City of Los Angeles

Recycled Water Master Planning

Los Angeles Department of Water and Power
and
Department of Public Works

Groundwater Replenishment Master Planning Report

Prepared by:

RMC in association with CDM Smith

Volume 1 of 3: Report
March 2012

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Abbreviations and Acronyms

ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ADA	American Disability Act
ADAAG	American Disability Act Accessibility Guidelines
AF	acre-feet
AFD	acre-feet per day
AFM	acre-feet per month
AFY	acre-feet per year
AISC	American Institute of Steel Construction
AOP	advanced oxidation process
APWA	American Public Works Association
AQMD	Air Quality Management District
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AVORS	Additional Valley Outfall Relief Sewer
AWP	advanced water purification
AWPF	advanced water purification facility
AWWA	American Water Works Association
BEP	best efficiency point
bgs	below ground surface
bhp	break horsepower
BOE	Bureau of Engineering, City of Los Angeles
BOS	Bureau of Sanitation, City of Los Angeles
$CaCO_3$	calcium carbonate
CALGreen	California Green Building Standards Code
CBC	California Building Code
CCB	chlorine contact basin
CCS 83	California Coordinate System of 1983
CDMG	California Division of Mines and Geology
CDPH	California Department of Public Health
CEC	constituents of emerging concern
CEQA	California Environmental Quality Act
CFC	California Fire Code
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIP	clean-in-place
CWC	California Water Code
d/yr	days per year

DCTWRP	Donald C. Tillman Water Reclamation Plant
DOC	dissolved organic carbon
DPR	direct potable reuse
EIR	environmental impact report
EIS	environmental impact statement
EPA	Environmental Protection Agency
EQ	equalization
EVIS	East Valley Interceptor Sewer
ft	foot
fpm	feet per minute
fps	feet per second
FRP	fiberglass reinforced plastic
FY	fiscal year
gal	gallons
gfd	gallons per day per square foot
GHG	greenhouse gas
gpm	gallons per minute
GWR	groundwater replenishment, groundwater recharge
H_2O_2	hydrogen peroxide
HDPE	high density polyethylene
hp	horsepower
HSC	horizontal split case
HSG	Hansen Spreading Grounds
HTP	Hyperion Treatment Plant
HVAC	Heating, Ventilation, and Air-Conditioning
Hz	hertz
IAA	integrated alternatives analysis
IAP	Independent Advisory Panel
ICC	International Code Council
IPR	indirect potable reuse
kV	kilovolt
kW	kilowatt
kW-hr	kilowatt-hour
LABC	Los Angeles Building Code
LACDPW	Los Angeles County Department of Public Works
LADPW	Los Angeles Department of Public Works (City)
LADWP	Los Angeles Department of Water and Power
LAGWRP	Los Angeles Glendale Water Reclamation Plant
lb	pound
LEED	Leadership in Energy and Environmental Design
LOX	liquid oxygen
LSI	Langelier Saturation Index

MF	microfiltration
MG	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
MOU	Memorandum of Understanding
MVA	million volt-amperes
NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NDMA	N-nitrosodimethylamine
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
ng/L	nanograms per liter
NGVD	National Geodetic Vertical Datum
NOP	Notice of Preparation
NPDES	National Pollutant Discharge Elimination System
NPR	non-potable reuse
NTU	Nephelometric Turbidity Units
O&M	operation and maintenance
O_3	ozone
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
OSHA	Occupational Safety and Health Administration
PAC	Planning Advisory Committee
PEI	Pump Engineering Inc.
PF	public facility
PFD	process flow diagram
ph	phase
ppb	parts per billion
PS	pump station
PSG	Pacoima Spreading Grounds
psi	pounds per square inch
PSU	Power Supply Unit
Pt-Co	Platinum-Cobalt
PVC	Polyvinyl Chloride
PVDF	Polyvinylidene Fluoride
PWPS	product water pump station
RCP	reinforced concrete pipe
RMC	RMC Water and Environment
RO	reverse osmosis
rpm	revolutions per minute
RW	recycled water
RWAG	Recycled Water Advisory Group

RWC	recycled water contribution
RWMP	Recycled Water Master Planning
RWQCB	Regional Water Quality Control Board
SDI	silt density index
sf	square foot
SFB	San Fernando Groundwater Basin
SFBGM	San Fernando Basin Groundwater Model
SM	silty sands
SP	poorly graded sands
SS	stainless steel
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDH	total dynamic head
TDS	total dissolved solids
TI WRP	Terminal Island Water Reclamation Plant
TM	technical memorandum
TOC	total organic carbon
TSG	Tujunga Spreading Grounds
UF	ultrafiltration
µg/l	microgram per liter
ULARA	Upper Los Angeles River Area
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USGBC	U.S. Green Building Council
UV	ultraviolet (light)
UWMP	Urban Water Management Plan
V	volt
VFD	variable frequency drive
VGS	Valley Generating Station
WDR	Waste Discharge Requirements
WRF	water reclamation facility
WRP	water reclamation plant
WRR	Water Recycling Requirements
WSE	water surface elevation
WWTP	wastewater treatment plant
WY	water year

Executive Summary

The Los Angeles Department of Water and Power (LADWP), in partnership with the Los Angeles Department of Public Works (LADPW) Bureau of Sanitation (BOS) and Bureau of Engineering (BOE), developed the Recycled Water Master Planning (RWMP) documents. Specifically, the RWMP process identified projects that will significantly increase the City's recycled water use locally. Recycling more water within the Los Angeles metropolitan area provides a number of benefits. For each acre-foot of recycled water used, an equal amount of imported water is saved. As a local source of water, recycled water is more reliable than imported water and is drought-resistant.

Since the early 1900s, Los Angeles has tapped into a variety of water sources. Today, the City's water comes from Northern California (California Aqueduct); Owens Valley and Mono Lake Basin (Los Angeles Aqueduct); Colorado River (Colorado River Aqueduct); and several local water sources including groundwater aquifers, stormwater capture, and recycled water. But securing water from distant sources has become more restricted and unreliable. LADWP's 2010 Urban Water Management Plan (UWMP) outlines a goal of increasing recycled water to 59,000 acre feet per year (AFY) by 2035 to reduce dependence on imported water.

The RWMP documents include an evaluation of alternatives – strategies that take into account forward-looking groundwater replenishment (GWR) options as well as the more familiar from of recycling water for non-potable reuse (NPR) purposes, such as for irrigation and industry. This GWR Master Planning Report is one element of the RWMP documents. It is a thorough examination of the facilities that are needed to purify recycled water from the Donald C. Tillman Water Reclamation Plant (DCTWRP) and replenish groundwater in the San Fernando Groundwater Basin (SFB).

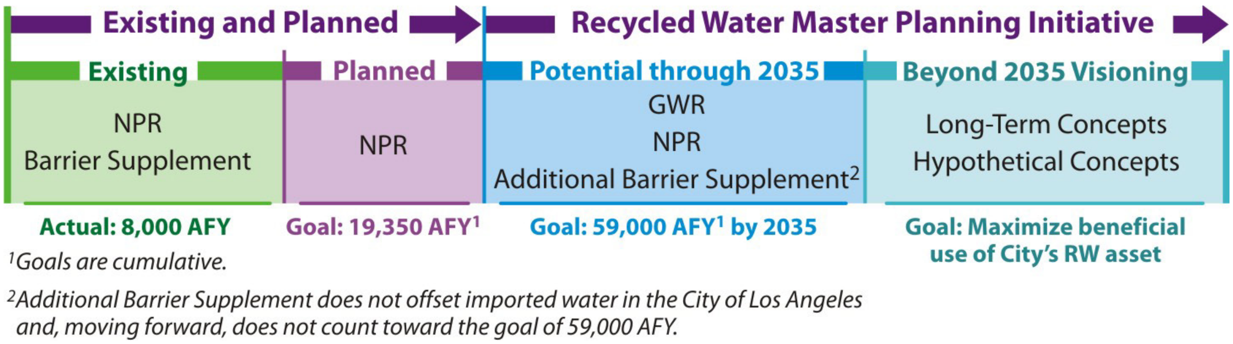
The results of this analysis will be combined with findings and recommendations of several other technical studies being completed for the RWMP effort. When implemented, the RWMP will provide project alternatives to deliver 59,000 AFY of recycled water in the near-term to offset imported water and potential implementation strategies for long-term concept projects.

ES.1 Introduction

LADWP is implementing its multi-faceted 2010 UWMP to ensure a safe and reliable water supply for future generations of Angelenos. This is a blueprint for the City's water future, and many elements go into such an important plan, such as the RWMP effort.

Figure ES-1 summarizes the City of Los Angeles' RWMP Initiative, which is guiding the development of recycled water planning for the near-term and long-term. The 2010 UWMP includes a near-term goal to develop 59,000 AFY of recycled water by 2035 as a sustainable source of local water. Of this amount, approximately 8,000 AFY is currently used for NPR and for barrier supplement in the Dominguez Gap Barrier. An additional 11,350 AFY of NPR projects are in development. The focus for the near-term is to develop the remaining 39,650 AFY (30,000 AFY from GWR and 9,650 AFY from NPR) of recycled water in Los Angeles to offset 59,000 AFY of imported water. The focus of the long-term is to offset imported water to the extent possible (up to 168,000 AFY) by 2085, fifty years after 2035.

Figure ES-1: Overview of RWMP Components



Purpose of this GWR Master Planning Report

GWR is a practical, proven way to increase the amount of water Los Angeles can get from a safe, reliable, locally-controlled water supply. The RWMP planning team has developed options and analyzed the science, technology, and regulatory arena to support the pursuit of using purified recycled water to replenish Los Angeles' groundwater basins – one significant, local source of the city's drinking water supply. The purpose of this study is to develop the GWR project components (e.g., treatment, conveyance, etc.) to a facilities planning level. Facilities planning is completed prior to starting the technical design, environmental assessment, and permitting processes.

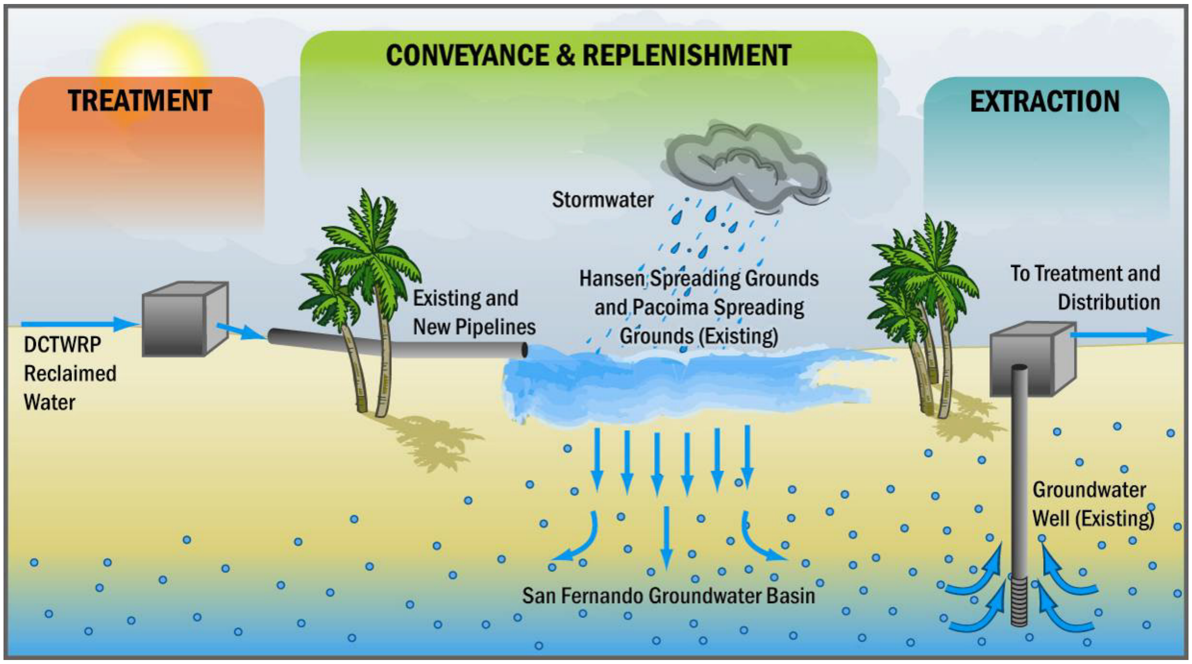
This study builds the GWR strategy around two City assets:

1. Water rights and existing facilities to add and extract water from the SFB in the San Fernando Valley.
2. Ownership and operation of the nearby DCTWRP.

Figure ES-2 below illustrates established GWR processes that begin with treating recycled water using advanced water purification (AWP) processes to near-distilled quality, conveying the water to spreading grounds, and allowing that water to percolate into natural underground aquifers to replenish the groundwater basin. It will take at least two years for water released into spreading basins to reach the well field for extraction.

The RWMP process relied on the August 2008 draft California Department of Public Health (CDPH) groundwater regulations. In late 2011, after the initial drafting of this report, CDPH released a new draft of its groundwater recharge regulations, which are currently being revised and are anticipated to be finalized by the end of 2013. The City will continue to evaluate the GWR project design with the evolving groundwater recharge regulations.

Figure ES-2: GWR Concept



Recycled Water Master Planning Approach

The RWMP multi-year planning process has focused on four major steps:

- Perform basic research and develop planning objectives;
- Formulate alternatives, based upon the research and objectives;
- Evaluate alternatives; and,
- Develop viable projects and opportunities.

Through the Recycled Water Advisory Group (RWAG), stakeholders have been involved in discussions with the recycled water planning team since late 2009. Their input has been folded into each of these major steps, resulting in viable projects and opportunities that include insights and interests of a very diverse cross-section of the Los Angeles community. **Figure ES-3** illustrates the main master planning steps and timeline.

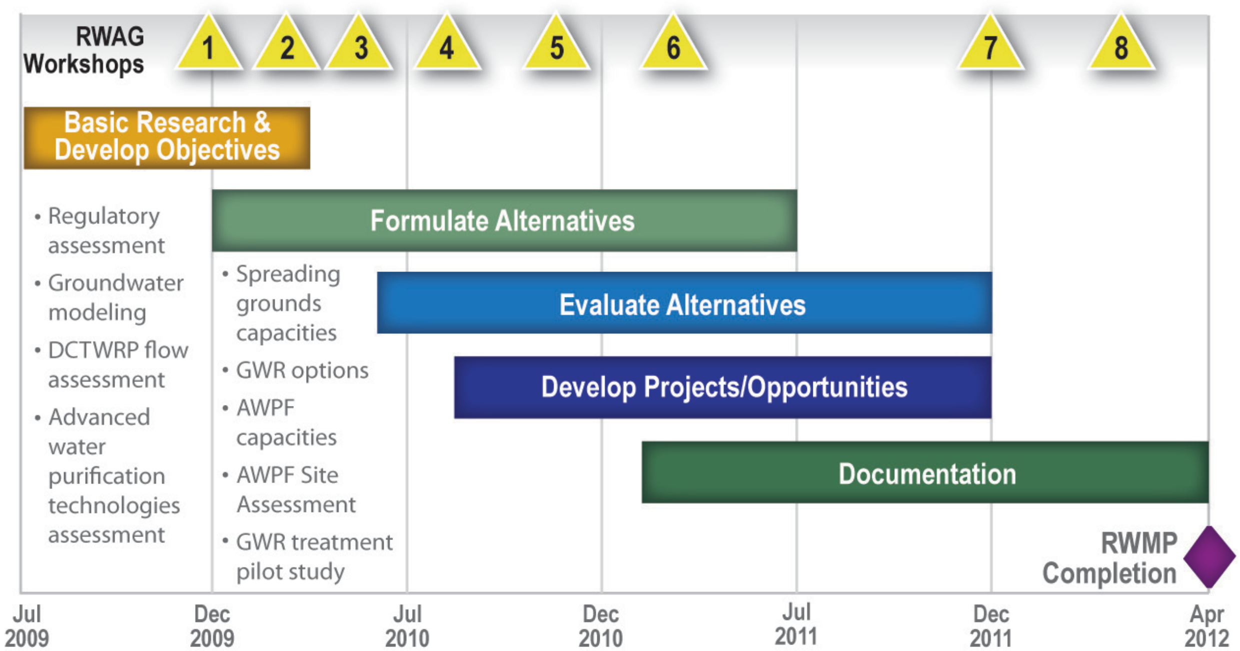


Figure ES-3: Recycled Water Master Planning Approach

Organization of the GWR Master Planning Report

The organization of the **GWR Master Planning Report** is as follows:

- Section 1 – Introduction
- Section 2 – Public Outreach
- Section 3 – Planning Parameters
- Section 4 – GWR Treatment Pilot Study
- Section 5 – Advanced Water Purification Facility
- Section 6 – Site Improvements at DCTWRP
- Section 7 – Conveyance and Replenishment Facilities
- Section 8 – Design Standards and Criteria
- Section 9 – Regulatory Requirements and Considerations
- Section 10 – Implementation Strategy
- Section 11 – Opinion of Probable Costs and Financial Analysis
- Appendices, including an evaluation of post-treatment options, additional information on the opinion of probable costs, and technical memoranda (TMs) that were completed as part of the GWR master planning effort.

ES.2 Public Outreach

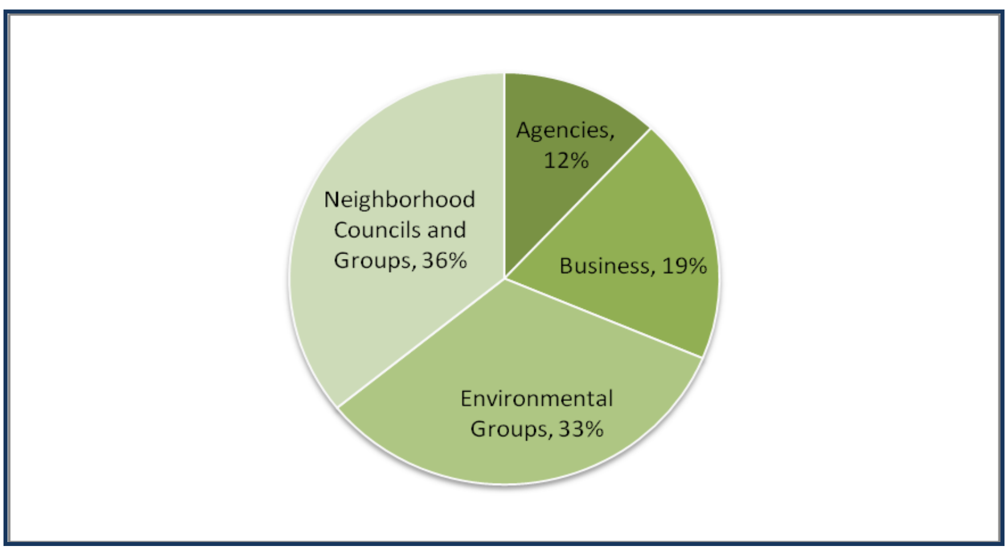
The City has been conducting an ambitious outreach program that is closely linked with RWMP activities, milestones, and decision points.

The objectives of that public outreach are:

- Build trust and confidence in the City and its departments as a provider of high-quality, safe, and reliable water;
- Achieve public understanding of recycled water and GWR as safe, beneficial sources of water;
- Receive knowledge and open stakeholder input to the RWMP documents;
- Be transparent in information sharing and inclusion; and,
- Support the media with responsive, accurate, and timely information.

The GWR master planning process has included presenting to and receiving feedback from the Recycled Water Advisory Group (RWAG). This group of highly interested stakeholders was formed to provide input and ideas related to increasing the amount of recycled water beneficially used in Los Angeles. The group has attended a series of half-day workshops, facility tours, and update sessions; listened to concepts and studies that are part of the RWMP process; and provided insightful feedback. RWAG members reflect a wide diversity of interests and are extremely well informed about recycled water and related issues. **Figure ES-4** shows participation in RWAG by category of interests. The City has reached out to many groups citywide. Additional outreach activities include briefings for City Council and other elected officials; one-on-one briefings with key stakeholders; presentations to Neighborhood Councils; presentations to Community Organizations, NGOs, Businesses, Recycled Water Forums throughout the city, and Urban Water Management Plan Workshops; informing LADWP/BOS employees; formation of an Independent Advisory Panel (IAP); gathering letters of support; and maintaining a stakeholder database.

Figure ES-4: RWAG Participants Represent Diverse Interests



ES.3 Planning Parameters

Planning parameters are essential for comparing concepts and alternatives. Planning parameters are often distinguishing characteristics or functions. Planning parameters include objectives, GWR goals, implementation phases, spreading grounds, and advanced water purification facility (AWPF) site selection, sizing, and influent water quality.

Planning Principles and Objectives

At the onset of the RWMP process in 2008, a number of guiding principles were established that shaped the alternatives considered for the GWR project. These principles included protection of public health and water quality, attainment of recycled water goals, compliance with regulatory frameworks, cost-effectiveness of the project, and engagement of stakeholders. Some very specific principles were identified in the City's May 2008 Water Supply Action Plan. The Plan called for the use of advanced treatment for recycled water used to replenish groundwater and a groundwater replenishment benchmark of 15,000 AFY. Subsequent to initiating the recycled water master planning process, the LADWP adopted the 2010 UWMP, which incorporated recycled water as a key water supply strategy for Los Angeles and superseded the 2008 Water Supply Action Plan. The 2010 UWMP now serves as the City's guiding document for expanding the recycled water program, including groundwater replenishment. The UWMP reflects realities of funding limitations that were not addressed in the 2008 Water Supply Action Plan document. Water rate increases are required to achieve even the revised projections in the UWMP.

In November 2011, as the planning process was nearing completion, the CDPH released a new draft of its groundwater recharge regulations. Although the groundwater recharge regulations will not be final until at least the end of 2013, the revised draft appears to provide flexibility for GWR projects that may allow the City to consider other alternatives that could reduce project costs, primarily through recognition of the proven role that natural systems play in the water purification process. These potential regulatory changes and the potential for other alternatives appear to be consistent with input provided to the City by the IAP. As the CDPH regulatory process evolves, the City will continue to evaluate opportunities to reduce project costs while developing the GWR project design within its guiding principles. Any new alternatives will also take into consideration the scope, timing, and implementation of the San Fernando Basin Groundwater Treatment Complex, a project that will focus on the treatment of legacy groundwater contamination in the San Fernando Groundwater Basin (SFB). At this time, it is anticipated that the construction of the GWR Project will proceed when the implementation of the San Fernando Basin Groundwater Treatment Complex moves forward.

In addition to these planning principles, planning objectives were also developed. Two threshold objectives were established, which had to be met regardless of the alternative:

- **Threshold Objective 1** – Meet all water quality regulations and health and safety requirements, and use proven technologies.
- **Threshold Objective 2** – Provide effective communication and education about the recycled water program.

In addition to the threshold objectives, six additional recycled water planning objectives were established, which include:

- **Objective 1 –** Promote Cost Efficiency
- **Objective 2 –** Achieve Supply and Operational Goals
- **Objective 3 –** Protect Environment
- **Objective 4 –** Maximize Implementation
- **Objective 5 –** Promote Economic and Social Benefits
- **Objective 6 –** Maximize Adaptability and Reliability

Planning Year and GWR Goals

An integrated alternatives analysis was completed to determine the balance between GWR and NPR to meet the City's recycled water goal of 59,000 AFY by 2035. The analysis compared alternatives that comprised different combinations of GWR and NPR, as shown in **Figure ES-5**. The planning objectives listed above were used to evaluate the alternatives.

Figure ES-5: Integrated Alternatives to Reach 50,000 AFY and 59,000 AFY[1]

	50,000 AFY[1]	59,000 AFY
	Alternative 1. More Purple Pipe (NPR) Existing NPR: 8,000 AFY Planned NPR: 11,350 AFY Potential NPR: 15, 650 AFY GWR: 15,000 AFY	**Alternative 1. More Purple Pipe (NPR)** Existing NPR: 8,000 AFY Planned NPR: 11,350 AFY Potential NPR: 24, 650 AFY GWR: 15,000 AFY
	Alternative 2. Moderate GWR/NPR Existing NPR: 8,000 AFY Planned NPR: 11,350 AFY Potential NPR: 8,150 AFY GWR: 22,500 AFY	**Alternative 2. Moderate GWR/NPR** Existing NPR: 8,000 AFY Planned NPR: 11,350 AFY Potential NPR: 17,150 AFY GWR: 22,500 AFY
	Alternative 3. More GWR Existing NPR: 8,000 AFY Planned NPR: 11,350 AFY Potential NPR: 650 AFY GWR: 30,000 AFY	**Alternative 3. More GWR** Existing NPR: 8,000 AFY Planned NPR: 11,350 AFY Potential NPR: 9, 650 AFY GWR: 30,000 AFY

Note:

1) The original recycled water goal for the RWMP was 50,000 AFY by 2019, which was established before the completion of the 2010 UWMP. The recycled water goal was revised to 59,000 AFY by 2035 with the issuance of the 2010 UWMP. The UWMP reflects realities of funding limitations that were not addressed in the 2008 Water Supply Action Plan. Water rate increases are required to achieve even the revised projections in the UWMP. The integrated alternatives analysis was originally focused on determining the balance of GWR and NPR to achieve 30,650 AFY so that when combined with the

19,350 AFY of existing and planned NPR demands would achieve an overall recycled water goal of 50,000 AFY.

The integrated alternatives analysis concluded that more GWR (Alternative 3) is most beneficial, since this alternative performs better than alternatives with less GWR in terms of capital costs and project implementation. Therefore, this GWR Master Planning Report is based on achieving a GWR goal of 30,000 AFY – the maximum amount of GWR that can be served by DCTWRP and the most conservative project size from a planning perspective. As shown in **Figure ES-5**, when combined with 30,000 GWR, 9,650 AFY of NPR projects are needed so that when added to the 19,350 AFY of existing and planned NPR demands the City will achieve the overall goal of 59,000 AFY by 2035.

To allow for the most flexibility for implementation, the NPR Master Planning Report identifies over 18,000 AFY of potential NPR projects. NPR projects that are most feasible considering cost and other important criteria will be the ones pursued.

The City relies on a mix of GWR and NPR projects to meet its goals, and has the flexibility to adjust the amount of GWR eventually implemented. As the recycled water program develops, the City can revisit the multi-criteria comparison of GWR and NPR to determine whether the GWR project should be expanded by an additional 15,000 AFY or less. If Phase 2 is less than 15,000 AFY, then more NPR projects would be implemented to achieve the goal of 59,000 AFY by 2035.

GWR Project Implementation Phases

The GWR project will be implemented in two phases. The implementation phases are shown in **Table ES-1** below.

Table ES-1: GWR Projects Implementation Schedule

GWR Project Phases	Imported Water Offset	Target Year
GWR Project – Phase 1	15,000 AFY	FY 2022 (In service by July 2022)
GWR Project – Phase 2	Up to 30,000 AFY [1]	FY 2035 (In service by July 2035)

Notes:
1) Due to limited flow from the DCTWRP and spreading grounds availability, 30,000 AFY of GWR may not be achievable unless groundwater injection wells are considered.

AWPF Site Selection

Another key planning parameter was selecting a preferred potential location for the AWPF. A separate study was done by the RWMP planning team to identify and evaluate several potential sites. From that process, five viable candidate sites were identified. These sites are located at the City's DCTWRP and Valley Generating Station (VGS). These sites were evaluated in more detail and based on this analysis; the City selected Site 2, DCTWRP Southwest, as the staff-preferred location for the GWR master planning and environmental documentation. The other four viable sites will be carried forward into environmental documentation. **Figures ES-6 and ES-7** are aerial photos of the City's DCTWRP and VGS with the five most viable candidate sites overlaid. **Table ES-2** shows some of the critical criteria used to evaluate the five sites.

Figure ES-6: AWPF Candidate Sites at or Near DCTWRP

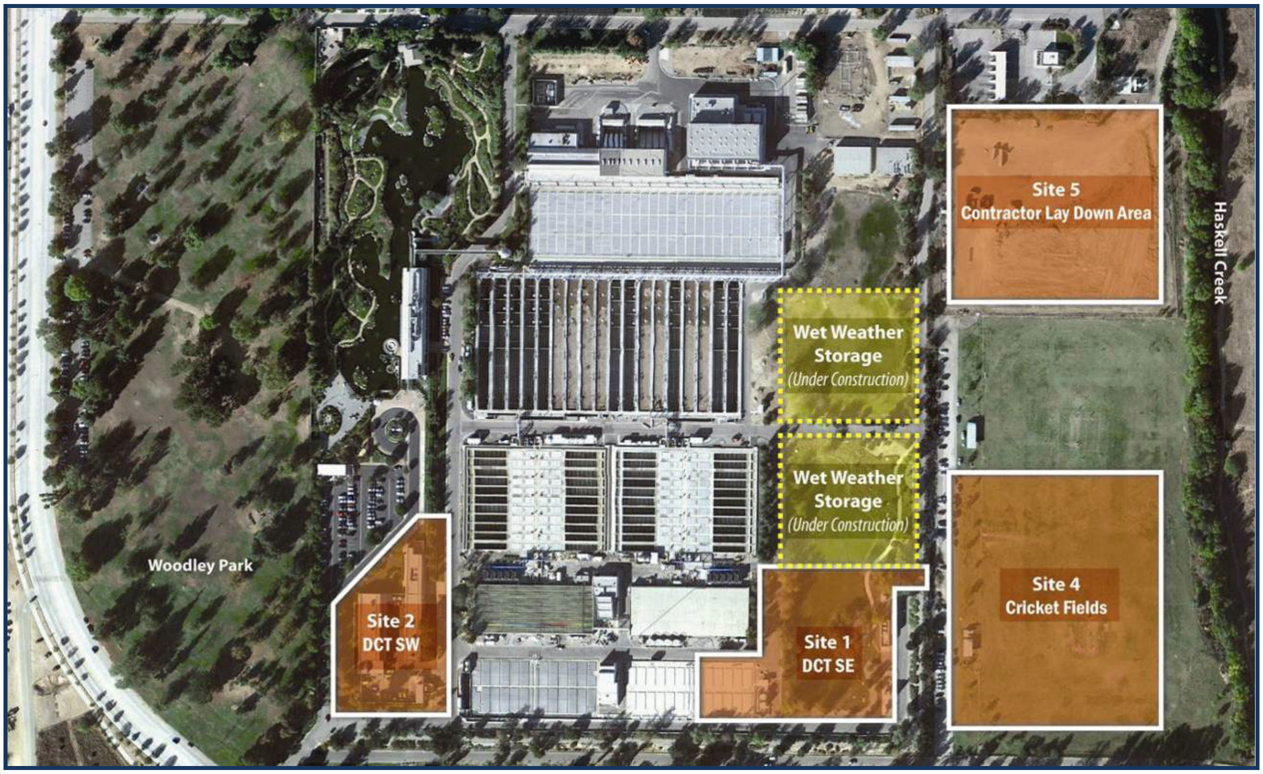


Figure ES-7: AWPF Candidate Site at VGS

Table ES-2: Critical Criteria for Evaluation of Five Candidate Sites

Critical Criteria	Site 1 DCTWRP SE	Site 2 DCTWRP SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Lay Down Area
Bureau of Sanitation (BOS) already has related facilities and staffing at the site to support the operation of the AWPF for GWR. Although new facilities will be built for GWR, there are benefits and economies of operation having new facilities alongside existing operational facilities and staff.	√	√		√	√
Site is within the boundaries of the existing berm or outside of the Sepulveda Flood Control Basin.	√	√	√		
Site is not in an area of potential future expansion to the existing treatment processes for producing tertiary treated effluent at DCTWRP.		√	√		

✓ = Site meets criterion.

DCTWRP Flows, Other Demands for Recycled Water and AWPF Capacity

Another key planning parameter was the amount of water that could be treated in the AWPF considering the influent to DCTWRP and other demands for recycled water. DCTWRP has capacity to treat up to 80 million gallons per day (mgd), of which approximately 29 mgd is for in-plant reuse, Lake Balboa, Wildlife Lake, Japanese Gardens, and the Los Angeles River. **Table ES-3** summarizes the DCTWRP flows and **Table ES-4** shows the AWPF capacity planning parameters. Data in Tables ES-3 and ES-4 are based upon the assumption that all recycled water from DCTWRP for both GWR and NPR is treated at the AWPF. However, through development of the GWR project, based on viability and cost, some of the NPR demands in the Sepulveda Basin area may be served with tertiary Title 22 recycled water and purified recycled water from the AWPF.

Table ES-3: DCTWRP Flows

Parameter	Phase 1 FY 2022	Phase 2 FY 2035
DCTWRP Title 22 Treatment Capacity	80 mgd	80 mgd
DCTWRP Influent	66 mgd [1,2,5]	80 mgd [1,3]
DCTWRP Effluent (Title 22 Recycled Water)	61 mgd [1,2]	73 mgd [1,3]
In-Plant Reuse	2 mgd	2 mgd
Flows to Lakes and LA River [4]	27 mgd	27 mgd
Influent to AWPF	32 mgd	44 mgd

Notes:

1) As noted in *Draft DCTWRP Maximum Flow Assessment TM* (Appendix G), Table 4-2, the DCTWRP tertiary effluent production capacity is estimated to be approximately 87% of the influent flow rate, based on plant flow data from January 2005 through December 2008. The new cloth media filters, which have fewer losses than the old granular media filters, came on-line in December 2009 so data from December 2009 through August 2011 were analyzed as part of this GWR Master Planning Report. The DCTWRP tertiary effluent production capacity is estimated to be approximately 92% of the influent flow rate. If DCTWRP secondary effluent is used for AWPF influent, slightly more flow will be available since losses from cloth media filters will be eliminated.
2) Approximate daily total influent and effluent flows, accounting for weekend diurnal curves and existing primary flow equalization capacity.
3) Maximum daily total influent and effluent flows, accounting for weekend diurnal curves and installation of additional primary flow equalization capacity. See Section 5 for more information.
4) Assumed flow to Lakes and LA River, based on 2006 Integrated Resources Plan Draft Environmental Impact Report.
5) For Phase 1 the influent flow rate will be managed to meet the recycled water demands (i.e., in-plant reuse, flows to Lakes and LA River, and influent to AWPF).

Table ES-4: AWPF Capacity

Parameter	Phase 1 (FY 2022)		Phase 2 (FY 2035)	
	Wet Year[2]	Dry Year[3]	Wet Year[2]	Dry Year[3]
AWPF Influent Flow	32 mgd	32 mgd	44 mgd	44 mgd
AWPF Product Water Capacity [1]	25 mgd [(5)]	25 mgd	35 mgd	35 mgd
AWPF Production, Potential	20,000 AFY	23,000 AFY	31,000 AFY	35,000 AFY
NPR [4]	5,000 AFY	5,000 AFY	5,000 AFY	5,000 AFY
GWR	15,000 AFY	18,000 AFY	26,000 AFY	30,000 AFY

Notes:

1) Assumes overall 79% AWPF recovery (93% MF recovery and 85% RO recovery).
2) Accounts for 92% AWPF online factor, and the maximum number of days HSG (70 days/year) and PSG (30 days/year) are unavailable to receive purified recycled water.
3) Accounts for 92% AWPF online factor, and the assumed minimum number of days HSG (10 days/year) and PSG (5 days/year) are unavailable to receive purified recycled water.
4) Includes existing and planned NPR users only. During wet years, NPR demands would be lower since demands for irrigation water would be lower.
5) While the required AWPF capacity to achieve 15,000 AFY of GWR in Phase 1 during wet years is 23.4 mgd, the AWPF equipment described in Section 5 are sized for 25.0 mgd capacity in Phase 1, since RO trains are sized in 5.0 mgd capacity units. The AWPF will have 5.0 mgd treatment capacity with one RO train online,

25.0 mgd capacity with five RO trains online (Phase 1), and 35.0 mgd capacity with seven RO trains online (Phase 2).

ES.4 GWR Treatment Pilot Study

A pilot study was conducted to evaluate the effectiveness of AWP processes on the DCTWRP recycled water, support public outreach, and test alternative advanced oxidation processes. The pilot study tested the following AWP technologies that are proposed for the AWPF:

- Microfiltration (MF);
- Reverse osmosis (RO);
- Advanced oxidation process (AOP) using ultraviolet (UV) light and hydrogen peroxide (H_2O_2); and,
- An alternative AOP using ozone and H_2O_2.

MF, RO, and AOP with UV/H_2O_2 have been successfully permitted by the California Department of Public Health (CDPH) for other GWR programs run by nearby water agencies, such as the Orange County Water District's (OCWD) GWR System.

The primary function of the MF system is to provide pretreatment for sustainable operation of the RO process. The MF also provides the first barrier against protozoa and bacteria, which should be undetectable in the MF product. The primary function of the RO process is to provide removal of dissolved salts and organic contaminants. The primary function of the AOP system is to destroy trace organic compounds not completely removed by the RO membranes.

A critically important part of the GWR master planning process was to conduct a pilot project consisting of these purification technologies using effluent (treated wastewater) from DCTWRP. Pilot testing was conducted over 16 months in three phases:

- Phase 1 validated the proposed processes used at existing advanced water purification facilities in California, including MF, RO, and UV/H_2O_2 – considered the baseline treatment process.
- Phase 2 evaluated ozone/H_2O_2 as an alternative to UV/H_2O_2, with both AOPs tested side-by-side and with target contaminants spiked into the AOP supply.
- Phase 3 confirmed the recommended operating conditions from Phases 1 and 2 and also evaluated two alternative RO membranes.

Source Water Evaluation: Design for Flexibility

Pilot testing results demonstrated that there were no significant differences in MF, RO, or AOP performance when secondary or tertiary effluents were used as feed water to the AWPF. With no difference in operating efficiency or water quality, it was recommended that the full-scale facility be designed to allow flexibility to use either secondary or tertiary effluent as source water, taken before chlorine addition.

Highlights of MF Pilot Testing Results

Two disinfection methods were pilot tested. The first, traditional chloramination – which was recommended for use in the full-scale facility – involved adding sodium hypochlorite and ammonium hydroxide at the same process location, immediately upstream of the MF feed tank. This method performed significantly better than the second method tested; sequential chlorination.

Highlights of RO Pilot Testing Results

Testing results demonstrated that the RO system effectively met the water quality goals, while removing constituents of emerging concern (CECs) to non-detectable levels for all but 11 compounds. Removal of these compounds was greater than 98 percent for all but NDMA, which was removed to non-detectable levels by the downstream UV/ H_2O_2 process. The testing demonstrated that RO provides an exceptional water quality for GWR.

Highlights of AOP Pilot Testing Results

Testing results support the conclusion that UV/ H_2O_2 is an effective method for removing trace organic compounds, which are only partially removed by the RO membranes. It also demonstrated that ozone/ H_2O_2 is promising for the removal of 1,4-dioxane and TCEP, two compounds that are more difficult to oxidize than most other CECs. Higher NDMA removal was achieved with UV/H_2O_2 as result of direct photolysis from the UV light. Based on the positive pilot results for ozone/H_2O_2, both UV/H_2O_2 and ozone/H_2O_2 are included as potential AOPs in the GWR Master Planning Report. Additional study and testing is required for ozone/ H_2O_2 to determine if it would be viable for the AWPF and to further refine the design criteria.

Water Quality

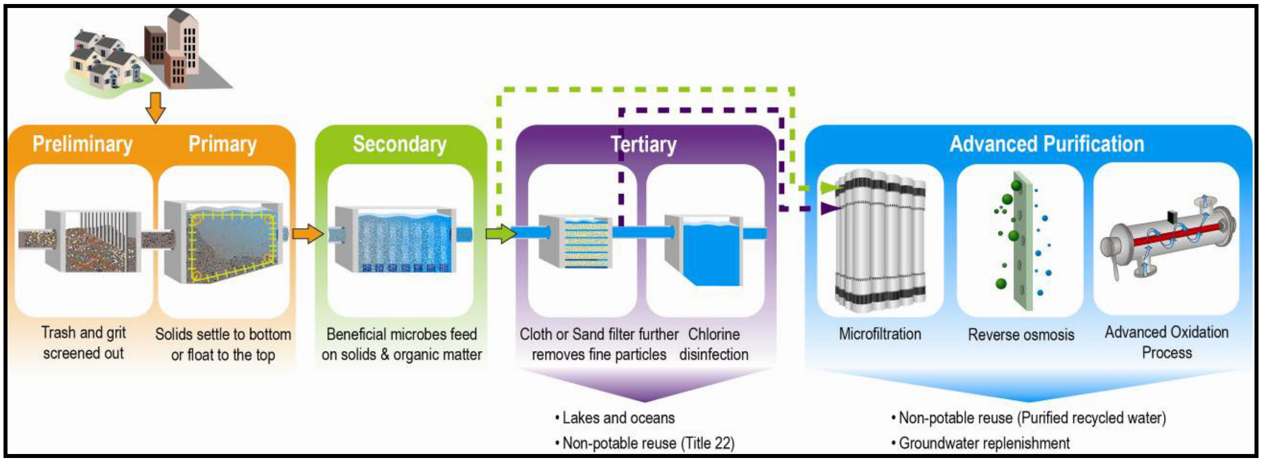
Water quality results from the pilot testing confirmed that all existing and draft drinking water and recycled water regulations can be met using the proposed treatment processes. All of the regulated compounds in the product water measured below their regulatory limits.

All but ten non-regulated pharmaceuticals and personal care products were removed to concentrations below detection levels by the RO process. All but three of these were removed to below detection levels by the UV/H_2O_2 process, and all but two by the ozone/H_2O_2. Overall, the removal of these three remaining compounds was greater than 98 percent, with their concentrations in the final product water averaging less than 10 nanograms per liter (ng/L), which is often considered to be a non-detectable level.

ES.5 Advanced Water Purification Facility at DCTWRP

The GWR Master Planning Report sizes and lays out the treatment processes for the AWPF. As discussed in Section ES.3, the City selected the DCTWRP Southwest location for the AWPF for the proposed site, which is the basis for this master planning report. **Figure ES-8** shows the major treatment processes that exist for DCTWRP and that are proposed for the AWPF.

Figure ES-8: Major Treatment Processes in at DCTWRP and Proposed for the AWPF



Each of the treatment processes shown in **Figure ES-8** have multiple components. Each of those components requires design criteria to enable the planning team to evalute how well that component of the AWPF will meet treatment goals. The design criteria, highly detailed and technical in nature, established standards for performance (e.g., that the product water would meet regulations), safety, and operational needs. As discussed in Section ES.3, the initial capacity of the AWPF for Phase 1 is 25 mgd, which would be expanded to 35 mgd for Phase 2. **Table ES-5** lists the design criteria categories addressed in the GWR Master Planning Report.

Table ES-5: AWPF Design Criteria Categories

AWPF Design Criteria Included in GWR Master Planning Report
• MF Feed Pumps • MF Pre-Filters • Pall MF System • MF/RO Break Tank • RO Transfer Pumps • RO Cartridge Filters, • RO Feed Pumps • RO Systems, including a comparison of 8-inch and 16-inch RO Systems • UV/H_2O_2 Systems (Calgon and Trojan) • Ozone/H_2O_2 System as Alternative AOP, based on pilot testing • Post-Treatment • Product Water Pump Station • Chemical Storage and Feed Systems, including Ammonium Hydroxide, Sodium Hypochlorite, Antiscalant, Sulfuric Acid, Hydrogen Peroxide, Carbon Dioxide, Calcium Chloride, Caustic Soda, Citric Acid, and Sodium Bisulfite • Backwash/Concentrate Pipe • Phase IV Primary Clarifiers/Equalization Basins

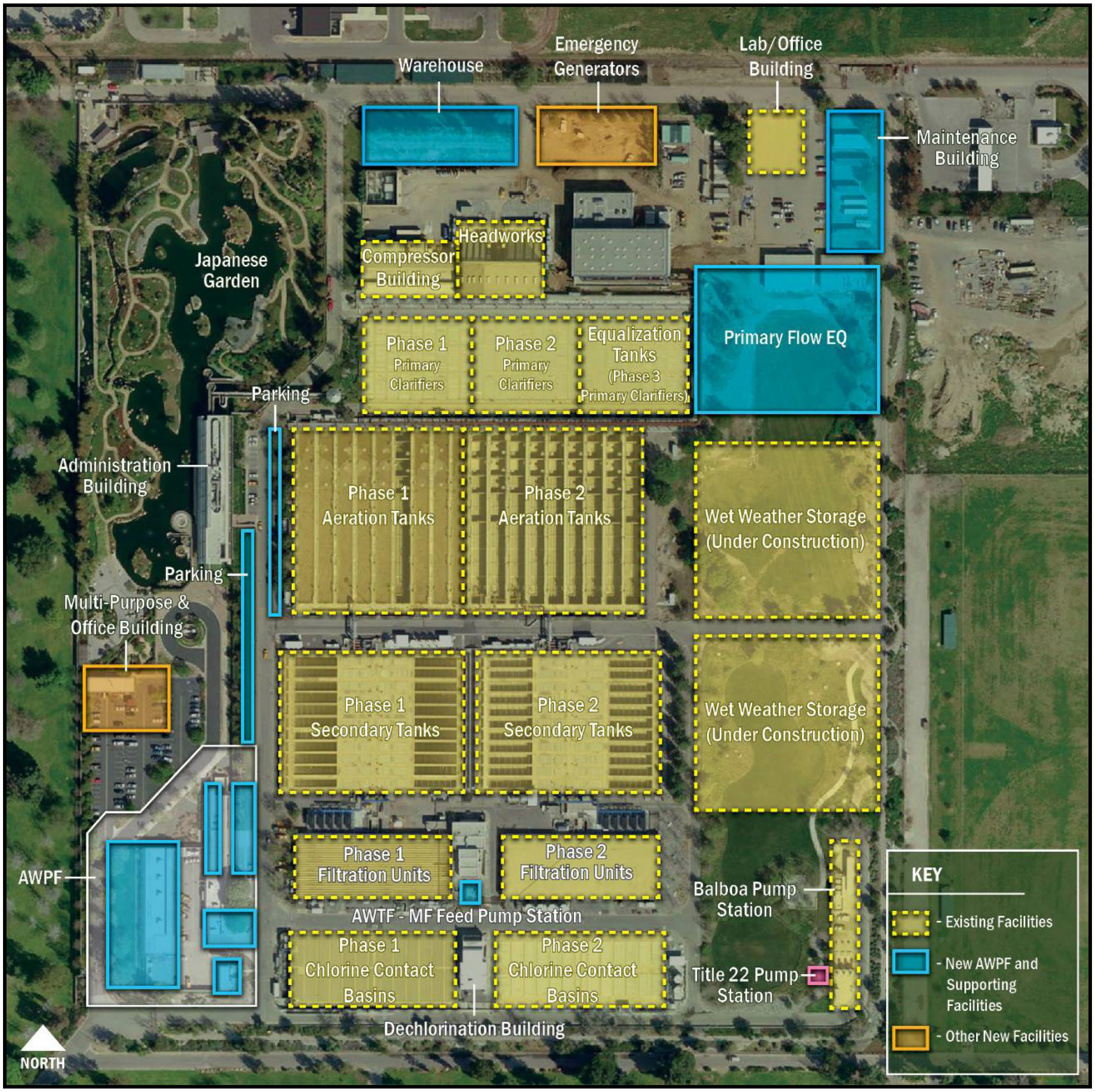
ES.6 Site Improvements at DCTWRP

The staff preferred site for the AWPF is located at the southwest corner of the DCTWRP. Currently, service buildings occupy the space where the main purification facilities will be constructed. Work at DCTWRP associated with the AWPF includes the following:

- Construction of the new maintenance and warehouse buildings on the north side of DCTWRP before construction of the AWPF;
- Demolition of the existing service buildings, parking lot, pavement, planters, and a buffer of vegetation;
- Construction of additional Phase IV clarifiers for flow equalization (before expansion to Phase 2);
- Construction of new Title 22 Pump Station (see Non-Potable Reuse Master Planning Report);
- Construction of the new AWPF structures; and,
- Installation of various piping.

Figure ES-9 shows an aerial view of the DCTWRP with proposed AWPF improvements.

Figure ES-9: Aerial View of DCTWRP Preliminary Site Plan



ES.7 Conveyance and Replenishment Facilities

After the water is treated in the AWPF, it will be conveyed to spreading grounds to replenish the groundwater basin. Ultimately it will be extracted as a safe, reliable, local supply of water.

The GWR Master Planning Report evaluated the different processes that will be capable of providing water in two phases: 15,000 AFY and 30,000 AFY.

- **Phase 1:** 15,000 AFY of GWR will be achieved by surface spreading at the HSG

- **Phase 2 Option A:** Up to 30,000 AFY of GWR will be achieved by surface spreading at the HSG and PSG
- **Phase 2 Option B:** Up to 30,000 AFY of GWR will be achieved by surface spreading at the HSG and PSG, as well as direct injection using injection wells, and/or Strathern Wetlands Project

The HSG and PSG are shown in **Figures ES-10 and ES-11**, respectively.

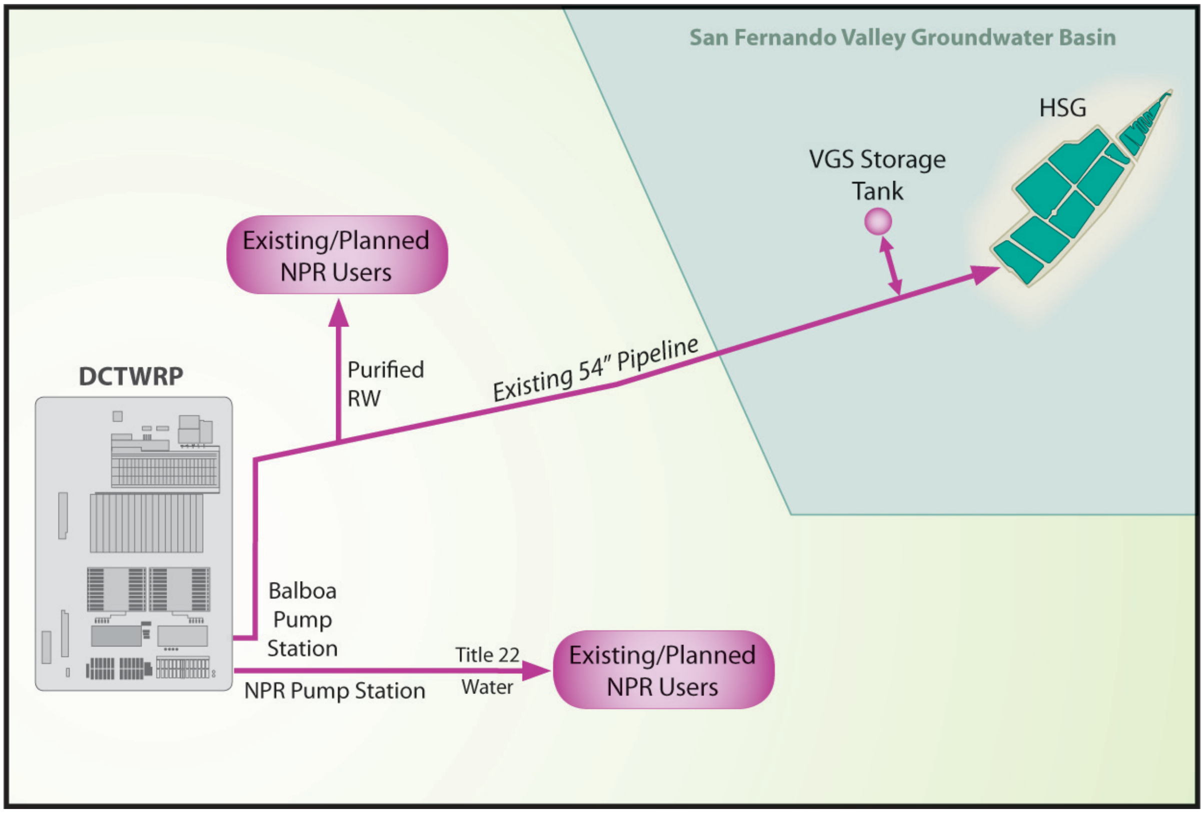
Figure ES-10: HSG Aerial Photograph

Figure ES-11: PSG Aerial Photograph

Phase 1: 15,000 AFY to Hansen Spreading Grounds

The goal of Phase 1 is to recharge the groundwater basin with an annual average of 15,000 AFY of purified recycled water at HSG. As shown in **Figure ES-12**, purified recycled water will be conveyed from DCTWRP to HSG through the existing 54-inch pipeline.

Figure ES-12: Schematic of Conveyance Facilities to Deliver 15,000 AFY from DCTWRP to HSG



Purified recycled water will be delivered at a relatively steady rate throughout the year, but stormwater is seasonal. Theoretically, there is more than adequate capacity at the HSG to achieve the 15,000 AFY target, however, there are two major reasons that the basin(s) at the HSG may be unavailable for recharge of the purified recycled water: (1) due to extreme wet weather conditions when stormwater takes precedence over purified recycled water; and (2) maintenance. These conditions require a careful plan of operations and close cooperation with Los Angeles County Department of Public Works (LACDPW) to be developed and followed.

The output capacity of the AWPF will be large enough to compensate for the downtime of the HSG and still meet the GWR goal of 15,000 AFY for the Phase 1.

For extraction, the two main quantitative considerations to demonstrate compliance with the CDPH 2008 draft groundwater recharge regulations are: (1) retention time and (2) recycled water contribution.

Under the 2008 draft regulations, retention time is six months from when purified recycled water is delivered to the spreading grounds until it reaches the nearest drinking water supply well. This must be verified by means of a tracer study. Prior to this, for planning purposes in siting a project, the project proponent may use numerical modeling to show that a minimum retention time of 12 months is met. LADWP applied its San Fernando Basin Groundwater Model (SFBGM) to assess the time for AWPF water to travel from HSG to the Tujunga Well Field (three years) and the Rinaldi-Toluca Well Field (six years). Compliance with the 12-month minimum retention time can easily be demonstrated.

The 2008 draft regulations also require that, initially, at least 50 percent of the water that replenishes the groundwater basin will come from non-recycled water sources, which can include stormwater. (This is referred to as "diluent" water. The recycled water divided by the sum of the recycled water and diluents water is referred to as the recycled water contribution, or RWC.) The planning team looked at historic hydrology and a wide range of potential conditions and determined that, with certain facility improvements to HSG, there a high probability that Phase 1 will meet the initial RWC requirement. Furthermore, the probability of meeting the initial RWC would even be higher assuming CDPH accepted an alternative approach that considered blending in the aquifer from multiple non-recycled water sources upgradient of potable supply wells such as several spreading grounds.

A Memorandum of Understanding (MOU) between LADWP and LACDPW is being developed with respect to recharging purified recycled water at the HSG.

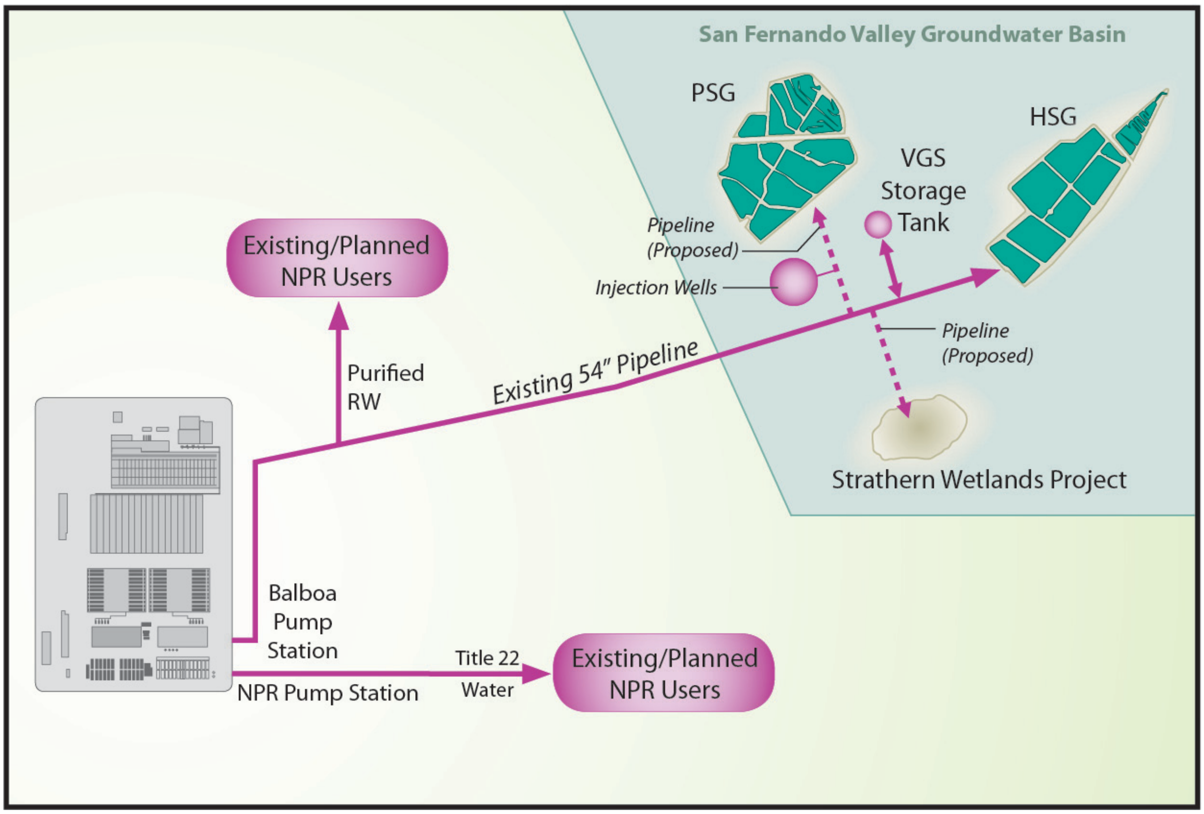
Phase 2 Options A and B: 30,000 AFY to Hansen and Pacoima Spreading Grounds

The goal of Phase 2 is to recharge an annual average volume of up to 30,000 AFY of purified recycled water. Use of HSG alone is not sufficient to allow GWR of 30,000 AFY for Phase 2. The use of stormwater for replenishment at the LACDPW spreading grounds is the first priority and based on historic volumes and recent improvements, it is assumed LACDPW will spread an average of 16,800 AFY of stormwater at HSG. Phase 1 of the GWR project will add another 15,000 AFY for a total of 31,800 AFY to be spread at HSG. Groundwater model results indicate that, while HSG has the percolation capacity to accept more than 15,000 AFY of recycled water, the underlying aquifer system may not have the capacity to transmit flows much in excess of 31,800 AFY without excessive groundwater mounding because of a fault downgradient of HSG (approximately at San Fernando Road). Mounding could bring groundwater levels very close to the surface and greatly reduce percolation capacity, as well as the potential to adversely impact operations at the nearby Bradley Landfill. Therefore, recharge of recycled water greater than 15,000 AFY is not proposed for the HSG and the use of both the HSG and the PSG is necessary to increase GWR in Phase 2.

Under Phase 2 Option A, the recharge will occur at both HSG and PSG. Distribution of the purified recycled water to each spreading ground will be approximately equal. Under Phase 2 Option B, injection wells may also be incorporated into the project to allow for additional groundwater recharge under certain conditions in the winter months when the spreading basins are unavailable for recycled water recharge. Injection wells are similar to groundwater production wells and have screens below the water table. The pressure in the existing delivery system would move the water down the injection wells where it exits into the groundwater basin through the screened zones. Another potential option is spreading at the Strathern Wetlands Project.

As shown in **Figure ES-13**, purified recycled water will be conveyed from DCTWRP to HSG through the existing 54-inch pipeline for both Options A and B. A new pipeline will be constructed to connect the 54-inch pipeline with PSG. For Option B, the injection wells will be located along this new pipeline route, as shown schematically in **Figure ES-13**.

Figure ES-13: Schematic of Conveyance Facilities to Deliver 30,000 AFY from AWTF to HSG and PSG (Phase 2 Option A), and Injection Wells and/or Strathern Wetlands Project (Phase 2 Option B)



As with Phase 1, there will be periods when the spreading grounds may be unavailable for the recharge of recycled water. In addition to HSG being unavailable for up to 70 days per year, LACDPW has indicated that PSG could be unavailable for 30 days per year. Based on this information, there may be times of year that the City cannot recharge purified recycled water at both HSG and PSG. Under Option B, injection wells and/or spreading at the Strathern Wetlands Project are being considered to allow recharge of water year-round regardless of the spreading basin availability.

The same two main quantitative considerations to demonstrate compliance with the 2008 draft regulations described earlier also apply to Phase 2 Option A. They are: (1) retention time and (2) recycled water contribution.

LADWP applied its SFBGM to assess the time for AWPF water to travel from HSG and PSG to the Tujunga Well Field and the Rinaldi-Toluca Well Field. Results are show in **Table ES-6** below. Compliance with the 12-month minimum retention time can easily be demonstrated.

Table ES-6: Simulated Retention Time for Phase 2 Option A

Source of Recycled Water	Simulated Retention Time (years)	
	Tujunga Well Field	Rinaldi-Toluca Well Field
Phase 2 Option A		
HSG	3	5.5
PSG	4.5	11

With the expansion from 15,000 AFY for Phase 1 to 30,000 AFY for Phase 2, the City will be expanding to a 100 percent recharge project where the RWC will be increased from 50 percent (50 percent purified recycled water and 50 percent stormwater) to as much as 75 percent purified recycled water. The 2008 draft groundwater recharge regulations permit an increase in the RWC up to 100 percent subject to demonstration of successful compliance with regulatory criteria including: 1) the 20-week total organic carbon (TOC) average in recycled water for a one year period must equal 0.5 mg/L divided by the proposed maximum RWC; 2) demonstration that monitoring wells have received specified percentages of recycled water for at least six months and twelve months; and 3) review by an expert panel.. Since the County will always be recharging stormwater at HSG, PSG, and Tujunga Spreading Grounds (TSG), all of which provide stormwater to effectively blend with purified recycled water, the RWC will never approach 100%. Therefore, the project is expected to be able to demonstrate the ability to operate and be allowed to expand to at least 75 percent RWC and be in compliance.

For Phase 2 Option B, the concept of adding injection wells to the operational strategy is to allow the City to continue replenishing the groundwater basin during wet periods when LACDPW would restrict spreading of purified recycled water. LACDPW could require LADWP to stop sending purified recycled water during storm event to either or both HSG and PSG for periods of time ranging from a few days to several weeks or longer. Therefore, the injection wells will be designed for the full capacity of the AWPF (35.0 mgd) so that for any day or extended periods that the basins are not available, the maximum amount of purified recycled water could still be injected by the wells to maximize groundwater replenishment. This is summarized in **Table ES-7**.

Table ES-7: Injection Well Flows and Operating Conditions

Injection Wells	Estimated Quantities
Total Injection Capacity	35.0 mgd
Operational Capacity per Well	2.7 mgd; 4.2 cfs
No. of Wells	13
Operating Conditions	Standby under normal conditions. To be used when HSG/PSG are not available for recycled water spreading.

An important consideration with respect to introducing injection wells is the question of meeting blend requirements under the 2008 draft regulations. Projects using AWPF purified recycled water, initially, are required to blend a maximum of 50% of recycled water with a minimum of 50% potable water from other sources. Under these requirements, it would be possible to inject 100% recycled water into the wells whenever the spreading basins are not available, and inject an equivalent amount of treated potable water into the wells to achieve a 50/50 blend on a seasonal or annual basis.

Groundwater Extraction

Groundwater will be ultimately extracted, treated and delivered to LADWP customers using existing wells. Of the 115 wells owned by LADWP in the SFB, over 50 have been shut down due to contamination, resulting in a loss of approximately 40 percent of LADWP's total pumping capacity. Of the remaining active wells, 45 wells have recorded contaminant concentrations above the corresponding maximum contaminant levels (MCLs). Most notable among these contaminants of concern are the volatile organic compounds (VOCs) TCE, PCE, and carbon tetrachloride; chromium; nitrate; and perchlorate. Thirteen wells have recorded marginal levels of contamination, mostly VOCs.

As part of a separate project to clean up groundwater contamination in the SFB, the future Groundwater Treatment Complex, which includes centralized treatment facilities and wellhead treatment, are being considered to allow LADWP to again have the ability to fully utilize the SFB groundwater supplies, including groundwater that has been replenished with purified recycled water. Locations of the centralized treatment are being considered in the vicinity of the LADWP North Hollywood Pump Station and Tujunga Well Field.

ES.8 Design Standards and Criteria

The GWR Master Planning Report addresses standards for the buildings and structures that will house the AWPF and related facilities. These standards included architectural, civil, geotechnical, structural, and electrical elements, which are required for any major public facility design. These criteria will need to be updated during pre-design to reflect code changes. The architectural and electrical design approaches are summarized below.

Architectural Considerations

The DCTWRP is well known for its Japanese Garden. BOS will be constructing a Multi-Purpose and Office Building immediately south of the Japanese Garden to facilitate public tours for the garden. A complementary architectural theme is recommended for the MF/RO Building, the primary building to be constructed as part of the AWPF. As with many recently designed City buildings, the MF/RO facility will be a model for stewardship and innovative design, without sacrificing functionality or ease of maintenance. Sustainable design strategies will be included to minimize energy consumption, greenhouse gas emissions, water consumption and solid waste generation.

The overall building footprint will be approximately 130 feet by 225 feet to be able to house all of the necessary equipment. The height of the MF/RO equipment requires the building to be two stories.

Electrical Considerations

The electrical system for the AWPF will be investigated further during the design phase of the project, which will include an evaluation of the costs and benefits of using renewable energy sources for powering the facilities.

The AWPF will require a new industrial substation. There are three options for providing power to the AWPF:

Combine with and Expand Existing DCTWRP Substation IS-2250: There may be enough capacity in the existing 20 million volt-amperes (MVA) substation to provide enough power for Phase 1. DCTWRP is currently operating with one treatment phase with a total power draw of 7 MVA; doubling this power draw to estimate the total DCTWRP power draw with both phases operating will be 14 MVA. Therefore, there may be enough power to supply the AWPF from the existing substation for Phase 1. The substation will need to be expanded to provide enough power for Phase 2. This will require distributing the 5 kilovolt (kV) medium voltage power from the north end of DCTWRP to the AWPF in SWRP Way, which is congested with existing utilities.

New AWPF Substation in Location of Existing IS-2250 Satellite Substation for Balboa Lake Feed Pumps: A new substation for the AWPF could be located within the AWPF site in the existing location of the IS-2250 satellite substation. This will require dual 35 kV lines to feed the proposed two (2) 10 MVA, 34.5 kV/4.16 kV transformers. The actual routing of the 35 kV lines will need to be determined by LADWP, but would likely need to be routed on Woodley Avenue. Overhead lines using power poles, underground ductbanks, or a combination of both, may be routed to the new substation. Because Woodley Avenue is on USACE-owned land, this approach would need to be discussed with USACE. This option would avoid running the 5 kV medium voltage power in SWRP Way.

New AWPF Substation Co-located with Existing IS-2626 Substation for the PWPS: The new AWPF substation could be located in the southeast corner of DCTWRP near the PWPS. As with the option of locating the new AWPF substation in the location of the existing IS-2250 satellite substation, this option requires dual 35 kV lines to feed the proposed two (2) 10 MVA, 34.5 kV/4.16kV transformers. The actual routing of the 35kV lines will need to be determined by

LADWP, but would likely come from Victory Boulevard and routed south along the eastern DCTWRP border. Overhead lines using power poles, underground ductbanks, or a combination of both, may be routed to the new substation. This would require approval to go through the property north of the DCTWRP and would also need to be discussed with USACE since DCTWRP is on USACE-owned land. This option would avoid running power lines down Woodley Avenue.

The power source needs to be investigated further and determined during pre-design.

ES.9 Regulatory Requirements and Considerations

The RWMP planning team conducted a thorough assessment of all applicable regulatory requirements and considerations for groundwater replenishment with highly purified AWPF water, including the 2008 draft CDPH groundwater recharge regulations. The following are highlights of the regulatory requirements and considerations:

Overview of the Regulators and Regulations that Apply to GWR Projects

The CDPH and the Los Angeles Regional Water Quality Control Boards (RWQCB) have regulatory oversight of groundwater recharge projects in the Los Angeles basin.

- CDPH regulates GWR projects under the State Water Recycling Criteria (Title 22) and makes recommendations for projects based on the draft groundwater recharge regulations.
- The Los Angeles RWQCB regulates groundwater recharge projects under numerous state laws and regulations, including the Los Angeles Water Quality Control Plan (Basin Plan) and the State Water Resources Control Board's Recycled Water Policy.

In addition, the project must comply with the California Environmental Quality Act (CEQA). Since the project is located on federally-owned land and because federal money will likely sought for funding, it must also comply with the National Environmental Policy Act (NEPA).

Overview of Permitting Process

The City has been deliberate in selecting a treatment train that is very similar to GWR projects that have been successfully permitted and are in operation, such as OCWD's GWR System in Fountain Valley and the West Basin Municipal Water District's facility in El Segundo. The following is a brief summary of the extensive, extremely detailed permitting process.

Engineering Report: The City will initiate the permitting process by preparing an Engineering Report and submitting it to CDPH and the Los Angeles RWQCB for approval.

The 2008 draft regulations do not have specific requirements for the Engineering Report, and this lack of specificity must be addressed with CDPH and the Los Angeles RWQCB to ensure that the report meets each agency's needs. The Engineering Report must include an anti-degradation analysis, confirming that the addition of GWR to the existing groundwater basin would not degrade the quality of the groundwater. Currently, there is no set process for conducting an anti-degradation analysis; this lack of specificity must be addressed with the Los Angeles RWQCB.

CDPH Findings of Fact and Conditions: CDPH will hold a public hearing and then issue its Findings and Conditions. This document serves as CDPH's recommendation to the Los Angeles RWQCB for the project's permit.

Environmental Documentation and Report of Waste Discharge: The City will prepare the project's draft environmental documents, receive public comments, and prepare a final environmental document(s). Once the Environmental Impact Report is certified, the City will then prepare and submit a Report of Waste Discharge to the Los Angeles RWQCB.

GWR Permit: The Los Angeles RWQCB will release a tentative GWR permit and hold a public hearing. Assuming no significant opposition, the RWQCB will issue the GWR permit.

California Water Code Section (CWC) 1211: Because the project will divert some treated wastewater from DCTWRP from flowing into the Los Angeles River, it must comply with the CWC 1211 process, which protects in-stream beneficial uses such as wildlife and recreation. The City will file a petition for change to be approved by the State Water Resources Control Board.

Other Requirements: Other agencies will be involved in the permitting process, including the United States Army Corps of Engineers (USACE).

Independent Advisory Panel: Initially, LADWP will develop a project that would blend a maximum of 50% of recycled water with a minimum of 50% diluent water from other sources, in accordance with the 2008 CDPH draft regulations. Projects that are allowed to increase the percentage of recycled water above 50% are subject to additional permit requirements including review by an Independent Advisory Panel (IAP).

In 2010, the City worked with the National Water Research Institute (NWRI) to establish an IAP to provide a panel of experts to provide input and advice for the project, and specifically to support the regulatory approval process. By establishing the IAP early in the process, the City will have additional flexibility with the project implementation and facility planning.

Monitoring GWR at all Stages

The recycled water, groundwater from monitoring wells, groundwater from production wells, and diluent water will be monitored for regulated constituents such as maximum contaminant levels (MCLs) and constituents with Basin Plan water quality objectives; notification levels (NLs); Priority Pollutants; microorganisms; constituents of emerging concern (CECs); and various performance parameters. See Section 9 for a more detailed and annotated list of monitoring requirements. See Section 9 for a more detailed and annotated list of monitoring requirements.

Environmental Documentation

The City has selected Site 2 DCTWRP Southwest as the proposed project location. In addition to the proposed location, the four other locations for the AWPF are considered.

Both CEQA and NEPA environmental assessments will be performed for the project. NEPA is required since the proposed project is located on federal land (DCTWRP is located on land owned by the USACE). NEPA will also be required if the City pursues federal funding for the project.

The CEQA and NEPA environmental reports are expected to be one joint document prepared by LADWP (CEQA lead agency) and the USACE (NEPA lead agency). The step for the environmental documentation process is to issue the Initial Study and Notice of Preparation (NOP), which is anticipated in 2013.

ES.10 Implementation Strategy

The GWR project implementation strategy is driven by the goal to achieve 59,000 AFY recycled water by 2035. Implementation will be done in two phases: Phase 1 - 15,000 AFY by July 2022 and Phase 2 – an additional 15,000 AFY to achieve a total of 30,000 AFY by July 2035. The remaining 29,000 AFY will be achieved by implementing NPR projects.

Planning and Permitting Activities

Planning and permitting activities include public outreach; coordination with the IAP; regulatory coordination with CDPH, Los Angeles RWQCB, and the State Water Resources Control Board, and others; and environmental documentation.

GWR Phase 1 Activities

During this phase, the GWR facilities to deliver 15,000 AFY will be designed and built, and placed into operation. Major steps include:

- Pre-design report
- Equipment pre-selection and vendor pilot testing required for prequalification
- Final design, including plans and specifications
- Bidding and contract award
- Construction
- Startup and final approvals

Before the construction of the AWPF can be started to implement GWR Phase 1, the new warehouse and maintenance buildings need to be designed and constructed to make room for the AWPF facilities.

GWR Phase 2 Activities

During this phase, the GWR facilities will be expanded to provide an additional 15,000 AFY. The major steps include all of the above for Phase 1 except for equipment pre-selection and vendor pilot testing. Before implementing GWR Phase 2, the City can revisit the multi-criteria comparison of GWR and NPR to determine if it is prudent to still implement a 15,000 AFY Phase 2 GWR project or to pursue a lesser amount of GWR that, when combined with additional NPR projects, achieves the 59,000 AFY recycled water goal.

By the time that Phase 2 is to be implemented by 2035, it is possible that the State of California may allow direct potable reuse (DPR) as an alternative to indirect potable reuse with GWR.

(The processes described in this document are indirect potable reuse.) If this happens, the City should reassess the project to determine if DPR would be a better option than GWR.

ES.11 Opinion of Probable Costs and Financial Analyses

Opinion of Probable Costs

GWR project costs were evaluated for all options for capital costs (cost to design and build) and operations and maintenance (O&M). The following tables summarize the opinion of probable costs: Table ES-8: Conceptual Level Capital Costs for AWPF, Table ES-9: Conceptual Level Capital Costs for Conveyance Pipelines and Improvements to Spreading Grounds, Table ES-10: Conceptual Level Capital Costs for Injection Wells, Table ES-11: Conceptual Level Capital Costs for all GWR Components, Table ES-12: Conceptual Level Annual O&M Costs for AWPF, and Table ES-13: Conceptual Level Annual O&M costs for all GWR Components.

Table ES-8: Conceptual-Level Capital Cost for AWPF

	Capital Cost[1]	
	Phase 1	Phases 1 and 2
AWPF	**25.0 mgd capacity**	**35.0 mgd capacity**
MF System [2]	$32,657,000	$42,212,000
MF/RO Equalization Basins [3]	$1,604,000	$1,604,000
RO System [4]	$36,337,000	$47,753,000
Two-Story MF/RO Building [5]	$42,727,000	$42,727,000
UV System [6]	$8,192,000	$10,188,000
Chemical Systems [7]	$3,170,000	$3,308,000
Balboa Pump Station Modification [8]	$0	$1,206,000
Primary Flow Equalization Basins [9]	$0	$16,538,000
Yard Piping [10]	$3,236,000	$3,236,000
Site Improvements [11]	$1,468,000	$1,468,000
Protection of Existing Satellite Substation (IS-2250) In Place	$337,000	$337,000
Relocation of Existing Electrical Ductbanks [12]	$1,687,000	$1,687,000
Demolition of Existing Service Buildings	$5,764,000	$5,764,000
Construction of New Service Buildings [13]	$30,000,000	$30,000,000
Construction Subtotal	***$167,179,000***	***$208,028,000***
30% Contingency	$50,154,000	$62,408,000
Construction Total	***$217,333,000***	***$270,436,000***
30% Implementation Cost [14]	$65,200,000	$81,131,000
Total Capital Cost (AWPF)	**$283,000,000**	**$352,000,000**

Notes:
1) All costs are in September 2011 dollars.
2) Includes MF Feed Pump Station. See Sections 5.3.2 and 5.3.4.
3) See Section 5.3.5.

4) Includes RO Transfer Pumps, RO Cartridge Filters, and RO Feed Pumps. See Sections 5.3.6 through 5.3.9.
5) Includes additional costs for architectural features and cost to depress the building below grade to meet building height limitations.
6) See Section 5.3.10. Hydrogen peroxide system is included with chemical systems.
7) Includes all chemical systems included in Section 5.3.13.
8) See Section 5.3.12.
9) See Section 5.3.16.
10) Includes gravity pipeline connections to secondary and tertiary effluent channels, pressure MF feed pipeline, pressure AOP product water pipeline, gravity AWPF backwash and concentrate pipeline and chemical feed pipelines.
11) Includes site grading, retaining wall at DCTWRP entrance, site security improvements, converting grass areas to parking spaces, and landscaping.
12) See Section 8.5.3.
13) Costs provided by BOE.
14) Includes Planning, Environmental Documentation, and Permits; Engineering Services (pre-construction and during construction); Construction Management and Inspection; Legal and Administrative Services; and Field Detail Allowance. See the *Cost Estimating Basis for Recycled Water Master Planning TM* (Appendix C) for more information.

Table ES-9: Conceptual-Level Capital Cost for Conveyance Pipeline and Spreading Grounds Improvements

	Capital Cost[1]	
	Phase 1	**Phases 1 and 2**
Conveyance and Replenishment – Spreading	**15,000 AFY**	**30,000 AFY**
HSG Improvements [2]	$1,217,000	$1,217,000
PSG Improvements and 54” Pipeline Connection to PSG [3]	$0	$14,734,000
Construction Subtotal	***$1,217,000***	***$15,951,000***
30% Contingency	$365,000	$4,785,000
Construction Total	***$1,582,000***	***$20,736,000***
30% Implementation Cost	$475,000	$6,221,000
Total Capital Cost (Spreading Grounds Improvements)	**$2,060,000**	**$27,000,000**

Notes:
1) All costs are in September 2011 dollars.
2) See Section 7.1.4.
3) See Section 7.2.4.

Table ES-10: Conceptual-Level Capital Cost for Injection Wells

	Capital Cost[1]	
	Phase 1	Phases 1 and 2
Conveyance and Replenishment - Injection	**0 AFY**	**600 AFY (dry) to 4,000 AFY (wet)**
Injection Wells [2]	$0	$21,067,000
Construction Subtotal	***$0***	***$21,067,000***
30% Contingency	$0	$6,320,000
Construction Total	***$0***	***$27,387,000***
30% Implementation Cost	$0	$8,216,000
Total Capital Cost (Injection Wells)	**$0**	**$35,600,000**

Notes:
1) All costs are in September 2011 dollars.
2) See Section 7.3.4.

Table ES-11: Conceptual-Level Capital Cost for All GWR Project Components

	Injection Wells	Capital Cost[1]	
		Phase 1	Phases 1 and 2
AWPF using UV/H_2O_2 with Trojan UV	**Not Included**	**$285M**	**$379M**
AWPF using UV/H_2O_2 with Trojan UV	**Included**	**$285M**	**$415M**

Note:
1) All costs are in September 2011 dollars.

Table ES-12: Conceptual-Level Annual O&M Cost

	Annual O&M Cost[2]	
	Phase 1	Phases 1 and 2
AWPF	**25.0 mgd capacity**	**35.0 mgd capacity**
Power Costs		
MF System	$360,000	$447,000
RO System	$2,053,000	$2,874,000
UV System – Trojan UV	$233,000	$434,000
PWPS [2]	$1,461,000	$2,045,000
Miscellaneous Equipment	$50,000	$53,000
MF/RO Building	$543,000	$543,000
Power Costs – Subtotal	***$4,700,000***	***$6,396,000***
Chemical Costs		
MF Pre-treatment	$343,000	$480,000
RO Pre-treatment	$378,000	$529,000
H_2O_2 for AOP	$352,000	$493,000
Post-treatment	$701,000	$981,000
Chemical Costs – Subtotal	***$1,773,000***	***$2,483,000***
Replacement of Consumables		
MF Membranes	$705,000	$987,000
RO Cartridge Filters and RO Membranes	$520,000	$728,000
UV Lamps and Ballasts – Calgon UV	$275,000	$367,000
Replacement of Consumables – Subtotal	***$1,500,000***	***$2,082,000***
Maintenance Costs [3]	***$1,847,000***	***$2,299,000***
Labor Costs [4]	***$3,219,000***	***$3,695,000***
Total Annual O&M Cost	**$13,039,000**	**$16,955,000**

Notes:
1) All costs are in September 2011 dollars.
2) Pumping from AWPF to spreading grounds.
3) Assumed to be 1.7% of the equipment construction cost.
4) Estimated staffing for Phase 1 = 19 personnel and for Phase 2 = 22 personnel. Estimates provided by BOS.

Table ES-13: Conceptual-Level Annual O&M Cost for All GWR Project Components

	Injection Wells	Annual O&M Cost	
		Phase 1	Phases 1 and 2
AWPF using UV/H_2O_2 with Trojan UV	Not Included	$13.0M	$17.0M
AWPF using UV/H_2O_2 with Trojan UV	Included	$13.0M	$17.9M

Notes:
1) All costs are in September 2011 dollars.
2) The O&M costs do not include labor costs.
3) The O&M costs for spreading grounds, excluding labor costs, are assumed to be negligible.
4) The estimated annual O&M cost for injection wells is $0.9M.
5) Groundwater extraction pumping is estimated to be an additional $68/AF, which is not included in annual O&M costs above. Estimate provided by LADWP.

