estimates, the following has been included.

- 20 year life cycle
- Unit power cost of $0.085/kWh. This is based on an evaluation of El Estero summer and winter 2011 electricity bills. The summer was approximately $0.11/kWh, while winter was $0.07/kWh. Additional information from Chris Toth (City of Santa Barbara) on April 26, 2012 showed that the expected power purchased from the new Cogen facilities would be $0.085/kWh, which was selected for the purposes of this study.
- 3.5% interest rate

This TM is organized into the following sections.

- Filtration requirements
- Existing filter complex
- Filtration alternatives
- Filtration alternatives evaluation
- Recommendations

Filtration Requirements

Recycled water quality criteria and usage are specified in Title 22, Division 4 of the California Code of Regulations (CCR). El Estero produces recycled water that meets the Title 22 criteria for disinfected tertiary recycled water. Depending on the groundwater basin and recycled water usage location, the Regional Water Quality Control Board (RWQCB) can include additional requirements to Title 22. At El Estero, the Central Coast Region of the RWQCB lists the current recycled water requirements in the Waste Discharge Requirements and Master Reclamation Permit Order No. 97-44. Note that Title 22 was written after Order No. 97-44. However, the requirements in Order No. 97-44 are more stringent than Title 22 and, therefore, apply to El Estero.

Table 1 summarizes the primary water quality requirements for disinfected tertiary recycled water.

Table 1 El Estero Recycled Water Permit Requirements per Order NO. 97-44

Parameter	Requirements
Turbidity[1]	2 NTU (Mean) 5 NTU (Maximum)
Total Non-filterable Residue (Suspended solids)	10 mg/L (Mean) [2] 25 mg/L (Maximum)
Settleable solids	0.1 mL/L (Maximum)
Total dissolved solids	1,500 mg/L (Maximum)
Cadmium	0.01 mg/L (Maximum)
Lead	5.0 mg/L (Maximum)
Total Coliform Most Probable Number (MPN)[3]	2.2 per 100 mL (Average) 23 per 100 mL (Maximum)

[1]Maximum limit shall not be exceeded more than five percent of the time during any 24-hour period.

[2]Compliance shall be determined from the results of the five most recent samples.

[3]No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL.

Title 22 provides requirements for both filtered wastewater and disinfected tertiary recycled water. For the purposes of this analysis, the filtered wastewater standards must be met using the filtration alternative selected. Disinfection occurs at El Estero in the chlorine contact basin and onsite storage reservoir.

Title 22 requirements for filtered wastewater are as follows.

> *"Filtered wastewater" means an oxidized wastewater that meets the criteria in subsection (a) or (b):*
>
> *(a) Has been coagulated and passed through natural undisturbed soils or a bed of filter media pursuant to the following:*
>
> *(1) At a rate that does not exceed 5 gallons per minute per square foot of surface area in mono, dual or mixed media gravity, upflow or pressure filtration systems, or does not exceed 2 gallons per minute per square foot of surface area in traveling bridge automatic backwash filters; and*
>
> *(2) So that the turbidity of the filtered wastewater does not exceed any of the following:*
>
> *(A) An average of 2 NTU within a 24-hour period;*
>
> *(B) 5 NTU more than 5 percent of the time within a 24-hour period; and*
>
> *(C) 10 NTU at any time.*
>
> *(b) Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:*
>
> *(1) 0.2 NTU more than 5 percent of the time within a 24-hour period; and*
>
> *(2) 0.5 NTU at any time."*

All of the technologies evaluated in this TM meet the Title 22 requirements for filtered wastewater.

Existing Filter Complex

The existing filter complex was constructed in 1988 as part of the City's Water Reclamation Project at El Estero. The existing chlorine contact basin and recycled water reservoir were constructed at the same time.

The filters are single-media gravity filter type filters with an air/water backwash system. The original manufacturer was General Filter Co., but this technology has since been purchased by Siemens and is currently marketed as CenTROL® LP Conventional Gravity Filters. The filters consist of four cells, each 14 ft x 14 ft and 20 ft deep with 4 ft of media depth. The design filter loading rate is 750 gpm/cell (3.83 gpm/sq ft). At this nominal loading rate, the influent filter loading capacity is 4.32 mgd, not accounting for backwash waste and time for backwashing of the filters. Table 2 provides original design details for the existing filters.

Table 2 Existing Filter Design

Description	Details
Type	Single-media gravity filter with air/water backwash
Manufacturer	General Filter Co. (now owned by Siemens)
Flocculation chamber HRT	7 minutes at 3,000 gpm
Size	4 cells, 14 ft x 14 ft each
Media depth	4 ft
Filter rate	750 gpm/cell (3.83 gpm/sq ft) (results in 4.32 mgd)

The filters receive secondary effluent that is pumped through two filter supply pumps, one duty and one standby. The filter supply pumps are supplied by a 48” secondary effluent pipe. Filter supply pumps feed flow to the flocculation chamber. At the design flowrate of 3000 gpm, the filter influent is in the flocculation chamber for approximately 7 minutes. Influent then flows into an influent flume to a center distribution box. The distribution box consists of internal stilling baffles and weirs, which are adjustable to divide flow to each of the filter cells. The design elevation of the filter influent weirs is set at 32.00 ft. Figure 1 shows the hydraulic profile of the original plant design for the filters. The full hydraulic profile, including the chlorine contact basin and reclaimed water storage reservoir, can be found in the Water Reclamation Project Treatment Systems 1988 Record Drawings, Dwg No. G-11.

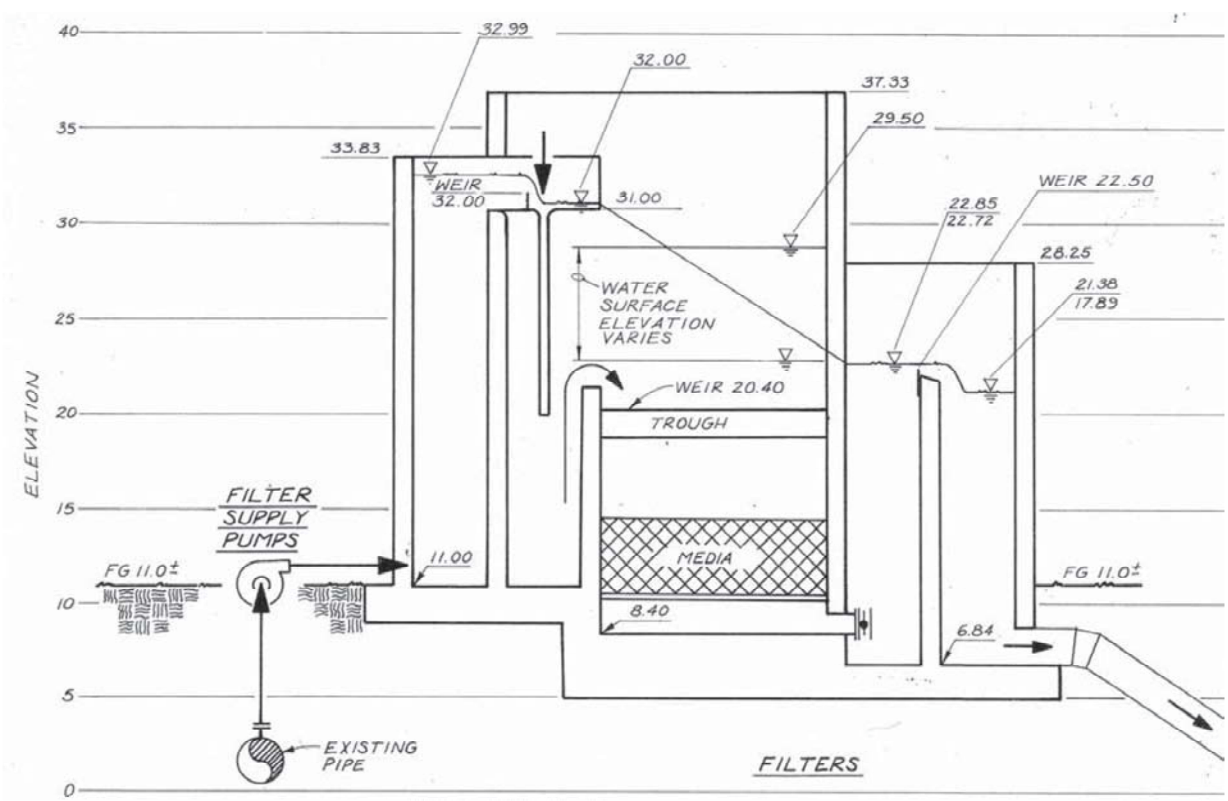


Figure 1
Filter Hydraulic Profile

A pneumatically operated valve is provided at the bottom of the distribution box for each cell, which is open during normal operation and closed during a backwash cycle. Filter influent flows through 4 ft of media, which was originally finely ground anthracite coal filter media ranging in size from 1.4 mm to 1.6 mm. The filter media has not been recently replaced, although additional media has been added on an as-needed basis. Figure 2 shows the general layout of the main features in the current filters.

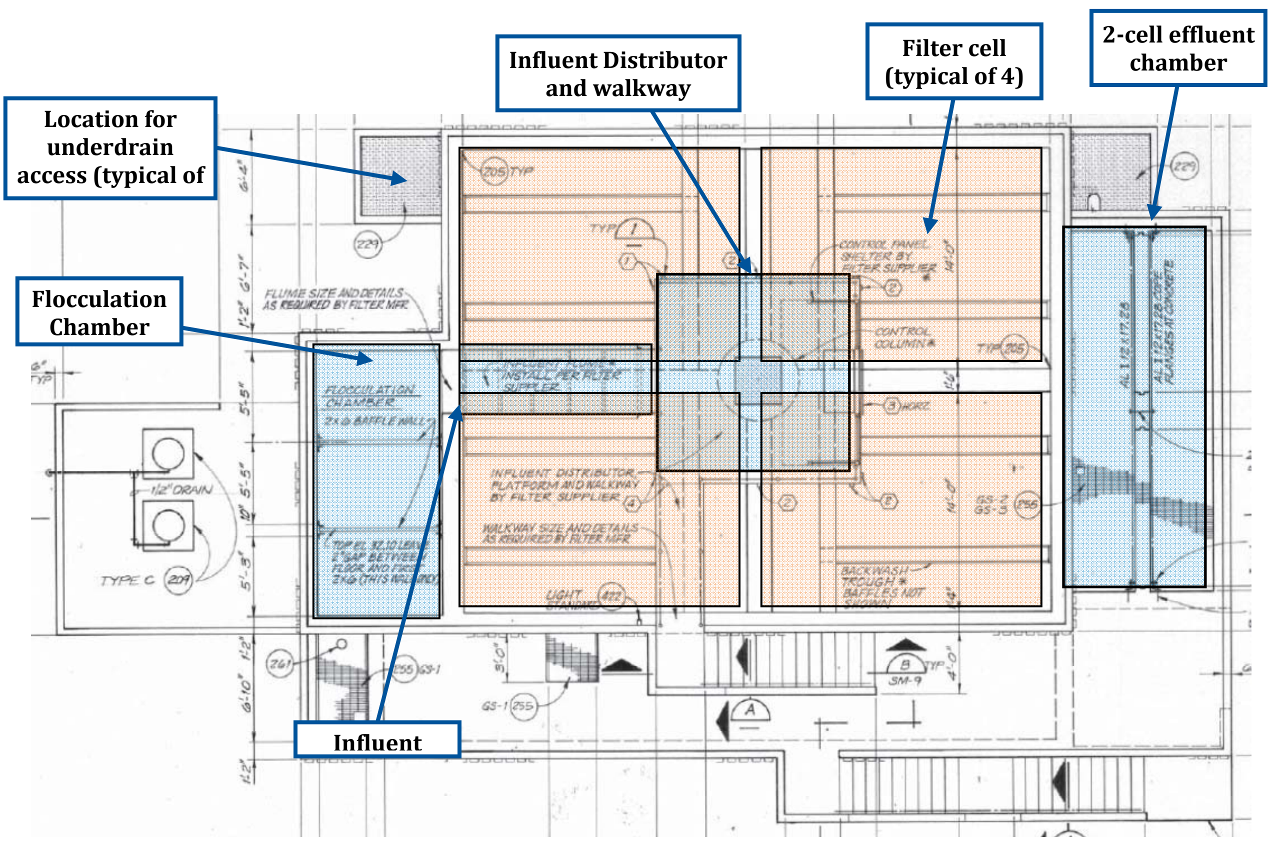


Figure 2
Existing Filter Layout

Following filtration, filtered effluent flows to 16” effluent collection pipes located under the underdrain. The effluent collection pipes have holes to provide distributed collection system for each filter. Effluent collection pipes convey the water to a two-cell effluent chamber. An effluent weir is set at 22.50 ft, resulting in maximum of 9.5 ft of headloss through the existing filters. Filter effluent flows by gravity to the chlorine contact basin.

Polymer and alum feed systems are provided for the filter complex, as well as the ability to add chlorine as needed. Anionic and cationic polymer are supplied prior to a static mixer in the filter influent line before the flocculation chambers. Alum and chlorine are added after the static mixer.

Repairs in a 2005 retrofit included the following: coating surfaces, replacing conduit, and replacing valve operators.

Existing Backwash System

Online instrumentation is provided to monitor the water level in each cell. When the water level in a cell has risen to approximately 8.5 ft above the filter media, a backwash cycle is designed to automatically start for that cell. In addition, turbidimeters are provided to monitor the filter effluent of each filter cell. The backwash system is designed to be controlled by an automatic backwash controller.

During backwash, the influent to the filter cell is closed and water is designed to be allowed to filter through until it reaches 1 ft above the effluent weir. At this point, the backwash waste valve for that cell in the center column is opened and water drains into the backwash equalization basin. When the water level reaches approximately the top of the backwash trough, the backwash air blower starts which forces air through the filter media. Filter effluent will also flow up through the media because the water level in the cell is less than the filter effluent chamber, forcing the water to back up in the effluent plenum. Following a backwash, the filters are operated as filter-to-waste to mitigate the potential of increased turbidity of the first flush.

Backwash water is collected in backwash troughs in the center column and sent in an 18” pipe to the backwash equalization tank and then to the plant influent sewer. Filter-to-waste is also sent to the backwash equalization tank.

Backwash air supply is provided by a low pressure air supply distribution header as part of the backwash system. Two backwash blowers feed the low pressure air supply for backwash. An air compressor pack, and an air dryer are utilized to operate filter function valves. Table 3 provides the existing backwash system design details.

Table 3 Existing Backwash System Design

Description	Details
Backwash rate	12 gpm/sq ft (2,400 gpm)
Backwash air rate	4 cfm/sq ft (780 cfm)
Backwash blowers	1 duty, 1 standby Positive displacement, capacity 780 cfm

Existing Filtration Complex Limitations

Existing filter limitations include difficulty to meet effluent turbidity requirements, continuous operational challenges, and operations and maintenance safety concerns. It is important to assess these limitations in order to evaluate what improvements to the existing system are needed and if a new process would be beneficial over improving the existing system.

The existing filter complex is a compact process which eliminates the need for a filter gallery and utilizes the effluent from other filters to backwash without the need for pumping. The process also does not require complex filter effluent rate of flow controls and relies simply on hydraulics with influent flow splitting and variable level filtration. The variable level is in response to increased headloss in the media during a filter run. This also provides the operator with a clear visualization of filter headloss without instrumentation. The overall headloss through this system can also be less than other granular media filtration systems. Although there are many positive features with this type of system, the current filter complex has clearly reached its useful life. In addition, the focus on compact design has also contributed to some difficulties associated with access. The materials of construction were also not optimized for a corrosive environment as will be discussed herein.

Structural and corrosion problems with the existing filter complex are well documented in the Corrosion Engineering Evaluation Report completed by HAE Engineers in January 2012. These structural and corrosion problems cause operational safety concerns for plant staff. The results of the study on the filter complex showed the following.

- Corrosion of multiple filter operational components, including the influent flume, influent distributor, air wash valves and piping, backwash valves (Figure 3), valve controllers, etc.
- Corrosion of many structural elements including stainless steel columns (Figure 4) and ladder braces.
- Deterioration and exposed aggregate on the concrete.

Figure 3
Valve Corrosion

Figure 4
Corrosion on Valve Control Rod Housing

The Corrosion Report also documents more than 70 photos of the filter complex and provides recommendations for improvements. The City of Santa Barbara has enlisted a contractor to make structural repairs to the filter complex so that plant staff can safely operate and maintain the units. These repairs will be completed in 2012.

In addition to the repairs noted in the Corrosion Report, plant staff has also expressed concern about maintenance access. The underdrain access is limited in the existing filters and only achieved through four 24" manholes located at each filter. This difficult confined-space entry creates operational challenges for assessing and maintains the filter underdrain and backwash system. There are also safety concerns entering this tight confined-space. Figure 5 is a photograph of the underdrain access point.

Figure 5
Underdrain Access Point

The filter media has not had a complete replacement in recent memory according to plant staff. Although filter media has been added periodically, this has not been a frequent occurrence. Therefore, the quality of the current filter media is questionable because filter media is typically inspected and replaced on a routine basis.

The filter effluent turbidity is variable and results in required blending with potable water to meet recycled water turbidity permit limits. Previous studies have shown that improvements to the secondary system are needed to improve filtered water quality due to the particle size that is leaving the secondary system and passing through the filters. Secondary improvements are currently in design at El Estero.

Filter effluent water quality may also be limited by the backwash process with the current filters. The existing liquid backwash system is limited in head to only the head available from the effluent chamber, instead of a separate backwash pumping system. This will frequently not provide the bed disruption needed to properly clean the filter for the next filter run.

Finally, one of the greatest challenges to operations is the instrumentation and controls with the existing filter complex. In recent years, the online instrumentation and automated backwashing has not been effective. As a result, plant operators will typically have to perform manual backwash cycles when the filters are running. Additionally, the control panel for backwashes is located in the middle of the structure. For operator safety, this should be located outside of the structure so that the operators do not need to walk on over-water walkways and platforms to access this important control panel. Access to control instrumentation such as level sensors is limited as well.

Filtration Alternatives

This section analyzes filtration technologies that meet Title 22 and permit limits including gravity deep bed filters, upflow continuous backwash media filters, cloth or disk filters, and microfiltration (MF). These alternatives are being evaluated to determine the best approach moving forward for filtration at El Estero. The overall selection process for filtration and demineralization is described in TM1. There is a description of each technology, water quality considerations, and a description of the proposed improvements for El Estero.

For the technologies listed, it is assumed that the planned secondary improvements will be implemented prior to installation of the filtration alternative. Table 4 provides the assumed secondary effluent quality that will be influent to the filters.

Table 4 Assumed Secondary Effluent Quality After Secondary Improvements at El Estero

Parameter	Level
Biochemical Oxygen Demand (BOD)	10 mg/L
Total Suspended Solids (TSS)	10 mg/L
Turbidity	<10 NTU

Filtration will be prior to any proposed demineralization. TM 5 provides a full alternative analysis for demineralization. For the purposes of this filtration analysis, it is assumed that reverse osmosis (RO) is the preferred alternative for demineralization. For any flow going through the RO, MF pretreatment is highly preferred. For the first four technologies listed (gravity deep bed filters, upflow continuous backwash media filters, cloth or disk filters), a sidestream of MF will be required prior to the RO. For the full MF alternative, no additional sidestream RO pretreatment is required.

Flow requirements for filtration are detailed in TM1. For the filtration alternative, it is assumed that the design capacity of the product water after filtration and demineralization is 2.7 mgd.

Retrofit of Existing Gravity Deep Bed Filters

Description of technology

Gravity deep bed filters typically have a media depth of greater than 40”. The required filtration loading rate to meet Title 22 is less than 5 gpm/sf. The existing filters are considered gravity deep bed filters. A full description of the operation of the existing deep bed gravity deep bed filters is provided in the review of the existing system. The existing deep bed filters meet these criteria.

Water quality considerations

As previously stated, the improvements to the secondary process at El Estero will be necessary in order to use gravity deep bed filters for filtration. This is because, based on pervious studies, turbidity and, particularly, the particle sizes currently coming out of the existing secondary clarifiers results in a filtration influent that is difficult to filter with the current gravity deep bed filters. This is further evidenced by the limited operation of the existing filters due to high effluent turbidity. For the purposes of this evaluation, it is assumed that the secondary improvements will be completed to meet a TSS of less than 10 mg/L out of the secondary clarifiers on an average basis.

Media selection is important in a gravity deep bed filter based on treating influent and meeting effluent water quality requirements. The selection of single or dual media should be evaluated during design if this technology is selected. In a dual media filter, a coarser media for a slight contact clarification step first would be preferred where the coagulated water hits the media. A finer media below could help with reducing turbidity. A full depth monomedia needs to meet both objectives. However, a dual media filter will result in more headloss. A pilot study would be recommended to optimize chemical pretreatment and media configuration. In addition, a pilot filter could be retained to facilitate future chemical pretreatment optimization evaluations in the future.

As previously stated, the existing liquid backwash system is limited in head to only the head available from the effluent chamber. Although this is a simple backwash system as it does not require a separate pump, it frequently will not provide the bed disruption needed to properly clean the filter. As an improvement, backwash water supply should be provided from the filtered water clearwell using backwash pumps. This will improve ongoing water quality and filterability.

If demineralization is required, a sidestream MF system would be needed following the gravity deep bed filters because the RO would need MF for pretreatment (see TM No. 4 for additional information).

Description of improvements
An extensive restoration of the existing gravity deep bed filters is recommended as an improvement to accomplish operations, safety, and water quality goals. The following improvements would be recommended for the retrofit of the existing filters.

- Demolition as needed for replacements of structures listed below.
- Replace influent flume, influent distribution structure, pipe, and valves. Note that the influent distribution structure may need to be custom-made to match the existing structure.
- Replace backwash troughs.
- Replace the walkway.
- Replace all backwash to waste piping and backwash air piping.
- Replace filter media.

- Replace filter feed pumps.
- Replace underdrain with a new underdrain system that is low profile and will improve overall air and water distribution. Alternatives include M-block style as well as monolithic underdrains using a nozzle system. Consideration to the height required for the underdrain and plenum would need to be considered.
- Add new pumps for pressurized backwash water flow. Two backwash pumps (one duty, one standby) are recommended in the effluent channel. The backwash header should be piped such that the effluent plenum each individual filter can be pressurized to provide backwash. The existing waste backwash system should be retained but all the backwash valves should be replaced.
- Provide adequate coating in the tank, flume, through and walkway supports to protect against future corrosion.
- Relocation/replace the control cabinet. The control cabinet is currently located in the center of the filter structure. This should be relocated to the side of the filter so that operators do not need to walk on the platform to access the control panel.
- Provide maintenance to the stainless steel shaft and replace piping/valve and motors.
- Replace and relocate filter instrumentation. Filter instrumentation, including level sensors and turbidity monitors, should be replaced and relocated so that they are easily accessible by plant operators.

Projected costs

Capital costs for the rehabilitation to the existing filters include the improvement items listed above. The estimated capital cost to rehabilitate the existing gravity deep bed filters is $3M. The annual costs for the existing filters include power required for influent pumping and backwash air and water flow as well as chemical pretreatment for coagulation. The annual cost for the existing filters is estimated at $40,000.

The estimated capital cost for a sidestream MF as a pretreatment for RO is $1.9M. Annual cost for the sidestream MF is an additional $40,000. The sidestream MF is described in the Media Filtration section of this TM.

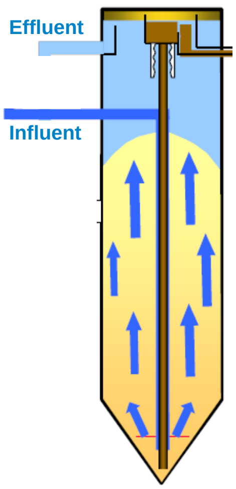
The total 20-year lifecycle cost for the rehabilitation to the existing filters with sidestream MF as a pretreatment to RO is $6.1M.

Upflow Continuous Backwash Filters

Description of technology

The upflow continuous backwash filter is a Title 22 approved granular medium sand filter technology. The system is an upflow, deep bed, continuously backwashing filter. The criteria for these system in the Title 22 approved technology list is for a filtration rate of less than 5 gpm/sf, along with 40-inch of sand media.

A flow distribution system is needed to distribute flow to each filter cell equally with isolation valves needed to take a cell offline. Influent flows into the base of the sand filter beds and subsequently flows upward through a sand media bed that is concurrently moving in a downward direction. Filtered effluent is removed from the top of the filter cells and is combined into a common effluent header. Schematics of the upflow continuous backwash filters are shown in Figure 6.



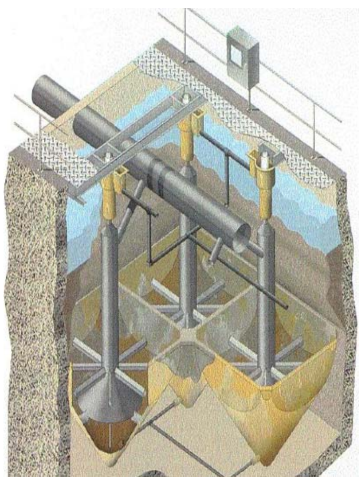


Figure 6
Upflow continuous backwash filter schematics

The filters are designed to allow for simple isolation of individual filter cells. There are no local pumps, blowers, or actuated valves required for operation of the filters, and there are low power loadings only due to a compressor that is required for continuous backwashing. The minimization of ancillary components such as automatic valves, blowers, and pumps provides energy efficiency, reduces facility maintenance, and minimizes electrical end rush loadings associated with starting and stopping equipment to perform backwashes.

Solids are continuously backwashed due to the constant recirculating airlift located in the center of each filter module. The airlift is generated by a common air compressor for the entire filter gallery. Sand media is pulled into the airlift and is continuously scoured within the airlift pipe thereby removing solids from the sand media. Solids are carried to the top of the airlift pipe and conveyed to waste while the clean sand is returned to the top of the downwardly moving sand bed.

The filters are protected from sunlight and debris via a fine grating located on the top of the filter structure that also provides access for maintenance staff.

Water quality considerations
As previously stated, the improvements to the secondary process at El Estero will be necessary in order to use upflow continuous backwash filters for filtration. This is because the upflow continuous backwash filter is a media filter, and will likely perform similarly to the existing gravity deep bed filters in terms of water quality. The continuous backwash filter, which is continuously backwashing, can improve filter run time and treated water quality. For the purposes of this evaluation, it is assumed that the secondary improvements will be completed to meet a TSS of less than 10 mg/L out of the secondary clarifiers on an average basis. These filters may be able to accommodate a wider range of influent conditions than the gravity deep bed filters due to the continuous backwashing, but secondary improvements will still be needed.

If demineralization is required, a sidestream MF system would be needed following the gravity deep bed filters because the RO would need MF for pretreatment (see TM No. 4 for additional information).

Description of improvements
Continuous backwash filters can be configured to fit into the site footprint of the existing structure or in a new structure. This will require that the existing filters be taken out of service during construction. If configured into the existing structure, the internal components of the structure would be demolished and replaced with the new filters.

Projected Costs
The estimated capital cost for upflow continuous backwash filters retrofit into the existing filter structure is $2.9M. The annual costs for the upflow continuous backwash filters include power required for influent pumping and backwash as well as chemical pretreatment for coagulation. The annual cost for the upflow continuous backwash filters is estimated at $40,000.

The estimated capital cost for upflow continuous backwash filters in a new structure is $6.6M. The annual costs is the same as in the existing structure.

The estimated capital cost for a sidestream MF as a pretreatment for RO is $1.9M. Annual cost for the sidestream MF is an additional $40,000.

The total 20-year lifecycle cost for the upflow continuous backwash filters retrofit into the existing filter structure with sidestream MF as a pretreatment to RO is $6M.

The total 20-year lifecycle cost for the upflow continuous backwash filters in a new filter structure with sidestream MF as a pretreatment to RO is $7.8M.

Disk Filters

Description of technology
Disk filters are set up in a series of disks using cloth media. Typical configurations are 8 to 12 disks per channels. The filters operate with the cloth media completely submerged. The disks are

typically stationary. Flow can either operate on an inside-out or outside-in configuration. In the inside-out configuration, flow enters the inside of the disk and flows to the outside where it is collected for reuse. Solids collect in the center for removal. In the outside-in configuration, flow is in the overall channel and filtered effluent is collected in the center of the disks.

Filter media can be woven (Figure 7) or pile (Figure 8) media. Both technologies are Title 22 approved, although the woven media can provide more consistent filtered water quality due to the consistent size of the openings. However, the pile media allows solids to accumulate, which results in longer times between backwashes as compared with the woven media.

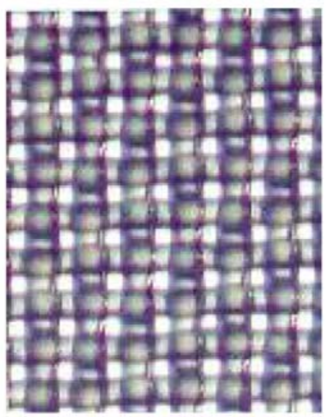


Figure 7 – Woven Media

Figure 8 – Pile Media

Solids are backwashed from the cloth media surface via pumps that pull suction on the cloth surface, thereby removing accumulated solids from the cloth surface. The disks slowly rotate during a backwash cycle, with two disks backwashing at a time. The backwash process can be intermittent or continuous depending on influent water quality and loading rate. The filter backwash can be initiated either by a timer or by the water level in the filter basin. Because solids accumulate at the bottom of the channel, the filters can be backwashed without interrupting filter operation.

Figure 9 is a configuration of a typical disk filter, and Figure 10 shows a disk filter installed, without water in the basin. When operating, the disks are covered with water.

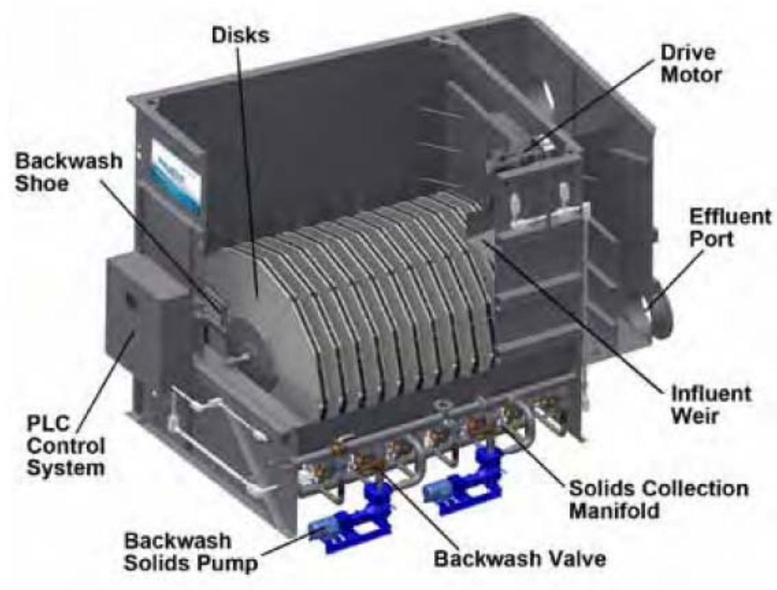


Figure 9. Typical disk filter configuration (Aqua Aeorbics AquaDisk® technology used for example)

Figure 10. Installed disk filter

Water quality considerations

There are water quality limitations on the influent to the disk filters to provide Title 22 required effluent turbidity. These requirements are typically more stringent than the media filter technologies (i.e. gravity deep bed filters or upflow continuous backwash filters). For example, for the AquaDisk filters, the secondary effluent turbidity must not exceed 5 NTU for more than 15 minutes and never shall exceed 10 NTU. In addition, there must be the ability to automatically activate chemical addition or divert wastewater from the filter if the influent turbidity exceeds 5 NTU for more than 15 minutes.

Description of improvements

Disk filters can be configured to fit into the site footprint of the existing structure or in a new structure. If configured into the existing structure, the internal components of the structure would be demolished and replaced with the new filters.

Projected Costs

The estimated capital cost for a retrofit of cloth or disk filters in the existing filter structure is $2.6M. The annual costs include power required for pumping for the influent and backwash as well as chemical pretreatment for coagulation. The annual cost for the existing filters is estimated at $40,000.

The estimated capital cost for a sidestream MF as a pretreatment for RO is $1.9M. Annual cost for the sidestream MF is an additional $40,000.

The total 20-year lifecycle cost for a retrofit of cloth or disk filters in the existing filter structure with sidestream MF as a pretreatment to RO is $5.8M.

Membrane Filtration

Description of technology

Microfiltration (MF) and Ultrafiltration (UF) are the two processes that are most often associated with the term “membrane filtration” and are alternatives to the media or cloth/disk filters discussed previously. These membranes provide a physical barrier, resulting in more complete rejection of particles greater than a specified size (on the order of 0.1 μm for MF and on the order of 0.01 μm for UF). Membranes of this kind remove particles down to such small sizes that they both remove pathogens and also particles that adversely affect the aesthetic appearance of the water. Membrane filtration has been successfully employed for several years in the treatment of secondary effluent to make it suitable for reverse osmosis.

In recent years, competition among manufactures and increasing number of successful installations has dramatically decreased both initial and long-term costs of membrane filtration.

Polymeric membranes are formed using either cellulose acetate (CA) or synthetic polymers, such as polypropylene (PP), polyvinylidene fluoride (PVDF), polysulfone (PS), or polyethersulfone (PES). The various membrane materials have different properties, including pH and oxidant sensitivity, and hydrophobicity (see Table 5). Most synthetic polymeric membranes are naturally hydrophobic and only upon surface modifications do they become hydrophilic. Therefore, these membranes have a special storage requirement -- they must be stored wet or filled with a wetting agent. If allowed to dry, they may experience a change in structure resulting in a loss of membrane permeability.

Table 5 Characteristics of Selected Membrane Materials

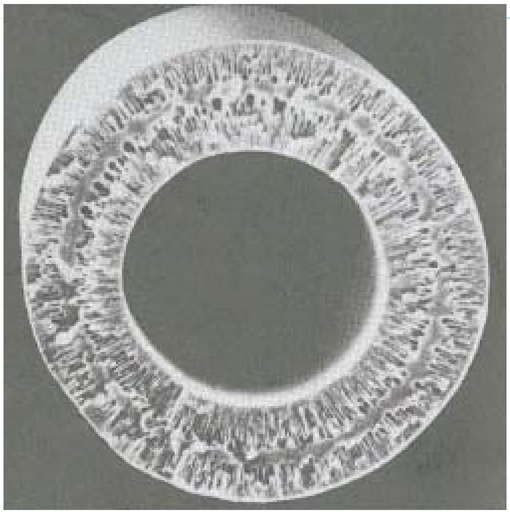
Membrane Material	Membrane Classification	Hydrophobicity	Oxidant Tolerance	pH Range	Fouling Resistance/ Cleanability
Polyvinylidene fluoride (PVDF)	MF/UF	Modified hydrophilic	Very High	2-11	Excellent
Polypropylene (PP)	MF	Slight hydrophobic	Low	2-13	Acceptable
Polyethersulfone (PES)	UF	Very hydrophilic	High	2-13	Very good
Polysulfone (PS)	UF	Modified hydrophilic	Moderate	2-13	Good
Cellulose acetate (CA)	UF	Naturally hydrophilic	Moderate	5-8	Good

(Adapted from Microfiltration and Ultrafiltration Membranes for Drinking Water, Manual of Water Supply Practices, M53)

Although polymeric MF/UF membranes are found in many configurations (hollow fiber, spiral wound, flat sheet, plate and frame), hollow fiber is recommended. These fibers have an inside diameter ranging from 0.4 to 1.0 mm and a wall thickness ranging from 0.07 to 0.6 mm (see Figure 11). The physical strength of the fibers allows them to be backwashed.

Hollow-fiber membranes are operated in either an inside-out or outside-in mode. During inside-out operation, the feed enters the fiber lumen and passes through the fiber wall to generate filtrate (Figure 11b). During outside-in operation, the filtrate is collected in the fiber lumen after the feed is passed through the membrane.

The pressure that is used to drive water through the membrane material is termed as transmembrane pressure. Depending upon the way membrane modules are pressurized, they are available in two basic configurations: pressure-vessel systems (Figure 12) and submerged systems (Figure 13). Pressure systems are operated under positive pressure (between 3 to 50 psi) and submerged system are under negative pressure (between -1 to -12 psi). Submerged systems tend to accommodate larger modules than pressure vessel systems and eliminate the need for pressure vessels to house the membranes. Additionally, submerged systems generally require fewer valves and piping connections with large facilities (greater than 10-20 mgd). Pressure vessel systems are generally more advantageous for facilities smaller than 10 mgd, have a greater degree of competition in the market, and are recommended for El Estero..



A

C

B

Figure 11
Hollow Fiber Membranes:
(A) Scanning electron microscope image of end view with cacrovoids for water passage,
(B) Example of a hollow fiber module
(C) Water permeating through hollow fibers

Figure 12

Pressure Vessel Configuration Membrane Filtration (Pall Corporation System)

Figure 13

Submerged configuration membrane filtration (Siemens Water Technologies)

Table 6 provides a list of key low-pressure membrane manufacturers in the USA. Most membrane filtration manufacturers currently produce membranes in the ultrafiltration size range rather than the microfiltration, however, there are very little differences observed in the performance or water quality that can be attributed to the classification as either UF or MF. For the remainder of this discussion, the term MF will be used to connote both types of membrane filtration.

Table 6 List of Key Low-Pressure Membrane Manufacturers in the USA

Manufacturer	Representative product name	Product specification
Pall Corporation	Microfiltration module (Microza hollow fiber USV modules)	Hollow fiber, pressurized system, outside-in flow, 0.1 micron pore size, PVDF material
Siemens	Microfiltration or Ultrafiltration modules (Memcor XP and CMF)	Hollow fiber, pressurized or submerged system, outside-in flow, 0.04-0.1 micron pore size, PP or PVDF material
X-Flow (Pentair)	Ultrafiltration modules (Aquaflex)	Hollow fiber, pressurized system, inside-out flow, 0.025 micron pore size, PES material
Zenon (GE Water & Process Technologies)	Ultrafiltration modules (ZeeWeed® 500 and ZeeWeed® 1000)	Hollow fiber, submerged or pressure system, outside-in flow, 0.02-0.1 micron pore size, PVDF material
Toray	Ultrafiltration modules (HFU and HSU)	Hollow fiber, pressurized system, outside-in flow, 0.01-0.02 micron pore size, PVDF material
Dow	Ultrafiltration modules (SFD)	Hollow fiber, pressurized system, outside-in flow, 0.02 micron pore size, PVDF material

Membrane Cleaning

Two types of chemical cleaning regimens are typically performed: (1) chemically enhanced backwashes (CEBs) to maintain the day by day membrane permeability, and (2) chemical clean-in-place (CIP) to restore the membrane permeability between phases or when the TMP reaches the terminal value (approximately 35 psi).

CEBs are preventive cleans performed in place at specified regular intervals to maintain the permeability of the membrane at an acceptable level. Typically, CEBs occur once every 1 to 7 days. During these types of cleanings, the membranes will be exposed to chemicals such as sodium hypochlorite, citric acid, and caustic soda, for a short period of time (<15 minutes). Other chemicals including strong acids may be used depending on the supplier's membrane chemical compatibility and foulants of concern. Chemical concentrations will depend on the severity of the organic or inorganic membrane fouling. Before resuming production, chemical residuals must be flushed out from the membrane tank. Typically, the equipment supplier is responsible for providing input for the optimization of the CEB cleaning regimen.

CIP cleans are an intensive chemical cleaning used to restore the membrane permeability to pre-fouled conditions. This intensive cleaning are typically performed roughly once every 30 days as needed, although longer cleaning intervals may be used if reliable operation is maintained. The chemicals used for recovery cleanings will depend on the severity of the organic or inorganic membrane fouling, and can include sodium hypochlorite, sodium hydroxide, and citric acid or other comparable acids. This cleaning is performed in place, requires a significant soaking or recirculation time (>4 hours), and typically uses higher chemical concentrations than CEBs.

Water quality considerations
As previously stated, MF can be used as a pretreatment to RO. MF filtered water quality is typically very consistent in terms of removal of suspended solids (measured as turbidity). The turbidity will be less than 0.1 NTU during operation, regardless of the quality of source water to the membranes. MF also achieves higher removals of bacteria and other viable microorganism, which significantly reduces the biofouling potential of the RO feedwater.

MF can typically handle a wider range of influent water quality (i.e. secondary effluent water quality at El Estero) than the granular media or cloth filter technologies. In the case of MF, it is likely that secondary improvements will not be necessary prior to filtration to provide high effluent quality for recycled water.

Description of improvements
MF would be installed on the same site at the existing filters. The MF units along with tankage for chemicals would be required and can fit in the existing filter footprint.

Projected Costs
The estimated capital cost for a full MF system is $6.5. The annual costs include power required for pumping the influent and backwash as well as chemicals for pretreatment and cleaning. The annual cost for the MF system is estimated at $100,000.

The total 20-year lifecycle cost for a full MF system is $7.9M.

A sidestream MF system would be implemented as a pretreatment to RO if other alternatives are selected. The flow for a sidestream MF will meet only the flow that must go through RO. The estimated capital cost for a sidestream MF as a pretreatment for RO is $1.9M. Annual cost for the sidestream MF is an additional $40,000. The life-cycle costs for sidestream MF are evaluated in other alternatives.

Filtration Alternatives Evaluation

In order to evaluate filtration alternatives, criteria were developed and scored during an April 9, 2012 workshop with City staff. The purpose of this workshop was to develop criteria to compare filtration alternatives. The process started with brainstorm to identify list of criteria. The list was narrowed down to the 6 most important criteria. Each meeting attendee then prioritize this list with weights, where 1 = low priority, and 5 = high priority. The weights were averaged and discussed to develop the final criteria and weights, provided in Table 7.

Table 7 Evaluation Criteria

Criteria	Weight
Increase ease of O&M and safety for plant staff	5
Optimize site layout	3
Minimize recycled water system shutdowns	4
Improved water quality: reduce turbidity & TDS	5
Minimize blending	4
Life-cycle cost	4

Note: 1 = low priority, 5 = high priority

This section analyzes filtration technologies against the evaluation criteria listed.

Gravity Deep Bed Filters – Retrofit of Existing Filters

Table 8 is a summary of the scores for the alternative of retrofitting the existing filters but keeping the same basic layout and technology. Included are both the scores as well as a description of the rationale behind the score. The weighted scores are the scores times the weights provided in Table 6 for the evaluation criteria

Table 8 Evaluation Summary for Gravity Deep Bed Filters with Sidestream MF

Criteria	Rationale	Score	Weighted Score
O&M and safety	• Continued difficult underdrain access, even with improvements • Regular starts and stops for backwashing	3	15
Optimize site layout	• Ongoing use of full existing site, while total flow may result in less site footprint required if alternatives were chosen	2	6
Minimize shutdowns	• Requires consistent, good secondary effluent quality	3	12
Reduce turbidity & TDS	• Turbidity will be less than 2 NTU, but not as low as full MF • Does not reduce TDS without sidestream MF and RO	3	15
Minimize blending	• With sidestream MF and RO, blending will be minimized	5	20
Life-cycle cost	• Twenty-year lifecycle cost = $6.1M	4	16
		Total Weighted Score	**84**

Note: 1 = lowest score or least benefit, 5 = highest score or greatest benefit

Upflow Continuous Backwash Filters

Two evaluation summaries are provided for the upflow continuous backwash filters. The first, provided in Table 9, is for the technology retrofit into the existing filter structure. The second, provided in Table 10, is for the technology in a new filter structure.

Table 9 Evaluation Summary for Upflow Continuous Backwash Filters in Existing Filter Structure with Sidestream MF

Criteria	Rationale	Score	Weighted Score
O&M and safety	• Potentially awkward configuration in an attempt to retrofit in existing filter structure • Common technology, typically automated and operator friendly • No requirement for shutdowns due to backwash cycles	3	15
Optimize site layout	• Ongoing use of full existing site, while total flow may result in less site footprint required if alternatives were chosen	2	6
Minimize shutdowns	• Requires consistent, good secondary effluent quality, but could accommodate a wider range than the gravity deep bed filters due to the continuous backwashing	4	16
Reduce turbidity & TDS	• Turbidity will be less than 2 NTU, but not as low as full MF • Does not reduce TDS without sidestream MF and RO	4	20
Minimize blending	• With sidestream MF and RO, blending will be minimized	5	20
Life-cycle cost	• Twenty-year lifecycle cost = $6M	4	16
		Total Weighted Score	**93**

Note: 1 = lowest score or least benefit, 5 = highest score or greatest benefit

Table 10 Evaluation Summary for Upflow Continuous Backwash Filters in a New Filter Structure with Sidestream MF

Criteria	Rationale	Score	Weighted Score
O&M and safety	• Common technology, typically automated and operator friendly • No requirement for shutdowns due to backwash cycles	4	20
Optimize site layout	• Filters can typically be in a small footprint, but cloth filters and MF typically require less overall footprint	3	9
Minimize shutdowns	• Requires consistent, good secondary effluent quality, but could accommodate a wider range than the gravity deep bed filters due to the continuous backwashing	4	16
Reduce turbidity & TDS	• Turbidity will be less than 2 NTU, but not as low as full MF • Does not reduce TDS without sidestream MF and RO	4	20
Minimize blending	• With sidestream MF and RO, blending will be minimized	5	20
Life-cycle cost	• Twenty-year lifecycle cost = $7.8M	3	12
		Total Weighted Score	**97**

Note: 1 = lowest score or least benefit, 5 = highest score or greatest benefit

Disk Filters

Table 11 is a summary of the scores for the alternative of retrofitting disk filters into the existing filter structure. Included are both the scores as well as a description of the rationale behind the score.

Table 11 Evaluation Summary for Disk Filters in Existing Filter Structure with Sidestream MF

Criteria	Rationale	Score	Weighted Score
O&M and safety	• Potentially awkward configuration in an attempt to retrofit in existing filter structure • Common technology, typically automated and operator friendly • No requirement for shutdowns due to backwash cycles	4	20
Optimize site layout	• Ongoing use of full existing site, while total flow may result in less site footprint required if alternatives were chosen	4	12
Minimize shutdowns	• Requires consistent, good secondary effluent quality • Will require shutdowns if secondary effluent quality is poor	3	12
Reduce turbidity & TDS	• Turbidity will be less than 2 NTU, but not as low as full MF • Does not reduce TDS without sidestream MF and RO	3	15
Minimize blending	• With sidestream MF and RO, blending will be minimized	5	20
Life-cycle cost	• Twenty-year lifecycle cost = $5.8M	4	16
		Total Weighted Score	**95**

Note: 1 = lowest score or least benefit, 5 = highest score or greatest benefit

Membrane Filtration (MF)

Table 12 is a summary of the scores for the full MF alternative. Included are both the scores as well as a description of the rationale behind the score.

Table 12 Evaluation Summary for MF with Sidestream MF

Criteria	Rationale	Score	Weighted Score
O&M and safety	• Completely enclosed MF vessels • Skid shutdowns required due to backwash cycles • Chemicals onsite for MF CIP	4	20
Optimize site layout	• Can fit into tight site footprint • Does not require an additional sidestream MF system	4	12
Minimize shutdowns	• Can accommodate variations in secondary effluent water quality • Consistently provides excellent effluent water quality	5	20
Reduce turbidity & TDS	• Provides best turbidity of all the filtration options • Provides additional bacteria removal as compared with other filtration options • Does not reduce TDS without sidestream RO	5	25
Minimize blending	• With sidestream RO, blending will be minimized	5	20
Life-cycle cost	• Twenty-year lifecycle cost = $7.9M	3	12
		Total Weighted Score	**109**

Note: 1 = lowest score or least benefit, 5 = highest score or greatest benefit

Evaluation Summary

In summary, five alternatives were analyzed. These include the following.

- Gravity deep bed filters (i.e. rehabilitation of existing filters) with sidestream MF
- Upflow continuous backwash media filters in the existing filter structure with sidestream MF
- Upflow continuous backwash media filters in a new filter structure with sidestream MF
- Disk filters in the existing filter structure with sidestream MF
- MF for the full filtration flow

Table 13 summarizes the cost evaluation of the various alternatives.

Table 13 Lifecycle Cost Evaluation Summary

	Rehab Existing Filters/ Sidestream MF	Upflow in Existing / Sidestream MF	New Upflow/ Sidestream MF	Disk Filters in Existing/ Sidestream MF	Full MF
Capital Cost	$4.9M	$4.8M	$6.6M	$4.6M	$6.5M
Yearly O&M Cost	$0.08M	$0.08M	$0.08M	$0.08M	$0.1M
20-Year Life-cycle cost	$6.1M	$6M	$7.8M	$5.8M	$7.9M
Life-cycle cost score*	4	4	3	4	3

Table 14 provides the complete filtration assessment scores for each alternative.

Table 14 Evaluation Summary

Criteria	Weight	Rehab Existing Filters/ Sidestream MF	Upflow in Existing / Sidestream MF	New Upflow/ Sidestream MF	Disk Filters in Existing/ Sidestream MF	Full MF
O&M and safety	5	3	3	4	4	4
Optimize site layout	3	2	2	3	4	4
Minimize shutdowns	4	3	4	4	3	5
Reduce turbidity & TDS	5	3	4	4	3	5
Minimize blending	4	5	5	5	5	5
Life-cycle cost	4	4	4	3	4	3
Total Score		84	93	97	95	109

Recommendation

Based on the evaluation criteria and filter scores, the full MF alternative is the recommended technology to proceed with for preliminary design. MF will provide excellent water quality for recycled water users and is a sufficient pretreatment for sidestream RO.

Figure 14 shows a conceptual site layout for the full MF system, with a sidestream of RO treatment in the solids handling building.

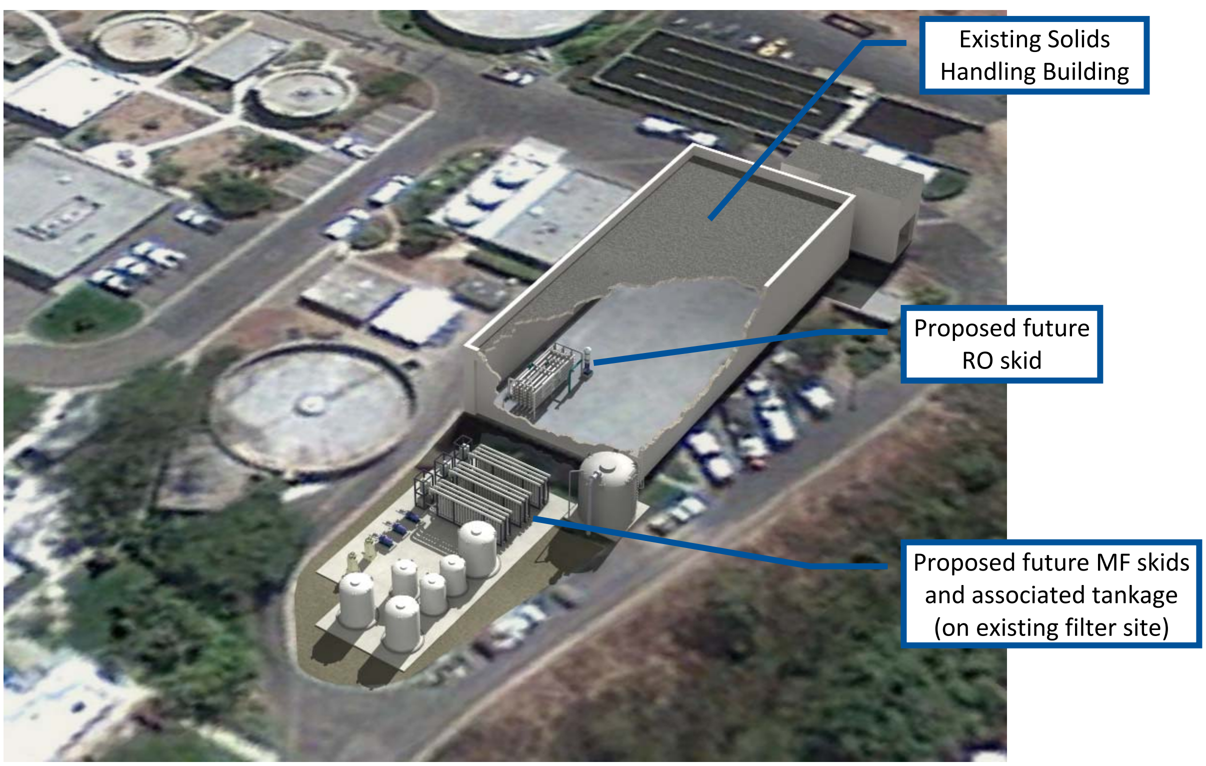


Figure 14. Conceptual MF layout

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Appendix B-4: AM No.4 Demineralization Alternatives

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Greg Wetterau, CDM Smith

Date: *June 4, 2012*

Subject: *Assessment Memorandum (AM) No. 4 – Demineralization Alternatives*

Purpose and Background

This technical memorandum (TM) evaluates treatment process alternatives for the demineralization of recycled water produced at the City of Santa Barbara's El Estero Wastewater Treatment Plant (El Estero).

The purpose of this memorandum is to present several demineralization treatment process alternatives and provide a preliminary analysis to recommend a treatment process to accomplish the desired demineralization of the recycled water produced at El Estero. The treatment processes that are considered in this evaluation are reverse osmosis (RO), nanofiltration (NF), electrodialysis reversal (EDR), and blending. The recommended treatment process will be further developed during the preliminary design phase.

El Estero is an 11 mgd wastewater treatment plant that was initially constructed in 1951; the plant has primary sedimentation, secondary processing, tertiary filtration, and disinfection. As part of El Estero, the City produces an average of 847 acre-feet per year (AFY) of Title 22 recycled water for 60 to 80 users, according to the 2009 Recycled Water Expansion Assessment. The City is committed to providing recycled water to system users who depend on the reliability of the recycled water system.

Recently, the water produced by the tertiary filters has not been able to reliably meet the required turbidity limit of less than 2 nephelometric turbidity units (NTU). The influent wastewater is also relatively high in total dissolved solids (TDS). As a result, the City currently blends with potable water to decrease turbidity and TDS in the recycled water. A planned improvement to the secondary treatment system will likely reduce secondary effluent turbidity, making the secondary effluent more amenable to filtration, and allowing the tertiary filter turbidity limit to be more easily met without blending. Even with these wastewater process improvements, however, the aging infrastructure of the filters may still require rehabilitation, retrofit or possibly replacement to reliably meet the turbidity limits. Evaluation of filter rehabilitation alternatives is provided in TM3 – Filtration Alternatives, evaluating multiple filtration alternatives to comply with the plant turbidity limits.

TDS varies greatly between the potable water system, where it averaged 599 mg/L at the Cater Water Treatment Plant in 2011, and the wastewater treatment plant effluent, where it averaged 1,160 mg/l in the secondary effluent in 2011. This increase of more than 560 mg/L TDS is believed to be caused by a combination of normal domestic water uses, infiltration and inflow from high salinity groundwater, and TDS added by domestic and commercial water softeners. The sources of salinity in the wastewater are discussed in a separate TM (Investigation of TDS from Water Softeners and Seawater Infiltration, May 29, 2012). The City's goal is to reduce TDS and chlorides to levels that will not cause adverse impacts to landscaping without relying on blending with potable water. This may be accomplished through a demineralization process if source control measures are not able to sufficiently control the salinity to acceptable levels.

Water Quality and Treatment Goals

Treatment goals for demineralization are based on historic water quality, regulatory requirements, and on specific water quality needs of recycled water customers. Each of these issues is discussed further below.

Historical Water Quality

Key water quality parameters that impact the demineralization process are summarized in Tables 1 and 2 for the years 2008 through 2011. Table 1 presents average values from the secondary effluent of El Estero and Table 2 presents maximum values from the same location.

Table 1 Historical Water Quality – Average Values

Parameter	Units	2007	2008	2009	2010	2011	5 Year Average
pH	-	7.8	7.9	7.8	7.8	8.0	**7.8**
Calcium	mg/L	95	95	99	95	95	**96**
Magnesium	mg/L	46	44	46	46	45	**45**
Sodium	mg/L	197	201	219	212	202	**206**
Potassium	mg/L	33	34	33	30	29	**32**
Ammonia	mg/L as N	33	24	23	28	30	**28**
Bicarbonate	mg/L	390	355	343	386	424	**380**
Sulfate	mg/L	301	293	315	316	290	**303**
Chloride	mg/L	273	308	328	343	307	**312**
Fluoride	mg/L	0.6	0.4	0.6	0.7	0.6	**0.6**
Nitrate	mg/L as N	0.5	3.0	6.2	3.3	1.7	**2.9**
Boron	mg/L	0.6	0.6	0.6	0.6	0.6	**0.6**
TDS	mg/L	1,296	1,259	1,331	1,225	1,160	**1,254**

Table 2 Historical Water Quality –Maximum Values

Parameter	Units	2007	2008	2009	2010	2011	5 Year Max
pH	-	8.0	8.1	8.0	8.0	8.1	**8.1**
Calcium	mg/L	103	107	112	105	100	**112**
Magnesium	mg/L	73	49	50	51	54	**54**
Sodium	mg/L	229	245	243	233	240	**245**
Potassium	mg/L	37	38	36	33	32	**38**
Ammonia	mg/L as N	37	34	31	44	38	**44**
Bicarbonate	mg/L	438	444	378	461	451	**461**
Sulfate	mg/L	321	350	365	388	328	**388**
Chloride	mg/L	318	379	421	529	505	**529**
Fluoride	mg/L	2.1	0.6	0.7	1.1	1.0	**2.1**
Nitrate	mg/L as N	3.1	5.1	10.9	12.6	7.7	**12.6**
Boron	mg/L	0.7	0.8	0.7	0.7	0.7	**0.8**
TDS	mg/L	1,614	1,398	1,502	1,354	1,264	**1,614**

Regulatory Requirements

Wastewater discharges, including recycled water, to waters of the United States are regulated under the Clean Water Act. The United States Environmental Protection Agency (USEPA) provides regulation of wastewater discharges through National Pollutant Discharge Elimination System (NPDES) permits. Wastewater discharges to State waters are regulated by the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (RWQCB). Regulations governing recycled water quality, usage, and design standards are promulgated by the California Department of Public Health (CDPH).

Recycled water quality criteria and usage are specified in Title 22, Division 4 of the California Code of Regulations (CCR). El Estero produces recycled water that meets the Title 22 criteria for disinfected tertiary recycled water. Table 3 summarizes the primary water quality requirements for disinfected tertiary recycled water.

Table 3 Disinfected Tertiary Recycled Water Quality Requirements

Parameter	Requirements
Turbidity	2 NTU (Average) 5 NTU (Maximum)
Total Coliform Most Probable Number (MPN)[1]	2.2 per 100 mL (Average) 23 per 100 mL (Maximum)

[1]No sample shall exceed an MPN of 240 total coliform bacteria per 100 mL during any 30 day period

Treatment Goals

Regulations governing water reuse are primarily concerned with protection of public health, focusing predominantly on the risk of pathogens rather than general mineral content, such as

TDS. Certain recycled water uses may have industry guidelines to prevent problems such as scaling or corrosion in cooling water, boiler feed water, or industrial process water systems. For irrigation, guidelines primarily focus on chloride concentrations, sodium content, and TDS as plants and crops may be sensitive to salts and other constituents in the recycled water. Recycled water that is high in TDS often has an adverse impact on plants and may require the user to grow plants that exhibit a higher salt tolerance or find alternative sources of water with more acceptable water quality conditions.

Current Water Quality Goals

The City used the guidelines in Water Quality for Agriculture (Ayers and Westcot, 1985) to develop their current recycled water quality goals, which include:

- Maintain chloride concentration below 300 mg/L during the irrigation season
- Maintain TDS concentration below 1,000 mg/L

To meet these goals, the City relies on blending of their recycled water with low TDS potable water supplies. The City also relies on blending to meet a turbidity goal of 2 NTU, however, current regulations require that recycled water meet the turbidity requirement without blending. Thus, the City is currently evaluating improvements to the secondary process to improve filterability, and rehabilitation or replacement of the tertiary filters to produce recycled water that is consistently at or below 2 NTU.

Recommended Water Quality Goals

Although the City's blended recycled water meets the Ayers and Westcot guidelines, the 2009 Recycled Water Expansion Assessment indicates that some landscape professionals have voiced concern with the mineral content of the City's recycled water. Also more recent guidelines, such as the 2004 USEPA Guidelines for Water Reuse, have been developed that the City is interested in using to develop revised water quality goals.

Guidelines for Water Reuse (USEPA, 2004) provides the following guidelines on TDS:

- TDS concentration less than 500 mg/L – no detrimental effects are usually noticed
- TDS concentration between 500 and 1,000 mg/L – can affect sensitive plants
- TDS concentration between 1,000 and 2,000 mg/L – can affect many crops and careful management practices should be followed
- TDS concentration greater than 2,000 mg/L – can only be used for tolerant plants on permeable soils

In addition to TDS, another parameter that can be used to assess the recycled water's suitability for irrigation is the sodium-adsorption-ratio (SAR). SAR is the concentration of sodium relative to calcium and magnesium in the water. High sodium water can cause soil dispersion and structural breakdown. This impairs the infiltration of water into the soil, which reduces the water available to the plants. For recycled water, the calcium concentration in the SAR calculation should be adjusted for alkalinity. The value determined using an adjusted calcium concentration is known as the adjusted SAR. Table 4 summarizes the United States Department of Agriculture (USDA) guidelines for irrigation usage restrictions based on the water's adjusted SAR and electrical conductivity, expressed as microsiemens per centimeter (µS/cm). It should be noted that a TDS between 500 and 1,000 mg/L in a natural water supply typically correlates with an electrical conductivity between approximately 700 and 1,400 µS/cm.

Table 4 USDA Irrigation Water Usage Restrictions

	Degree of Restriction on Use at Electrical Conductivity (µS/cm)		
SAR	None	Slight to Moderate	Severe
0 – 3	> 700	700 – 200	< 200
3 – 6	> 1,200	1,200 – 300	< 300
6 – 12	> 1,900	1,900 – 500	< 500
12 – 20	> 2,900	2,900 – 1,300	< 1,300
20 – 40	> 5,000	5,000 – 2,900	< 2,900
Source: Integrated Cropping Systems and Water Management Handbook, Section 2j - Irrigation Water Salinity and Sodium Adsorption Ratio (SAR) Assessment Guide (USDA, 2009)			

Based on these USDA guidelines, a water with a conductivity of 1,200 µS/cm or higher, corresponding to a TDS of 850 mg/L, would need to have an SAR of 6 or less to avoid recommended restrictions for use in irrigation. It is recommended that an SAR goal be included with the chloride and TDS goals already established by the City. The recommended water quality goals for recycled water are therefore:

- Maintain chloride concentration below 300 mg/L during the irrigation season
- Maintain TDS concentration below 1,000 mg/L
- Maintain SAR below 6

Treatment System Capacity

Because filtration alone cannot reduce TDS, chlorides, or SAR, a demineralization treatment process will need to treat a portion of the tertiary treated water to comply with the water quality requirements. The demineralized water can then be blended back in with the non-demineralized recycled water to create product water that meets the desired water quality goals.

The amount of flow that needs to be treated by the demineralization process depends on the process technology used to provide treatment. Based on a maximum recycled water flow of 2.7

mgd and on preliminary water quality projections, the required treatment capacities for the three demineralization alternatives are:

- RO – 1.0 mgd product water (1.18 mgd feed water, based on 85 percent recovery)
- NF – 2.0 mgd product water (2.35 mgd feed water, based on 85 percent recovery)
- EDR – 1.3 mgd product water (1.53 mgd feed water, based on 85 percent recovery)

The rationale for sizing of each alternative is included below along with a description of each process.

Treatment Alternatives

Reverse Osmosis

Description of Technology

The RO process uses pressure to drive water across a semipermeable membrane and remove dissolved solids through a diffusion-controlled separation process. The dissolved solids are retained by the membranes as the water permeates through, creating both a demineralized permeate stream and a concentrated reject stream. Pre-treatment of the RO feed water using MF or UF membrane processes is highly advisable for wastewater sources as the non-porous membrane surfaces are susceptible to fouling if operated with high particulate loading. RO membranes can also be subject to biological growth, requiring removal of microorganisms through membrane filtration and maintenance of a steady chloramines residual (3 to 4 mg/L) to prevent.

Low pressure RO membranes typically used for demineralization of brackish or recycled water remove all pathogens, all turbidity, all color and dissolved organic carbon (DOC), nearly all hardness and other divalent ions, and most chloride and other monovalent ions. These membranes operate at feed pressures of 100 to 500 pounds per square inch (psi) with a flux (throughput) between 10 to 20 gallons per square foot per day (gfd). Recovery for two-stage systems typically range from 75 to 85 percent.

