City of Los Angeles

Recycled Water Master Planning

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

Non-Potable Reuse Master Planning Report

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Volume 2 of 3: Appendices A-G

March 2012

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Appendix A

Existing and Planned Recycled Water Systems TM

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Technical Memorandum

Title: Existing and Planned Recycled Water Systems
Date: March 2012

Acronyms

AF	Acre-Feet
AFY	Acre-Feet per Year
AWPF	Advanced Water Purification Facility
BOS	Bureau of Sanitation, City of Los Angeles
City	City of Los Angeles
CRWRF	Carson Regional Water Reclamation Facility
DCTWRP	Donald C. Tillman Water Reclamation Plant
DGB	Dominguez Gap Barrier
ELWRF	Edward C. Little Water Recycling Facility
gpm	Gallons per Minute
hp	Horsepower
HGS	Harbor Generating Station
HTP	Hyperion Treatment Plant
LACDPW	Los Angeles County Department of Public Works
LADPW	Los Angeles Department of Public Works
LADWP	Los Angeles Department of Water and Power
LAGWRP	Los Angeles Glendale Water Reclamation Plant
LAX	Los Angeles International Airport
LF	Linear Feet
LVMWD	Las Virgenes Municipal Water District
MG	Million Gallons
mgd	Million Gallons per Day
MW	megawatt
NdN	Nitrification Denitrification
NPR	Non-Potable Reuse
O&M	Operation and Maintenance
POLA	Port of Los Angeles
psi	Pounds per Square Inch
RWMP	Recycled Water Master Plan
TIWRP	Terminal Island Water Reclamation Plant
TM	Technical Memorandum
WBMWD	West Basin Municipal Water District
WRP	Water Reclamation Plant or [LADWP non-potable] Water Recycling Project

1. Introduction

This Technical Memorandum (TM) describes City of Los Angeles' (City) existing and planned recycled water systems in each service area. The purpose of this TM is to document the existing and planned project facilities (pipelines, pump stations and storage), identify the existing customers currently (as of January 2012) served with recycled water, and to clearly define the planned customers and demand to be served.

This TM consists of four sections describing each recycled water service area: Harbor, Metro, Valley and Westside (**Figure 1**). Each service area has at least one existing recycled water system and each system has a unique recycled water supply that is hydraulically independent from the others. A second system is planned for the Harbor Service Area. Each system's section consists of three subsections:

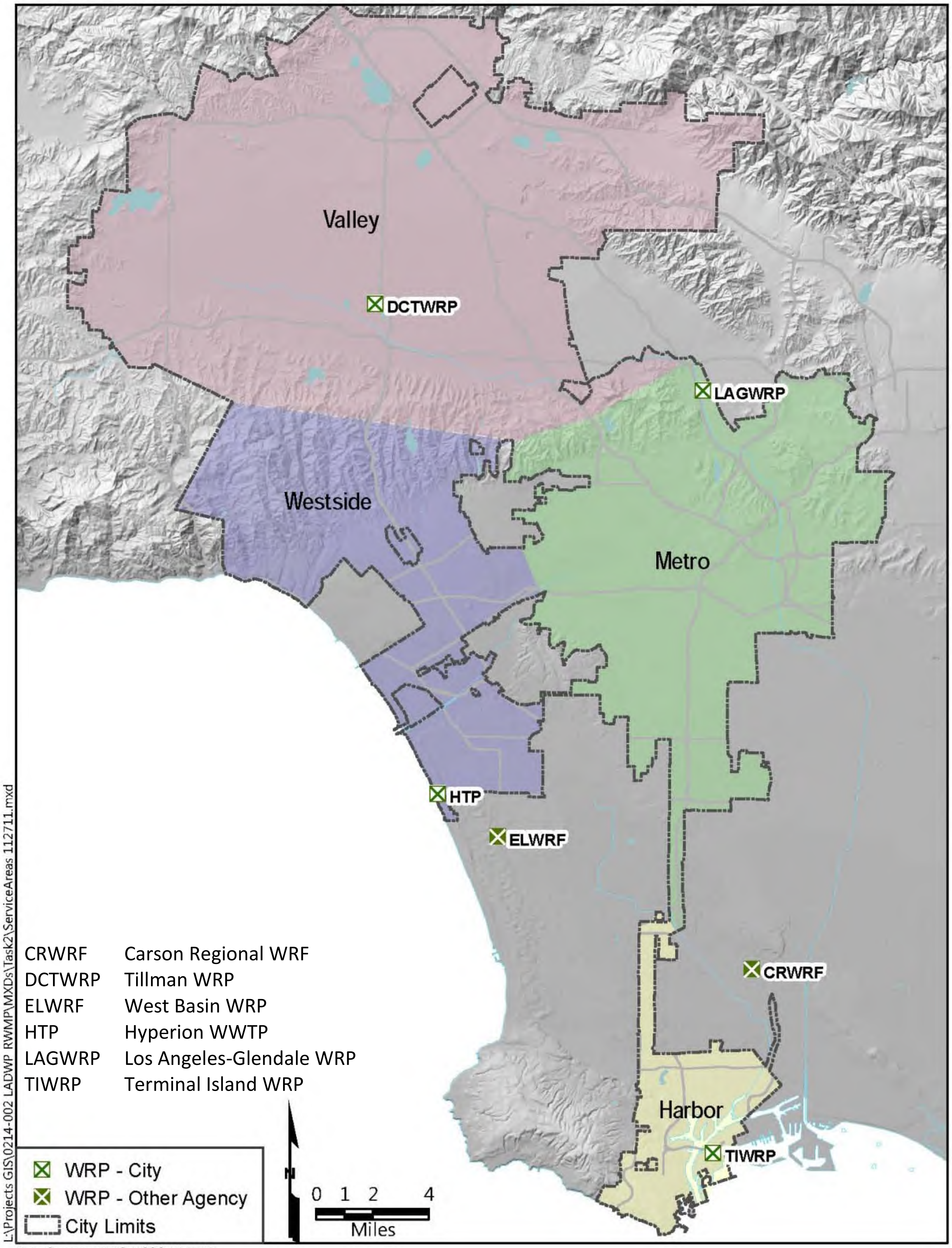
1. **Existing System:** Describes the existing recycled water facilities and customers being served as of January 2012.
2. **Planned System:** Reflects projects that that are already either in construction, design or planning as of January 2012.
3. **Summary:** Provides a summary of the existing and planned recycled water facilities and customers for each area.

1.1 Definitions

This section defines terms commonly used throughout this TM:

- Existing: LADWP's existing systems and customers discussed in this report consist of the existing recycled water facilities and customers being served as of January 2012.
- Planned: Planned systems consist of water recycling projects (WRPs) and customers that are already either in a stage of planning, design, or construction as of January 2012.

Figure 1 - LADWP Recycled Water Service Areas



Data Sources: RMC, USGS, LADWP

2. Harbor Service Area – TIWRP System

The existing recycled water distribution system serving the Harbor Service Area is supplied with advanced treated recycled water from the Terminal Island Water Reclamation Plant (TIWRP). TIWRP is located 20 miles south of downtown Los Angeles in San Pedro and treats wastewater from the industrialized Los Angeles Harbor area, including the communities of Wilmington, San Pedro, and a portion of Harbor City. A second distribution system in the Harbor Service Area is being constructed and will be supplied with recycled water from the Carson Regional Water Recycling Facility (CRWRF) located in Carson, CA. This system is discussed in Section 3. Both systems in the Harbor Service Area are shown in **Figure 2**.

2.1 Existing TIWRP System

Recycled water from TIWRP is currently used for groundwater injection and irrigation through the Harbor Water Recycling Project. The Harbor Water Recycling Project is a multi-phase project that was developed jointly between LADWP, the Bureau of Sanitation (BOS) and the Bureau of Engineering (BOE). This project is owned and operated by BOS and funded by LADWP. The project started delivering water in July 2006 and currently supplies approximately 3,000 AFY for industrial and irrigation uses in the Harbor Service Area.

Originally built in 1935, TIWRP has been providing secondary treatment since the 1970s. Tertiary treatment was added in 1996 and the advanced water treatment facility (AWTF) (microfiltration, reverse osmosis, lime addition and chloramination) was completed in 2002. The design capacity of the tertiary plant is 30 mgd and the plant received an average influent flow of 15.4 mgd from May 2008 to July 2009. The design capacity of the AWTF is 5 mgd (5,600 AFY). Treated water from TIWRP AWTF is currently used for non-potable customers and seawater intrusion barrier injection. The remaining tertiary treated effluent and brine is currently discharged into the Los Angeles Harbor via an existing outfall.

2.1.1 Existing Customers

Currently, TIWRP supplies recycled water to Harbor Generating Station (HGS) for landscape irrigation and to Water Replenishment District (WRD) for injection into the Dominquez Gap Barrier (DGB), an injection well barrier designed to prevent seawater intrusion. The DGB is owned and operated by Los Angeles County Department of Public Works (LACDPW).

Table 1 provides a summary of the existing demands for the TIWRP System, including type of use, timing of use, and estimated and metered annual average demands. The estimated annual demand was provided by LADWP. As shown in this table, the existing demands within the TIWRP System are 3,001 AFY on an annual average basis.

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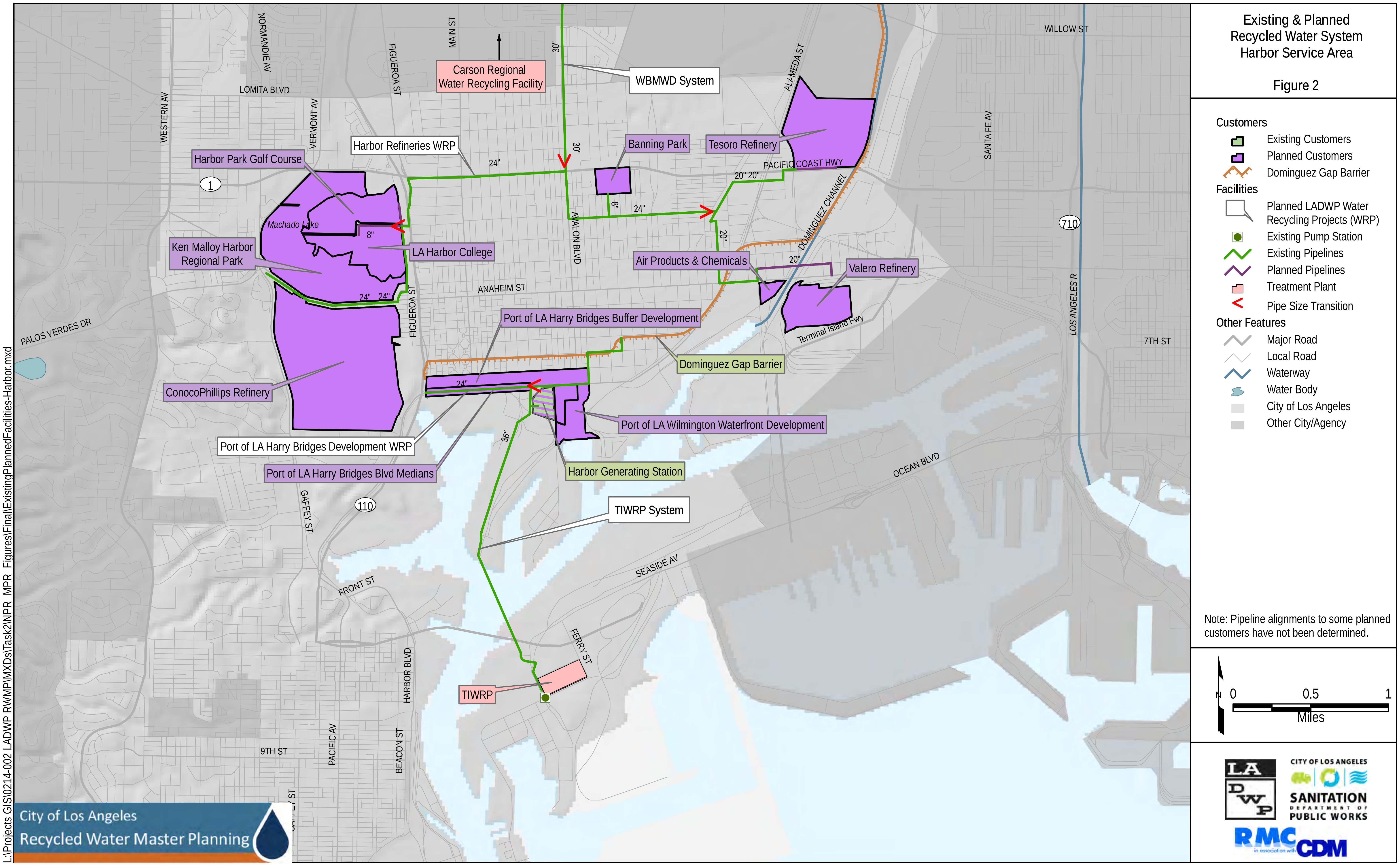

Data Sources: USGS, LADWP

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Table 1: Existing Recycled Water Customers – TIWRP System

Name	Type of Use [a]	Time of Use [b]	Estimated Annual Demand (AFY)	Service Date (Year)	Notes
Harbor Generating Station	L	N	<1	2006	
Dominguez Gap Barrier	GWR	A	3,000	2006	c
Total			**3,000**		

Notes:

a. Landscape irrigation, only (L); Groundwater Replenishment (GWR)
b. Night (N); Day (D); Anytime (A)
c. DGB requires water quality specified in RWQCB Order No. R4-2003-0134 WRR for groundwater injection and minimum pressure is 60 psi at the point of connection.
d. These are existing customers as of January 2012.

Harbor Generating Station

Harbor Generating Station (HGS) is a 472 megawatt (MW) natural gas–fired steam electric generating facility owned and operated by LADWP. HGS currently uses less than 1 AFY of recycled water for landscape irrigation.

HGS has plans to use recycled water for evaporative cooling and boiler makeup feed. Although recycled water connections are currently in place, HGS has not used the recycled water for these purposes due to concerns about potential incompatibility between the recycled water quality and the cooling tower and boiler makeup feed system components.

Dominguez Gap Barrier

As part of its efforts to prevent seawater intrusion and promote groundwater replenishment throughout Southern Los Angeles County, WRD uses TIWRP recycled water for groundwater injection at the Dominquez Gap Barrier. The DGB is located along the Dominguez Channel, in Wilmington and Carson, north of HGS. The DGB is one of three barriers designed to prevent further seawater intrusion into the West Coast Basin. Additionally, the DGB replenishes the West Coast Basin groundwater supply.

The DGB is allowed to use a blend of up to 50% of recycled water and 50% imported water for groundwater injection and currently receives approximately 3,000 AFY of advanced treated recycled water from TIWRP (BOS, 2009).

2.1.2 Existing Facilities

Existing recycled water facilities for the Harbor Water Recycling Project (WRP) include a pump station at TIWRP (the Product Water Pump Station) and over 3 miles of distribution pipelines. The current system does not include any recycled water storage facilities. In 2011, the Port of Los Angeles (POLA) completed installation of new pipeline to extend the TIWRP System. LADWP plans additional expansion of the system to primarily consist of small extensions and laterals off existing facilities to various POLA sites.

The Product Water Pump Station, shown in **Figure 3**, is located at the southwest end of TIWRP, near the end of the chlorine contact basins. Additional information about this pump station is summarized in **Table 2** and additional information about the pipelines is summarized in **Table 3**.

Figure 3: Product Water Pump Station

Photo by RMC, 2009

Table 2: Major Existing Recycled Water Pump Stations – TIWRP System

Name	Location	Type	No. of Pumps	Power per Pump	Capacity per Pump	Year Constructed
Product Water PS	TIWRP	Vertical turbine	3 Existing 3 Future	150 HP	2,100 gpm	2002

Table 3: Major Existing Recycled Water Pipelines – TIWRP System

Name	Diameter (in)	Length (mi)	Major Roads	Year Constructed
TIWRP to HGS	36	2.2	S. Neptune Ave, E. Harry Bridges Blvd	2006
HGS to DGB	24	0.9	N. Avalon Blvd, E. D Street	2006
Port of Los Angeles Harry Bridges Development WRP				
Harry Bridges Boulevard	24	0.6	Harry Bridges Boulevard	2011

2.2 Planned TIWRP System

LADWP plans to expand recycled water use to planned customers from TIWRP.

2.2.1 Planned Customers

Planned customers who may eventually be served from TIWRP system include Port of LA Harry Bridges Buffer Development, Port of LA Harry Bridges Boulevard Medians, and Port of LA Wilmington Waterfront Development as well as inlet air coolers at Harbor Generating Station.

Table 4 summarizes the planned demands for the TIWRP System, including type of use, timing of use, and estimated annual average demands. As shown in this table, the average annual planned demands within the TIWRP System are estimated to be 211 AFY.

Table 4: Planned Recycled Water Customers – TIWRP System

Name	Type of Use [a]	Time of Use [b]	Average Annual Demand (AFY) [c]	Notes
Existing Customers				
Harbor Generating Station	C/I	A	50	
Port of LA Harry Bridges Development WRP				
Port of LA Harry Bridges Buffer Development	L	N	100	
Port of LA Wilmington Waterfront Development	L	N	60	
Port of LA Harry Bridges Boulevard Medians	L	N	1	
Total			**211**	

Notes:

a. Landscape irrigation, only (L); Commercial/Industrial (C/I)
b. Night (N); Day (D); 24-Hours (24)

Port of Los Angeles

At the Port of Los Angeles, Harry Bridges Buffer Development, Harry Bridges Boulevard Medians, and the Wilmington Waterfront Development potentially can use recycled water from TIWRP for landscaping, water features and flushing toilets.

The Wilmington Waterfront Development Project Final Environmental Impact Report was approved by the Board of Harbor Commissioners in June 2009. The Wilmington Waterfront Program is focused on connecting the Wilmington community with the waterfront, creating open space, and developing commercial and green technology business opportunities in and around the Port.

As part of the Wilmington Waterfront Program, the Harry Bridges Buffer Development is a 30-acre site providing public open space between the Port and adjacent residences.

2.2.2 Planned Facilities

There are no planned facilities in the TIWRP System.

2.3 TIWRP System Summary

The TIWRP System demands and facilities are summarized in **Table 9**.

Table 5: Summary of Existing and Planned TIWRP System

Phase	No. of Customers	Estimated Annual Demand	No. of Pump Stations	No. of Storage Tanks	Miles of Pipeline
Existing	2	3,000	1	--	3.7
Planned	4	211	--	--	--
Total	**5[a]**	**3,211**	**1**	**--**	**3.7**

a. Harbor Generating Station is considered an existing and planned customer so it is counted once in the total.

Recycled water customers presented by customer type that will be served by TIWRP are shown in **Table 6**. The peak day demand for the TIWRP System is 3.06 mgd.

Table 6: Summary of Customer Types and Demands – TIWRP System

Customer Type	Average Annual Demand (AFY)	Peak Day Peaking Factor	Peak Day Demand (mgd)
Irrigation	161	2.2	0.32
Industrial	50	1.3	0.06
Mixed Use	--	--	--
Barrier	3,000	1.0	2.68
Total	**3,211**		**3.06**

3. Harbor Service Area – WBWMD System

LADWP plans to expand recycled water use within the Harbor Service Area from a second recycled water supply. The WBMWD System is a new system that will be supplied from the WBMWD Juanita Millender-McDonald Water Recycling Facility, referred to as the Carson Regional Water Reclamation Facility (CRWRF). The planned system will supply 9,300 AFY of recycled water to several refineries and irrigation customers within the Harbor Service Area (see Figure 2 and Table 7). LADWP and West Basin Municipal Water District (WBMWD) have developed an agreement to serve approximately 9,300 AFY of nitrified recycled water from the CRWRF to the Los Angeles Harbor.

The basic components of the agreement are:

- LADWP will contribute funds toward expansion of nitrification treatment portion of the CRWRF
- WBMWD will continue to operate the CRWRF
- WBMWD will provide nitrified tertiary water at a minimum pressure and flow at the CRWRF boundary
- LADWP will purchase up to 9,300 AFY of nitrified water from CRWRF over 30 years
- LADWP will own and operate all new pipelines for the project (including those within the WBMWD service area)

The system facilities within the City are referred to as the Harbor Refineries WRP and include 7.6 miles of pipe to serve mostly large industrial customers along with some irrigation customers in the City's Harbor Area. Approximately 6.4 miles of this pipe has already been constructed.

3.1.1 WBMWD System Customers

The Harbor Refineries WRP will supply an additional 9,300 AFY to several planned customers located in the Wilmington Area of the City. These include potential industrial customers who have year-round non-potable water demands such as ConocoPhillips Refinery, Tesoro Refinery, Valero Refinery and Air Products & Chemicals, as well as the following irrigation customers: Ken Malloy Harbor Regional Park, Harbor Park Municipal Golf Course, Los Angeles Harbor College and Banning Park.

Table 4 summarizes the planned demands for the WBWMD System, including type of use, timing of use, and estimated annual average demands. As shown in this table, the average annual planned demands within the WBMWD System are estimated to be 9,510 AFY. ConocoPhillips, Tesoro's Los Angeles Refinery, Valero's Wilmington Refinery and Air Products & Chemicals are the largest customers in the planned system and have demands ranging from 1,500 to 4,000 AFY.

Table 7: Planned Recycled Water Customers – WBMWD System

Name	Type of Use [a]	Time of Use [b]	Average Annual Demand (AFY) [c]	Notes
Harbor Refineries WRP				
ConocoPhillips Refinery	C/I	A	4,000	c
Valero Refinery	C/I	A	2,000	
Air Products & Chemicals	C/I	A	1,500	
Tesoro Refinery	C/I	A	1,500	c
Harbor Park Golf Course	L	N	120	
Banning Park	L	N	60	
Ken Malloy Harbor Regional Park	L	N	60	
Los Angeles Harbor College	L	N	60	
Total			**9,300**	

Notes:
a. Landscape irrigation, only (L); Commercial/Industrial (C/I)
b. Night (N); Day (D); 24-Hours (24)
c. On site storage assumed for this customer

ConocoPhillips

ConocoPhillips' Wilmington Plant is a 245-acre facility located in a heavily industrialized area where refinery operations have been conducted since 1919. ConocoPhillips is a crude oil refining, processing and storage facility which receives crude oil by pipelines, rail and ship for conversion to fuel products. Currently, ConocoPhillips uses 4,000 AFY of LADWP potable water supplies for their boiler makeup and cooling tower demand. Nearly all of the current LADWP potable water use will be replaced with recycled water.

Valero

Valero's Wilmington Refinery is located on a compact 120-acre site and was commissioned in 1969. The refinery has had three major expansions to become a fully integrated refinery and several upgrades to meet clean-fuel standards. Products include California Air Resources Board gasoline, jet fuel, ultra-low-sulfur diesel (ULSD), CARB diesel, propane, coke and asphalt. Currently, Valero uses 2,000 AFY of LADWP potable water supplies for cooling tower demands. Nearly all of the current LADWP potable water use will be replaced with recycled water.

Air Products & Chemicals

Air Products & Chemicals produces atmospheric gases, process and specialty gases for a variety of customers worldwide. Currently, Air Products & Chemicals uses 1,500 AFY of LADWP potable water supplies for their boiler makeup demand. Nearly all of the current LADWP potable water use will be replaced with recycled water.

Tesoro

Tesoro's Los Angeles Refinery is an approximately 300-acre facility and was acquired from Shell (Royal Dutch Shell) by Tesoro in May 2007. The refinery processes heavy crude from California's San Joaquin Valley and Los Angeles Basin as well as imported crudes from South America and other international sources via the Port of Long Beach. The refinery manufactures gasoline, jet fuel, diesel fuels, petroleum coke and fuel oil. Currently, Tesoro uses 1,500 AFY of LADWP potable water supplies for their boiler makeup and cooling tower demands. Nearly all of the current LADWP potable water use will be replaced with recycled water.

City of Los Angeles

Other planned recycled water customers part of the Harbor Refineries WRP include Ken Malloy Harbor Regional Park, Harbor Park Municipal Golf Course, Los Angeles Harbor College and Banning Park which are irrigation customers.

3.1.2 WBWMD System Facilities

The Harbor Refineries WRP is planned to consist of approximately 11.7 miles of 8 to 30-inch recycled water pipeline starting from the CRWRF. This distribution system is summarized in **Table 8**. The proposed pipeline alignment heads south from CRWRF, and splits to the west and east after entering the City limits. The west branch would supply irrigation customers and one industrial customer (ConocoPhillips), and the east branch would supply mostly industrial customers. The planned system does not encompass any pump stations because it is expected that WBMWD will supply the recycled water at a sufficient minimum pressure and flow to supply all planned customers. The planned expansion of CRWRF will include a 1 MG storage tank; yet, there will be no other storage facilities along the new recycled water alignment. The four large industrial customers will have on-site storage.

Table 8: Major Existing and Planned Recycled Water Pipelines – WBMWD System

LADWP Water Recycling Project	Diameter (in)	Length (mi)	Major Roads	Year Constructed
Existing				
South from CRWRF	30	0.9	Avalon Blvd	2011
West and East Alignment	24	4.2	Pacific Coast Hwy, W Anaheim, Figueroa St	2011
East Alignment	20	1.5	Mauretania St, Coil Ave, Mahar Ave, E Anaheim St	2011
Connection to Banning Park	8	0.1	Banning Blvd	2011
Planned				
West Alignment	8	0.3	L St	N/A
East Alignment	20	0.9	E I St	N/A

3.2 WBMWD System Summary

The WBMWD System planned system is summarized in **Table 9**.

Table 9: Summary of Existing and Planned WBMWD System

Phase	No. of Customers	Estimated Annual Demand	No. of Pump Stations	No. of Storage Tanks	Miles of Pipeline
Existing	--	--	--	--	6.7
Planned	8	9,300	1[a]	1[a]	5.0[a]
Total	**8**	**9,300**	**1[a]**	**1[a]**	**11.7[a]**

a. The pump station, storage tank, and 3.8 miles of pipe are located outside of the City limits and will be owned and operated by WBMWD.

The WBMWD System's recycled water customers presented by customer type are shown in **Table 10**. The peak day demand for the WBWMD System is 11.03 mgd.

Table 10: Summary of Customer Types and Demands – WBMWD System

Customer Type	Average Annual Demand (AFY)	Peak Day Peaking Factor	Peak Day Demand (mgd)
Irrigation	300	2.2	0.59
Industrial	9,000	1.3	10.44
Mixed Use	--	--	--
Total	**9,300**		**11.03**

4. Metro Service Area System

The existing system is supplied with recycled water from the Los Angeles-Glendale Water Reclamation Plant (LAGWRP). Operating since 1976, LAGWRP serves eastern San Fernando Valley including Glendale-Burbank-La Crescenta areas. With a design capacity of 20 million gallons per day (mgd), LAGWRP treats water to Title 22 standards with nitrification/denitrification. The City of Glendale has the right to half of the recycled water produced at the plant and serves a number of customers in their service area. Unused recycled water is currently discharged to the Los Angeles River. LADWP is in the process of implementing several water recycling projects in this area to serve additional identified planned customers. The existing and planned system is shown in **Figure 4**.

4.1 Existing System

4.1.1 Existing Customers

Currently, LAGWRP supplies recycled water to several irrigation customers within the Metro Service Area as shown in **Figure 4**. **Table 11** provides a summary of the existing demands for the Metro Service Area, including type of use, timing of use and estimated and metered annual average demands. As shown in this table, the existing demand within the Metro Service Area is estimated to be 2,380 AFY on an annual average basis. Information about these customers and their associated demands is provided below.

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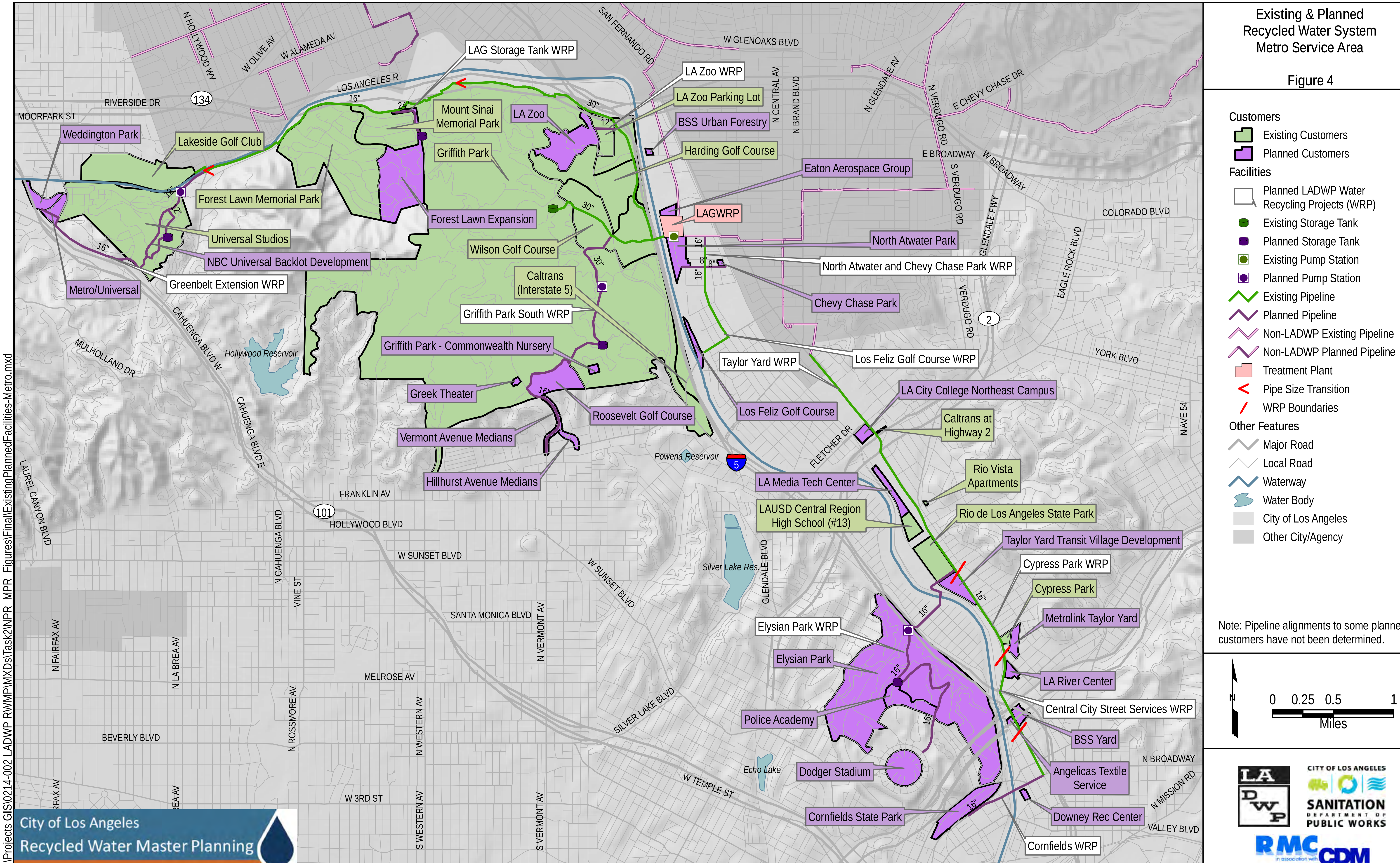

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Data Sources: USGS, LADWP

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Table 11: Existing Recycled Water Customers

Name	Type of Use [a]	Time of Use [b]	Estimated Annual Demand (AFY)	Service Date (Year)	Notes
Cypress Park					
Cypress Park	L	N	10	2010	
Greenbelt					
Forest Lawn Memorial Park	L	N	690	1992	c
Lakeside Golf Club	L	N	200	1992	d
Mount Sinai Memorial Park	L	N	200	1992	e
Universal Studios	L	A	130	1992	f
Griffith Park					
Harding Golf Course	L	N	485	1992	
Wilson Golf Course	L	N	485	1992	
Griffith Park	L	N	100	1979	
L.A. Zoo Parking Lot	L	N	20	2009	
Caltrans (along Interstate 5)	L	N	<1	1992	g
Taylor Yard					
Rio de Los Angeles State Park	L	N	73	2009	
LAUSD Central Region H.S. (#13)	L	N	34	2011	
Caltrans at Hwy-2 Freeway	L	N	1	2011	
Rio Vista Apartments	L	N	<1	2011	
Total			**2,428**		

Notes:

a. Landscape irrigation only (L)
b. Night (N); Day (D); Anytime (A)
c. Forest Lawn Memorial Park uses on-site storage and on-site pumping.
d. Lakeside Golf Club uses on-site storage and on-site pumping.
e. Mount Sinai Memorial Park uses on-site pumping.
f. Universal Studios uses on-site storage and on-site pumping.
g. Plant life has been established in this area and use is expected to be minimal in the future.

Cypress Park

Cypress Park is using recycled water for landscape irrigation was connected in 2010.

Forest Lawn Memorial Park

Forest Lawn Memorial Park has been using recycled water to irrigate the turf grass throughout the cemetery since 1992. Forest Lawn has three pumps (two duty and one standby, 800 gal/min each) that pump from a wet well to two 100,000 gallon storage tanks at the north-end of the property. Recycled water is distributed via gravity to the irrigation system. The estimated average annual demand is 690 AFY.

Lakeside Golf Club

LAGWRP has been serving recycled water to Lakeside Golf Course since 1992. The golf course has an 8,900 gallon tank connected to a pump station with one 75 hp and one 20 hp pumps. The pump station provides a system pressure of 90 psi for distribution to the irrigation system. The estimated average annual demand is 100 AFY.

Mount Sinai Memorial Park

Mount Sinai Memorial Park has been using recycled water to irrigate the turf grass throughout the cemetery since 1992. Mount Sinai has two pumps (one duty and one standby) that pump from a wetwell to a 1,000 gallon surge tank and then to customers. The estimated average annual demand is 200 AFY.

Universal Studios

LAGWRP has been serving recycled water to Universal Studios since 1992. Recycled water is pumped by three 40 hp pumps up to a 100,000 gallon reservoir at the elevation high-point on the property. Water is then pumped from the reservoir to customer sites. The estimated average annual demand is 130 AFY.

Griffith Park

Griffith Park was the first recycled water customer served by LAGWRP and has been using recycled water since 1979 to irrigate turf grass and natural areas in the park as well as landscaping along Interstate 5. Recycled water is pumped from LAGWRP to the 2 MG storage tank on the Griffith Park property. Recycled water is distributed via gravity to the irrigation system. There are 11 recycled water meters that are spread throughout the park. The estimate average annual demand is 100 AFY.

LA Zoo Parking Lot

An estimated 20 AFY of recycled water will be used at the LA Zoo Parking Lot for landscape irrigation. Final DPH inspection was completed and recycled water was turned-on on May 21, 2009.

Wilson and Harding Golf Courses

Wilson and Harding Golf Courses have been receiving recycled water since 1992. They are hydraulically fed from the Greenbelt Tank in Griffith Park. The estimated average annual demand is 600 AFY in total for both golf courses.

Rio de LA State Park

Rio de LA State Park was connected to recycled water system in July 2009. An estimated 73 AFY will be used at the state park for landscape irrigation.

LAUSD Central Region H.S. (#13)

This customer is served from the Taylor Yard WRP and uses 73 AFY of recycled water for irrigation.

Caltrans at Hwy-2 Freeway

This customer is served from the Taylor Yard WRP and uses 1 AFY of recycled water for irrigation.

Rio Vista Apartments

This customer is served from the Taylor Yard WRP and uses less than 1 AFY of recycled water for irrigation.

4.1.2 Existing Facilities

Recycled water generated at LAGWRP is distributed in two directions: east towards the City of Glendale and west towards the Greenbelt system. The LAGWRP Reclaimed Pump Station is the major existing pump station serving the Metro system and is summarized in **Table 12**. It consists of five 600 hp vertical turbine pumps with a capacity of 4,500 gpm each. The pump station feeds the Greenbelt Tank, the Greenbelt system, and the City of Glendale customers. The Greenbelt Tank, summarized in **Table 13,** is 100 feet in diameter, 30 feet high with a maximum water elevation of 28 feet. The tank, at elevation 711 feet, serves the Greenbelt System and could serve planned customers.

Table 12: Major Existing Recycled Water Pump Station Facilities

Name	Location	Type	No. of Pumps	Power per Pump	Capacity per Pump	Year Constructed
LAGWRP Reclaimed Pump Station	LAGWRP	Vertical turbine	5 Existing 3 Future	600 HP	4,500 gpm	1979

Table 13: Major Existing Recycled Water Storage Facilities

Name	Location	Volume (MG)	Material	Type	Year Constructed
Greenbelt Tank	Griffith Park	2.0	Steel	Aboveground	1979

The existing system comprises over 11 miles of pipeline, as summarized in **Table 14** and shown in Figure 4. The 30-inch LADWP recycled water pipeline crosses Interstate 5 and the Los Angeles River, then forks into two 30-inch pipelines. One pipeline continues up through the Harding and Wilson Golf Courses (which use recycled water) in Griffith Park to Greenbelt Tank. The other pipeline continues northwest in Forest Lawn Drive serving Forest Lawn Memorial Park, Lakeside Golf Course, Mount Sinai Memorial Park, and Universal Studios. The 30-inch pipe reduces to 16-inch prior to the Mount Sinai Memorial Park service lateral.