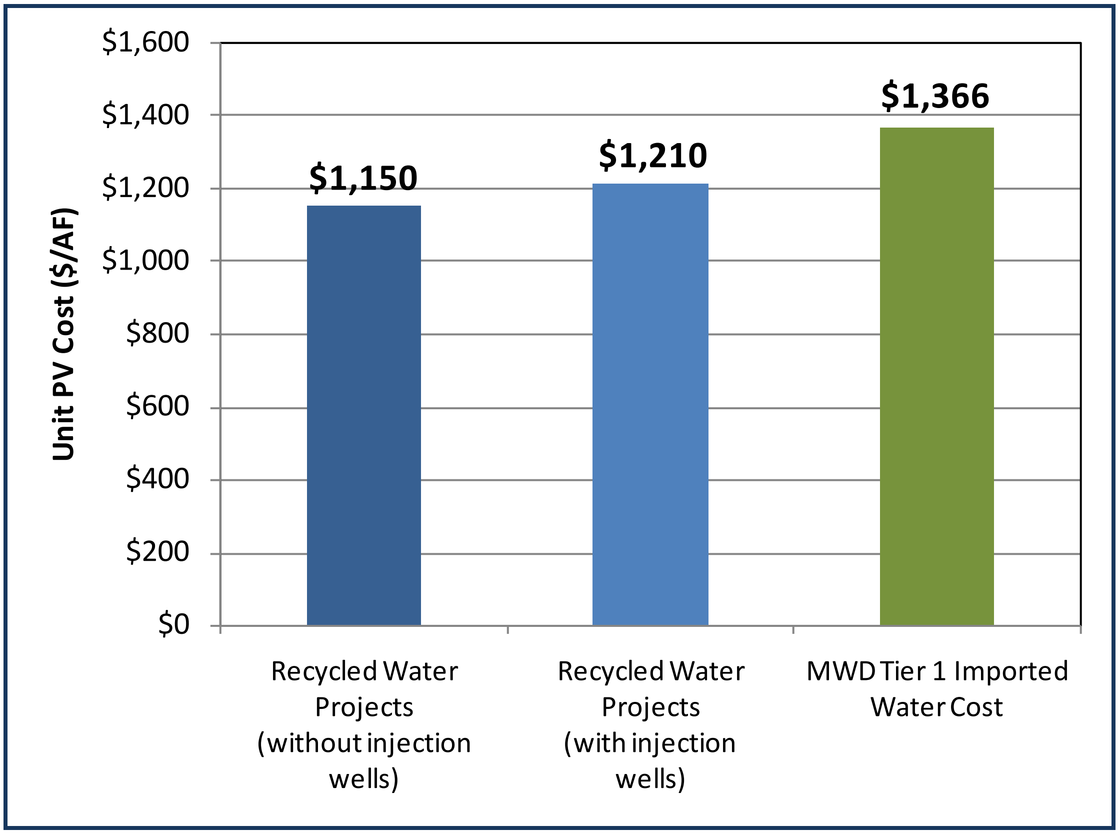
Financial Analyses

This section presents financial analyses of the GWR project costs. There are many different ways that the GWR program could be financed, which impacts the total cost of producing the purified recycled water. In this section two potential methods are presented, "pay-as-you-go" (no financing) and financing using borrowed funds, with the resulting cumulative cost over a 50-year period. For both evaluations, the projected cumulative cost is compared with projected Tier 1 Metropolitan Water District of Southern California (MWD) imported water cumulative costs. Historically, LADWP has funded its recycled water projects entirely through its Water Rates Ordinance Water Procurement Adjustment Surcharge (Surcharge) without borrowing money. This is called the "pay-as-you-go" method that provides funding during each of the project's planning, design, and construction phases, and also for ongoing O&M costs.

To evaluate and compare future recycled projects for the RWMP documents, a standard economic method called the present value (PV) approach was used. This approach first estimates future capital and O&M costs for the lifecycle of each project, accounting for inflation. Then all future year O&M and capital costs are brought back to PV terms using a discount rate. To determine the cost-effectiveness of the recycled water projects under pay-as-you-go financing, a PV unit cost in dollars per acre-foot ($/AF) for the GWR project was estimated by taking the sum of the PV costs divided by the sum of water yield over the 50-year life of the program. This PV unit cost was then compared to the PV unit cost of MWD Tier 1 water purchases.

The PV unit cost for the GWR project is estimated to be $1,150/AF without injection wells and $1,210/AF with injection wells, which includes potential capital and O&M costs for the AWPF (summarized in Section 11.1) over the 50-year life of the recycled water projects. The PV also includes groundwater extraction pumping costs of $68/AF starting the year after Phase 1 and 2 are implemented (i.e., groundwater extraction pumping increased by 15,000 AFY in 2023 and by an additional 15,000 AFY in 2036). The PV unit cost for MWD Tier 1 water purchases over the same 50-year period is estimated to be $1,366/AF, which is about 13% greater than the estimated PV for the GWR project with injection wells and 19% greater than the estimate PV for the GWR project without injection wells. The MWD Tier 1 water rates were forecasted based on current MWD rate projections through 2018 (averages 5% per year), historical rate increases (through 2012), and an assumed 5% annual growth from 2019 on. **Figure ES-14** shows the PV unit costs for the imported water rate projections along with the present value unit costs for the GWR project with and without injection wells. As shown in the figure, both GWR options cost less than purchasing Tier 1 water from MWD.

Figure ES-14: Unit PV Cost for GWR Project Compared with Projected MWD Tier 1 Imported Water Costs



An alternative funding approach is to borrow money through long-term financing to fund capital expenditures. Borrowing to fund these costs reduces the near-term impact on customer's water rates, but the costs will have to be repaid with interest over a long-term period. The same future MWD Tier 1 imported water rates were estimated for the long-term financing option as with the pay-as-you-go analysis, which is based on a 5% annual growth from 2012 to 2061.

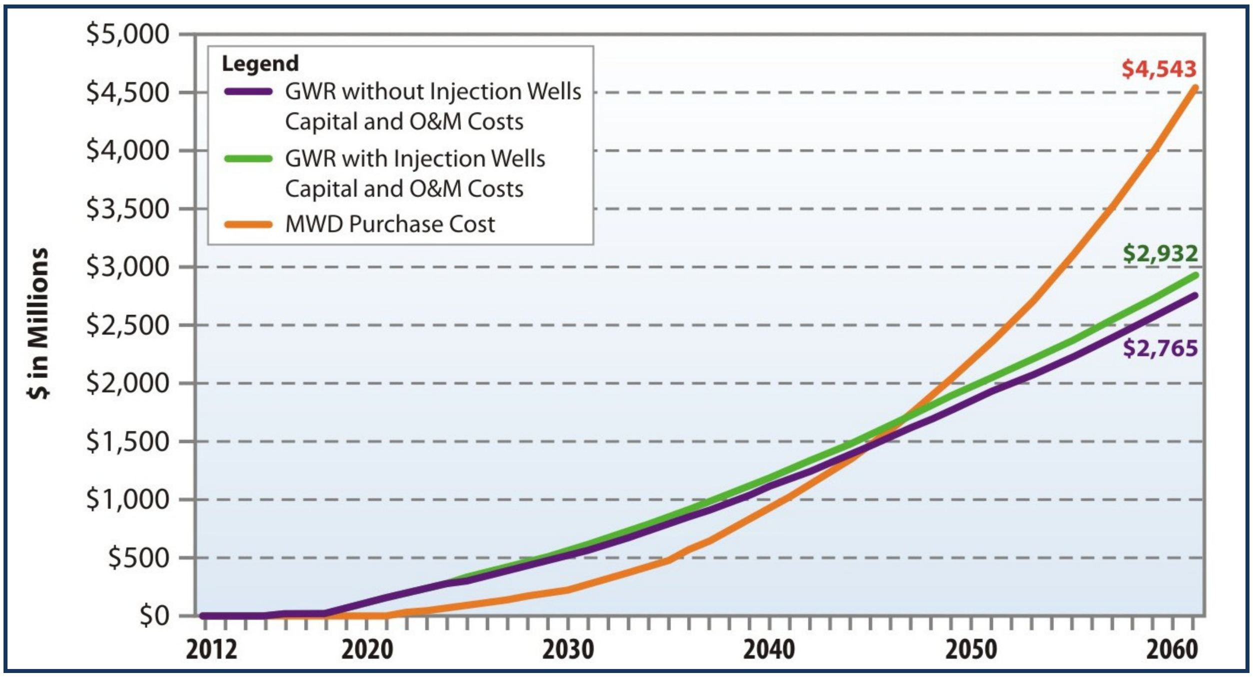
To determine the annual expenditures of the recycled water projects using this alternative funding approach, the following assumptions were made:

1. Sixty percent of capital expenditures are financed over 30 years at 5% interest, resulting in an annual amortized payment.
2. The remaining forty percent of capital expenditures plus O&M costs are paid using the "pay-as-you-go" method in each future year.
3. All costs include the effects of inflation.

The above costs are projected for each year and added together to arrive at a total annual project cost. **Figure ES-15** shows the cumulative annual expenditures over a 50-year period compared to the cumulative costs of purchasing equivalent amounts of Tier 1 MWD water. The same assumption regarding the future cost of MWD water used for the "pay-as-you-go" method described in Section 11.2.1 was used for this comparison.

The cumulative cost for the GWR alternatives is $2.93 billion and $2.77 billion with and without groundwater injection wells, respectively. Comparatively, the cumulative cost of purchasing MWD water is $4.54 billion. The payback year for GWR is 2047 with groundwater injection wells and 2045 without. A similar cumulative cost analysis for the pay-as-you-go model yields a 50-year GWR Program cost of $2.63 billion (payback year of 2045) with groundwater injection wells and $2.49 billion (payback year of 2043) without groundwater injection wells.

Figure ES-15: Future Annual GWR Project Costs
Compared with Projected Annual MWD Tier 1 Imported Water Costs



In conclusion, cumulative MWD water purchases over a 50-year period are expected to be greater than LADWP's GWR program costs under either financing model. MWD water purchases will be 73-82% greater under the pay-as-you-go analysis and 55-64% under the alternative financial analysis. **Over the long term, the GWR program will cost less than the cost of purchasing MWD imported water.**

In addition, there are important operational and reliability benefits that are gained by having an increased amount of local water supplies. Recycled water is not subject to drought or imported water short or long term emergency outages that can significantly reduce MWD's imported water availability to Los Angeles.

Acknowledgments

The RWMP process was commissioned in 2009 through the vision of LADWP, in partnership with the BOS and BOE. Critical to the development of the RWMP documents was a diverse team of contributors and reviewers. The following individuals have dedicated significant time and effort to shaping a reliable, sustainable water future for Los Angeles.

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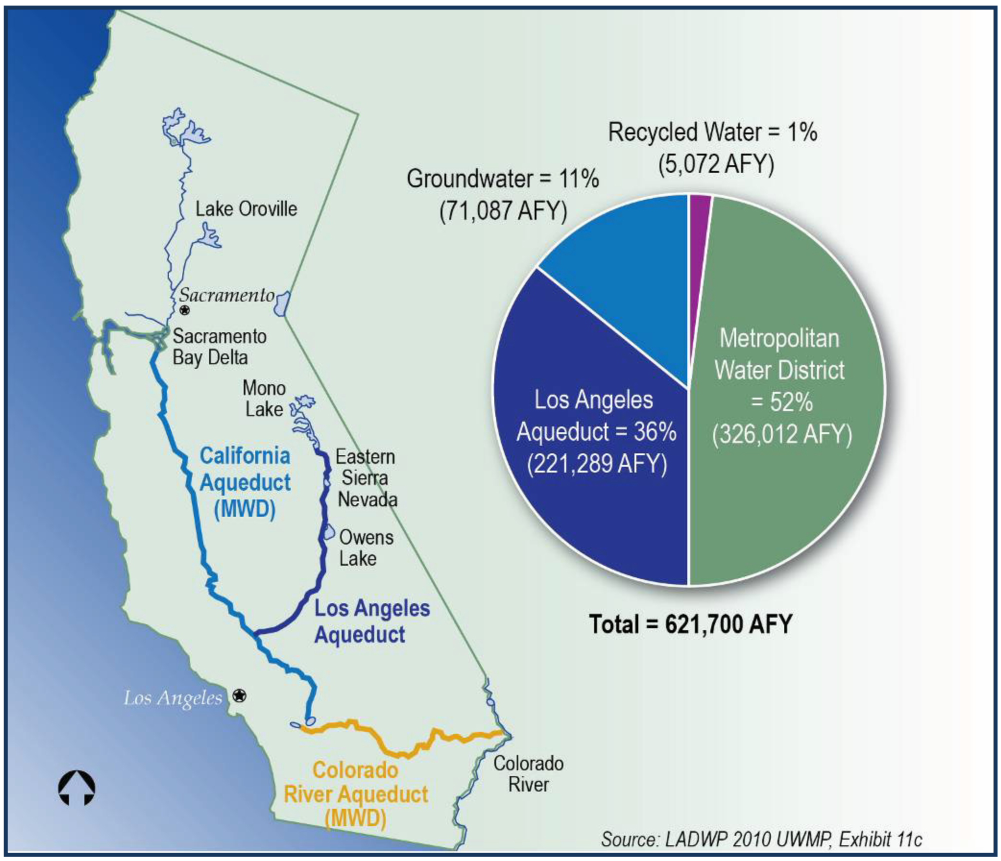
1. Introduction

1.1 Background

The City of Los Angeles (the City), with its location in a naturally dry area with warm temperatures, little rainfall, and few local sources of water, relies heavily on imported water from the Sacramento Delta (California Aqueduct), Eastern Sierra Nevada (Los Angeles Aqueduct), and Colorado River (Colorado River Aqueduct). More recently, local groundwater sources have only accounted for 11 percent of the total supply. These sources of water for the City, and annual average source water distribution for years 2006-2010, are illustrated in **Figure 1-1**.

Figure 1-1: Current Sources of Water for City of Los Angeles (FY 2006-2010)



The City's imported supplies have been significantly cut in recent years – some by as much as half – due to periods of dry weather and low snowpack, environmental commitments, and judicial decisions. In addition, the City's ability to utilize limited groundwater supplies has been impacted by contamination.

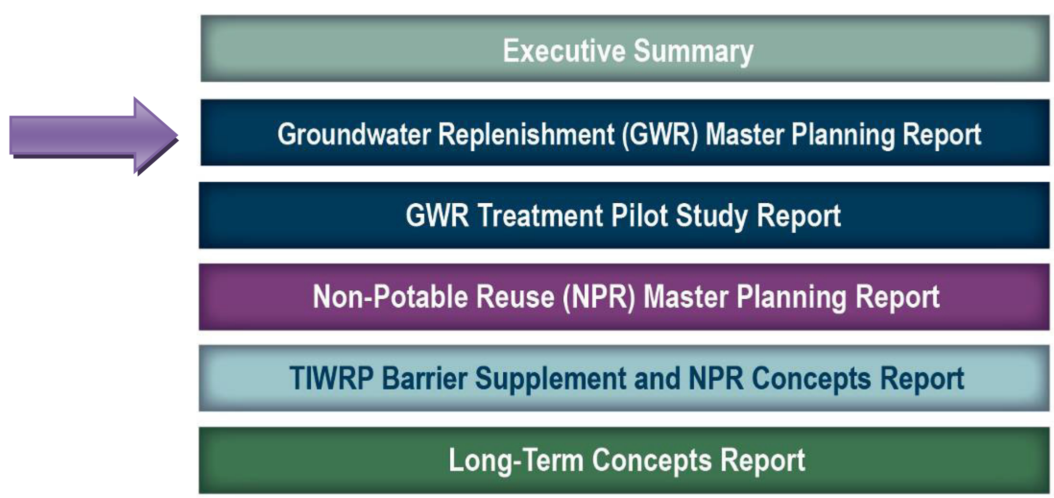
Conservation has helped Angelenos maintain about the same total water use since 1980, despite a population growth of 1 million people. However, conservation alone cannot meet future demands.

The City developed five key strategies to secure a more reliable water supply for the City: 1) Increase water conservation, 2) Increase water recycling, 3) Enhance stormwater capture, 4) Accelerate groundwater cleanup, and 5) Green Building Initiatives. These strategies are being implemented through a number of parallel efforts and are documented in the 2010 Urban Water Management Plan (UWMP) for the City. The Los Angeles Department of Water and Power's (LADWP) UWMP outlines a goal of increasing recycled water use citywide to 59,000 acre feet per year (AFY) by 2035. The City currently delivers approximately 8,000 AFY for non-potable reuse (NPR) and for barrier supplement in the Dominguez Gap Barrier.

LADWP, in partnership with the City of Los Angeles Department of Public Works (LADPW), Bureau of Sanitation (BOS) and Bureau of Engineering (BOE), is developing Recycled Water Master Planning (RWMP) documents to outline strategies to offset imported water demand by utilizing recycled water. Specifically, the RWMP process will identify projects to significantly increase the City's recycled water use. Originally, the RWMP was to identify groundwater replenishment (GWR) and NPR projects to achieve 50,000 AFY. But after development of the 2010 UWMP, the goal of the RWMP was modified to identify, evaluate, and set a course for achieving a total use of 59,000 AFY[1] by 2035, as well as developing a plan to maximize reuse.

The RWMP documentation includes a series of volumes comprised of an Executive Summary, GWR Master Planning Report, GWR Treatment Pilot Study Testing Report, NPR Master Planning Report, TIWRP Barrier Supplement and NPR Concepts Report, and Long-Term Concepts Report, as well as a series of supporting technical memoranda (TMs). **Figure 1-2** illustrates the organization of these volumes.

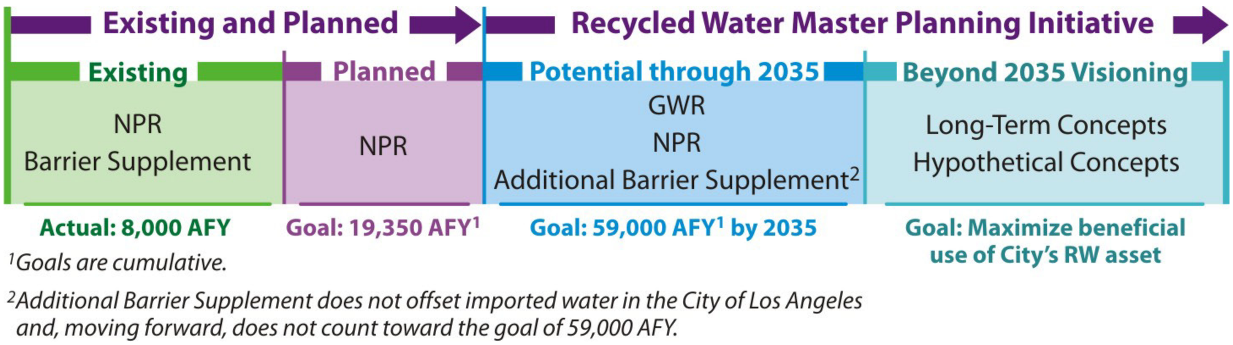
Figure 1-2: RWMP Documentation



[1] LADWP has 8,000 AFY of existing recycled water customers, including both NPR and barrier supplement in the Dominguez Gap Barrier. LADWP has identified 11,350 AFY of new customers (19,350 AFY total), which are a portion of the overall 59,000 AFY goal. Therefore, the RWMP reports identify the additional 39,650 AFY of recycled water to meet the overall 59,000 AFY goal.

Figure 1-3 illustrates the breadth and linkage of the various RWMP components.

Figure 1-3: Overview of RWMP Components



The purpose of this GWR Master Planning Report is to research, identify, develop, evaluate, and recommend the most cost-effective options for offsetting imported water use within the City by utilizing recycled water from the Donald C. Tillman Water Reclamation Plant (DCTWRP) through GWR in the San Fernando Basin. Opportunities to increase reuse from the City's other water reclamation plants (e.g., Los Angeles Glendale Water Reclamation Plant (LAGWRP), Terminal Island Water Reclamation Plant (TIWRP), and Hyperion Treatment Plant (HTP)) are discussed in the separate NPR Master Planning Report and/or the Long-Term Concepts Report.

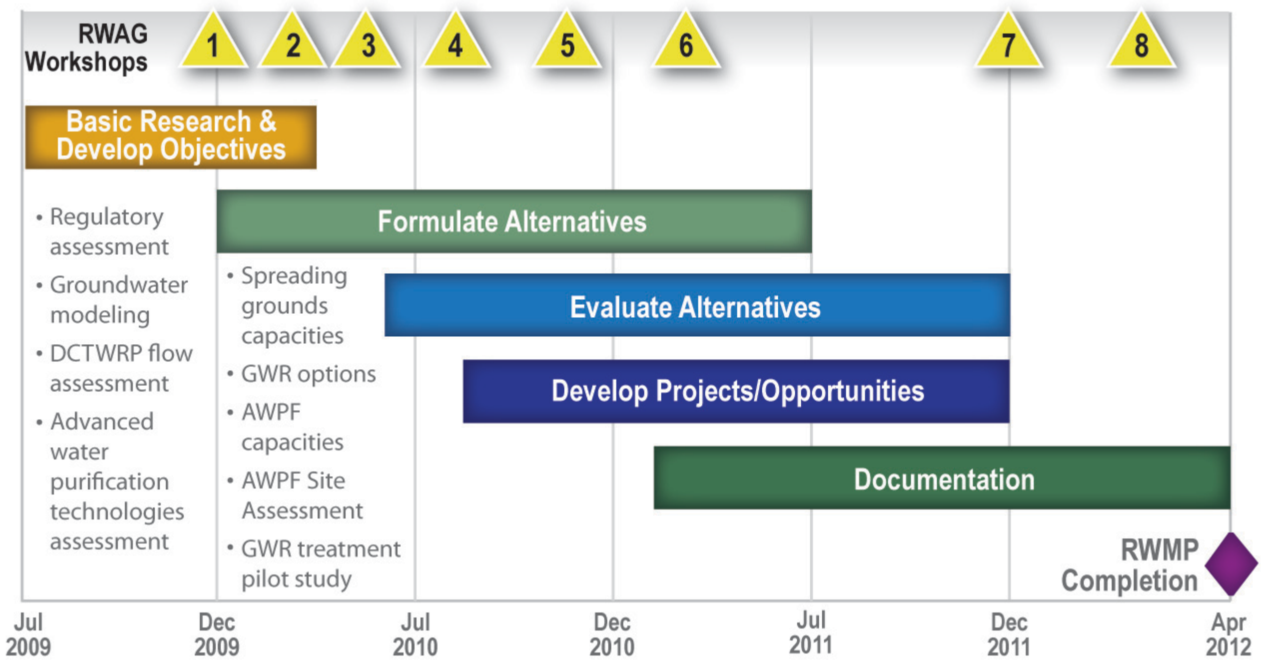
1.2 Recycled Water Master Planning Approach

The overall approach for the RWMP was to develop objectives, conduct basic research for GWR and NPR, formulate and evaluate integrated alternatives that include varying amounts of GWR and NPR, and from that analysis develop specific projects/opportunities and the associated master planning reports to implement the opportunities. **Figure 1-4** illustrates the main master planning steps and the timeline.

An important part of the RWMP is including stakeholders in the development process. In parallel to the RWMP, the City established a Recycled Water Advisory Group (RWAG) comprised of key public stakeholders representing neighborhood councils, environmental groups, industry, homeowners associations, and others. At key steps in the RWMP, the team held workshops with the RWAG to present information and seek feedback, which was then incorporated into the RWMP documents. In addition, Recycled Water Forums were held throughout the City to inform and receive input from the general public. The City's public outreach program is summarized in Section 2.

In 2010, the City contracted with the National Water Research Institute (NWRI) to establish an Independent Advisory Panel (IAP). Using an IAP increases the credibility of the project by providing an independent evaluation of the technical, regulatory, and health-related elements of the RWMP projects. By establishing the IAP early in the process, the City will have additional flexibility with the project implementation and facility planning issues that may arise during the engineering report.

Figure 1-4: Recycled Water Master Planning Approach and Schedule

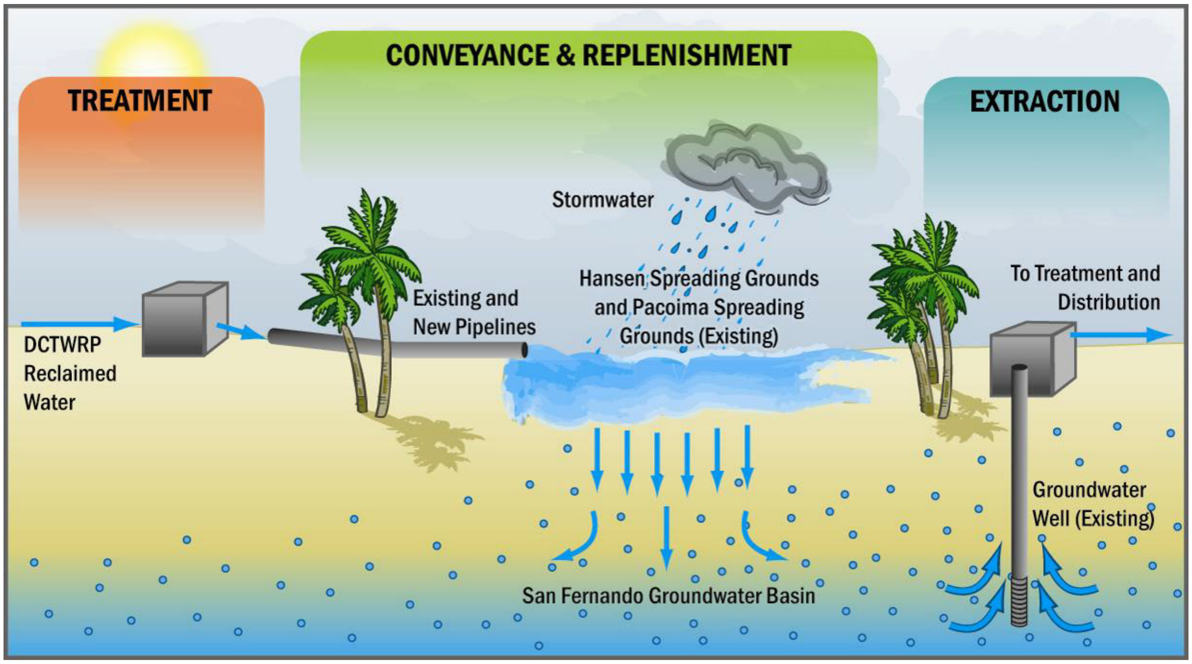


1.3 Overview of GWR Concept

Groundwater replenishment is a practical, proven way to increase the availability of a safe, reliable, locally-controlled water supply. As shown on **Figure 1-5**, using state-of-the-art technology, the GWR system would include treating recycled water from the DCTWRP to produce purified recycled water using advanced water purification (AWP) processes. This purified recycled water would be conveyed to spreading grounds, where it would percolate into natural underground groundwater, and potentially injection wells to inject the water into the groundwater. This water replenishes the aquifers that feed the City's water supply production wells. After the minimum required blend time within the aquifer, the water would be extracted (or pumped) from the existing groundwater basins for treatment and distribution to LADWP drinking water customers. This GWR Master Planning Report covers treatment, conveyance, and replenishment of the purified recycled water. The extraction facilities (City's water supply production wells), treatment of extracted groundwater, and distribution to drinking water customers are not included in the RWMP documents.

The RWMP process relied on the August 2008 draft California Department of Public Health (CDPH) groundwater regulations. In late 2011, after the initial drafting of this report, CDPH released a new draft of its groundwater recharge regulations, which are currently being revised and are anticipated to be finalized by the end of 2013. The City will continue to evaluate the GWR project design with the evolving groundwater recharge regulations.

Figure 1-5: GWR Concept



There are three major sources of groundwater for the City: the Upper Los Angeles River Area (ULARA), which includes the San Fernando Basin; the Central Basin; and the West Coast Basin. The ULARA provides approximately 90 percent of the City's groundwater supplies. The San Fernando Basin is 112,000 acres and is replenished by deep percolation from rainfall, surface runoff, and from a portion of the water used (mainly for irrigation) in the basin. Due to increasing development and establishment of non-pervious facilities in the San Fernando Valley, there is an increasing need to replenish the aquifer with additional sources of water, including stormwater, and GWR with recycled water. Los Angeles County Department of Public Works (LACDPW) owns several spreading basins in the San Fernando Basin, including the Hansen Spreading Grounds (HSG) and the Pacoima Spreading Grounds (PSG). LADWP owns the Tujunga Spreading Grounds (TSG). These spreading grounds are currently used to percolate stormwater into the San Fernando Basin (SFB).

The LADPW BOS owns and operates the DCTWRP in the San Fernando Valley, which provides a potential source of recycled water for advanced treatment to be used for GWR. There are 10.3-miles of an existing 54-inch pipeline to convey recycled water to the Hansen storage tank, near the HSG. **Figure 1-6** shows the location of these existing GWR facilities.

This GWR Master Planning Report builds the GWR strategy around two City assets: 1) water rights and existing facilities to add and extract water from the existing groundwater basins in the San Fernando Valley; and 2) City ownership and operation of the nearby DCTWRP.

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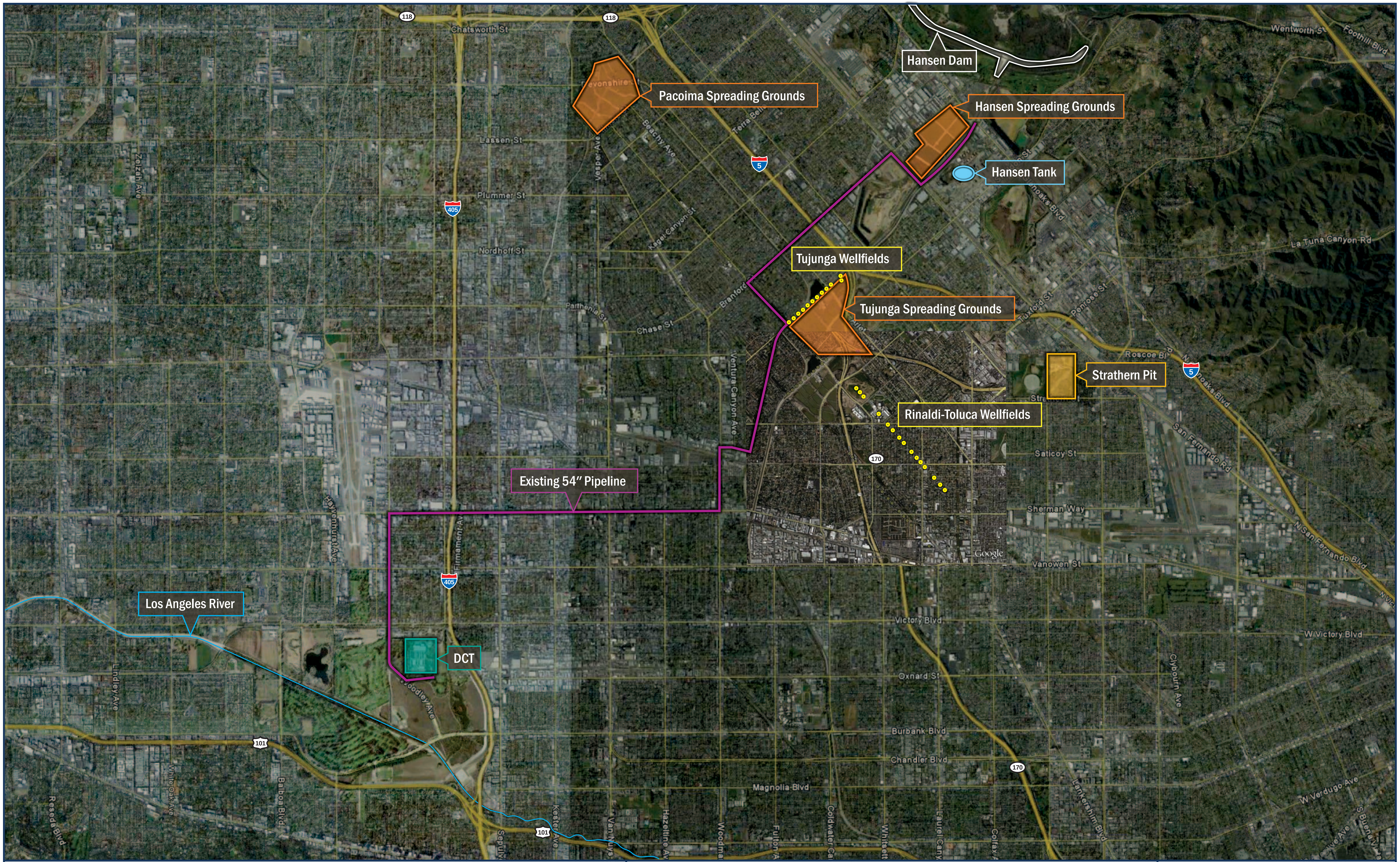

City of Los Angeles
Recycled Water Master Planning

Figure 1-6:
Vicinity Map of GWR Facilities in the San Fernando Valley

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1.4 Overview of Document

The purpose of the GWR Master Planning Report, this document, is to develop the GWR project components to a facilities planning level. The GWR project components include an advanced water purification facility (AWPF), conveyance, and replenishment facilities. This GWR Master Planning Report serves as the Scope of Work document for the GWR project, which will be implemented as outlined in Section 10, Implementation Strategy.

The GWR Master Planning Report is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Public Outreach
- Section 3 – Planning Parameters
- Section 4 – GWR Treatment Pilot Study
- Section 5 – Advanced Water Purification Facility at DCTWRP
- Section 6 – Site Improvements at DCTWRP
- Section 7 – Conveyance, Replenishment and Extraction Facilities
- Section 8 – Design Standards and Criteria
- Section 9 – Regulatory Requirements and Considerations
- Section 10 – Implementation Strategy
- Section 11 – Opinion of Probable Costs and Financial Analyses

1.5 Coordination with Other Activities and Deliverables

Table 1-1 summarizes the TMs that were developed and used as the basis for this GWR Master Planning Report. These TMs are included in the appendices.

Table 1-1: Related GWR Master Planning TMs

TM Title	Location in Report
Cost Estimating Basis for Recycled Water Master Planning TM	Appendix C
This TM describes the cost estimating basis used for the analysis of options and alternatives developed under the RWMP.	
DCTWRP Data Summary TM	Appendix D
This TM provides a summary of historical flow and water quality data at DCTWRP and was used to support the development of other RWMP TMs.	
Advanced Water Treatment Technology Assessment TM	Appendix E
This TM provides initial technology assessment for the advanced water treatment processes and residuals management for the AWPF. This TM recommended MF, RO, and UV/H_2O_2 for the AWPF, as well as consideration of alternative AOPs upon completion of pilot testing.	

Table 1-1: Related GWR Master Planning TMs (Continued)

TM Title	Location in Document
Site Assessment TM	Appendix F
This TM provides identification, screening, and selection of candidate sites for the AWPF based on initial screening criteria; and compares candidate sites based on detailed site evaluation criteria to assist the City with the selection of a preferred site to be able to move forward with the GWR Master Planning Report. In conjunction with the Integrated Alternatives Analysis – Preliminary Cost Summary TM prepared for the RWAG, the site assessment identified DCTWRP SW as the preferred candidate site for the AWPF that best meets the overall recycled water master planning objectives. See Section 3.5 for more information.	
DCT Maximum Flow Assessment TM	Appendix G
This TM provides evaluation of maximum wastewater flows that could be routed to DCTWRP from the TSA to determine the maximum DCTWRP effluent flow available for existing in-plant uses, Lakes and LA River, GWR and NPR. This TM concluded that by 2020 there would be 70.9 to 81.5 mgd of influent wastewater to DCTWRP, and 76.9 to 88.1 mgd by 2035. Based on an analysis of the DCTWRP operating data, it was estimated that 87% of influent wastewater is converted to tertiary effluent. This was used to estimate the tertiary effluent production from DCTWRP in future years. This percentage was updated as part of the development of the GWR Master Planning Report and is discussed further in Section 3.6	
DCT Dry Weather Flow Equalization Evaluation TM	Appendix H
This TM provides an assessment of the primary flow equalization needs at DCTWRP to meet the recycled water delivery goals. Additional primary flow equalization beyond the existing DCTWRP primary flow equalization storage of 3.24 MG is required to provide a DCTWRP tertiary effluent of 70 mgd and 44.3 mgd for GWR. This analysis was updated as part of the GWR Master Planning Report; see Section 5.3.16 for more information.	
City of Los Angeles Industrial Waste Management Division Source Control Program – 2010 (Source Control Summary Document)	Appendix I
This TM provides a summary of the City's source control program and identifies how this program meets the intent of the 2008 CDPH Draft GWR Regulations.	
Groundwater Replenishment Evaluation TM	Appendix J
This TM summarizes preliminary results of numerical simulation using SFBGM analyzing potential impacts from the proposed plan to spread 15,000 AFY, 22,500 AFY, and 30,000 AFY of purified recycled water from the AWPF at the HSG and the PSG, and potentially injection wells. This TM also provides preliminary evaluation of the potential to release arsenic from soil as a result of GWR. A summary of this TM is provided in Section 7.	
Conveyance System Alternative Alignments to Pacoima Spreading Grounds Evaluation TM	Appendix K
This TM provides evaluation of conveyance facilities to support GWR at PSG. Based on a cost and non-cost evaluation, the Canterbury alignment was recommended. See Section 7 for more information.	

Table 1-1: Related GWR Master Planning TMs (Continued)

TM Title	Location in Document
Engineering Report Outline	Appendix L
This report outline provides detailed breakdown and explanation for Engineering Report components.	
Integrated Alternatives Development and Analysis TM	Appendix M
This TM combines independent GWR and NPR project options into integrated alternatives to meet the near-term RW goals; and compare and rank the integrated alternatives based on City's RWMP objectives. The outcome of the integrated alternatives analysis was to plan for the more aggressive GWR alternative (30,000 AFY), but also identify potential NPR projects to develop in parallel. See Section 3.2 for more information. The Integrated Alternatives Analysis – Preliminary Cost Summary, that provides an overview of the IAA alternatives and associated costs for the RWAG to supplement the information they received at the March 2011 RWAG meeting, is included as an appendix to the Integrated Alternatives Development and Analysis TM.	

Note: Abbreviations and Acronyms list is included on Pages xiii through xviii.

1.6 Definitions

This section defines the two types of recycled water that are included in the RWMP projects.

Title 22 recycled water – recycled water that has gone through a series of treatment processes, including filtration and disinfection, to remove contaminants. Title 22 recycled water is clean enough to be used for a wide variety of reuse purposes, including irrigation of landscaping, food crops and ornamental plants, filling of recreational lakes, and circulation in industrial cooling towers.

Purified recycled water – recycled water that has been treated through AWP processes, including multiple barrier filtration (including microfiltration and reverse osmosis) and advanced oxidation. Purified recycled water has near-distilled water quality and can be used to replenish the City's groundwater supplies.

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2. Public Outreach

This section summarizes the City's public outreach efforts to support the implementation of the GWR project, described in the *Draft Outreach and Communication Plan for the Recycled Water and Groundwater Replenishment* (Draft Outreach Plan).

2.1 Outreach Plan and Progress

Well before the launch of the RWMP process, the City committed to conducting an extensive public outreach effort to educate and engage the public about the City's plans for moving forward with recycled water. As the RWMP was initiated, the City articulated its commitment to fully and clearly communicate with stakeholders on important water supply information, including the City's Recycled Water Program and plans to implement GWR in Los Angeles. The articulated goals have been to:

- Build trust and confidence in the City and its departments as a provider of high-quality, safe and reliable water;
- Achieve public understanding of recycled water and GWR as safe, beneficial sources of water;
- Receive stakeholder input for the RWMP documents;
- Be transparent in information sharing and inclusion; and,
- Support the media with responsive, accurate, and timely information.

To support these communications goals, the City has developed a Draft Outreach Plan, which outlines a framework for communicating the water supply challenges facing Los Angeles, and the need for the recycled water program, including GWR as a key strategy for securing sustainable water resources for the City's future. This plan describes a multi-year, citywide outreach campaign LADWP, in collaboration with the BOS, aimed at creating general support and acceptance for the recycled water program and, specifically, for GWR with outreach activities and milestones identified through the year 2012 and beyond.

For the first few years, the plan is premised on building awareness of California's water picture and the City's water future, recognizing we can no longer count on traditional water resources to meet the city's water needs, and conveying the importance of recycled water as an available resource that is sustainable. The plan targets outreach about water supply issues and solutions, particularly the recycled water program including GWR, to identified stakeholders, including decision-makers, elected officials, ratepayers and neighborhood council members, community and homeowners groups, environmental leaders, business and industry, and other supporters and critics.

The initial outreach implementation schedule is largely driven by the schedule of the RWMP Documents. Outreach activities during subsequent years will be planned to support major milestones of the various projects outlined in the RWMP, particularly the GWR project. However, there will be a sustained outreach program throughout the duration of the planning, design and construction, and operation of the recycled water program and the GWR project.

The strategies for stakeholder engagement described in this document include opportunities for public engagement such as Recycled Water Advisory Group, Recycled Water Forums, Neighborhood Councils, Independent Advisory Panel (IAP), facility tours, and school education. The City has identified a broad range of outreach, information sharing, and public engagement activities targeted to specific audiences, as set forth in **Table 2-1**.

Table 2-1: Overview of Recycled Water Program Outreach Activities

Within LADWP
• Presentations and information sessions
• Feature articles in "Contact" newsletter and Intake Magazine
• Displays at fairs and information sessions
• Board of Water and Power updates
Within the City Family
• Board of Public Works updates
• City Councilmember and other elected official briefings
• Information sessions for other departments
• E-mail updates to other departments
• Inclusion in Recycled Water Advisory Group outreach updates
In the Community
• One-on-one briefings with key community leaders
• Recycled Water Advisory Group (RWAG) formation and workshops
• Facility tours
• Speakers Corps presentations to organizations and groups
• Recycled Water Forums
• Neighborhood Council presentations
• Water Fairs

As a result of aggressive and active stakeholder engagement during planning, considerable progress has been made. The stakeholder engagement process is described in the Draft Outreach Plan and summarized in **Table 2-2**.

Table 2-2: Outreach and Communications Plan Activities Underway

Activity	Progress
Recycled Water Advisory Group	• 68 participants • 6 workshops conducted • 2 overview (catch-up) sessions for new members • 1 technical tour of DCTWRP and AWP Pilot Plant • 1 overview tour of DCTWRP and Japanese Gardens • 2 tours of Tujunga Spreading Grounds & Pumping Station • 1 tour of West Basin Water Recycling Facility
Briefings for City Council and other elected officials	• Information to all council offices through varied forums, both formal and informal • 7 Councilmembers briefed directly • 8 direct Council staff briefings • Briefing on RW and GWR, with tour of Tujunga Spreading Grounds for staff of 2 state assembly members, a US congressman and US senator. Two additional briefings scheduled.
One-on-one briefings with key stakeholders	• 27 conducted • More in planning
Presentations to Neighborhood Councils	• 16 presentations delivered to councils and leadership groups • 7 in planning
Presentations to Community Organizations	• 11 presentations delivered
Recycled Water Forums	• Completed Forums in 7 diverse locations throughout the City
Informing LADWP/BOS employees	• 3 articles in “Contact” newsletter • 10 e-mail blasts • Booths at 2 events
Formation of Independent Advisory Panel (IAP)	• Panel formed • First meeting convened October 2010 • Second meeting convened November 2011
Letters of Support	• Letters of support from 15 groups and individuals, including 3 City Councilmembers. • Postcards indicating support from 21 groups and individuals. • Letters from 82 of LADWP’s largest customers in support of LADWP’s request for Water Resources Development Act (WRDA) funding
Stakeholder Database	• Detailed information on contacts and people with interest in the project are being gathered and tracked.

Note: Activities listed are as of November 2011.

2.2 Media Coverage

Media coverage related to expanding recycled water use has been limited, but quite positive, including coverage of plans to reconsider GWR. A notable example is the *LA Daily News* coverage of the final tour of the GWR Treatment pilot plant at DCTWRP[2]. The article was fair, accurate and supportive of the City's approach. When this coverage drew a negative article from *LA Weekly*[3] and a blog citing "Toilet to Tap," numerous responding grassroots comments provided corrections and support for GWR as a water supply option. LADWP staff also developed and posted on their website a "Fact Check" sheet that corrected inaccurate information contained in the *LA Weekly* article.

These results offer testimony to the possible benefits achieved through strategic and well-orchestrated public and media outreach.

2.3 Recycled Water Advisory Group (RWAG)

Concurrent with launch of the RWMP process, the City engaged a core group of community leaders to provide input and ideas to be integrated into the RWMP process and documents. The RWAG consists of a diverse group of leaders representing Neighborhood Councils, homeowner associations, environmental groups, businesses, business associations, academia, and faith-based groups. Participants, representative of residents throughout the City, has increased since the RWAG was formed in 2009.

The geographic distribution of RWAG participants is shown in **Figure 2-1**. **Figure 2-2** and **Table 2-3** show the RWAG representation by category.

[2] http://www.dailynews.com/ci_18273171; posted on June 14, 2011.
[3] http://blogs.laweekly.com/informer/2011/06/la_dwp_sewage_drinking_water.php; posted on June 15, 2011.

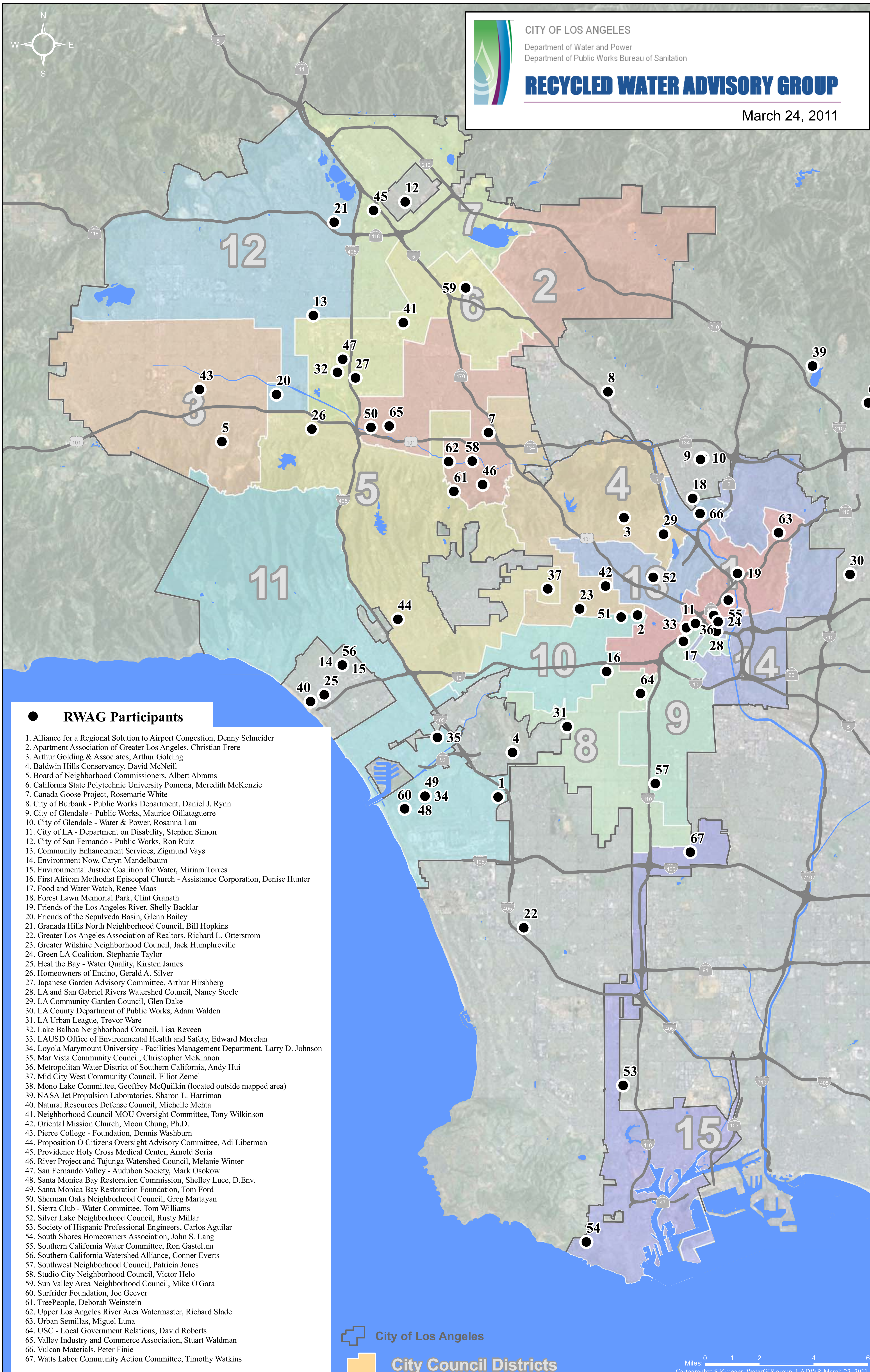
CITY OF LOS ANGELES

Department of Water and Power

Department of Public Works Bureau of Sanitation

RECYCLED WATER ADVISORY GROUP

March 24, 2011



RWAG Participants

1. Alliance for a Regional Solution to Airport Congestion, Denny Schneider
2. Apartment Association of Greater Los Angeles, Christian Frere
3. Arthur Golding & Associates, Arthur Golding
4. Baldwin Hills Conservancy, David McNeill
5. Board of Neighborhood Commissioners, Albert Abrams
6. California State Polytechnic University Pomona, Meredith McKenzie
7. Canada Goose Project, Rosemarie White
8. City of Burbank - Public Works Department, Daniel J. Rynn
9. City of Glendale - Public Works, Maurice Oillataguerre
10. City of Glendale - Water & Power, Rosanna Lau
11. City of LA - Department on Disability, Stephen Simon
12. City of San Fernando - Public Works, Ron Ruiz
13. Community Enhancement Services, Zigmund Vays
14. Environment Now, Caryn Mandelbaum
15. Environmental Justice Coalition for Water, Miriam Torres
16. First African Methodist Episcopal Church - Assistance Corporation, Denise Hunter
17. Food and Water Watch, Renee Maas
18. Forest Lawn Memorial Park, Clint Granath
19. Friends of the Los Angeles River, Shelly Backlar
20. Friends of the Sepulveda Basin, Glenn Bailey
21. Granada Hills North Neighborhood Council, Bill Hopkins
22. Greater Los Angeles Association of Realtors, Richard L. Otterstrom
23. Greater Wilshire Neighborhood Council, Jack Humphreville
24. Green LA Coalition, Stephanie Taylor
25. Heal the Bay - Water Quality, Kirsten James
26. Homeowners of Encino, Gerald A. Silver
27. Japanese Garden Advisory Committee, Arthur Hirshberg
28. LA and San Gabriel Rivers Watershed Council, Nancy Steele
29. LA Community Garden Council, Glen Dake
30. LA County Department of Public Works, Adam Walden
31. LA Urban League, Trevor Ware
32. Lake Balboa Neighborhood Council, Lisa Reveen
33. LAUSD Office of Environmental Health and Safety, Edward Morelan
34. Loyola Marymount University - Facilities Management Department, Larry D. Johnson
35. Mar Vista Community Council, Christopher McKinnon
36. Metropolitan Water District of Southern California, Andy Hui
37. Mid City West Community Council, Elliot Zemel
38. Mono Lake Committee, Geoffrey McQuilkin (located outside mapped area)
39. NASA Jet Propulsion Laboratories, Sharon L. Harriman
40. Natural Resources Defense Council, Michelle Mehta
41. Neighborhood Council MOU Oversight Committee, Tony Wilkinson
42. Oriental Mission Church, Moon Chung, Ph.D.
43. Pierce College - Foundation, Dennis Washburn
44. Proposition O Citizens Oversight Advisory Committee, Adi Liberman
45. Providence Holy Cross Medical Center, Arnold Soria
46. River Project and Tujunga Watershed Council, Melanie Winter
47. San Fernando Valley - Audubon Society, Mark Osokow
48. Santa Monica Bay Restoration Commission, Shelley Luce, D.Env.
49. Santa Monica Bay Restoration Foundation, Tom Ford
50. Sherman Oaks Neighborhood Council, Greg Martayan
51. Sierra Club - Water Committee, Tom Williams
52. Silver Lake Neighborhood Council, Rusty Millar
53. Society of Hispanic Professional Engineers, Carlos Aguilar
54. South Shores Homeowners Association, John S. Lang
55. Southern California Water Committee, Ron Gastelum
56. Southern California Watershed Alliance, Conner Everts
57. Southwest Neighborhood Council, Patricia Jones
58. Studio City Neighborhood Council, Victor Helo
59. Sun Valley Area Neighborhood Council, Mike O'Gara
60. Surfrider Foundation, Joe Geever
61. TreePeople, Deborah Weinstein
62. Upper Los Angeles River Area Watermaster, Richard Slade
63. Urban Semillas, Miguel Luna
64. USC - Local Government Relations, David Roberts
65. Valley Industry and Commerce Association, Stuart Waldman
66. Vulcan Materials, Peter Finie
67. Watts Labor Community Action Committee, Timothy Watkins

RWAGparticipants.mxd

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Figure 2-2: RWAG Representation

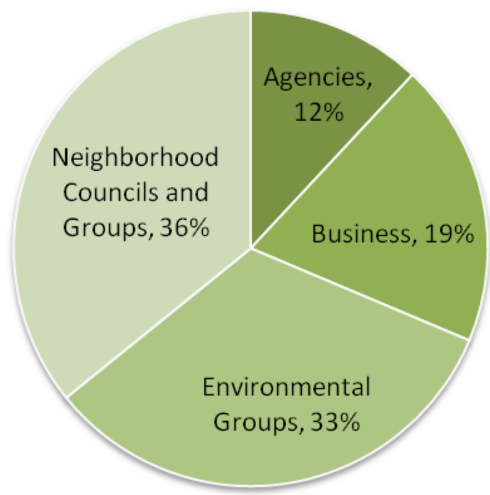


Table 2-3: RWAG Representation

Category	Organization	
Agencies (12%)	• City of Glendale - Water & Power • City of Glendale - Public Works • City of San Fernando - Public Works • City of Burbank - Public Works Department • City of LA - Department on Disability	• LA County Department of Public Works • Metropolitan Water District of Southern California • Upper Los Angeles River Area Watermaster
Business (19%)	• Apartment Association of Greater LA • Arthur Golding & Associates • Baldwin Hills Conservancy • California State Polytechnic University Pomona • Forest Lawn Memorial Park • Greater Los Angeles Association of Realtors • Loyola Marymount University - Facilities Management Department	• NASA Jet Propulsion Laboratories • LAUSD Office of Environmental Health and Safety • Pierce College – Foundation • Providence Holy Cross Medical Center • USC - Local Government Relations • Valley Industry and Commerce Association • Vulcan Materials

Table 2-3: RWAG Representation (Continued)

Category	Organization	
Environmental Groups (33%)	• Alliance for a Regional Solution to Airport Congestion • Canada Goose Project • Environment Now • Environmental Justice Coalition for Water • Food and Water Watch • Friends of the Los Angeles River • Friends of the Sepulveda Basin • Green LA Coalition • Heal the Bay - Water Quality • LA and San Gabriel Rivers Watershed Council • Mono Lake Committee	• Natural Resources Defense Council River Project and Tujunga Watershed Council • San Fernando Valley - Audubon Society • Santa Monica Bay Restoration Commission • Santa Monica Bay Restoration Foundation • Sierra Club - Water Committee • Southern California Water Committee • Southern California Watershed Alliance • Surfrider Foundation • TreePeople • Urban Semillas
Neighborhood Councils and Other Groups (36%)	• Community Enhancement Service • First African Methodist Episcopal Church - Assistance Corporation • Granada Hills North Neighborhood Council • Greater Wilshire Neighborhood Council • Homeowners of Encino • Japanese Garden Advisory Committee • Lake Balboa Neighborhood Council • LA Community Garden Council • LA Urban League • Los Angeles Board of Neighborhood Commissioners • Mar Vista Community Council • Mid City West Community Council	• Neighborhood Council MOU Oversight Committee • Oriental Mission Church • Proposition O Citizens Oversight Advisory Committee • Sherman Oaks Neighborhood Council • Silver Lake Neighborhood Council • South Shores Homeowners Association • Southwest Neighborhood Council • Society of Hispanic Professional Engineers • Studio City Neighborhood Council • Sun Valley Area Neighborhood Council • Watts Labor Community Action Committee

Note: Group representation on the RWAG has fluctuated since December 2009. Some groups have discontinued their participation while others continue to express interest in joining the RWAG.

A major component of the RWAG's engagement has been participation in a series of workshops to discuss issues related to recycled water. Considerable effort has been devoted to balance the content and technical complexity of workshop presentations, given the diverse levels of existing understanding of GWR by different RWAG participants. Workshop topics have included water quality, water resources, public health, regulations, treatment technologies, complexity of pipeline alignments, demand projections, and cost estimates.

Workshop sessions have been of particular importance in development of the RWMP, as the RWAG has provided input on objectives, alternatives and costing estimates. At each workshop, the City has been presenting ideas, getting feedback, and moving forward with a better understanding of public concerns and potential acceptance. As the RWMP documents continue towards completion and individual projects move into the environmental review process, RWAG participants likely will become further engaged both in extending outreach among their own stakeholders and by providing input to the project development and review processes.

Beyond workshops, RWAG participants have engaged in webinars on technical topics as well as tours of facilities related to water recycling, including the primary, secondary, and tertiary processes at DCTWRP, the AWP pilot plant at DCTWRP; the Tujunga Well Fields and Spreading Grounds; and the Edward C. Little Water Recycling Facility owned by the West Basin Municipal Water District (WBMWD). These additional activities have helped to build a deeper understanding of the technology and issues related to expanding water recycling within the City.

In addition to these activities, RWAG participants have been engaged in broadening awareness of the City's current recycled water planning activities and goals. Active RWAG participants have informed members of their groups as well as the broader community, have assisted in planning and delivering information to Neighborhood Councils, and have attended and helped with presentations at Recycled Water Forums. The neighbor-to-neighbor communication role of the RWAG has strengthened the City's public outreach and made real many more technical elements of water recycling, particularly for RWAG participants new to the topic.

2.4 One-on-one Sessions with Key Community Leaders

Concurrent with the RWAG, the City initiated meetings with key community leaders for one-on-one sessions. Such sessions are a powerful method to assess the current climate of public opinion within specific communities and populations regarding important issues. While termed one-on-ones, these meetings often included multiple people on each side of the table. Also, these sessions focused more on listening than on providing information, offering a unique opportunity to collect input from people within a community and to hear their perceptions and concerns.

Fifty diverse stakeholders were identified for one-on-one sessions, including leaders from environmental groups, community-based organizations, Neighborhood Councils, and business associations. Comments and input from each session were memorialized, as a basis for further informing the outreach effort. This input reflects a collective deep knowledge of many of Los Angeles' groups and communities.

2.5 City Councilmembers and Other Elected or Appointed Officials

Awareness, understanding and, ideally, support from elected and appointed officials are critical elements in the success of recycled water and GWR initiatives, as has been demonstrated by past experience of utilities throughout the U.S. and across the globe. The first of 15 planned Los Angeles City Councilmember briefings began in 2009. As of November 2011, seven Councilmembers had been directly briefed, four Councilmember staff briefings had been conducted, and additional Councilmember office staff has been informed through other methods, resulting in letters of support from three Councilmembers.

2.6 Presentations to Neighborhood Councils and Community Groups

The political organization of Los Angeles' broad geography into Neighborhood Councils provides an existing, organized forum for information sharing on topics of public impact and interest. Neighborhood Councils are an important mechanism for spreading word of current and future recycled water plans throughout the City; the results of sessions with Councilmembers and community leaders and ongoing comments from RWAG participants have confirmed this.

As of July 2011, 15 presentations have been made to Neighborhood Councils, with presentations pending to 7 more. While Neighborhood Councils comprise an important audience, those in attendance tend to be a highly-involved and civic-minded sub-group of the general public. Additional venues are being developed to more directly touch a broader public and provide opportunities to reach more deeply into the community. These include presentations to local organizations, interest groups, religious groups, informal community gatherings, and other community-specific organizations—large and small. The results to date indicate that members of the community are eager to learn more about the City's plans for recycled water and GWR, and to provide input and feedback.

2.7 Recycled Water Forums

As part of the strategy to broaden outreach, these open information and comment gathering sessions have been designed to bring information about the City's plans for expanded water recycling to the general public. Over 120 stakeholders participated in seven Recycled Water Forums held in April and May 2011. Attendees included residents, neighborhood council members, stakeholders and RWAG participants. Although most of the Forums were attended by relatively small groups, participants were engaged, insightful, and open to the overall ideas being presented. Topics covered included Los Angeles' water supply sources and availability, an explanation of what recycled water is and how it is used, and an overview of LADWP's Recycled Water Program. The response from the public at all forums was very positive in support of recycled water and GWR.

2.8 Summary

The City has undertaken a substantive and ambitious outreach program, closely linked with activities, milestones, and decision points in the RWMP. This outreach program has included convening the RWAG, holding one-on-one sessions with key community leaders, conducting briefings for City Councilmembers and other officials, delivering presentations to Neighborhood Councils and Community Groups, completing a series of Recycled Water Forums and responding openly and transparently to Press inquiries. Future plans call for public outreach activities required during the environmental process, and ongoing outreach to an increasingly broader audience. The goal is to engage members of the City's diverse population; share thorough, fact-based, easy-to-understand information; and collect feedback on the City's plans for implementing GWR in Los Angeles.

3. Planning Parameters

This section outlines the guiding principles, planning parameters for the GWR project including the RWMP objectives, the GWR goals and phases, the assumed locations for the AWPF and recharge, and the AWPF capacities. These parameters are the basis for the AWPF process sizing presented in Section 5.

3.1 Guiding Principles for the Groundwater Replenishment Project

At the onset of the RWMP process in 2008, a number of guiding principles were established that shaped the alternatives considered for the GWR project. These principles included protection of public health and water quality, attainment of recycled water goals, compliance with regulatory frameworks, cost-effectiveness of the project, and engagement of stakeholders. Some very specific principles were identified in the City's May 2008 Water Supply Action Plan entitled Securing L.A.'s Water Supply. In that plan, the City laid out specific concepts and benchmarks for the use of recycled water for groundwater replenishment:

- Implementing state-of-the-art, advanced treatment of effluent from the Donald C. Tillman Reclamation Plant similar to the Orange County Water District's (OCWD) recently implemented GWR System. Advanced treatment was acknowledged as proven technology that had been successfully used for indirect potable reuse projects, including GWR System.
- Using 15,000 AFY of advanced treated recycled water for groundwater replenishment.

To meet the 15,000 AFY reuse goal and to comply with the CDPH 2008 draft groundwater recharge regulations (in regards to the allowable recycled water contribution for a groundwater recharge project), it was necessary for the proposed GWR project to utilize advanced treatment. In particular, advanced treatment allowed the requirements for blend water to be met. In addition, it was determined that using proven advanced treatment technologies, such as those used for GWRS, would allow the City to meet the GWR project's original timeline. It was anticipated that the environmental review process and the regulatory review/approval process to meet Los Angeles RWQCB and all other CDPH regulatory requirements would be timelier. In 2008, the choice to incorporate proven advanced treatment technologies represented the most conservative approach from a planning perspective to determine project feasibility, evaluate the various recycled water supply options, and estimate conservative project costs. Hence, recycled water master planning has been based on the initial decision to proceed with planning a GWR project that incorporates advanced treatment, based on the CDPH 2008 draft regulations.

Subsequent to initiating the recycled water master planning process, the LADWP developed the 2010 UWMP, which incorporated recycled water as a key water supply strategy for Los Angeles and superseded the 2008 Water Supply Action Plan. The 2010 UWMP now serves as the City's guiding document for expanding the recycled water program, including groundwater replenishment. The UWMP reflects realities of funding limitations that were not addressed in the 2008 Water Supply Action Plan document. Water rate increases are required to achieve even the revised projections in the UWMP.

In November 2011, CDPH released a new draft of its groundwater recharge regulations. Although these pending new regulations will not be final until at least the end of 2013, the revised draft appears to provide flexibility for GWR projects that may allow the City to consider other alternatives that could reduce project costs, primarily through recognition of the proven role that natural systems play in the water purification process. The changes to the draft regulations are being developed by CDPH with the primary objective of ensuring the protection of public health.

In 2010, the City began working with NWRI to establish an IAP to provide a panel of experts to provide input and advice for the GWR project, and specifically to support the regulatory approval process. By establishing the IAP, the City received early input to the planning process. Subsequent consultation with the IAP will provide additional flexibility with the project implementation and facility planning issues that may arise going forward. Specifically, the IAP can provide guidance on opportunities the pending regulatory changes provide, including the potential to consider other treatment alternatives to reduce project costs while developing the GWR project design within its guiding principles of protecting public health and water quality, meeting recycled water supply objectives, meeting or exceeding all regulatory requirements, and engaging stakeholders.

Any GWR alternative will also take into consideration the scope, timing, and implementation of another key local water supply project, the LADWP San Fernando Basin Groundwater Treatment Complex. The Groundwater Treatment Complex will focus on the treatment of legacy groundwater contamination in the SFB and will likely consist of centralized treatment facilities and wellhead treatment to allow LADWP to again have the ability to fully utilize the SFB groundwater supplies. At this time, it is anticipated that the construction of the GWR Project will proceed when the implementation of the San Fernando Basin Groundwater Treatment Complex moves forward.

3.2 Recycled Water Master Planning Objectives

The RWMP team established objectives at the beginning of the planning process for the purpose of establishing criteria by which different alternatives can be compared against each other.

Several guidelines were used when establishing the objectives. The objectives had to be easy to understand, not redundant, measureable with evaluation criteria, and, concise in number. Generally there should be no more than five to eight total. It is also important to note that objectives are not solutions. Objectives define ***what*** the City is trying to achieve through the RWMP, and solutions (i.e., alternatives) represent ***how*** these objectives will be achieved.

Two threshold objectives were established, which had to be met regardless of the alternative:

- **Threshold Objective 1** – Meet all water quality regulations and health & safety requirements, and use proven technologies.
- **Threshold Objective 2** – Provide effective communication and education on recycled water program.

In addition to the threshold objectives, six additional objectives summarized in **Table 3-1** were established. The RWAG (see Section 2) assisted in the development of these objectives.

Table 3-1: Recycled Water Planning Objectives

Recycled Water Planning Objectives
1 - Promote Cost Efficiency: Meet the goals of the recycled water program in a cost-effective manner, considering both City and recycled water customer costs.
2 – Achieve Supply and Operational Goals: Meet or exceed water supply targets and operational goals established by the City.
3 – Protect Environment: Develop projects that not only protect the environment, but also provide opportunities to enhance it.
4 - Maximize Implementation: Maximize implementation by minimizing typical hurdles including institutional complexity, permitting challenges, and maximizing customer acceptance.
5 - Promote Economic and Social Benefits: Provide economic and social benefits in the implementation and operation of recycled water projects
6 – Maximize Adaptability and Reliability: Maximize adaptability and reliability to be able to adapt to uncertainties and to maximize reliability of operations once projects are implemented.

3.3 Planning Year and GWR Goals

The initial basis for GWR and NPR Master Planning was to provide a framework to achieve 50,000 AFY. However, as mentioned in Sections 1 and 3.1, the City's UWMP calls for 59,000 AFY of imported water supplies to be replaced by recycled water by 2035. The UWMP reflects realities of funding limitations that were not addressed in the 2008 Water Supply Action Plan document. Water rate increases are required to achieve even the revised projections in the UWMP. Although this RWMP was initially structured to achieve the 50,000 AFY goal, combinations of GWR and NPR alternatives are included to support the UWMP 59,000 AFY goal by 2035.

The City has existing[4] non-potable reuse projects and a barrier supplement project with a combined average annual reuse of 8,000 AFY and has planned non-potable reuse projects that are under construction or in planning/design with an average annual reuse of 11,350 AFY. The total imported water offset capacity of these recycled water projects is 19,350 AFY.

The goal of new recycled water projects, planned as part of the RWMP, is to offset the remaining 39,650 AFY of imported water. **Table 3-2** summarizes the City's recycled water goals.

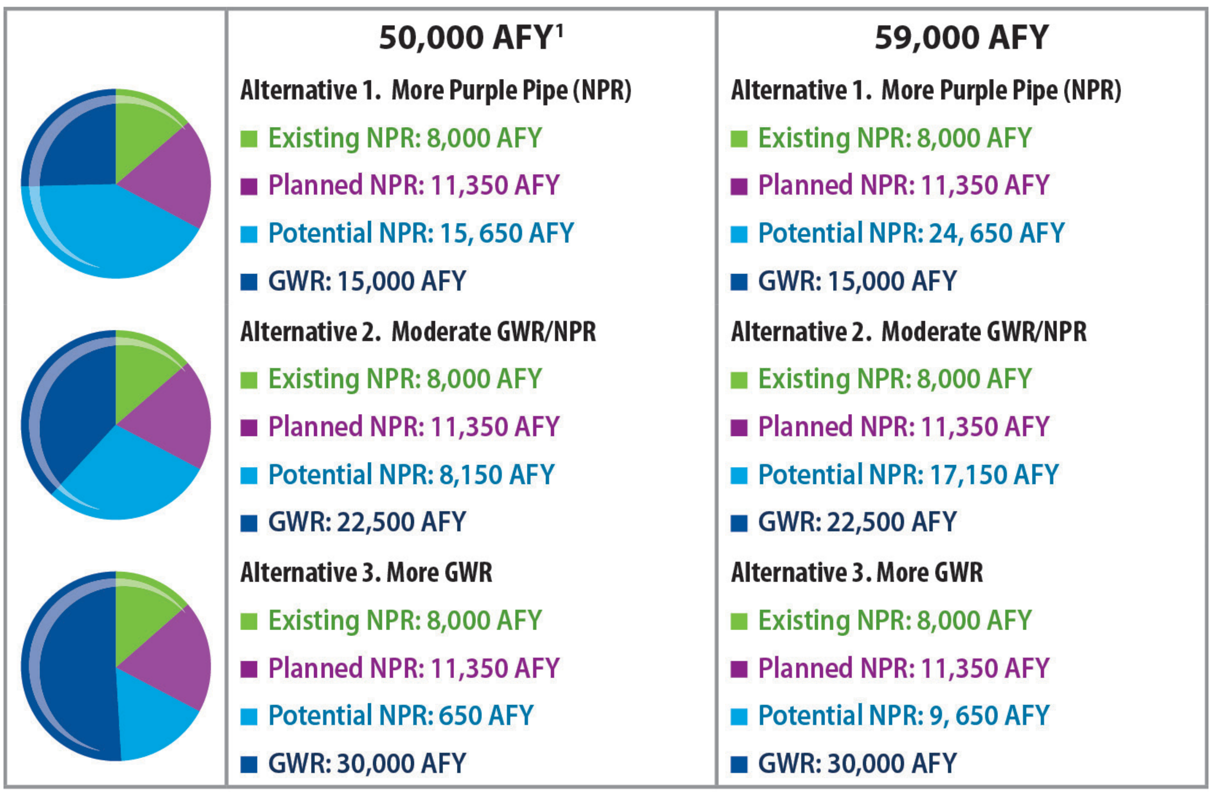
[4] For the purposes of accounting in this report, "existing" customers are those that were served as of January 2012.

Table 3-2: City's Recycled Water Project Goals

Recycled Water Projects	Imported Water Offset
"Existing" Projects	**19,350 AFY**
Currently in operation (NPR and Barrier Supplement)	8,000 AFY
In construction, or in planning/design (NPR)	11,350 AFY
New Recycled Water Projects, planned as part of RWMP	**39,650 AFY**
Total	**59,000 AFY**

When the RWMP was initiated, the recycled water goal was originally 50,000 AFY, which meant that originally 30,650 AFY of new recycled water projects (GWR and NPR) needed to be planned as part of the RWMP. To meet this 30,650 AFY goal, the RWMP team developed and evaluated integrated alternatives comprised of varying amounts of GWR and NPR. The *Integrated Alternatives Development and Analysis TM*, included in Appendix M, documents this analysis. As part of the Integrated Alternatives Analysis, three integrated alternatives with different combinations of GWR and NPR projects were evaluated. **Figure 3-1** summarizes the three integrated alternatives developed to offset the initial goal of 50,000 AFY of imported water as well as modifications to achieve the UWMP goal of 59,000 AFY.

Figure 3-1: Integrated Alternatives to Reach 50,000 AFY and 59,000 AFY



Note:

1) The original recycled water goal for the RWMP was 50,000 AFY by 2019, which was established before the completion of the 2010 UWMP. The recycled water goal was revised to 59,000 AFY by 2035 with the issuance of the 2010 UWMP. The UWMP reflects realities of funding limitations that were not

addressed in the 2008 Water Supply Action Plan. Water rate increases are required to achieve even the revised projections in the UWMP. The integrated alternatives analysis was originally focused on determining the balance of GWR and NPR to achieve 30,650 AFY so that when combined with the 19,350 AFY of existing and planned NPR demands would achieve an overall recycled water goal of 50,000 AFY.

The integrated alternatives analysis concluded that more GWR (Alternative 3) is most beneficial, since this alternative performs better than alternatives with less GWR in terms of capital costs and project implementation. Alternative 3 also has many benefits for implementation because of having more GWR than NPR, fewer contracts and agreements are needed with outside agencies. With Alternative 3 implementing one larger GWR project rather than many, smaller NPR projects requires fewer projects/contracts; and will also result in fewer public construction impacts due to temporary traffic, noise, odor, and dust caused by construction of NPR pipelines.

Therefore, this GWR Master Planning Report is based on achieving a GWR goal of 30,000 AFY – the maximum amount of GWR that can be served by DCTWRP and the most conservative project size from a planning perspective. As shown in Figure 3-1, when combined with 30,000 GWR, 9,650 AFY of NPR projects are needed so that when added to the 19,350 AFY of existing and planned NPR demands the City will achieve the overall goal of 59,000 AFY by 2035.

To allow for the most flexibility for implementation, the NPR Master Planning Report identifies over 18,000 AFY of potential NPR projects. NPR projects that are most feasible considering cost and other important criteria will be the ones pursued.

The City relies on a mix of GWR and NPR projects to meet its goals, and has the flexibility to adjust the amount of GWR eventually implemented. As the recycled water program develops, the City can revisit the multi-criteria comparison of GWR and NPR to determine whether the GWR Phase 2 project should be expanded by an additional 15,000 AFY or less. If Phase 2 is less than 15,000 AFY, then more NPR projects would be implemented to achieve the goal of 59,000 AFY by 2035.

3.4 GWR Project Implementation Phases

Based on discussions with the City, it is assumed that the GWR projects will be implemented in two phases. **Table 3-3** summarizes the implementation schedule for the GWR project, which is described in detail in Section 10. The implementation of the GWR project will depend on funding availability.

Table 3-3: GWR Projects Implementation Schedule

GWR Project Phases	Imported Water Offset	Target Year
GWR Projects – Phase 1	15,000 AFY	FY 2022 (in service by July 2022)
GWR Projects –Phase 2	Up to 30,000 AFY [1]	FY 2035 (in service by July 2035)

Notes:

1) Due to limited flow from DCTWRP (discussed in Section 3.6) and spreading grounds availability (discussed in Section 3.4), 30,000 AFY of GWR may not be achievable unless groundwater injection wells are implemented See Section 7 for more information.

3.5 Spreading Grounds for GWR

The GWR will be performed in the SFB using the existing spreading grounds currently owned and operated by LACDPW. **Figure 1-5** in Section 1 illustrates the location of the spreading grounds. The primary spreading grounds used for the GWR of purified recycled water will be the HSG. The PSG will not be used for the GWR of purified recycled water during Phase 1, but will be used at Phase 2. Both HSG and PSG are currently used by LACDPW for the recharge with stormwater. Based on LACDPW's operating practices of reserving the use of spreading grounds first for the capture and recharge of stormwater, LACDPW has informed the City to assume that HSG will not be available for GWR of purified recycled water for up to 70 days per year during wet years, and PSG will not be available for up to 30 days per year during wet years.

As discussed in Section 7, due to the subsurface conditions downgradient of HSG (including the presence of a fault), additional spreading capacity at PSG is required when the project expands from Phase 1 to Phase 2 to prevent excessive groundwater mounding under the HSG. In addition, injection wells were investigated as an additional option for GWR for periods when either HSG or PSG or both are unavailable to receive purified recycled water. The use of injection wells and potential spreading at Strathern Wetlands Project provide additional flexibility in GWR operations as discussed in Section 7. **Table 3-4** summarizes the use of spreading grounds at different phases of the GWR project.

Table 3-4: Spreading Grounds for GWR

	Days Unavailable [1]	Phase 1	Phase 2
Target Amount of GWR using Recycled Water		15,000 AFY	30,000 AFY
Hansen Spreading Grounds (HSG)	70 days/year	Used	Used
Pacoima Spreading Grounds (PSG)	30 days/year	Not Used	Used
Injection Wells	N/A	Not Used	Potentially Used
Strathern Wetlands Project	N/A	Not Used	Potentially Used

Notes:
1) Estimated by LACDPW for wet years. Actual number of unavailable days will likely be less for dry years.
N/A: Not applicable

3.6 AWPF Location

Determining the potential location of the AWPF is a key planning consideration. The RWMP team completed a separate study identifying potential sites and evaluating them against the project objectives summarized in Section 3.1. *Site Assessment TM*, included in Appendix F, provides a detailed summary of the investigation and evaluation. As summarized in the *Site Assessment TM*, the RWMP team short-listed five candidate sites for the AWPF. Four candidate sites were at or near DCTWRP, as shown on **Figure 3-2,** and one candidate site was located at the Valley Generating Station (VGS), as shown on **Figure 3-3**.

Figure 3-2: AWPF Candidate Sites at or Near DCTWRP

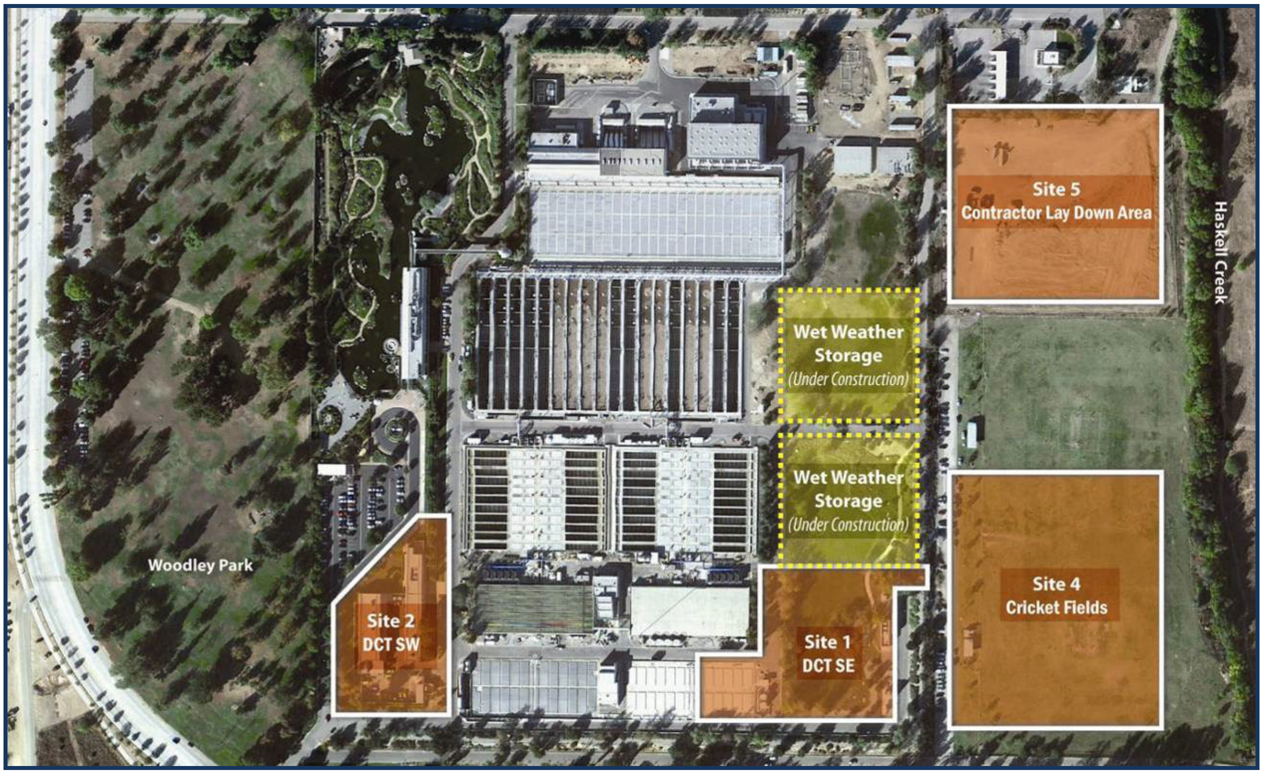


Figure 3-3: AWPF Candidate Site at VGS

The five candidate sites for the AWPF were initially and preliminarily evaluated based on the objectives described in Section 3.1. The capital costs and O&M costs for the five candidate sites for the 30,000 AFY GWR project option are shown in **Table 3-5**, and presented in more detail in the *Site Assessment TM* (Appendix F) and the *Integrated Alternatives Analysis – Preliminary Cost Summary (*Appendix M).

Cost is one of many logistical and operational parameters considered in selecting a staff-preferred site for the AWPF for the RWMP. In addition to the non-cost factors described in Objectives 2-6 (see Section 3.1 for list of objectives, and see the Site Assessment TM for detailed discussion of evaluation parameters), three specific, critical criteria were identified by LADWP and BOS management for consideration and are summarized in **Table 3-5**. Only Site 2 DCTWRP SW meets each of these three criteria.

Table 3-5: Critical Criteria for Evaluation of Five Candidate Sites

Critical Criteria	Site 1 DCTWRP SE	Site 2 DCTWRP SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Lay Down Area
Bureau of Sanitation (BOS) already has related facilities and staffing at the site to support the operation of the AWPF for GWR. Although new facilities will be built for GWR, there are benefits and economies of operation having new facilities alongside existing operational facilities and staff.	✓	✓		✓	✓
Site is within the boundaries of the existing berm or outside of the Sepulveda Flood Control Basin.	✓	✓	✓		
Site is not in an area of potential future expansion to the existing treatment processes for producing tertiary treated effluent at DCTWRP.		✓	✓		

✓ = Site meets criterion.

Based on this analysis, the City selected Site 2 DCTWRP SW as the staff-preferred location for the proposed project. Therefore, for the GWR Master Planning Report, the RWMP team assumed that the AWPF would be located at DCTWRP, within the flood control berm and in the southwest location. All sites will be evaluated equally for environmental impacts as part of the environmental documentation.

3.7 AWPF Capacities

This section summarizes the AWPF capacities for Phase 1 and 2. A portion of DCTWRP effluent (recycled water) will be treated to produce the purified recycled water for GWR and to serve existing NPR customers that are connected to the 54-inch pipeline that conveys the purified recycled water to the spreading grounds. There are many factors that impact the size of the AWPF, which include:

- Wastewater flows to DCTWRP;
- Availability of secondary/tertiary effluent from DCTWRP;
- Recycled water (Title 22) commitments to the lakes, LA River, and in-plant reuse; and,
- Availability of the spreading grounds.