RO membranes are generally made from either cellulose acetate (CA) or thin film composite (TFC) polymers. A materials comparison is provided in Table 5. It should be noted that TFC membranes are by far the primary membranes used in RO facilities today, in spite of their sensitivity to free chlorine, due primarily to a higher permeability and longer membrane life.

Table 5 Membrane Materials Comparison[1]

Parameter	Thin Film Composite Polymer Membranes	Cellulose Acetate Membranes
Salt rejection	Higher (greater than 99.5%)	Lower (up to 95%)
Net driving pressure	Lower	Higher
Surface charge	More negative	Less negative
Chlorine tolerance	Poor	Fair
Cleaning frequency	Higher	Lower
Organics removal	Higher	Lower
Biofouling	More susceptible	Less susceptible
Biodegredation	None	Higher
pH tolerance	High (2 to 13)	Limited (4 to 8)

[1]Adapted from American Water Works Association. 2007. *Manual of Water Supply Practices – M46, Second Edition, Reverse Osmosis and Nanofiltration*. Table 1-3.

Nearly all RO membranes use a spiral wound configuration, in which the membrane is wound around a central permeate collection tube to form a membrane element. Spiral wound membrane elements cannot be backwashed. The most common dimension for RO elements is 8-inch-diameter, 40 inches long, containing 400 square feet of membrane surface area, however, larger and smaller elements are also in use in the industry. Several membrane elements (typically 6 to 8) are housed in series inside a pressure vessel. Multiple pressure vessels can be mounted on a skid to form a single membrane treatment train.

Major suppliers of RO membranes used in the wastewater treatment industry include Hydranautics, Dow FilmTec, Toray Industries, Woongjin Chemical, and Koch Membrane Systems. Of these, Hydranautics ESPA2 elements are the most commonly used RO membranes in wastewater applications within the United States, and were used for all water quality projections shown below. Membranes from other manufacturers will produce similar water quality, but may differ slightly.

Water Quality Considerations

Table 6 summarizes the projected water quality for demineralized recycled water using an RO treatment system. Projections were made using Hydranautics IMSDesign software, assuming a two-stage design, 85 percent recovery, 13.7 gallons per day per square foot (gfd) average flux, and use of an energy recovery device for flow balancing and interstage boost. This design is similar to a comparably sized demonstration system currently operating at a wastewater treatment plant in San Diego. Because the ion rejection of the membranes decreases with time, water quality projections were made both for new membranes treating feed water under average conditions (initial average) and for seven year old membranes treating feed water under maximum conditions (7 year maximum). Seven years was chosen for maximum conditions, as RO membranes are commonly replaced on a seven year cycle.

Table 6 RO Membrane Treatment System Projected Water Quality

Parameter	Units	Average Feed	Max Feed	Initial (Avg)		7 Year (Max)	
				RO Perm	Blend	RO Perm	Blend
Flow	mgd	2.9	2.9	1.0	2.7	1.0	2.7
pH	-	7.8	8.1	5.5	7.0	5.7	7.2
Turbidity	NTU	3.0	3.0	0.01	1.9	0.01	1.9
Temperature	deg C	20	24	20	20	24	24
Calcium	mg/L	96	106	0.5	61	0.9	68
Magnesium	mg/L	45	55	0.25	29	0.5	35
Sodium	mg/L	206	238	5.9	132	10	155
Potassium	mg/L	32	36	1.0	20.5	1.9	23
Ammonia	mg/L	28	44	1.0	19	4.3	29
Bicarbonate	mg/L	380	430	10.5	238	20.7	280
Sulfate	mg/L	303	347	1.7	193	3.4	221
Chloride	mg/L	312	414	5.9	**197**	13.6	**267**
Fluoride	mg/L	0.6	1.03	0.02	0.35	0.06	0.67
Nitrate	mg/L	2.9	8.2	0.4	2.3	1.8	5.8
Boron	mg/L	0.62	0.73	0.53	0.58	0.73	0.73
Silica	mg/L	9.0	10.0	0.16	0.06	0.27	0.10
Total Dissolved Solids	mg/L	1,259	1,465	27.9	**807**	58.5	**948**
Adjusted SAR	-	5.3	5.8	0.5	**4.0**	0.9	**4.4**

Water quality projections suggest that the 1 mgd RO treatment system is capable of producing 2.7 mgd of blended product water that meets the recommended water quality goals for chloride, TDS, and SAR under both the initial average and the seven year maximum scenarios.

Description of Improvements

The RO treatment system includes the following components:

- Cartridge filters
- RO feed pump
- RO skid, including first and second stage membrane filtration vessels
- Chemical clean-in-place (CIP) system, including tank and pump
- System controls

Table 7 summarizes the design criteria for the RO Membrane Treatment System.

Table 7 RO Membrane Treatment System Design Criteria

Parameter	Criterion
Feed Capacity	1.2 mgd
Permeate Capacity	1.0 mgd
Recovery	85%
Assumed Membrane	Hydranautics ESPA2
Feed Pressure (Initial)	150 psi
Feed Pressure (7-Year)	292 psi
Stages	2
First Stage	
RO Element Size	8-inch-diameter x 40-inch long
No. of Elements per Vessel	7
Vessel Pressure Rating	300 psi
Number of Vessels	18
Second Stage	
RO Element Size	8-inch-diameter x 40-inch long
No. of Elements per Vessel	7
Vessel Pressure Rating	300 psi
Number of Vessels	8
Cartridge Filters	
Number of Vessels	2 (1 duty, 1 standby)
Flow per Vessel	833 gpm
Housing Material	316 SS
Pressure Rating	150 psi
Cartridges per Vessel	86
Cartridge Length	40 inches
Nominal Filter Size	5 micron
Cartridge Material	Polypropylene

Figure 1 shows a similarly sized RO system operating at a wastewater treatment plant in San Diego.

Figure 1 – 1.0 mgd RO Treatment Facility

Projected Costs
The estimated capital cost for a 1.0 mgd RO treatment system is $3.0 million. Annual cost for power, chemicals, and equipment replacement is estimated at $220,000 per year.

The total 20-year lifecycle cost for the RO alternative is $6.1 million, based on an assumed discount rate of 3.5 percent.

Nanofiltration

Description of Technology
NF membranes operate under the same principle as RO membranes and use the same TFC materials and spiral wound configuration, but operate at lower pressures and at lower salt rejection rates. NF membranes remove all pathogens, all turbidity, all color and DOC, most hardness and other divalent ions, and some chlorides and other monovalent ions. These membranes typically operate at feed pressures of 60 to 200 psi with a flux between 10 to 20 gallons per square foot per day (gfd). Recovery for two-stage systems ranges from 75 to 85 percent.

Major suppliers of NF membranes include Hydranautics, Dow FilmTec, and Koch Membrane Systems. NF membranes are not commonly used in wastewater applications, however, Dow NF200 membranes were used for the water quality projections to represent relatively typical NF membranes. Because these membranes have not been used in a full-scale wastewater application, it is not certain how they will perform under long-term operation with wastewater.

Water Quality Considerations

Table 8 summarizes the projected water quality for demineralized recycled water using an NF treatment system. Projections were made using ROSA design software from Dow Chemical, assuming a two-stage design, 85 percent recovery, 13.7 gallons per day per square foot (gfd) average flux, and use of an energy recovery device for flow balancing and interstage boost. These design conditions are identical to the previously described RO system. Because the ion rejection of the membranes decreases with time, water quality projections were made both for new membranes treating feed water under average conditions (initial average) and for seven year old membranes treating feed water under maximum conditions (7 Year maximum).

Table 8 NF Membrane Treatment System Projected Water Quality

		Average	Max	Initial (Avg)		7 Year (Max)	
Parameter	**Units**	**Feed**	**Feed**	**NF Perm**	**Blend**	**NF Perm**	**Blend**
Flow	mgd	3.1	3.1	2.0	2.7	2.0	2.7
pH	-	7.8	8.1	6.5	6.8	6.7	7.1
Turbidity	NTU	3.0	3.0	0.01	0.8	0.01	0.8
Temperature	deg C	20	24	20	20	24	24
Calcium	mg/L	96	106	21	42	29	50
Magnesium	mg/L	45	55	7.8	18	11	23
Sodium	mg/L	206	238	133	153	154	177
Potassium	mg/L	32	36	18	22	22	25
Ammonia	mg/L	28	44	17	21	26	37
Bicarbonate	mg/L	380	430	139	202	181	249
Sulfate	mg/L	303	347	8.2	89	10.9	102
Chloride	mg/L	312	414	225	**247**	320	**346**
Fluoride	mg/L	0.6	1.0	0.5	0.5	0.8	0.9
Nitrate	mg/L	2.9	8.2	3.2	3.3	8.0	8.1
Boron	mg/L	0.6	0.7	0.6	0.6	0.7	0.7
Silica	mg/L	9.0	10.0	4.6	5.8	4.6	6.1
Total Dissolved Solids	mg/L	1,259	1,465	577	**762**	792	**975**
Adjusted SAR	-	5.3	5.8	6.0	**5.4**	6.4	**5.9**

Water quality projections suggest that the 2 mgd NF treatment system is capable of producing 2.7 mgd of blended product water that meets the recommended water quality goals for chloride, TDS, and SAR under the initial average scenario and meets the TDS and SAR goals under the maximum scenario. The water quality goal for chlorides would not be met after 7 years of operation with NF membranes, and while the SAR goal would be met, the value is extremely close to the maximum recommended 6.

Description of Improvements

The NF Membrane Treatment System includes the following components:

- Cartridge filters
- NF feed pump
- NF skid, including first and second stage membrane filtration vessels
- CIP system, including tank and pump
- System controls

Table 9 summarizes the design criteria for the NF Membrane Treatment System.

Table 9 NF Membrane Treatment System Design Criteria

Parameter	Criterion
Feed Capacity	2.4 mgd
Permeate Capacity	2.0 mgd
Recovery	85%
Assumed Membrane	Dow NF200
Feed Pressure (Initial)	102 psi
Feed Pressure (7-Year)	141 psi
Stages	2
First Stage	
RO Element Size	8-inch-diameter x 40-inch long
No. of Elements per Vessel	7
Vessel Pressure Rating	150 psi
Number of Vessels	32
Second Stage	
RO Element Size	8-inch-diameter x 40-inch long
No. of Elements per Vessel	7
Vessel Pressure Rating	150 psi
Number of Vessels	16
Cartridge Filters	
Number of Vessels	3 (2 duty, 1 standby)
Flow per Vessel	816 gpm
Housing Material	316 SS
Pressure Rating	150 psi
Cartridges per Vessel	86
Cartridge Length	40 inches
Nominal Filtration Size	5 micron
Cartridge Material	Polypropylene

The NF system would look identical to the RO system, described previously, but would hold twice as many pressure vessels to treat the higher flow required for NF.

Projected Costs

The estimated capital cost for a 2.0 mgd NF treatment system is $5.8 million. Annual cost for power, chemicals, and equipment replacement is estimated at $390,000 per year.

The total 20-year lifecycle cost for the NF alternative is $11.3 million, based on an assumed discount rate of 3.5 percent.

Electrodialysis Reversal

Description of Technology

Although EDR is a membrane process, it differs from the other two membrane processes in that it is driven by electric charge rather than pressure. In RO and NF, the dissolved solids are rejected by the membranes as the clean water is pushed through the membranes to the permeate side. In EDR the charged ions are pulled through membranes with an electric charge, retaining deionized water within the original flow stream. As a result, the EDR system is only capable of removing charged ions, and has no impact on microorganisms, suspended solids, or neutral ions present in the water.

An EDR unit consists of a membrane stack with a cathode on one end of the stack and an anode on the other. A typical stack consists of up to 500 membranes with flow channels between the membranes. Half of the membranes are made of anion resin, while the other half are made of cation resin. As the feedwater flows through the stack, an electrical charge is imposed via the electrodes. The cations move toward the cathode, passing through the membranes made of cation resin. The anions move toward the anode, passing through the membranes made of anion resin. Two streams then exit the stack, which are: the “dilute”, from which the ions have been removed, and the “concentrate”, into which the ions have been carried.

EDR differs from the related process known as electrodialysis (ED), in that the charge of the electrodes in an EDR facility is periodically reversed and alternated to reduce the quantity of precipitates, which build up on the membranes. This reversal of charge also changes the flow channels from “dilute” to “concentrate” at each charge reversal. Therefore all of the channels must be valved to both the dilute and concentrate piping. At each charge reversal, all of the valves actuate to redirect the product waters to the appropriate receiving stream. This charge reversal is typically two to four times per hour. Special consideration must be given to valving and piping in an EDR system, to accommodate this frequent reversal of charges and flows. Because ED has little use in the municipal water industry, only EDR is considered in this evaluation.

The only supplier of EDR for the municipal market is GE Water & Process Technologies.

Water Quality Considerations

Table 10 summarizes the projected water quality for demineralized recycled water using an EDR treatment system. These projections were made using the WATSYS EDR Design Program by GE Water, assuming a design with two electrical stages, two hydraulic stages, and an 85 percent overall system recovery. Unlike with RO and NF membranes, the salt removal efficiency with EDR does not vary significantly as the membranes age. Table 10 therefore shows the projected water quality under average and maximum feed water quality conditions, without regard for the age of the membranes.

Table 10 EDR Treatment System Projected Water Quality

		Average	Max	Avg		Max	
Parameter	**Units**	**Feed**	**Feed**	**EDR Prod**	**Blend**	**EDR Prod**	**Blend**
Flow	mgd	2.9	2.9	1.3	2.7	1.3	2.7
pH	-	7.8	8.1	7.5	7.7	7.7	7.9
Temperature	deg C	20	24	20	20	24	24
Calcium	mg/L	96	106	21	59.3	22.8	65.60
Magnesium	mg/L	45	55	11	29	14	35
Sodium	mg/L	206	238	68	138	79	161
Potassium	mg/L	32	36	7.9	20	8.9	23
Ammonia	mg/L	28	44	18	24	25	35
Bicarbonate	mg/L	380	430	171	273	199	317
Sulfate	mg/L	303	347	58	184	67	210
Chloride	mg/L	312	414	73	**193**	98	**260**
Fluoride	mg/L	0.6	1.0	0.2	0.4	0.4	0.7
Nitrate	mg/L	2.9	8.2	0.9	2.2	2.1	5.2
Boron	mg/L	0.6	0.7	0.6	0.6	0.7	0.7
Silica	mg/L	9.0	10.0	9.0	9.0	10.0	10.0
Total Dissolved Solids	mg/L	1,259	1,465	381	**832**	444	**968**
Adjusted SAR	-	5.3	5.79	2.99	**4.24**	3.34	**4.64**

Water quality projections suggest that the 1.3 mgd EDR treatment system is capable of producing 2.7 mgd of blended product water the meets the recommended water quality goals for chloride, TDS, and SAR under both average and maximum water quality conditions.

Description of Improvements

The EDR treatment system includes the following components:

- EDR lines, including first and second stage EDR units
- EDR concentrate recycle pump
- EDR electrode waste degasification system blower
- CIP/Neutralization tank

- CIP pump skid

Cartridge filters are not required unless the feed water turbidity exceeds 2 NTU.

Table 11 summarizes the design criteria for the EDR Treatment System.

Table 11 EDR Treatment System Design Criteria

Parameter	Criterion
Feed Capacity	1.53 mgd
EDR Product Capacity	1.3 mgd
Recovery	85%
Assumed System	GE 2020-6L-2S
Anion Membrane	GE AR204
Cation Membrane	GE CR67
Feed Pressure	36.86 psi
Lines	6
Stages	2
First Stage	
Voltage	406 V
Current	15.8 A
Second Stage	
Voltage	353 V
Current	9.1 A

Figure 2 shows an EDR system operating at a wastewater treatment plant in San Diego, CA.

Figure 2 – EDR Treatment Facility at North City Water Reclamation Plant, San Diego

Projected Costs

The estimated capital cost for a 1.3 mgd EDR treatment system is $3.5 million. Annual cost for power, chemicals, and equipment replacement is estimated at $370,000 per year.

The total 20-year lifecycle cost for the EDR alternative is $8.8 million, based on an assumed discount rate of 3.5 percent.

Blending with Potable Water Supplies

The City currently uses blending with potable water supplies to meet their water quality goals in the recycled water. While it is not their intention to continue relying on blending in the future, blending was considered to compare the water quality and long term cost of this current practice against the proposed demineralization alternatives.

Water Quality Considerations

Table 12 summarizes the projected water quality for recycled water blended with potable water.

Table 12 Blending Projected Water Quality

Parameter	Units	Average Feed	Max Feed	Avg Potable	Avg Blend	Max Potable	Max Blend
Flow	mgd	1.6	1.1	1.1	2.7	1.6	2.7
pH	-	7.8	8.1	8.1	7.9	8.5	8.3
Temperature	deg C	20	24	18	19	22	23
Calcium	mg/L	96	106	88	93	95	100
Magnesium	mg/L	46	55	38	43	44	49
Sodium	mg/L	205	238	42	138	47	125
Potassium	mg/L	32	36	3.2	20	4.0	17
Ammonia	mg/L	28	44	0.5	16	0.8	18
Bicarbonate	mg/L	370	430	194	298	211	300
Sulfate	mg/L	304	347	235	276	278	306
Chloride	mg/L	308	414	14	**188**	24.6	**183**
Fluoride	mg/L	0.6	1.0	0.4	0.5	0.4	0.7
Nitrate	mg/L	3.4	8.2	0.5	2.2	0.5	3.7
Boron	mg/L	0.6	0.7	0.6	0.6	0.7	0.7
Silica	mg/L	9.0	10.0	9.0	9.0	10.0	10.0
Total Dissolved Solids	mg/L	1,259	1,465	591	**987**	660	**988**
Adjusted SAR	-	5.3	5.8	1.1	**3.6**	1.2	**3.1**

Description of Improvements

The blending scenario assumes that no demineralization improvements would be added to the El Estero plant, however, the cost of blended water would be expected to increase over time as new water supply alternatives are implemented.

Projected Costs

The cost of blending will depend on the cost of water supply alternatives used for the blend water. Water is currently available to the City at a cost of $350 per acre-foot (AF), however, it is anticipated that as current water supplies become increasingly stressed, new water supply alternatives will need to be implemented. If the City choose to continue using potable water for blending with the recycled water, the City has estimated a cost of new blend water supplies of $600/AF. Based on this range of water supply costs, the total cost of blending could be expected to vary from $700,000 to $1.2 million per year.

These annual costs equate to a 20-year lifecycle cost between $10 million and $17 million, based on an assumed discount rate of 3.5 percent.

Treatment Alternative Evaluation

In order to evaluate demineralization alternatives, criteria were developed and scored during an April 9, 2012 workshop with City staff. These criteria are the same as were used in the filtration alternatives discussed in TM3. Criteria included in the evaluation were based on the project goals and the consensus of City staff during the April 9 workshop. Each criteria was given an importance rating by City workshop attendees, where 1 = low priority and 5 = high priority. The weights were averaged and discussed to develop the final criteria and weights provided in Table 13.

Table 13 Evaluation Criteria

Criteria	Weight
Increase ease of O&M and safety for plant staff	5
Optimize site layout	3
Minimize recycled water system shutdowns	4
Improved water quality: reduce turbidity & TDS	5
Minimize blending	4
Life-cycle cost	4

Note: 1 = low priority, 5 = high priority

This section analyzes demineralization alternatives against the evaluation criteria listed.

Reverse Osmosis

RO requires the smallest footprint compared to NF and EDR but has the highest feed pressure requirements. The small footprint will likely allow the RO skid, RO feed pump, CIP tank, and CIP pump to be housed inside the existing solids handling building. The cartridge filters should be installed outside the building to allow for easier washdown when changing out spent cartridges.

The following provides a brief summary of the evaluation factors for the RO treatment system alternative.

- O&M and safety – the RO system is typically fully automated and requires little operator attention during normal operation. The systems do require operators to perform a chemical clean-in-place (both a low pH and a high pH clean) approximately twice a year.
- Site layout – the RO Treatment System requires the least amount of space compared with NF and EDR alternatives. Locating the equipment in the solids handling building will require the relocation of the existing scrubber equipment.
- Recycled system shut-downs – the RO system will allow for continuous operation of the recycled water system. During twice a year chemical cleanings or other maintenance periods, there could be a short-term impact to recycled water production.
- Satisfies water quality goals – the RO treatment system satisfies the water quality goals under the full life of the RO membranes.
- Blending – the use of RO eliminates the need to blend to meet water quality goals.

- Lifecycle cost – the RO alternative has the lowest lifecycle cost of the alternatives evaluated

Table 14 summarizes the scoring for the RO treatment system alternative.

Table 14 RO Treatment System Evaluation Scoring Summary

Evaluation Factor	Weight	Rationale	Score	Weighted Score
O&M and Safety	5	• fully automated • chemical cleaning 2x/yr	3	15
Optimize Site Layout	3	• Smallest footprint • Requires relocation of scrubber	3	9
Minimize Shutdowns	4	• low likelihood of shutdowns	4	16
Reduce Turbidity and TDS	5	• best water quality	5	25
Minimize Blending	4	• no blending required	5	20
Life-Cycle Cost	4	• $6.1 mil	4	16
			Total Weighted Score	**101**

Nanofiltration

NF requires a skid that is double the size the RO skid, but has a lower feed pressure requirement. The NF treatment system would require relocation of some existing equipment in order to be housed inside the existing solids handling building. The NF treatment system would not meet the chloride goal as the membranes age, allowing more salt to pass through.

The following provides a brief summary of the evaluation factors for the NF Treatment System alternative.

- O&M and safety – the NF system is typically fully automated and requires little operator attention during normal operation. The systems do require operators to perform a chemical clean-in-place (both a low pH and a high pH clean) approximately twice a year.
- Site layout – the NF treatment system requires twice the amount of space as the RO alternatives. Locating the equipment in the solids handling building will require the relocation of the existing scrubber equipment.
- Recycled system shut-downs – the NF system will allow for continuous operation of the recycled water system. During twice a year chemical cleanings or other maintenance periods, there could be a short-term impact to recycled water production.
- Water quality goals – the NF treatment system satisfies the water quality goals under initial conditions, but would not meet the chloride goal as the membranes age.

- Blending – the use of NF eliminates the need to blend under initial operating conditions, but could require blending to meet chloride goals as the membranes age.
- Lifecycle cost – the NF alternative has the highest lifecycle cost of the alternatives evaluated, due to the higher treatment capacity required.

Table 15 summarizes the scoring for the NF Treatment System alternative.

Table 15 NF Treatment System Evaluation Scoring Summary

Evaluation Factor	Weight	Rationale	Score	Weighted Score
O&M and Safety	5	• fully automated • chemical cleaning 2x/yr	3	15
Optimize Site Layout	3	• 2x RO footprint • Requires relocation of scrubber	2	6
Minimize Shutdowns	4	• low likelihood of shutdowns	4	16
Reduce Turbidity and TDS	5	• does not meet chloride goal	2	10
Minimize Blending	4	• Blending may be required for chloride	3	12
Life-Cycle Cost	4	• $11.3 mil	2	8
			Total Weighted Score	**67**

Electrodialysis Reversal

The EDR Treatment System requires the largest footprint, but has lower feed pressure requirements than the RO Treatment System. The EDR Treatment System would likely require relocation of some existing equipment in order to be housed inside the existing solids handling building.

- O&M and safety – the EDR system is typically fully automated and requires little operator attention during normal operation. The EDR system requires operators to perform an acid clean-in-place approximately twice a year and an organics clean-in-place three or four times a year. Operator attention during cleaning can be extensive. High voltage equipment can create hazards for operators.
- Site layout – the EDR treatment system requires the largest amount of space. Locating the equipment in the solids handling building will require the relocation of the existing scrubber equipment.
- Recycled system shut-downs – the EDR system will allow for continuous operation of the recycled water system. During chemical cleanings or other maintenance periods, there could be a short-term impact to recycled water production.

- Water quality goals – the EDR treatment system satisfies the water quality goals under all water quality conditions.
- Blending – the use of EDR eliminates the need to blend to meet water quality goals.
- Lifecycle cost – the EDR alternative has a moderate lifecycle cost

Table 16 summarizes the scoring for the EDR Treatment System alternative.

Table 16 EDR Treatment System Evaluation Scoring Summary

Evaluation Factor	Weight	Rationale	Score	Weighted Score
O&M and Safety	5	• fully automated • chemical cleaning 4x/yr • high voltage equipment	2	10
Optimize Site Layout	3	• largest footprint • Requires relocation of scrubber	2	6
Minimize Shutdowns	4	• low likelihood of shutdowns	4	16
Reduce Turbidity and TDS	5	• best water quality	5	25
Minimize Blending	4	• no blending required	5	20
Life-Cycle Cost	4	• $8.8 mil	3	12
			Total Weighted Score	**89**

Blending with Potable Water

The blending alternative requires no equipment and no additional equipment operation, however, it does not meet the project goal of minimizing blending. Table 17 summarizes the scoring for the blending alternative.

Table 17 Blending Evaluation Scoring Summary

Evaluation Factor	Weight	Rationale	Score	Weighted Score
O&M and Safety	5	• no equipment	5	25
Optimize Site Layout	3	• no equipment	5	15
Minimize Shutdowns	4	• low likelihood of shutdowns	4	16
Reduce Turbidity and TDS	5	• acceptable water quality	3	15
Minimize Blending	4		0	0
Life-Cycle Cost	4	• $10-17 mil	2	8
			Total Weighted Score	**79**

Recommendations

Based on the evaluation criteria and demineralization alternative scores, the RO treatment system is the recommended alternative to proceed with for preliminary design. RO will provide the highest quality water with the smallest treatment facility footprint and lowest lifecycle cost.

Figure 3 shows a conceptual layout for the RO system, located within the existing solids handling building. The layout also shows microfiltration equipment outside the building, which will be required as pretreatment for the RO system. The layout for the demineralization system should be further developed during preliminary design of the facilities.

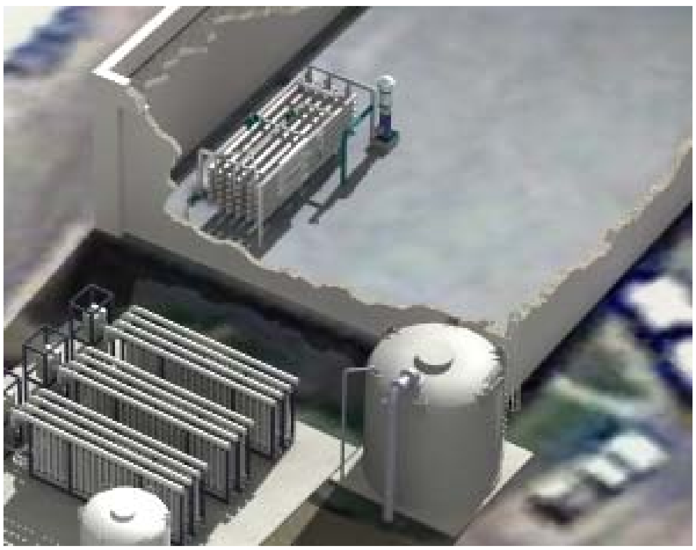

Figure 3 – Conceptual RO System Layout

Appendix B-5: AM No.5 Investigation of TDS Sources

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CDM Smith

Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Greg Wetterau, CDM Smith

Date: *June 4, 2012*

Subject: *Assessment Memorandum (AM) No. 5 – Investigation of TDS from Water Softeners and Seawater Infiltration*

Purpose and Background

The purpose of this Technical Memorandum is to evaluate the potential sources of high total dissolved solids (TDS) concentrations seen in the City of Santa Barbara (City) wastewater collection system. These levels are significantly higher than the TDS seen in the potable water supply feeding into the collection system. It is typical for TDS to be higher in wastewater collection systems than in the associated potable water supplies, due to dissolved solids introduced from the various domestic, commercial, and industrial water uses, however, these introduced solids are normally limited to a 150 to 380 mg/L increase, which would not account for the much larger increase seen in the City's system. Table 1 presents 2011 average water quality characteristics in the potable water supply, based on treated water from the Cater Water Treatment Plant (CWTP), and collected wastewater, based on secondary effluent at the El Estero Wastewater Treatment Plant (EEWWTP). The table also shows the average increase in water quality constituents between these two locations and the normal or typical increases expected for wastewater collection systems.

These sampling results indicate that while the overall TDS increase is substantial, almost doubling from the potable water supply to the wastewater treatment plant, concentrations of a few key constituents are increasing far more than others. Bromide, chloride, potassium, and sodium all increase by more than 300 percent, while relative increases in calcium, magnesium, and sulfate are much less substantial and are generally within the range of normal increases expected from domestic and commercial water uses.

Three potential sources of the large increase in TDS could include:

- Inflow and infiltration (I&I) into the sewers from high salinity groundwater
- Contributions from residential and commercial water softener regeneration waste
- Flow contributions from other high salinity dischargers

Table 1 – Dissolved Constituents in Potable Water Supply and Collected Wastewater for City of Santa Barbara (2011 Average)

	Potable Water[1]	Wastewater[2]	Calculated Increase[3]	Normal Increase[4]
Total Dissolved Solids (mg/L)	599	1,160	561 (94%)	150-380
Boron (mg/L)	0.3	0.6	0.3 (100%)	0.1-0.4
Bromide (mg/L)	ND[5]	0.5	0.5 (>500%)	<0.1
Calcium (mg/L)	87	95	8 (9%)	6-16
Chloride (mg/L)	39	307	268 (687%)	20-50
Potassium (mg/L)	4.8	29	24 (504%)	7-15
Magnesium (mg/L)	38	45	7 (18%)	4-10
Sodium (mg/L)	44	202	158 (359%)	40-70
Sulfate (mg/L)	236	290	54 (23%)	15-30

1. *Based on 2011 annual average for Cater Water Treatment Plant Effluent*
2. *Based on 2011 annual average for El Estero Wastewater Treatment Plant Secondary Effluent*
3. *Calculated as wastewater concentration minus potable water concentration*
4. *Adapted from Metcalf and Eddy (1991) Wastewater Engineering: Treatment Disposal Reuse. No data was included on typical bromide increases, however, the relatively uncommon use of bromide for domestic uses suggests a very low contribution to wastewater. Data available from the Orange County Sanitation District (2008), where seawater infiltration is not a concern in the sewer collection system, indicates that bromide remained below 0.1 mg/L in the wastewater supply.*
5. *Below detection limit of 0.1 mg/L*

A 2008 Tertiary Filter Rehabilitation study conducted by Carollo Engineers looked at potential sources of the TDS increase within the collection system, specifically evaluating the potential for seawater infiltration. The study compared concentration changes with flow, time, and tide levels finding that TDS was generally highest at night and during periods of low flow, but did not correlate well with tide levels. Additional monitoring of salinity in different manholes resulted in somewhat inconclusive findings, suggesting that water softeners may be contributing to the TDS increase, but seawater infiltration may be contributing as well.

Because of the inconclusive findings from previous studies, it was believed that a more thorough look at the specific water quality constituents increasing in the collection system would help to better identify the sources of this TDS.

Inflow and Infiltration

I&I are common challenges for waste water collection systems with aging infrastructure, forcing utilities to maintain aggressive pipe rehabilitation and replacement programs to address. To investigate the presence of infiltration within the sewer collection system, the City periodically initiates close circuit television (CCTV) inspections of different portions of the collection system thought to be at risk. One such study was conducted in the fall of 2011 looking at a stretch of sewer along Cabrillo Boulevard between Manhole H11-001 and H10-036. This area includes the low elevation portion of Cabrillo along Chase Palm Park and Stearns Wharf to the harbor, and is the area where high TDS infiltration would be the most likely. A copy of the CCTV report is attached with this memorandum.

The investigation found that small amounts of infiltration were observed at numerous joints in the piping, most of which was seeping along the joint edges, but some was openly flowing into the pipe. The photos included in Figure 1 show one of these observed leaks.

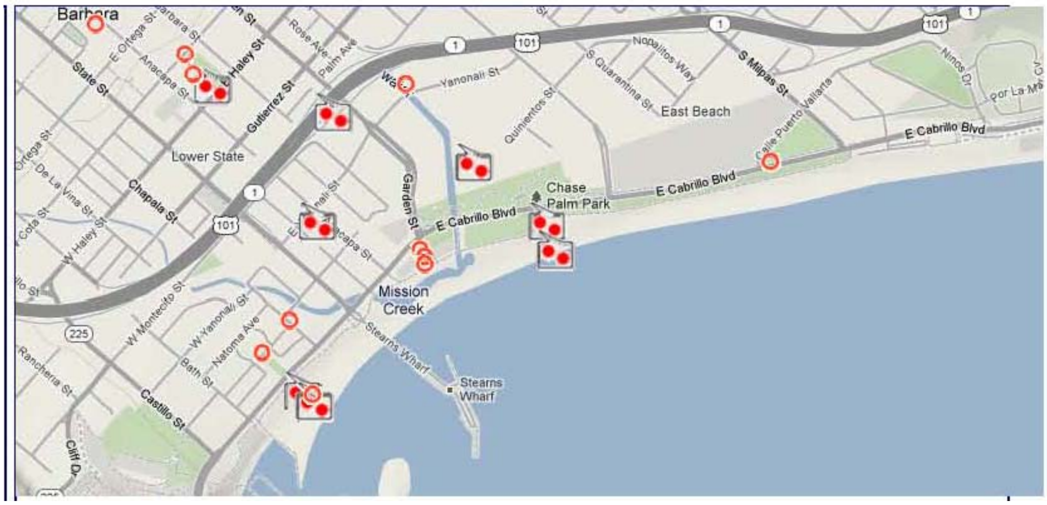
Figure 1
Infiltration Observed in Sewer Line Along Cabrillo During 2011 CCTV Study

Photo: 117_118_1477_A.jpg, VCR No.: 01-22-11
201.68FT, Infiltration Runner, at 12 o'clock, within 8 inches of joint: YES

Photo: 117_118_1477_B.jpg, VCR No.: 01-22-11
201.68FT, Infiltration Runner, at 12 o'clock, within 8 inches of joint: YES

Infiltration or inflow could be expected to cause large increases in the TDS if the I&I water is sufficiently high in TDS or the flows are sufficiently large. A survey, conducted as part of this study, of historic monitoring well data available on the USGS website (http://wdr.water.usgs.gov) suggest that the most probable location for high salinity groundwater inflows is along Cabrillo Boulevard in the downtown area. Locations of wells with data available on the USGS website are shown on Figure 2. Well data from a site within Chase Palm Park, presented in Table 2 as Cabrillo Well, showed water quality characteristics very similar to seawater, with a TDS exceeding 30,000 mg/L and chlorides above 17,000 mg/L. Comparing these results with limited data from a well on West Main Street, one block inland from Cabrillo, suggests that the high salinity groundwater may not extend far enough inland to impact collection sewers beyond Cabrillo.

Figure 2
Available Well Data From USGS (http://wdr.water.usgs.gov/nwisgmap)



Water depths and sewer depths were not evaluated when surveying well data, and it is therefore not known how frequently or to what extent the various collection sewers are below the groundwater levels. What the well results do suggest is that shallow groundwater can reach water quality concentrations approaching seawater along Cabrillo Boulevard, and could cause significant impacts on collection sewer TDS if sufficient quantities of this water are infiltrating into the sewers. If such infiltration is the cause of the TDS climb, it should also be expected that the unique water quality signature of seawater, as presented in Table 2, would be reflected in the water quality changes within the collection sewers.

Table 2 – Water Quality Characteristics of Seawater and Santa Barbara Monitoring Wells Near Ocean

	Seawater[1]	Cabrillo Well[2]	West Main St. Well[3]
Total Dissolved Solids (mg/L)	35,079	30,500	1,086
Boron (mg/L)	4.4	2.9	
Bromide (mg/L)	70	53	0.6
Calcium (mg/L)	419	942	
Chloride (mg/L)	19,350	17,700	180
Potassium (mg/L)	390	43	
Magnesium (mg/L)	1,304	1,130	
Sodium (mg/L)	10,710	8,670	
Sulfate (mg/L)	2,690	2,390	450

1. *From Desalination of Seawater: AWWA Manual of Practice M61*
2. *2010 sample results from well located in Chase Palm Park - USGS Site #342452119405504*
3. *2007 sample results from well located on W Main St – USGS Site #342439119413201. Blank spaces remain for parameters where no data was available.*

To test how closely the observed water quality changes match the signature of seawater infiltration, projections were made of the expected wastewater quality with no infiltration and with low levels of infiltration (1 to 2 percent), assuming infiltration water with the quality of the Cabrillo Well presented in Table 2. Expected water quality with no infiltration was based on average potable water quality, listed in Table 1, and average values for the typical increases expected for wastewater, also listed in Table 1. Table 3 presents the results from this analysis with the first column showing 2011 average wastewater, measured at the EEWWTP secondary effluent, the second column showing expected wastewater quality without infiltration, and the third column showing expected wastewater with 1% infiltration from high salinity groundwater (Cabrillo Well from Table 2).

This analysis demonstrates that an infiltration rate of only 1 percent, representing 60 gpm for an 8.5 mgd average wastewater flow, results in a water quality closely correlating with the actual measured conditions in the secondary effluent. Water quality for most parameters, including TDS, boron, bromide, calcium, sodium, and sulfate, are within 95 percent of what would be expected for this level of high salinity infiltration. These results, coupled with the results of the CCTV study, suggest that seawater I&I has a high likelihood of being a major contribution to the increasing TDS within the collection system.

Table 3 – Measured and Anticipated Wastewater Quality With and Without Infiltration

	Average Wastewater[1]	Expected Wastewater (no infiltration)[2]	Expected Wastewater (1% infiltration)[3]
Total Dissolved Solids (mg/L)	1,160	819	1,145
Boron (mg/L)	0.6	0.5	0.6
Bromide (mg/L)	0.5	0.1	0.6
Calcium (mg/L)	95	87	96
Chloride (mg/L)	307	79	273
Potassium (mg/L)	29	19	19
Magnesium (mg/L)	45	38	50
Sodium (mg/L)	202	104	198
Sulfate (mg/L)	290	261	284

1. *Based on 2011 annual average for El Estero Wastewater Treatment Plant Secondary Effluent*
2. *Expected wastewater based on typical water quality changes listed in Table 1.*
3. *Calculated based on 1.1% blending with water quality listed for Cabrillo Well in Table 2.*

One constituent which does not show a good correlation between measured values and projected blended concentrations is potassium. Here the projected concentration is 19 mg/L, while an average of 29 mg/L was measured in the secondary effluent in 2011. This suggests that another source of TDS is contributing to the collection system as well, impacting potassium concentrations beyond what would be expected from I&I.

Water Softeners

Water softeners are used by residential and commercial users to reduce hardness in water. The softeners employ either sodium chloride or potassium chloride to replace calcium and magnesium cations (also referred to as hardness) with either sodium or potassium ions. Water softeners therefore result in an increased concentration of either sodium or potassium, depending on which type of salt is employed. Potassium salts are often used in residential water softeners, due to perceived health concerns associated with sodium intake. Water softeners must be periodically regenerated using sodium chloride or potassium chloride solution, releasing high concentrations of sodium or potassium, chloride, calcium, and magnesium into the wastewater collection system. Regeneration is often done at night when water is not being used within the household or business, however, there should be no net impact on calcium or magnesium concentrations over a full 24 hour period, since these ions are removed from the water during the day and released at night. As a result, the use of water softeners should be expected to increase sodium, potassium, and chloride, at proportionate concentrations, without impacting other dissolved salts.

Because of the significant increase in potassium concentrations seen between the potable water supply and the wastewater at EEWWTP, there is a reasonable likelihood that water softeners are contributing to the observed TDS increase. Table 4 presents measured and projected wastewater quality for EEWWTP with and without projected flow contributions from water softeners. These projections assume there is not impact of seawater I&I in the sewers. The forth column shows projected results assuming that water softeners in the area are evenly divided between those employing sodium chloride and those using potassium chloride. While this is a reasonable assumption, no information was obtained on the relative use of each salt in the Santa Barbara area. The fifth column therefore includes projected results if 95 percent of the area water softeners employed sodium chloride and only 5 percent used potassium chloride.

Table 4 – Measured and Anticipated Wastewater Quality With and Without Water Softeners

	Average Wastewater[1]	Expected without Softeners[2]	Expected with Softeners (50% NaCl/50% KCl)[3]	Expected with Softeners (95% NaCl/5% KCl)
Total Dissolved Solids (mg/L)	1,160	819	856	1,160
Boron (mg/L)	0.6	0.5	0.5	0.5
Bromide (mg/L)	0.5	0.1	0.1	0.1
Calcium (mg/L)	95	87	87	87
Chloride (mg/L)	307	79	99	284
Potassium (mg/L)	29	19	29	29
Magnesium (mg/L)	45	38	38	38
Sodium (mg/L)	202	104	111	231
Sulfate (mg/L)	290	261	261	261

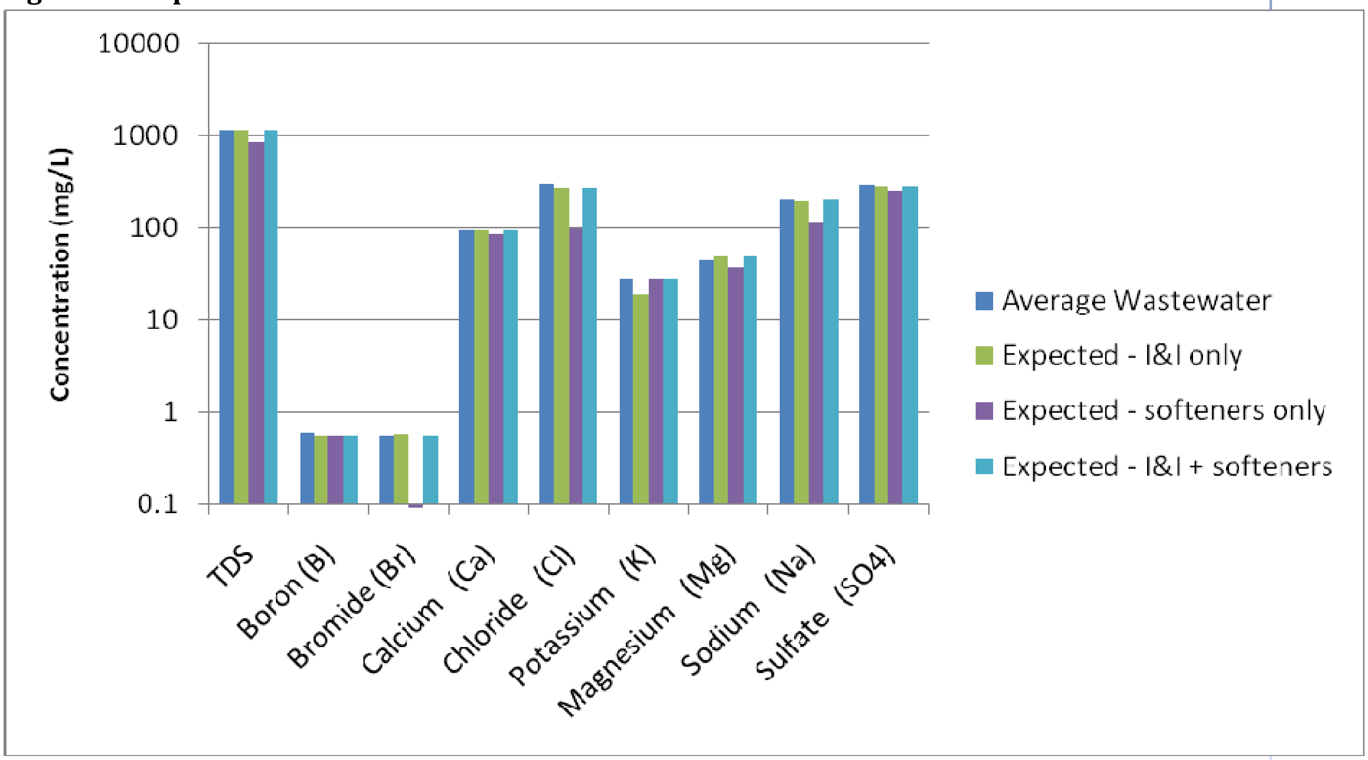
1. *Based on 2011 annual average for El Estero Wastewater Treatment Plant Secondary Effluent*
2. *Expected wastewater based on typical water quality changes listed in Table 1.*
3. *Calculated based on 1.1% blending with water quality listed for Cabrillo Well in Table 2.*

The results shown in Table 4 demonstrate that the use of water softeners alone cannot explain the full increase in TDS seen in the Santa Barbara wastewater, if softeners using potassium salts are assumed to represent half or less off the water softeners used in the area. An increase of only 37 mg/L of TDS would be expected from area water softeners, based on the potassium increases observed, indicating that softeners would be contributing only 5 percent of the overall TDS increase, under this scenario. If a much smaller contribution from potassium based water softeners is assumed (5 percent of the total softeners), a much higher TDS increase could be anticipated, however, such softener use would not explain the bromide, boron, sulfate, calcium, or magnesium increases observed, and would only partially explain the chloride levels. Similarly, the sodium levels in the wastewater should be expected to be significantly higher if sodium chloride was the primary contributor to the TDS increases observed. Based on this review of the different water quality constituents, it should be concluded that water softeners are contributing to the TDS increase in the wastewater, but this impact is likely not more than 5 or 10 percent of the total TDS increase.

Combined Effects of Infiltration and Water Softeners

Because neither seawater I&I or water softeners alone are able to explain the pattern of water quality changes in the wastewater, it is likely that both are contributing to the TDS increase in the City's collections system. Figure 3 presents the average wastewater characteristics compared against projected water quality when only I&I is impacting the quality, when only water softeners are impacting the quality, and when both I&I and water softeners are impacting the quality. In the scenario where both I&I and softeners are impacting TDS, I&I is responsible for 90 percent of the TDS increase, while softeners are responsible for 10 percent. A good correlation can be seen in Figure 2 between the measured wastewater quality and the projected quality with both I&I and softeners impacting the TDS. These comparisons suggest that a combination of infiltration and inflow from high TDS groundwater and water softeners from commercial and residential customers are the primary sources of the larger than normal TDS increase seen in the City's wastewater.

Figure 3 – Expected Wastewater Characteristics with I&I and Softener Contributions



Conclusions and Recommendations

The City has been seeing larger than normal increases in TDS within their wastewater collection system, compared with typical wastewater systems throughout the country. Potential sources of this TDS increase were investigated by comparing specific water quality constituents in the water against the relative distribution of those constituents in potential TDS sources, such as seawater and water softeners. Infiltration and inflow from high TDS (near seawater) groundwater was found to be a likely contributor to the TDS increase, with the resulting water quality from a 1 percent (60 gpm) infiltration rate matching the measured water quality for all constituents except potassium. A significant portion of this infiltration appears to be coming from the collection sewers along Cabrillo Boulevard, where a recent CCTV study found a large number of joints to be leaking groundwater into the piping.

The presence of higher than normal potassium in the wastewater suggests that water softeners are also contributing to the TDS increase, however, it is unlikely that their contribution is responsible for more than around 10 percent of the TDS increase, based on the levels of potassium measured.

It is recommended that the influence of infiltration and water softeners be further investigated through the measurement of specific water quality constituents, including boron, bromide, and potassium, at different points in the collection system, both along Cabrillo Blvd and in the segments feeding into the Cabrillo trunk line. Pipe rehabilitation efforts should be investigated to determine the anticipated cost of repairing the Cabrillo trunk line, and the amount of piping that would need to be repaired or replaced. The potential for inflow and infiltration from non-City owned lateral lines should also be investigated to determine their impact to the overall TDS increases.

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Appendix B-6: AM No.6 Recycled Water System Hydraulic Analysis

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In association with

Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Leroy Cadena, MNS Engineers, INC*
Jason Yoshimura, CDM Smith
Don Cutler, CDM Smith
Greg Wetterau, CDM Smith

Date: *February 19, 2013*

Subject: *Assessment Memorandum (AM) No. 6 – Recycled Water System Hydraulic Analysis*

Purpose and Background

This assessment memorandum (AM) discusses hydraulic conditions of the existing recycled water distribution system, including the on-site reservoir and transfer pump station at the El Estero Wastewater Treatment Plant (EEWWTP) and the off-site reservoir and pump stations. An assessment of the existing system has been performed to evaluate how to reliably achieve disinfection CT, and to provide better control of the recycled water distribution system.

Data and information gathered for this report were compiled from the Operation and Maintenance Manual (OMM) for the EEWWTP, previous reports prepared by the city of Santa Barbara (City), EEWWTP monitoring data from May 31, 2012, through June 6, 2012, and conversations with EEWWTP operators.

Recycled Water System Overview

The City's recycled water distribution system was developed in two phases. Phase I was completed in July 1989 and Phase II was completed in May 1991. Phase I and Phase II consist of approximately 14 miles of piping, which ranges in size from 2-inches to 18-inches. The map of the recycled water distribution system is included in Attachment A.

Recycled Water Production

The EEWWTP has a design capacity of 11 mgd and a peak hydraulic capacity of 30 mgd. Table 1 summarizes the treatment processes utilized at the EEWWTP.

Table 1 EEWWTP Treatment Processes

Treatment	Process Facilties
Primary Treatment	Influent pump station
	Aerated Grit Removal
	Sedimentation
Secondary Treatment	Biological Activated Sludge
Tertiary Treatment	Flocculation Basins
	Filtration
Disinfection	Chlorination
	Chlorine Contact Basin
	On-site El Estero Reservoir

The recycled water treatment system utilizes tertiary filtration with coagulation/flocculation and granular media filtration, and disinfection using chlorine addition to comply with California Title 22 requirements. Effluent from the secondary clarifiers is pumped to the granular media filters, and the filtered water is disinfected in the chlorine contact basin. After these treatment steps, the recycled water is pumped to the storage reservoir and distribution facilities. A separate chlorine contact tank and chlorination and dechlorination systems are used for secondary effluent sent to the ocean outfall.

Coagulation/Flocculation Chemical Systems

Alum and polymers are added for coagulation and flocculation of suspended particles and to help increase the filtration efficiency. This system includes chemical storage tanks, pumps, filter effluent flow indicators, and their controls. The existing coaulation/flocculation chemical systems design criteria are summarized in Table 2.

Table 2 Existing Coagulation/Flocculation Chemical Systems Design Criteria

Parameter	Criteria
Alum	
Alum Storage capacity	5,000 gallons
Maximum Alum Feed Rate	16 gal/hr
Alum Pumps	Diaphragm metering pumps with adjustable output
Manufacturer	Alldos
Polymer	
Polymer Type	Anionic, cationic, or nonionic liquid polymer
Polymer Solution Feed Rate	10 to 100 gal/hr
Polymer Mixer / Feed Pumps	Static mixing with adjustable speed positive displacement polymer metering pump
Manufacturer	Fluid Dynamics

Tertiary Filtration System

The existing tertiary filtration system consists of filter supply pumps, filters, backwash blowers, compressed air system, and equipment and system controls. The existing tertiary filtration system design criteria are summarized in Table 3.

The filter influent and effluent turbidity is monitored continuously. At effluent turbidity of two NTU, an alarm notifies the operators, and at effluent turbidity of five NTU, the effluent is diverted to the plant influent sewer.

Table 3 Existing Tertiary Filtration System Design Criteria

Parameter	Criteria
Filter Supply Pumps	
Number of Units	2 Duty, 1 Standby
Capacity, Each	4.3 mgd
VFD	Yes
Coagulation	
Chemicals	Polymer and Alum
Mixing	Static Mixer and Flocculation Chamber
Tertiary Filters	
Type	Single media Gravity Filter with Air/Water Backwash
Number of Filters	4 Cells
Size, Each	14ft x 14ft
Manufacturer	General Filter Co.
Media Type	Anthracite Coal
Media Depth	4 ft
Filter Rate, Nominal	3.8 gpm/sf 750 gpm/cell
Backwash Rate	12 gpm/sf
Backwash Air Rate	4 cfm/sf
Backwash Air Pressure	6 psi
Backwash Blowers	
Number of Units	1 Duty, 1 Standby
Capacity, Each	780cfm
Type	Positive displacement
Air Compressor	
Number of Units	1 Duty, 1 Standby
Capacity, Each	4cfm at 100 psig, with 120-gallon receiver
Type	air cooled, reciprocating,

Note that the existing tertiary filters will be demolished and replaced with microfiltration/ultrafiltration (MF/UF) system as recommended in AM3 – Filtration Alternatives.

Chlorination System
California Title 22 section 60301.230, Paragraph (b), requires effluent coliform to not exceed a concentration of 2.2 MPN/100 mL for more than 5 percent of the samples. Paragraph (a), subparagraph (1), requires a minimum modal contact time of 90 minutes; however, the OMM Chapter 2 Disinfection section, indicates a required modal contact time of two hours. This contact time is achieved by utilizing the chlorine contact basin, which provides one hour of contact time at a flow rate of 3,000 gpm, and the effluent storage reservoir, which provides additional detention time based on the water level.

The chlorine contact basin is covered with removable aluminum covers to block light and hinder algae growth. Sodium hypochlorite is added at the inlet to the chlorine contact basin. It is also before pumping into the reservoir and before the distribution system. These two application points can be flow-paced and allow more flexibility to the system. Details of the flow-paced system are outlined in the OMM.

California Title 22, section 60301.230, Paragraph (a), subparagraph (1), also requires a CT value of not less than 450 milligram-minutes per liter (mg-min/L). The CT value is a product of the chlorine residual and the modal contact time. Based on quarterly reports supplied by the EEWWTP, the daily average CT values, residual chlorine levels, and daily modal contact times are as follows:

- Daily average CT values range from 400 to 4,000 mg-min/L. During the 3rd quarter of 2011, the EEWWTP experienced one day of CT violation, when the CT value was less than 450 mg-min/L.

- Daily average residual chlorine levels generally range from 1.0 to 5.0 mg/L.

- Daily modal contact time ranges from 400 minutes to 800 minutes.

As outlined on the OMM, the EEWWTP originally used chlorine gas to disinfect the recycled water. Currently the plant uses sodium hypochlorite. The change from the chlorine gas system to the sodium hypochlorite system was made as part of the Liquid Chlorination/Dechlorination Storage and Feed System project in 1993.

Recycled Water Storage System
The recycled water is pumped from the chlorine contact basin to the on-site reservoir. The on-site reservoir provides not only storage, but also additional chlorine contact time. The chlorine contact basin provides one hour of chlorine contact time. Depending on the water levels, the on-site reservoir has the ability to provide an additional 1.3 to 2.6 hours of chlorine contact time. The storage tank has been retrofitted with a hypalon baffle curtain to provide more efficient chlorine mixing.

The recycled water storage reservoirs are shown in the Distribution System Schematics included in Attachment B and described in Table 4.

Table 4 Recycled Water Storage Reservoirs Design Criteria

	EEWWTP On-site Reservoir	Golf Course (Phase II) Reservoir
Type	Above-grade, Steel	Subsurface, Concrete
Capacity	670,000 gallons	1,500,000 gallons
Height	22 feet	25 feet
Diameter	72 feet	105 feet
Minimum Water Level	6 feet	6 feet
Maximum Water Level	21.5 feet	22 feet

An alarm sounds when the water level of the on-site reservoir drops below eight feet or increases above 21.5 feet. If the recycled water production does not meet demands, an 8-inch pipe provides potable water to the storage reservoir for additional supply. The potable water flow is automatically initiated when the reservoir level drops below six feet. In the event that the reservoir becomes too full, a 24-inch standpipe inside the tank is utilized as an emergency overflow drain. The overflow drains to the site overland flow outfall.

California Title 22 requires that "Disinfected Tertiary Recycled Water" must have an average turbidity less than 2.0 NTU and a maximum of 5.0 NTU. Potable water is added to the system when the turbidity of the filter effluent is between 2.0 and 5.0 NTU. When the filter effluent turbidity is above 5.0 NTU the effluent is diverted back to the EEWWTP sewer influent. This process is described in Assessment Memo 2 (AM2) – Recycled Water System Study.

Recycled Water Distribution

Recycled Water Demands

According to the OMM, the on-site storage was initially sufficient to provide two to three hours of peak summer irrigation demand. The estimated current and projected average daily recycled water demands are discussed in detail in AM2.

Recycled Water Distribution System Configuration

Attachment A shows the distribution of customers of Phase I and Phase II recycled water system. Phase II system is broken up into Phase II North and Phase II South sections. Phase II North is situated north of Highway 101 and Phase II is situated to the south.

Recycled water is distributed to customers between the hours of 9:00 pm and 6:00 am. Phase I customers are served directly by the on-site recycled water reservoir and Phase II customers are served by the storage reservoir situated under the Municipal Golf Course (Golf Course Reservoir). The Golf Course Reservoir is intended to be filled between the hours of 6:00 am and 9:00 pm, when the recycled water customers are not being supplied.

During the day, recycled water is pumped to the Golf Course Reservoir. This water travels via Phase I and Phase II piping varying in diameter from 12- to 14-inches for Phase I and 16-inches for Phase II. The La Mesa Pump Station is situated approximately half way between EEWWTP and the Golf Course Reservoir to provide an extra boost of pressure to reach the reservoir.

When distribution occurs at night, Phase II pipeline is hydraulically shut off from Phase I by sealing Phase I system at the La Mesa check valve. Phase II system is divided into a North Zone and a South Zone. The South Zone consists of a 16-inch transmission pipeline from Shoreline Park to the Golf Course. It is used for filling the reservoir during the day and delivering recycled water in the evening. Phase II North system consists of a 14-inch distribution line from the Golf course Pump Station to La Cumbre Junior High School, and a 10-inch branch line to McKenzie Park. The Golf Course Pump Station and a hydropneumatic tank work together to supply the Phase II North and South pressure zones. Phase II North is always pressurized. Motor controlled valves separate Phase II North from the 16-inch pipeline and, at night, the valves open and the Golf Course pump station is able to provide pressure to the North and South portions of Phase II.

A map displaying Phase I and Phase II, North and South, service areas, prepared as part of August 2009 Water Planning Study is attached in Attachment A. The pipeline elevations in Phase 1 range from 7 to 85 feet above mean sea level, and the hydraulic grade line (HGL) at the EEWWTP is 288 feet. The pipeline elevations in Phase II South Service Area range from 100 to 260 feet, and the HGL varies from 234 feet at Los Positas Park to 434 feet at Elings Park. Pipeline elevations in Phase II North Area Service Area range from 159 to 200 feet, and the HGL varies from 220 feet near the Golf Course Tank to 543 feet near McKenzie Park.

Recycled Water Distribution Pump Stations

The EEWWTP Recycled Water Pump Station takes water from the on-site reservoir and pumps it to the distribution system. Surge protection is accomplished with a hydro-pneumatic tank at the pump station. There are five pumps; three at constant speed and two at variable speed. A capacity of 3,200 gpm is achieved when one variable speed pump and the three constant speed pumps are used. The other variable speed pump is a standby, and there is space provided for an additional pump. The EEWWTP Recycled Water Pump Station design criteria are summarized in Table 5.

Table 5 EEWWTP Recycled Water Pump Station Design Criteria

Parameter	Criteria
Design Capacity	Phase I: Distribution 3,200 gpm at 117 psi Phase II: Conveyance 1,700 gpm at 145 psi
Number of Pumps	2-Variable speed – (one duty, one standby) 3-Constant speed – (two duty, one standby)
Manufacturer	Peabody Floway
Type	Vertical Turbine
Rated Capacities	Variable Speed: 1,080 gpm at 117 psi, 100 hp Constant Speed: 710 gpm at 117 psi, 75 hp
Variable Speed Drives	Adjustable frequency type, 125 hp, 460 V, 3-phase, 1,800 rpm synchronous speed
Manufacturer	Reliance Electric Co.

Parameter	Criteria
Surge Tank	3,000-gallon, 150 psi rated

The recycled water is boosted, as necessary, midway to the Golf Course Reservoir by the La Mesa Pump Station. La Mesa Pump Station maintains a sufficient pressure in the line for the recycled water to reach Golf Course Reservoir. During distribution, the two high-head pumps at La Mesa Pump Station pump recycled water from Phase I distribution zone to Phase II distribution zone. The La Mesa Pump Station design criteria are summarized in Table 6. Space exists at the pump site for two future pumps.

Table 6 La Mesa Recycled Water Pump Station Design Criteria

Parameter	Criteria
Design Capacity	LH Pumps: 1,230 gpm at 45 psi HH Pumps: 525 gpm at 108 psi
Number of Pumps	Low Head - 2 High Head - 2
Type	Vertical Turbine
Rated Capacities	LH: Variable Speed, 1230 gpm each at 45 psi HH: Variable speed, 525 gpm each at 108 psi

During distribution, recycled water is pumped from the Golf Course Reservoir by the Golf Course Pump Station. Phase II pipeline is hydraulically isolated from the Phase I system by the La Mesa check valve. The golf course pump station also has a hydro-pneumatic tank with a 25,857 gal capacity. The Golf Course Pump Station design criteria are summarized in Table 7.

Table 7 Golf Course Recycled Water Pump Station Design Criteria

Parameter	Criteria
Design Capacity	Constant Speed: 2,950 gpm at 160 psi
Number of Pumps	Constant Speed - 5
Type	Vertical Turbine
Rated Capacities	Constant Speed: 600 gpm each at 160 psi

Recycled Water System Limitations

The storage capacity of the On-site Reservoir and the Golf Course Reservoir are limiting factors in the recycled water distribution system. The reservoirs are filled during the day and the recycled water is distributed to customers at night. Currently, the demand for Phase I exceeds that of Phase II, but the 0.67 million gallons storage capacity for Phase I (On-Site Reservoir) is considerably lower than the 1.5 million gallon storage available in Phase II (Golf Course Reservoir). Only the On-site Reservoir has continuous access to the recycled water produced throughout the day. If the demand for Phase II exceeds the storage capacity of the Golf Course Reservoir, then additional storage will be needed.

The On-site Reservoir is also needed for additional contact time. This is an additional limiting factor of the storage and distribution system. One way to improve the capacity of the reservoir is to improve or change the way the chlorine contact basin operates. If a new chlorine contact basin were added to provide sufficient chlorine contact time, then the On-site Reservoir would not be needed for additional contact time and would be used solely for storage. However, the construction of a new chlorine contact basin or a new on-site reservoir may be difficult due to the limited space available on-site at EEWWTP.

Recycled Water System Operation

EEWWTP staff provided 7 days (May 31, 2012 through June 6, 2012) of recycled water system operation data, including 15 minute sample data for the Chlorine Contact Basin (CCB) Influent chlorine residual, Distribution chlorine residual, filter water production flow rate, blending water flow rate, On-site Reservoir water levels, Off-site Reservoir water levels, On-site Reservoir distribution flow rate, Off-site Golf Course Reservoir fill flow rate, and Off-site Golf Course Reservoir distribution flow rate. These data are included in Attachment C.

Based on our review of this data the following observations were made:

CCB Influent Chlorine Residual

- CCB influent chlorine residual varied widely from hour to hour.
- CCB influentchlorine residual generally ranged between 10 to 20 mg/L.

Distribution Chlorine Residual

- Distribution system chlorine remained relatively stable, generally ranging between 3 and 7 mg/L during these 7 days.
- An increase in blend water often corresponded with a decrease in residual.

Blending Water

- Blending water is applied daily during tank filling in the morning, then again in the early afternoon and peaks around 11:00 pm.
- During one morning, blending water was applied during the early morning hours from 3:00 am to 5:30 am.
- Generally, blending water is applied during filter production.

Filter Production

- Filter production is generated early in the morning while the storage tanks are being filled.
- Filter production water coincides with the blending water application.
- Filter production shutdown is generally followed by a drop in chlorine residual.

On-Site Reservoir Level

- Empties from midnight until early morning around 5:00 or 7:00 am.
- Refills from about 7:00 am until 1:00 pm.
- Empties again in the late afternoon.
- Level fluctuates in the early evening.
- Tops off at 11:30 pm.
- Stays between 8ft and 20ft.
- Level drops when off-site tank is filled the second time.

Distribution Flow

- Distribution flow measures both the Golf Course Reservoir fill flow and the distribution to the Phase I customers.
- Flow is decreasing in the early morning hours from 12:00 am until 6:00 am.
- One of two peak flows occurs when the offsite reservoir is flowing. The second peak flow occurs when the onsite reservoir is discharging.
- Distribution to customers begins around 7:00 pm and increases into the night.

Off-site Golf Course Reservoir Level

- Fills from 7:00 am – 9:30 am and from 3:30 pm – 5:30 pm.
- Empties from 8:00 pm until 8:00 am.
- Levels remain constant and do not fluctuate.