A 16-inch pipeline on San Fernando Road connects to the southern terminus of the City of Glendale's recycled water system at Glendale Avenue and serves Rio de Los Angeles State Park.

Table 14: Major Existing Recycled Water Pipelines Facilities

Water Recycling Project	Diameter (in)	Length (mi)	Major Roads	Year Constructed
Griffith Park Line WRP	30	1.2	Through Harding and Wilson Golf Courses	1979
Greenbelt Line WRP	30	2.4	Forest Lawn Drive	1992
	16	2.6	Forest Lawn Drive	1992
Taylor Yard Line WRP	16	2.2	San Fernando Road	2008

Water Recycling Project	Diameter (in)	Length (mi)	Major Roads	Year Constructed
Central City Street Services WRP	16	0.7	San Fernando Road	2011
Cornfields	16	0.4	San Fernando Rd	2011
Cypress Park WRP	16	0.8	San Fernando Rd	2011
Los Feliz Golf Course WRP	16	0.9	Brunswick Ave Los Feliz Blvd	2011
North Atwater and Chevy Chase Park WRP	16	0.2	Brunswick Ave	2011

4.2 Planned System

This section describes the recycled water facilities that are planned for construction and customers currently anticipated to be served by 2015. The planned system will be supplied with recycled water from LAGWRP within the existing treatment capacity and LADWP allotment of 10 mgd.

4.2.1 Planned Customers

Table 15 provides a summary of the planned demands for the Metro Service Area, including type of use, timing of use, estimated annual average demands and expected service date. As shown in this table, the existing demands within the Metro Service Area are estimated to be 2,400 AFY on an annual average basis.

Table 15: Planned Recycled Water Customers

Name	Type of Use [a]	Time of Use [b]	Average Annual Demand (AFY)	Notes
Central City Street Services WRP				
Angelica Textile Service	C/I	A	50	
L.A. River Center	L	N	30	c
BSS Yard	C/I	A	10	
Cornfields WRP				
Cornfields State Park	L	N	190	
Downey Rec Center	L	N	5	
Cypress Park WRP				
MetroLink Taylor Yard	C/I	A	35	
Elysian Park Tank & Pump Station WRP				
Elysian Park	L	N	400	
Greenbelt Extension WRP				
NBC-Universal Backlot Development	L	N	246	
Metro/Universal	L	N	111	
Weddington Park	L	N	35	
Griffith Park South WRP				
Roosevelt Golf Course	L	N	450	
Griffith Park – Commonwealth Nursery	L	N	46	
Vermont Avenue Medians	L	N	11	

Name	Type of Use [a]	Time of Use [b]	Average Annual Demand (AFY)	Notes
Greek Theater	L	N	7	
Hillhurst Avenue Medians	L	N	2	
LAGWRP Storage Tank WRP				
Forest Lawn Expansion	L	N	364	
LA Zoo WRP				
LA Zoo	L	N	210	
Los Feliz Golf Course WRP				
Los Feliz Golf Course	L	N	23	
North Atwater and Chevy Chase Park WRP				
North Atwater Park	L	N	12	
Chevy Chase Park	L	N	5	
Taylor Yard WRP				
Los Angeles Media Tech Center	L	N	17	
Taylor Yard Transit Village Development	C/I	A	13	
LA City College Northeast Campus	L	N	6	
Miscellaneous				
Dodger Stadium	L	N	40	
Police Academy	L	N	28	
Eaton Aerospace Group	C/I	A	18	
BSS Urban Forestry	L	N	8	
Total			**2,372**	

Notes:

a. Landscape irrigation, only (L); Commercial/Industrial (C/I)
b. Night (N); Day (D); Anytime (A)
c. Owned and operated by the Mountains Recreation & Conservation Authority.

Central City Street Services WRP

L.A. River Center, Angelica Textile Service and BSS Yard can be connected to the recycled water system through this WRP. An estimated 90 AFY of average annual demand will be used for commercial, industrial and landscape irrigation.

Recycled water will serve City of Los Angeles Public Works Bureau of Street Services (BSS) at their main yard. The BSS Yard will use recycled water for street sweeping and washing of vehicles. Angelica Textiles can use recycled water for laundry facilities.

Cornfields WRP

Cornfields State Park and Downey Recreation Center can be connected to the recycled water system through this WRP. An estimated 195 AFY of average annual demand will be used for landscape irrigation.

Cypress Park WRP

MetroLink Taylor Yard can be connected to the recycled water system through this WRP. An estimated average annual demand of 35 AFY will be used for train washing at MetroLink Taylor

Yard. Train washing could utilize recycled water at any time of the day which will be help increase daytime demand.

Elysian Park Tank & Pump Station WRP

This WRP would serve Elysian Park. Elysian Park would utilize approximately 400 AFY of recycled water for irrigation purposes.

Greenbelt Extension WRP

This WRP involves serving additional recycled water to the NBC-Universal Backlot Development, Metro/Universal, and Weddington Park. Landscape irrigation is the main use of recycled water in this project. The anticipated annual average recycled water demand for serving this expansion is estimated to be 392 AFY.

Griffith Park South WRP

The Griffith Park South WRP can connect a number of irrigation customers: Roosevelt Golf Course, Commonwealth Nursery, medians along Hillhurst Avenue and Vermont Avenue, and the Greek Theater. The total average annual demand is 516 AFY.

LAGWRP Storage Tank WRP

This WRP includes the expansion of Forest Lawn Memorial Park. An estimated 364 AFY will be used as landscape irrigation.

LA Zoo WRP

The LA Zoo uses potable water for landscape irrigation (65% of water use), animal uses (25% of water use), and domestic (10% of water use). Recycled water is proposed for exterior landscape irrigation only in the LA Zoo WRP, which is estimated to be about 210 AFY of annual average demand.

Los Feliz Golf Course WRP

This WRP can connect Los Feliz Golf Course to the recycled water system. It is estimated that 23 AFY will be used for irrigation of the golf course annually.

North Atwater and Chevy Chase Park WRP

This WRP can connect North Atwater and Chevy Chase Park to the recycled water system. An average annual demand is estimated to be 17 AFY.

Taylor Yard WRP

This WRP can serve several customers, including LA City College – Northeast Campus, LA Media Tech Center, and Taylor Yard Transit Village Development. The total average annual recycled water use is estimated to be 36 AFY. The majority of these customers will use recycled water for irrigation.

Miscellaneous

Dodger Stadium, City of LA Police Academy, Eaton Aerospace Group and BSS Urban Forestry can be connected to the recycled water system. An estimated 94 AFY of average annual demand will be used for landscape irrigation at each site.

4.2.2 Planned Facilities

The proposed planned facilities as shown in Figure 4 would build upon existing facilities to expand recycled water use west and south of currently served areas. Proposed pump station capacity information is summarized in **Table 16**.

Table 16: Major Planned Recycled Water Pump Stations – Metro System

Name	Location	Type	No. of Pumps	Power per Pump	Capacity per Pump
Elysian Park	North side of Elysian Park by I-5	Unknown	3	Unknown	2 – 600 gpm; 1 – 1,800 gpm
Griffith Park	Foot of Fern Canyon Trail	Unknown	3	Unknown	2 – 1,150 gpm; 1 – 1,150 gpm backup
Universal Backlot	East of Barham Blvd	Unknown	1	Unknown	1-900 gpm

Planned recycled water storage facilities are summarized in **Table 17.**

Table 17: Major Planned Recycled Water Storage Facilities – Metro System

Name	Location	Volume (MG)	Material	Type
Elysian Park	On hilltop near Elysian Fields	1.5	Unknown	Above ground
LAGWRP	Easterly property line of Forest Lawn Cemetery	1.25	Pre-stressed concrete	Above ground
Griffith Park South	Tank replaced potable water tank 114 in Griffith Park	1.0	Unknown	Above ground
Universal Backlot	East of Barham Blvd	0.8	Unknown	Above ground

The planned system comprises over 9 miles of pipeline, as summarized in **Table 18**.

Table 18: Major Planned Recycled Water Pipelines – Metro System

LADWP Water Recycling Projects	Diameter (in)	Length (mi)	Major Roads
Cornfields WRP	16	0.7	San Fernando Road, N. Broadway, N. Spring Street
Elysian Park WRP	16	2.5	Dorris Place Under Interstate 5 To Elysian Park Tank
Greenbelt Expansion WRP	16	2.6	Buddy Holly Drive
Griffith Park South WRP	16 30	1.6 1.1	Through Griffith Park to abandoned Tank 114

LADWP Water Recycling Projects	Diameter (in)	Length (mi)	Major Roads
LAGWRP Storage Tank WRP	24	0.4	Forest Lawn Drive
LA Zoo WRP	12	0.2	Griffith Park Drive
North Atwater and Chevy Chase Park WRP	16	0.1	Brunswick Ave
	8	0.4	Chevy Chase Dr Alger St

Notes:
a. Increase size of existing 16-inch pipeline to 30-inch pipeline from tank connection to the Universal Studios. Existing 16-inch pipe will remain in place.

The following is a summary of planned facilities planned to be constructed to serve planned customers.

Elysian Park Tank & Pump Station WRP

To serve Elysian Park and Dodger Stadium, a 16-inch pipe will branch off of the existing 16-inch line on San Fernando Road, cross the LA River and Interstate 5. The pipe will connect to a proposed pump station and then to proposed one 1.5 MG storage tank. Elysian Park and Dodgers Stadium will be served via the storage tank.

Greenbelt Extension WRP

Approximately 2.5 miles of 16-inch pipe would be constructed to extend the existing Greenbelt water recycling system west to the proposed Metro Universal Project and Weddington Park.

Griffith Park South WRP

The distribution system in Griffith Park is planned to be expanded. A pipeline will be installed through the park to an abandoned potable water tank (Tank 114). The extension of this line will serve customers on the south side of the park (such as Roosevelt Golf Course). The potable tank will be demolished and a 1.0 MG tank would be constructed along with a new pump station to support the new demand.

LAGWRP Storage Tank WRP

As part of the LAGWRP Storage Tank WRP, a 1.25 MG storage tank will be constructed to provide additional storage and surge protection in the Greenbelt distribution system. This project also includes upsizing the line on Forest Lawn Road from 16-inch to 30-inch. This project includes constructing a new 5 MG recycled water storage tank neat LAGWRP.

LA Zoo WRP

Approximately 3,200 feet of 12-inch pipe from the Greenbelt recycled water system will be necessary to deliver recycled water to the LA Zoo for exterior irrigation.

North Atwater and Chevy Chase Park WRP

This project includes a pipe to tee off of the City of Glendale's recycled water line east out of the LAGWRP on Goodwin Avenue to run south on Brunswick Avenue, then east and west on Chevy Chase Park to serve North Atwater and Chevy Chase Park.

4.3 Summary

The Metro Service Area existing and planned systems are summarized in **Table 19**. As noted in the table, the existing and planned recycled water demands total approximately 4,800 AFY for this service area.

Table 19: Summary of Existing and Planned Metro Systems

Phase	No. of Customers	Estimated Annual Demand	No. of Pump Stations	No. of Storage Tanks	Miles of Pipeline
Existing	14	2,428	1	1	11.4
Planned	27	2,372	3	4	9.6
Total	**41**	**4,800**	**4**	**5**	**21.0**

Recycled water customers presented by customer type are shown in **Table 20.** The peak day demand for the Metro Service Area is 9.33 mgd.

Table 20: Summary of Customer Types and Demands – Metro System

Customer Type	Average Annual Demand (AFY)	Peaking Factor	Peak Day Demand (mgd)
Irrigation	4,674	2.2	9.18
Industrial	126	1.3	0.15
Mixed Use	--	--	--
Total	**4,800**		**9.33**

5. Valley Service Area System

The existing and planned system serving the San Fernando Valley (Valley) Service Area is supplied with recycled water from the Donald C. Tillman Water Reclamation Plant (DCTWRP). DCTWRP is located in the San Fernando Valley on a 91-acre site within the Sepulveda Flood Control Basin in Van Nuys. The existing and planned system is shown in **Figure 5**.

In service since 1985, DCTWRP has a capacity of 80 mgd. DCTWRP provides preliminary, primary, secondary, and tertiary treatment with disinfection. The secondary treatment system was recently upgraded for nitrification denitrification (NdN) in 2007 and tertiary filters were upgraded in 2010. While chlorinated recycled water supplies are used to serve LADWP non-potable irrigation customers, dechlorinated recycled water from DCTWRP is used for in-plant processes and environmental reuse. Excess treated flow from DCTWRP that is not reused is discharged into the Los Angeles River after dechlorination, which in itself provides environmental benefits.

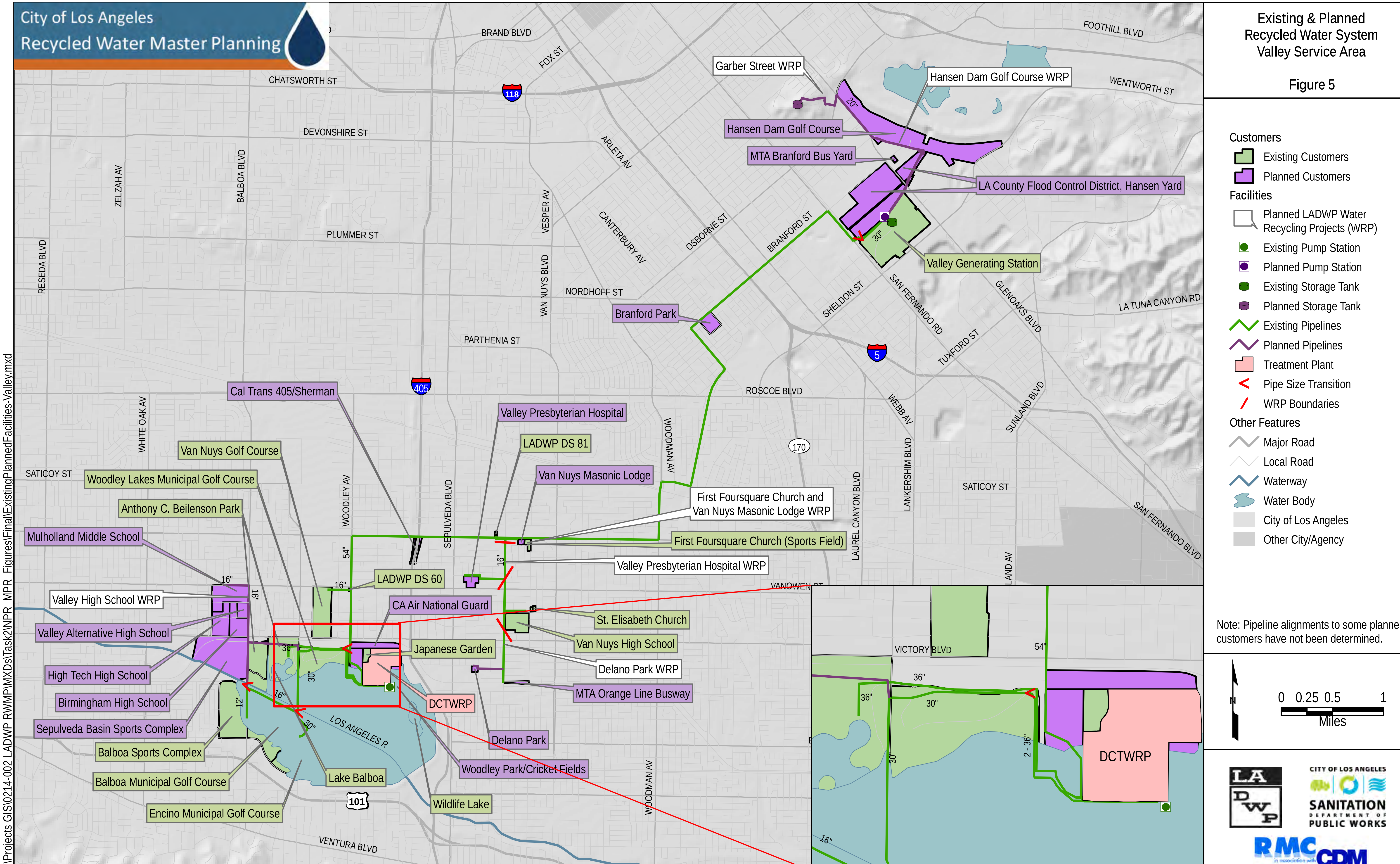
5.1 Existing System

5.1.1 Existing Customers

Information about the current recycled water uses (e.g. customers and demands) within the Valley Service Area is summarized in the following sections. LADWP customers are first described and then environmental reuse.

LADWP Recycled Water Customers

DCTWRP currently produces chlorinated recycled water to existing LADWP non-potable customers for industrial and irrigation uses. Recycled water is diverted to LADWP distribution facilities from the DCTWRP effluent stream prior to dechlorination of the remaining recycled water. **Table 21** provides a summary of the existing demands for the Valley Service Area, including type of use, timing of use, and estimated annual average demands.



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Data Sources: USGS, LADWP

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Table 21: Existing LADWP Recycled Water Customers – Valley System

Name	Type of Use [a]	Time of Use [b]	Estimated Annual Demand (AFY)	Service Date (Year)	Notes
First Foursquare Church and Van Nuys Masonic Lodge WRP					
First Foursquare Church (Sports Field)	L	N	11	2010	
LADWP Distribution System 81	L	N	1	2010	
Van Nuys Golf Course WRP					
Van Nuys Golf Course (LAWA)	L	N	150	2010	
LADWP Distribution System 60	L	N	1	2010	
Van Nuys Area WRP					
Van Nuys High School	L	N	30	2010	
St. Elisabeth Church	L	N	5	2010	
Hansen Area WRP					
Valley Generating Station	C/I	A	2,100	2008	c
Sepulveda Basin WRP					
Woodley Lakes Municipal Golf Course	L	N	470	2007	
Anthony C. Beilenson Park	L	N	370	2010	
Balboa Municipal Golf Course	L	N	350	2008	
Encino Municipal Golf Course	L	N	350	2008	
Balboa Sports Complex	L	N	150	2009	
Total			**3,988**		

Notes:

a. Landscape irrigation, only (L); Commercial/Industrial (C/I)
b. Night (N); Day (D); Anytime (A)
c. Valley Generating Station utilizes an onsite storage tank, Hansen Tank (see Section 5.1.2). Extra tank capacity is used for DCTWRP recycled water system storage.

Valley Generating Station

Current power generating facilities at Valley Generating Station (VGS) include Unit 5, a simple cycle 50 megawatt (MW) gas turbine and Unit 6, a combined cycle 550 MW power plant comprising two gas turbines feeding a single steam generator.

Currently, potable water is utilized for inlet air chilling on Unit 5 and demineralized potable water is used for boiler makeup water for the steam turbine.

Unit 6 currently uses recycled water for cooling towers for the unit's steam generator. Unit 6 operates nearly continuously with one gas turbine operating at night and two gas turbines operating during the day. Power output follows demand on the grid. Recycled water deliveries to VGS began in June 2008. Makeup water for the Unit 6 steam generator is continuous, with a recycled water demand of approximately 120 AFY. VGS has an onsite recycled water storage facility, Hansen Tank.

Woodley Lakes Municipal Golf Course

Woodley Lakes Municipal Golf Course is an 18-hole regulation length golf course located west of the DCTWRP in the Sepulveda Dam Recreation Area. The golf course is operated by the City of Los Angeles Department of Recreation and Parks (RAP) and has been receiving recycled water system since November 2007. Approximately 470 AFY of recycled water is currently used for irrigation and potable water is used for pond filling.

Balboa Municipal Golf Course

Balboa Municipal Golf Course is an 18-hole golf course located west of DCTWRP in the Sepulveda Dam Recreation Area. The golf course is operated by RAP and has been connected to recycled water system since August 2008. Approximately 350 AFY of recycled water is currently used for irrigation.

Encino Municipal Golf Course

Encino Municipal Golf Course is an 18-hole golf course located west of the DCTWRP in the Sepulveda Dam Recreation Area. The golf course is operated by RAP and has been connected to the recycled water system since August 2008. Approximately 350 AFY of recycled water is currently used for irrigation.

Balboa Sports Complex

Balboa Sports Complex is located west of Balboa Municipal Golf Course and consists of a baseball diamond, football field, soccer field and other recreational activities. The complex is operated by RAP and was connected to the recycled water system in 2009. Approximately 150 AFY of recycled water is currently used for irrigation.

Environmental Reuse

Disinfected tertiary effluent that is not diverted for LADWP non-potable use, is dechlorinated for in-plant uses and environmental reuse. This flow is accessed from the South Gate Collection Channel.

Table 22 summarizes environmental reuse of dechlorinated recycled water from DCTWRP. The type of use, timing of use, estimated and metered annual average demands are summarized in the table below.

Table 22: Existing DCTWRP Environmental Reuse

Name	Type of Use [a]	Time of Use [b]	Estimated Annual Demand (AFY) [c]	Service Date (Year)
Lake Balboa	Env	A	22,400	1990
Wildlife Lake	Env	A		1991
Japanese Garden	L, Env	A	4,590	1984
Total			**26,990**	

Notes:

a. Landscape irrigation, only (L); Environmental Reuse (Env)
b. Night (N); Day (D); Anytime (A)

Lake Balboa

Lake Balboa is a popular 80-acre water recreation facility located in Anthony C. Beilenson Park, a planned customer (formerly Balboa Park), within the Sepulveda Flood Control Basin. Lake Balboa and the park are operated by RAP. Recycled water from DCTWRP maintains water levels in the lake.

Delivery to the lake is continuous throughout the day. Flow to the lake is controlled by the combined capacity of the two constant speed lake supply pumps. Overflow from the Lake Balboa is discharged into the LA River.

Wildlife Lake

Wildlife Lake is located in the Sepulveda Basin Wildlife Reserve within the Sepulveda Flood Control Basin. The reserve and lake are operated by RAP and recycled water from DCTWRP maintains the water level in the lake.

Average annual recycled water delivery to Wildlife Lake based on monthly flow data from 2005 to 2008 was approximately 7,700 AFY and monthly deliveries ranged from 590 AF to 702 AF per month. Delivery to the lake is continuous throughout the day. Flow to the lake is controlled by an effluent weir at DCTWRP. Overflow from the Wildlife Lake is discharged into the LA River.

Japanese Garden

The Japanese Garden is a 6.5-acre garden located at the DCTWRP site. The garden is open to the public for viewing and serves as an educational center for water recycling. City staff members maintain the garden and the Mayor of Los Angeles appoints members of the Japanese Garden Mayor's Citizens Advisory Committee to oversee all major decisions related to use, maintenance and future plans. Recycled water is used for landscape irrigation and to maintain water levels in the 2.75-acre Japanese Garden Lake.

A pipeline branching off of the lake supply line provides water for decorative fountains and a water curtain. Flow to the lake is controlled by the rate of the constant speed supply pump (DCTWRP Pump 6) and flow to the irrigation system is controlled by a programmable sprinkler system. Overflow from the Japanese Garden Lake is discharged into the LA River.

5.1.2 Existing Facilities

This section summarizes the existing recycled water facilities in place to serve the existing customers described in Section 4.1.1. Existing facilities are presented under two categories: LADWP and Environmental Reuse (Lake Balboa, Wildlife Lake and Japanese Garden).

Existing LADWP recycled water facilities include pump stations (**Table 23**) and storage (**Table 24**). The Existing System comprises over 14 miles of pipeline, as summarized in **Table 25**.

Table 23: Major Existing Recycled Water Pump Station Facilities – Valley System

Name	Location	Type	Pump Capacity & Power	Year Constructed
Balboa Pump Station	DCTWRP	Vertical Turbine	#1 – 7,600 gpm; 1,000 HP #2 – 7,600 gpm; 1,000 HP #3 – 7,600 gpm; 1,000 HP	2001

Table 24: Major Existing Recycled Water Storage Facilities – Valley System

Name	Location	Volume	Type	Year Constructed
Hansen Tank	Valley Generating Station	7 MG	Above Ground	2007

Table 25: Major Existing Recycled Water Pipelines Facilities – Valley System

LADWP Water Recycling Projects	Diameter (in)	Length (mi)	Major Roads	Year Constructed
East Valley WRP Trunk Line	54 30	9.6 0.3	Woodley Ave, Sherman Way, Woodman Ave, San Fernando Rd	2001
Sepulveda Basin WRP Phase III Pipeline	36	1.2	Woodley Ave, N Balboa Blvd (park service road south of Victory Blvd)	1994
Sepulveda Basin WRP Phase II Pipeline	12 16	0.3 0.6	Along Los Angeles River, Balboa Blvd	1994
Sepulveda Basin WRP Phase I Pipeline	36 30	0.6 1.4	Woodley Ave, N Balboa Blvd (park service road south of Victory Blvd), Hayvenhurst Channel	1992
Delano WRP	16	0.6	Kester Ave, Delano St	2011
First Foursquare Church and Van Nuys Masonic Lodge WRP	16	0.4	Sherman Way and Kester Ave	2011
Valley Presbyterian Hospital WRP	16	0.9	Kester Ave, Hartland St	2011
Van Nuys Golf Course WRP	16	1.0	Vanowen St	2011
Van Nuys High School WRP	16	0.8	Kester Ave, Kittridge St	2011

Sources: As-built drawings and GIS provided by DWP.

LADWP Facilities

The following section presents descriptions of existing LADWP recycled water facilities.

East Valley Water Recycling Project

In 1990, LADWP began development of the East Valley Water Recycling Project (EVWRP). The EVWRP was designed to ultimately provide up to 35,000 AFY of tertiary treated recycled water from DCTWRP for groundwater recharge at the Hansen and Pacoima Spreading Grounds and for industrial and irrigation uses along the pipeline route. However, due to public acceptability issues at the time, the use of DCTWRP effluent for groundwater recharge via the EVWRP was suspended.

The EVWRP facilities include the Balboa Pump Station located at the DCTWRP site and the existing 54-inch EVWRP trunk line. Currently, Balboa Pump Station and the trunk line are the backbone of LADWP's distribution system to deliver recycled water throughout the San Fernando Valley for irrigation, commercial, and industrial use. The EVWRP also included a discharge structure and flow control facilities at Hansen Spreading Grounds for groundwater recharge, which are currently not in use.

Balboa Pump Station, as shown in **Figure 6**, consists of three, 1000-hp vertical turbine pumps operating on variable frequency drives. The influent to the pump station flows over a control weir and through concrete channel branching off the DCTWRP effluent channel prior to dechlorination. The pumps are mounted on top of the channel. Other facilities onsite include an electrical building, flow meter vault and a 1000-gallon surge tank.

Figure 6: Balboa Pump Station

Photo by RMC, 2009

Each pump has an 18-inch discharge that increases to 24-inch then connects to a common 54-inch header. A 30-inch pipeline splits off of the 54-inch piping onsite and connects to Sepulveda Basin Phase III Pipeline. The 54-inch line continues and becomes the EVWRP trunk line. Construction of the pump station was completed in 2001.

The 54-inch EVWRP trunk line is approximately 10.2 miles (54,100 LF) of pressure class 200 ductile iron trunk pipeline starting at the Balboa Pump Station. Construction was completed in 2001. The pipeline originally terminated at a discharge structure at Hansen Spreading Grounds, which is not currently in use. It now connects to the Hansen Area WRP– Phase I Pipeline.

Hansen Area Water Recycling Project - Phase I

The Hansen Area WRP – Phase I extends from the EVWRP trunk line 1,840 feet of 36-inch pipeline north to a new recycled water storage tank (Hansen Tank), and new service water pump station to deliver water to VGS. Construction of the project was completed in 2007.

The Hansen tank is a 7 million gallon, above ground, concrete recycled water storage tank located on the Los Angeles County Flood Control District site at Hansen Spreading Grounds. Construction of the project was completed in 2007. The Hansen Tank includes a potable water makeup system for use during outages of the DCTWRP supply.

Sepulveda Basin Phase I Pipeline

The Sepulveda Basin Phase I Pipeline was the first phase of pipeline to serve demands in the Sepulveda Basin Recreation Area. The pipeline is 2,960 and 7,620 feet of 36-inch and 30-inch diameter, respectively, and begins at DCTWRP's Dechlorination Building, branching off of the 54-inch discharge line just upstream of the Balboa Pump Station effluent flow meter vault. At Hayvenhurst Channel, the pipeline splits into a 36" pipeline, which continues west to supply Lake Balboa, and into a 30" pipeline which heads south on Hayvenhurst Channel and crosses the LA River. Currently, Sepulveda Basin Phase I Pipeline only serves dechlorinated recycled water from DCTWRP's Dechlorination Building to Lake Balboa. Once the Sepulveda Basin Phase III Pipeline was built, chlorinated recycled water from Balboa Pump Station is distributed into the 30" Phase I Pipeline which heads south on Hayvenhurst Channel, crosses the Los Angeles River and serves Woodley Golf Course, Balboa Municipal Golf Course and Encino Golf Course.

Sepulveda Basin Phase II Pipeline

The Sepulveda Basin Phase II Pipeline was the second phase of pipeline installed to serve demands in the Sepulveda Basin Recreation Area. The pipeline is 3,080 and 1,630 feet of 16-inch and 12-inch diameter, respectively, and is connected to the 30-inch Sepulveda Basin Phase I Pipeline just south of the LA River crossing, heads westerly parallel to the river to serve Balboa Sports Complex.

Sepulveda Basin Phase III Pipeline

The Sepulveda Basin Phase III Pipeline was the third phase of pipeline installed to serve demands in the Sepulveda Basin Recreation Area. The pipeline is 6,305 feet of 36-inch diameter and begins at the Balboa Pump Station. The pipeline runs south and parallel to the Sepulveda Basin Phase I Pipeline (west on the Park Service Road, north on Woodley Ave, west on a park service road) to Hayvenhurst Channel. On Hayvenhurst Channel, the 36" Phase III Pipeline ties into the 30" Phase I Pipeline and supplies chlorinated recycled water to Woodley Golf Course, Balboa Municipal Golf Course and Encino Golf Course. A butterfly valve was installed at this connection to block the dechlorinated and chlorinated recycled water from mixing.

Van Nuys Golf Course WRP

This project consists of 1,200 feet of 16-inch diameter pipeline to deliver recycled water to Van Nuys Golf Course for irrigation purposes. The pipeline is connected to the existing EVWRP trunk line at the intersection of Vanowen St. and Woodley Ave. The project completed construction in 2011.

Valley Presbyterian Hospital WRP

This project consists of 2,500 feet of 16-inch diameter and 2,400 feet of 8-inch diameter pipeline to deliver recycled water to Valley Presbyterian Hospital for cooling tower and evaporative coolers. The pipeline connects to the existing EVWRP trunk line at the intersection of Sherman Way and Kester Ave. The project completed construction in 2011.

Delano Park WRP

This project consists of 5,350 feet of 16-inch diameter pipeline to deliver recycled water to Delano Park and MTA Orange Line Busway off of EVWRP. The project completed most of its construction (0.3 miles of 0.9 miles) in 2011.

First Foursquare Church and Van Nuys Masonic Lodge WRP

This project consists of 1,500 feet of 16-inch diameter pipeline to deliver recycled water to First Foursquare Church sports field and LADWP Distribution System 81. The project completed construction in 2011.

Environmental Reuse Facilities

Japanese Garden

The system delivering recycled water to Japanese Garden consists of one pump with a capacity of 6,000 gpm. The pump delivers water through a pipeline to the Japanese Garden waterfall, which is the main entry for supply to the lake. A pipeline splits off of the lake supply line to provide water to the irrigation system, decorative fountains and the water curtain.

Lake Balboa

The system delivering recycled water to Lake Balboa consists of two pumps with a capacity of 10 mgd (6,950 gpm) each drawing from the South Effluent Collection Channel and a pipeline to the lake. A manual valve must be adjusted during the diurnal low flow period to ensure sufficient water remains in the wet well.

Wildlife Lake

Wildlife Lake is served by a 24-inch gravity line originating in the South Effluent Collection Channel. Flow to Wildlife Lake is controlled by an effluent weir; therefore rate of flow is dependent on depth of water in the channel.

5.2 Planned System

The planned system will supply an additional 1,984 AFY recycled water from DCTWRP to potential irrigation and industrial customers along the existing recycled water systems as well as expand the recycled water system. A description of these customers and their associated demands is provided below.

5.2.1 Planned Customers

Planned customers, described below and summarized in **Table 26,** are generally located near existing recycled water facilities, either in the Sepulveda Basin Recreation Area or surrounding areas, or are in close proximity to the EVWRP trunk pipeline.

Table 26: Planned Recycled Water Customers – Valley System

Name	Type of Use[a]	Time of Use[b]	Average Annual Demand (AFY)
Delano WRP			
MTA Orange Line Busway	L	N	32
Delano Park	L	N	10
First Foursquare Church of Van Nuys and Van Nuys Masonic Lodge WRP			
Van Nuys Masonic Lodge	L	N	1
Hansen Dam Golf Course WRP			
Hansen Dam Golf Course	L	N	490
LA Co. Flood Control District, Hansen Yard	C/I	D	30
MTA Branford Bus Yard	C/I	D	12
Valley High School WRP			
Valley Alternative High School	L	N	200
Mulholland Middle School	L	N	128
Sepulveda Basin Sports Complex	L	N	100
Birmingham High School	L	N	100
High Tech High School	L	N	0
Valley Presbyterian Hospital WRP			
Valley Presbyterian Hospital	M	N	44
Sepulveda Basin WRP			
Woodley Park/Cricket Fields	L	N	160
Miscellaneous			
Branford Park	L	N	35
CalTrans 405/Sherman	L	N	10
CA Air National Guard	L	N	7
Total			**1,359**

Notes:
a. Landscape irrigation, only (L); Commercial/Industrial (C/I); Mixed Use (M)
b. Night (N); Day (D); Anytime (A)

Schools

Several planned customers are public schools, operated by Los Angeles Unified School District (LAUSD).

Recreation and Parks

Several planned customers are operated by RAP. LADWP and RAP have successfully connected several existing customers and ongoing cooperation between the two will provide for significant additional use of recycled water. LADWP has worked with RAP in the past to develop a list of facilities to be converted.

LADWP Facilities

Several planned customers are facilities operated by LADWP. LADWP has a commitment to utilize recycled water at its facilities to the extent possible. Internal coordination with various divisions within LADWP is ongoing and will facilitate connection of these facilities.

Other Public Agencies

Other public agencies that operate planned customer facilities are State (Caltrans and National Guard) and County (Metropolitan Transit Authority) operated. LADWP has an existing agreement with Caltrans for recycled water use.

Privately Owned Facilities

Privately owned facilities can consist of a wide range of facilities, from heavy irrigation customers such as golf courses to hospitals to industry. Planned includes Valley Presbyterian Hospital and Van Nuys Masonic Lodge.

5.2.2 Planned Facilities

This section describes planned facilities in the Valley Service Area. Planned encompasses the several recycled water pipeline projects in the Valley Service Area, including over 2 miles of pipeline, summarized in **Table 27**. Planned storage facility is summarized in **Table 28** and the planned pump station is summarized in **Table 29**.

Table 27: Major Planned Recycled Water Pipelines – Valley System

LADWP Water Recycling Project	Diameter (in)	Length (mi)	Major Roads
Garber Street WRP	20	1.6	Garber Street
Hansen Dam Golf Course WRP	20	0.9	Tujunga Wash, Glenoaks Blvd
Valley High School WRP	16	1.9	Balboa Blvd
Delano WRP	16	0.3	Delano St

Table 28: Major Planned Recycled Water Storage Facilities – Valley System

Name	Location	Volume	Type
Garber Street Tank	Top of hill - adjacent to Garber St. & Whiteman Airport	1.0 MG	Steel

Table 29: Major Planned Recycled Water Pump Stations – Valley System

Name	Location	Volume	Type
Hansen Dam Golf Course Pump Station	VGS	TBD	TBD

The following is a summary of planned facilities planned to be constructed to serve planned customers.

Hansen Dam Golf Course WRP

This project consists of 4,750 feet of 20-inch diameter from the Valley Generating Station to Hansen Dam Golf Course.

Garber Street WRP

The Garber Street Pipeline expands on Hansen Dam Golf Course WRP and consists of 8,430 LF of 20-inch diameter from Hansen Dam Golf Course to a new storage tank on a hill adjacent to Garber Street and Whiteman Airport. The steel storage tank will have a volume of 1.0 MG.