Table 3-6 summarizes the DCTWRP flows for influent, average recycled water production, and distribution of recycled water flows for in-plant reuse, the lakes and LA River, and influent to the AWPF. For Phase 1, the AWPF is not flow limited and the influent flow to DCTWRP will be managed to meet the demands. The AWPF will be flow limited for Phase 2 and this may impact the City's ability to achieve 30,000 AFY of recharge without utilization of injection wells and/or potentially Strathern Wetlands Project.

Table 3-6: DCTWRP Flows

Parameter	Phase 1 FY 2022	Phase 2 FY 2035
DCTWRP Title 22 Treatment Capacity	80 mgd	80 mgd
DCTWRP Influent	66 mgd [1,2,5]	80 mgd [1,3]
DCTWRP Effluent (Title 22 Recycled Water)	61 mgd [1,2]	73 mgd [1,3]
In-Plant Reuse	2 mgd	2 mgd
Flows to Lakes and LA River [4]	27 mgd	27 mgd
Influent to AWPF	32 mgd	44 mgd

Notes:
1) As noted in *Draft DCTWRP Maximum Flow Assessment TM* (Appendix G), Table 4-2, the DCTWRP tertiary effluent production capacity is estimated to be approximately 87% of the influent flow rate, based on plant flow data from January 2005 through December 2008. The new cloth media filters, which have fewer losses than the old granular media filters, came on-line in December 2009 so data from December 2009 through August 2011 were analyzed as part of this GWR Master Planning Report. The DCTWRP tertiary effluent production capacity is estimated to be approximately 92% of the influent flow rate. If DCTWRP secondary effluent is used for AWPF influent, slightly more flow will be available since losses from cloth media filters will be eliminated.
2) Approximate daily total influent and effluent flows, accounting for weekend diurnal curves and existing primary flow equalization capacity.
3) Maximum daily total influent and effluent flows, accounting for weekend diurnal curves and installation of additional primary flow equalization capacity. See Section 5 for more information.
4) Assumed flow to Lakes and LA River, based on 2006 Integrated Resources Plan Draft Environmental Impact Report.
5) For Phase 1 the influent flow rate would be managed to meet the recycled water demands (i.e., in-plant reuse, flows to Lakes and LA River, and influent to AWPF).

The existing 54-inch pipe that extends from DCTWRP to VGS will be used for the conveyance of purified recycled water from the AWPF. Since some NPR users are located at or near VGS, these NPR customers will be served with purified recycled water. To be conservative in the sizing of the AWPF, it is assumed that all existing and planned NPR users will be served with AWPF purified recycled water as well. Since purified recycled water will not have chlorine residual, individual chlorination stations will be considered on a case-by-case basis for NPR users served with purified recycled water. **Table 3-7** summarizes the AWPF capacities for the Phase 1 and the Phase 2 of GWR, which is based on the following assumptions:

- AWPF recovery of 79 percent, which is based on 93 percent microfiltration (MF) system recovery and 85 percent reverse osmosis (RO) recovery. These assumptions are explained in *Draft Advanced Water Treatment Technology Assessment TM* (Appendix E).
- Online factor of 92 percent (i.e., 30 days offline/year) that was also used for the OCWD GWR System project, which has the same treatment processes.
- Wet Year: For Phase 1, HSG offline for 70 days/year. For Phase 2, HSG and PSG are offline for a total of 50 days/year, which is the average of the maximum number of days

per spreading grounds (HSG 70 days/year and PSG 30 days/year), which assumes that there will be times that the spreading grounds are offline at the same time.

- Dry Year: For Phase 1, HSG offline for 10 days/year. For Phase 2, HSG and PSG are offline for a total of 8 days/year, which is the average of the assumed minimum number of days per spreading grounds (HSG 10 days/year and PSG 5 days/year), which assumes that there will be times that the spreading grounds are offline at the same time.

Table 3-7: AWPF Capacity and Projected Yield for NPR and GWR

Parameter	Phase 1 (FY 2022)		Phase 2 (FY 2035)	
	Wet Year[2]	Dry Year[3]	Wet Year[2]	Dry Year[3]
AWPF Influent Flow	32 mgd	32 mgd	44 mgd	44 mgd
AWPF Product Water Capacity [1]	25 mgd [(5)]	25 mgd	35 mgd	35 mgd
AWPF Production, Potential	20,000 AFY	23,000 AFY	31,000 AFY	35,000 AFY
NPR [4]	5,000 AFY	5,000 AFY	5,000 AFY	5,000 AFY
GWR	15,000 AFY	18,000 AFY	26,000 AFY	30,000 AFY

Notes:
1) Assumes overall 79% AWPF recovery (93% MF recovery and 85% RO recovery).
2) Accounts for 92% AWPF online factor, and the maximum number of days HSG (70 days/year) and PSG (30 days/year) are unavailable to receive purified recycled water.
3) Accounts for 92% AWPF online factor, and the assumed minimum number of days HSG (10 days/year) and PSG (5 days/year) are unavailable to receive purified recycled water.
4) Includes existing and planned NPR users only. During wet years, NPR demands would be lower since demands for irrigation water would be lower.
5) While the required AWPF capacity to achieve 15,000 AFY of GWR in Phase 1 during wet years is 23.4 mgd, the AWPF equipment described in Section 5 are sized for 25.0 mgd capacity in Phase 1, since RO trains are sized in 5.0 mgd capacity units. The AWPF will have 5.0 mgd treatment capacity with one RO train online, 25.0 mgd capacity with five RO trains online (Phase 1), and 35.0 mgd capacity with seven RO trains online (Phase 2).

As shown in **Table 3-7**, there may not be enough water during the wet years for Phase 2 to achieve 30,000 AFY of GWR when assuming a 92 percent online factor that does not overlap with the spreading basins being out of service. It is estimated that during a dry year that the City would be able to meet the goal of 30,000 AFY of GWR. LADWP is considering implementing injection wells to inject the additional 4,000 AFY of purified recycled water into the groundwater basin to be able to meet the 30,000 AFY GWR goal during wet years. But, depending on actual AWPF operating conditions and rain conditions (i.e., wet, average, or dry), the City may be able to recharge more purified recycled water during average and dry years to achieve a long-term average of 30,000 AFY of GWR.

Table 3-8 shows the range of total, annual GWR quantities assuming both 92 percent and 100 percent online factors and wet, average, and dry rain conditions. A 100 percent online factor assumes that any AWPF downtime would occur at the same time that the spreading basins are unavailable for recharge. This may not be a valid assumption for every year, but demonstrates the range of GWR flows that would be available when the AWPF does not need to be taken out of service for maintenance. As shown in **Table 3-8**, the range of purified recycled water available for GWR during Phase 1 is 15,000 AFY to 21,000 AFY, and 26,000 AFY to 33,000 AFY for Phase 2. Based on the actual operating conditions demonstrated during Phase 1, an assessment can be made to determine if injection wells or potential spreading at the Strathern Wetlands Project are needed or if the City can meet the annual recharge goal by recharging more during dry years and less during wet years.

Table 3-8: Range of Total Flows to GWR

Phase & AWPF Capacity	Online Factor	AWPF Production (mgd)	Flow to NPR (mgd)	Flow to GWR (mgd)	Annual Rain Condition	HSG Offline Days (d/yr)	PSG Offline Days (d/yr)	Total SGs Offline Days (d/yr)	Total GWR (AFY)
Phase 1 AWPF Capacity = 23.4 mgd	92%	21.5	4.5	17.0	Wet	70	N/A	100	15,000
		21.5	4.5	17.0	Average	35	N/A	65	17,000
		21.5	4.5	17.0	Dry	10	N/A	40	18,000
	100%	23.4	4.5	18.9	Wet	70	N/A	70	17,000
		23.4	4.5	18.9	Average	35	N/A	35	19,000
		23.4	4.5	18.9	Dry	10	N/A	10	21,000
Phase 2 AWPF Capacity = 35.0 mgd	92%	32.1	4.5	27.7	Wet	70	30	80	26,000
		32.1	4.5	27.7	Average	35	15	55	29,000
		32.1	4.5	27.7	Dry	10	5	38	30,000
	100%	35.0	4.5	30.5	Wet	70	30	50	29,000
		35.0	4.5	30.5	Average	35	15	25	32,000
		35.0	4.5	30.5	Dry	10	5	8	33,000

3.8 AWPF Influent Water Quality

The GWR treatment pilot study results, summarized in the GWR Treatment Pilot Study Report showed that the AWPF treating the DCTWRP secondary effluent performed similarly to the AWPF treating the DCTWRP tertiary effluent. Therefore, the AWPF will be provided with the flexibility to use either the secondary effluent or the tertiary effluent from DCTWRP for the AWPF influent. **Table 3-9** summarizes the water quality of the secondary effluent and tertiary effluent at DCTWRP.

Table 3-9: DCTWRP Effluent Water Quality

Constituent	Units	DCTWRP Secondary Effluent[1] (Average)	DCTWRP Tertiary Effluent[2] (Average)
Temperature	°C	24.7	25.1
Color	Pt-Co	46	37
Turbidity	NTU	1.5	0.8
TOC	mg/L	8.3	8.7
Iron	mg/L	0.027	0.028
Oil and grease	mg/L	1.4	2.0

Notes:
1) Secondary effluent shows average values of measurements made at pilot facilities between May 15 and August 2, 2010 and between January 27 and February 28, 2011.
2) Tertiary effluent shows average values of measurements made at pilot facilities between February 18 and May 14, 2010 and between August 3, 2010 and January 26, 2011.

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4. GWR Treatment Pilot Study

LADWP and LADPW performed a 16-month pilot study to test the proposed advanced water purification processes. The pilot study was conducted from February 2010 through June 2011 and was located at the DCTWRP. This section presents an overview of the GWR Treatment pilot study. The complete results and discussions are presented in the Groundwater Replenishment Treatment Pilot Study Report.

4.1 Pilot Testing Goals and Project Set-up

The purpose of the pilot study was to evaluate the treatment efficacy of using AWP processes on the alternative source waters available at the DCTWRP. AWP is used to remove pathogens, salts, and organic compounds from treated wastewater, creating purified recycled water that can be used indirectly to supplement potable water supplies. Typical advanced purification consists of microfiltration (MF), reverse osmosis (RO), and advanced oxidation. For this study, the two advanced oxidation processes (AOPs) were evaluated, including ultraviolet light (UV) with hydrogen peroxide and ozone with hydrogen peroxide.

Pilot testing was conducted in three phases. Phase 1 validated the proposed processes used at existing AWPFs in California, including MF, RO, and UV/H_2O_2, considered the baseline treatment process. Phase 2 evaluated O_3/H_2O_2 as an alternative to UV/H_2O_2, with both AOPs tested side-by-side and with target contaminants spiked into the AOP supply. Phase 3 confirmed the recommended operating conditions from Phases 1 and 2 and also evaluated two alternative RO membranes.

4.2 Operating Conditions

The pilot plant evaluated various operating conditions to aid in process optimization and to determine recommended design criteria for a future treatment facility. The primary conditions that were varied include:

- Source of water supply
- Chlorination approach
- MF flux
- MF chemically enhanced backwash usage
- RO flux
- RO recovery
- RO membrane configuration
- RO membrane type
- Advanced oxidation approach

The baseline operating conditions were chosen based on operational information at existing facilities, such as the OCWD GWR System, Terminal Island Water Reclamation Plant's Advanced Water Treatment Facility, WBMWD's Edward C. Little Water Recycling Facility (West Basin WRF), and Water Replenishment District's Vander Lans plant. By optimizing these operating conditions through the pilot testing, a more efficient, more effective treatment process can be designed for the future AWPF.

4.3 Source Water Evaluation

Pilot testing included a source water evaluation to determine the most appropriate supply for the AWP facility (AWPF). Source waters considered at the beginning of the testing included: 1) secondary effluent before chlorination, 2) tertiary effluent before chlorination, and 3) tertiary effluent after the chlorine contact tank. Preliminary bench testing and water quality monitoring for n-nitrosodimethylamine (NDMA) were conducted, resulting in a recommendation that source water not be taken after the chlorine contact tank due to the presence of NDMA levels 10 times higher than the levels before chlorine addition. Pilot testing was therefore conducted using both secondary effluent and tertiary effluent, drawn before chlorine addition. During Phase 2 of the pilot testing, tertiary effluent after chlorination was used only when a source of high NDMA water was needed to evaluate the AOP alternatives.

Pilot testing results demonstrated that for the DCTWRP water, there were no significant differences in MF, RO, or AOP performance when secondary or tertiary effluents were used. MF and RO fouling rates were comparable for both source waters. While NDMA levels were slightly lower in the tertiary effluent, NDMA formation (after chlorine addition) was slightly higher, such that the levels of NDMA in the RO feed water and the RO product were the same for both source waters.

With no difference in operating efficiency or water quality for the DCTWRP water, it was recommended that the full-scale facility be designed to allow flexibility for either secondary or tertiary effluent source water, taken before chlorine addition. Chlorine and ammonia addition and contact time should be carefully controlled through the AWP process to prevent biofouling on the membranes, while minimizing the formation of NDMA.

4.4 Microfiltration

The primary function of the MF system is to provide adequate pretreatment for sustainable operation of the RO process. The MF also provides the first barrier against protozoa and bacteria, which should be undetectable in the MF product. The pilot testing objectives were to maintain reliable performance, achieving filter run lengths of at least 30 days between chemical cleanings, while meeting water quality goals for turbidity, SDI, protozoa, and bacteria. Several different operating conditions were tested to determine the optimal system performance, including:

- Chemically enhanced backwash frequency
- Source of water supply
- Flux
- Disinfection method

Each of these conditions was tested independently to confirm operation with a minimum 30-day cleaning frequency. The study found that chemically enhanced backwashes were not needed to meet this goal, however, a filter run in excess of 200 days was achieved without a full chemical clean-in-place when chemically enhanced backwashes were employed. Chemically enhanced backwashes were discontinued at the end of the Phase 1 testing to evaluate the impact of other operating conditions on chemical cleaning frequency.

The MF flux was varied from 25 to 48 gallons per square foot per day (gfd). It was found that a maximum 35 gfd flux was required to achieve a minimum 30-day cleaning frequency, when no chemically enhanced backwashes were employed. It was recommended that a flux of 35 gfd be assumed in the planning process for full-scale operation, however, pilot testing should be conducted with alternative membrane filtration systems before recommending maximum operating fluxes for each system.

Two disinfection methods were tested during the study. The first, traditional chloramination, involved adding sodium hypochlorite and ammonium hydroxide at the same process location, immediately upstream of the MF feed tank. This allowed a chloramine residual to prevent biological growth in the MF and RO membranes, while preventing a free chlorine residual, which can damage RO membranes, reducing their ability to remove salts and dissolved organic compounds. The second method, sequential chlorination, added the sodium hypochlorite before the MF, but added the ammonium hydroxide downstream of the MF membranes. A free chlorine residual was maintained within the MF membranes, but was converted to chloramines with the ammonia addition after the MF.

It was anticipated that sequential chlorination would result in improved operation with the MF membranes, while reducing the formation of NDMA. The results, however, did not indicate a significant improvement in MF performance or a reduction in NDMA formation. Significant damage of the RO membranes occurred during the period when sequential chlorination was employed, due to the repeated loss of ammonia feed during evenings, which allowed a free chlorine residual to reach the RO membranes. Sequential chlorination also required a chlorine dose 2.5 times higher than the dose required for traditional chloramination, and resulted in increased formation of trihalomethanes (THMs). Sequential chlorination is not recommended for use in the full-scale facility.

4.5 Reverse Osmosis

The primary function of the RO process is to provide adequate removal of dissolved salts and organic contaminants. The specific operating objectives for the RO system were to:

- Confirm that the water quality produced by the RO system meets the water quality goals, removes constituents of emerging concern (CECs), and is comparable with other operational AWPFs.
- Achieve stable operation with minimal fouling and projected run lengths of at least 6 months between chemical cleanings. To meet this goal, the RO must sustain permeabilities with no more than 5 percent permeability loss per month under optimized operating conditions.
- Determine if a 2-stage or 3-stage RO configuration provides more efficient, reliable performance at an 85 percent hydraulic recovery rate.
- Determine whether operation at a flux greater than 12 gfd provides an advantage or is a detriment to membrane fouling.

- Determine if membranes from any of three selected manufacturers provides improved performance or contaminant removal.

Testing results demonstrated that the RO system effectively met the water quality goals, while removing CECs to non-detectable levels for all but 11 compounds. Removal of these compounds was greater than 98 percent for all but NDMA, which was removed to non-detectable levels by the downstream UV/peroxide process. The testing demonstrated that RO provides an exceptional water quality for GWR.

Stable operation was achieved during Phases 2 and 3, with less than 5 percent permeability decline per month in a two-stage configuration with 85 percent recovery and a flux of 14 gfd. Testing found that the selection of source water had no impact on the RO system. No improvement in performance was seen with 3-stage operation over 2-stage, however, optimization of the 3-stage system using a different antiscalant was not attempted. Higher feed pressures were required for 3-stage operation, making it less desirable, as 2-stage operation was maintained without fouling.

Testing found that fouling in the second stage was higher when operating at 12 gfd compared with 14 gfd. It is believed that the higher fouling rate seen at 12 gfd is related to poor hydraulic conditions in the second stage membranes when operating at 85 percent recovery.

Membranes from three RO manufacturers (Hydranautics, CSM, and Toray) were compared side-by-side to observe their capabilities for performance. Permeabilities, fouling rates, and removal efficiencies for all three membranes were nearly identical, providing three nearly interchangeable membrane alternatives for the future facility. It was recommended that the full-scale facility be designed to incorporate a flux of 14 gfd at 85 percent recovery using any of the three membranes tested.

4.6 Advanced Oxidation Process Results

The primary function of the AOP system is to break down trace organic compounds not completely removed by the RO membranes. Two alternative AOPs were evaluated during pilot testing, including UV/peroxide and ozone/peroxide. The AOP testing had the following, process-specific objectives:

- Evaluate the effectiveness of the UV/peroxide process to destroy trace organic compounds not completely removed by RO, comparing results with existing operational facilities.
- Compare ozone/peroxide with UV/peroxide in terms of effectiveness at destroying NDMA and other CECs, meeting the minimum requirement of 1.2-log NDMA reduction and 0.5-log 1,4-dioxane reduction.

The pilot testing results support the conclusion that UV/peroxide is an effective method for removing trace organic compounds, which are only partially removed by the RO membranes. UV/peroxide was effective at reducing NDMA by greater than 1.2-log units, reducing 1,4-dioxane by greater than 0.5-log, and meeting all regulatory requirements for groundwater recharge.

The pilot testing also demonstrated that ozone/peroxide is promising for the removal of 1,4-dioxane and tris(2-carboxyethyl)phosphine (TCEP), two compounds that are more difficult to oxidize than most other constituents of emerging concern. Removal for 1,4-dioxane, TCEP, and chloramines was significantly better when using ozone/peroxide, when an ozone dose greater than 6 mg/L was employed. A 1.2-log reduction in NDMA, however, was not achieved, even with ozone doses reaching 14 mg/L. The higher NDMA removal achieved with UV/peroxide is the result of direct photolysis from the UV light rather than from oxidation.

The results demonstrated that ozone/peroxide can potentially be used in place of UV/peroxide to meet all regulatory requirements except for the current 1.2-log NDMA reduction requirement. NDMA levels less than the 10 nanograms per liter (ng/L) notification level, however, were achieved by both processes. In the event that the regulations are modified to relax or remove the NDMA log reduction requirement, the use of ozone/peroxide could provide a benefit when compared with UV/peroxide, in terms of lower energy usage and greater removal of CECs. Additional study and testing of ozone/peroxide is required to refine design criteria, such as ozone dose and contact time.

4.7 Product Water Quality

Water quality results from the pilot testing confirmed that all existing and draft drinking water and recycled water regulations can be met using the proposed treatment processes. All of the regulated compounds had average and maximum values in the product water below their regulatory limits, with the vast majority already below regulatory limits in the source water.

In addition to the regulated parameters, all but ten non-regulated pharmaceuticals and personal care products were removed to concentrations below detection levels by the RO process. All but three of these (TCEP, Tris (chloroisopropyl) phosphate (TCPP), and 1,3-Dichloro-2-propanol phosphate (TDCPP)) were removed to below detection levels by the UV/peroxide process, and all but two by the ozone/peroxide.

Overall, the removal of the three remaining personal care products (all flame retardants) was greater than 99 percent, with their concentrations in the final product water averaging less than 5 ng/L. No significant health risks have been suggested for these compounds at these concentrations. TCEP data from imported State Project Water (NWRI, 2010) was found to be higher than the levels measured in either the ozone or UV product during the pilot testing. Measurable concentrations of other CECs, such as carbamazepine, sulfamethoxazole, caffeine, primidone, and gemfibrozil have also been found in imported State Project Water, but were all below detection levels in the DCTWRP AWP product. It is concluded that the advanced water purification processes tested here provided an exception water quality for use in groundwater replenishment.

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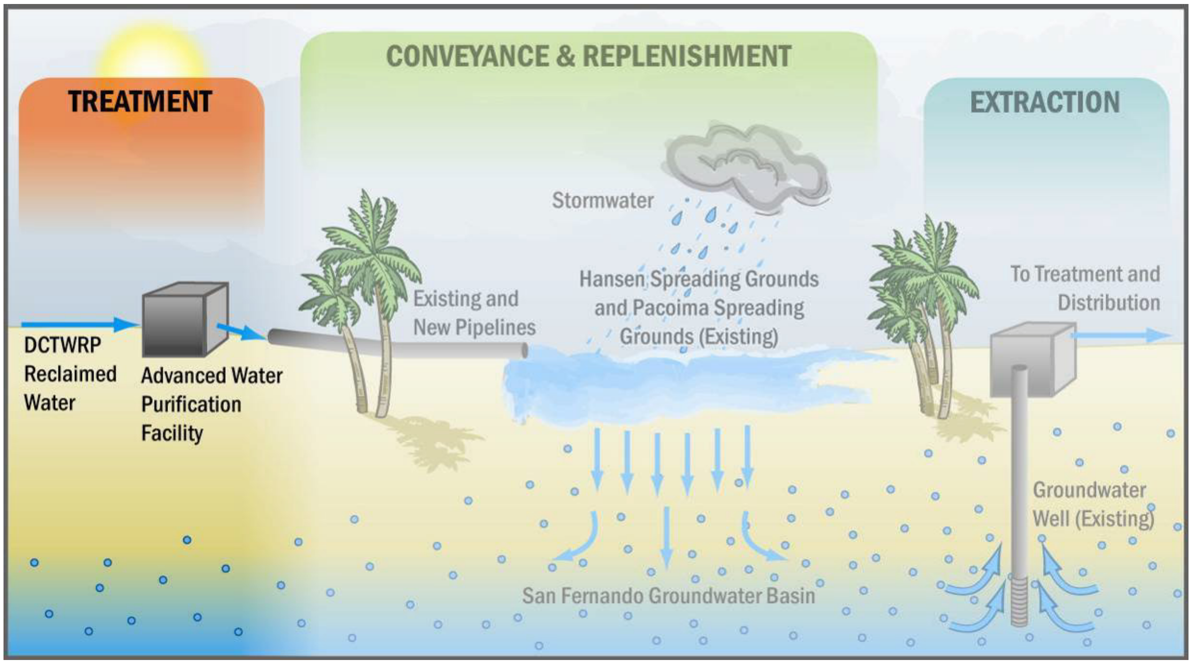
5. Advanced Water Purification Facility

This section will focus on the advanced water treatment processes required to produce purified recycled water for GWR. As shown on **Figure 5-1**, treatment is the first component of GWR. As discussed in Section 3, this GWR Master Planning Report assumes that the AWPF would be located at DCTWRP within the limits of the flood control berm.

Figure 5-1: GWR - Treatment



5.1 Advanced Water Treatment Compliance Requirements

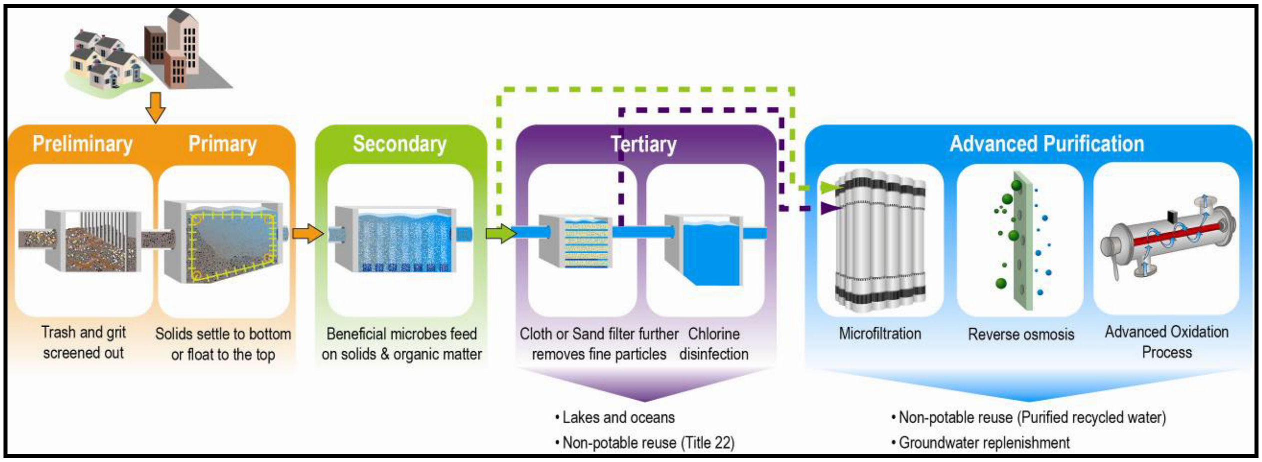
The advanced water treatment requirements include:

- Produce purified recycled water that complies with:
  - The CDPH requirements for GWR projects, including drinking water maximum contaminant levels (MCL), nitrogen limits, and treatment performance; and
  - The Regional Water Quality Control Board (RWQCB) requirements to protect beneficial uses of groundwater, including the Los Angeles Basin Plan water quality objectives and the State Water Resources Control Board's (SWRCB) Recycled Water Policy.
- Effectively remove regulated chemicals; microorganisms; and CECs of wastewater origin of interest to CDPH, including pharmaceuticals, personal care products, and endocrine disrupting compounds. The relevant CECs are summarized in *Draft GWR Treatment Pilot Study Testing Report*.
- Meet water quality requirements or better for indirect reuse by groundwater recharge.

5.2 AWPF Overview

The AWPF processes were selected to meet the advanced water treatment requirements summarized in Section 5.1. The process to produce purified recycled water for GWR begins with reclaimed water (e.g., secondary or tertiary effluent from water reclamation facilities), as shown in **Figure 5-2**.

Figure 5-2: Recycled Water Treatment 101



A series of AWP processes can be applied to designated DCTWRP reclaimed water to produce a potable water quality water supply to replenish the City's groundwater supplies. The AWP processes include MF, RO, and AOP with UV and H_2O_2.

While the required AWPF capacity to achieve 15,000 AFY of GWR in Phase 1 during wet years is 23.4 mgd, the AWPF equipment described in Section 5 are sized for 25.0 mgd capacity in Phase 1, since RO trains are sized in 5.0 mgd capacity units. The AWPF will have 5.0 mgd treatment capacity with one RO train online, 25.0 mgd capacity with five RO trains online (Phase 1), and 35.0 mgd capacity with seven RO trains online (Phase 2).

The AWPF consists of the following treatment components, as shown in **Figure 5-3**:

- MF Feed Pumps
- Pre-treatment Chemical Addition (Chloramination for biofouling control)
- MF Pre-Filters (300 microns)
- MF
- MF/RO Break Tank
- RO Transfer Pumps
- RO Pre-treatment Chemical Addition (Antiscalant and sulfuric acid for scale control)
- Cartridge Filters (5 microns)
- RO Feed Pumps
- RO
- AOP using UV/H_2O_2

- Post-treatment/Stabilization Chemical Addition (pH and LSI adjustment for corrosion control)

Figure 5-3 shows these treatment processes in a process flow diagram. **Figure 5-4** shows the preliminary hydraulic profile of the AWPF. Refer to Section 6 Site Improvements at DCTWRP for the existing DCTWRP site plan (**Figure 6-2)**, DCTWRP preliminary site plan (**Figure 6-4**), AWPF preliminary enlarged site plan (**Figure 6-5**), and AWPF preliminary utility and yard piping plan (**Figure 6-6**).

5.2.1 Proven Advanced Treatment Process Technologies and Equipment Manufacturers

Several advanced treatment process technologies and candidate equipment manufacturers are identified in this GWR Master Planning Report and information provided by the manufacturers forms a part of this evaluation and recommendations. The technologies identified have been previously implemented and equipment manufacturers identified have provided process equipment for other AWPF projects of similar size and complexity. During the detailed design phase of this project, additional equipment manufacturers may be considered based on specifications summarized herein. The minimum qualifications for consideration include:

- Technology and equipment shall have been used for reuse applications for indirect potable reuse (IPR) in the United States, at recycled water treatment facilities of 5.0 mgd capacity or greater; and,
- Technology shall have operating experience and reference plans that been approved by the CDPH.

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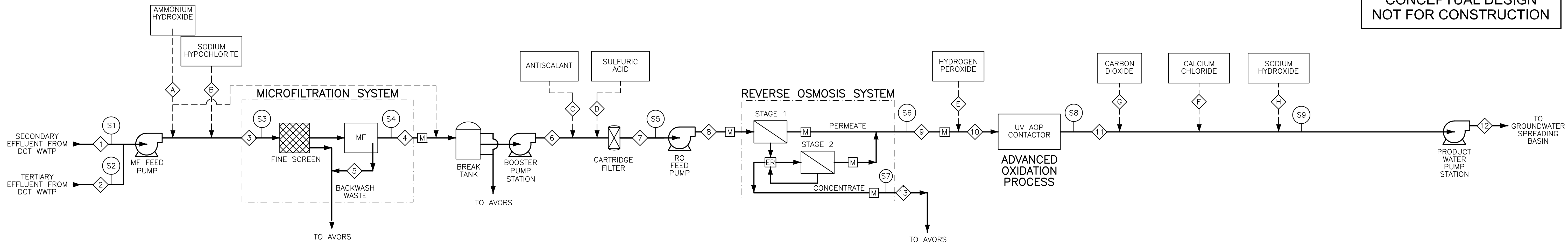


	AWPF INFLUENT	MF FEED	MF PERMEATE	MF BACKWASH WASTE	CARTRIDGE FILTER FEED	CARTRIDGE FILTER PRODUCT	RO FEED	RO PERMEATE	UV / H202 AOP FEED	UV / H202 AOP PRODUCT	PRODUCT WATER	RO CONCENTRATE		AMMONIUM HYDROXIDE	SODIUM HYPOCHLORITE	ANTISCALANT	SULFURIC ACID	HYDROGEN PEROXIDE	CALCIUM CHLORIDE	CARBON DIOXIDE	SODIUM HYDROXIDE
PROCESS STREAM ID	1/2	3	4	5	6	7	8	9	10	11	12	13	CHEMICAL ID	A	B	C	D	E	F	G	H
DESIGN PARAMETERS																					
RECOVERY (%)			93%					85%													
SALT REJECTION (%)								97%													
TOC REJECTION (%)								99%													
CHLORINE REJECTION (%)								10%													
													CHEMICAL DOSE, AVG. (mg/L)	1.3	5.0	4.0	20	5.0	18.5	15.0	18.0
													CHEMICAL DOSE, MIN. (mg/L)	0.8	3.0	2.0	15	1.0	10.0	--	5.0
FLOWS (PHASE 1)																					
DESIGN FLOW (mgd)	31.6	31.6	29.4	2.2	29.4	29.4	29.4	25.0	25.0	25.0	25.0	4.4									
DESIGN FLOW (gpm)	22,000	22,000	20,400	1,600	20,400	20,400	20,400	17,400	17,400	17,400	17,400	3,100									
FLOWS (PHASE 2)																					
DESIGN FLOW (mgd)	44.3	44.3	41.2	3.1	41.2	41.2	41.2	35.0	35.0	35.0	35.0	6.2									
DESIGN FLOW (gpm)	30,700	30,700	28,600	2,100	28,600	28,600	28,600	24,300	24,300	24,300	24,300	4,300									
PRESSURES																					
PRESSURE, AVG. (psi)	5	40	5	GRAVITY	100	80	175	13	13	3.5	125	GRAVITY									
PRESSURE, MAX. (psi)	7	50	5	GRAVITY	125	105	175	13	13	3.5	130	GRAVITY									
CONSTITUENTS																					
pH, AVG.	7.2	7.2	7.3		7.3	7.3	7.1	6.4	6.4	6.3		7.6	pH	11.6	12.0	2 - 4	0.03	3.3	3.8-9	-	14.0
pH, MIN.	6.3	6.3	6.1		6.1	6.1	6.1	5.2	5.4	5.1	8.5	5.5									
pH, MAX.	10.2	10.2	10.3		10.3	10.3	8.9	9.1	8.1	8.4		8.8									
TDS, AVG. (mg/L)	502	502	502		502	502	502	20	20	20	20	3,200									
TDS, MAX. (mg/L)	640	640	640		640	640	640	20	20	20	20	4,200									
TOC, AVG. (mg/L)	9.0	9.0	9.0		9.0	9.0	9.0	0.1	0.1	0.1	0.1	59									
TOC, MAX. (mg/L)	9.8	9.8	9.8		9.8	9.8	9.8	0.1	0.1	0.1	0.1	65									
TOTAL NH3Cl, AVG. (mg/L)	0.4	0.4	0.4		0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.6									
TOTAL NH3Cl, MAX. (mg/L)	1.1	1.1	1.1		1.1	1.1	1.1	1.0	0.9	0.8	0.7	1.7									

SYMBOL LEGEND

S# SAMPLING LOCATION

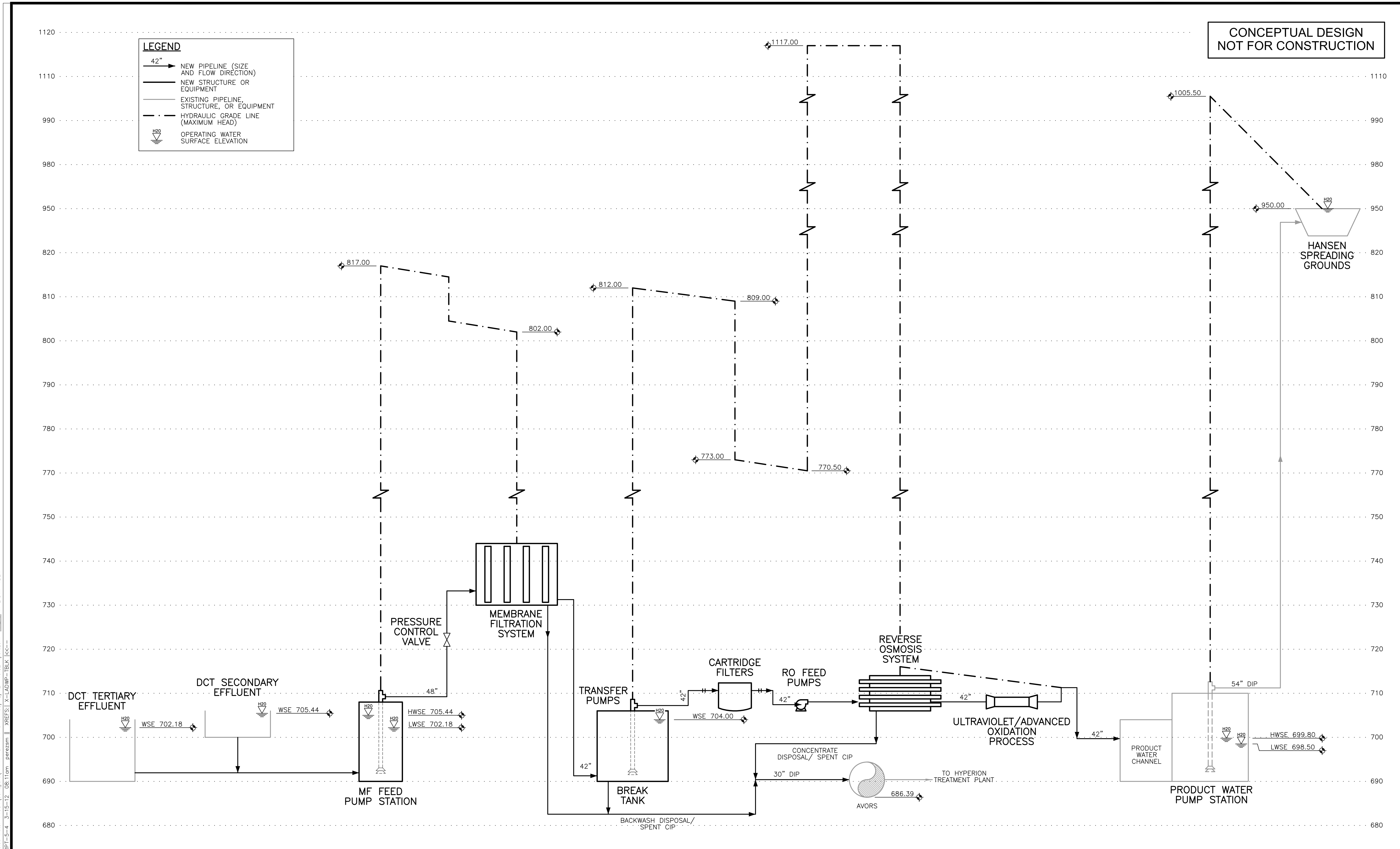
M FLOW METER

2 STREAM ID

B CHEMICAL ID

NOTES

1. BACKWASH SYSTEMS FOR MF AND CIP SYSTEMS FOR MF AND RO ARE NOT SHOWN FOR CLARITY.
2. FLOWS FOR MF SYSTEMS ARE SHOWN AS INSTANTANOUS FLOWS DURING FILTRATION MODES OPERATION (GPM) OR AVERAGE DAILY FLOW RATE (MGD). FLOWS ARE INTERRUPTED FOR BACKWASH, CHEMICAL CLEANING, AND MEMBRANE INTEGRITY TESTING.



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APPROVED: RMC ENGR C____

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PRELIMINARY HYDRAULIC PROFILE

FIG NO	5-4
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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5.3 Process Descriptions and Preliminary Design Criteria

Note that reliability and redundancy for respective system is discussed further in the sub-sections below.

5.3.1 AWPF Influent (MF Feed Pump Station) Wet well

As discussed in Section 3.7, the AWPF will be provided with flexibility to use either the secondary or tertiary effluent from DCTWRP for the AWPF influent. Therefore, separate feed connections will be made at the following four existing locations:

- Phase I secondary effluent channel,
- Phase II secondary effluent channel,
- Phase I tertiary effluent channel, and
- Phase II tertiary effluent channel.

The above configuration will allow the operator to select from any one or two of the four connection points for the AWPF influent source.

A buried, concrete wet well structure will be located between the Phase I and II tertiary filters at the existing DCTWRP Chlorination Building/Loading Dock, as shown on **Figures 5-4 and 5-5**, to serve as a central collection point for AWPF influent source waters and AWPF Influent (MF Feed) Pump Station. This location is recommended to minimize piping/utility conflicts and maximize operational flexibility. The DCTWRP as-built drawings showed that the layout and water surface elevations of Phase I secondary clarifiers are identical to Phase II secondary clarifiers, and Phase I tertiary filters identical to Phase II tertiary filters, which make it difficult to tap the outlet of each process unit and flow by gravity westward to the AWPF.

The MF feed pump station wet well will have two influent pipes, one pipe from secondary effluent channels and one pipe from the tertiary effluent channels, as shown on **Figure 6-6**. Power-actuated gates, with actuators for local-remote raising and lowering of gates, will be provided at each of the four connection points to control the specific feed source for the AWPF influent. The AWPF influent will be drawn from either the secondary effluent channel(s) or the tertiary effluent channel(s) at any one time. The mixing of secondary and tertiary effluent sources is not recommended due to potential complications with DCTWRP permit and plant hydraulics. Depending on the AWPF operating conditions, up to two secondary effluent gates will be opened while the tertiary effluent gates are closed/isolated. Conversely, up to two tertiary effluent gates can be opened while the secondary effluent gates are isolated. The secondary or tertiary effluent will flow by gravity via new pipelines into the MF feed pump station wet well. The water surface elevation (WSE) within the wet well will “float” with the WSE at the respective secondary or tertiary connection points maintaining the same WSEs.

5.3.2 MF Feed Pump Station

The MF feed pumps will pump the AWPF influent water from the MF feed pump station wet well to the MF system in the MF/RO Building. **Table 5-1** presents the design criteria for the MF Feed Pumps.

Table 5-1: MF Feed Pumps Design Criteria

Parameter	Phase 1	Phase 2
MF Feed Flow, Design	22,000 gpm = 31.6 mgd	30,750 gpm = 44.3 mgd
MF Feed Flow, Minimum	4,390 gpm = 6.3 mgd	4,390 gpm = 6.3 mgd
Pump Type	Vertical Turbine	Vertical Turbine
No. of Pumps	3 Duty, 1 Standby	4 Duty, 1 Standby
Capacity, each	7,690 gpm	7,690 gpm
TDH, each	50 psi	50 psi
Motor Size, each	300 hp	300 hp
Pump Efficiency	±80%	±80%
VFD	Yes	Yes
At Design Flow, Operate:	3 Pumps at 95% Capacity	4 Pumps at 100% Capacity
At Minimum Flow, Operate:	1 Pump at 57% Capacity	1 Pump at 57% Capacity

A total of five multi-stage vertical turbine pumps (four duty and one standby) will be used to supply the AWPF influent for Phase 2. The MF feed pump station wet well will be designed to accommodate all five pumps. The high efficiency (approximately 80 percent) of the pumps and relatively steep pump curve allows for smaller changes in flow relative to a change in system pressure. Considering Phase 2 design conditions, each pump will be rated for a flow rate of 7,690 gpm at a total dynamic head (TDH) of approximately 50 psi. The TDH is dependent on the maximum WSE in the MF/RO break tank, losses through the MF system, and amount of yard piping and fittings required. Piping to the MF/RO building is assumed to be underground; however, should further investigation during pre-design determine that the alignment is too congested; above-grade piping may be considered. When the AWPF piping configuration is finalized during detailed design, the pump sizing will need to be reviewed and refined. The MF feed pumps will be equipped with variable frequency drives (VFDs) to address variable flow conditions. **Figure 5-5** shows the MF feed pump station layout.

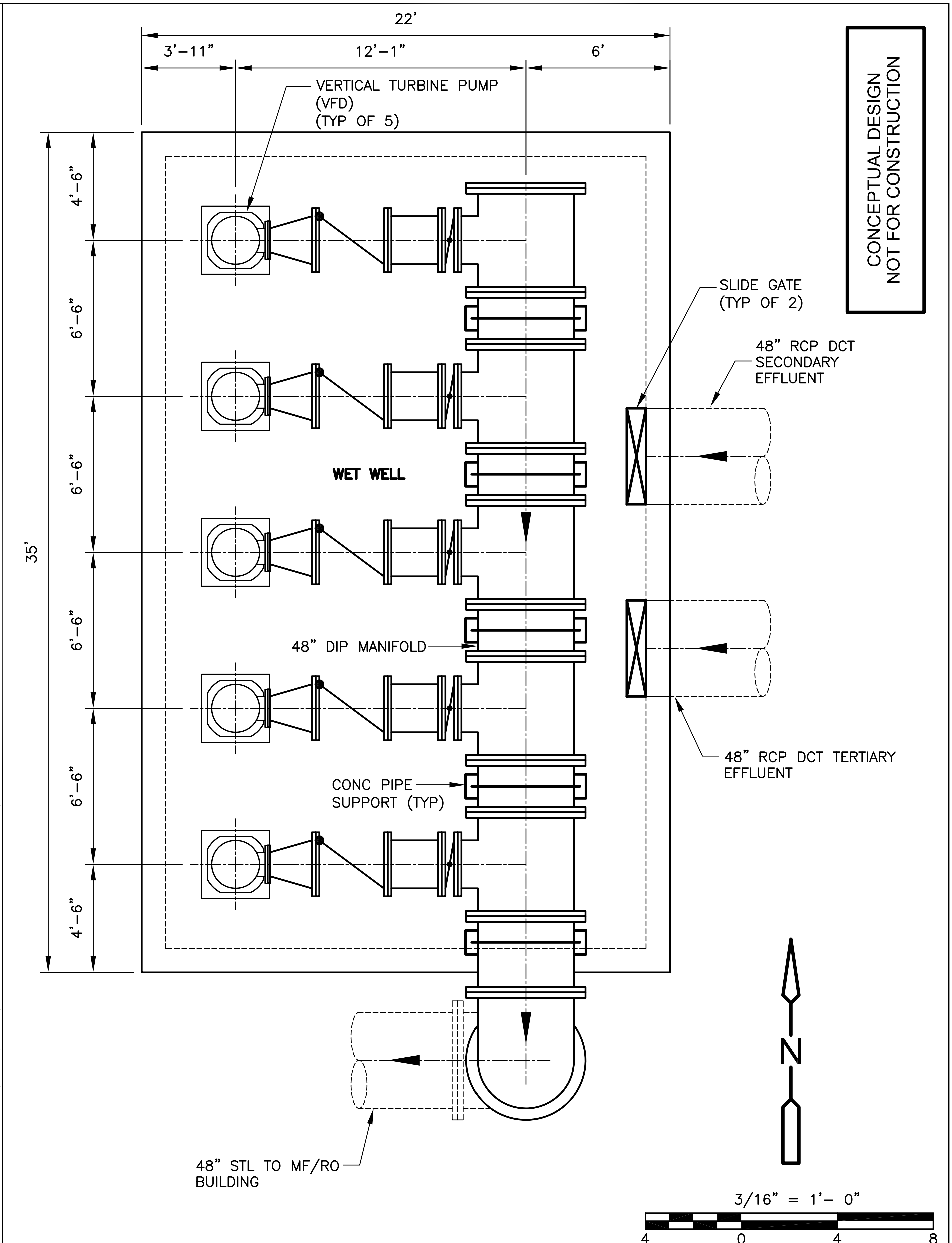

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FIGURE 5-5
MF FEED PUMP
PRELIMINARY STATION LAYOUT

5.3.3 Pre-treatment Chemical Addition

Ammonium hydroxide and sodium hypochlorite will be added downstream of the MF feed pumps and upstream of the MF pre-filters for chloramination to control the biological fouling of the MF membranes. The target combined chlorine concentration (chloramines) is 3 to 5 mg/L. The chemicals will be flow paced based on the MF feed flow rate and trimmed based on combined chlorine concentration. **Table 5-2** summarizes the chemical dose requirements for ammonium hydroxide and sodium hypochlorite. The design criteria for these chemical systems are described in detail in Section 5.3.13.

Table 5-2: Ammonium Hydroxide and Sodium Hypochlorite Doses

Parameter	Phase 1	Phase 2
MF Feed Flow, Design	22,000 gpm = 31.6 mgd	30,750 gpm = 44.3 mgd
MF Feed Flow, Minimum	4,390 gpm = 6.3 mgd	4,390 gpm = 6.3 mgd
Ammonium Hydroxide Doses		
Design	1.3 mg/L	1.3 mg/L
Minimum	0.8 mg/L	0.8 mg/L
Sodium Hypochlorite Doses		
Design	5.0 mg/L	5.0 mg/L
Minimum	3.0 mg/L	3.0 mg/L

5.3.4 Microfiltration

The MF system provides pretreatment for RO system to reduce the particulate and biological fouling of the RO membranes. The MF 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 5-3** presents the MF filtrate water quality goals.

Table 5-3: MF Filtrate Water Quality Goals

Constituent	Design Criteria
Cryptosporidium	Undetectable[1]
Giardia	Undetectable[2]
Suspended Solids	Undetectable[3]
95^{th} Percentile Filtrate Turbidity	< 0.1 NTU
Filtrate Silt Density Index (SDI)	< 3

Note:
1) EPA Method 1623. Method detection limit for *Cryptosporidium* is 1 Oocysts/100L, so the MF water quality goal is zero Oocysts/100L.
2) EPA Method 1623. Method detection limit for *Giardia* is 1 Cysts/100L, so the MF water quality goal is zero Cysts/100L.
3) EPA Method 160.2. Method detection limit is 1.0 mg/L, so the goal is to be < 1.0 mg/L.

MF Pre-Filters

The MF pre-filters or strainers will be provided immediately upstream of the MF membranes to protect the MF membranes from damage and/or fouling due to larger particles. The MF pre-filters will be provided by the membrane manufacturers as part of a complete MF system package. **Table 5-4** presents the design criteria for the MF pre-filters.

Table 5-4: MF Pre-Filters Design Criteria

Parameter	Phase 1	Phase 2
MF Feed Flow, Design	22,000 gpm = 31.6 mgd	30,750 gpm = 44.3 mgd
MF Feed Flow, Minimum	4,390 gpm = 6.3 mgd	4,390 gpm = 6.3 mgd
Type	Auto-Backwash Strainer	Auto-Backwash Strainer
Filter Vessels		
No. of Units	5 Duty, 1 Standby	7 Duty, 1 Standby
Strainer Recovery, Minimum	98%	98%
Design Flow, each	5,000 gpm	5,000 gpm
Vessel Material	316 SS	316 SS
Filter Screen		
Screen Pore Size, Minimum	300 microns	300 microns
Clean Strainer Headloss, Maximum	1.0 psi	1.0 psi
Dirty Strainer Headloss, Maximum	10.0 psi	10.0 psi
Screen Material	316 SS	316 SS
Manufacturer, Model [1]	Eaton Model 2596, or equal	Eaton Model 2596, or equal
Under Normal Operating Conditions (At Any Flow), Operate:	6 (All Available Units)	8 (All Available Units)
During Maintenance Conditions (At Any Flow), Operate:	5 (With 1 Unit Down for Maintenance)	7 (With 1 Unit Down for Maintenance)

Notes:
1) As noted in Section 5.2.1, additional manufacturers meeting qualifications will be considered during detailed design.

Pressure MF System vs. Submerged MF System

The MF system will be a pressure system. Submerged MF systems were not considered because they require one more pumping system than the pressure MF system. For a submerged MF system, a pumping system would be required to pump the MF feed water from the MF feed pump station to the submerged membrane tanks (because the water levels in the secondary and tertiary effluent channels would be lower than the water levels in the submerged membrane tanks, if the submerged membrane tanks were to be installed at grade). A second pumping system would be required to pump the MF permeate from the submerged membrane tanks to the MF/RO break tank. For a pressure MF system, one pumping system pumps the process water from the MF feed pump station through the MF pre-filters and the MF system without breaking head to the MF/RO break tank.

Candidate MF System Vendors

There are several MF vendors who meet the requirements in Section 5.2.1. For this GWR Master Planning Report, information from two vendors are presented: Pall and Siemens. Pall was tested as part of the GWR Treatment Pilot Study and Siemens was selected as it was used at local AWPFs, such as West Basin WRF and TIWRP. The vendors are summarized in **Table 5-5**.

Table 5-5: Pressure MF System Candidate Vendors

Parameter	Pall	Siemens
Membrane Model	Microza	Memcor CP-L20V
Membrane Classification	MF	MF
Nominal Pore Size	0.10	0.04
Material	PVDF	PVDF
Membrane Area per Module	538 sf/module	410 sf/module
Flow Direction	Outside-In	Outside-In
Pilot Study Required	No [1]	Yes

Note:
1) Pall MF system was used for the GWR treatment pilot study conducted from February 2010 to June 2011.
2) As noted in Section 5.2.1, additional manufacturers meeting qualifications will be considered during detailed design.

Since the Pall MF system has been pilot tested at DCTWRP, acceptable design flux for the Pall MF system is known. Additional pilot testing of multiple vendors side-by-side prior to the detailed design is recommended to establish the acceptable design flux requirements for other MF systems meeting qualifications. **Table 5-6** presents the design criteria for the Pall MF system based on the recent pilot testing.

Table 5-6: Pall MF System Design Criteria

Parameter	Phase 1	Phase 2
MF Feed Flow, Design	22,000 gpm = 31.6 mgd	30,750 gpm = 44.3 mgd
MF Feed Flow, Minimum	4,390 gpm = 6.3 mgd	4,390 gpm = 6.3 mgd
Configuration		
No. of Skids	15	21
Redundancy	N + 1	N + 1
Total Membrane Area Required	951,150 sf	1,331,600 sf
Total No. of Membrane Modules Required	1,770 modules	2,480 modules
No. of Membrane Modules Per Train	120 modules/skid	120 modules/skid
Membrane Area Per Train	64,560 sf/skid	64,560 sf/skid
Operating conditions		
MF Recovery, Minimum	95%	95%
Filtration		
Instantaneous Flux, Maximum	35 gfd	35 gfd
Average Flux, Maximum	33 gfd	33 gfd
Cleaning		
Backwash Frequency	25 to 30 minutes	25 to 30 minutes
Maintenance Clean Frequency, Minimum	1 day	1 day
CIP Frequency, Minimum	30 days	30 days
CIP Duration, Typical	4-6 hours	4-6 hours
At Design Flow, Operate:	14 to 16 skids @ 29 to 33 gfd	20 to 22 skids @ 29 to 33 gfd
At Minimum Flow, Operate:	3 to 5 skids @ 18 to 30 gfd	3 to 5 skids @ 18 to 30 gfd

Figures 5-6 and **5-7** show the Pall MF system layout and Siemens MF system layout, respectively. Siemens MF system layout shows more membranes, which is based on a more conservative design flux than the flux used in the Pall MF system since Siemens membranes have not been pilot-tested to verify performance with DCTWRP effluent water and optimize design. After the vendor prequalification and equipment pre-selection, the size of the MF/RO building will need to be adjusted to accommodate the pre-selected MF vendor.

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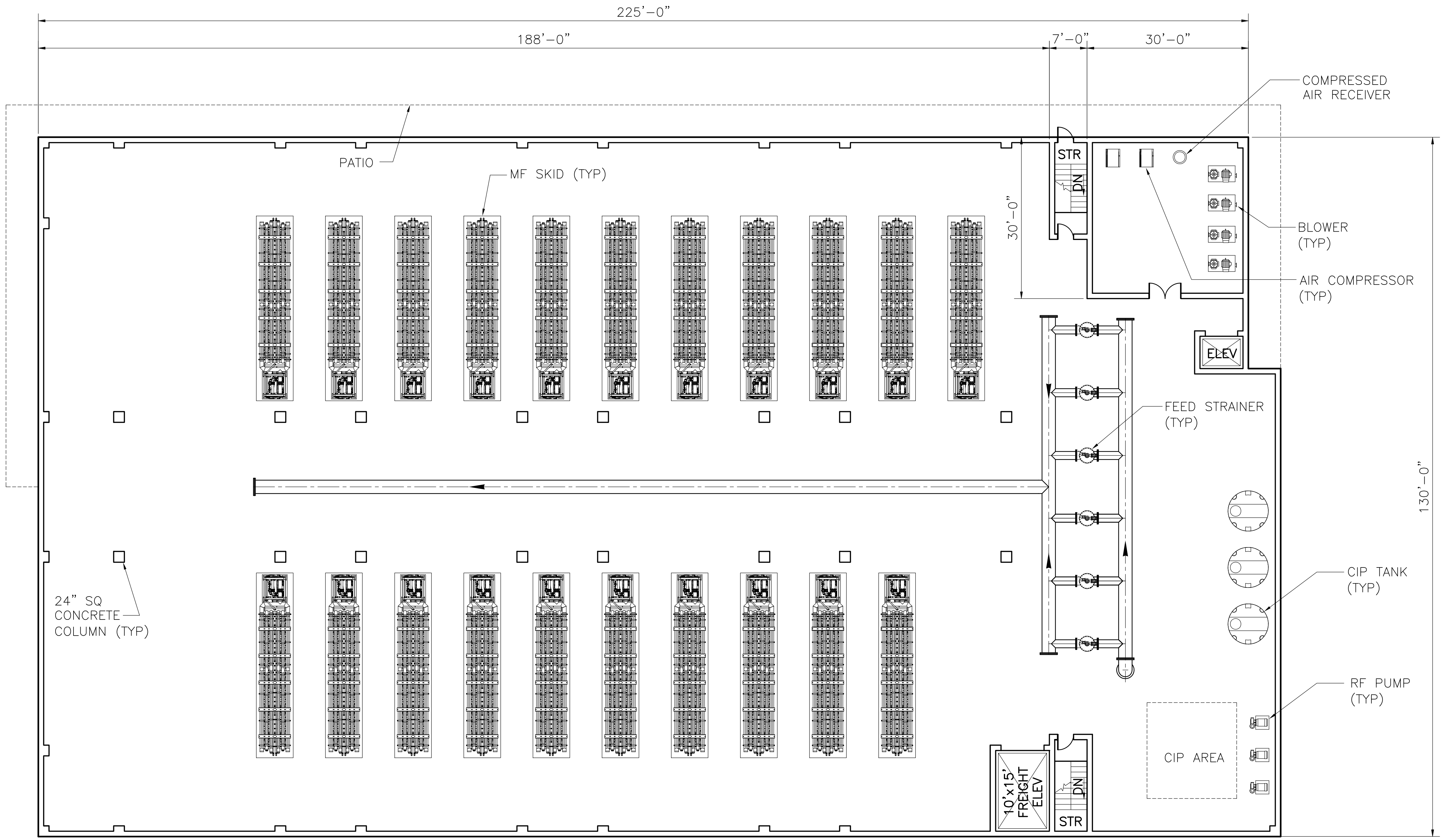

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APPROVED: RMC ENGR C

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MF SYSTEM PRELIMINARY LAYOUT (PALL)

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PROJ NO	86538-71984
DATE	MARCH 2012

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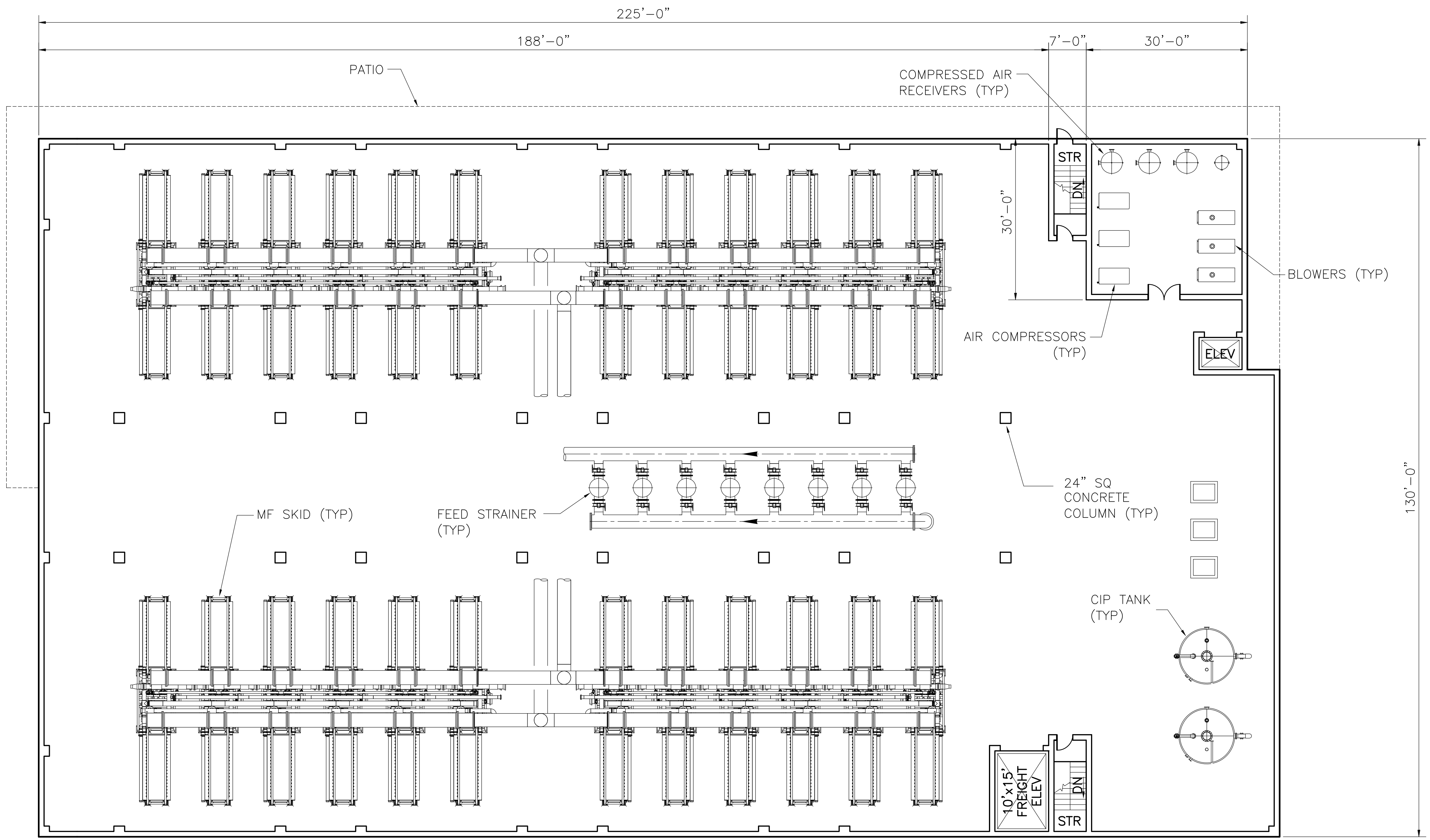

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MF SYSTEM PRELIMINARY LAYOUT (SIEMENS)

FIG NO	5-7
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PROJ NO	86538-71984
DATE	MARCH 2012

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5.3.5 MF/RO Break Tank

The MF/RO break tank will serve as a flow equalization reservoir for MF filtrate prior to being pumped to the RO system. The MF filtrate will be conveyed to the MF/RO break tank with residual pressure from the MF system. The MF/RO break tank will mitigate the impact of variations (resulting from backwashes, cleaning, and integrity tests) in MF filtrate flow, by providing equalization volume equivalent to approximately 25 minutes of the maximum RO feed flow between the MF and RO processes. The MF filtrate flow varies due to MF backwashes (occur every 25 to 30 minutes for each unit), daily maintenance cleans, and daily membrane integrity tests.

The MF/RO break tank will be designed and constructed for Phase 2 capacity. The MF/RO break tank will be a covered concrete structure installed below grade, and will include a middle dividing wall that splits the tank into two cells for redundancy, should one cell require maintenance. Under normal operation, both cells would be used to achieve the minimum residence time. The RO transfer pumps and RO cartridge filters will be installed on the roof of the MF/RO break tank. **Figures 6-4 and 6-5** show the location of the break tank. **Table 5-7** presents the MF/RO break tank design criteria.

Table 5-7: MF/RO Break Tank Design Criteria

Parameter	Phase 1	Phase 2
RO Feed Flow, Design	20,430 gpm = 29.4 mgd	28,600 gpm = 41.2 mgd
RO Feed Flow, Minimum	4,090 gpm = 5.9 mgd	4,090 gpm = 5.9 mgd
No. of Tanks	2 Duty, 0 Standby (Design for Phase 2)	
Residence Time [1]	35 minutes	25 minutes
Volume Required, Total	715,000 gal	
Height, Total	16.0 ft	
Width, Total	83.0 ft	
Length, Total	83.0 ft	
Length, Each	41.5 ft	

Notes:

1) Due to the lower design flow rate during the Phase 1, the actual residence time provided is up to 35 minutes.

5.3.6 RO Transfer Pumps

The RO transfer pumps will pump MF filtrate from the MF/RO break tank through the RO cartridge filters and subsequently to the RO. **Table 5-8** presents the design criteria for the RO transfer pumps.

Table 5-8: RO Transfer Pumps Design Criteria

Parameter	Phase 1	Phase 2
RO Feed Flow, Design	20,430 gpm = 29.4 mgd	28,600 gpm= 41.2 mgd
RO Feed Flow, Minimum	4,090 gpm = 5.9 mgd	4,090 gpm = 5.9 mgd
Pump Type	Vertical Turbine	Vertical Turbine
No. of Pumps	5 Duty, 1 Standby	7 Duty, 1 Standby
Capacity, each	4,090 gpm	4,090 gpm
TDH, each	50 psi	50 psi
Motor Size	200 hp	200 hp
Pump Efficiency	±80%	±80%
VFD	Yes	Yes
At Design Flow, Operate:	5 Pumps at 100% Capacity	7 Pumps at 100% Capacity
At Minimum Flow, Operate:	1 Pump at 100% Capacity	1 Pump at 100% Capacity

A total of eight multi-stage vertical turbine pumps (seven duty and one standby) will be used to supply adequate pressure upstream of the RO system for Phase 2. A minimum of one pump will be operating to deliver the minimum RO feed flow of 4,090 gpm to operate one RO train. Considering both hydraulic and site constraints, vertical turbine pumps are more advantageous when compared to centrifugal pumps. The high efficiency (approximately 80 percent) of the pumps and relatively steep pump curve allows for smaller changes in flow relative to a change in system pressure.

The pumps will be installed on the roof of the MF/RO break tank, utilizing the break tank as a wet well to maximize use of site space. One cell of the break tank will serve three pumps, while the other cell will serve four. The RO transfer pumps will provide some residual pressure in the RO suction header while conveying flows well within the maximum operating pressure of the cartridge filters, which are rated at approximately 150 psi. Considering Phase 2 design conditions, each RO transfer pump will be rated for 4,090 gpm at approximately 50 psi of TDH. The RO transfer pumps will be equipped with VFDs to address variations in flow.

5.3.7 RO Cartridge Filters

The RO cartridge filters, located upstream of the RO, help protect the RO membranes from particulates that may be introduced in the MF/RO break tank or through chemical addition. **Table 5-9** presents the design criteria for the RO cartridge filters.

Table 5-9: RO Cartridge Filters Design Criteria

Parameter	Phase 1	Phase 2
RO Feed Flow, Design	20,430 gpm = 29.4 mgd	28,600 gpm = 41.2 mgd
RO Feed Flow, Minimum	4,090 gpm = 5.9 mgd	4,090 gpm = 5.9 mgd
Cartridge Filter Vessels		
No. of Vessels	10 Duty, 1 Standby	14 Duty, 1 Standby
Flow per Vessel	2,100 gpm	2,100 gpm
Filtration Rate, Maximum	12.0 gpm/40 inch	12.0 gpm/40 inch
Housing Material	316 SS	316 SS
Pressure Rating	150 psi	150 psi
Cartridges		
Number per Vessel	176	176
Nominal Pore Size	5 microns	5 microns
Material	Polypropylene	Polypropylene
Manufacturer, Model [1]	Parker Fulflo MP, or equal	Parker Fulflo MP, or equal
Under Normal Operating Conditions (At Any Flow), Operate:	11 (All Available Units)	15 (All Available Units)
During Maintenance Conditions (At Any Flow), Operate:	10 (With 1 Unit Down for Maintenance)	14 (With 1 Unit Down for Maintenance)

Notes:
1) As noted in Section 5.2.1, additional manufacturers meeting qualifications will be considered during detailed design.

A total of 15 horizontal cartridge filter vessels (14 duty and one standby) will be provided for Phase 2. The cartridge filters have the capacity to filter 2,100 gpm each and will provide a total peak design flow of 41.2 mgd with 14 filters in operation and one filter in standby. All 15 cartridge filters will be operated under normal conditions. Each cartridge filter will be provided with isolation valves upstream and downstream of the filter vessel to allow each vessel to be isolated and the filters replaced while the remaining filter vessels remain online.

5.3.8 RO Feed Pumps

Each RO train will be paired with a dedicated feed pump. Note that these pumps are required in addition to the RO transfer pumps as the pressure needed to feed RO is greater than the typical rated pressure of the cartridge filter vessels. **Table 5-10** presents the design criteria for the RO feed pumps.

Table 5-10: RO Feed Pumps Design Criteria

Parameter	Phase 1	Phase 2
RO Feed Flow, Design	20,430 gpm = 29.4 mgd	28,600 gpm m= 41.2 mgd
RO Feed Flow, Minimum	4,090 gpm = 5.9 mgd	4,090 gpm = 5.9 mgd
Pump Type	Vertical Turbine	Vertical Turbine
No. of Pumps	5 Duty, 1 Standby	7 Duty, 1 Standby
Capacity, each	4,090 gpm	4,090 gpm
TDH, each	150 psi	150 psi
Motor Size	500 hp	500 hp
Pump Efficiency	±80%	±80%
VFD	Yes	Yes
At Design Flow, Operate:	5 Pumps at 100% Capacity	7 Pumps at 100% Capacity
At Minimum Flow, Operate:	1 Pump at 100% Capacity	1 Pump at 100% Capacity

The required RO feed pump pressure is a function of the incoming pressure from the RO transfer pumps, the headloss in the cartridge filters upstream and associated piping, and the required feed pressure into the RO system. At the design flow rate, the residual pressure in the RO suction header is expected to be approximately 25 psi. Therefore, to provide the required RO feed pressure of 175 psi for each RO train, the RO feed pumps discharge pressure would need to be approximately 150 psi. Therefore, the design pump flow rate will be equal to the RO train design feed flow of approximately 4,090 gpm (at 85 percent recovery) at an approximate TDH of 150 psi.

The required discharge pressure for the RO feed pumps will vary as the RO operating pressure changes due to water quality changes and RO membrane fouling. Therefore, the VFDs will be used for the RO feed pumps to adjust to varying pressure requirements. The rated design point for the pumps will be selected from within this range such that the pumps will operate near best efficiency for the most common operating conditions.

Vertical turbine lineshaft can pumps are commonly used for RO feed service. The high efficiency (approximately 80 percent) of the pumps and relatively steep pump curve allows for smaller changes in flow relative to a change in system pressure. To maximize efficiency, the pumps will be equipped with VFDs. Pump materials will be suitable for low pH RO feed water service, with major components being 316L SS or similar grade of stainless steel.

5.3.9 Reverse Osmosis

While RO is used for purification and desalination in water treatment, it also has an extensive history of being effectively utilized in wastewater treatment processes for removal of a wide array of dissolved constituents, including CECs that are not removed through a tertiary filtration process. RO has proven to be effective at removing the refractory organics and volatile organic fractions of dissolved organic constituents. It can also remove some complex organic constituents such as taste and odor causing compounds. RO is generally recognized as the best available treatment for reducing the total dissolved solids (TDS) and many CECs in wastewater effluent intended for GWR. The relevant CECs and effectiveness of RO at CECs removal are summarized in *Draft GWR Treatment Pilot Study Testing Report*.

8-inch RO vs. 16-inch RO

For the RO system, both 8-inch and 16-inch elements are under consideration. Larger diameter elements are often recommended for their space-saving capabilities. The main criteria when making this decision are floor space and vertical height limitations, lifting requirements for loading and unloading of RO elements, pressure vessel and piping considerations, and long-term performance history. **Table 5-11** compares the membrane parameters for the 8-inch and 16-inch RO elements. The decision to use 8-inch or 16-inch elements will be made during pre-design.

Table 5-11: Comparison of 8-inch and 16-inch RO Elements

Parameter	8-Inch RO Element	16-Inch RO Element
Material	Composite Polyamide	Composite Polyamide
Configuration	Spiral Wound	Spiral Wound
Type	High Rejection, Low Fouling	High Rejection, Low Fouling
Element Size Diameter	8 inch	16 inch
Membrane Area Per Element	400 sf	1600 sf
Manufacturer, Model	Hydranautics, ESPA2	Hydranautics ESPA2 1640
Manufacturer, Model	CSM RE8040 FEn	CSM RE16040 FEn
Manufacturer, Model	Toray TML20-400	Toray TML20-1600
Benefits	Does not require special machinery for membrane loading/unloading.	Typically requires fewer numbers of membrane elements, pressure vessels, valves and piping. Could save overall footprint and equipment/material costs for large capacity plants.

Notes:

1) As noted in Section 5.2.1, additional manufacturers meeting qualifications will be considered during detailed design.

RO Configuration

The RO system will feature a two-stage configuration with energy recovery, based on the GWR treatment pilot study results (see *Draft GWR Treatment Pilot Study Testing Report*), which showed that a three-stage configuration provided no improvement in performance over a two-stage configuration. The optimal RO design flux of 14.0 gfd was also recommended based on the GWR treatment pilot study results. A 14.0 gfd flux rate will provide a lower capital cost than the common 12.0 gfd flux rate, as fewer membranes, pressure vessels, RO trains, etc. will be required. Operating at the 14.0 gfd flux also reduces the TDS in the permeate, but this must be balanced with potential membrane fouling and energy costs. Flux rates elevated above the recommended 14.0 gfd flux could result in higher concentrations of TSS and TDS at the membrane face, which may cause the membranes to foul more rapidly. This could increase the frequency of chemical cleaning, increase cleaning chemical consumption and system down time, and decrease membrane life.

Tables 5-12 and 5-13 present the design criteria for the 8-inch RO system and 16-inch RO system, respectively. The design criteria are developed based on the RO design flux of 14.0 gfd recommended based on the GWR treatment pilot study results.

Table 5-12: 8-inch RO System Design Criteria

Parameter	Phase 1	Phase 2
RO Permeate Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
RO Permeate Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
No. of Trains	5 Duty, 1 Standby	7 Duty, 1 Standby
Capacity per Train	5.0 mgd	5.0 mgd
RO Train Configuration		
No. of Stages	2	2
Stage 1		
No. of Vessels	84	84
Elements per Vessel	7	7
Stage 2		
No. of Vessels	42	42
Elements per Vessel	7	7
Total No. of Elements per Train	882	882
Total No. of Vessels per Train	126	126
Energy Recovery		
Manufacturer	Pump Engineering Inc. (PEI)	PEI
Type	Turbocharger	Turbocharger
Operating Condition		
Overall Flux, Maximum	14.0 gfd	14.0 gfd
Maximum Permeate Headloss	5.0 psi	5.0 psi
Cleaning Frequency		
CIP Interval, Minimum	6 months	6 months
CIP Duration, Typical	4 hours	4 hours
At Design Flow, Operate:	5 trains@ 14 gfd, or 6 trains @ 12 gfd	7 trains@ 14 gfd, or 8 trains @ 12 gfd
At Minimum Flow, Operate:	1 train @ 14 gfd	1 train @ 14 gfd

Notes:

1) Additional manufacturers meeting qualifications listed in Section 5.2.1 will be considered during detailed design.

Table 5-13: 16-inch RO System Design Criteria

Parameter	Phase 1	Phase 2
RO Permeate Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
RO Permeate Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
No. of Trains	5 Duty, 1 Standby	7 Duty, 1 Standby
Capacity per Train	5.0 mgd	5.0 mgd
RO Train Configuration		
No. of Stages	2	2
Stage 1		
No. of Vessels	20	20
Elements per Vessel	7	7
Stage 2		
No. of Vessels	12	12
Elements per Vessel	7	7
Total No. of Elements per Train	224	224
Total No. of Vessels per Train	32	32
Energy Recovery		
Manufacturer [1]	PEI	PEI
Type	Turbocharger	Turbocharger
Operating Condition		
Overall Flux, Maximum	14.0 gfd	14.0 gfd
Maximum Permeate Headloss	5.0 psi	5.0 psi
Cleaning Frequency		
CIP Interval, Minimum	6 months	6 months
CIP Duration, Typical	4-6 hours	4-6 hours
At Design Flow, Operate:	5 trains@ 14 gfd, or 6 trains @ 12 gfd	7 trains@ 14 gfd, or 8 trains @ 12 gfd
At Minimum Flow, Operate:	1 train @ 14 gfd	1 train @ 14 gfd

Notes:
1) Additional manufacturers meeting qualifications listed in Section 5.2.1 will be considered during detailed design.

Figures 5-8 and 5-9 show the 8-inch RO system layout and the 16-inch system layout, respectively.

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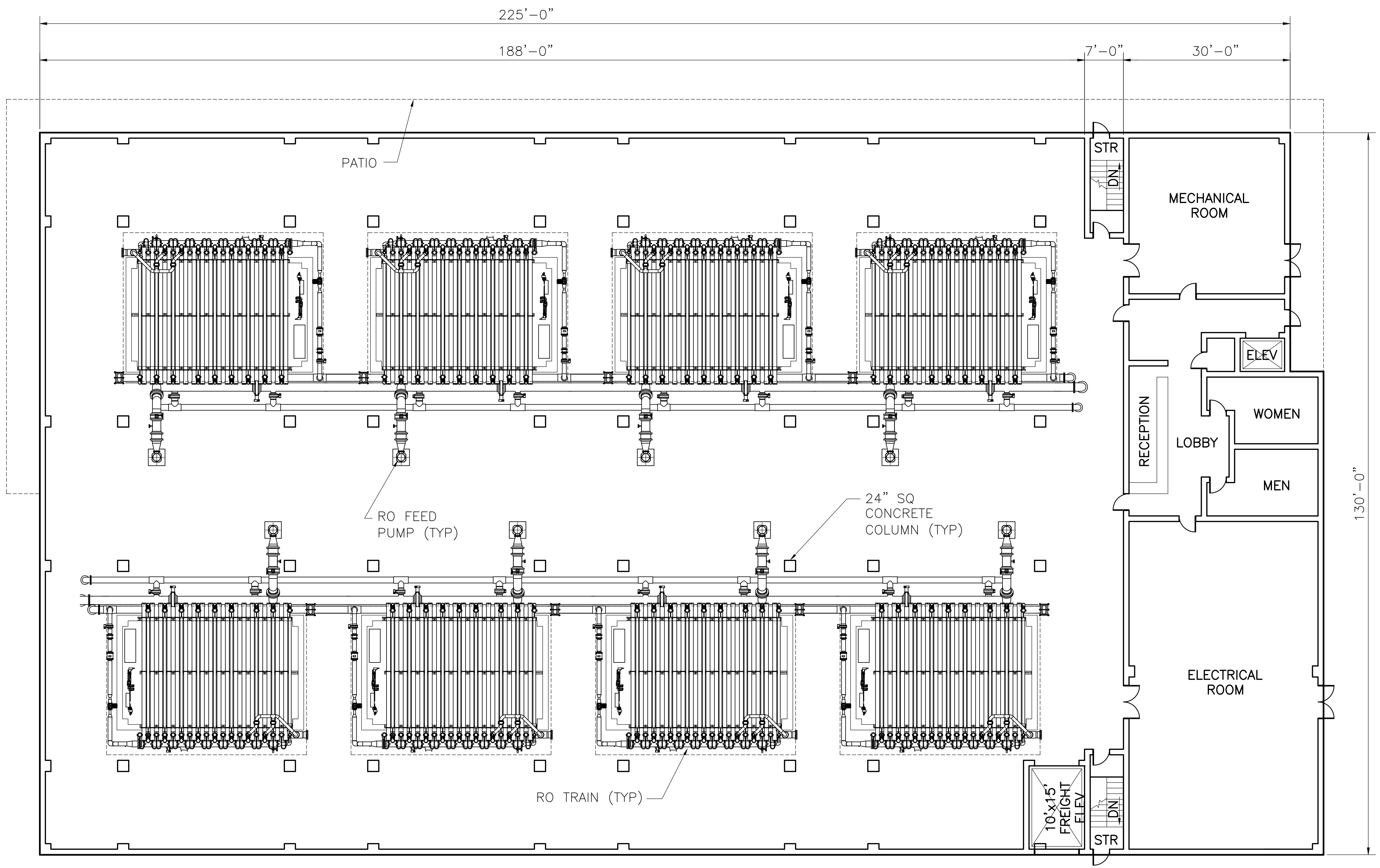

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3/32" = 1'– 0"
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VERIFY SCALES
BAR IS ONE INCH LONG ON FULL SIZE DRAWING. IF NOT ONE INCH LONG ON THIS DRAWING, ADJUST SCALES ACCORDINGLY

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REV	DATE	BY	APVD	DESCRIPTION

DESIGNED	AG
DRAWN	CEB
CHECKED	ECY

SUBMITTED: RMC PROJ ENGR C
APPROVED: RMC ENGR C

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RO SYSTEM PRELIMINARY LAYOUT
(8- INCH ELEMENTS)

FIG NO	5-8
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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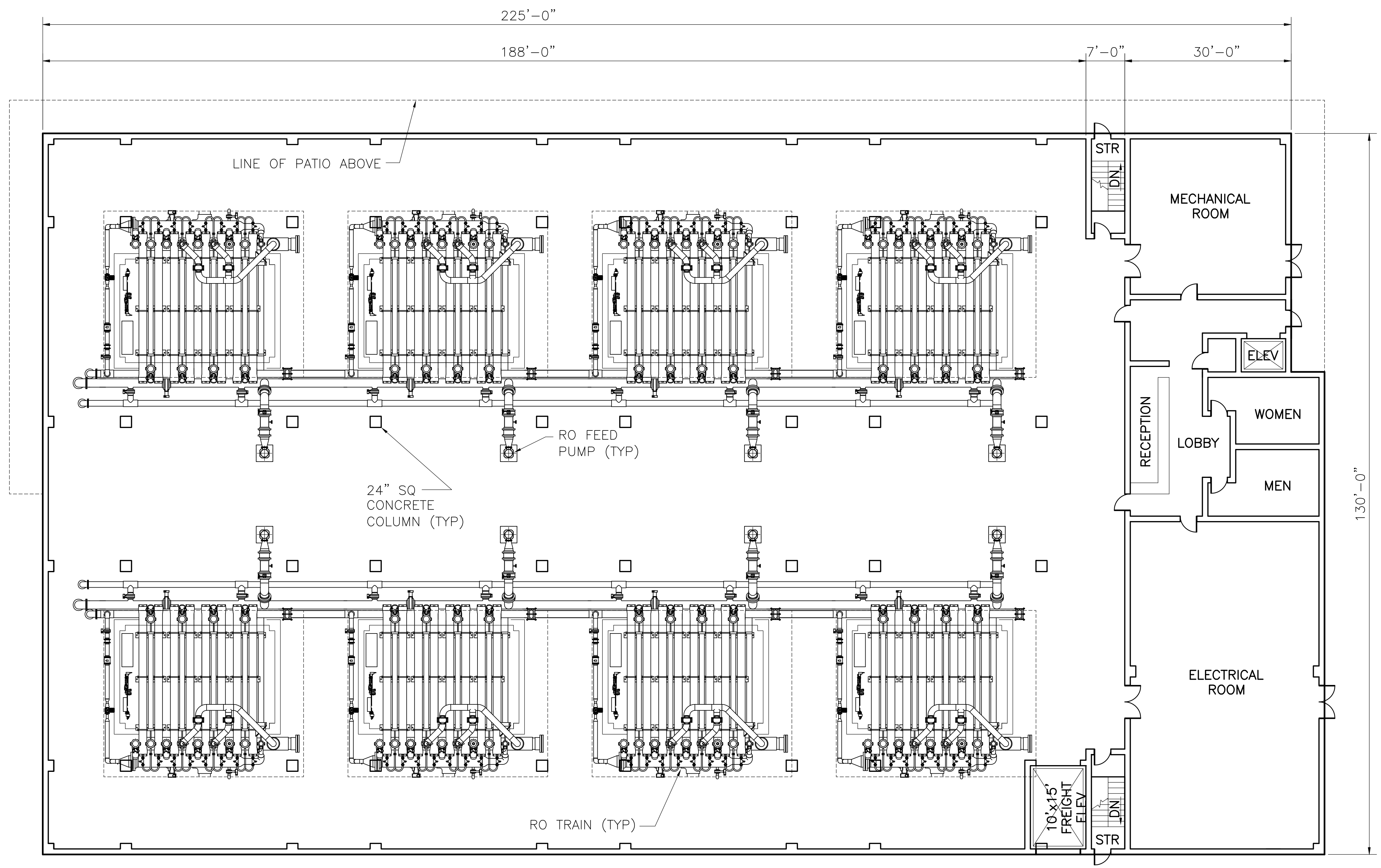

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IF NOT ONE INCH LONG ON THIS DRAWING, ADJUST SCALES ACCORDINGLY

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RO SYSTEM PRELIMINARY LAYOUT
(16- INCH ELEMENTS)

FIG NO	5-9
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

L:\City of LA-86538\Recycled Water-71984\03Report\ RWMP-SF-RPT-5-9a 03/13/12 09:42 perezsm XREFS: X-LADWP-TBLK, RO_MF FLOOR PLAN (1ST FLOOR), RO BLDG02 (3RD FLR), RO_MF FLOOR PLAN (1ST FLOOR)-ALT
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5.3.10 Advanced Oxidation Process

AOPs are considered the best available technology to address the destruction of CECs that are not fully removed by the RO membranes, notably NDMA, flame retardants, and 1,4-dioxane. The most common AOP alternatives with operating history include various combinations of UV exposure, ozonation, and H_2O_2 application. Existing AOP technologies considered for the AWPF include: UV with hydrogen peroxide (UV/H_2O_2), and ozone with hydrogen peroxide (O_3/H_2O_2). As discussed in Section 3.9, UV/H_2O_2 will be the basis of design for the Phase 1 of the AWPF as it has been previously permitted by CDPH for several operating AWPFs.