Off-site Golf Course Reservoir Fill Flow

- Generally the Off-site Golf Course Reservoir fill flow occurs from 7:00 am until 9:30 am and from 3:30 pm – 5:30 pm.
- Additional lower flows with higher peak flows occur throughout the day until the late afternoon and early evening around 5:00 pm.

Off-site Golf Course Reservoir Distribution Flow

- Distribution flow occurs from 9:00 pm until 6:30 am the next morning.
- There are a few spikes of flow during the day when the flow should be off.

Summary of Operational Review

The plant is operating as outlined in the OMM. However, based on the data supplied for this report, there are several questionable readings. For instance:

- Recycled water distribution is periodically recorded during the day.
- Off-site fill flow surges during the day with frequent starts and stops of pumps.

Generally, residual chlorine levels in recycled water distribution system are higher in the morning and begin dropping in the late morning to early afternoon. The drop in residual chlorine levels in recycled water distribution system coincides with long term peak blending water applications.

The CT values presented in the 2011 Third Quarter Reclamation Quarterly Report are acceptable. During this period, only one day was below the minimum 450 mg-min/L. Increasing the CT value can be accomplished by increasing the contact time or the chlorine residual. It should be noted that the average chlorine residuals reported in the 2011 Third Quarter Reclamation Quarterly Report were one-third to one-half the values observed for the seven days of operating data included in Attachment C.

There is a need for additional storage in their Phase I system. Based on the current plant design, increasing contact time would not be conducive to producing more recycled water. This leaves the option of increasing the amount of chlorine applied. The additional amount of chlorine applied will vary depending on the temperature, the quality of the water being received, and the contact time.

While increasing the recycled water capacity requires increasing storage capacities and disinfection contact times, the distribution and pumping capacities must also be monitored so that they continue to meet the demands of the system.

Proposed Tertiary Filtration Upgrade

Microfiltration/Ultrafiltration (MF/UF) is the process of filtering a solution, in this case wastewater effluent, through a semi-permeable membrane with pore sizes ranging from 0.1 to 0.5 micrometers (μm) in size. MF/UF is an excellent process for removing suspended solids, although salts and dissolved metals are not removed. MF/UF can operate efficiently at low pressures, producing water with no measurable turbidity and reduced chlorine demand.

Improvements in the secondary process and use of MF/UF prior to chlorination are expected to produce cleaner and more consistent water quality for chlorination. A more reliable and consistent product will eliminate fluctuations in the chlorine residuals as seen in the monitoring data shown in Attachment C.

Proposed On-Site Storage Reservoir Upgrade

As previously discussed, the existing on-site reservoir is one of the limiting factors in operating the recycled water system. To accommodate the proposed recycled water production of 2.5 mgd an increase in on-site storage capacity is recommended. An evaluation to determine the required amount of on-site storage capacity was performed using the proposed recycled water production rate and the existing recycled water distribution data.

Distribution flow data from 2011 was provided in 15 minute increments. For this evaluation, a high demand day (July 27, 2011) was selected. The evaluation assumed that the daily recycled water demand patterns under the proposed production rate of 2.5 mgd will remain the same as the current demand patterns. Current daily distribution flows are less than 2.5 million gallons, so to simulate the storage reservoir outflow rate, the existing distribution flows were scaled up to provide a total average daily outflow of 2.5 million gallons. To accomplish this, a ratio of the flow rate at each time increment to the average flow rate for the day was calculated. An adjusted distribution flow rate at each time increment was then estimated by multiplying the previously calculated ratios by the average production rate (1740 gpm to 2.5 mgd). These values were used as the storage tank outflow rate.

To determine the required storage reservoir capacity, a flow equalization calculation was performed. The cumulative daily inflow and outflow values, at 15 minute intervals, were calculated and compared. The largest difference between the cumulative inflow and outflow values is the required storage capacity. The results of this calculation indicate that about 1.1 million gallons of usable storage will be required in order to adequately equalize the flow for 2.5 mgd of production. It is recommended that the existing storage reservoir be demolished and replaced with a new 1.4 million gallon storage reservoir, which will provide the required usable storage volume and a small amount of additional volume to maintain inlet submergence for the recycled water pumps.

Figure 1 illustrates the flow equalization calculation by illustrating the cumulative daily inflow and outflow and the volume difference. Figure 2 is a plot of the recycled water production and demands used in the evaluation.

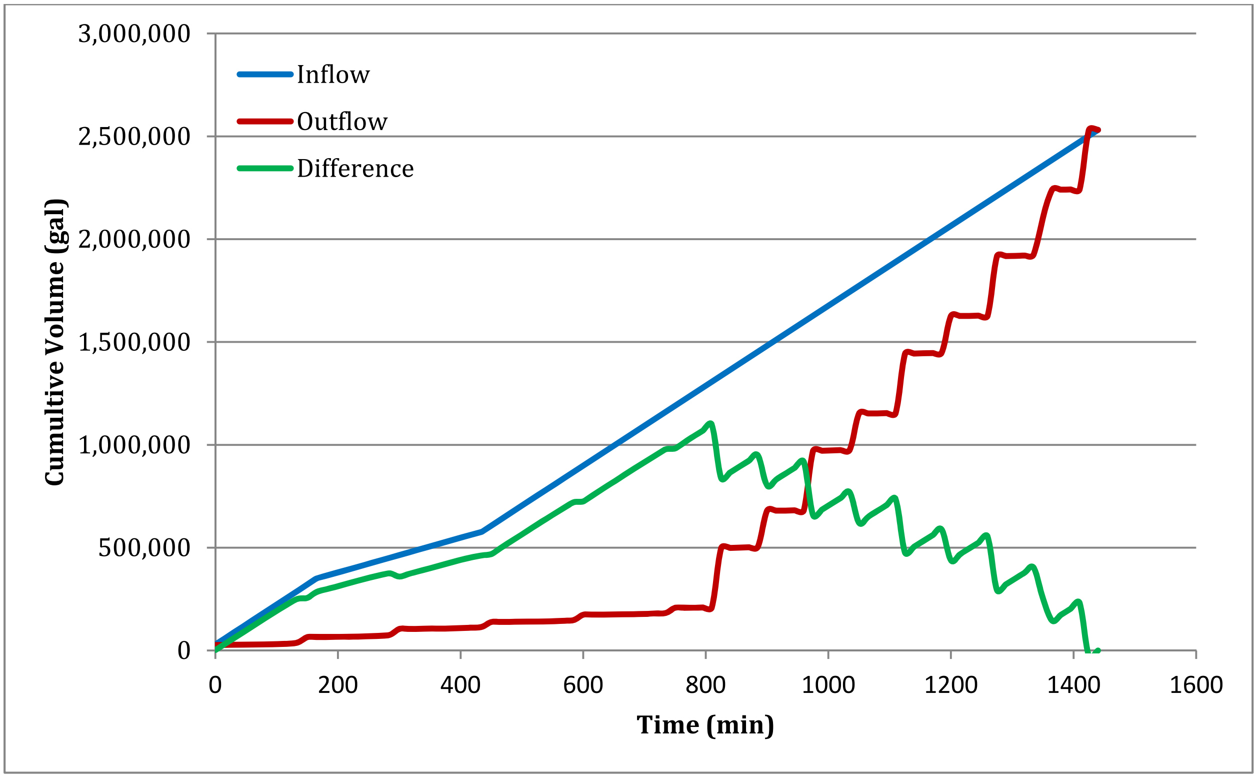

Figure 1
Cumulative Daily Inflow, Outflow, and Volume Difference

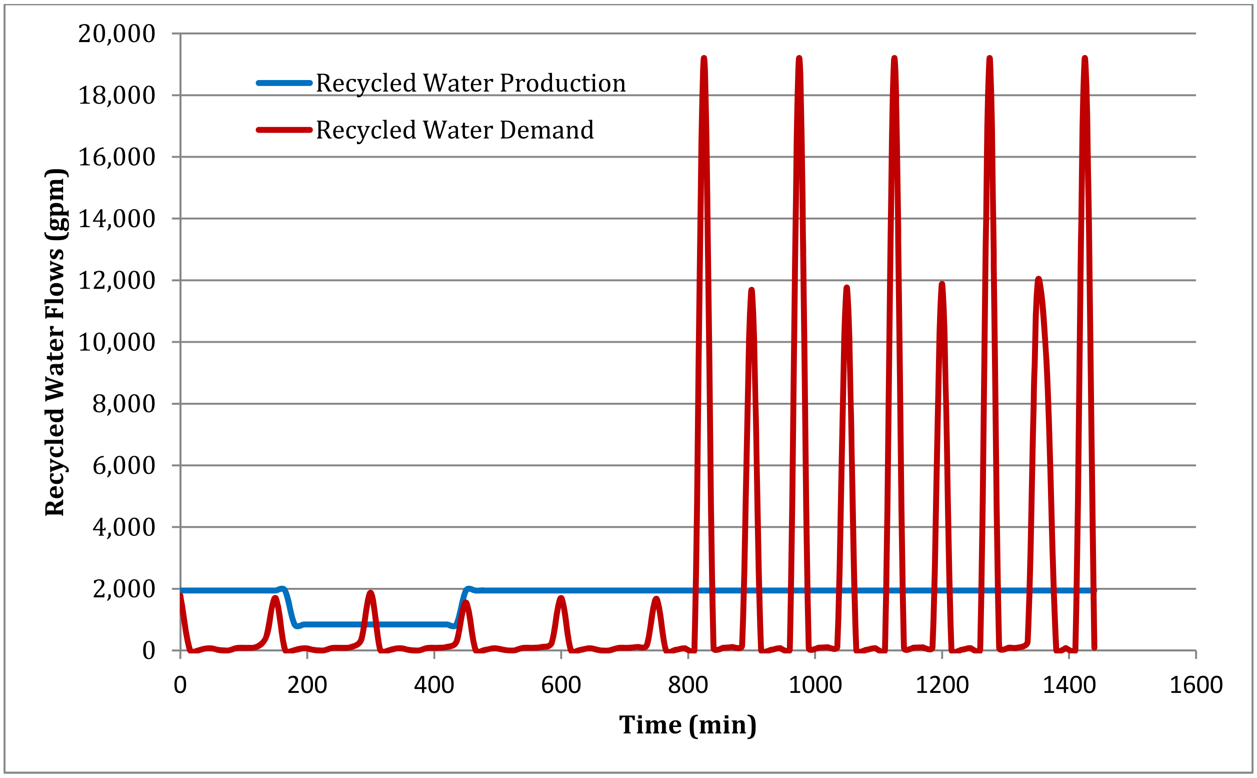

Figure 2
Recycled Water Production and Demands

Conclusions

Per the City of Santa Barbara Long-Term Water Supply Plan dated 2011, the expected recycled water demands from the year 2010 to 2030 are estimated to increase linearly by 1,000 acre-feet. That is an approximately 33.3 acre-feet (10.8 million gallons) increase each year.

The chlorine contact basin and the on-site storage reservoir provide storage for 1 hour and 1.3 to 2.6 hours, respectively. The current practice of using the on-site storage system to supplement the chlorine contact time results in significant limitations on available storage to meet recycled water demands. The recycled water system is currently operated as a process, limiting the system from maximizing the use of the recycled water it produces. The batch process must handle effluent with inconsistent turbidity and chlorine residuals. A continuous process should be provided to produce a more consistent and predictable effluent supply.

El Estero Recycled Water system is currently operating in a batch mode which produces inconsistent levels of turbidity and which requires blending the effluent with potable water and leads to inconsistent chlorine residuals and CT Values. Improvements to the secondary treatment system and replacement of the tertiary treatment facilities with MF/UF are expected to provide more consistent effluent and give the plant the opportunity to produce a continuous and more consistent level of recycled water. The continuous process system will also make it easier to optimize the size of additional storage tanks to meet future demands.

It is recommended that additional storage be provided at the EEWWTP by replacing the existing on-site reservoir with a 1.4 million gallon reservoir. This new reservoir will serve to equalize flows throughout the day, providing the necessary storage volume to meet the projected system demands over the planning period.

ATTACHMENT A
Map of Recycled Water System Phases

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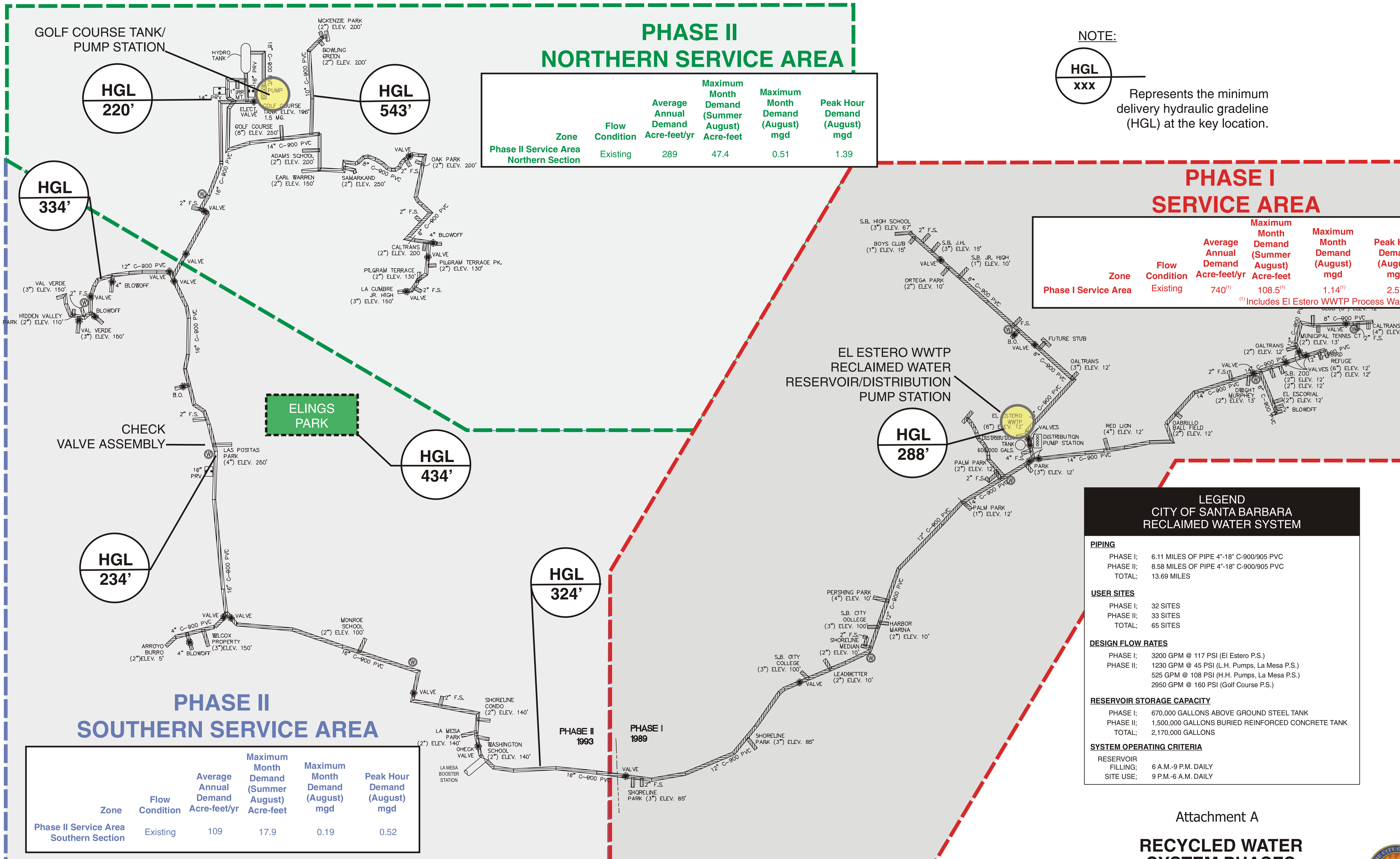

Zone	Flow Condition	Average Annual Demand Acre-feet/yr	Maximum Month Demand (Summer August) Acre-feet	Maximum Month Demand (August) mgd	Peak Hour Demand (August) mgd
Phase II Service Area Northern Section	Existing	289	47.4	0.51	1.39

Zone	Flow Condition	Average Annual Demand Acre-feet/yr	Maximum Month Demand (Summer August) Acre-feet	Maximum Month Demand (August) mgd	Peak Hour Demand (August) mgd
Phase I Service Area	Existing	740[1]	108.5[1]	1.14[1]	2.5[1]

[1] Includes El Estero WWTP Process Water.

Zone	Flow Condition	Average Annual Demand Acre-feet/yr	Maximum Month Demand (Summer August) Acre-feet	Maximum Month Demand (August) mgd	Peak Hour Demand (August) mgd
Phase II Service Area Southern Section	Existing	109	17.9	0.19	0.52

LEGEND
CITY OF SANTA BARBARA
RECLAIMED WATER SYSTEM

PIPING

PHASE I; 6.11 MILES OF PIPE 4"-18" C-900/905 PVC
PHASE II; 8.58 MILES OF PIPE 4"-18" C-900/905 PVC
TOTAL; 13.69 MILES

USER SITES

PHASE I; 32 SITES
PHASE II; 33 SITES
TOTAL; 65 SITES

DESIGN FLOW RATES

PHASE I; 3200 GPM @ 117 PSI (El Estero P.S.)
PHASE II; 1230 GPM @ 45 PSI (L.H. Pumps, La Mesa P.S.)
525 GPM @ 108 PSI (H.H. Pumps, La Mesa P.S.)
2950 GPM @ 160 PSI (Golf Course P.S.)

RESERVOIR STORAGE CAPACITY

PHASE I; 670,000 GALLONS ABOVE GROUND STEEL TANK
PHASE II; 1,500,000 GALLONS BURIED REINFORCED CONCRETE TANK
TOTAL; 2,170,000 GALLONS

SYSTEM OPERATING CRITERIA

RESERVOIR FILLING; 6 A.M.-9 P.M. DAILY
SITE USE; 9 P.M.-6 A.M. DAILY

Figure 4.9 from Water Supply Planning Study Dated August 2009

Attachment A

RECYCLED WATER SYSTEM PHASES

CITY OF SANTA BARBARA

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ATTACHMENT B
Recycled Water System Schematic

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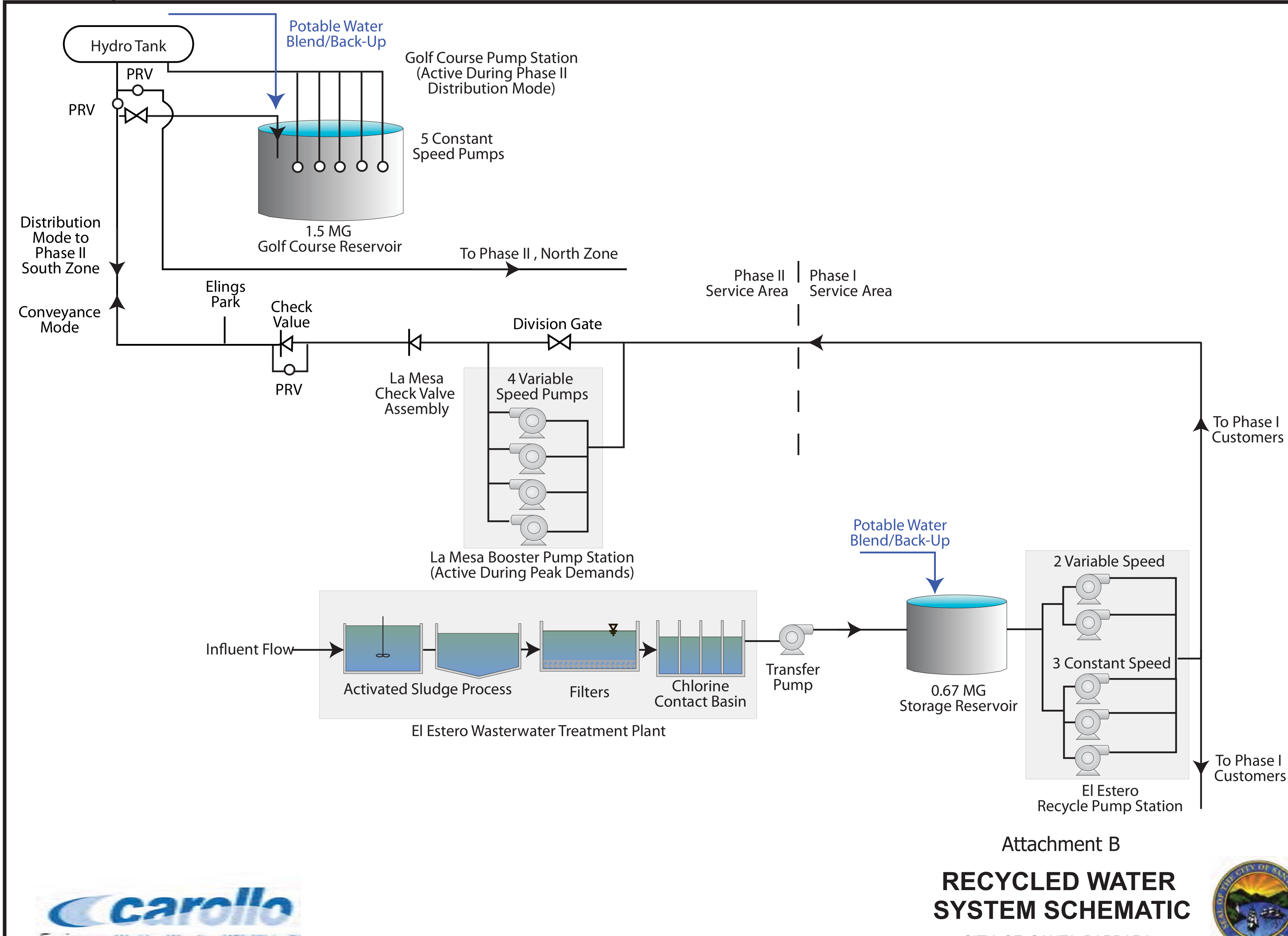

Attachment B

RECYCLED WATER SYSTEM SCHEMATIC

CITY OF SANTA BARBARA

Engineers...Working Wonders With Water™

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ATTACHMENT C
Recycled Water System Operation Data
(May 31, 2012 through June 6, 2012)

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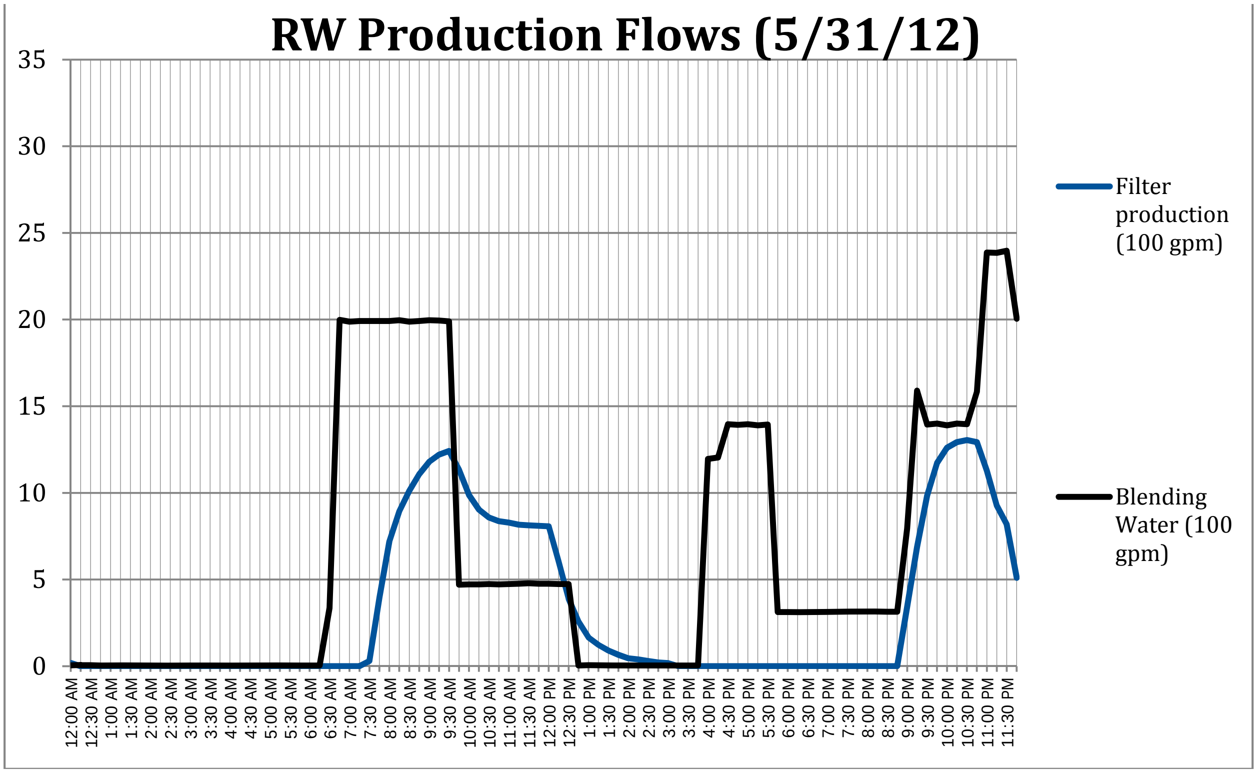
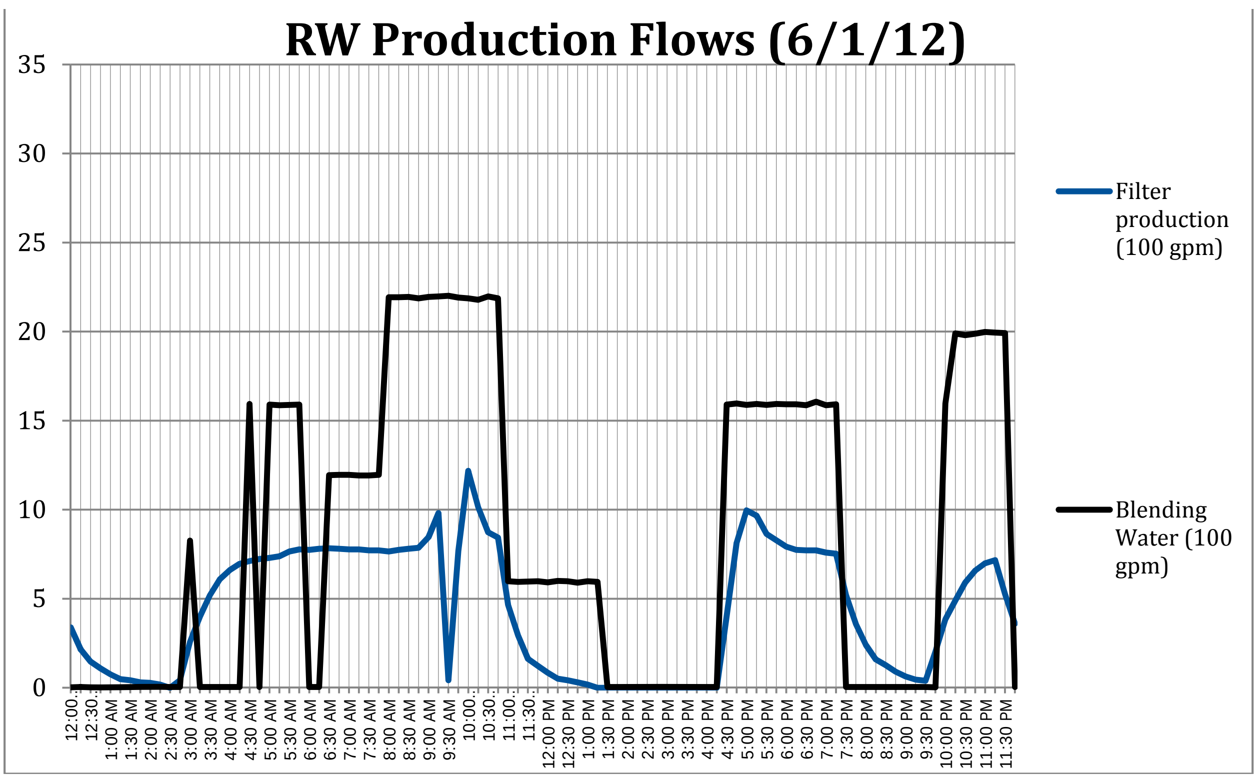
Attachment C





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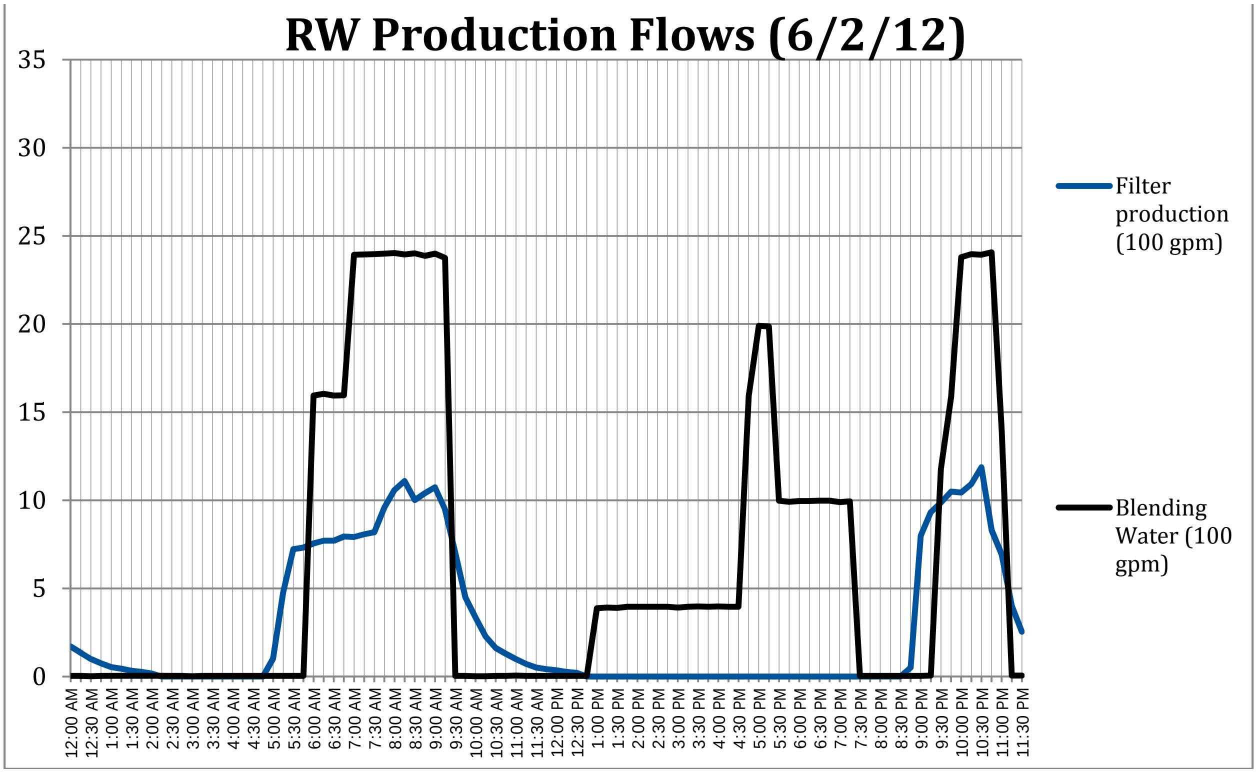

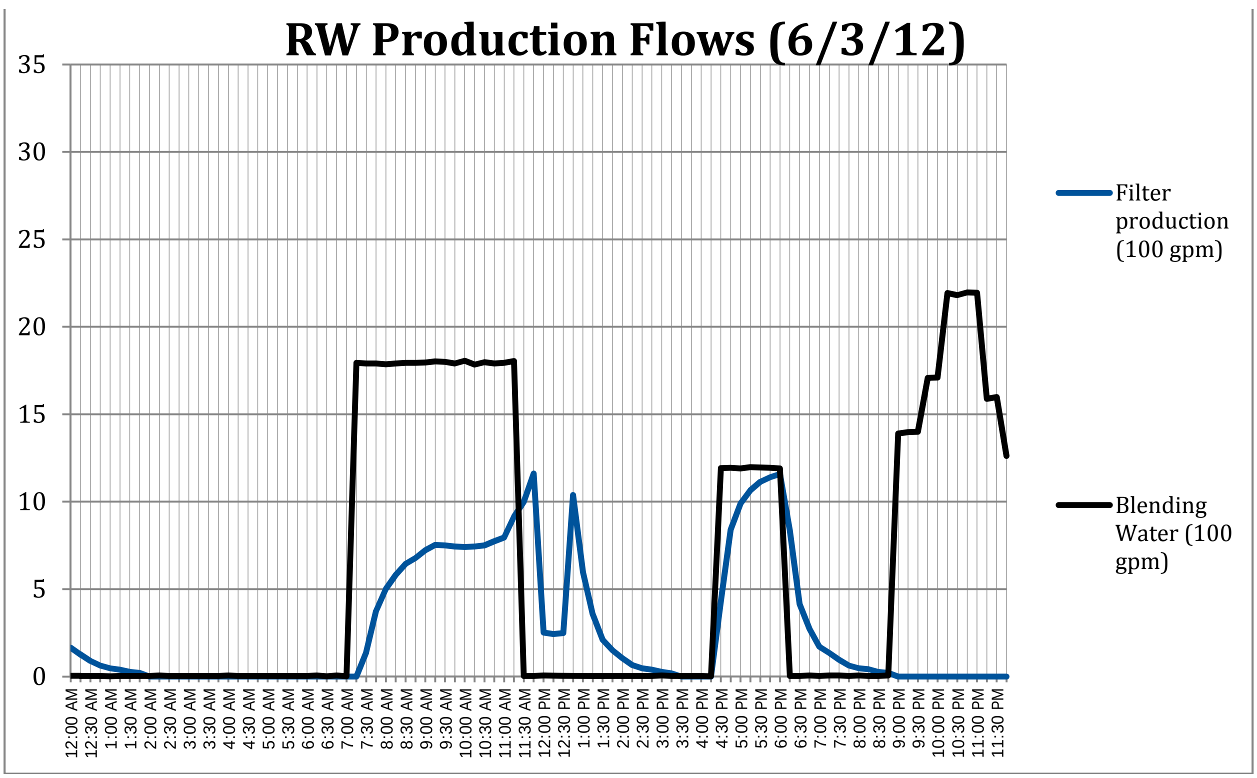

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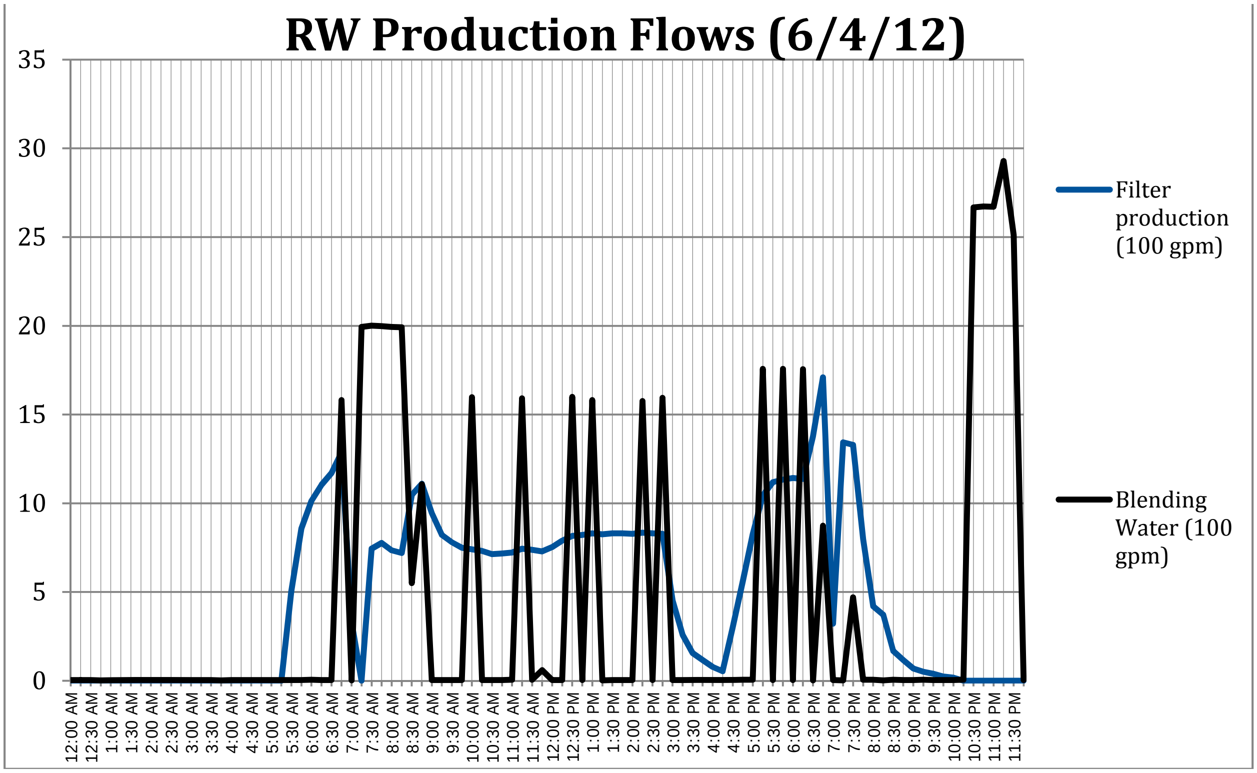

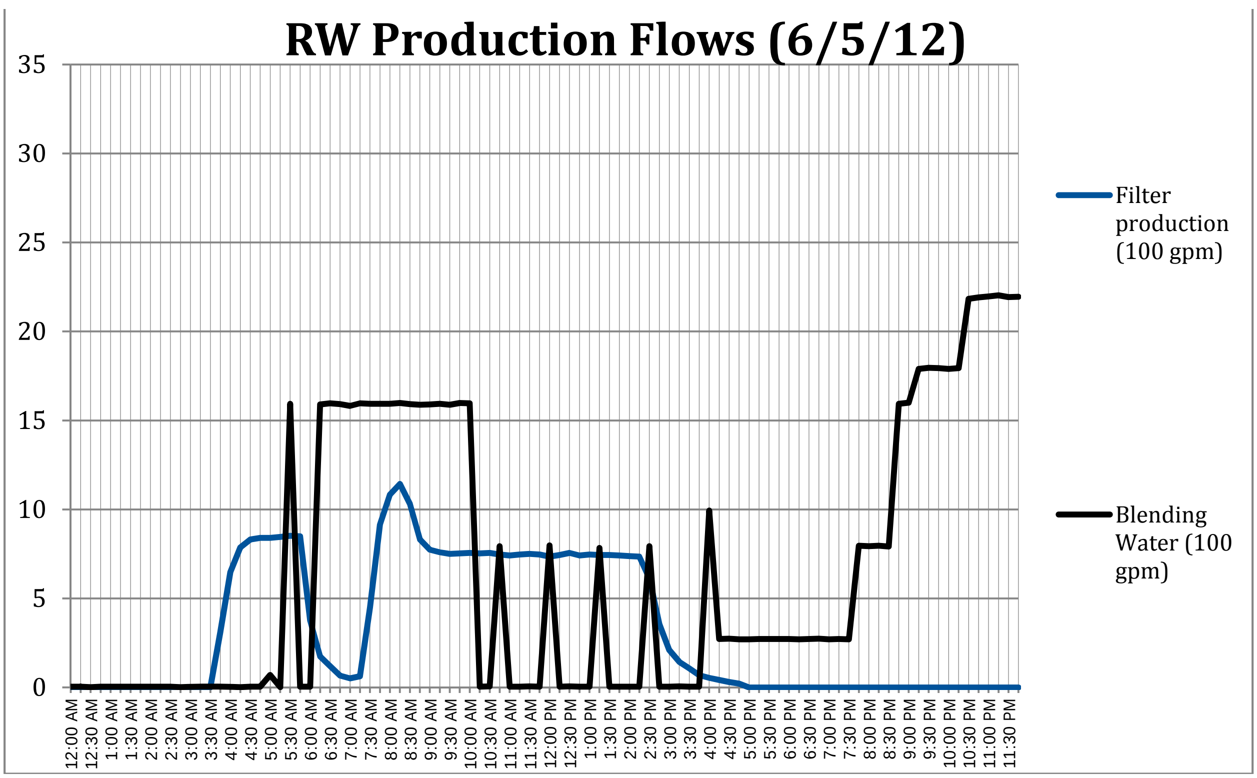

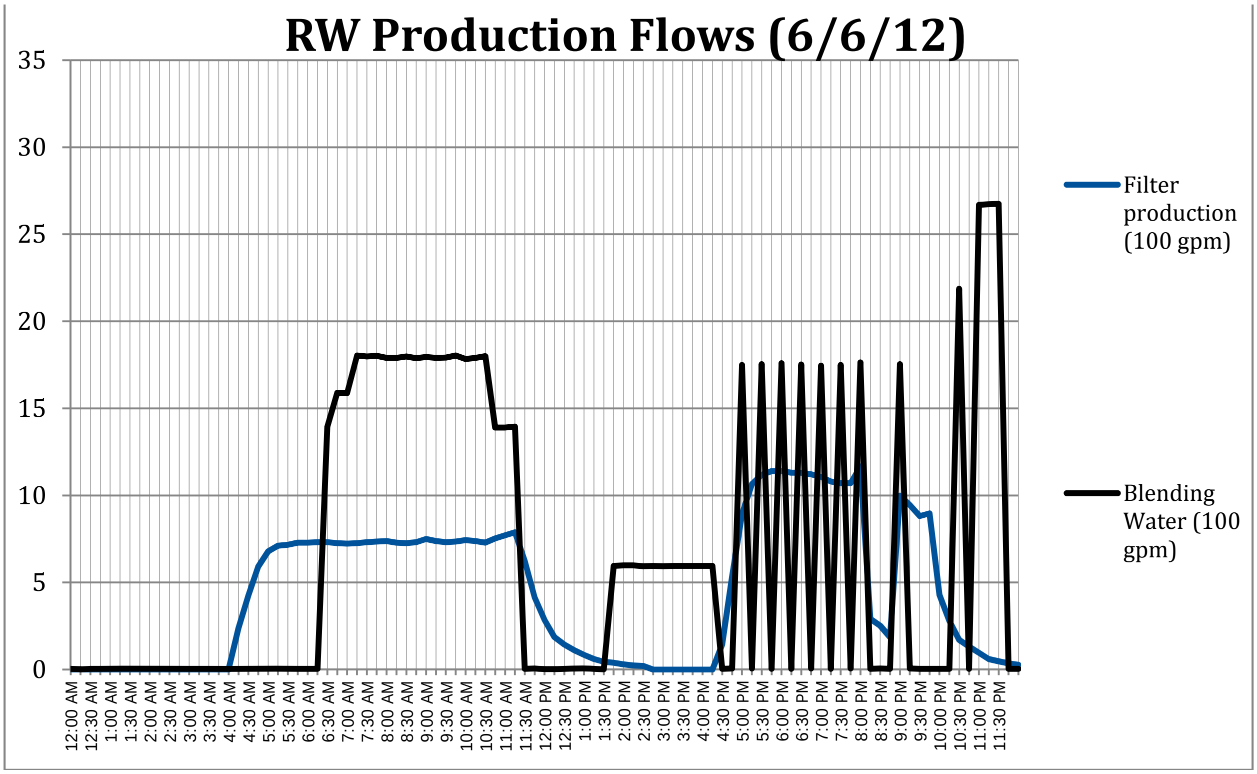
RW Production Flows (6/6/12)
35
30
25
20
15
10
5
0
12:00 AM
12:30 AM
1:00 AM
1:30 AM
2:00 AM
2:30 AM
3:00 AM
3:30 AM
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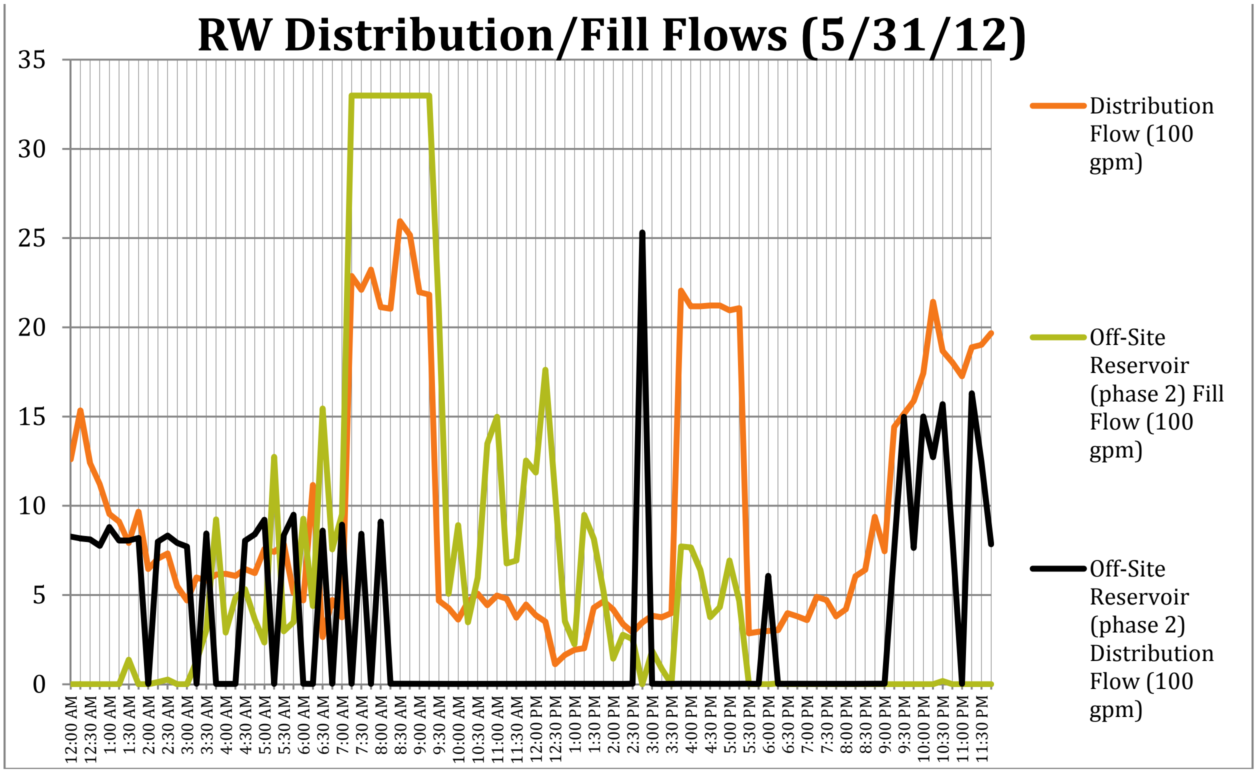
11:30 PM
Filter production (100 gpm)
Blending Water (100 gpm)


RW Distribution/Fill Flows (5/31/12)
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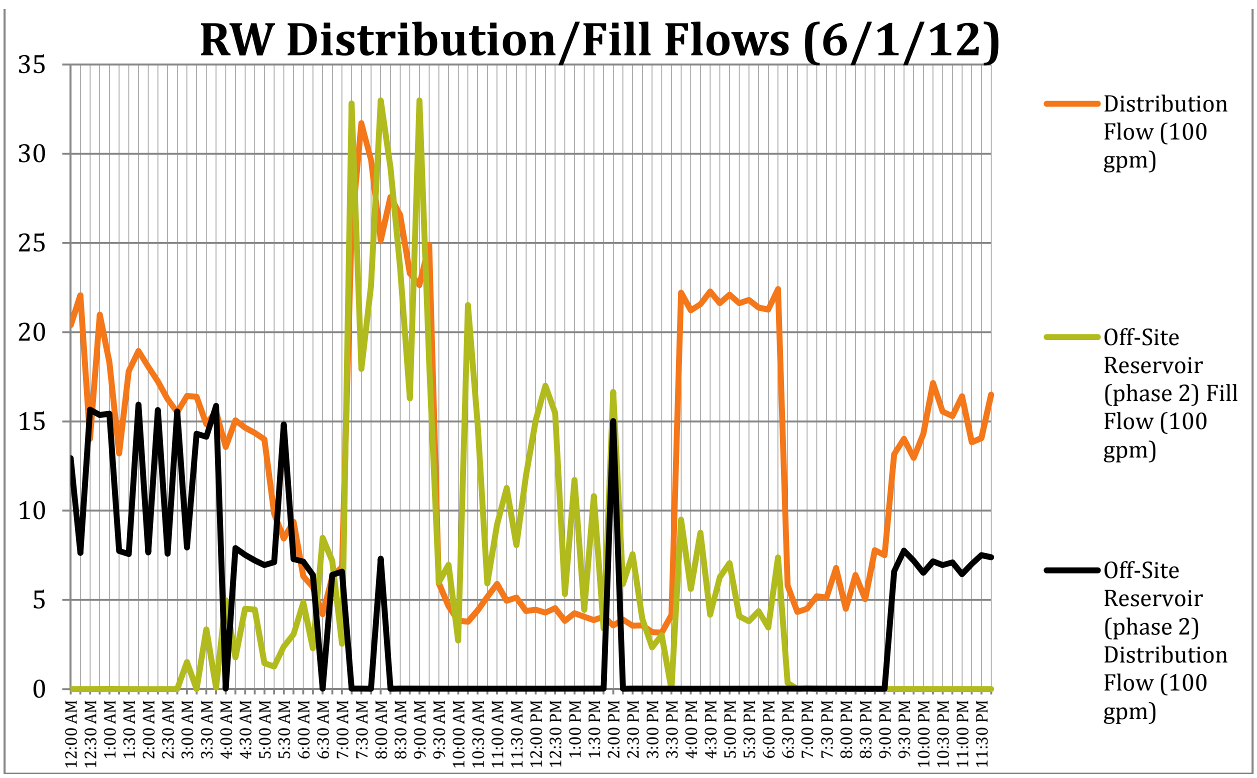
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


RW Distribution/Fill Flows (6/1/12)
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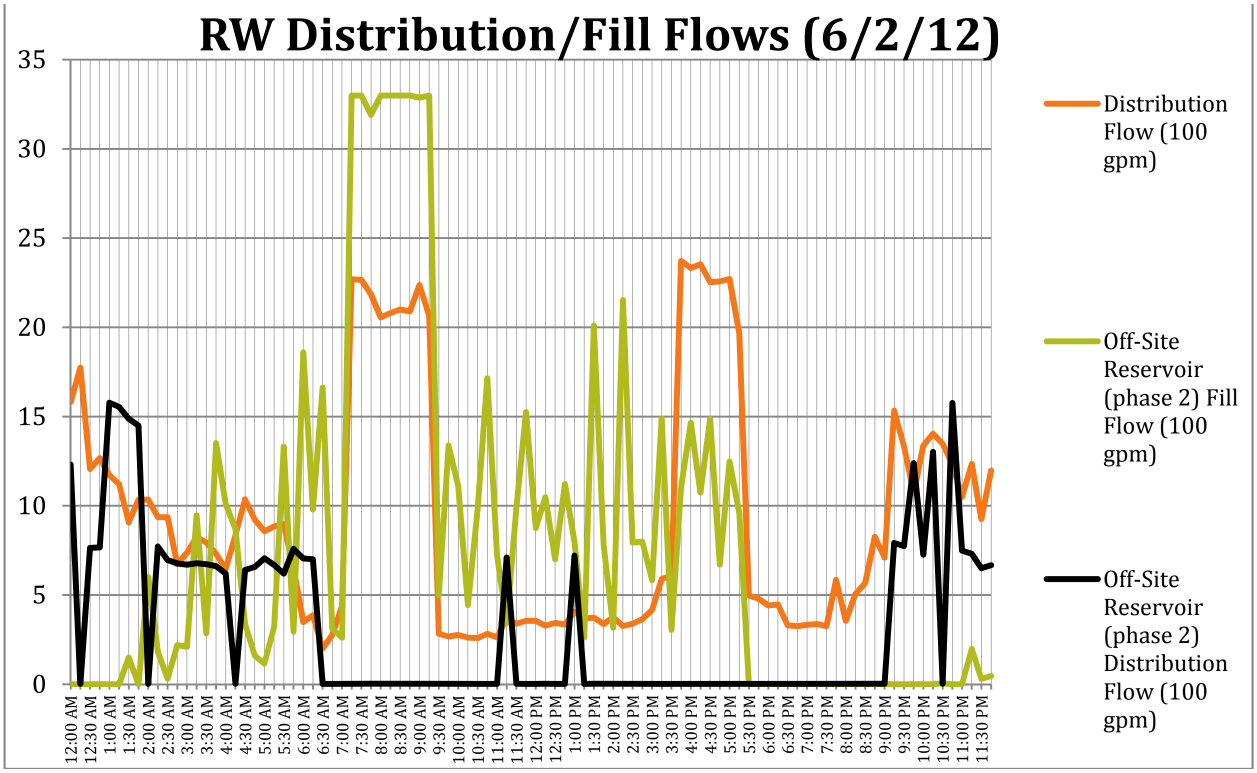
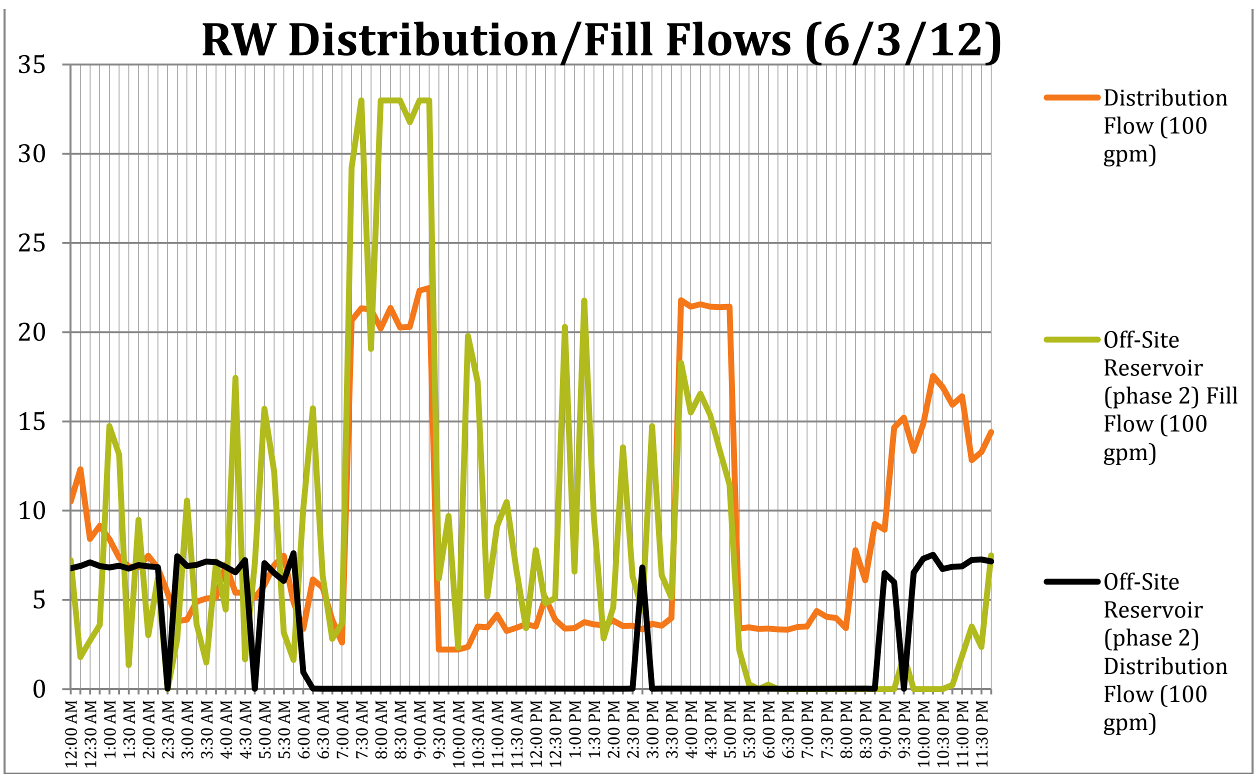
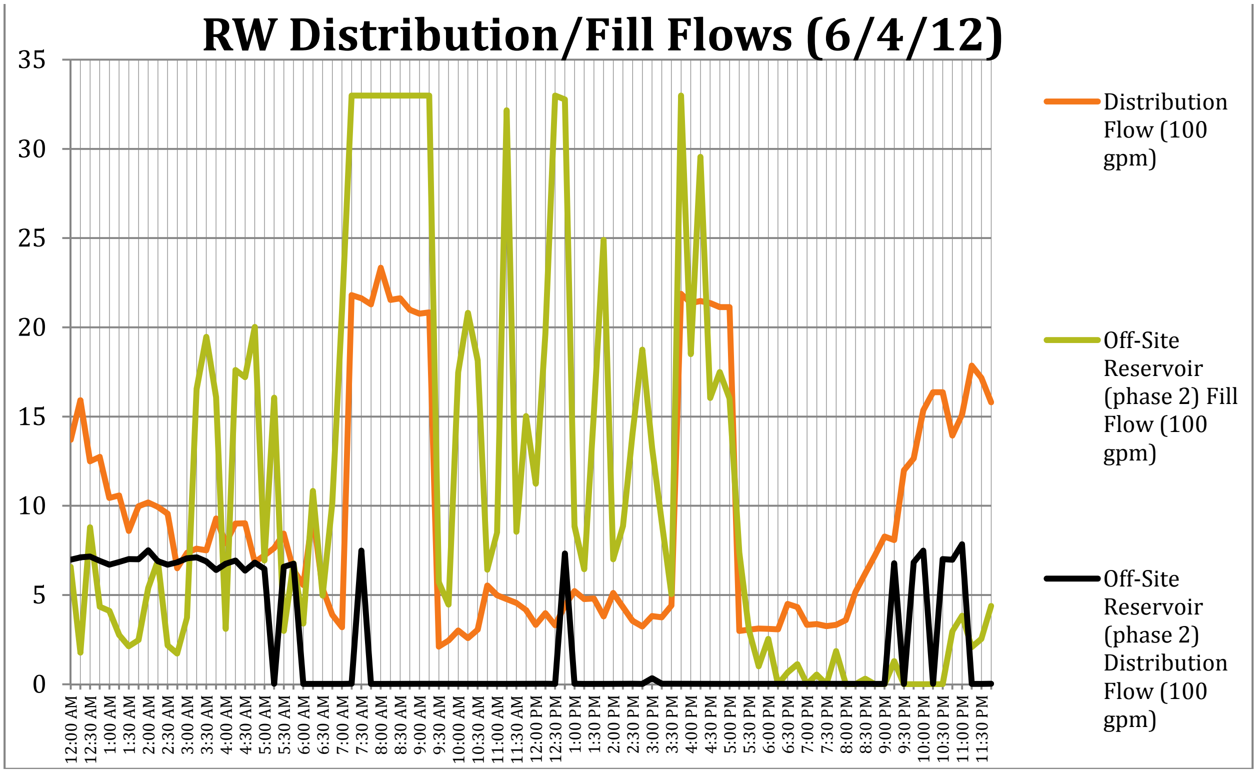
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)

Attachment C



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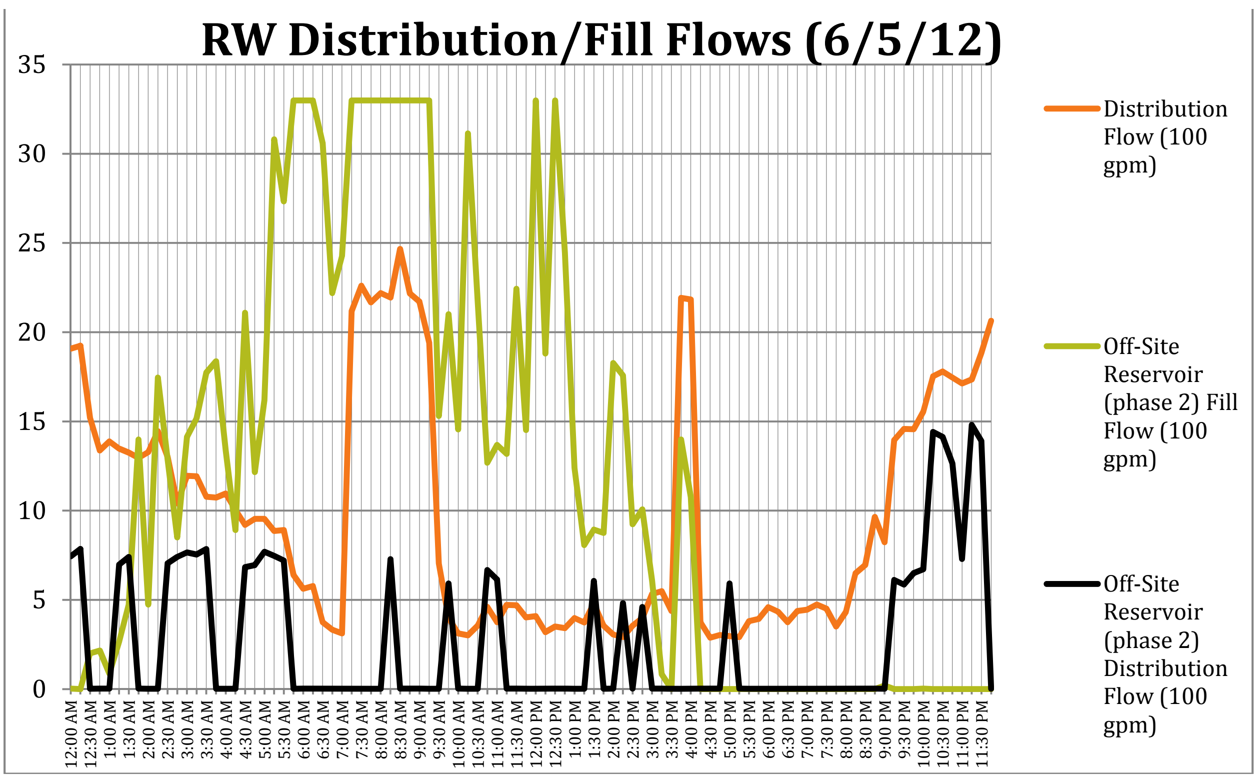
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


RW Distribution/Fill Flows (6/5/12)
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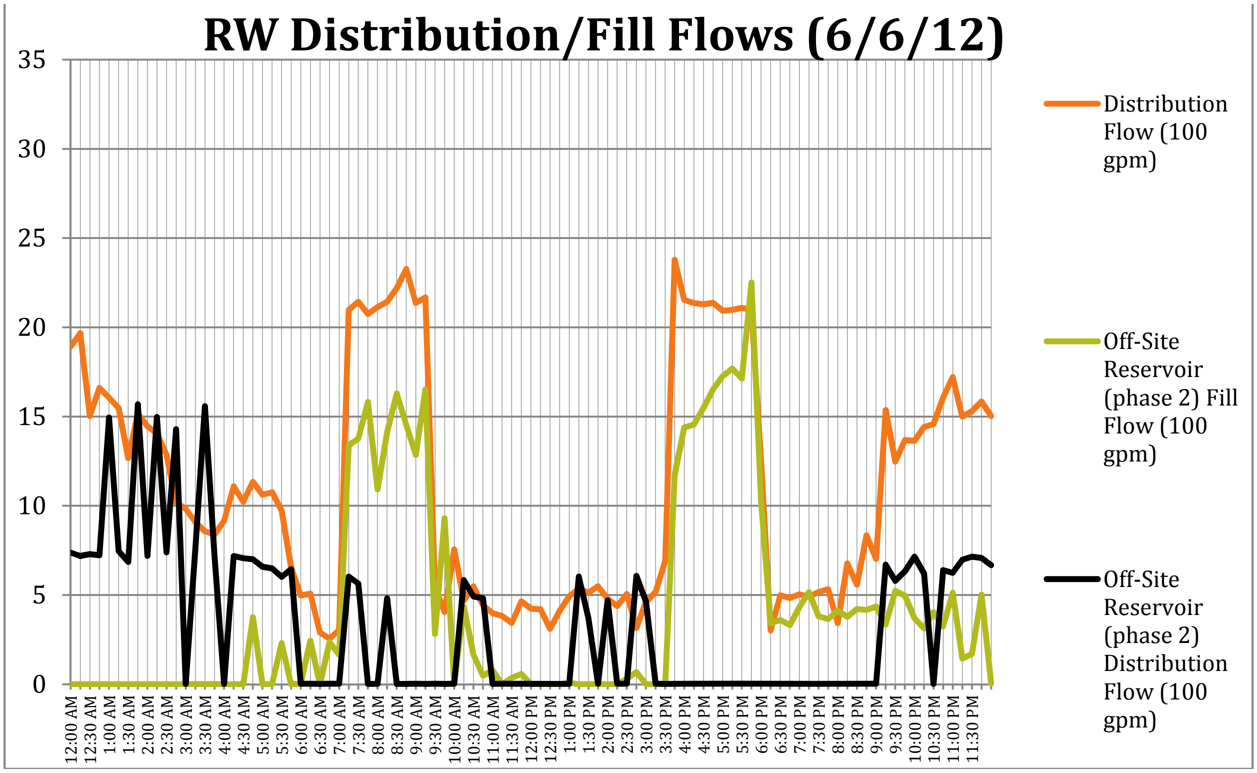
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