Valley High School WRP

This project consists of 2 miles of 16-inch diameter to deliver recycled water to Birmingham High School, High Tech High School, Valley Alternative High School, Mulholland Middle School and Sepulveda Basin Sports Complex for irrigation purposes. The pipelines will connect to the existing Sepulveda Basin Phase II and III Pipelines 30-inch and 16-inch diameter pipeline, respectively.

5.3 Summary

The Valley Service Area existing and planned systems are summarized in **Table 30**. As noted in the table, the existing and planned recycled water demands total 5,354 AFY for this service area.

Table 30: Summary of Existing and Planned Valley Systems

Phase	No. of Customers	Estimated Annual Demand	No. of Pump Stations	No. of Storage Tanks	Miles of Pipeline
Existing	12	3,988	1	1	17.7
Planned	16	1,359	1	1	4.7
Total	**28**	**5,347**	**2**	**2**	**22.4**

Recycled water customers presented by customer type are shown in **Table 31.** The peak day demand for the Valley Service Area is 8.77 mgd.

Table 31: Summary of Service Area Customer Types and Demands – Valley System

Customer Type	Average Annual Demand (AFY)	Peak Day	
		Peaking Factor	Demand (mgd)
Irrigation	3,161	2.2	6.21
Industrial	2,142	1.3	2.49
Mixed Use	44	1.7	0.07
Total	**5,347**		**8.76**

6. Westside Recycled Water System

The Existing System in Westside Service Area is supplied with tertiary-treated recycled water by West Basin Municipal Water District (WBMWD). WBMWD receives secondary-treated water from the Hyperion Treatment Plant (HTP), which is located southwest of Los Angeles International Airport (LAX), and further treats this water to Title 22 standards. WBMWD's Edward C. Little Water Recycling Plant (WBWRP) located in the City of El Segundo, just south of LAX. The WBWRP started operations in 1992 and has an existing production capacity of 40 mgd for Title 22 non-potable water.

Recycled water is then sold back to the City for distribution to LADWP non-potable customers. Operating since 1894, HTP is the oldest and largest of the City's wastewater treatment plants and was upgraded to full secondary treatment in 1999. The current capacity of HTP is 450 mgd, with an average wastewater flow of 350 mgd.

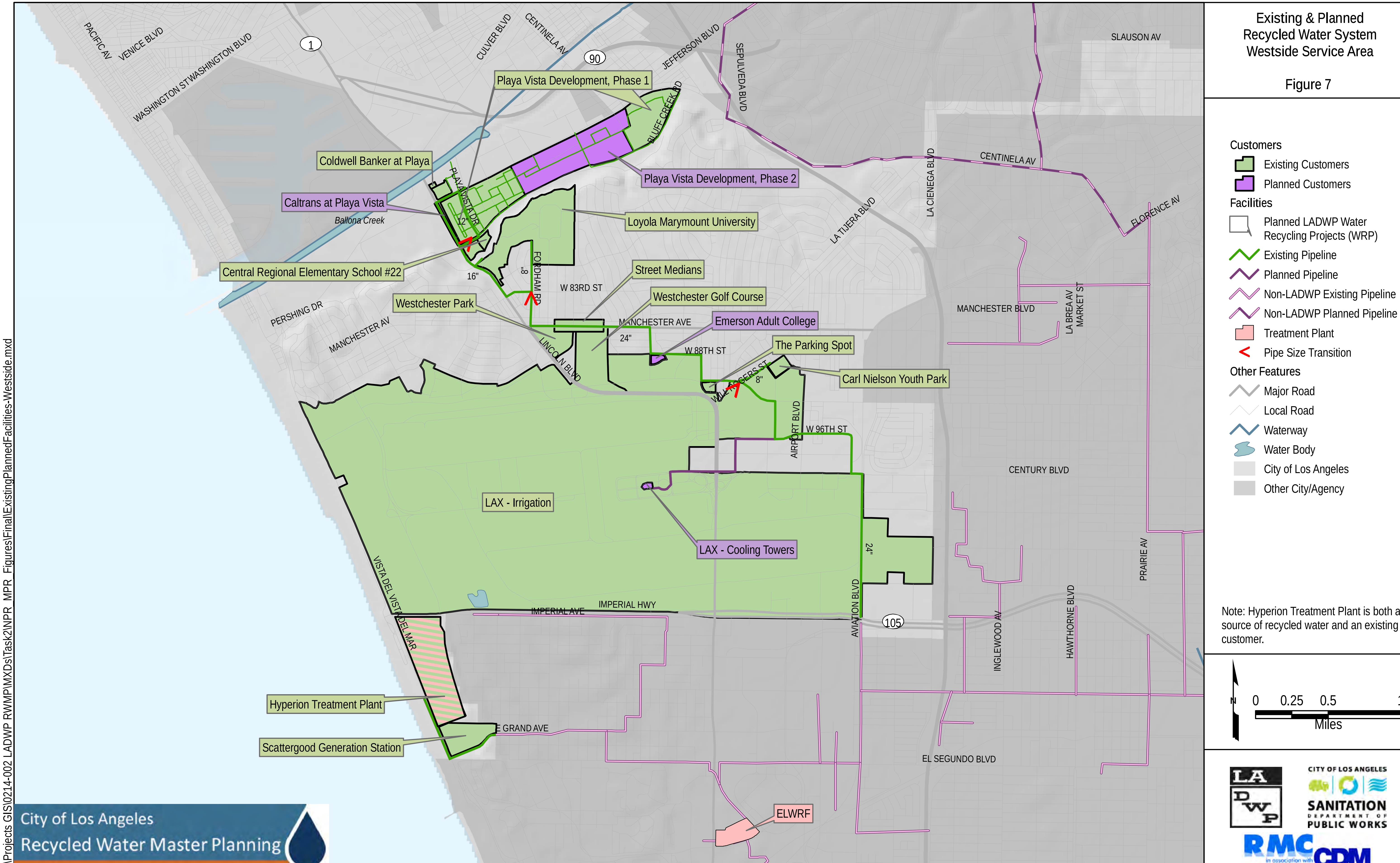
LADWP and WBMWD have an existing agreement in which WBMWD purchases secondary-treated effluent from HTP and LADWP has the right to purchase up to 25,000 AFY of recycled water. In 2008, over 37,300 AF was purchased by WBMWD and approximately 380 AF was sold back LADWP to serve non-potable customers that are part of the Westside Water Recycling Project (Westside WRP).

The Westside WRP was initiated in 1996 and comprises the existing recycled water system in the Westside Service Area. The existing system customers and facilities are defined in Section 5.1. LADWP plans to expand service off of the existing system to provide recycled water to customers, including increased deliveries to two existing customers. This planned system is detailed in Section 5.2. Existing Westside WRP customers and facilities are shown in **Figure 7** and discussed in the following sections.

6.1 Existing System

6.1.1 Existing Customers

Currently, LADWP serves nine customers with recycled water in the Westside Service Area as part of the Westside WRP. Large customers include Playa Vista Development (Playa Vista, Phase 1), LAX, Loyola Marymount University (LMU), and HTP. Information about these customers and their associated demands is provided below. **Table 32** provides a summary of the existing demands for the Westside Service Area, including type of use, timing of use, and estimated annual average demands.



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Data Sources: RMC, USGS, LADWP

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Table 32: Existing Recycled Water Customers – Westside System

Name	Type of Use [a]	Time of Use [b]	Estimated Annual Demand (AFY)	Service Date (Year)
Westside WRP				
Westchester Golf Course	L	N	250	2009
Playa Vista Development, Phase 1[c]	L	N	189	2009
	DP	A	11	2009
Los Angeles International Airport (LAX)	L	A	160	1996
Loyla Marymount University (LMU)	L	N	125	1996
Hyperion Treatment Plant (HTP)	L	A	64	1996
	DP	A	1	1996
Westchester Park	L	N	30	1996
Central Regional Elementary School #22	L	N	25	2011
Carl Nielsen Youth Park	L	N	15	1996
Scattergood Generating Station	L	N	5	2003
Street Medians	L	N	5	2008
Coldwell Banker at Playa	L	N	3	2009
The Parking Spot	L	N	1	2003
Total			**884**	

Notes:

a. Landscape irrigation, only (L), Dual Plumbing (DP)
b. Night (N); Day (D); Anytime (A)
c. See Attachment 1 for all Playa Vista Development, Phase I customers.

Playa Vista Development, Phase 1

Playa Vista is a multiphase planned commercial and residential development. Recycled water service to Playa Vista Development Phase 1 began in February 2009 for all landscaping. Recycled water use was required as part of mitigation commitments from their environmental review process. Additionally, recycled water is used for toilet flushing in commercial buildings. The projected annual average recycled water demand is approximately 200 AFY. All of Playa Vista's Development, Phase I customers are listed in **Attachment 1**.

Playa Vista plans to double the size of the property and increase recycled water use as part of the Phase 2 development. These new recycled water uses are described in Section 5.2. No additional phases have been identified.

Los Angeles International Airport

LAX is located north of the City of El Segundo and has been connected to the recycled water system since 1996. Recycled water is currently used for irrigation of landscaping along the boundary of the property.

LADWP's estimated average annual demand for the airport is 160 AFY. There are additional opportunities for expanding recycled water use at LAX, including LAX cooling towers, which is included in Section 5.2.

Hyperion Treatment Plant

HTP is provided recycled water via a 20-inch line from the WBWRP separated from the Westside WRP for landscape irrigation and for toilet flushing in the new administration building. HTP has been connected to the recycled water system since 1996 and estimated average annual demand is 65 AFY.

HTP has experienced water quality issues that probably result from stagnant water from an oversized pipe. Currently, HTP filters and disinfects the recycled on-site prior to its on-site use. The existing pipeline to HTP was sized to provide Scattergood Generating Station with a much larger volume of water (discussed below).

Loyola Marymount University

LMU is a private university located in Westchester and has been connected to the recycled water system since 1996. LMU approximately uses 125 AFY of recycled water for landscape irrigation for a portion of the campus.

Westchester Park

Westchester Park has been using an estimated 30 AFY of recycled water for irrigation purposes since 1996.

Westchester Golf Course

Westchester Golf Course is a 15-hole executive golf course located next to LAX. The course is owned by LAX and operated by American Golf. LADWP estimates recycled water demand to be 250 AFY. It will be served by a 24-inch pipeline from Manchester Ave. Recycled water deliveries began in November 2009.

Scattergood Generating Station

Scattergood Generating Station is an LADWP power generating station located in the City of El Segundo just north of HTP. Scattergood Generating Station has been connected to the recycled water system since December 2003 to meet on-site landscape irrigation demands of 5 AFY.

Scattergood Generating Station is provided recycled water via the same 20-inch line from the WBWRP that supplies HTP. Similar to HTP, Scattergood Generating Station has experienced water quality issues that probably result from stagnant water. The existing pipeline to HTP was sized to provide Scattergood Generating Station with a much larger volume of water for use as cooling water.

Other Customers

Carl Nielsen Youth Park, The Parking Spot, and street medians on Manchester Ave currently use recycled water for landscape irrigation. Located in Westchester, north of LAX, these customers in total use an estimated 21 AFY.

6.1.2 Existing Facilities

The existing LADWP recycled water facilities are comprised primarily of pipelines that are supplied from the WBMWD distribution system. The existing system comprises of over seven miles of pipeline, as summarized in **Table 33.** No LADWP pump stations are necessary since delivery pressure is provided by the connection with WBMWD. Also, no storage is necessary because the existing system has more than sufficient conveyance capacity in existing pipes and available supplies far exceed demands throughout the day and night.

Table 33: Major Existing Recycled Water Pipelines – Westside System

Pipe Segment	Diameter (in)	Length (mi)	Major Roads	Year Constructed
Westside WRP				
LADWP / WBMWD Connection to LMU	24	4.4	Aviation Blvd, Manchester Ave	1996
Carl Nielsen Youth Park Lateral	8	0.3	Will Rodgers St	1996
HTP Pipeline	20	0.8	Grand Ave	1996
LMU Lateral	8	0.3	Fordham Dr	1996
LMU to Playa Vista	16	1.3	Sepulveda Blvd	2008
Playa Vista Development	Up to 12	7.9	Bluff Creek Road	2008

6.2 Planned System

The planned system will consist of connecting new customers in the vicinity of the existing Westside WRP pipelines. The system will supply additional recycled water for industrial and irrigation uses in the Westside Service Area, shown in Figure 7.

6.2.1 Planned Customers

LADWP plans to expand recycled water service by adding five new customers plus expanding use at LAX and Playa Vista as summarized in **Table 34.** Large customers, described in additional detail below, include Westchester Golf Course, LAX cooling towers, and Playa Vista Phase 2.

Table 34: Planned Recycled Water Customers – Westside System

Name	Type of Use [a]	Time of Use [b]	Average Annual Demand (afy)
CalTrans at Playa Vista	L	N	5
Emerson Adult College	L	N	20
LAX – Cooling Towers	C/I	A	350
Playa Vista Development, Phase 2			
Bluff Creek – Dawn Creed	L	N	54
Millennium Dr – Mc Connell	L	N	54
Millennium Dr – Village	M	A	17
Millennium Dr – Westlawn	L	N	54
Bluff Creek – Westlawn	L	N	54
Total			**608**

Notes:

a. Landscape irrigation, only (L); Commercial/Industrial (C/I); Mixed Use (M); Dual Plumbing (DP)
b. Night (N); Day (D); Anytime (A)

Los Angeles International Airport

LAX currently uses recycled water for landscape irrigation and plans to start using recycled water for their cooling towers. LADWP estimates recycled water demand to be 350 AFY; however, the estimate is still preliminary. The industrial applications allows for water to be used throughout the day.

Playa Vista Development, Phase 2

Phase 2 of the Playa Vista development includes commercial and office buildings as well as residential development. Phase 2 is expected to come online in 2016 and use an estimated 200 AFY for irrigation and dual plumbing.

6.2.2 Planned Facilities

The planned system will build upon the Westside WRP existing system. The only identified planned pipeline is to serve LAX cooling towers, which is summarized in **Table 35.** There is no pump station or storage.

Table 35: Major Planned Recycled Water Pipelines – Westside System

LADWP Recycled Water Project	Diameter (in)	Length (mi)	Major Roads
LAX Cooling Towers	12	1.2	Century Blvd
Westchester Golf Course	24	0.0	Manchester Ave

6.3 Summary

The Westside Service Area existing and planned systems are summarized in **Table 36**. As noted in the table, the existing and planned recycled water demands total 1,492 AFY for this service area.

Table 36: Summary of Existing and Planned Westside Systems

Phase	No. of Customers	Estimated Annual Demand	No. of Pump Stations	No. of Storage Tanks	Miles of Pipeline
Existing	103	884	--	--	15.0
Planned	8	608	--	--	1.2
Total	**111**	**1,492**	**--**	**--**	**16.2**

Recycled water customers presented by customer type are shown in **Table 37**. The peak day demand for the Westside Service Area is 2.63 mgd.

Table 37: Summary of Customer Types and Demands – Westside System

Customer Type	Average Annual Demand (AFY)	Peak Day	
		Peaking Factor	Demand (mgd)
Irrigation	1,113	2.2	2.19
Industrial	350	1.3	0.41
Mixed Use	17	1.7	0.03
Dual Plumbing	12	1.0	0.01
Total	**1,492**		**2.63**

7. Summary

Existing and planned systems facilities are summarized in **Table 38**. There are 131 existing customers are served with a cumulative average annual demand of 10,300 AFY. A total average annual demand of 24,150 AFY of recycled water will be served in the City once the 63 planned customers are online.

Table 38: Summary of Existing and Planned Systems Facilities

Phase	No. of Customers	Estimated Annual Demand	No. of Pump Stations	No. of Storage Tanks	Miles of Pipe
Existing	131	10,300	3	2	55.8
Planned	63	13,850	5	6	18.8
Total	**193**[a]	**24,150**	**8**	**8**	**74.6**

Note:
a. Harbor Generating Station is an existing and a planned customer and therefore it is counted once.

Existing and planned demands broken down by customer type are shown in **Table 39**. The largest share of the demands will be served to commercial/industrial customers. Landscape irrigation (golf courses, parks, and landscaping) is the second largest type of demand.

Table 39: Summary of Existing and Planned Customers by Type

Customer Type	Existing		Planned		Total	
	# of Customers	Demand (AFY)	# of Customers	Demand (AFY)	# of Customers	Demand (AFY)
Irrigation	124	5,190	48	4,220	172	9,410
Industrial	1	2,100	13	9,570	14	11,670
Mixed Use	--	--	2	60	2	60
Barrier	1	3,000	--	--	1	3,000
Dual Plumbing	6	10	--	--	6	10
Total, Ultimate	**131**[a]	**10,300**	**63**	**13,850**	**193**[a,b]	**24,150**
Total, Projected		**8,000**[c]		**11,350**[d]		**19,350**

Notes:
a. HTP has both irrigation and dual-plumbed uses so it is counted once in the total.
b. Harbor Generating Station is both an existing irrigation and planned industrial customer so it is counted once in the total.
c. Recent recycled water sales totaled 8,000 AFY but the ultimate demand estimate for existing customers is 10,300 AFY based on expected sales once all existing customer maximize available supplies.
d. Assumes all planned customers may not reach their ultimate demand or ultimately connect as customers.

Existing and planned customer demands are summarized by service area in **Table 40**. The WBMWD System has the largest planned demand, mainly because of the four refineries in the area. The Metro and Valley service areas both will serve around 5,000 AFY after all the planned customers are connected, and the Westside will serve just over 1,400 AFY.

Table 40: Summary of Existing and Planned Customers by Service Area

	Existing		Planned		Total	
Service Area	# of Customers	Demand (AFY)	# of Customers	Demand (AFY)	# of Customers	Demand (AFY)
Harbor – TIWRP System	2	3,000	4	210	6	3,210
Harbor – WBMWD System	--	--	8	9,300	8	9,300
Metro	14	2,430	27	2,370	41	
Valley	12	3,990	16	1,360	18	5,350
Westside	103	880	8	610	111	1,490
Total, Ultimate	**131**	**10,300**	**63**	**13,850**	**193**[a]	**24,150**
Total, Projected		**8,000**[b]		**11,350**[c]		**19,350**

Note:

a. Harbor Generating Station is an existing and a planned customer and therefore it is counted once under Existing Customer.

b. Recent recycled water sales totaled 8,000 AFY but the ultimate demand estimate for existing customers is 10,300 AFY based on expected sales once all existing customer maximize available supplies.

c. Assumes all planned customers may not reach their ultimate demand or ultimately connect as customers.

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Attachment 1

Table 1: Existing Playa Vista Phase 1 Customer:

Meter Number	Customer Name	Address	Customer Type	Demand Estimate (AFY)
90071619	Avalon Maintenance Corp	13075 Pacific Prom, 9002	Irrigation	0.83
90020676	Bridgeway Mills HOA	5300 1/2 Playa Vista Dr	Irrigation	1.26
90020692	Bridgeway Mills HOA	5350 1/2 Playa Vista Dr	Irrigation	1.06
90071632	Bridgeway Mills HOA	5300 Playa Vista Dr	Irrigation	2.18
96152843	CAL TRANS	5456 Lincoln Bl	Irrigation	0.00
90183225	Campus At Playa	12434 Bluff Creek Dr	Irrigation	0.00
90185783	Campus At Playa	12066 Bluff Creek Dr	Irrigation	0.00
90201903	Campus At Playa (2 meters)	11861 Bluff Creek Dr	Irrigation	5.33
90201924	Campus At Playa (2 meters)	--	--	--
90185780	Campus At Playa Parcel 8	12402 Bluff Creek Dr	Irrigation	0.00
90185787	Campus At Playa Parcel 9 (2 meters)	5859 Campus Center Dr	Irrigation	0.00
90185789	Campus At Playa Parcel 9 (2 meters)	--	--	--
90185786	Campus At Playa Parcel 10 (2 meters)	12485 Bluff Creek Dr	irrigation	0.00
90185781	Campus At Playa Parcel 10 (2 meters)	--	--	--
96120909	Campus at Playa Vista Corporation	11862 Bluff Creek Drive	Irrigation	0.04
90086272	Capri Court HOA	13042 Villosa Pl	Irrigation	0.51
90155277	Capri Court II Corp	12921 Runway Rd	Irrigation	1.27
90131791	Carabella Community	12975 Agustin Pl, 9001	Irrigation	6.18
90061451	Catalina Maintenance Corporation	12963 Runway Rd, 9001-101	Irrigation	2.56
90131572	Chatelaine	5721 Crescent Pk W	Irrigation	0.48
90071591	City LA Bureau Public Buildings	6400 Playa Vista Dr, 9001	Irrigation	1.18
96100538	City LA Bureau Public Buildings	5451 Playa Vista Dr, 9001	Irrigation	0.09
96152844	COLDWELL BANKER	5450 Lincoln Bl	Irrigation	1.76
90071618	Crescent Park East	5710 Crescent Pk E, 9001-201	Irrigation	6.74
90071598	Crescent Walk At Playa	6100 Crescent Pk E	Irrigation	1.31
90125802	Crescent Walk At Playa	6200 Crescent Pk E	Irrigation	0.70
90171338	Cronado Maintenance Corporation	7100 Playa Vista Dr	Irrigation	1.54
90015265	Dreamworks Interactive	5570 Lincoln Bl, 9005	Irrigation	2.62
90030978	Dreamworks Interactive	5511 EA Wy	Dual Plumbing	6.43
90030984	Dreamworks Interactive	13197 Fountain Park Dr, 9001	Dual Plumbing	1.46
90030878	Essex Property Trust Inc. (2 meters)	13191 Fountain Park Dr, 9002	Irrigation	6.81
90030879	Essex Property Trust Inc. (2 meters)	--	--	--
96100514	Finvest Playa LLC Building	7225 Crescent Pk W	Irrigation	4.25
96101346	Finvest Playa LLC Building	6565 Crescent Pk W	Irrigation	1.15
96100571	ICON Community Assoc	13078 Discovery Crk	Irrigation	1.03
96100572	ICON Community Assoc	13076 Discovery Crk	Irrigation	1.41
96156111	Lincoln ASB Playa Vista (2 meters)	12180 Millennium, 9002	Irrigation	0.00
96156115	Lincoln ASB Playa Vista (2 meters)	--	--	--
96156112	Lincoln ASB Playa Vista (2 meters)	12180 Millennium, 9003	Irrigation	4.29
96156116	Lincoln ASB Playa Vista (2 meters)	--	--	--
90015762	OFF	5452 Playa Vista Dr	Irrigation	0.00
96116635	Playa Capital Company LLC	12980 Discovery Crk,9001	Irrigation	5.76

Meter Number	Customer Name	Address	Customer Type	Demand Estimate (AFY)
90091867	Paraiso	13173 Pacific Prom, 9002	Irrigation	1.68
90129724	PH & L Community	13020 Pacific Prom, 102	Irrigation	0.80
90132653	PH & L Community	13020 Pacific Prom, 103	Irrigation	1.62
90054966	Playa Capital Company LLC	12980 Discovery Crk	Irrigation	0.18
90086247	Playa Capital Company LLC	6003 Crescent Pk E	Irrigation	0.00
90169177	Playa Capital Company LLC	12981 Discovery Crk	Irrigation	0.00
90185788	Playa Capital Company LLC	12552 Bluff Creek Dr	Irrigation	0.49
90201919	Playa Capital Company LLC	5805 Campus Center Dr	Irrigation	4.24
90243641	Playa Capital Company LLC	6775 Crescent Pk W	Irrigation	3.05
96100554	Playa Phase 1	11882 Bluff Creek Dr	Irrigation	9.34
90023644	Playa Vista Parks	13061 Villosa Pl	Irrigation	1.64
90030876	Playa Vista Parks	13157 W Jefferson Bl	Irrigation	0.12
90030902	Playa Vista Parks	13160 Fountain Park Dr	Irrigation	6.21
90030985	Playa Vista Parks	13197 Fountain Park Dr,9001	Irrigation	2.97
90071054	Playa Vista Parks	5997 Crescent Pk W	Irrigation	0.56
90086246	Playa Vista Parks	6010 Playa Vista Dr	Irrigation	3.46
90086253	Playa Vista Parks	6000 Playa Vista Dr	Irrigation	3.23
90086254	Playa Vista Parks	5871 Crescent Pk E	Irrigation	2.79
90086255	Playa Vista Parks	6100 Seabluff Dr	Irrigation	3.93
90086256	Playa Vista Parks	5622 Seawalk Dr	Irrigation	1.18
90086257	Playa Vista Parks	5622 Seawalk Dr	Irrigation	2.08
90086258	Playa Vista Parks	5747 Crescent Pk E	Irrigation	3.59
90086259	Playa Vista Parks	13063 Villosa Pl	Irrigation	2.90
90086260	Playa Vista Parks	6033 Playa Vista Dr	Irrigation	2.08
90086273	Playa Vista Parks	5950 Para Wy	Irrigation	4.04
90103968	Playa Vista Parks	13044 Pacific Prom	Irrigation	2.10
90123700	Playa Vista Parks	6011 Dawn Creek	Irrigation	6.55
90123899	Playa Vista Parks	12947 Agustin Pl	Irrigation	0.95
90140903	Playa Vista Parks	12993 Bluff Creek Dr	Irrigation	3.95
90155308	Playa Vista Parks	12950 Bluff Creek Dr	Irrigation	2.39
90155309	Playa Vista Parks	12950 Bluff Creek Dr	Irrigation	--
90169520	Playa Vista Parks	6201 Playa Vista Dr	Irrigation	0.00
90186312	Playa Vista Parks	13212 Bluff Creek Dr	Irrigation	--
95011614	Playa Vista Parks	6660 Crescent Pk W	Irrigation	4.87
95011615	Playa Vista Parks	13151 Bluff Creek Dr	Irrigation	4.29
96100520	Playa Vista Parks	12951 Bluff Creek Dr	Irrigation	0.82
96110753	Playa Vista Parks	6335 Crescent Pk W	Irrigation	1.06
96156070	Playa Vista Parks (2 meters)	13212 Bluff Creek Dr	Irrigation	7.66
90186317	Playa Vista Parks (2 meters)	--	--	--
90129724	Promenade at Playa	13044 Pacific Prom, 9002	Irrigation	1.83
96118166	PV Campus Parcel 3 (2 meters)	12000 Waterfront Drive	Irrigation	0.00
96118167	PV Campus Parcel 3 (2 meters)	--	--	--
96152275	PV Campus Parcel 3 (2 meters)	12015 Waterfront Drive	Dual Plumbing	0.83
96152276	PV Campus Parcel 3 (2 meters)	--	--	--
96120910	PV Campus Parcel 3 LP	12045 Waterfront Drive, 9001	Irrigation	7.74
96118152	PV Campus Parcel 3 LP (2 meters)	12045 Waterfront Drive, 9001	Dual Plumbing	1.62

Meter Number	Customer Name	Address	Customer Type	Demand Estimate (AFY)
96118153	PV Campus Parcel 3 LP (2 meters)	--	--	--
90141956	Serenade Community Association	13031 1/2 Villosa Pl	Irrigation	1.93
90171871	Standard Pacific Homes	6241 Crescent Pk W, 9002	Irrigation	1.70
90030981	Sunrise Playa Vista Senior	5506 EA Wy	Dual Plumbing	1.02
90169176	Tapestry II Maintenance Corporation	6011 Dawn Creek	Irrigation	2.05
90071579	Tapestry Maintenance Corporation	5701 Kiyot Wy	Irrigation	1.31
90169521	Tempo Community Association	6020 Seabluff Dr, 9001	Irrigation	1.54
90051179	The Espalade Association	13079 Discovery Crk	Irrigation	1.61
96101285	The Lee Group Inc.	12907 1/2 Bluff Creek Dr	Irrigation	1.23
90061435	The Metro Condo Association	5625 Crescent Pk W, 9001	Irrigation	2.62
90091878	Villa D'Este Corporation	13215 Pacific Prom, 9002	Irrigation	1.31
96101665	Villa Savona Maintenance Corporation	7101 Playa Vista Dr, 9002	Irrigation	0.94
96100521	Warmington PV 325 Assoc LLC	13045 Pacific Prom	Irrigation	1.61
90134134	Waterstone Condo Association	6400 Crescent Pk E	Irrigation	1.29
96130371	William J. Hoffman--Receiver	12402 Bluff Creek Dr	Irrigation	0.80
90173230	William J. Hoffman--Receiver	12065 Bluff Creek Dr	Irrigation	0.00
			Total	**200.00**

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Appendix B

Non-Potable Reuse Regulatory and Practices TM

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Technical Memorandum

Title: **Non-Potable Reuse Regulatory and Practices TM**
Date: March 2012

Table of Contents

1. Introduction

The purpose of this Technical Memorandum (TM) is to define existing recycled water regulatory and policy conditions and identify items to consider during development of projects for the Non Potable Reuse (NPR) Master Plan. Any recommendations for modifications to existing rules and regulations will be addressed at a later time in the project.

This TM consists of the following sections:

- **Section 1 – Introduction:** This section describes the project background and purpose of the TM.
- **Section 2 – Overview of Recycled Water Regulations:** This section provides a summary of the major recycled water regulations applicable to the NPR Master Plan.
- **Section 3 – Recycled Water Policies:** This section provides an overview of specific policies applicable to the City of Los Angeles' (City) recycled water projects.
- **Section 4 – Items to Consider for NPR Master Plan:** This section identifies topics for further considerations based upon information provided in the previous sections.

2. Overview of Recycled Water Regulations

This section provides a summary of the major recycled water regulations applicable to the NPR Master Plan, including:

- Title 22 and Title 17 regulations
- Waste Discharge Requirements (WDR)/Water Reclamation Requirements (WRR)
- California Department of Public Health (CDPH) and LA County Department of Public Health (DPH) requirements
- Basin Plan/Water Quality Requirements
- State Water Resources Control Board (SWRCB) Recycled Water Policy
- SWRCB General Landscape Irrigation Permit
- Los Angeles Regional Water Quality Control Board (LA RWQCB) Non-Irrigation Reuse Order

2.1 Title 22 and Title 17 Overview for Non-Potable Reuse

2.1.1 Title 22 Overview

The CDPH establishes criteria and guidelines for producing and using recycled water. These criteria are codified in the California Code of Regulations (CCR), Title 22, Division 4, Chapter 3 entitled "Water Recycling Criteria". Commonly referred to as Title 22 Criteria, the treatment and effluent quality requirements are dependent upon the proposed type of NPR. In addition to these requirements, Title 22 specifies reliability criteria to ensure protection of public health.

The SWRCB and its nine Regional Water Quality Control Boards are responsible for enforcing these criteria. The City of Los Angeles recycled water facilities are under the jurisdiction of Regional Board No. 4, the Los Angeles RWQCB.

According to Title 22, treatment and effluent quality requirements are dependent upon the proposed type of water reuse. In addition to these requirements, Title 22 specifies reliability criteria to ensure protection of public health.

Treatment, Water Quality and Reliability

In general, Title 22 requires that wastewater be treated using designated processes to achieve a specified level of quality. Higher quality effluents, such as disinfected tertiary recycled water or disinfected advanced treated recycled water, may be utilized for more types of reuse with fewer restrictions. Lesser quality effluents, such as disinfected secondary effluent or undisinfected secondary effluent, have restricted uses. One of the main factors determining use restrictions is the degree to which the public has exposure or access to areas where recycled water is used and the proximity of drinking water wells and food crops. Because Donald C Tillman Water Reclamation Plant (DCTWRP) and Los Angeles-Glendale Water Reclamation Plant (LAGWRP) recycled water receives disinfected tertiary treatment and Terminal Island Water Reclamation Plant (TIWRP) receives advanced treatment, it may be used for many types of NPR. These higher levels of treatment and quality are described in this subsection.

Title 22 requires that wastewater be oxidized, which means that its organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen. Secondary treatment is necessary to produce oxidized and stabilized wastewater.

Moving beyond secondary treatment is tertiary treatment involving coagulation and media filtration or membrane filtration is required to meet Title 22 turbidity criteria measured in nephlometric turbidity units (NTU) for many types of reuse.

Title 22 (Section 60301.320) defines filtered wastewater as "an oxidized wastewater that meets the criteria in subsection (a) or (b):

- (a) Has been coagulated and passed through natural undisturbed soils or a bed of filter media pursuant to the following:
  - (1) At a rate that does not exceed 5 gallons per minute per square foot of surface area in mono, dual or mixed media gravity, upflow or pressure filtration systems, or does not exceed 2 gallons per minute per square foot of surface area in traveling bridge automatic backwash filters [a rate that does not exceed 6 gallons per minute per square foot of surface area for cloth disc filters has been approved]; and
  - (2) So that the turbidity of the filtered wastewater does not exceed any of the following:
    - (A) An average of 2 NTU within a 24-hour period;
    - (B) 5 NTU more than 5 percent of the time within a 24-hour period; and
    - (C) 10 NTU at any time.

(b) Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:
   (1) 0.2 NTU more than 5 percent of the time within a 24-hour period; and
   (2) 0.5 NTU at any time."

Following tertiary treatment, disinfection ensures that the recycled water is safe for NPR with unrestricted public contact.

According to Title 22 (Section 60301.230), "disinfected, tertiary recycled water means a filtered and subsequently disinfected wastewater that meets the following criteria:

(a) The filtered wastewater has been disinfected by either:
   (1) A chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or
   (2) A disinfection process that, when combined with the filtration process, has been demonstrate to inactivate and/or remove 99.999 percent of the plaque-forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.

(b) The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN [most probable number] of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters."

Where ultraviolet light (UV) is used for disinfection, the UV system must comply with the "Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse" published by the National Water Research Institute (NWRI, 2003). For recycled water, these Guidelines specify minimum UV dose criteria for different upstream filtration technologies (media filtration, membrane filtration, and RO). The UV system must deliver, under worst operating conditions, a designated minimum UV dose at the maximum weekly flow and at the peak daily flow, as approved by CDPH for specific manufacturers and models of UV equipment.

Title 22 (Section 60320.5) specifies that other methods of treatment and their associated reliability features may be acceptable to CDPH if they are demonstrated as equivalent to the treatment methods and reliability features set forth in Title 22.

In addition to treatment and quality requirements, Title 22 contains reliability requirements and provisions for alarms to be included in the design of facilities. Title 22 (Articles 9 and 10) specify that the facilities must be designed to provide operational flexibility. Multiple treatment units capable of producing the required quality must be provided in the event that one unit is not in operation. In lieu of multiple units, alternative treatment processes, storage or disposal provisions may be provided for redundancy. Alarms are required to alert plant operators of power supply failure or failure of any treatment plant unit processes. In the event of a power supply failure, Title 22 requires the plant to provide either a standby power source or automatically actuated short-term or long-term storage or disposal provisions.

Recycled water quality sampling and analyses requirements are set forth in Title 22 (Article 6) to monitor treatment performance for compliance with total coliform bacteria limits and turbidity. The regulations also include requirements for operations personnel (Section 60325), maintenance (Section 60326), and reporting (Section 60329). Bypassing of treatment processes and/or discharge of inadequately treated effluent is not allowed (Section 60331).

In order to assure that recycled water facilities comply with the regulations, Title 22 (Section 60323) requires that an engineering report describing the proposed recycled water system and the means for the system complying with listed requirements be prepared and submitted to the RWQCB and CDPH for approval. The engineering report must be amended or resubmitted in the event that there are significant modifications to an existing project.

Uses of Recycled Water

Title 22 (Article 3) provides for many types of recycled water use. **Table 1** summarizes the currently approved recycled water uses.