UV and H_2O_2

The UV/H_2O_2 system is the most common AOP technology for GWR, and it has been used extensively for the removal of microconstituents found in treated water. The UV dose required to achieve 1-log removal of NDMA is approximately 1,000 mJ/cm^2 (Mitch et al., 2003) and for 2-log reduction is approximately 1,400 to 1,700 mJ/cm^2 (Sharpless and Linden, 2003) compared to a UV dose less than approximately 100 mJ/cm^2 for UV disinfection only. UV/H_2O_2 destroys microconstituents through two simultaneous mechanisms:

- The first mechanism is through UV light reacting with H_2O_2 to generate hydroxyl radicals. The H_2O_2 is added to the RO permeate upstream of the UV process at a dose of approximately 5.0 mg/L.
- The second mechanism is through UV photolysis (exposure to UV light) where UV photons are able to break the bonds of certain chemicals if the bond's energy is less than the photon energy.

Two candidate manufacturers of UV/H_2O_2 systems include Calgon Carbon Corporation, UV Technologies Division (Calgon) and Trojan Technologies, Inc. (Trojan). Both manufacturers have experience providing UV/H_2O_2 equipment for at least one operating reuse facility rated at 5 mgd or larger, and a potable water facility with a capacity of at least 20 mgd. Both manufacturers utilize closed-vessel UV/H_2O_2 systems, where the UV lamps are installed in quartz sleeves inside a stainless steel vessel or chamber; no open-channel equipment is marketed for UV/H_2O_2 applications. Calgon's lamps are oriented perpendicular to the direction of flow, while Trojan's lamps are nominally parallel to the direction of flow. Electrical connections for the lamps are located outside the lamp chamber. UV/H_2O_2 lamp chambers are kept full of water and pressurized and recycled water is circulated when operated to cool the lamps. Each chamber includes flanged connections for feed piping and discharge piping. Isolation valves are required upstream and downstream of each chamber to allow draining individual chambers for maintenance or replacement.

The Calgon Sentinel® system is a medium pressure (MP) system and the Trojan UVPhox® system is a low pressure, high output (LPHO) system. The two different systems have trade-offs: the Calgon system typically has lower capital cost and a smaller footprint than the Trojan system, but the Trojan system typically has lower energy usage than the Calgon system. Both systems can fit within the available space. UV systems should be procured based on lifecycle cost, as opposed to capital cost, to take into account operating costs (i.e., power usage), lamp replacement, and ballast replacement.

Tables 5-14 and **5-15** provide the design criteria for Calgon and Trojan UV systems, respectively.

Table 5-14: UV/H_2O_2 System Design Criteria - Calgon

Parameter	Phase 1	Phase 2
AOP Feed Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Feed Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Manufacturer, Model [1]	Calgon, Sentinel®	Calgon, Sentinel®
Type	Medium Pressure (MP)	Medium Pressure (MP)
No. of Trains	3 Duty, 1 Standby	3 Duty, 1 Standby
Flow Capacity per Train	11.7 mgd	11.7 mgd
Maximum operating pressure	50 psi	50 psi
Power Draw per Train	396 kW	396 kW
Lamp input power	20 kW each	20 kW each
No. of Lamps per Train	18	18
Total No. of Lamps	36	54
Lamp Orientation	Horizontal, Perpendicular to direction of flow	Horizontal, Perpendicular to direction of flow
Lamp cleaning	Automated, SST wire brush	Automated, SST wire brush
Ballast type	Electromagnetic, variable power	Electromagnetic, variable power
Warm-Up Time	2-5 minutes	2-5 minutes
Cool-Down Time	2-3 minutes with flow 6 minutes without flow	2-3 minutes with flow 6 minutes without flow
System Footprint Area	66 ft x 46 ft	66 ft x 46 ft
At Design Flow, Operate:	3 Trains at 95% Capacity (5% turn-down)	4 Trains at 100% Capacity
At Minimum Flow, Operate:	1 Train at 57% Capacity (43% turn-down)	1 Train at 57% Capacity (43% turn-down)

Notes:
1) As noted in Section 5.2.1, additional manufacturers meeting qualifications will be considered during detailed design.

Table 5-15: UV/H_2O_2 System Design Criteria - Trojan

Parameter	Phase 1	Phase 2
AOP Feed Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Feed Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Manufacturer, Model [1]	Trojan, UVPhox®	Trojan, UVPhox®
Type	Low Pressure, High Output (LPHO)	Low Pressure, High Output (LPHO)
No. of Trains	3 Duty, 1 Standby	4 Duty, 1 Standby
Flow Capacity per Train	8.75 mgd	8.75 mgd
Maximum operating pressure	65 psi duty, 130 psi surge	65 psi duty, 130 psi surge
Power Draw per Train	111 kW	111 kW
Lamp input power	0.25 kW each	0.25 kW each
No. of Lamps per Train	432	432
Total No. of Lamps	1,300	1,700
Lamp Orientation	Parallel	Parallel
Ballast type	Electronic, variable power	Electronic, variable power
Warm-Up Time	3 minutes	3 minutes
Cool-Down Time	3 minutes	3 minutes
System Footprint Area	90 ft x 30 ft	90 ft x 30 ft
At Design Flow, Operate:	3 Trains at 71% Capacity (29% turn-down)	3 Trains at 100% Capacity
At Minimum Flow, Operate:	1 Train at 43% Capacity (57% turn-down)	1 Train at 43% Capacity (57% turn-down)

Notes:
1) As noted in Section 5.2.1, additional manufacturers meeting qualifications will be considered during detailed design.

Preliminary layouts for the Calgon Sentinel® and Trojan UVPhox® systems are provided on **Figures 5-10** and **5-11**, respectively.

The UV/H_2O_2 system will be installed on a concrete pad covered with a canopy. Based on preliminary layout configurations provided by each manufacturer, typical piping configurations (including influent/effluent manifolds), ballast panels, control panels, and associated fittings were arranged to provide a realistic footprint of each UV/H_2O_2 system. Calgon's Sentinel® system is estimated to occupy an area of 66 ft by 46 ft, including a dedicated room for its PLC and ballast panels. In comparison, Trojan's UVPhox® system is estimated to occupy an area of 90 ft by 30 ft with ballasts located outside with the UV equipment. The site layouts show a 90 ft by 46 ft footprint to accommodate either system.

The UV/H_2O_2 effluent manifold in either layout configuration will discharge southward towards Keshiki Way for post-treatment stabilization (see Section 5.3.11) prior to gravity conveyance to the Product Water Pump Station (see Section 5.3.12).

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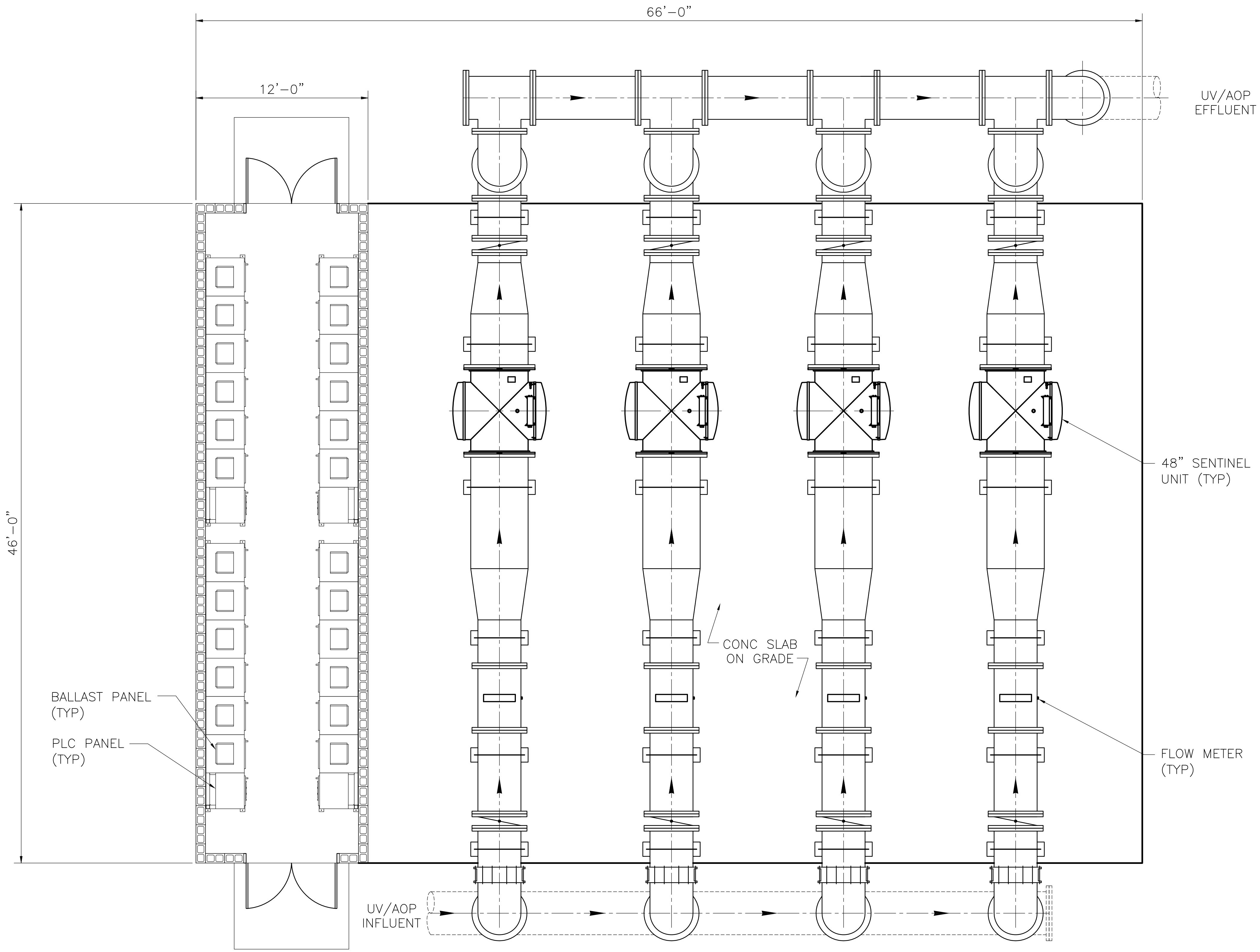

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IF NOT ONE INCH LONG ON THIS DRAWING, ADJUST SCALES ACCORDINGLY

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APPROVED: ________ RMC ENGR C____

CITY OF LOS ANGELES - GWR MASTER PLANNING DOCUMENT

UV/AOP PRELIMINARY LAYOUT
(CALGON SENTINEL UNITS)

FIG NO	5-10
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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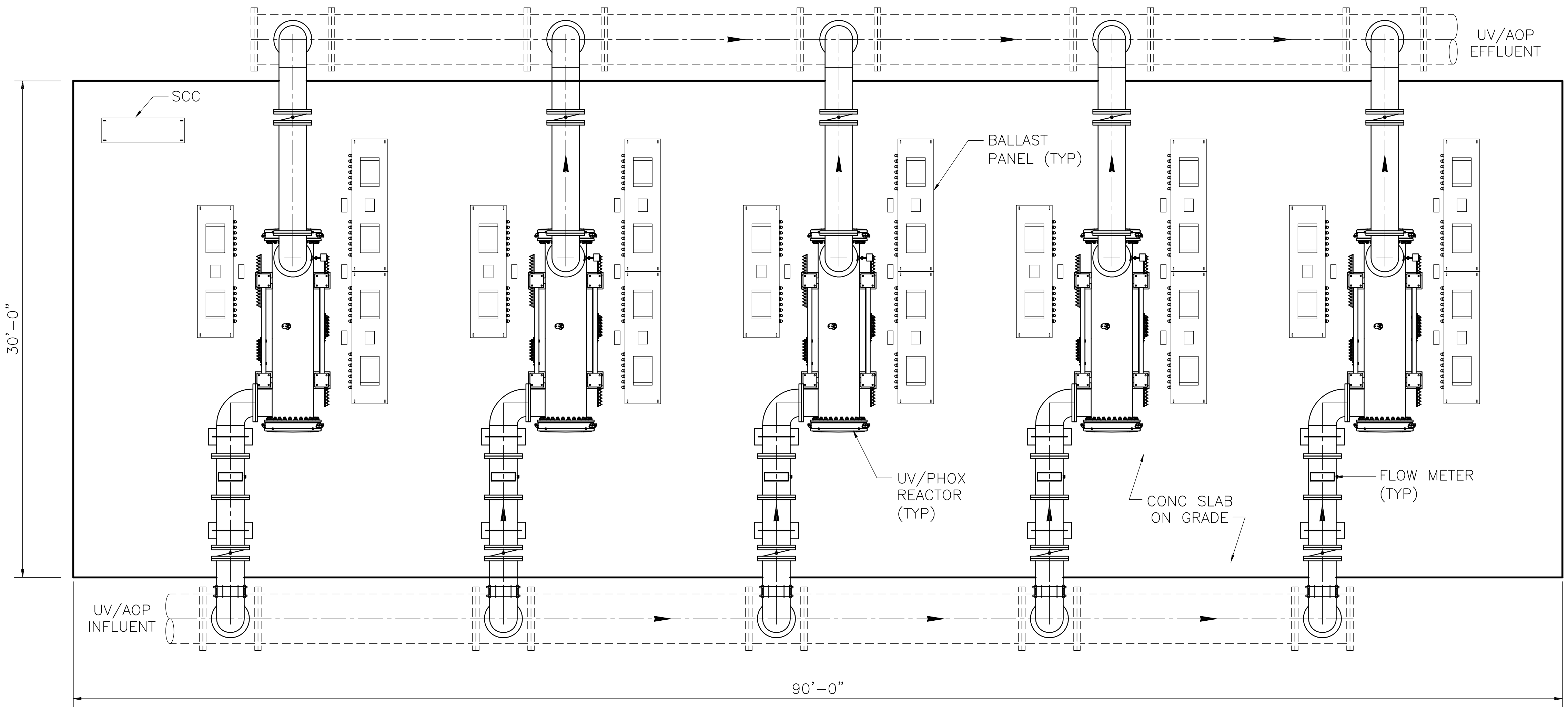

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IF NOT ONE INCH LONG ON THIS DRAWING, ADJUST SCALES ACCORDINGLY

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REV	DATE	BY	APVD	DESCRIPTION

DESIGNED	AG
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SUBMITTED: RMC PROJ ENGR C____
APPROVED: RMC ENGR C____

CITY OF LOS ANGELES - GWR MASTER PLANNING DOCUMENT
UV/AOP PRLIMINARY LAYOUT
(TROJAN UV/PHOX UNITS)

FIG NO	5-11
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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Ozone and H_2O_2 as Alternative AOP

Since UV/H_2O_2 is an energy-intensive AOP, an analysis of alternative AOP technologies to achieve the reduction of NDMA, 1,4-dioxane, and other CECs was completed as part of the *Draft Advanced Water Treatment Technology Assessment TM*. Based on the evaluation, O_3/H_2O_2 was investigated as an alternative AOP technology during the pilot study as a comparison against the baseline AOP (UV/H_2O_2). As described in the *GWR Treatment Pilot Study Report*, O_3/H_2O_2 had promising results and it might be possible to consider O_3/H_2O_2 as an alternative for the AWPF. Additional pilot testing would be required to refine design criteria and confirm that it will meet water quality goals. Section 4 discusses the pilot results in more detail. This section presents preliminary design criteria for an O_3/H_2O_2 system.

The O_3/H_2O_2 system will use liquid oxygen (LOX) instead of air as the feed gas for the ozone generators. The LOX system includes LOX storage tanks, vaporizers, particulate filters, a gas flow calibration station and a supplemental nitrogen boost skid. LOX is passed through a vaporizer to warm the liquid into the gaseous form prior to ozone generation. The addition of a small concentration of nitrogen in the gas stream retards the rapid decay of the ozone. Piping between the LOX tanks and the vaporizers will be insulated to limit potential condensation and freezing of ambient air due to the subzero storage temperature of the LOX.

The ozone generation system consists of ozone generators, the power supply units (PSUs), cooling water system, and ozone destruct units. Feed gas from the LOX system is passed through the ozone generator vessel where dielectrics powered by the PSU transforms a percentage of the oxygen gas into ozone. An ozone concentration of 10-percent by weight will be targeted. Both the ozone generators and PSUs will require new cooling water systems sized to meet the requirements of the selected alternative and manufacturer. The cooling water system will consist of an open loop system and a closed loop system with heat exchangers located between the two systems.

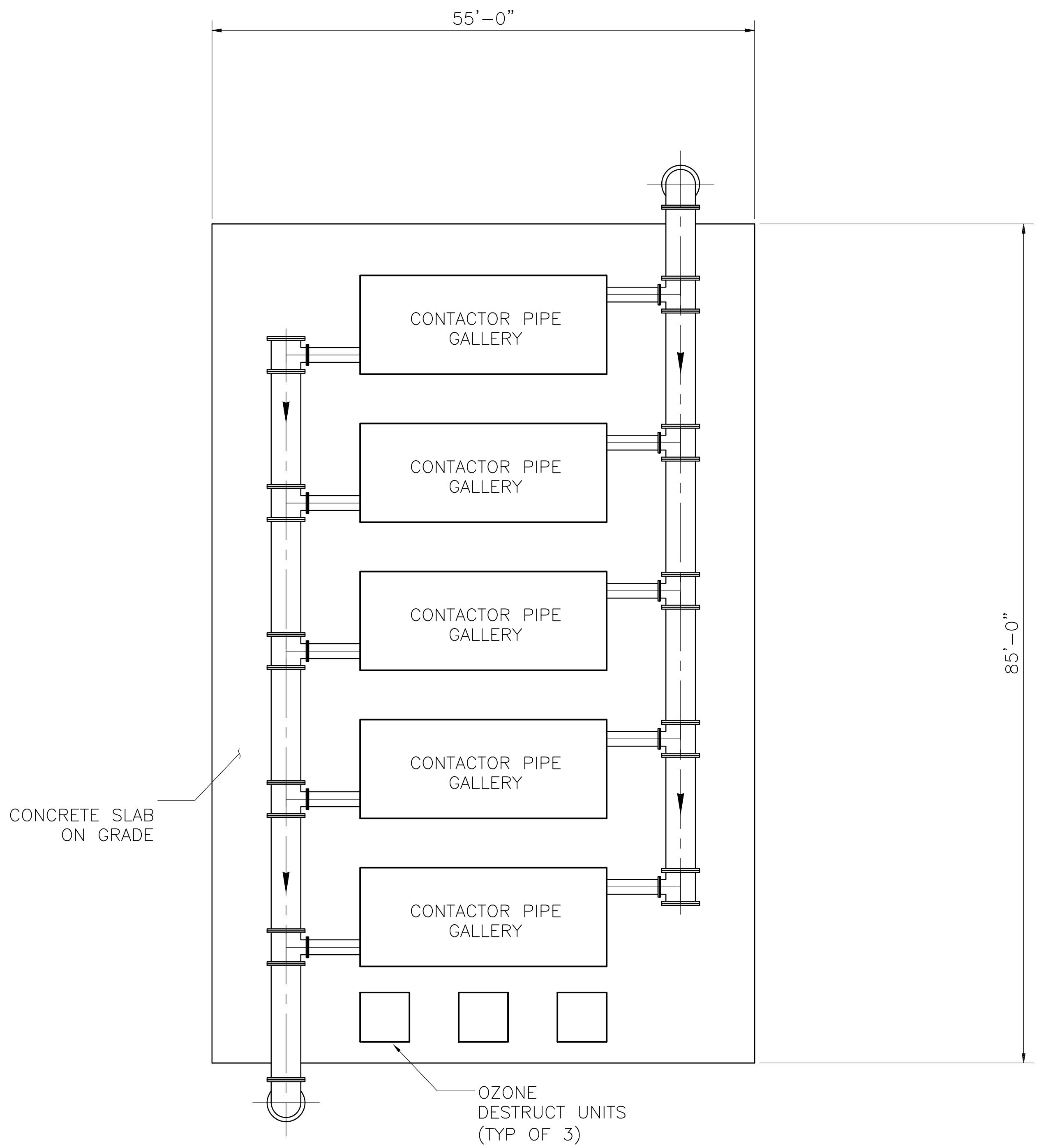
Ozone dissolution prior to the addition of H_2O_2 typically comes in three forms: 1) fine bubble diffusion, whereby ozone is dissolved into water via a porous stone diffuser grid installed inside a contact basin; 2) sidestream injection system, whereby ozone is dissolved into a sidestream flow prior to the mixing with the mainstream flows in a pipeline before a contact basin; and, 3) proprietary in-contactor injection systems, whereby a grid/series of nozzles is used to dissolve ozone in water inside a contact vessel. A proprietary in-contactor injection and plug flow reactor system is the preferred technology for ozone dissolution, specifically for improved treatment performance (higher mass transfer efficiency, improved gas-liquid mixing, more stable ozone residual, lower ozone production rates), smaller contactor footprint, no confined space entry, and reduced maintenance costs.

The O_3/H_2O_2 system will be installed in two locations: the ozone generator system will be located on the first floor of the MF/RO building while the ozone contactors will be installed on a concrete pad outside. Typical piping and equipment configurations were arranged to provide a realistic footprint of the O_3/H_2O_2 system. **Table 5-16** provides the design criteria for the O_3/H_2O_2 system. If O_3/H_2O_2 were used, the design criteria would need to be defined with additional pilot testing. Preliminary layouts for the O_3/H_2O_2 system are provided on **Figure 5-12** and **Figure 5-13**.

Table 5-16: O_3/H_2O_2 System Design Criteria

Parameter	Phase 1	Phase 2
AOP Feed Flow, Design	17,400 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Feed Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Ozone		
Concentration	10%	10%
Specific Gravity	1.61	1.61
Dose, Design [2]	7.0 mg/L	7.0 mg/L
Dose, Minimum [2]	5.0 mg/L	5.0 mg/L
Daily Demand (as oxygen)	1,500 ppd	2,000 ppd
Liquid Oxygen (LOX) System		
Daily Demand (as LOX)	1,590 gpd	2,120 gpd
Days of Storage	30 days	30 days
No. of Tanks	2 Duty, 0 Standby	3 Duty, 0 Standby
Tank Volume	23,000 gal	23,000 gal
Hydrogen Peroxide		
Concentration	50%	50%
Specific Gravity	1.19	1.19
Dose, Design [2]	1.5 mg/L	1.5 mg/L
Dose, Minimum [2]	1.0 mg/L	1.0 mg/L
Daily Demand (as 100%)	310 ppd	440 ppd
Daily Demand	63 gpd	88 gpd
Vaporizing System		
No. of Units	3 Total	3 Total
Ozone Generating System		
No. of Generators	2 Duty, 1 Standby	2 Duty, 1 Standby
Capacity, each	1,000 lbs/day	1,000 lbs/day
Ozone Contactor		
Type	In-contactor injection, Plug flow reactor	In-contactor injection, Plug flow reactor
Contact Time [2]	1.5 min	1.5 min
Ozone Destruct System		
No. Units	2 Duty, 1 Standby	2 Duty, 1 Standby
Supplemental Nitrogen System		
No. of Units	1 Duty, 0 Standby	1 Duty, 0 Standby

Notes:
1) Additional manufacturers meeting qualifications listed in Section 5.2.1 will be considered during detailed design.
2) To be refined during design with additional pilot testing.



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DRAWN MP	APPROVED: RMC ENGR C____	OZONE / AOP SYSTEM (PART 1)	SHEET NO OF
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			DATE MARCH 2012

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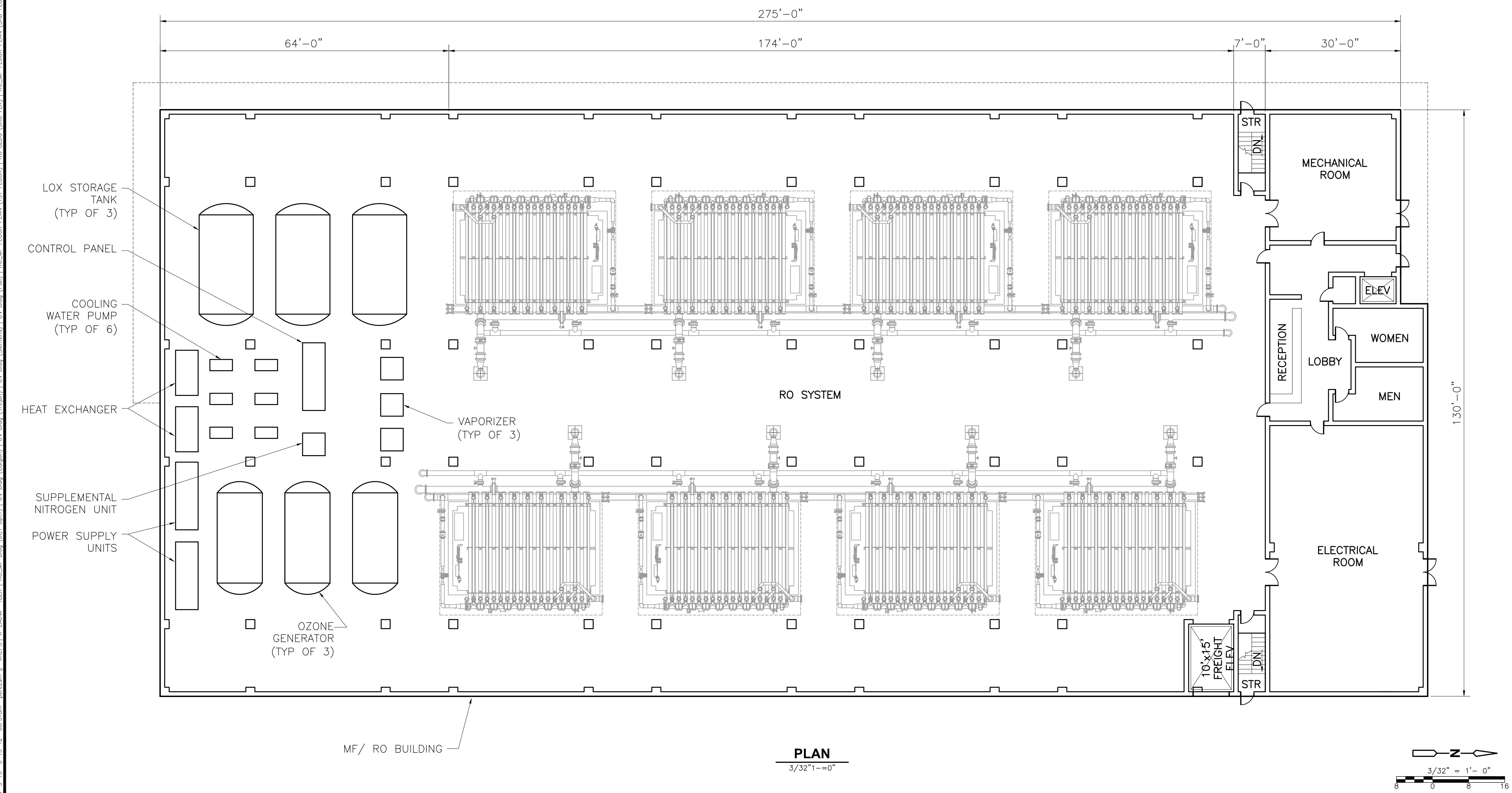

PLAN

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APPROVED: RMC ENGR C____

CITY OF LOS ANGELES - GWR MASTER PLANNING DOCUMENT

OZONE/ AOP SYSTEM
(PART 2)

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PROJ NO	86538-71984
DATE	MARCH 2012

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UV and Ozone Comparison

Table 5-17 summarizes the comparisons of key design parameters between the UV and ozone systems for Phase 2 design conditions.

Table 5-17: AOP System Comparison: UV and Ozone Systems

Parameter	UV (Calgon)	UV (Trojan)	Ozone
Ozone Feed			
Ozone Dose, Design	N/A	N/A	7 mg/L
Annual Demand (LOX)	N/A	N/A	547,500 gal
Unit Cost	N/A	N/A	$0.40/ccf[1]
Hydrogen Peroxide			
Dose, Design	5 mg/L	5 mg/L	1.5 mg/L
Annual Demand	107,000 gal	107,000 gal	32,200 gal
Unit Cost	$4.94/gal	$4.94/gal	$4.94/gal
Annual Power Draw [2]	9,700,000 kWh	3,640,000 kWh	3,930,000 kWh
Capital Cost	$13.2M [3]	$16.2M [3]	$26.6M to $32.2M [4]
Annual O&M Cost [5]	$1.74M	$1.29M	$0.980M
NPV of 50-year Lifecycle Cost [6]	$104M	$91M	$86M to $91M
System Footprint [7]	90 ft x 30 ft	66 ft x 46 ft	55 ft x 85 ft

Notes:

1) CCF = 100 cubic feet
2) Power draw for the ozone system includes PSUs, destruct units, supplemental nitrogen, and cooling system pumps.
3) Includes 30% contingency and $3M implementation cost.
4) Includes 30% contingency and $5M implementation cost, of which $2M is assumed necessary for pilot testing to get approval from CDPH. A range of capital cost for ozone system is provided for a range of ozone contact time (approximately 15 seconds to 100 seconds) that may be required.
5) Annual O&M costs include power cost, chemical cost, and replacement of consumables. Consumables for UV system include lamps and ballasts. Consumables for Ozone system include ozone dielectric tubes and destruct system catalyst.
6) 50-year lifecycle cost is calculated from year 2015 to 2064. See Appendix B for detailed cost estimates.
7) Footprint of ozone contactor half of the overall ozone system. The ozone generator system will be located inside the MF/RO building and will require a larger floor/building plan compared to UV.

Some key findings include:

- A larger system footprint is required for the ozone system compared to both UV systems because more equipment is required, especially the LOX storage tanks, ozone generators, and contactors. Both UV systems are more compact than an ozone system.
- The ozone system will require a much smaller dosage and overall demand for H_2O_2, which will save chemical supply costs. Although the ozone system will require additional chemical supply (LOX), the low cost of bulk LOX supply and delivery will have negligible impact to the estimated O&M cost for the ozone system.

- The capital cost for the UV systems are lower than the capital cost for the ozone system, while the O&M cost of the UV system is higher than the O&M cost for the ozone system. Over a 50-year lifecycle the difference between the lifecycle costs of UV system and ozone system is small. Therefore, both UV system and ozone system should be considered in future AWPF design.

5.3.11 Post-Treatment/Stabilization

The product water from the AWPF will be pumped to the spreading grounds in the East San Fernando Valley. Injection wells are also being considered by the City to address spreading ground availability issues during wet years. Key design criteria for the product water quality must address the following requirements:

- NPR irrigation users
- NPR industrial users, such as VGS power plant cooling towers
- Injection wells: Minimize turbidity, and MFI
- Spreading basins: Compatibility with the aquifer water at the percolation basins without causing scaling, corrosion, or solubilization (minimize TDS)
- Conveyance pipeline: Minimize corrosion of the 54-inch ductile iron pipe with double cement mortar lining (Langelier Saturation Index, LSI)
- Pumping equipment: Minimize corrosion of the product water pumping equipment (LSI)

Table 5-18 summarizes the product water stabilization goals for the AWPF product water.

Table 5-18: AWPF Product Water Post-Treatment/Stabilization Goals

Constituent	Design Criteria
pH	7.5 to 8.5
Hardness	> 20 mg/L as $CaCO_3$
Langelier Saturation Index (LSI)	-0.5 to 0.5
MFI [1]	< 3

Notes:
1) MFI is only applicable if injection wells will be used.

Several post-treatment options were evaluated:

- Alternative 1 – Lime Addition and Decarbonation
- Alternative 2 – Lime Addition, Calcium Chloride Addition, and Decarbonation
- Alternative 3 – Calcium Chloride Addition, Caustic Soda Addition, and Carbon Dioxide Addition
- Alternative 4 – Lime addition, Carbon Dioxide Addition, and Decarbonation

Of the four alternatives, Alternative 3, using calcium chloride, caustic soda and carbon dioxide was recommended based on the following evaluation results:

- Best overall control of water quality,
- Ease of operation,
- Smallest footprint,
- Lowest capital cost , and
- Lowest lifecycle cost.

The detailed evaluation of the four alternatives is described in Appendix A.

Alternative 3: Calcium Chloride, Caustic Soda and Carbon Dioxide – Control Philosophy

Alternative 3 involves addition of calcium chloride to increase hardness, and addition of caustic soda to increase pH. Both calcium chloride and caustic soda could be purchased in liquid form, which allows the operators to avoid use of labor-intensive dry feed systems and saturators associated with lime addition.

This alternative allows operators to control hardness and pH independently, producing a stable product water that can be matched to any desired combination of pH, hardness, and alkalinity. Furthermore, the addition of carbon dioxide, which lowers the pH and LSI, ahead of calcium chloride and caustic soda addition decreases the overall demand of calcium chloride, and also enables better overall control of water quality.

The chemical addition for post-treatment/stabilization will be automated. The carbon dioxide will be added first followed by calcium chloride; both carbon dioxide and calcium chloride feeds will be flow paced based on the AOP product flow rate. The caustic soda will be added last and the feed will be flow paced based on the AOP product flow rate and trimmed based on the product water pH.

Table 5-19 summarizes the chemical dose requirements for calcium chloride, carbon dioxide, and caustic soda. The design criteria for these chemical systems are described in detail in Section 5.3.13.

Table 5-19: Post-Treatment Design Criteria

Parameter	Phase 1	Phase 2
AOP Product Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Product Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Calcium Chloride Doses		
Design	18.5 mg/L	18.5 mg/L
Minimum	10 mg/L	10 mg/L
Carbon Dioxide Doses		
Design	15 mg/L	15 mg/L
Minimum	TBD mg/L	TBD mg/L
Sodium Hydroxide Doses		
Design	18 mg/L	18 mg/L
Minimum	10 mg/L	10 mg/L

5.3.12 Product Water Pump Station

The AWPF product water will be delivered to the spreading grounds by the Product Water Pump Station (PWPS). The PWPS will consist of the existing Balboa Pump Station with one additional pump to provide the required capacity/redundancy for conveying 25.0 mgd of product water during Phase 1 and 35.0 mgd during Phase 2 to the spreading grounds via the existing 54-inch pipeline.

The Balboa Pump Station consists of three existing 3-stage vertical turbine pumps (two duty and one standby) that currently pump DCTWRP effluent to the Hansen Tank, located at VGS. The current capacity of the Balboa Pump Station is sufficient for Phase 1 of the AWPF. There are existing provisions, e.g., pump pedestals and blind-flanged connections, which will facilitate the installation of an additional pump for the proposed PWPS configuration for Phase 2. The additional pump will be a multi-stage vertical turbine pump similar to the existing installations. The City may investigate the conditions of the existing pumps and consider replacement when expanding the AWPF to the Phase 2 capacity.

Therefore, the PWPS will consist of a total of four pumps (three duty and one standby) each rated for a flow rate of 8,100 gpm at a TDH of 133 psi for Phase 2. The anticipated pumping head was determined based on the 10.2-mile conveyance of 35.0 mgd of product water via the existing 54-inch conveyance pipeline to the HSG. To maximize efficiency, the new pump will be equipped with a VFD similar to the existing pumps.

See **Table 5-20** for the design criteria of the existing Balboa Pump Station as well as the proposed PWPS.

Table 5-20: Product Water Pump Station Design Criteria

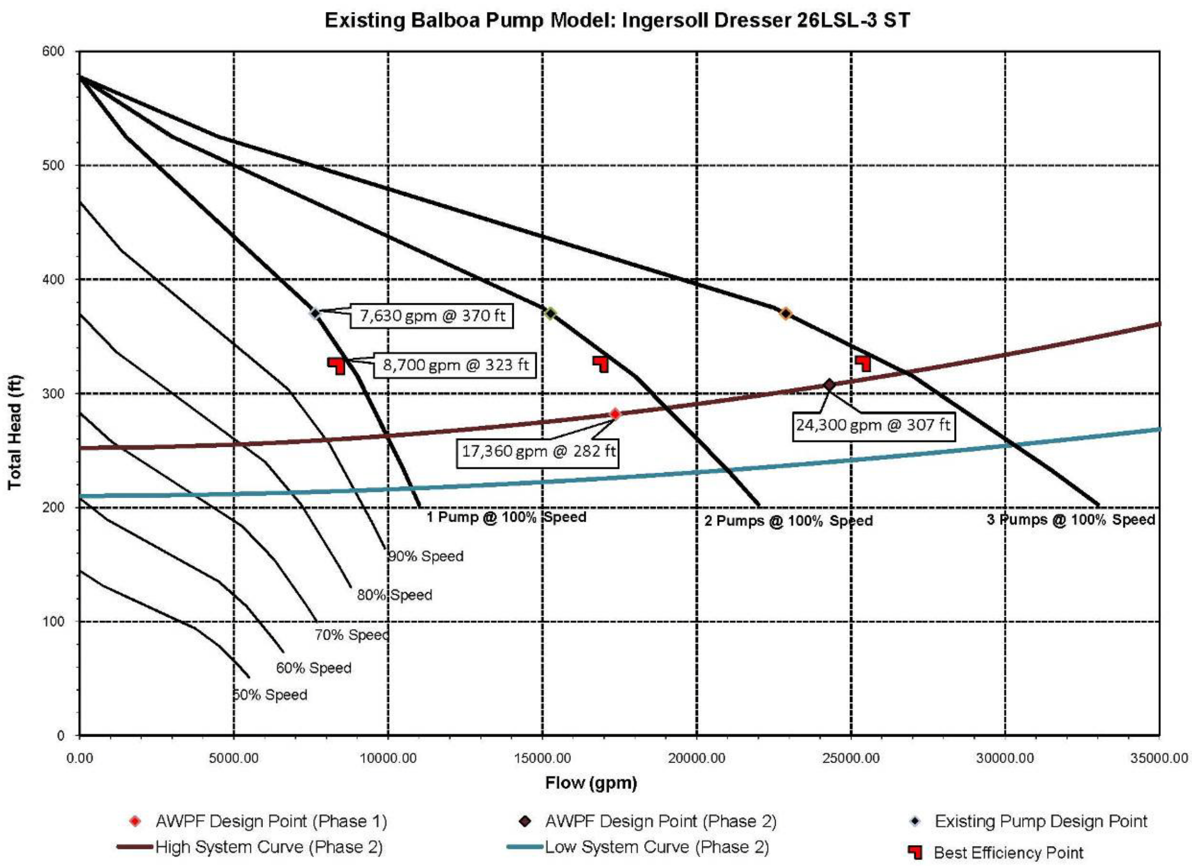
Parameter	Phase 1 Balboa Pump Station	Phase 2 Product Water Pump Station
AWPF Product Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AWPF Product Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Pump Type	Vertical Turbine	Vertical Turbine
No. of Duty Pumps	2	3
No. of Standby Pumps	1	1
Design Flow	8,300 gpm	8,100 gpm
Target Pressure	122 psi	133 psi
Target Head	282 ft	307 ft
Pump Efficiency	80%	±80%
VFD	Yes	Yes
Brake Horsepower	730 bhp	690 bhp
Motor Size	1,000 hp	1,000 hp (3 existing) 800 hp (1 new)
Motor Speed	1,200 rpm	1,200 rpm
Voltage	4160V	4160V
Manufacturer	Ingersoll Dresser	Match Existing
Model	26LSL-3 ST	Match Existing
At Design Flow, Operate:	2 Pumps at 96% Capacity	3 Pumps at 90% Capacity
At Minimum Flow, Operate:	1 Pump at 39% Capacity	1 Pump at 39% Capacity

Figure 5-14 shows the PWPS pump system curves that bookend the anticipated operating conditions between the PWPS and HSG. A high system curve assumes a pipe roughness coefficient (C) of 100, which is a conservative assumption for an existing pipe; a low system curve assumes a C-value of 140. Existing Balboa Pump Station pump curves are also included on **Figure 5-14** to evaluate future pump operations should all three of the existing pumps be used in some configuration to convey product water to the HSG. The chart suggests the following:

- The speed of a single pump can be turned down to a range between 80 percent to 90 percent speed to meet the new operating conditions while maintaining its designed Best Efficiency Point (BEP) that the manufacturer had designated for this particular pump. The BEP of the existing pump is rated at 85 percent efficiency.
- At a minimum RO production of 3,470 gpm (5.0 mgd), product water delivery can be achieved by utilizing a single pump turned down to a range between 70 percent to 80 percent speed. The pump will likely be operating up the curve left of the BEP, but still within the range of 80 percent efficiency.

- For the Phase 1 design condition of (17,360 gpm @ 282 ft), product water delivery can be achieved by utilizing two existing pumps turned down to a range between 85 percent to 95 percent speed. The pump will likely be operating just slightly left of BEP, which is typical for these types of pumps.
- For the AWPF Phase 2 design condition (24,300 gpm @ 307 ft), product water delivery can be achieved by utilizing all three existing pumps turned down to a range between 85 percent to 95 percent speed. The pump will likely be operating just slightly left of BEP, which is typical for these types of pumps.

Figure 5-14: Existing Pump Curves vs Proposed System Curves



5.3.13 Chemical Storage and Feed Facilities

This section describes the chemical storage and feed facilities required for the AWPF. The chemical application points are shown on **Figure 5-3**, Process Flow Diagram. There are ten chemical systems used throughout the AWPF as listed in **Table 5-21**.

Table 5-21: AWPF Chemical Requirements

Chemical	Feed Location	Usage
Ammonium Hydroxide (19%)	MF Feed	Combines with sodium hypochlorite to provide a combined chlorine residual in the MF system for control of membrane biofouling.
Sodium Hypochlorite (12.5%)	MF Feed AWPF Product	Combines with ammonium hydroxide to provide a combined chlorine residual in the MF system for control of membrane biofouling.
Antiscalant (100%)	RO Feed	Prevents scaling potential in RO feed water
Sulfuric Acid (93%)	RO Feed	Reduces RO feed water pH to reduce membrane fouling due to calcium phosphate scaling.
Hydrogen Peroxide (50%)	AOP Feed	Promotes advanced oxidation.
Calcium Chloride (34.7%)	AOP Product	Adds hardness to increase stability of the product water.
Carbon Dioxide (Gas)	AOP Product	Adds carbonate into product water to lower pH for more balance.
Caustic Soda (50%)	AOP Product MF CIP System RO CIP System	Allows fine-tuning of product water pH of the product water. CIP waste neutralization for MF. CIP and CIP waste neutralization for RO.
Citric Acid (50%)	MF CIP System RO CIP System	CIP for MF. CIP and CIP waste neutralization for RO.
Sodium Bisulfite (38%)	MF Feed AOP Product	Eliminates hydrogen peroxide residual and reduces chlorine residual in product water and RO flush water.

Preliminary feed requirements for each chemical system were calculated to estimate chemical consumption, and size of the storage tanks and pumps. The limited area available for the AWPF site makes it more advantageous to provide a centralized bulk chemical storage and feed facility with a common chemical delivery containment pad. The proposed layout aims to minimize space requirements and costs while providing a chemical storage and feed facility that is accessible for maintenance, and provides a safe and reliable system. The proposed location for the chemical facilities is shown on **Figures 6-4 and 6-5**.

The 10 States Standards for Wastewater Systems and the 10 States Standards for Water Works recommend that facilities provide a minimum of 10 and 30 days of bulk chemical storage, respectively. Based on these requirements, a target bulk storage capacity of 14 days was used for sodium hypochlorite because it decreases concentration over time, and 30 days for all other chemicals. The bulk storage systems are designed with a minimum of two storage tanks, and each tank will be sized to store a minimum of a full truck-load delivery. Where only two tanks are required for Phase 2, both tanks will be installed during Phase 1. Where more than two tanks are required for Phase 2, then the number of tanks proportional to Phase 1 capacity, with a minimum of two tanks, will be installed during Phase 1. The chemical storage tanks will be operated with one tank on-line at a time and remaining tank(s) off-line, filled, and on standby. The multi-tank system will be designed to provide the required total usable storage capacity with all tanks combined.

All bulk chemical storage tanks and metering pumps will be located outdoors in a chemical containment area covered with a canopy. Separate secondary containment areas will be provided for each chemical to avoid mixing of incompatible chemicals. Each chemical containment area will be sized to contain the volume of one tank of the respective chemical. The containment area will not be sized to contain rainwater since the area will be covered with a canopy. Concrete containment areas will be protected with a coating system that is proven to be compatible with the stored chemical. The floor of the containment area will be sloped toward a sump equipped with a float switch, which will alarm when there is a spill and the sump fills with a liquid, including area washdown water or minimal amounts of rainwater.

All bulk chemical storage tanks will be cylindrical in shape and constructed of steel, fiberglass reinforced plastic (FRP), or high density polyethylene (HDPE). Most chemicals will be stored in vertical tanks, whereas sulfuric acid and carbon dioxide will be stored in horizontal tanks. The diameter of the storage tanks will be limited to 12 ft due to shipping constraints. The bulk chemical storage tanks will be installed on top of concrete pads, which will be above the maximum chemical spill level.

Day tanks and metering pumps for CIP chemicals will be provided in the MF/RO Building, near MF and RO systems.

The chemical feed pumps will be diaphragm metering pumps or peristaltic pumps and installed on concrete pedestals to elevate the pumps above the maximum chemical spill level. A minimum of two feed pumps will be installed to provide redundancy for the system. The pumps and injection points will be shielded with clear Plexiglas to provide a safety barrier from splashing or spills.

One emergency eyewash/shower will be provided inside each chemical containment area, and additional emergency eyewash/showers will be provided outside near the chemical fill stations as needed. Each emergency eyewash/shower will be equipped with a flow switch to alarm when the emergency eyewash/shower is used.

See **Figures 5-15** and **5-16** for the layout of the western and eastern bays of the chemical storage and feed facility.

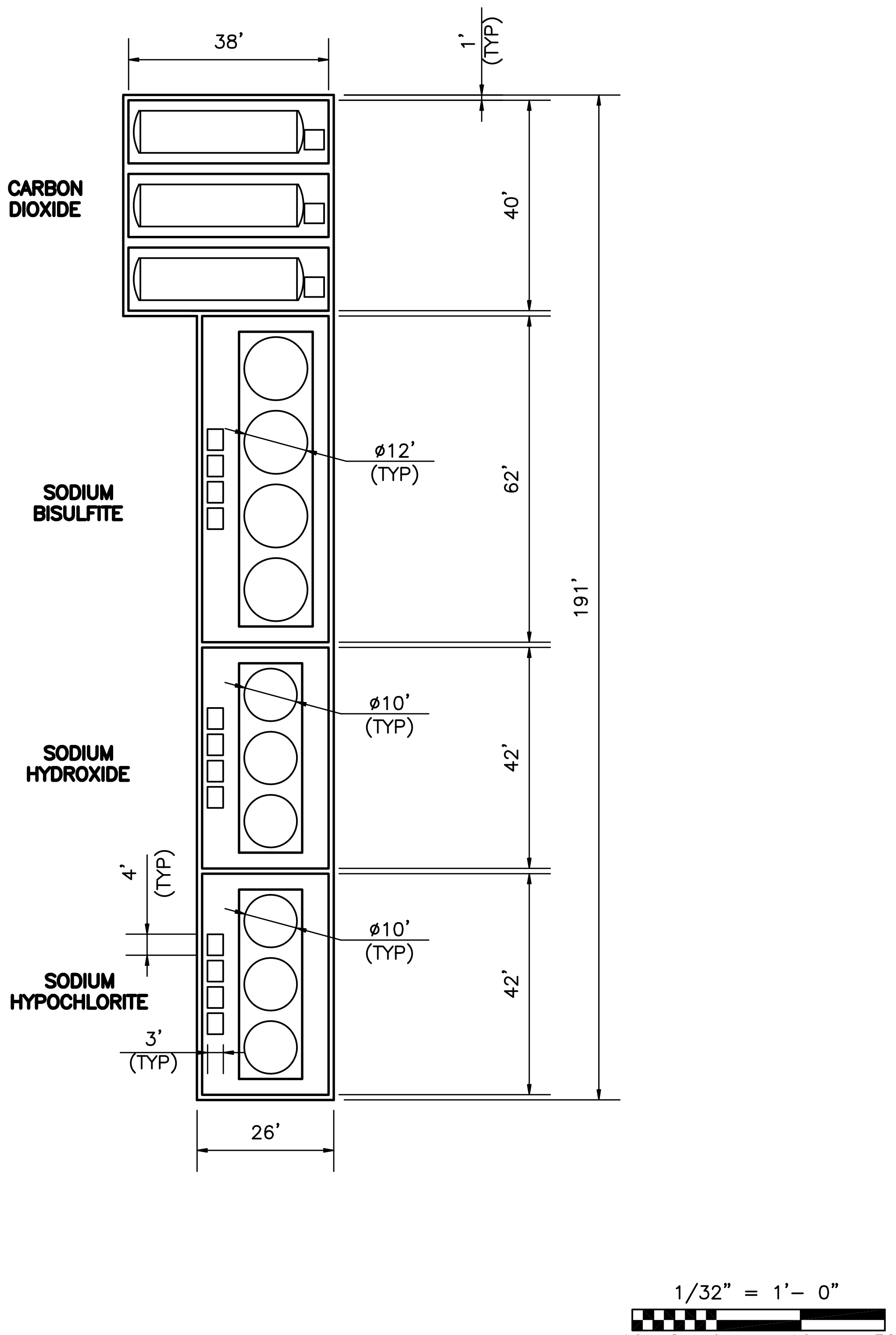


FIGURE 5-15
CHEMICAL FEED AND STORAGE AREA – EAST

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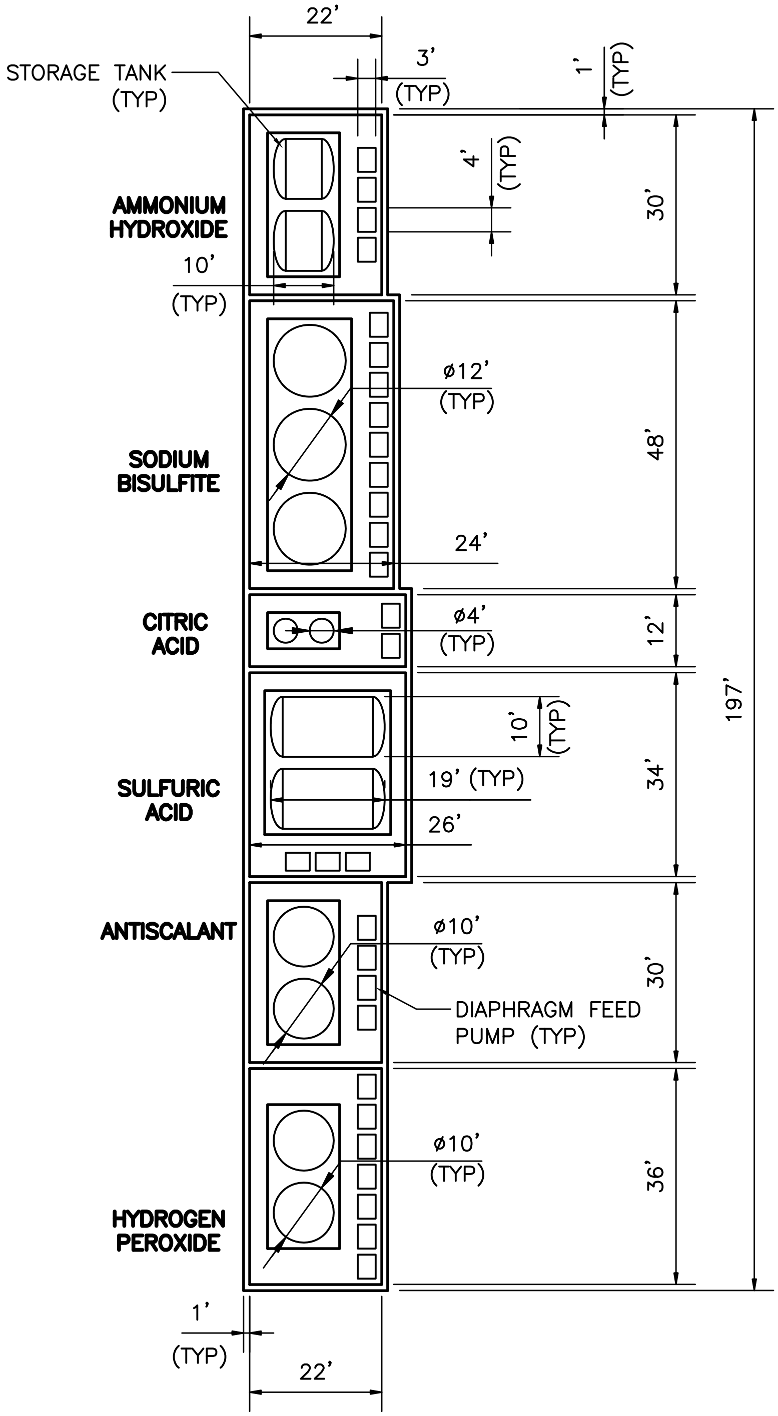

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FIGURE 5–16
CHEMICAL STORAGE
AND FEED AREA – WEST

Ammonium Hydroxide

Ammonium hydroxide will be added downstream of the MF feed pumps and upstream of the MF pre-filters for chloramination to control the biological fouling of the MF membranes. The chemical will be flow paced based on the MF feed flow rate. **Table 5-22** presents the design criteria for the ammonium hydroxide storage and feed system.

Table 5-22: Ammonium Hydroxide Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
MF Feed Flow, Design	22,000 gpm = 31.6 mgd	30,750 gpm = 44.3 mgd
MF Feed Flow, Minimum	4,390 gpm = 6.3 mgd	4,390 gpm = 6.3 mgd
Chemical	Ammonium Hydroxide	Ammonium Hydroxide
Concentration	19%	19 %
Specific Gravity	0.92	0.92
Demand		
Dose, Design	1.3 mg/L	1.3 mg/L
Dose, Minimum	0.8 mg/L	0.8 mg/L
Daily Demand (as 100%)	330 ppd	462 ppd
Daily Demand	226 gpd	317 gpd
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	2 Duty, 0 Standby
Days of Storage	30 days	30 days
Total Storage Volume Required	6,800 gal	9,500 gal
Tank Volume, each	5,200 gal	5,200 gal
Tank Diameter	10.0 ft	10.0 ft
Tank Type	Horizontal Carbon Steel or 316SS	Horizontal Carbon Steel or 316SS
Scrubber		
No. of Storage Tanks	2 Duty, 0 Standby	2 Duty, 0 Standby
Tank Volume, each	115 gal	115 gal
Tank Diameter	2.5 ft	2.5 ft
Tank Type	Vertical HDPE	Vertical HDPE
Pumps		
No. of Pumps	2 Duty, 1 Standby	3 Duty, 1 Standby
Pump Capacity, each	4.9 gph	4.9 gph
Pump Type	Diaphragm Metering	Diaphragm Metering

Sodium Hypochlorite

Sodium hypochlorite will be added downstream of the MF feed pumps and upstream of the MF pre-filters for chloramination to control the biological fouling of the MF membranes. The chemical will be flow paced based on the MF feed flow rate, and combined chlorine residual or ORP will be monitored to alarm when the measured levels are outside of acceptable range. The target combined chlorine concentration is 3.0 to 5.0 mg/L. **Table 5-23** presents the design criteria for the sodium hypochlorite storage and feed system. For flows to NPR users, individual chlorination stations will be considered as needed.

Table 5-23: Sodium Hypochlorite Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
MF Feed Flow, Design	22,000 gpm = 31.6 mgd	30,750 gpm = 44.3 mgd
MF Feed Flow, Minimum	4,390 gpm = 6.3 mgd	4,390 gpm = 6.3 mgd
Concentration	12.5 %	12.5 %
Specific Gravity	1.2	1.2
Demand – AWPF Pre-Treatment		
Dose, Design	5.0 mg/L	5.0 mg/L
Dose, Minimum	3.0 mg/L	3.0 mg/L
Daily Demand (as 100%)	1,319 ppd	1,846 ppd
Daily Demand	1,054 gpd	1,476 gpd
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	3 Duty, 0 Standby
Days of Storage	14 days	14 days
Total Storage Volume Required	14,800 gal	20,700 gal
Tank Volume, each	8,050 gal	8,050 gal
Tank Diameter	10 ft	10 ft
Tank Type	Vertical FRP	Vertical FRP
Pumps – AWPF Pre-Treatment		
No. of Pumps	2 Duty, 1 Standby	3 Duty, 1 Standby
Pump Capacity, each	22.8 gph	22.8 gph
Pump Type	Diaphragm Metering	Diaphragm Metering
Transfer Pumps (Transfer to Day Tanks for MF CIP)		
No. of Pumps	1 Duty, 1 Standby	1 Duty, 1 Standby
Pump Capacity, each	TBD gpm	TBD gpm
Pump Type	TBD	TBD

Antiscalant

Antiscalant (threshold inhibitor) will be provided to control scaling of the RO membranes. See *Draft GWR Treatment Pilot Study Testing Report* for pilot test results using different types of antiscalant. Antiscalant will be fed upstream of the RO cartridge filters. The antiscalant dose will be approximately 2.0 to 4.0 mg/L. The chemical will be flow paced based on the RO feed flow rate. **Table 5-24** presents the design criteria for the antiscalant storage and feed system.

Table 5-24: Antiscalant Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
RO Feed Flow, Design	20,425 gpm = 29.4 mgd	28,595 gpm = 41.2 mgd
RO Feed Flow, Minimum	4,090 gpm = 5.9 mgd	4,090 gpm = 5.9 mgd
Concentration	100%	100%
Specific Gravity	1.2	1.2
Demand		
Dose, Design	4.0 mg/L	4.0 mg/L
Dose, Minimum	2.0 mg/L	2.0 mg/L
Daily Demand (as 100%)	981 ppd	1,374 ppd
Daily Demand	98 gpd	137 gpd
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	2 Duty, 0 Standby
Days of Storage	30 days	30 days
Total Storage Volume Required	2,900 gal	4,100 gal
Tank Volume, each [1]	5,100 gal	5,100 gal
Tank Diameter	10.0 ft	10.0 ft
Tank Type	Vertical FRP	Vertical FRP
Pumps		
No. of Pumps	2 Duty, 1 Standby	3 Duty, 1 Standby
Pump Capacity, each	2.1 gph	2.1 gph
Pump Type	Diaphragm Metering	Diaphragm Metering

Notes:
1) Based on minimum truck delivery volume.

Sulfuric Acid

The common compounds that limit RO recovery are calcium carbonate, sulfates of calcium, barium and strontium, silicates and calcium phosphate. Most of these compounds are kept soluble by lowering the pH of the RO feed water with economical doses of sulfuric acid. While it is unlikely that the AWPF will require pH adjustment of the RO feed water, the sulfuric acid dose, if used, will be approximately 20.0 mg/L. Sulfuric acid will be fed upstream of the RO cartridge filters. The chemical will be flow paced based on the RO feed flow rate, and trimmed based on pH. **Table 5-25** presents the design criteria for the sulfuric acid storage and feed system.

Table 5-25: Sulfuric Acid Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
RO Feed Flow, Design	20,425 gpm = 29.4 mgd	28,595 gpm = 41.2 mgd
RO Feed Flow, Minimum	4,090 gpm = 5.9 mgd	4,090 gpm = 5.9 mgd
Concentration	93%	93%
Specific Gravity	1.84	1.84
Demand		
Dose, Design	20 mg/L	20 mg/L
Dose, Minimum	15 mg/L	15 mg/L
Daily Demand (as 100%)	4,906 ppd	6,868 ppd
Daily Demand	344 gpd	481 gpd
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	2 Duty, 0 Standby
Days of Storage	30 days	30 days
Total Storage Volume Required	10,300 gal	14,400 gal
Tank Volume, each	7,400 gal	7,400 gal
Tank Diameter	10 ft	10 ft
Tank Type	Horizontal Carbon Steel	Horizontal Carbon Steel
Pumps		
No. of Pumps	2 Duty, 1 Standby	3 Duty, 1 Standby
Pump Capacity, each	7.4 gph	7.4 gph
Pump Type	Diaphragm Metering	Diaphragm Metering

Hydrogen Peroxide

As discussed in Section 5.3.10, hydrogen peroxide will be added to the RO permeate flow for AOP. The hydrogen peroxide dose will be approximately 5.0 mg/L. The chemical will be flow paced based on the AOP feed flow rate. **Table 5-26** presents the design criteria for the hydrogen peroxide storage and feed system.

Table 5-26: Hydrogen Peroxide Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
AOP Feed Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Feed Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Concentration	50%	50%
Specific Gravity	1.19	1.19
Demand		
Dose, Design	5.0 mg/L	5.0 mg/L
Dose, Minimum	1.0 mg/L	1.0 mg/L
Daily Demand (as 100%)	1,043 ppd	1,460 ppd
Daily Demand	210 gpd	294 gpd
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	2 Duty, 0 Standby
Days of Storage	30 days	30 days
Total Storage Volume Required	6,300 gal	8,800 gal
Tank Volume, each	5,100 gal	5,100 gal
Tank Diameter	10 ft	10 ft
Tank Type	Vertical HDPE	Vertical HDPE
Pumps		
No. of Pumps	5 Duty, 1 Standby	7 Duty, 1 Standby
Pump Capacity, each	1.9 gph	1.9 gph
Pump Type	Diaphragm Metering	Diaphragm Metering

Carbon Dioxide

As discussed in Section 5.3.11, carbon dioxide will be used in conjunction with calcium chloride and caustic soda for post-treatment/stabilization of AOP product flow. Carbon dioxide will be added first, followed by calcium chloride, and caustic soda will be added last.

The carbon dioxide dose will be approximately 15 mg/L. The chemical will be flow paced based on the AOP product flow rate. **Table 5-27** presents the design criteria for the carbon dioxide storage and feed system.

Table 5-27: Carbon Dioxide Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
AOP Product Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Product Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Demand		
Dose, Design	15 mg/L	15 mg/L
Daily Demand (as 100%)	3,130 ppd	4,380 ppd
Storage		
No. of Storage Tanks	2 duty, 1 standby	2 duty, 1 standby
Days of Storage	30 days	30 days
Total Storage Volume Required	47 ton	66 ton
Tank Capacity, each	34 ton	34 ton
Tank Volume, each	12,000 gallons	12,000 gallons
Tank Diameter	8 ft	8 ft
Tank Type	Stainless Steel	Stainless Steel
Vaporizer		
No. of Units	2 duty, 1 standby	2 duty, 1 standby
Condenser		
No. of Units	2 duty, 1 standby	2 duty, 1 standby

Calcium Chloride

As discussed in Section 5.3.11, calcium chloride will be added to the AOP product flow for post-treatment/stabilization. The calcium chloride dose will be approximately 18.5 mg/L. The chemical will be flow paced based on the AOP product flow rate. **Table 5-28** presents the design criteria for the calcium chloride storage and feed system.

Table 5-28: Calcium Chloride Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
AOP Product Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Product Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Concentration	34.7%	34.7%
Specific Gravity	1.35	1.35
Demand		
Dose, Design	18.5 mg/L	18.5 mg/L
Dose, Minimum	10 mg/L	10 mg/L
Daily Demand (as 100%)	3,860 ppd	5,400 ppd
Daily Demand	990 gpd	1,380 gpd
Storage		
No. of Storage Tanks	3 Duty, 0 Standby	4 Duty, 0 Standby
Days of Storage	30 days	30 days
Total Storage Volume Required	29,600 gal	41,500 gal
Tank Volume, each	12,150 gal	12,150 gal
Tank Diameter	12 ft	12 ft
Tank Type	Vertical HDPE	Vertical HDPE
Pumps		
No. of Pumps	2 Duty, 1 Standby	3 Duty, 1 Standby
Pump Capacity, each	21.3 gph	21.3 gph
Pump Type	Diaphragm Metering	Diaphragm Metering

Sodium Hydroxide (Caustic Soda)

As discussed in Section 5.3.11, caustic soda will be fed into the AOP product flow, downstream of the calcium chloride and carbon dioxide feed locations for post-treatment/stabilization. The caustic soda dose will be approximately 18 mg/L. The chemical will be flow paced based on the AOP product flow rate, and trimmed based on pH.

Also, caustic soda will be used intermittently for the neutralization of MF CIP waste, and RO CIP and CIP waste neutralization.

Table 5-29 presents the design criteria for the caustic soda storage and feed system.

Table 5-29: Caustic Soda Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
AOP Product Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Product Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Concentration	50%	50%
Specific Gravity	1.53	1.53
Demand for Post-Treatment/Stabilization		
Dose, Design	18 mg/L	18 mg/L
Dose, Minimum	10 mg/L	10 mg/L
Daily Demand (as 100%)	3,750 ppd	5,250 ppd
Daily Demand	590 gpd	820 gpd
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	3 Duty, 0 Standby
Days of Storage	30 days	30 days
Total Storage Volume	17,600 gal	24,700 gal
Tank Volume, each	9,100 gal	9,100 gal
Tank Diameter	10 ft	10 ft
Tank Type	Vertical FRP or HDPE	Vertical FRP or HDPE
Pumps for Post-Treatment/Stabilization		
No. of Pumps	2 Duty, 1 Standby	3 Duty, 1 Standby
Pump Capacity, each	12.7 gph	12.7 gph
Pump Type	Diaphragm Metering	Diaphragm Metering
Transfer Pumps (Transfer to Day Tanks for MF CIP Waste Neutralization and RO CIP/Neutralization)		
No. of Pumps	1 Duty, 1 Standby	1 Duty, 1 Standby
Pump Capacity, each	TBD gpm	TBD gpm
Pump Type	TBD	TBD

Citric Acid

Citric acid will be used for the cleaning of the MF membranes and RO membranes. **Table 5-30** presents the design criteria for the citric acid storage and feed system. The cleaning requirements are specific to each membrane system vendor, so the citric acid system design would be completed after the MF equipment preselection.

Table 5-30: Citric Acid Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	2 Duty, 0 Standby
Days of Storage	1 month	1 month
Total Storage Volume Required	TBD gal	TBD gal
Tank Volume (each)	TBD gal	TBD gal
Tank Diameter	TBD ft	TBD ft
Tank Type	Vertical HDPE	Vertical HDPE
Transfer Pumps (Transfer to Day Tanks for MF CIP and RO CIP/Neutralization)		
No. of Pumps	1 Duty, 1 Standby	1 Duty, 1 Standby
Pump Capacity, each	TBD gpm	TBD gpm
Pump Type	TBD	TBD

Sodium Bisulfite

Sodium bisulfite will be added downstream of the AOP to quench any residual hydrogen peroxide present after the AOP. The chemical will be flow paced based on the AOP product flow rate, and downstream ORP will be monitored.

In addition, sodium bisulfite will be used for the pickling of MF and RO membranes when the membrane systems are put offline for extended periods of time.

Table 5-31 presents the design criteria for the sodium bisulfite storage and feed system.

Table 5-31: Sodium Bisulfite Storage and Feed System Design Criteria

Parameter	Phase 1	Phase 2
AOP Product Flow, Design	17,360 gpm = 25.0 mgd	24,300 gpm = 35.0 mgd
AOP Product Flow, Minimum	3,470 gpm = 5.0 mgd	3,470 gpm = 5.0 mgd
Concentration	38%	38%
Specific Gravity	1.33	1.33
Demand for Quenching Peroxide Residual		
Dose, Design	14.3 mg/L	14.3 mg/L
Dose, Minimum	2.9 mg/L	2.9 mg/L
Daily Demand (as 100%)	2,980 ppd	4,170 ppd
Daily Demand	710 gpd	990 gpd
Storage		
No. of Storage Tanks	2 Duty, 0 Standby	3 Duty, 0 Standby
Days of Storage	30 days	30 days
Total Storage Volume	21,200 gal	29,700 gal
Tank Volume, each	10,300 gal	10,300 gal
Tank Diameter	12 ft	12 ft
Tank Type	Vertical FRP	Vertical FRP
Heat Trace/Insulate	Yes	Yes
Pumps for Quenching Peroxide Residual		
No. of Pumps	5 Duty, 1 Standby	7 Duty, 1 Standby
Pump Capacity, each	6.6 gph	6.6 gph
Pump Type	Diaphragm Metering	Diaphragm Metering
Transfer Pumps (Transfer to Day Tanks for MF and RO Membranes Pickling)		
No. of Pumps	1 Duty, 1 Standby	1 Duty, 1 Standby
Pump Capacity, each	TBD gpm	TBD gpm
Pump Type	TBD	TBD

5.3.14 MF Backwash and RO Concentrate Disposal

The waste side-streams of the AWPF include MF backwash waste, RO concentrate, and spent CIP solutions. It is assumed these waste side-streams, including RO concentrate, from the AWPF would be discharged to the Hyperion Service Area (HSA) for treatment at the HTP.

As discussed in the *Long-Term Concept Report*, an evaluation conducted for the City looked at the potential impacts of discharging RO concentrate to HTP and estimated that the TDS at HTP influent would increase by approximately 200 mg/L (from 800 mg/L to 1,000 mg/L). The *Draft Long-Term Concept Report*, which also looked at existing variability in the HTP influent TDS, concluded that implementation of the AWPF at DCTWRP would maintain the TDS concentration at or below 1,000 mg/L, which is desired for landscape irrigation. Other discharge alternatives evaluated were cost-prohibitive and are not considered for the AWPF at DCTWRP. However, the *Draft Long-Term Concept Report* noted that any additional AWPFs after implementation of the proposed facility at DCTWRP could be a significant impact to the TDS levels at HTP and West Basin WRF and recommended that a more detailed and in-depth study be completed on the impacts at HTP and the WBWRP before any decisions are made concerning RO concentrate disposal in the long-term.

The waste side-streams from the AWPF will be discharged to Additional Valley Outfall Relief Sewer (AVORS), the nearest outfall sewer at DCTWRP to be treated at HTP. The waste side-streams from the AWPF are summarized in **Table 5-32.**

Table 5-32: AWPF Waste Side-Streams Flows

Flows	Frequency	% of Feed Flows	TDS (mg/L)	Phase 1	Phase 2
MF Pre-Filters Backwash Flows	Intermittent	2% of AWPF Influent Flow	Average 500 Maximum 640	400 gpm (0.6 mgd)	600 gpm (0.9 mgd)
MF Backwash Waste Flows	Intermittent	5% of AWPF Influent Flow	Average 500 Maximum 640	1,100 gpm (1.6 mgd)	1,500 gpm (2.2 mgd)
RO Concentrate Flows	Continuous	15% of RO Feed Flow	Average 3,200 Maximum 4,200	3,100 gpm (4.4 mgd)	4,300 gpm (6.2 mgd)
Total			**Average 2,300** **Maximum 3,000**	**4,600 gpm** **(6.6 mgd)**	**6,400 gpm** **(9.3 mgd)**

Note: All flows are in daily average.

The AWPF backwash/concentrate flows will discharge on the east side of the MF/RO building and subsequently convey northward along SWRP Way in a proposed 36-inch HDPE sewer to an existing junction structure next to the existing 96-inch AVORS to be further conveyed to HTP. **Figure 6-6** shows the preliminary alignment of the backwash/concentrate discharge pipeline.

See **Table 5-33** for a summary of the backwash/concentrate pipe design criteria.

Table 5-33: Backwash/Concentrate Pipe Design Criteria

Parameter	Type/Value
Material	HDPE
Diameter	36 inch
Slope, Minimum	0.1%
Velocity, Maximum	5 fps
Percent Full, Maximum	75 %

Existing utilities within the disposal pipeline alignment will need to be considered to mitigate vertical and horizontal utility conflicts. Existing utilities along SWRP Way are shown on **Figure 6-6** and include ductbanks, sewer lines/drains, potable water, and lighting conduits.

The existing junction structure where connection is proposed currently receives influent from a 20-inch scum disposal pipeline from the Phase 1 Secondary Clarifiers before conveying flow to the AVORS via a 20-inch connector pipeline. To maintain pipeline capacity for both the AWPF backwash/concentrate flows and the DCTWRP scum flow, the connector pipe between the junction structure and the AVORS will be expanded to a 48-inch pipeline.

5.3.15 Ancillary Facilities

Ancillary facilities at the AWPF include:

- MF System
    - MF Backwash System, including Backwash Pumps
    - MF Blowers and Air Compressors
    - MF Clean-In-Place (CIP) System, including CIP/Neutralization Tanks, CIP Pumps, CIP Chemical Day Tanks, and CIP Chemical Metering Pumps
- RO System
    - RO Flush System, including Flush Tanks and Flush Pumps
    - RO CIP System, including CIP/Neutralization Tanks, CIP Pumps, CIP Chemical Day Tanks, and CIP Chemical Metering Pumps

The ancillary facilities for the MF system will be located near the MF system, on the second floor of the MF/RO building, as shown on **Figures 5-6 and 5-7**. The ancillary facilities for the RO system will be located near the RO system, on the first floor of the MF/RO building, as shown on **Figures 5-8 and 5-9**.

5.3.16 DCTWRP Primary Equalization Storage

The DCTWRP secondary treatment system is limited to a maximum capacity of 80 mgd. Therefore, to be able to produce a constant secondary or tertiary effluent flow of 80 mgd, primary flow equalization (EQ) is needed to feed the secondary treatment system at a constant rate of 80 mgd. The primary flow EQ is needed to capture the peak diurnal flows (when the

DCTWRP influent flow available exceeds 80 mgd) and treat them during the night-time, low flow periods (when the DCTWRP influent flow available is less than 80 mgd).

Existing Primary Flow EQ Capacities at DCTWRP

DCTWRP currently utilizes Phase III primary clarifiers as primary flow EQ storage volume. The nine Phase III primary clarifiers have a total volume of approximately 3.24 million gallons (MG). As part of the DCTWRP In-Plant Wet Weather Storage Project, BOS plans to convert six of the Phase II primary clarifiers to EQ basins, which will provide additional 2.16 MG of primary flow EQ capacity. Once this conversion is complete, DCTWRP will have a total of 5.40 MG of primary flow EQ volume that could be used to equalize the diurnal flow variations during the dry weather. During rain events, the 5.40 MG of primary EQ volume will be reserved for wet weather flow storage.

In addition, two wet weather storage basins are currently being constructed east of the aeration tanks and secondary clarifiers as part of the In-Plant Wet Weather Storage Project, as shown on **Figures 6-1 and 6-2**. However, these two storage basins will be used for temporary storage, without treatment, of wet weather flows and will not be available for primary flow EQ due to the basin configurations and plant hydraulics.

See **Table 5-34** for a summary of the existing and planned primary flow EQ volumes.

Table 5-34: Primary Flow EQ Volume Summary – Existing and Planned

	Primary EQ Storage Volume (MG)
Existing and Planned Primary Flow EQ Volume	**5.40**
Converted Nine Phase III Primary Clarifiers	*3.24*
Planned Conversion of Six Phase II Primary Clarifiers	*2.16*

Projected DCTWRP Influent Flows

The projected maximum influent flows to DCTWRP were estimated in the *Draft DCT Maximum Flow Assessment TM* as summarized in **Table 5-35**.

Table 5-35: Comparison of Total DCTWRP Influent Estimates[a]

Estimate	Flow (mgd)							
	2008	2010	2015	2020	2025	2030	2035	2040
Primary Sewer Basin ADWF Projections [b]	67.8	68.5	69.6	70.9	72.2	74.5	76.9	79.2
ADWF Projections Using MIKE URBAN Model Results	77.8	78.4	79.9	81.5	83.0	85.5	88.1	90.7
% Difference	14.7%	14.5%	14.8%	15.0%	14.8%	14.8%	14.6%	14.5%
Average	**72.8**	**73.5**	**74.8**	**76.2**	**77.6**	**80.0**	**82.5**	**85.0**

Footnotes:

a. Assumes flow diversions in the sewer system to route all DCTWRP-tributary wastewater to DCTWRP as outlined in the *Draft DCT Maximum Flow Assessment TM*.
b. Assumes 75% of the Pacoima and Van Nuys-Sylmar primary basin flows are tributary to DCT.

Projected DCTWRP Influent Flows for Phase 1

Based on the projected flows summarized in **Table 5-35**, the average daily influent flow of 76.2 mgd for year 2020 is assumed for Phase 1 of the GWR project, which is scheduled to be implemented by year 2022.

The peaking factors for the weekday and weekend diurnal curves are based on the January 7, and January 8, 2005, flow data generated by the MIKE URBAN Model, respectively. Since DCTWRP receives influent wastewater from AVORS and East Valley Interceptor Sewer (EVIS), the diurnal flow curves for these two outfall sewers were extracted from the MIKE URBAN Model and combined to generate overall diurnal curves for DCTWRP.

Using the projected average daily flow of 76.2 mgd for year 2020, and the diurnal flow peaking factors from year 2005, the estimated weekday and weekend diurnal flow curves and effluent flow distribution for DCTWRP for year 2020 were generated as shown on **Figures 5-17 and 5-18**, respectively.