RW Distribution/Fill Flows (6/6/12)
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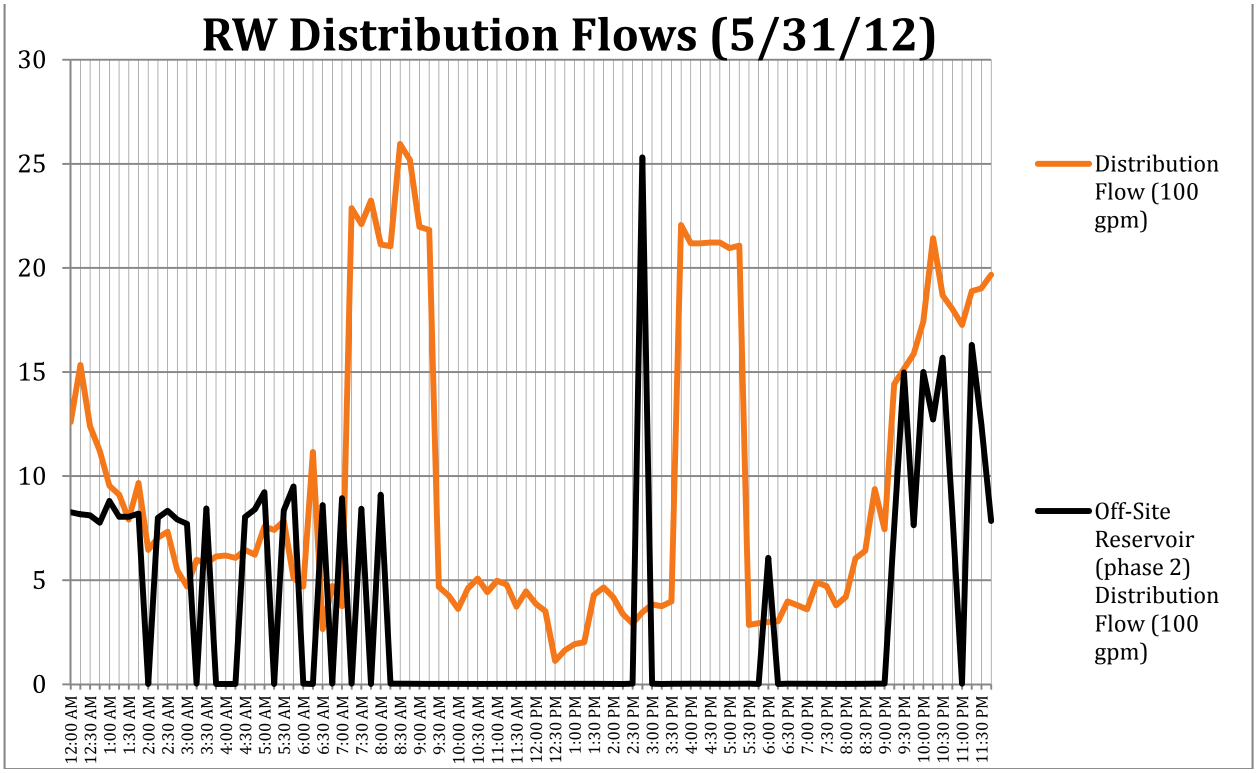
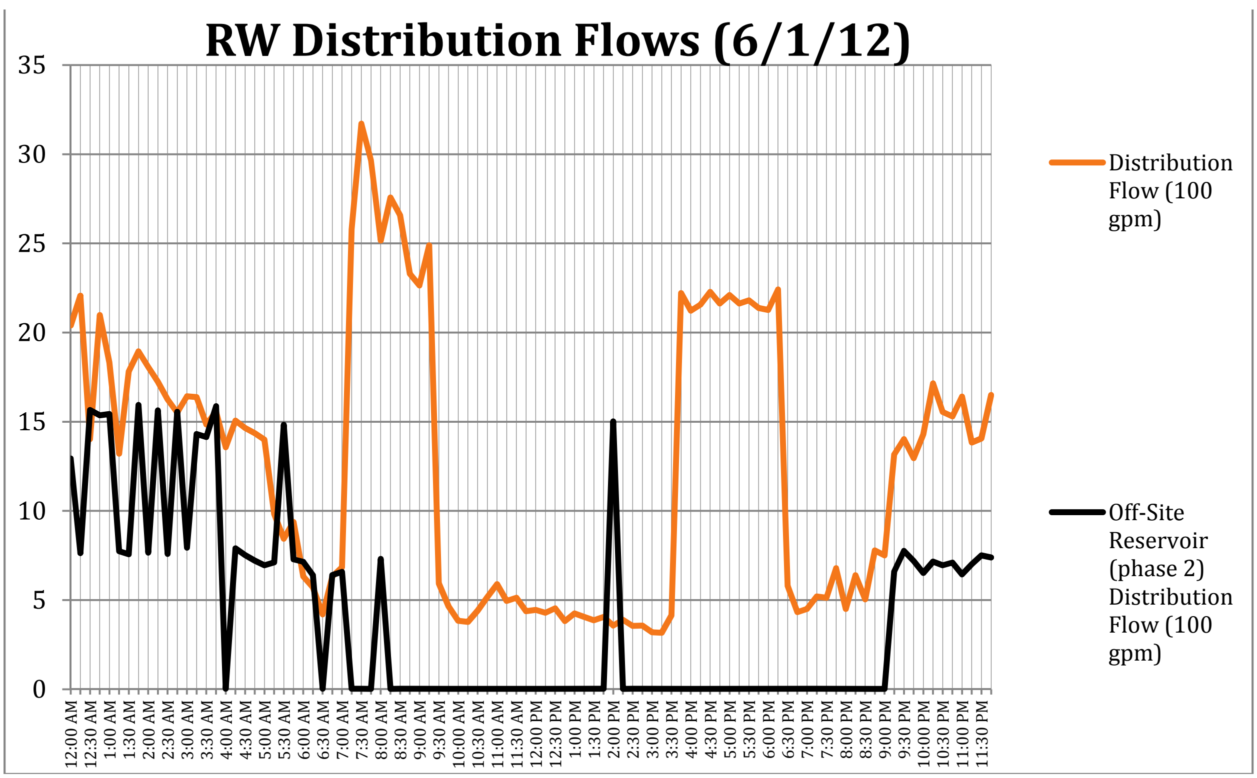
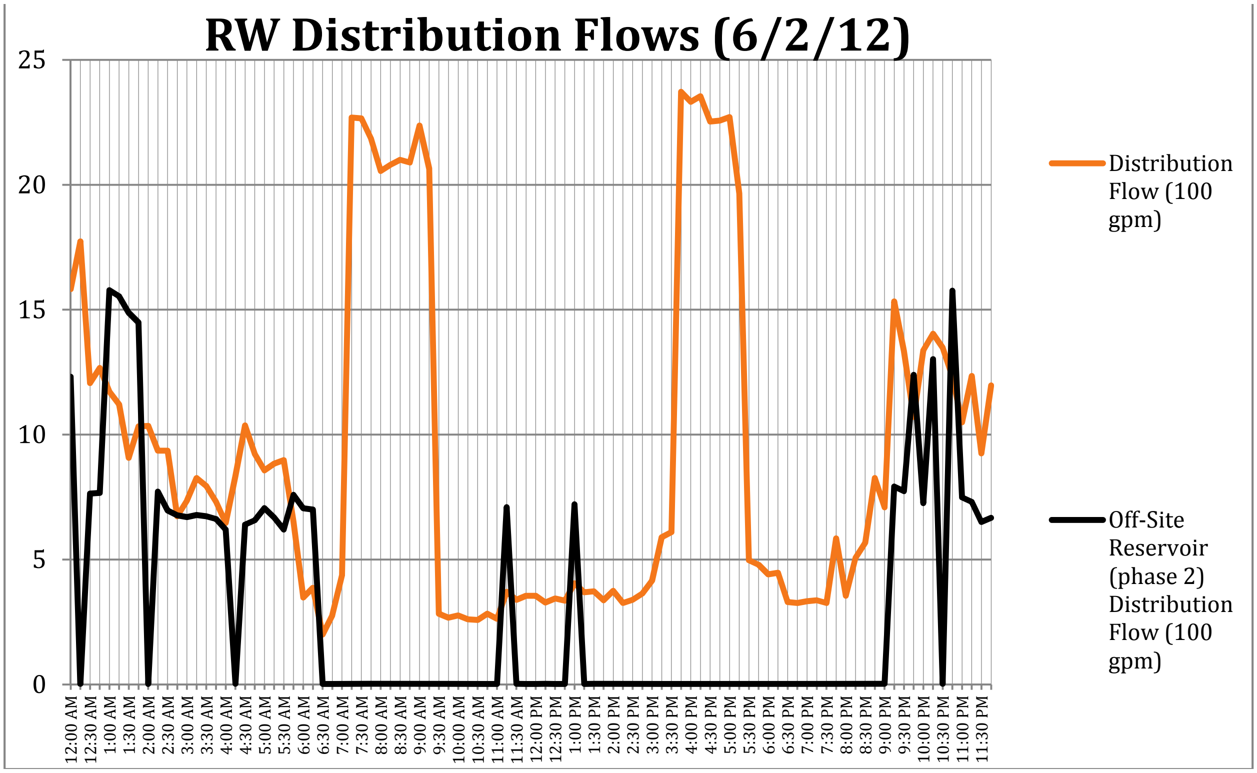
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)

Attachment C



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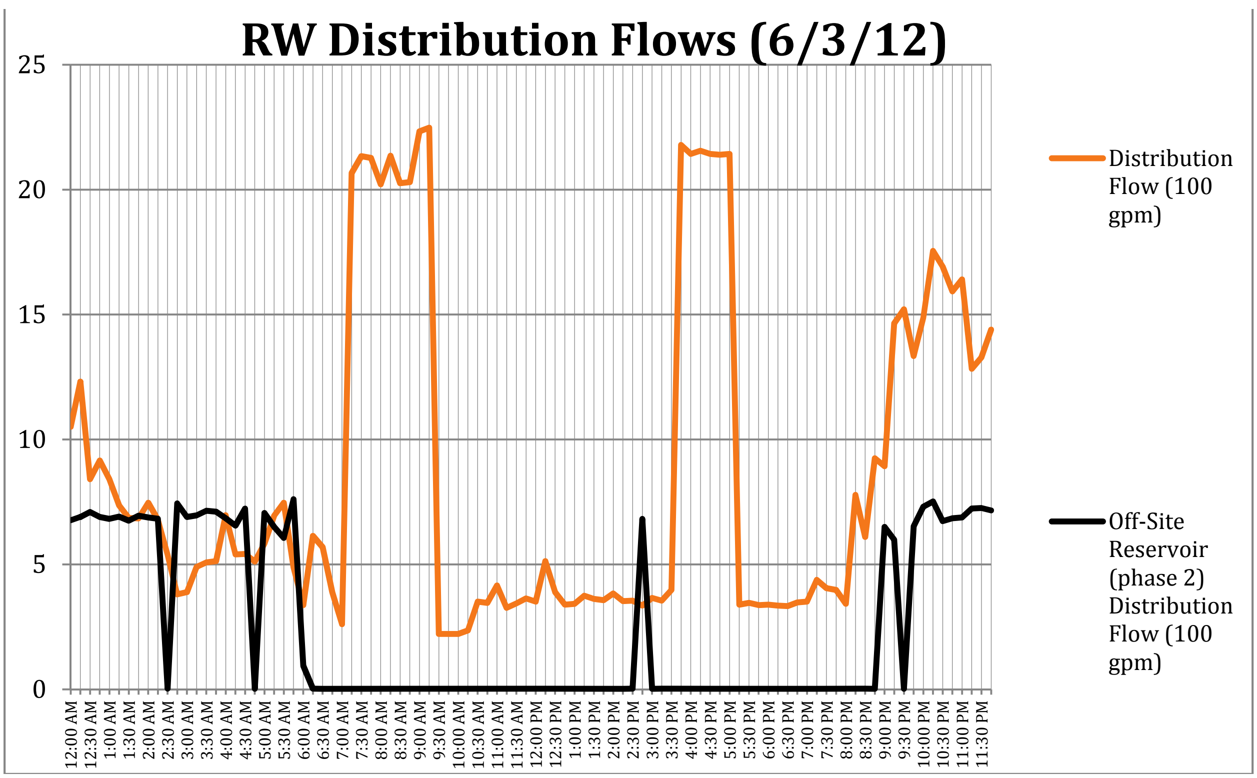
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


RW Distribution Flows (6/3/12)
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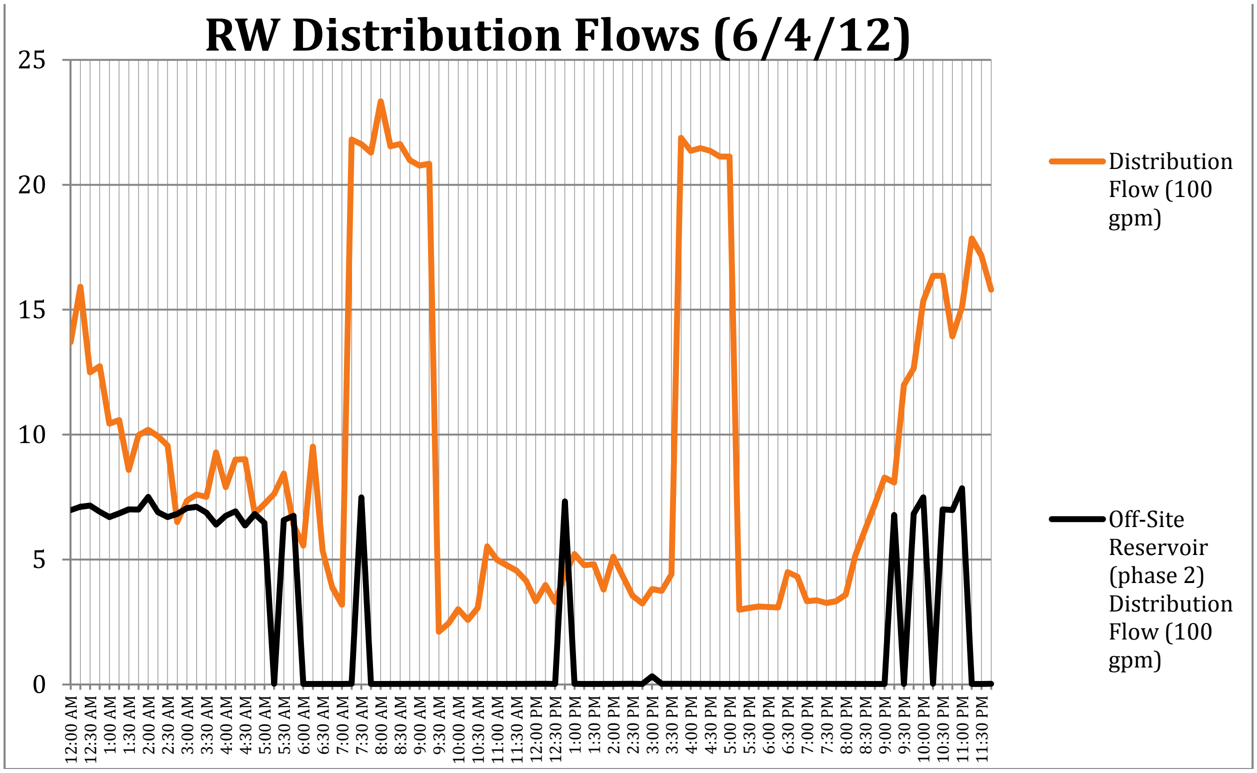
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


RW Distribution Flows (6/4/12)
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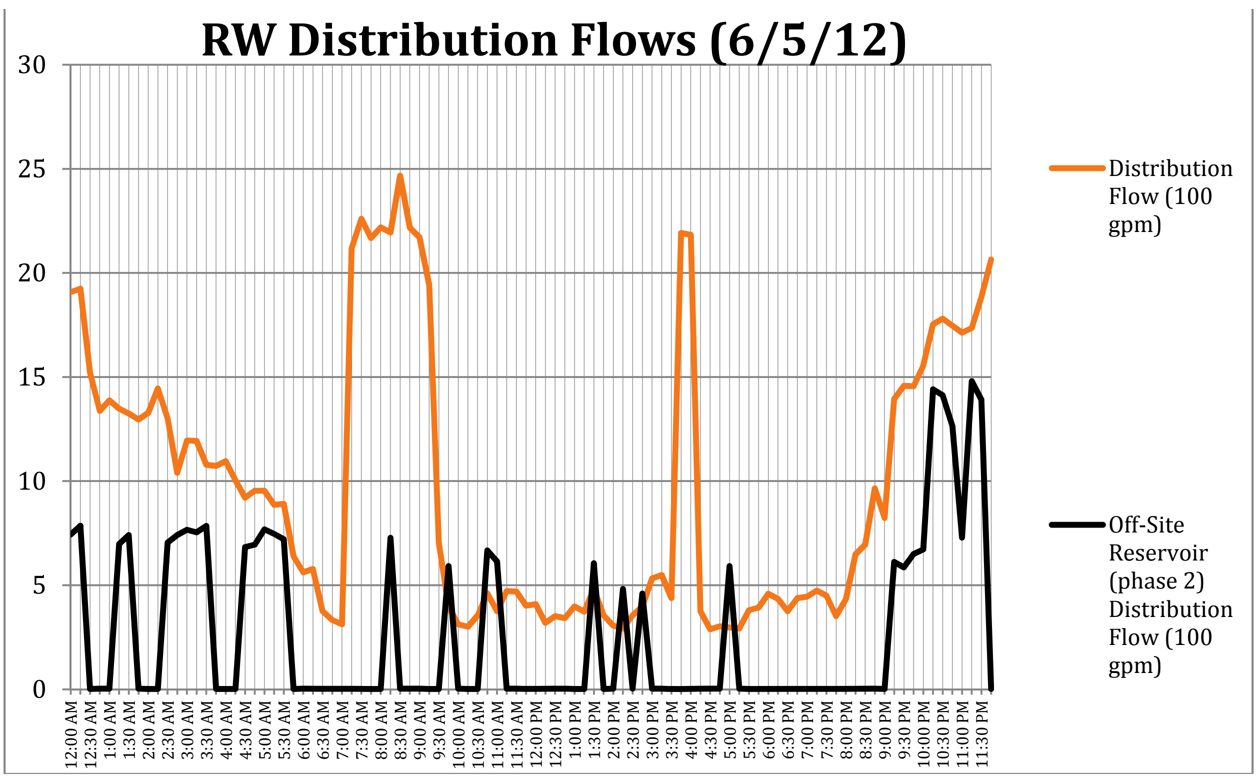
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


RW Distribution Flows (6/5/12)
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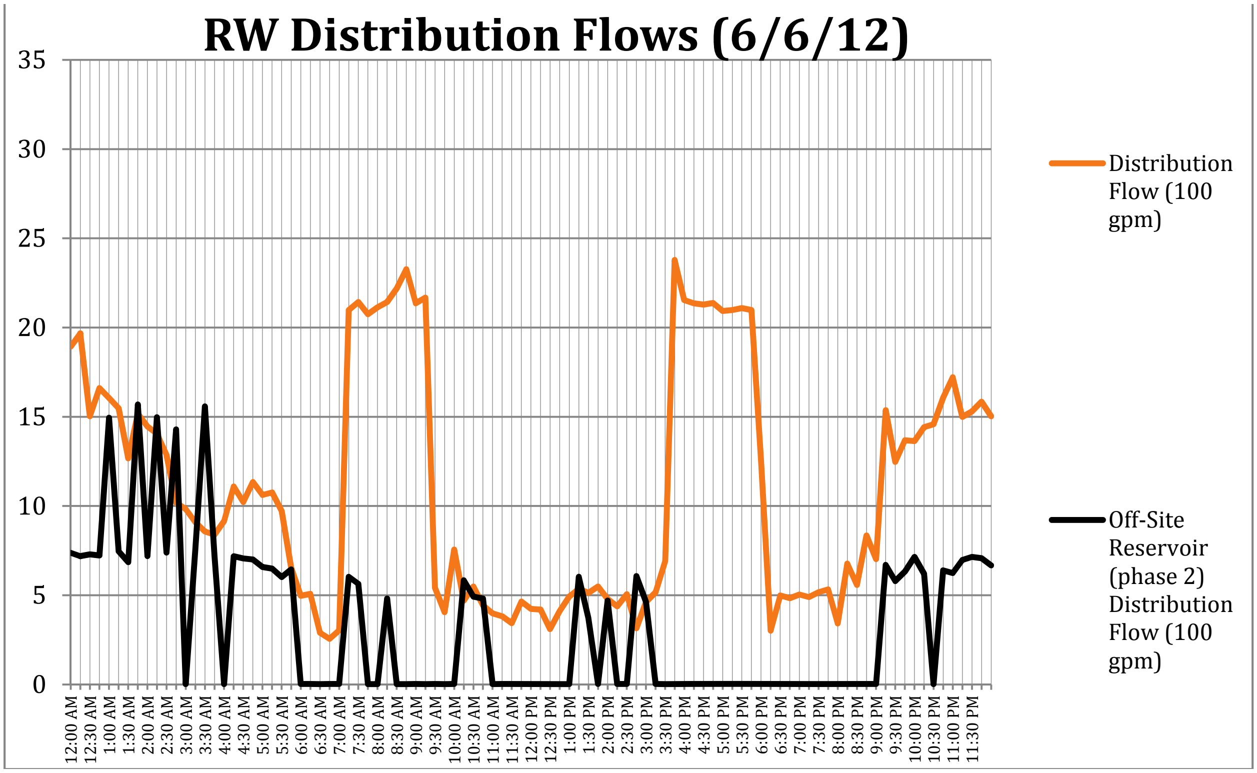
Distribution Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)

Attachment C



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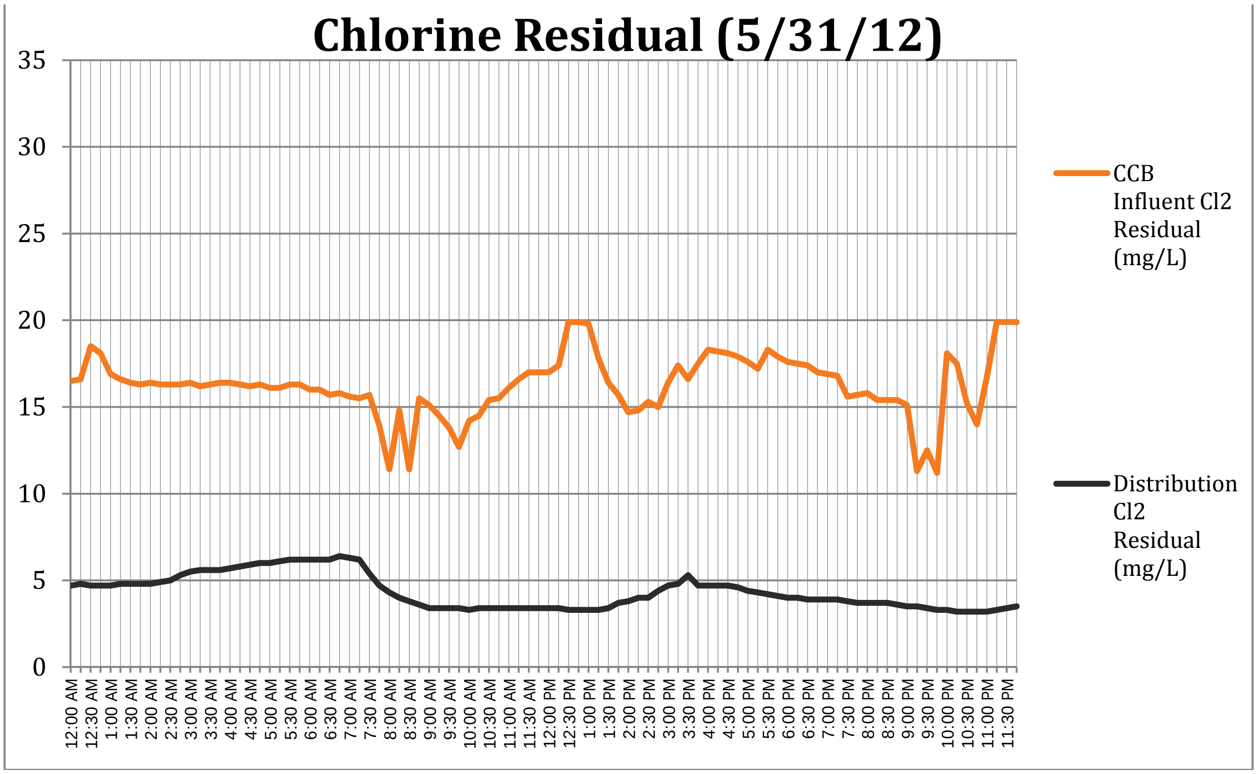

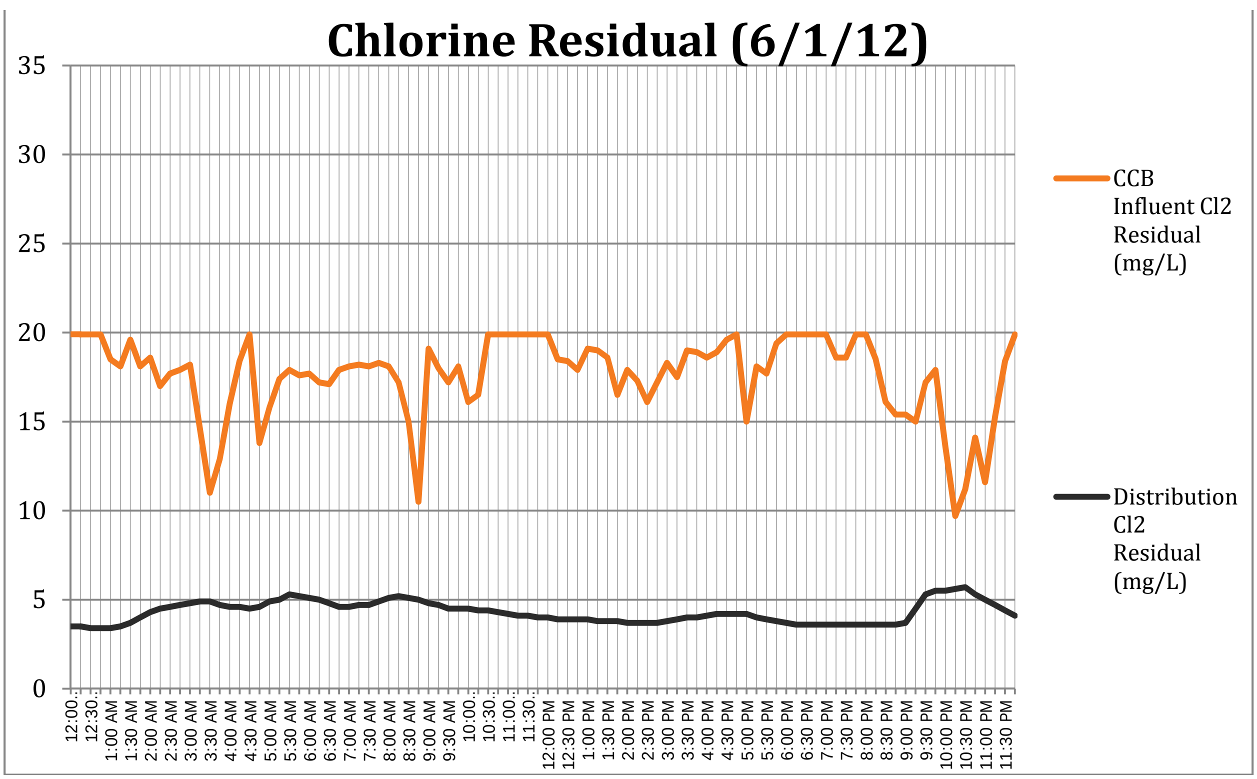

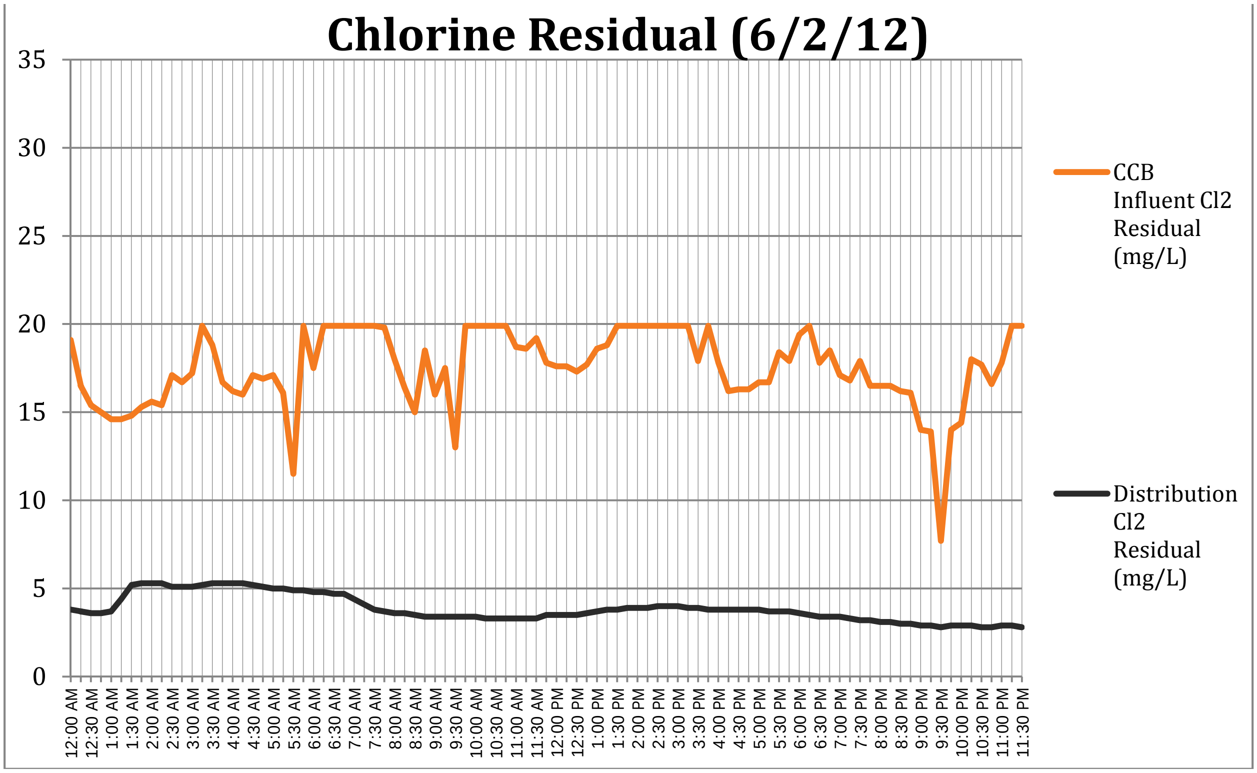
Chlorine Residual (6/2/12)
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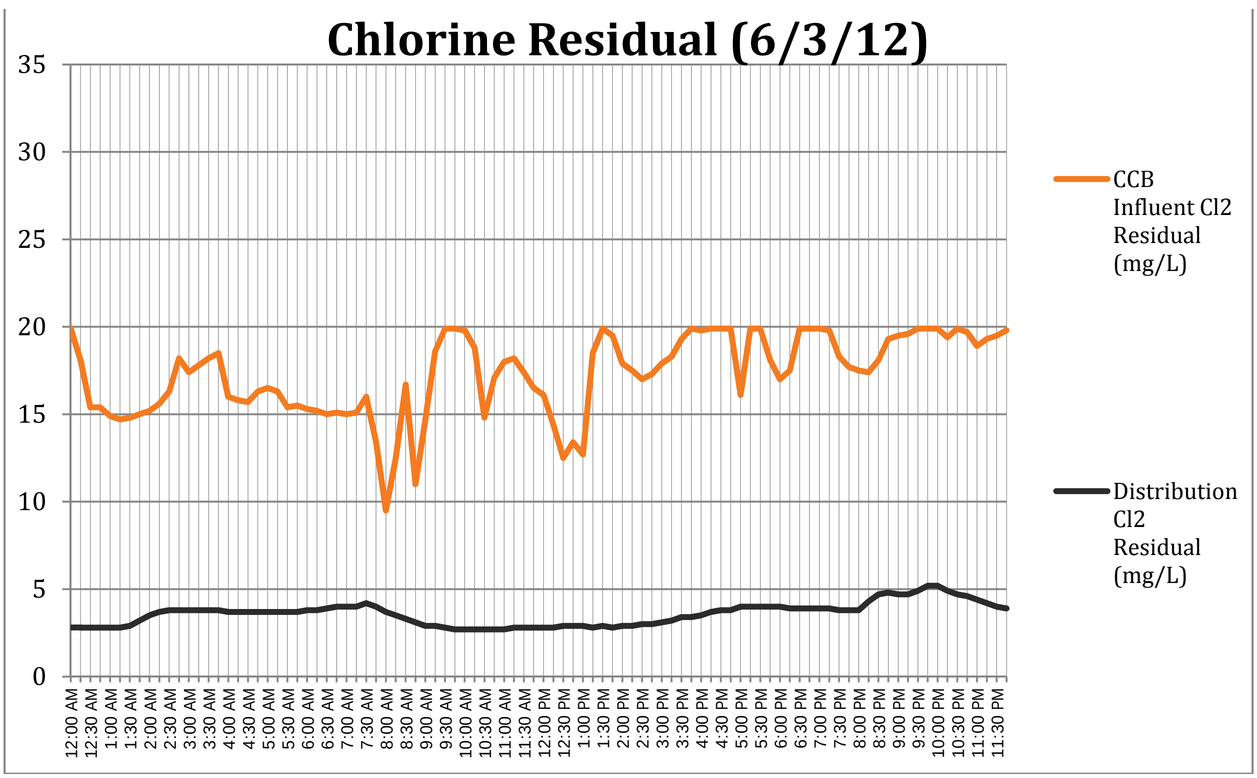
CCB Influent Cl2 Residual (mg/L)
Distribution Cl2 Residual (mg/L)


Chlorine Residual (6/3/12)
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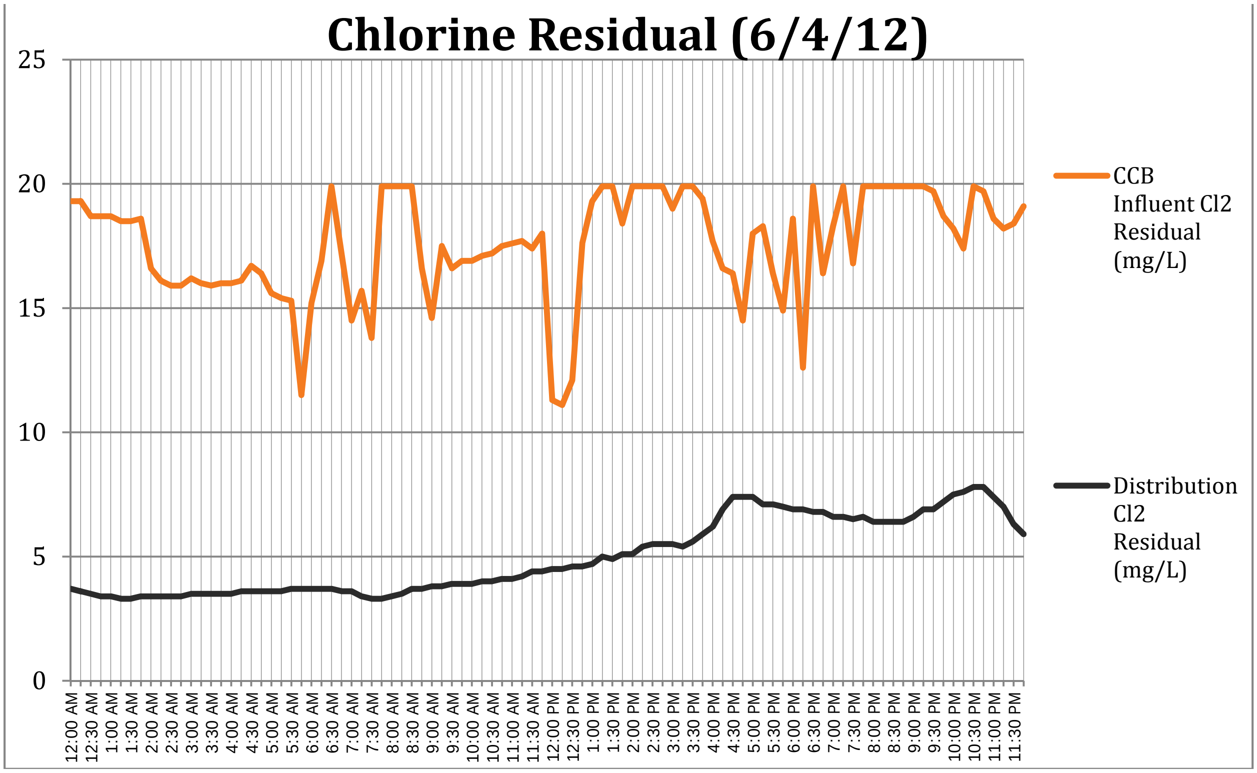
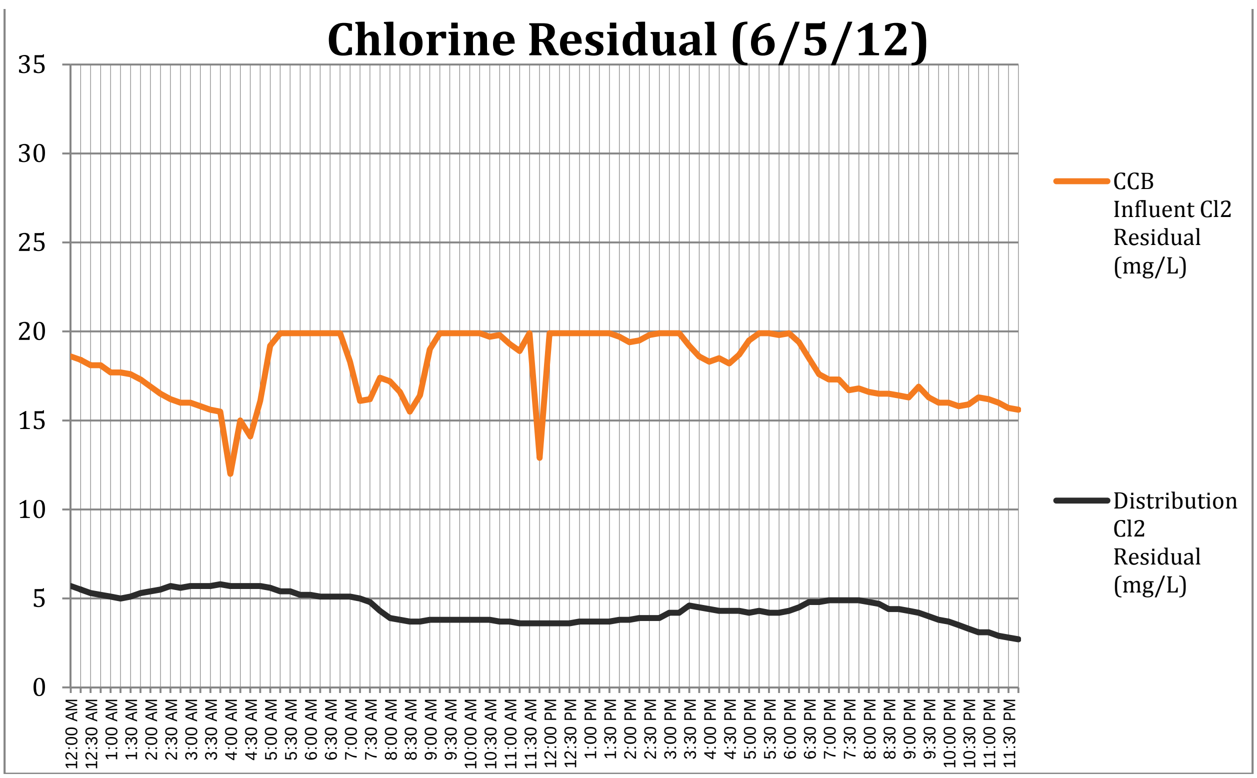
CCB Influent Cl2 Residual (mg/L)
Distribution Cl2 Residual (mg/L)

Attachment C





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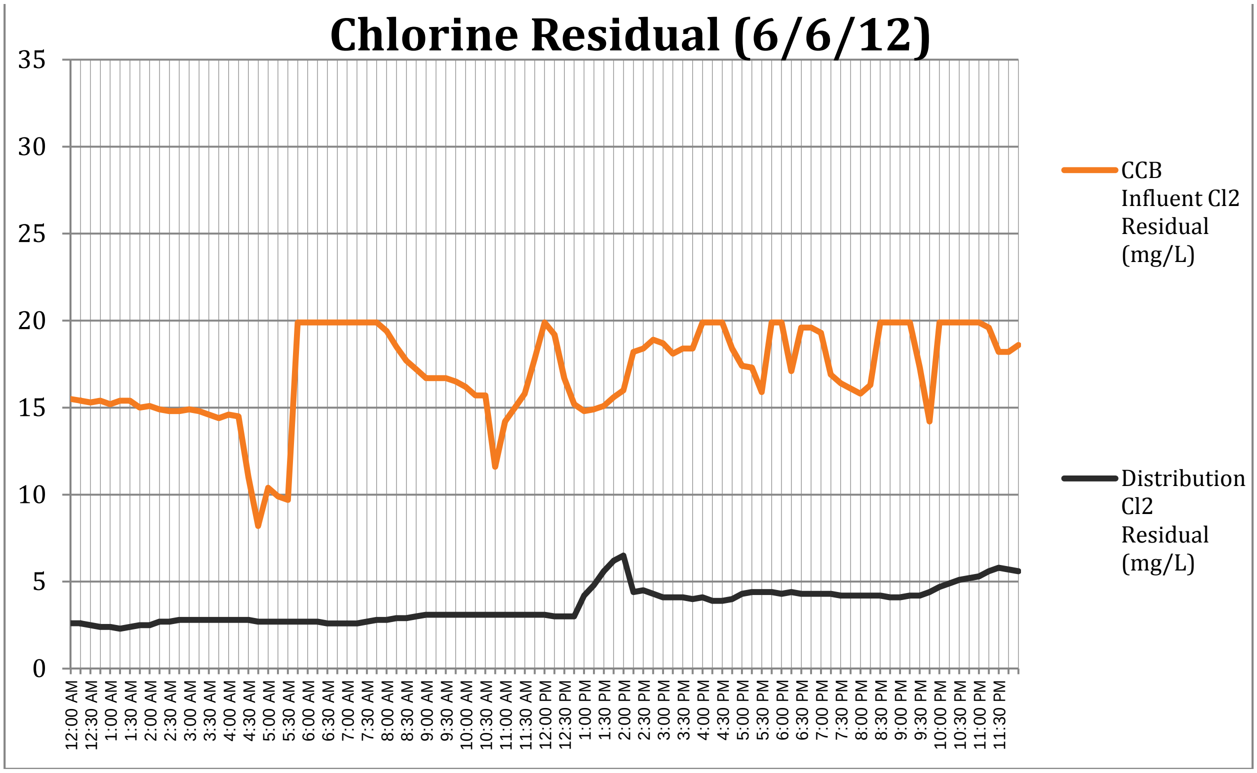

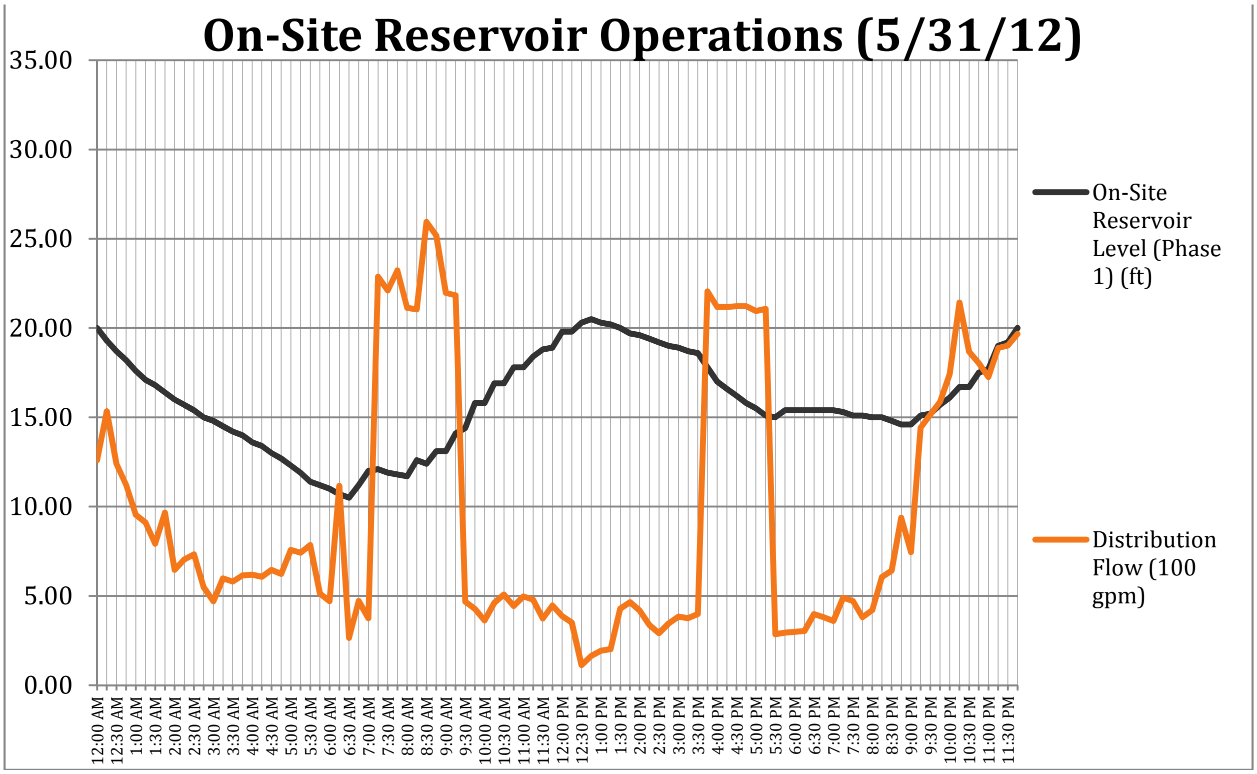
On-Site Reservoir Operations (5/31/12)
35.00
30.00
25.00
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On-Site Reservoir Level (Phase 1) (ft)
Distribution Flow (100 gpm)
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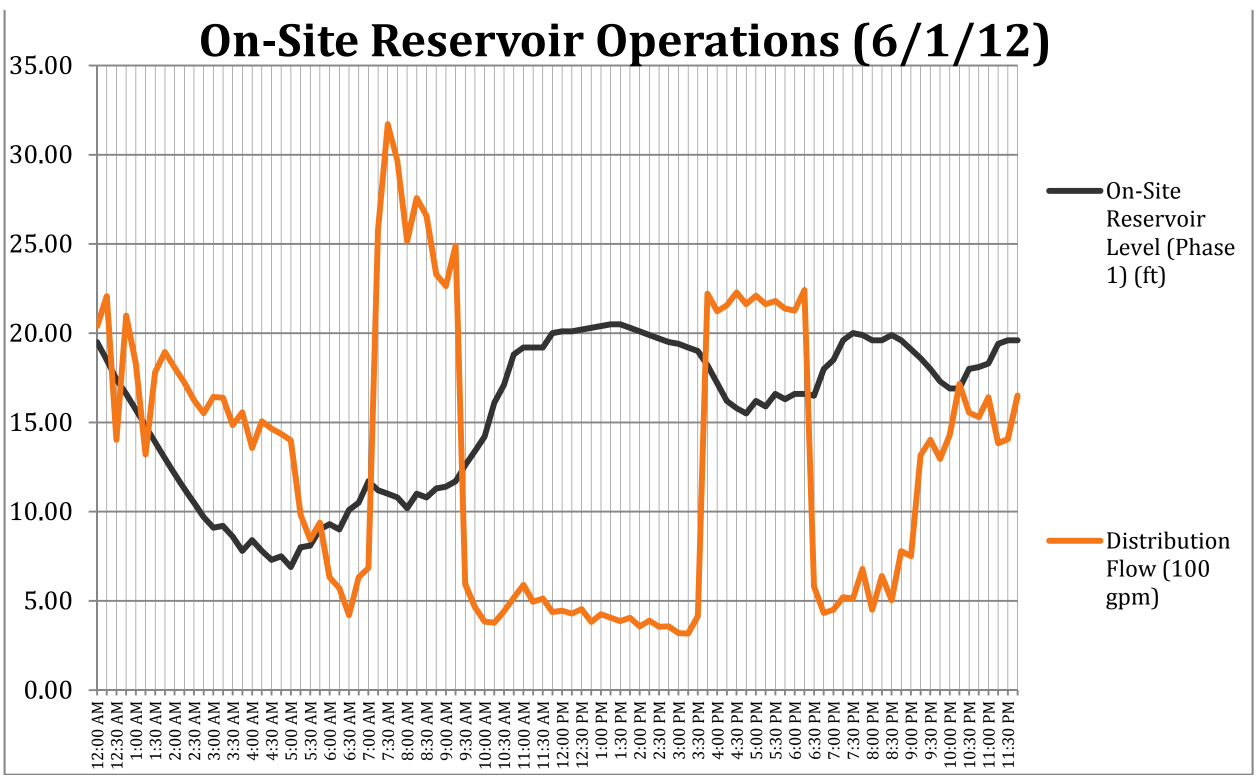
On-Site Reservoir Operations (6/1/12)
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On-Site Reservoir Level (Phase 1) (ft)
Distribution Flow (100 gpm)
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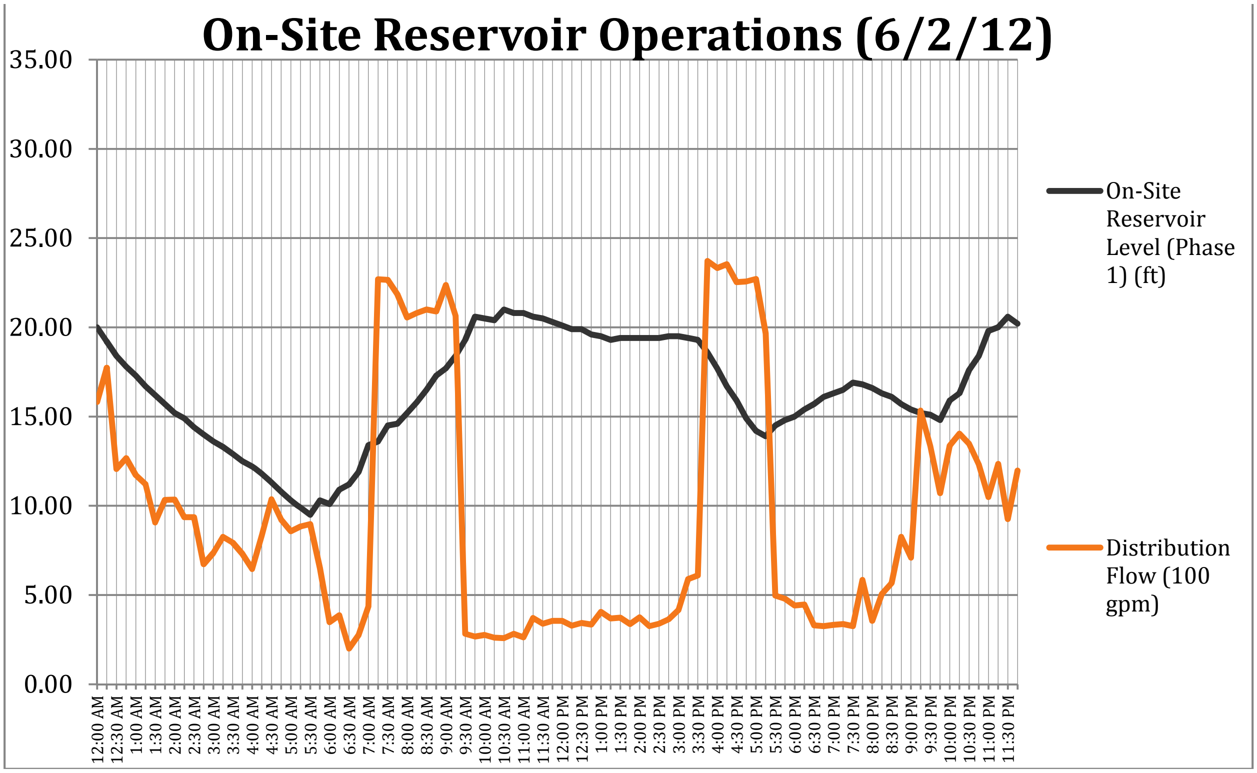
On-Site Reservoir Operations (6/2/12)
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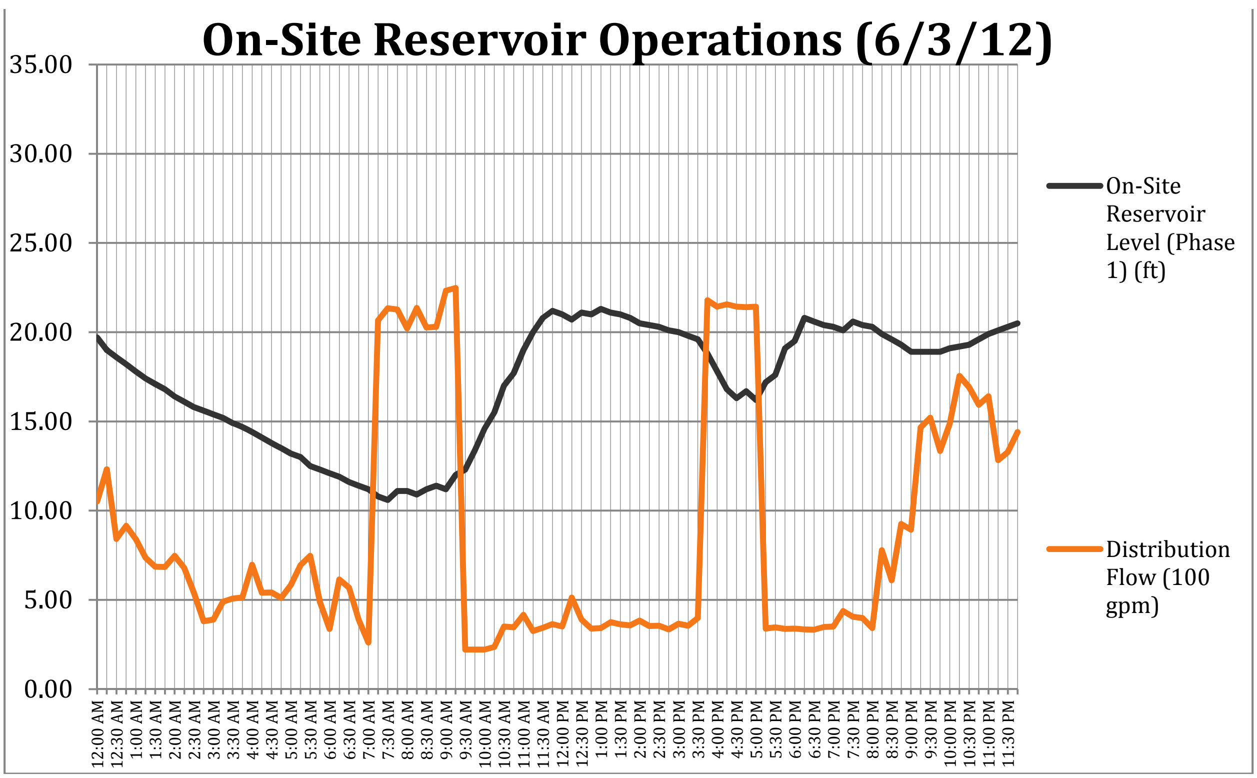
On-Site Reservoir Level (Phase 1) (ft)
Distribution Flow (100 gpm)


On-Site Reservoir Operations (6/3/12)
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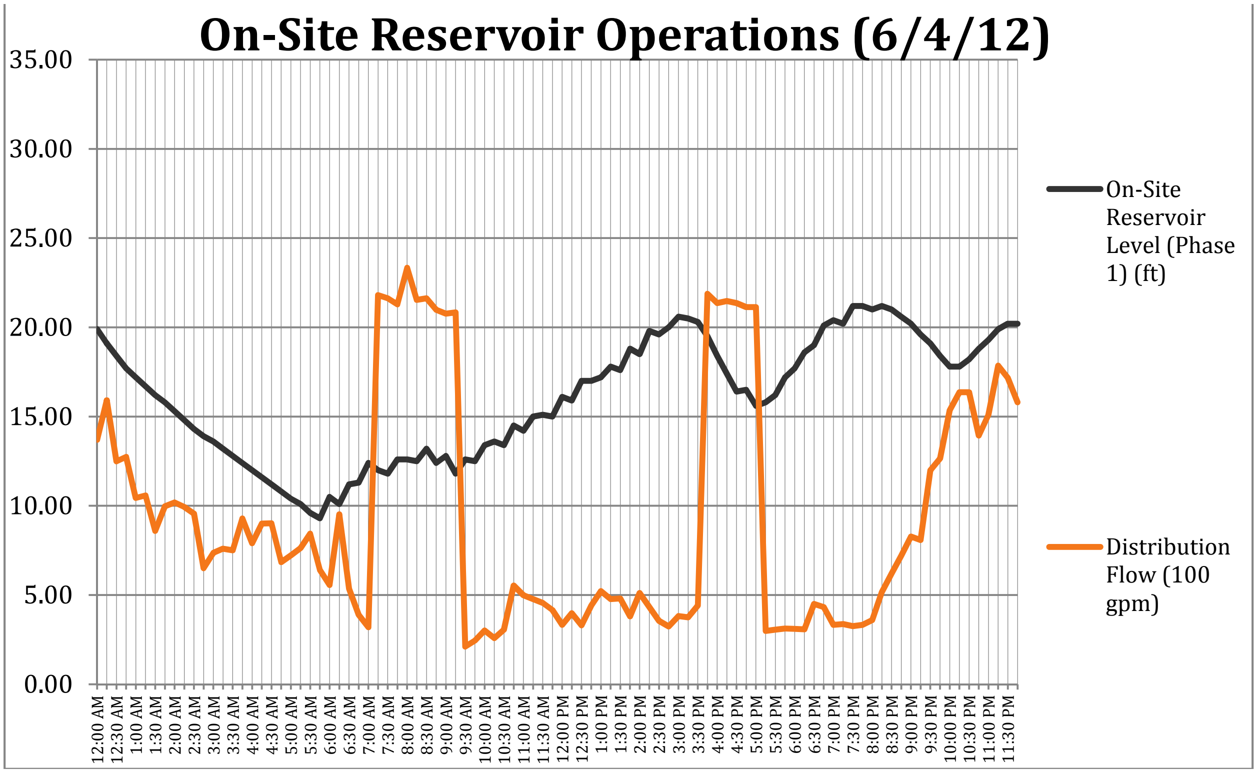
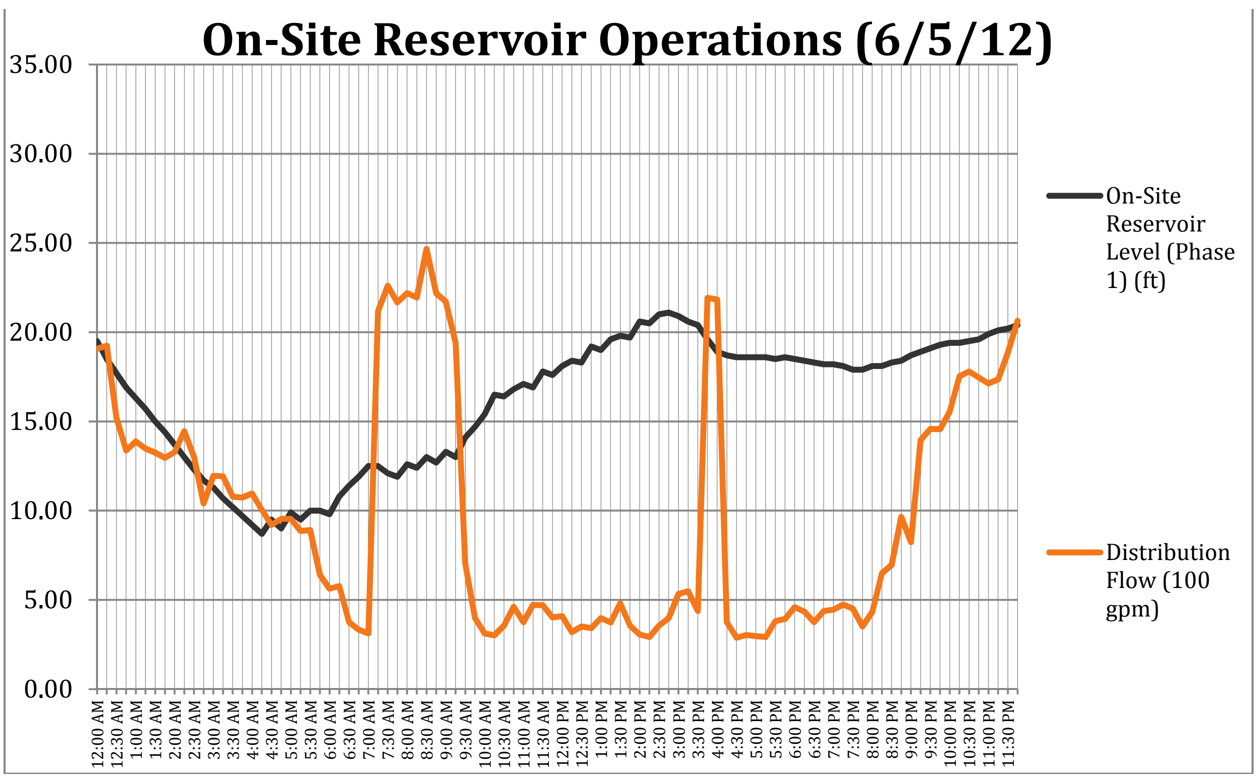
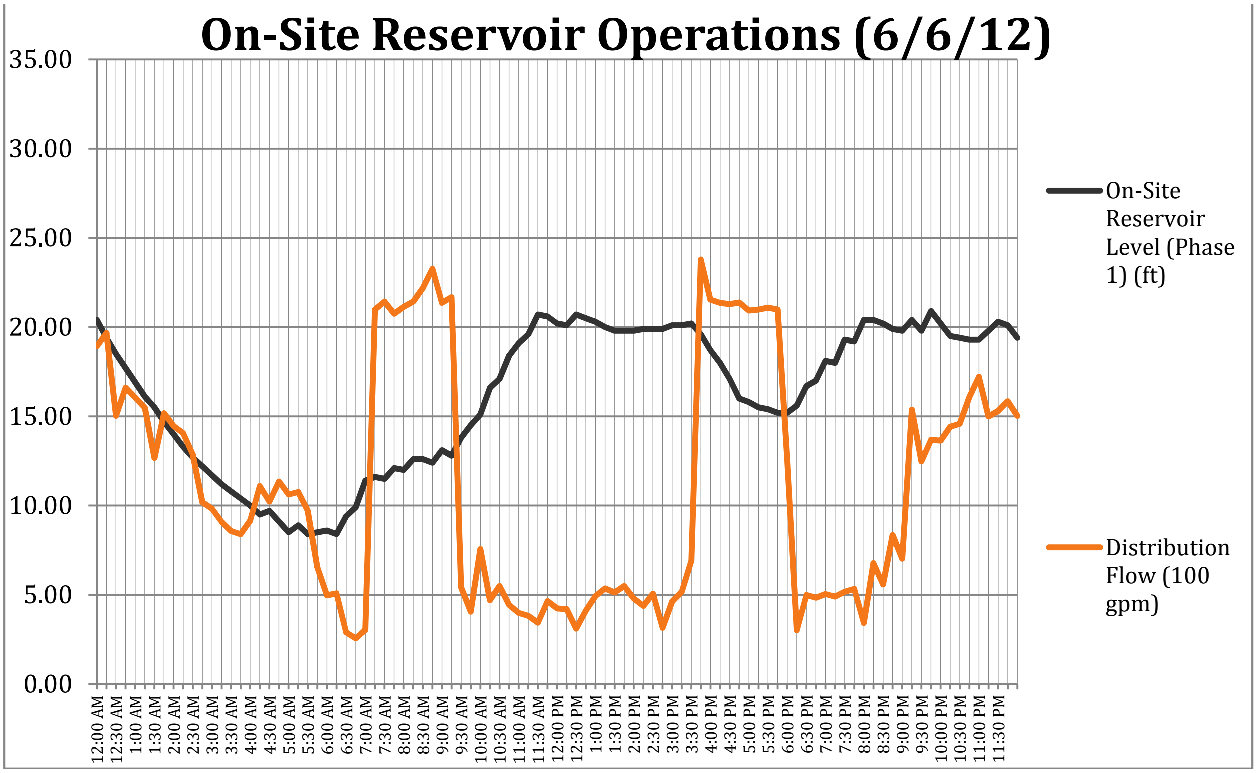
On-Site Reservoir Level (Phase 1) (ft)
Distribution Flow (100 gpm)