Table 1: Summary of Existing Allowable Recycled Water Uses

Allowable Title 22 Recycled Water Uses	Title 22 Section
Irrigation	
Food crops where recycled water contacts the edible portion of the crop, including all root crops	60304 (a) (1)
Parks and playgrounds	60304 (a) (2)
School yards	60304 (a) (3)
Residential landscaping	60304 (a) (4)
Unrestricted-access golf courses	60304 (a) (5)
Any other irrigation uses not prohibited by other provisions of the California Code of Regulations	60304 (a) (6)
Food crops, surface-irrigated, above-ground edible portion, and not contacted by recycled water	60304 (b)
Cemeteries	60304 (c) (1)
Freeway landscaping	60304 (c) (2)
Restricted-access golf course	60304 (c) (3)
Ornamental nursery stock and sod farms with unrestricted public access	60304 (c) (4)
Pasture for milk animals for human consumption	60304 (c) (5)
Non-edible vegetation with access control to prevent use as park, playground or school yard	60304 (c) (6)
Orchards with no contact between edible portion and recycled water	60304 (d) (1)
Vineyards with no contact between edible portion and recycled water	60304 (d) (2)
Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest	60304 (d) (3)

Allowable Title 22 Recycled Water Uses	Title 22 Section
Fodder and fiber crops and pasture for animals not producing milk for human consumption	60304 (d) (4)
Seed crops not eaten by humans	60304 (d) (5)
Food crops undergoing commercial pathogen-destroying processing before consumption by humans	60304 (d) (6)
Ornamental nursery stock and sod farms not irrigated less than 14 days before harvest, sale, or allowing public access	60304 (d) (7)
Supply for impoundment	
Non-restricted recreational impoundments	60305 (a)
Non-restricted recreational impoundments, with supplemental monitoring for pathogenic organisms in lieu of conventional treatment	60305 (b)
Restricted recreational impoundments and publicly accessible fish hatcheries	60305 (d)
Landscape impoundments without decorative fountains	60305 (e)
Supply for cooling or air conditioning	
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	60306 (a)
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	60306 (b)
Other Uses	
Dual plumbing systems (flushing toilets and urinals)	60307 (a) (1)
Priming drain traps	60307 (a) (2)
Industrial process water that may contact workers	60307 (a) (3)
Structural fire fighting	60307 (a) (4)
Decorative fountains	60307 (a) (5)
Commercial laundries	60307 (a) (6)
Consolidation of backfill material around potable water pipelines	60307 (a) (7)
Artificial snow making for commercial outdoor uses	60307 (a) (8)
Commercial car washes, not heating the water, excluding the general public from washing process	60307 (a) (9)
Industrial boiler feed	60307 (b) (1)
Nonstructural fire fighting	60307 (b) (2)
Backfill consolidation around non-potable piping	60307 (b) (3)
Soil compaction	60307 (b) (4)
Mixing concrete	60307 (b) (5)
Dust control on road and streets	60307 (b) (6)
Cleaning roads, sidewalks and outdoor work areas	60307 (b) (7)
Industrial process water that will not come into contact with workers	60307 (b) (8)
Flushing sanitary sewer	60307 (c)
Groundwater recharge	60320 (a)

As noted in this table, irrigation with recycled water is a common application. Depending on the level of treatment and quality, recycled water may be used to irrigate numerous different areas (Section 60304). For example, disinfected tertiary recycled water may be used to irrigate parks and school yards; whereas disinfected secondary effluent may be used to irrigate cemeteries and freeway landscaping, and undisinfected secondary effluent may be used to irrigate non-food-bearing trees and orchards where the recycled water does not come into contact with the edible crop. Disinfected tertiary water may be used in lieu of the lesser quality recycled waters for irrigation.

Disinfected tertiary effluent may be used for non-restricted recreational impoundments (Section 60305). Disinfected secondary or tertiary effluent may be used for restricted recreational impoundments and publically accessible impoundments at fish hatcheries.

Specifically, Title 22 (Section 60301.620) defines a non-restricted recreational impoundment as "an impoundment of recycled water, in which no limitations are imposed on body-contact water recreational activities". With regard to use of recycled water for impoundments, Title 22 (Section 60305 states:

"(a) Except as provided in subsection (b), recycled water used as a source of water supply for non-restricted recreational impoundments shall be disinfected tertiary recycled water that has subjected to conventional treatment.

(b) Disinfected tertiary recycled water that has not received conventional treatment may be used for non-restricted recreational impoundments provided the recycled water is monitored for the presence of pathogenic organisms in accordance with the following:

(1) During the first 12 months of operation and use the recycled water shall be sampled and analyzed monthly for *Giardia*, enteric viruses, and *Cryptosporidium*. Following the first 12 months of use, the recycled water shall be sampled and analyzed quarterly for *Giardia*, enteric viruses, and *Cryptosporidium*. The ongoing monitoring may be discontinued after the first two years of operation with the approval of the [CDPH]. This monitoring shall be in addition to the monitoring set forth in Section 60321.

(2) The samples shall be taken at a point following disinfection and prior to the point where the recycled water enters the use impoundment. The samples shall be analyzed by an approved laboratory and the results submitted quarterly to the regulatory agency.

(c) The total coliform bacteria concentrations in recycled water used for non-restricted recreational impoundments, measured at a point between the disinfection process and the point of entry to the use impoundment, shall comply with the criteria specified in Section 60301.230 (b) for disinfected tertiary recycled water.

(d) Recycled water used as a source of supply for landscape impoundments that do not utilize decorative fountains shall be at least disinfected secondary-23 recycled water."

Title 22 (Section 60306) allows disinfected tertiary recycled water to be used for cooling purposes where mist may be created. If the application does not produce mist, then at least disinfected secondary effluent must be used.

Title 22 (Section 60307) includes provisions for many other types of reuse, as listed in Table 1. Disinfected tertiary effluent may be used for any of these NPR.

Title 22 (Section 60320) covers recycled water use for groundwater recharge of domestic water supply aquifers. Title 22 specifies that CDPH make recommendations to the RWQCB for groundwater recharge projects on a case-by-case basis. CDPH have published Draft Groundwater Recharge Criteria for indirect potable reuse. A separate *Regulatory Assessment TM* addresses groundwater recharge and is included as an appendix in the Groundwater Replenishment Master Planning Report.

Use Area Requirements

Under Title 22, a use area is an area of recycled water use with defined boundaries, which may contain one or more facilities where recycled water is used.

Title 22 (Section 60310) sets forth detailed use area requirements for irrigation in the vicinity of domestic water supply wells and strict limits on runoff, spray, and protection of drinking water fountains and food handling/eating areas, residences. Any connection between the recycled water and potable water systems, except as allowed under Title 17, are prohibited. Quick couplers that differ from hose bibs must be used in the recycled water piping system. Signs need to be posted to notify the public that recycled water is used at the site.

Specific requirements are contained in Title 22 (Article 5) for dual plumbed recycled water systems. Separate reports and tests are required for dual plumbed systems to demonstrate proper design, operation, and confirmation that cross-connections are not present.

Potential Recycled Water Uses Beyond Title 22

LADWP recently submitted a list of proposed additional recycled water uses to CDPH for approval. Summarized in **Table 2**, these potential new uses are similar to those already covered under Title 22.

Table 2: Summary of Potential Recycled Water Uses Beyond Title 22

Proposed New Recycled Water Uses	Similar Title 22 Section
Commercial Washing / Equipment Washing	
Washing airplanes/trains/fleets	60307 (a) (9)
Pressurized equipment washing	60307 (a) (9)
Window washing/other washing	60307 (a) (9)
Washdown of ships that are dry-docked	60307 (a) (9)
Commercial Uses	
Coin-operated laundries	60307 (a) (6)
Grinding for street resurfacing	60307 (b) (7)
Industrial	
Ice chillers	60306 (b)

2.1.2 Title 17 Overview

Title 17, Division 1, Chapter 5 "Sanitation (Environmental)", Group 4 "Drinking Water Supplies", of the CCR (California, 2009), specifies that the water supplier must protect the public drinking water supply from contamination by implementation of a cross-connection control program. Title 17 (Group 4, Article 2) sets forth requirements for protection of the water system and specifies the minimum backflow prevention required on the potable water system for situations where there is potential for contamination to the potable water supply. For recycled water, construction and location of backflow preventers is addressed in Title 17 as follows:

- An air-gap separation shall be at least double the diameter of the supply pipe, measured vertically from the flood rim of the receiving vessel to the supply pipe. The air-gap separation shall be located as close as practical to the user's connection and all piping between the user's connection and the receiving tank shall be entirely visible unless otherwise approved in writing by the City and health agency (LA County DPH for this project).
- A double check valve assembly shall conform to American Water Works Association (AWWA) standards and shall be located as close as practical to the user's connection and shall be installed above grade, if possible, in a manner where it is readily accessible for testing and maintenance.
- A reduced pressure principle backflow prevention device shall conform to AWWA standards and shall be located as close as practical to the user's connection and shall be installed a minimum of 12 inches above grade and not more than 36 inches above grade from the bottom of the device and with a minimum of 12 inches side clearance.

An air-gap separation is defined as a physical break between the supply line and a receiving vessel. A double check valve assembly is an assembly of at least two independently acting check valves including tightly closing shut-off valves on each side of the check valve assembly and test cocks available for testing the water tightness of each check valve. A reduced pressure principle backflow preventer is a backflow prevention device incorporating not less than two check valves, an automatically operated differential relief valve located between the two check valves, a tightly closing shut-off valve on each side of the check valve assembly, and equipped with necessary test cocks for testing.

In addition, the City has its own "Rules Governing Water and Electric Service in the City of Los Angeles" which include "Protection of Public Water Supply and Backflow Prevention Guidelines for Water Service Rule 16-D" (LADWP, 2006). Title 17 requires that each water purveyor develop and implement its own comprehensive backflow prevention program for protecting the public water supply from contamination or pollution. This Rule fulfills this requirement and specifies specific procedures to be followed within the City and supplement the Title 17 requirements. In certain places, for example, installation of a reduced pressure principal backflow prevention assembly may be allowed in place of an air gap if approved by LADWP. This Rule includes other similar measures to protect the City's potable water supply.

2.2 Existing Waste Discharge Requirements / Water Reclamation Requirements

The RWQCB issued separate WDR and WRR for two of the City's water reclamation plants:

- Donald C. Tillman Water Reclamation Plant (DCTWRP)
- Los Angeles/Glendale Water Reclamation Plant (LAGWRP)

The RWQCB issued WDR for the other two City's treatment plants:

- Terminal Island Water Reclamation Plant (TIWRP)
- Hyperion Treatment Plant (HTP)

It should be noted that the TIWRP also has a WRR and a master water recycling permit for the Harbor Water Recycling Project (HWRP) and the Dominguez Gap Barrier Project. The HTP has no WRR of its own.

For all of the above facilities, the WDR also serve as National Pollution Discharge Elimination System (NPDES) permits, which regulate discharges of treated wastewater to waters of the State of California and the United States.

Current recycled water regulations and permit requirements for each facility are described in the following sections.

2.2.1 DCTWRP

Owned and operated by the City's Department of Public Works, Bureau of Sanitation (BOS), DCTWRP is located in Van Nuys. DCTWRP consists of two identical tertiary treatment trains, each with a dry weather average design capacity of 40 million gallons per day (mgd), for a total capacity of 80 mgd. Currently, DCTWRP treats an average flow of approximately 58 mgd of municipal wastewater. Treatment processes consist of screening, grit removal, primary sedimentation, activated sludge nitrification-denitrification (NdN) biological treatment, secondary clarification, coagulation, dual media filtration, chlorination, and dechlorination (if needed or for river discharge). Solids are returned to the sewer for treatment downstream at HTP. DCTWRP operates under the WDR and WRR listed in **Table 3**.

Table 3: Donald C. Tillman Water Reclamation Plant WDR and WRR

RWQCB Order No.	Description	Date
R4-2006-0091	Reissuance of WDR that serves as a NPDES permit	December 14, 2006
R4-2007-0008	Stand alone WDR	January 11, 2007
R4-2007-0009	Stand alone WRR	January 11, 2007
R4-2008-0040	Amendment to WDR Order No. R4-2007-0008	July 10, 2008
R4-2011-0032	Amendment to WRR Order No. R4-2007-0009	February 3, 2011

DCTWRP Recycled Water Limitations

DCTWRP's WRR (RWQCB Order No. R4-2007-0009) allows use of recycled water for all irrigation, impoundments, industrial, and other uses permissible under Title 22 Water Recycling Criteria for disinfected tertiary effluent. Disinfected tertiary-treated effluent may also be used for NPR applications that require lesser levels of treatment. In-plant uses of recycled water at the DCTWRP site where access by the public is restricted are not limited to disinfected tertiary effluent, and may be plant water of lesser quality; however, typically, disinfected tertiary effluent is used on-site at the DCTWRP. Direct or indirect potable uses and planned groundwater recharge are not allowable under the current WRR for DCTWRP.

DCTWRP's WRR amendment (RWQCB Order No. R4-2011-0032), allows use of recycled water for dust control at permanent facilities. Permanent facilities would include, but not be limited to, horse ranches, open fields, and fairgrounds. In a letter dated August 10, 2010, California Department of Public Health finds that recycled water for dust control at permanent facilities is an appropriate and safe use, and recommends that the Regional Board approve such use.

DCTWRP Specifications for Use of Recycled Water

DCTWRP must comply with Title 22 for filtration and disinfection for production of recycled water, and the treatment facilities must provide sufficient redundancy in the form of standby treatment units or storage, to ensure that the level of treatment and quality of the recycled water are maintained at all times for the designated types of use.

Use of DCTWRP recycled water must comply with end-use requirements per Title 22 Water Recycling Criteria. In summary, DCTWRP recycled water may be used for irrigation, non-restricted recreational impoundments, cooling, and other types of NPR.

DCTWRP Use Area Requirements

In accordance with the WRR, the City is responsible for end use of recycled water, including processing use applications, inspecting point-of-use facilities and making sure that customers comply with recycled water use requirements. A use area is defined in the WRR as an area of recycled water use with defined boundaries, which may contain one or more facilities where recycled water is used.

DCTWRP's WRR specify that recycled water use comply with Title 22 Criteria. In general, irrigation or impoundments with disinfected tertiary effluent must be setback from domestic wells. Appropriate signage indicating the use of recycled water must be posted at the site. No connections between the recycled water and potable water systems are permissible. Use areas with public access must install quick couplers rather than hose bibs to differentiate between the recycled and potable water systems. Besides these State criteria, recycled water use must also comply with Los Angeles County Department of Public Health (LA County DPH) requirements. This local authority is responsible for site inspections and cross-connection prevention.

DCTWRP's WRR require that recycled water used at irrigation areas be applied at rates and volumes that do not exceed vegetative demand and soil moisture conditions to prevent clogging of spray nozzles, over-watering, and to minimize runoff and pipe leakage. Dwellings, outdoor food handling/eating areas, and drinking fountains must be protected from recycled water spray or runoff. Recycled water should not be used during wet weather conditions that would promote runoff. Sites should be irrigated during the night when parks and golf courses are not occupied.

Comparison of DCTWRP WRR with Title 22/17 Requirements

DCTWRP's WRR include the same water recycling requirements for disinfected tertiary effluent as those contained in the Title 22 Water Recycling Criteria and for cross-connection control in the Title 17 backflow prevention requirements. Allowable uses of recycled water produced at DCTWRP are in accordance with Title 22.

DCTWRP Title 22 Engineering Report

An original Title 22 Engineering Report was submitted in 1992 to CDPH for the San Fernando Valley Water Recycling Project. There was a revision in the WRR (RWQCB Order No. R4-2007-0009) which triggered a revised Title 22 Engineering Report to be submitted to CDPH. The report was submitted in draft form on January 2008. The final report was submitted to CDPH in April 2009.

2.2.2 LAGWRP

LAGWRP is jointly owned by the City of Los Angeles and City of Glendale. The City of Los Angeles operates LAGWRP, which treats wastewater from the cities of Glendale, Burbank, Los Angeles, La Canada-Flintridge, and from the Los Angeles Zoo. Although approximately half of the recycled water produced at LAGWRP is utilized within the boundaries of the City of Glendale, the City of Los Angeles is responsible for complying with all WDR/WRR permit requirements, including the Monitoring and Reporting Plan (MRP). LAGWRP is designed to handle an average dry weather flow of 20 mgd, and it currently treats about 20 mgd of municipal wastewater. Treatment processes consist of screening, primary sedimentation, activated sludge biological treatment, secondary sedimentation, filtration, chlorination, and dechlorination (if needed or for river discharge). Installation of NdN facilities was completed in 2007 for nitrogen removal. Solids are returned to the sewer for downstream treatment at the City's HTP. LAGWRP operates under the WDR and WRR listed in **Table 4**.

Table 4: Los Angeles/Glendale Water Reclamation Plant WDR and WRR

RWQCB Order No.	Description	Date
R4-2006-0092	Reissuance of WDR that serves as a NPDES permit	December 14, 2006
R4-2007-0006	Stand alone WDR	January 11, 2007
R4-2007-0007	Stand alone WRR	January 11, 2007
R4-2008-0040	Amendment to WDR Order No. R4-2007-0006	July 10, 2008
R4-2011-0035	Amendment to WDR Order No. R4-2007-0007	February 3, 2011

LAGWRP Recycled Water Limitations

Recycled water produced by LAGWRP may be used for all irrigation, impoundments, industrial, dust control at permanent facilities and other uses approved under Title 22 Water Recycling Criteria for disinfected tertiary effluent in accordance with RWQCB Order No. R4-2007-0007 and RWQCB Order No. R4-2011-0035. LAGWRP's WRR are essentially identical to those for DCTWRP. Where Title 22 allows the use of disinfected secondary effluent, disinfected tertiary effluent, which includes filtration that improves water quality, may be substituted. In-plant uses of recycled water where public access is restricted may use lesser-quality water; however, LAGWRP uses disinfected tertiary effluent for plant water. Direct or indirect potable uses and planned groundwater recharge are not allowable under the current LAGWRP WRR.

LAGWRP Specifications for Use of Recycled Water

Recycled water produced by LAGWRP may only be used for those applications specified in Title 22 Criteria in accordance with and RWQCB Order No. R4-2007-0007. LAGWRP permit requirements for recycled water are essentially the same as those for DCTWRP and are based on Title 22. LAGWRP must provide filtration and disinfection to reliably meet Title 22 water quality requirements for disinfected tertiary effluent at all times for the majority of the types of NPR that are served.

LAGWRP Use Area Requirements

Recycled water use areas are specific locations with defined boundaries where recycled water is used. A use area may contain one or more facilities where recycled water is used. In accordance with LAGWRP WRR, the City is responsible for end use of recycled water. The City processes applications, inspects point-of-use facilities, and ensures that customers comply with the WRR.

The WRR specify that LAGWRP's recycled water use comply with Title 22 Criteria. In general, domestic wells must be setback or protected from recycled water irrigation areas and impoundments. Appropriate signage indicating that recycled water is used at the site is required. Connections between the recycled water and potable water systems are prohibited. As for DCTWRP, LAGWRP's recycled water use areas are regulated by the LA County DPH with regard to site inspections and cross-connection prevention. Inspections ensure that the recycled water irrigation rates and volumes are appropriate for the vegetative demand and soil moisture conditions to prevent clogging of spray nozzles, over-watering, and to minimize runoff and pipe leakage. Recycled water spray, mist, or runoff should be kept away from dwellings, outdoor food handling/eating areas, and drinking fountains at the sites. During rainy periods, recycled water use should be reduced to control runoff. Sites should be irrigated during the night when parks and golf courses are not occupied.

Comparison of LAGWRP WRR with Title 22/17 Requirements

LAGWRP WRR include the same water recycling requirements for disinfected tertiary effluent as those contained in the Title 22 Water Recycling Criteria and for cross-connection control in the Title 17 backflow prevention requirements. Allowable uses of recycled water produced at LAGWRP are in accordance with Title 22.

LAGWRP Title 22 Engineering Report

There was a revision in the WRR (RWQCB Order No. R4-2007-0007) which triggered a revised Title 22 Engineering Report which had to be submitted to CDPH. The report was submitted in draft form on January 2008. The final report was submitted to CDPH in April 2009. The City of Glendale was a contributing agency for the report.

2.2.3 TIWRP

TIWRP supplies recycled water to the Harbor Water Recycling Project (HWRP). TIWRP is owned and operated by the BOS. LADWP owns the Advanced Wastewater Treatment Facility (AWTF), and BOS operates the AWTF.

Located about 20 miles south of downtown Los Angeles, TIWRP receives wastewater from Terminal Island, San Pedro, Wilmington, and portions of Harbor City. The majority of the wastewater (approximately 60%) treated at TIWRP is from industrial/commercial sources, and the remainder (approximately 40%) is from residential sources.

In service since 1935 and periodically upgraded and expanded, TIWRP has an existing average dry weather flow capacity of 30 mgd. TIWRP presently treats an average flow of about 16 mgd and is located in San Pedro. Treatment processes consist of screening, grit removal, primary sedimentation, activated sludge biological treatment, secondary clarification, tri-media filtration and advanced treatment. The AWTF processes have a rated production capacity of 5 mgd and include microfiltration and reverse osmosis (RO) followed by lime stabilization and sodium hypochlorite disinfection. Tertiary effluent flows above the capacity of the AWTF are discharged into Los Angeles Harbor. Brine wastes generated from the AWTF are also discharged to the Harbor. Solids are thickened, anaerobically digested, dewatered, and land-applied in Kern County.

Recycled water produced by TIWRP AWTF is high-quality advanced treated and disinfected effluent that is used primarily for the Dominguez Gap Barrier Project and for irrigation at the LADWP Harbor Generating Station. Approximately 2,500 AFY (2.2 mgd average) of RO-treated disinfected recycled water produced by TIWRP currently serves IPR and NPR uses. Any excess product water (above reuse demands) is returned to the outfall and discharged to the harbor.

TIWRP operates under the WDR and WRR listed in **Table 5**. TIWRP has two types of WRR: 1) RWQCB Order No. R4-2003-0025, a master water recycling permit for NPR for irrigation, industrial, and recreational uses and 2) RWQCB Order No. R4-2003-0134 for IPR injection at the Dominguez Gap Barrier Project.

Table 5: Terminal Island Water Reclamation Plant WDR and WRR ATWF

RWQCB Order No.	Description	Date
R4-2003-0025	WRR and master water recycling permit for the HWRP NPR [a]	January 30, 2003
R4-2003-0134	WRR for the HWRP and Dominguez Gap Barrier Project (IPR) [b]	October 2, 2003
R4-2005-0024	Reissuance of WDR that serves as a NPDES permit	April 7, 2005
R4-2008-0082	Amending WDR Order No. R4-2005-0024	August 25, 2008
R4-2011-0033	Amending WRR Order No. R4-2003-0025	February 3, 2011
R4-2011-0034	Amending WRR Order No. R4-2003-0134	February 3, 2011

Notes:

a. Permit holders are: LADWP and BOS.
b. Permit holders are: LADWP, BOS, LA County Department of Public Works (LACDPW) and Water Replenishment District of Southern California (WRD).

TIWRP Recycled Water Limitations

Under the two WRR, recycled water from TIWRP may be used for various irrigation and industrial uses, recreational impoundments, as well as for the Dominguez Gap Barrier Project. Of these types of reuse, the barrier project constitutes a planned groundwater recharge project, which is approved on a case-by-case basis under Title 22 Water Recycling Criteria as IPR. The other types of permitted recycled water uses are for NPR.

RWQCB Order No. R4-2003-0025 is a WRR and master water recycling permit that allows recycled water use for surface irrigation, industrial or commercial cooling towers, industrial boiler feed, and recreational impoundments. TIWRP's WRR amendment (RWQCB Order No. R4-2003-0025) allows the use of recycled water for dust control at permanent facilities and for street sweeping in the area covered by the HWRP. Designated surface irrigation may include food crops, including all edible root crops where the recycled water comes into contact with the edible portion of the crop, parks and playgrounds, school yards, residential and freeway landscaping, and unrestricted access golf courses. Other irrigation applications in accordance with Title 22 Criteria are also allowed, provided that approvals from CDPH and RWQCB Executive Officer are obtained prior to delivery. The WRR specifically state that the TIWRP recycled water may not be used for any other uses unless a Title 22 Engineering Report has been submitted for those specific uses. This master permit specified that RO-treated disinfected recycled water may be used for NPR and acknowledges that the quality of this recycled water is better than that required for the applications in the permit and under Title 22. It does, however, require approval of additional types of NPR uses which are not specifically included in the WRR.

RWQCB Order No. R4-2003-0134 is a WRR for the HWRP and specifically for the Dominguez Gap Barrier Project. These WRR name four agencies as permittees because each has a role in the Dominguez Gap Barrier Project. BOS owns and operates TIWRP. The LADWP owns the AWTF and BOS operates it. LADWP is the purveyor of the recycled water produced at the AWTF. The LACDPW owns, operates, and maintains the Dominguez Gap Barrier to prevent seawater intrusion into the West Coast Groundwater Basin. The WRD is responsible with replenishing and maintaining the groundwater quality of the Central and West Coast Groundwater Basins. Thus, all four agencies are involved in the WRR for the HWRP, which is supplied by TIWRP.

TIWRP's WRR amendment (RWQCB Order No. R4-2011-0034) removes the blending station requirement for the Dominguez Gap Barrier Project.

Both of the above permits require that TIWRP produce RO-treated and disinfected effluent for recycled water uses. Stringent effluent limits are set for the disinfected RO-treated recycled water, primarily because it is used for IPR purposes. More information about the IPR from TIWRP is contained in a separate TM. In addition to the Title 22 requirements, TIWRP AWTF effluent water quality must comply with the limits shown in **Table 6**.

Table 6: Summary of Key Recycled Water Quality Limits beyond Title 22 at TIWRP

Constituent	Daily Maximum
Oil and grease	15 mg/L (Monthly Average = 10 mg/L)
Total dissolved solids	800 mg/L
Chloride	250 mg/L
Sulfate	250 mg/L
Boron	1.5 mg/L
Total nitrogen	10 mg/L
pH	6 to 9 (Monthly Average = 6.5 to 8.5)
Primary Drinking Water MCLs and Action Levels	Drinking Water Standards
Radioactivity	Drinking Water Standards
Taste and Odor-Producing Substances	Not causing nuisance or adversely impacting groundwater
Organics	No measurable increase in the groundwater
Turbidity (NTU)	Per Title 22 for membrane filtration
Total Coliform	Per Title 22

TIWRP Specifications for Use of Recycled Water

According to the WRR/Master Water Recycling Permit (RWQCB Order No. R4-2003-0025 and RWQCB Order No. R4-2011-0033), the RO-treated disinfected recycled water produced by TIWRP may be used for irrigation, cooling, industrial boiler feed, recreational impoundments, street sweeping and dust control at permanent facilities. Surface irrigation uses listed in the permit include: food crops, parks, playgrounds, school yards, residential and freeway landscaping, unrestricted access golf courses, and other Title 22 irrigation applications with CDPH and RWQCB approval. The WRR/Master Water Recycling Permit specifically states that recycled water may not be used for any other purposes unless an engineering report has been submitted for that application and requirements for that use are prescribed by the RWQCB. Recycled water may not be used for direct human consumption or food/drink processing. Delivery of recycled water to end users requires the approval of CDPH or LA County DPH.

RWQCB Order No. R4-2004-0134 and RWQCB Order No. R4-2011-0034 specify requirements for use of recycled water only for the Dominguez Gap Barrier Project, which is a planned groundwater recharge project involving IPR. A separate TM describes IPR. TIWRP is the City's only plant currently permitted to use recycled water for groundwater recharge.

TIWRP Use Area Requirements

The WRR/Master Water Recycling Permit (RWQCB Order No. R4-2003-0025) defines a use area as an area of recycled water use with defined boundaries, which may contain one of more facilities where recycled water is used. The City is responsible for recycled water use, including processing use applications, inspecting point-of-use facilities and ensuring that customers comply with Title 22 and Title 17 requirements for use of recycled water.

The WRR/Master Water Recycling Permit specifies that all recycled water use comply with Title 22 Criteria. As a brief summary, irrigation or impoundments must be setback from domestic wells, no connections can be made between the recycled water and potable water systems. Title 22 signage indicating the use of recycled water at the site must be posted. For cooling water applications, mist drift eliminators and chlorination systems must be installed. As required for Title 22 irrigation applications, the rate and volume applied must be controlled to prevent over-watering and minimize runoff.

Comparison of TIWRP WRR with Title 22/17 Requirements

TIWRP's WRR/Master Water Recycling Permit (RWQCB Order No. R4-2003-0025) reference Title 22 and acknowledge that the RO-treated disinfected recycled water produced at TIWRP exceeds the quality required for the Title 22 applications included in that permit. TIWRP's WRR (RWQCB Order No. R4-2003-0134) for supplying recycled water to the Dominguez Gap Barrier specify stringent water quality limits for that planned groundwater recharge project for IRP. Both of TIWRP's WRR require compliance with Title 17 backflow prevention requirements for production and use of recycled water.

TIWRP Title 22 Engineering Report

LADWP, BOS, and WRD jointly prepared and submitted a Title 22 Engineering Report for the HWRP and Dominguez Gap Barrier Project for use of recycled water in May 1998. In May 2001, the CDPH approved the Title 22 Engineering Report and, following a public hearing, provided comments and recommendations to the RWQCB for incorporation into the WRR.

2.2.4 HTP

HTP, located in Playa Del Rey, is owned and operated by the BOS and serves the City and numerous other cities and agencies that contract with the City for services. HTP is the oldest and largest of the City's wastewater treatment plants and has been expanded and upgraded numerous times since beginning operation in 1925. Major upgrades to provide full secondary treatment were completed in 1999.

HTP's average dry weather design capacity is 450 mgd and existing average dry weather flows are approximately 300 mgd. Treatment processes at HTP include screening, grit removal, primary sedimentation with coagulation and flocculation, high-purity oxygen activated sludge biological treatment and secondary clarification. Solids treatment features thickening, thermophilic anaerobic digestion, dewatering, and land application or composting resulting in Class A solids.

The majority of the undisinfected secondary effluent is discharged to the Pacific Ocean at Santa Monica Bay. Solids from DCTWRP and LAGWRP are discharged to the wastewater collection system and treated at HTP. Solids from the Burbank Water Reclamation Plant are also treated at HTP. HTP operates under the discharge permit listed in **Table 7**.

Table 7: Hyperion Treatment Plant WDR

RWQCB Order No.	Description	Date
R4-2005-0020	Reissuance of WDR and NPDES permit	April 7, 2005

Besides the ocean outfall, secondary effluent from HTP is delivered to the West Basin Water Recycling Plant (WBWRP), which is owned and operated by West Basin Municipal Water District (WBMWD) in El Segundo. WBMWD is contractually entitled to receive up to 70 mgd of secondary effluent from HTP for tertiary and advanced treatment. WBMWD produces five types of "designer" recycled water at the WBWRP ranging in water quality from disinfected tertiary effluent to ultra-pure advanced treated recycled water. The disinfected tertiary effluent is used for irrigation and irrigation uses. Nitrified water is used for industrial cooling towers. The WBWRP AWTF provides microfiltration (MF), RO treatment, and ultraviolet light disinfection/advanced oxidation using hydrogen peroxide (UV/AOP) to produced high-quality recycled water for injection at the West Coast Barrier Project, which is a planned groundwater recharge project and IRP. WBMWD also produces two types of specially treated RO product water which are used for refinery low- and high-pressure boiler feed water. The WBWRP produces a total of 30 mgd of various types of recycled water. Waste brine from these facilities is discharged to the ocean via HTP outfall.

WBMWD also owns and operates the Carson Regional Water Recycling Plant, which is located in Carson. Disinfected tertiary effluent from the WBWRP is sent to the CRWRP where it receives advanced treatment using two separate trains. Approximately 5 mgd of MF/RO treated recycled water is delivered to industrial customers. The second train produces approximately 0.9 mgd for industrial cooling towers/boilers. Waste brine from the CRWRP is discharged to the ocean using the Los Angeles County Sanitation District's Joint Water Pollution Control Plant outfalls.

WBMWD's water reclamation and discharge permits for WBWRP and CRWRP are listed in **Table 8**.

Table 8: West Basin Municipal Water District WDR and WRR

Order No.	Description	Date
West Basin Water Recycling Plant		
01-043	Stand alone WRR	March 29, 2001
R4-2002-0173	Amending WRR Order No. 01-043	September 16, 2002
R4-2006-0067	Reissuance of WDRs that serves as a NPDES permit	July 20, 2006
Carson Regional Water Recycling Plant		
R4-2007-0001	WDR	December 20, 2006

HTP Recycled Water Limitations

HTP does not produce recycled water for reuse. No WRR are approved specifically for HTP. Secondary effluent from HTP is treated and recycled at the WBWRP. RWQCB R4-2005-0020 specifies that secondary effluent be conveyed to WBMWD for water reclamation. WBMWD is responsible for the permits for the WBWRP. HTP uses disinfected tertiary effluent from the WBWRP.

RWQCB Order No. 01-043 states that recycled water produced at the WBMWD West Basin Water Recycling Plant may be used for irrigation and industrial purposes.

HTP Specifications for Use of Recycled Water

As noted above, HTP does not have its own specifications for production or use of recycled water. HTP provides secondary effluent to the WBWRP. WBMWD has its own separate WRR.

WBWRP provides recycled water to several users for irrigation and industrial uses WBWRP also produces advanced treated recycled water for injection at the West Coast Barrier and other industrial customers with special water quality requirements.

HTP Use Area Requirements

HTP has no WRR or use area requirements for recycled water. HTP provides secondary effluent for the WBMWD water reclamation facilities. HTP uses WBMWD's disinfected tertiary recycled water to irrigate the plant site.

WBMWD's recycled water irrigation areas and other industrial use sites are subject to Title 22 and Title 17 requirements.

Comparison of HTP WRR with Title 22/17 Requirements

HTP does not have its own WRR, but rather pumps secondary effluent to WBMWD for water reclamation. Title 22 and 17 requirements are contained in the WBMWD WRR. HTP WDR references the WBMWD recycled water facilities. Compliance with Title 17 backflow prevention requirements is required at HTP site.

2.3 California DPH and LA County DPH Requirements

2.3.1 CDPH Requirements

In addition to the Title 22 and Title 17 regulations previously described, CDPH has other documents related to recycled water production and use:

- Guidelines for the Preparation of an Engineering Report for the Production, Distribution and Use of Recycled Water (CDPH, 2001) – This report provides a framework to assist in developing a Title 22 Engineering Report that addresses the necessary elements of a proposed of modified recycled water project to facilitate regulatory review and approval.

- Treatment Technology Report for Recycled Water (CDPH, 2007) – This report provides reference information about treatment technologies meeting filtration performance and disinfection requirements for compliance with Title 22.
- Guidance Memo No. 2003-02: Guidance Criteria for the Separation of Water Mains and Non-Potable Pipelines (CDPH, 2003) – This memorandum provides separation criteria for design and installation of drinking water and non-potable (recycled water and sewers) pipelines to prevent contamination of the drinking water supply.
- Draft Groundwater Recharge Reuse Criteria (August 5, 2008 or later revision) – These Draft Criteria reflect CDPH's current views on the regulation of recharge of groundwater with recycled municipal wastewater.

DCTWRP, LAGWRP, and TIWRP operate with Title 22 Engineering Reports which have been reviewed by CDPH. WBMWD has a CDPH-approved Title 22 Engineering Reports for its WBWRP and CRWRF. As described in Section 2.2, these reports document how the facilities and recycled water uses comply with Title 22 Water Recycling Criteria.

2.3.2 LA County DPH Requirements

The LA County DPH Environmental Health Division administers a Cross Connection and Water Pollution Control Program. The LA County DPH is responsible for enforcing recycled water use regulations, such as Title 22 and Title 17. LA County DPH staff review plans, conduct on-site inspections, and grant approval for recycled water use at specific customer sites after the CDPH approves the recycled water project and the City reaches an agreement for recycled water service with that customer.

The LA County DPH is responsible for field surveys and inspections of customer sites to ensure that no backflow, cross-connections or hazardous conditions exist between the recycled water system and the potable water system. Certification of backflow prevention testers and devices is also their duty.

The LA County DPH has a "Guide to Safe Recycled Water Use, Pipeline Construction and Installation" (LA County DPH, 2010) to protect the domestic water supply and public health. This Guide requires compliance with Title 22 Water Recycling Criteria and all CDPH and RWQCB requirements. Plans and specifications must be submitted for review and approval to the LA County DPH prior to implementation and construction. The LA County DPH then inspects the system, conducts pressure tests and cross-connection tests. Separation between recycled water (and wastewater sewers) and potable water lines is required, and all pipelines must be labeled. The LA County DPH reviews the system operation with the on-site supervisor to confirm their understanding of the recycled water use requirements. Approved backflow prevention devices must be installed and tested.

2.4 Basin Plan/Water Quality Objectives

The Water Quality Control Plan for the Los Angeles Region (RWQCB, 1994), commonly referred to as the "Basin Plan", was adopted by the RWQCB on July 13, 1994. Subsequent amendments to the Basin Plan have been adopted by the RWQCB in 1997 through 2003. The Basin Plan designates beneficial uses for surface waters and groundwater, sets narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the State Anti-Degradation Policy (SWRCB Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California" (SWRCB, 1968), and describes implementation programs to achieve and maintain water quality standards contained in the Basin Plan in order to protect all waters in the Region.

The Basin Plan divides the Los Angeles Region into surface water hydrologic units, areas and subareas and into groundwater basins. All of the City's wastewater treatment/reclamation facilities are located in the Los Angeles-San Gabriel Hydrologic Unit of the Region's surface waters. This Unit is further subdivided into drainage areas and subareas. Similarly, the Region has several groundwater basins. Beneficial uses and water quality objectives are designated for each of these water bodies. Amendments to the Basin Plan updated water quality objectives for ammonia and chloride for some segments of the Los Angeles River. Discharge permits include final effluent limitations based on the latest water quality objectives with the compliance point being "end of pipe".