Figure 5-17: DCTWRP Influent Diurnal Flow Curve and Effluent Flow Distribution – Weekday for Year 2020

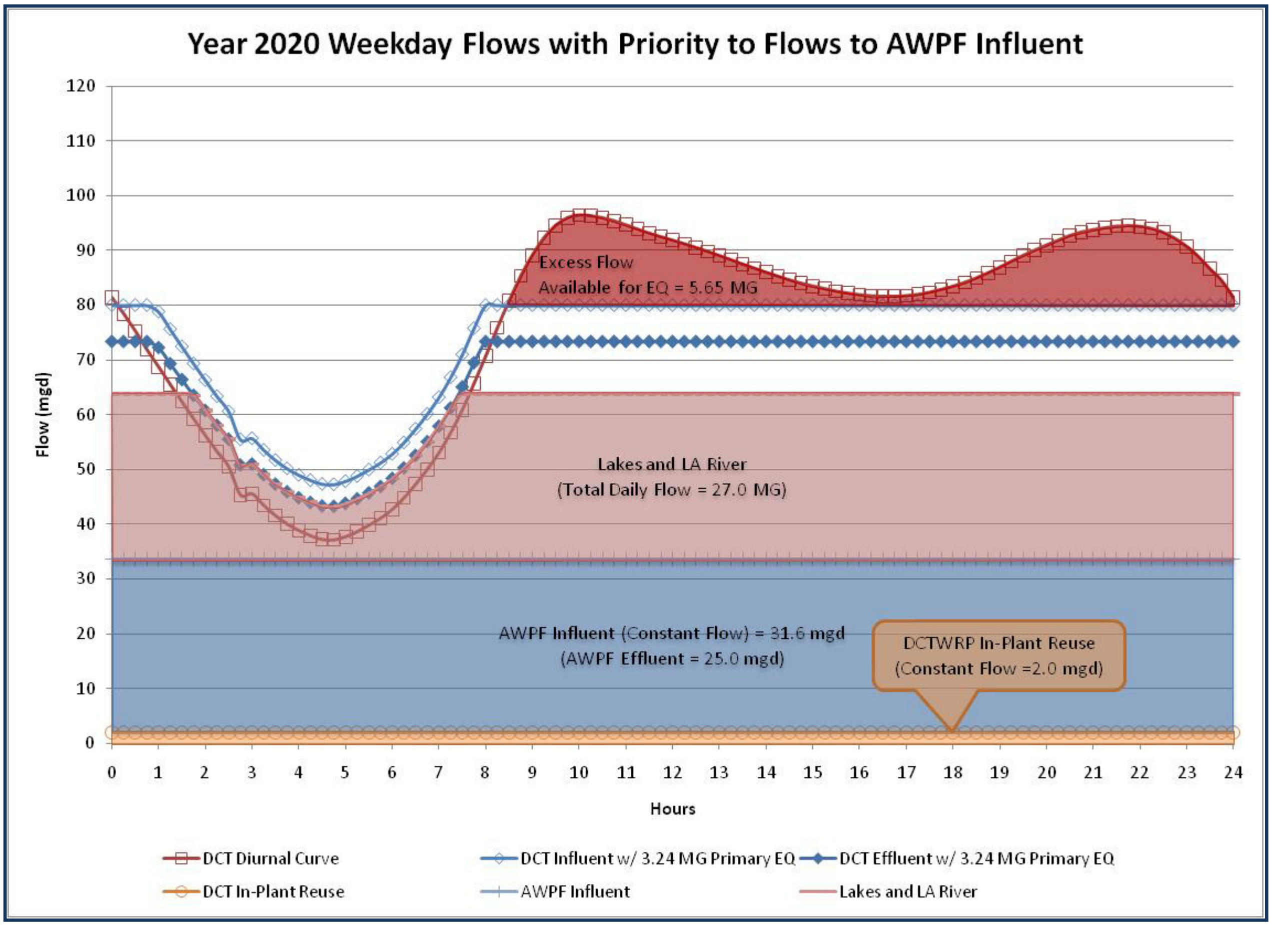
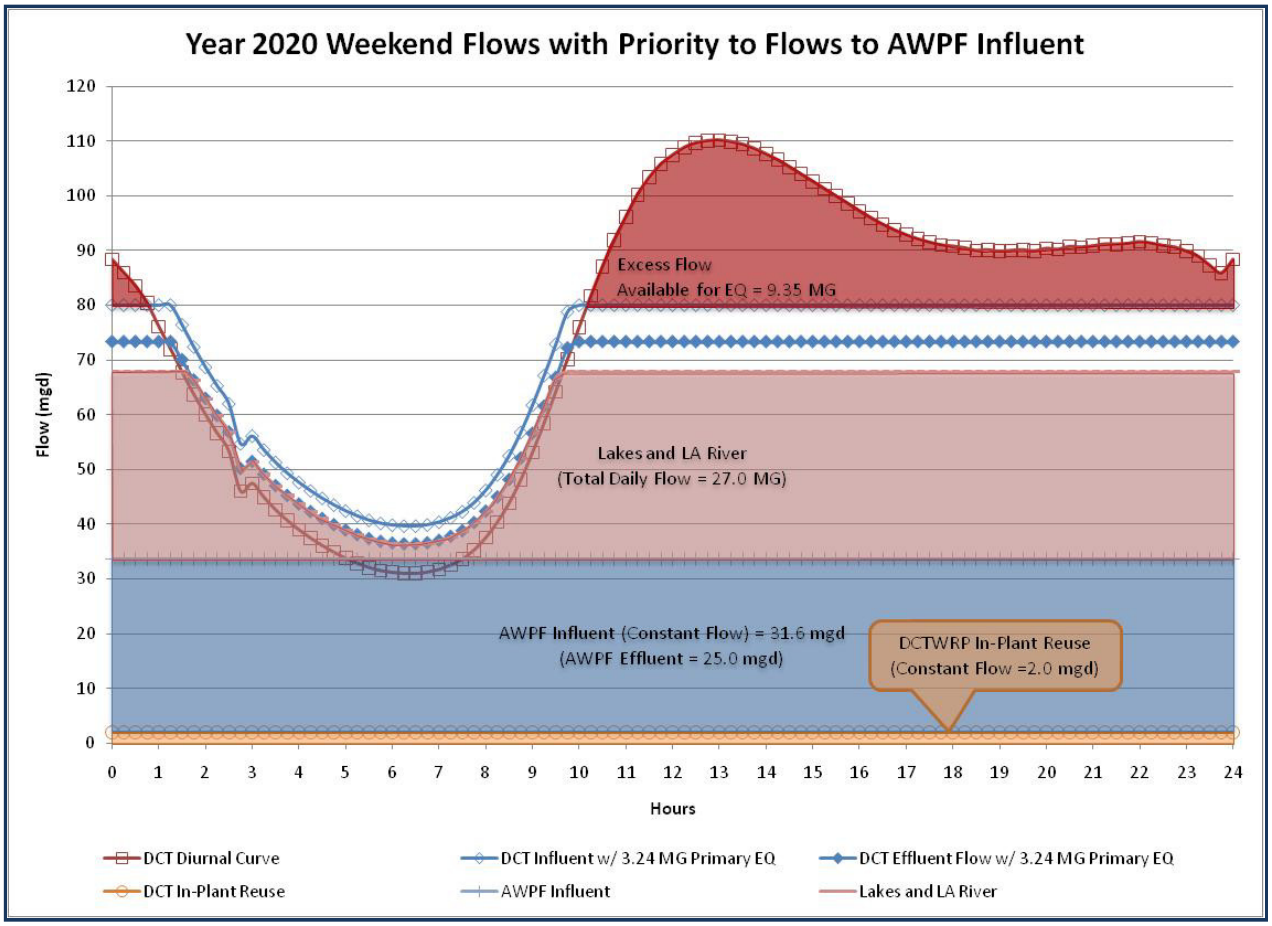


Figure 5-18: DCTWRP Influent Diurnal Flow Curve and Effluent Flow Distribution – Weekend for Year 2020



As shown on **Figures 5-17 and 5-18**, all flow requirements, including 2.0 mgd flow for DCTWRP influent reuse, 31.6 mgd AWPF influent, and 27 MG total flow to lakes and LA River per day could be satisfied with existing 3.24 MG of primary flow EQ. As shown in **Figures 5-17 and 5-18**, the flow to the lakes and LA River would be varied throughout the day to maintain a constant flow to the AWPF. A daily total of 27 MG to the lakes and LA River would be met.

Required Primary Flow EQ Capacity for Phase 1

The existing 3.24 MG of primary flow EQ capacity is sufficient to provide continuous AWPF influent flow of 31.6 mgd for Phase 1 AWPF operation.

Projected DCTWRP Influent Flows for Phase 2

Based on the projected flows summarized in **Table 5-35**, the average daily influent flow of 80.0 mgd for year 2030 is assumed for Phase 2 of the GWR project to estimate a conservative EQ capacity since Phase 2 is scheduled to be implemented by year 2035.

The peaking factors for the weekday and weekend diurnal curves for the Phase 2 analysis were based on the year 2050 diurnal flow curves provided by BOS, which reflect the current network settings. BOS indicated that the diversions in the sewer system will need to be changed back to the current network settings in order to avoid relief of the EVIS by around the year 2050. These diurnal flow curves for year 2050 have lower troughs than the diurnal flow curves for year 2005 and therefore are more conservative. Also, the year 2050 diurnal flow curves show average daily flows of 80.6 mgd on weekdays and 75.4 mgd on weekends, which is lower than the estimated 2030 flow projections of 80.0 mgd, which assumes the sewer system diversions to route wastewater to DCTWRP. As explained in **Table 3-6** of Section 3.6, an influent wastewater flow of 80.0 mgd is needed to produce a tertiary effluent of 73 mgd to have sufficient tertiary effluent for all end uses (in-plant reuse, AWPF feed, and lakes/LA River). Therefore, the available influent flows to DCTWRP will need to be monitored closely during implementation of Phase 2 AWPF expansion and the City may need to make provisions to keep the diversions in place to make sure there will be enough AWPF tertiary effluent to feed the AWPF.

Using the projected average daily flow of 80.0 mgd for year 2030 (**Table 5-35**), and the diurnal flow peaking factors from year 2050, the estimated weekday and weekend diurnal flow curves for DCTWRP for year 2030 were generated as shown on **Figures 5-19 and 5-20**, respectively.

Figure 5-19: DCTWRP Influent Diurnal Flow Curve – Weekday for Year 2030

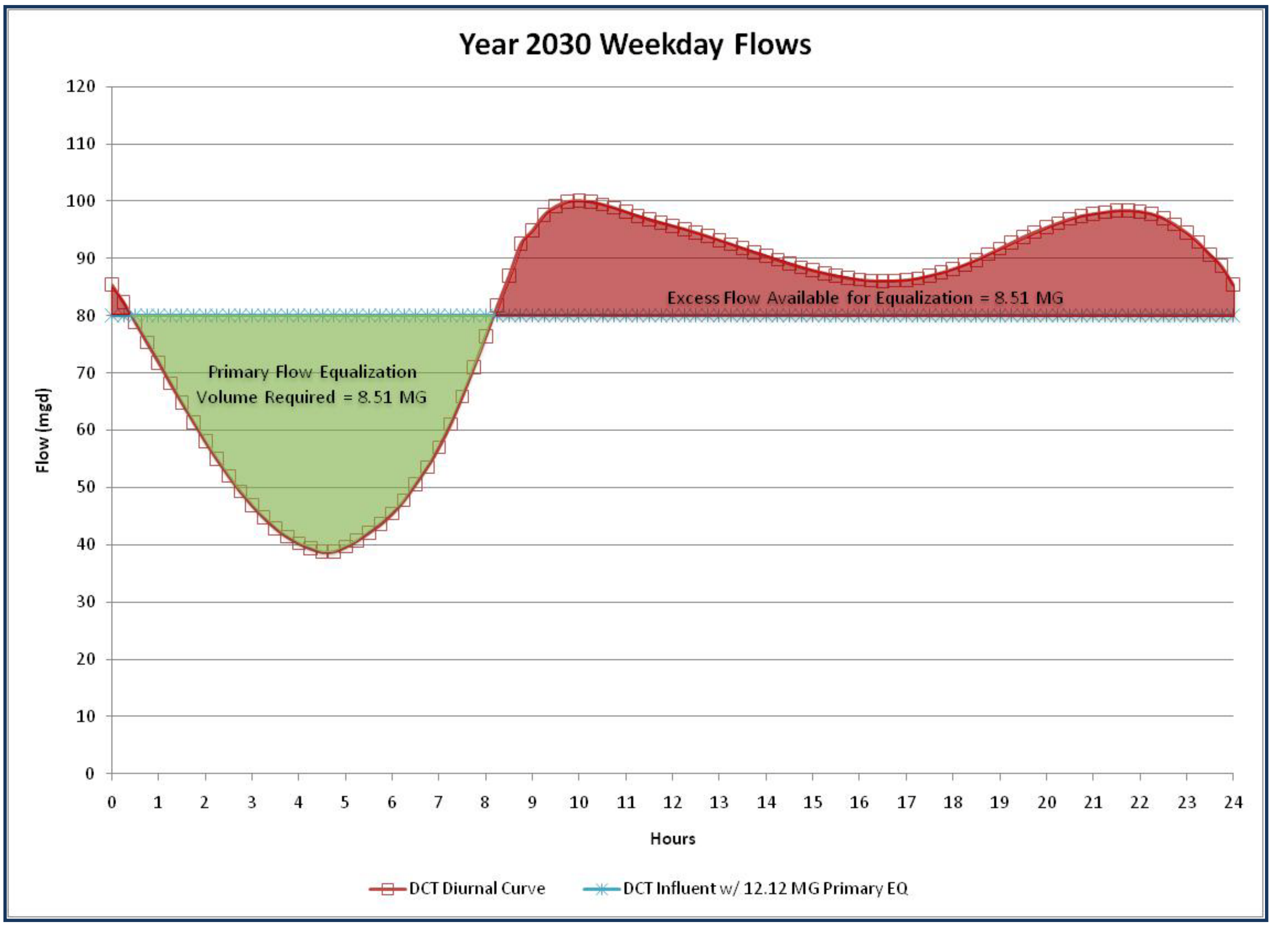
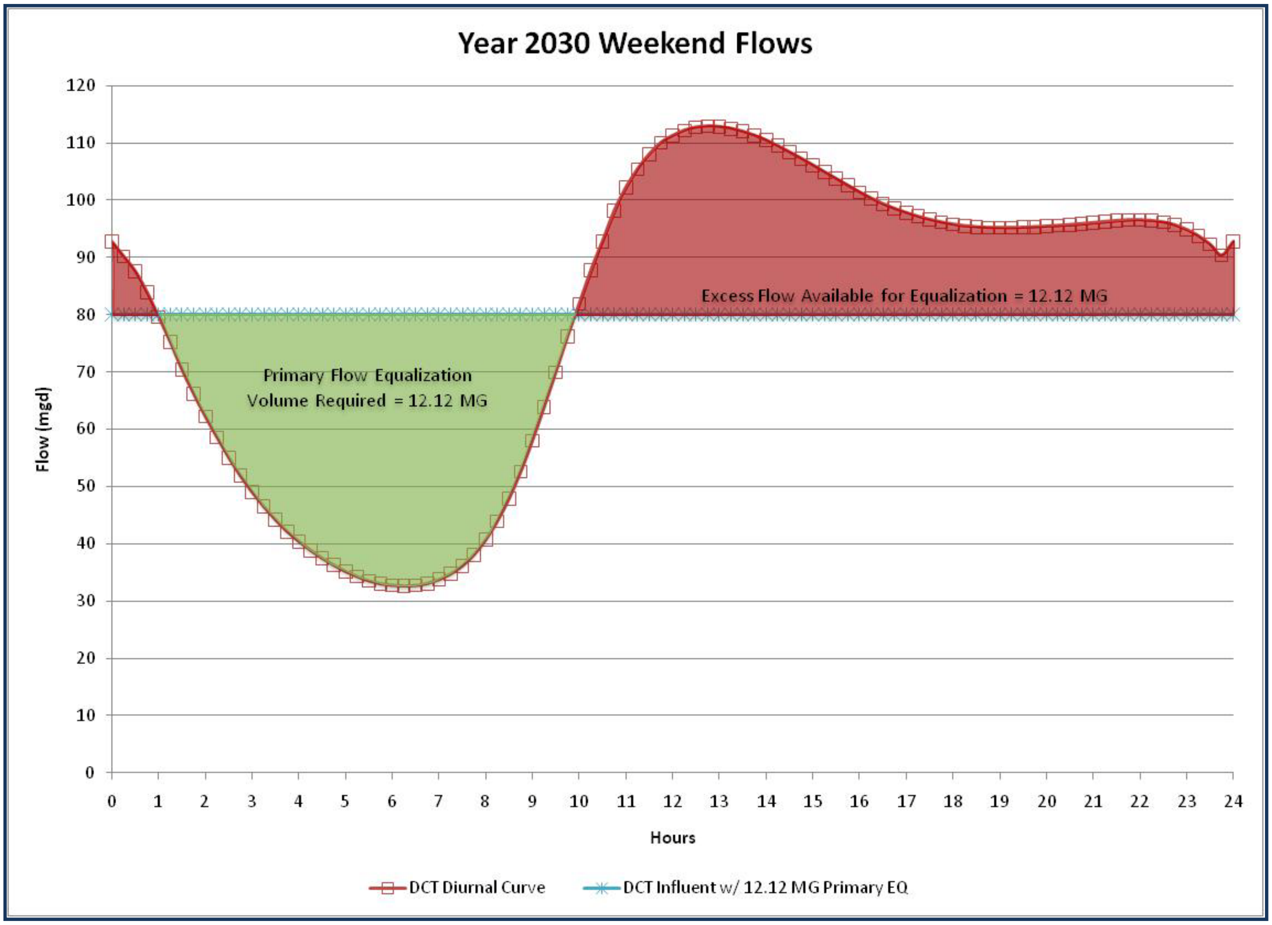


Figure 5-20: DCTWRP Influent Diurnal Flow Curve – Weekend for Year 2030



As shown on **Figures 5-19, and 5-20**, the total primary flow EQ capacity required is 8.51 MG on weekdays and 12.12 MG on weekends to provide constant 80 mgd influent flow to DCTWRP.

The DCTWRP effluent flow distribution between DCTWRP in-plant reuse (2.0 mgd), AWPF influent (44.3 mgd), and flows to Lakes and LA River (27.0 mgd), for weekdays and weekends for year 2030, is shown on **Figures 5-21 and 5-22**, respectively.

Figure 5-21: DCTWRP Influent Diurnal Flow Curve and Effluent Flow Distribution – Weekend for Year 2030

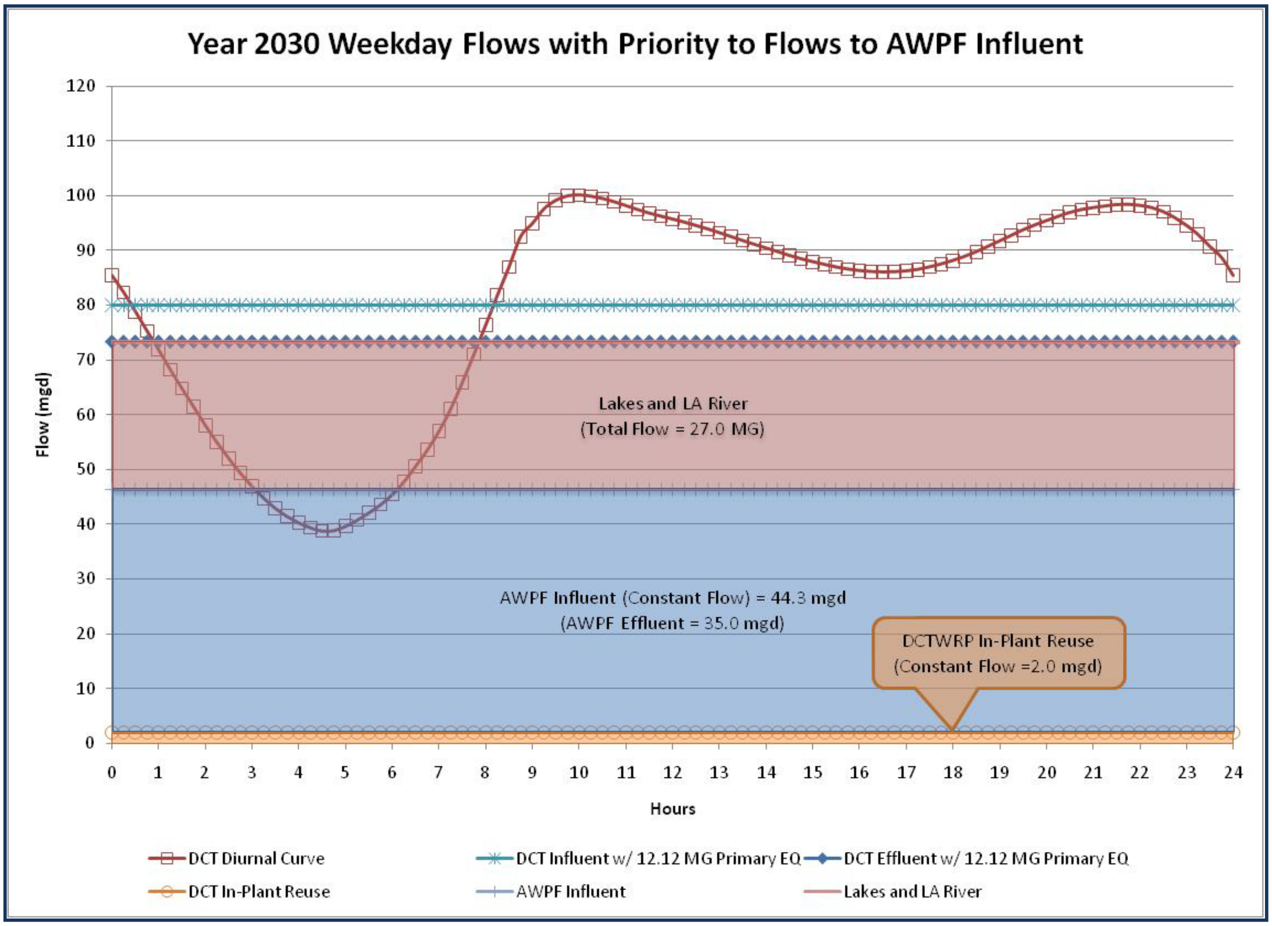
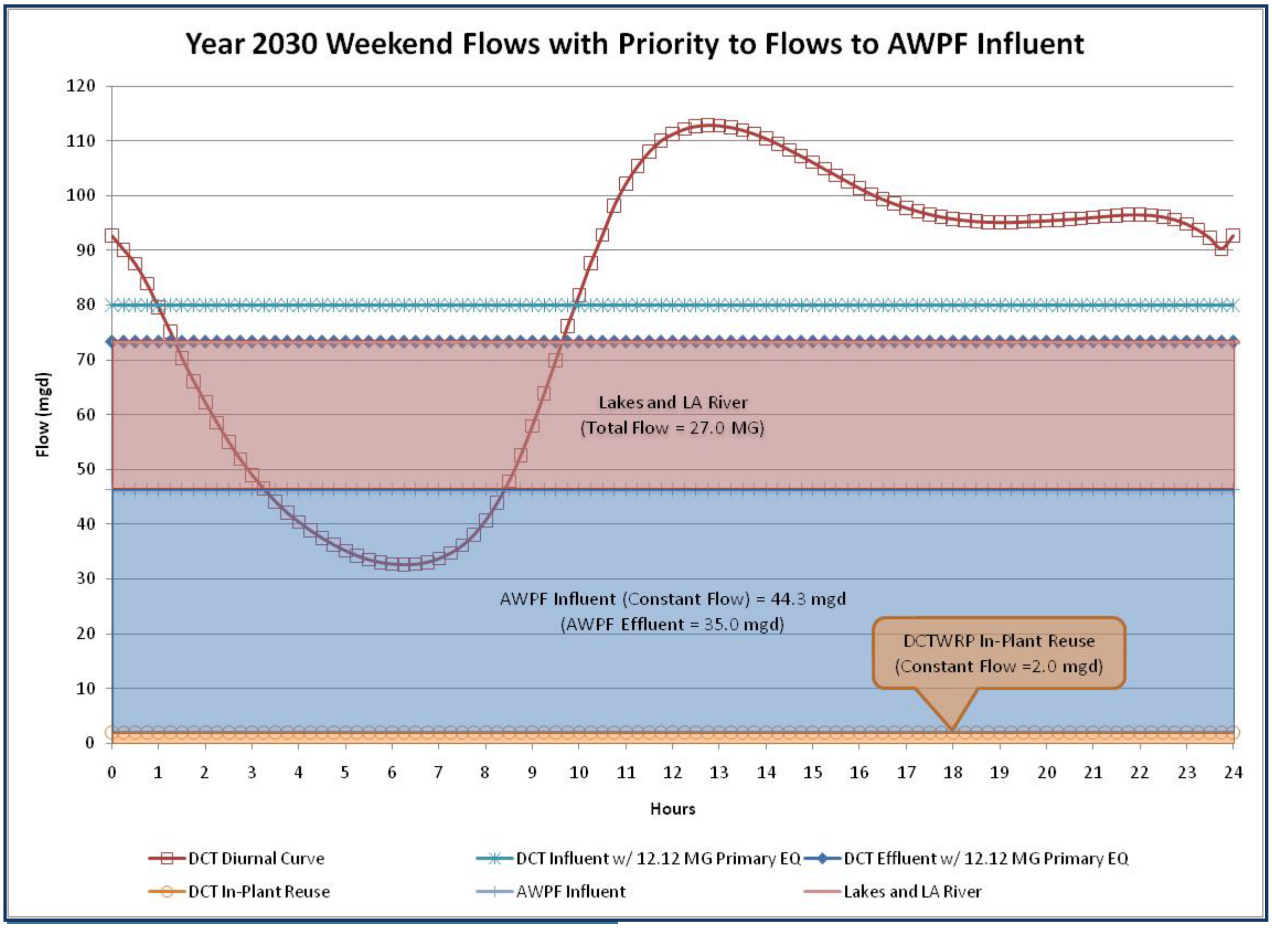


Figure 5-22: DCTWRP Influent Diurnal Flow Curve and Effluent Flow Distribution – Weekend for Year 2030



For Phase 2 of the GWR project, a total of 12.12 MG of primary flow EQ volume is needed to equalize influent wastewater flows to produce a constant secondary/tertiary effluent for the end uses (in-plant reuse, lakes/LA River, and AWPF feed). Since there will be 5.40 MG of EQ volume after BOS converts six of the Phase II clarifiers, this means that 6.72 MG of additional EQ volume is required for Phase 2, as summarized in **Table 5-36**.

Table 5-36: Additional Primary Flow EQ Volume Required for Phase 2

	Primary EQ Storage Volume (MG)
Total Primary Flow EQ Volumes Required [1]	12.12
Existing and Planned Primary Flow EQ Volume	5.40
Additional Primary Flow EQ Volume Required for Phase 2	**6.72**

Notes:
1) Based on weekend diurnal flow conditions for Year 2030.

A future expansion of the primary flow EQ volume would consist of constructing the next phase of primary clarifiers, i.e. Phase IV. The Phase IV primary clarifiers will provide the additional 7.02 MG of storage volume with thirteen 300 ft x 20 ft tanks installed between the Phase III primary clarifiers and Teibo Drive, as shown on **Figures 6-3 and 6-4**. Two existing trailers to the north that currently serve as temporary DCTWRP lab/offices will be removed after construction of the lab building is completed to enable the installation of the Phase IV primary clarifiers, which will be longer than the existing Phases I – III primary clarifiers. See **Table 5-37** for a summary of the Phase IV primary clarifiers/EQ basins design criteria.

Table 5-37: Phase 1V Primary Clarifiers/EQ Basins Design Criteria

Phase IV Primary Clarifiers/EQ Basins	Value
No. of Tanks	13
Individual Tank Configuration	
Length	300 ft
Width	20 ft
Average Flow Depth	12 ft
Volume	0.54 MG
Total Phase IV Flow EQ Volume	7.02 MG

5.4 System Reliability and Redundancy

The AWPF will be provided with sufficient redundancies built into the design of the process equipment to achieve the target 92 percent online factor described in Section 3.6. **Table 5-38** summarizes the redundancies for each process equipment. Electrical system reliability and standby power for AWPF are discussed in Section 7.5.

Table 5-38: AWPF Process Equipment Redundancies

Process Equipment	Level of Redundancy	Description
MF System		
MF Feed Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
MF Strainers	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
MF	N+1 Design	All units will be operated under normal conditions. Will not exceed average design flux with one unit offline. Will not exceed maximum instantaneous flux with one unit offline and one unit in backwash mode.
MF Backwash Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
MF Blowers	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
MF Air Compressors	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
MF CIP/Neutralization Tanks	2 Duty Tanks	MF CIP could be delayed if one unit if offline for maintenance or fails.
MF CIP Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
Day Tanks for MF Cleaning Chemicals	0 Standby	Portable drums could be used of MF CIP could be delayed if tank is offline for maintenance or fails.
Metering Pumps for MF Cleaning Chemicals	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
RO System		
MF/RO Break Tank	2 Duty Cells	Will have 50% flow equalization capacity when one cell is offline for maintenance.
RO Transfer Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.

Table 5-38: AWPF Process Equipment Redundancies (Continued)

Process Equipment	Level of Redundancy	Description
Cartridge Filters	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
RO Feed Pumps		Each RO feed pump is designated to one RO train.
RO	N+1 Design	Will have full capacity when one unit is offline for maintenance or fails. Will have full capacity when one unit is offline for maintenance.
RO Flush Tanks	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
RO Flush Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
RO CIP/Neutralization Tanks	2 Duty Tanks	RO CIP could be delayed if one unit if offline for maintenance or fails.
RO CIP Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
Day Tanks for RO Cleaning Chemicals	0 Standby	Portable drums could be used of RO CIP could be delayed if tank is offline for maintenance or fails.
Metering Pumps for RO Cleaning Chemicals	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
UV System		
UV	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
Chemical Storage and Feed System		
Chemical Storage Tanks (Sodium Hypochlorite)	Minimum 2 Duty Tanks	Will have minimum 7 days of storage with one tank offline for maintenance or fails.
Chemical Storage Tanks (All other chemicals)	Minimum 2 Duty Tanks	Will have minimum 14 days of storage with one tank offline for maintenance or fails.
Chemical Metering Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.
Chemical Transfer Pumps	1 Standby Unit	Will have full capacity when one unit is offline for maintenance or fails.

5.5 AWPF Overall Operational Strategy

The operations of the AWPF will need to be modified under various conditions, including:

- Unavailability of GWR spreading grounds;
- AWPF power outages;
- AWPF equipment failure;
- AWPF treatment process upsets; and,
- Groundwater basin conditions upsets.

The AWPF operational strategies under these conditions and shut-down protocol are described below.

5.5.1 AWPF Operation during Unavailability of Spreading Grounds

When the spreading grounds are not available for the GWR of purified recycled water, due to the spreading of the stormwater as described in Section 3.4, the operations of the AWPF will need to be modified. While the GWR of purified recycled water could be interrupted in accordance with LACDPW's operations of the spreading grounds, the service of purified recycled water to NPR users (especially the industrial users, such as VGS), that require continuous supply, cannot be interrupted. The options for producing purified recycled water for NPR demands are as follows:

- **Option 1 – Continue Operating AWPF at Full Capacity:** Of 70 mgd DCTWRP effluent, use 44.3 mgd for AWPF influent (35.0 mgd product water) and 2 mgd for DCTWRP in-plant reuse, and send the remaining 27 mgd to the Lakes/LA River. Of 35.0 mgd AWPF purified recycled water, use up to 8.1 mgd for NPR and send the remaining purified recycled water to LA River. If injection wells are constructed, the purified recycled water could be recharged via direct injection when spreading grounds are unavailable. Additionally, purified recycled water could potentially be recharged at the Strathern Wetlands Project.
- **Option 2 – Operate AWPF at Reduced Capacity:** Of 70 mgd DCTWRP effluent, use up to 11.1 mgd for AWPF influent (up to 8.8 mgd product water) and 2 mgd for DCTWRP in-plant reuse, and send the remaining 56.9 mgd to the Lakes/LA River. Use all AWPF purified recycled water for NPR (users who are served from the 54-inch pipeline). Additionally, purified recycled water could potentially be recharged at the Strathern Wetlands Project.
- **Option 3 – Shutdown AWPF and Serve Title 22 Water to NPR Users:** Send all 70 mgd effluent to the CCBs for Title 22 treatment. Of 70 mgd Title 22 water, use up to 8.1 mgd for NPR (Title 22 users) and 2 mgd for DCTWRP in-plant reuse, and send the remaining 59.9 mgd to the Lakes/LA River.
- **Option 4 – Shutdown AWPF and Serve Potable Water to NPR Users:** Send all 70 mgd effluent to the CCBs for Title 22 treatment. Of 70 mgd Title 22 water, use 2 mgd for DCTWRP in-plant reuse, and send the remaining 68 mgd of Title 22 water to the

Lakes/LA River. Switch to the potable water system to serve NPR users with potable water.

Table 5-39 summarizes the advantages and disadvantages of the options listed above.

Table 5-39: Comparison of Options for Producing Recycled Water for NPR Demands when Spreading Grounds are Unavailable

	Options	Advantages	Disadvantages
1	Continue Operating AWPF at Full Capacity	Minimal operational changes.	High O&M cost.
2	Operate AWPF at Reduced Capacity	Reduced O&M cost.	Requires operational changes, such as cycling water through MF and pickling RO membranes, to reduce AWPF production.
3	Shut Down AWPF and Serve Title 22 Water to NPR Users	Minimum O&M cost.	Requires operational changes, such as cycling water through MF and pickling RO membranes, to reduce AWPF production. May require additional water quality monitoring for sharing the exiting 54" pipe for both purified recycled water and Title 22 water. Non-irrigation NPR users, such as VGS, may not be receptive to variations in water quality when switching from purified recycled water to Title 22 water. May require additional communication with NPR users.
4	Shut Down AWPF and Service Potable Water to NPR Users	Reduced O&M cost. Infrastructure for switching to potable water already exists.	Requires operational changes, such as cycling water through MF and pickling RO membranes, to reduce AWPF production.

Based on the above evaluation, Options 2 and 4 are both viable.

AWPF Ramp-Down and Shut-Down Protocols

To operate the AWPF at reduced capacity (Option 2):

- If the reduced capacity operation is shorter than two weeks, the MF skids should be operated in cycles, and the RO membranes should be flushed to sit idle.
- If the reduced capacity operation is longer than two weeks, the MF skids should be operated in cycles, and the RO membranes should be "pickled" (i.e., stored immersed in protective solution containing approximately 0.1 percent to 1.0 percent food grade sodium bisulfite).

To shut down the AWPF (Options 3 and 4):

- If the shutdown is shorter than two weeks, the MF and RO membranes should be flushed to sit idle.
- If the shutdown is shorter than two weeks, the MF and RO membranes should be pickled.

5.5.2 AWPF Operation during Power Outages

The operations of the AWPF will need to be modified when DCTWRP experiences plant power outages. The AWPF will not have emergency backup power as it is not a critical process.

- For momentary outages, the AWPF could be restarted when the power is restored.
- For extended outages (i.e., outages lasting longer than 5 to 10 minutes), the RO system should be flushed after 2 minutes of outage using RO flush system, which will be on backup power. The AWPF could then be restarted when the power is restored.

5.5.3 AWPF Operation during Equipment Failure

As described in Section 5.4, the AWPF is designed with sufficient redundancies built into the design of the process equipment, such that the equipment failures do not result in loss of production. As described in **Table 5-38**, for most equipment failures, standby units could be operated, membranes could be operated at higher flux, or chemicals delivered more frequently, until the respective equipment is fixed.

However, in the unlikely case of pipe failures, the AWPF must be shut down until the pipe is repaired. The AWPF shut-down protocol described in Section 5.5.1 should be followed.

5.5.4 AWPF Operation during Treatment Process Upsets

The operations of the AWPF will need to be modified when the purified recycled water quality does not meet permit requirements. The permit requirements will depend on many factors, including:

- Whether the purified recycled water will be used for GWR using spreading grounds only, or if injection wells will also be used for direct injection
- Changing regulations, such as the groundwater recharge regulations, which are anticipated to be finalized by the end of 2013
- New contaminants may be of concern to the regulators could be found in the future

Tables 5-40 and 5-41 summarize the potential permit requirements and actions to be taken when the permit requirements are not met.

Table 5-40: Potential AWPF Permit Requirements and AWPF Operational Strategies – Online Monitoring Parameters

No.	WQ Parameter	Potential Permit Requirement	Action
1	Turbidity	If the purified recycled water exceeds 0.2 NTU more than 5% of the time within a 24-hour period; and 0.5 NTU at any time [1]	Suspend delivery to spreading basins until the criteria are met
2	Conductivity	Conductivity of RO water upstream of UV system shall not exceed TBD µS/cm at any time using an online meter [2]	Suspend delivery to the spreading basins until the criteria are met
3	UV System	If: > 10% lamp failure; > 10% ballast failure within a reactor; low UV reactor intensity (7.7 mW/cm^2); loss of a reactor; EE/O value < 0.19 to 0.23 kW/kgal based on lamp age [2]	Suspend delivery to the spreading basins until the criteria are met

Notes:
1) Based on August 2008 Draft GWR Regulations (subject to change)
2) Based on West Basin WRF Permit

Table 5-41: Potential AWPF Permit Requirements and AWPF Operational Strategies – Sampling Parameters

No.	WQ Parameter	Potential Permit Requirement	Action
1	Coliform	If the purified recycled water fails to meet disinfection requirements: a 7-day median of 2.2 MPN per 100 milliliters for two consecutive days; 23 MPN per 100 milliliters in more than one sample in any 30-day period; and, 240 MPN per 100 milliliters in any sample [1]	Suspend delivery to the spreading basins until the criteria are met
2	Total Nitrogen	If the purified recycled water average total N concentration in purified recycled water > 5 mg/L during any consecutive four weeks [1]	Suspend delivery to the spreading basins until corrective actions are made and two consecutive total N samples are less than 5 mg/L
3	Contaminants of Acute Health Effects	If the purified recycled water running average exceeds MCLs for contaminants with acute health effects during a consecutive 4 weeks (e.g., perchlorate) [1]	Suspend delivery to the spreading basins if directed by CDPH or RWQCB
4	Contaminants of Chronic Health Effects	If the purified recycled water running average exceeds MCLs for contaminants with chronic health effects during consecutive 16 weeks [1]	Suspend delivery to the spreading basins if directed by CDPH or RWQCB
5	Average TOC	If the purified recycled water 20 week running average TOC exceeds the TOC_{max} (= 0.5/RWC) [1]	Suspend delivery to the spreading basins until at least two consecutive results, 3 days apart, are less than the limit

Notes:
1) Based on August 2008 Draft GWR Regulations (subject to change).

5.5.5 AWPF Operation during Groundwater Basin Conditions Upsets

In addition to the treatment process upsets, groundwater basin conditions may also impact the ability to recharge purified recycled water, as described in **Table 5-42** below.

Table 5-42: Potential AWPF Permit Requirements and AWPF Operational Strategies – Groundwater Basin Conditions

No.	WQ Parameter	Potential Permit Requirement	Action
1	RWC	If the purified recycled water exceeds the 60 month average RWC or diluent water is not available [1]	Adjust or suspend delivery of purified recycled water to meet RWC
2	Contamination	If the purified recycled water causes the downgradient drinking water wells to be degraded so that they cannot be used for drinking [1]	Suspend operation and either provide drinking water or a CDPH approved treatment system for the wells

Notes:
1) Based on August 2008 Draft GWR Regulations (subject to change).

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6. Site Improvements at DCTWRP

This section focuses on the DCTWRP site improvements to accommodate the AWPF. As discussed in Section 3, this GWR Master Planning Report assumes that the AWPF would be located at DCTWRP, within the berm.

6.1 Existing Site Features

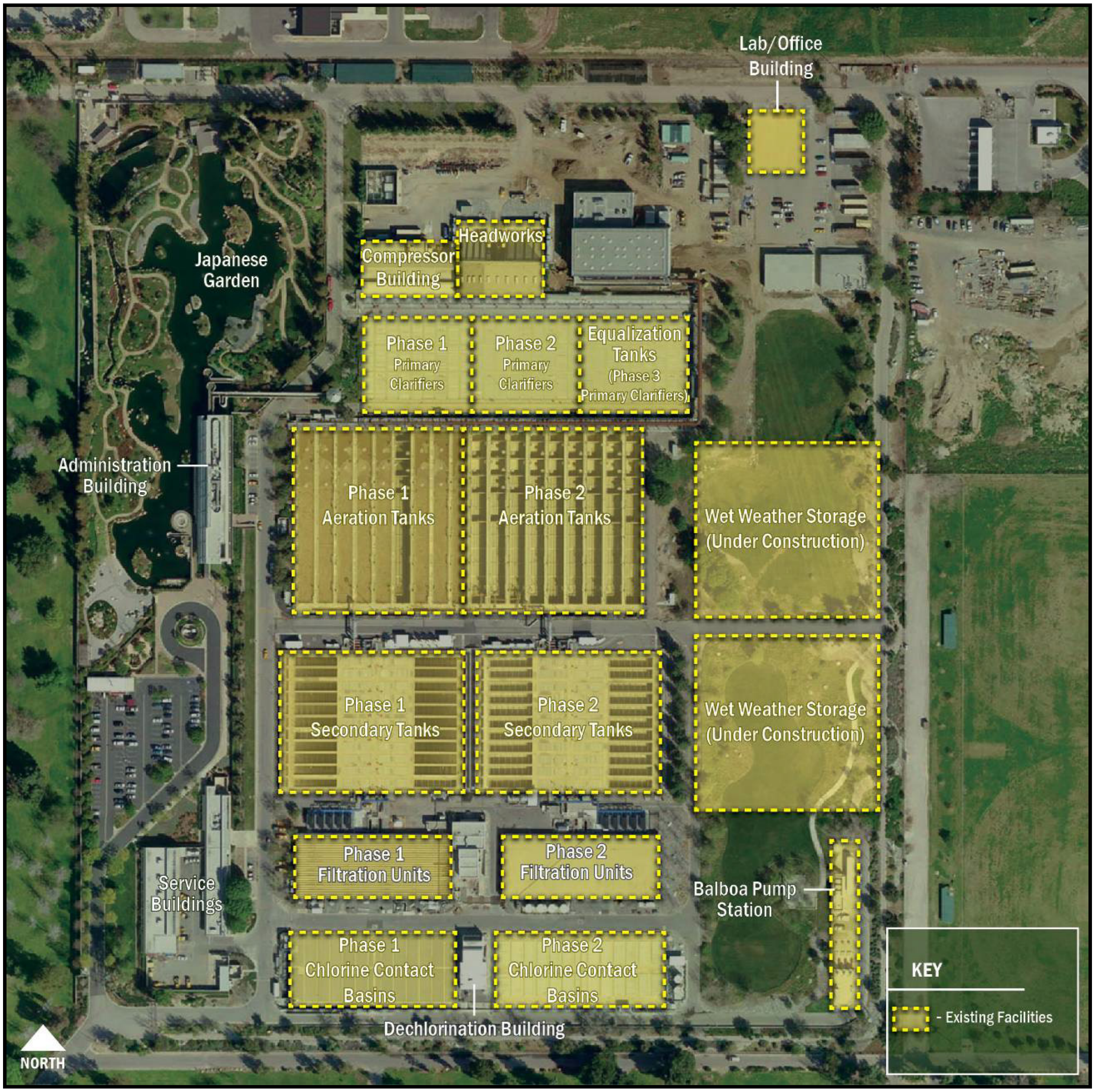
The aerial view of existing DCTWRP site is shown on **Figure 6-1**, and the existing site plan is shown on **Figure 6-2**.

As discussed in Section 3.5, the staff preferred project site for the AWPF will be at the DCTWRP southwest area, at the location of the existing service buildings (see **Figure 6-2**). The service buildings are enclosed to the west and south with landscaping in the form of tiered planters, as well as a vegetated buffer between Sansui Way to the west.

Existing site features, including yard piping, subsurface utilities, surface drainage, access roads, parking, and landscaping, will be considered for the conceptual design of the AWPF and site improvements at DCTWRP. Buried yard piping at the site include potable water and storm/sanitary sewer drains that are generally constructed of ductile iron, cast iron, or vitrified clay. Existing utilities are discussed further in Section 6.4.

The existing site is graded such that the main DCTWRP entrance driveway and gate are at a higher elevation compared to elevation of the service buildings. The area around the service buildings is generally flat, where stormwater runoff flows away from the service buildings towards the north and east. Runoff from the service yard is collected in a drain that conveys flow to the AVORS sewer. Access to the site is provided by 20-foot wide paved roads from the DCTWRP main entryways, namely Sansui Way to the west and Keshiki Way to the south. Asphalt paving is provided between and to the south of the two service buildings.

Figure 6-1: Aerial View of DCTWRP Existing Site Plan



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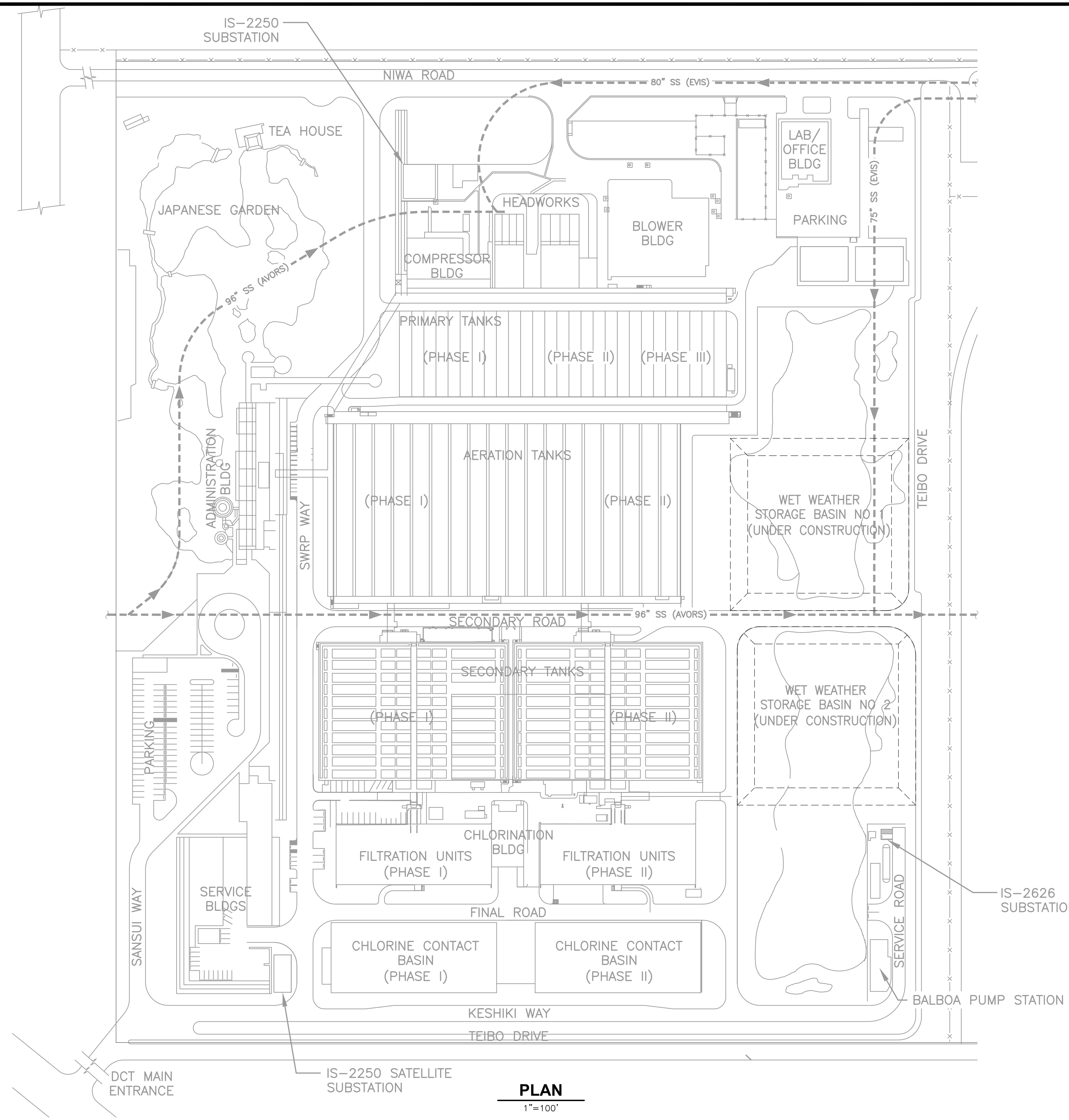

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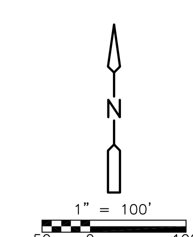

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DCT EXISTING SITE PLAN

FIG NO	6-2
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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6.2 Proposed Upgrades and Additions

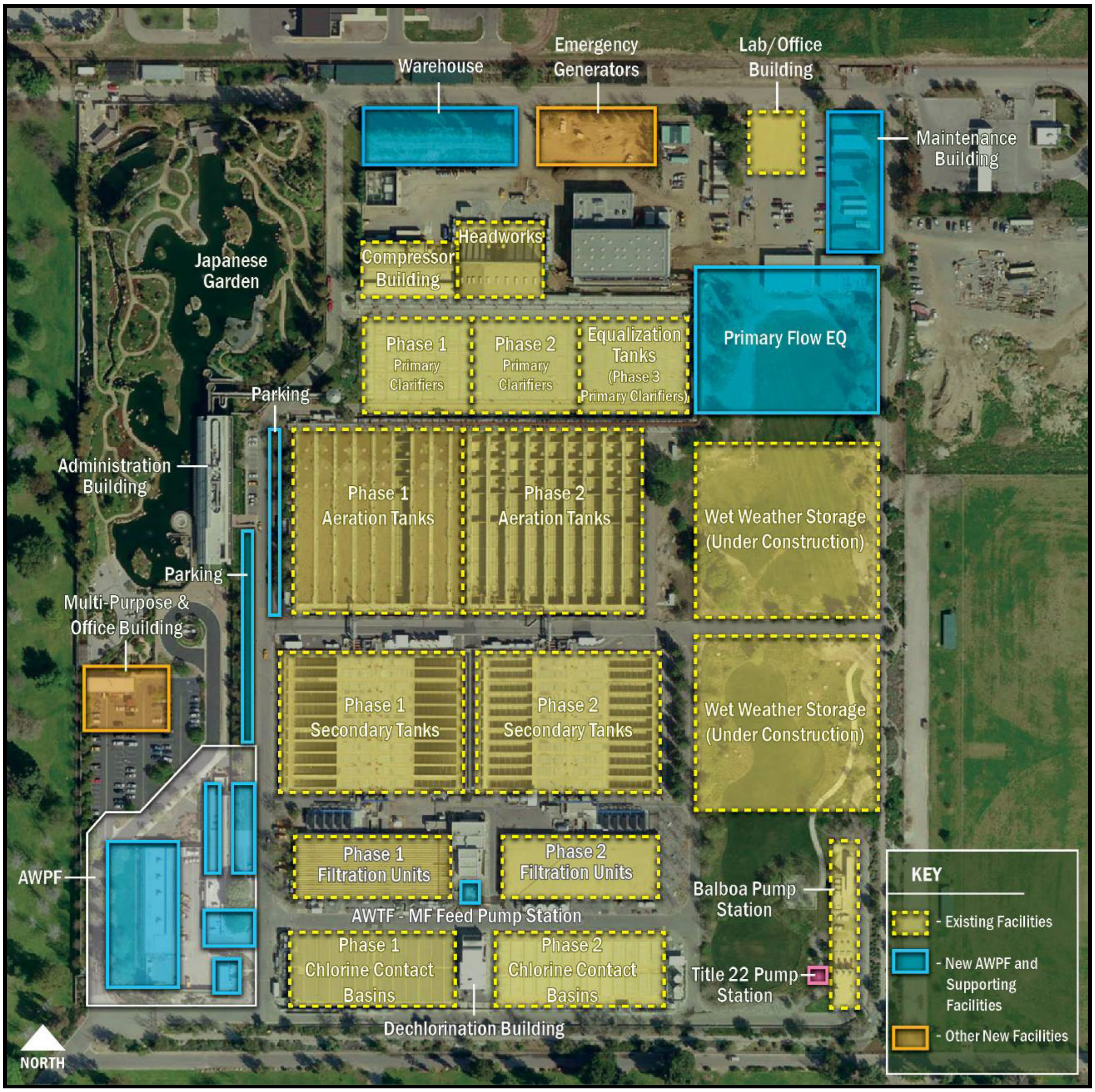
Work associated with the proposed AWPF at the DCTWRP southwest location includes:

- Construction of the new maintenance and warehouse buildings on the north side of DCTWRP before the construction of the AWPF begins.
- Demolition of existing service buildings and associated parking/yard located west of the SWRP Way.
- Demolition of pavement, trees, shrubs, tiered planters, and vegetated buffer between Sansui Way and the existing service buildings.
- Regrading of the west and south ends of the site to both accommodate the proposed facilities associated with the AWPF and transition into the grading of the entrance driveways on both Sansui Way and Keshiki Way. This grading will potentially include the construction of retaining walls on the southwest corner of the site.
- Construction of new employee parking spaces along SWRP Way next to the Phase I Secondary Clarifiers.
- Construction of Phase IV primary clarifiers for DCTWRP primary flow EQ in the area vacated by the demolished trailers.
- Relocation of existing underground utilities, including buried odor control duct east of the Phase III primary EQ basins.
- Construction of the AWPF structures including:
    - MF Feed Pump Station
    - MF/RO Building
    - MF/RO Break Tank, RO Transfer Pump Station, and RO Cartridge Filters
    - Chemical Storage and Feed Facility, outdoors under canopy
    - UV/H_2O_2 Area, outdoors under canopy
    - Product Water Pump Station (Expansion of Balboa Pump Station)
- Construction of new Title 22 Pump Station (see NPR Master Planning Report)
- Installation of new yard piping, including:
    - 48-inch AWPF influent pipe connections from existing DCTWRP secondary and tertiary effluent channels to MF feed pump station.
    - 48-inch AWPF influent line from the new MF feed pump station to MF/RO building.
    - 42-inch AWPF product water pipe from UV/H_2O_2 area to the PWPS (Balboa Pump Station) along Keshiki Way.
    - 36-inch AWPF backwash/concentrate waste discharge pipe, and new or relocated drain lines.
    - Other proposed yard piping modifications include relocation of existing utilities to accommodate the proposed location of AWPF process facilities and interconnecting pipelines within the AWPF site between different process equipments.

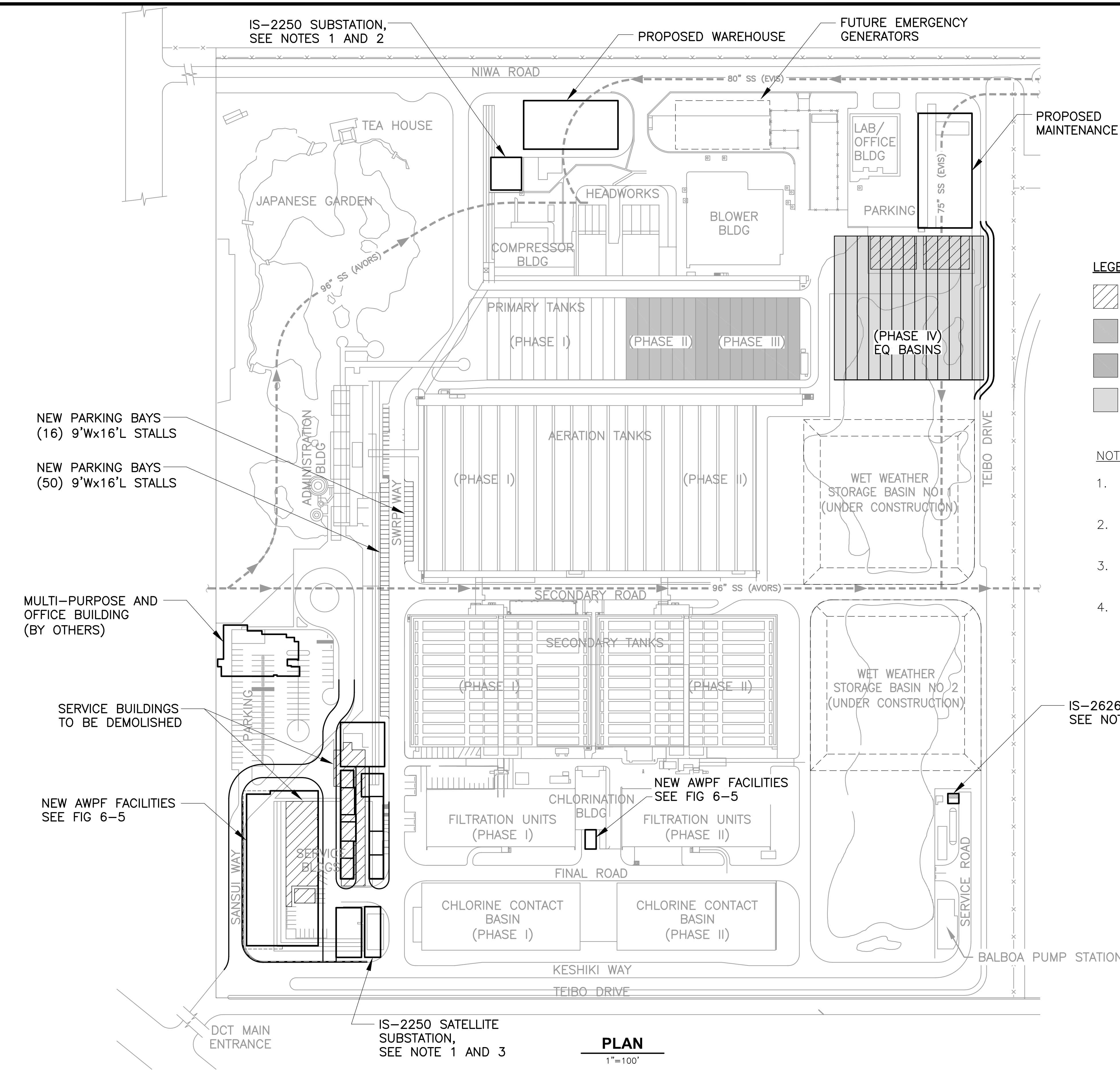
6.3 Overall Site Layout

The AWPF layout for the proposed project was conceptualized as part of the *Final Site Assessment TM* and is developed further in this section. The AWPF site will be configured to facilitate the functional and operational requirements of the AWPF. The aerial view of the DCTWRP site with proposed improvements for the AWPF and future improvements is shown on **Figure 6-3**. See **Figure 6-4** for the DCTWRP preliminary site plan and **Figure 6-5** for the AWPF preliminary enlarged site plan.

Figure 6-3: Aerial View of DCTWRP Preliminary Site Plan



Notes:
1) The new Warehouse and Maintenance Buildings to be built prior to starting construction on the AWPF.
2) More information on the new Title 22 pump station is included in the Non-Potable Reuse Master Planning Report.



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LEGEND

- STRUCTURES TO BE DEMOLISHED
- PRIMARY FLOW EQUALIZATION (PLANNED PHASE II CONVERSION – 6 TANKS)
- PRIMARY FLOW EQUALIZATION (EXISTING PHASE III CONVERSION – 9 TANKS)
- PRIMARY FLOW EQUALIZATION (POTENTIAL PHASE IV CONSTRUCTION – 13 TANKS)

NOTES:

1. POTENTIAL AWPF SUBSTATION LOCATIONS SHOWN HEREIN ARE DISCUSSED IN SECTION 8.5.3 OF THIS DOCUMENT.
2. OPTION 1: COMBINE WITH AND EXPAND EXISTING IS-2250.
3. OPTION 2: NEW SUBSTATION IN LOCATION OF EXISTING IS-2250 SATELLITE.
4. OPTION 3: CO-LOCATE WITH EXISTING IS-2626.

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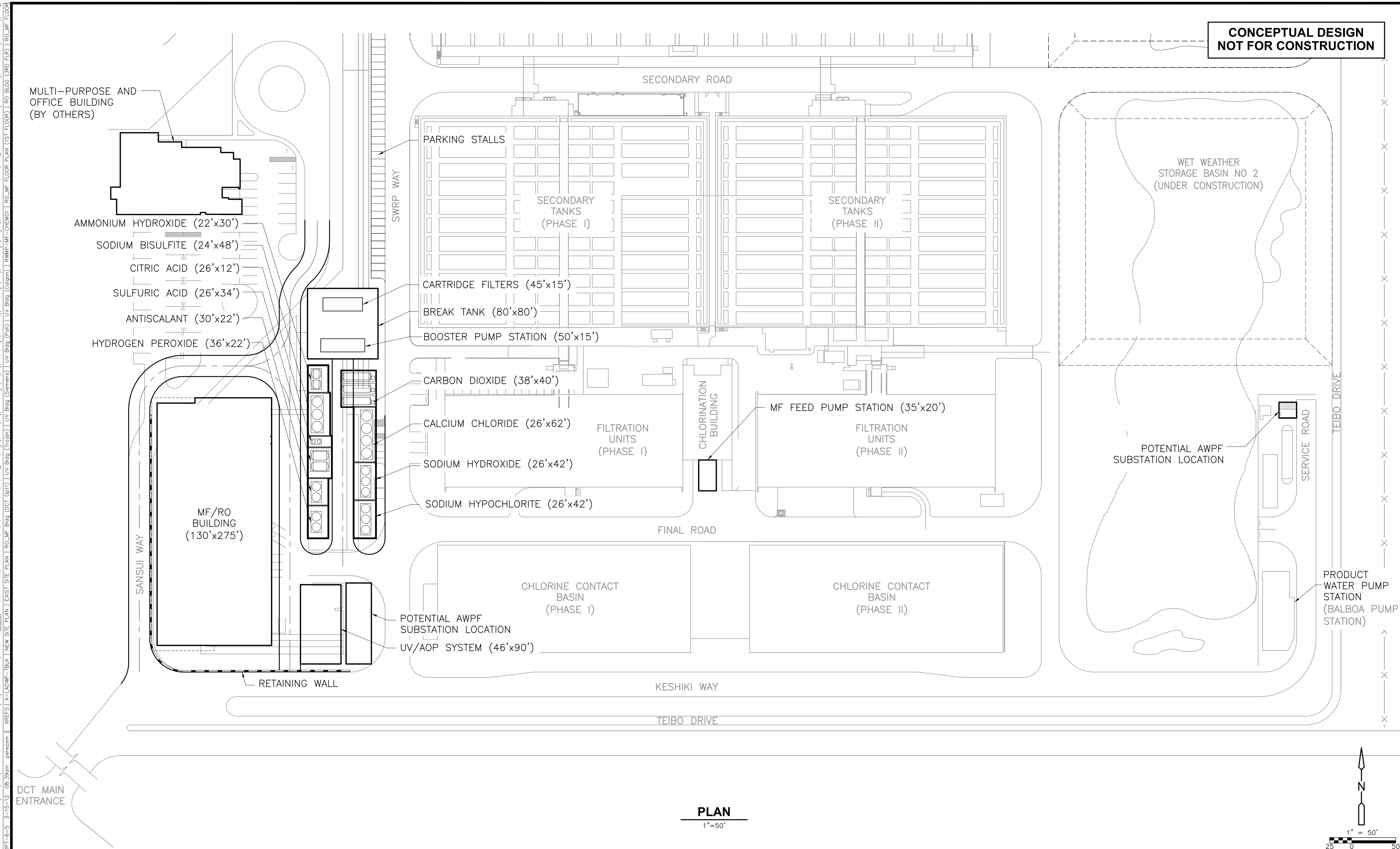

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AWTF PRELIMINARY ENLARGED SITE PLAN

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PROJ NO	86538-71984
DATE	MARCH 2012

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6.3.1 Layout Requirements

As shown on **Figures 6-4 and 6-5,** the MF feed pump station will be located just south of the existing Chlorination Building, between the Phase 1 and II Filtration Units. The MF/RO building will be located on the west side of the proposed AWPF site next to Sansui Way. The buried MF/RO break tank will be located on the northeast side of the proposed AWPF site; the RO transfer pump station and RO cartridge filters will be located on top of the MF/RO break tank. The chemical storage and feed facility will be located south of the MF/RO break tank. The UV/H_2O_2 process area will be located south of the chemical storage and feed facility. See **Table 6-1** for a breakdown of the approximate space requirements for the AWPF process and administration areas. Space requirements are based on process equipment sizing and footprint requirements discussed in Section 5 and shown on **Figures 5-5 to 5-14**.

Table 6-1: AWPF Space Requirements

Facility	Approximate Dimensions (ft x ft)	Approximate Area (sf)
MF Feed Pump Station	20 x 35	700
MF System including: Pre-filters, MF, Backwash System, Blowers, Air Compressors, CIP Tanks and Pumps, Chemical Day Tanks and Pumps	130 x 275	35,800
MF/RO Break Tank	80 x 80	6,400
RO Transfer Pump Station (located on top of MF/RO Break Tank)	15 x 50	750
Cartridge Filters (located on top of MF/RO Break Tank)	15 x 45	680
RO System including: RO Feed Pumps, RO, CIP Tanks and Pumps, Chemical Day Tank and Pumps	130 x 190	24,700
UV System	45 x 90	4,100
Chemical Storage and Feed Facility	80 x 210	16,800
Control Room	30 x 45	1,350
Mechanical Room	30 x 30	900
Electrical Room	36 x 60	2,200
Blower/Compressor Room	30 x 30	900

Notes: See Table 8-4 for non-process areas.

Zoning Requirements

Based on the zoning maps available from the City's Planning Department, the current zoning for the DCTWRP property is PF, Public Facility. Typically, the PF zoning designation does not have requirements or restrictions for building height, lot area, density, site yards or building setbacks. However, there is a maximum building height limitation of 35 vertical feet for DCTWRP set by the City's Planning Department. The existing blower building at DCTWRP has a constructed height of approximately 40 feet that was approved through a variance. The MF/RO building height will have to be approved via a similar variance.

6.3.2 Overall Site Access and Circulation

Vehicular Access and Traffic Flows

A 20-ft wide, asphalt concrete paved access road that loops around the site will be provided to allow vehicular access to the MF/RO Building and other process areas, including the chemical storage and feed facility. The MF/RO Building and other process areas will require access by maintenance and chemical delivery trucks. The turning radii will be a minimum of 35-ft to allow vehicle access around the site. Visitor vehicle access will be maintained on Sansui Way.

Chemical delivery trucks will enter the site through the existing motorized access gate on Keshiki Way on the south side of the site and drive to the designated unloading areas on either side of the chemical storage and feed facility via SWRP Way. The chemical delivery trucks will exit the site via the same motorize access gate. Guard posts will be provided around structures that could be subject to damage from vehicular traffic and moving equipment.

Vehicle Parking

The parking requirement for non-process areas of the MF/RO building is one parking space for every 300 sf. The parking requirement for process areas of the MF/RO building is one parking space per 500 sf for the first 10,000 sf, and one space per 5,000 sf thereafter. Based on the estimated footprint of non-process areas (4,800 sf) and process areas (57,050 sf) summarized in **Table 8-4**, a minimum of 30 parking spaces will be required for non-process areas and a minimum of 16 parking spaces will be required for process areas. Therefore, a total of 46 new parking spaces would be required for the AWPF.

In addition, additional parking spaces will be required to service the new Multi-Purpose and Office Building, and make up for approximately 20 existing parking spaces that are expected to be displaced by the construction of the new Multi-Purpose and Office Building. Therefore, a total of 66 parking spaces would need to be provided.

The west shoulder of SWRP Way next to the Phase I Secondary Tanks has been identified as potential location for new vehicle parking spaces. The available area is currently a vegetated buffer strip measuring approximately 18 ft wide by 450 ft long between the proposed AWPF site and the existing parking bay in front of the DCTWRP Administration Building. At a minimum individual parking space width of 9 ft, this area will accommodate approximately 50 parking spaces for compact-sized cars. In addition, the east shoulder of SWRP Way, next to the Phase I Aeration Tanks has also been identified as a potential location for new parking. This area will accommodate the additional 16 parking spaces.

Widths of individual parking spaces can be adjusted accordingly for bigger vehicles (e.g., 14-ft width for vans, SUVs, etc.). However, the 18 ft width of the shoulder space of SWRP Way available restricts the types of vehicles that could park in the new parking spaces.

6.4 Utilities

Many existing utilities, including sanitary sewers, waste lines, electrical ductbanks, lighting conduits, potable water lines, etc., run along SWRP Way east of the AWPF site. The proposed alignments for the AWPF influent water, product water, and backwash/concentrate waste discharge pipelines will need to consider the existing utilities, especially along Final Road and SWRP Way. See **Figure 6-6** for a plan showing both existing and proposed utilities for the site.

6.5 Survey

Ground surveys will be needed to support the detailed design and construction. Ground surveys will use the locally established horizontal and vertical control datums. The survey will include topographic and surface features as well as buried utilities. The basis of bearings will be the North American Datum of 1983 (NAD 83), California Zone 6, and the vertical datum will be the NAVD 88 control, with the project coordinate system to be California Coordinate System (CCS83).

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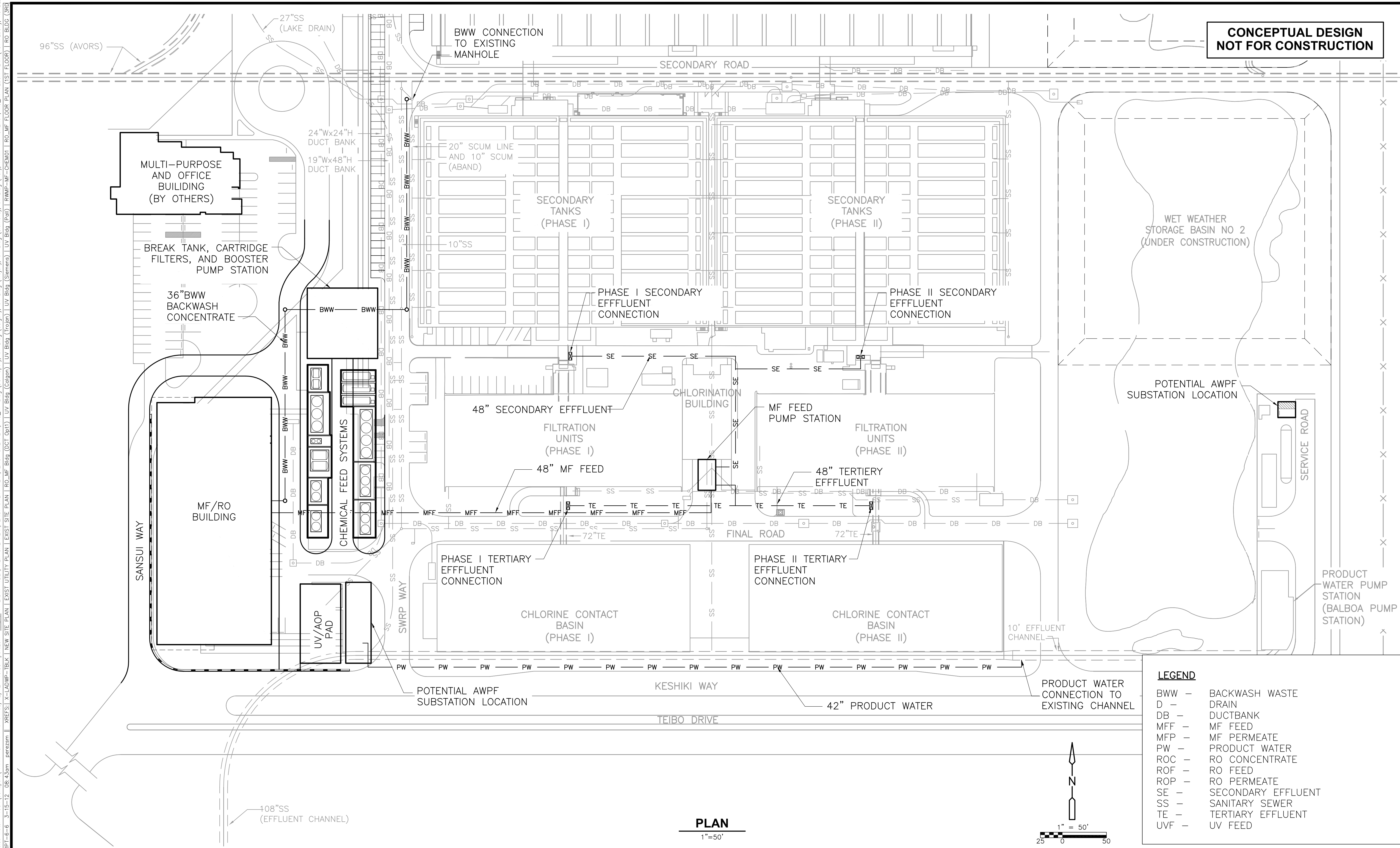

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AWTF PRELIMINARY UTILITY AND YARD PIPING PLAN

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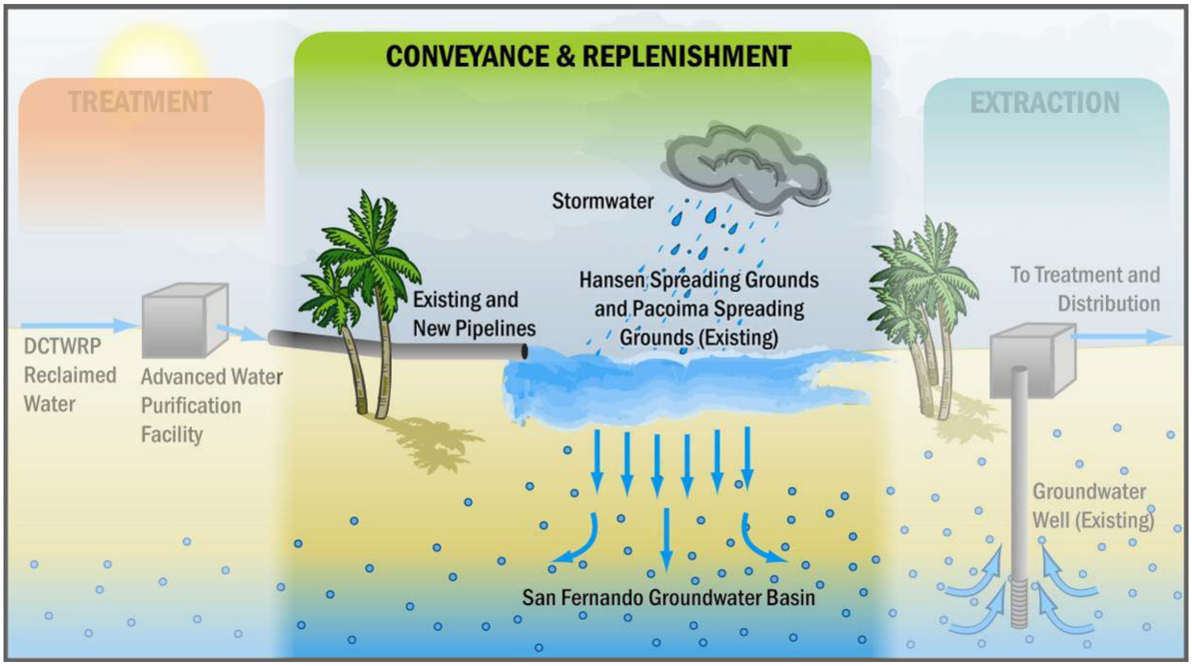
7. Conveyance and Replenishment Facilities

In addition to treatment, other key aspects for GWR are the conveyance of purified recycled water to the spreading grounds (or injection wells), the replenishment of the groundwater basin with purified recycled water via spreading grounds (or injection wells), and the ultimate extraction of groundwater for treatment and connection to the distribution system for delivery to the customer (see **Figure 7-1**.) The conveyance and replenishment facilities are included in this section. The extraction facilities are part of LADWP's existing drinking water production and supply facilities and are not included in the RWMP documents.

Figure 7-1: GWR – Conveyance and Replenishment

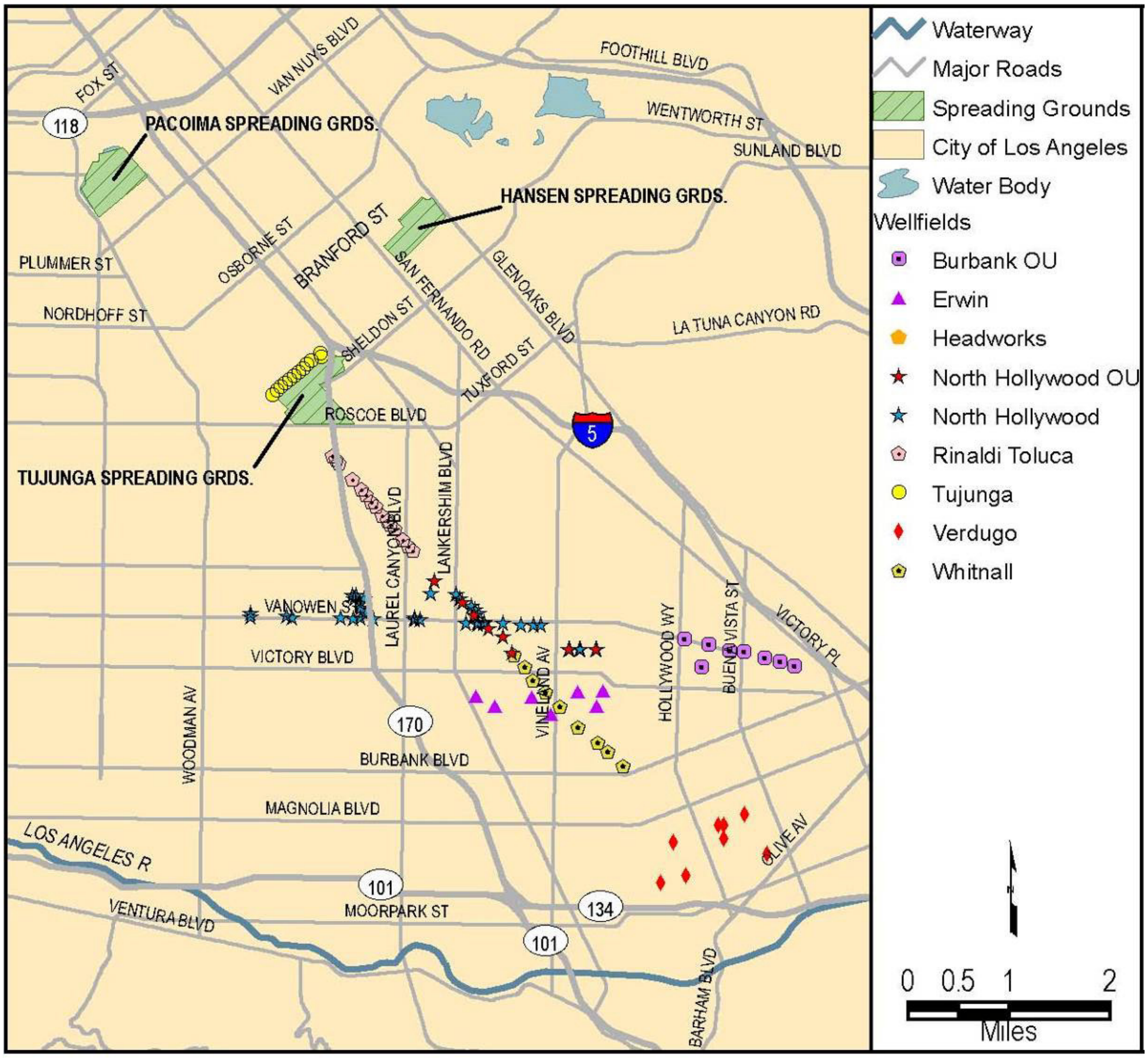


This section provides an overview of the conveyance, and replenishment facilities required for implementing GWR and the relationship to the extraction of waters for potable supply. The complete groundwater evaluations are presented in the *Groundwater Replenishment Evaluation TM*. Section 7 is organized as follows:

- **Phase 1:** Up to 15,000 AFY of GWR achieved via surface water spreading at the Hansen Spreading Grounds (HSG)
- **Phase 2 Option A:** Up to 30,000 AFY of GWR achieved via surface water spreading at HSG and Pacoima Spreading Grounds (PSG)
- **Phase 2 Option B:** Up to 30,000 AFY of GWR achieved via surface water spreading at HSG and PSG, plus direct injection using injection wells and/or the Strathern Wetlands Project

Figure 7-2 illustrates the location of the replenishment facilities including HSG, PSG, and the existing well fields.

Figure 7-2: Existing Spreading Grounds and Well Fields



The HSG is owned and operated by LACDPW. **Figures 7-3 and 7-4** show the basin configurations of the HSG and PSG, respectively. **Table 7-1** shows the size and hydraulic characteristics of the HSG and PSG.

Figure 7-3: Existing HGS

Figure 7-4: Existing PSG

Table 7-1: Physical Attributes of the HSG and PSG

Characteristic	HSG	PSG
Maximum Intake Rate	400 cubic feet per second (cfs)	600 cfs
Maximum Wetted Area	Total: 105 acres	Total: 107 acres
Number of Spreading Basins	6	12
Maximum Storage Volume	1,420 acre-feet (AF)	440 AF
Average Percolation Rate	150 cfs (1) (297 AFD)	65 cfs (129 AFD)

Notes:
1) Percolation capacity is artificially limited to prevent high water levels at adjacent Bradley landfill.

While the stated capacities were provided by LACDPW for basins in a relatively "clean" condition, they have noted that when used for stormwater spreading, the percolation rates can significantly decline, particularly in high runoff years. LACDPW conducts basin maintenance activities typically following high runoff seasons, as described further in Section 7.1.2. In contrast, GWR with purified recycled water is not expected to cause any significant decline in percolation rates as the purified recycled water is extremely low in suspended solids and turbidity.

7.1 Phase 1 - Hansen Spreading Grounds

The GWR spreading operations and improvements described in this section accommodate operations consistent with the Phase 1 of the project. The goal of the Phase 1 is to recharge an annual average volume of 15,000 AFY of purified recycled water at the HSG. The target GWR volume and AWPF capacity for Phase 1 are shown in **Table 7-2**.

Table 7-2: Target GWR Volume and AWPF Capacity for Phase 1

	Target Rate
Annual Average Volume and Average Flow Rate of GWR	15,000 AFY (13.4 mgd)
Required AWPF Production Capacity (Maximum Flow Rate)	23.4 mgd

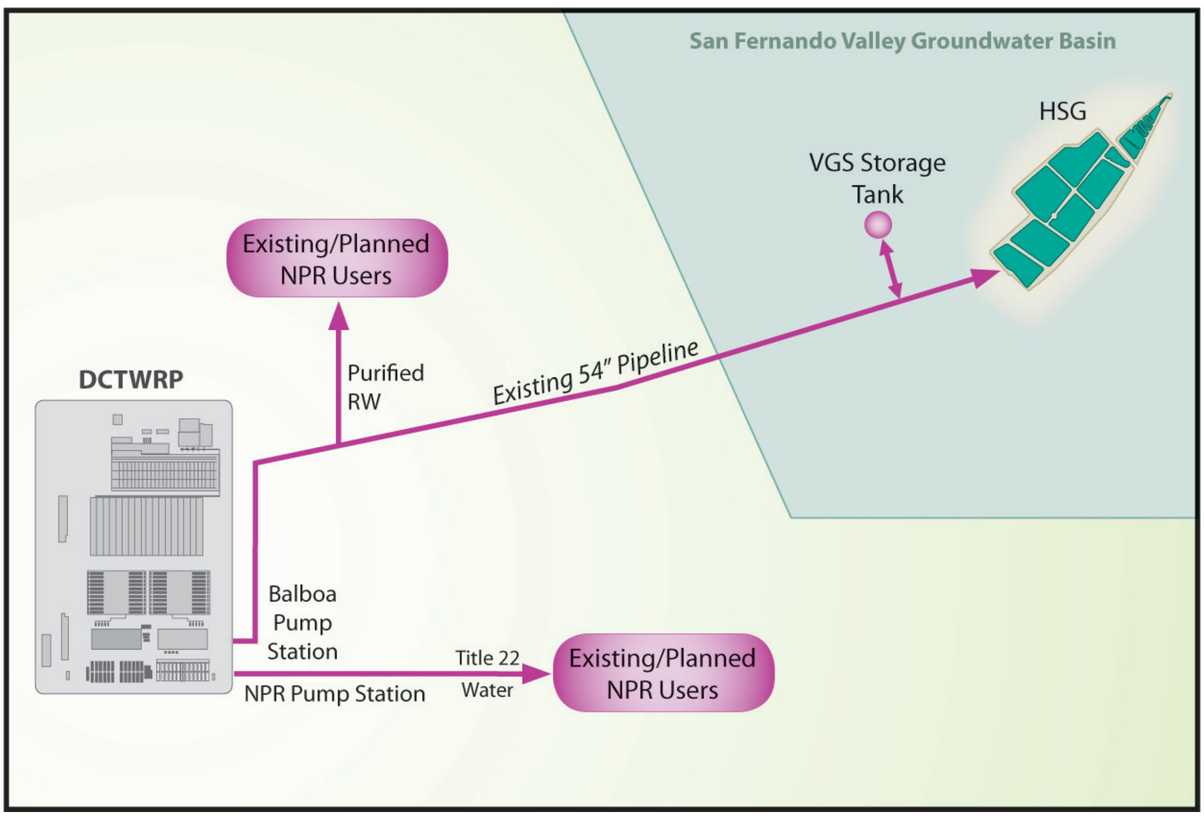
The ability to deliver water year-round is significantly constrained by several factors including:

- AWPF Online Factor: As discussed in Section 3.6, the AWPF is designed with a 92 percent online factor. This assumes that the actual AWPF production would be 92 percent of the plant capacity due to scheduled and unscheduled down times for maintenance and repair, and other unforeseen events.
- NPR Demands: The purified recycled water will also serve existing (except in Sepulveda Basin) and planned NPR demands off of the 54-inch pipeline. These demands are seasonal and peak during the summer months.
- Unavailability of HSG: As discussed in Section 3.4, there will be periods (up to 70 days per year) when the HSG will not be available for purified recycled water spreading based on LACDPW's operations. These periods will primarily be during the winter months in wetter years when the entire HSG is dedicated to receiving and recharging stormwater runoff.