Attachment C






On-Site Reservoir Operations (6/6/12)
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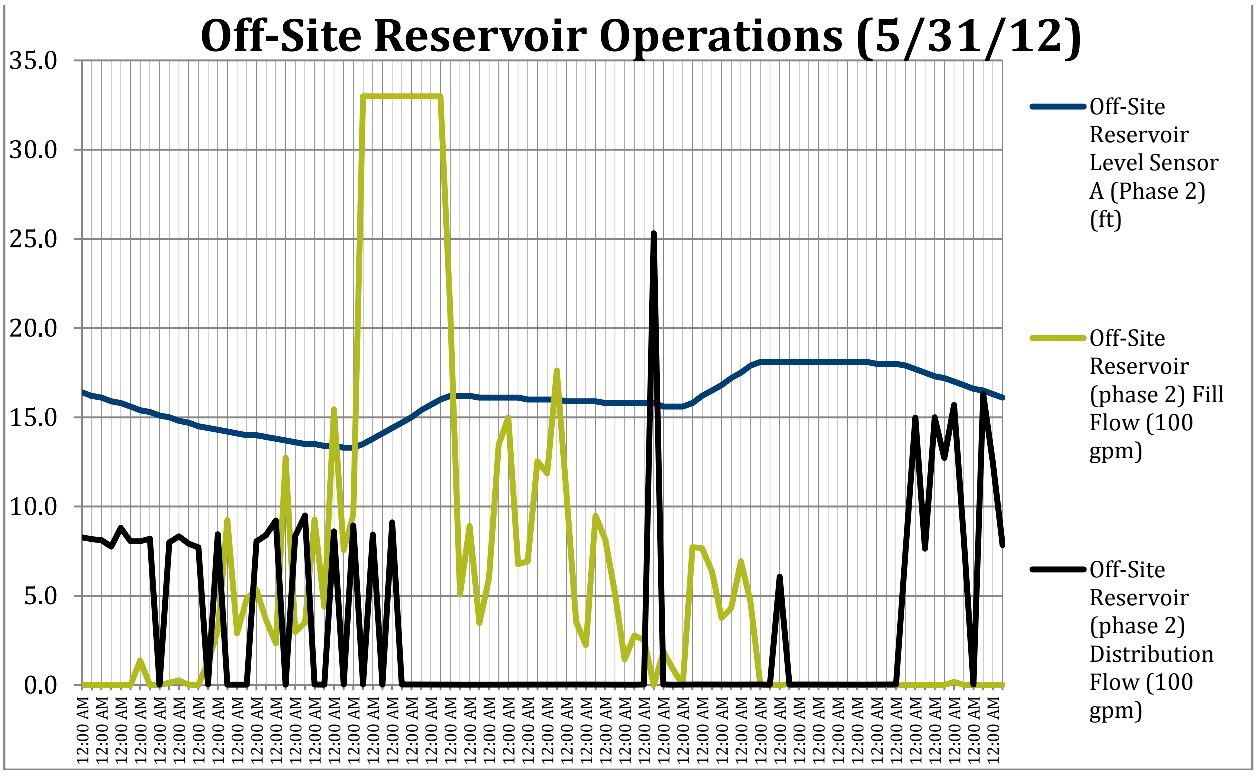
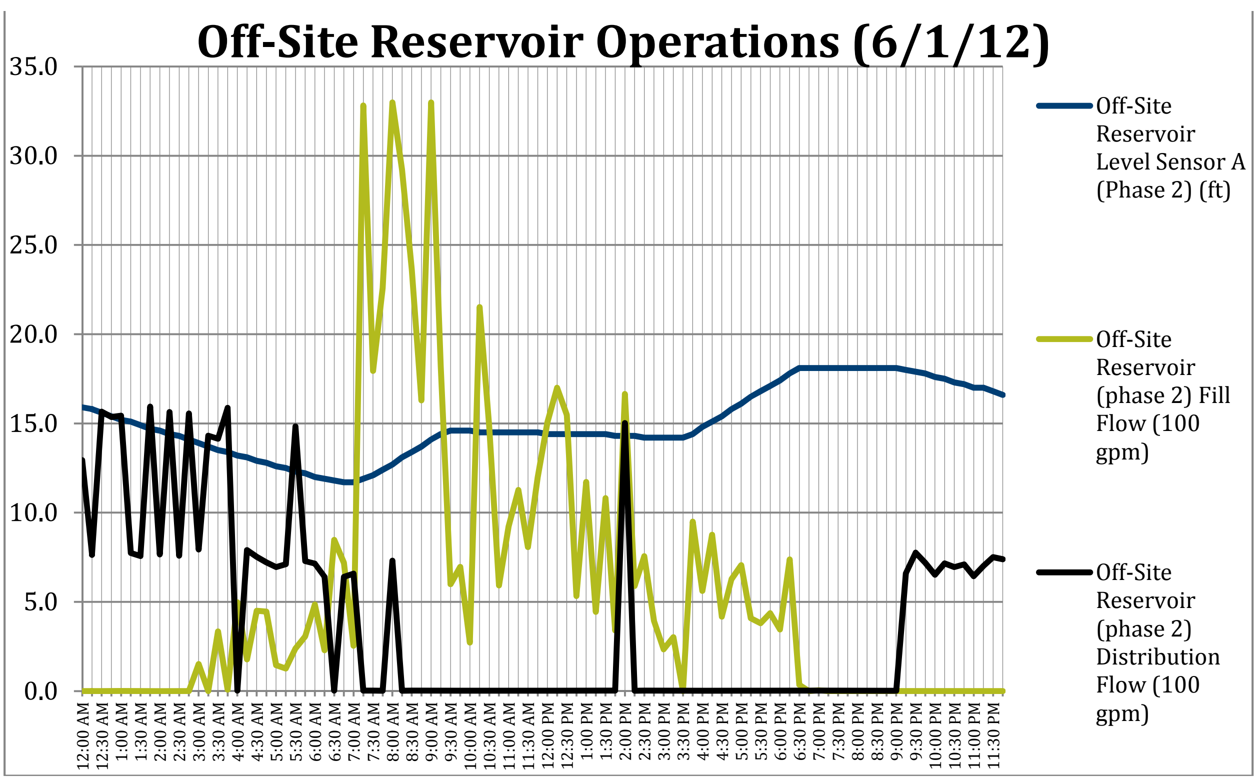
On-Site Reservoir Level (Phase 1) (ft)
Distribution Flow (100 gpm)


Off-Site Reservoir Operations (5/31/12)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
12:00 AM
Off-Site Reservoir Level Sensor A (Phase 2) (ft)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


Off-Site Reservoir Operations (6/1/12)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
12:00 AM
12:30 AM
1:00 AM
1:30 AM
2:00 AM
2:30 AM
3:00 AM
3:30 AM
4:00 AM
4:30 AM
5:00 AM
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
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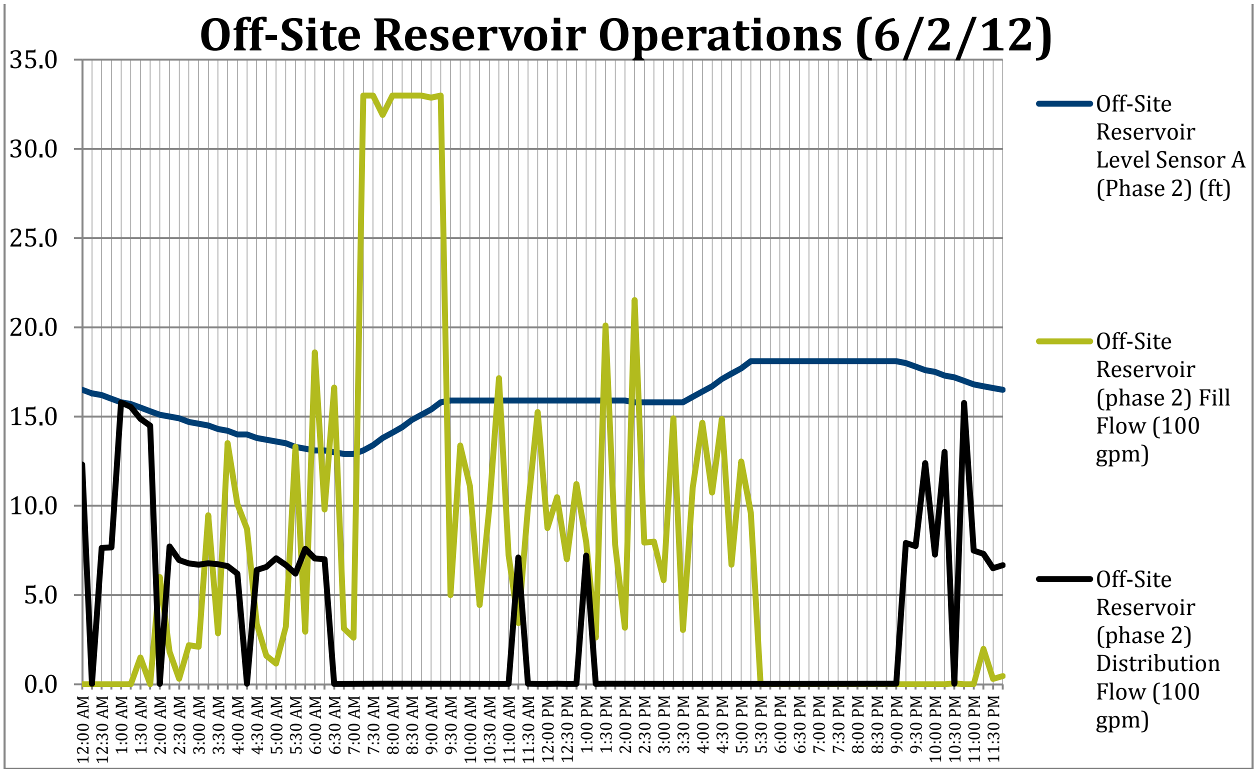
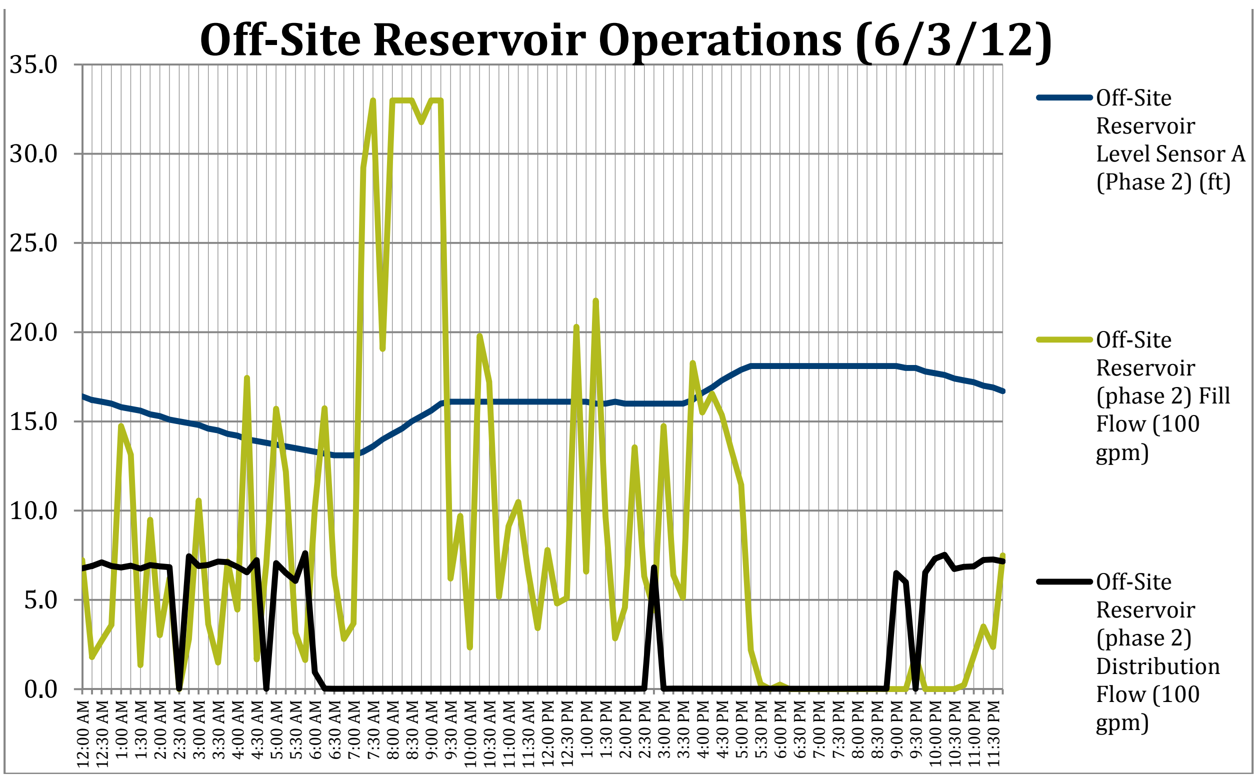
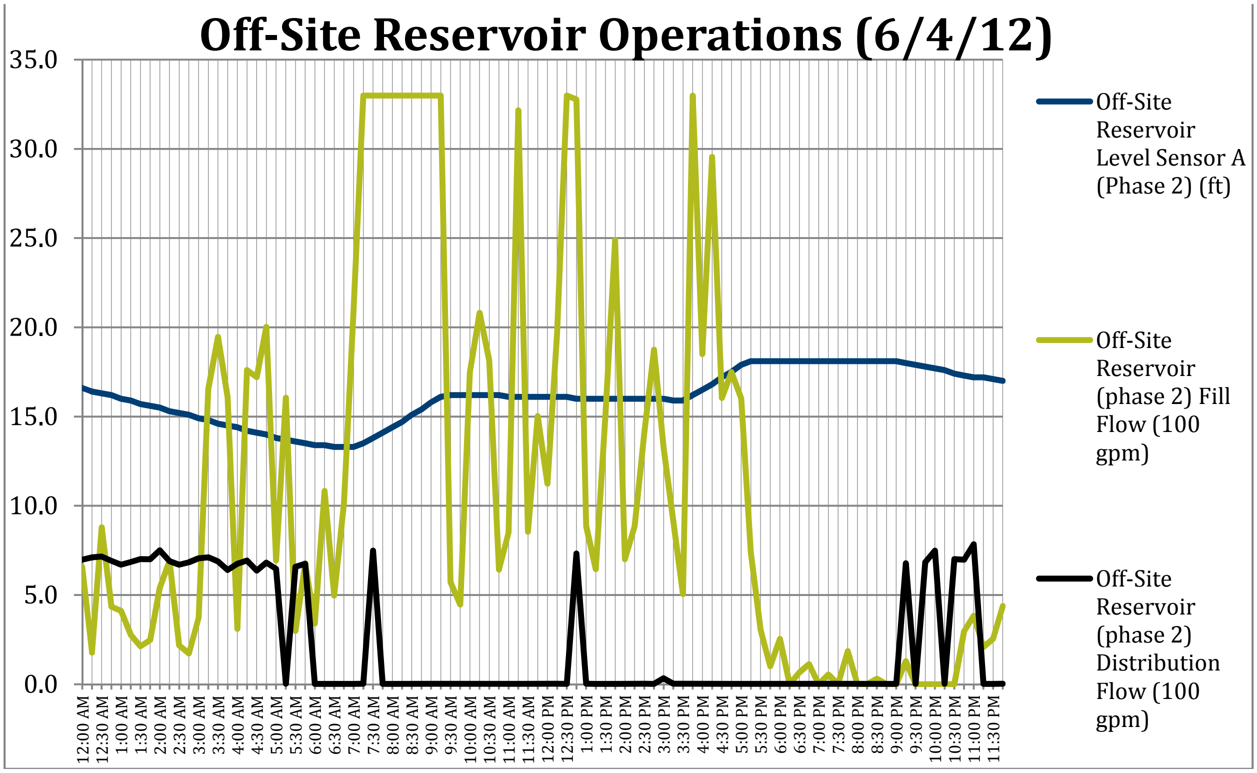
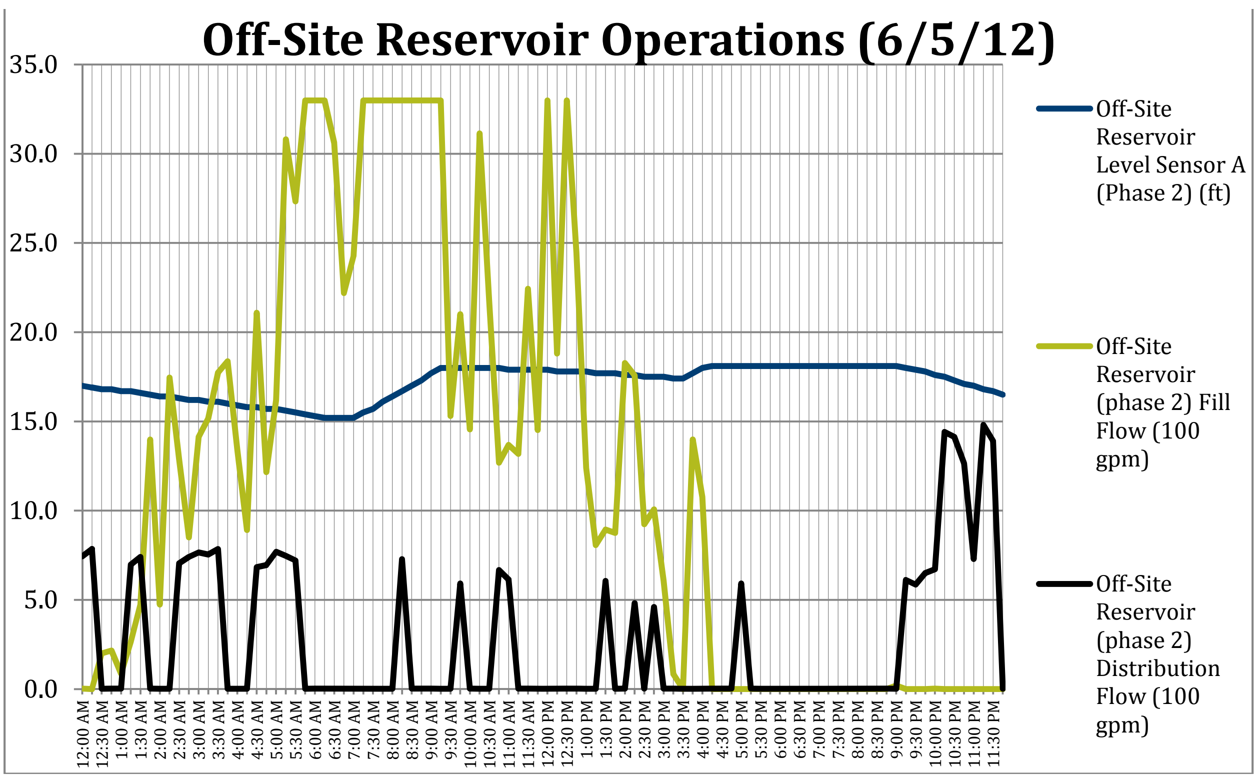
4:30 PM
5:00 PM
5:30 PM
6:00 PM
6:30 PM
7:00 PM
7:30 PM
8:00 PM
8:30 PM
9:00 PM
9:30 PM
10:00 PM
10:30 PM
11:00 PM
11:30 PM
Off-Site Reservoir Level Sensor A (Phase 2) (ft)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


Off-Site Reservoir Operations (6/2/12)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
12:00 AM
11:30 PM
Off-Site Reservoir Level Sensor A (Phase 2) (ft)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)


Off-Site Reservoir Operations (6/3/12)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
12:00 AM
11:30 PM
Off-Site Reservoir Level Sensor A (Phase 2) (ft)
Off-Site Reservoir (phase 2) Fill Flow (100 gpm)
Off-Site Reservoir (phase 2) Distribution Flow (100 gpm)

Attachment C





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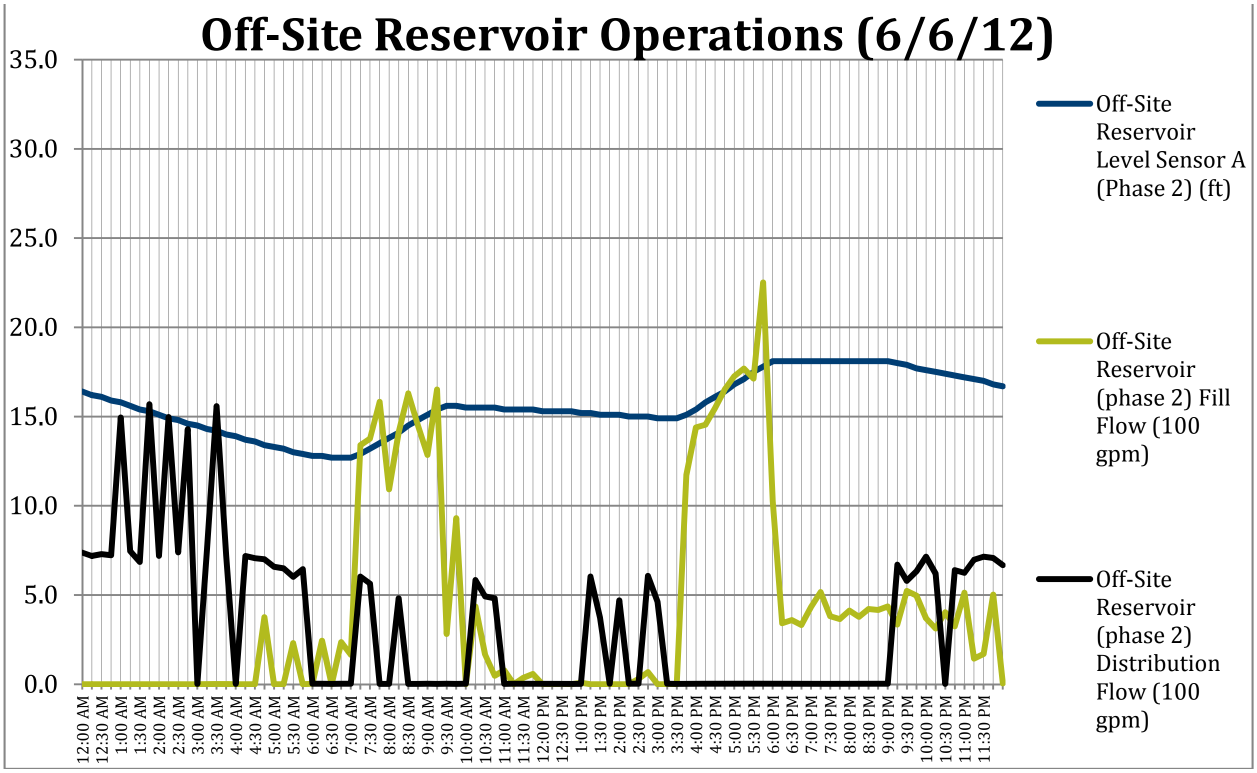
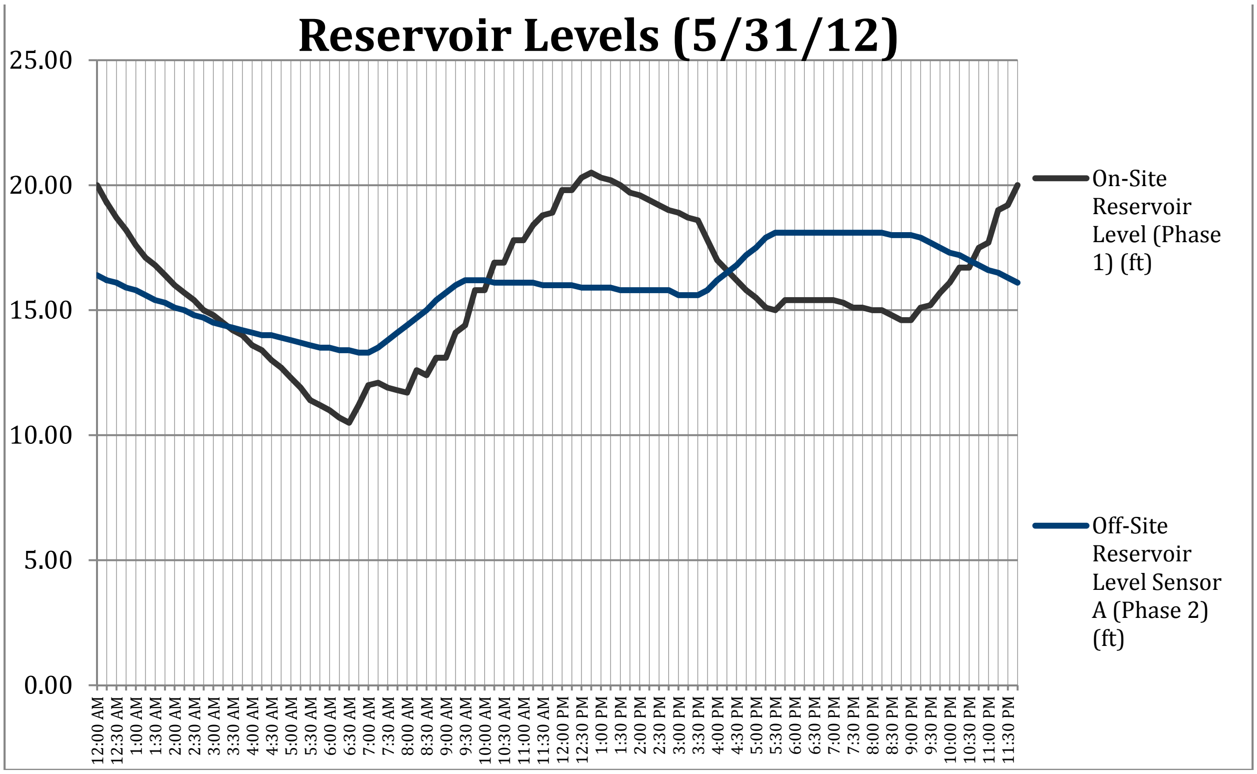
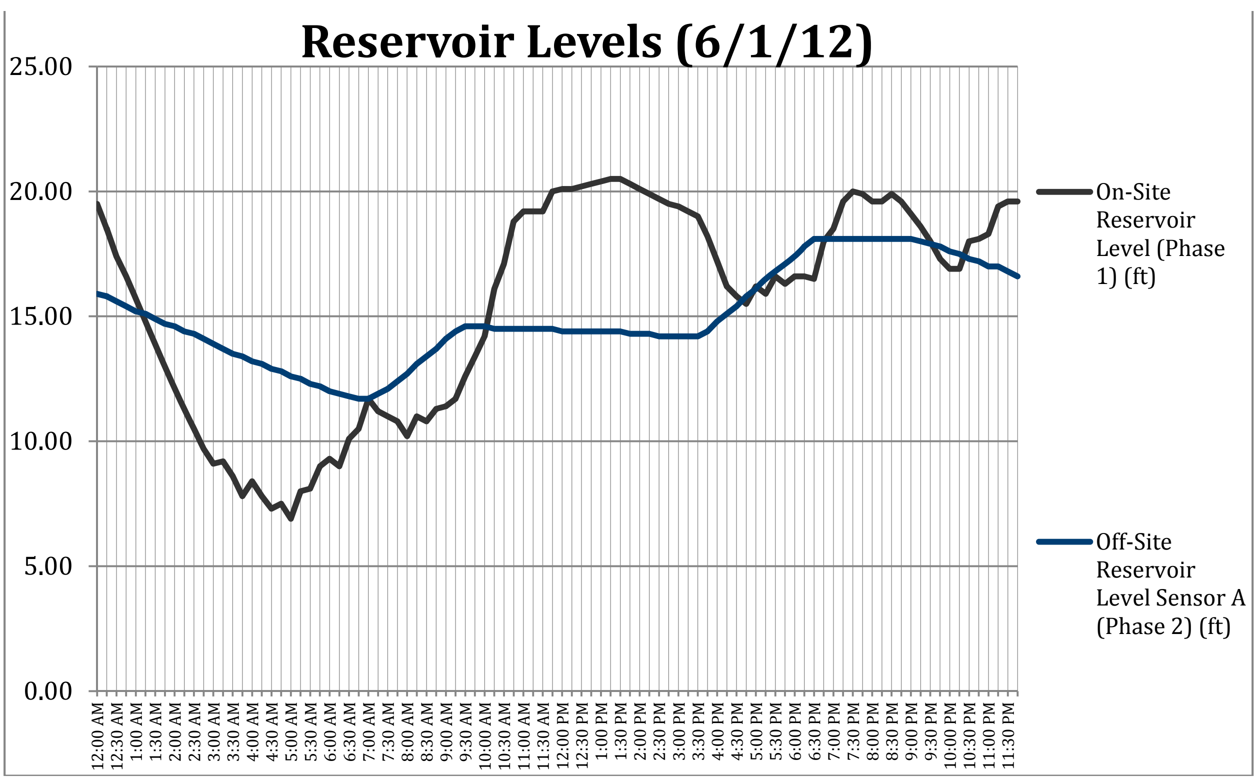


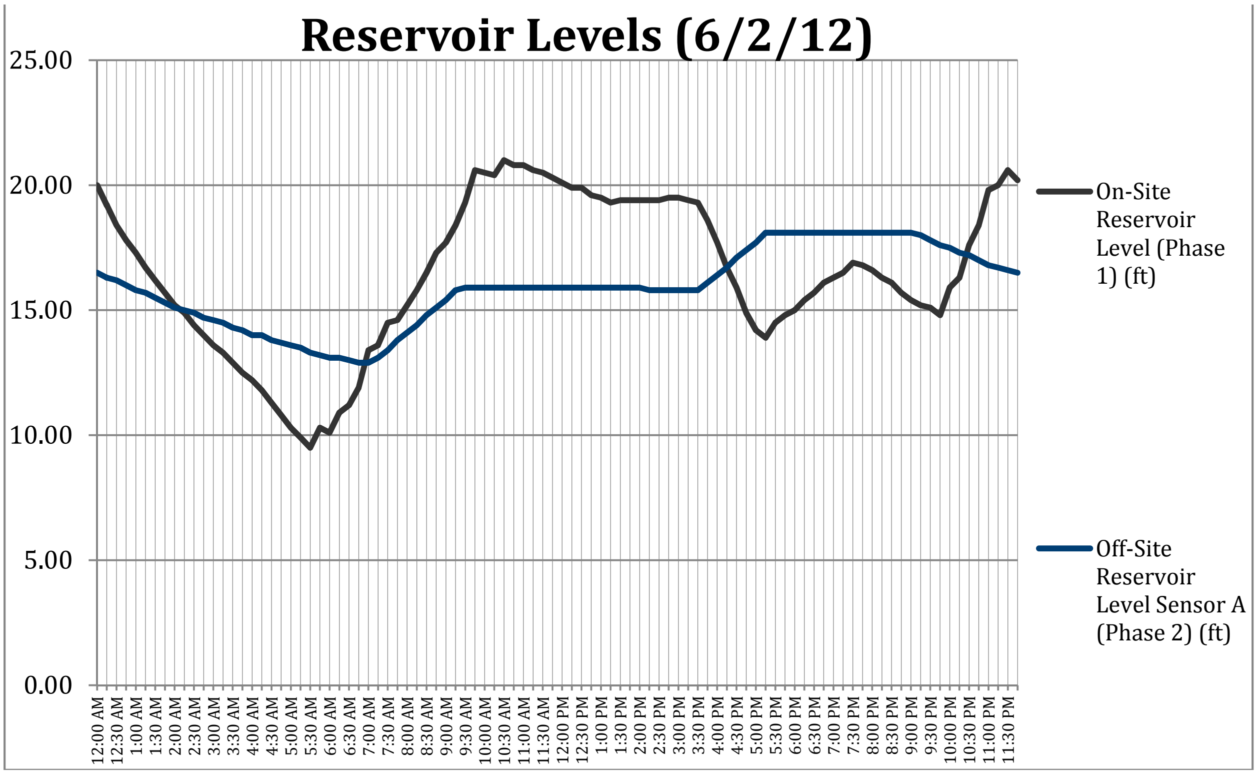


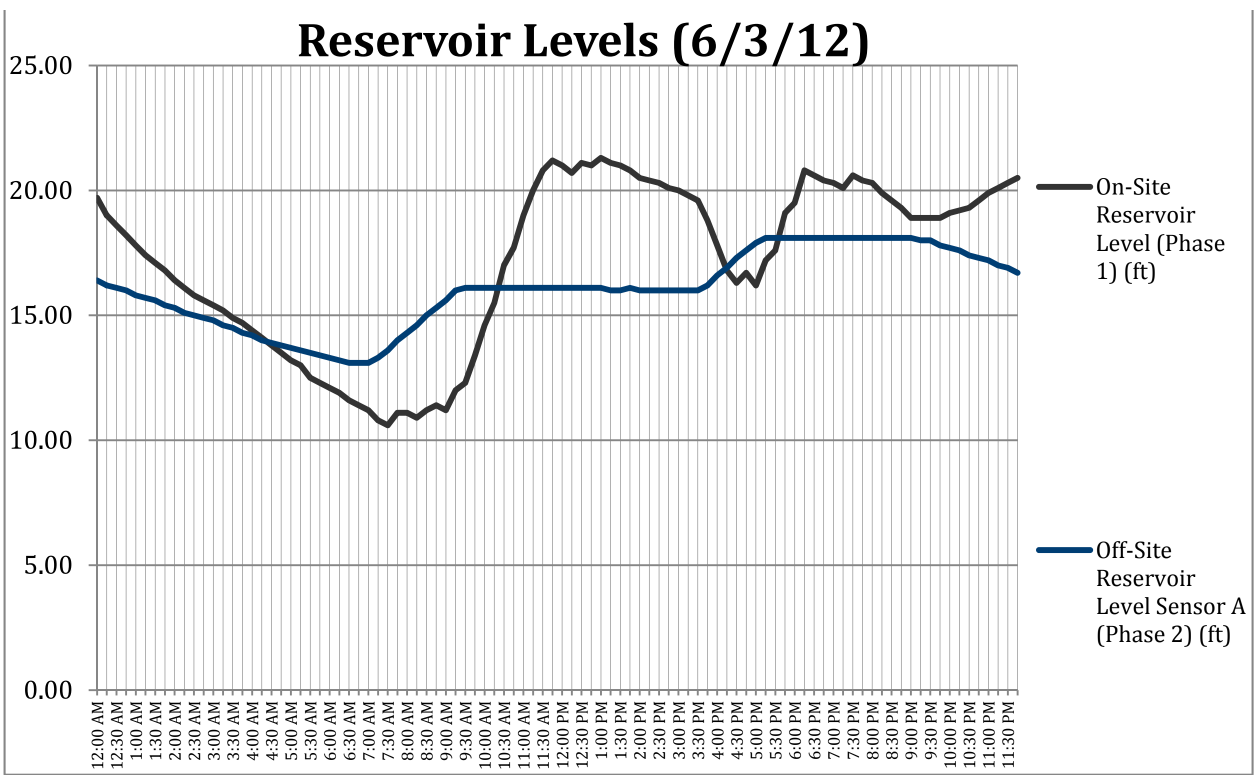
Reservoir Levels (5/31/12)
25.00
20.00
15.00
10.00
5.00
0.00
12:00 AM
11:30 PM
On-Site Reservoir Level (Phase 1) (ft)
Off-Site Reservoir Level Sensor A (Phase 2) (ft)



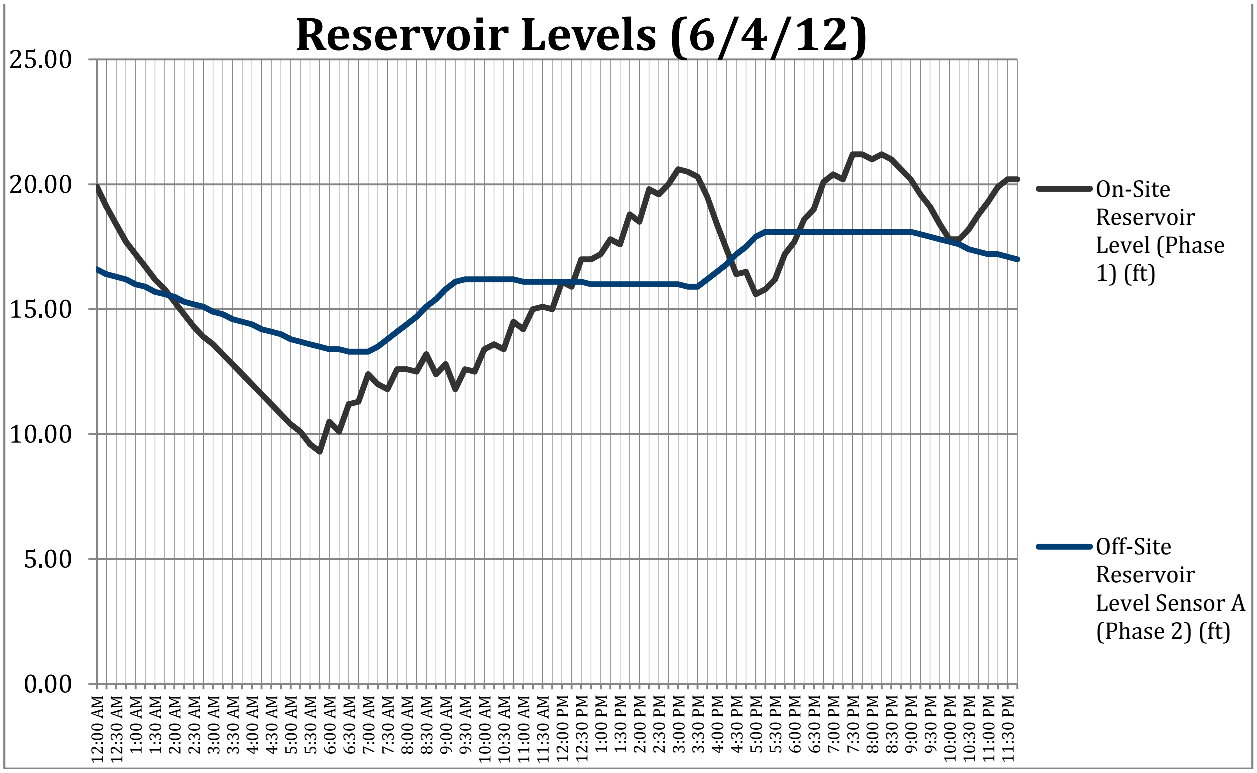
Reservoir Levels (6/1/12)
25.00
20.00
15.00
10.00
5.00
0.00
12:00 AM
11:30 PM
On-Site Reservoir Level (Phase 1) (ft)
Off-Site Reservoir Level Sensor A (Phase 2) (ft)

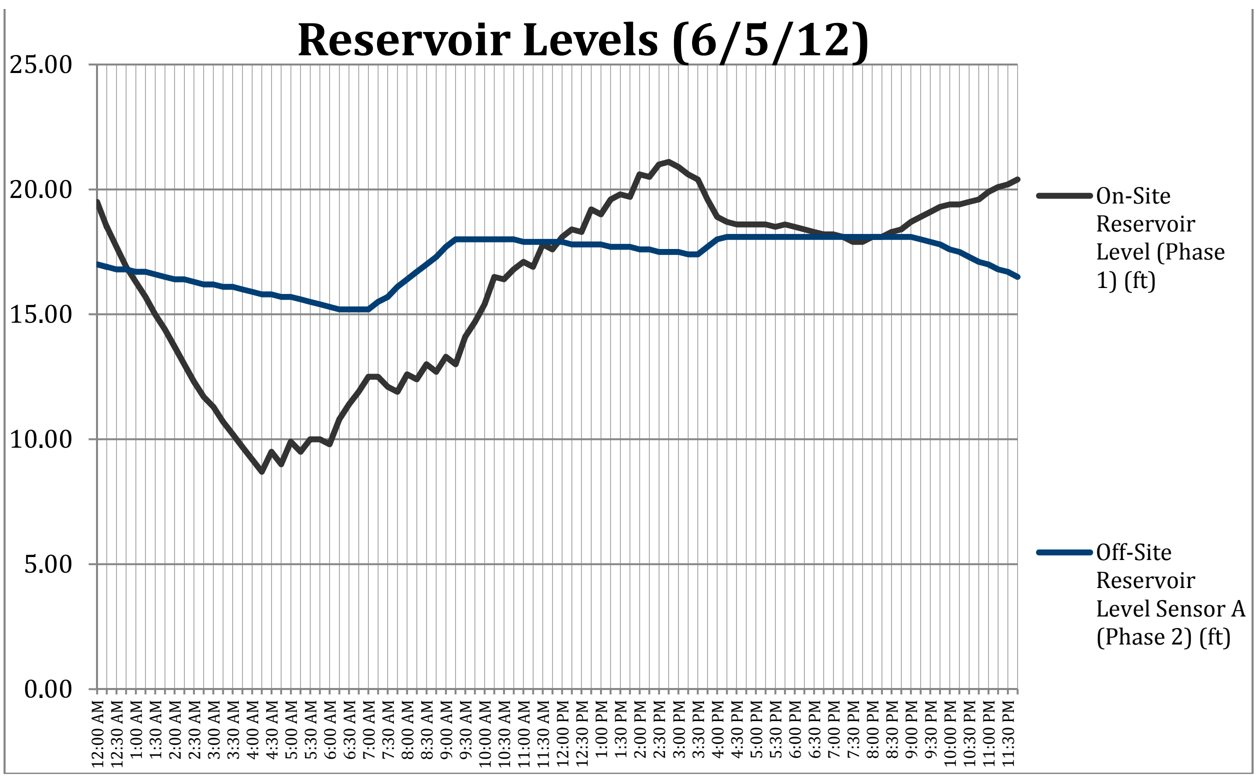
Attachment C



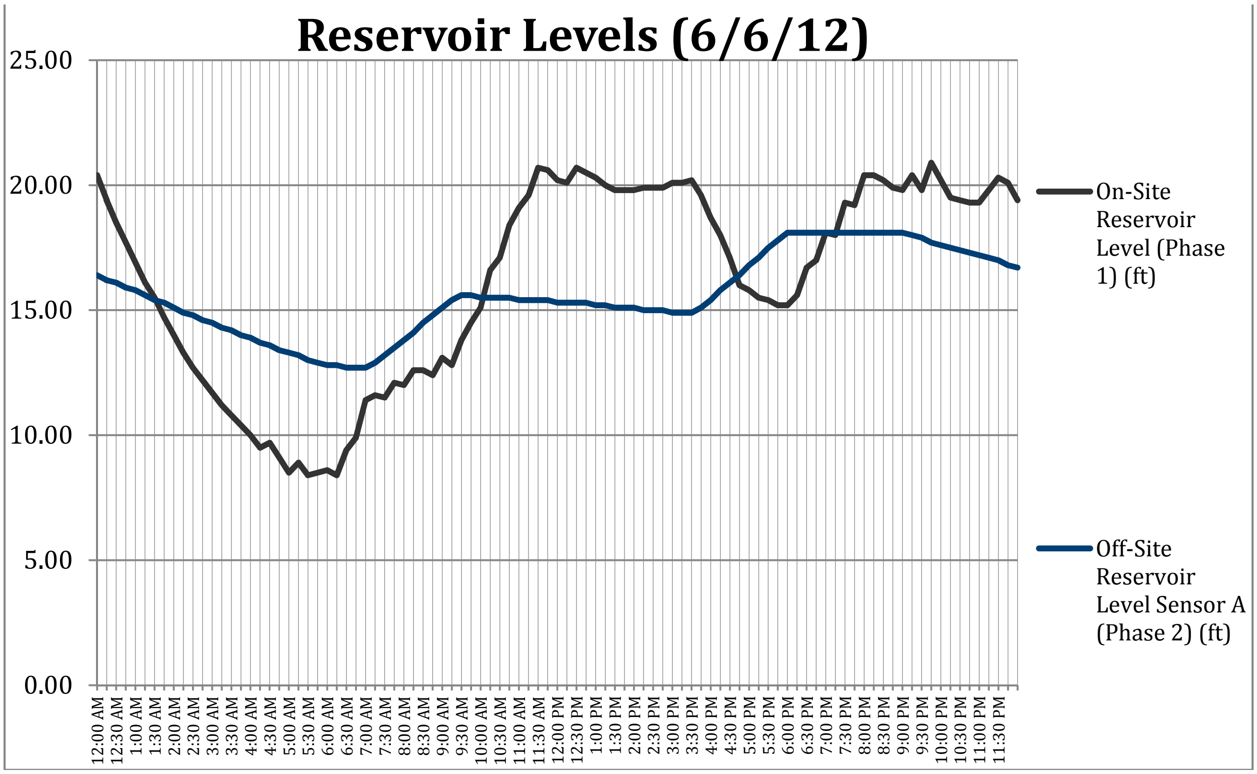


Attachment C





Attachment C



Appendix C

Supplemental Design Information

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Appendix C-1: Process Design Calculations

- MF System Design Criteria
- UF System Design Criteria
- On-Site Recycled Water Storage Tank Sizing
- Chemical Systems Design Criteria
- Chemical Material Safety Data Sheets
  - Aqueous Ammonia
  - Sodium Hypochlorite
  - Citric Acid
  - Sodium Hydroxide (Caustic Soda)

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MF System Design Criteria

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Client: **Santa Barbara**		Job No.: **120499-90670**		Computed By: **E. You**	
Project: **El Estero WWTP Tertiary Filtration Facility**		Checked By: **J. Yoshimura**		Date: **7/9/2012**	
Detail: **MF System Design Criteria**		Date Checked: **11/19/2012**			
3 Skids					

MF System				
MF Influent Flow	3,222,342	gpd	2,238	gpm
MF Influent Pressure	50 to 70	psi		
Overall MF System Recovery, Minimum	93%			
MF Filtrate Flow	3,000,000	gpd	2,083	gpm
MF Feed Pump				
No. of Duty Pumps	2			
No. of Standby Pumps	1			
Flow per Pump	1,119	gpm		
Head	60	psi		
Motor bHP	39	hp		
Motor HP	40	hp		
VFD	Yes			
Strainer				
Type	Auto-Backwash Strainer			
No. of Units	2	units		
Flow Capacity per Unit	1,119	gpm		
Screen Pore Size, Minimum	300	microns		
Strainer Recovery, Minimum	98%			
MF Membrane				
MF Recovery, Minimum	95%			
Nominal Pore Size	0.10	micron		
Material	PVDF			
Type/Fiber Flow Path	Pressurized/Outside-In			
Membrane Area Per Module	538	sf	(Based on Asahi Membranes)	
ManMFacturer	Pall Corporation			
Model	Microza			
MF System Configuration				
No. of Duty Trains	2			
No. of Standby Trains	1			
MF Train				
Production Capacity per Train	1,000,000	gpd	694	gpm
Average Design Flux	20	gfd	(without CEBs)	
Max Instantaneous Flux	30	gfd		
Required Membrane Area per Train	50,000	sf		
Required No. of Membrane Elements per Train	93			
Total No. of Installed Membranes	88			
Spare Space	15%			
Total No. of Membrane Space	101			
Operating Flux				
Online Factor	89%			
Average Flux	21	gfd		
Maximum Instantaneous Flux	25	gfd		
Maximum Instantaneous Flux with 1 Skid Offline	37	gfd		

Client: **Santa Barbara**		Job No.: **120499-90670**	Computed By: **E. You**
Project: **El Estero WWTP Tertiary Filtration Facility**		Checked By: **J. Yoshimura**	Date: **7/9/2012**
Detail: **MF System Design Criteria**		Date Checked: **11/19/2012**	Page No.: **2 of 3**
3 Skids			

Operating Conditions

Filtration				
	Instantaneous Flux, Maximum	37	gfd	
	Filtration Duration	30	min	
Backwash				
	Backwash Interval	34	minutes	
	Air Scour/Reverse Filtration (AS/RF) Flo	704	gpm	(based on 8 gpm per module)
	AS/RF Duration	1.00	minutes	
	Reverse Filtration (RF) Flow Rate	1,584	gpm	(based on 18 gpm per module)
	RF Duration	0.33	minutes	
	Total Backwash Cycle Duration (incl. backwash, air scour, drain, refill, etc.)	3.58	minutes	
CIP				
	CIP Interval, Minimum	30	days	
	CIP Duration, Maximum	8	hours	

Calculated Recovery

Total Filtered Water	3,157,895	gpd
Total Backwash Water	158,479	gpd
Actual Recovery	95%	

MF Filtrate Tank

No. of Duty Tanks	1	
Type of Tank	HDPE or FRP	
Nominal Capacity per Tank	12,000	gallons
Tank Diameter, Maximum	12	ft
Tank Sideshell Height, Minimum	16.5	ft
Residence Time at Design Flow	5.8	minutes

MF Backwash Pump

No. of Duty Pumps	1	
No. of Standby Pumps	1	
Flow per Pump	1,584	gpm
Head	50	psi
Motor bHP	46	hp
Motor HP	50	hp
VFD	Yes	

Client:	**Santa Barbara**	Job No.:	**120499-90670**	Computed By:	**E. You**
Project:	**El Estero WWTP Tertiary Filtration Facility**	Checked By:	**J. Yoshimura**	Date:	**7/9/2012**
Detail:	**MF System Design Criteria**	Date Checked:	**11/19/2012**	Page No.:	**3 of 3**
	3 Skids				

CIP Tank Sizing

Required Capacity for MF CIP =	1,584	gal	(Assumed 3 Volumes (1V for batch chemical solution + 2V for rinse cycles))
Required Capacity for RO Flush =	846	gal	
Required Capacity for RO CIP =	1,692	gal	
Required CIP Tank Usable Volume =	1,700	gal	
Diameter =	7.00	ft	
Area =	38	ft^2	
Usable Height =	5.90	ft	
Freeboard (above LSHH) =	0.50	ft	
Min Level (below LSLL) =	0.50	ft	
Required Sideshell Height =	6.90	ft	
Required Nominal Volume =	2,000	gal	

CIP Tank

No. of Duty Tanks	2	
Type of Tank	HDPE or FRP	
Heater	Yes	
Nominal Capacity per Tank	2,000	gallons
Tank Diameter, Maximum	7	ft
Tank Sideshell Height, Minimum	7.0	ft

CIP Pump

No. of Duty Pumps	1	
No. of Standby Pumps	1	
Flow per Pump	704	gpm
Head	50	psi
Motor bHP	21	hp
Motor HP	25	hp
VFD	Yes	

UF System Design Criteria

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Client: **Santa Barbara**		Job No.: **120499-90670**		Computed By: **E. You**
Project: **El Estero WWTP Tertiary Filtration Facility**		Checked By: **J. Yoshimura**		Date: **7/9/2012**
Detail: **UF System Design Criteria**		Date Checked: **11/19/2012**		Page No.: **1 of 3**
3 Skids				

UF System				
UF Influent Flow	3,222,342	gpd	2,238	gpm
UF Influent Pressure	50 to 70	psi		
Overall UF System Recovery, Minimum	93%			
UF Filtrate Flow	3,000,000	gpd	2,083	gpm
UF Feed Pump				
No. of Duty Pumps	2			
No. of Standby Pumps	1			
Flow per Pump	1,119	gpm		
Head	60	psi		
Motor bHP	39	hp		
Motor HP	40	hp		
VFD	Yes			
Strainer				
Type	Auto-Backwash Strainer			
No. of Units	2	units		
Flow Capacity per Unit	1,119	gpm		
Screen Pore Size, Minimum	300	microns		
Strainer Recovery, Minimum	98%			
UF Membrane				
UF Recovery, Minimum	95%			
Nominal Pore Size	0.02	micron		
Material	PVDF			
Type/Fiber Flow Path	Pressurized/Outside-In			
Membrane Area Per Module	775	sf	(Based on Toray Membranes)	
Manufacturer	Toray			
Model	HFS-2020			
UF System Configuration				
No. of Duty Trains	2			
No. of Standby Trains	1			
UF Train				
Production Capacity per Train	1,000,000	gpd	694	gpm
Average Design Flux	20	gfd	(without CEBs)	
Max Instantaneous Flux	30	gfd		
Required Membrane Area per Train	50,000	sf		
Required No. of Membrane Elements per Train	65			
Total No. of Installed Membranes	62			
Spare Space	15%			
Total No. of Membrane Space	71			
Operating Flux				
Online Factor	88%			
Average Flux	21	gfd		
Maximum Instantaneous Flux	25	gfd		
Maximum Instantaneous Flux with 1 Skid Offline	37	gfd		

3 Skids

Operating Conditions

Filtration			
	Instantaneous Flux, Maximum	37	gfd
	Filtration Duration	25	min
Backwash			
	Backwash Interval	28	minutes
	Reverse Filtration (RF) Flow Rate	1,042	gpm
	Backwash Flow Duration	1.00	minutes
	Total Backwash Cycle Duration	3.25	minutes
	(incl. backwash, air scour, drain, refill, etc.)		
CIP			
	CIP Interval, Minimum	30	days
	CIP Duration, Maximum	8	hours

Calculated Recovery

Total Filtered Water	3,157,895	gpd
Total Backwash Water	159,292	gpd
Actual Recovery	95%	

UF Filtrate Tank

No. of Duty Tanks	1	
Type of Tank	HDPE or FRP	
Nominal Capacity per Tank	12,000	gallons
Tank Diameter, Maximum	12	ft
Tank Sideshell Height, Minimum	16.5	ft
Residence Time at Design Flow	5.8	minutes

UF Backwash Pump

No. of Duty Pumps	1	
No. of Standby Pumps	1	
Flow per Pump	1,042	gpm
Head	50	psi
Motor bHP	30	hp
Motor HP	40	hp
VFD	Yes	

CIP Tank Sizing

Required Capacity for UF CIP =	3,125	gal	(Assumed 3 Volumes (1V for batch chemical solution + 2V for rinse cycles))
Required Capacity for RO Flush =	846	gal	
Required Capacity for RO CIP =	1,692	gal	
Required CIP Tank Usable Volume =	3,200	gal	
Diameter =	7.00	ft	
Area =	38	ft^2	
Usable Height =	11.11	ft	
Freeboard (above LSHH) =	0.50	ft	
Min Level (below LSLL) =	0.50	ft	
Required Sideshell Height =	12.11	ft	
Required Nominal Volume =	3,500	gal	

CIP Tank

No. of Duty Tanks	1	
Type of Tank	HDPE or FRP	
Heater	Yes	
Nominal Capacity per Tank	3,500	gallons
Tank Diameter, Maximum	7	ft
Tank Sideshell Height, Minimum	12.5	ft

CIP Pump

No. of Duty Pumps	1	
No. of Standby Pumps	1	
Flow per Pump	1,042	gpm
Head	50	psi
Motor bHP	30	hp
Motor HP	40	hp
VFD	Yes	

On-Site Recycled Water Storage Tank Sizing

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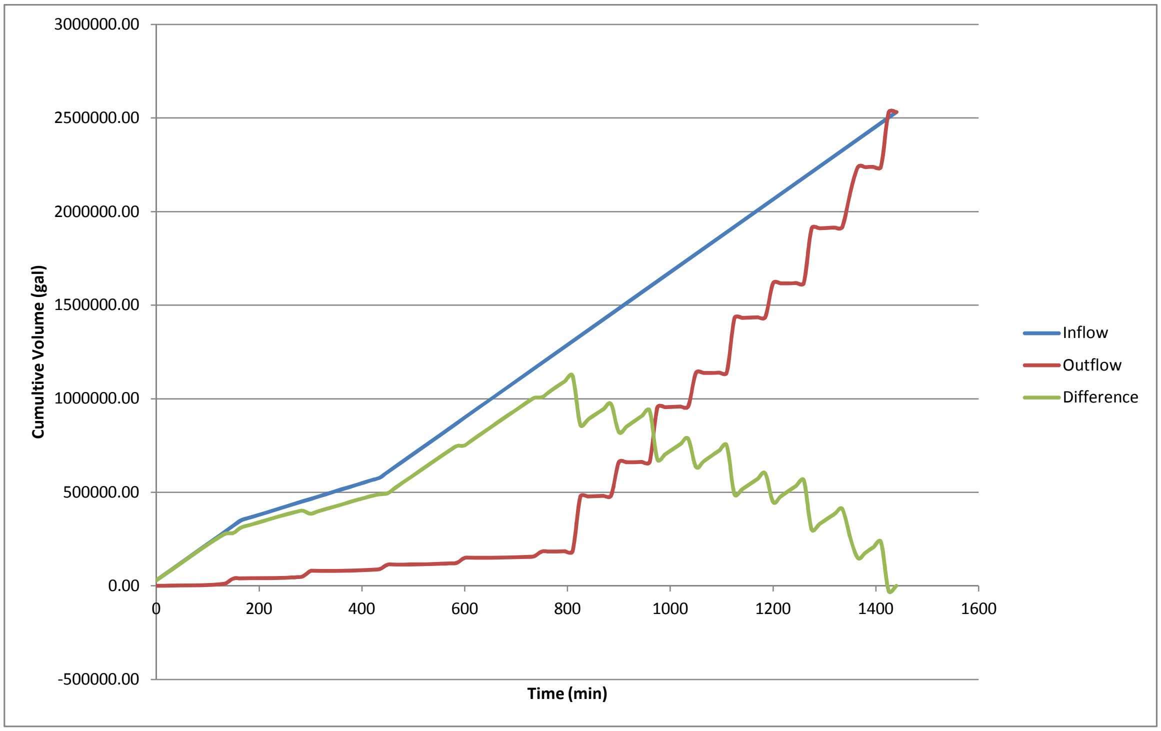
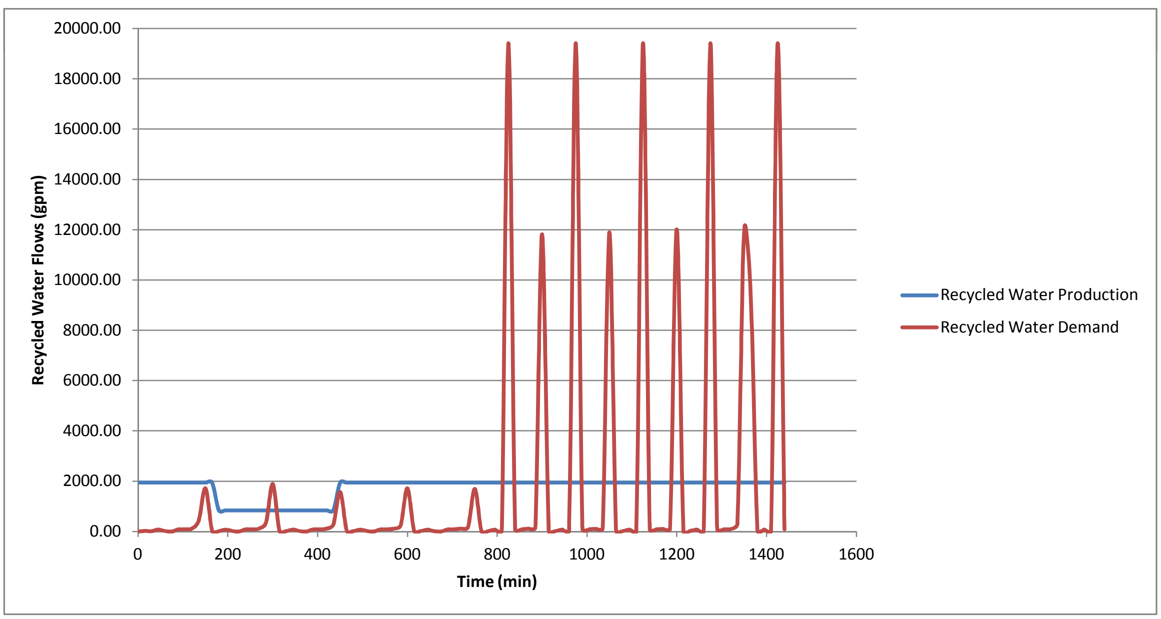
Client: **City of Santa Barbara**	Job No.: **120499-90670**	Computed By: **J. Yoshimura**
Project: **Tertiary Filtration Facility**	Date Checked:	Date: **10/15/2012**
Detail: **Recycled Water Storage**	Checked By:	Page No.: **1**

Cumulative Inflow	2,531,602	gal	
Cumulative Outflow	2,531,602	gal	
RW Storage Required	1,122,376	gal	Daily peak flows for 1 day





Distribution Storage Sizing

Time	Recycled Water Production Flow (gpm)	Distribution Flow (gpm)	Cumulative Inflow (gal)	Cumulative Outflow (gal)	Difference (gal)	Absolute Difference (gal)	Distribution Flow from SCADA (gpm)	Cumulative Volume (gal)	Target Values	Ratio	Adjusted Distribution Flow (gpm)
0	1943.89	0.00	29158.33	0.00	29158.33	29158.33	306.00	4590			0.00
15	1943.89	23.54	58316.67	353.08	57963.59	57963.59	4.00	60			23.54
30	1943.89	15.30	87475.00	582.58	86892.42	86892.42	2.60	99			15.30
45	1943.89	78.27	116633.33	1756.56	114876.77	114876.77	13.30	298.5			78.27
60	1943.89	19.42	145791.67	2047.88	143743.78	143743.78	3.30	348.0049505			19.42
75	1943.89	0.00	174950.00	2047.88	172902.12	172902.12	0.00	348.0049505			0.00
90	1943.89	84.23	204108.33	3311.37	200796.97	200796.97	14.31	562.7139214			84.23
105	1943.89	86.88	233266.67	4614.57	228652.09	228652.09	14.76	784.1735674			86.88
120	1943.89	118.28	262425.00	6388.79	256036.21	256036.21	20.10	1085.673567			118.28
135	1943.89	423.69	291583.33	12744.20	278839.14	278839.14	72.00	2165.673567			423.69
150	1943.89	1718.31	320741.67	38518.89	282222.77	282222.77	292.00	6545.673567			1718.31
165	1943.89	23.54	349900.00	38871.97	311028.03	311028.03	4.00	6605.673567			23.54
180	844.79	15.89	362571.88	39110.30	323461.58	323461.58	2.70	6646.173567			15.89
195	844.79	75.32	375243.75	40240.15	335003.60	335003.60	12.80	6838.173567			75.32
210	844.79	19.42	387915.63	40531.47	347384.16	347384.16	3.30	6887.678518			19.42
225	844.79	0.00	400587.50	40531.47	360056.03	360056.03	0.00	6887.678518			0.00
240	844.79	84.23	413259.38	41794.95	371464.42	371464.42	14.31	7102.387489			84.23
255	844.79	86.88	425931.25	43098.16	382833.09	382833.09	14.76	7323.847135			86.88
270	844.79	117.69	438603.13	44863.55	393739.57	393739.57	20.00	7623.847135			117.69
285	844.79	353.08	451275.00	50159.72	401115.28	401115.28	60.00	8523.847135			353.08
300	844.79	1888.97	463946.88	78494.23	385452.64	385452.64	321.00	13338.84713			1888.97
315	844.79	23.54	476618.75	78847.31	397771.44	397771.44	4.00	13398.84713			23.54
330	844.79	17.07	489290.63	79103.29	410187.33	410187.33	2.90	13442.34713			17.07
345	844.79	77.09	501962.50	80259.62	421702.88	421702.88	13.10	13638.84713			77.09
360	844.79	19.42	514634.38	80550.94	434083.43	434083.43	3.30	13688.35209			19.42
375	844.79	0.00	527306.25	80550.94	446755.31	446755.31	0.00	13688.35209			0.00
390	844.79	84.09	539978.13	81812.22	458165.90	458165.90	14.29	13902.68602			84.09
405	844.79	86.81	552650.00	83114.33	469535.67	469535.67	14.75	14123.95815			86.81
420	844.79	116.52	565321.88	84862.06	480459.81	480459.81	19.80	14420.95815			116.52
435	844.79	282.46	577993.75	89099.00	488894.75	488894.75	48.00	15140.95815			282.46
450	1943.89	1571.20	607152.08	112666.96	494485.13	494485.13	267.00	19145.95815			1571.20
465	1943.89	23.54	636310.42	113020.04	523290.38	523290.38	4.00	19205.95815			23.54
480	1943.89	18.24	665468.75	113293.67	552175.08	552175.08	3.10	19252.45815			18.24
495	1943.89	74.15	694627.08	114405.87	580221.22	580221.22	12.60	19441.45815			74.15
510	1943.89	19.42	723785.42	114697.19	609088.23	609088.23	3.30	19490.9631			19.42
525	1943.89	0.00	752943.75	114697.19	638246.56	638246.56	0.00	19490.9631			0.00
540	1943.89	84.16	782102.08	115959.57	666142.52	666142.52	14.30	19705.48455			84.16
555	1943.89	86.88	811260.42	117262.78	693997.64	693997.64	14.76	19926.94419			86.88
570	1943.89	115.93	840418.75	119001.68	721417.07	721417.07	19.70	20222.44419			115.93
585	1943.89	247.15	869577.08	122709.00	746868.08	746868.08	42.00	20852.44419			247.15
600	1943.89	1718.31	898735.42	148483.70	750251.72	750251.72	292.00	25232.44419			1718.31