In 1988, the RWQCB adopted Resolution No. 88-012 "Supporting Beneficial Use of Available Reclaimed Water in Lieu of Potable Water for the Same Purpose" (RWQCB, 1988), which encourages the beneficial use of recycled wastewater and supports water recycling projects.

The Basin Plan establishes many types of beneficial uses for water bodies in the Los Angeles Region, which are summarized in **Table 9**. Specific beneficial uses for each inland surface watershed and groundwater basin vary from location to location within the Region.

Table 9: Beneficial Uses in the Los Angeles Region Basin Plan

Abbrev.	Use Type	Description
AGR	Agricultural Supply	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
AQUA	Aquaculture	Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting or aquatic plants and animals for human consumption or bait purposes.
BIOL	Preservation of Biological Habitats	Uses of water that support designated areas or habitats, such as Areas of Special Biological Significance, established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.
COLD	Cold Freshwater Habitat	Uses of water that support cold water ecosystems including, but not limited to preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
COMM	Commercial and Sport Fishing	Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.
EST	Estuarine Habitat	Uses of water that support estuarine ecosystems including, but not limited to preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).
FRSH	Freshwater Replenishment	Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).
GWR	Groundwater Recharge	Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.
IND	Industrial Service Supply	Uses of water for industrial activities that do not depend primarily on water quality, including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
MAR	Marine Habitat	Use of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).
MIGR	Migration of Aquatic Organisms	Uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.
MUN	Municipal and Domestic Supply	Uses of water for community, military, or individual water supply systems including, but not limited to drinking water supply.
NAV	Navigation	Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.
POW	Hydropower	Uses of water for hydropower generation
PROC	Industrial Process Supply	Uses of water for industrial activities that depend primarily on water quality.
RARE	Rare, Threatened, or Endangered	Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Abbrev.	Use Type	Description
	Species	
REC-1	Water Contact Recreation	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfacing, white water activities, fishing or use of natural hot springs.
REC-2	Non-Contact Water Recreation	Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
SAL	Inland Saline Water Habitat	Uses of water that support inland saline water ecosystems including, but not limited to, preservation or enhancement of aquatic saline habitats, vegetation, fish, or wildlife, including invertebrates.
SHELL	Shellfish Harvesting	Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.
SPWN	Spawning, Reproduction, and/or Early Development	Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.
WARM	Warm Freshwater Habitat	Uses of water that support warm water ecosystems including, but not limited to preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
WET	Wetland Habitat	Uses of water that support wetland ecosystems, including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.
WILD	Wildlife Habitat	Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Basin Plan surface water quality objectives, including numeric and narrative objectives, have been developed for the following parameters and apply to all inland surface waters in the Region:

- Ammonia
- Bacteria (Total Coliform 1.1/100 mL)
- Bioaccumulation
- Biochemical Oxygen Demand (BOD_5)
- Biostimulatory substances
- Oil and Grease
- Dissolved Oxygen
- Pesticides
- pH
- Polychlorinated Biphenyls (PCBs)

- Chemical constituents
- Total Residual Chlorine
- Color
- Exotic Vegetation
- Floating material
- Methylene Blue Active Substances (MBAS)
- Mineral quality
- Nitrogen (nitrate and nitrite drinking water MCLs for municipal and domestic uses)
- Radioactive substances
- Solid/suspended/settable materials
- Taste and Odor
- Temperature
- Toxicity
- Turbidity

Basin Plan groundwater quality objectives, include numeric and narrative objectives, have been developed for the following parameters and apply to all groundwater in the Region:

- Bacteria (Total Coliform 1.1/100 mL)
- Chemical constituents
- Nitrogen (nitrate and nitrite drinking water MCLs for municipal and domestic supply uses)
- Radioactive substances
- Taste and Odor

Specific beneficial uses and water quality objectives vary from location to location within the Los Angeles Basin. Designated water quality objectives are established in the Basin Plan for each individual surface water hydrologic units, areas, and subarea. Similarly, specific water quality objectives are established for individual groundwater basins in the Basin Plan. WDR and WRR may vary depending upon where the point(s) of discharge and/or proposed recycled water use site(s) are located. Typically, the most restrictive water quality objectives are used for the WDR and WRR. Proposed recycled water use in new locations in the future could impact the WRR and WDR, particularly if the site(s) are located in a more restrictive area of the Los Angeles Basin. **Figure 1** and **Figure 2** illustrate the surface watersheds and groundwater basins, respectively, in the region.

Figure 1: City of Los Angeles Inland Surface Watersheds

Figure 2: City of Los Angeles Groundwater Basins

2.4.1 DCTWRP

DCTWRP is located in the Los Angeles River Upstream of Figueroa Street Surface Water Hydrologic Area and in the San Fernando Groundwater Basin, West of Highway 405 Sub-basin. DCTWRP discharges to the Los Angeles River so beneficial uses and water quality objectives for downstream surface waters are also considered in its WDR. Non-potable reuse from DCTWRP occurs in both sub-basins in the San Fernando Groundwater Basin: 1) West of Highway 405; and 2) East of Highway 405 (Overall). Designated beneficial uses for DCTWRP surface waters and groundwater basins are shown in **Table 10** and **Table 11**, respectively. Applicable water quality objectives established in the Basin Plan for DCTWRP are summarized in **Table 12**.

Table 10: DCTWRP Designated Beneficial Uses for Surface Waters

Section of Los Angeles River (Basin Plan Hydrological Area #)	Existing Beneficial Use	Future Beneficial Use
Upstream of Figueroa St (405.21)	GWR, REC-1, REC-2, WARM, WILD, WET	MUN, IND
Downstream of Figueroa St (405.15)	GWR, REC-1, REC-2, WARM	MUN, IND, WILD
Downstream of Figueroa St to Estuary (405.12)	GWR, REC-1, REC-2, WARM, MAR, WILD, RARE	MUN, IND, PROC, MIGR, SPWN, SHELL
Estuary (405.12)	IND, NAV, REC-1, REC-2, COMM, EST, MAR, WILD, RARE, MIGR, SPWN	SHELL

Table 11: DCTWRP Designated Beneficial Uses for Groundwater Basins

Groundwater Basin & Sub-basin	Existing Beneficial Use	Future Beneficial Use
San Fernando Groundwater Basin		
West of Highway 405 Sub-basin	MUN, IND, PROC, AGR	
East of Highway 405 Sub-basin (Overall)	MUN, IND, PROC, AGR	

Table 12: DCTWRP Surface Water and Groundwater Quality Objectives from Basin Plan

	TDS (mg/L)	Sulfate (mg/L)	Chloride [a] (mg/L)	Boron (mg/L)	Nitrogen (mg/L)	SAR [b] (mg/L)	Ammonia [a] (mg/L)
Surface Water: Los Angeles River Watershed							
Above Figueroa Street	950	300	150 [c]	N/A [d]	8	N/A [d]	--
Downstream of Figueroa Street	1500	350	150	N/A [d]	8	N/A [d]	--
Downstream of Figueroa to Estuary	--	--	--	--	--	--	--
Estuary	--	--	--	--	--	--	--
Regional Groundwater: San Fernando Groundwater Basin							
West of Highway 405	800	300	100 [e]	1.5	--	--	--
East of Highway 405 Overall	700	300	100 [e]	1.5	--	--	--
WDR Permit							
R4-2006-0091	800	300	190 [c]	1.5	7.2 [f]	--	1.4 [f]

Notes:

a. Ammonia Water Quality Objective and Chloride Water Quality Objectives per the 1994 Basin Plan.
b. Sodium Absorption Ratio (SAR) predicts the degree to which irrigation water tends to enter into cation-exchange reactions in soil. SAR = Na+/99Ca++ + Mg++)/2)1/2
c. In accordance with the Resolution 97-02, adopted by the RWQCB on January 27, 1997, the chloride limitation has been increased from 150 to 190 mg/L, per Order No. R4-2006-0091, which applies only to the discharge from DCTWRP.
d. Agricultural supply is not a beneficial use of the surface water in the specified reach.
e. This is based on the revised chloride Water Quality Objective for water body of Los Angeles River between Sepulveda Flood Control Basin and Figueroa Street in the Resolution No. 97-02. However, the chloride concentrations in the aquifers located below the above areas shall not be greater than 100 mg/L, groundwater water quality objective for chloride in the Basin Plan, as a result of using tertiary treated and disinfected effluent used as recycled water.
f. This is the waste load allocation (WLA), according to the Nitrogen Compounds TMDL Resolution No. 2003-009, adopted by the RWQCB on July 10, 2003. The WLA serves as the effluent limitation for the discharge. It became effective on March 23, 2004, after the USEPA approved the Nitrogen Compounds TMDL, and after the RWQCB filed the Notice of Decision with the California Resources Agency, per Order No. R4-2006-0091, which applies only to the discharge from DCTWRP. 7.2 is the limit for monthly average of Nitrate + Nitrite as Nitrogen and 1.4 is the monthly average limit for Total Ammonia as Nitrogen.

2.4.2 LAGWRP

LAGWRP is located in the Los Angeles River Upstream of Figueroa Street Surface Water Hydrologic Area and in the San Fernando Groundwater Basin, Narrows Area below Confluence of Verdugo Wash with the Los Angeles River. Because the LAGWRP discharges to the Los Angeles River, downstream beneficial uses and water quality objectives are also considered in its WDR. Designated beneficial uses for LAGWRP surface waters and groundwater basins these areas are shown in **Table 13** and **Table 14**, respectively. Applicable water quality objectives established in the Basin Plan for LAGWRP are summarized in **Table 15**.

Table 13: LAGWRP Designated Beneficial Uses for Surface Waters

Section of Los Angeles River (Basin Plan Hydrological Area #)	Existing Beneficial Use	Future Beneficial Use
Upstream of Figueroa St (405.21)	GWR, REC-1, REC-2, WARM, WILD, WET	MUN, IND
Downstream of Figueroa St (405.15)	GWR, REC-1, REC-2, WARM	MUN, IND, WILD
Downstream of Figueroa St to Estuary (405.12)	GWR, REC-1, REC-2, WARM, MAR, WILD, RARE	MUN, IND, PROC, MIGR, SPWN, SHELL
Estuary (405.12)	IND, NAV, REC-1, REC-2, COMM, EST, MAR, WILD, RARE, MIGR, SPWN	SHELL

Table 14: LAGWRP Designated Beneficial Uses for Groundwater Basins

Groundwater Basin & Sub-basin	Existing Beneficial Use	Future Beneficial Use
San Fernando Groundwater Basin		
East of Highway 405 Sub-basin	MUN, IND, PROC, AGR	
Narrows Area Below Confluence of Verdugo Wash	MUN, IND, PROC, AGR	

Table 15: LAGWRP Surface Water and Groundwater Quality Objectives from Basin Plan

	TDS (mg/L)	Sulfate (mg/L)	Chloride [a] (mg/L)	Boron (mg/L)	Nitrogen (mg/L)	SAR [b] (mg/L)	Ammonia [a] (mg/L)
Surface Water: Los Angeles River Watershed							
Above Figueroa Street	950	300	150 [c]	N/A [d]	8	N/A [d]	--
Downstream of Figueroa Street	1500	350	150	N/A [d]	8	N/A [d]	--
Downstream of Figueroa to Estuary	--	--	--	--	--	--	--
Estuary	--	--	--	--	--	--	--
Regional Groundwater: San Fernando Groundwater Basin							
East of Highway 405 Overall	700	300	100 [f]	1.5	--	--	--
Narrows Area (below confluence of Verdugo Wash with LA River)	900	300	150	1.5	--	--	--
WDR Permit							
R4-2006-0092	900	300	190 [c]	1.5	7.2 [e]	--	2.2 [e,g]

Notes:

a. Ammonia Water Quality Objective and Chloride Water Quality Objectives per the 1994 Basin Plan.

b. Sodium Absorption Ratio (SAR) predicts the degree to which irrigation water tends to enter into cation-exchange reactions in soil. SAR = Na+/99Ca++ + Mg++)/2)1/2

c. In accordance with the Resolution 97-02, adopted by the RWQCB on January 27, 1997, the chloride limitation has been increased from 150 to 190 mg/L, per Order No. R4-2006-0092, which applies only to the discharge from LAGWRP

d. Agricultural supply is not a beneficial use of the surface water in the specified reach.
e. This is the waste load allocation (WLA), according to the Nitrogen Compounds TMDL Resolution No. 2003-009, adopted by the RWQCB on July 10, 2003. The WLA serves as the effluent limitation for the discharge. It became effective on March 23, 2004, after the USEPA approved the Nitrogen Compounds TMDL, and after the RWQCB filed the Notice of Decision with the California Resources Agency, per Order No. R4-2006-0092, which applies only to the discharge from DCTWRP. 7.2 is the limit for monthly average of Nitrate + Nitrite as Nitrogen and 1.4 is the monthly average limit for Total Ammonia as Nitrogen.
f. This is based on the revised chloride Water Quality Objective for water body of Los Angeles River between Sepulveda Flood Control Basin and Figueroa Street in the Resolution No. 97-02. However, the chloride concentrations in the aquifers located below the above areas shall not be greater than 100 mg/L, groundwater water quality objective for chloride in the Basin Plan, as a result of using tertiary treated and disinfected effluent used as recycled water.
g. The City of Los Angeles is pursuing a water effect ration (WER) study for ammonia, Order No. R4-2006-0092 contains a reopener which allows for modifications of final effluent limits at the discretion of the Regional Board.

2.4.3 TIWRP

TIWRP is located in the Los Angeles/Long Beach Harbor and Dominguez Channel Watersheds Hydrologic Area and West Coast Groundwater Basin. Designated beneficial uses for TIWRP surface waters and groundwater basins these areas are shown in **Table 16** and **Table 17**, respectively. Applicable water quality objectives established in the Basin Plan for TIWRP are summarized in **Table 18**.

Table 16: TIWRP Designated Beneficial Uses for Surface Waters

Surface Water (Basin Plan Hydrological Area #)	Existing Beneficial Use	Future Beneficial Use
Los Angeles/Long Beach Harbor and Dominguez Channel Watersheds (405.12)[a]	NAV, REC-1, REC-2, COMM, MAR, RARE, IND, WILD, SHELL, EST, WET	SHELL, SPWN
Dominguez Channel estuary	MIGR	NAV
Inner areas		REC-1

Note:
a. TIWRP WDR for discharge to the Los Angeles/Long Beach Harbor includes the beneficial uses for the Outer Harbor, Marinas, Public Beach Area, Inner Areas, Dominguez Channel Estuary and Los Angeles River Estuary per the Basin Plan.

Table 17: TIWRP Designated Beneficial Uses for Groundwater Basins

Groundwater Basin & Sub-basin	Existing Beneficial Use	Future Beneficial Use
Los Angeles Coastal Plain Groundwater Basin		
West Coast Sub-basin	MUN, IND, PROC, AGR	

Table 18: TIWRP Surface Water and Groundwater Quality Objectives from Basin Plan

	TDS (mg/L)	Sulfate (mg/L)	Chloride [a] (mg/L)	Boron (mg/L)	Nitrogen (mg/L)	SAR [b] (mg/L)	Ammonia [a] (mg/L)
Surface Water: Los Angeles/Long Beach and Dominguez Channel Watershed							
Entire Watershed	N/A [c]	N/A [c]	N/A [c]	N/A [c]	N/A [c]	N/A [c]	44 [d]
Regional Groundwater: Los Angeles Coastal Plain Groundwater Basin (West Coast Sub-basin)							
All of Basin	800	250	250	1.5	--	--	--
WDR Permit							
R4-2003-0134	800	250	250	1.5	--	--	--

Notes:

a. Ammonia Water Quality Objective and Chloride Water Quality Objectives per the 1994 Basin Plan.
b. Sodium Absorption Ratio (SAR) predicts the degree to which irrigation water tends to enter into cation-exchange reactions in soil. SAR = Na+/99Ca++ + Mg++)/2)1/2
c. Site-specific objectives have not been determined for these reaches at this time. There areas are often impaired (by high levels of minerals) and there is not sufficient historic data to designate objectives based on natural background conditions.
d. The effluent concentration is based on a dilution ratio of 61. Limit per NPDES No. CA 0053856.

2.4.4 HTP

HTP is located in the Santa Monica Bay Watershed Hydrologic Area and West Coast Groundwater Basin. Designated beneficial uses for these areas are shown in **Table 19** and **Table 20**, respectively. Applicable water quality objectives established in the Basin Plan for HTP are summarized in **Table 21**.

Table 19: HTP Designated Beneficial Uses for Surface Waters

Surface Water (Basin Plan Hydrological Area #)	Existing Beneficial Use	Future Beneficial Use
Santa Monica Bay Watershed (405.12)[a]	IND, NAV, REC-1, REC-2, COMM, MAR, WILD	SPWN

Note:

a. HTP discharges to the Pacific Ocean at the Dockweiler Beaches part of El Segundo/LAX Sub-Watershed of the Santa Monica Bay Watershed.

Table 20: HTP Designated Beneficial Uses for Groundwater Basins

Groundwater Basin & Sub-basin	Existing Beneficial Use	Future Beneficial Use
Los Angeles Coastal Plain Groundwater Basin		
West Coast Sub-basin [a]	MUN, IND, PROC, AGR	

Note:

a. Recycled water use area served by West Basin Municipal Water District.

Table 21: HTP Surface Water and Groundwater Quality Objectives from Basin Plan

	TDS (mg/L)	Sulfate (mg/L)	Chloride [a] (mg/L)	Boron (mg/L)	Nitrogen (mg/L)	SAR [b] (mg/L)	Ammonia [a] (mg/L)
Inland Surface Water: Santa Monica Bay Watershed							
Entire Watershed	N/A [c]	N/A [c]	N/A [c]	N/A [c]	N/A [c]	N/A [c]	35 [d]
Regional Groundwater: Los Angeles Coastal Plain Groundwater Basin (West Coast Sub-basin)							
All of Basin [e]	1,000	250	200	0.5	--	--	--
WDR Permit for West Basin WRP							
Order No. 01-043	800	250	250	1.5	--	--	--

Notes:

a. Ammonia Water Quality Objective and Chloride Water Quality Objectives per the 1994 Basin Plan.
b. Sodium Absorption Ratio (SAR) predicts the degree to which irrigation water tends to enter into cation-exchange reactions in soil. SAR = Na+/99Ca++ + Mg++)/2)1/2
c. Site-specific objectives have not been determined for these reaches at this time. There areas are often impaired (by high levels of minerals) and there is not sufficient historic data to designate objectives based on natural background conditions.
d. Limit per NPDES Permit No. CA0109991
e. Values based on recycled water use area served by West Basin Municipal Water District.

2.5 SWRCB Recycled Water Policy

In February 2009, the SWRCB adopted Resolution 2009-0011 "Recycled Water Policy" (SWRCB, 2009a). This Recycled Water Policy sets uniform standards for how individual RWQCBs interpret and implement the Anti-Degradation Policy (SWRCB Resolution No. 68-16; SWRCB, 1968) for water recycling projects. Prior to this, water recycling projects were impacted by the differing actions of some RWQCBs based on application of the Anti-Degradation Policy. The RWQCB interpretations generally sought to prevent any change in groundwater quality, regardless of considerations around the provision to meet the "maximum benefit to the people of the State" as stated in the SWRCB Recycled Water Policy. For example, a RWQCB may have determined that any change in salinity was unacceptable, even though the change still allowed the groundwater to meet State water quality and health standards. To resolve these permitting discrepancies, the SWRCB adopted the Recycled Water Policy, which provides direction to the RWQCBs and includes key provisions that must be considered when planning and implementing recycled water projects:

- Mandate for recycled water use
- Salt/nutrient management plans
- Landscape irrigation projects' control of incidental runoff and streamlined permitting
- Groundwater recharge
- Anti-degradation
- Constituents of emerging concern (CECs) (e.g., endocrine disrupters, personal care products or pharmaceuticals).

2.5.1 Mandate for Recycled Water Use

In the Recycled Water Policy, the SWRCB supports and encourages use of recycled water. Specific targets are mandated to increase recycled water use. The Recycled Water Policy requires agencies producing recycled water that is available for reuse and not being put to beneficial use to make that recycled water available to water purveyors for reuse on reasonable terms and conditions. Such terms and conditions may include payment by the water purveyor of a fair and reasonable share of the cost of the recycled water supply and facilities.

The SWRCB declared that it is a waste and unreasonable use of water for water agencies not to use recycled water when recycled water of adequate quality is available and is not being put to beneficial use. The SWRCB also acknowledged that it shares jurisdiction over the use of recycled water with the RWQCB and CDPH and that other agencies, such as the California Department of Water Resources and California Public Utilities Commission, are also involved in encouraging water reclamation.

2.5.2 Salt/Nutrient Management Plans

The Recycled Water Policy recognizes that some groundwater basins contain salts and nutrients that exceed or threaten to exceed water quality objectives established in the applicable Basin Plans, and not all Basin Plans include adequate implementation procedures for achieving or ensuring compliance with the water quality objectives for salt or nutrients. These conditions can be caused by natural soils, discharges of waste, irrigation using surface water, groundwater or recycled water, and water supply augmentation using surface or recycled water. The Recycled Water Policy determines that regulation of recycled water alone will not address these conditions.

The Recycled Water Policy calls for salts and nutrients from all sources to be managed on a basin-wide or watershed-wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses. According to the SWRCB, the most appropriate way to address salt and nutrient issues is through the development of regional or subregional salt and nutrient management plans by local water and wastewater agencies, rather than through imposing requirements solely on individual recycled water projects.

The Recycled Water Policy requires every groundwater basin/sub-basin in California to have a salt/nutrient management plan. Salt/nutrient management plans need to be tailored to address the water quality concerns in each basin/sub-basin and may include constituents other than salt and nutrients that impact water quality in the basin/sub-basin. Stormwater recharge must be included in the salt/nutrient management plans because stormwater is typically lower in nutrients and salts and can augment local water supplies. The plans must address all sources of salts and nutrients to groundwater basins, including recycled water irrigation projects and groundwater recharge reuse projects. Other constituents may also be addressed if they adversely affect groundwater quality. The Recycled Water Policy requires salt/nutrient management plans to be completed and submitted to the RWQCB within five years (or seven years with an approved extension).

According to the Recycled Water Policy, each salt/nutrient management plan shall include:

- Monitoring network to provide a cost-effective means of determining whether the concentrations of salt, nutrients, and other constituents of concern as identified in the salt and nutrient plans are consistent with applicable water quality objectives. The monitoring frequency must be determined in the salt/nutrient management plan and approved by the RWQCB.
- Annual monitoring of CECs consistent with recommendations by CDPH and consistent with any actions by the SWRCB.
- Water recycling and stormwater recharge/use goals and objectives.
- Salt and nutrient source identification, basin/sub-basin assimilative capacity and loading estimates, together with fate and transport of salts and nutrients.
- Implementation measures to manage salt and nutrient loading in the basin on a sustainable basis.
- An anti-degradation analysis demonstrating that the projects included within the plan will, collectively, satisfy the requirements of the Anti-Degradation Policy, Resolution No. 68-16.

The SWRCB requires each RWQCB, within one year of receipt of a proposed salt/nutrient management plan, to consider adopting revised implementation plans, consistent with Water Code Section 13242, for those groundwater basins within their regions where water quality objectives for salts or nutrients are being, or are threatening to be, exceeded. The implementation plans shall be based on the salt/nutrient management plans required by the Recycled Water Policy.

Plans which are more protective than applicable standards in the Basin Plan may be developed. However, the RWQCBs may not modify Basin Plan water quality objectives without getting full approval in accordance with existing law. Areas that have already completed a RWQCB approved salt/nutrient management plan for a basin/sub-basin that is functionally equivalent to the Recycled Water Policy requirements are exempt.

In August 2009, the SWRCB issued a memorandum (SWRCB, 2009) to all of the RWQCBs to clarify their role in implementing the Recycled Water Policy. This memorandum describes specific actions for each RWQCB:

- Initiate and participate in the stakeholder process for development of salt/nutrient management plans.
- Track and report development of salt/nutrient management plans.
- Input groundwater data into GeoTracker (the SWRCB database).
- Incorporate incidental runoff provisions.
- Streamline permitting of eligible recycled water irrigation projects.
- Implement groundwater recharge reuse provisions.
- Implement anti-degradation provisions.
- Cooperate with water recycling mandates, stormwater reuse, and total maximum daily loads.

San Fernando Groundwater Basin

The WDR amendment (RWQCB Order No. R4-2008-0040) revised the WDRs for both DCTWRP (RWQCB Order No. R4-2007-0008) and LAGWRP (RWQCB Order No. R4-2007-0006) to require effluent monitoring for all constituents with drinking water MCLs and notification levels (NLs) and their use as triggers for accelerated groundwater monitoring. In June 2009, LADWP finalized a "Salt Loading Analysis for the San Fernando Groundwater Basin" (LADWP, 2009) which documents impacts to the groundwater resulting from four years of salt loading from different sources of recharge. Extensive chloride and TDS monitoring of potable water wells was conducted from 2005 to 2008. The loading analysis evaluated the level of these salts being input to the groundwater basin by various recharge sources: (1) recycled water, (2) delivered return water (3) rain on spreading grounds, (4) rainfall on the valley floor, and (5) rain on hills and mountains. The study evaluated use of 10,000 AFY of recycled water for irrigation purposes and found this NPR would have a negligible impact on groundwater salinity in the San Fernando Basin. The analysis concluded that using recycled water for irrigation will maintain groundwater quality within the Basin Plan water quality objectives, and thus will protect beneficial uses.

With regard to the SWRCB's Recycled Water Policy, the "Salt Loading Analysis for the San Fernando Groundwater Basin" evaluates salts only and did not address nutrients, such as nitrogen species. Increased recycled water use in the basin would also impact the analysis. In a letter dated June 24, 2008, the RWQCB stated that "since nutrients are actively attenuated in both soil and groundwater, unlike chloride, there is no data to support Basin-wide concern on increasing nutrient loading as a result of the application of recycled water from the [DCTWRP and LAGWRP]." At that time, it appeared to the RWQCB's position that the "Salt Loading Analysis for the San Fernando Groundwater Basin" was sufficient and that a plan for nitrogen management would not be required of the plants because DCTWRP and LAGWRP had both installed NdN facilities to reduce their nitrogen discharges and that recycled water application in the area was unrelated to groundwater nitrate levels. It should be noted, however, that the RWQCB's letter pre-dates the SWRCB's Recycled Water Policy. The Recycled Water Policy indicates that more evaluation of salts and nutrients is needed for all basins statewide, including the San Fernando Groundwater Basin. The previous analysis will be useful to form a basis for development of a Salt/Nutrient Management Plan for submittal to the RWQCB for compliance with the Recycled Water Policy. The first Preliminary Stakeholder Meeting to discuss the development of salt / nutrient plan for this basin was hosted by the RWQCB at the LADWP's Valley Service Center on September 16, 2009. On August 22, 2011, representatives of the Upper Los Angeles River Area Watermaster (ULARA Watermaster), LADWP, and BOS met with RWQCB staff to discuss the ULARA Watermaster becoming the lead entity in the development of the salt / nutrient plan. LADWP and BOS will continue to be active partners in this effort.

West Coast Groundwater Basin

Development of a salt/nutrient management plan for the West Coast Groundwater Basin will be required to be submitted to the RWQCB by 2014 in order to comply with the Recycled Water Policy. WRD is leading the effort to develop the West Coast Groundwater Basin salt/nutrient management plan with input from multiple stakeholders, including LADWP. The first Preliminary Stakeholder Meeting to discuss the development of salt/nutrient plans for this basin took place on July 27, 2009. On October 12, 2010, WRD partnered with the Los Angeles County Flood Control District to prepare the Central and West Coast Basins Salt and Nutrient Management Plan.

Central Groundwater Basin

A salt/nutrient management plan for Central Groundwater Basin will need to be prepared and submitted to the RWQCB by 2014 in compliance with the Recycled Water Policy. WRD is leading the effort to develop the Central Groundwater Basin salt/nutrient management plan with input from multiple stakeholders, including LADWP. The first Preliminary Stakeholder Meeting to discuss the development of salt/nutrient plans for this basin took place on July 27, 2009. On October 12, 2010, WRD partnered with the Los Angeles County Flood Control District to prepare the Central and West Coast Basins Salt and Nutrient Management Plan.

2.5.3 Landscape Irrigation Projects

The SWRCB Recycled Water Policy addresses two issues for landscape irrigation projects: 1) incidental runoff and 2) streamlining permitting. Under the Recycled Water Policy, control of incidental runoff must be addressed by landscape irrigation uses:

- Incidental runoff is defined as unintended small volumes of runoff from recycled water use areas, such as unintended minimal over-spray from sprinklers that leaves the use area. Intentional overflow or over-application due to design or negligence is not considered to the incidental runoff. The Recycled Water Policy states that incidental runoff may be regulated by WDRs. Regardless of how incidental runoff may be regulated, landscape irrigation projects must include an operation and maintenance plan to detect leaks and stipulate correction measures within 72 hours of the runoff or prior to the release of 1,000 gallons of recycled water.
- Sprinklers at use sites must be properly designed.
- Irrigation must be discontinued during rain events.
- Recycled water impoundments, such as ponds, must be managed so as not to overflow and discharge recycled water, unless the discharge is caused by a storm event with a magnitude greater than 25-year frequency.

The SWRCB also requires that RWQCB streamline processing permits for recycled water landscape irrigation projects. If the project has unusual or unique site conditions, then the RWQCB may require more detailed information about the landscape irrigation system. However, most landscape irrigation projects will be permitted under a general RWQCB order. Recycled water monitoring should be conducted as well as project specific monitoring to support the development and implementation of the salt/nutrient management plan. The Recycled Water Policy specifies criteria for eligibility for streamlined permitting:

- Compliance with Title 22 Water Recycling Criteria.
- Application amounts and rates which are appropriate for the landscape at the use site.

- Compliance with the applicable salt/nutrient management plan.
- Appropriate use of fertilizers that accounts for nutrients present in the recycled water.

With respect to the LADWP facilities, the existing WRR for DCTWRP, LAGWRP, and TIWRP include provisions for irrigation which are somewhat less restrictive that the SWRCB Recycled Water Policy. For example, the WRR do not limit incidental runoff to less than 1,000 gallons and require correction within 72 hours, nor do the WRR address fertilizer use and coordination with recycled water nutrient values. On the other hand, the WRD for DCTWRP, LAGWRP, and TIWRP include specific requirements for irrigation uses, which may be more restrictive than the SWRCB Recycled Water Policy. For example, the WDR specify effluent quality requirements that are protective of groundwater quality in each specific area, as well as triggers for monitoring and attenuation studies. A detailed analysis of the WRR and WDR and how they relate to the SWRCB Recycled Water Policy should be made for each facility.

2.5.4 Groundwater Recharge Projects

The SWRCB Recycled Water Policy includes provisions for recycled water groundwater recharge projects. These are discussed in a separate TM that addresses IPR.

2.5.5 Anti-degradation

In 1968, the SWRCB adopted Resolution No. 68-16 "Statement of Policy with Respect to Maintaining High Water Quality in California". This Anti-Degradation Policy specifies:

1. "Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality water will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies."

2. "Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to ensure that (a) pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."

The Recycled Water Policy recognizes the SWRCB Resolution No. 68-16, Anti-Degradation Policy (SWRCB, 1968) that regulates waters to achieve the highest quality consistent with the maximum benefit to the people of the State. It requires that best practicable treatment or control of waste discharges be used to maintain the highest water quality consistent with the maximum benefit to the people of the State. Specific anti-degradation issues related to groundwater recharge are addressed in a separate TM.

Landscape irrigation with recycled water is a benefit, but this NPR can affect groundwater quality over time. The SWRCB's intent is to address such impacts with the salt/nutrient management plans. As such, the Recycled Water Policy states that landscape irrigation projects may be approved:

- Without an anti-degradation analysis, provided that the project is consistent with the salt/nutrient management plan and qualifies for permit streamlining.
- By demonstrating through a salt/nutrient mass balance that the project uses less than 10 percent of the available assimilative capacity of the basin/sub-basin.

2.5.6 Constituents of Emerging Concern (CECs)

The SWRCB Recycled Water Policy included a provision establishing a Science Advisory Panel. The panel's primary charge is to provide guidance for developing monitoring programs that assess potential CEC impacts to public health from various water recycling practices, including groundwater recharge with recycled water. The panel was formed in May 2009 and includes six national experts in the fields of chemistry, biochemistry, toxicology, epidemiology, risk assessment and engineering. Panelists include:

- Dr. Paul Anderson, Human Health Toxicologist, Vice President and Technical Director, Risk Assessment AMEC Earth and Environment
- Dr. Nancy Denslow, Biochemist. Associate Professor Toxicology, Molecular Biology and Proteomics, University of Florida
- Dr. Jörg Drewes, Civil Engineer Familiar with the Design and Construction of Recycled Water Treatment Facilities, Environmental Science and Engineering Division, Colorado School of Mines
- Dr. Adam Olivieri, Epidemiologist/Risk Assessor, Vice President, EOA, Inc.
- Dr. Daniel Schlenk, Environmental Toxicologist, Department of Environmental Sciences, University of California, Riverside
- Dr. Shane Snyder, Analytical Chemist Familiar with the Design and Operation of Advanced Laboratory Methods for the Detection of Emerging Constituents, R&D Project Manager Applied Research and Development Center, Southern Nevada Water Authority

Draft recommendations were submitted to the SWRCB for public comment on April 15, 2010 and final recommendations were provided on June 25, 2010[1]. The SWRCB planned a public hearing on December 15, 2010 to accept comments and in summer 2011, SWRCB will plan a hearing to adopt the recommendations.

The Panel held four in-person meetings and numerous conference calls over the last year. The meetings included the opportunity for stakeholder input in clarifying their charge, exchange of information, dialog with the Panel and consideration of public comments on the draft report. This report provides the results from the Panel's deliberations, including four products intended to assist the State in refining its recycled water policy:

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[1] http://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/cec_monitoring_rpt.pdf

- Product #1: A conceptual framework for determining which CECs to monitor
- Product #2: Application of the framework to identify a list of chemicals that should be monitored presently
- Product #3: A sampling design and approach for interpreting results from CEC monitoring programs
- Product #4: Priorities for future improvements in monitoring and interpretation of CEC data

2.6 SWRCB General Landscape Irrigation Permit

The SWRCB adopted Water Quality Order No. 2009-0006-DWQ "General Waste Discharge Requirements for Landscape Irrigation uses of Municipal Recycled Water" in July 2009 (SWRCB, 2009b). This General Permit is intended to streamline the regulatory process for landscape irrigation uses of recycled water. Some projects may be unique or site-specific and not be appropriate for permitting under the General Permit; however, the majority of recycled water irrigation of landscaping at parks, greenbelts, playgrounds, school yards, athletic fields, golf courses, cemeteries, residential common areas, commercial and industrial areas (except eating areas), and along freeways, highways, and streets will be eligible for coverage under the General Permit. Participation in the General Permit is optional; in other words, agencies are not required to apply for the General Permit, even if their projects meet the criteria, but instead, they may maintain their current WRR and WDR.

Recycled water projects covered by the General Permit must meet the following:

- Disinfected tertiary effluent in accordance with Title 22 Criteria
- Distribution of recycled water in accordance with Title 22 Criteria and Title 17 backflow and prevention requirements
- Recycled water uses in accordance with Title 22 Criteria
- All applicable requirements of the Recycled Water Policy, including salt/nutrient management
- Manage chlorine usage to prevent discharge of chlorinated recycled water that would be toxic to aquatic life
- Best management practices to prevent unauthorized discharges of recycled water, control incidental runoff and prevent overflow of impoundment.

Producers and distributors of recycled water may file applications to be covered under this General Permit by completing a Notice of Intent (NOI) form, Operation and Maintenance (O&M) Plan, and pay associated application fees. The General Permit contains requirements for disinfected tertiary recycled water production, management, distribution, and use that are the same as those in Title 22 Recycled Water Criteria. Prior to commencing recycled water irrigation, the Administrator must submit an O&M Plan to the SWRCB containing specific elements:

- Operations Plan for the recycled water use areas

- Irrigation Management Plan showing that recycled water will be applied at an agronomic rate for irrigation efficiency and to minimize application of salts
- Summary of the Title 22 Engineering Report approved by CDPH
- Rules and Regulations approved by CDPH governing the design and construction of recycled water use facilities and use of recycled water
- Copies of agreements between the responsible parties for producing, distributing, and using the recycled water
- Documentation on the Recycled Water Use Supervisor's training and responsibilities

When enrolled in the General Permit, if the Producers or Distributors are subject to general or individual WDRs or WRRs, the provisions of those permits for recycled water use are replaced by the requirements of the General Permit. At this time, the City's irrigation activities will continue to be covered under the existing WRRs and WDRs instead of applying for General Permit coverage.