7.1.1 Conveyance Facilities

As shown on **Figure 7-5**, conveyance from the AWPF at DCTWRP to the HSG would be accomplished through the existing 54-inch pipeline. Section 5.3.12 provides a detailed discussion of the pumping requirements.

Figure 7-5: Schematic of Conveyance Facilities to Deliver 15,000 AFY from AWPF to HSG



7.1.2 Operational Strategy

The operation of the GWR at the HSG is governed by both the availability of purified recycled water and the capacity of the spreading grounds to percolate the purified recycled water. The capacity of HSG to accept and recharge with purified recycled water is dependent on LACDPW's operations to capture and recharge native stormwater.

Existing Stormwater Recharge Conditions

LACDPW has a policy "to conserve the maximum possible amount of stormwater consistent with runoff quantity and quality, capacities of the spreading facilities, and groundwater conditions." One of the main focuses of water conservation is the capture of stormwater and subsequent recharge at the HSG. Stormwater runoff is of generally high quality, particularly with respect to TDS and nitrate levels, and is essentially "free" water. Therefore, LACDPW will continue to utilize their resources in such a way as to maximize the capture of stormwater.

Diversion of stormwater flows to the spreading grounds may also provide some limited downstream flood hazard reduction benefits. However, most of the flood hazard reduction activities are focused on storage and operation of the upstream dams and reservoirs, and when high flow releases are required; these are typically greater than the diversion capacity of the spreading grounds.

The stormwater recharge typically occurs at the HSG when water is available in the Tujunga Wash. The volume of water recharged at the HSG varies greatly from year to year, depending on the hydrology of the surrounding upgradient watershed. **Table 7-3** shows the historical volume of water spread at the HSG from Water Year (WY) 1968-69 through WY 2009-10.

Table 7-3: Historical Annual Recharge at the HSG

Metric	Annual Rate (AFY)
Average	13,903
Minimum [1]	1,342
Maximum	35,192

Source: Watermaster 2011

1) Excluding WY 2008-09 when the HSG was unavailable for stormwater recharge due to construction activities.

The stormwater recharge at the HSG is also seasonal, with over 80 percent of long term stormwater runoff occurring between the months of December to May, as shown in **Table 7-4**.

Table 7-4: Average Monthly Distribution of Recharge the HSG

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
4%	4%	6%	13%	16%	22%	15%	9%	5%	2%	2%	2%

Notes: Based on monthly recharge data provided by LACDPW for WY 1997-98 through WY 2008-09

Recent capital improvements to the HSG consisted of improved diversion facilities, increased upstream retention, reconfiguration of basins with spreading grounds, and increased temporary storage volume in the basins to retain more stormwater runoff from storm events. These improvements will increase the volume of water captured and recharged compared to that released downstream. The projected increase in long term average volume captured is estimated to be approximately 2,640 AFY. **Figure 7-6** shows the historic average volume of stormwater recharge at the HSG along with the projected increase in recharge expected due to the recent capital improvements. **Figure 7-7** shows the same information for the two historically wettest years, WY 1983 and WY 2005.

Figure 7-6: Historic Average Volume of Stormwater Captured at HSG, WY 1969-2008

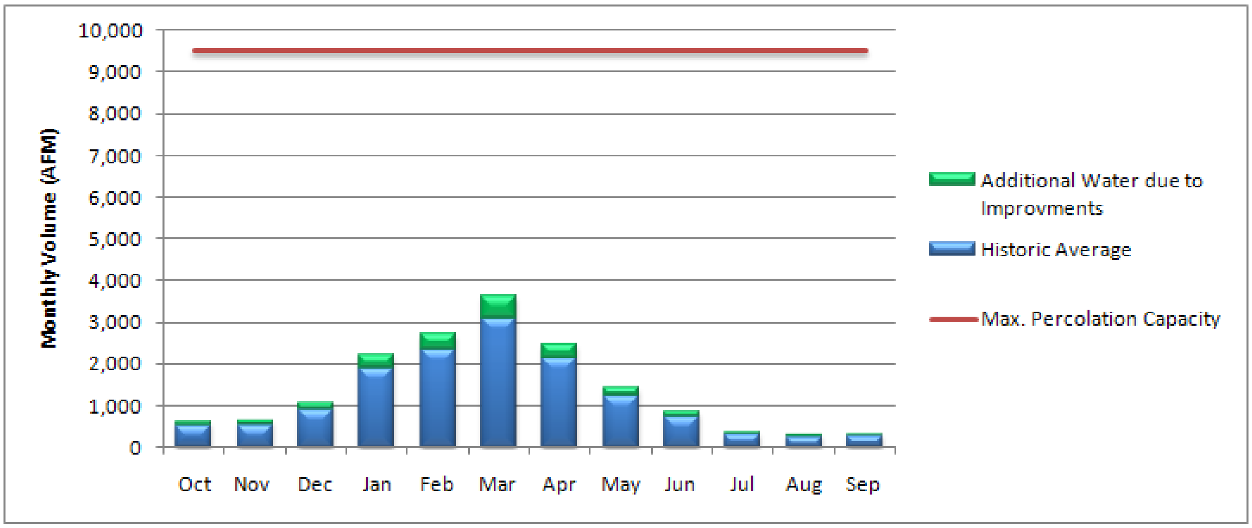
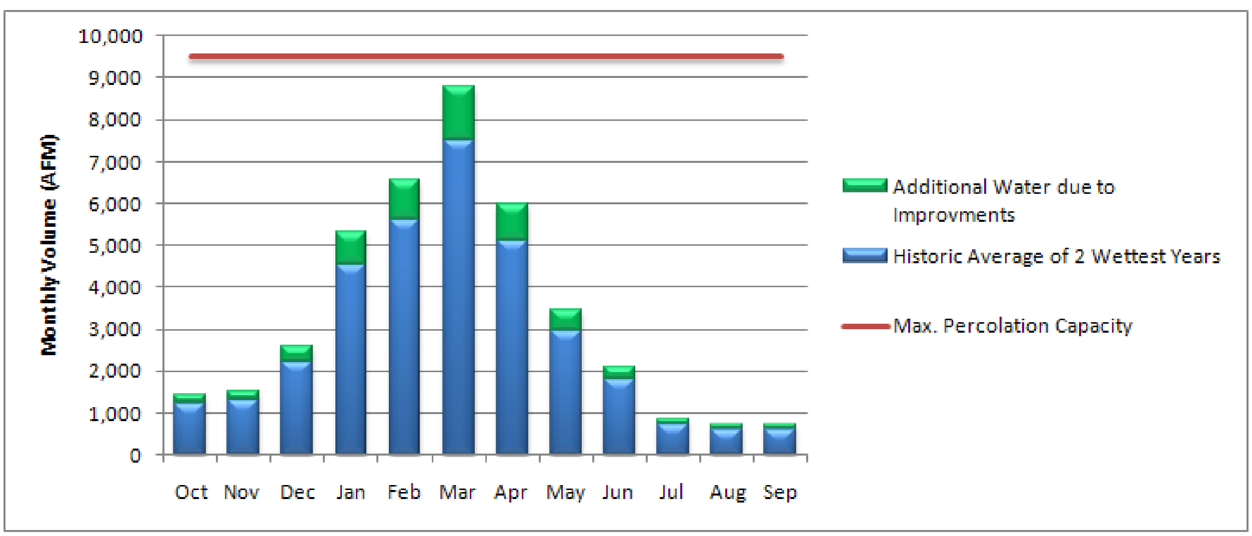


Figure 7-7: Historic Average Volume of Stormwater Captured at HSG, 2 Wettest Years (WY 1983 and WY 2005)



Future Recharge Conditions

The goal of the Phase 1 of the project is to recharge an annual average volume of 15,000 AFY (average of 1,250 acre-feet per month (AFM)) of purified recycled water at the HSG. Based on available information, the percolation capacity of the HSG would be more than sufficient to allow for continued recharge with stormwater as well as the additional volume of purified recycled water, if the HSG could receive water continuously throughout the year. The annual average volume of 15,000 AFY equates to a long term average of approximate 41 acre-feet per day (AFD). This rate is well below the percolation capacity of the entire HSG. While each of the six basins within the HSG are not evenly sized (see **Table 7-1**), the use of one basin at a time should be approximately sufficient to recharge the average instantaneous rate of purified recycled water without significantly ponding.

Figure 7-8 shows the additional purified recycled water recharge volume along with historic average stormwater recharge volume at the HSG for WY 1969 through WY 2008. **Figure 7-9** shows similar information for the two wettest years, WY 1983 and WY 2005.

Figure 7-8: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the HSG, WY 1969-2008

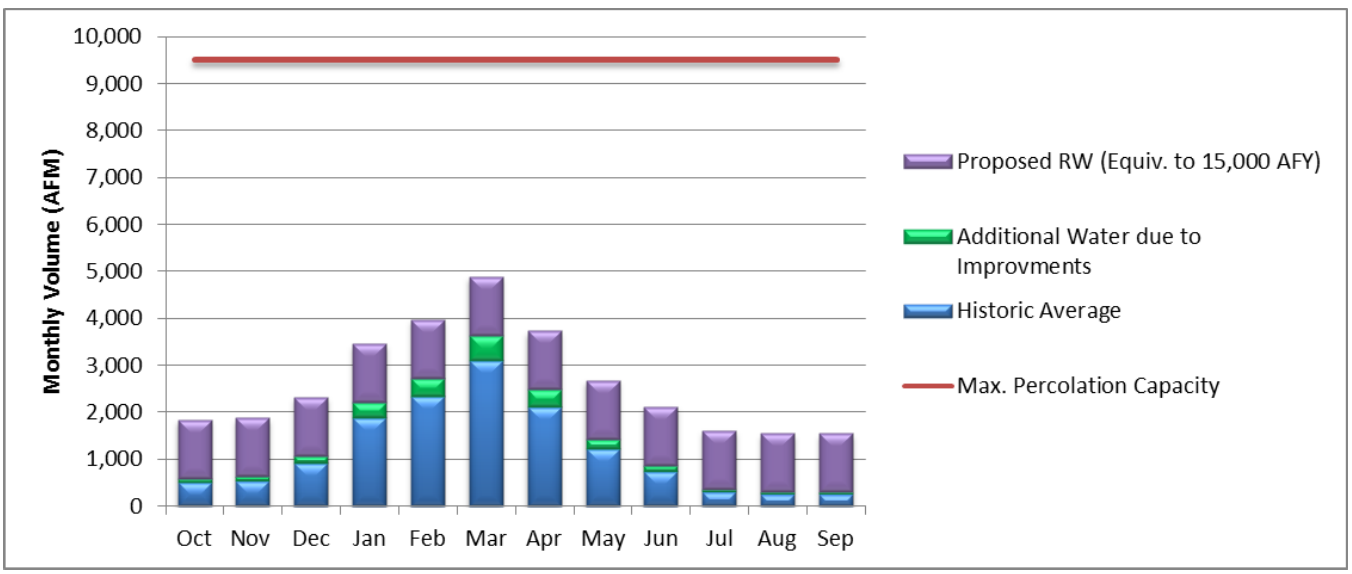
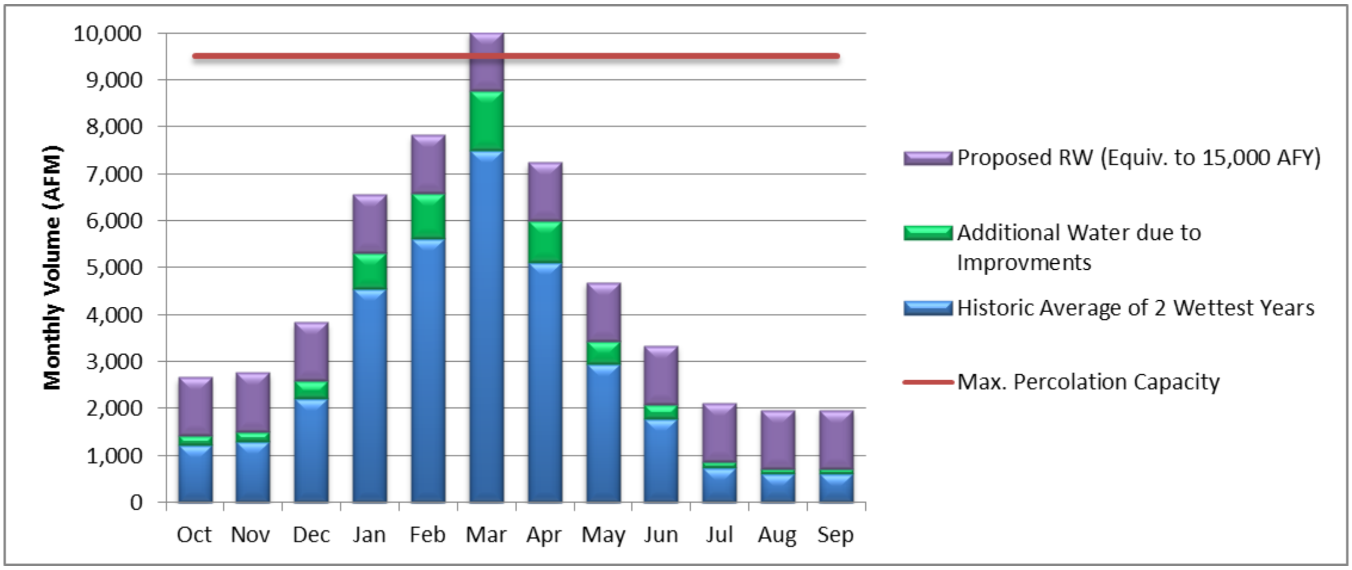


Figure 7-9: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the HSG, Two Wettest Years (WY 1983 and WY 2005)



Spreading Basin Availability

While the previous section suggested that while there is more than adequate metering into the basin capacity at the HSG to achieve the 15,000 AFY target, there are two major reasons that the basin(s) at the HSG may be unavailable for recharge with the purified recycled water: (1) due to the use of the basins for stormwater capture during high wet weather runoff periods; and (2) maintenance. These conditions require a careful plan of operations and close cooperation with LACDPW to be developed and followed to consistently meet the GWR goals.

As discussed previously, the primary objective of LACDPW's operation of the HSG is to capture and recharge the maximum quantity of stormwater possible. This objective may result in LACDPW not allowing purified recycled water to be distributed to and recharged at the HSG for 70 days. During these periods, the purified recycled water would need to be conveyed to another location used for another purpose or the AWPF would need to stop delivering treated water. The duration and frequency of these periods is dependent on the frequency, duration, and intensity of the wet weather conditions that occur during each particular year. LACDPW also attempts to maximize storage in the upstream reservoirs behind Hansen Dam, Big Tujunga Dam, and Pacoima Dam, and release water at lower rates over an extended period of time, which can extend the period over which stormwater is available for spreading, particularly in wetter years.

LACDPW has stated that LADWP should plan for up to 70 days per year, during which time the HSG will be unavailable to recharge purified recycled water. Therefore, if the HSG is available for recharge with purified recycled water for only 295 days per year, the average daily flow rate of purified recycled water to the HSG would need to be increased accordingly. As shown in **Table 7-2**, the AWPF maximum production and delivery capacity is 23.4 mgd, on days the spreading grounds are available. Therefore, the output capacity of the AWPF will be large enough to compensate for the downtime of the HSG and still meet the GWR goal of 15,000 AFY for the Phase 1 of the project.

LACDPW also routinely takes spreading basin(s) out of service for maintenance. The basins require maintenance to remove accumulated fines and restore the surface infiltration capability to sustain long term percolation rates. The maintenance typically involves removal of accumulated fine grained material from the basin bottoms to restore percolation capacity. This activity normally occurs during dry periods of the year when stormwater is not being recharged and is typically performed sequentially from one basin to the next. During the maintenance period, which may be as short as one day per basin, which also requires a drying period in the basin, the basin having maintenance done cannot be used for recharge.

LACDPW's current practice allows for maintenance to occur during the normally dry (i.e., late spring or summer) portion of the year. However, with the introduction of year-round recharge with the purified recycled water, LADWP and LACDPW will need to work together to allow for continued recharge with the purified recycled water as well as the necessary maintenance. Typically only one basin will be taken out of service at a time, and because only one basin would normally be needed to recharge daily purified recycled water flows, there appears to be significant flexibility to direct purified recycled water to different basins as needed to minimize interference with maintenance operations. This concept has been discussed with LACDPW and basin maintenance should not be a major interference with purified recycled water recharge.

Figure 7-10 shows a Phase 1 scenario. The figure shows the average monthly mass balance if the 70 days of HSG unavailability is assumed to occur during the winter months of December through April. LACDPW has indicated that HSG could be unavailable for 70 days during a typical year. During a wet year this number could increase, potentially up to 150 days per year.

Figure 7-10

AWPF Capacity and GWR Capability Monthly Flow Chart

Phase 1 - Spreading at HSG, SG Downtimes in Winter Months Only

AWPF Capacity (min)[1]: 23.4 mgd

Total GWR: 15,000 AFY

AWPF		
Phase 1 Capacity (min)[1]	23.4	mgd
Phase 2 Capacity	35.0	mgd
Stage	Phase 1	
AWPF Recovery	79%	
Plant Capacity	23.4	mgd
Downtime	30	days/year
Online Factor	92%	
Offline Factor	8%	
Downtime	**Y/N**	**day/mo**
Jan	Y	2.5
Feb	Y	2.5
Mar	Y	2.5
Apr	Y	2.5
May	Y	2.5
Jun	Y	2.5
Jul	Y	2.5
Aug	Y	2.5
Sep	Y	2.5
Oct	Y	2.5
Nov	Y	2.5
Dec	Y	2.5
		30

NPR		
Existing/Tier 1	5,010	AFY
Existing/Tier 1	4.5	mgd
Max Tier 2	0	AFY
Max Tier 2	0.0	mgd
Total	5,010	AFY
Total	4.5	mgd
Peaking Factor		
Jan	0.5	
Feb	0.5	
Mar	0.6	
Apr	0.9	
May	1.2	
Jun	1.5	
Jul	1.8	
Aug	1.6	
Sep	1.3	
Oct	0.9	
Nov	0.7	
Dec	0.5	

HSG		
% of GWR	100%	
Downtime	70	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	14.0
Feb	Y	14.0
Mar	Y	14.0
Apr	Y	14.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	14.0
		70

PSG		
% of GWR	0%	
Downtime	30	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	6.0
Feb	Y	6.0
Mar	Y	6.0
Apr	Y	6.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	6.0
		30

Notes:

1) While the minimum Phase 1 AWPF capacity is 23.4 mgd, the recommended AWPF design capacity for Phase 1 is 25 mgd. See Section 5 for more information.

Month	**No. of Days in Month**	**AWPF Product Water**	**Flow to NPR**	**Max Flow Available for GWR**			**Average Flows to Spreading Grounds**			**GWR Operations**				
										Operation Period		**Spreading Grounds**		
	days	mgd (Note 2)	mgd	**HSG** mgd (Note 3)	**PSG** mgd (Note 3)	**Total** mgd (Note 3)	**HSG** mgd (Note 4)	**PSG** mgd (Note 4)	**Total** mgd (Note 4)	**HSG** days	**PSG** days	**HSG** (Note 5)	**PSG** (Note 5)	**Total**
Jan	31	21.5	2.2	19.2	0.0	19.2	10.6	0.0	10.6	17	25	327 MG/mo	0 MG/mo	1,004 AF/mo
Feb	28	21.5	2.2	19.2	0.0	19.2	9.6	0.0	9.6	14	22	269 MG/mo	0 MG/mo	827 AF/mo
Mar	31	21.5	2.7	18.8	0.0	18.8	10.3	0.0	10.3	17	25	320 MG/mo	0 MG/mo	981 AF/mo
Apr	30	21.5	4.0	17.5	0.0	17.5	9.3	0.0	9.3	16	24	279 MG/mo	0 MG/mo	857 AF/mo
May	31	21.5	5.4	16.1	0.0	16.1	16.1	0.0	16.1	31	31	500 MG/mo	0 MG/mo	1,533 AF/mo
Jun	30	21.5	6.7	14.8	0.0	14.8	14.8	0.0	14.8	30	30	443 MG/mo	0 MG/mo	1,360 AF/mo
Jul	31	21.5	8.1	13.4	0.0	13.4	13.4	0.0	13.4	31	31	416 MG/mo	0 MG/mo	1,278 AF/mo
Aug	31	21.5	7.2	14.3	0.0	14.3	14.3	0.0	14.3	31	31	444 MG/mo	0 MG/mo	1,363 AF/mo
Sep	30	21.5	5.8	15.7	0.0	15.7	15.7	0.0	15.7	30	30	470 MG/mo	0 MG/mo	1,442 AF/mo
Oct	31	21.5	4.0	17.5	0.0	17.5	17.5	0.0	17.5	31	31	541 MG/mo	0 MG/mo	1,661 AF/mo
Nov	30	21.5	3.1	18.4	0.0	18.4	18.4	0.0	18.4	30	30	551 MG/mo	0 MG/mo	1,690 AF/mo
Dec	31	21.5	2.2	19.2	0.0	19.2	10.6	0.0	10.6	17	25	327 MG/mo	0 MG/mo	1,004 AF/mo
Average		**21.5**	**4.5**	**17.0**	**0.0**	**17.0**	**13.4**	**0.0**	**13.4**					
Total	**365**									**295**	**335**	**4,888** MG/yr	**0** MG/yr	**15,000 AFY**

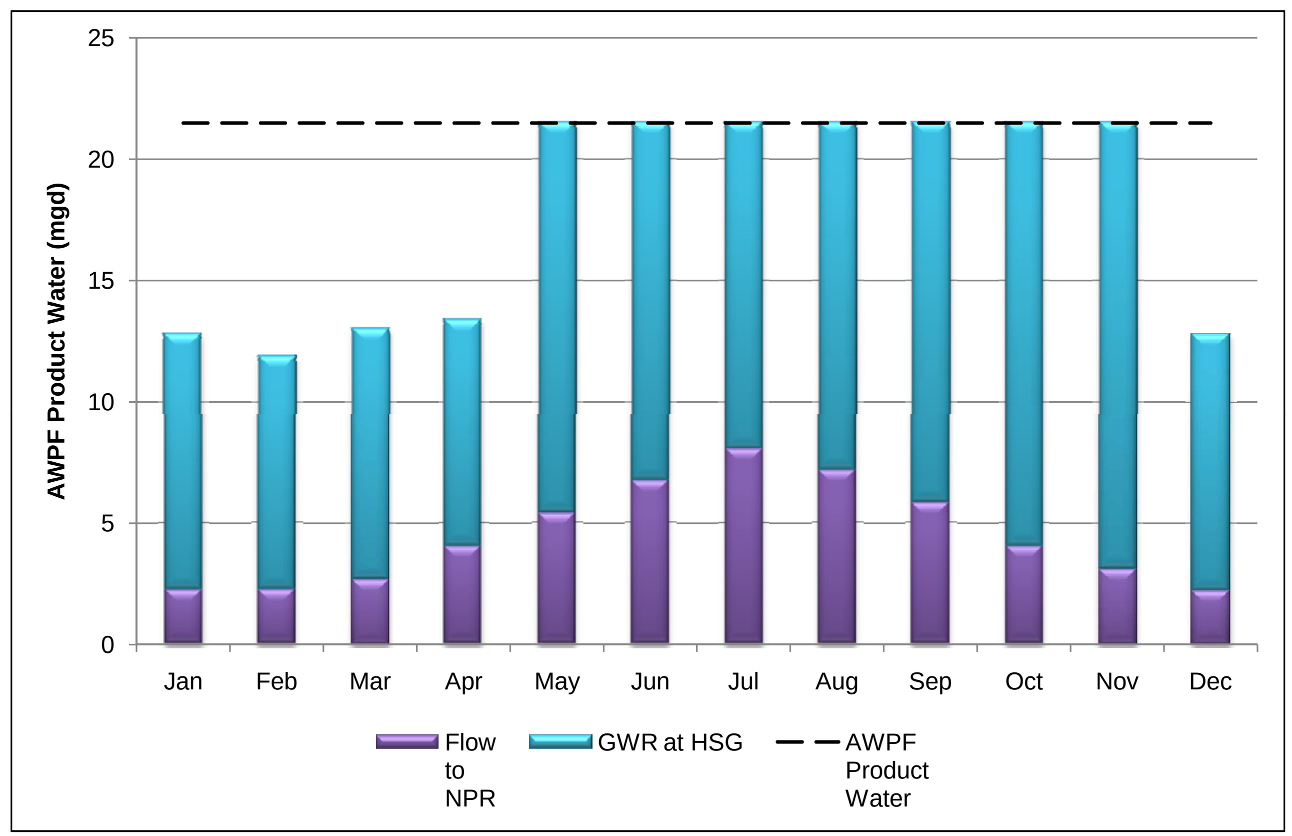
Notes:

2) Applied AWPF offline factor.

3) Before applying spreading grounds downtimes.

4) After applying spreading grounds downtimes.

5) Monthly spreading amounts (maximum flows available for GWR * no. of days of operation).



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7.1.3 Anticipated Permit Conditions

The two main quantitative considerations to demonstrate compliance with the 2008 draft CDPH regulations are: (1) retention time and (2) recycled water contribution (RWC).

Retention Time

The 2008 draft CDPH regulations require a minimum underground retention time of six months from introduction of the purified recycled water to interception at the nearest drinking water supply well. CDPH requires that this retention time be verified with a tracer test aimed to calculate groundwater retention time based on 2 percent of an added tracer arriving at its endpoint from the spreading basin (T2). However, the draft regulations allow initial estimates of retention time to be developed through three different methods as shown in **Table 7-5.** The San Fernando Basin Groundwater Flow Model was used to estimate travel time for the Phase 1 project conditions. Therefore, a minimum retention time of 12 months must be demonstrated utilizing this methodology.

Table 7-5: Options for Estimating Retention Time (2008 Draft CDPH Regulations)

Method Used to Estimate Retention Time to Nearest Downgradient Drinking Water Supply Well	Minimum Estimated Retention Time
Tracer study utilizing an intrinsic tracer based on T10 (i.e., the time for 10% of tracer concentration to reach the endpoint) conducted under hydraulic conditions representative of normal project operations	9 months
Numerical modeling (i.e., calibrated finite element or finite difference models using verified computer codes such as MODFLOW, FEFLOW, SUTRA, FEMWATER, etc.)	12 months
Analytical modeling (i.e., using existing equations such as Darcy's Law to estimate groundwater flow conditions based on simplifying aquifer assumptions)	24 months

The San Fernando Basin Groundwater Model (SFBGM) simulation was used to assess groundwater flow paths between the point of application of the purified recycled water (at HSG) and downgradient drinking water supply wells. Flow paths were generated by using the "back tracking" routine in MODPATH beginning at the two major downgradient well fields, the Tujunga Well Field (TWF) and the Rinaldi-Toluca Well Field (RTWF). Based on the modeled results (**Table 7-6**), the simulated retention time from the HSG to the TWF is estimated to be three years. A retention time of six years is estimated from the HSG to the RTWF. Therefore, compliance with this requirement can be easily demonstrated.

Table 7-6: Simulated Retention Time for Phases 1

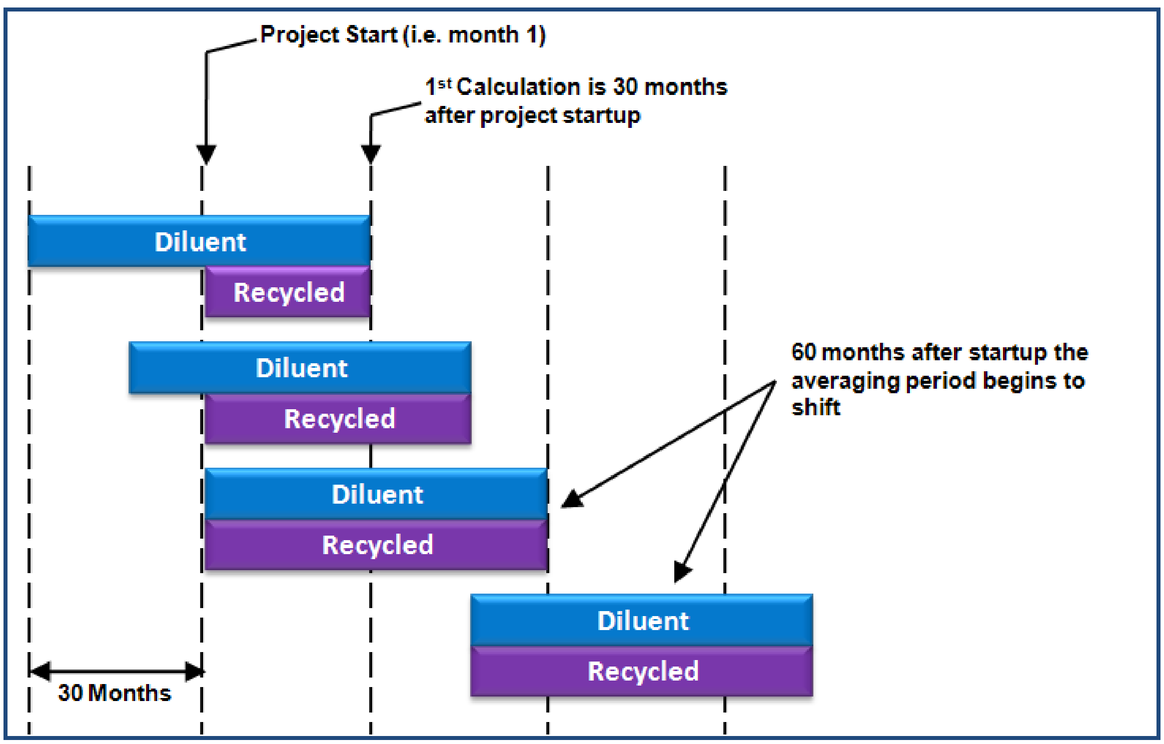
Source of Recycled Water	Simulated Retention Time (years)	
	Tujunga Well Field	Rinaldi-Toluca Well Field
Phase 1		
HSG	3	6

Recycled Water Contribution

The RWC is a calculation of the amount of purified recycled water received as a portion of the total amount of water recharged. **Figure 7-11** shows a simplified schematic of the RWC calculation. An initial maximum RWC is assumed to be 50 percent for the Phase 1 since LADWP plans to treat all recycled water with RO and AOP processes. According to the 2008 draft CDPH regulations, the RWC:

- Should be calculated for the preceding 60 months;
- Must not exceed 50 percent; and,
- Is calculated as the amount of purified recycled water delivered for groundwater replenishment divided by the total amount of groundwater replenished (recycled water plus diluent water).

Figure 7-11: Schematic Diagram of RWC Calculation Period



The RWC could potentially be increased following a period of project operations with sufficient data collected and evaluated and a review by an Independent Advisory Panel (IAP) and CDPH. However, under the current draft regulations, the project could not be permitted to start up with an allowable RWC greater than 50 percent. While it may be theoretically possible for a project sponsor to seek a higher initial RWC in accordance with the alternatives allowance in the draft regulations (Section 60320.005) and approval from an independent advisory panel, LADWP is not planning to pursue this for the initial permitted operations.

Based on discussions with CDPH and the IAP's Groundwater Subcommittee, it is anticipated that LADWP could get approval to count the measured stormwater that is recharged at the HSG, PSG, and TSG as diluent water. This should allow the RWC to be achieved for 15,000 AFY of GWR for the Phase 1 of the project under a wide range of potential conditions based on extension of historic hydrology, and the improvements completed at the spreading grounds with only a very low probability that the RWC could be exceeded. Furthermore, there is evidence that s additional upgradient natural recharge occurs in Tujunga Wash, which could further add to the dilution water totals. However, this is not accounted for in the analyses presented in Appendix J which provides some "factor of safety" to the analysis.

Further discussion and demonstration of the ability to meet the RWC is presented in Appendix J.

7.1.4 Recommended Facility Improvements

The configuration of the HSG was recently modified to allow for enhanced capture and recharge of stormwater from the Tujunga Wash. **Figure 7-12** shows the layout of the basins within the HSG and the locations of control structures between the individual basins that LACDPW can use to regulate flow from one basin to another.

During the initial stages of LADWP's East Valley Project, a 54-inch diameter pipe was installed on the southeastern boundary of the HSG, along the Tujunga Wash. A turnout and dispersion structure was constructed at the end of the pipeline, but the existing pipe is currently capped at the upstream end (near the northwestern corner of the HSG) as shown on **Figure 7-12**. This existing line will be able to be used to deliver purified recycled water to the HSG area. However, several additional ancillary facilities are recommended to allow for system flexibility. These improvements will allow for the delivery of purified recycled water to each spreading basin individually to be able to provide maximum flexibility in coordinating activities with LACDPW as discussed below. With these additional facilities, water could be delivered to any of the basins individually or in combination.

Turn-out at North End of Pipe

To re-activate the discharge at the northeast end of the 54-inch line, the segment of line that was removed and capped will need to be replaced and a new gate valve installed at the end of the pipe to allow purified recycled water to be discharged into Basin "S" in the HSG (**Figure 7-12**); or to isolate this discharge point when water is to be directed to other lower basins. Water in Basin S can then be directed, by LACDPW, to either Basins 1 or 2.

Additional Lateral A

An additional lateral would be installed from the transmission pipe to allow for discharge of purified recycled water directly into Basins 1, 2, 3, or 4 (see **Figure 7-12)**. A discharge structure to allow water to exit the lateral into one or more of the basins would also be necessary. The lateral pipe would need to be sized for full purified recycled water flow from the AWPF to allow the full flow to be distributed to a single basin. A 36-inch diameter pipeline is recommended.

Additional Lateral B

An additional 36-inch diameter lateral and discharge structure would be installed from the transmission pipe to a location between Basins 5 and 6 (**Figure 7-12**). The lateral pipe would need to be sized for full purified recycled water flow from the AWPF to allow the full flow to be distributed to either Basin 5 or 6 or a combination of both basins.

Figure 7-12: Hansen Spreading Grounds Improvements

7.1.5 Coordination with LACDPW Operations

A Memorandum of Understanding (MOU) between LADWP and LACDPW is being developed with respect to recharging purified recycled water at the HSG. The main topics that would need to be addressed in the MOU are described below.

Objectives of Operations

A set of stated objectives should be developed so that both LADWP and LACDPW have a common understanding of the joint operation of the HSG to achieve both stormwater spreading and purified recycled water recharge objectives. The objectives will include LACDPW's goal of maximizing capture and recharge of available stormwater, and LADWP's goal to recharge an annual average of 15,000 AF of purified recycled water.

Delivery Flow Rate and Location of Purified Recycled Water Recharge

The anticipated range of flow rates at which purified recycled water will be provided to the HSG will need to be discussed. Both LADWP and LACDPW will need to understand the variation in flow rates as well as some of the drivers that may cause changes in the flow rates. The expectations of both agencies will need to be discussed so that there is an understanding as to which agency(ies) can have control over any changes to the flow rates and cycling, as necessary, to different basins during normal operations. It is assumed that LACDPW will make the primary decision on a daily or less frequent basis as to which basin(s) purified recycled water should be delivered to at any given time. This may take into account whether any of the basins are being used for stormwater recharge at a given time and whether any basins need to be taken out of service for maintenance. Over time, both parties may develop an understanding based on prior operating records as to whether it is more or less beneficial to alternate the use of basins more or less frequently for purified recycled water spreading.

Downtime

The MOU will need to address issues related to downtime of the HSG. LACDPW has indicated that purified recycled water may not be accepted and recharged at the HSG for up to 70 days per year. The MOU will discuss the drivers that LACDPW reviews to determine when, and for how long, the HSG will be unavailable. This discussion will also provide information regarding availability of the HSG (i.e., all basins vs. individual basins).

7.1.6 System Reliability and Redundancy

The installation of Laterals A and B described in Section 7.1.4 will maximize the flexibility of the distribution of purified recycled water within the HSG. This will allow LACDPW to utilize the appropriate basin(s) based on the current hydrologic conditions and maintenance needs. Allowing for three separate turnout locations from the transmission pipe to the HSG will also provide redundancy if maintenance needs to be performed.

7.2 Phase 2 Option A - Hansen and Pacoima Spreading Grounds

The goal of the Phase 2 is to recharge an annual average volume of up to 30,000 AFY of purified recycled water. The target GWR volume and AWPF capacity for Phase 2 are shown in **Table 7-7**.

Table 7-7: Target GWR Volume and AWPF Capacity for Phase 2

	Target Rate
Annual Average Volume of GWR	30,000 AFY
AWPF Production Capacity (Maximum Flow Rate)	35.0 mgd

Use of HSG alone is not sufficient to allow GWR of 30,000 AFY for Phase 2. The use of stormwater for replenishment at the LACDPW spreading grounds is the first priority. Based on historic volumes over 40 years and factoring in recent improvements to the spreading facilities, it is assumed LACDPW will spread an average of 16,800 AFY of stormwater at HSG. Phase 1 of the GWR project will add another 15,000 AFY for a total of 31,800 AFY to be spread at HSG. Groundwater model simulations were conducted to assess the potential change in groundwater levels in the vicinity of the HSG due to spreading under various recharge scenarios. The model results indicate that, while HSG has the percolation capacity to accept more than 15,000 AFY of recycled water, the underlying aquifer system may not have the capacity to transmit flows much in excess of 31,800 AFY without excessive groundwater mounding because of a fault downgradient of HSG (approximately at San Fernando Road). These hydrogeologic conditions may cause excessive groundwater mounding in the HSG area if GWR flow is increased much above the Phase 1 condition of 15,000 AFY. Mounding could bring groundwater levels very close to the surface and greatly reduce percolation capacity, as well as the potential to adversely impact operations at the nearby Bradley Landfill. Therefore, recharge of recycled water greater than 15,000 AFY is not proposed for the HSG and the use of both the HSG and the PSG is necessary to increase GWR in Phase 2.

As with Phase 1, while the Phase 2 values shown in **Table 7-7** would imply that there is more treatment capacity than needed to meet the GWR target, the ability to deliver water year-round is constrained by the same factors as in Phase 1 including:

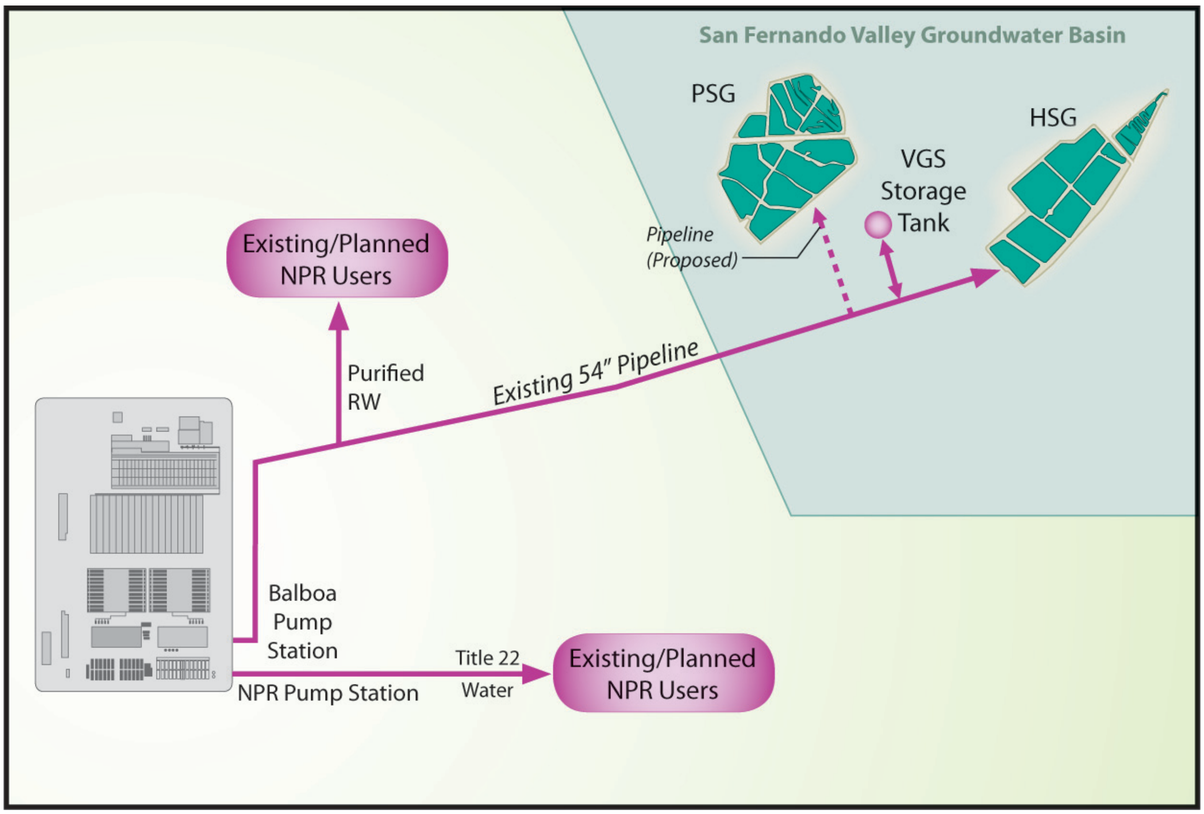
- AWPF Online Factor: The AWPF is assumed to have a 92 percent online factor. This assumes that the actual AWPF production would be average annual 92 percent of the plant capacity due to scheduled and unscheduled down times for maintenance and repair, and other unforeseen events.
- NPR Demands: The purified recycled water will also serve existing (except in Sepulveda Basin) and planned NPR demands off of the 54-inch pipeline. These demands are seasonal and peak during the summer months.
- Unavailability of Spreading Grounds: There will be periods (up to 70 days per year at HSG and 30 days per year at PSG) when the spreading grounds will not be available for purified recycled water spreading based on LACDPW's operations. These periods will

primarily be during the winter months in wetter years when the entire HSG is dedicated to receiving and recharging stormwater runoff.

7.2.1 Conveyance Facilities

As shown on **Figure 7-13**, conveyance from the AWPF at DCTWRP to the HSG would be accomplished through the existing 54-inch pipeline. The facility improvements to HSG, mentioned in Section 7.1.1, are assumed to have previously been constructed under Phase 1 and will continue to be used for Phase 2 Option A.

Figure 7-13: Schematic of Conveyance Facilities to Deliver 30,000 AFY from AWPF to HSG and PSG, Phase 2 Option A



To provide purified recycled water to PSG additional facility improvements will also be necessary. This proposed pipeline is discussed in the next section.

Pipeline to PSG

A new conveyance pipeline to deliver purified recycled water to the PSG is required for Phase 2 Option A. Four alignment alternatives were identified and are presented in **Figure 7-14**.

- **Van Nuys Blvd:** Developed to maximize the number of potential non-potable demands that could be connected along the conveyance pipeline route and, as a result, this is the longest alternative with approximately 17,400 feet of pipeline.

- **Woodman Ave:** Developed as the shortest pipeline route within a major road. This is the second-longest alternative with approximately 12,800 feet of pipeline.
- **Canterbury Ave:** The most direct route to PSG (10,200 feet), within existing City right-of-way, and located adjacent to a city-owned corridor with overhead power lines that is the former Whitnall Highway.
- **LACFCD Channel:** Also the most direct route (10,200 feet) and within LACFCD right-of-way along the Tujunga Wash channel, which minimizes traffic impacts and avoids utility congestion associated with construction within roadways.

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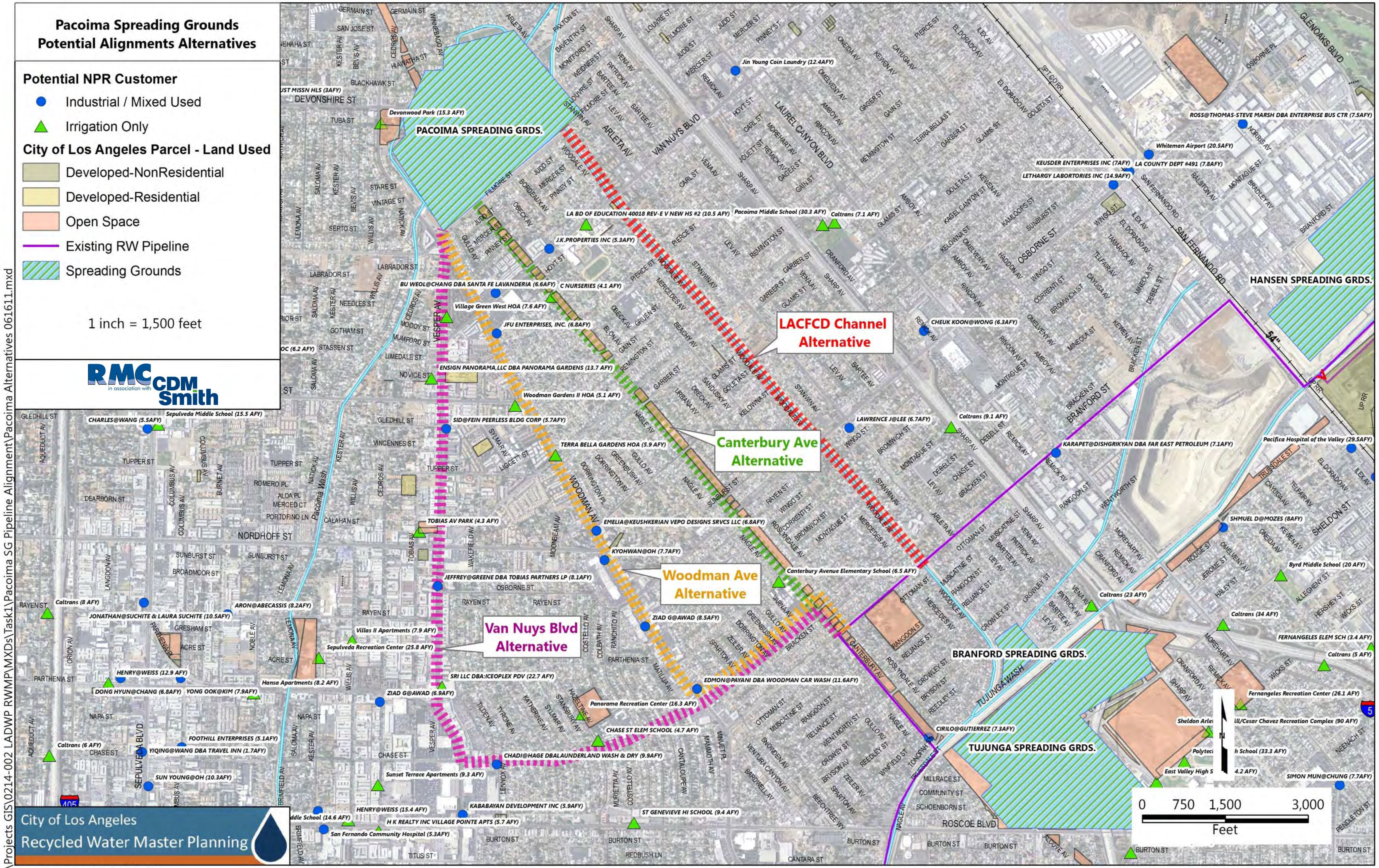
Figure 7-14: Pacoima Spreading Grounds Potential Alignment Alternatives



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Data Sources: USGS, LADWP

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The alignment alternatives were evaluated based on the criteria presented below.

- **Construction Cost Estimate:** Capital costs were estimated and O&M costs were assumed to be similar for all four alternatives so they were not estimated.
- **Constructability:** Constructability challenges identified in the field include narrow construction corridors, utility congestion, and major infrastructure crossings.
- **Right-of-Way Considerations:** Purchase costs for right-of-way are included and, in addition to the cost of easements, there is a risk in being able to secure the necessary easements, as well as potential schedule impacts.
- **Permitting Requirements:** General permitting requirements include the need for encroachment permits for installation within the right-of-way. Additional potential permits such as flood control and environmental permits could delay the project or add risk.
- **Traffic Impacts:** Traffic impacts primarily involve the need for lane or street closures and construction in streets with significant traffic volume and businesses will have relatively more impact to the public.
- **Injection Wells:** Proximity to potential injection well locations, which primarily include undeveloped City-owned properties. Injection wells are discussed as part of Phase 2 Option B in Section 7.3.

The Canterbury Ave alternative is the preferred alternative because this alternative has the lowest capital cost, the least traffic and utility congestion, minimal permitting issues, and runs parallel with the best potential site for injection wells. Further detail on each of the alternative alignments and the evaluation results are available in Appendix K.

7.2.2 Operational Strategy

As in Phase 1, the operation of the GWR at the HSG and PSG is governed by both the availability of purified recycled water and the capacity of the spreading grounds to percolate the purified recycled water. The capacity of HSG and PSG to accept and recharge purified recycled water is dependent on LACDPW's operations to capture and recharge native stormwater.

Existing Stormwater Recharge Conditions

As mentioned in Section 7.1.2, LACDPW has a policy "to conserve the maximum possible amount of stormwater consistent with runoff quantity and quality, capacities of the spreading facilities, and groundwater conditions." One of the main focuses of water conservation is the capture of stormwater and subsequent recharge at the HSG and PSG . Stormwater runoff is of generally high quality, particularly with respect to TDS and nitrate levels, and is essentially "free" water. Therefore, LACDPW will continue to utilize their resources in such a way as to maximize the capture of stormwater.

Diversion of stormwater flows to the spreading grounds may also provide some limited downstream flood hazard reduction benefits. However, most of the flood hazard reduction activities are focused on storage and operation of the upstream dams and reservoirs, and when high flow releases are required, these are typically greater than the diversion capacity of the spreading grounds.

The stormwater recharge at HSG was discussed in Section 7.1.2. Stormwater recharge at PSG typically occurs when water is available in the Pacoima Wash. The volume of water recharged at the PSG varies greatly from year to year, depending on the hydrology of the surrounding upgradient watershed. **Table 7-8** shows the historical volume of water spread at the PSG from WY 1968-69 through WY 2009-10.

Table 7-8: Historical Annual Recharge at the PSG

Metric	Annual Rate (AFY)
Average	6,515
Minimum	436
Maximum	22,972

Source: Watermaster 2011

The stormwater recharge at the PSG is also seasonal, with nearly 80 percent of long term stormwater runoff occurring between the months of December to May, as shown in **Table 7-9**.

Table 7-9: Average Monthly Distribution of Recharge the PSG

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2%	1%	3%	14%	16%	19%	16%	11%	10%	5%	2%	1%

Notes: Based on monthly recharge data provided by LACDPW for WY 1997-98 through WY 2008-09

Recent capital improvements to the PSG consisted of improved diversion facilities and increased upstream retention. These improvements will increase the volume of water captured and recharged compared to that released downstream. **Figure 7-15** shows the historic average volume of stormwater recharge at the PSG along with the projected increase in recharge expected due to the recent capital improvements. **Figure 7-16** shows the same information for the two historically wettest years, WY 1983 and WY 2005.

Figure 7-15: Historic Average Volume of Stormwater Captured at PSG, WY 1969-2008

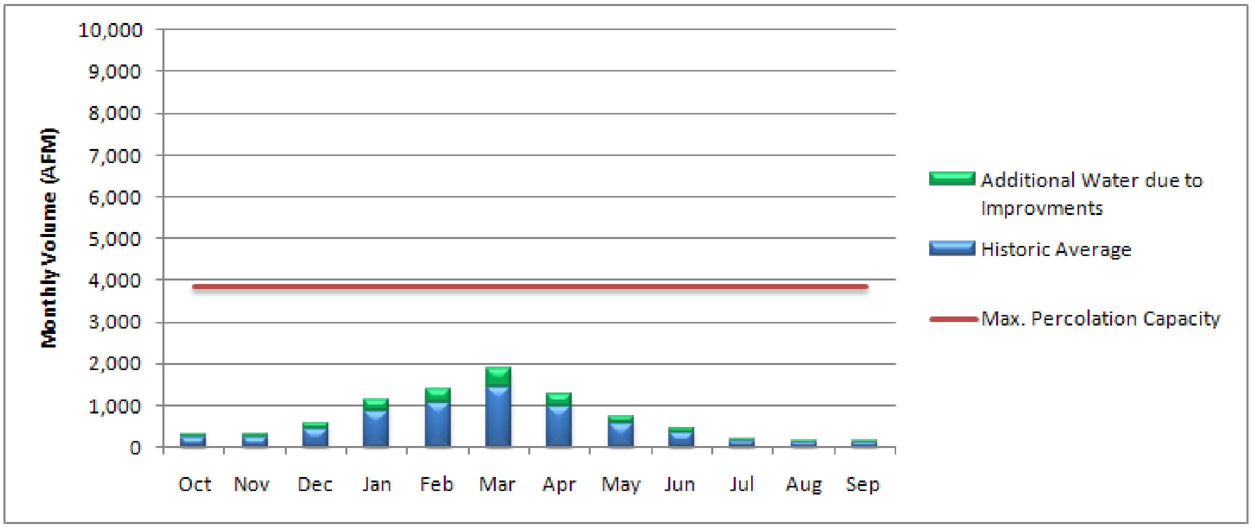
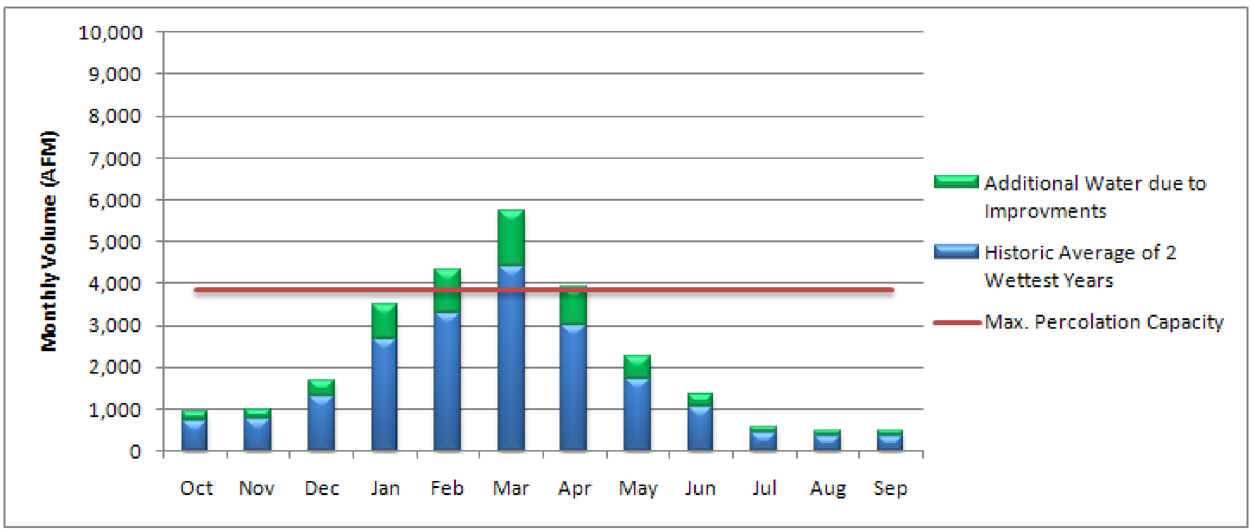


Figure 7-16: Historic Average Volume of Stormwater Captured at PSG, 2 Wettest Years (WY 1983 and WY 2005)



Future Recharge Conditions

The goal of the Phase 2 of the project is to recharge an annual average volume of up to 15,000 AFY (average of 1,250 AFM) of purified recycled water at the HSG and up to 15,000 AFY at the PSG. Future conditions at the HSG where discussed in Section 7.1.2.

Based on available information, the percolation capacity of the PSG would be sufficient to allow for continued recharge with stormwater as well as the additional volume of purified recycled water. The annual average volume of 15,000 AFY equates to a long term average of approximate

41 AFD. This rate is significantly below the percolation capacity of the entire PSG of approximately 128 AFD.

Figure 7-17 shows the additional purified recycled water recharge volume along with historic average stormwater recharge volume at the PSG for WY 1969 through WY 2008. **Figure 7-18** shows similar information for the two wettest years, WY 1983 and WY 2005. Because the percolation capacity of the PSG is lower than the HSG, there may be additional instances of the PSG being filled to capacity, especially during wet years.

Figure 7-17: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the PSG, WY 1969-2008

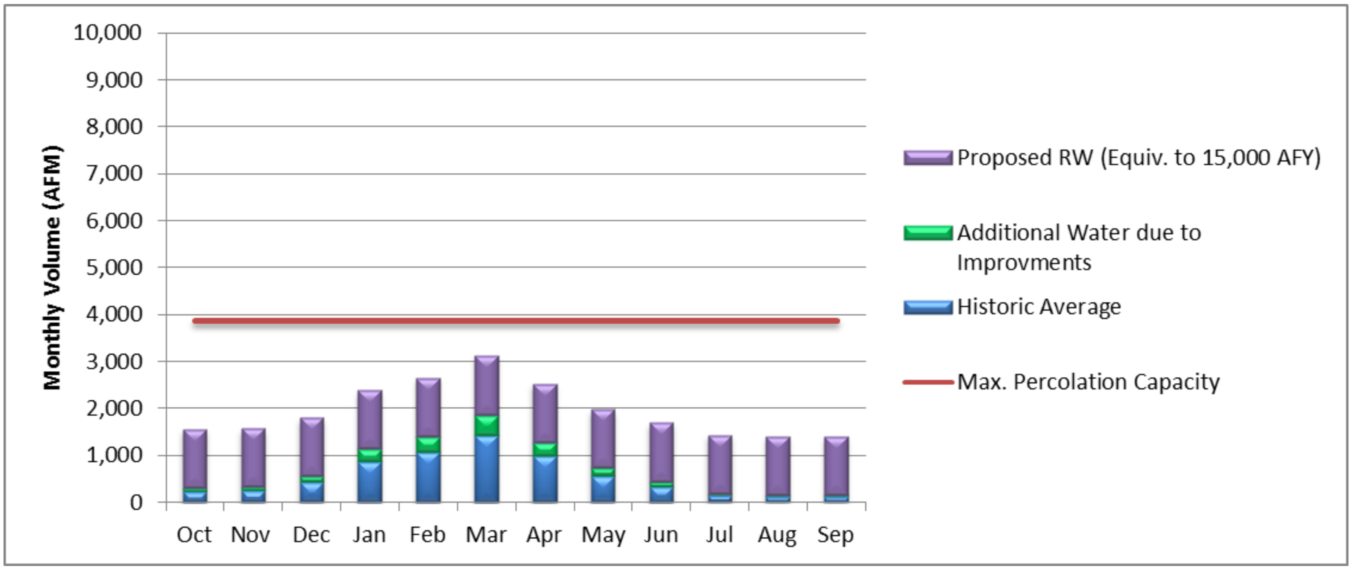
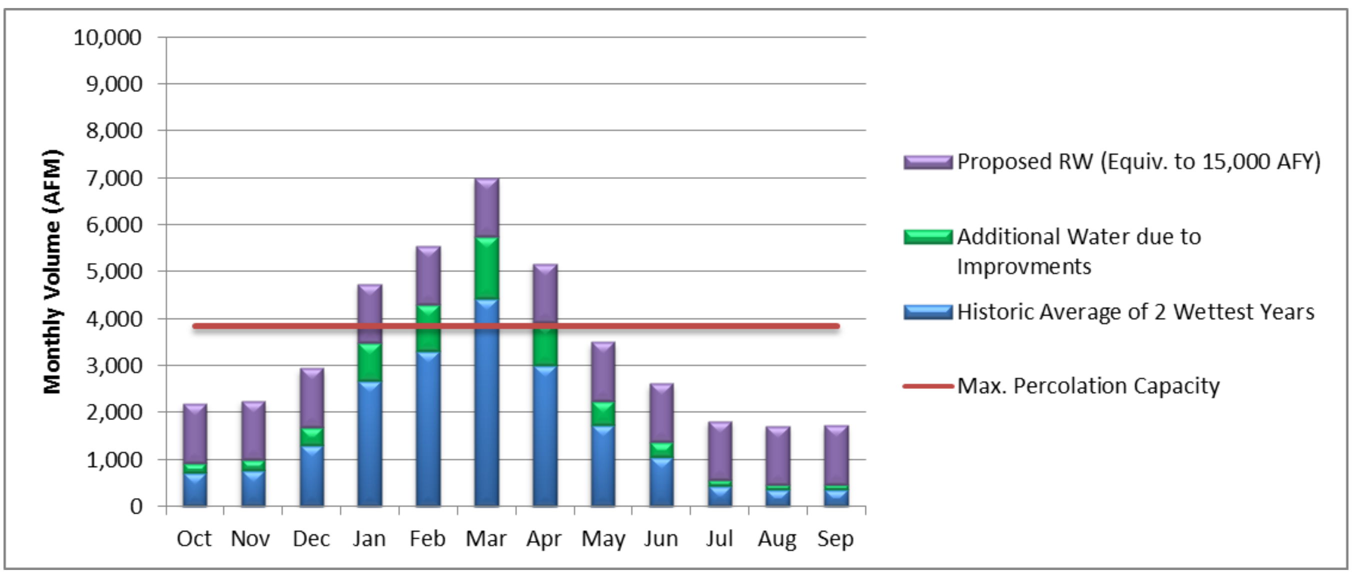


Figure 7-18: Additional Purified Recycled Water Recharge with Historic Average Stormwater Recharge Volume at the PSG, Two Wettest Years (WY 1983 and WY 2005)



Spreading Basin Availability

As with Phase 1, there will periods when the spreading grounds are unavailable for the recharge with purified recycled water. LACDPW has indicated that PSG could be unavailable for up to 30 days per year.

Similar to **Figure 7-10** for Phase 1, **Figure 7-19** shows how Phase 2 operations would incorporate downtime at both HSG and PSG. The figure shows the average monthly mass balance if the 70 days of HSG and 30 days of PSG unavailability is assumed to occur during the winter months of December through April.

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Figure 7-19

AWPF Capacity and GWR Capability Monthly Flow Chart

Phase 2 Option A - Spreading at HSG and PSG - SG Downtimes in Winter Months Only

AWPF Capacity: 35.0 mgd

Total GWR: 26,400 AFY

AWPF		
Phase 1 Capacity (min)[1]	23.4	mgd
Phase 2 Capacity	35.0	mgd
Stage	Phase 2	
AWPF Recovery	79%	
Plant Capacity	35.0	mgd
Downtime	30	days/year
Online Factor	92%	
Offline Factor	8%	
Downtime	**Y/N**	**day/mo**
Jan	Y	2.5
Feb	Y	2.5
Mar	Y	2.5
Apr	Y	2.5
May	Y	2.5
Jun	Y	2.5
Jul	Y	2.5
Aug	Y	2.5
Sep	Y	2.5
Oct	Y	2.5
Nov	Y	2.5
Dec	Y	2.5
		30

NPR		
Existing/Tier 1	5,010	AFY
Existing/Tier 1	4.5	mgd
Max Tier 2	0	AFY
Max Tier 2	0.0	mgd
Total	5,010	AFY
Total	4.5	mgd
Peaking Factor		
Jan	0.5	
Feb	0.5	
Mar	0.6	
Apr	0.9	
May	1.2	
Jun	1.5	
Jul	1.8	
Aug	1.6	
Sep	1.3	
Oct	0.9	
Nov	0.7	
Dec	0.5	

HSG		
% of GWR	50%	
Downtime	70	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	14.0
Feb	Y	14.0
Mar	Y	14.0
Apr	Y	14.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	14.0
		70

PSG		
% of GWR	50%	
Downtime	30	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	6.0
Feb	Y	6.0
Mar	Y	6.0
Apr	Y	6.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	6.0
		30

Notes:

1) While the minimum Phase 1 AWPF capacity is 23.4 mgd, the recommended AWPF design capacity for Phase 1 is 25 mgd. See Section 5 for more information.

Month	No. of Days in Month	AWPF Product Water	Flow to NPR	Max Flow Available for GWR			Average Flows to Spreading Grounds			GWR Operations							
										Operation		Spreading Grounds					
				HSG	PSG	Total	HSG	PSG	Total	HSG	PSG	HSG		PSG		Total	
	days	mgd (Note 2)	mgd	mgd (Note 3)	mgd (Note 3)	mgd (Note 3)	mgd (Note 4)	mgd (Note 4)	mgd (Note 4)	days	days	(Note 5)		(Note 5)			
Jan	31	32.1	2.2	14.9	14.9	29.9	8.2	12.1	20.2	17	25	254	MG/mo	374	MG/mo	1,926	AF/mo
Feb	28	32.1	2.2	14.9	14.9	29.9	7.5	11.7	19.2	14	22	209	MG/mo	329	MG/mo	1,651	AF/mo
Mar	31	32.1	2.7	14.7	14.7	29.4	8.1	11.9	19.9	17	25	250	MG/mo	368	MG/mo	1,897	AF/mo
Apr	30	32.1	4.0	14.0	14.0	28.1	7.5	11.2	18.7	16	24	225	MG/mo	337	MG/mo	1,725	AF/mo
May	31	32.1	5.4	13.4	13.4	26.8	13.4	13.4	26.8	31	31	415	MG/mo	415	MG/mo	2,545	AF/mo
Jun	30	32.1	6.7	12.7	12.7	25.4	12.7	12.7	25.4	30	30	381	MG/mo	381	MG/mo	2,340	AF/mo
Jul	31	32.1	8.1	12.0	12.0	24.1	12.0	12.0	24.1	31	31	373	MG/mo	373	MG/mo	2,290	AF/mo
Aug	31	32.1	7.2	12.5	12.5	25.0	12.5	12.5	25.0	31	31	387	MG/mo	387	MG/mo	2,375	AF/mo
Sep	30	32.1	5.8	13.2	13.2	26.3	13.2	13.2	26.3	30	30	395	MG/mo	395	MG/mo	2,422	AF/mo
Oct	31	32.1	4.0	14.0	14.0	28.1	14.0	14.0	28.1	31	31	436	MG/mo	436	MG/mo	2,673	AF/mo
Nov	30	32.1	3.1	14.5	14.5	29.0	14.5	14.5	29.0	30	30	435	MG/mo	435	MG/mo	2,669	AF/mo
Dec	31	32.1	2.2	14.9	14.9	29.9	8.2	12.1	20.2	17	25	254	MG/mo	374	MG/mo	1,926	AF/mo
Average		**32.1**	**4.5**	**13.8**	**13.8**	**27.7**	**11.0**	**12.6**	**23.6**								
Total	**365**									**295**	**335**	**4,013**	MG/yr	**4,602**	MG/yr	**26,441**	**AFY**

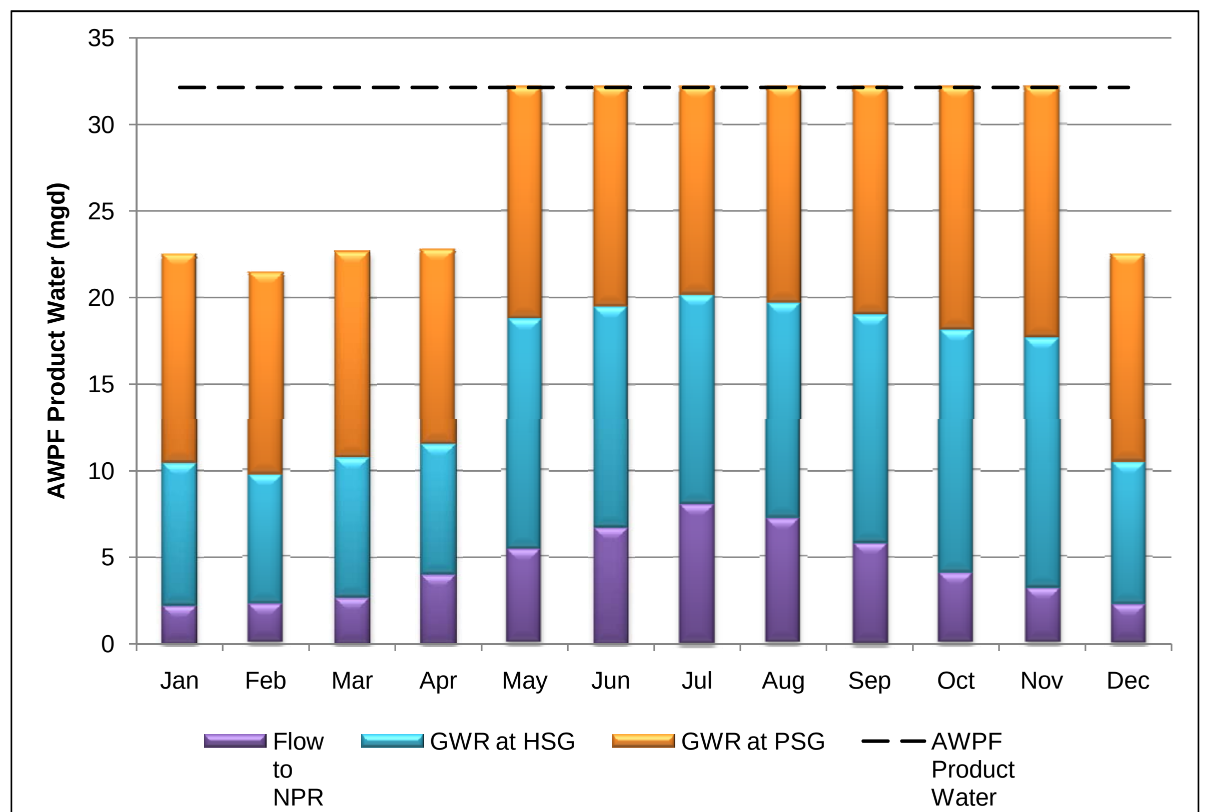
Notes:

2) Applied AWPF offline factor.

3) Before applying spreading grounds downtimes.

4) After applying spreading grounds downtimes.

5) Monthly spreading amounts (maximum flows available for GWR * no. of days of operation).



RMC in association with CDM Smith

LA DWP

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The data provided in **Figure 7-19** assumes that the HSG will be unavailable for recharge with purified recycled water 70 days year and 30 days at the PSG. It is likely that that during average and dry years the number of days that the HSG and PSG will not be available will be less than 70 and 30 days. **Figures 7-20 and 7-21** show the actual daily inflow to the HSG and PSG, respectively, from October 2001 through March 2011. These figures show that the inflows to the HSG and PSG were below the percolation capacities during the majority of days. Based on the frequency and volume of inflow during each WY, the WYs were grouped into "Dry", "Average", and "Wet" years as shown in **Figures 7-22 and 7-23**.

Figure 7-20: Historical Daily Inflow to the HSG, October 2001 through March 2011

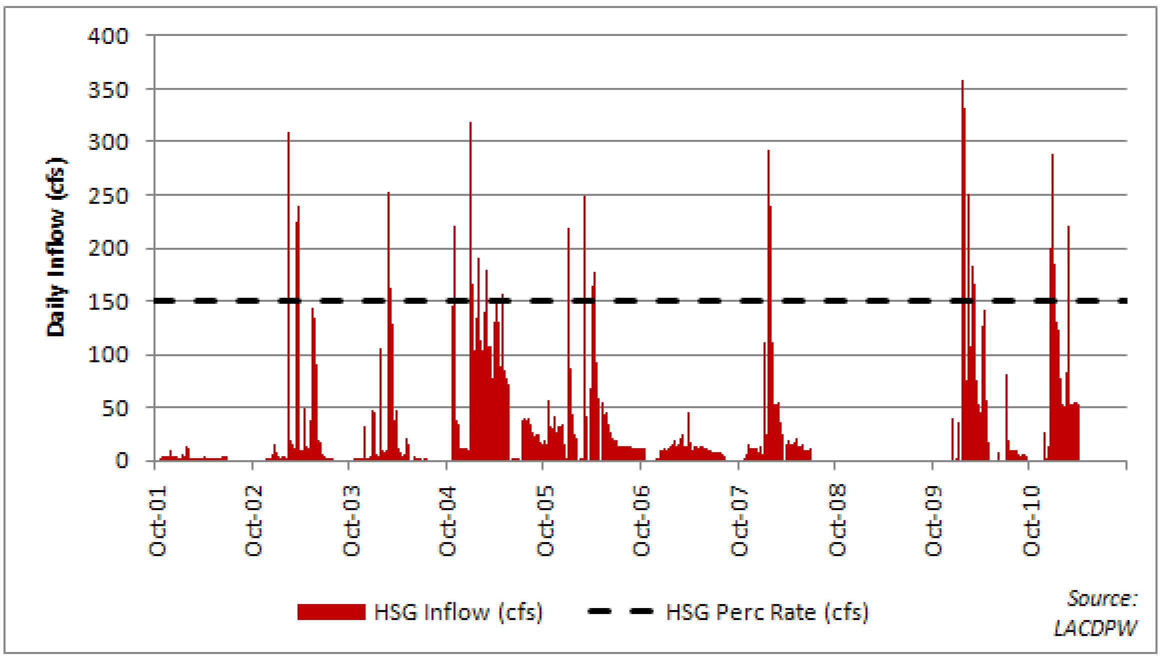


Figure 7-21: Historical Daily Inflow to the HSG, Separated by Year Type, October 2001 through March 2011

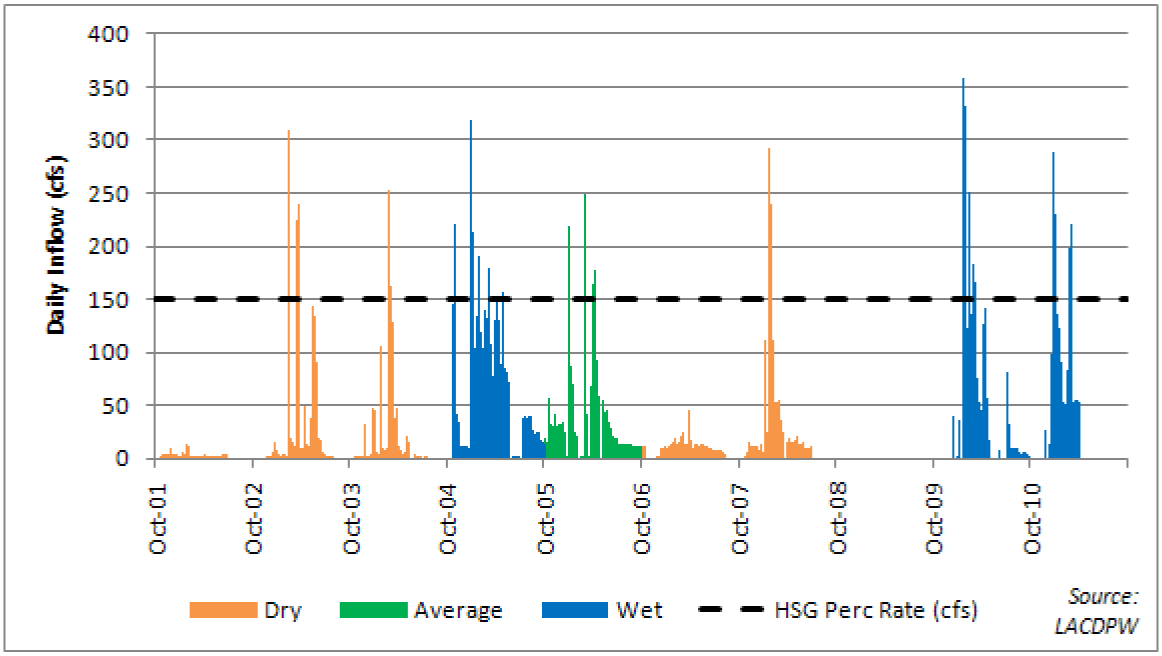


Figure 7-22: Historical Daily Inflow to the PSG, October 2001 through March 2011

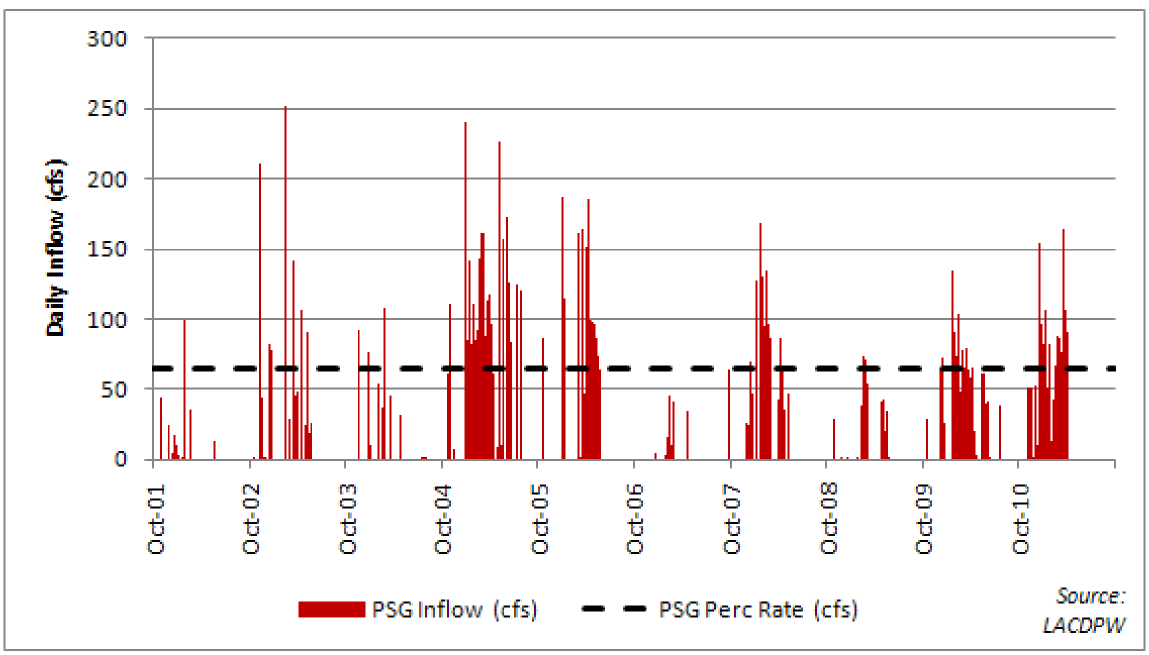
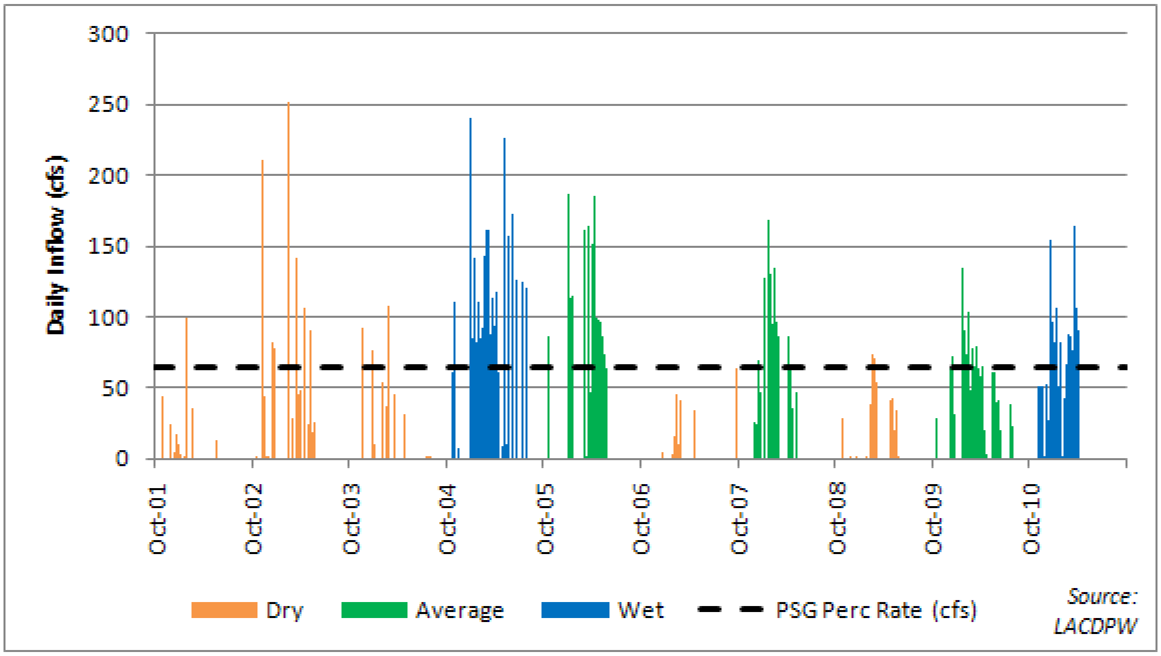


Figure 7-23: Historical Daily Inflow to the HSG, Separated by Year Type, October 2001 through March 2011



Assuming that the HSG and PSG would be available more frequently during dry and average years, as compared to wet years, the calculations shown in **Figure 7-20** were modified to assume fewer days when the spreading grounds would be unavailable. As an example, during average years it was assumed that the periods of unavailability would be 35 and 15 days at the HSG and PSG, respectively. During dry years it was assume the number of days when the HSG and PSG would be unavailable would be 10 and 5 days, respectively. Note that the number of days that the spreading grounds would be available for each year type are assumed and used for illustrative purposes. **Table 7-10** shows the resulting average volume of GWR that could be expected under these assumed conditions.

Table 7-10: Average GWR Volume based on Water Year Types

Year Type	Assumed Number of Days when SGs are Not Available[1]	Average GWR
Wet	HSG: 70 days; PSG: 30 days	26,441 AFY
Average	HSG: 35 days; PSG: 15 days	28,699 AFY
Dry	HSG: 10 days; PSG: 5 days	30,280 AFY
Weighted Average[2]	Varies	29,004 AFY

Notes:
1) The number of days that the spreading grounds would be available for each year type are assumed and used for illustrative purposes.
2) Based on the assumption of 5.5 dry years, 2 average years, and 2.5 wet years every 10 years. Number of each year type was based on 10 years of actual flow data for LACDPW.

7.2.3 Anticipated Permit Conditions

It is anticipated that the permit conditions for Phase 2 Option A would be the same as for Phase 1. The calculation of retention time and RWC would be applied to water recharged at both HSG and PSG.

Retention Time

Similar to Phase 1, a SFBGM simulation was used to assess groundwater flow paths between the point of application of purified recycled water (HSG and PSG) and the downgradient drinking water supply wells. Based on the modeled results (**Table 7-11**), the simulated retention time from the HSG to the TWF is estimated to be three years. A retention time of six years is estimated from the HSG to the RTWF. The retention time between the PSG and the TWF (4.5 yrs) and RTWF (11 yrs) is also greater than the anticipated permit requirements. Therefore, compliance with this requirement can be easily demonstrated.