Time	Recycled Water Production Flow (gpm)	Distribution Flow (gpm)	Cumulative Inflow (gal)	Cumulative Outflow (gal)	Difference (gal)	Absolute Difference (gal)	Distribution Flow from SCADA (gpm)	Cumulative Volume (gal)	Target Values	Ratio	Adjusted Distribution Flow (gpm)
615	1943.89	23.54	927893.75	148836.78	779056.97	779056.97	4.00	25292.44419			23.54
630	1943.89	18.83	957052.08	149119.24	807932.84	807932.84	3.20	25340.44419			18.83
645	1943.89	73.56	986210.42	150222.61	835987.81	835987.81	12.50	25527.94419			73.56
660	1943.89	9.71	1015368.75	150368.27	865000.48	865000.48	1.65	25552.69667			9.71
675	1943.89	0.00	1044527.08	150368.27	894158.81	894158.81	0.00	25552.69667			0.00
690	1943.89	84.09	1073685.42	151629.55	922055.87	922055.87	14.29	25767.0306			84.09
705	1943.89	86.81	1102843.75	152931.65	949912.10	949912.10	14.75	25988.30273			86.81
720	1943.89	115.34	1132002.08	154661.73	977340.35	977340.35	19.60	26282.30273			115.34
735	1943.89	176.54	1161160.42	157309.82	1003850.60	1003850.60	30.00	26732.30273			176.54
750	1943.89	1694.77	1190318.75	182731.44	1007587.31	1007587.31	288.00	31052.30273			1694.77
765	1943.89	11.77	1219477.08	182907.98	1036569.11	1036569.11	2.00	31082.30273			11.77
780	1943.89	18.83	1248635.42	183190.44	1065444.98	1065444.98	3.20	31130.30273			18.83
795	1943.89	72.97	1277793.75	184284.98	1093508.77	1093508.77	12.40	31316.30273			72.97
810	1943.89	19.42	1306952.08	184576.30	1122375.78	1122375.78	3.30	31365.80768			19.42
825	1943.89	19411.52	1336110.42	475749.16	860361.26	860361.26	3298.68	80846.0057			19411.52
840	1943.89	84.82	1365268.75	477021.47	888247.28	888247.28	14.41	81062.21482			84.82
855	1943.89	87.47	1394427.08	478333.51	916093.57	916093.57	14.86	81285.17462			87.47
870	1943.89	112.98	1423585.42	480028.28	943557.13	943557.13	19.20	81573.17462			112.98
885	1943.89	158.89	1452743.75	482411.56	970332.19	970332.19	27.00	81978.17462			158.89
900	1943.89	11816.35	1481902.08	659656.74	822245.34	822245.34	2008.00	112098.1746			11816.35
915	1943.89	23.54	1511060.42	660009.82	851050.60	851050.60	4.00	112158.1746			23.54
930	1943.89	19.42	1540218.75	660301.11	879917.64	879917.64	3.30	112207.6746			19.42
945	1943.89	76.50	1569377.08	661448.61	907928.47	907928.47	13.00	112402.6746			76.50
960	1943.89	29.13	1598535.42	661885.59	936649.83	936649.83	4.95	112476.932			29.13
975	1943.89	19411.52	1627693.75	953058.45	674635.30	674635.30	3298.68	161957.1301			19411.52
990	1943.89	86.59	1656852.08	954357.24	702494.84	702494.84	14.71	162177.8396			86.59
1005	1943.89	89.31	1686010.42	955696.87	730313.55	730313.55	15.18	162405.4874			89.31
1020	1943.89	106.51	1715168.75	957294.55	757874.20	757874.20	18.10	162676.9874			106.51
1035	1943.89	123.58	1744327.08	959148.21	785178.88	785178.88	21.00	162991.9874			123.58
1050	1943.89	11892.85	1773485.42	1137540.89	635944.53	635944.53	2021.00	193306.9874			11892.85
1065	1943.89	23.54	1802643.75	1137893.97	664749.78	664749.78	4.00	193366.9874			23.54
1080	1943.89	19.42	1831802.08	1138185.26	693616.83	693616.83	3.30	193416.4874			19.42
1095	1943.89	75.32	1860960.42	1139315.11	721645.31	721645.31	12.80	193608.4874			75.32
1110	1943.89	9.71	1890118.75	1139460.76	750657.99	750657.99	1.65	193633.2399			9.71
1125	1943.89	19411.52	1919277.08	1430633.62	488643.46	488643.46	3298.68	243113.4379			19411.52
1140	1943.89	88.57	1948435.42	1431962.21	516473.20	516473.20	15.05	243339.2105			88.57
1155	1943.89	91.22	1977593.75	1433330.53	544263.22	544263.22	15.50	243571.7337			91.22
1170	1943.89	101.22	2006752.08	1434848.76	571903.32	571903.32	17.20	243829.7337			101.22
1185	1943.89	105.92	2035910.42	1436437.61	599472.80	599472.80	18.00	244099.7337			105.92
1200	1943.89	12010.54	2065068.75	1616595.69	448473.06	448473.06	2041.00	274714.7337			12010.54
1215	1943.89	11.77	2094227.08	1616772.23	477454.86	477454.86	2.00	274744.7337			11.77
1230	1943.89	20.60	2123385.42	1617081.17	506304.25	506304.25	3.50	274797.2337			20.60
1245	1943.89	77.09	2152543.75	1618237.50	534306.25	534306.25	13.10	274993.7337			77.09

Time	Recycled Water Production Flow (gpm)	Distribution Flow (gpm)	Cumulative Inflow (gal)	Cumulative Outflow (gal)	Difference (gal)	Absolute Difference (gal)	Distribution Flow from SCADA (gpm)	Cumulative Volume (gal)	Target Values	Ratio	Adjusted Distribution Flow (gpm)
1260	1943.89	19.42	2181702.08	1618528.82	563173.26	563173.26	3.30	275043.2387			19.42
1275	1943.89	19411.52	2210860.42	1909701.68	301158.74	301158.74	3298.68	324523.4367			19411.52
1290	1943.89	90.19	2240018.75	1911054.54	328964.21	328964.21	15.33	324753.3347			90.19
1305	1943.89	92.91	2269177.08	1912448.24	356728.84	356728.84	15.79	324990.1709			92.91
1320	1943.89	97.68	2298335.42	1913913.51	384421.90	384421.90	16.60	325239.1709			97.68
1335	1943.89	300.12	2327493.75	1918415.26	409078.49	409078.49	51.00	326004.1709			300.12
1350	1943.89	11934.04	2356652.08	2097425.83	259226.26	259226.26	2028.00	356424.1709			11934.04
1365	1943.89	9321.26	2385810.42	2237244.73	148565.68	148565.68	1584.00	380184.1709			9321.26
1380	1943.89	21.18	2414968.75	2237562.50	177406.25	177406.25	3.60	380238.1709			21.18
1395	1943.89	79.44	2444127.08	2238754.14	205372.94	205372.94	13.50	380440.6709			79.44
1410	1943.89	19.42	2473285.42	2239045.46	234239.96	234239.96	3.30	380490.1758			19.42
1425	1943.89	19411.52	2502443.75	2530218.32	-27774.57	27774.57	3298.68	429970.3738			19411.52
1440	1943.89	92.25	2531602.08	2531602.08	0.00	0.00	15.68	430205.5224	2531602.08	5.884634	92.25
						1122375.78					

Chemical Systems Design Criteria

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Client: **Santa Barbara**	Job No.: **120499-90670**	Computed By: **J. Yoshimura**
Project: **El Estero WWTP Tertiary Filtration Facility**	Checked By: **E. You**	Date: **7/9/2012**
Detail: **Chemical Systems Design Criteria** **Tertiary Filtration Facilities**	Date Checked: **11/19/2012**	Page No.: **1 of 1**

Aqueous Ammonia (system to be added as part of secondary improvements project)

sg_{AA} = 0.92
$soln_{AA}$ = 19.0%
rho_{AA} = 7.67 lbs/gal

	Flows (mgd)			Dosages (mg/L)			Feed Rates (gph)		
	Min	Avg	Max	Min	Avg	Max	Min Q/ Min Dose	Avg Q/ Avg Dose	Max Q/ Max Dose
Chloramination - MF/UF Feed	1.07	2.87	3.22	2.5	3	4.5	0.64	2.06	3.46
30 Days of Storage (gal)							461	1,480	2,488
Days of Storage Provided with 1,600 gallon Tank							104	32	19

Sodium Hypochlorite (use existing storage tanks)

sg_{SHC} = 1.22
$soln_{SHC}$ = 12.5%
rho_{SHC} = 10.18 lbs/gal

	Flows (mgd)			Dosages (mg/L)			Feed Rates (gph)		
	Min	Avg	Max	Min	Avg	Max	Min Q/ Min Dose	Avg Q/ Avg Dose	Max Q/ Max Dose
Chloramination - MF/UF Feed	1.07	2.87	3.22	10	12	18	2.93	9.42	15.85
Total							2.93	9.42	15.85
30 Days of Storage (gal)							2,113	6,786	11,409
Days of Storage Provided with 7,500 gallon Tank							106	33	20

Citric Acid

sg_{CIT} = 1.24
$soln_{CIT}$ = 50.0%
rho_{CIT} = 10.34 lbs/gal

	Flows (mgd)			Dosages (mg/L)			Feed Rates (gph)		
	Min	Avg	Max	Min	Avg	Max	Min Q/ Min Dose	Avg Q/ Avg Dose	Max Q/ Max Dose
MF/UF CIP	N/A	N/A	N/A	TBD	TBD	TBD	#VALUE!	#VALUE!	#VALUE!
Total							#VALUE!	#VALUE!	#VALUE!
30 Days of Storage (gal)							#VALUE!	#VALUE!	#VALUE!
Days of Storage Provided with 300 gallon Tote							#VALUE!	#VALUE!	#VALUE!

Caustic Soda (Sodium Hydroxide)

sg_{CS} = 1.252
$soln_{CS}$ = 25.0%
rho_{CS} = 10.44 lbs/gal

	Flows (mgd)			Dosages (mg/L)			Feed Rates (gph)		
	Min	Avg	Max	Min	Avg	Max	Min Q/ Min Dose	Avg Q/ Avg Dose	Max Q/ Max Dose
MF/UF CIP	N/A	N/A	N/A	TBD	TBD	TBD	#VALUE!	#VALUE!	#VALUE!
Total							#VALUE!	#VALUE!	#VALUE!
30 Days of Storage (gal)							#VALUE!	#VALUE!	#VALUE!
Days of Storage Provided with 300 gallon Tote							#VALUE!	#VALUE!	#VALUE!

Chemicals Material Safety Data Sheets

- Aqueous Ammonia
- Sodium Hypochlorite
- Citric Acid
- Sodium Hydroxide (Caustic Soda)

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Terra Industries Inc.
Terra Centre – 600 Fourth Street
Sioux City, Iowa 51101

Material Safety Data Sheet

Aqua Ammonia ($19\% NH_3$)

MSDS Number 2050A (Revised February 16, 2007) 8 Pages

1. CHEMICAL PRODUCT and EMERGENCY TELEPHONE CONTACT

Product Name:	Aqua Ammonia (19% NH_3)
Chemical Family:	Inorganic Nitrogen Compound
Synonyms:	Ammonium Hydroxide; Ammonia Solution, Aqueous Solution; Ammonia Monohydrate; Ammonia Water; Ammonia Liquor
Formula:	NH_4OH in H_2O
Product Use:	Fertilizers; Pharmaceuticals; Lubricants; Household Cleaners; SCR NO_x Control

EMERGENCY TELEPHONE NUMBERS

CHEMTREC (U.S.):	800-424-9300
CANUTEC (Canada):	613-996-6666

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient Name/CAS Number	Concentration	Exposure Limits (NH_3)
Ammonium Hydroxide / 1336-21-6	39.1%	25 ppm TWA
Water / 7732-18-5	60.9%	35 ppm STEL
		50 ppm PEL
Contains 19% ammonia as NH_3		300 ppm IDLH

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Corrosive liquid! May be fatal if swallowed. Vapor is toxic and irritating to eyes, nose, throat and skin. Liquid will burn skin and eyes. Vapor is flammable under limited conditions. Use water to control fire and disperse vapors.

NFPA Hazard Classification (for ammonia vapor)		
	Health Hazard (Blue)	3
	Flammability (Red)	1
	Reactivity (Yellow)	0

POTENTIAL HEALTH EFFECTS

Primary Routes of Entry: Inhalation, skin contact/absorption and eye contact.

General Acute Exposure: Aqua ammonia may cause caustic injury. The severity of injury depends upon the concentration and duration of exposure. The extent of injury ranges from mild skin irritation or cough to severe burns or laryngeal edema and life-threatening pulmonary edema.

Inhalation:
Corrosive! Ammonia vapor is toxic and a severe irritant of the respiratory tract. It may cause a running nose, coughing, chest pain, cessation of respiration and death. It may cause severe breathing difficulties, which may be delayed in onset. ADDITIONAL MEDICAL INFORMATION: Bronchospasm, laryngitis, tracheitis, wheezing, dyspnea, and laryngeal stridor may be noted. Mucosal burns to the tracheobronchial tree, Pulmonary Edema, and associated hypoxemia frequently occur following exposure to concentrated ammonia.

Skin Contact:
Corrosive! Aqua ammonia is a severe irritant of the skin. Skin exposure to high concentrations may cause pain and deep and severe burns to the skin. ADDITIONAL MEDICAL INFORMATION: Corrosive effects on the skin and other tissues may be delayed, and damage may occur without the sensation or onset of pain. Strict adherence to first aid measures following exposure is essential.

Eye Contact:
Corrosive! Vapors cause irritation. Effects as a result of direct contact with aqua ammonia may range from irritation and lacrimation to severe injury and blindness. ADDITIONAL MEDICAL INFORMATION: Eye exposure may result in conjunctivitis, lacrimation and/or corneal irritation. Total corneal epithelial loss may occur.

Ingestion:
Toxic! May cause corrosion to the esophagus and stomach with perforation and peritonitis. Symptoms may include pain in the mouth, chest, and abdomen, with coughing, vomiting and collapse. Ingestion of as little as 3-4 ml of ammonium hydroxide may be fatal.

Note to the Physician: Pneumonitis should be anticipated after severe inhalation or ingestion. If severe exposure is suspected, observe for 48-72 hours for delayed pulmonary edema.

Carcinogenicity:

NTP:.. Not Listed
IARC:.. Not Listed
OSHA:... Not Regulated

Medical Conditions Aggravated by Exposure: Chronic respiratory or skin disease.

4. FIRST AID MEASURES

First Aid for Eyes: Immediately flush eyes with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, excessive tearing, or light sensitivity persists, the patient should be seen in a health care facility and referral to an ophthalmologist considered.

First Aid for Skin: Immediately flush exposed area with copious amounts of tepid water for at least 15 minutes followed by washing area thoroughly with soap and water. The patient should be seen in a health care facility if irritation or pain persists.

First Aid for Inhalation: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If trained to do so administer supplemental oxygen with assisted ventilation as required. Administer artificial respiration if patient is not breathing.

First Aid for Ingestion: Call a physician. If conscious, give the patient 4 to 8 ounces of milk or water to drink immediately. Do not induce vomiting.

5. FIRE FIGHTING MEASURES

Flash Point: .... Not Applicable
Lower Flammable Limit: .... 15.5 % Volume in Air (for NH3)
Upper Flammable Limit: .... 27.0 % Volume in Air (for NH3)
Autoignition Temperature .... 1204^{o} F (651^{o} C) (for NH3)

Extinguishing Media: Stopping the flow of gas rather than extinguishing the fire is usually the best procedure to follow when escaping gas is burning.

Small Fire: .... Dry chemical or CO_2
Large Fire: .... Water spray, fog or foam

Special Fire Fighting Procedures: Use water to keep fire exposed containers cool. Use water fog or foam to reduce vapor concentrations if necessary. Full protective equipment including a self-contained breathing apparatus should be worn in a fire involving the material.

6. ACCIDENTAL RELEASE MEASURES

Spill or Leak Measures: Stop leak if you can do so without risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Evaluate the affected area to determine whether to evacuate or shelter-in-place by taping windows and doors, shutting off outside air intake (attic fans, etc.), and placing a wet towel or cloth over the face (if needed). Self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing used in conjunction with water spray will provide limited protection in outdoor releases for short-term exposure. Fully encapsulating, vapor-protective clothing should be worn for spills and leaks with no fire. Use water spray to control vapors.

CAUTION:
Runoff from vapor control or dilution of spilled product may cause pollution.

Determining Spill Size: Generally, a small spill is one that involves a single, small Package (i.e. up to a 55 gallon drum), small cylinder, or a small (non-continuing) leak from a large container. **Small Spill:**

a. Flush area with flooding amounts of water.
b. First isolate 100 feet in all directions and then protect persons downwind 0.1 miles during daylight and 0.1 miles at night (recommended for ammonia vapor).

Large Spill:

a. Dike far ahead of liquid spill for later disposal.
b. Follow local emergency protocol for handling.
c. First isolate 200 feet in all directions, than protect persons downwind 0.4 miles during daylight and 1.4 miles at night (recommended for ammonia vapor).

7. HANDLING AND STORAGE

Handling: Avoid contact with either liquid or vapors. Direct contact with mercury must be avoided. Use proper PPE when working with or around aqua ammonia (See section 8).

Storage: Ambient temperature. Store in dry, well-ventilated area away from incompatible materials. Protect against physical damage. Keep out of direct sunlight and away from heat sources.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Respiratory Protection Requirements: (for NH3)

<25 ppm:	No protection required.
25 to 35 ppm:	Protection required if the daily TWA is exceeded.
35 to 50 ppm:	Protection required if exposed for more than 15 minutes.
50 to 250 ppm:	Minimum of an air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
250 to 300 ppm:	Minimum of a full-face air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
>300 ppm:	A fresh air supply system must be used (i.e. SCBA)

Skin Protection Requirements: Nitrile rubber, neoprene, or PVC gloves and protective clothing should be used.

Eye Protection Requirements: Use chemical (indirectly vented) goggles when there is a potential for eye contact. A full-face shield is recommended in addition to goggles for added protection.

Other Protective Equipment: Safety shower and eyewash fountain should be provided in the aqua ammonia handling area. When transporting, provide at least 5 gallons of readily accessible, clean water and personal protective equipment.

Engineering Controls: Maintain adequate ventilation to keep ammonia concentrations below applicable standards.

NOTE: See Section 2 for regulatory exposure limits.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form: .... Liquid
Color: .... Colorless
Odor: .... Strong pungent penetrating odor, ammonia.
pH:... 12.0 (neat)
Specific Gravity: .... 0.9277 (@ 20^{o} C)
Vapor Density: .... 0.60 (@ 15.5^{o} C) for NH3
Vapor Pressure:.. 236 mm Hg (@ 15.5^{o} C)
Molecular Weight: 35.05
Relative Density:.. 0.9261 kg/l (@ 20^{o} C)

10. REACTIVITY

Stability:...This is a stable material.
Hazardous Polymerization:...........................Will not occur.

Decomposition: Will liberate ammonia if heated. Hydrogen is released on heating ammonia above 850^{o} F (454^{o} C). The decomposition temperature may be lowered to 575^{o} F (300^{o} C) by contact with certain metals such as nickel. At 1290^{0} F (690^{0} C) or in the presence of electric spark ammonia decomposes into nitrogen and hydrogen gases, which may form a flammable mixture in the air.

Conditions to avoid: Excessive heat.

Materials to avoid: Contact with calcium hypochlorite, bleaches, gold, mercury, and silver may form highly explosive products. Contact with iodine, bromine or chlorine may cause violent spattering.

11. TOXICOLOGICAL INFORMATION

Toxicity

Acute Oral Toxicity
LD_{50} Rat:..350 mg/kg bw
LD_{50} Cat:………………………………...750 mg/kg bw
Acute Toxicity, Other Routes
LD_{LO} Rabbit:……………………………..10 mg/kg bw
Skin Irritation / Corrosion
Rabbit:………………………………………Corrosive at 20% but not 10%
Eye Irritation / Corrosion
Rabbit:………………………………………Irritating
Genetic Toxicity *in vitro*
Gene Mutation *E. Coli*:.................................Negative
Genetic Toxicity *in vivo*
Gene Mutation *Drosophila melanogaster*:....No evidence for mutagenicity

Ecotoxicity

Acute Toxicity to Fish
LC_{50} *Cyprinus carpio*:............................1.34 – 1.70 mg un-ionized NH_3/L (48 hr semi-static)
Acute Toxicity to Aquatic Invertebrates
LC_{50} *Daphnia magna*: ....32 mg NH_4OH/L (48 hr static)
Chronic Toxicity to Fish
LC_{50} *Ictalurus punctatus*: ....37.5 ppm (8 days)

Source: TFI Product Testing Program April 2003

12. ECOLOGICAL INFORMATION

a. Ammonia is harmful to aquatic life in very low concentrations and may be hazardous if it enters water intakes.
b. Local health and wildlife authorities, as well as operators of water intakes in the vicinity, should be notified of water releases.
c. Waterfowl toxicity may occur at elevated concentrations.
d. Ammonia does not concentrate in the food chain.
e. The conversion of ammonia to nitrites/nitrates by bacteria in aquatic systems can reduce the concentration of dissolved oxygen (referred to as nitrogenous oxygen demand).

Effect on water treatment process: Chlorination will produce chloramines, which are more readily detected by taste and odor.

Note: See Ecotoxicity information in section 11.

13. DISPOSAL CONSIDERATIONS

Reclaim as fertilizer if possible. Otherwise, waste must be disposed of in accordance with federal, state, and local environmental control regulations.

14. TRANSPORTATION INFORMATION

U.S. DOT and Canadian TDG Act

Shipping Name:	Ammonia solutions, (*more than 10% but not more than 35 % ammonia*)
Hazard Class/Division:	8
Label Code:	8 Corrosive Liquid
Product Identification Number (PIN):	UN2672
Packing Group	III
OSHA Label Required:	Yes
RQ (Reportable Quantity):	1000 pounds (as NH_4OH)
TDG Reporting Quantity:	5 kg or 5 liters

15. REGULATORY INFORMATION

Controlled Products Regulations Classification:
D-1B: Toxic (Acute Lethality); E: Corrosive

OSHA: This product is considered a hazardous material under criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200 (Toxic; Corrosive).

CAA Chemical Accident Prevention:
Ammonia solution with a concentration less than 20% is not subject to the provisions of 40 CFR Part 68.

CERCLA Hazardous Substances List:

a. RQ (Reportable Quantity): 1000 pounds (as NH_4OH)
b. Regulation: "Designation, Reportable Quantities, Notification" - 40 CFR Part 302

SARA TITLE III:
Ammonia (including ammonia solution) is subject to the reporting requirements of Section 313 "Specific Toxic Chemical Listings" 40 CFR Part 372. Terra is required by 40 CFR Part 372.45 to notify certain customers as to which of its mixture or trade name products contain those chemicals. The purpose of that notification is to ensure that facilities that may be subject to the reporting requirements of Section 313 and that use products of unknown formulation will have knowledge that they are receiving products that contain chemicals subject to those reporting requirements.

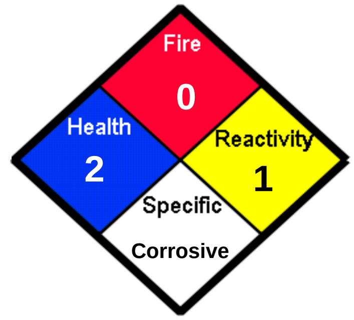
16. OTHER INFORMATION

May 5, 2003:	This MSDS was written to comply with ANSI Standard Z400.1-1993.
July 1, 2003:	Added toxicity information from the TFI Product Testing Program April 2003.
October 4, 2006:	Added NFPA hazard classification information and updated isolation / protective action distances per ERG 2004.
February 16, 2007:	Created separate MSDS for 19% Aqua Ammonia.

The information and recommendations herein are taken from data contained in independent, industry-recognized references including but not limited to NIOSH, OSHA, ANSI, NFPA, DOT ERG, the TFI Product Testing Program, Global Engineering Documents, MEDITEXT, HAZARDTEXT, SARATEXT, CHRIS, OHM/TADS, and IRIS. Terra Industries Inc. makes no guarantee, warranty or other representation concerning this substance, since conditions of its use are beyond the control of the company. Terra Industries Inc. disclaims any liability for loss or damage incurred in connection with the use of this substance.

Horizon Chemical Co., Inc

2125 Energy Park Drive, St. Paul, MN 55108
651.917.3075 • FAX 651.917.3087



MATERIAL SAFETY DATA SHEET

PRODUCT NAME: SODIUM HYPOCHLORITE 6-16% DATE: 1/21/2004

MANUFATURER'S NAME: Vertex Chemical Corporation
9909 Clayton Road
Suite 219
St. Louis, MO 63124
314.991.4005

DISTRIBUTED BY: Horizon Chemical Co., Inc.
2125 Energy Park Drive
St. Paul, MN 55108
651.917.3075

NATIONAL EMERGENCY RESPONSE CENTER: 1-800-424-8802
FOR EMERGENCY DURING TRANSPORTATION ONLY: 1-800-535-5053

SECTION I - PRODUCT IDENTIFICATION

TRADE NAME: Horizon Liquified Chlorinator

PRODUCT USE: Sanitation

CHEMICAL NAME: Sodium Hypochlorite

CHEMICAL FORMULA: NaOCl

CHEMICAL FAMILY: Oxidizing Agent (Hypochlorite)

CAS NO.: 7681-52-9

SYNONYMS/ COMMON NAMES:
Liquid Bleach, Soda Bleach, VERTEX CSS-6, VERTEX CONCENTRATE, VERTEX CSS-10, VERTEX CSS-12, VERTEX Germicidal Ultra Bleach, Chlorine, Horizon Liquified Chlorinator.

SHIPPING NAME & HAZARD CLASS- (DOT):
Hypochlorite Solution 8
Corrosive Material, UN1791
PG III, RQ (Sodium Hypochlorite)

SECTION II - EMERGENCY RESPONSE INFORMATION

HEALTH HAZARDS: See Section VI

FIRE OR EXPLOSION: See Section IX

IMMEDIATE PRECAUTIONS: WASH FROM EYES:

Section V, First Aid
Section X, Reactivity
Section XI, Spill, Leak & Disposal Procedures

SPILLS OR LEAKS: See Section XI

FIRST AID: See Section V

SECTION III - COMPOSITION

COMPONENT	CAS NO.	% by weight	PEL	TLV	OTHER	HAZARD
Sodium Hypochlorite	7681-52-9	6-16	None	None	None	Corrosive/Oxidizer
Sodium Chloride	7647-14-5	5-13	None	None	None	None
Sodium Hydroxide	1310-73-2	0.2-4.0	2MG/M3	2MG/M3	None	Corrosive
Water	7732-18-5	Balance	None	None	None	None

SECTION IV - PHYSICAL PROPERTIES

Concentration	6% NaOCl	11%NaOCl	13%NaOCl
Appearance	Banana-Colored Clear Liq.	Banana-Colored Clear Liq.	Banana-Colored Clear Liq.
Boiling Point, F	219°F	222°F	225°F
Color	Clear Yellow	Clear Yellow	Clear Yellow
Density	NA	NA	NA
Evaporation Rate	NA	NA	NA
Freeze Point, F	20°F	-1°F	-12°F
Melting Point	NA	NA	NA
Molecular Weight	74.45	74.45	74.45
Odor	Pungent Chlorine Odor	Pungent Chlorine Odor	Pungent Chlorine Odor
pH	12.31	12.95	13.05
Solubility	Soluble in Water	Soluble in Water	Soluble in Water
Specific Gravity	1.115	1.173	1.211
Vapor Density	NA	NA	NA
Vapor Pressure @ 55°C (Kpa)	7.63	7.63	9.34
Viscosity	NA	NA	NA
Vapor Pressure @ 50°C (Kpa)	6	6.2	7.5

SECTION V - FIRST AID MEASURES

EYES: Immediately flush eyes thoroughly and continue to repeatedly flush eyes with constantly running water for 15 minutes, lifting the upper and lower eyelids occasionally. Get immediate medical attention.

SKIN: Immediately flush skin thoroughly and continue to repeatedly flush eyes with constantly running water for 15 minutes. Remove contaminated clothing and shoes; wash before reuse. Get immediate medical attention.

INHALATION: Remove to fresh air. Give artificial respiration if not breathing. Administer Oxygen if breathing is difficult. Get immediate medical attention.

INGESTION: Do not induce vomiting. If conscious, give water or milk, or milk of magnesia. Do not give baking soda or acid antidotes. Do not give anything by mouth to an unconscious or convulsing person. Get immediate medical attention.

NOTES TO PHYSICIAN:
None.

SECTION VI - HEALTH HAZARDS IDENTIFICATION / INFORMATION

OVERVIEW: Primary Routes of Exposure: Skin or eye contact, inhalation Avoid eye or skin contact, inhalation.

SHORT-TERM EXPOSURE (ACUTE)

INHALATION: Inhalation of fumes or mists causes respiratory tract irritation and irritation of mucous membranes. If sodium hypochlorite is mixed with ammonia or other chemicals, evolution of chlorine or chlorine based compounds results. These gases can produce pulmonary edema. Never mix with any other chemicals.

EYES: Liquid and mists may severely irritate or damage eyes.

SKIN: The liquid will irritate the skin, causing redness and possibly inflammation, or chemical burns to broken skin.

INGESTION: Mists and liquid are extremely corrosive to the mouth and throat, mucous membranes and stomach. Swallowing the liquid burns the tissues, causes severe abdominal pain, nausea, vomiting, circulatory collapse, confusion, delirium, coma and collapse. Swallowing large quantities can cause death.

OTHER HEALTH EFFECTS OR NOTES:

Chronic Effects of Exposure: Irritation effects increase with strength of solution and time of exposure. Prolonged or repeated exposure can lead to constant irritation of eyes and throat. Prolonged or repeated contact may cause dermatitis and sensitization.

Medical Conditions Generally Aggravated By Exposure: Asthma or other pre-existing ling/respiratory illness.

SECTION VII - TOXICOLOGICAL INFORMATION

ACUTE ORAL: For 5% Solution Rat LD50 = 13 G/KG
For 12.5% Solution Rat LD50 = 5G/KG

DERMAL: Rat LD50 > 3.0 G/KG

ACUTE INHALATION: No Data Available

CARCINOGENICITY: This material is not considered to be a carcinogen by the National Toxicology Program, the International Agency for Research of Cancer, or the Occupational Safety and Health Administration.

OTHER DATA: None.

SECTION VIII - PERSONAL PROTECTION / EXPOSURE CONTROLS

VENTILATION: Local mechanical exhaust ventilation to minimize exposure to vapors or mist at the point of use.

RESPIRATORY: Wear a NIOSH-approved respirator appropriate for the vapor of mist concentration at the point of use. Appropriate respirators may be a full face-piece or a half mask air-purifying cartridge respirator equipped for acid gases/mists, a self-contained breathing apparatus in the pressure demand mode, or a supplied-air respirator.

EYE/FACE: Chemical goggles and full face-shield unless a full face-piece respirator is also worn. It is generally recognized that contact lenses should not be worn when working with chemicals because contact lenses may contribute to the severity of an eye injury. In laboratory situation, where running water is immediately available and an eyewash nearby, for handling of sixteen (16) ounces or less of product, safety glasses are acceptable eye protection.

SKIN: Long-sleeved shirt, trousers, rubber boots, rubber gloves, and rubber apron. In a laboratory situation, where running water is immediately available and an eyewash nearby, for handling sixteen (16) ounces or less of product, rubber gloves can be omitted. Hands should be rinsed immediately until slick feeling is gone from skin is exposure occurs.

OTHER: An eyewash and safety shower should be nearby and ready for use.

SECTION IX - FIRE FIGHTING MEASURES

FLASH POINT: Not Flammable
METHOD: N/A
AUTOIGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS IN AIR, BY % VOLUME
LOWER: N/A UPPER: N/A

FLAMMABLE LIMITS (% BY VOLUME)
LOWER: N/A UPPER: N/A

EXTINGUISHING MEDIA: This material is not combustible. Use extinguishing media appropriate for surrounding fire.

FIRE FIGHTING PROCEDURES:
Fire fighters should wear self-contained breathing apparatus and full protective clothing. Use water spray to cool nearby containers and structures exposed to fire.

FIRE & EXPLOSION HAZARD:
Containers of this material can explode as oxygen is liberated under high heat or fire conditions. Toxic fumes similar to chorine gas are liberated by contact with acids, ammonia, some detergent cleaners, organic materials, oxidizing agents and some reducing agents. See Special Precautions Section for TLV of elemental chlorine. Highly exothermic reactions with organic materials and oxidizable materials may cause fires in adjacent, heat sensitive materials: Do not store where contact may result with organic or oxidizable materials, e.g., sawdust, paper waste, or others.

SENSITIVITY TO MECHANICAL IMPACT: N/A

SENSITIVITY TO STATIC DISCHARGE: N/A

NFPA RATING:	HEALTH:	2	REACTIVITY:	1
	FIRE:	0	SPECIFIC HAZARD:	Corrosive

SECTION X - STABILITY AND REACTIVITY

STABILITY: STABLE X UNSTABLE ____

HAZARDOUS POLYMERIZATION: OCCURS ____ WILL NOT OCCUR X

REACTS WITH:	AIR		OXIDIZERS	X	METALS	X
	WATER		ACIDS	X	OTHER	X
	HEAT		ALKALIS		NONE	

HAZARDOUS DECOMPOSITION PRODUCTS:

HOCL, Chlorine, HCL, NACL, Sodium Chlorate, and oxygen which depend on pH, temperature and time.

COMMENTS: Stability decreases with increased concentration, heat, light exposure, decrease in pH and contamination with heavy metals such as nickel, cobalt, copper and iron. DECREASES IN PH AND/OR CONTAMINATION CAN RESULT IS EVOLUTION OF CHLORINE (TOXIC) GAS.

CONDITIONS TO AVOID: EXCESSIVE HEAT, EXPOSURE TO LIGHT, REDUCED ALKALINITY, AND CONTAMINATION OF ANY KIND. REDUCED ALKALINITY OR CONTAMINATION CAN RESULT IN EVOLUTION OF CHLORINE (TOXIC) GAS.

STRONG OXIDIZING AGENT: in contact with the following incompatible, oxidizable materials, chemical reaction will occur allowing hazardous gases to evolve: Ether, ammonia, acids, oxidizing agents, reducing agents, oxidizable or combustible materials such as wood, cloth or organic materials, heavy metals such as iron, copper, magnesium, aluminum, tin, manganese, zinc, chromium, nickel, and their alloys. DO NOT MIX THIS PRODUCT WITH ANY OF THE FOREGOING OR HAZARDOUS GASES CAN RESULT.

SECTION XI - SPILL, LEAK AND DISPOSAL PROCEDURES

PERSONAL PRECAUTIONS:

Wear alkali-resistant slicker suit and complete protective equipment including goggles, rubber gloves, rubber boots, and a self-contained breathing apparatus in the pressure demand mode or a supplied-air respirator. If the spill or leak is small, a full face-piece air-purifying cartridge respirator equipped with acid gases/mists filters may be satisfactory. In any event, always wear eye protection.

- Follow protective measures provided under Personal Protection in Section 8.

ENVIRONMENTAL PRECAUTIONS:

Keep non-neutralized material out of sewers, storm drains, surface waters, and soil. This product is very toxic to aquatic life.

According to 40 CFR 302 Table 302.4 (CERCLA), environmental releases that exceed the RQ must be reported to the National Response Center by calling 800-424-8802 (202-426-2675) and the state emergency response commission and the local emergency planning committee (40 CFR 355.49) as appropriate.

METHODS FOR CLEANING UP:

For small spills or drips, mop or wipe up and dispose of in DOT-approved waste containers. For large spills, contain by diking with soil or other non-combustible absorbent material and dispose according to federal or local regulations.

Comply with all applicable governmental regulations on spill reporting, and handling of disposal waste.

DISPOSAL METHODS:

Dispose of contaminated product and materials used in cleaning up spills or leaks in a manner approved for this material.

Consult appropriate federal, state and local regulatory agencies to ascertain proper disposal procedures.

OTHER NOTES: Empty containers can have residues, gases and mists and are subject to proper waste disposal, as above.

SECTION XII - HANDLING AND STORAGE

HANDLING: Do not use pressure to empty container. Wash thoroughly after handling. Do no get in eyes, on skin, or on clothing. Store in original containers only at temperatures below 85°F. Do not store near acids, oxidizable materials, or organics. Do not store on wooden floors.

ATTENTION: When empty, the container may still be hazardous. Because container, even after they have been emptied, still retain product residues(vapor, liquid or solid), all labeled hazard precautions MUST BE OBSERVED. If "emptied" product containers of 110 gallons or greater volume are to be shipped, DOT requires the containers to be triple rinsed (or equivalent) to remove any residue and DOT placards be removed or covered with plain placards before they can be shipped as empty containers.

SPECIAL MIXING AND HANDLING INSTRUCTIONS:

Containers, even those that have been emptied, will retain product residue and vapors. Always obey hazard warnings and handle empty containers as if they were full. Do not mix or contaminate this product with ammonia, acids, hydro-carbons, alcohols, ethers, reducing agents, oxidizers, cleaning agents or other products which may liberate chlorine or other toxic vapors. For elemental chlorine, the OSHA PEL is .5 PPM TWA and 1 PPM STEL; the ACGIH TLV is 1 PPM TWA, with a STEL of 3 PPM. This product degrades with age. Use it within one month of receipt. It is a violation of federal law to use this product in a manner inconsistent with its labeling. EPA pesticides regulations apply, and EPA registration is required when using for disinfecting or sanitation purposes. THIS PRODUCT IS LISTED ON THE TOXIC SUBSTANCES CONTROL ACT (TSCA) INVENTORY OF CHEMICAL SUBSTANCES.

STORAGE: Store in a cool, dry, well-ventilated place away from incompatible materials. Keep container tightly closed and vented when no in use.

SECTION XIII - ECOLOGICAL INFORMATION

AQUATIC ECOTOX DATA

FISH: This product is very toxic to aquatic life.

INVERTEBRATES:

This product is very toxic to aquatic life.

AMPHIBIANS: This product is very toxic to aquatic life.

PLANTS: This product is very toxic to aquatic life.

TERRESTRIAL ECOTOX DATA

WILDLIFE: No Data.

PLANTS: No Data.

ENVIRONMENTAL FATE DATA

BIOTIC: No Data.

ABIOTIC: No Data.

ADDITIONAL INFORMATION

None.

SECTION XIV - DISPOSAL CONSIDERATIONS

See Section VII, Handling and Storage.

SECTION XV - TRANSPORT INFORMATION

DOT PROPER SHIPPING NAME:	Hypochlorite Solution
DOT HAZARD CLASS:	8
DOT IDENTIFICATION NUMBER:	UN1791
DOT PACKING GROUP:	PG III
DOT HAZARDOUS SUBSTANCE(S):	RQ 100 LBS.
DOT MARINE POLLUTANT(S):	MARINE POLLUTANT
ADDITIONAL DESCRIPTION RQMT:	

SECTION XVI - REGULATORY INFORMATION

US FEDERAL REGULATIONS:

OSHA Standard 29 CFR 1910.1200 requires that information be provided to employees regarding the hazards of chemicals by means of a hazard communication program including labeling, material safety data sheets, training and access to written records. We request that you, and it is your legal duty to, make all information in this material safety data sheet available to your employees.

TSCA Inventory Status: Listed on inventory.
SARA - 313 Listed Chemicals - No
RCRA Hazardous Waste No.: N/A
CERCLA: Yes

Vertex sodium hypochlorite is regulated under many federal and local laws, including OSHA, TSCA, RCRA, FIFRA, CERCLA and EPCRA. It is NOT on the list of Extremely Hazardous Substances, 40 CFR Part 355 Appendix A, nor on the "337 Toxic Chemicals" list, 40 CFR 372.

SARA/TITLE III HAZARD CATEGORIES:

IMMEDIATE (ACUTE) HEALTH:	N/A	REACTIVE HAZARD:	N/A
DELAYED (CHRONIC) HEALTH:	N/A	SUDDEN RELEASE OF PRESSURE:	N/A
FIRE HAZARD:	N/A		

HMIS HAZARD RATINGS:

HEALTH HAZARD: 2 FIRE HAZARD: 0 REACTIVITY: 1

SPECIFIC HAZARD: Corrosive

STATE REGULATIONS:

No Data.

INTERNATIONAL REGULATIONS:

No Data.

SECTION XVII - OTHER INFORMATION

MSDS LEGEND:

ACGIH	AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS
CAS	CHEMICAL ABSTRACTS SERVICE REGISTRY NUMBER
CEILING	CEILING LIMIT (15 MINUTES)
CEL	CORPORATE EXPOSURE LIMIT
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
PEL	PERMISSIBLE EXPOSURE LIMIT (OSHA)
STEL	SHORT TERM EXPOSURE LIMIT (15 MINUTES)
TDG	TRANSPORTATION OF DANGEROUS GOODS (CANADA)
TLV	THRESHOLD LIMIT VALUE (ACGIH)
TWA	TIME WEIGHTED AVERAGE (8 HOURS)
WHMIS	WORKER HAZARDOUS MATERIALS INFORMATION SYSTEM (CANADA)

FOR ADDITIONAL INFORMATION

CONTACT: MSDS Coordinator Horizon Chemical Co., Inc. During Business Hours, Central Time
651.917.3075

Manufacturer MSDS's can also be obtained by contacting the number above. See notice below.

NOTICE

Horizon Chemical Co., Inc. ("Horizon") expressly disclaims all express or implied warranties of merchantability and fitness for a particular purpose, with respect to the product or information provided herein, and shall under no circumstances be liable for incidental or consequential damages.

Do not use ingredient information and/or ingredient percentages in this MSDS as a product specification. For product specification information refer to a product specification sheet and/or a certificate of analysis. These can be obtained from the Horizon sales office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Horizon makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Horizons control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information obtained herein. This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process.

END OF MSDS

Univar USA Inc.
17425 NE Union Hill Road
Redmond, WA 98052
(425) 889-3400

For Emergency Assistance involving chemicals call - CHEMTREC (800) 424-9300
===

The Version Date and Number for this MSDS is : 12/02/2005 - #007

PRODUCT NAME:	CITRIC ACID, SOLUTION
MSDS NUMBER:	HX17030
DATE ISSUED:	11/21/2005
SUPERSEDES:	6/22/2005
ISSUED BY:	006768

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Material Safety Data Sheet

Section 1 - Chemical Product and Company Identification

Chemical Name: Citric Acid, Solution
Product Use: For Manufacturing Use
Synonyms: 1,2,3-Propanetricarboxylic acid, 2-hydroxy-; 2-Hydroxy-1,2,3-propanetricarboxylic acid; Propane-1,2,3-tricarboxylic acid, 2-hydroxy-;
beta-hydroxytricarballylic acid.

Supplier Information
Distributed by:
UNIVAR USA
6100 Carillon Point
Kirkland, WA 98033
425-889-3400
Emergency: 1-800-424-9300 or (703)527-3887

General Comments: FOR MANUFACTURING USE ONLY; NOT TO BE USED AS A PESTICIDE.

NOTE: Emergency telephone numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure, or accident involving chemicals. All non-emergency questions should be directed to customer service. * * * Section 2 - Composition / Information on Ingredients

CAS #	Component	Percent
77-92-9	Citric Acid	30-50%
7732-18-5	Water	Balance

Component Information/Information on Non-Hazardous Components
This product is considered hazardous under 29 CFR 1910.1200 (Hazard Communication).

Section 3 - Hazards Identification

Emergency Overview
Citric Acid Solution is a clear or yellow to brown liquid, with a faint sugary odor. Citric Acid is moderately to severely irritating to eyes, and moderately irritating to skin, and respiratory tract. Citric Acid Solution is not combustible. Use methods suitable for containing (diking) the solution in case of fire or spill. Firefighters should wear full protective equipment when fighting a fire involving this product.

Hazard Statements
DANGER! THIS SOLUTION CAUSES EYE, SKIN, AND RESPIRATORY TRACT IRRITATION OR BURNS. MAY CAUSE ALLERGIC SKIN SENSITIZATION REACTION. Do not breath or ingest mists, vapors, or aerosols. Do not allow contact with eyes, skin, or clothing. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling.

Potential Health Effects: Eyes
This solution may cause severe irritation to the eyes, with symptoms that include redness, tearing, and pain. Concentrated solutions may be corrosive to the eyes and cause corneal ulcerations.

Potential Health Effects: Skin
This product may cause moderate irritation of the skin. Citric Acid may cause allergic contact dermatitis with prolonged or repeated contact in sensitive individuals.

Potential Health Effects: Ingestion
Citric Acid may cause mild gastrointestinal irritation, with symptoms including nausea, diarrhea, vomiting, and abdominal pain. Concentrated solutions may cause necrotic and ulcerative lesions on oral mucous membranes. Chronic ingestion of high concentration Citric Acid can result in erosion of tooth enamel. Repeated ingestion of this solution can result in sensitization to the sun, causing sunburn.

Potential Health Effects: Inhalation
Aerosols and mists from solutions may cause mild to moderate irritation of the nose and throat. Overexposure could cause coughing, sneezing, and labored breathing.

Other Potential Health Effects
Chronic, high concentration overexposure to Citric Acid can result in a reduction of plasma calcium concentration, which can lead to cardiac

arrhythmias, reduced cardiac output and, in severe cases, death.

HMIS Ratings: Health Hazard: 2* Fire Hazard: 0 Physical Hazard: 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

Section 4 - First Aid Measures

First Aid: Eyes
Immediately flush the contaminated eye with plenty of water for 15 minutes. Get medical attention if symptoms of pain, swelling, or tearing exist after flushing the eyes.

First Aid: Skin
For skin contact, immediately wash extremely thoroughly with soap and water. Get medical attention if irritation develops or persists.

First Aid: Ingestion
DO NOT INDUCE VOMITING. Have victim rinse mouth with water, if conscious. Never give anything by mouth to a victim who is unconscious or having convulsions. Contact a physician or poison control center immediately.

First Aid: Inhalation
Remove source of contamination or move victim to fresh air. Apply artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult. Get immediate medical attention.

First Aid: Notes to Physician
There is no specific antidote. Care is symptomatic and supportive.

Section 5 - Fire Fighting Measures

Flash Point: Not applicable.
Method Used: Not applicable.
Upper Flammable Limit (UEL Not applicable.
Lower Flammable Limit (LEL): Not applicable.
Auto Ignition: Not applicable.
Flammability Classification: Not applicable.
Rate of Burning: Not applicable.
General Fire Hazards
Not considered flammable although if allowed to evaporate to dryness, residue may burn in presence of strong ignition source.

Hazardous Combustion Products
Applies to residue: Carbon dioxide and carbon monoxide are normal products of combustion. Incomplete combustion may produce irritating fumes and acrid smoke.

Extinguishing Media
Water, foam, dry chemical, or carbon dioxide. Dike and collect water used to fight fire; runoff may cause damage.

Fire Fighting Equipment/Instructions
Firefighters should wear full protective clothing including self contained breathing apparatus.

NFPA Ratings: Health: 2 Fire: 0 Reactivity: 0 Other:
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

Section 6 - Accidental Release Measures

Containment Procedures
Stop the flow of material, if this can be done without risk. Contain the discharged solution; dike runoff to prevent spill from contaminating storm drains, sewers, soil or groundwater waterways.

Clean-Up Procedures
Wear appropriate protective equipment and clothing during clean-up. Addition of sodium bicarbonate or lime (soda ash) will neutralize Citric Acid and precipitate calcium citrate. Test area of spill with pH paper to assure neutralization. Thoroughly wash the area after a spill clean-up with large quantities of water, flush to drain.

Evacuation Procedures
Evacuate the area promptly and keep upwind of the spilled material. Isolate the spill area to prevent people from entering. Keep incompatible materials away from spilled solution. In case of large spills, follow all facility emergency response procedures.

Special Procedures
Remove soiled clothing and launder before reuse. Avoid all skin contact with the spilled material. Have emergency equipment readily available.

Section 7 - Handling and Storage

Handling Procedures
All employees who handle this material should be trained to handle it safely. Do not breathe vapors or mists. Avoid all contact with skin and eyes. Use this product only with adequate ventilation. Wash thoroughly after handling.

Storage Procedures
Keep container tightly closed when not in use. Keep containers upright, do not drop, roll or skid. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Material should be stored in secondary containers or in a diked area, as appropriate. Store containers away from incompatible chemicals (see Section 10, Stability and Reactivity). Storage areas should be made of fire- and corrosion-resistant materials. Post warning and "NO SMOKING" signs in storage and use areas, as appropriate. Use corrosion-resistant structural materials, lighting, and ventilation systems in the storage area. Floors should be sealed to prevent absorption of this material. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged. Have appropriate extinguishing equipment in the storage area (i.e., sprinkler system, portable fire extinguishers).
Empty containers may contain residual particulates; therefore, empty

containers should be handled with care. Never store food, feed, or drinking water in containers which held this product. Keep this material away from food, drink and animal feed. Do not store this material in open or unlabeled containers. Limit quantity of material stored. Wipe down area of use periodically as area can become sticky.

Section 8 - Exposure Controls / Personal Protection

Exposure Guidelines

A: General Product Information
No exposure guidelines have been established.
B: Component Exposure Limits
ACGIH, OSHA, and NIOSH have not developed exposure limits for any of this product's components.

Engineering Controls

Use mechanical ventilation such as dilution and local exhaust. Use a corrosion-resistant ventilation system and exhaust directly to the outside. Supply ample air replacement.

PERSONAL PROTECTIVE EQUIPMENT

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132). Please reference applicable regulations and standards for relevant details.

Personal Protective Equipment: Eyes/Face

Faceshields and goggles should be worn when working with solutions of Citric Acid. If necessary, refer to U.S. OSHA 29 CFR 1910.133.

Personal Protective Equipment: Skin

Use impervious gloves. Butyl rubber, natural rubber, neoprene, nitrile rubber, polyethylene, or PVC are recommended. If necessary, refer to U.S. OSHA 29 CFR 1910.138.

Personal Protective Equipment: Respiratory

None required where adequate ventilation conditions exist. If airborne concentration is high, use an appropriate respirator with acid dust/mist pre-filters. If respiratory protection is needed, use only protection authorized in the U.S. Federal OSHA Standard (29 CFR 1910.134), applicable U.S. State regulations. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).

Personal Protective Equipment: General

Have an eyewash fountain and safety shower available in the work area. Use good hygiene practices when handling this material including changing and laundering work clothing after use. Wash hands thoroughly after handling material. Do not eat, drink, or smoke in work areas.

Section 9 - Physical & Chemical Properties

Physical Properties: Additional Information

The data provided in this section are to be used for product safety handling purposes. Please refer to Product Data Sheets, Certificates of Conformity or Certificates of Analysis for chemical and physical data for determinations of quality and for formulation purposes.

Appearance:	Colorless or yellow to brown
Odor:	Slight sugar odor.
Physical State:	Liquid
pH:	Approx 2.5 or lower
Vapor Pressure:	Not available.
Vapor Density:	Not available.
Boiling Point:	104 deg C (219 deg F)
Melting Point:	Not applicable.
Solubility (H20):	162 g/100 mL water at 25 deg C
Specific Gravity:	1.24 @ 25 deg C (77 deg F)
Freezing Point:	0 deg C (32 deg F)
Particle Size:	Not applicable.
Softening Point:	Not applicable.
Evaporation Rate:	Similar to water.
Viscosity:	7.0 centipoise at 25 deg C
Bulk Density:	Not applicable.
Percent Volatile:	Not available.
Molecular Weight:	192.13 (Citric Acid, Anhydrous)
Chemical Formula:	C6H807 (Citric Acid, Anhydrous)

Section 10 - Chemical Stability & Reactivity Information

Chemical Stability
Stable under normal conditions. Dilute aqueous solutions of Citric Acid may ferment if left standing for long period of time.

Chemical Stability: Conditions to Avoid
Heat, moisture and incompatible materials.

Incompatibility
Potentially explosive reaction with metal nitrates, strong bases, and oxidizers. Citric Acid is incompatible with reducing agents.
Citric Acid Solution is corrosive to brass, copper, zinc, aluminum and their alloys, lead, cast iron and steel (not stainless steel).

Hazardous Decomposition
Residue: Carbon dioxide and carbon monoxide are normal products of combustion. Incomplete combustion may produce irritating fumes and acrid smoke.

Hazardous Polymerization
Hazardous polymerization will not occur.

Section 11 - Toxicological Information

Acute and Chronic Toxicity
A: General Product Information
Citric Acid has been reported to have allergenic properties, and might cause allergic contact dermatitis and sensitization to the sun.
Irritation of the skin, eyes, and gastrointestinal tract may occur, but should not require extensive therapy beyond dilution/irrigation. Vapors and solution may cause severe irritation to the eyes, with symptoms that include redness, tearing, and pain. Concentrated solutions may be

corrosive to the eyes and cause corneal ulcerations. This product may cause moderate irritation of the skin. Citric Acid may cause mild gastrointestinal irritation, with symptoms including nausea, diarrhea, vomiting, abdominal pain. Concentrated solutions may cause necrotic and ulcerative lesions on oral mucous membranes. Dusts and mists from solutions may cause mild to moderate irritation to the nose and throat. Higher concentrations could cause coughing, sneezing, and labored breathing.
Chronic, high concentration overexposure to Citric Acid can result in a reduction of plasma calcium concentration, which can lead to cardiac arrhythmias, reduced cardiac output and, in severe cases, death.

B: Component Analysis - LD50/LCso
Citric Acid (77-92-9)
LD50 (Oral-Rat) 3 gm/kg; LD50 (Oral-Mouse) 5040 mg/kg: Lungs, Thorax, or Respiration changes; Musculoskeletal changes; LD50 (Subcutaneous-Rat) 5500 mg/kg; LD50 (Subcutaneous-Mouse) 2700 mg/kg: Lungs, Thorax, or Respiration changes; Musculoskeletal changes; LD50 (Intraperitoneal-Rat) 290 mg/kg; LD50(Intraperitoneal-Mouse) 903 mg/kg; LD50 (Intravenous-Mouse) 42 mg/kg: Behavioral: convulsions or effect on seizure threshold; Lungs, Thorax, or Respiration: cyanosis; Gastrointestinal: changes in structure or function of salivary glands; LD50 (Intravenous-Rabbit) 330 mg/kg

B: Component Analysis - TDLo/TCLo/LD/LDLo
Citric Acid (77-92-9)
LDLo (Oral-Rabbit) 7 gm/kg: Behavioral: tremor, convulsions or effect on seizure threshold, muscle contraction or spasticity

Carcinogenicity
A: General Product Information
No information identified.

B: Component Carcinogenicity
None of this product's components are listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Epidemiology
No information available.

Neurotoxicity
Has not been identified.

Mutagenicity
Citric Acid would not be expected to be genotoxic at physiological concentrations because it is a normal metabolite. It was not mutagenic in Salmonella typhimurium, and did not induce chromosome aberrations in cultured Chinese hamster fibroblast cells.

Teratogenicity
Citric Acid did not cause reproductive effects when tested in experimental animals. The sodium salt did not cause birth defects in rats. When given to rats at 1.2% in the diet over 2 generations, it did not affect reproduction. It did not affect litter size or survival of mice with prenatal exposure to up to 5% in the diet.

Other Toxicological Information
Persons with pre-existing eye, skin, respiratory, or allergic conditions may be more sensitive.

Section 12 - Ecological Information

Ecotoxicity
A: General Product Information
Water Solubility = 59.2% (20 deg C); 84% (100 deg C). Biological Oxygen Demand (BOD): 40%, 5 days; 60%, 10-20 days. Citric Acid biodegrades quite rapidly. It is dangerous to aquatic life in high concentrations. Lowers pH in water but does not dissociate to any great extent.
Food Chain Concentration Potential: Very Low

B: Ecotoxicity
TLm (immersion-shore crab) 48 hours = 160 ppm (salt water); TLm (immersion-goldfish) 4 hr = 894 ppm (fresh water/ killed); ECo (Pseudomonas putida bacteria) 16 hours = >10,000 mg/L; EC0 (Microcystis aeruginosa algae) 8 days = 80 mg/L; ECo (Scenedesmus quadricauda green algae) 7 days = 640 mg/L; ECo(Entosiphon sulcatum protozoa) 72 hours = 485 mg/L; ECo (Uronema parduczi Chatton-Lwoff protozoa) = 622 mg/L; LD0 (Daphnia magna) = 80 mg/L, long-time exposure in soft water; LD0 (goldfish) = 625 mg/L, long-time exposure in hard water; LD100 (goldfish) = 894 mg/L, long-time exposure in hard water; LD100 (Daphnia magna) 120 mg/L long-time exposure in soft water; toxic (Daphnia) = 100 mg/L; period of survival at pH 4.0 (goldfish) 48 hours = 894 mg/L; period of survival at pH 4.5 (goldfish) 48 hours = 625 mg/L

Environmental Fate
Citric Acid is a naturally occurring chemical and is biodegradable.
Octanol/Water Partition Coefficient Log P (oct): -1.72.

Section 13 - Disposal Considerations

US EPA Waste Number & Descriptions
A: General Product Information
Concentrated solutions may be considered D002 wastes (corrosive) by RCRA. Wastes should be tested prior to disposal to determine classification.

B: Component Waste Numbers
No EPA Waste Numbers are applicable for this product's components.

Disposal Instructions
Review federal, provincial, and local government requirements prior to disposal.

Section 14 - Transportation Information

US DOT Information
Shipping Name: Not Regulated

Section 15 - Regulatory Information

US Federal Regulations
A: General Product Information
No additional information.

B: Component Analysis
None of this product's components are listed under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), or CERCLA (40 CFR 302.4).

SARA 302 (EHS TPQ) There are no specific Threshold Planning Quantities for Citric Acid. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lbs. (4,540 kg) therefore applies, per 40 CFR 370.20.

C: Sara 311/312 Tier II Hazard Ratings:

Component	CAS #	Fire Hazard	Reactivity Hazard	Pressure Hazard	Immediate Health Hazard	Chronic Health Hazard
Citric Acid	77-92-9	No	No	No	Yes	Yes

State Regulations
A: General Product Information
Other state regulations may apply.

B: Component Analysis - State Citric Acid and Water are listed as follows:
NJ4: New Jersey other (included in 5 predominant ingredients >1%); PA3: Pennsylvania (non-hazardous - present at 3% or greater)

Component	CAS #	CA	FL	MA	MN	NJ	PA
Citric Acid	77-92-9	No	No	No	No	Yes	Yes

Other Regulations
A: General Product Information No additional information.

B: Component Analysis - Inventory

Component	CAS #	TSCA	DSL	EINECS
Citric Acid	77-92-9	Yes	Yes	Yes

C: Component Analysis - WHMIS IDL
The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Citric Acid	77-92-9	1% item 409 (80)

ANSI Labeling (Z129.1):
DANGER! CORROSIVE. CAUSES EYE, SKIN, AND RESPIRATORY TRACT IRRITATION OR BURNS. MAY CAUSE ALLERGIC SKIN SENSITIZATION REACTION. Do not taste or swallow. Do not get on skin or in eyes. Avoid breathing aerosols or mists. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Keep from contact with clothing. Wear gloves, goggles, faceshields, suitable body protection, and NIOSH/MSHA-approved respiratory protection, as appropriate. FIRST-AID: In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. If inhaled, remove to fresh air. If ingested, do not induce vomiting. Get medical attention. IN CASE OF FIRE: Use water fog, dry chemical, CO2, or "alcohol" foam. IN CASE OF SPILL: Neutralize spill and wash area. Place residue in suitable container. Consult Material Safety Data Sheet for additional information.

For Additional Information:
Contact: MSDS Coordinator - Univar USA
During business hours, Pacific Time - (425) 889-3400

NOTICE
Univar USA expressly disclaims all express or implied warranties of merchantibility and fitness for a particular purpose with respect to the product or information provided herein, and shall under no circumstances be liable for incidental or consequential damages.

Do not use ingredient information and/or ingredient percentages in this MSDS as a product specification. For product specification information refer to a Product Specification Sheet and/or a Certificate of Analysis. These can be obtained from your local Univar USA Sales Office.

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END OF MSDS

Material Safety Data Sheet

Revision Issued: 11/30/2009 Supercedes: 3/17/2006 First Issued: 12/12/86

Section I - Chemical Product And Company Identification

Product Name: Sodium Hydroxide 10-50% Liquid

CAS Number: 1310-73-2 HBCC MSDS No. CC12000

HILL BROTHERS Chemical Co.
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(714) 998-8800 • FAX: (714) 998-6310
http://hillbrothers.com

1675 No. Main Street, Orange, California 92867
Telephone No: 714-998-8800 | Outside Calif: 800-821-7234
Chemtrec: 800-424-9300

Section II - Composition/Information On Ingredients

			Exposure Limits (TWAs) in Air		
Chemical Name	CAS Number	%	ACGIH TLV	OSHA PEL	STEL
Sodium Hydroxide	1310-73-2	10-50	2 mg/m³	2 mg/m³	N/A

Section III - Hazard Identification

Routes of Exposure: Sodium hydroxide can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

Summary of Acute Health Hazards

Ingestion: Corrosive! Swallowing sodium hydroxide may cause severe burns of the mouth, throat, esophagus, and stomach. Death may result. Severe scarring of the throat may occur on recovery after swallowing sodium hydroxide. Symptoms may include sneezing, bleeding, vomiting, diarrhea, fall in blood pressure. Damage may appear days after exposure. An increased number of esophageal cancer cases have been reported to occur in individuals who have scarring of the esophagus from swallowing sodium hydroxide.

Inhalation: Severe Irritant. Effects from inhalation of the dusts, mists, or spray will vary from mild irritation to destructive burns depending on the severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Severe pneumonitis may occur.

Skin: Corrosive! Contact of the skin may cause skin irritation and, with greater exposure, severe burns with scarring.

Eyes: Corrosive! Sodium hydroxide is destructive to eye tissues on contact, will cause severe burns that result in damage to the eyes and even blindness. Contact lenses should not be worn when working with this chemical.

Summary of Chronic Health Hazards: The chronic local effect may consist of multiple areas of superficial destruction of the skin or of primary irritant dermatitis. Similarly, inhalation of dust, spray, or mist may result in varying degrees of irritation or damage to the respiratory tract tissues and an increased susceptibility to respiratory illness. Effects may be delayed.

Signs and Symptoms of Exposure: A physician should be contacted if anyone

develops any signs or symptoms and suspects that they are caused by exposure to sodium hydroxide.
Effects of Overexposure: Sodium hydroxide is a strong alkali and is corrosive to any tissue with which it comes in contact.
Medical Conditions Generally Aggravated by Exposure: Sodium hydroxide is a respiratory irritant. Persons with pre-existing skin disorders or eye problems or impaired pulmonary function may be at increased risk from exposure, and should have limited exposure to this material.
Note to Physicians: Perform endoscopy in all cases of suspected sodium hydroxide ingestion. In cases of severe esophageal corrosion, the uses of therapeutic doses of steroids should be considered. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required.

Section IV - First Aid Measures

Ingestion: Do Not Induce Vomiting. If the person is conscious, give him large quantities of water immediately to dilute the sodium hydroxide. Do not attempt to make the exposed person vomit. DO NOT INDUCE VOMITING! GET MEDICAL ATTENTION IMMEDIATELY.
Inhalation: Move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. If breathing is difficult, give oxygen. Keep the affected person warm and at rest. GET MEDICAL ATTENTION IMMEDIATELY.
Skin: Immediately flush contaminated skin with water. If large areas of the body are contaminated or if clothing is penetrated, immediately use safety shower, removing clothing while under the shower. Flush exposed areas with large amounts of water for at least 15 minutes. GET MEDICAL ATTENTION IMMEDIATELY. Wash clothing before reuse.
Eyes: Immediately flush eyes with a directed stream of water for at least 15 minutes. Forcibly hold eyelids apart to ensure complete irrigation of all eye and lid tissue. Washing eyes within 1 minute is essential to achieve maximum effectiveness. GET MEDICAL ATTENTION IMMEDIATELY. Contact lenses should not be worn when working with this chemical.