2.6.1 DCTWRP

DCTWRP produces disinfected tertiary effluent and supplies recycled water to landscape irrigation users in compliance with Title 22. The City could apply for a General Landscape Irrigation Permit by submitting the appropriate documentation to the SWRCB.

The existing WRR and WDR for DCTWRP include provisions for irrigation which differ from those in the SWRCB General Landscape Irrigation Permit. For example, the DCTWRP WRR do not limit incidental runoff to a specific volume or require an irrigation management plan for recycled water application rates with specific types of landscaping, whereas participation in the General Permit would impose such requirements. The DCTWRP WDR specify effluent and groundwater quality requirements with triggers for monitoring and attenuation studies, whereas the General Permit would not necessitate those constraints.

It is recommended that a detailed analysis and comparison of the WRR and WDR requirements with the General Permit provisions be made before the City can assess if any benefit for DCTWRP would be achieved by applying for the General Landscape Irrigation Permit.

2.6.2 LAGWRP

LAGWRP produces disinfected tertiary effluent and supplies recycled water to landscape irrigation users in compliance with Title 22. The City could apply for a General Landscape Irrigation Permit by submitting the appropriate documentation to the SWRCB.

Similar to DCTWRP, the existing WRR and WDR for LAGWRP include provisions for irrigation which differ from those in the SWRCB General Landscape Irrigation Permit. While recycled water use must still comply with Title 22, LAGWRP's WRR do not limit incidental runoff to a specific volume or require an irrigation management plan for recycled water application rates with specific types of landscaping. Such requirements would be imposed for LAGWRP under the General Permit. Furthermore, the LAGWRP WDR specify triggers for monitoring and attenuation studies to protect groundwater quality, which would not be required by the General Permit.

It is recommended that a point-by-point comparison of the LAGWRP WRR and WDR with the landscape irrigation requirements from the General Permit to determine if it would be advantageous for the City to apply for a General Landscape Irrigation Permit.

2.6.3 TIWRP

TIWRP produces RO-treated disinfected effluent, and therefore, it appears unlikely that the TIWRP would be eligible for a General Landscape Irrigation Permit because the General Permit applies to landscape irrigation with disinfected tertiary effluent. While the TIWRP WRR and WRD allow landscape irrigation uses, the majority of its high-quality recycled water is injected at the Dominguez Gap Barrier. It is recommended that a detailed comparison of the TIWRP WRR and WDR be made with the General Permit requirements to assess if the City should pursue such an option.

2.6.4 HTP

HTP produces undisinfected secondary effluent for discharge to water reclamation facilities owned and operated by WBMWD. HTP would not be eligible for a General Landscape Irrigation Permit.

2.7 RWQCB Non-Irrigation General Reuse Order

In April 2009, the LA RWQCB adopted Non-Irrigation General Reuse Order No. R4-2009-0049 "General Waste Discharge and Water Recycling Requirements for Title 22 Recycled Water for Non-Irrigation Uses over the Groundwater Basins Underlying the Coastal Watersheds of Los Angeles and Ventura Counties" (LA RWQCB, 2009). This intent of this General Order is to promote recycled water use and streamline the permitting process and delegate the responsibility of administrating water reuse programs to local agencies to the fullest extent possible. This General Order serves as a region-wide general permit for non-irrigation uses of recycled water for public agencies that recycle treated municipal wastewater as producers and/or distributors of disinfected secondary- and tertiary-treated recycled water that meets Title 22 Criteria.

Specific uses of at least disinfected secondary-treated recycled water covered by this General Order present a low risk to the beneficial uses of groundwater because their potential for runoff is limited. These uses include:

- industrial boiler feed
- non-structural fire fighting
- backfill consolidation around non-potable piping
- soil compaction
- mixing concrete
- dust control on roads and streets
- cleaning roads and outdoor work areas
- industrial process water that does not come into contact with workers
- flushing sanitary sewers
- industrial and commercial cooling or air conditioning that does not create a mist

Irrigation and impoundment uses are not covered by this General Order.

To apply for coverage under this General Order, Producers and/or Distributors shall submit a NOI to the RWQCB. Documentation of compliance with Title 17 backflow and cross-connection prevention requirements must be submitted to CDPH for approval prior to using recycled water at new or complex sites, at high volumes, or for dual plumbed systems. Producers must hold Distributors and Users responsible for proper application and use of recycled water at their use sites in accordance with Title 22. O&M Plans must be submitted and contain the following:

- Operations Plan for each recycled water use area
- Title 22 Engineering Report approved by CDPH
- Rules and Regulations approved by CDPH governing the design and construction of recycled water use facilities and use of recycled water in accordance with Title 22
- Copies of agreements between the responsible parties for producing, distributing, and using the recycled water
- Documentation on the Recycled Water Use Supervisor's training and responsibilities

2.7.1 DCTWRP

DCTWRP produces Title 22 disinfected tertiary effluent, which exceeds the minimum recycled water quality for the General Order. The City could apply for a General Non-Irrigation Permit by submitting the appropriate documentation to the RWQCB to serve the above types of uses; however, its current WRR at the DCTWRP already allow non-irrigation Title 22 uses.

It appears that one purpose of the General Non-Irrigation Permit is to enable the RWQCB to delegate responsibility for administering specific non-irrigation uses to a local agency, such as LA County DPH. In the case of the DCTWRP, LADWP already has WRR and WDR from the RWQCB that cover non-irrigation uses, and the LA County DPH already performs on-site inspections for backflow prevention compliance at these sites. Also, while the General Non-Irrigation Permit would allow the use of disinfected secondary effluent for some non-irrigation uses (per Title 22), it is highly unlikely that the DCTWRP would effectively produce two different levels of effluents (disinfected secondary effluent for some uses and disinfected tertiary effluent for others). Production of disinfected tertiary serves all approved Title 22 uses in the current WRR and WDR.

Before proceeding with an application for a General Non-Irrigation Permit, it is recommended that a detailed review of the WRR and WDR as compared with the General Permit provisions be made to determine if there would be any advantages for non-irrigation use.

2.7.2 LAGWRP

LAGWRP produces Title 22 disinfected tertiary effluent, which exceeds the minimum recycled water quality for the General Order. The City could apply for a General Non-Irrigation Permit by submitting the appropriate documentation to the RWQCB to serve the above types of uses; however, its current WRR and WDR already allow non-irrigation Title 22 uses.

With respect to LADWP applying for a General Non-Irrigation Permit in lieu of the current WRR and WDR provisions, the same reasoning applies for the LAGWRP as that discussed above for the DCTWRP. Administration of a General Non-Irrigation Permit would be done by a local agency, such as the LA County DPH, rather than the RWQCB. For LAGWRP, LA County DPH already performs on-site inspections for backflow prevention. Similarly, the LAGWRP could selectively produce disinfected secondary effluent for some customers under a General Non-Irrigation Permit, though this would require separate disinfection, pumping and pipelines to those sites. Maintaining production and distribution of disinfected tertiary effluent for all users would be more efficient.

On this basis, it is recommended that a detailed analysis of WRR and WDR provisions and General Non-Irrigation Permit requirements be prepared to assess if the General Permit would offer any advantages for the LAGWRP.

2.7.3 TIWRP

TIWRP produces RO-treated disinfected effluent primarily for injection at the Dominguez Gap Barrier. Its WRR/Master Water Recycling Permit WRR for the Harbor Water Recycling Project allows non-irrigation uses, such as supplying recycled water for boiler make-up water at the LADWP Harbor Generating Station. TIWRP may be eligible for the General Non-Irrigation Permit; however, the WRR/Master Water Recycling Permit already allows non-irrigation Title 22 uses.

Similar to the DCTWRP and LAGWRP above, the City could apply for a General Non-Irrigation Permit for the TIWRP if a detailed evaluation determined that the General Permit would offer any advantages. The LA County DPH currently performs on-site inspections for cross-connection control, and the RWQCB administers the existing WRR. The TIWRP produces disinfected RO-treated effluent and depending on the amount of non-irrigation production, it would likely be inefficient to produce separate, lesser quality recycled water services (disinfected secondary and tertiary effluents) for specific customers.

It is recommended that a detailed comparison of the General Non-Irrigation Permit with the WRR and WDR for the TIWRP be prepared to assess if applying for the General Permit would be beneficial.

2.7.4 HTP

HTP produces undisinfected secondary effluent for discharge to WBMWD's water reclamation facilities. HTP would not be eligible for a General Non-Irrigation Permit under RWQCB Order No. R4-2009-0049.

3. Recycled Water Practices

This section provides an overview of specific policies applicable to the City's recycled water projects, including:

- Operating and Design Criteria
- Connections to Recycled Water System
- Recycled Water Pricing
- Customer Agreements

3.1 Operating and Design Criteria

The City uses the "Recycled Water Urban Irrigation User's Manual" prepared by the Los Angeles County Recycled Water Advisory Committee (LACRWAC, a local chapter of the California Section of the WateReuse Association) and dated February 15, 2005 (LACRWAC, 2005). LADWP was a member of the LACRWAC at the time the Manual was prepared. This Manual contains general rules, regulations, and guidelines regarding the safe use of recycled water for landscape irrigation in Los Angeles County and other areas of California. The purpose of the Manual is to provide the recycled water user and site supervisor information for the day-to-day operation and control of the recycled water system, in order to protect the health and welfare of the personnel involved with its use as well as the general public and to protect the quality of local water resources.

3.1.1 Service Commitments

The City is the responsible permitted agency for recycled water production and distribution from DCTWRP, LAGWRP, and TIWRP, and is responsible for delivering secondary effluent from HTP as source water to the WBMWD water reclamation facilities. WBMWD is the permit holder for its facilities. The RWQCB issues all permits for recycled water production, distribution, and use. All facilities must be designed and operated to meet Title 22 Water Recycling Criteria and Title 17 backflow prevention requirements.

The City enters into agreements or makes commitments to supply recycled water to its customers. The City is responsible for operation and maintenance of its distribution system up to the point of connection with its users. The user is responsible for operation and maintenance of its own on-site recycled water system and for ensuring that recycled water is properly used at its site in accordance with all the applicable rules and regulations. Recycled water service may be revoked if it not properly used.

LADWP does not guaranteed continuous service or uniform quality of recycled water for its customers. As such, customers are required to have a separate service connection for potable water for potable uses and as a back-up water supply. Recycled water is supplied where it is available and can be supplied at a reasonable cost.

3.1.2 Use Restrictions

Recycled water must be used in accordance with the Title 22 Water Recycling Criteria, Title 17 backflow prevention requirements, and LA County's "Recycled Water Urban Irrigation User's Manual". Section 2.2 describes recycled water use requirements. Recycled water may only be used in areas and for purposes allowed by these regulations and approved by the City. Recycled water must be metered, and one user may not supply recycled water to another user. Use restrictions and conditions of service include but are not necessarily limited to the following:

- Control of runoff – irrigation systems must be designed, constructed, and operated to minimize incidental runoff
- Avoid ponding, except for approved impoundments – irrigation systems must be designed, constructed, and operated to minimize ponding
- Minimize windblown spray conditions from leaving the approved use site
- Use recycled water only for the approved purpose and only in the approved area
- Prohibit any cross-connections
- Comply with approved periods of operation – irrigate during periods of least use of the site by the general public, which is typically between the hours of 10 pm and 6 am
- Prevent application of recycled water on drinking fountains, food eating areas, and near domestic wells per Title 22
- Comply with site inspections and tests
- Designate a responsible Site Supervisor who is trained in use of recycled water

3.1.3 Design and Construction Standards

Design plans and specifications must be approved by CDPH and LA County DPH prior to beginning construction. Design documents must include:

- Detailed description of the intended use of recycled water and a clear identification of the area of use
- Details showing the potable and recycled water systems. Conversions of existing facilities must show the exact location of all existing water piping systems.
- Descriptions of the intended installation procedures (e.g., backflow preventer location(s), color and type of pipe, signage)

During construction, the City and LA County DPH will make periodic inspections of the user's site to ensure that the materials and installation are being done in accordance with the approved plans and specifications. The City and LA County DPH will inspect the recycled water system when construction is completed and during start-up to ensure that it complies with the approved design and rules and regulations. The site inspection will confirm that proper equipment is used, irrigation spray patterns are properly adjusted, and that there are no cross-connections with the on-site potable water system. Any conditions that might create runoff, ponding or spray must be corrected. Upon completion of the site inspection, recycled water service may begin.

3.1.4 Monitoring and Inspection

Each user must designate a Site Supervisor who is responsible for recycled water use at the site. The Site Supervisor must be trained and knowledgeable about recycled water regulations and be responsible for operation and maintenance of all water systems at the site. Accurate records must be kept to document the safe use of recycled water, including personnel training, any system failures or emergencies, use records, and maintenance logs. Proper signage marking recycled water use areas, pipes, valves, and other components of the on-site facilities are required.

The City makes periodic site inspections of the use areas and reviews Site Supervisors' records. In the case of many of the LAGWRP service area customers, the City of Glendale conducts their own site inspections and monitors the Site Supervisor records for those customers within its jurisdiction. Site inspections are required by the WRR. Staff from LA County DPH may also inspect the use area facilities and conduct cross-connection testing.

Any non-compliance or violations of the recycled water use agreements must be corrected. Unauthorized discharges of more than 50,000 gallons of disinfected tertiary recycled water must be reported to the City by the Site Supervisor. If a cross-connection is discovered, the user must immediately implement the Emergency Cross-Connection Response Plan and notify the City and LA County DPH. In this case, recycled water service to the site would cease until the problem is corrected and the site facilities would be re-inspected for compliance.

3.2 Connection to Recycled Water System

3.2.1 Use Ordinance

LADWP Ordinance No. 170435 amended by Ordinance No. 179802 on June 19, 2008, requires customers to use recycled water where recycled water service is available and can be supplied at a reasonable cost. However, LADWP is encouraging customers to connect to the recycled water distribution system on a voluntary basis where feasible, without enforcement action.

3.2.2 Enforcement and Penalties

LADWP may cease recycled water service to a customer if recycled water use does not comply with Title 22 Water Recycling Requirements, Title 17 backflow prevention requirements, and the LA County "Recycled Water Urban Irrigation User's Manual".

3.3 Recycled Water Pricing

LADWP provides recycled water service where it is available and can be supplied at a reasonable cost. Many factors are considered in determining the reasonable cost of recycled water, among which are: present and projected costs of supplying potable domestic water versus recycled water to designated irrigation areas or customer sites. Grants or other subsidies may be used to reduce total development costs.

The City has six fee schedules for all types of water service, as established by Ordinance No. 170435, which was adopted in June 1, 1995, and has been amended numerous times, most recently on June 19, 2008, by Ordinance No. 179802 and shown in Table 22.

Table 22: Summary of Water Rate Schedules

Schedule	Rate Schedule Description
A	Single-Dwelling Unit Residential Customers
B	Multi-Dwelling Unit Residential Customers
C	Commercial, Industrial and Governmental Customers and Temporary Construction
D	Reclaimed [Recycled] Water Service
E	Private Fire Service
F	Publicly-Sponsored Irrigation; Recreational; Agricultural, Horticultural, and Floricultural Uses; Community Gardens and Youth Sports

Currently, all recycled water agreements must be approved by the Board. The Schedule D rate for recycled water service is limited to no more than the Schedule A single-dwelling unit residential first tier commodity charge with no surcharge adjustments.

3.3.1 Charges – Connection, Meter, Service

LADWP Ordinance No. 170435 defines "service connection" as "the pipe or tubing, fittings, and valves necessary to conduct water from the distribution main through the meter or shutoff valve on an unmetered service connection".

LADWP imposes charges for installation of service and meter connections based on the "Schedule of Charges for Water Facilities" which is updated every fiscal year.

3.3.2 Rates

Commodity charges for recycled water service are set by the LADWP Board of Water and Power Commissioners in Ordinance No. 170435, amended by Ordinance No. 179802 on June 19, 2008. Schedule D is currently used for all retail and wholesale recycled water service within the City.

Recycled water will be set by individual contracts approved by Board (as stated in Schedule D). A treatment surcharge may be added to the base commodity rate for recycled water service. The treatment surcharge, if applicable, is based on the cost of treatment or the recycled water beyond that which would be required for discharge of the treated wastewater to the ocean or river.

3.4 Customer Agreements

LADWP has agreements with individual customers for recycled water service. Each agreement is unique and must be approved by the LADWP Board of Water and Power Commissioners.

Customers may apply for recycled water service by following these general steps:

1. Contact LADWP for recycled water service.
2. Prepare plans for irrigation or other proposed use stamped and signed by a registered landscape architect or registered civil engineer. Submit plans to LADWP for review and comments.
3. Submit recycled water service application to LADWP and pay application fee. Application form requires information about the owner, type of use, site location and size, demand (average and peak flow), and site contact. Review recycled water service agreement. This agreement must be signed prior to the start of the recycled water delivery.
4. Submit application to LADWP for a recycled water service meter.
5. LADWP notifies LA County DPH and CDPH of the submitted application.
6. Submit Cross-Connection Plan Approval application along with two sets of plans to LADWP and LA County DPH for review and pay applicable plan check fees.
7. LA County DPH complete plan check and return plans for corrections.
8. Make corrections and resubmit revised plans with the marked-up plans to LA County DPH.
9. Once approved by LA County DPH, submit four sets of final signed plans each to LADWP and LA County DPH.
10. Before construction, hold a pre-job meeting with LADWP's representative, on-site supervisor, and the contractor to cover the plan's general notes, specific job requirements and any questions. Following this meeting, conduct an initial cross-connection test on the existing system with LADWP and the LA County DPH.
11. Begin construction according to the approved plans, contingent upon any other permits or approvals being obtained. Any approvals for deviations to the approved plans must be obtained as needed during construction.
12. LADWP and LA County DPH will inspect the work prior to backfilling any buried piping. If any piping is installed before plan check approval and/or inspection, all or any portion of the piping system may be required to be exposed and corrected as necessary.
13. When construction is completed, notify LADWP and LA County DPH for the final inspection and cross-connection test utilizing potable water supplied through an approved backflow prevention device on dual source sites.
14. Make any necessary corrections and conduct a follow-up walk-through and cross connection test.
15. Designate on-site supervisor and obtain training from LADWP.
16. Upon successful completion of the inspection and cross-connection tests, LADWP and LA County DPH will grant permission for recycled water service to begin.

4. Items to Consider for the NPR Master Plan

The DCTWRP, LAGWRP, and TIWRP all have their own distinct WRR and WDR, which regulate recycled water use for allowable Title 22 uses. The HTP has WDR, but no WRR because it does not directly provide recycled water service, but rather provides secondary effluent to WBMWD facilities, which operate under separate WRR to produce recycled water. TIWRP is the only LADWP facility where groundwater recharge is presently allowed.

Since these WRR were adopted by the RWQCB, the SWRCB and RWQCB have recently issued three new regulations, which impact the City's water recycling program.

SWRCB Recycled Water Policy

Compliance with the SWRCB Recycled Water Policy requires that the City prepare and submit salt/nutrient management plans by 2014.

The City previously submitted the "Salt Loading Analysis for the San Fernando Groundwater Basin", which addressed salts, but not nutrients. Based on a 2008 letter from the RWQCB, it appears that further evaluation of the San Fernando Groundwater Basin for nutrients may not be required. It is recommended that LADWP and BOS confirm with the RWQCB that the "Salt Loading Analysis for the San Fernando Groundwater Basin is sufficient to comply with the SWRCB Recycled Water Policy.

Submittal of salt/nutrient management plans for the West Coast Groundwater Basin and Central Groundwater Basin is required by 2014. LADWP, along with other stakeholders, have begun to develop these plans. WRD is the lead agency for coordination of these efforts. It is recommended that LADWP continue to provide input for preparation of salt/nutrient management plans for the West Coast Groundwater Basin and Central Groundwater Basin in order to comply with the SWRCB Recycled Water Policy.

SWRCB General Landscape Irrigation Permit

The existing WRR and WDR for the DCTWRP, LAGWRP, and TIWRP allow landscape irrigation with recycled water. It is not necessary for the City to apply for a General Landscape Irrigation Permit to address existing or proposed irrigation uses; however, it may be advantageous, based on a detailed analysis of the WRR and WDR with the provisions of the General Permit. Preliminary comparison of the WRR and WDR with the General Landscape Irrigation Permit indicates that transferring to the new permit would add new requirements for landscape irrigation which are not specifically included in the current WRR, but may reduce other requirements which are imposed by the WDR. Examples of these new requirements include runoff limits and irrigation management plans for coordination of recycled water application rates for specific types of landscaping. Although such procedures may be indicative of a well-managed program, the current WRR do not specifically include these requirements. Examples of less restrictive requirements under the General Permit may include triggers for groundwater monitoring and attenuation studies, which are included the current WDR.

On this basis, it is recommended that detailed evaluations of the existing WRR and WRR for the DCTWRP, LAGWRP, and TIWRP be prepared to facilitate a comparison with the requirements that would be imposed if the City elects to apply for General Landscape Irrigation Permits.

RWQCB General Non-Irrigation Reuse Permit

The existing WRR and WDR for the DCTWRP, LAGWRP, and TIWRP allow recycled water for non-irrigation uses in accordance with Title 22. It is not necessary for LADWP to apply for a General Non-Irrigation Reuse Permit in order to address existing or proposed non-irrigation uses. The main purpose of the RWQCB General Non-Irrigation Reuse Permit is to streamline the permitting process and delegate administrative authority for non-irrigation uses to the local agency. LA County DPH already provides on-site inspections for backflow prevention and the RWQCB administers the existing WRR, which cover non-irrigation uses. For these reasons, it is recommended that a detailed analysis of the existing WRR and WDR for the DCTWRP, LAGWRP, and TIWRP be prepared to determine if it would be advantageous to apply for General Non-Irrigation Reuse Permits.

Other General Regulatory and Policy

During this review of existing recycled water regulations and policies, the following additional conclusions and recommendations are offered for LADWP's consideration.

The City presently has no standard agreement for recycled water service. Instead, the City has service agreements with individual customers which are unique and must be approved by the LADWP Board of Water and Power Commissioners. To improve and expand its recycled water system, it is recommended that LADWP develop a standard agreement for recycled water service. Recognizing that a draft standard agreement is in progress, and it is further recommended that a standard recycled water service agreement be adopted in 2010 in order to enhance LADWP's ability to expand recycled water use and meet the 2014 goals.

The City currently utilizes the "Recycled Water Urban Irrigation User's Manual" prepared LACRWAC, the Los Angeles chapter of the California Section of the WateReuse Association in 2005 to provide operational information for its recycled water customers.

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Appendix C

Integrated Alternatives Development and Analysis TM

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Integrated Alternatives Development and Analysis TM

Prepared by:

RMC in association with CDM Smith

LADWP
City of Los Angeles Sanitation Department of Public Works

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Technical Memorandum

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Date:	March 2012
Reference:	Task 2b: Non Potable Reuse Master Plan and Project Management Task 2.9: Integrated Alternatives Development and Analysis

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Executive Summary

The Los Angeles Department of Water and Power (LADWP), in partnership with the Los Angeles Department of Public Works, Bureau of Sanitation (BOS), and Bureau of Engineering (BOE), developed the Recycled Water Master Planning Documents (RWMP). The RWMP documents include the development and evaluation of several integrated alternatives – strategies that take into account forward-looking groundwater replenishment (GWR) options as well as the more familiar form of recycling water for non-potable reuse (NPR) purposes such as irrigation and industry.

The Final Integrated Alternatives Development and Analysis (IAA) Technical Memorandum documents a thorough examination of alternatives that integrate multiple recycled water management strategies, satisfy master planning objectives, and would meet the City's goals for increasing the use of recycled water.

LADWP's 2010 Urban Water Master Plan (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 non-potable reuse and barrier supplement in the Dominguez Barrier Gap. An additional 11,350 AFY of proposed NPR projects are in development. The focus for the near-term, therefore, is to develop the remaining 39,650 AFY of recycled water in Los Angeles.

The original recycled water goal for the RWMP was 50,000 AFY, which was established before the completion of the 2010 UWMP. The recycled water goal was increased to 59,000 AFY with the issuance of the 2010 UWMP. The integrated alternatives analysis was initially 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. While the themes and integrated alternatives of this Technical Memorandum were developed to meet the 50,000 AFY goals, it should be noted that the resulting findings and conclusions would not change if the alternatives were based on 59,000 AFY.

This Integrated Alternatives Analysis TM includes preliminary capital and operations and maintenance (O&M) cost estimates to help determine the split of GWR and NPR to meet the City's recycled water goals. To provide consistency between the initial RWMP documents, the following documents were updated to include the same cost estimates:

- Site Assessment TM
- Integrated Alternatives Development and Analysis TM (this document)
- Integrated Alternatives Analysis – Preliminary Cost Summary

Note that the GWR and NPR project costs were developed in more detail as part of the GWR and NPR Master Planning Reports, respectively. The most current GWR and NPR project costs developed as part of the RWMP are included in the GWR and NPR Master Planning Reports, respectively, and would not change the outcome of this analysis.

ES.1 Overview Statement

For this technical study, independent recycled water management strategies – such as groundwater replenishment (GWR), non-potable reuse (NPR), maximum reuse, and satellite reuse -- were combined to develop integrated alternatives with the goal of replacing potable water supplies with recycled water.

The integrated alternatives analysis compared different alternatives formed by several overarching themes. Each of the themes includes varying amounts of GWR in the San Fernando Basin (from 15,000 AFY to 30,000 AFY).

Comparing alternatives with varying GWR capacities gave insight as to what combination of GWR and NPR projects may best meet the City's recycled water goals. Ultimately, the analysis results formed the basis for planning recommendations for the Groundwater Replenishment and Non-Potable Reuse Master Planning Reports.

The organization of the draft Integrated Alternatives Development and Analysis Technical Memorandum is as follows:

Section 1 - Introduction

Section 2 - Integrated Alternatives Analysis Approach

Section 3 - Description of Alternatives

Section 4 - Evaluation Criteria and Performance Measures

Section 5 - Evaluation Results

Section 6 - Key Findings and Conclusions

Section 7 - References

Appendices

The results from the Integrated Alternatives Development and Analysis TM were the ranking of alternatives from highest to lowest, based upon meeting the objectives, performance criteria, and sensitivity tests. Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April 2011. Updated costs are shown in the GWR and NPR Master Planning Reports. Two other studies of similar technical detail and investigative scope were conducted concurrently with the integrated alternatives development and analysis: the assessment of potential sites for GWR projects and a GWR treatment pilot study. These three studies provided the technical foundation for the Groundwater Replenishment Master Planning Document.

ES.2 Integrated Alternatives Analysis Approach

Planning Objectives

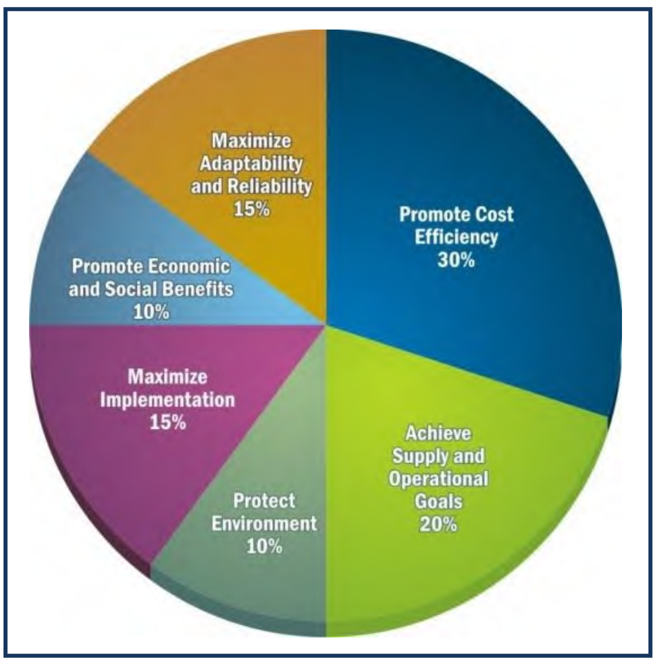
The studies for each of the planning documents mentioned in Section ES.1, including the Integrated Alternatives Development and Analysis, were based upon a common set of planning objectives, as follows.

Incorporating guidance from the Recycled Water Advisory Group (RWAG), 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. These are shown in Figure ES-1 along with their relative weights.

Figure ES-1: Objectives Weighting for the Integrated Alternatives Analysis



Alternative Evaluation Approach

The integrated alternatives are composed of different project options, which are single-focused concepts such as new supplies (e.g., expansion of existing water reclamation plants, additional level of treatment, and/or new satellite plants) and new conveyance/distribution facilities to meet new demands (e.g., NPR and GWR). Individual project options cannot fully achieve all the RWMP goals; instead, project options form the building blocks for each of the integrated alternatives.

Figure ES-2 illustrates the approach used to develop and evaluate the integrated alternatives.

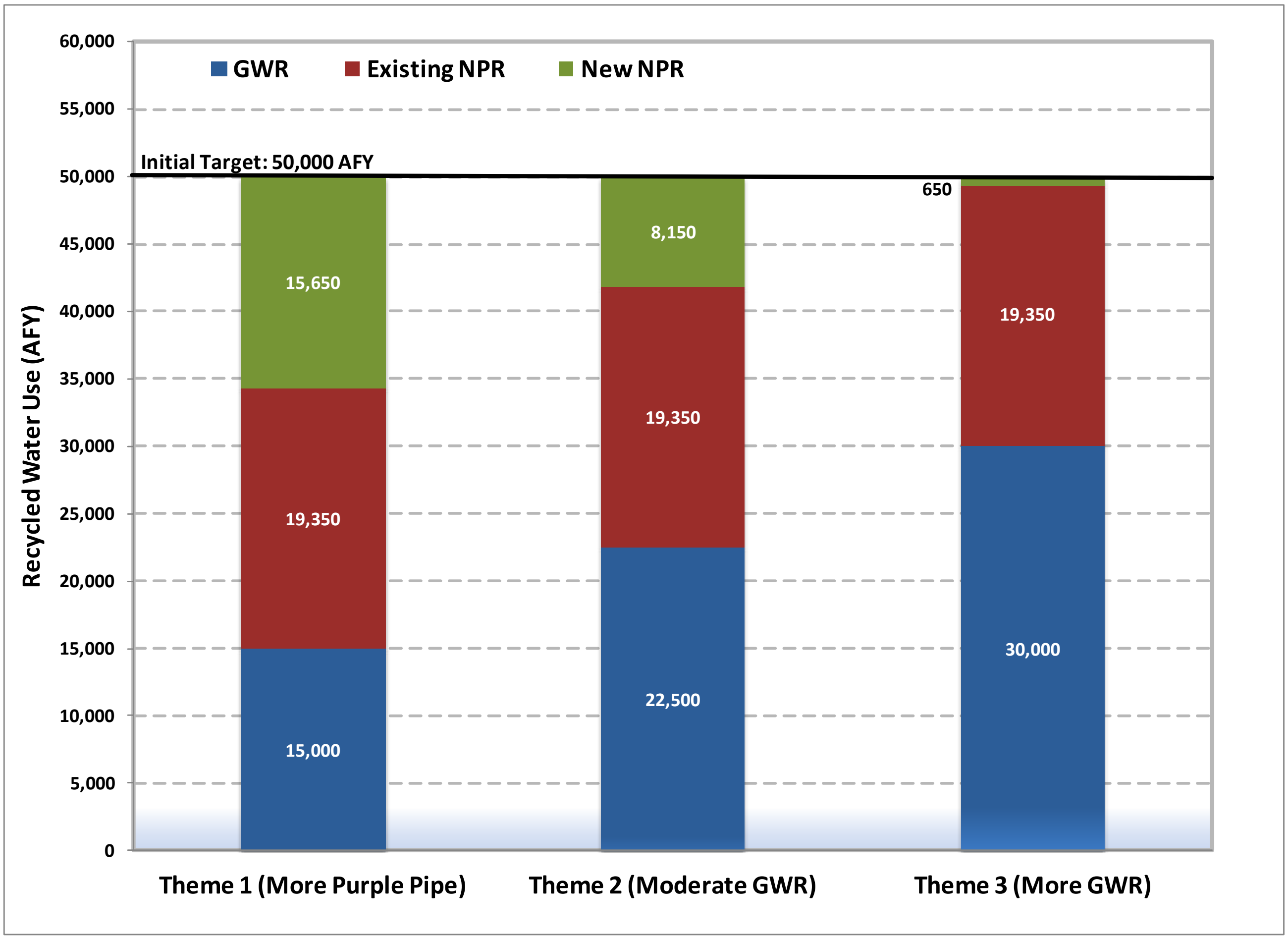
Figure ES-2: Integrated Alternatives Development and Analysis Approach

Themes

As shown in Figure ES-3, three themes were established to guide the development of integrated alternatives. Themes included the following:

- **Theme 1**: More Purple Pipe (NPR): GWR = 15,000 AFY
- **Theme 2**: Moderate GWR: GWR = 22,500 AFY
- **Theme 3**: More GWR: GWR = 30,000 AFY

Figure ES-3: Themes for the Integrated Alternatives Analysis

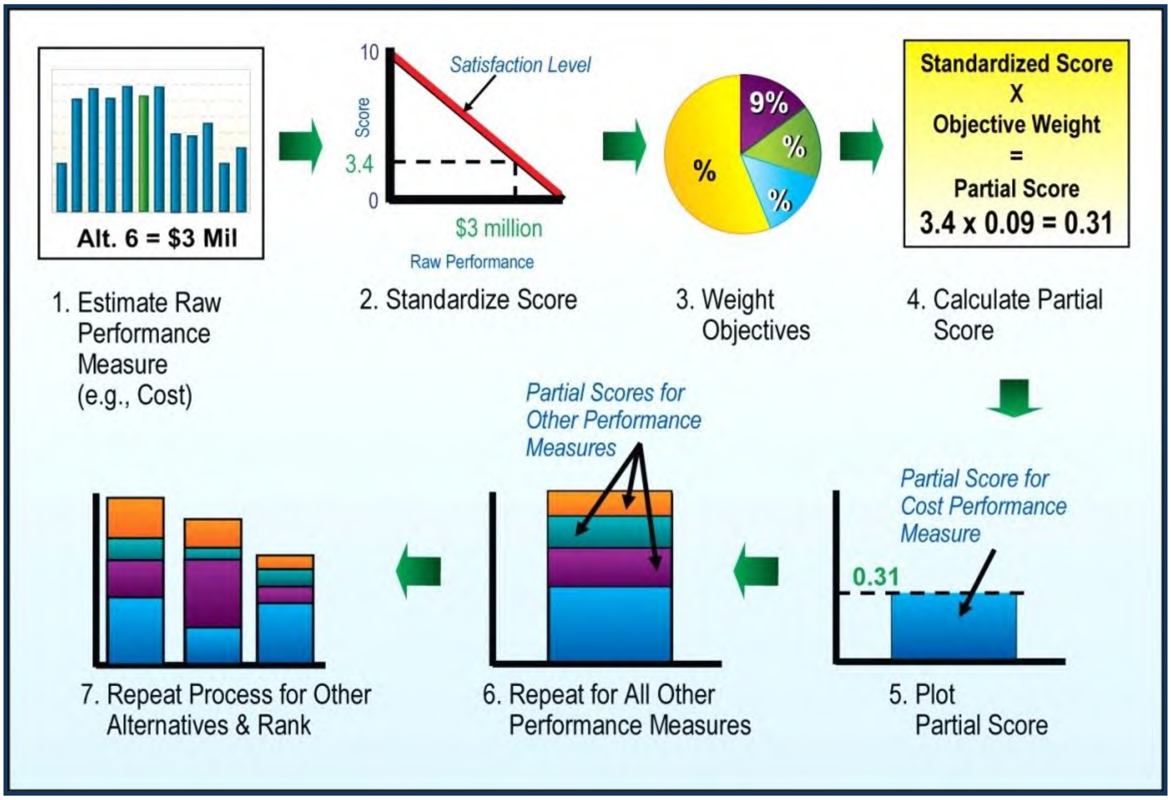


Note: The original recycled water goal for the RWMP was 50,000 AFY, which was established before the completion of the 2010 UWMP. The recycled water goal was increased to 59,000 AFY with the issuance of the 2010 UWMP. The integrated alternatives analysis was initially focused on determining the balance 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. While the themes and integrated alternatives of this Technical Memorandum were developed to meet the 50,000 AFY goals, it should be noted that the resulting findings and conclusions would not change if the alternatives were based on 59,000 AFY.

Decision Model Process

Figure ES-4 below illustrates the seven-step evaluation process that was performed for each alternative.