Table 7-11: Simulated Retention Time for Phase 2 Option A

Source of Recycled Water	Simulated Retention Time (years)	
	Tujunga Well Field	Rinaldi-Toluca Well Field
Phase 2 Option A		
HSG	3	5.5
PSG	4.5	11

Recycled Water Contribution

The RWC is a calculation in Phase 2 would be similar to that in Phase 1, as described in Section 7.1.3. The RWC calculation in Phase 2, however, would include all purified recycled water that was recharged at HSG and PSG.

Further discussion and demonstration of the ability to meet the RWC is presented in Appendix J.

7.2.4 Recommended Facility Improvements

In addition to the new conveyance pipe line that would be required to connect from the existing 54-inch line to PSG. Improvements would also need to be made to the PSG facility.

These improvements are shown in **Figure 7-24** and would include:

- New piping around PSG. Additional piping would need to be installed to allow purified recycled water to be delivered to all basins within the PSG.
- Additional Laterals. Similar to the improvements at HSG, to provide maximum flexibility in providing purified recycled water to the PSG, laterals from the main PSG transmission line to each of the individual basins within PSG would need to be constructed. These laterals are shown conceptually in **Figure 7-24** in one potential

layout. The laterals would need to be sized according to the total percolation capacity of each of the individual basin(s) served by the lateral.

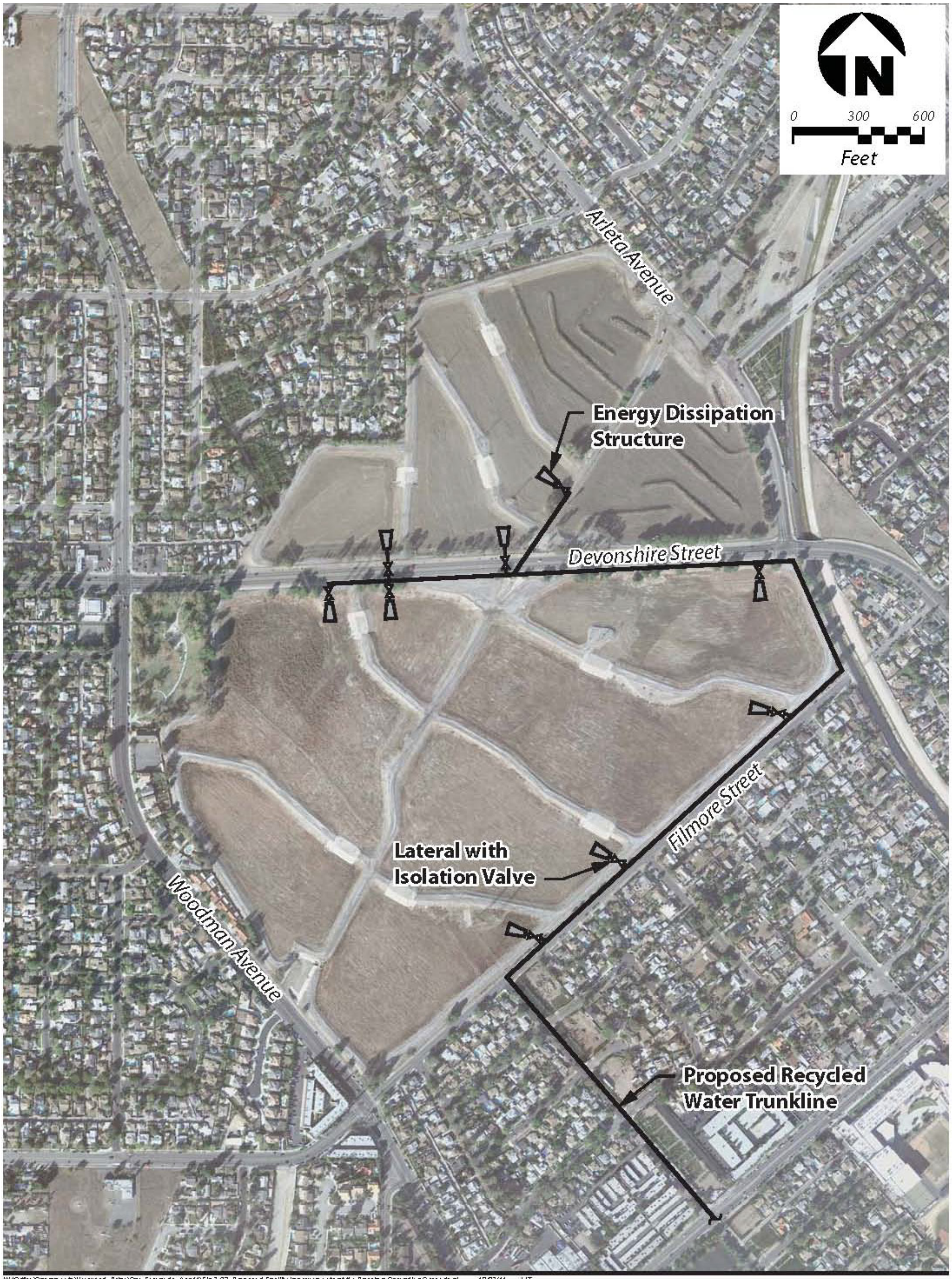
7.2.5 Coordination with LACDPW Operations

As discussed in Section 7.1.5, a MOU is being developed between LADWP and LACDPW to guide the process of the recharge with purified recycled water. In addition to the items necessary for Phase 1, the MOU will also need to address issues related to the delivery of purified recycled water to PSG. The issues related to the downtime of PSG will also need to be discussed.

7.2.6 System Reliability and Redundancy

The installation of the piping and laterals described in Section 7.2.4 will maximize the flexibility of the distribution of purified recycled water within the PSG. These improvements will allow LACDPW to utilize the appropriate basin(s) based on the current hydrologic conditions and maintenance needs. Allowing for multiple separate turnout locations from the pipe will also provide redundancy if maintenance needs to be performed.

Figure 7-24: Proposed Facility Improvements at the PSG

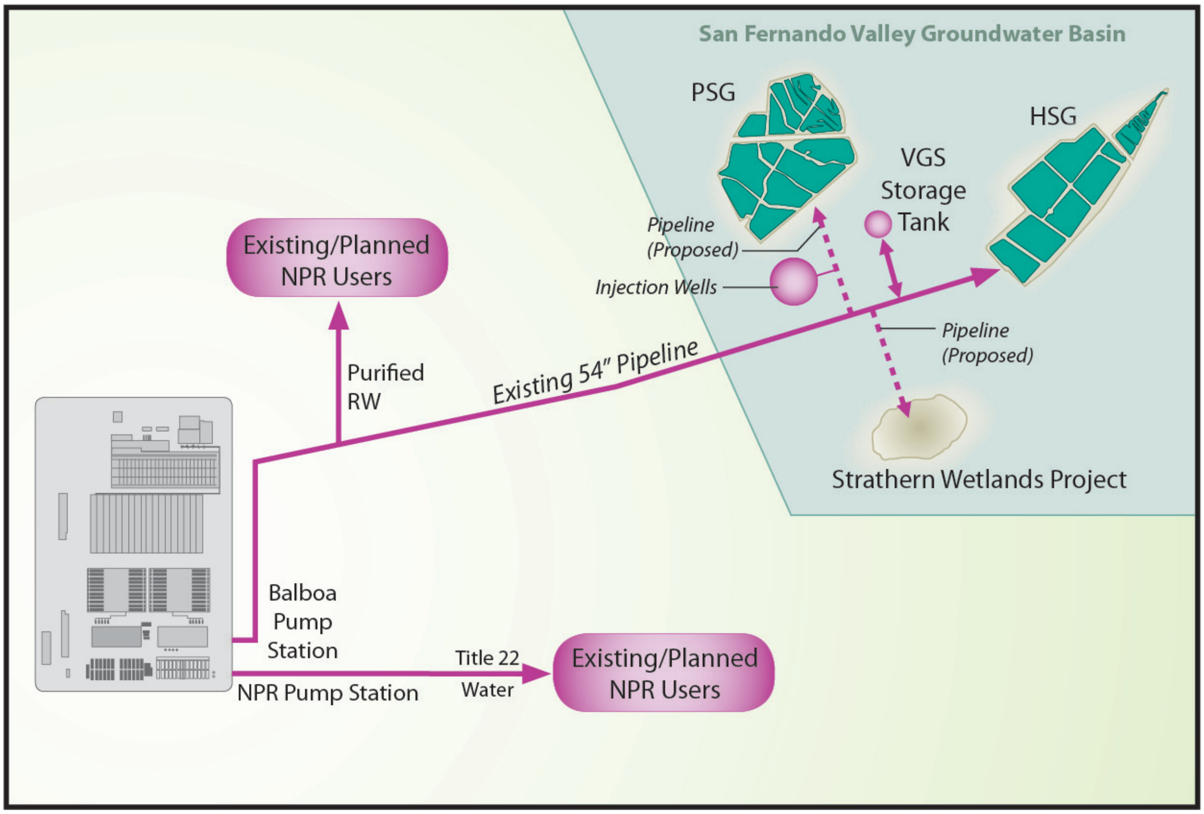


W:\Office\Sacramento\Heywood_Brian\San Fernando_Aug11\Fig 7-23_Proposed Facility Improvements at the Pacoima Spreading Grounds.ai 10/07/11 JJT

7.3 Phase 2 Option B - Hansen and Pacoima Spreading Grounds and Injection Wells and/or the Strathern Wetlands Project

As with Phase 2 Option A, the goal is to recharge an annual average volume of 30,000 AFY of purified recycled water. In addition to the use of HSG and PSG, Option B adds the potential use of injection wells and/or the Strathern Wetlands Project to recharge the product water (**Figure 7-25**).

Figure 7-25: Schematic of Conveyance Facilities to Deliver 30,000 AFY from AWPF to HSG, PSG, Injection Wells, and/or the Strathern Wetlands Project (Phase 2 Option B)



7.3.1 Conveyance Facilities

The existing 54-inch pipeline and the proposed conveyance pipeline to the PSG would also be utilized in Phase 2 Option B. Additional lateral piping would be needed from the proposed PSG conveyance pipeline to the injection wells (see Section 7.3.4).

7.3.2 Operational Strategy

The injection wells would be used only during the rainy season and particularly in the wetter years when HSG and PSG are being used exclusively for stormwater spreading and are, therefore, not available for purified recycled water spreading. It is anticipated that under such conditions, LACDPW could require LADWP to stop sending any purified recycled water to the either or both spreading grounds for periods of time ranging from a few days to several weeks or longer depending upon rainfall and runoff conditions in the upstream watersheds including water stored behind the upstream dams. Therefore, the injection wells would be designed for the full capacity of the AWPF at 35.0 mgd so that for any day and extended periods that the basins are not available, the full output capacity of the AWPF could be delivered to the wells to maximize groundwater replenishment and an annual average of 30,000 AF can be achieved. The system flows and operational conditions for the injection wells are summarized in **Table 7-12**.

Injection wells are similar to groundwater production wells and have screens below the water table. The pressure in the existing delivery system would move the water down the injection wells where it exits into the groundwater basin through the screened zones. The capacity for individual wells was estimated at 4.2 cubic feet per second (cfs) or approximately 50 percent of the capacity of the larger production wells at the Tujunga well field. For this analysis, no redundant or standby wells were included because it is not essential that the system be 100 percent reliable at all times. This assumption can be further evaluated at a later time.

Table 7-12: System Flows and Operating Conditions

Text	Text
Total Injection Capacity	35.0 mgd
Operational Capacity per Well	2.7 mgd; 4.2 cfs
No. of Wells	13
Operating Conditions	Standby under normal conditions. To be used when HSG/PSG are not available for recycled water spreading.

An important consideration with respect to introducing injection wells is the question of meeting blend requirements under the 2008 draft CDPH regulations. Projects using AWPF treated recycled water can start at maximum RWC of 50 percent. Under these requirements, it would be possible to inject 100 percent recycled water into the wells whenever the spreading basins are not available, and as necessary to meet regulations, inject an equivalent amount of treated potable water into the wells to achieve a 50/50 blend on a seasonal or annual basis during spring and fall months or during extended dry periods in the winter time when recycled water can be delivered to the basins. Therefore, no additional infrastructure has been included to accommodate blend water.

Spreading Basin Availability

Similar to **Figure 7-19** for Phase 2 Option A, **Figure 7-26** shows how Phase 2 Option B would incorporate downtime at both HSG and PSG assuming that the 70 days of HSG and 30 days of PSG unavailability occurs during the winter months of December through April. In addition to the volume of water recharged via GWR, the figure shows the volume of water that would potentially be available, on average, to be recharged at the injection wells and/or the Strathern Wetlands Project.

Figure 7-26

AWPF Capacity and GWR Capability Monthly Flow Chart

Phase 2 Option B - Spreading at HSG and PSG, Supplemented by Injection Wells - SG Downtimes in Winter Months Only

AWPF Capacity: 35.0 mgd

Total GWR: 31,000 AFY

AWPF		
Phase 1 Capacity (min)[1]	23.4	mgd
Phase 2 Capacity	35.0	mgd
Stage	Phase 2	
AWPF Recovery	79%	
Plant Capacity	35	mgd
Downtime	30	days/year
Online Factor	92%	
Offline Factor	8%	
Downtime	**Y/N**	**day/mo**
Jan	Y	2.5
Feb	Y	2.5
Mar	Y	2.5
Apr	Y	2.5
May	Y	2.5
Jun	Y	2.5
Jul	Y	2.5
Aug	Y	2.5
Sep	Y	2.5
Oct	Y	2.5
Nov	Y	2.5
Dec	Y	2.5
		30

NPR		
Existing/Tier 1	5,010	AFY
Existing/Tier 1	4.5	mgd
Max Tier 2	0	AFY
Max Tier 2	0.0	mgd
Total	5,010	AFY
Total	4.5	mgd
Peaking Factor		
Jan	0.5	
Feb	0.5	
Mar	0.6	
Apr	0.9	
May	1.2	
Jun	1.5	
Jul	1.8	
Aug	1.6	
Sep	1.3	
Oct	0.9	
Nov	0.7	
Dec	0.5	

HSG		
% of GWR	50%	
Downtime	10	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	2.0
Feb	Y	2.0
Mar	Y	2.0
Apr	Y	2.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	2.0
		10

PSG		
% of GWR	50%	
Downtime	5	days/year
Downtime	**Y/N**	**day/mo**
Jan	Y	1.0
Feb	Y	1.0
Mar	Y	1.0
Apr	Y	1.0
May	N	0.0
Jun	N	0.0
Jul	N	0.0
Aug	N	0.0
Sep	N	0.0
Oct	N	0.0
Nov	N	0.0
Dec	Y	1.0
		5

Notes:

1) While the minimum Phase 1 AWPF capacity is 23.4 mgd, the recommended AWPF design capacity for Phase 1 is 25 mgd. See Section 5 for more information.

Month	No. of Days in Month	AWPF Product Water	Flow to NPR	Max Flow Available for GWR			Average Flows to Spreading Grounds			Remaining Flow for Injection
				HSG	PSG	Total	HSG	PSG	Total	
	days	mgd (Note 2)	mgd	mgd (Note 3)	mgd (Note 3)	mgd (Note 3)	mgd (Note 4)	mgd (Note 4)	mgd (Note 4)	mgd
Jan	31	32.1	2.2	14.9	14.9	29.9	14.0	14.5	28.4	1.4
Feb	28	32.1	2.2	14.9	14.9	29.9	13.9	14.4	28.3	1.6
Mar	31	32.1	2.7	14.7	14.7	29.4	13.8	14.2	28.0	1.4
Apr	30	32.1	4.0	14.0	14.0	28.1	13.1	13.6	26.7	1.4
May	31	32.1	5.4	13.4	13.4	26.8	13.4	13.4	26.8	0.0
Jun	30	32.1	6.7	12.7	12.7	25.4	12.7	12.7	25.4	0.0
Jul	31	32.1	8.1	12.0	12.0	24.1	12.0	12.0	24.1	0.0
Aug	31	32.1	7.2	12.5	12.5	25.0	12.5	12.5	25.0	0.0
Sep	30	32.1	5.8	13.2	13.2	26.3	13.2	13.2	26.3	0.0
Oct	31	32.1	4.0	14.0	14.0	28.1	14.0	14.0	28.1	0.0
Nov	30	32.1	3.1	14.5	14.5	29.0	14.5	14.5	29.0	0.0
Dec	31	32.1	2.2	14.9	14.9	29.9	14.0	14.5	28.4	1.4
Average		**32.1**	**4.5**	**13.8**	**13.8**	**27.7**	**13.4**	**13.6**	**27.0**	**0.6**
Total	**365**									

GWR Operations														
Operation Period			Spreading Grounds						Injection Wells				Total	
HSG	PSG	Wells	HSG		PSG		Total		Wells		Total			
days	days	days	(Note 6)		(Note 6)		(Note 6)						AF/mo	
29	30	2	433	MG/mo	448	MG/mo	2,706	AF/mo	45	MG/mo	138	AF/mo	2,843	AF/mo
26	27	2	389	MG/mo	403	MG/mo	2,431	AF/mo	45	MG/mo	138	AF/mo	2,568	AF/mo
29	30	2	427	MG/mo	442	MG/mo	2,665	AF/mo	44	MG/mo	136	AF/mo	2,801	AF/mo
28	29	2	393	MG/mo	407	MG/mo	2,458	AF/mo	42	MG/mo	129	AF/mo	2,587	AF/mo
31	31	0	415	MG/mo	415	MG/mo	2,545	AF/mo	0	MG/mo	0	AF/mo	2,545	AF/mo
30	30	0	381	MG/mo	381	MG/mo	2,340	AF/mo	0	MG/mo	0	AF/mo	2,340	AF/mo
31	31	0	373	MG/mo	373	MG/mo	2,290	AF/mo	0	MG/mo	0	AF/mo	2,290	AF/mo
31	31	0	387	MG/mo	387	MG/mo	2,375	AF/mo	0	MG/mo	0	AF/mo	2,375	AF/mo
30	30	0	395	MG/mo	395	MG/mo	2,422	AF/mo	0	MG/mo	0	AF/mo	2,422	AF/mo
31	31	0	436	MG/mo	436	MG/mo	2,673	AF/mo	0	MG/mo	0	AF/mo	2,673	AF/mo
30	30	0	435	MG/mo	435	MG/mo	2,669	AF/mo	0	MG/mo	0	AF/mo	2,669	AF/mo
29	30	2	433	MG/mo	448	MG/mo	2,706	AF/mo	45	MG/mo	138	AF/mo	2,843	AF/mo
355	**360**	**10**	**4,896**	**MG/yr**	**4,970**	**MG/yr**	**30,280**	**AFY**			**678**	**AFY**	**30,958**	**AFY**

Notes:

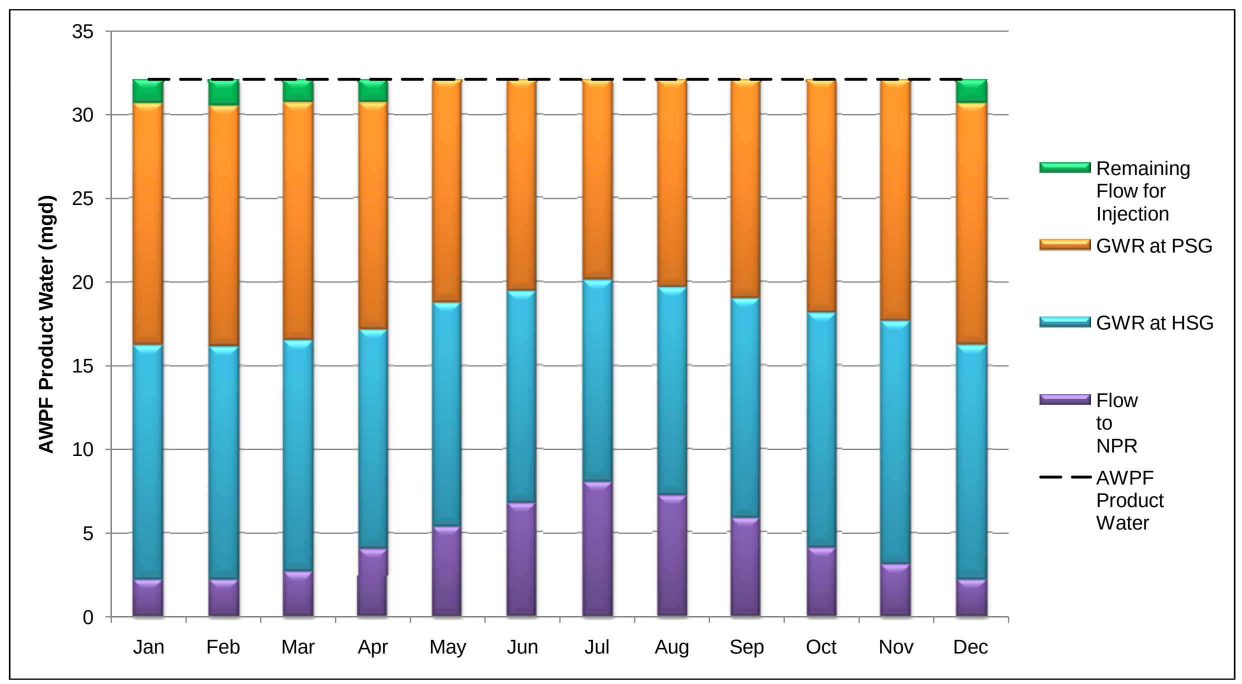
2) Applied AWPF offline factor.

3) Before applying spreading grounds downtimes.

4) After applying spreading grounds downtimes.

5) Actual number of days of operation will vary depending on ability to send flows to PSG.

6) Monthly spreading amounts (maximum flows available for GWR * no. of days of operation).



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As discussed in Section 7.2.2, the HSG and PSG are expected to be available more days during average and dry years than during wet years when the HSG and PSG may be available for purified recycled water recharge for 70 and 30 days, respectively. Using the same assumptions as in Section 7.2.2, **Table 7-13** shows the expected purified recycled water that would be available for recharge in the injection wells.

Table 7-13: Average Volume Available for Recharge at Injection Wells, based on Water Year Types

Year Type	Assumed Number of Days when SGs are Not Available[1]	Water Available for Injection Wells
Wet	HSG: 70 days; PSG: 30 days	4,517 AFY
Average	HSG: 35 days; PSG: 15 days	2,259 AFY
Dry	HSG: 10 days; PSG: 5 days	678 AFY
Weighted Average[2]	Varies	1,954 AFY

Notes:

1) The number of days that the spreading grounds would be available for each year type are assumed and used for illustrative purposes.
2) Based on the assumption of 5.5 dry years, 2 average years, and 2.5 wet years every 10 years. Number of each year type was based on 10 years of actual flow data for LACDPW.

7.3.3 Anticipated Permit Conditions

It is anticipated that the permit conditions for Phase 2 Option B would be the same as for Option A for surface recharge with the purified recycled water. If injection wells were to be used for additional recharge as described above, the calculation of retention time and RWC would be applied to water recharged at both the HSG and PSG as well as the water introduced through the injection wells and/or potentially the Strathern Wetlands Project.

Retention Time

Similar to Phase 1, and Phase 2 Option A, a SFBGM simulation was used to assess groundwater flow paths between the point of application of purified recycled water (HSG, PSG and injection wells) and the downgradient drinking water supply wells. Based on the modeled results (**Table 7-14**), the simulated retention time from the HSG to the TWF is estimated to be three years. A retention time of six years is estimated from the HSG to the RTWF. The retention time between the PSG and the TWF (4.5 yrs) and RTWF (11 yrs) is also greater than the anticipated permit requirements. Therefore, compliance with this requirement can be easily demonstrated.

Table 7-14: Simulated Retention Time for Phase 2 Option B

Source of Recycled Water	Simulated Retention Time (years)	
	Tujunga Well Field	Rinaldi-Toluca Well Field
Phase 2 Option B		
HSG	4	6
PSG	4.5	12.5
Injection Wells	2	---[1]

Note:
1) Water from the injections wells does not flow to the Rinaldi-Toluca Well Field.

Recycled Water Contribution

The RWC is a calculation in Phase 2 would be similar to that in Phase 2 Option A, as described in Section 7.2.3. The RWC calculation in Phase 2, however, would include all purified recycled water that was recharged at HSG, PSG and at the injection wells.

Further discussion and demonstration of the ability to meet the RWC is presented in Appendix J.

7.3.4 Recommended Facility Improvements

The same improvements to PSG discussed in Section 7.2.3 would also be required for Phase 2 Option B, in addition to the Phase 1 improvements at HSG. Additionally, injection wells would need to be installed along the proposed Canterbury alignment of the conveyance pipeline to PSG.

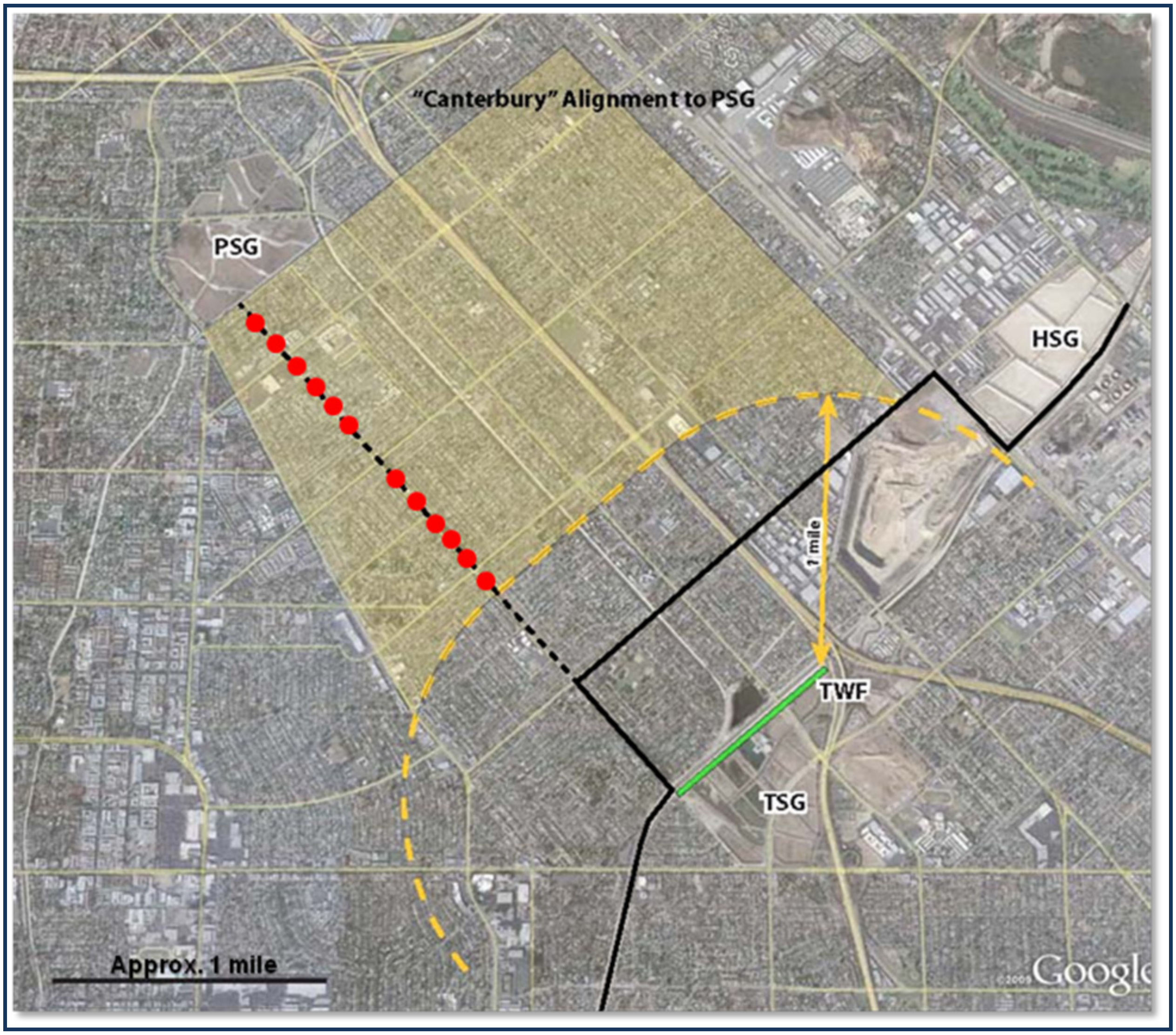
Injection Well Site Locations

The potential sites for injection wells considered the following:

- The closest well would be constructed approximately 1 mile upgradient from the TWF to provide adequate retention time with some safety factor,
- Sites would be chosen to the maximum extent possible in close proximity to one of the proposed alignments of the recycled water pipeline to PSG, and
- Sites would be located on City-owned land or right-of-way where possible.

Based on these criteria, the potential zone for injection wells is shown in **Figure 7-27**. The sites are conceptually located along the preferred Canterbury Avenue delivery pipeline alignment where there is significant City-owned right-of-way to consider for well locations.

Figure 7-27: Potential Locations for Injection Wells



Preliminary Design Criteria

The preliminary design criteria for the injection wells are summarized in **Table 7-15**.

Table 7-15: Conceptual Injection Well Design Criteria

Total No. of Wells	12
Operational Capacities per Well	2.7 mgd; 4.2 cfs
Diameter	16 - 20 inch
Ground Elevation	865 to 915 ft mean sea level
Screen Intervals	To be determined
Well Depth	500 to 600 ft below ground surface
Well Type	Cluster Injection Well
Drilling Method	TBD
Well Construction Materials	
Casing Materials	Stainless steel or FRP
Well Screens	316L continuous slot or 316L shutter screen
Sealing Materials	TBD
Gravel Pack Materials	TBD

7.3.5 Coordination with LACDPW Operations

The MOU discussed previously in Sections 7.1.5 and 7.2.5 would address the issues regarding coordination and cooperation with LACDPW for use of the HSG and PSG. Assuming the injection wells are not cited on LACDPW property there would be no direct coordination with LACDPW regarding injection well operations.

7.3.6 System Reliability and Redundancy

In addition to the reliability and redundancy issues discussed previously with regard to the use of the spreading basins, having injection wells available would significantly increase the ability of LADWP to maintain delivery of AWPF to groundwater recharge operations throughout the year and minimize any disruption or downtime associated with lack of access to the spreading grounds.

7.4 Strathern Wetlands Project

The Strathern Wetlands Project is being developed at the Strathern Pit, a former gravel mining pit and inert materials landfill, that may potentially be used for purified recycled water recharge if necessary to achieve the GWR goal of 30,000 AFY. The proposed Strathern Wetlands Project will consist of stormwater capture and treatment facilities within the bounds of the 46-acre Strathern Pit site, formerly used as a gravel pit and construction debris landfill. This is a

BOS and LACDPW Flood Control District joint project, identified in the Sun Valley Watershed Management Plan (LACDPW, 2004). The project site, located south of the Golden State Freeway (Interstate 5) in the community of Sun Valley, is bounded by Strathern Street on the south, Tujunga Avenue on the west, Roscoe Boulevard on the north and Fair Avenue on the east.

The Strathern Wetlands Project will construct detention ponds and wetlands to store and treat stormwater runoff. The treated flows will then be pumped to the adjacent Sun Valley Park for infiltration in two underground basins with a total of 7 AF of storage. The project will also provide habitat restoration and recreational opportunities. It is estimated that the proposed Strathern Wetlands Project will capture and treat approximately 895 AFY of dry and wet urban weather runoff, primarily during five months of the year (LACFCD and LABOS, 2006). The captured runoff would also support the wetlands when runoff is low or nonexistent.

Purified recycled water from the AWPF may potentially be supplied to the Strathern Wetlands Project along with injection wells if these facilities are necessary to achieve the GWR goal of 30,000 AFY. If necessary, purified recycled water would be conveyed to the Strathern Wetlands Project in a lateral from the existing 54-inch-diameter pipeline from DCTWRP toward HSG. The sizing and alignments have not yet been identified, but the water would be conveyed in buried pipelines constructed under existing paved streets.

7.5 Groundwater Extraction

Groundwater will be ultimately extracted, treated and delivered to LADWP customers using existing wells. Of the 115 wells owned by LADWP in the SFB, over 50 have been shut down due to contamination, resulting in a loss of approximately 440 AF per day or 40 percent of LADWP's total pumping capacity. Of the remaining wells, which have a pumping capacity of approximately 600 AF per day, 45 wells have recorded contaminant concentrations above the corresponding maximum contaminant levels (MCLs). Most notable among these contaminants of concern are the volatile organic compounds (VOCs) TCE, PCE, and carbon tetrachloride; chromium; nitrate; and perchlorate. Thirteen wells have recorded marginal levels of contamination, mostly VOCs.

As part of a separate program to clean up groundwater contamination in the SFB, future centralized treatment facility/s and wellhead treatment are being considered as part of the San Fernando Basin Groundwater Treatment Complex to allow LADWP to again have the ability to fully utilize the SFB groundwater supplies that is planned to include groundwater replenishment with purified recycled water. Locations of the centralized treatment are being considered in the vicinity of the LADWP North Hollywood Pump Station and Tujunga Well Field.

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8. Design Standards and Criteria

This section presents design standards and criteria for the architectural, civil, geotechnical, structural, and electrical components of the GWR proposed project with AWPF at the DCTWRP southwest location. The codes and standards referenced in this section are current for this GWR Master Planning Report. When the City starts design, the governing codes and standards need to be re-evaluated.

8.1 Architectural Design Criteria

This section addresses the architectural design criteria relating to the construction of the new MF/RO building. The MF/RO building will need to accommodate the process areas for the MF and RO systems, as well as a control room, a mechanical/maintenance room, an electrical room, a laboratory, storage rooms, restrooms, a lunch room, conference rooms, office spaces, and a lobby. There will also be canopies for the outside process areas, e.g. UV system. The public outreach spaces will be provided at the new Multi-Purpose and Office Building (by others).

8.1.1 Codes and Standards

All new building construction shall be designed in accordance with the following codes and standards:

- 2009 California Building Code (CBC), with current amendments
- 2009 California Fire Code (CFC), with current amendments
- National Fire Protection Association (NFPA)
- Occupational Safety and Health Administration (OSHA)
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- California Title 24, CalGREEN Code and LEED, (Leadership in Energy and Environmental Design), Criteria for sustainability.

8.1.2 Area Classifications

Tables 8-1 through **8-3** describe the building occupancy ratings, construction time, and general description of the general process areas, non-process areas, and chemical storage and feed facilities, respectively.

Table 8-1: Building Occupancy Rating – General Process Area

Category	Description
Building Occupancy	Factory Industrial, F-2
Construction Type	Type IIB, non-combustible, unprotected
General Description	Cast-in-place concrete, structural steel columns and beams, steel roof deck, hollow metal doors and frames.

Table 8-2: Building Occupancy Rating – Non-Process Areas

Category	Description
Building Occupancy	Business, B
Construction Type	Type IIB, non-combustible, unprotected
General Description	Cast-in-place concrete floor, structural steel columns and beams, metal roof deck, light gauge metal framed partition walls with gypsum board finish, aluminum storefront and exterior doors with insulated low-e glass.

Table 8-3: Building Occupancy Rating – Chemical Storage and Feed Facilities

Category	Description
Building Occupancy	High Hazard, H-3 or H-4 depending on chemicals
Construction Type	Type IIB, non-combustible, unprotected
General Description	Cast-in-place concrete floors, stairs and depressed containment areas, structural steel columns and beams, steel roof deck, CMU partitions where required.

8.1.3 MF/RO Building Design Criteria

The MF/RO building will be designed and constructed as an integral part of DCTWRP, not serving only the utilitarian need for water services but contributing to the overall vision of a facility that creates a model for stewardship and innovative design. The AWPF will provide innovative building design without sacrificing user functionality, ease of maintenance or integration into the facility as a whole.

Sustainable Design

The purpose of sustainable design is to incorporate design principles and practices in buildings or facilities that minimize energy consumption, greenhouse gas emissions, water consumption, and solid waste generation. In addition to being environmentally responsible; sustainable design enhances and has a positive impact on, the health, productivity, and comfort of occupants. Sustainable design strategies take an integrated approach to design and consider the life-cycle of a building to reduce cost and increase value of the built environment. While this project will not be submitting to the U.S. Green Building Council (USGBC) for LEED Certification, it will be implementing, practical, sustainable design strategies, such as energy efficient lighting, water efficient fixtures, and others.

Design Considerations

The MF/RO building will be comprised of two basic areas: the process area and the non-process (administration) area. The process area will house the MF and RO process areas on two floors, in addition to a control room, a mechanical/maintenance room, an electrical room, and a blower/compressor room. The administration area will house a laboratory, storage rooms, restrooms, a lunch room, conference rooms, office spaces, and a lobby.

The floor to floor height necessary to accommodate the process equipment provides a unique opportunity to double up the floors for the administration areas, creating a building design that has two floors for process equipment and a mezzanine level on the first floor for additional administrative spaces.

The overall building footprint is approximately 130 ft by 225 ft. The first floor RO process area is approximately 24,700 square feet (sf). The mechanical room and electrical room, also located on the first floor add up to 3,100 sf. The second floor MF process area will occupy the entire second floor of 29,250 sf. The administrative space on the first floor is 1,700 sf, and 3,200 sf on the first floor mezzanine level, for a total of 4,900 sf. See **Table 8-4** for a breakdown of the approximate space requirements for the process and administration areas within the MF/RO building. See **Figures 8-1 through 8-4** for the MF/RO building floor plans and elevations.

Table 8-4: MF/RO Building Space Requirements

Facility	P or NP [1]	Approximate Dimension (ft x ft)	Approximate Area (sf)
First Floor			
Process Area for RO	P	130 x 190	24,700
Mechanical/Maintenance Room	P	30 x 30	900
Electrical Room	P	36 x 60	2,200
Restrooms	NP	(2) 13 x 22	580
Lobby and Reception Area	NP	15 x 26	208
Elevator/Circulation	NP		900
First Floor Mezzanine			
Process Bay for RO	P	Open to Below	
Lunch/Conference Room	NP	13 x 30	390
Lab	NP	17 x 28	480
Control Room	NP	30 x 45	1,350
Computer Room	NP	17 x 28	480
Restrooms	NP	(2) 13 x 22	580
Elevator/Circulation	NP		300
Second Floor			
Process Area for MF including Blower/Compressor Room	P	130 x 225	29,250
Total Process Areas			**57,050**
Total Non-Process Areas			**4,800**

Notes:
1) P = process area, NP = non-process area

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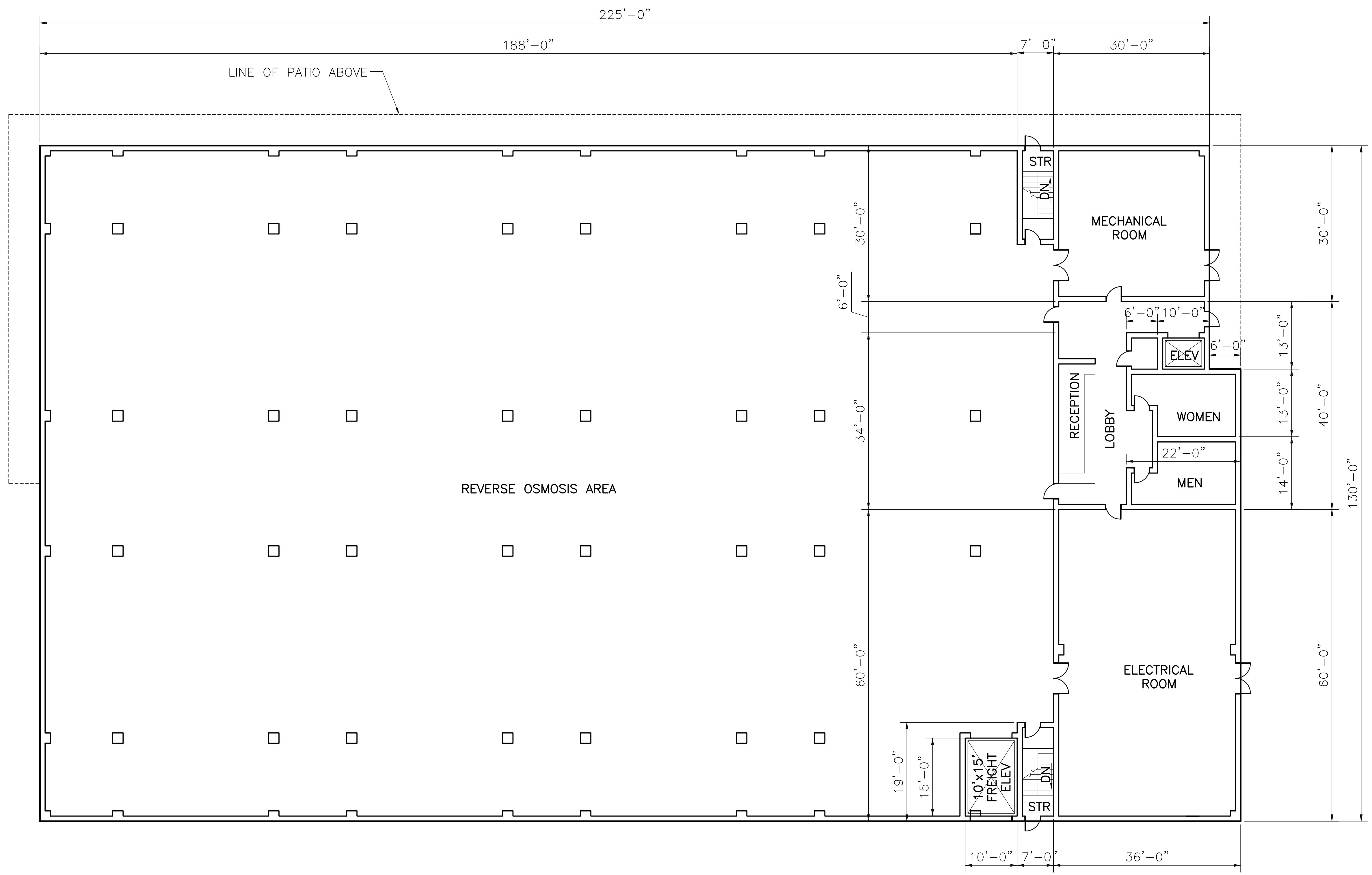

PLAN
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0" 1"
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REV	DATE	BY	APVD	DESCRIPTION

DESIGNED	AG
DRAWN	CEB
CHECKED	ECY

SUBMITTED: ______ RMC PROJ ENGR C______
APPROVED: ______ RMC ENGR C______

CITY OF LOS ANGELES - GWR MASTER PLANNING DOCUMENT

MF/RO BUILDING
FIRST FLOOR PLAN

FIG NO	8-1
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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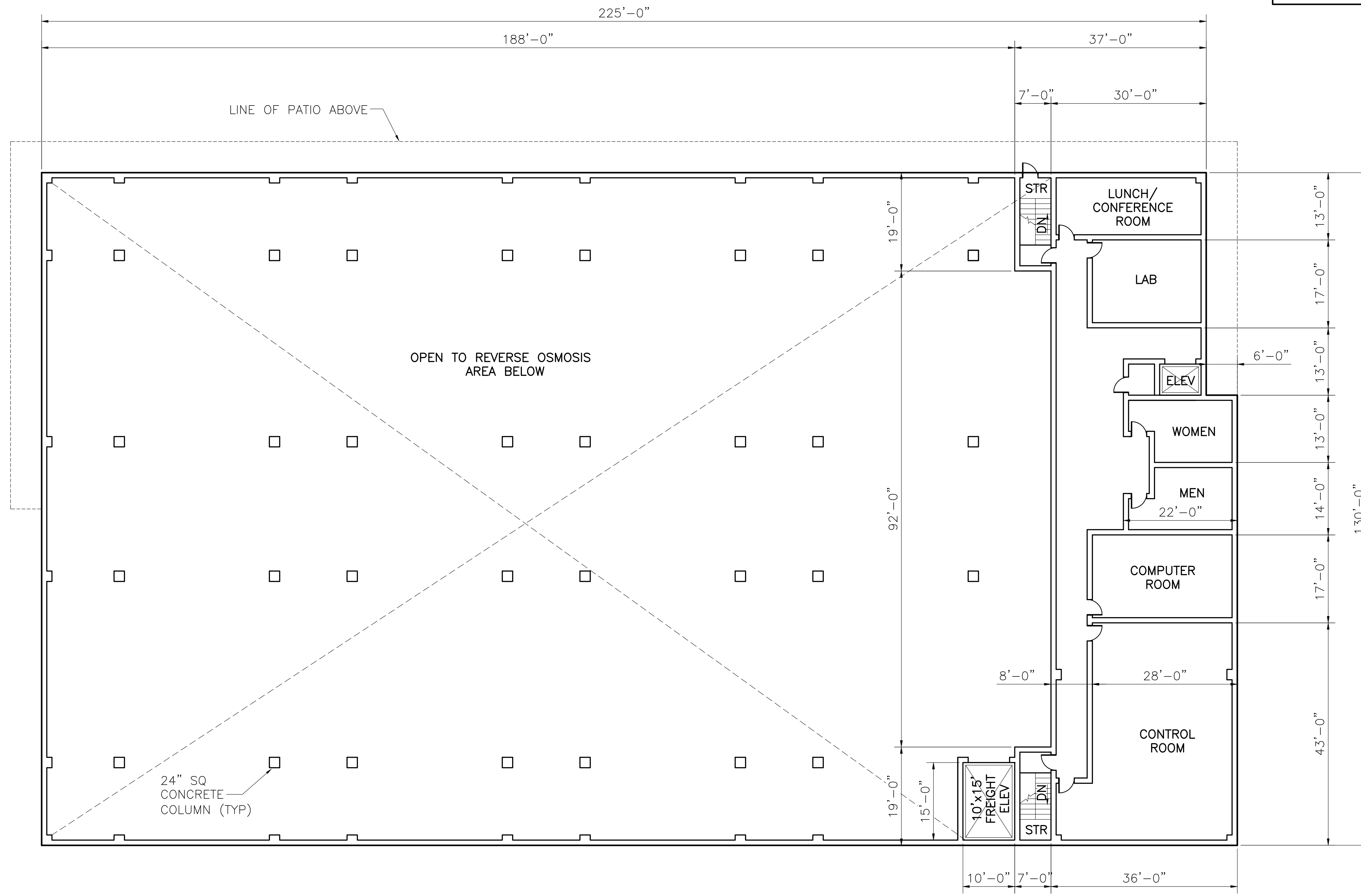

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SUBMITTED: RMC PROJ ENGR C
APPROVED: RMC ENGR C

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MF/RO BUILDING
MEZZANINE FLOOR PLAN

FIG NO	8-2
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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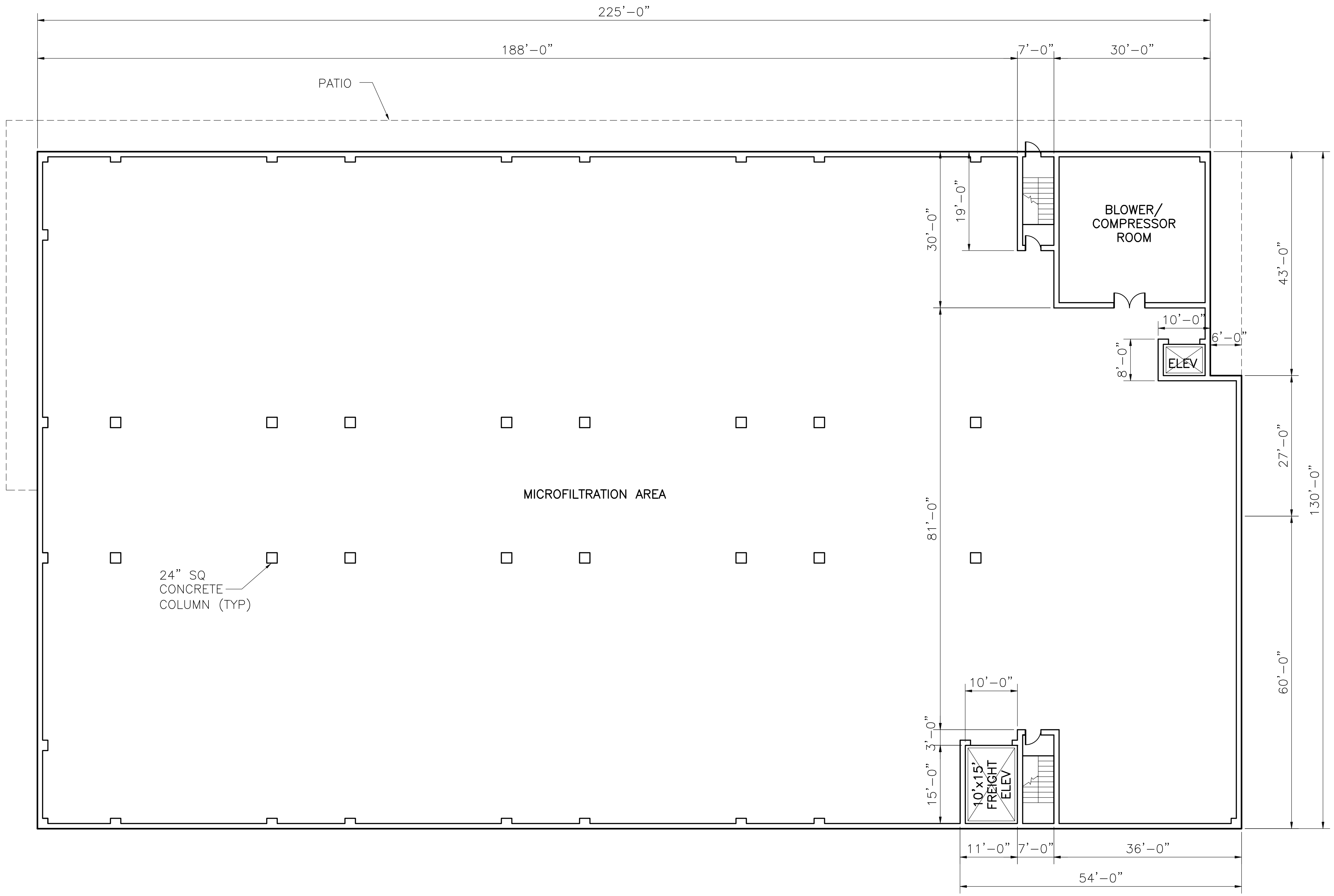

PLAN

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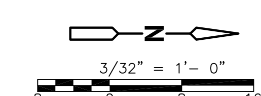

0" 1"
VERIFY SCALES
BAR IS ONE INCH LONG ON FULL SIZE DRAWING.
IF NOT ONE INCH LONG ON THIS DRAWING, ADJUST SCALES ACCORDINGLY

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APPROVED: RMC ENGR C

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MF/RO BUILDING
SECOND FLOOR PLAN

FIG NO	8-3
SHEET NO	OF
PROJ NO	86538-71984
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NORTH
ELEVATION
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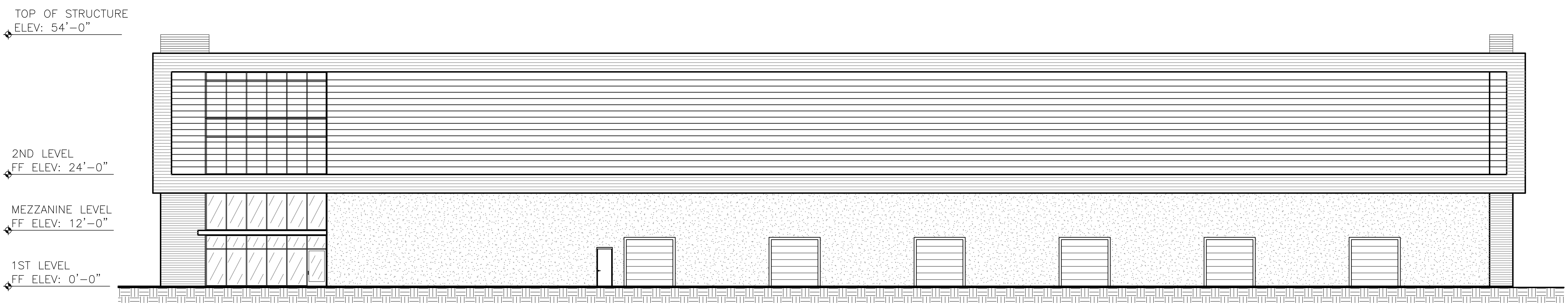

WEST
ELEVATION
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0" 1"
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APPROVED: RMC ENGR C

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MF/RO BUILDING
ELEVATIONS

FIG NO	8-4
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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Exterior Architectural Features

The MF/RO building will present an Asian theme to be compatible with both the Japanese Garden and the new Multi-purpose and Office Building. This will be accomplished by using similar building forms and construction materials with an emphasis on sustainability including the wooden panels. The building will have a low-slope roof with parapet walls. The roof can be prepared to accept a green roof system for all or a portion of the roof. Low-e glazing will be used extensively in the occupied areas of the administration portion on north and translucent panels on the south walls of the process areas to provide natural daylighting as well as aid in reducing heat gain associated with large areas of glass. Glazed openings, shading devices and glazing materials will be arranged to take advantage of beneficial solar heat gain in winter months and to minimize summer solar heat gain in spaces that are mechanically cooled. Finishes and color(s) will be selected to enhance the juxtaposition of the natural environment and the technology that the building represents.

See **Figure 8-5** for the conceptual rendering of the MF/RO Building exterior features.

Interior Architectural Features

The interior spaces will be designed so as to take advantage of natural light and ventilation to the extent feasible. Materials will be selected using sound, environmental principles, i.e. low VOC sealants, paints and finishes and non-ureaformaldehyde products to avoid indoor air contaminants in accordance with CalGREEN and LEED principals. Finishes will also be selected based on durability and maintenance considerations. For example, restrooms will have ceramic tile walls and floors; conference/break rooms will have resilient flooring, and the process area will be sealed concrete floors and painted walls. Materials and finishes will also be selected with regards to recycled content and location of manufacturing and processing plants.

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DESIGNED	AG
DRAWN	CEB
CHECKED	ECY

SUBMITTED: RMC PROJ ENGR C

APPROVED: RMC ENGR C

CITY OF LOS ANGELES - GWR MASTER PLANNING DOCUMENT

MF/RO BUILDING
VIEW FROM SOUTHWEST

FIG NO	8-5
SHEET NO	OF
PROJ NO	86538-71984
DATE	MARCH 2012

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FILENAME: RWMP-SF-RPT-8-5 3-15-12 08:52am perezsm || XREFS: X-LADWP-TBLK

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8.2 Civil Design Criteria

This section provides the design criteria that will be used in the civil design of the AWPF.

8.2.1 Codes and Standards

The following are the primary documents that will be used for the civil design of the project. Where conflicts occur between two or more of the documents presented, the design Engineer of Record will make the determination of which shall apply.

- City of Los Angeles Department of Public Works Standard Plans
- American Public Works Association (APWA) Standard Plans for Public Works Construction (2009 Edition)
- APWA Standard Specifications for Public Works Construction (2009 Edition)
- City of Los Angeles Department of Public Works, Brown Book (Additions and Amendments to the APWA Standard Specifications for Public Works Construction)
- County of Los Angeles Hydrology Manual (2006)
- American Concrete Pipe Association (ACPA) Concrete Pipe Design Manual
- American Society of Civil Engineers (ASCE) Standards
- American Society of Mechanical Engineers (ASME), Codes and Standards
- American Society of Testing and Materials (ASTM) Standards
- American Water Works Association (AWWA) Standards
- AWWA M11 Steel Pipe – A Guide for Design and Installation
- AWWA M23 PVC Pipe – Design and Installation
- AWWA M41 Ductile-Iron Pipe and Fittings
- Environmental Protection Agency (EPA) Technical Bulletin EPA-430-99-74-001, Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, "Reliability Class I"

8.2.2 Site Development Constraints

The site constraints for the GWR proposed project with AWPF at the DCTWRP southwest location include:

- Development of the AWPF will be physically bounded by Sansui Way to the west, SWRP Way to the east, and Keshiki Way to the south.
- The AWPF will be located at the main entrance to DCTWRP and the Japanese Gardens. Therefore, the building and site will need to be aesthetically pleasing for visitors.
- New Japanese Garden Multi-Purpose and Office Building to be located north of the AWPF across the visitor parking lot.
- AWPF encroachment into the existing visitor parking lot to the north will need to be minimized as much as possible.

- The existing vegetated buffer on the east side of Sansui Way will be replaced by the AWPF. Therefore, aesthetic considerations need to be taken into account for the new development.
- Property line/berm east of where the Phase 1V primary clarifiers are proposed.
- AWPF effluent pipe to exit site to the south and run along Keshiki Way.
- Finished floor elevation to be set at elevation 706.0 ft NGVD.

8.2.3 Yard Piping

Process Water

The new process water pipes for the AWPF influent and purified recycled water, leading into and out of the AWPF process facilities, will be cement mortar-lined steel pipe, in accordance with AWWA C200 and C205 suitable for pressures up to 150 psi. The process water pipes for RO permeate and AOP feed will be PVC C900 suitable for pressure up to 150 psi. Joints will be mechanical joints with either restraints or thrust blocks as appropriate.

Valves will be butterfly type in accordance with AWWA C504 and will include a valve box and buried manual operator. The design of all process water lines will also conform to the City's water system design standards referenced above.

Sanitary Sewer

As discussed previously, the AWPF will also include the installation of a new gravity waste discharge pipe to convey MF backwash and RO concentrate flows to the 97-inch AVORS sewer located north of the site. At a minimum, the new pipe will be designed in accordance with City of Los Angeles sewer design standards referenced above.

Table 8-5 summarizes the yard piping design criteria.

Table 8-5: Yard Piping Design Criteria

Process Flows	AWPF Influent [1], AWPF Product	MF Feed [2], RO Feed, AOP Feed	RO Permeate	MF Backwash Waste, RO Concentrate
Material/Lining	Carbon Steel w/ Cement Mortar Lining	316 SS	PVC	HDPE
Joints	Mechanical	Mechanical	Mechanical	Fusion Butt Weld
Joint Restraint	Restrained joints	Restrained joints	Restrained joints	N/A
Design Velocity	5 to 7 fps	5 to 7 fps	5 to 7 fps	5 to 7 fps
Valves	Butterfly (AWWA C504)	Butterfly (AWWA C504)	Butterfly (AWWA C504)	Butterfly (AWWA C504)

Notes:
1) Before MF Pre-filters
2) After MF Pre-filters

Storm Drains

Storm drains will be reinforce concrete pipe (RCP). The pipes will be sized based on criteria presented in the City of Los Angeles Storm Drain Design Manual.

8.2.4 Grading and Drainage

Grading will be performed to accommodate the MF/RO building and process areas to maintain current drainage away from all structures. Slopes will generally be at a 2:1 maximum, and other surfaces will have a minimum slope of 2 percent if unpaved and 1 percent if paved, wherever possible. Access roads will have a maximum slope of 10:1 in general. Full access to the site will be provided in accordance with American Disability Act (ADA) Guidelines, where applicable.

8.2.5 Dust and Erosion Control

Dust and erosion control during construction will be provided as needed to minimize adverse consequences to neighboring properties, residents, and to comply with environmental regulations including CEQA mitigation requirements. Continuous measures to control dust and erosion during both construction and operation will be provided as needed.

8.2.6 Noise Control

Sound pressure level guidelines are provided by the Code of Federal Regulations Title 29, Part 1910.95 (29 CFR 1910.95) and enforced by the Occupational Safety and Health Administration (OSHA). These guidelines provide acceptable sound pressure levels for different frequencies and durations. Consideration must also be paid to the City of Los Angeles Noise Ordinance regulations regarding community impact.

Blower and compressor equipment associated with the MF system will be located within a dedicated mechanical room on the second level of the MF/RO building to mitigate noise levels. The RO feed pumps, although located on the first level of the MF/RO building, may require individual noise curtain enclosures to control noise levels in consideration for operators who may be working on the RO system. The City of Los Angeles standard is to maintain noise levels less than 85 decibels adjusted (dBA) at 3 ft.

8.3 Geotechnical Considerations

8.3.1 Site Geology and Anticipated Subsurface Conditions

The site is located to the northwest of the intersection of the 405/101 Freeway in the Van Nuys area of Los Angeles. Based on the quaternary geology map of the Van Nuys 7.5 Minute Quadrangle as well as available borings in the vicinity, the site is underlain by alluvium consisting of predominantly firm to stiff clay classifying as CL in accordance with the Unified Soil Classification System (USCS). Sand and silty sand layers (SP-SM, SM) were generally encountered from approximately 25 to 40 feet below ground surface (bgs) in the previous borings. A layer of undocumented fill was encountered in some of the previous borings in the southeast portion of the existing plant. It should be noted that fill could be encountered in other parts of the site.

Groundwater was not encountered in two of the previous borings (~ 40 feet bgs) at the time of the investigation. Based on review of the Seismic Hazard Zones Report 08 for the Van Nuys 7.5 Minute Quadrangle published by the California Division of Mines and Geology (CDMG), the historical high groundwater could be within 20 feet bgs in the site vicinity.

It should be noted that water levels are expected to fluctuate with season, temperature, climate, construction in the area, and other factors. Actual conditions during construction may be different from those observed at the time of the test borings.

8.3.2 Faulting and Seismicity

The AWPF site is situated within the seismically active region of southern California. Although the site is not located within a currently designated State of California Earthquake Fault Zone (previously known as Special Studies Zones prior to January 1, 1994), there are a number of nearby faults that could potentially produce significant ground shaking at the site during a major earthquake.

8.3.3 Liquefaction Potential

Soil liquefaction is a phenomenon that occurs when saturated cohesionless soil layers, located within about 50 feet of the ground surface, lose strength during cyclic loading, as caused by earthquakes. During the loss of strength, the soil acquires "mobility" sufficient to permit both horizontal and vertical movements. Soils that are most susceptible to liquefaction are clean, loose, saturated, uniformly graded, fine-grained sands that lie below the groundwater table within a depth usually considered to be about 50 feet. The factors known to influence liquefaction potential include soil type and depth, grain size, density, groundwater level, degree of saturation, and both the intensity and duration of ground shaking.

The site is located within an area that is mapped to have the potential to experience soil liquefaction during a seismic event according to the State of California, Seismic Hazard Zones Map for the Van Nuys 7.5-Minute quadrangle. However, available borings in the vicinity indicated the subsurface soils are generally clayey with layers of granular soils from approximately 25 to 40 feet bgs. Previous investigation concluded limited potential for soil liquefaction at the site with liquefaction induced settlement of about 1 inch.

8.3.4 Preliminary Observations

Based on preliminary review, the following were noted:

- The site is underlain by alluvial deposits. Previous borings indicated the subsurface soils are generally consisted of firm to very still clay within the upper 25 feet with layers of sand and silty sand from 25 to 40 feet bgs. Undocumented fill was encountered at the southeast corner of the site.
- Groundwater was encountered at 40 feet some of the previous borings at the time of the investigation. The historical high groundwater could be within 20 feet bgs.
- The site is located in an area mapped to have the potential to experience soil liquefaction during a seismic event. However, available borings in the site vicinity generally

indicated clayey soils with limited potential for soil liquefaction. Seismically-induced settlement of about 1-inch was reported in the previous report.

- The site is not located within a currently designated State of California Earthquake Fault Zone.
- The undocumented fill, if present within the footprint of the proposed structures, is not suitable for support of new foundation. The fill should be entirely removed and be replaced with compacted non-expansive fill.
- It is anticipated that the new structures can be supported on shallow footings or mat foundations on a zone of compacted fill.
- Corrosion results were not available from the previous reports. Based on the clayey nature of the soils within the upper 25 feet, the site soils should be considered to have moderate to high corrosion potential.
- For preliminary analysis, the site can be considered as having Site Class D profile. The following parameters may be used: Fa= 1.0, Fv=1.5, Sds=1.123, Sd1=0.617.

8.3.5 Recommendations

Based on preliminary review, it is recommended that a site specific geotechnical investigation be performed within the project area during the next phase. The investigation is directed towards the following objectives:

- Obtain more specific engineering characteristics of the foundation soils and rocks and other geologic conditions that may influence the design of the new structures.
- Evaluate the presence of undocumented fill and the potential for soil liquefaction within the proposed expansion area.
- Perform field screening for volatile organic compounds (VOCs) and organochlorine pesticides (DDT, DDD, and DDE) to evaluate whether or not fuel spills or other contamination of the soil has occurred in the proposed expansion area.

8.4 Structural Design Criteria

This section provides the design criteria that will be used in the structural design for the AWPF buildings and structures.

8.4.1 Codes and Standards

The applicable provisions from the following codes will be used in the design:

- Los Angeles Building Code (LABC)-2011
- California Building Code (CBC)-2010
- American Society of Engineers (ASCE), ANSI/ASCE 7-05 – Minimum Design Loads for Buildings and Other Structures
- American Concrete Institute (ACI), ACI 318-08, Building Code Requirements and Commentary for Reinforced Concrete

- American Concrete Institute (ACI), ACI 350-06, Code Requirements for Environmental Engineering Concrete Structures
- American Concrete Institute (ACI), ACI 350.3-06, Seismic Design of Liquid-Containing Concrete Structure
- American Institute of Steel Construction (AISC), 13th Edition
- Aluminum Design Manual, 2005

8.4.2 Materials

Concrete

Concrete materials will conform to the requirements of Chapter 19 of the LABC, ACI 318 and ACI 350.

- Structural concrete: f'_c = 4,000 psi
- Concrete fill, duct encasements, civil structures and where noted: f'_c = 3,000 psi
- Reinforcing steel: ASTM A706 or ASTM A615 Grade 60, f_y = 60 ksi
- 1-inch nominal maximum aggregate (maximum, for design).
- Protective coating will be applied to the concrete face that has potential to be exposed to chemicals and other corrosive materials.

Structural Steel

Structural steel materials will conform to the requirements of Chapter 22 of the LABC and AISC.

- W shapes: ASTM A992, f_y = 50 ksi
- Other structural shapes, plates and bars: ASTM A36, f_y = 36 ksi
- Hollow structural sections: ASTM A500, Grade B.
- Welding electrode: E70XX, 70 ksi
- High-strength bolts: ASTM A325 with a minimum diameter of 5/8 inch, unless noted otherwise.
- Cast-in anchor bolts: ASTM F1554 zinc coated unless stainless steel anchors are specifically required with a minimum diameter of ¾ inch, unless noted otherwise.

Aluminum

Aluminum materials will conform to the requirements of Chapter 20 of the LABC and Aluminum Design Manual.

- Structural shapes and plates: Alloy 6061-T6
- Extruded pipe: Alloy 6063-T6
- Fasteners: Stainless steel Type 304

Waterstop

Waterstops will be provided in all joints in walls and slabs of liquid containing concrete structures.

- 6" ribbed PVC waterstops will be used in the construction joints and contraction joints, unless noted otherwise.
- 9" ribbed with centerbulb PVC waterstops will be used in the expansion joints, unless noted otherwise.
- 6" thermoplastic elastomeric rubber waterstops may be used in the construction joints of chemical containment areas.

8.4.3 Loading

Dead Loads

Dead loads consist of the weight of the structure, pipes, and all equipment, including but not limited to: HVAC equipment and ductwork, electrical wiring and lighting, and interior partitions.

Live Loads

Uniform and concentrated loads will conform to LABC as modified below:

- Non-Concrete Roof – 20 psf
- Concrete Roof – 50 psf unless noted otherwise
- Pump Station Floor – 250 psf or actual equipment load, whichever is greater

Wind Loads

Wind loads will conform to the requirements of the LABC, Section 1609.

- Basic wind speed, 3-second gust: 85 mph
- Exposure: C
- Importance factor: I = 1.15

Seismic Loads

Seismic Loads will conform to the requirements of the LABC, Section 1613.

The following general criteria are developed based on the geotechnical report for the DCTWRP Plant In-Plant Storage (CIP #6178) provided by the City of Los Angeles Dept. of General Services, Geotechnical Engineering Group/LADWP, dated January 4, 2010 and supplemental geotechnical report dated January 5, 2011. Site-specific recommendations will be provided after geotechnical field investigation and analysis is completed during detailed design.

- Site Class D
- Mapped acceleration parameters: S_s = 1.684 & S_1 = 0.616
- Design spectral response accelerations: S_{DS} = 1.123 & S_{D1} = 0.617

- Importance factors: I = 1.25 & I_p = 1.0 except I_p = 1.5 for components contain hazardous materials.

Hydrodynamic Loads

- Both impulsive and convective forces are based on the criteria of ACI 350.3 as modified by ASCE 7 section 15.7.7.
- Effects from both horizontal and vertical seismic accelerations will be considered.

Dynamic Soil Loads

In addition to static lateral earth pressures, fully and partially embedded structures will be designed to resist an additional load due to seismically induced lateral earth pressures as recommended in the project geotechnical report.

8.4.4 Structural Design Approach

Occupancy Category

All structures will be classified occupancy category III, unless noted otherwise.

Load Combinations

- Comply with requirements of the ACI 350 for water containing concrete structures.
- Comply with requirements of the LABC for other structures.

Stability Requirements

A continuous load path will be provided for all vertical and lateral loads to deliver reactions to the foundation material.

- Safety factor against sliding and overturning for structures with unbalanced loads under static loading conditions: 1.5
- Safety factor against sliding and overturning for structures under wind or seismic load: 1.1
- Safety factor against buoyancy for geotechnical recommended design groundwater level: 1.25

Liquid Containing Concrete Structure Design Conditions

- Test/Overflow case for water at overflow level without backfilled soil.
- Static case for water at maximum operating level and adjacent soil at finished grade (with surcharge).
- Static case with basin empty and adjacent soil at finished grade (with surcharge).
- Seismic case for water at maximum operating level and adjacent soil at finished grade (without surcharge).
- Seismic case with basin empty and adjacent soil at finished grade (without surcharge).

Component/Equipment and Nonbuilding Structure Anchorage

- Anchorage will be designed in accordance with LABC and ASCE 7 section 13.4 or appropriate requirements in ASCE 7 Chapter 15.
- Determine capacities for cast-in and post-installed anchors in concrete in accordance with ACI 318 Appendix D and appropriate ICC Evaluation Service Reports, assuming cracked concrete for resisting seismic loads.
- Where post-installed anchors are used to resist seismic loads, the anchors shall have current ICC Evaluation Service Reports indicating that anchors are adequate to resist seismic loads in cracked concrete.

Foundation Design

- Foundations of facilities will be designed in accordance with the conclusions and recommendations of the site-specific geotechnical investigation and analysis.

8.5 Electrical Design Criteria

This section provides an overview of the existing electrical system at DCTWRP and the design criteria that will be used for the design of the AWPF.

8.5.1 Codes and Standards

The applicable provisions from the following codes and standards will be used in the design:

- Los Angeles Electrical Code (LAEC)
- National Electrical Code (NEC-NFPA 70)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Underwriters Laboratories (UL)

8.5.2 Existing Electrical System at DCTWRP

Existing Utility Service

The existing electrical substations located within DCTWRP are shown on **Figure 6-2** and described below:

IS-2250 Substation - LADWP provides the power source to the existing DCTWRP and the satellite substation that feeds the Balboa Lake Feed Pumps. The substation consists of two (2) industrial-type, high voltage transformers rated at 20 million volt-amperes (MVA), 34.5 kilovolt (kV)/4.16 kV and located at the north end of DCTWRP. The medium voltage system is distributed to the satellite substation that feeds the Balboa Lake Feed Pumps and DCTWRP's main switchboards MSB-1, MSB-2, MSB-3 and MSB-4. The substation is operated and maintained by LADWP personnel.

IS-2250 Satellite Substation for Balboa Lake Feed Pumps - This satellite substation is located on the southwest corner of the proposed location for the AWPF. Currently, this substation with an outdoor-type motor control center (MCC) enclosure provides power to two (2) remote pumps rated at 100 hp, 3 ph, 480 V each. It is proposed that this satellite substation be demolished to provide space for a new substation for the AWPF. Prior to demolition, a temporary metered (power consumption monitoring) feeder coming from an existing DCTWRP MCC shall be provided. New circuit breakers, metering device, cables, ductbanks and other raceways will be required. The existing underground ductbank will be intercepted and the new and existing cables will be spliced. The AWPF electrical design will provide the permanent power feed for the Balboa Pumps.

IS-2626 Substation for the Product Water Pump Station (PWPS) - The PWPS (Balboa Pump Station) is located on the southeast corner of DCTWRP. The facility contains one main switchgear rated at 1200 A and is fed via underground feeders. The incoming utility voltage to this switchgear is 4.16 kV.

Existing Medium Voltage System – 5 kV

The existing main switchboards, MSB-1 and MSB-2 located at the old Electrical Room and MSB-3 and MSB-4 located at the Blower Building, distribute the 5 kV power system to the entire DCTWRP. The switchboards normal operating condition is that both main breakers are normally closed and the tie breaker is normally open. Upon failure of one source, the tie breaker will automatically close to maintain power to DCTWRP. The 5 kV feeder breakers at the main switchboards distribute power via underground ductbanks to various double-ended unit substations throughout DCTWRP and transforms power to the utilization voltage of 480 V. Solid-state relay protective devices are used and the control power for these relays, including circuit breaker control, is 125 VDC. A Battery Room is provided to house the large batteries including chargers. The electrical rooms that house the 5 kV switchboards are air-conditioned and have high roll-up doors accessible from the street for maintenance and repair.

Existing Utilization Voltage - 480 V

The secondary unit substations provide the required 480 V that is distributed via different types of raceways (ductbanks, cable trays and conduits) throughout DCTWRP feeding numerous MCCs. Step down transformers are provided for other lower voltages (120 V/240 V). The grounding system used varies from solidly grounded to high resistance grounding. Unit substation transformers at DCTWRP are a combination of dry and oil type.

8.5.3 Proposed Electrical System for AWPF

This section describes the proposed electrical system for the AWPF. These options will be investigated further during the design phase of the project, as well as an evaluation of the costs and benefits of using renewable energy sources for powering the facilities.

AWPF Electrical Demand Load

The estimated electrical demand loads for the AWPF are summarized in **Table 8-6**.

Table 8-6: Proposed Process Load Schedule

Category	Description	Phase 1		Phase 2	
		Rating (kVA)	Estimated Load (kVA)	Rating (kVA)	Estimated Load (kVA)
Process Load No. 1	MF/RO Building	3,000	2,900	4,000	3,700
Process Load No. 2	RO Booster Pumps	1,000	900	1,500	1,200
Process Load No. 3	UV/H_2O_2 Facility [1]	2,000	1,600	2,000	1,600
Process Load No. 4	MF Feed Pump Station	1,000	900	1,500	1,100
Total Electrical Demand for AWPF [2]			**6,300**		**7,600**
Process Load No. 5	Product Water Pump Station [3]		2,200		2,800

Notes:
1) Loads are based on Calgon UV system, which has higher power demand than Trojan UV or ozone system.
2) Does not include load from product water pump station.
3) The load for product water pump station is currently powered by Substation IS-2626.

Proposed Electrical Substation

The AWPF will require a new industrial substation. There are three options for providing power to the AWPF and these options are shown on **Figure 6-4** and described below:

Option 1 – Combine with and Expand Existing DCTWRP Substation IS-2250: There may be enough capacity in the existing 20 MVA substation to provide enough power for Phase 1. DCTWRP is currently operating with one treatment phase with a total power draw of 7 MVA; doubling this power draw to estimate the total DCTWRP power draw with both phases operating would be 14 MVA. Therefore, there may be enough power to supply the AWPF from the existing substation for Phase 1. The substation would need to be expanded to provide enough power for Phase 2. This would require distributing the 5 kV medium voltage power from the north end of DCTWRP to the AWPF in SWRP Way, which is congested with existing utilities.

Option 2 – New AWPF Substation in Location of Existing IS-2250 Satellite Substation for Balboa Lake Feed Pumps: A new substation for the AWPF could be located within the AWPF site in the existing location of the IS-2250 satellite substation. This would require dual 35 kV lines to feed the proposed two (2) 10 MVA, 34.5 kV/4.16 kV transformers. The actual routing of the 35 kV lines would need to be determined by LADWP, but would likely need to be routed on Woodley Avenue. Overhead lines using power poles, underground ductbanks, or a combination of both, may be routed to the new substation. Because Woodley Avenue is on USACE-owned land, this approach would need to be discussed with USACE. This option would avoid running the 5 kV medium voltage power in SWRP Way.

Option 3 – New AWPF Substation Co-located with Existing IS-2626 Substation for the PWPS: The new AWPF substation could be located in the southeast corner of DCTWRP near the PWPS. As with the option of locating the new AWPF substation in the location of the existing IS-2250 satellite substation, this option requires dual 35 kV lines to feed the proposed two (2) 10 MVA, 34.5 kV/4.16kV transformers. The actual routing of the 35kV lines would need to be determined by LADWP, but would likely come from Victory Boulevard and routed south along the eastern DCTWRP border. Overhead lines using power poles, underground ductbanks, or a combination of both, may be routed to the new substation. This would require approval to go through the property north of the DCTWRP and would also need to be discussed with USACE since DCTWRP is on USACE-owned land. This option would avoid running power lines down Woodley Avenue.

Proposed Medium and Low Voltage System

The infrastructure for the AWPF will follow the same approach used at DCTWRP for the medium and low voltage system with some exceptions. The 5 kV secondary voltage of substation transformers will be connected to the AWPF main switchboards MSB-3A and MSB-3B to be located in the Electrical Room of the new MF/RO Building. The preliminary one-line diagram is shown on **Figure 8-6**, which indicates the 5 kV distribution from LADWP IS-2250 substation to the main switchboards MSB-3A and MSB-3B and to various double-ended substations. The main circuit breakers at the 5 kV and 480 V voltage levels will use the automatic control of two-out-of-three concepts (main-tie-main). At both voltage levels, the main circuit breakers and the main busses will be sized to handle the full 100 percent load if one power source fails (tie breaker at closed position).

The preliminary load schedule for the AWPF is summarized in **Table 8-6**. The double-ended substations #1, #2, #3 and #4 with ratings based on the estimated load are shown on **Figure 8-6** One-Line Diagram. The substations will distribute the 480 V utilization voltage to various MCCs that provide power to AWPF process facilities. Additional substations may be required and transformer sizes may be adjusted to account for changes when final process loads are determined.

The control voltage for relay protection and breaker control will be 120 VAC uninterruptable power supply to achieve a safe and scheduled shutdown upon a complete power loss. DCTWRP currently uses 125 VDC system for better and more reliable control power because of the critical processes at DCTWRP. However, this system will require additional equipment and larger footprint.

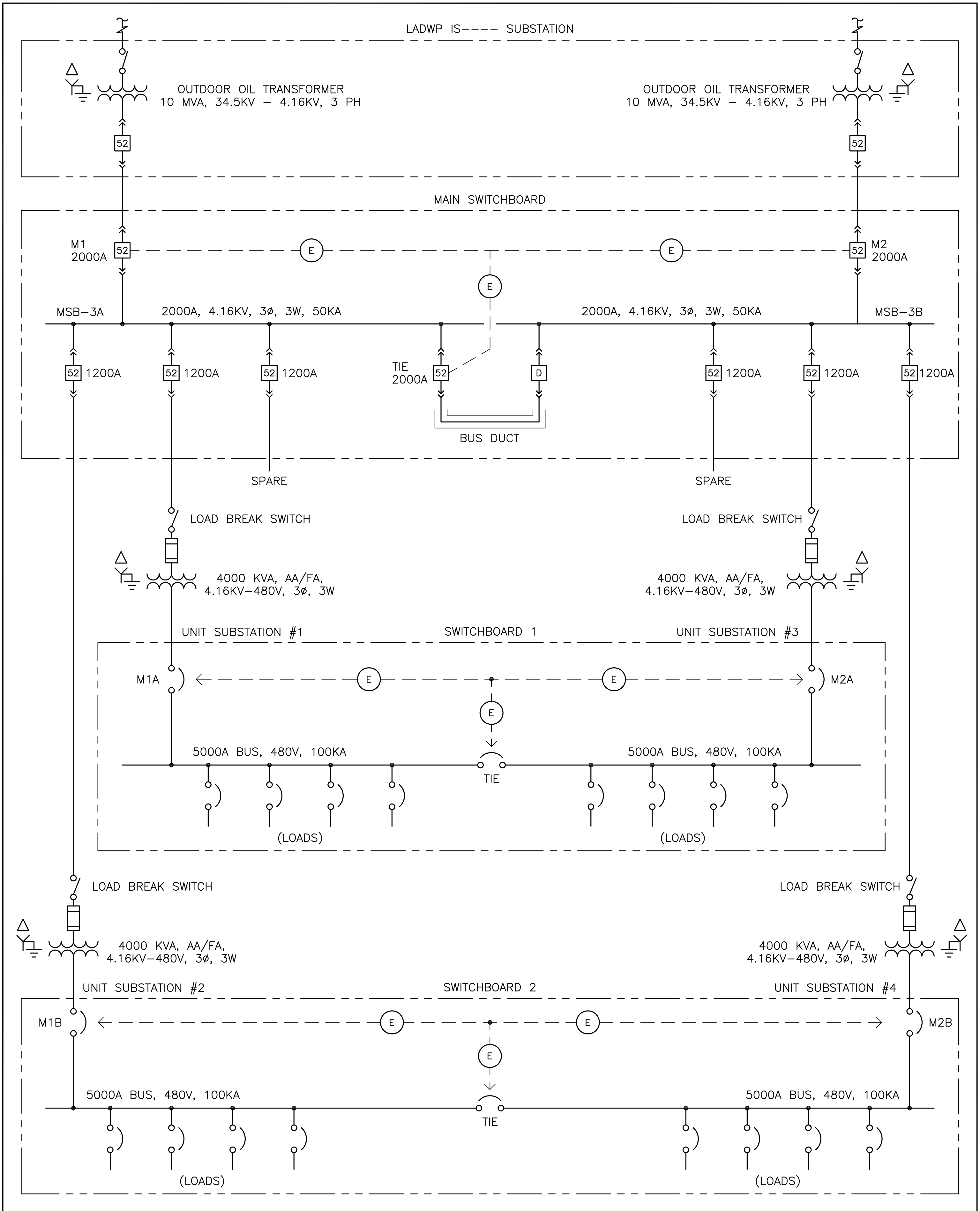
Standby Power

In the event of a power loss where both utility service feeds fail, the AWPF will not have power since it will not be provided with its own power generating equipment. However, due to the importance of flushing the RO membranes prior to shut-down to prevent scaling, the AWPF RO flushing system must be provided with emergency power supply. It is recommended that all critical loads associated with the RO flush system be connected to the future DCTWRP emergency power system, as there will be sufficient generating capacity to power these small loads. Underground ductbanks shall be provided at the nearest DCTWRP emergency power source.