Section V - Fire Fighting Measures

Flash Point: Not combustible	**Autoignition Temperature:** Not combustible
Lower Explosive Limit: N/A	**Upper Explosive Limit:** N/A

Unusual Fire and Explosion Hazards: Not combustible but solid form in contact with moisture or water may generate sufficient heat to ignite combustible materials. Contact with some metals can generate hydrogen gas. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Vapors may be heavier than air.

Extinguishing Media: Foam, carbon dioxide, or dry chemicals may be used where this product is stored. Adding water to caustic solution generates large amounts of heat. Do NOT get water inside containers.

Special Firefighting Procedures: This product is not combustible. Full protective clothing and self-contained breathing apparatus should be worn in areas where product is stored.

Section VI - Accidental Release Measures

Leaks should be stopped. Spills should be contained and cleaned up immediately. Spills should be removed by using a vacuum truck. Neutralize remaining traces of material with any dilute inorganic acid such as hydrochloric, sulfuric, nitric, phosphoric, or acetic acid. The spill area should then be flushed with water, followed by liberal covering of sodium bicarbonate. All clean-up material should be removed and placed in approved containers, labeled and stored in a safe place to await proper treatment or disposal. Spills on areas other than pavement (dirt or sand) may be handled by removing the affected soils and placing in approved containers. Avoid runoff into storm sewers and ditches which lead to waterways. Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

Section VII - Handling and Storage

Prevent possible eye and skin contact by wearing protective clothing and equipment. Storage tanks must be vented and diked. Store drums of sodium hydroxide separate from acids, metals and explosives. Provide adequate drainage. When diluting, use agitation and add concentrated sodium hydroxide to water at a controlled rate to control heat of dilution and to avoid splattering. Do not add water to sodium hydroxide. Do not store with aluminum or magnesium. Store above 60°F (16°C) to prevent freezing.

Other Precautions: Sodium hydroxide reacts with reducing sugars such as fructose, lactose, maltose, galactose, levulose, and arabinose to form carbon monoxide. While the potential for worker exposure to carbon monoxide may be small, a potential does exist during cleaning of certain dairy and possibly other industry equipment. Carbon monoxide gas can form upon contact with food and beverage products in enclosed spaces and can cause death. Follow appropriate tank entry procedures.

Special Mixing and Handling Instructions: Considerable heat is generated when water is added to sodium hydroxide; therefore, when making solutions always add the sodium hydroxide to the water with constant stirring. The water should always be lukewarm (80° - 100° F). Never start with hot or cold water. If sodium hydroxide becomes concentrated in one area, or if added too rapidly, or if added to hot or cold water, a rapid temperature increase can result in dangerous boiling and/or spattering or may cause an immediate violent eruption.

Section VIII - Exposure Controls/Personal Protection

Respiratory Protection: Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration or by the National Institute for Occupational Safety and Health.

Ventilation: Ventilation is not usually required for sodium hydroxide solutions. Avoid creation of mist or spray. If present wear appropriate safety clothing and provide local exhaust systems. Where carbon monoxide may be generated, special ventilation may be required.

Protective Clothing: Employees should be provided with and required to use impervious clothing, gloves, face shield (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with solutions of sodium hydroxide. Materials suggested for use are natural rubber, butyl rubber, neoprene, or vinyl.

Eye Protection: Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of sodium hydroxide

contacting the eyes. Contact lenses should not be worn when working with this chemical.
Other Protective Clothing or Equipment: Eyewash stations and safety showers must be available in the immediate work area for emergency use.
Work/Hygienic Practices: Avoid contact with the skin and avoid breathing dust or mist. Do not eat, drink, or smoke in work area. Wash hands before eating, drinking, or using toilet facilities. Do NOT place food, coffee or other drinks in the area where dusting or splashing of solutions is possible.

Section IX - Physical and Chemical Properties

Physical State: Liquid **pH:** 14.0

% of Solution	10%	25%	30%	33%	36%	50%
Boiling Point(°F):	217	234	242	245	253	288

Melting Point/Range: -10°C to 12°C **Molecular Weight:** 40.00 (dry basis)

Appearance/Color/Odor: Clear to slightly gray liquid with no odor

Solubility in Water: Complete **Vapor Pressure(mmHg):** 1.5 to 1.6 @ 20°C; 68°F

% of Solution	10%	25%	30%	33%	36%	50%
Specific Gravity(Water=1)@20°C:	1.109	1.252	1.328	1.363	1.397	1.525

% of Solution	10	25	30	33	36	50
% Volatiles	90	75	70	67	64	50

Vapor Density(Air=1): N/A

% of Solution	10%	25%	30%	33%	36%	50%
Freezing Point (°F):	10	-13.9	36	44	58	54

How to detect this compound: Sampling and analyses may be performed by collection of sodium hydroxide in a glass bubbler containing hydrochloric acid, followed by subsequent titration. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure sodium hydroxide may be used.

Section X - Stability and Reactivity

Stability: Stable **Hazardous Polymerization:** Will not occur

Conditions to Avoid: Overheating in storage accelerates corrosion.

Materials to Avoid: Contact with water, acids, flammable liquids, and organic halogen compounds, especially trichloroethylene, may cause fires and explosions. Contact with metals such as aluminum, tin, and zinc and alloys containing these metals cause formation of flammable hydrogen gas. Contact with nitromethane and other similar nitro compounds cause formation of shock-sensitive salts. Contact with water releases heat which can result in boiling and splattering. Sodium hydroxide, even in fairly dilute solution, reacts readily with various sugars to produce carbon monoxide.

Hazardous Decomposition Products: None

Section XI - Toxicological Information

Sodium hydroxide is a strong alkali; the mist, dust and solutions cause severe injury to the eyes, mucous membranes, and skin. Although inhalation is usually of secondary importance in industrial exposures, the effects from the dust or mist will vary from mild irritation of the nose at 2 mg/m³ to severe pneumonitis, depending on the severity of exposure. The greatest industrial hazard is rapid tissue destruction of eyes or skin upon contact with either the solid or with concentrated solutions. Contact with the eyes causes disintegration and sloughing of conjunctival and corneal epithelium, corneal opacification, marked edema, and ulceration; after 7 to 13 days either gradual recovery begins, or there is progression of ulceration and corneal opacification. Complications of severe eye burns are symblepharon (adhesion of the lid to the eyeball) with overgrowth of the cornea by a vascularized membrane, progressive or recurrent corneal ulceration, and permanent corneal opacification. On the skin, solutions of 25 to 50% cause the sensation of irritation within about 3 minutes; with solutions of 4%, this does not occur until after several hours. If not removed from the skin, severe burns with deep ulceration will occur; exposure to the dust or mist may cause multiple small burns, with temporary loss of hair. Ingestion produces severe pain in the esophagus and stomach, corrosion of the lips, mouth, tongue, and pharynx and the vomiting of large pieces of mucosa; cases of squamous cell carcinoma of the esophagus have occurred with latent periods of 12 to 42 years after ingestion; these cancers may have been sequelae of tissue destruction and possibly scar formation rather than from a direct carcinogenic action of sodium hydroxide itself. Sodium hydroxide: irritation data: skin, rabbit: 500 mg/24H; severe; eye rabbit: 50 ug/24H severe. Investigated as a mutagen.

Section XII - Ecological Information

N/A

Section XIII - Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements. Do not flush to sewer.

Section XIV - Transport Information

DOT Proper Shipping Name: Sodium Hydroxide, Solution
DOT Hazard Class/ I.D. No.: 8, UN1824, II

Section XV - Regulatory Information

Reportable Quantity: 1000 Pounds (454 Kilograms)
NIOSH: 10 mg/m³ IDLH
NFPA Rating: Health - 3; Flammability - 0; Instability - 1
0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme
Carcinogenicity Lists: No **NTP:** No **IARC Monograph:** No **OSHA Regulated:** Yes

25%	Certified to NSF/ANSI Standard 60	Maximum Use	200 mg/L
30%	Certified to NSF/ANSI Standard 60	Maximum Use	167 mg/L
33%	Certified to NSF/ANSI Standard 60	Maximum Use	152 mg/L
50%	Certified to NSF/ANSI Standard 60	Maximum Use	100 mg/L

Section XVI - Other Information

Synonyms/Common Names: Sodium Hydroxide; Soda Lye; Lye; Caustic Soda
Chemical Family/Type: Alkali
Change Since Last Revision: Sections: III, V, VI,VII, VIII, XIII, XV

IMPORTANT! Read this MSDS before use or disposal of this product. Pass along the information to employees and any other persons who could be exposed to the product to be sure that they are aware of the information before use or other exposure. This MSDS has been prepared according to the OSHA Hazard Communication Standard [29 CFR 1910.1200]. The MSDS information is based on sources believed to be reliable. However, since data, safety standards, and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, **Hill Brothers Chemical Company** makes no warranty, either expressed or implied, with respect to the completeness or continuing accuracy of the information contained herein and disclaims all liability for reliance thereon. Also, additional information may be necessary or helpful for specific conditions and circumstances of use. It is the user's responsibility to determine the suitability of this product and to evaluate risks prior to use, and then to exercise appropriate precautions for protection of employees and others.

Appendix C-2: Project Equipment Lists and Cut Sheets

- MF/UF Membrane Modules
  - Toray UF
  - Dow UF
  - Asahi MF
- Tanks
  - MF Filtrate Tank
  - CEB/CIP Tank

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MF/UF Membrane Modules

- Toray UF
- Dow UF
- Asahi MF

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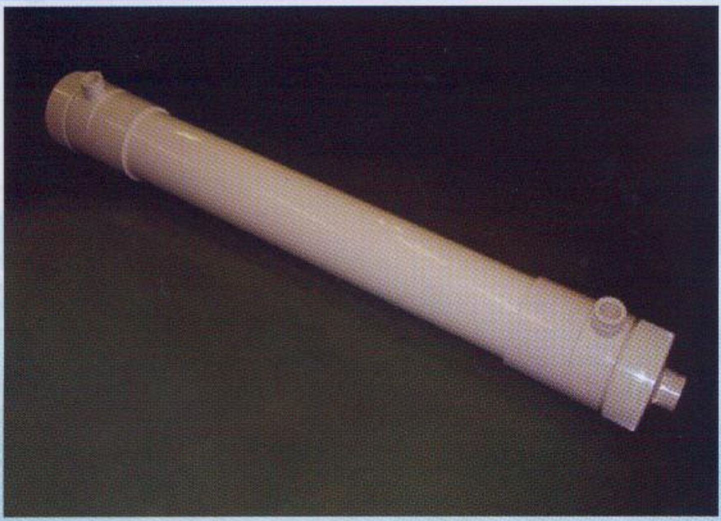
'TORAY'

TORAY PVDF Hollow Fiber UF Membrane Module



Advantage of TORAY UF Module

1. Effective Pathogen Removal such as Colon Bacillus and Cryptosporidium
2. High Quality Module and Durable PVDF Membrane for Reliable Water Production
3. High Flux at Lowest Operating Pressure
4. NSF-61 Approved for Use in Drinking Water Installations
5. High Membrane Surface Module ($72m^2$) for Large Scale Plants

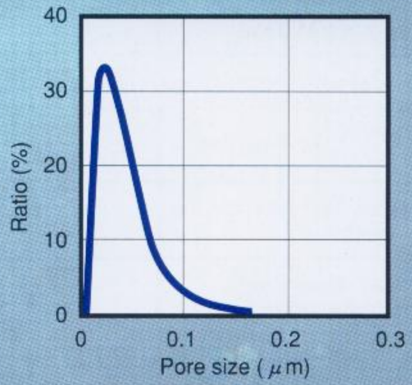
Characteristics of TORAY PVDF Hollow Fiber Membrane

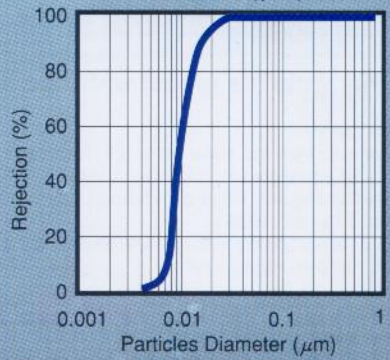
1. High Flux
Special spinning method with PVDF enables high mechanical strength and high permeability at the same time.

2. Small Pore Size & Best Pathogens Removal
The integrity of membrane with 0.02 micron meter of nominal pore size provides a stable quality of filtrate water.

3. High Mechanical Strength
Its excellent mechanical strength ensures sufficient durability against hundreds thousand times of air scrubbing operations.

4. High Chemical Strength
The outstanding chemical resistance of PVDF as membrane material allows chemical cleaning with strong acid or strong oxidation agent.





Rejection Property and Pore Size Distribution

Applications

1. Production of Municipal Drinking Water
2. Reuse of Waste Water (Treatment of secondary effluent)
3. Pretreatment for RO Membrane process (Sea Water Desalination, Waste Water Reuse)
4. Crud Removal in Condensate of Boiler Water
5. Treatment of Industrial Water

Drinking Water Production Plant (Capacity 5,000m^3/d)

Specifications

Membrane

Membrane Material	PVDF (Polyvinylidene fluoride)
Nominal Pore Size	0.02 micron meter

Module Specifications

Module Type		HFS-2020	HFS-2008	HFS-1020	HFS-1010
Membrane Surface Area [Outer Surface]		$72m^2$ ($775 ft^2$)	$11.5m^2$ ($124 ft^2$)	$29m^2$ ($312 ft^2$)	$7m^2$ ($75 ft^2$)
Pure Water Flow Rate at 50kPa,25℃		$20m^3/h$ and over (88gpm and over)	$3.0m^3/h$ and over (13gpm and over)	$10m^3/h$ and over (44gpm and over)	$2.5m^3/h$ and over (11gpm and over)
Dimensions	diameter	216 mm (8.50 inches)	89 mm (3.50 inches)	216 mm (8.50 inches)	114 mm (4.49 inches)
	length	2,160mm (7.087 ft.)	2,000mm (6.562 ft.)	1,120mm (3.675 ft.)	1,078mm (3.537 ft.)
Weight	full of water	110kg	18kg	60kg	15kg
	after draining	67kg	11kg	40kg	9kg

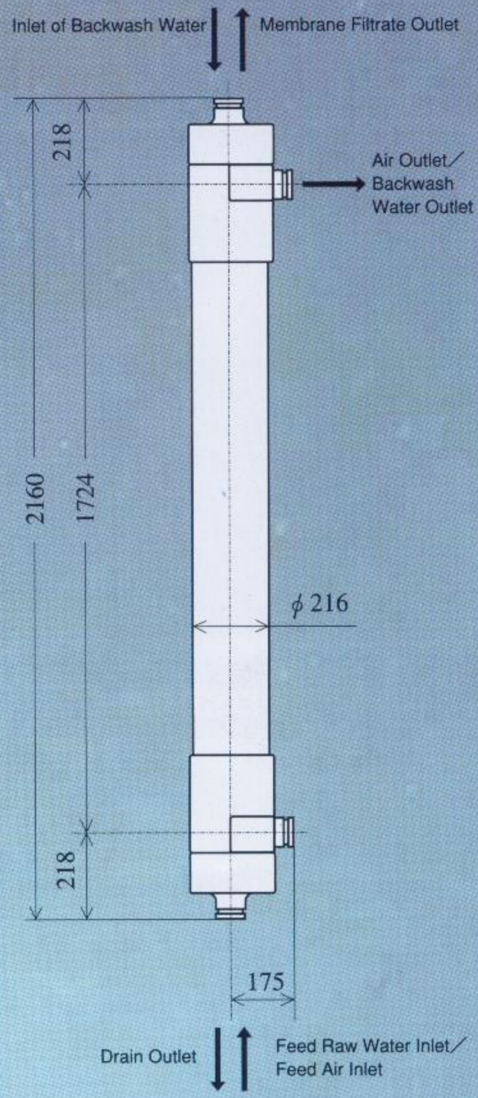
Materials

Housing	Polyvinylchloride
Potting Material	Epoxy Resin

Operating Conditions

Max. Inlet Pressure	300 kPa (44 psi)
Max. Transmembrane Pressure	300 kPa (44 psi)
Max. Operating Temperature	40°C (104°F)
pH Range	1-10 at Filtration, 0-12 at Chemical Cleaning

Module Figure of HFS-2020



Toray satisfies global water treatment needs.

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'TORAY'

Toray Industries, Inc.

DOW™ Ultrafiltration Modules

Model SFP-2860 and SFD-2860

Features

The DOW™ Ultrafiltration (UF) modules are made from high strength, hollow fiber membranes that have excellent features and benefits:

- 0.03 μm nominal pore diameter for removal of bacteria, viruses, and particulates including colloids to protect downstream processes such as RO
- PVDF polymeric hollow fibers for high strength and chemical resistance allows long membrane life
- Hydrophilic PVDF fibers for easy cleaning and wettability that help maintain long term performance
- Outside In flow configuration for high tolerance to feed solids that help reduce the need for pretreatment processes
- U-PVC housing, helping to eliminate the need for costly pressure vessels

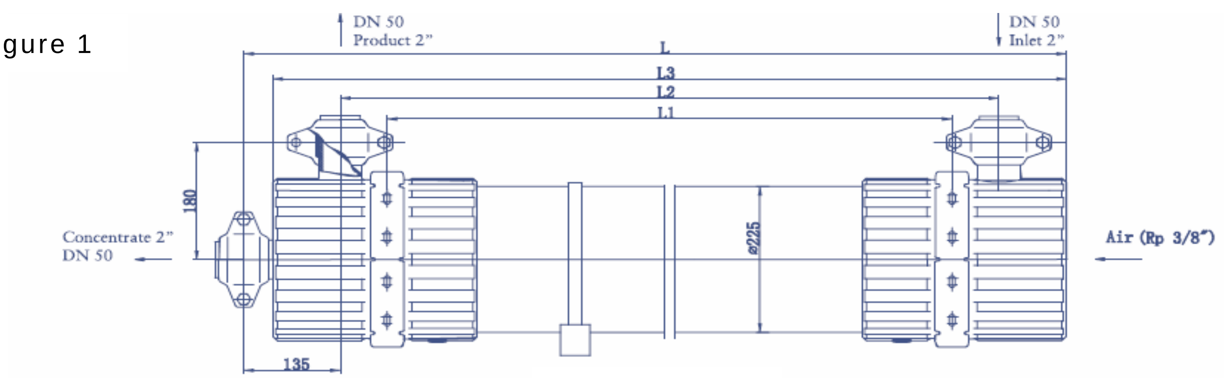
This module is an ideal choice for systems with capacities greater than 50 m^3/hr (220 gpm). The larger, 8 inch diameter module offers the highest effective membrane area of the DOW UF modules, which contributes to a more economical membrane system design. The shorter, 60 inch length module offers higher efficiencies over a wider range of feed water conditions compared to longer length modules.

DOW™ Ultrafiltration Modules can be used for a wide variety of treatment applications such as surface water, seawater, industrial wastewaters, and secondary effluent wastewater.

Product Specifications

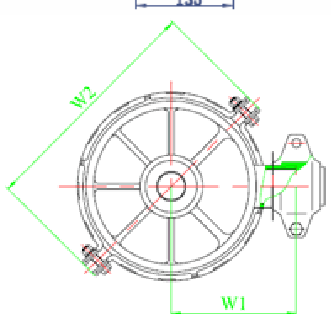
Model	Type	Part Number	Membrane Area m^2	Membrane Area ft^2	Module Volume liters	Module Volume gallons	Weight (empty/water filled) kg	Weight (empty/water filled) lbs
SFP-2860	Pretreatment	280933	51	549	35	9.3	48/83	106/183
SFD-2860	NSF/ANSI 61 Drinking Water	324168	51	549	35	9.3	48/83	106/183

Figure 1



SFP and SFD 2860
(8-inch diameter)

Figure 2



Units \ Properties	Length L	Length L1	Length L2	Length L3	Diameter D	Width W1	Width W2
SI (mm)	1860	1500	1630	1820	225	180	342
US (inch)	73.2	59.1	64.2	71.7	8.9	7.1	13.5

Form No. 795-00013-0411

Operating Parameters

	SI units	US units
Filtrate Flux @ 25ºC	40 - 120 l/m²/hr	24 - 70 gfd
Flow Range	2.0 – 6.1 m³/hr	9.2 – 26.7 gpm
pH, Operating	2 - 11	
Temperature	1 - 40ºC	34 - 104ºF
Max. Inlet Module Pressure (@ 20°C)	6.25 bar	93.75 psi
Max. Operating TMP	2.1 bar	30 psi
Max. Operating Air Scour Flow	12 Nm³/hr	7.1 scfm
Max. Backwash Pressure	2.5 bar	36 psi
NaOCl (max)	2,000 mg/L	
TSS (max)	100 mg/L	
Turbidity (max)	300 ntu	
Particle Size (max)	300 µm	
Flow Configuration	Outside In, Dead End Flow	
Expected Filtrate Turbidity	≤ 0.1 NTU	
Expected Filtrate SDI	≤ 2.5	

Important Information

Proper start-up of a UF system is essential to prepare the membranes for operating service and to prevent membrane damage. Following the proper start-up sequence also helps ensure that system operating parameters conform to design specifications so that system water quality and productivity goals can be achieved. Before initiating system start-up procedures, membrane pretreatment, installation of the membrane modules, instrument calibration and other system checks should be completed. Please refer to the product technical manual.

Operation Guidelines

Avoid any abrupt pressure variations during start-up, shutdown, cleaning or other sequences to prevent possible membrane damage. Flush the UF system to remove shipping solution prior to start up. Remove residual air from the system prior to start up. Manually start the equipment. Target a permeate flow of 60% of design during initial operations. Depending on the application, permeate obtained from initial operations should be discarded. Please refer to the product technical manual.

General Information

If operating limits and guidelines given in this bulletin are not strictly followed, the limited warranty (Form No. 795-00027) will be null and void.

To prevent biological growth during system shutdowns, it is recommended that preservative solution be injected into the membrane modules.

Regulatory Note

NSF/ANSI 61 certified drinking water modules require specific conditioning procedures prior to producing potable water. Please refer to the product technical manual flushing section for specific procedures. Drinking water modules may be subjected to additional regulatory restrictions in some countries. Please check local regulatory guidelines and application status before use and sale.

DOW™ Ultrafiltration
For more information about DOW Ultrafiltration, call the Dow Water & Process Solutions business:

North America: 1-800-447-4369
Latin America: (+55) 11-5188-9222
Europe: (+32) 3-450-2240
Pacific: +60 3 7958 3392
Japan: +813 5460 2100
China: +86 21 3851 1000
http://www.dowwaterandprocess.com/uf

Asahi Kasei Corporation
Module Data Sheet

Module Type	UNA-620A
Date	29 October 2003
Dimensions	
Membrane Area (m^2)	50
Module Length (mm)	2160
Module Diameter (mm)	165
Nominal Pore Size (µm)	0.1
Operating Conditions	
Max. Operating Temp. (Deg. C)	40
pH Range (Long Term Operation)	1 - 10
pH Range (Short Term for Cleaning)	1 – 13
Max. Transmembrane Pressure (bar)	3.0
Max. Inlet Pressure (bar)	3.0
Materials	
Membrane	Polyvinylidenefluoride (PVDF)
Housing	ABS Resin
Potting Material	Polyurethane Resin
Antifreeze/Bacteriostat	40% Calcium Chloride Solution

Tanks

- MF/UF Filtrate Tank
- CEB/CIP Tanks

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NOZZLE SCHEDULE & ACCESSORIES

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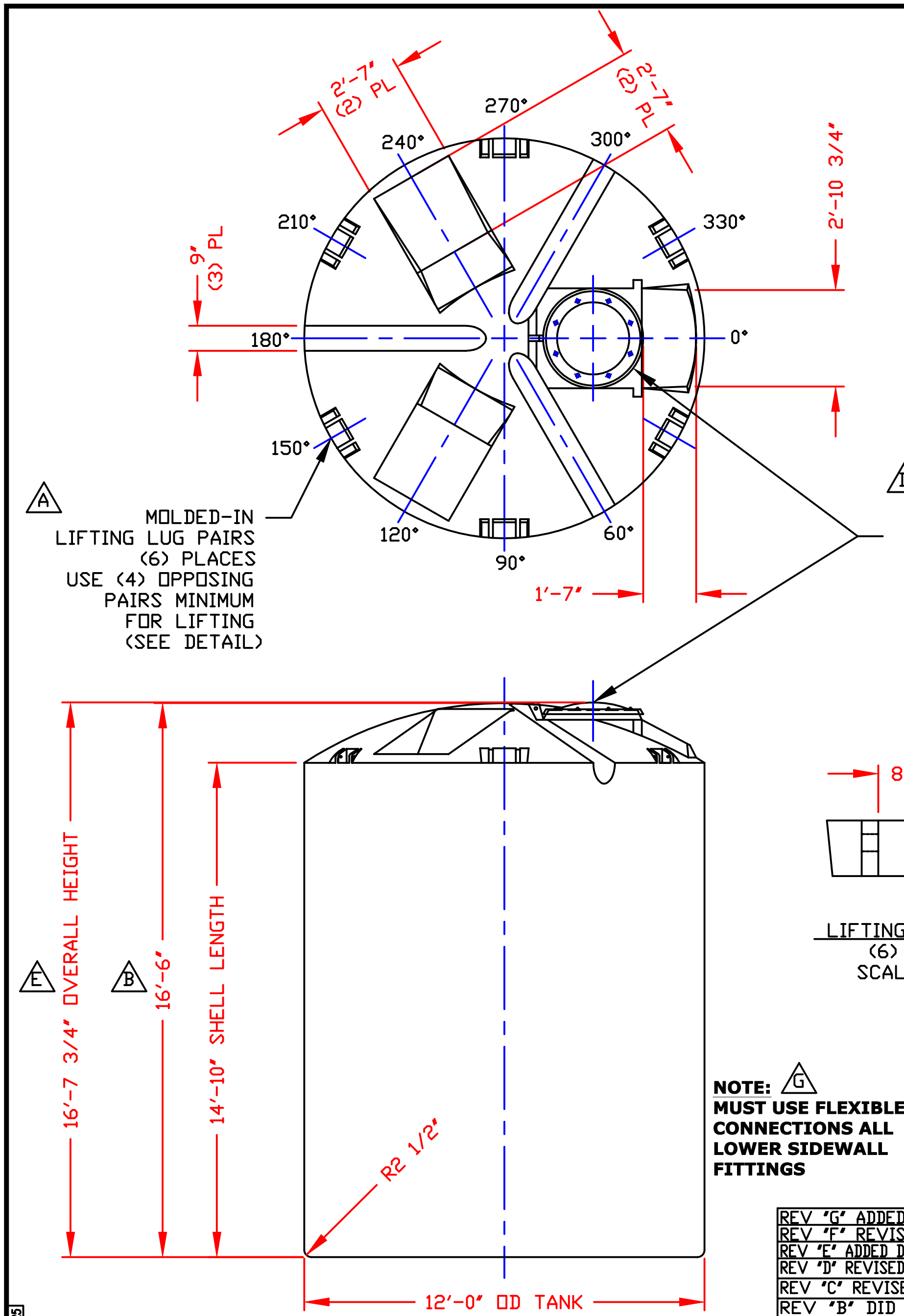
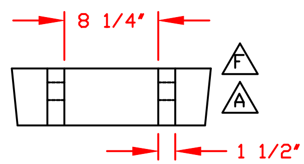


D

STANDARD COVER:
24"/(8) BOLTS MANWAY COVER/PE (SHOWN)
STOCK NO. 3218 OR
24"/STRAPPED MANWAY COVER/PE
STOCK NO. 3217
(OPTIONAL 24" COVERS AVAILABLE)



LIFTING LUG DETAIL
(6) PLACES
SCALE: 1"=1'-0"

NOTE: G
MUST USE FLEXIBLE CONNECTIONS ALL LOWER SIDEWALL FITTINGS

NOTES
1. THIS IS A COMPUTER GENERATED DWG. DO NOT REVISE BY HAND.
2. DIMENSIONS WILL VARY ±3% DUE TO VARIATIONS IN MULTIPLE MOLDS & CONDITIONS PREVALENT DURING MANUFACTURE & USAGE.
3. NO MOLDED IN GALLONAGE MARKERS THIS TANK.

C

CALCULATED CAPACITIES/ VOLUME IN U.S. GALLONS		
DESIGN CAP	DOME VOL	TOTAL VOL
12189	640	12829

REV 'G' ADDED FITTING NOTE BY:JB 2/13/03 CK:MBW
REV 'F' REVISED LIFTING LUG DETAIL BY:JB 1/14/03 CK:WM
REV 'E' ADDED DIMENSION BY:JB 10/22/02 CK:MBW
REV 'D' REVISED DOME & MWY CONFIGURATION BY:MBW 8/28/02 CK:JB
REV 'C' REVISED CALCULATED CAPACITY BY:JB 4/1/02 CK:MBW
REV 'B' DID SAY 16'-7 1/2" BY:JB 4/1/02 CK:MBW
REV 'A' ADDED LIFTING LUGS & DETAIL BY:JB 4/1/02 CK:MBW

DWG TITLE
12150 GALLON UPRIGHT TANK

SCALE: 1/4"=1'-0"	POLY PROCESSING Company	Western Region P.O. Box 80 8055 South Ash Street French Camp, CA 95231 (209) 982-4904 FAX (209) 982-0455	DR: MB WILKERSON
DATE: 3/4/00			CK: D. RECTOR
SHEET 1 OF 1	COMPUTER FILE 11012150	REV G	

B-25

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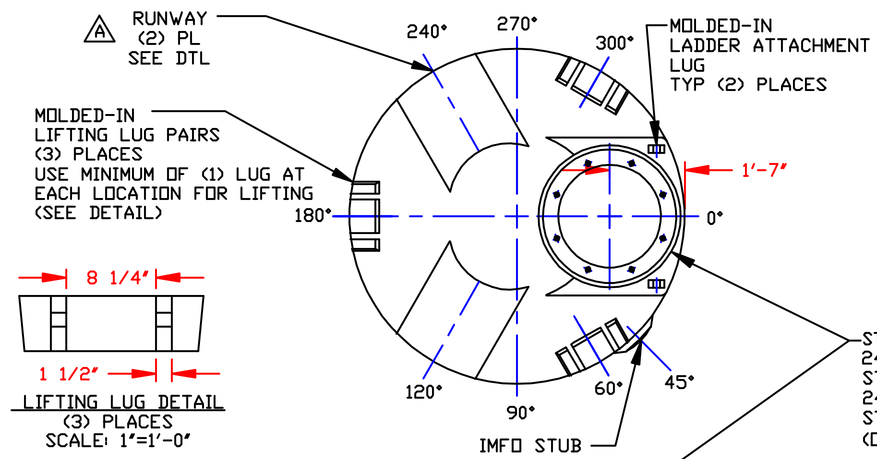
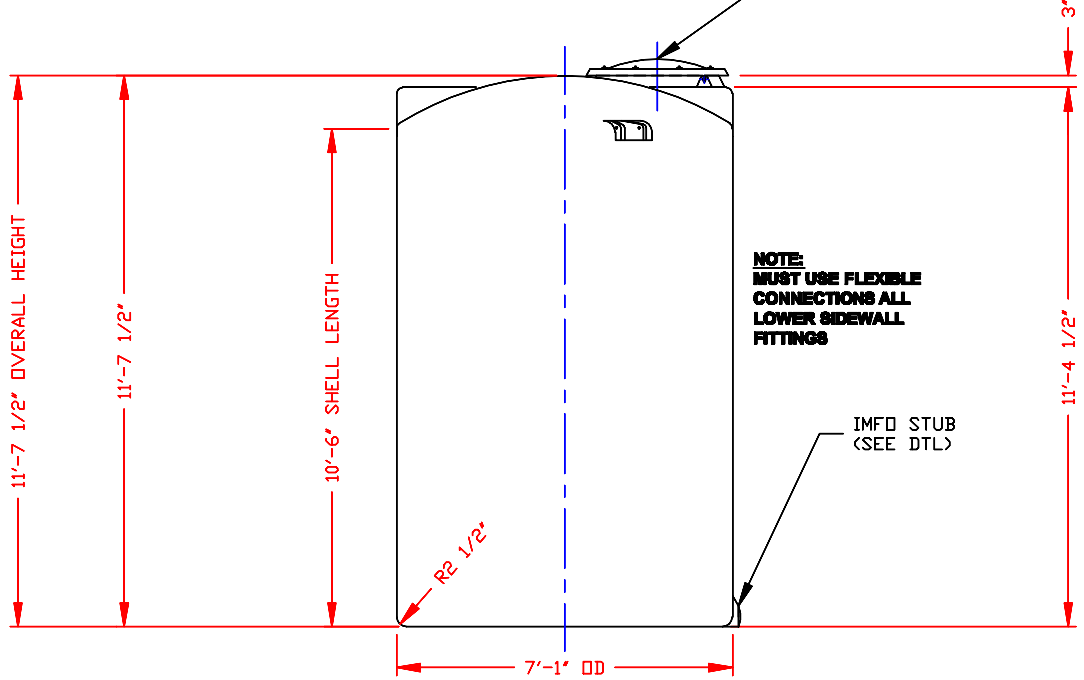
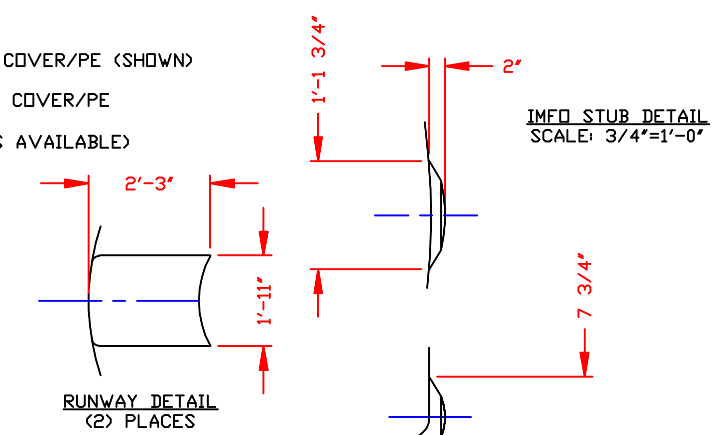


STANDARD COVER:
24"/(8) BOLT MANWAY COVER/PE (SHOWN)
STOCK NO. 3218 OR
24"/STRAPPED MANWAY COVER/PE
STOCK NO. 3217
(OPTIONAL 24" COVERS AVAILABLE)



NOTE:
MUST USE FLEXIBLE CONNECTIONS ALL LOWER SIDEWALL FITTINGS



NOZZLE SCHEDULE & ACCESSORIES

SERVICE	MK	STOCK NO.	SIZE	FITTING	DEG	ELEV

NOTES
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3. MOLDED IN GALLONAGE MARKERS @ APPROX 60° IN 200 GAL INCREMENTS UP TO 2800 GAL.

CALCULATED CAPACITIES/ VOLUME: IN U.S. GALLONS		
DESIGN CAP	DOME VOL	TOTAL VOL
3031	142	3173

DWG TITLE
3000 GALLON UPRIGHT TANK (LA)

SCALE: 3/8"=1'-0"
DATE: 8/12/09

POLY PROCESSING COMPANY LLC

Central Region
P.O. Box 4150 (71211)
2201 Old Sterlington Rd.
Monroe, LA 71203
(318) 343-7565
FAX (318) 343-8795

DR: J. BRANTLEY
CK: W. MANUEL

SHEET 1 OF 1
COMPUTER FILE 1003000L
REV A

REV 'A' ADDED RUNWAYS BY:JB 9/22/09 CK:WM

B-375

Appendix C-3: Electrical Equipment Evaluations

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480 V " MF System "

11/12/12

NO.		DESCRIPTION	LOAD SIZE	LOAD UNIT	LOAD MOTOR RPM	QUANTITY CONN	QUANTITY OPER	QUANTITY EMER	FEEDER SIZING FACTOR	DEM FAC	VOLT KV	CONN KVA	OPER DEMAND KVA	EMERG KVA	FEEDER SIZING CONN. KVA	FEEDER SIZING DEM. KVA	FEEDER SIZING E. KVA
1	-	MF/UF Feed Pump 1	50	HP-VFD	1800 RPM @ 60Hz	1	1	1	1	1	0.48	54.0	54.0	54.0	54.0	54.0	54.0
2	-	MF/UF Feed Pump 2	50	HP-VFD	1800 RPM @ 60Hz	1	1	1	1	1	0.48	54.0	54.0	54.0	54.0	54.0	54.0
3	-	MF/UF Feed Pump 3	50	HP-VFD	1800 RPM @ 60Hz	1	0	0	1	1	0.48	54.0	0.0	0.0	54.0	0.0	0.0
4	-	Automatic Strainer 1	0.5	HP	1800 RPM @ 60Hz	1	1	1	1	1	0.48	0.9	0.9	0.9	0.9	0.9	0.9
5	-	Automatic Strainer 2	0.5	HP	1800 RPM @ 60Hz	1	0	0	1	1	0.48	0.9	0.0	0.0	0.9	0.0	0.0
6	-	MF/UF Backwash Pump 1	50	HP-VFD	1800 RPM @ 60Hz	1	1	1	1	1	0.48	54.0	54.0	54.0	54.0	54.0	54.0
7	-	MF/UF Backwash Pump 2	50	HP-VFD	1800 RPM @ 60Hz	1	0	0	1	1	0.48	54.0	0.0	0.0	54.0	0.0	0.0
8	-	MF/UF CIP Pump 1	40	HP	1800 RPM @ 60Hz	1	1	1	1	1	0.48	43.2	43.2	43.2	43.2	43.2	43.2
9	-	MF/UF CIP Pump 2	40	HP	1800 RPM @ 60Hz	1	0	0	1	1	0.48	43.2	0.0	0.0	43.2	0.0	0.0
10	-	MF/UF CIP 1 Tank Heater	100	FLA		1	1	1	1.25	1	0.48	83.1	83.1	83.1	103.9	103.9	103.9
11	-	MF/UF CIP 2 Tank Heater	100	FLA		1	1	1	1.25	1	0.48	83.1	83.1	83.1	103.9	103.9	103.9
12	-	Air Compressor 1	25	HP	1800 RPM @ 60Hz	1	1	1	1	1	0.48	28.3	28.3	28.3	28.3	28.3	28.3
13	-	Air Compressor 2	25	HP	1800 RPM @ 60Hz	1	0	0	1	1	0.48	28.3	0.0	0.0	28.3	0.0	0.0
14	-			KVA					1.25		0.48	0.0	0.0	0.0	0.0	0.0	0.0
		SPARE CAPACITY	10	%								58.1	40.1	40.1	62.3	44.2	44.2
TOTAL	-	**" MF System "**									**0.48**	**639.1**	**440.7**	**440.7**	**684.9**	**486.4**	**486.4**
		CONNECTED LOAD				STARTER		LARGEST MOTOR					MIN BREAKER TRIP =				868.8
		LARGEST MOTOR CONNECTED	50	HP		VFD		MAX BREAKER TRIP =			110	A	MIN FEEDER AMPS =				900.0
		TOTAL MOTOR HP	381	HP				MAIN BREAKER		80 %		RATED	MAX BREAKER TRIP =				900.0
		TOTAL VFD LOAD	270	KVA													
		DEMAND LOAD				STARTER		LARGEST MOTOR					MIN BREAKER TRIP =				630.0
		LARGEST MOTOR OPERATING	50	HP		VFD		MAX BREAKER TRIP =			110	A	MIN FEEDER AMPS =				601.3
		TOTAL MOTOR HP	216	HP				MAIN BREAKER		80 %		RATED	MAX BREAKER TRIP =				700.0
		TOTAL VFD LOAD	162	KVA													
		EMERGENCY LOAD				STARTER		LARGEST MOTOR					MIN BREAKER TRIP =				630.0
		LARGEST MOTOR OPERATING	50	HP		VFD		MAX BREAKER TRIP =			110	A	MIN FEEDER AMPS =				601.3
		TOTAL MOTOR HP	216	HP				MAIN BREAKER		80 %		RATED	MAX BREAKER TRIP =				700.0
		TOTAL VFD LOAD	162	KVA													
		COMMENTS:															

Appendix C-4: Control Narratives

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Memorandum

To: *Rebecca Bjork, City of Santa Barbara*

From: *Don Cutler, CDM Smith*
Evelyn You, CDM Smith
Ben Teymouri, CDM Smith

Date: *November 21, 2012*

Subject: *Tertiary Filtration Preliminary Design – Control Narratives for MF/UF System*

C.1 Overview of Control System Architecture

The Membrane Filtration (MF/UF) and Demineralization designs for El Estero Wastewater Treatment Plant (EEWWTP) will include the addition of three new programmable logic controllers (PLCs) at the facility (See Drawing I-2A of Appendix A, Preliminary Design Drawings):

- Master PLC – Communicates with the MF/UF and Demineralization system PLCs and provides a means for connecting signals from the new systems with the existing EEWWTP control system. Also communicates directly with new equipment that is not being provided as part of the MF/UF or Demineralization system packages.
- MF/UF System PLC – Vendor provided PLC communicates with MF/UF equipment and Master PLC.
- Demineralization System PLC (Future) – Vendor provided PLC communicates with Demineralization equipment and Master PLC

C.1.1 Communication between MF/UF System PLC and Master PLC

Table C-1 lists the signals that the Master PLC is expected communicate with the MF/UF system PLC. The following sections of this document will only address signals communicated between the MF/UF system PLC with equipment being provided as part of the MF/UF system package.

Table C-1 Master PLC Communication with MF/UF System PLC

MF/UF System Signals
System mode
Feed pump run status
Feed pump fault
Feed flow
Feed pressure
Feed water total chlorine residual
Strainer status
Strainer differential pressure
Transmembrane pressure
Filtrate flow
Filtrate turbidity
Filtrate tank level
BW pump run status
BW pump fault
BW flow
CEB tank level
CEB tank high-high level alarm
CEB tank high temperature alarm
CIP tank level
CIP tank high-high level alarm
CIP tank high temperature alarm
CIP pump run status
CIP pump fault
CIP flow

MF/UF System Signals
Air compressor run status
Air compressor fault
NaOCl CIP pump run status
NaOCl CIP pump fault
Citric acid CIP pump run status
Citric acid CIP pump fault
NaOH CIP pump run status
NaOH CIP pump fault

C.1.2 Communication between Master PLC and Existing Facility SCADA System

The new PLCs for the MF/UF and Demineralization systems will also communicate with the existing EEWWTP PLCs and will be fully integrated into the existing facility Supervisory Control and Data Acquisition (SCADA) system. The plan for this integration will be developed during final project design.

C.2 MF/UF System Components

The following lists the primary components controlled by the MF/UF PLC. See Section C.4 for control descriptions specific to individual equipment.

- Feed Pumps – Three (2 duty, 1 standby) pumps boost pressure from secondary effluent to MF/UF skids.
- Automatic Strainers – Two parallel strainers installed immediately upstream of MF/UF skids to protect membranes from damage and/or fouling due to larger particles.
- MF/UF Skids – Three (2 duty, 1 standby) standard vendor skids with pressurized outside-in configuration.
- Filtrate Tank – One 6,000 gallon tank for equalization of filtrate for MF/UF backwashing and future demineralization system feed.
- Backwash Pumps – Two (1 duty, 1 standby) pumps for MF/UF backwashing.
- Clean-in-Place (CIP) System and Chemically Enhanced Backwash (CEB) System – Includes CIP tank (common with future demineralization system), CEB tank and CEB/CIP pumps for membrane cleaning.
- Compressed Air System – Two (1 duty, 1 standby) air compressors for air scour during membrane backwash, membrane integrity testing and pneumatic actuated control valves.
- Chemical Feed Systems – Chemical feed equipment for feed water chloramination and membrane cleaning.

C.3 MF/UF Process Descriptions

There are five basic modes of operation for the MF/UF skids:

- Filtration – MF/UF skid is filtering secondary effluent and filling filtrate tank.
- Backwash and Air Scour – Each skid is expected to backwash with air-scour approximately every 20-30 minutes (operator adjustable time interval) with no overlap in backwash sequences between skids.
- Membrane Integrity Test (MIT) – Membrane integrity test of each skid expected to be performed on a regular basis to test the integrity of the filters to ensure that there are no leaks in the membrane fibers. The MIT is a pressure decay test, performed by pressurizing one side of the module with compressed air, isolating the module, and measuring how fast the pressure on the high-pressure side decreases. Since the extremely small pores in the module fibers will not allow free passage of undissolved air through the membrane, the pressurized side should maintain nearly constant pressure if the membrane has no flaws. However, if one or more of the modules being tested has broken fibers, the air is allowed to pass through to the other side of the membrane, and the pressure on the high-pressure side decreases.
- Chemically Enhanced Backwash (CEB) – Each skid is cleaned by soaking in dilute chlorine solution for 15-60 minutes (operator adjustable duration) daily for membrane performance retention. Provisions will be made for daily CEBs, but system will not rely on daily CEBs to maintain production capacity.
- Clean-in-Place (CIP) – Each skid is shut down and isolated every 30-40 days for chemical recirculation and soaking (in chlorine solution or acid solution) to restore membrane performance.
- Standby – Skid is online and ready to be put into service.
- Offline – Skid is taken out of service.

The level of automation for the MF/UF system will be as follows:

- Start-Up – Operator initiated. Fully automated using operator-input set-points. Operator input of the production capacity set-point is required to start the MF/UF system.
- Filtration – Based on the production capacity set-point and available secondary effluent flow, the number of MF/UF skids online will be determined. The MF/UF skids will maintain constant flow based on the set-point.
- Shut-Down – Fully automated. The MF/UF skids will shut down one skid at a time if pressure in the secondary effluent pipe decreases, or if the chlorine contact basin level increases above alarm level.
- Backwash and Air Scour – Fully automated. Backwashes are initiated on a timer and high transmembrane pressure. The MF/UF backwashes are prevented in MF/UF filtrate tank level is below a setpoint.
- Membrane Integrity Test – Fully automated. MITs are initiated based on a timer, or Operator initiated.
- CEB – Fully automated.

- CIP – Operator initiated. Fully automated using operator-input setpoints.

C.3.1 Filtration Mode

C.3.1.1 Filtration Pre-Startup

Prior to MF/UF startup, operators shall perform the following checks:

- Ensure all equipment is energized, in automatic and ready to receive flow.
- System valves are configured to allow secondary effluent flow to MF/UF feed pumps, strainers and to duty MF/UF skids.
- Facilities downstream of MF/UF system are ready to receive flow.
- Chemical storage tank levels and metering pumps skids are ready for operation.
- MF/UF system is placed in "Standby-Ready to Receive Flow" mode through system HMI or EEWWTP SCADA system.

C.3.1.2 Filtration

- Start MF/UF feed pumps through system HMI or EEWWTP SCADA system.
- Feed water pressure is sensed and transmitted to system PLC.
- Flow passes through automatic strainers which start on signal from MF/UF feed pumps. Strainer differential pressure is sensed and transmitted to system PLC.
- Strainer discharge flow is sensed and transmitted to system PLC.
- Strainer discharge total chlorine residual is analyzed and transmitted to system PLC.
- Sodium hypochlorite (SHC) feed pumps start on signal from MF/UF feed pumps. Chemical pump speed is flow paced and trimmed based on total chlorine residual reading.
- Flow passes through influent pneumatically operated isolation flow control valves for duty skids. Valve position is transmitted to system PLC.
- MF/UF feed pressure and temperature are sensed and transmitted to system PLC. The pressure signal is also used as the high pressure signal source of the MF/UF module differential pressure computed by the system PLC.
- Feed water is fed to the supply (lower connection) of the MF/UF modules.
- MF/UF filtrate (top connection) flow and pressure is sensed and transmitted to system PLC.
- Filtrate passes through effluent pneumatically operated isolation flow control valves. Valve position is transmitted to system PLC.
- Filtrate turbidity and pressure are sensed and transmitted to system PLC. The pressure signal is also used as the low pressure signal source of the MF/UF module differential pressure computed by the system PLC.
- Flow discharges to the filtrate tank.

C.3.2 Backwash and Air Scour Mode

MF/UF backwash (BW) is estimated to occur every 20-30 minutes and last approximately 30-60 seconds. The MF/UF system PLC is programmed to automatically initiate a BW without overlap in BW sequences between skids.

- BW water is supplied from the filtrate tank. Tank level is sensed and transmitted to system PLC.
- BW pumps run on variable frequency drives (VFDs) and are speed controlled by the MF/UF system PLC. Discharge pressure and flow is sensed and transmitted to system PLC.
- BW supply passes through BW influent pneumatically operated isolation flow control valve. Valve position is transmitted to system PLC.
- BW supply pressure and flow is sensed and transmitted to system PLC.
- BW supply flows to MF/UF module top connections.
- BW flow discharges MF/UF modules through upper side ports and passes through the BW discharge pneumatically operated isolation flow control valve. Valve position transmitted to system PLC.
- BW water is discharged to drain.

Immediately following an MF/UF skid BW, an air-scour is automatically initiated by the system PLC and is estimated last 30-60 seconds.

- The compressed air system supplies dry air at 40 psi to the MF/UF modules through a refrigerated air dryer, condensing filter and air control valve. Valve position is transmitted to system PLC. Discharge air flow and pressure are sensed and transmitted to the system PLC.
- Air flow passes through the air scour influent pneumatically operated isolation control valve. Valve position is transmitted to the system PLC.
- Air scour supply enters the MF/UF modules through the bottom connection and discharges through the upper side port. Air flow then passes through the pneumatically actuated BW discharge flow control valve. Valve position is transmitted to system PLC.
- Air scour flow is discharged to drain.

C.3.3 CEB Cleaning Mode

Chemically enhanced backwash (CEB) cleanings may be utilized on an as-needed basis, as often as daily, for MF/UF skids in service. The CEBs involve a 15-60 minute (operator adjustable duration) soak with SHC solution (500 to 1,000 mg/L solution). These daily cleanings are described in the sequence below and can be initiated and controlled automatically from the MF/UF system PLC. The same pumps are used to perform an MF/UF CEB or CIP.

- CEB water is supplied from the CEB tank. CEB tank is filled with MF/UF filtrate for batching (RO permeate will be used to fill the tank once RO system is installed). Tank level is sensed and transmitted to system PLC.

- CEB/CIP pump starts and runs for a period of time as programmed by system PLC. Discharge flow, pressure and temperature are sensed and transmitted to system PLC.

- SHC pump starts on signal from MF/UF PLC and runs for a period of time programmed by system PLC.

- CEB/CIP pump and SHC pumps stop. Air exhaust valve and BW discharge pneumatically operated flow control valve closes. Valve position is transmitted to system PLC.

- MF/UF modules soak for 15 to 60 minutes (operator adjustable duration). During the soak, Air scour is periodically initiated through compressed air system.

- The CEB waste solution must be drained manually by opening drain valve BFV-XXX.

- After the soak, the BW pump can be used to flush filtrate from the filtrate tank through the modules with additional air scour from the compressed air system until the overflow meets the desired water quality.

C.3.4 CIP Mode

CIP cleanings are required every 30-40 days for MF/UF skids in service and involve soaking or recirculation with SHC or citric acid (CA) chemical solutions. The CIP cleanings are described in the sequence below and are initiated from the MF/UF system HMI. The same pumps are used to perform an MF/UF CEB or CIP. CIP using SHC will be performed using CEB Tank. CIP using CA will be performed using CIP Tank.

- CIP water is supplied from the CEB tank (for SHC CIP) or CIP tank (for CA CIP). CEB tank (or CIP tank) is filled with MF/UF filtrate for batching (RO permeate will be used to fill the tank once RO system is installed). Tank level is sensed and transmitted to system PLC.

- On the MF/UF HMI, operator selects the SHC chemical feed pump or CA chemical feed pump. SHC or CA pump automatically starts and runs for a period of time programmed by the system PLC to achieve a target chemical concentration in the CIP tank.

- For SHC CIP solution batching, add SHC (500 to 1,000 mg/L dose) directly to CEB Tank and recirculate in tank to mix. Immersion heater is provided in CEB tank to heat solution on an as-needed basis for improved cleaning.

- For CA CIP solution batching, add CA (20,000 mg/L dose) directly to CIP tank and recirculate in tank to mix. Immersion heater is provided in CIP tank to heat solution on an as-needed basis for improved cleaning.

- Plant operator initiates CIP soak or CIP recirculation from MF/UF HMI for MF skid that is shut down and isolated.

- Recirculate CIP solution through membranes for 30 minutes. For CIP recirculation, operator selects flow rate and duration on MF/UF HMI in accordance with vendor O&M information and starts the CEB/CIP duty pump.

- Soak membranes in CIP solution for 1 to 4 hours. For soaking, the operator stops the pump after a period of time to displace the water from the MF/UF modules in accordance with vendor

O&M information. Discharge flow, pressure and temperature are sensed and transmitted to system PLC.

- After soaking is complete recirculate CIP solution through membranes for additional 30 minutes.
- After recirculation is complete, return CIP waste solution to tank. Add neutralization chemical (sodium bisulfite to waste SHC CIP solution, and sodium hydroxide (NaOH) for waste CA CIP solution) to respective tank and recirculate in tank to mix.
- Confirm neutralization is complete (check chlorine residual for waste SHC CIP solution, and pH for waste CA CIP solution) and drain tank to sewer.

C.3.5 Shutdown Mode

- All pumps off.
- All automated valves shut.
- All PID loops inactive.
- All instruments ignored.
- All pressure switches remain active to protect pumps, piping, and equipment.

C.4 Equipment Control Narratives

C.4.1 Feed Pumps

The MF/UF feed pumps are fed from the secondary effluent clarifiers and pump through the automatic strainers to the MF/UF skids. The operator selected duty pumps are started by plant operators when the MF/UF system and associated equipment is ready to receive flow. Pump speed is controlled through the MF/UF system PLC in order to maintain constant feed flow as transmembrane pressure varies. The pumps will automatically shut down on high pressure signal from MF/UF module feed header or from local high discharge pressure and high motor temperature switches.

Table C-2 lists feed pump signals that are communicated with the system PLC and displayed locally, typical for three pumps.

Table C-2 Feed Pump PLC and Local Signals

PLC Signals	Local Display
Flow set point	Pump Fault
Pump speed	Discharge pressure
Run status	
Automatic/local status	
Pump fault	
Start/stop command	
High motor temperature alarm	
High discharge pressure alarm	

C.4.2 Automatic Strainers

The MF/UF automatic strainers are installed downstream of the feed pumps and discharge to the MF/UF modules .They are automatically started on signal from the MF/UF feed pumps. Differential pressure is monitored upstream and downstream of the strainer screens and transmitted to the system PLC. Strainer backwash cleaning cycles are initiated when a preset differential pressure between 5 -10 psi is reached. The system PLC is programmed such that cleaning cycles for the two strainers will not overlap. Backwashes can also be initiated manually through the local control panel. The strainers will automatically turn off when MF/UF feed pumps are shutdown.

Table C-3 lists automatic strainer signals that are communicated with the system PLC and displayed locally, typical for two strainers.

Table C-3 Automatic Strainer PLC and Local Signals

PLC Signals	Local Display
High differential pressure alarm	Influent pressure
Run status	Discharge pressure
Automatic/local status	Differential pressure
BW flow control valve position	

C.4.3 MF/UF Skids

The MF/UF skids receive pressurized flow from the MF/UF feed pumps and discharges to the filtrate tank. The modes of operation for the system are controlled through the system PLC and described in Section C.3.

Table C-4 lists MF/UF system signals that are communicated with the system PLC and displayed locally, typical for three skids where applicable. This table does not include signals that are directly associated with other equipment and listed elsewhere in Section C.4.

Table C-4 MF/UF System PLC and Local Signals

PLC Signals	Local Display
Influent header feed flow	Influent total chlorine residual
Influent total chlorine residual	Influent feed pressure
Influent isolation flow control valve position	Filtrate pressure
Influent pressure	
Influent temperature	
Filtrate flow	
Filtrate pressure	
Effluent isolation flow control valve position	
Effluent turbidity	
Discharge pressure	
BW influent isolation flow control valve position	
BW discharge isolation flow control valve position	
Drain discharge isolation flow control valve position	

C.4.4 Filtrate Tank

The filtrate tank is continuously filled with filtrate from the MF/UF system and overflows into the chlorine contact basin. The tank is used for MF/UF BW supply water and feeds the BW pumps. Filtrate tank level is sensed and transmitted to the MF/UF PLC. A sight gauge also allows for local monitoring of tank level. The MF/UF system is programmed to operate such that the tank continuously overflows and there is always a sufficient BW supply source. A high-high level switch is installed in the tank and if activated will shut down the MF/UF feed pumps.

After future installation of the EEWWTP demineralization system, the filtrate tank will also be filled with permeate from the reverse osmosis (RO) system. The combined mixture of MF/UF filtrate and RO permeate will be used to feed the RO system and the remaining flow will overflow to the chlorine contact basin. The filtrate tank will also continue being used for MF/UF BW supply.

Table C-5 lists the filtrate tank signals that are communicated with the system PLC and displayed locally.

Table C-5 Filtrate Tank PLC and Local Signals

PLC Signals	Local Display
Tank level	Tank level
Tank high level alarm	
Tank influent MF/UF filtrate flow control valve position for low tank connection	
Tank influent MF/UF filtrate flow control valve position for high tank connection	
Tank influent RO permeate flow control valve position (Future)	

C.4.5 Backwash Pumps

The MF/UF backwash (BW) pumps are fed from the MF/UF filtrate tank and pump to the top connection of MF/UF skids opposite to normal flow path during filtration mode. The operator selected duty pump is started automatically in accordance with system PLC programming that initiates an MF/UF backwash approximately every 20-30 minutes and lasts approximately 30-60 seconds. Pump speed is controlled through the MF/UF PLC in order to meet a system flow set point. The pump automatically shuts down after BW cycle is complete or from local high discharge pressure and high motor temperature switches.

Table C-6 lists the BW pump signals that are communicated with the system PLC and displayed locally, typical for two pumps.

Table C-6 BW Pump PLC and Local Signals

PLC Signals	Local Display
Flow set point	Discharge pressure
Pump speed	
Run status	
Automatic/local control status	
Pump fault	
Start/stop command	
High motor temperature alarm	
High discharge pressure alarm	
Discharge flow	

C.4.6 CEB Tank

The CEB tank is filled with filtrate from the MF/UF system. It is used for MF/UF CEB supply water and feeds the CEB/CIP pumps. A tank heater is installed within the tank to heat the tank contents to enhance membrane cleaning performance. The tank heater is controlled by the MF/UF system PLC to meet a system temperature set point. A high temperature switch is installed in the tank and if activated will turn off the tank heater and send an alarm to the system PLC.

Tank level is sensed and transmitted to the MF/UF PLC. A sight gauge also allows for local monitoring of tank level. To fill the tank, the tank influent flow control valve automatically opens and fills to a system PLC programmed level set point. The tank is also filled with CEB return solution during an CEB cleaning. The SHC chemical feed pump for membrane cleaning is started automatically by the system PLC and runs for a system PLC programmed duration, filling the tank to achieve a target chemical concentration.

After future installation of the EEWWTP demineralization system, the CEB tank will be filled with RO permeate water using the RO flush pumps instead of MF/UF filtrate. A tank influent flow control valve will also be used on this line to control tank level.

A high-high level switch is installed in the tank and if activated will close all influent flow control valves.

Table C-7 lists the CEB tank signals that are communicated with the system PLC and displayed locally.

Table C-7 CEB Tank PLC and Local Signals

PLC Signals	Local Display
Tank level	Tank level
Tank high level alarm	
Tank high temperature alarm	
Tank influent MF/UF filtrate flow control valve position	
Tank influent CIP recirculation flow control valve position	
Tank influent RO permeate flow control valve position (Future)	

C.4.7 CIP Tank

The CIP tank is filled with filtrate from the MF/UF system. It is used for MF/UF CIP supply water and feeds the CEB/CIP pumps. A tank heater is installed within the tank to heat the tank contents to enhance membrane cleaning performance. The tank heater is controlled by the MF/UF system PLC to meet a system PLC programmed temperature set point. A high temperature switch is installed in the tank and if activated will turn off the tank heater and send an alarm to the system PLC.

Tank level is sensed and transmitted to the MF/UF PLC. A sight gauge also allows for local monitoring of tank level. To fill the tank, the tank influent flow control valve automatically opens and fills to a programmed level set point. The tank can also be filled from the CIP return line during CIP recirculation. An influent flow control valve is installed on this line and opens automatically during CIP recirculation.

The operator selected duty SHC or CA chemical feed pump is started automatically by the system PLC and runs for a system set duration filling the tank to achieve a target chemical concentration.

After future installation of the EEWWTP demineralization system, the CEB tank will be filled with RO permeate water from the RO flush pumps instead of MF/UF filtrate. A tank influent flow control valve will also be used on this line to control tank level. In addition to MF/UF CIP operation, this tank will also be used for RO system CIP operation.

A high-high level switch is installed in the tank and if activated will close all influent flow control valves.

Table C-8 lists the CIP tank signals that are communicated with the system PLC and displayed locally.

Table C-8 CIP Tank PLC and Local Signals

PLC Signals	Local Display
Tank level	Tank level
Tank high level alarm	
Tank high temperature alarm	
Tank influent MF/UF filtrate flow control valve position	
Tank influent CIP recirculation flow control valve position	
Tank influent RO permeate flow control valve position (Future)	

C.4.8 CEB/CIP Pumps

The CEB/CIP pumps are fed from the CEB tank or CIP tank and pump to the MF/UF module influent header. The operator selected duty pump is started through the MF/UF system HMI when the operator decides to perform an CEB or CIP. CEB events can be programmed to initiate automatically once a day for each skid in service. The pumps are constant speed and will run for a duration determined by the MF/UF PLC depending on if a CIP or CEB is initiated. The pumps can supply cleaning solution for soaking or recirculation in accordance with process descriptions presented in Section C.3.

The pumps will automatically shut down on from local high discharge pressure and high motor temperature switches.

After future installation of the EEWWTP demineralization system, the CEB/CIP pumps will also be used for RO system CIP operation.

Table C-9 lists the BW pump signals that are communicated with the system PLC and displayed locally, typical for two pumps.

Table C-9 CEB/CIP Pump PLC and Local Signals

PLC Signals	Local Display
Flow set point	Discharge pressure
Run status	
Automatic/local control status	
Pump fault	
Start/stop command	
High motor temperature alarm	
High discharge pressure alarm	
Discharge flow	

C.4.9 Compressed Air System

The MF/UF compressed air system includes an air compressor, refrigerated air dryer, condensing filter and associated valves and piping. The system feeds compressed air to the pneumatically actuated MF/UF system flow control valves and also supplies air scour supply to the MF/UF membrane modules. When in automatic, the air compressor runs as needed to supply 40 psi pressurized air for air scour and 80 psi for flow control valves. The air compressor can also be started or stopped from its local control panel.

The MF/UF system PLC sends signals to the pneumatically actuated flow control valves in accordance with system modes described in Section C.3.

Table C-10 lists compressed air system signals that are communicated with the system PLC and displayed locally.

Table C-10 Compressed Air System PLC and Local Signals

PLC Signals	Local Display
Run status	Tank pressure
System fault	System fault
Automatic/local status	Air scour supply discharge pressure
Air scour supply discharge flow	Control air supply discharge pressure
Air scour supply flow control valve position	
Air scour supply discharge pressure	

C.4.10 Sodium Hypochlorite Feed Pumps for MF/UF Pre-Treatment

The SHC chemical feed pumps are fed from a storage tank and supply SHC to the MF/UF feed water downstream of the MF/UF feed pumps. The operator selected duty SHC chemical feed pump starts on signal from MF/UF feed pumps and SHC pump speed is flow paced from MF/UF feed flow and trimmed based on total chlorine residual reading. The pumps will automatically shut down on loss of signal from the MF/UF feed pumps or from local high discharge or high motor temperature switches.

Table C-11 lists the SHC chemical feed pump signals that are communicated with the system PLC and displayed locally, typical for two pumps.

Table C-11 SHC Chemical Feed Pump PLC and Local Signals

PLC Signals	Local Display
Pump speed set point	Discharge pressure
Pump speed	
Run status	
Automatic/local status	
Pump fault	
Start/stop command	
High motor temperature alarm	
Low suction pressure alarm	
High discharge pressure alarm	

C.4.11 Sodium Hypochlorite Feed Pumps for MF/UF CEB

The CEB SHC chemical feed pumps are fed from a storage tank and supply SHC to the CEB tank. The operator selected duty CEB SHC chemical feed pump is started automatically by the system PLC and runs for a system set duration filling the tank to achieve a target chemical concentration for MF/UF CEB. The pumps will automatically shut down from local high discharge or high motor temperature switches.