Figure ES-4: Multi-Attribute Rating Technique for Evaluating Alternatives



The process of evaluating multiple alternatives for multiple criteria is extremely complex. Planners use computer software to do the evaluation accurately and to help support the selection of a preferred alternative. For this evaluation, the planners used a multi-attribute decision model (computer software) called Criterium® DecisionPlus® (CDP).

Briefly, the seven steps can be described as follows:

1. **Estimate the raw performance measure.** The RWMP team determined how to measure performance, for example, tons of CO_2 emissions was used as a quantitative measure of the objective Protect Environment; while other objectives were evaluated using qualitative scores 1 to 5. In the first step, the CDP was used with this input to estimate a raw score for each alternative for further refinement.

2. **Standardize the score.** Because the performance measures vary significantly – dollars, tons, numeric score of 1 – 5, etc. – the next step was to standardize the raw performance measures into comparable numeric scores. This enables the scores to be additive (the higher the score, the better the performance).

3. **Weight the objectives.** Early in the planning process, LADWP and BOS, RWAG members, and others participated in a weighting exercise. This resulted in the weighted percentages for each planning objective shown in Figure ES-1. The CDP weights evaluation criteria in terms of their importance to the overall RWMP objectives.

4. **Calculate a partial score.** A standardized score (step 2) was multiplied by its relative weight of importance (step 3) to arrive at a partial score for a particular alternative.

5. **Plot the partial score.** The partial score (step 4) was plotted on a graph to represent the results of the individual performance measure for the alternative.

6. **Repeat for all other performance measures.** Steps 1 – 5 were repeated for all of the performance measures until a total score for the alternative was calculated.

7. **Repeat the process for other alternatives and rank them.** Steps 1 – 6 were repeated for each of the alternatives. This produced graphs showing the total score for each alternative. Then the total score for each alternative was compared and ranked to other alternatives.

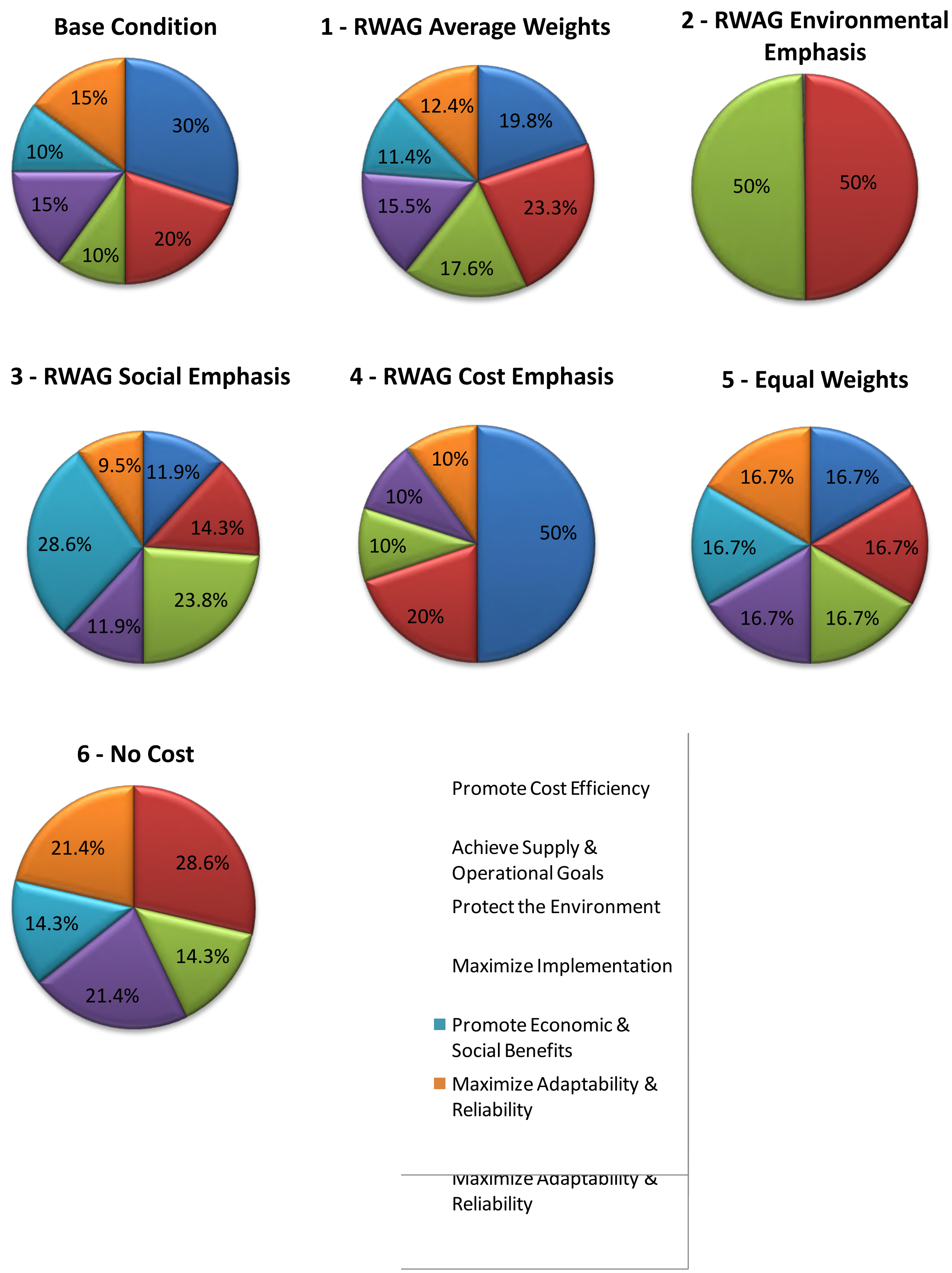
Sensitivity Analysis

Sensitivity analyses helped verify the robustness of the initial alternatives rankings. Using input from RWAG members, six sensitivity runs were developed by the RWMP team:

1. Average weights
2. Environmental emphasis
3. Social emphasis
4. Cost emphasis
5. Equal weights for all objectives
6. Cost = 0% weight (cost not considered in the comparison of alternatives)

The modified objectives weightings for the sensitivity runs are displayed graphically in Figure ES-5.

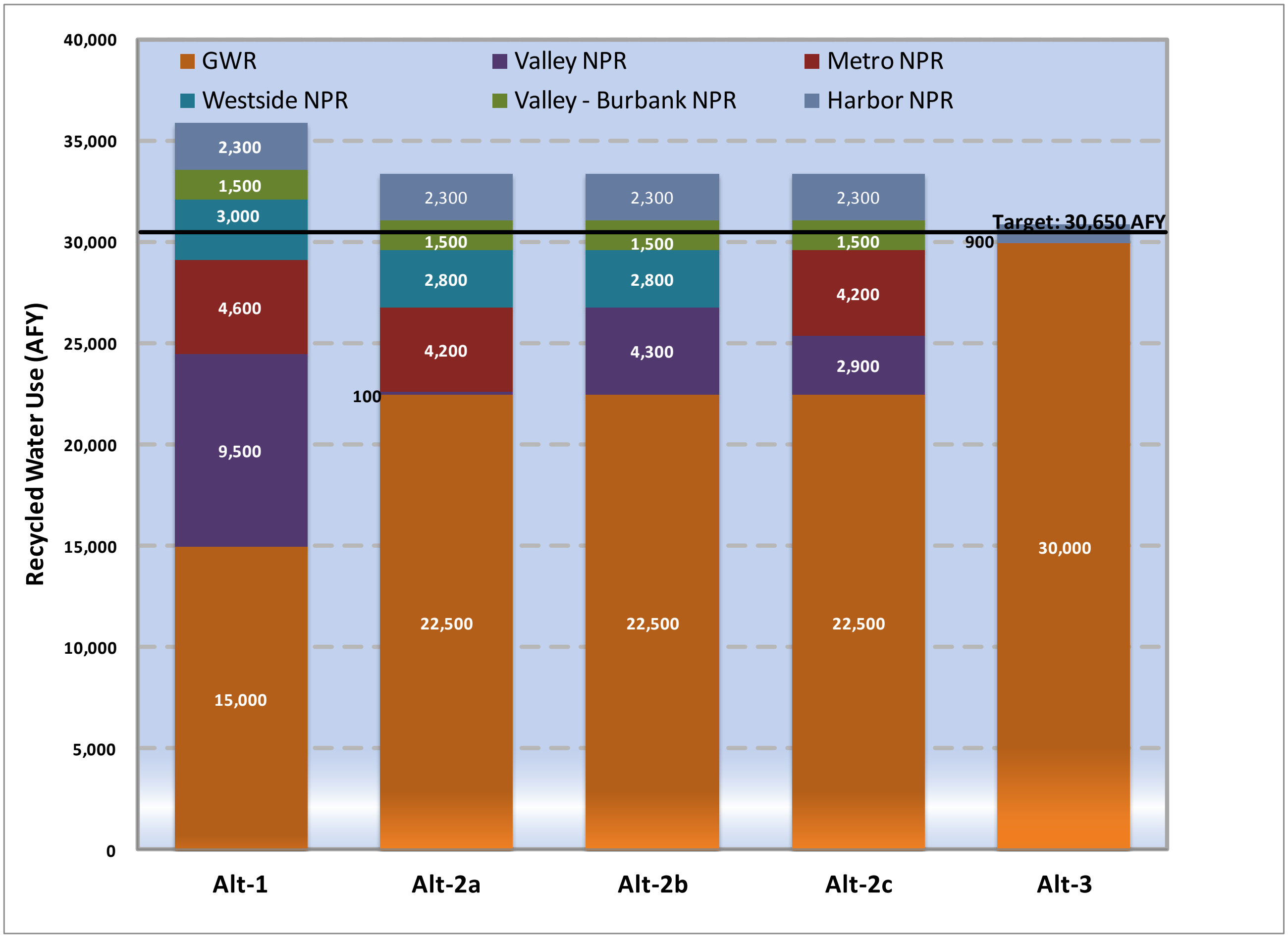
Figure ES-5: Modified Objectives Weightings for Sensitivity Analysis



ES.3 Alternatives Development and Evaluation

Candidate alternatives were developed based upon the three Themes discussed earlier. The alternatives combined GWR and NPR projects to meet the different targets established by the themes. Figure ES-6 compares each of the alternatives for the volume of GWR and NPR that would be distributed to the seven service areas and sub-areas analyzed.

Figure ES-6: Comparison of Alternatives -- GWR and NPR by Service Area



Note: Amounts shown above do not include existing and planned non-potable reuse and barrier supplement projects that total an average annual reuse of 19,350 AFY.

The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

GWR Assumptions in Alternatives

All alternatives include GWR in varying capacities. For this Technical Memorandum, it was assumed that GWR included the following facilities:

- New Advanced Water Purification Facility (AWPF), treating DCTWRP tertiary product via microfiltration and reverse osmosis (MF/RO) and providing advanced oxidation via ultra violet (UV) light and hydrogen peroxide.
- Existing/New Conveyance pipelines from AWPF to Hansen and Pacoima Spreading Grounds for replenishment into the San Fernando Groundwater Basin
- Existing Extraction wells to pump groundwater from San Fernando Groundwater Basin to drinking water distribution system.[1]

Another key assumption for this TM is that the potential location for the AWPF is either the City's DCTWRP or Valley Generating Station (VGS).

A total of 10 near-term integrated alternatives were evaluated, which are described in Table ES-1, Alternatives, Summary of Recycled Water Volume by Component.

[1] As a separate project to improve the groundwater quality in the San Fernando Basin, the City is planning the San Fernando Basin Groundwater Treatment Complex. Since this project is being pursued in parallel to the GWR Project, the costs for this program are not included in this integrated alternatives analysis.

Table ES-1: Alternatives – Summary of Recycled Water Volume by Component

		DCT Alternatives					VGS Alternatives				
		Alternative 1	Alternative 2			Alternative 3[b]	Alternative 1	Alternative 2			Alternative 3[b]
		Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
		(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)
GWR	Valley	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000
NPR	Valley	9,500	100	4,300	2,900	0	9,500	100	4,300	2,900	0
	Metro	4,600	4,200	0	4,200	0	4,600	4,200	0	4,200	0
	Westside	3,000	2,800	2,800	0	0	3,000	2,800	2,800	0	0
	Valley-Burbank	1,500	1,500	1,500	1,500	0	1,500	1,500	1,500	1,500	0
	Harbor	2,300	2,300	2,300	2,300	900	2,300	2,300	2,300	2,300	900
	NPR Total	20,900	10,900	10,900	10,900	900	20,900	10,900	10,900	10,900	900
	NPR Total – With Contingency	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700
Total Without Contingency		35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900
Total With Contingency[a]		30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700

Footnote:

a. *The total is rounded from 30,650 AFY to 30,700 AFY for simplicity.*
b. *The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.*

ES.4 Evaluation Criteria and Performance Measures

The RWMP team developed criteria and performance measures to evaluate the alternatives identified in the previous section. Table ES-2 lists the evaluation criteria and performance measures that were used in the CDP decision-model to analyze and rank the integrated alternatives.

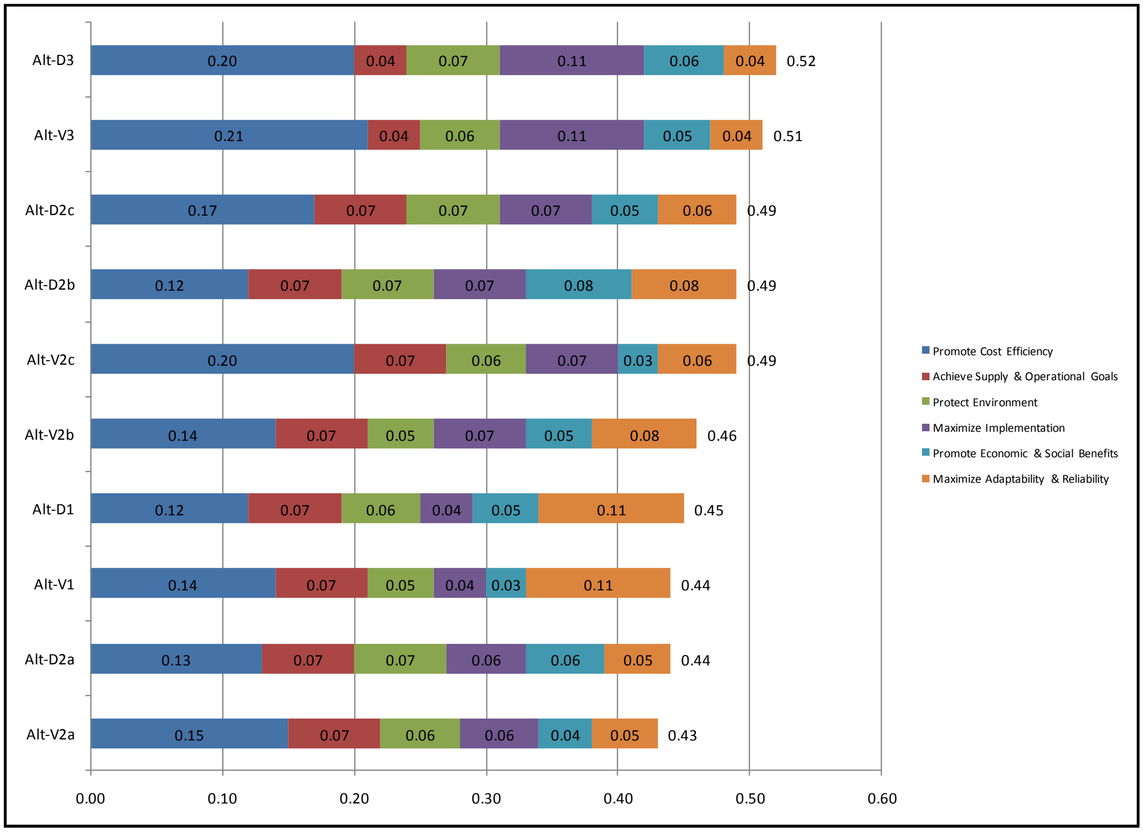
Table ES-2: Planning Objectives and Evaluation Criteria and Performance Measures

Objectives	Evaluation Criteria and Performance Measures
Objective 1: Promote Cost Efficiency	▪ Unit capital cost ▪ Unit annual operations & maintenance (O&M) cost
Objective 2: Achieve Supply and Operational Goals	▪ Reduction in imported water ▪ Water system flexibility ▪ Overall wastewater system benefits 1. Hyperion Treatment Plant (HTP) service area collection system (sewer system) benefits 2. HTP treatment impacts 3. Terminal Island Water Reclamation Plant benefits
Objective 3: Protect Environment	▪ Groundwater quality ▪ Greenhouse gas emissions
Objective 4: Maximize Implementation	▪ Public acceptance ▪ Institutional complexity ▪ Permitting ▪ Implementation complexity ▪ Construction impacts
Objective 5: Promote Economic and Social Benefits	▪ Temporary job creation ▪ Permanent job creation ▪ Environmental justice
Objective 6: Maximize Adaptability and Reliability	▪ Recycled water demand reliability ▪ Water supply reliability

ES.5 Evaluation Results

The chart below shows the results of the CDP decision-model evaluation to analyze and rank the integrated alternatives. Figure ES-7 shows the scores and ranking of the alternatives.

Figure ES-7: Alternatives Scoring (In Order of Ranking)



Sensitivity Analysis

Sensitivity analyses were conducted on all alternatives using the CDP decision model. The sensitivity runs involved deliberately altering the objectives weightings to determine sensitivity to the specific objectives. Table ES-3 summarizes the Integrated Alternatives scoring for base and sensitivity runs. The left column of the table lists the objective weighting that was altered to examine sensitivity to that objective. Ideally, sensitivity runs would have no effect on the highest ranked alternatives, meaning that the alternative was not sensitive to different interests and scenarios.

Table ES-3: Summary of Alternatives Scoring for the Base Run and Sensitivity Runs

	CDP Rankings									
	Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
0 Base	7	8	3	3	1	8	10	6	3	2
1 RWAG Average Weights	7	8	2	4	1	10	9	5	5	3
2 RWAG Environmental Emphasis	4	1	3	1	5	9	5	8	7	10
3 RWAG Social Emphasis	8	5	3	3	1	10	9	6	7	2
4 RWAG Cost Emphasis	9	10	8	4	3	5	5	5	1	2
5 Equal Weights	5	7	1	3	2	9	9	6	7	3
6 No Cost	2	6	1	4	4	7	10	3	9	7
Average Ranking	6.0	6.4	3.0	3.1	2.4	8.3	8.1	5.6	5.6	4.1
Total Number of Times Ranked No.1	0	1	2	1	3	0	0	0	1	0

Color Coding of Rankings:

1	2	3	4	5	6	7	8	9	10

Highest Ranked ← → Lowest Ranked

ES.6 Key Findings and Results

The key findings from the CDP evaluation of Integrated Alternatives are summarized below:

Alternatives That Ranked Higher Than Others

Alternatives D3, D2b, D2c and V3 consistently ranked highest among all alternatives evaluated. Alternatives D3 and V3 (More GWR):

- Rank strongly due to their having the lowest capital costs, nearly the lowest O&M costs, and the highest operational flexibility.
- Do not require any agreements with outside agencies, have the least amount of individual NPR projects, and the lowest potential construction impacts (e.g., miles of pipe through streets).
- Have the lowest temporary job creation (estimated as a function of capital costs)
- Have the highest estimated permanent jobs created.
- Impact the least number of low-income and/or minority census tracts with permanent above-grade facilities.
- Are considered to be less drought-proof than other alternatives since D3 and V3 have the lowest NPR irrigation quantity. Title 22 recycled water is considered a drought-proof water supply because is not subject to water use restrictions.
- Do not have the highest scores for protecting the environment, primarily because of Greenhouse Gas emissions related to pumping.

Alternatives That Ranked Lower Than Others

Alternatives V1, V2a, D2a, and D1 ranked lowest among all alternatives evaluated. These alternatives would achieve 15,000 AFY (V1 and D1, More Purple Pipe) and 22,500 AFY (V2a and D2a, Moderate GWR) respectively. They consistently ranked low due to their emphasis on NPR project options in the dense and built-up Metro and Westside service areas, which increase the amount of recycled water pipelines required.

Conclusion: More GWR (Alternative D3) is Best

Based on this integrated analysis, it was concluded that More GWR (Alternative D3) is best, since it has the lowest cost (capital and operation and maintenance (O&M) costs) and the fewest hurdles for implementation.

Therefore, it is recommended that the GWR Master Planning Report be developed with facilities planning for the more aggressive GWR alternative (30,000 AFY). But, to recognize the supply reliability benefits and potential ability to implement smaller individual projects as funding becomes available, it is also recommended that the NPR Master Planning be developed identifying potential NPR projects to be developed in parallel.

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1. Introduction

The purpose of this TM is to combine independent project options (e.g., groundwater replenishment (GWR), non-potable reuse (NPR), maximum reuse, and satellite reuse) into integrated alternatives with the goal of replacing imported water with recycled water. These integrated alternatives will be evaluated to understand their benefits and tradeoffs, and ultimately establish planning recommendations for the GWR and NPR Master Planning Reports.

The initial basis for GWR and NPR Master Planning was to provide a framework to achieve 50,000 AFY, tentatively by 2030. Therefore, the analysis in this TM was based upon achieving this goal. However, the City's 2010 UWMP calls for 59,000 AFY of imported water to be replaced by recycled water by 2035, which serves as the updated recycled water goal for the RWMP. While the alternatives in this TM were developed to meet the 50,000 AFY goals, it should be noted that the resulting findings and conclusions would not change if the alternatives were based on 59,000 AFY. Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April 2011. Updated costs are shown in the GWR and NPR Master Planning Reports.

The City has existing[2] non-potable reuse and barrier supplement projects with an 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. Therefore, the goal of alternatives developed as part of this TM is to offset the remaining 39,650 AFY of imported water.

The integrated alternatives analysis seeks to compare different alternatives that are formed by several overarching themes, where the different focus of each theme provides opportunities for understanding tradeoffs. In particular, each theme includes varying amounts of GWR in the San Fernando Valley to provide insight as to what combination of GWR and NPR may provide the best solution to meet the City's recycled water goals. The alternatives will be compared and ranked according to the RWMP objectives for the City's consideration to achieve the recycled water goals.

This Integrated Alternatives Analysis TM includes preliminary capital and operations and maintenance (O&M) cost estimates to help determine the split of GWR and NPR to meet the City's recycled water goals. To provide consistency between the initial RWMP documents, the following documents were updated to include the same cost estimates:

- Site Assessment TM
- Integrated Alternatives Development and Analysis TM (this document)
- Integrated Alternatives Analysis – Preliminary Cost Summary

Note that the GWR and NPR project costs were developed in more detail as part of the GWR and NPR Master Planning Reports, respectively. The most current GWR and NPR project costs developed as part of the RWMP are included in the GWR and NPR Master Planning Reports, respectively, and would not change the outcome of this analysis.

[2] For the purposes of accounting in this TM, "existing" customers are those that were served as of December 1, 2011.

This Integrated Alternatives Development and Analysis TM is organized into the following sections:

Section 1 – **Error! Reference source not found.**

Section 2 – Integrated Alternatives Analysis Approach

Section 3 – Description of Alternatives

Section 4 - Evaluation Criteria and Performance Measures

Section 5 – Evaluation Results

Section 6 – Key Findings and Conclusions

Section 7 - References

Appendices

2. Integrated Alternatives Analysis Approach

Due to the complexity of decision-making associated with the integrated alternatives analysis, a detailed evaluation process was developed to enable the comparison of various alternatives using multiple criteria. This section outlines the overall approach for the analysis starting with a review of the RWMP objectives that guide the formation of integrated alternatives followed by the an evaluation process to compare and rank alternatives in how they meet those objectives. This section also describes the framework used for the detailed evaluation, including the decision model process.

2.1 Recycled Water Master Planning Objectives

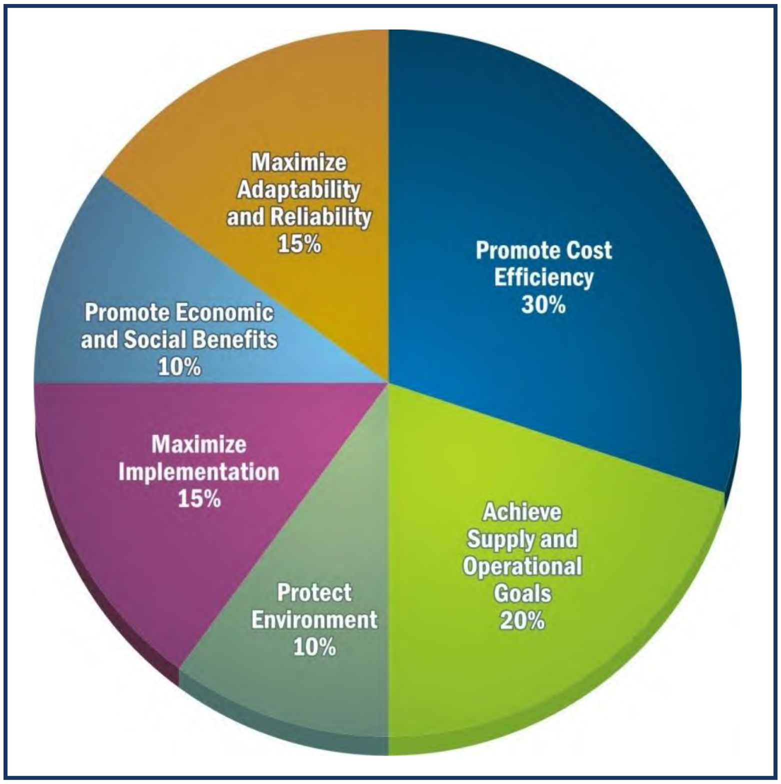
Establishing planning objectives was an early step in the planning process. Objectives support the goals of the RWMP and establish criteria by which alternatives can be compared against each other. Several guidelines were used when establishing objectives. The objectives must be: easy to understand; non-redundant; measureable with evaluation criteria; and, concise in numbers, generally no more than five to eight objectives. 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.

The objectives were developed based on guidance from the community Recycled Water Advisory Group (RWAG), which is a group of Los Angeles residents who represent specific community groups and their interests. The RWAG provided feedback about the RWMP throughout the planning Process. The following objectives were developed and used for the RWMP evaluations:

- **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.
- **Objective 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.
- **Objective 2 – Achieve Supply and Operational Goals:** Meet or exceed water supply targets and operational goals established by the City.
- **Objective 3 – Protect Environment:** Develop projects that not only protect the environment, but also provide opportunities to enhance it.
- **Objective 4 - Maximize Implementation:** Maximize implementation by minimizing typical hurdles including institutional complexity, permitting challenges, and maximizing customer acceptance.
- **Objective 5 - Promote Economic and Social Benefits:** Provide economic and social benefits in the implementation and operation of recycled water projects.
- **Objective 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.

To determine the relative weights of the objectives, the RWMP team established preliminary weightings for the RWMP tasks. The objectives weightings for the integrated alternatives analysis are presented graphically in **Figure 2-1**. The two threshold criteria are not included in this chart because all alternatives need to meet the threshold criteria in order to be considered.

Figure 2-1: Objectives Weighting for the Integrated Alternatives Analysis



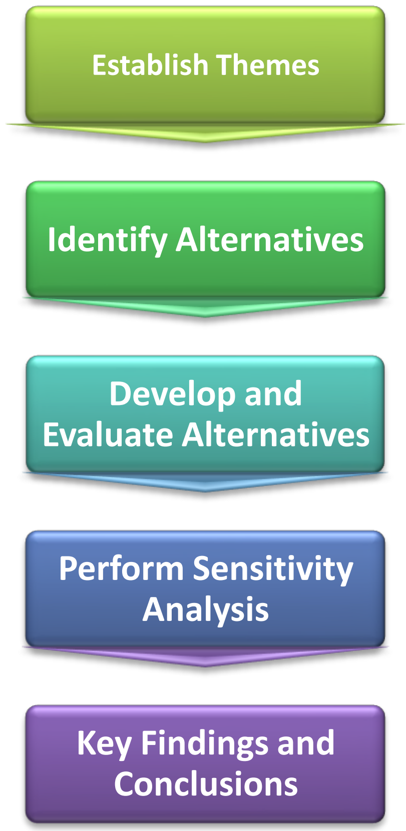
In addition, the City also conducted a weighting exercise with the members of the RWAG at their first meeting in December 2009. The RWAG objectives weightings were used in the sensitivity analysis, which is described in Section 2.3.1.

2.2 Alternatives Evaluation Approach

The integrated alternatives are composed of different project options, which are single-focused concepts such as new supplies (e.g., expansion of existing water reclamation plants, additional level of treatment, and/or new satellite plants) and new conveyance/distribution facilities to meet new demands (e.g., NPR and GWR). These project options were evaluated and documented in the Groundwater Replenishment Master Planning Report (GWR MPR) and the Non-Potable Reuse Master Planning Report (NPR MPR). Individual project options cannot fully achieve all the RWMP goals; instead, project options form the building blocks for each of the integrated alternatives. The following describes the approach used to develop and evaluate the integrated alternatives.

The alternatives evaluation approach is presented in **Figure 2-2** and described in detail in the following steps.

Figure 2-2: Alternatives Development and Evaluation Approach



Step 1: Establish Themes

Overarching themes were established to guide the development of alternatives that have different focuses in order to provide opportunities for trade-off comparisons. To evaluate the relative complexity of attaining GWR permitting, three themes with varying GWR capacities were identified to meet the original goal of 30,650 AFY, supplemented by NPR or additional GWR projects:

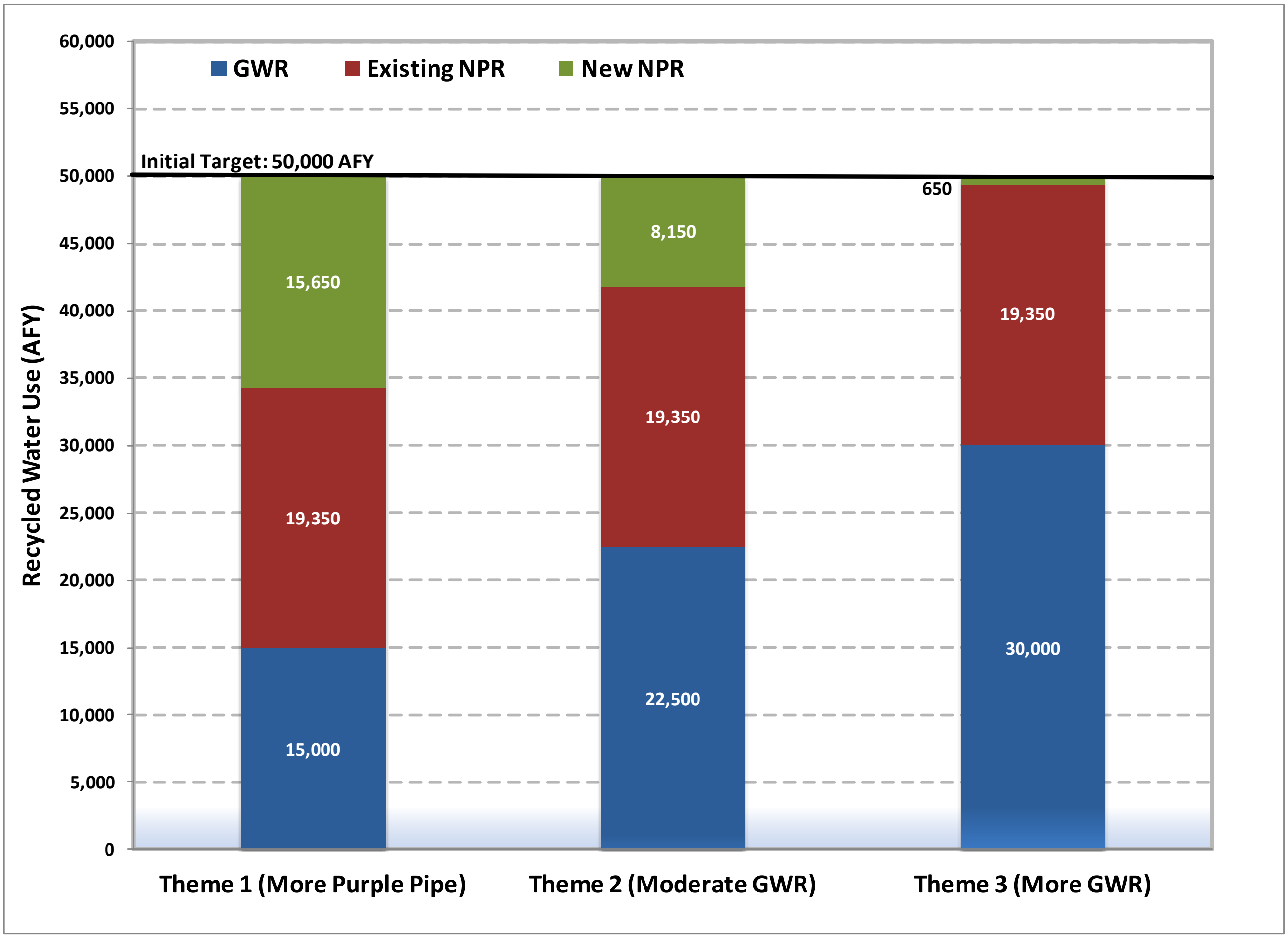
Theme 1 – "More Purple Pipe (NPR)": GWR = 15,000 AFY

Theme 2 – "Moderate GWR": GWR = 22,500 AFY

Theme 3 – "More GWR": GWR = 30,000 AFY

Figure 2-3 summarizes the themes and Section 3.1 provides additional details.

Figure 2-3: Themes for the Integrated Alternatives Analysis



Step 2: Identify Alternatives

The alternatives are integrated combinations of available project options that represent a means of accomplishing the RWMP goals. Each alternative identified is based on the themes from Step 1. After the main alternatives were identified, different option variations were applied to create more focused scenarios pertaining to different NPR project portfolios and GWR site. See Section 3.2 for more details.

Step 3: Develop and Evaluate Alternatives

After the alternatives were identified in Step 2, further technical assumptions and assessment (e.g., facility sizing, energy costs, etc.) were developed based on the different project options that compose a particular alternative. These performance measures were used as the basis of comparison between the different alternatives with respect to the RWMP objectives described in Section 2.1. For each objective, evaluation criteria (or sub-objectives) were established to further define the meaning of the objectives. A performance measure was defined for each evaluation criterion as a quantitative value to determine how well an alternative meets a given evaluation criteria and objective. See Section 4 for more details on how evaluation criteria and performance measures were assigned to each alternative.

After performance measures were assigned to the alternatives, each alternative was ranked with respect to the objective weighting identified in Section 2.1. See Section 2.3 for more details on the decision model process; see Section 5 for the decision model results.

Step 4: Perform Sensitivity Analysis

After the initial decision model run using the base condition objectives weightings, a series of sensitivity runs were also conducted using the decision model. The sensitivity runs involved altering the objectives' weightings based on the RWAG weightings to verify the robustness of the initial alternatives rankings. If the alternatives rankings change with the sensitivity runs, then this means that the alternative selection was sensitive to that particular element that was emphasized in the sensitivity run. See Section 2.3.1 for more details on the sensitivity analysis approach; see Section 5.3 for the sensitivity analysis results.