Miscellaneous Electrical Systems

- Lighting – High-efficiency fluorescent, high intensity discharge and other energy-efficient lamps will be specified. Battery operated lighting fixtures will be specified to provide emergency lighting at required locations. Time clock and photocell devices will be used to control lighting circuits as needed.

- Fire Alarm System – A basic fire alarm system, such as smoke detectors, pull stations and other fire alarm devices, in compliance with California Fire Marshall will be provided for personnel safety and equipment protection.
- UPS – An uninterruptable power supply will provide 120 VAC power to the distributed control system (DCS), relay protective devices, 5 kV breaker control and other electronic equipment that may be sensitive to voltage fluctuations. UPS will require panel board and batteries with battery charger.
- Classified Areas- Areas determined hazardous will be designed in strict compliance with Article 500 of NEC.



CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS

RMC in association with CDM Smith

ELECTRICAL DISTRIBUTION

ONE LINE DIAGRAM

FIGURE 8-6

NOT TO SCALE

9. Regulatory Requirements and Considerations

Implementing an IPR project such as this GWR project involves understanding and meeting all regulatory requirements and considerations. This section provides a summary of the regulatory overview, permitting overview, and permitting and implementation strategy for the GWR project.

9.1 Regulatory Overview

The reuse of recycled water for groundwater recharge is carefully regulated under several state laws and regulations to ensure protection of public health and water quality. Regulatory oversight of groundwater recharge projects is carried out by the CDPH and the individual RWQCBs. For this project, the Los Angeles RWQCB would have jurisdiction.

CDPH regulates GWR projects under the State Water Recycling Criteria (Title 22) and makes recommendations for projects based on the draft groundwater recharge regulations. The Water Recycling Criteria include narrative requirements for groundwater recharge projects, with projects evaluated on a case-by-case basis. The current draft recharge regulations, which were released in August 2008, are used as guidance in evaluating projects, and specifically address protection of public health in terms of chemicals, microorganisms, and CECs, such as pharmaceuticals, personal care products, and endocrine disrupting compounds.

The RWMP process relied on the August 2008 draft CDPH regulations for the alternatives evaluation and are the focus of this regulatory overview. In late 2011, CDPH released a new draft of its groundwater recharge regulations just as the City was completing the RWMP process. Although the groundwater recharge regulations will not be final until at least the end of 2013, the revised draft appears to provide flexibility for GWR projects that may allow the City to consider other alternatives that could reduce project costs, primarily through recognition of the proven role that natural systems play in the water purification process. As the CDPH regulatory process evolves, the City will continue to evaluate opportunities to reduce project costs while developing the GWR project design within its guiding principles with respect to protecting public health and water quality, meeting recycled water supply objectives, regulatory requirements, and engagement of stakeholders and the IAP. Any new alternatives will also take into consideration the scope, timing, and implementation of another key water supply project, the San Fernando Basin Groundwater Treatment Complex, a project that will focus on the treatment of legacy groundwater contamination in the SFB. It will be important for the City to work closely with CDPH on potential project requirements.

The 2008 draft recharge regulations require that the recycled water meets drinking water MCLs[5]. The draft regulations also govern the amount of recycled water that can be used based on TOC and specified levels of dilution, as well as the level of treatment required. For surface spreading projects that use advanced treatment, an initial permissible RWC up to 50 percent is allowed for at least the first year of a new project. If the initial project RWC is 50 percent, advanced treatment must include RO and AOP, and the TOC must equal 0.5/RWC. Advanced oxidation is defined as achieving at a minimum a 1.2-log NDMA reduction and 0.5 log 1,4-

[5] Except for nitrogen (primary MCL) and color (secondary MCL).

dioxane reduction, whether NDMA and 1,4-dixoane are present or not. The draft groundwater recharge regulations include a requirement that the recycled water must be retained underground for six months before reaching a drinking water well, and that the 6-month residence time must be validated by a tracer study. Projects that are allowed to increase RWCs above 50 percent are subject to additional requirements, including review by an IAP.

The Los Angeles RWQCB regulates groundwater recharge projects under numerous state laws and regulations, including the Los Angeles Basin Plan[6] and the SWRCB's Recycled Water Policy[7]. For the proposed project, the permit requirements would be based on beneficial uses for groundwater and the applicable Basin Plan numeric or narrative water quality objectives to protect the uses. The key beneficial uses are drinking water supply, and commercial and agricultural supply. The Basin Plan requirements include numeric objectives for minerals and compliance with drinking water MCLs. The Basin Plan also applies the state's Anti-degradation Policy, which has been further interpreted pursuant to the 2009 SWRCB Recycled Water Policy.

The project must comply with the California Environmental Quality Act (CEQA). Because DCTWRP is located on land owned by the U.S. Army Corps of Engineers (USACE) and because the City will be seeking federal money to fund the project, it must also comply with the National Environmental Policy Act (NEPA). Under CEQA, the City would have to prepare a project level Environmental Impact Report (EIR) that addresses aspects of the project that were not assessed in the 2006 EIR prepared for the Integrated Resources Plan (IRP). Under NEPA, the City would have to prepare an Environmental Impact Statement (EIS) or a joint EIR/EIS. There are differences between NEPA and CEQA that will have to be carefully addressed in the environmental documentation. It is generally the case that the time commitment for an EIS is longer than for an EIR alone. This is discussed further in Section 9.5.

9.2 Permitting Overview

For the Phase 1 (15,000 AFY) GWR project, the expected advanced treatment process would be similar to the treatment train that is used at existing permitted groundwater recharge projects, including the OCWD GWR System in Fountain Valley, California, and the West Basin WRF in El Segundo, California. The treatment system would include MF, RO, and AOP. The City's original plan was to implement a groundwater recharge project within a relatively short time-frame. This treatment train was selected to meet anticipated regulatory requirements and to streamline the regulatory approval process.

It is assumed that residuals, including RO concentrate, from the AWPF would be discharged to the Hyperion Service Area (HSA) for treatment at the HTP, and thus would not require a separate discharge permit. A previous evaluation conducted for the City looked at the impact of RO concentrate at the HTP and concluded there were no significant water quality issues, but recommended that a more detailed and in-depth study be completed on the impacts at HTP and the WBWRP before any decisions are made concerning RO concentrate disposal.

[6] http://www.swrcb.ca.gov/rwqcb4/water_issues/programs/basin_plan/
[7] http://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf

In order to start the permitting process, a project must have an Engineering Report submitted to CDPH and the RWQCB. The 2008 draft CDPH groundwater recharge regulations, unlike previous drafts, did not include specific requirements for the types of information and analyses that must be included in the report. It will be critical to have a clear understanding from CDPH and the RWQCB about what will need to be included in the report. Lack of clarity or unclear expectations could impact the permitting strategy and schedule if a report is deemed to be incomplete or if CDPH and/or the RWQCB request additional information and the report must undergo extensive review and revisions. The draft Engineering Report Outline is included in Appendix L.

The Engineering Report must include an anti-degradation analysis that satisfies the provisions of the SWRCB Recycling Policy. For a project that uses advanced treatment, it is unlikely that it would adversely impact groundwater quality and thus would not likely trigger a complicated anti-degradation analysis. However, a project proponent must still develop the baseline assimilative capacity for salts, nutrients, and any other constituents of interest to CDPH and the RWQCB for the analysis, and receive approval from the RWQCB on the method for conducting the analysis. Pursuant to the Recycled Water Policy, the project proponent must also ensure that a recharge project does not impact an existing groundwater contaminant plume or cause dissolution of naturally occurring chemicals such as arsenic. Since there is no set process for conducting an anti-degradation analysis, it might take time to obtain approval of the methodology to be used and to obtain approval of the results. It will be critical early in the planning process to have agreement with the RWQCB and CDPH on the constituents of interest, and with the RWQCB on the baseline assimilative capacities for each constituent and the methodology for conducting the anti-degradation analysis.

The 2008 draft groundwater regulations require that project sponsors conduct a tracer study to validate the requirement to maintain a 6-month residence time. The study must be conducted during the first three months of operation, but it can be conducted before a project is initiated or as part of the development of the Engineering Report using non-recycled water, which can save time for a project's schedule.

After the Engineering Report is completed, CDPH schedules a public hearing. At the conclusion of the public hearing, CDPH will issue Findings of Fact and Conditions, which serve as the agency's recommendations to the RWQCB for the project's permit. To expedite a project, a project sponsor can offer to draft the Findings of Fact and Conditions for CDPH. Issuance of the final Findings of Fact and Conditions by CDPH can also be an iterative process that can take some time to resolve.

After CDPH has issued its Findings of Fact and Conditions, and after the project's CEQA document is certified, a project proponent will submit a Report of Waste Discharge to initiate the RWQCB permitting process. In accordance with the SWRCB Recycled Water Policy, a groundwater recharge project that uses AWP should be permitted within a year from receipt of the Findings of Fact and Conditions. Therefore, it will be important to initiate and complete the CEQA process as soon as possible to expedite project permitting. It will also be important to work with the RWQCB to structure the permit so that it allows 1) the initial RWC of 50 percent to be increased to 75 percent and ultimately to 100 percent without having to re-open permit, and 2) the monitoring and reporting program for the permit to be revised by the RWQCB's

Executive Officer without having to re-open the permit, thereby providing flexibility for making changes in the monitoring requirements. If the permit is modeled after the West Basin Barrier Project permit, the phased increases in RWC will be contingent upon compliance with all permit requirements, the review by the IAP, an approved enhanced source control program, and a demonstration that the project has not impacted groundwater. It is also important to be aware that under the SWRCB Recycled Water Policy, the RWQCB has the authority to include more stringent requirements in a GWR permit than those recommended by CDPH if the more stringent requirements are needed to protect public health and the environment. This qualification could create uncertainty in project requirements, treatment needs, and implementation schedule.

The RWQCB will release a tentative permit for public review and then hold a public hearing. If the permit is approved, it typically goes into effect 30 days after approval. If there is opposition to a permit that has been adopted by the RWQCB, either by the project proponent or another party, then the permit can be appealed to the SWRCB. The SWRCB has the option to consider the petition, issue its own Water Quality Order, remand the permit back to the RWQCB, or to not consider the petition.

Because the proposed project will divert water from the Los Angeles River, it must comply with the California Water Code (CWC) Section 1211 process with regard to water diversions and any impacts on in-stream beneficial uses such as wildlife and recreation. After the CEQA document is certified, the project sponsor would be required to file a petition for change that would have to be approved by the SWRCB and the California Department of Fish and Game. The petition should be accompanied by the EIR for the IRP and the project, which provides information on the minimum flow to be maintained in the Los Angeles River after considering recycled water alternatives. Even if a project is considered to be noncontroversial, the CWC 1211 process will impact the schedule for a project since it can be a lengthy procedure based on limited SWRCB resources and the number of projects with pending petitions (e.g., it can take from one to two years for noncontroversial projects).

Depending on the specifics of a GWR project, additional agreements or other permits may be required from other agencies such as the SWRCB or the USACE, which can take a considerable amount of time to conclude. The City must certify CEQA before applying for these agreements or permits, and thus it will be very important to initiate and complete the CEQA process as soon as possible.

9.2.1 Permit and Implementation Strategy

The fundamental strategy to expeditiously obtain approval from CDPH and to obtain permits from the RWQCB and other applicable agencies for the proposed GWR project consists of the following elements. The timing for implementation will be driven by a number of project elements and assumptions, which is discussed in Section 10. An overview of the recommended strategy is presented in **Figure 9-1**.

- Clearly define the program objectives. Successfully implemented GWR projects include specific objectives such as improving water quality, replacing potable water with recycled water, and augmenting water supplies.

- Continue to engage CDPH and RWQCB in the permitting process. It is very important to have a close and effective working relationship with both agencies because 1) many of the requirements may necessitate authorization by CDPH under the "Alternative" section of the 2008 draft regulations or revisions to the regulations as CDPH moves forward with promulgating final regulations; 2) many of the RWQCB requirements under the Recycled Water Policy have not yet been "road" tested; and 3) their approval and subsequent support will be critical for the project's credibility and public.

- Continue to implement the public outreach plan to gain public and political acceptance of the proposed GWR project.

- Start the Engineering Report and CEQA/NEPA effort simultaneously and early in the implementation process. An approved Engineering Report is needed for CDPH to hold a hearing and issue recommendations to the RWQCB for the permit. CEQA certification is needed for the CWC 1211 petition and before a project proponent can submit a permit application to the RWQCB. Other permits and authorizations may be required for a project, and CEQA certification is needed before a project proponent can apply for these regulatory authorizations. It will be essential to have a clear understanding from CDPH and RWQCB what must be addressed in the Engineering Report, including:

    - The method for determining compliance with the RWC.

    - What can be counted as diluent water and a source water assessment for the allowable diluent water.

    - The methods for conducting 1) the groundwater anti-degradation analysis for the recharge project, 2) the baseline assimilative capacity evaluations for constituents of interest, 3) assessing the potential impacts of the project on existing contaminant plumes, and 4) assessing the potential dissolution of naturally occurring chemicals as a result of the proposed recharge project.

    - Source control program requirements.

    - Location and construction of monitoring wells.

    - Validation of tracer testing to demonstrate the 6-month retention time.

    - The monitoring program for CECs.

    - Background water quality data.

    - Changes to the draft groundwater recharge regulations.

    - What must be included in a contingency plan for ensuring that inadequately treated water is not used for recharge.

- Form the IAP early in the planning process to facilitate, review, and provide support for 1) the pilot testing program; 2) critical elements of the Engineering Report, including treatment, residence time, source control, and monitoring, and 3) any alternatives to the

CDPH draft groundwater recharge regulations that might be needed to effectuate the project. The IAP will also be needed to review the project for allowing increased percentages of recycled water to be used for recharge.

- Engage CDPH and RWQCB through project permitting and implementation. It will be important to work with both agencies so that the permit is designed to allow for increased percentages of recycled water to be used for recharge without having to re-open the permit. It will also be important to complete requirements scheduled for completion during the first year of operation, such as the operations and alternative water supply plans.
- Initiate other permitting requirements as soon as the CEQA EIR has been certified since it may take significant time to obtain necessary authorizations from the SWRCB or USACE.

Figure 9-1: Regulatory Permitting Strategy

Regulatory Permitting Strategy
Public Outreach
Engage CDPH/RWQCB – Form IAP → Define Project Requirements
Initiate Engineering Report Preparation and CEQA
Finalize Engineering Report
CDPH Hearing → Issue Findings of Fact & Conditions
CEQA Certification
Submit Permit Applications → RWQCB and SWRCB
RWQCB Hearing → WDRs/WRRs Adopted
SWRCB → Approves Petition for Change
Preliminary Pre-construction Regulatory Requirements Completed

Footnote:

a. Does not include AWPF facility permitting, including City of Los Angeles Building and Safety Permitting, South Coast Air Quality Management District (SCAQMD) permitting, or any necessary construction permitting.

9.3 Monitoring

This section presents the anticipated regulatory monitoring requirements for the proposed groundwater recharge project by either surface spreading or subsurface application (injection). These requirements would be included in the project permit based on recommendations from CDPH and the Los Angeles RWQCB. For an injection project, it is assumed that the injection wells would be operated by the City.

9.3.1 Background on CDPH Monitoring Requirements

The monitoring requirements presented are based on the CDPH 2008 draft Groundwater Recharge Regulations (draft GWR regulations), which have been used as guidance for developing monitoring programs for GWR projects. It is important to note that in some cases the 2008 draft GWR regulations contain specific monitoring obligations. In other cases, the requirements, such as type of water (recycled, diluent, groundwater), constituent, and/or monitoring frequency, are to be specified by CDPH based on information provided by the project sponsor in the Engineering Report.

9.3.2 Regional Water Quality Control Board

The RWQCB monitoring requirements for the GWR project are intended to ensure compliance with the Los Angeles Basin Plan and SWRCB Recycled Water Policy. An amendment to the Recycled Water Policy is pending and is expected to be adopted next year regarding monitoring for CECs, including the specific constituents and monitoring frequencies. Information is provided on the latest thoughts from SWRCB staff on what the CEC monitoring will entail.

9.3.3 Monitoring Requirements for Surface and Injection Projects

Table 9-1 presents the anticipated CDPH and RWQCB monitoring requirements for recycled water from the AWPF, diluent water, and groundwater. The monitoring requirements included for the RWQCB are primarily based on the 2006 WBMWD's Groundwater Recharge Permit and may be subject to change based on the RWQCB's current perspective regarding monitoring for potable reuse projects. The 2008 draft GWR regulations include requirements for monitoring wells. The wells are to be located such that the recharge water can be retained in the saturated zone for 1-3 months, but will take at least three months before reaching the nearest domestic water supply well, and at an additional point or points between the surface or subsurface application facility and the nearest down gradient domestic water supply well.

Table 9-1: CDPH and RWQCB Expected GWR Monitoring Requirements

Constituent	CDPH			RWQCB	
	Recycled Water[a]	Diluent Water	Groundwater Monitoring Wells	Influent to AWPF, Recycled Water, Blend Water[o]	Groundwater Monitoring Wells[p]
Total coliform	NS[b]		Two background samples; 1 sample/quarter	Recycled water: 1 sample/day	1 sample/quarter
Turbidity	NS – but typically on-line monitoring			Influent, recycled water, RO: on-line	1 sample/quarter
Total nitrogen	2 samples/week[c]	1 sample/quarter for NO_3 & NO_2 Added sampling when exceed MCL	Two background samples; 1 sample/quarter	Recycled water: 2 samples/week; Blend: 1 sample/week	1 sample/quarter
TOC	1 sample/week[d]		Two background samples; 1 sample/quarter	Recycled water: 1 sample/week	1 sample/quarter
Primary MCLs[e]	1 sample/quarter[f] Added sampling when exceed MCL	CDPH approved plan based on source water assessment	Two background samples; 1 sample/quarter	Recycled water: 1 sample/quarter	1 sample/quarter
Secondary MCLs	1 sample/year Added sampling when exceed MCL		Two background samples; 1 sample/quarter	Recycled water: 1 sample/quarter	
Priority Pollutants[g]	1 sample/quarter[h]	CDPH approved plan based on source water assessment	Two background samples 1 sample/quarter[h]	Recycled water 1 sample/quarter	2 samples/year
NLs[h]	1 sample/quarter[k]	CDPH approved plan based on source water assessment	Two background samples; 1 sample/quarter[j]	Recycled water 1 sample/month	1 sample/quarter
Other chemicals[k]	1 sample/quarter[l]		Two background samples; 1 sample/quarter[l]	To be determined[r]	To be determined
CECs	1 sample/year[m]	CDPH approved plan based on source water assessment	Two background samples; 1 sample/quarter[m]	Recycled water: 1 sample/quarter for 1st year; 2 samples/year[s]	1 sample/quarter for 1st year; 2 samples/year[t]
Flow				Influent, recycled water: on-line; blend: monthly	
UV dose[p]	Likely to be specified by CDPH			On-line monitoring	
Conductivity				Influent, recycled water: on-line	
Total dissolved solids				Blend: 1 sample/week	
Sulfate				Blend: 1 sample/week	

Table 9-1: CDPH and RWQCB Expected GWR Monitoring Requirements (Continued)

	CDPH			RWQCB	
Constituent	Recycled Water[a]	Diluent Water	Groundwater Monitoring Wells	Influent to AWPF, Recycled Water, Blend Water[o]	Groundwater Monitoring Wells[p]
Chloride				Blend: 1 sample/week	
Boron				Blend: 1 sample/week	1 sample/quarter
pH				Influent, recycled water: on-line	1 sample/quarter
Total suspended solids				Influent: daily	1 sample/quarter
$CBOD_5$ 20°C				Influent: 1 sample/week	
Temperature				Recycled water: 1 sample/week	
Oil and grease				Recycled water: 1 sample/week	
General physical and mineral[r]				Recycled water: 1 sample/quarter	1 sample/quarter
Chlorine residual				Blend: 1 sample/week (for injection projects)	
NDMA				Influent: 1 sample/month	
Recycled water flow path					Quarterly groundwater elevations

Notes:

a. Final recycled water applied for GWR.
b. NS – the frequency of sampling is not specified.
c. Samples can be collected in recycled water, recharge water (blend of recycled and diluent water), or after surface or subsurface application.
d. Samples can be collected in the recycled water prior to recharge/injection or for surface spreading projects after recharge (discounting any dilution).
e. MCLs – Maximum Contaminant Levels. MCLs for inorganic chemicals, radionuclide chemicals, organic chemicals, disinfection byproducts, and lead and copper.
f. For surface spreading projects, samples can be collected after percolation (discounting any dilution) for disinfection byproducts.
g. See 40 Code of Federal Regulations Part 131, *Federal Register* 65(97), May 18, 2000.
h. The exact priority pollutants will be specified by CDPH based on the review of the Engineering Report. Monitoring for recycled water can be reduced to 1 sample/year based on CDPH approval.
i. NLs – Notification Levels.
j. The exact NLs will be specified by CDPH based on the review of the Engineering Report and the affected groundwater basins. Monitoring for recycled water can be reduced to 1 sample/year based on CDPH approval.
k. The chemicals are to be specified by CDPH. Examples include Chromium-6, Diazinon, and Nitrosamines for which the US Environmental Protection Agency has developed analytical methods.
l. Monitoring can be reduced to 1 sample/year based on CDPH approval.

m. CECs include pharmaceuticals, endocrine disruptors, and other wastewater indicator chemicals as specified by CDPH based on the review of the Engineering Report, the affected groundwater basins, and the assessment of the fate of industrial chemicals through the wastewater and recycled municipal wastewater treatment systems (one of the requirement of the Source Control Program).
n. The RWQCB is likely to include multiple process point sampling; this will be negotiated with the RWQCB during the permit process. The blend water is the combination of recycled water and diluent water.
o. The nearest domestic water supply well may also be included.
p. Transmittance, UV intensity, and operational dose.
q. The RWQCB may elect to include other compounds despite CDPH recommendations and the CECs to be specified in the Recycled Water Policy. For example, the DCTWRP permit may include CECs as part of the NPDES permit (to be revised in 2011) that may be included here.
r. Calcium, Chloride, Copper, Iron, Potassium, Manganese, Sodium, Sulfate, Total Hardness, Zinc; Color, Corrosivity, Foaming Agents, Odor, Total Dissolved Solids.
s. The list of CECs is scheduled to be finalized in 2012 based on amendments to the SWRCB Recycled Water Policy. In 2010, the recommendations for projects using AWP were as follows: 17b-estradiol, Triclosan, Caffeine, NDMA, DEET, and Sucralose.
t. The list of CECs is scheduled to be finalized in 2012 based on amendments to SWRCB Recycled Water Policy. In 2010, the recommendations for projects using AWP were as follows: 17b-estradiol, Triclosan, Caffeine, NDMA.

9.3.4 Other CDPH Monitoring Requirements

Pathogen Control

The 2008 draft GWR regulations require that the AWPF disinfection process (e.g., AOP) must achieve a 5-log reduction of F-specific bacteriophage MS2, or polio virus. The demonstration is typically achieved as part of pilot testing or by using technology that has already been shown to achieve this performance and has been approved by CDPH.

Tracer Study

Within the first three months of operation, a project sponsor must demonstrate that recycled water is retained underground for six months by conducting a tracer study. The study must use an added tracer, such as sulfur hexafluoride (SF6) that is capable of demonstrating that two percent of the tracer concentration arrives at its endpoint (T2). California has enacted regulations that will ban the use of SF6 for tracer studies in January 2013 and currently there is no available alternative that is as accurate as SF6. A WateReuse Research Foundation study is looking at alternatives, but the study has not yet started. CDPH has not decided how tracer studies will be handled if SF6 is not longer available for use.

Source Control

Project sponsors are required to conduct an assessment of the fate of CDPH specified contaminants through the wastewater and recycled water treatment systems. The constituents are those considered of importance based on industrial discharges to the wastewater system and the source control program inventory of contaminants.

Advanced Oxidation

A project sponsor must demonstrate that the AOP system can provide a level of treatment equivalent to a 1.2-log NDMA reduction and a 0.5-log 1,4-dioxane reduction, whether NDMA or 1,4-dioxane are present or not. It is probable that this demonstration can be satisfied by pilot testing or the use of technology and operating parameters that have already been approved by CDPH. CDPH has not yet established requirements for full scale assessment of AOP performance, but may want a project sponsor to propose a surrogate or indicator compound other than NDMA and 1,4-dioxane. As demonstrated by the pilot project, since reverse osmosis removes most CECs to levels below or just above detection, selecting an indicator compound for AOP performance monitoring will necessitate further study and discussion with CDPH. Possible candidates include total chlorine (e.g., chloramines) and two taste and odor compounds: Geosmin and Methylisoborneol (MIB). The theory would be to correlate the observed reduction of one of these compounds with the required 0.5 log reduction of 1,4-dioxane. For example, a 50 percent reduction of total chlorine correlates to 50 percent or greater reduction of 1,4-dioxane.

Increased Recycled Water Contribution

Projects with AWP are allowed to begin operations with an RWC of 50 percent and can after the first year of operation increase the RWC typically in phases, such as 75 percent and then 100 percent, based on certain conditions laid out in the draft regulations. These conditions include demonstrating that a monitoring well has received recharge water for (1) at least six months such that the fraction of recycled water in the monitoring well equals a value of at least 0.5 multiplied by $RWC_{proposed}$; and (2) at least 12 months such that the fraction of recycled water in the monitoring well equals a value of at least 0.8 multiplied by $RWC_{maximum}$. Thus, a project sponsor will need to collect background information from one or more monitoring wells and additional data thereafter than can be used to make this demonstration. The types of data that can be used include cations and anions or indicator compounds, such as Sucralose or Ethylenediaminetetraacetic acid (EDTA), that can be used to show when water quality in the monitoring wells transitions from ambient water to recycled water.

Process Performance and Optimization

The draft GWR regulations require that a project sponsor operate the treatment process in a manner that provides optimal reduction of all contaminants, including microbial contaminants, regulated contaminants, and unregulated contaminants. The means of making this demonstration are not specified in the regulations. However, monitoring using the following parameters are recommended to scrutinize the performance of the AWPF and the integrity of unit processes.

Membrane Filtration

- Online turbidity monitoring (feed, filtrate).
- Flow rate (filtrate, backwash, chemical dosing pumps).
- Chlorine (feed, filtrate).
- Integrity testing (pressure decay testing).

Reverse Osmosis

- Online conductivity (feed, permeate).
- Online TOC monitoring for the combined permeate.

- Flow rate (permeate – each stage and combined, acid dosing pump, anti-scalant dosing pump).
- Pressure (feed, permeate – each stage and combined, concentrate).
- Oxidation reduction potential (feed).
- Integrity testing (vacuum decay pressure hold testing).

UV/H_2O_2 AOP

- Reactor power (lamp input).
- UV intensity (lamps).
- UV transmittance (feed, product).
- Flow rate (feed, peroxide pump).

9.4 Other Permits

9.4.1 Building Permits

A building permit will need to be obtained prior to the construction phase of the AWPF. Final construction drawings (stamped and signed) should be submitted for plan check review at the Los Angeles Department of Building and Safety (LADBS). Since the AWPF is a large, complex project, it will need to be submitted for regular plan check. At the time of submittal, plans are screened for completeness and the appropriate plan check fees will be required to be paid. While there will be a primary plan check engineer assigned to the project, respective types of plans will need to be submitted to separate plan check counters at LADBS Construction Service Centers, including:

- Building (structural, geotechnical)
- Electrical
- Mechanical (HVAC, plumbing, fire sprinkler, elevator)
- Grading

Depending on complexity of the project, the assignment and review time could take up to four weeks or longer after the receipt of final plans at the various counters. An approximate timeline of three months should be allotted for the review and approval of the building permit to account for initial review time, receipt of comments, incorporation of comments, and subsequent comment address and review cycles to ensure the completeness of addressing all plan check comments.

The review of regular plan check projects can be expedited by paying an Expedite Fee equal to 50 percent of the plan check fee. Plans being expedited are usually assigned to a plan check engineer within five working days from the time of submittal. Another alternative to expedite the plan check process is LADBS' Parallel Design-Permitting Process that will allow the design process and permitting process to run concurrently starting from the conceptual design phase throughout the various design phases. This new process has several benefits including, but not limited to: early identification and correction of code violations; early identification of clearances and sign-offs from other agencies required; and, reduction of overall permit processing time, hence overall project cost reduction as well. The building permit is typically ready to be issued upon the completion of the final plans.

9.4.2 AQMD Permits

The Air Quality Management District (AQMD) permits are not required for the treatment processes proposed in Section 5 but could be required for chemicals. **Table 9-2** summarizes the chemical systems and preliminary assessment of the AQMD rules.

Table 9-2: Chemical Systems and AQMD Permit Exemption

Chemical System		Exemption
Ammonium Hydroxide (19%)		Rule 219(m)(1)(C): water based solutions of salts
Sodium Hypochlorite (12.5%)		Rule 219(m)(1) (C): water based solutions of salts
Antiscalant (100%)		
Sulfuric Acid (93%)		Rule 219(m)(1)(A): sulfuric acid w/acid strength 99% or less by weight
Liquid Oxygen (99%)	Needed if Ozone/H_2O_2 AOP is used	Non-VOC, non-toxic
Hydrogen Peroxide (50%)		Non-VOC, non-toxic
Calcium Chloride (34.7%)		Rule 219(m)(1) (C): water based solutions of salts
Carbon Dioxide		Non-VOC, non-toxic
Sodium Hydroxide (50%)		Rule 219(m)(1) (C): water based solutions of salts
Citric Acid (50%)		Non-VOC, non-toxic
Sodium Bisulfite (38%)		Rule 219(m)(1) (C): water based solutions of salts

As discussed in Section 5.3.11, the recommended post-treatment process for the AWPF includes calcium chloride, caustic soda, and carbon dioxide addition. However, if another post-treatment process using lime is utilized, then AQMP permitting may be required due to potential particulate matter (PM) emissions from using powdered lime.

As discussed in Section 8.5, no additional emergency generator system is proposed for the AWPF. Therefore, AQMD permitting for emergency generator will not be required.

9.5 Environmental Documentation

This section provides background on the CEQA environmental review process, the NEPA environmental review process, and next steps for the GWR projects in the CEQA and NEPA processes.

9.5.1 CEQA Overview

CEQA applies only to discretionary government activities, referred to as “projects.” Under CEQA, a “project” is defined as the whole of an action, which has the potential for resulting in either direct physical change in the environmental or a reasonable indirect physical change in the environment or a reasonable foreseeable indirect physical change in the environment. Once a determination has been made that a “project” exists, there are three basic levels of environmental documentation: Exemption; Negative Declaration (includes those with or without mitigation); and, EIR. Exemptions from CEQA applies to activities that are specifically identified as being exempt from CEQA under Article 18 of the CEQA Guidelines (i.e., Statutory Exemptions) and categories of activities that are recognized under CEQA as generally having no significant effect on the environment pursuant to Article 19 of the CEQA Guidelines (i.e., Categorical Exemptions).

If a project is not exempt, CEQA provides for the preparation of an Initial Study to analyze whether the project will have a significant impact upon the environment. A Negative Declaration/Mitigated Negative Declaration (ND/MND) can be issued if the analysis in the Initial Study determines that the project or action, as proposed or as proposed with specific mitigation measures, will not have a significant impact upon the environment. If the analysis in the Initial Study determines that the project that the project or action has the potential to result in a significant impact(s) to the environment, then an EIR would need to be prepared to further address such impacts.

CEQA Guidelines Section 15126.6 provides for the discussion of alternatives to the proposed project. This section requires:

- A description of “...a range of reasonable alternatives to the project, or to the location of a project which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project , and evaluate the comparative merits of the alternatives.”
- A setting forth of alternatives that “…shall be limited to ones that would avoid or substantially lessen any of the significant effects of the project." Of those alternatives, the EIR need examine in detail only the ones that the lead agency determines could feasibly attain most of the basic objectives of the project.
- A discussion of the “No Project” alternative, and “…If the environmentally superior alternative is the “no project” alternative, the EIR shall also identify an environmentally superior alternative among the other alternatives”
- A discussion and analysis of alternative locations “…that would substantially lessen any of the significant effects of the project need to be considered for inclusion in the EIR.”

The document uses an alternative screening analysis to limit the number of alternatives evaluated in detail throughout the EIR. The use of an alternative screening analysis provides the detailed explanation of why some of the alternatives were rejected from further analysis, and assures that only the alternatives that could lessen any of the significant effects of the proposed project are evaluated and compared in the EIR. This screening methodology uses the "*rule of reason*" approach to alternatives. The rule of reason approach has been defined to require that EIRs address a range of feasible alternatives that have the potential to diminish or avoid adverse environmental impacts.

If an alternative is found to be technically infeasible, then it can be eliminated without further screening analysis. Also, CEQA states that alternatives should "…*attain most of the basic objectives of the project*…" If an alternative is found to not obtain the basic objective, it can be eliminated.

Alternatives analysis for the Project focuses on the location of the AWPF because all spreading grounds available in the eastern San Fernando Valley would be included in the proposed Project except TSG. In addition to the proposed Project location at DCTWRP Southwest, four other locations for the AWPF are considered. Three locations are at or near DCTWRP: DCTWRP Southeast, Cricket Fields and the Contractor Lay Down Area. The fourth site considered would be at Valley Generating Station.

9.5.2 NEPA Overview

In addition to CEQA, a project is subject to NEPA if it jointly carried out by a federal agency (i.e., USACE), requires a federal permit, entitlement, or authorization, requires federal funding, and/or occurs on federal land. In this case, the proposed Project is located on federal land. Because the DCTWRP is located within the Sepulveda Flood Control Basin on land owned by the USACE and leased to the City of Los Angeles Department of Public Works Bureau of Sanitation and because the Project may seek federal funding, compliance with NEPA will also be required for the proposed Project. Coordination with the USACE, the NEPA lead agency, is in progress to identify the form and content of the appropriate NEPA document.

The NEPA process consists of an evaluation of the environmental effects of a federal undertaking including its alternatives. There are three levels of analysis: categorical exclusion determination; preparation of an environmental assessment/finding of no significant impact (EA/FONSI); and preparation of an EIS.

- Categorical Exclusion: At the first level, an undertaking may be categorically excluded from a detailed environmental analysis if it meets certain criteria which a federal agency has previously determined as having no significant environmental impact. A number of agencies have developed lists of actions which are normally categorically excluded from environmental evaluation under their NEPA regulations.
- EA/FONSI: At the second level of analysis, a federal agency prepares a written environmental assessment (EA) to determine whether or not a federal undertaking would significantly affect the environment. If the answer is no, the agency issues a finding of no significant impact (FONSI). The FONSI may address measures which an agency will take to mitigate potentially significant impacts.

- EIS: If the EA determines that the environmental consequences of a proposed federal undertaking may be significant, an EIS is prepared. An EIS is a more detailed evaluation of the proposed action and alternatives. The public, other federal agencies and outside parties may provide input into the preparation of an EIS and then comment on the draft EIS when it is completed. After a final EIS is prepared and at the time of its decision, a federal agency will prepare a public record of its decision addressing how the findings of the EIS, including consideration of alternatives, were incorporated into the agency's decision-making process.

9.5.3 Estimated Schedule

The CEQA and NEPA environmental reports are expected to be one joint document prepared by LADWP (CEQA lead agency) and the USACE (NEPA lead agency). The estimated CEQA/NEPA schedule for the joint document is shown in **Table 9-3**. Actual initiation of the Initial Study and Notice of Preparation (NOP) will depend upon the schedule for the San Fernando Basin Groundwater Treatment Complex. For planning purposes in the RWMP, the Initial Study and NOP are planned for the middle of 2013.

Table 9-3: Estimated CEQA/NEPA Schedule

Joint CEQA/NEPA Milestones	Start Date	End Date
Finalize Project Description	1/2013	4/2013
EIR Consultant Kick-Off Meeting	4/2013	4/2013
USACE Kick-Off Meeting	4/2013	4/2013
Prepare Initial Study and NOP	4/2013	6/2013
LADWP/USACE Review of Initial Study and NOP	6/2013	8/2013
Council Office and Neighborhood Council Briefings	8/2013	9/2013
Public Review of Initial Study and NOP	9/2013	11/2013
NOP Public Scoping Meetings	9/2013	11/2013
Prepare Draft EIR	11/2013	2/2014
LADWP/USACE Review of Draft EIR	2/2014	5/201
Filing of Notice of Completion	5/2014	5/2014
Public Review of Draft EIR	5/2014	7/2014
EIR Public Meetings	5/2014	7/2014
Prepare Final EIR /Response to Comments/Statement of Overriding Considerations	8/2014	10/2014
LADWP/USACE Review of Final EIR	10/2014	12/2014

Joint CEQA/NEPA Milestones	Start Date	End Date
Board Package Preparation	10/2014	12/2014
Board Package Review	12/2014	1/2015
Board Certification of Final EIR	2/2015	2/2015
Filing of the NOD (30 day appeal period)	2/2015	2/2015
Filing of CA Dept. Fish and Game Fees	2/2015	2/2015
USACE NEPA Approval	2/2015	2/2015
NEPA Record of Decision	2/2015	2/2015
NOD Appeal Period Ends	3/2015	3/2015

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10. Implementation Strategy

This GWR project is one component to reach the City's goal of 59,000 AFY of recycled water by 2035. To meet these goals, the City is planning to implement Phases 1 and 2 of the GWR project by 2035, with the two phases implemented as follows:

- Phase 1: 15,000 AFY online by July 2022 (FY 2022-2023)
- Phase 2: 30,000 AFY online by July 2035 (FY 2035-2036)

This section describes the steps required to implement the GWR project phases within these timeframes. The overall timeline for Phases 1 and 2 is shown in **Figure 10-1**. LADWP is currently determining funding sources and a financing plan for the project. The implementation plan will need to be adjusted as the funding sources and financing plan are finalized.

10.1 Planning and Permitting Activities

There are several planning and permitting activities that are needed to implement the GWR program. These include public outreach, recycled water master planning, IAP, regulatory coordination with CDPH and the RWQCB, and environmental documentation, including coordination with the USACE. Many of these activities will continue throughout the implementation of Phases 1 and 2 of the GWR project. The planning and permitting activities will be led by LADWP.

10.1.1 Public Outreach

Fostering public understanding and acceptance will be critical to the success of GWR. In 2009, the LADWP embarked on a public outreach program to support GWR and the RWMP. Garnering broad support for the project early often provides comfort to the regulatory community and smooths the approval process.

The public outreach activities have included convening the RWAG, holding one-on-one sessions with key community leaders, conducting briefings for City Councilmembers and other officials, delivering presentations to Neighborhood Councils and Community Groups, completing a series of Recycled Water Forums and responding openly and transparently to Press inquiries. Future plans call for public outreach activities required during the environmental process, and ongoing outreach to an increasingly broader audience. The goal is to engage members of the City's diverse population; share thorough, fact-based, easy-to-understand information; and collect feedback on the City's plans for implementing GWR in Los Angeles. The City's public outreach program is summarized in Section 2.

As shown in the timeline (**Figure 10-1**), public outreach will be an ongoing activity throughout the implementation of the GWR program to keep the public informed and engaged about the project activities.

10.1.2 Independent Advisory Panel (IAP)

Using an IAP increases the credibility of the project and further helps to secure public support. In 2010, LADWP worked with the National Water Research Institute (NWRI) to establish an

IAP to provide input and advice for the project, and specifically to support the regulatory approval process. By establishing the IAP early in the process, the City will have additional flexibility with the project implementation and facility planning issues that may arise during the engineering report. The 2008 draft groundwater recharge regulations require an IAP to expand to Phase 2, when the project would go beyond a 50 percent RWC; that this requirement was eliminated in the 2011 draft groundwater recharge regulations.

The full-IAP met in October 2010 for a briefing on the overall project and to receive information on the groundwater evaluations, the GWR treatment pilot study, and the public outreach activities. As a follow-up to the first meeting, a groundwater subcommittee met in March 2011 to review the groundwater evaluations in more detail. The full-IAP met again in November 2011 to be followed by a second meeting of the groundwater subcommittee in 2012.

Like public outreach, the IAP will continue to be engaged in the project throughout the permitting, design, and implementation phases. The IAP's expertise will be sought during development and regulatory review of the engineering report and into preliminary design of the GWR project.

10.1.3 Regulatory Coordination

The regulatory approval process has been identified as the longest lead element of the GWR project implementation schedule. The regulatory approval process includes the following primary sub-elements:

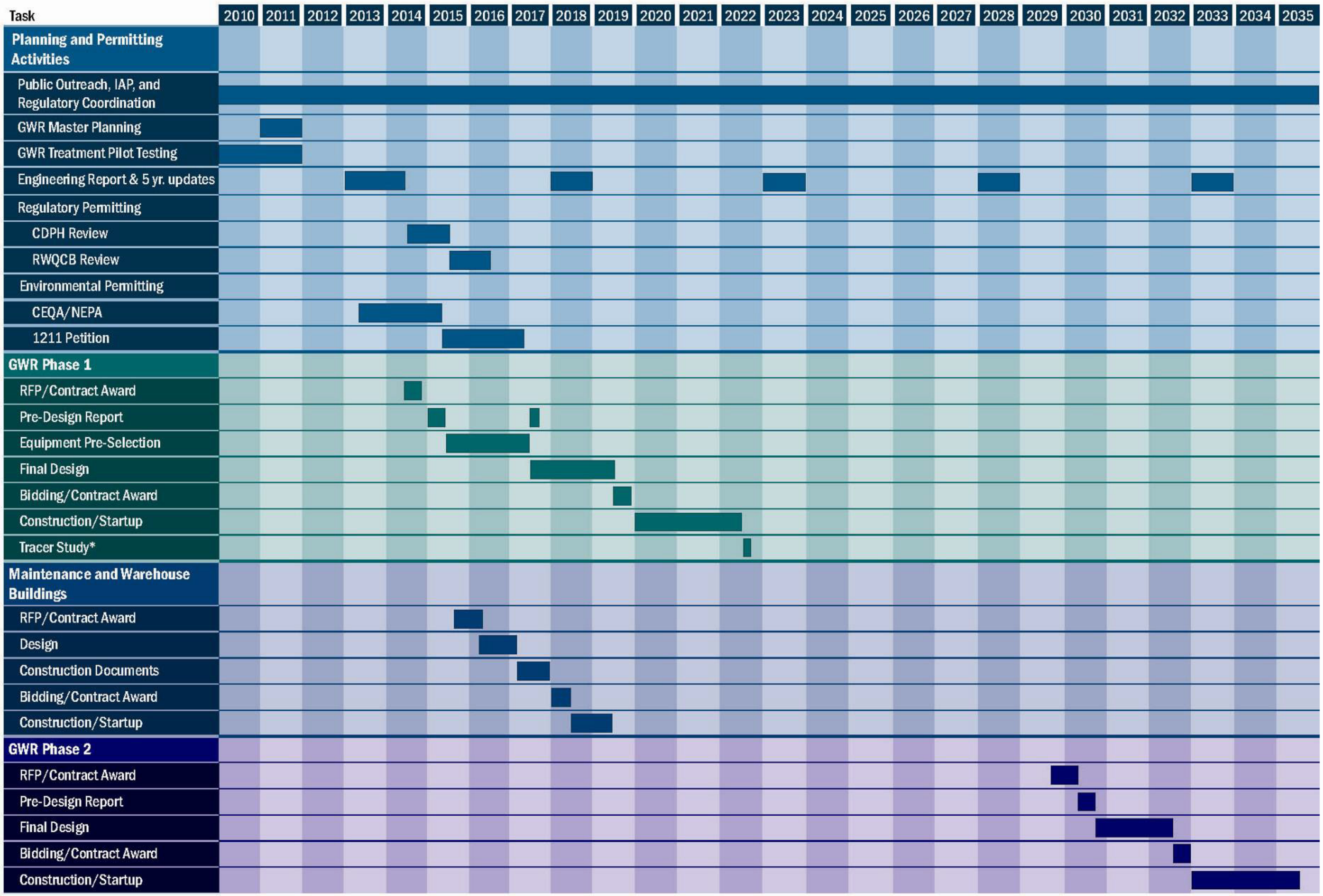
- The GWR Master Planning process, which includes a regulatory approach, groundwater recharge evaluations, and an assessment of the City's source control program. These elements will be folded into the engineering report.
- The Engineering Report, which will begin upon completion of the GWR Master Planning Report, is required to initiate the review process by the CDPH.
- CDPH review and Findings of Fact and Conditions issuance
- RWQCB review and permit issuance
- SWRCB 1211 Petition

Each of these elements is described in more detail below.

GWR Master Planning Report

The GWR Master Planning Report, this document, includes development of a regulatory approach and coordination with the CDPH and RWQCB. The GWR Master Planning process also includes the groundwater recharge evaluations, which will be folded into the engineering report, and an assessment of the City's source control program. The GWR Master Planning Report and supporting documentation will be completed by March 2012.

Figure 10-1: GWR Implementation Timeline



***To be completed within the first three months of operation.**

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Engineering Report

The Engineering Report is planned to be initiated after the GWR Master Planning Report and supporting documentation are completed. The Engineering Report is a critical path as it is necessary to start the CDPH review process. The outline for the Engineering Report was developed as part of the GWR Master Planning process and is included in Appendix L. The Engineering Report Outline was reviewed by CDPH and the RWQCB and will be updated with the 2011 draft groundwater recharge regulations. The Engineering Report is estimated to take 18 months to complete.

The Engineering Report needs to be updated every five years and before the City implements Phase 2 of the project.

CDPH Review

CDPH review will commence once the engineering report is submitted for review. Once CDPH has completed their review of the engineering report they will conduct a technical hearing and then issue their Findings of Facts and Conditions for the project. This overall process is estimated to take about 18 months, which assumes that the City will be actively involved during the review period, make timely modifications to the engineering report and prepare the Draft Findings of Facts and Conditions.

RWQCB Review and Approval

The project permit application can be submitted to the RWQCB after the following two milestones:

- CDPH issues Findings of Facts and Conditions
- CEQA documentation has been certified

According to the Recycled Water Policy, the RWQCB will issue a permit within one year of the permit application. Like the CDPH review, the City will be actively involved during the review period.

SWRCB 1211 Petition

Similarly to the RWQCB permit, the 1211 Petition can be submitted to the SWRCB once the CEQA documentation has been certified. The petition process can be time consuming even for non-controversial applications based on the pending petitions and the limited availability of SWRCB resources. The petition is assumed to take two years for approval. Any delays in this schedule would impact the start of construction.

10.1.4 Environmental Documentation

In 2010, LADWP started preliminary planning for the environmental documentation for the GWR project. Both CEQA and NEPA environmental documentation will be required. An EIR will be prepared to comply with the CEQA requirements. NEPA documentation is required because the project is located on USACE-owned land (Sepulveda Basin) and for potential federal funding for the project. The level of NEPA documentation that will be required is still being assessed.

LADWP plans to move forward with the Initial Study and NOP, which includes the Project Description, when the San Fernando Basin Groundwater Treatment Complex is ready to move forward. For panning purposes in the RWMP, the Initial Study and NOP are planned for the middle of 2013. After the initial study is completed, the schedule can be confirmed for the remainder of the environmental documentation. At this time, it is anticipated that the CEQA and NEPA environmental documentation will be completed in 2015.

As noted in Section 10.1.3, LADWP can move forward with the RWQCB review and the SWRCB 1211 petition once the CEQA document has been certified. At this time, it is anticipated that the environmental documentation will be complete in 2015.

10.2 Phase 1

The Phase 1 project includes design, construction, and startup of the first phase of the AWPF and improvements at the HSG. As outlined in Section 5, the Phase 1 AWPF construction involves construction of all of the elements of the AWPF. Since the AWPF will be located at DCTWRP and operated by BOS staff, it is assumed that BOE will lead the design, construction, and startup of the facility.

To meet the in-service target date for Phase 1 of June 2022, the pre-design will need to commence before the environmental documentation is completed. As discussed in Section 7.5, the implementation of the GWR project is closely linked with the construction of the Groundwater Treatment Complex due to the contamination in the SFB. The Groundwater Treatment Complex needs to be in service to allow LADWP to extract the recharged water.

The Phase 1 project involves the steps described below.

10.2.1 Request for Proposals and Contract Award

It is anticipated that BOE will hire a design consultant from their existing on-call consultant list. This step is anticipated to take approximately six months.

10.2.2 Pre-design Report

The first step of BOE's design process is development of a pre-design report. During pre-design, the conceptual design developed for the GWR Master Planning Report will be further developed, and assumptions will be updated, validated and documented in a pre-design report. Major assumptions and design decisions that need to be determined/updated/confirmed during pre-design are summarized in **Table 10-1**. The pre-design report will need to be updated and finalized at the end of the equipment pre-selection process to include the selected MF and UV vendors. The pre-design report is anticipated to take approximately 6 months, with an additional three months to finalize the report at the end of the equipment pre-selection process.

The pre-design report also needs to address the flow diversions in the tributary sewer system. These diversions are required to convey additional wastewater to DCTWRP to have enough water for all end uses.

Table 10-1: Major Assumptions and Design Decisions that Need to be Determined/Updated/Confirmed During Pre-design

Action	Result
AWPF Sizing	
In conjunction with BOS, update the wastewater flow projections for DCTWRP for 2020 and 2030. Need to include collection system diversions to route additional wastewater to DCTWRP.	Update the projected DCTWRP influent flows.
Analyze updated DCTWRP data for treatment plant losses and tertiary effluent production.	Update assumptions about tertiary flow available from DCTWRP.
Update overall NPR demands (current and projected).	Refine AWPF sizing.
Decide if NPR flows near DCTWRP will be served with Title 22 water or purified recycled water.	Refine AWPF sizing.
MF/RO Building	
Further evaluation of height variance.	Refine MF/RO building concept from three-stories above grade to a basement and two stories above grade.
MF	
Through equipment pre-selection process, select MF vendor.	Update MF/RO building layout based on selected MF vendor.
RO	
Refine RO skid arrangement with operations staff (e.g., maximum height).	Update MF/RO building layout based on updated RO skid layout.
Determine if 8-inch or 16-inch elements will be used.	Update MF/RO building layout based on updated RO skid layout.
UV	
Determine advanced oxidation approach (UV/H_2O_2 or O_3/H_2O_2).	Revise AWPF process flow.
If UV, select UV vendor through equipment pre-selection process.	Update UV layout based on selected UV vendor.
Title 22	
Determine if a chlorine residual is desired for purified recycled water delivery for Title 22 customers.	Incorporate individual chlorination stations for Title 22 users or hydrogen peroxide quenching and chlorine addition at AWPF.
Instrumentation & Controls	

Action	Result
Develop overall process control strategy.	
Resolution of AWPF operations if spreading grounds are not available (Section 3.4).	Determine operations strategy for periods when spreading grounds are not available.
Power Supply	
Confirm if a new substation is needed for both Phases 1 and 2, or just Phase 2.	Determine if a new substation is needed.
Evaluate medium voltage power supply routing in street.	Determine routing for power supply within DCTWRP.
Start-up	
Requirements/procedures to convert the 54-inch line to purified recycled water service.	Determine if pipeline flushing is required and where the flush water will be discharged.

10.2.3 Equipment Pre-selection and Vendor Pilot Testing

It is recommended that vendor prequalification and equipment selection will be done for the AWPF. Additional pilot testing is recommended to support the procurement process. The pilot testing would serve two purposes:

- Equipment pre-approval for bidding, including establishing equipment-specific design criteria and operating parameters
- Equipment pre-selection for the MF and UV systems for design

Table 10-2 summarizes the equipment recommended for pre-approval and pre-selection for the AWPF.

Table 10-2: Summary of Equipment Recommended for Pre-Approval and Pre-Selection

Equipment	Pre-Approval	Pre-Selection
MF	Y	Y
RO	Y	N
UV	Y	Y

It is recommended that the City pre-select the MF and UV equipment during pre-design because the MF and UV equipment designs vary significantly between vendors. This will allow the design to be based on a single vendor for each system during final design.

The candidate MF and UV systems vary on both capital and O&M costs and should be procured using a lifecycle cost evaluation. The design criteria that form the basis of the lifecycle evaluation can either be defined by the vendors based on other installations, or proven through pilot testing on DCTWRP secondary effluent. The latter option (proven through pilot testing) is recommended to confirm how the equipment operates on the DCTWRP secondary effluent, identify potential performance issues before installation in the full-scale plant, and provide confidence that the full-scale facility will meet water production goals within the established capital and O&M budgets. This pilot testing would give the City confidence that the selected equipment would meet the full-scale facility operating goals.

It is also recommended that RO vendors complete pilot testing to pre-approve equipment for final design and establish performance requirements for the system sizing. It is not necessary to pre-select RO membranes since the RO membrane skids have a standardized design.

After equipment pre-selection, the City has several options to procure the MF and UF equipment. The options range from assigning the purchasing responsibility to the contractor, to the City pre-purchasing the equipment and assigning the equipment to the contractor.

The equipment pre-selection process, including vendor pilot testing, pre-selection/procurement documents, and the procurement methodology will be determined at the onset of pre-design. The implementation schedule assumes that the City will go through a vendor pre-qualification step with pilot testing and issue RFPs for the MF and UV equipment to select the equipment for the facility. The City would select the vendors and evaluate their shop drawings to be used as the basis of design. It is assumed that equipment pre-selection and vendor pilot testing will take approximately two years. The pre-selection needs to be completed before the commencement of final design.

10.2.4 Final Design

The final design is assumed to take approximately 18 months, plus an additional month to prepare bid documents after the City of Los Angeles Building and Safety Permitting is completed.

The assumed duration of each portion of the design process is as follows:

- 30% design submittal - 6 months
- 50% design submittal - 4 months
- 90% design submittal - 4 months
- 100% design submittal – 4 months
- Prepare bid package (after permitting completed) – 2 months

During the facility design, two facility permits will be obtained:

- City of Los Angeles Building and Safety Permitting, which can be initiated with the sealed design submittal (100% design submittal). These approvals are assumed to take three months to be completed after the 100% design submittal is prepared. A case manager will be assigned early in the design process to help keep this approval process to three months.

- Air permitting with the AQMD for liquid oxygen system if ozone/H_2O_2 AOP is selected. This permit application would be initiated after 50% design and is assumed to take about seven months.

10.2.5 Bidding/Contract Award, Construction, and Startup/Final Approvals

Bidding and contract award will commence once the bid package is complete. These tasks are assumed to take 6 months. The bidding and contract award period is defined from when the bid package is sent to the City's Project Award and Control Division (PAC) for advertisement to the day that Board issues NTP to the contractor. This also includes the Good Faith Effort review by the Office of Contract compliance.

Construction of the AWPF is anticipated to take 2 years.

The startup period and final approvals of the AWPF and overall GWR project is anticipated to take six months.

10.2.6 Tracer Study

Per the 2008 draft groundwater recharge regulations, a tracer study needs to be performed within the first six months of operation. The tracer study needs to be completed during the six-month startup period.

10.3 New Warehouse and Maintenance Building

The AWPF will be constructed in the area where the existing warehouse and maintenance building are located. Therefore, the new warehouse and maintenance building need to be constructed in the north end of the plant before the Phase 1 AWPF construction can begin.

As shown on the timeline (**Figure 10-1**), the RFP for the design consultant for the new warehouse and maintenance building project needs to be initiated about the same time as the Phase 1 project. The design phase of the Phase 1 project will have a longer schedule because of the equipment pre-selection and testing phase between pre-design report and final design.

To avoid delays with the Phase 1 AWPF construction, it is recommended that the City initiate the necessary design, permitting, and construction process on the warehouse and maintenance building as soon as possible.

10.4 Phase 2

The Phase 2 expansion will increase the capacity of the AWPF from 25 mgd to 35 mgd. The City will need to complete an updated engineering report to implement the Phase 2 expansion, which can be completed as part of one of the required five-year updates. The Phase 1 facility permit will include language for the expansion.

Like Phase 1, the implementation of Phase 2 includes the following steps:

- Pre-design report
- Final Design

- Bidding/Contract Award
- Construction
- Start-up

At this time, it is not anticipated that equipment pre-approval/pre-selection will be required for the Phase 2. But, if there is a substantial delay between Phases 1 and 2, then there may be new equipment that should be considered for the Phase 2 expansion.

Before implementing GWR Phase 2, the City can revisit the multi-criteria comparison of GWR and NPR. This will determine whether it is prudent to still implement a 15,000 AFY Phase 2 GWR project or to pursue a lesser amount of additional GWR for Phase 2. If it is preferable based on cost and other important non-cost criteria for Phase 2 GWR to be less than 15,000 AFY, then more NPR projects would be implemented to make up the balance to achieve the 59,000 AFY recycled water goal.

In addition, the City can investigate ways to decrease the cost of the Phase 2 GWR project. Based on actual Phase 1 operations experience, the City may be able to achieve the desired 30,000 AFY goal for GWR without injection wells. The City could also consider lowering the GWR goal to avoid injection wells and make up the difference with additional NPR projects if this is more preferable from a cost and other important criteria.

By the time that Phase 2 is implemented (between 2029 and 2035), the State of California may allow direct potable reuse (DPR) as an alternative to indirect potable reuse using GWR. At that time, the project should be reassessed to determine if DPR would be more appropriate than GWR.

As with Phase 1, the Phase 2 pre-design report also needs to reconfirm the flow diversions in the tributary sewer system. The Wastewater Engineering Services Division (WESD) has indicated that the diversions may need to be changed back to 2011 settings in the year 2050. It needs to be confirmed that there will be sufficient wastewater in 2050 to have enough water for all end uses.

As with Phase 1, there are assumptions and design decisions that will need to be determined/updated/confirmed during the Phase 2 pre-design. Examples of these assumptions and design decisions are summarized in **Table 10-3**.

Table 10-3: Examples of Major Assumptions and Design Decisions that Need to be Determined/Updated/Confirmed During Phase 2 Pre-design

Action	Result
AWPF Sizing	
In conjunction with BOS, update the wastewater flow projections for DCTWRP for 2035. Need to include collection system diversions to route additional wastewater to DCTWRP.	Update the projected DCTWRP influent flows.
Analyze updated DCTWRP data for treatment plant losses and tertiary effluent production.	Update assumptions about tertiary flow available from DCTWRP.
Update overall NPR demands (current and projected).	Refine AWPF sizing.
Decide if NPR flows near DCTWRP will be served with Title 22 water or purified recycled water.	Refine AWPF sizing.
Update primary equalization evaluation.	Confirm amount of primary equalization needed.
MF/RO/UV	
Complete technology assessment to confirm that MF/RO/UV processes are still appropriate.	Potentially change AWPF treatment technologies to take advantage of technology improvements.
Evaluate performance of existing MF/RO/UV equipment.	Determine if should expand facility with same equipment, or select new equipment.
Confirm actual on-line factor based on Phase 1 operations.	Refine AWPF sizing.
Groundwater Replenishment	
Complete preliminary engineering and confirm Cantebury alignment, which was selected during preliminary planning.	Confirm alignment to PSG.
Determine if injection wells will be implemented.	Injection wells are included as an option for Phase 2 to achieve 30,000 AFY GWR every year.
Power Supply	
Re-evaluate power supply approach.	Determine if can use existing substation or if a new substation is required.

11. Opinion of Probable Costs and Financial Analyses

This section provides the opinion of probable capital and O&M costs for all the GWR project components, as well as financial analyses to evaluate and compare future recycled water projects.

11.1 Opinion of Probable Costs

11.1.1 Capital Costs

As discussed earlier, preliminary costs were developed for various GWR alternatives as part of the *Final Integrated Alternatives Development and Analysis TM*. Now that more detailed, facilities planning-level engineering has been completed, costs have been refined. This section provides these conceptual level estimates of capital costs for the GWR project components described in Sections 5 through 7. The conceptual-level estimates of capital cost for the GWR project components described in Sections 5 through 7 are presented in tables below. The capital cost estimates for AWPF using UV/H_2O_2, spreading grounds improvements, and injection wells, are summarized in **Tables 11-1**, **11-2**, and **11-3** respectively. The sum of estimated capital costs for all GWR project components are presented in **Table 11-4**.

The cost estimating procedures for the RWMP are described in the *Cost Estimating Basis for Recycled Water Master Planning TM* (Appendix C).

Table 11-1: Conceptual-Level Capital Cost for AWPF Using UV/H_2O_2

	Capital Cost[1]	
	Phase 1	Phases 1 and 2
AWPF	**25.0 mgd capacity**	**35.0 mgd capacity**
MF System [2]	$32,657,000	$42,212,000
MF/RO Equalization Basins [3]	$1,604,000	$1,604,000
RO System [4]	$36,337,000	$47,753,000
Two-Story MF/RO Building [5]	$42,727,000	$42,727,000
UV System [6]	$8,192,000	$10,188,000
Chemical Systems [7]	$3,170,000	$3,308,000
Balboa Pump Station Modification [8]	$0	$1,206,000
Primary Flow Equalization Basins [9]	$0	$16,538,000
Yard Piping [10]	$3,236,000	$3,236,000
Site Improvements [11]	$1,468,000	$1,468,000
Protection of Existing Satellite Substation (IS-2250) In Place	$337,000	$337,000
Relocation of Existing Electrical Ductbanks [12]	$1,687,000	$1,687,000
Demolition of Existing Service Buildings	$5,764,000	$5,764,000
Construction of New Service Buildings [13]	$30,000,000	$30,000,000
Construction Subtotal	***$167,179,000***	***$208,028,000***
30% Contingency	$50,154,000	$62,408,000
Construction Total	***$217,333,000***	***$270,436,000***
30% Implementation Cost [14]	$65,200,000	$81,131,000
Total Capital Cost (AWPF)	**$283,000,000**	**$352,000,000**

Notes:
1) All costs are in September 2011 dollars.
2) Includes MF Feed Pump Station. See Sections 5.3.2 and 5.3.4.
3) See Section 5.3.5.
4) Includes RO Transfer Pumps, RO Cartridge Filters, and RO Feed Pumps. See Sections 5.3.6 through 5.3.9.
5) Includes additional costs for architectural features and cost to depress the building below grade to meet building height limitations.
6) See Section 5.3.10. Hydrogen peroxide system is included with chemical systems.
7) Includes all chemical systems included in Section 5.3.13.
8) See Section 5.3.12.
9) See Section 5.3.16.
10) Includes gravity pipeline connections to secondary and tertiary effluent channels, pressure MF feed pipeline, pressure AOP product water pipeline, gravity AWPF backwash and concentrate pipeline and chemical feed pipelines.
11) Includes site grading, retaining wall at DCTWRP entrance, site security improvements, converting grass areas to parking spaces, and landscaping.
12) See Section 8.5.3.
13) Costs provided by BOE.
14) Includes Planning, Environmental Documentation, and Permits; Engineering Services (pre-construction and during construction); Construction Management and Inspection; Legal and Administrative Services; and Field Detail Allowance. See the *Cost Estimating Basis for Recycled Water Master Planning TM* (Appendix C) for more information.

Table 11-2: Conceptual-Level Capital Cost for Conveyance Pipeline and Spreading Grounds Improvements

	Capital Cost[1]	
	Phase 1	Phases 1 and 2
Conveyance and Replenishment – Spreading	**15,000 AFY**	**30,000 AFY**
HSG Improvements [2]	$1,217,000	$1,217,000
PSG Improvements and 54" Pipeline Connection to PSG [3]	$0	$14,734,000
Construction Subtotal	***$1,217,000***	***$15,951,000***
30% Contingency	$365,000	$4,785,000
Construction Total	***$1,582,000***	***$20,736,000***
30% Implementation Cost	$475,000	$6,221,000
Total Capital Cost (Spreading Grounds Improvements)	**$2,060,000**	**$27,000,000**

Notes:
1) All costs are in September 2011 dollars.
2) See Section 7.1.4.
3) See Section 7.2.4.

Table 11-3: Conceptual-Level Capital Cost for Injection Wells

	Capital Cost[1]	
	Phase 1	Phases 1 and 2
Conveyance and Replenishment – Injection	**0 AFY**	**600 AFY (dry) to 4,000 AFY (wet)**
Injection Wells [2]	$0	$21,067,000
Construction Subtotal	***$0***	***$21,067,000***
30% Contingency	$0	$6,320,000
Construction Total	***$0***	***$27,387,000***
30% Implementation Cost	$0	$8,216,000
Total Capital Cost (Injection Wells)	**$0**	**$35,600,000**

Notes:
1) All costs are in September 2011 dollars.
2) See Section 7.3.4.

Table 11-4: Conceptual-Level Capital Cost for All GWR Project Components

	Injection Wells	Capital Cost[1]	
		Phase 1	Phases 1 and 2
AWPF using UV/H_2O_2 with Trojan UV	**Not Included**	**$285M**	**$379M**
AWPF using UV/H_2O_2 with Trojan UV	**Included**	**$285M**	**$415M**

Notes:
1) All costs are in September 2011 dollars.

11.1.2 O&M Costs

Table 11-5 present the conceptual-level estimates for annual O&M costs for the AWPF using UV/H_2O_2 with Trojan UV. The annual O&M costs for the injection wells are estimated to be $900,000 per year, and the annual O&M costs for the groundwater extraction pumping using existing LADWP wells are estimated to be $68/AF. The sum of estimated annual O&M costs for all GWR project components, with and without injection wells, are presented in **Table 11-6**.

Table 11-5: Conceptual-Level Annual O&M Cost for AWPF Using UV/H_2O_2

	Annual O&M Cost	
	Phase 1	Phases 1 and 2
AWPF	**25.0 mgd capacity**	**35.0 mgd capacity**
Power Costs		
MF System	$360,000	$447,000
RO System	$2,053,000	$2,874,000
UV System – Trojan UV	$233,000	$434,000
PWPS [2]	$1,461,000	$2,045,000
Miscellaneous Equipment	$50,000	$53,000
MF/RO Building	$543,000	$543,000
Power Costs – Subtotal	***$4,700,000***	***$6,396,000***
Chemical Costs		
MF Pre-treatment	$343,000	$480,000
RO Pre-treatment	$378,000	$529,000
H_2O_2 for AOP	$352,000	$493,000
Post-treatment	$701,000	$981,000
Chemical Costs – Subtotal	***$1,773,000***	***$2,483,000***
Replacement of Consumables		
MF Membranes	$705,000	$987,000
RO Cartridge Filters and RO Membranes	$520,000	$728,000
UV Lamps and Ballasts – Trojan UV	$275,000	$367,000
Replacement of Consumables – Subtotal	***$1,500,000***	***$2,082,000***
Maintenance Costs[3]	***$1,847,000***	***$2,299,000***
Labor Costs[4]	***$3,219,000***	***$3,695,000***
Total Annual O&M Cost	**$13,039,000**	**$16,955,000**

Notes:
1) All costs are in September 2011 dollars.
2) Pumping from AWPF to spreading grounds
3) Assumed to be 1.7% of the equipment construction cost.
4) Estimated staffing for Phase 1 = 19 personnel and for Phase 2 = 22 personnel. Estimates provided by BOS.

Table 11-6: Conceptual Level Annual O&M Cost for All GWR Project Components

	Injection Wells	Annual O&M Cost	
		Phase 1	Phases 1 and 2
AWPF using UV/H_2O_2 with Trojan UV	**Not Included**	**\$13.0M**	**\$17.0M**
AWPF using UV/H_2O_2 with Trojan UV	**Included**	**\$13.0M**	**\$17.9M**

Notes:
1) All costs are in September 2011 dollars.
2) The O&M costs do not include labor costs.
3) The O&M costs for spreading grounds, excluding labor costs, are assumed to be negligible.
4) The estimated annual O&M cost for injection wells is \$0.9M.
5) Groundwater extraction pumping is estimated to be an additional \$68/AF, which is not included in annual O&M costs above. Estimate provided by LADWP.

11.2 Financial Analyses

This section presents financial analyses of the GWR project costs presented in Section 11.1. There are many different ways that the GWR project could be financed, which impacts the total cost of producing the purified recycled water. In this section two potential methods are presented, "pay-as-you-go" (no financing) and financing using borrowed funds, with the resulting cumulative costs over a 50-year period. For both evaluations, the projected cumulative cost is compared with projected Tier 1 Metropolitan Water District of Southern California (MWD) imported water cumulative costs.

11.2.1 Pay-As-You-Go Analysis

Historically, LADWP has funded its recycled water projects entirely through its Water Rates Ordinance Water Procurement Adjustment Surcharge (Surcharge) without borrowing money. This is called the "pay-as-you-go" method that provides funding during each of the project's planning, design, and construction phases, and for ongoing O&M costs.

To evaluate and compare future recycled projects for the RWMP documents, a standard economic method called the present value (PV) approach was used. This approach first estimates future capital and O&M costs for the lifecycle of each project, accounting for inflation. Then all future year O&M and capital costs are brought back to PV terms using a discount rate. The discount rate accounts for the time value of money, which captures the economic principle that a dollar today is worth more than a dollar tomorrow because of the opportunity cost or investment potential. Typically, the discount rate is set equal to the interest rate if capital costs are financed using borrowed funds. However, for the pay-as-you-go analysis presented in the RWMP documents, the discount rate was set at 3% (equal to projected inflation) as historically LADWP has not financed recycled water program capital costs using borrowed funds and unused monies from the Surcharge cannot be carried over to subsequent years.

To determine the cost-effectiveness of the recycled water projects under pay-as-you-go financing, a PV unit cost in dollars per acre-foot (\$/AF) for the GWR project was estimated by taking the sum of the PV costs divided by the sum of water yield over the 50-year life of the project. This PV unit cost was then compared to the PV unit cost of MWD Tier 1 water purchases.

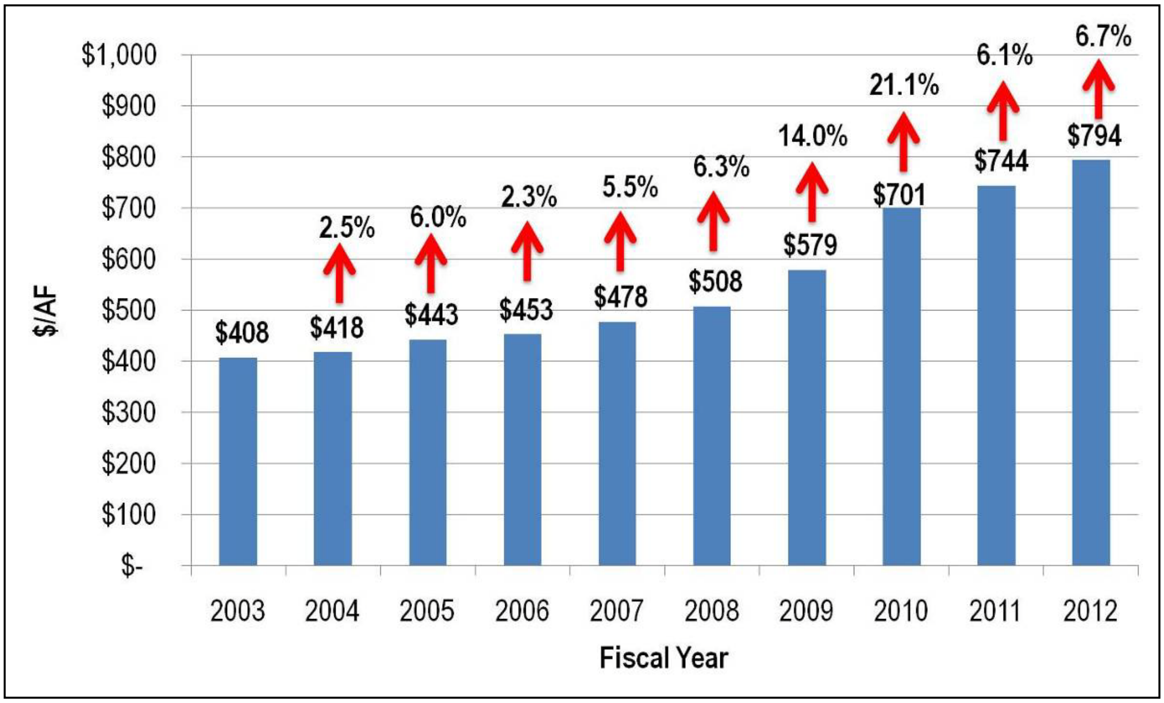
The PV unit cost for the GWR project is estimated to be $1,150/AF without injection wells and $1,210/AF with injection wells, which includes potential capital and O&M costs for the AWPF (summarized in Section 11.1) over the 50-year life of the recycled water projects. The PV also includes groundwater extraction pumping costs of $68/AF starting the year after Phase 1 and 2 are implemented (i.e., groundwater extraction pumping increased by 15,000 AFY in 2023 and by an additional 15,000 AFY in 2036). The PV unit cost for MWD water purchases over the same 50-year period is estimated to be $1,366/AF, which is about 13% greater than the estimated PV for the GWR project with injection wells and about 19% greater than the estimated PV for the GWR project without injection wells.

11.2.1.1 PV of Forecasted MWD Tier 1 Water Rates

LADWP purchases imported water from MWD under both Tier 1 and Tier 2 treated water rates. MWD sells a limited amount of Tier 1 imported water to each of its contractors (such as LADWP) and, once this allotment is met, the contractor must purchase more expensive Tier 2 supplies. Based on LADWP's UWMP, LADWP plans to stay within their Tier 1 allotment throughout the project period (through 2035). As a result, the cost of providing 30,000 AFY through GWR is being compared to the cost of MWD Tier 1 imported water. For the purpose of this comparison, the PV of water purchase costs for MWD Tier 1 imported water were estimated based on MWD Tier 1 rate projections.

As shown in Figure 11-1, MWD rates have increased significantly over the last 10 years. The figure shows those increases from FY 2003 through FY 2012. The increases may seem smooth, but looking at it on an annual basis you can see they are highly volatile, ranging from a low of 2.3% to a high of over 21%. This makes estimating rates into the future very difficult.

Figure 11-1: Historical and Approved MWD Tier 1 Imported Water Rates

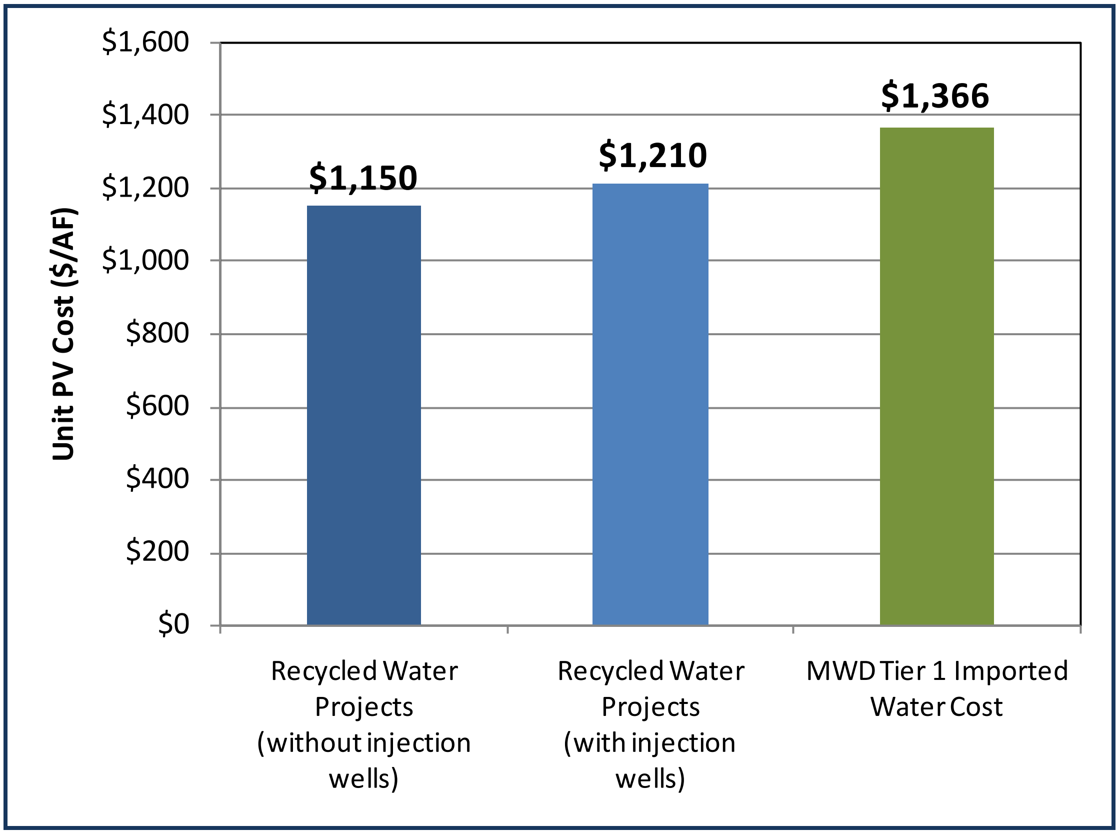


In July 2010, MWD issued a draft water rate forecast through 2018. The forecasted annual rate increase averaged 5% for Tier 1 water. For years after 2018 it was assumed that MWD's Tier 1 water rates would continue to increase at an average of 5% per year. This assumption was discussed with MWD's water resources group and they concurred that it was a good "planning" estimate, as there are many unknowns such as how much a Delta solution would cost, when it would be implemented, and how costs for this solution would be allocated.

Based on current MWD rate projections through 2018 (averages 5% per year), historical rate increases (through 2012), and an assumed 5% annual growth from 2019 on, the future MWD Tier 1 rates were forecasted. This is conservative in comparison with 2004 to 2012 historical increases from MWD that averaged just under 8% per year (as shown in Figure 11-1).

Using this forecast, the PV of future MWD Tier 1 imported water rates were estimated to compare to the PV for the GWR project. The PV of the future MWD Tier 1 imported water is $1,366/AF. **Figure 11-2** shows the PV unit costs for the imported water rate projections along with the present value unit costs for the GWR project with and without injection wells. As shown in the figure, both GWR options cost less than purchasing Tier 1 water from MWD.

Figure 11-2: Unit PV Cost for GWR Project Compared with Projected MWD Tier 1 Imported Water Costs



11.2.2 Alternative Financial Analysis (Long-Term Financing)

An alternative funding approach is to borrow money through long-term financing to fund capital expenditures. Borrowing to fund these costs reduces the near-term impact on customer's water rates, but the costs will have to be repaid with interest over a long-term period.

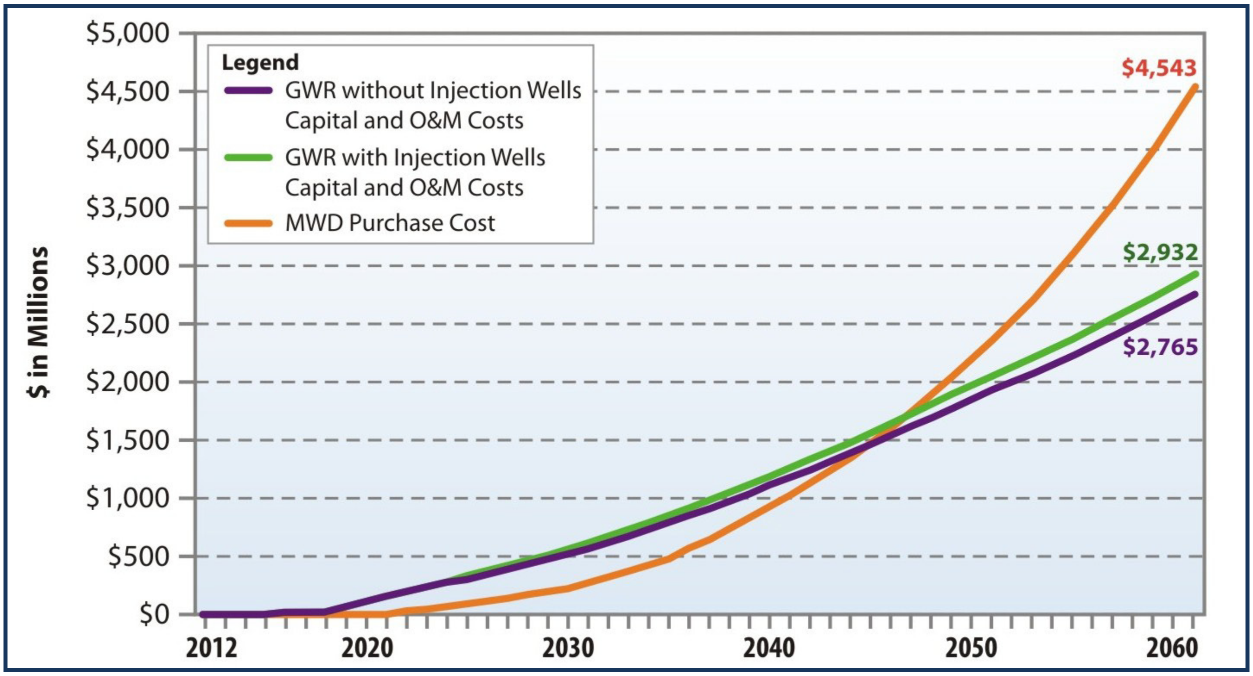
To determine the annual expenditures of the recycled water projects using this alternative funding approach, the following assumptions were made:

1. Sixty percent of capital expenditures are financed over 30 years at 5% interest, resulting in an annual amortized payment.
2. The remaining forty percent of capital expenditures plus O&M costs are paid using the "pay-as-you-go" method in each future year.
3. All costs include the effects of inflation.

The above costs are projected for each year and added together to arrive at a total annual project cost. **Figure 11-3** shows the cumulative annual expenditures over a 50-year period compared to the cumulative costs of purchasing equivalent amounts of Tier 1 MWD water. The same assumption regarding the future cost of MWD water used for the "pay-as-you-go" method described in Section 11.2.1 was used for this comparison.

The cumulative cost for the GWR alternatives is $2.93 billion and $2.77 billion with and without groundwater injection wells, respectively. Comparatively, the cumulative cost of purchasing MWD water is $4.54 billion. The payback year for GWR is 2047 with groundwater injection wells and 2045 without. A similar cumulative cost analysis for the pay-as-you-go model yields a 50-year GWR Program cost of $2.63 billion (payback year of 2045) with groundwater injection wells and $2.49 billion (payback year of 2043) without groundwater injection wells.

Figure 11-3: Future Annual GWR Project Costs Compared with Projected Annual MWD Tier 1 Imported Water Costs



11.2.3 Conclusion

In conclusion, cumulative MWD water purchases over a 50-year period are expected to be greater than LADWP's GWR program costs under either financing model. MWD water purchases will be 73-82% greater under the pay-as-you-go analysis and 55-64% under the alternative financial analysis. **Over the long term, the GWR program will cost less than the cost of purchasing MWD imported water.**

In addition, there are important operational and reliability benefits that are gained by having an increased amount of local water supplies. Recycled water is not subject to drought or imported water short or long term emergency outages that can significantly reduce MWD's imported water availability to Los Angeles.

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