Table C-12 lists the CEB SHC chemical feed pump signals that are communicated with the system PLC and displayed locally, typical for two pumps.

Table C-12 CEB SHC Chemical Feed Pump PLC and Local Signals

PLC Signals	Local Display
Pump speed set point	Discharge pressure
Pump speed	
Run status	
Automatic/local status	
Pump fault	
Start/stop command	
High motor temperature alarm	
Low suction pressure alarm	
High discharge pressure alarm	

C.4.12 Citric Acid Feed Pumps for MF/UF CIP

The CA chemical feed pumps are fed from a storage tank and supply CA to the CIP tank. The operator selected duty CA chemical feed pump is started automatically by the system PLC and runs for a system set duration filling the tank to achieve a target chemical concentration for MF/UF CIP. The pumps will automatically shut down from local high discharge or high motor temperature switches.

Table C-13 lists the CA chemical feed pump signals that are communicated with the system PLC and displayed locally, typical for two pumps.

Table C-13 Citric Acid Chemical Feed Pump PLC and Local Signals

PLC Signals	Local Display
Pump speed set point	Discharge pressure
Pump speed	
Run status	
Automatic/local status	
Pump fault	
Start/stop command	
High motor temperature alarm	
Low suction pressure alarm	
High discharge pressure alarm	

C.4.13 Sodium Hydroxide Feed Pumps for MF/UF CIP

The sodium hydroxide (NaOH) chemical feed pumps are fed from a storage tank and supply NaOH to the CIP tank. The operator selected duty NaOH chemical feed pump is started automatically by the system PLC and runs for a system set duration filling the tank to achieve a target chemical concentration for MF/UF CIP. The pumps will automatically shut down from local high discharge or high motor temperature switches.

Table C-14 lists the NaOH chemical feed pump signals that are communicated with the system PLC and displayed locally, typical for two pumps.

Table C-14 Sodium Hydroxide Chemical Feed Pump PLC and Local Signals

PLC Signals	Local Display
Pump speed set point	Discharge pressure
Pump speed	
Run status	
Automatic/local status	
Pump fault	
Start/stop command	
High motor temperature alarm	
Low suction pressure alarm	
High discharge pressure alarm	

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Appendix C-5: Opinion of Probable Cost of Construction

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Opinion of Probable Construction Cost-Filtration Option-October 2012

Project name	El Estero TertFiltFac
Estimator	KJ
Labor rate table	CA12 - LA County EE
Equipment rate table	00 12 Equip BOF
Bid date	10/18/2012
Notes	This is an Opinion of Probable Construction Cost only, as defined by the documents provided at the level of design indicated above. CDM has no control over the cost of labor, materials, equipment, or services furnished, over schedules, over contractor's methods of determining prices, competitive bidding (at least 3 each - both prime bidders and major subcontractors), market conditions or negotiating terms. CDM does not guarantee that this opinion will not vary from actual cost, or contractor's bids. There are not any costs provided for: Change Orders, Design Engineering, Construction Oversight, Client Costs, Finance or Funding Costs, Legal Fees, Land Acquisition or temporary/permanent Easements, Operations, or any other costs associated with this project that are not specifically part of the bidding contractor's proposed scope. Assumptions: No rock excavation is required. Only nominal dewatering is needed. No consideration for contaminated soils or hazardous materials (e.g. asbestos, lead) Based on a 40 hour work week with no overtime. Electric Utility line extensions/service drops not estimated.
Report format	Sorted by 'Area/95CSI Sctn/Element' 'Detail' summary

Spreadsheet Level	Takeoff Quantity	Labor Man Hrs	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Amount
010 MF									
0222D Demolition - Existing Filtration Area									
02220.220A Equipment Demolition	6.00 cd	54.000	20,753		7,711	1,240		4,950.61 /cd	29,704
02220.222A Piping Demolition	5.00 cd	52.000	17,696		6,865	1,116		5,135.50 /cd	25,678
02220.224A Structural Steel and Metals Demolition	3.00 cd	32.000	10,664		4,170	775		5,202.70 /cd	15,608
02220.226A Asphalt Paving Demolition	1.00 ls	40.333	2,446		1,612	1,616		5,673.15 /ls	5,673
02220.228A Concrete Demolition	750.00 cy	284.000	54,083		39,421	19,695		150.93 /cy	113,200
02220.228B Can Pump Station Demo	2.00 cd	32.000	7,732		6,076	773		7,290.56 /cd	14,581
15000.2212 Influent/Effluent Connections	1.00 ls					50,000		50,000.00 /ls	50,000
16010.2001 Electrical Demo	1.00 ls	224.000	17,641		6,720			24,361.12 /ls	24,361
0222D Demolition - Existing Filtration Area		718.333	131,015		72,574	75,215		/cd	278,804
02300 Earthwork									
02300.2202 Structural Excavation and Fill	1.00 ls	66.000	4,794		2,653			7,446.12 /ls	7,446
02300 Earthwork		66.000	4,794		2,653				7,446
03000 Concrete									
03000.2202 Allowance for new Piles	1.00 ea					24,000		24,000.00 /ea	24,000
03000.2204 New Pilecap Slab - MF	130.00 cy					71,500		550.00 /cy	71,500
03000.2205 Housekeeping Pads	15.00 cy					11,250		750.00 /cy	11,250
03000.2206 Pipe Trench Concrete	45.00 cy					31,500		700.00 /cy	31,500
03000.2215 New Chemical Area	35.00 cy					24,500		700.00 /cy	24,500
03000.2216 Future Chemical Area	25.00 cy					17,500		700.00 /cy	17,500
03000 Concrete						180,250			180,250
05000 Metals									
05000.2202 Grating - Trench Cover	576.00 sf	47.998	2,880	40,320				75.00 /sf	43,200
05000 Metals		47.998	2,880	40,320					43,200
09000 Finishes									
09000.2600 Finishes Allownace	1.00 allw					16,000		16,000.00 /allw	16,000
09000 Finishes						16,000			16,000
11200 Water Treatment Equipment									
11200.2202 Auto Strainers MF System	2.00 ea	64.000	3,385	62,392	722			33,249.35 /ea	66,499
11200 Water Treatment Equipment		64.000	3,385	62,392	722				66,499
11210 Water Supply & Treatment Pumps									
11210.2014 MF Feed Pumps	3.00 ea	180.000	13,219	77,175	2,452	800	762	31,469.22 /ea	94,408
11210.2015 Backwash Pumps	3.00 ea	222.000	16,303	38,175	2,861	800	762	19,633.50 /ea	58,900
11210.2206 Citric Acid Feed Pumps	2.00 ea	8.000	408	6,112				3,260.10 /ea	6,520
11210.2601 Hydrochloric Acid Feed Pumps	4.00 ea	28.002	1,406	64,368		1,500	88	16,840.40 /ea	67,362
11210.2602 Ammonium Hydrixide Feed Pumps	2.00 ea	13.200	675	16,209				8,441.79 /ea	16,884
11210 Water Supply & Treatment Pumps		451.202	32,011	202,038	5,313	3,100	1,612		244,074
11228 Filter Membrane Systems									
11228.2600 MF Skid (Pall System)	3.00 ea	828.000	44,321	1,537,966	9,808			530,698.31 /ea	1,592,095

Spreadsheet Level	Takeoff Quantity	Labor Man Hrs	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Amount
11228 Filter Membrane Systems		828.000	44,321	1,537,966	9,808				1,592,095
11375 Aeration Equipment									
11375.2250 Air Compressor Install	1.00 ea	34.500	5,541		800		286	6,627.46 /ea	6,627
11375.2251 Air Receiver Install	1.00 ea	28.000	5,050				592	5,642.12 /ea	5,642
11375 Aeration Equipment		62.500	10,592		800		878		12,270
13200 Tanks									
13200.2205 CIP Tank	1.00 ea	49.600	2,695	6,380	218			9,292.90 /ea	9,293
13200.2600 Filtrate tank	1.00 ea	52.000	2,829	10,136	272			13,237.12 /ea	13,237
13200.2602 Sodium Hypochlorite Storage	1.00 ea	66.000	3,601	25,000	545			29,145.63 /ea	29,146
13200 Tanks		167.600	9,124	41,516	1,035				51,676
15060 Hangers & Supports									
15060.2600 Pipe Support Racks	3.00 ea	18.000	977	12,000				4,325.66 /ea	12,977
15060.2601 Pipe Supports - Trench	10.00 ea	20.000	1,086	4,000				508.55 /ea	5,086
15060.2606 Pipe Support Stands	25.00 ea	16.750	909	3,000				156.37 /ea	3,909
15060 Hangers & Supports		54.750	2,972	19,000					21,972
15110 Valves									
15110.22031 CV Check Val	8.00 ea	11.680	634	16,056				2,086.25 /ea	16,690
15110.2600 BFV	36.00 ea	74.000	4,016	17,582				599.95 /ea	21,598
15110.2612 Misc Valves	32.00 ea			963				30.09 /ea	963
15110.2704 ARV / PRV	16.00 ea	23.200	1,259	5,200				403.70 /ea	6,459
15110 Valves		108.880	5,910	39,800					45,710
15120 Pipe Specialties									
15120.2204 Static Mixer	1.00 ea	12.210	809	12,000				12,809.19 /ea	12,809
15120 Pipe Specialties		12.210	809	12,000					12,809
15210 Ductile Iron Pipe									
15210.22201 MF Feed	112.00 lf	148.430	8,056	11,822			8,000	248.91 /lf	27,878
15210 Ductile Iron Pipe		148.430	8,056	11,822			8,000		27,878
15221 Stainless Steel Pipe									
15221.0717 Compressed Air	40.00 lf	22.500	1,652	2,268			850	119.26 /lf	4,770
15221 Stainless Steel Pipe		22.500	1,652	2,268			850		4,770
15240 Plastic Pipe									
15240.22011 Aqueous Ammonia	240.00 lf	31.200	1,693	1,834				14.70 /lf	3,527
15240.22012 Caustic Soda/Sodium Hydroxide	190.00 lf	24.700	1,341	1,452				14.70 /lf	2,792
15240.22013 Citric Acid	110.00 lf	14.300	776	840				14.70 /lf	1,617
15240.22014 Sodium Hypo	180.00 lf	23.400	1,270	1,375				14.70 /lf	2,645
15240.22081 11									
15240.22083 Drain	160.00 lf	21.280	1,155	1,920				19.22 /lf	3,075
15240.22201 BWS	60.00 lf	8.350	463	780				20.72 /lf	1,243
15240.22202 CIP	180.00 lf	27.640	1,598	2,760				24.21 /lf	4,358
15240.22203 MF Filtrate	90.00 lf	14.650	805	1,860			1,380	44.94 /lf	4,045

Spreadsheet Level	Takeoff Quantity	Labor Man Hrs	Labor Amount	Material Amount	Equip Amount	Sub Amount	Other Amount	Total Cost/Unit	Total Amount
15240.22204 Overflow	60.00 lf	12.600	684	2,160				47.40 /lf	2,844
15240.22205 SE	60.00 lf	13.230	718	2,160			200	51.30 /lf	3,078
15240.22206 Strainer Backwash	100.00 lf	10.000	543	1,200				17.43 /lf	1,743
15240 Plastic Pipe		201.350	11,045	18,341			1,580		30,966
16000 Electrical									
16000.2600 Electrical Allowance	1.00 ls					350,000		350,000.00 /ls	350,000
16000 Electrical						350,000			350,000
17000 Instrumentation and Control									
13000.2600 I&C Allowance	1.00 ls					100,000		100,000.00 /ls	100,000
17000 Instrumentation and Control						100,000			100,000
010 MF		**2,953.752**	**268,565**	**1,987,463**	**92,904**	**724,565**	**12,920**		**3,086,418**

Estimate Totals

Description	Amount	Totals	Hours	Rate	
Labor	268,566		2,954 hrs		5.04%
Material	1,987,463				37.32%
Subcontract	724,565				13.61%
Equipment	92,904		1,141 hrs		1.74%
Other	12,920				0.24%
	3,086,418	**3,086,418**			**57.96**

Subtotal Direct Cost		**3,086,418**			

GC General Conditions	308,642			10.00 %	5.80%
Subtotal General Conditions	**308,642**	**3,395,060**			**5.80**
Building Permits	33,951			1.00 %	0.64%
Sales Tax (MEO)	162,230			7.75 %	3.05%
Subtotal Permits & Sales Tax	**196,181**	**3,591,241**			
Construction Contingency	897,810			25.00 %	16.86%
Subtotal Contingency	**897,810**	**4,489,051**			
Contractor Total OH&P	448,905			10.00 %	8.43%
Subtotal OH&P	**448,905**	**4,937,956**			**8.43**
Bldr's Risk Insurance	9,876			0.20 %	0.19%
Gen Liab Insurance	49,380			1.00 %	0.93%
GC Bonds	74,069			1.50 %	1.39%
Subtotal Insurance & Bond	**133,325**	**5,071,281**			**2.50**

Escalation	253,564			5.00 %	4.76%
Mid-point, 2 years					
Subtotal Escalation	**253,564**	**5,324,845**			**4.76**
Total		***5,324,845***			

Appendix C-6: City of Santa Barbara Building Permit Submittal Package

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City of Santa Barbara

DART SUBMITTAL PACKET ADDENDUM

Starting July 1, 2012, the DART submittal requirements will change. Prior to July 1, 2012, the Planning Division required 10 sets of plans, two copies of the Preliminary Title Report, and one copy of everything else.

Effective July 1, 2012, applicants will have two options for application submittal:

- ☐ **Option 1 – Electronic Submittal (*preferred option*):**
  - ☐ 1 electronic copy of everything on a CD or electronic media (.pdf or .doc format), PLUS:
  - ☐ 1 hard copy of each item/document that's on the CD, with the following EXCEPTIONS:
    - ☐ 10 hard copy sets of plans
    - ☐ 2 sets of mailing labels and Affidavit (*if applicable*)
  - ☐ 1 hard copy (electronic copy not needed) of the Planning Commission & Staff Hearing Officer Submittal Cover Sheet

- ☐ **Option 2 – Hard Copy Submittal:**
  - ☐ 10 hard copies of everything (Master Application, Letter from Applicant, PRT/DART Letter, Plans, etc.), with the following EXCEPTIONS:
    - ☐ 1 hard copy of the Planning Commission & Staff Hearing Officer Submittal Cover Sheet
    - ☐ 1 set of photos
    - ☐ 2 sets of mailing labels and Affidavit (*if applicable*)
    - ☐ 2 hard copies of the Preliminary Title Report
    - ☐ 5 hard copies of hydrology calculations/drainage report (i.e. SWMP compliance)
    - ☐ 3 hard copies of special studies (e.g. biology reports, traffic studies, geotechnical reports, etc.)
    - ☐ 2 hard copies of the Condominium Conversion Packet (*if a condo conversion is requested*)
    - ☐ 1 hard copy of the Coastal Development Permit Application form (*if a CDP is requested*)

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City of Santa Barbara

DEVELOPMENT APPLICATION REVIEW TEAM (DART) SUBMITTAL PACKET

- ☐ DART Application Submittal Requirements*
- ☐ Project Plan Requirements
- ☐ Hazardous Waste and Substances Requirement
- ☐ The 30-Day Development Application Review Process
- ☐ Planning Commission & Staff Hearing Officer Process

Note: *Please submit a completed Master Application and Planning Commission & Staff Hearing Officer Submittal Cover Sheet with your initial submittal.*

***** ***Additional handouts that applicants may need to obtain and are available online (http://www.santabarbaraca.gov/Resident/Home/Forms/planning.htm/), include:***
1) Coastal Development Permit Submittal Packet
2) Condominium Conversion Packet
3) Subdivision Ordinance
4) Visual Aid Submittal Packet

****** **Projects which require Planning Commission approval, also require review by the Pre-Application Review Team (PRT) prior to submitting for Planning Commission (*PRT Review is a pre-application concept review meeting with City Staff from various City departments*).**

*** **Please be advised** that all submittal materials (including plans) are subject to the **Public Records Act** and may be reproduced for the public without agent/owner authorization.

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City of Santa Barbara

DART Application
Submittal Requirements

The following information is ***required*** for project analysis and scheduling for review and decision. Applications that do not contain full and complete information will not be accepted, but will be returned to you for completion.

We strongly encourage that you review all files and archived plans for your project site prior to submittal. Resources such as the Santa Barbara Municipal Code (SBMC), handouts, guidelines, Street and Planning Files (a.k.a. LDT Record Archives), parcel and case information can be found online via links on our "Planning Central" page at http://www.santabarbaraca.gov/Resident/planning. Or, you can look at these documents at the Records and Archives counter (located at 630 Garden St., (805) 564-5554). Questions regarding application submittal contents and process can be answered at the Planning and Zoning counter at 630 Garden St. at (805) 564-5578, or by appointment with a Case Planner at (805) 564-5470. Please note that we are closed every other Friday.

Please submit the following information:

1. COMPLETED MASTER APPLICATION FORM:

- ☐ a. Project Address
- ☐ b. Assessor's Parcel Number(s) and Land Use Zone(s)
- ☐ c. Existing use(s)
- ☐ d. Construction Type
- ☐ e. Complete Project Description (detailed description in letter, see below)
- ☐ f. Approval(s) requested
- ☐ g. Proposed use(s)/Occupancy
- ☐ h. Owner and Agent - Name, Address (include Zip Code), Phone Number, & E-mail Address - give a numbered address [not "the corner of…"]
- ☐ i. Square footage, number of existing and proposed structures, number and size of existing and proposed units
- ☐ j. Lot size (gross and net)
- ☐ k. Signature of Applicant/Agent **and** Property Owner

2. LETTER FROM APPLICANT: *(addressed to Decision-maker)*

- ☐ a. Include what discretionary approval is being sought (i.e., "I am seeking a Conditional Use Permit and need Planning Commission approval".)
- ☐ b. Include a detailed description of the proposed project. This may include, but not be limited to, the following information:
  - ☐ 1) Uses of existing and proposed structures.
  - ☐ 2) Square footages of existing and proposed structures.
  - ☐ 3) Demolition or removal of any structures.
  - ☐ 4) Site square footage and acreage.
  - ☐ 5) Removal of any existing trees or significant vegetation.
  - ☐ 6) Relevant drainage information.
  - ☐ 7) Parking and landscaping statistics.

- ☐ 8) Proposed grading to occur with cut and fill given in cubic yards of soil and whether balanced onsite or import/export is involved. If import/export is involved, identify source or disposal site.
- ☐ 9) Identify adjacent surrounding land use designations and zone districts to the north, south, east, and west.
- ☐ 10) Provide answers to the following questions:
  - ☐ i. Does the proposed project include added exterior lighting? If yes, please describe locations, type, height, etc.
  - ☐ ii. Would the proposed project involve the creation of smoke or odors? If yes, describe the source and its location.
  - ☐ iii. Would the proposed project involve the creation of new noise sources? If yes, describe the source and its location.
  - ☐ iv. Have geotechnical studies (e.g., soils reports, earthquake fault location studies, geology reports, etc.) previously been prepared for the project site? If yes, please provide a copy with your application and explain how the recommendations have been addressed in the project.
  - ☐ v. Have resource or constraint studies (e.g., biological assessment reports, archaeological reports, historic structures reports, etc.) previously been prepared for the project site? If yes, please provide a copy with your application and explain how the recommendations have been addressed in the project.
  - ☐ vi. Are there any existing or proposed designated recreational trails or easements traversing the project site?
  - ☐ vii. Is the property located adjacent or near a creek or other water course?
  - ☐ viii. Who provides sewer services? Is it on septic?
  - ☐ ix. Who is the water purveyor?
- ☐ 11) Describe demolition and construction activity in detail, including the following:
  - ☐ i. Identify the estimated duration of demolition.
  - ☐ ii. Identify the estimated duration of grading.
  - ☐ iii. Identify the estimated duration of construction activity.
  - ☐ iv. Identify the number of workers and number and type of equipment necessary for each phase of demolition, grading, and construction.
  - ☐ v. Identify equipment and construction materials staging area(s).
- ☐ 12) **Subdivisions (including Condominium projects) that involve two (2) or more residential units/lots are subject to the Inclusionary Housing Ordinance (SBMC §28.43).** Describe compliance *(if applicable).*
- ☐ 13) Any additional pertinent information (i.e., number of bedrooms, number of restaurant seats) and any other information as required by City Staff.

☐ c. Provide the following dates for the pre-application reviews which have taken place within a maximum of six (6) months prior to the date of application:

Airport Commission Meeting Date: ____________________________

Architectural Board of Review	Meeting Date:	____________________________
Historic Landmarks Commission	Meeting Date:	____________________________
Harbor Commission	Meeting Date:	____________________________
Modification Hearing Officer	Meeting Date:	____________________________
Parks & Recreation Commission	Meeting Date:	____________________________
Planning Commission Action	Meeting Date:	____________________________
City Council Action	Meeting Date:	____________________________
Other ____________________	Meeting Date:	____________________________

☐ d. Provide any relevant information on previous contact/correspondence with City staff.

☐ e. Include a discussion justifying the project, including background and reasons. This is your opportunity to explain your proposed project goals and why you are seeking approval.

☐ f. Indicate the significant issues and problem areas, as you understand them.

☐ g. Hazardous Materials.

- ☐ 1) Would the proposed project involve use or disposal of hazardous materials? Is there any known site contamination from hazardous materials? Are there any abandoned oil wells in the area? If yes, has remediation been completed in accordance with State requirements? If yes, please provide evidence of compliance.
- ☐ 2) Pursuant to the Permit Streamlining Act (PSA), the applicant is required to submit a signed statement indicating whether the proposed project site or any alternative site(s) is on the lists of hazardous waste sites maintained by the Secretary for Environmental Protection. Provide a copy of any environmental site assessments prepared for the proposed project site and any alternative site(s). If the proposed project site or any alternative site(s) is on the lists of hazardous waste sites maintained by the Secretary for Environmental Protection, a signed statement must be submitted. See attached statement.

3. PRT/DART LETTER: (*If the project has had previous PRT or DART reviews.)*

☐ a. Include a copy of the last PRT or DART Letter **and** how you addressed the comments.

☐ b. You **must** contact the assigned Case Planner to set up an appointment for submittal of your project. (Projects that have previously gone through the PRT or DART process have been assigned a Case Planner and will not be accepted by Planning Counter Staff.) If the previous Case Planner is no longer assigned to the project, please contact the Development Review Supervisor in order to get a new case planner assigned to the project.)

4. PLANS:

10 copies of plans - folded to 8 ½” x 11”. (Minimum acceptable sheet size is 18” x 24”) Please note that additional sets of plans may be required, depending on the scope of the project.

☐ a. Refer to the ***Project Plan Requirements section*** for required information on plans.

☐ b. All applications for subdivisions shall be required to provide a Tentative Map. See SBMC Chapter 27.07.030 for Tentative Map requirements.

5. PHOTOGRAPHS: *(Photographs must remain with this submittal. The applicant must provide duplicates for each separate submittal if photographs are also required for other discretionary applications (i.e. Design Review, etc.).)*

- ☐ a. Current color photographs of the site from the street, each elevation of the building(s), adjacent properties, surrounding neighborhood area and streetscape, to provide an accurate depiction of the location of the subject parcel(s).

  Include a composition panoramic view of the site within the context of the surrounding neighborhood.

  Photographs **must** be clear, visually legible, in color **AND** a **minimum** of 3"x5" size. Dark and/or discolored photographs are not acceptable. Polaroid or instamatic photographs are also not acceptable.

  Mount and **label** each photograph for submittal on foldable 8½" x 11" heavy paper (loose photographs are **not** acceptable). All photographs must be labeled with the project address and the relationship of the photograph to the project site. Digital photographs may be printed on 8½" x 11" regular white paper.

- ☐ b. Include a map showing locations where photographs were taken.

6. PUBLIC NOTICE REQUIREMENTS:

- ☐ a. Property Owner mailing labels. The City will provide property owner labels for a fee. Otherwise, please obtain the "Mailing Label Preparation for Property Owners" handout for more information on the required noticing distance and how to prepare mailing labels for your project. If you are preparing the labels, be sure to include labels for all involved applicants (i.e., agent, architect, etc).
- ☐ b. Tenant mailing labels. If the project site is located within the City's Coastal Zone or the project involves a Condominium Conversion, tenant mailing labels are required to be submitted. Please obtain the "Mailing Label Preparation for Residential Tenants" handout for more information on the required noticing distance and how to prepare mailing labels for your project. (Please note that the City does not provide this service.)
- ☐ c. Affidavit signed by the person who compiled the mailing labels, if the labels were not prepared by the City.
- ☐ d. On-site posting must be installed during the ten (10) calendar days prior to **ANY** mailed noticed hearing for the project and during the entire construction of the project. At the time of submittal for a project which is required to be noticed, the City will provide the applicant with a yellow pre-printed sign. The sign must be filled out, and placed on or within 2 feet of the property line of the subject site, so that it can be easily read by pedestrians on the public right-of-way.

7. HYDROLOGY CALCULATIONS: *(Contact Public Works Engineering staff with any related questions at (805) 564-5552.)*

- ☐ a. Applicant shall indicate how site drainage is being transmitted through the subject property to the public right-of-way or to a natural watercourse. Indicate all existing and proposed drainage conveyance systems located on the proposed project site. Submit hydrology calculations for the 25-year and 100-year storm events. Indicate the 100-year inundation areas and overload escape route(s).

  OR

- ☐ b. Provide documentation that the Public Works Engineering Division staff has waived the hydrology calculations requirement.

8. SPECIAL STUDIES: (*If the project has had previous PRT or DART reviews and special studies and/or reports were requested such as Historic Structures Report, Traffic Study, Geo-technical Report, Biological Assessment, etc.)*

9. COASTAL REVIEW:

- ☐ a. If the project requires a Coastal Development Permit (CDP), submit the completed Coastal Development Permit Application. The property owner on the CDP application **must** match the signature on the Master Application.
- ☐ b. Submit two sets of Tenant Labels and a signed affidavit as outlined in the "Mailing Label Preparation for Residential Tenants" handout.
- ☐ c. **PROJECTS IN THE APPEALABLE JURISDICTION:** Include the geology reports where the information has been derived from:
  - ➢ 50-foot setback from the edge of the coastal bluff
  - ➢ 75-year geologic cliff retreat setback area.

10. CONDOMINIUM CONVERSIONS:

If the project requires a Condominium Conversion Permit, review the Condominium Conversion Packet and submit the following with your application**:**

- ☐ a. A Physical Elements Report and show compliance with the recommendations outlined in the report.
- ☐ b. Proof of on-site tenant notification 60 days prior to filing application in accordance with SBMC 28.88.100.

11. PRELIMINARY TITLE REPORT:

- ☐ a. Two (2) copies of a current preliminary title report (issued within three (3) months of the application date) for all involved parcels. The Title Report **must** show ownership and all easements. *(Following review of the preliminary title report, copies of easement documents referred to in the preliminary title report may be required.)*
- ☐ b. Property owner must match signature on the Master Application.

12. TENANT DISPLACEMENT ORDINANCE:

- ☐ a. If a residential unit is being demolished or converted as part of the proposal, the project is subject to compliance with SBMC §28.89. If so, provide a demolition plan. Submit proof of notice to tenants which is required before application submittal. A proof of payment is required prior to building permit issuance. This does not apply to illegal dwelling units.

13. COVER SHEET:

- ☐ a. Submit a completed Planning Commission Submittal Cover Sheet ***(lilac)*** with **ALL** of your submittal

14. FEES:

- ☐ a. To be paid in the amount indicated on the fee resolution adopted by the City Council.

15. PROCESSING INFORMATION:

- ☐ a. Upon submittal of your application, a case planner will be assigned. (Projects that have previously gone through the PRT or DART process have already been assigned a Case Planner.) The Case Planner is responsible for coordinating the staff review of your application. The Case Planner can also answer any questions you may have regarding your application. Please note that representatives from Building & Safety, Public Works Engineering, Public Works Transportation Planning and the Fire

Department are also assigned to your project. In order to maintain consistency in the processing of your application, it is highly recommended that you confine your questions to the staff members assigned to your case unless otherwise directed.

- ☐ b. During review of the application, additional information and studies may be necessary before the application is determined to be complete and additional processing can occur. The Case Planner will notify you if additional information and studies are required.
- ☐ c. Prior to the application being scheduled for Planning Commission review, additional copies of plans submitted will be necessary. The Case Planner will notify you of the number of additional plans required.
- ☐ d. Visual Aids: The Planning Commission conducts regular site visits to project sites, generally the Tuesday morning prior to the scheduled hearing date. The Commission has requested that markers be provided on the site for all projects that may have size, bulk and scale, visual impacts or view issues, to provide a basic visual representation of project size and scale. The Case Planner will advise you when deeming your application complete, whether this will be required. Please refer to the "Visual Aid Submittal Packet" for more information.
- ☐ e. As part of deeming the application complete, 8½" x 11" reductions of the site plan, elevations and/or Tentative Map (for subdivisions only) must be provided to the Case Planner. Please review your completeness letter for any additional information required and related timelines.
- ☐ f. The owner and/or agent will be sent an agenda and legal notice in the mail concerning the application hearing date and time.

City of Santa Barbara

PROJECT PLAN REQUIREMENTS

This is a detailed list of project plan requirements for the Planning Division. **Some items may not apply to your particular project**. For instance, projects receiving Conceptual Review only at a design review board may provide significantly less information, while other projects may require more information. Contact Planning counter staff or your designated case planner to determine whether or not an item is required.

Note: The minimum acceptable sheet size for plans is 18” x 24” and the maximum size is 36” x 42”. Plans must be complete, accurate and DRAWN TO SCALE. Plans must also be legible and able to be scanned for archival purposes.

I. PROJECT DATA – *GENERAL (see samples at the end of this document)*

- ☐ 1. Project Address(es)
- ☐ 2. County Assessor’s Parcel Number(s) (APNs)
- ☐ 3. Land Use Zone District(s)
- ☐ 4. General Plan Land Use Designation(s)
- ☐ 5. Property Owner(s) – Name, Address, Phone Number
- ☐ 6 Architect/Designer – Name, Address, Phone Number
- ☐ 7. Sheet Index (for plan sets with more than five sheets)
- ☐ 8. List of applicable Building Codes for the project (e.g., California Building Code, CA Energy regulations, Ordinance #5440)
- ☐ 9. Existing and Proposed Lot Size (Net and Gross Area)
- ☐ 10. Average Slope of Property for <u>every</u> lot (per SBMC §28.15.080)
- ☐ 11. Grading (in cubic yards, includes recompaction)
  - ☐ a. Cut and/or fill <u>under</u> the main building footprint
  - ☐ b. Cut and/or fill <u>outside</u> the main building footprint
  - ☐ c. Include the amounts of import/export/offsite/onsite
- ☐ 12. Construction Type and Occupancy Group
- ☐ 13. High Fire (YES/NO)
- ☐ 14. Flood Plain (YES/NO)
- ☐ 15. Scope of Work – Project description shall include all work proposed as part of the project. Include the existing and proposed use(s) of all buildings or structures and whether the work is to abate violations from outstanding enforcement cases and/or a Zoning Information Report (reference the appropriate ENF and/or ZIR case number).

II. PROJECT DATA – *SPECIFIC (if applicable)*

- ☐ 1. **For Enforcement Cases ONLY,** reproduce the Building and Safety “Notice of Violation” on the plans.
- ☐ 2. **For Single Family Residences over 4,000 square feet ONLY (prior to Project Design Approval)**, show how the project meets the standards for a Three-Star rating of

the Santa Barbara Built Green Program. Reproduce the checklist on the plans and register the project on the SBCA website at http://www.builtgreensb.org/home.html

- ☐ 3. **For Building Permit Applications ONLY**, if the plans are drawn by a licensed design professional, a wet signature and wet stamp are required.
- ☐ 4. **For Projects with Planning Commission or Staff Hearing Officer approval ONLY**, reproduce a legible copy of the signed Final Resolution at the front of the plan set.
- ☐ 5. **For Projects with Conditions of Approval ONLY,** reproduce all board or commission conditions of approval, environmental conditions, or mitigation measures on the plans (e.g., tree protection measures, archeological monitoring requirements, historic structures report conditions)

III. PROJECT DATA – *FLOOR AREA AND USES (Provide both NET and GROSS floor area)*

- ☐ 1. Existing floor area and uses
- ☐ 2. New or proposed floor area and uses
- ☐ 3. Floor area to be converted (e.g., garage to living space)
- ☐ 4. Floor area and uses to be demolished
- ☐ 5. Floor area (and uses, if applicable) to be remodeled
- ☐ 6. Total detached “accessory” buildings (e.g., tool shed, workshop)
- ☐ 7. Garages and carports
- ☐ 8. Basements/cellars
- ☐ 9. Patios/decks (covered and uncovered)
- ☐ 10. New non-residential floor area subject to SBMC §28.87.300 (i.e., Measure E)
- ☐ 11. Floor area of each FLOOR separately (e.g., 1^{st} floor, 2^{nd} floor)
- ☐ 12. Floor area of all BUILDINGS on site separately (e.g., Unit A, Unit B)
- ☐ 13. If multiple residential units, include TOTAL floor area of each unit
- ☐ 14. If mixed-use, total all residential and non-residential floor area separately
- ☐ 15. “Grand Total” floor area of all buildings/structures on site

IV. PROJECT DATA – *RESIDENTIAL PROJECTS ONLY*

- ☐ 1. Number of Residential Dwelling Units (existing, proposed, and demolished)
- ☐ 2. Residential Density, if applicable
  - ☐ a. Number of bedrooms in each unit if using variable density
  - ☐ b. Minimum lot area requirements for each unit
  - ☐ c. Slope density, if applicable
- ☐ 3. **For Single Family Residences ONLY**, determine the Maximum Net Floor Area and Floor to Lot Area Ratio (FAR), if required, per SBMC §28.15.083. Reproduce the City’s FAR Calculator on the plans
- ☐ 4. **For Single Family Residences ONLY**, provide the amount of basement/cellar FAR discount, if applicable per SBMC §28.15.083

V. PROJECT DATA – *PARKING*

- ☐ 1. Existing Number of Parking Spaces (covered and uncovered)
- ☐ 2. Required Number of Parking Spaces per the Zoning Ordinance (covered and uncovered)

- ☐ 3. Proposed Number of Parking Spaces (covered and uncovered)
- ☐ 4. Any Special Parking Circumstances (e.g., Zone of Benefit, Central Business District, mixed use, building greater than 10,000 s.f., nonconforming parking, off-site parking agreement)
- ☐ 5. Number of Restaurant Seats (interior and exterior) or Hotel Rooms, if applicable
- ☐ 6. Existing and Proposed Number of Bicycle Parking Spaces

VI. PROJECT DATA – *LOT COVERAGE DATA*

Provide as shown:

LOT COVERAGE	EXISTING		PROPOSED	
Building	________ s.f.	____%	________s.f.	____%
Paving/Driveway	________ s.f.	____%	________s.f.	____%
Landscaping	________ s.f.	____%	________s.f.	____%
TOTAL LOT AREA	________ s.f.	100%	________s.f.	100%

VII. SITE PLAN – *VICINITY MAP*

- ☐ 1. Major Streets and Surrounding Properties to the Project
- ☐ 2. North Arrow – Show both Reference North and True North
- ☐ 3. Project Site identified

VIII. SITE PLAN – *ZONING REQUIREMENTS*

- ☐ 1. Required Setbacks
  - ☐ a. Front
  - ☐ b. Interior
  - ☐ c. Rear
- ☐ 2. Location and Height of all Fences, Hedges, Walls or Screens (Existing and Proposed)
- ☐ 3. Required Open Yard Area – Show Size, Dimensions, and Location
  - ☐ a. Single Family Residence Zones (SBMC §28.15.060.C)
    - ☐ i. Required 1,250 s.f. open yard; and
    - ☐ ii. Required 160 s.f. flat area for open yards with >20% average slope
  - ☐ b. Two-Family Residence Zones (SBMC §28.18.060.C)
    - ☐ i. Required 1,250 s.f. open yard
    - ☐ ii. Private outdoor living space (4+ units only)
    - ☐ iii. Alternative open yard and private outdoor living space for accessory dwelling units
  - ☐ c. Multi-Family Residence Zones (SBMC §28.21.081)
    - ☐ i. Method A: private outdoor living space – labeled for each unit; and
    - ☐ ii. Method A: 10% open space area – not including setbacks; and
    - ☐ iii. Method A: 225 s.f. (15'x15') common open yard area; or
    - ☐ iv. Method B: 15% common outdoor living space

IX. SITE PLAN – *BUILDING AND STRUCTURE LOCATIONS*

- ☐ 1. True North Arrow
- ☐ 2. Scale – 1/8" Scale is Preferred for Site Plans
- ☐ 3. Show all existing and proposed Public and Private Streets, Alleys, Driveways, Paseos, and Turnarounds that abut the Property.
- ☐ 4. Paved Areas – Identify Materials (permeable or non-permeable)
- ☐ 5. Location of All Existing, Proposed, and Demolished Vehicle and Bicycle Parking
  - ☐ a. Show dimensions, transition areas, and all maneuvering areas
  - ☐ b. Show entrance and exit points
  - ☐ c. Indicate slope of driveway and length of driveway throat
  - ☐ d. Note location and dimensions of pedestrian walkways to building entrances
  - ☐ e. Dimension the parking stalls, drive aisles and bay widths, and number the spaces
  - ☐ f. Show angle of parking spaces
  - ☐ g. Show the pedestrian site triangle, if required per SBMC §28.90.001.11
  - ☐ h. Show any loading areas/spaces (see SBMC §28.90.001)
- ☐ 6. Improvements in the City Right-of-Way
  - ☐ a. Existing and proposed improvements/repairs to curb, gutter, sidewalks, bike lanes, utilities, water and gas meters, and driveway entrance(s)
  - ☐ b. Indicate width of the sidewalks, City right-of-way and edge of street pavement
  - ☐ c. Existing and proposed curb cuts within 50 feet of the property frontage
- ☐ 7. Property Lines – Dimensions and Bearings
- ☐ 8. Easements – Location and Dimensions of Existing and Proposed (e.g., sewer, water, drainage, utilities, view, access)
- ☐ 9. Utility Connections – Existing and Proposed
- ☐ 10. Location of any Wells, Power Poles, Street Lights, Fire Hydrants, and nearest Transit Stops
- ☐ 11. Topography – Grade Levels on Site and within 5' of the Property Lines
  - ☐ a. Use 5-foot contour intervals; for driveways use 1-foot contour intervals. Extend contours 100 feet on all sides beyond the proposed project site.
  - ☐ b. Natural drainage patterns, culverts, drainpipes, existing and proposed drainage
  - ☐ c. Adjacent creeks or watercourses; flood plain or flood way
  - ☐ d. Top of creek bank calculation per SBMC §28.87.250.3
  - ☐ e. Earthquake faults
- ☐ 12. Outline of all Existing, Proposed, and Demolished Buildings and Structures on Site
  - ☐ a. Show footprints of buildings and structures on adjacent parcels
  - ☐ b. Indicate the distance between buildings
  - ☐ c. Indicate distances from all structures to property lines
  - ☐ d. Identify area of work (use clouding or shading, etc)
  - ☐ e. Identify trash enclosure/trash can storage area (See the Space Allocation Guide for Trash and Recycling for information on adequate access and drainage.)

☐ 13. Highlight or somehow delineate the locations of any requested Modifications.

☐ 14. Show compliance with the City's Storm Water Management Plan (SWMP) on all applicable projects. Indicate the required level (Tier 1, Tier 2, and Tier 3) and show the appropriate Best Management Practices (BMPs) on the site plan or on a separate drainage plan. For Tier 3 projects, drainage calculations must be provided (see BMP Sizing Worksheets in Appendix D of the SWMP).

X. ELEVATIONS

☐ 1. Label each elevation (i.e., North, South, East, West)

☐ 2. Scale – 1/4" scale is preferred for elevations

☐ 3. Views of all sides of the building(s) involved in the project – clearly indicate all existing, to be demolished, and proposed new work

☐ 4. Grade – Existing (natural) and proposed (finished) grades

☐ 5. **For Projects which include grading ONLY, show** Cross-Sections for areas being cut or filled

☐ 6. Building Height – Per SBMC §28.04.120, measure from existing or finished grade (whichever is lower) to top of ridge, of all proposed buildings and structures involved in the project, on all elevations

☐ 7. **For Residential Zones ONLY**, show compliance with Solar Access Ordinance (SBMC §28.11). Please refer to the Solar Access Packet.

☐ 8. Relative property elevations, finish floor elevations, nearest upstream manhole elevation

☐ 9. Outline of buildings and structures on adjacent parcels

☐ 10. Identify Design Review (ABR, HLC, or SFDB) approved exterior colors and materials, if applicable

XI. FLOOR PLANS

☐ 1. Scale – 1/4" scale is preferred for floor plans

☐ 2. Label each Floor Plan (e.g., 1st Floor, 2nd Floor)

☐ 3. Existing and Proposed Floor Plans

- ☐ a. Complete (not partial) floor plans of all floors of all buildings
- ☐ b. Show access, all window(s), door(s); label existing and proposed
- ☐ c. Clearly indicate what is being removed, replaced and/or altered
- ☐ d. Show property lines/setbacks on floor plans

☐ 4. Demolition Plan – Show all areas to be removed if demolition is proposed

☐ 5. Label all Rooms (e.g., Bedroom #1, Bedroom #2, kitchen, bathroom)

☐ 6. Interior Dimensions of Garage/Carports

XII. LANDSCAPE PLAN

☐ 1. Show all existing and proposed plant material and indicate species and size

☐ 2. Indicate total proposed water-wise and non-water-wise planting areas in square feet and as a percentage of total area landscaped with plants. (See the Landscape Design Standards for Water Conservation handout for more details.)

- ☐ 3. Indicate type and size of existing trees (diameter measured at 4 feet above grade), and outline of canopy
- ☐ 4. Indicate extent of root zones for trees adjacent to proposed ground disturbance
- ☐ 5. Indicate with an X through trees proposed to be removed
- ☐ 6. Show required parking lot landscaping
- ☐ 7. Show existing and proposed landscaping for street parkway strips front the subject property
- ☐ 8. Indicate status of Parks and Recreation approval for any new or removed trees in the front setback or public right-of-way
- ☐ 9. Indicate the location and type of all paved surfaces
- ☐ 10. Indicate irrigation system
- ☐ 11. **For High Fire Hazard Area ONLY:** Show compliance with additional submittal requirements. (See the City of Santa Barbara Fire Prevention Bureau High Fire Hazard Area Landscape Guidelines.)
- ☐ 12. **For High Fire Hazard Area ONLY:** Indicate status of Fire Department approval of new landscaping in High Fire Hazard Area
- ☐ 13. A Compliance Statement for Low-Water Using Landscape Design must be completed, signed and reproduced on the landscape plans at the time the plans are submitted for building plan check

City of Santa Barbara

HAZARDOUS WASTE AND SUBSTANCES REQUIREMENT

1. Provide a copy of any environmental site assessments prepared for the proposed project site and any alternative site(s).
2. Pursuant to the Permit Streamlining Act (PSA), the applicant is required to submit a signed statement indicating whether the proposed project site or any alternative site(s) is on the lists of hazardous waste sites compiled pursuant to Section 65962.5 of the Government Code by the California Secretary for Environmental Protection and available at **http://www.calepa.ca.gov/SiteCleanup/CorteseList/**

HAZARDOUS WASTE AND SUBSTANCES STATEMENT

Name of applicant: ____

Address: ____

____

Phone Number: ______________________

Address of site (street name and number if available, and ZIP code): ______________________

____

Local Agency (city/county): ____

Assessor's book, page, and parcel number: ______________________________

Specify any list pursuant to Section 65962.5 of the Government Code: ______________________

____

Regulatory identification number: ______________________________

Date of list: ______________________

______________________________ ______________________

Applicant's signature Date

Note: Lead and other constituents of concern may be found in surface and subsurface soils within the city limits of Santa Barbara. Please refer to the EPA's Soil Screening Guidance: User's Guide (http://www.epa.gov/superfund/health/conmedia/soil/pdfs/ssg496.pdf) when disturbing soil for construction or other purposes.

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City of Santa Barbara

THE 30-DAY DEVELOPMENT APPLICATION REVIEW PROCESS

The following types of projects are subject to the Development Application Review Process pursuant to the Permit Streamlining Act (Gov't Code §65920-65963.1). Development Projects – Any project undertaken for the purpose of development including issuance of a permit for construction or reconstruction, including but not limited to:

- Coastal Development Permits (CDP)
- Conditional Use Permits (CUP)
- Conditional Certificates of Compliance
- Development Plan Approvals (DPA)
- Design Review Applications to the Architectural Board of Review (ABR) and Historic Landmarks Commission (HLC)
- Lot Line Adjustments (LLA)
- Modifications (Except Applications for Modifications or Performance Standard Permits only to be reviewed by the Staff Hearing Officer)
- Tentative Subdivision Maps
- Variances
- Waivers

The following types of projects are ***not*** subject to the 30-Day Development Application Review Process. However, the City makes every attempt to process these types of applications in a similar time frame as projects subject to the 30-Day Development Application Review Process:

- Annexations, General Plan Amendments, Rezonings, and Specific Plans.
- Ministerial projects including: Certificates of Compliance (with no conditions), mergers, approval of final subdivision maps, approval of design review applications that are reviewed administratively, and Coastal Exclusions.
- Administrative appeals.

The City strives for excellence in customer service in all areas of land development. In order for City staff to be efficient and timely in its review of your application, it is imperative that your application contains the information as listed in the Submittal Requirements handout for the appropriate hearing body.

Applications not containing the information as listed in the Submittal Requirements handout for the appropriate hearing body may not be accepted for processing.

Once you have submitted your proposed project's application and it has been accepted for processing, it will be reviewed in accordance with the provisions of the Permit Streamlining Act §65943. For applications requiring Planning Commission/Staff Hearing Officer review, a Case Planner from the Planning Division will be assigned to your project. The Case Planner will be the lead contact regarding your application. For applications only requiring ABR, HLC, or SFDB review, the lead contact regarding your application will be the ABR, HLC, or SFDB staff planner. Any questions or concerns you may have relative to the processing of your application should be directed to the Case Planner or ABR, HLC, or SFDB staff planner at (805) 564-5470.

The City has 30 days from the date the application is accepted for processing to determine if the application is "complete" (i.e. contains all of the required information necessary for project analysis and decision). The application will be forwarded to various City departments and divisions for their review and comments. At the end of the 30-day period, the City shall transmit in writing its determination to you.

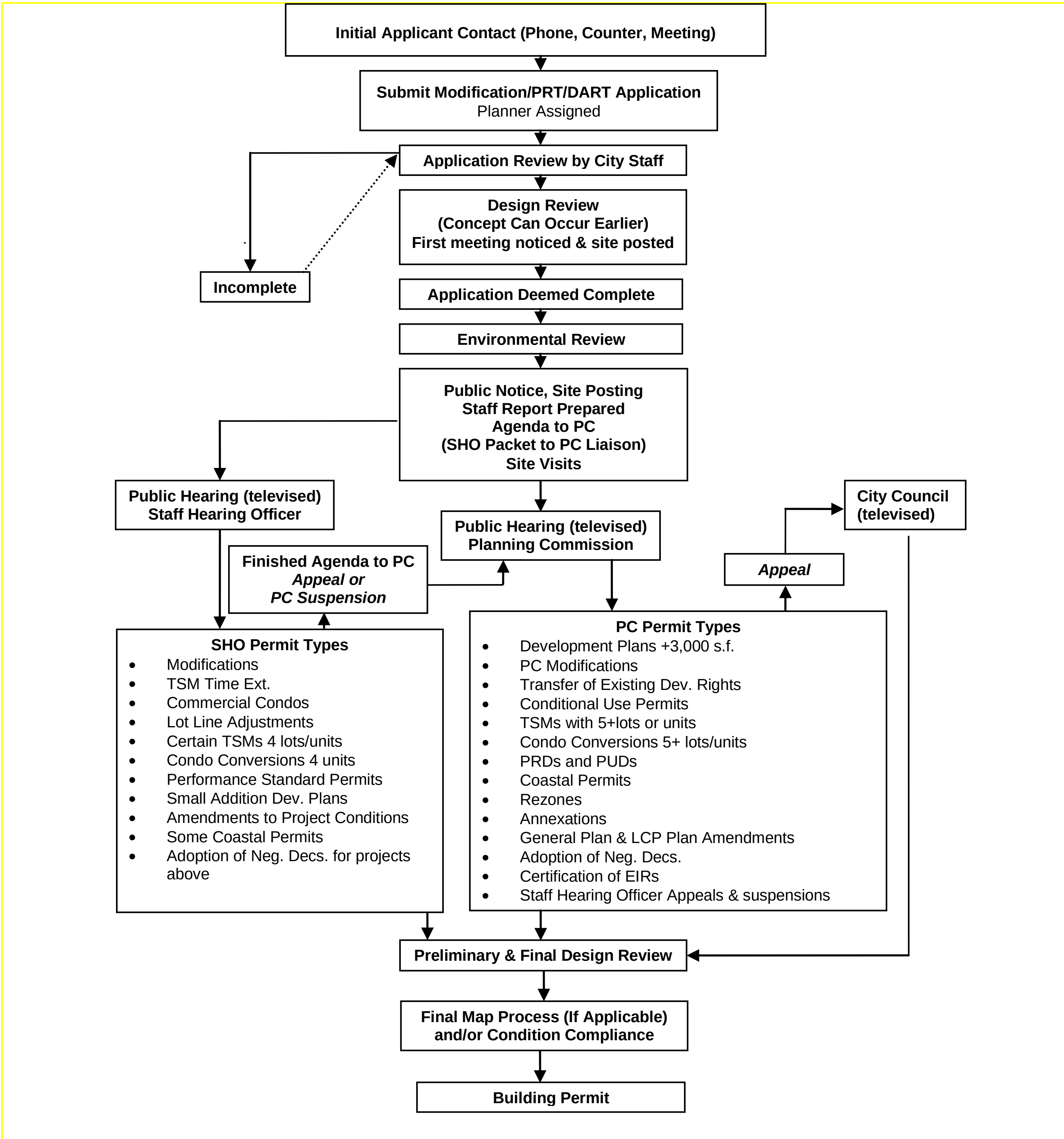
If additional information is required, the City will specify the required additional information in the letter. The application will be placed "on-hold" until the required information is received. Not later than 30-days from receipt of the additional required information, the City will again determine if the application is complete. If the application remains incomplete, the City will again transmit its determination to you and specify the additional information required. If the City determines the application is "complete," further processing shall commence. Further processing includes environmental review of the proposed project, analysis for compliance with applicable plans, policies, ordinances, codes, etc., and action on the proposed project application by the appropriate decision-making body(ies).

If the application is found to be incomplete, the additional information required should be submitted within 30 days of the date of the written transmission stating the requirement for additional information. If the additional information required is not received within 120 days of the date of the written transmission stating the requirement for additional information, the City will transmit in writing to you that an unreasonable delay in response to the request for additional information has transpired. If the additional information is not received within 60 days of the date of the unreasonable delay transmittal, the application shall be closed and all processing fees forfeited. Prior to the application being closed, you may request up to an additional 180 days to submit the required additional information. The request for a time extension must be in writing, addressed to the Community Development Director, and must contain justification for the delay in responding to the request for additional information. Once an application has been closed, a new, full and complete application as specified in the Submittal Requirements handout for the appropriate hearing body and payment of all applicable fees will be required in order to pursue the project.

APPEAL RIGHTS: If the application is found to be incomplete, you may appeal the decision to require additional information. An appeal must be filed at the Community Development Department's Planning and Zoning Counter within 10-days of the date of the written transmittal that the application is deemed "incomplete." The appeal must consist of written notification indicating your grievance with the determination that your application is "incomplete" and the appropriate appeal fee. The appeal will be scheduled for review by the appropriate decision making body and you will receive notice of the hearing date.

City of Santa Barbara

PLANNING COMMISSION & STAFF HEARING OFFICER PROCESS



Disclaimer: *This is a basic outline of the process for Staff Hearing Officer and Planning Commission review of projects. Some projects, especially those that include annexations, General Plan Amendments or Zone Changes and those that require California Coastal Commission approval, will include additional steps. Also depending on the type of environmental documentation required, additional steps may be necessary.*

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City of Santa Barbara

COASTAL DEVELOPMENT PERMIT SUBMITTAL PACKET

- ☐ Coastal Development Permit Application
- ☐ Coastal Development Permit Tenant Notification Instructions
- ☐ Coastal Development Permit Tenant Notification Affidavit

Note:

- **For additional submittal requirements**, please obtain the following: (1) Master Application, (2) Development Application Review Team (DART) Submittal Packet, (3) Planning Commission & Staff Hearing Officer Submittal Cover Sheet, and (4) On-Site Posting Instructions
- **Questions** regarding application submittal content and process can be answered at the Planning and Zoning counter at 630 Garden Street, or (805) 564-5578.
- **Research:** It is important that you research the project site prior to submitting an application. Resources such as the Santa Barbara Municipal Code (SBMC), handouts, guidelines, Street and Planning Files (a.k.a. LDT Record Archives), parcel and case information can be found online via links on our "Planning Central" page at http://www.santabarbaraca.gov/Resident/planning.
    - **Zoning Ordinance:** When developing your proposal, **ALWAYS** refer to the Zoning Ordinance (Title 28 of the SBMC) for the most complete information. As a rule of thumb we recommend that the following sections be reviewed carefully for additional information: Definitions (SBMC §28.04), General Provisions (SBMC §28.87), and the Automobile Parking Requirements (SBMC §28.90). The Zoning Ordinance may be purchased at the City Clerk's Office at City Hall (735 Anacapa Street, or (805) 564-5309).
    - **Records:** The history of the property needs to be researched. Street and Planning files, and archived plans are located at the Records and Archives counter (630 Garden Street or (805) 564-5554). Please note that requests to view archived plans are on an appointment basis. Street and Planning files can be viewed online via the "Planning Central" webpage.
    - **Unpermitted Work:** Please note that outstanding violations identified in pending enforcement cases and Zoning Information Reports must be addressed as part of your application.
- **Please be advised** that all submittal materials (including plans) are subject to the **Public Records Act** and may be reproduced for the public without agent/owner authorization.

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City of Santa Barbara

COASTAL DEVELOPMENT PERMIT APPLICATION

This section is to be filled out by Planning Division Staff Only	
MST#:________________	CDP#________________
ENVIRONMENTAL DETERMINATION (IF NECESSARY):________________	
CONCURRENT APPLICATION(S): ☐ ABR/SFDB ☐ HLC ☐ PC/SHO ☐ PRT ☐ BP	
APPLICATION REVIEWED BY:________________	DATE: ____________

NOTE: **A Coastal Development Permit does not preclude any other City approvals or permits which would normally be required. The applicant must submit, in addition to this form, a Master Application as well as any other materials normally required by other review bodies or departments within the City of Santa Barbara**

I. TYPE OF APPLICATION

☐ LCP Exclusion

☐ Coastal Development Permit:

1. Appealable
2. Non-Appealable
3. California Coastal Commission (State) Permit

II. PROJECT OWNER/APPLICANT AND LOCATION

Owner:________________________________ Phone No:______________

Address:________________________________

____

E-mail Address:________________________________

Applicant:________________________________ Phone No:______________

Address:________________________________

____

E-mail Address:________________________________

Project Location:________________________________

Parcel No(s).:________________________________

III. PROJECT INFORMATION:

THE FOLLOWING INFORMATION IS REQUIRED FOR A COASTAL DEVELOPMENT PERMIT APPLICATION TO BE CONSIDERED COMPLETE:

PLEASE NOTE:

*Where questions do not apply to your project, indicate "NOT APPLICABLE" or "N/A".

*Within thirty (30) days of receipt of an application, the Planning Division will inform the applicant in writing if the application is complete, or not, and what items must be submitted. Processing of the application will not begin until it is complete.

A. TYPE OF PROJECT:

- ☐ New ________________ Sq. Ft.
- ☐ Addition ________________ Sq. Ft.
- ☐ Remodel ________________ Sq. Ft.
- ☐ Repair ________________ Sq. Ft.
- ☐ Demolition ________________ Sq. Ft.
- ☐ Removal ________________ Sq. Ft.
- ☐ Grading Cut ________________ Cu. Yds. Fill ___________ Cu. Yds.
- ☐ Paving ________________ Amount
- ☐ Fences/Walls Height ________________ and Length ________________
- ☐ Retaining Walls Height ________________ and Length ________________
- ☐ Change of Use From ______________________ To ______________________
- ☐ Other ____

B. RESIDENTIAL:

	LOT AREA	NO. OF BLDGS.	BLDG. SQ. FT.[1]	DEMO'D BLDG. SQ.FT.	STORIES/ BLDG. HEIGHT	UNITS	BEDROOMS PER UNIT
EXISTING							
PROPOSED							

[1] Include the square footage of **all buildings** on the project site including accessory structures and garages.

C. NON-RESIDENTIAL:

	LOT AREA	NO. OF BLDGS.	BLDG. SQ. FT.	DEMO'D BLDG. SQ.FT.	STORIES/BLDG HEIGHT
EXISTING					
PROPOSED					

D. DESCRIBE THE EXISTING CONDITION OF THE PROPERTY. INCLUDE NUMBER, SIZE, AND USE OF ANY EXISTING BUILDINGS, AND EXISTING NUMBER OF UNITS:

____

____

____

____

____

____

E. DESCRIBE THE PROPOSED DEVELOPMENT. INCLUDE SQUARE FOOTAGE, INCIDENTAL IMPROVEMENTS SUCH AS SEPTIC TANKS, WATER WELLS, ROADS, DRIVEWAYS, ACCESSORY BUILDINGS, FENCES, GRADING, VEGETATION REMOVAL, ETC. ALSO, INCLUDE WHETHER ANY EXISTING BUILDING(S) WILL BE DEMOLISHED OR REMOVED:

____

____

____

____

____

____

F. NUMBER OF PARKING SPACES:

	REQUIRED	EXISTING	PROPOSED	TOTAL
COVERED				
UNCOVERED				
BICYCLE PARKING				

G. ADDITIONAL INFORMATION:

1. Has any application for development on this site been submitted previously to the City of Santa Barbara, California Coastal Zone Conservation Commission or Coastal Commission?

   ☐ YES ☐ NO

   If yes, state previous Application Number(s):________________________________

2. Are utility extensions for the following needed to serve the project?

Water	☐ YES	☐ NO
Gas	☐ YES	☐ NO
Electric	☐ YES	☐ NO
Sewer	☐ YES	☐ NO
Telephone	☐ YES	☐ NO

   Would any of these extensions be above ground? ☐ YES ☐ NO

   If yes, explain below:

   ____

   ____

3. If the development is between the first public road and the sea, is public access to the shoreline and along the coast currently available near the site?

   ☐ YES ☐ NO

   If yes, indicate the location of the nearby access, including the distance from the project site:

   ____

   ____

   ____

4. Will any aspect of the project (i.e. construction, grading, landscaping, vegetation removal, fences, interior remodel, window/door changes, etc.) occur within 50 feet of a coastal bluff or within the 75-year seacliff retreat line?

   ☐ YES ☐ NO

   If yes, explain below and include the distance from the edge of the coastal bluff:

   ____

   ____

   ____

   ____

5. Does the project include the removal of trees, hedges, shrubs or other vegetation?

☐ YES ☐ NO

If yes, indicate the number, location, type and size of trees and the type and area of other vegetation to be removed:

____

____

6. Does the development involve diking, filling, dredging or placing structures in open coastal waters, wetlands, estuaries, lakes, or creeks?

☐ YES ☐ NO

If yes, explain. (Include amount of material to be dredged or filled and the location of the dredged material disposal site).

____

____

Has the U.S. Army Corps of Engineers Permit been applied for? ☐ YES ☐ NO

7. Will the development extend into or adjoin any beach, tidelands, submerged lands or public trust lands?

☐ YES* ☐ NO

8. Is the proposed development in or near (within 100 feet):

- Sensitive habitat areas? ☐ YES* ☐ NO
- 100-year floodplain? ☐ YES* ☐ NO
- Park or recreation area? ☐ YES* ☐ NO

9. Is the proposed development visible from:

- U.S. Highway 101 or other scenic routes? ☐ YES* ☐ NO
- Park, beach or recreation areas? ☐ YES* ☐ NO
- Harbor area? ☐ YES* ☐ NO

10. Does the site contain any:

- Historic resources? ☐ YES* ☐ NO
- Archaeological resources? ☐ YES* ☐ NO

***NOTE:** If yes to items 8 through 10 above, please explain on a separate sheet or below.

____

____

____

____

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City of Santa Barbara

COASTAL DEVELOPMENT PERMIT TENANT NOTIFICATION INSTRUCTIONS

If a project involves a coastal development permit, notification is also required for residential tenants in addition to the standard noticing requirements for the project. Two (2) sets labels are required for residential tenants residing on parcels within 100 feet of the property lines of the subject parcel(s). **Residential Tenant** mailing labels must be provided by the applicant using the instructions outlined below. **The City does not provide tenant mailing labels.**

Instructions

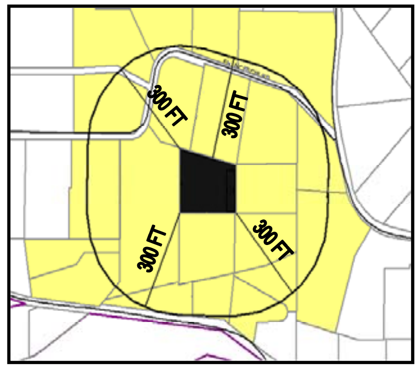
1. City Staff can provide a map indicating the parcels located within the required noticing distance for the project. Or, if preferred, applicants can create a noticing distance map using the City's online map at http://www.santabarbaraca.gov/Government/GIS/.

    a. To determine the parcels to be noticed, locate the subject parcel on the interactive map either by typing in the address in the search field or by zooming into the map on the screen.

    b. Click on the subject parcel. (If there are multiple subject parcels, shift-click to select additional parcels.)

    c. Right-click on the selected parcel(s).

    d. Select "Buffer…" from the drop down menu and change the settings to 100 feet. When done, click the "OK" button to show the 100-foot buffer. All parcels that are wholly or partially inside the buffer must be included in the mailing labels. The adjoining example shows parcels within 300 feet of the subject property.



2. The two (2) sets of mailing labels must contain the following information:

    (a) APN of the property where the Residential Tenant resides

    (b) "Tenant". (It is not necessary to include the Tenant's name)

    (c) Tenant's mailing address

    The Assessor Parcel Numbers (APN), names and addresses that have been compiled must be **TYPED** on self-adhesive labels in the format shown below. **Please provide label sheets in an 8½" x 11" format, equivalent to Avery labels #5160, size 1" x 2-5/8", 30 labels per sheet.**

TENANT EXAMPLE:

(a)	099-010-010
(b)	TENANT
(c)	100 MARINA ST, #9
	SANTA BARBARA, CA 93101

3. When preparing labels for residential tenants of multi-unit buildings, a label must be submitted for **each individual** unit on the property.

    For projects located adjacent to the Santa Barbara Harbor, please contact the Waterfront Department at (805) 564-5531 to obtain two (2) sets of mailing labels for residents ("live-aboards") within the harbor.

Applicants must verify this information by walking the neighborhood and identifying any residential tenants.

4. Submit an affidavit signed by the person(s) who has compiled the residential tenant labels. The affidavit certifies that the two (2) sets of mailing label(s) are complete and accurate. If the submitted label(s) are inaccurate, the item will be continued (i.e. delayed) and re-noticed with revised mailing labels.

City of Santa Barbara

COASTAL DEVELOPMENT PERMIT
TENANT NOTIFICATION AFFIDAVIT

STATE OF CALIFORNIA)

COUNTY OF SANTA BARBARA) ss.

CITY OF SANTA BARBARA)

I, ____ hereby certify that the two (2) sets of
(Print Name)

attached labels contain the Assessors Parcel Numbers' and addresses of all residential tenants living on parcels within 100 feet of the property lines of the subject parcel(s) at ______________________________

____. I have verified, to the best of my
(Address/APN)

ability, that the attached labels are accurate.

I CERTIFY UNDER PENALTY OF PERJURY AS DEFINED BY THE LAWS OF THE STATE OF CALIFORNIA THAT THE FOREGOING IS TRUE AND CORRECT.

SIGNED: ____
(Signature)

NAME: ____
(Print Name)

ADDRESS: ____

PHONE ______________________________

DATE: ______________________________

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