Step 5: Key Findings and Preferred Alternatives

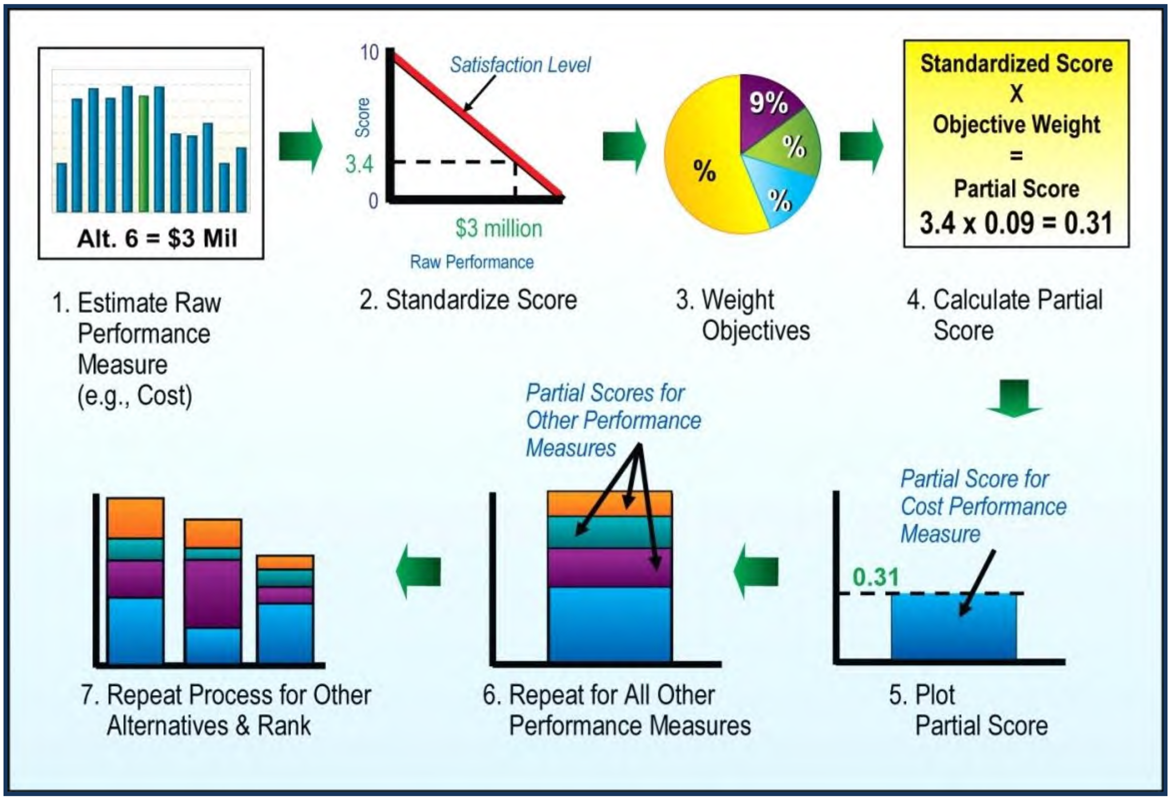
Once the alternatives are ranked using the results of the decision model results and sensitivity analysis, the City can use the key findings discussed in Section 6 and their financial analysis to identify preferred options for moving forward to meet the original 30,650 AFY goal. The timing for the individual projects within the preferred alternative would be refined with the financial analysis.

2.3 Decision Model Process

As stated in Step 3, a decision model based on a multi-attribute rating methodology was developed to support the selection of a preferred alternative. The objectives, evaluation criteria, and performance measures for each alternative were inputs to the decision model. Developing such a decision model is helpful when there are multiple alternatives that can be measured differently against multiple criteria, and when no single alternative clearly performs the best in all areas. In these cases, systematizing the decision process by explicitly defining and weighting criteria and then giving scores to the alternatives for those criteria can make the ultimate decision easier and more objective.

The decision model based on the multi-attribute rating methodology was developed using the commercial software Criterium® DecisionPlus® (CDP). This software was developed by Infoharvest Inc., and was selected to rank the alternatives because of its sophistication, ease of understanding and use, and its ability to conduct sensitivity analyses. There are seven procedures in the multi-attribute rating technique, which are shown in **Figure 2-4**.

Figure 2-4: Multi-Attribute Rating Technique for Evaluating Alternatives



Descriptions of the seven procedures in Figure 2-4 are as follows:

1. Estimate Raw Performance Measure

The engineering analysis provides information about the raw performance of each alternative with respect to each of the criteria. The performance score can either be quantitative or qualitative in nature. For example, the objective to Protect Environment uses both Groundwater Quality evaluation criterion (with a qualitative performance measure based on a numeric scale from 1 to 5 as determined by expert opinion), and Greenhouse Gas Emissions evaluation criterion (with a quantitative performance measure of the metric tons of CO_2 equivalents emissions per year). For quantitative performances measures, a range of possible scores must be set. In the CDP model, the range of possible scores was set from 90% of the lowest score to 110% of the highest score.

2. Standardize Score

Because different criteria are measured in different units (e.g., lifecycle cost estimate is measured in dollars; public acceptance is ranked on a 1 to 5 scale, etc.), it is necessary to standardize the raw performance measures into comparable numeric scores. This ensures that all scores are additive (the higher the score, the better the performance of the alternative). In this example, the lifecycle cost estimate is an inverse function—meaning that the higher the cost, the lower the performance and vice versa. Based on a min-max technique using the capital cost of all alternatives in question, a linear satisfaction curve is generated to measure how the alternative satisfies the objective. As part of the internal process of CDP, the raw performance of a certain cost for an alternative is translated into a standardized score (where the score of 1 indicates the worst performance and the score of 5 indicates the best performance).

3. Weight Objectives

The criteria are weighted in terms of their importance to the overall RWMP objectives as described in Section 2.1.

4. Calculate Partial Score

A standardized score is multiplied by its relative weight of importance in order to get a partial score for a particular alternative.

5. Plot Partial Score

The partial score is then plotted on a graph for an alternative.

6. Repeat for All Other Performance Measures

This procedure is repeated for all of the other criteria for an alternative until a total score for the alternative is calculated.

7. Repeat Process for Other Alternatives & Rank

Finally, the total score for an alternative is compared to the total scores of the other alternatives in order to get a ranking or prioritization for implementation.

2.3.1 Sensitivity Analysis

As described in Step 4, sensitivity analyses were performed to verify the robustness of the initial alternatives rankings. A total of six sensitivity runs were conducted. The variations in objectives weightings for the sensitivity runs were developed based on input from the RWAG and the City. The six sensitivity runs are summarized below.

Sensitivity Runs 1 through 6: Modified Objectives Weighting

Sensitivity Runs 1 through 4 were developed based on input from the RWAG. At the first RWAG workshop in December 2009, the members completed a survey about the weightings for the RWMP objectives to reflect their interests. Based on the input from the RWAG, the following sensitivity runs were developed by the RWMP team:

- *Average Weights:* an average of the inputs on weightings from all RWAG members.
- *Environmental Emphasis:* weightings based on the inputs of RWAG members who felt the environment was their primary concern.
- *Social Emphasis:* weightings based on the inputs of RWAG members who felt that social issues were their chief concern.
- *Cost Emphasis:* weighting based on the inputs of RWAG members who felt that cost issues were their chief concern.

Sensitivity Runs 5 and 6 were developed by the RWMP team to test the alternatives rankings:

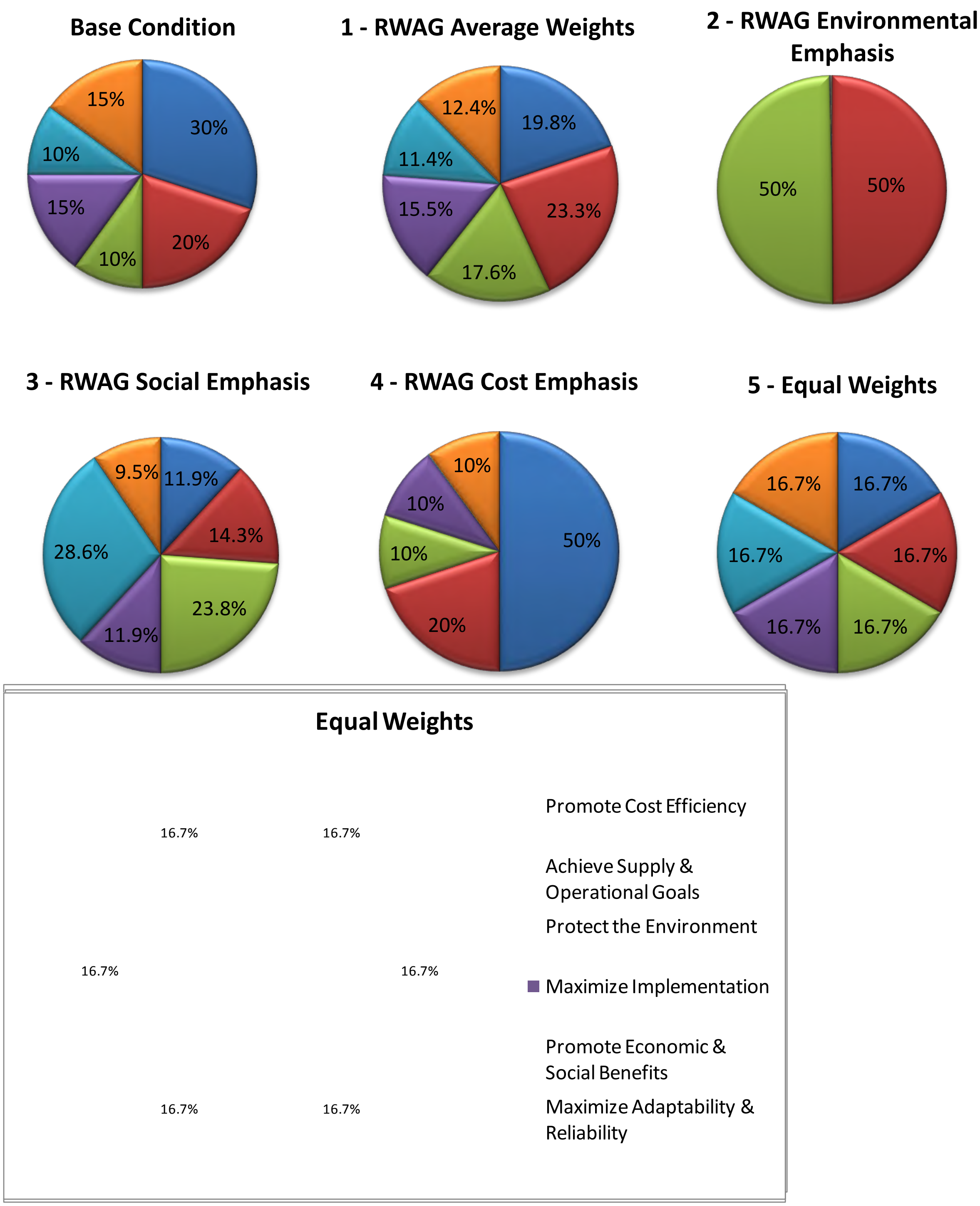
- *Equal Weights:* equal weighting for all objectives to see if the results change if none of the objectives are weighted higher than the others.
- *No Cost:* cost receives 0% weighting to see if the results change if cost is not an issue.

The modified objectives weightings for Sensitivity Runs 1 through 6 are summarized in Table 2-1 and displayed graphically in **Figure 2-5**.

Table 2-1: Modified Objectives Weightings for Sensitivity Analysis

Sensitivity Run Number	Base Condition	1 RWAG Average Weights	2 RWAG Environmental Emphasis	3 RWAG Social Emphasis	4 RWAG Cost Emphasis	5 Equal Weights	6 No Cost
Promote Cost Efficiency	30%	19.8%	0%	11.9%	50%	16.7%	0.0%
Achieve Supply & Operational Goals	20%	23.3%	50%	14.3%	20%	16.7%	28.6%
Protect the Environment	10%	17.6%	50%	23.8%	10%	16.7%	14.3%
Maximize Implementation	15%	15.5%	0%	11.9%	10%	16.7%	21.4%
Promote Economic & Social Benefits	10%	11.4%	0%	28.6%	0%	16.7%	14.3%
Maximize Adaptability & Reduce Risk	15%	12.4%	0%	9.5%	10%	16.7%	21.4%
Total	100%	100%	100%	100%	100%	100%	100%

Figure 2-5: Modified Objectives Weightings for Sensitivity Analysis



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3. Description of Alternatives

Expanding on the outline of steps in Section 2, this section describes the alternatives, including facility assumptions. Section 4 describes their associated evaluation criteria and performance measures. Then, the results of the decision model are presented in Section 5 and key findings are discussed in Section 6.

3.1 Themes

As described in Section 2.2, three overarching themes were formed based on different GWR production capacities that reflect different levels of permitting complexities. After the amount of GWR was set for each theme, NPR project options were used to supplement the remaining amount of recycled water use to achieve the original overall goal of 30,650 AFY. All themes have some NPR and GWR. The three themes are as follows:

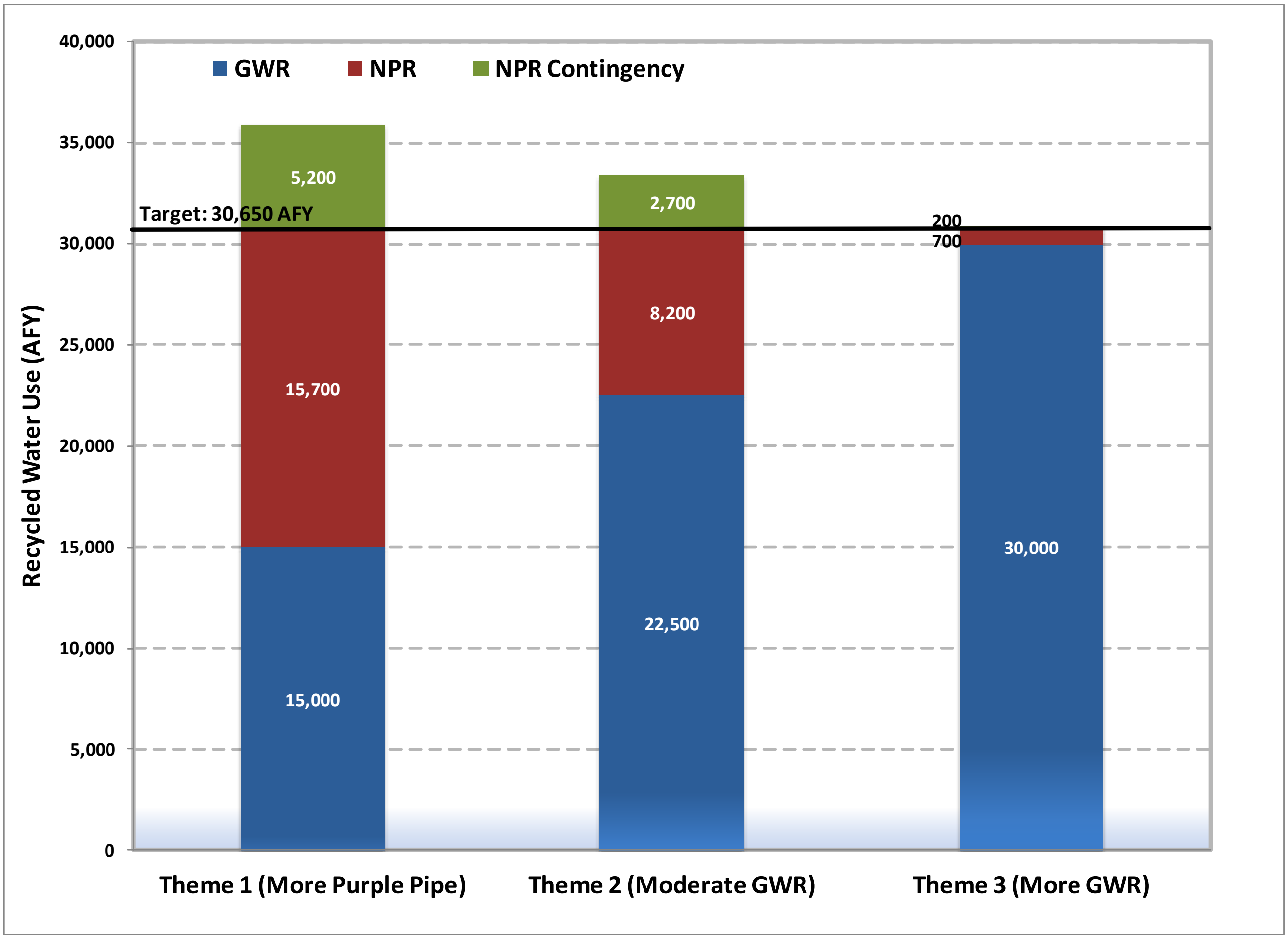
- **Theme 1 – More Purple Pipe (NPR) (GWR = 15,000 AFY, NPR = 15,650 AFY)**
  GWR of 15,000 AFY was chosen as the lower limit, because it is assumed to be achievable with 50/50 blend of purified recycled water and stormwater. The California Department of Public Health (CDPH) draft regulations (August 2008) in place at the time of this analysis in 2010 stipulated initial recycled water contribution (RWC) to be 50% for projects using purified recycled water, which could be achieved with 15,000 AFY.

- **Theme 2 – Moderate GWR (GWR = 22,500 AFY, NPR= 8,150 AFY)**
  GWR of 22,500 AFY was set between the lower (Theme 1) and upper (Theme 3) GWR limits. This size of GWR project would likely need to be implemented in phases to start at 15,000 AFY and be expanded to 22,500 AFY.

- **Theme 3 – More GWR (GWR = 30,000 AFY, NPR = 650 AFY)**
  GWR of 30,000 AFY was chosen as the upper limit because it is the maximum amount of purified recycled water that could be produced from Donald C. Tillman Water Reclamation Plant (DCTWRP) effluent available for GWR. This size of GWR project would likely need to be implemented in phases to start at 15,000 AFY and be expanded up to 30,000 AFY.

NPR demands can be uncertain because they rely on individual customers to convert to using recycled water. To ensure that the necessary amount of NPR can be achieved, additional projects and customers were identified as a contingency, which constitutes an additional 25% of the NPR demands. **Figure 3-1** shows the amounts of GWR and NPR as well as the NPR contingency for each theme.

Figure 3-1: Themes – GWR and NPR Targets



Note: Does not include existing and planned non-potable reuse and barrier supplement projects with an average annual reuse of 19,350 AFY.

3.2 Alternatives Identification and Variations

All alternatives are developed to meet the themes described in Section 3.1. Once the total amount of GWR was set and the required amount of supplemental NPR, including NPR contingency, was determined for each alternative, NPR project options were selected for each alternative. The following sections describe the five alternatives that were evaluated for this TM.

3.2.1 Theme 1 More Purple Pipe (NPR) - Alternative 1

Based on Theme 1, this alternative includes the minimum GWR amount of 15,000 AFY and maximum NPR projects (15,650 AFY) to meet the original recycled water use goal of 30,650 AFY. Therefore, Alternative 1 requires the most NPR projects among all alternatives. The assumed NPR customers and distribution system are shown in **Figure 3-2.** The NPR project portfolio for Alternative 1 includes:

- Valley Service Area, DCTWRP: 9,500 AFY

- Metro Service Area: 4,600 AFY
- Westside Service Area: 3,000 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY

3.2.2 Theme 2 Moderate GWR - Alternative 2a

Based on Theme 2 (Moderate GWR), this alternative includes moderate or mid-range GWR amount of 22,500 AFY and moderate NPR projects (8,150 AFY plus 2,750 AFY of contingency) as a supplement to meet the original recycled water use goal of 30,650 AFY. Alternative 2a includes a reduction of Valley NPR projects in order to preserve DCTWRP recycled water supply for future GWR expansion. The assumed NPR customers and distribution system are shown in **Figure 3-3**. The NPR project portfolio for Alternative 2a includes:

- Metro Service Area: 4,200 AFY
- Westside Service Area: 2,800 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY
- Valley Service Area, DCTWRP: 100 AFY

3.2.3 Theme 2 Moderate GWR - Alternative 2b

Similar to Alternative 2a, this alternative includes moderate GWR amount of 22,500 AFY and moderate NPR recommended projects (8,150 AFY plus 2,750 AFY of contingency) as a supplement to meet the original recycled water use goal of 30,650 AFY. However, Alternative 2b includes the elimination of Metro NPR projects since Metro NPR projects could be among the most difficult to implement due to its dependence on conversion of industrial customers. The assumed NPR customers and distribution system are shown in **Figure 3-5**. The NPR project portfolio for Alternative 2b includes:

- Valley Service Area, DCTWRP: 4,300 AFY
- Westside Service Area: 2,800 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY

3.2.4 Theme 2 Moderate GWR - Alternative 2c

Similar to Alternative 2a and 2b, this alternative includes moderate GWR amount of 22,500 AFY and moderate NPR recommended projects (8,150 AFY plus 2,750 AFY of contingency) as a supplement to meet the original recycled water use goal of 30,650 AFY. However, Alternative 2c includes the elimination of Westside NPR projects since Westside NPR projects could be more difficult to implement due to the distance of demands from available supplies. The assumed NPR customers and distribution system are shown in **Figure 3-6**. The NPR project portfolio of Alternative 2c includes:

- Valley Service Area, DCTWRP: 2,900 AFY
- Metro Service Area: 4,200 AFY
- Harbor Service Area: 2,300 AFY
- Valley Service Area, Burbank: 1,500 AFY

3.2.5 Theme 3 More GWR - Alternative 3

Based on Theme 3 (More GWR), this alternative includes the maximum GWR amount of 30,000 AFY and nominal NPR (650 AFY plus 250 AFY of contingency) as a supplement to meet the recycled water use goal of 30,650 AFY. Therefore, Alternative 3 requires minimal amount of NPR projects compared to other alternatives. The NPR projects will be located entirely in the Harbor service area and are shown in Figure 3-7. The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.The NPR projects (900 AFY with contingency) could be served by TIWRP or with other NPR projects in the City.

3.2.6 Alternatives Summary

Table 3-1 shows the service areas which would include NPR and GWR projects, according to each alternative. **Figure 3-2** shows the amounts of GWR and NPR (with and without contingency) by service area for each alternative. **Figure 3-3** through **Figure 3-6** depict the approximate geographic locations of NPR projects for Alternatives 1, 2a, 2b, 2c and 3. Note that the pipelines and facilities are diagrammatic and not intended to reflect proposed specific locations or alignments.

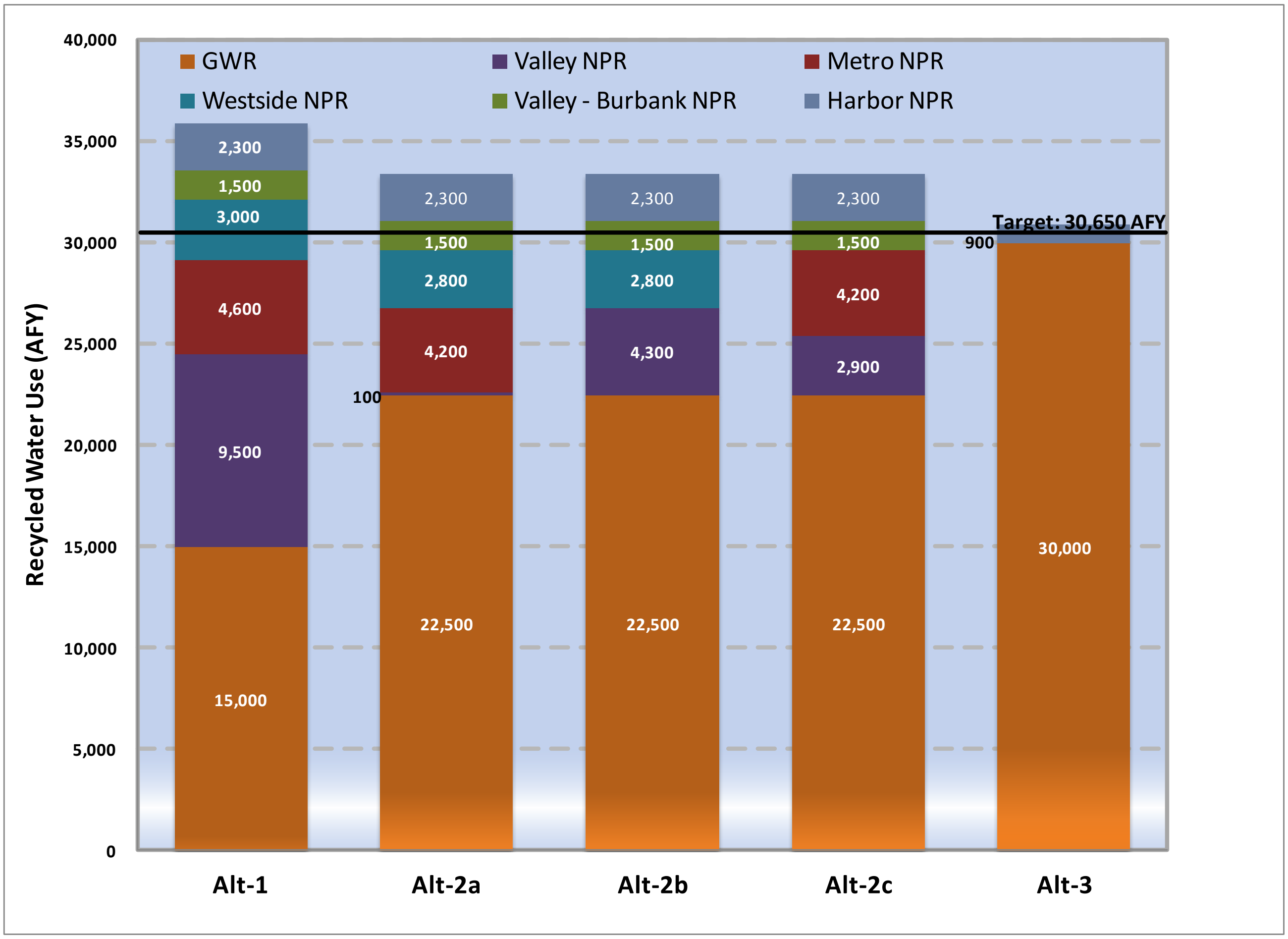
Table 3-1: Alternatives and Services Areas

Alternative	NPR					GWR
	Valley, DCTWRP	Valley, Burbank	Metro	Westside	Harbor	Valley
1	X	X	X	X	X	X
2a		X	X	X	X	X
2b	X	X		X	X	X
2c	X	X	X		X	X
3					X[a]	X

Footnote

a. The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

Figure 3-2: Alternatives – GWR and NPR by Service Area



Notes:
Does not include existing and planned non-potable reuse and barrier supplement projects with an average annual reuse of 19,350 AFY.
The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

Figure 3-3: Alternative 1 Proposed NPR Projects

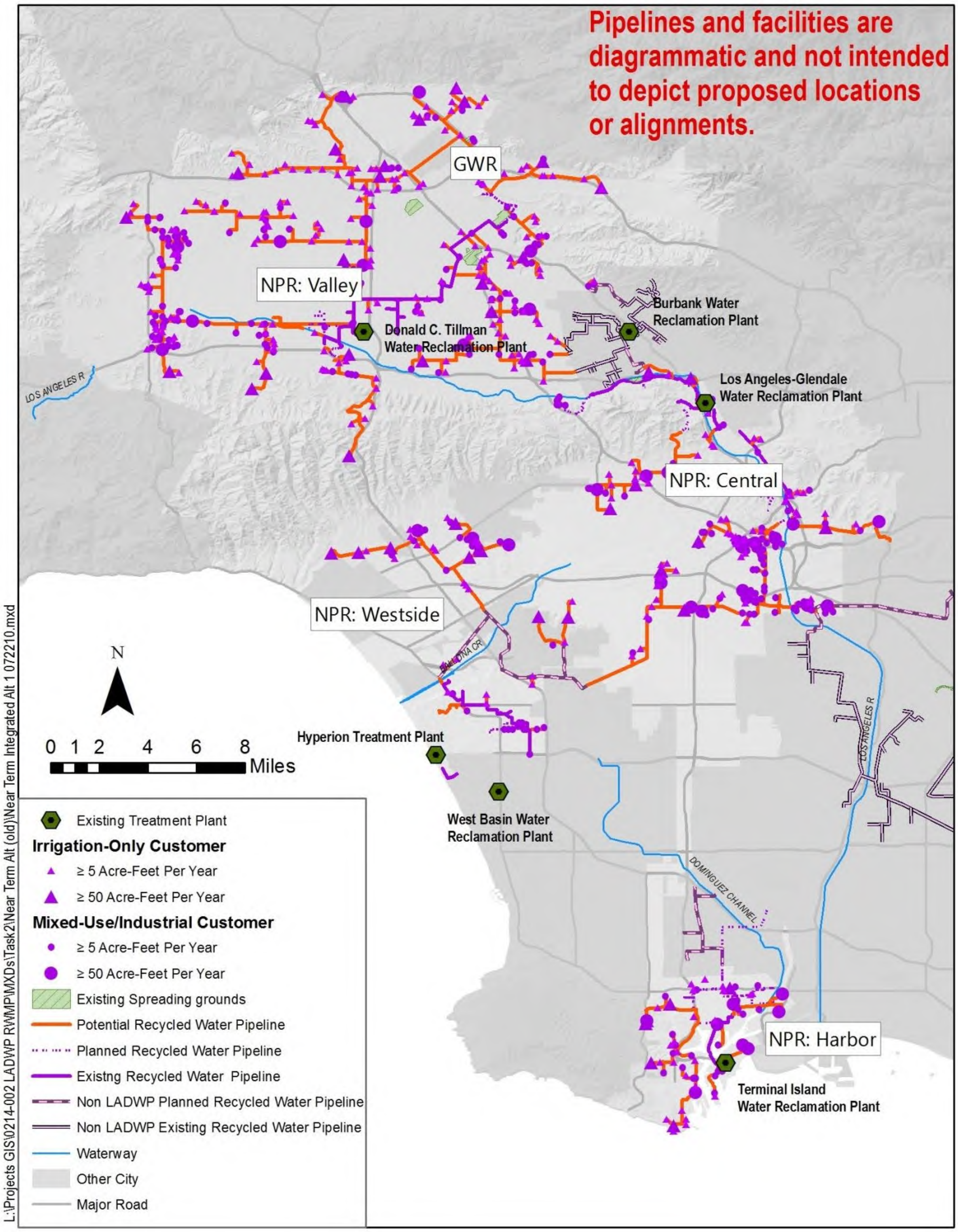


Figure 3-4: Alternative 2a Proposed NPR Projects

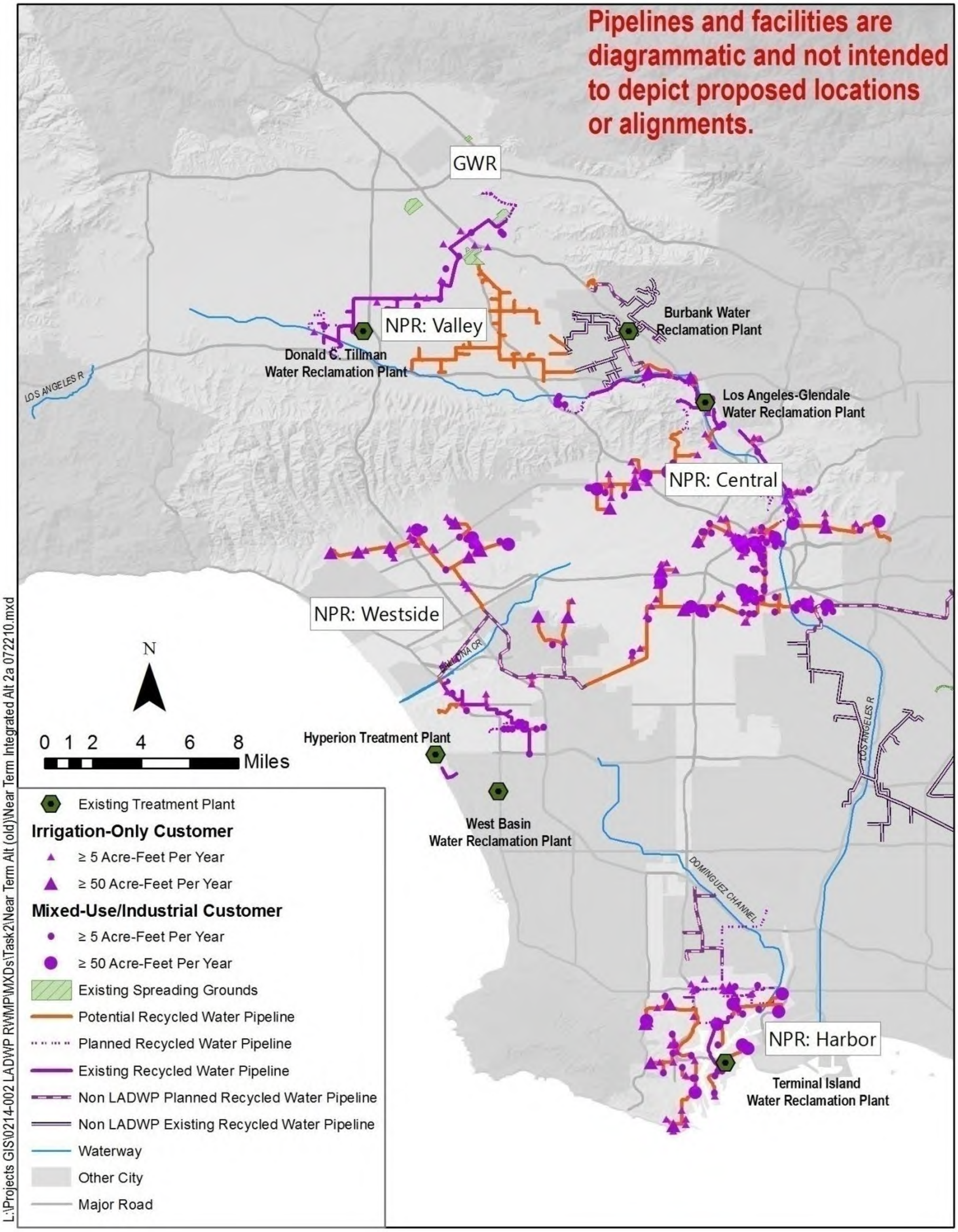


Figure 3-5: Alternative 2b Proposed NPR Projects

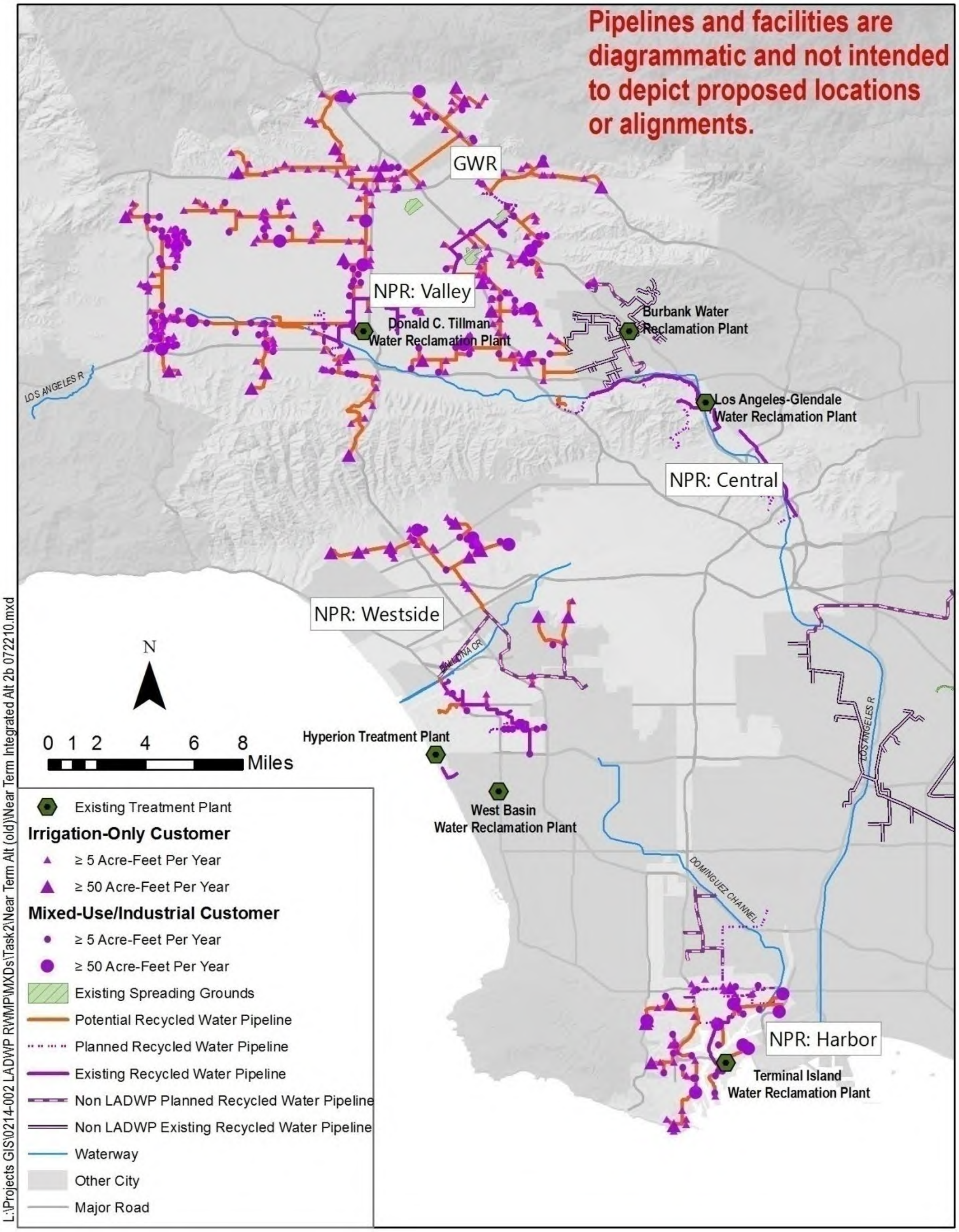


Figure 3-6: Alternative 2c Proposed NPR Projects

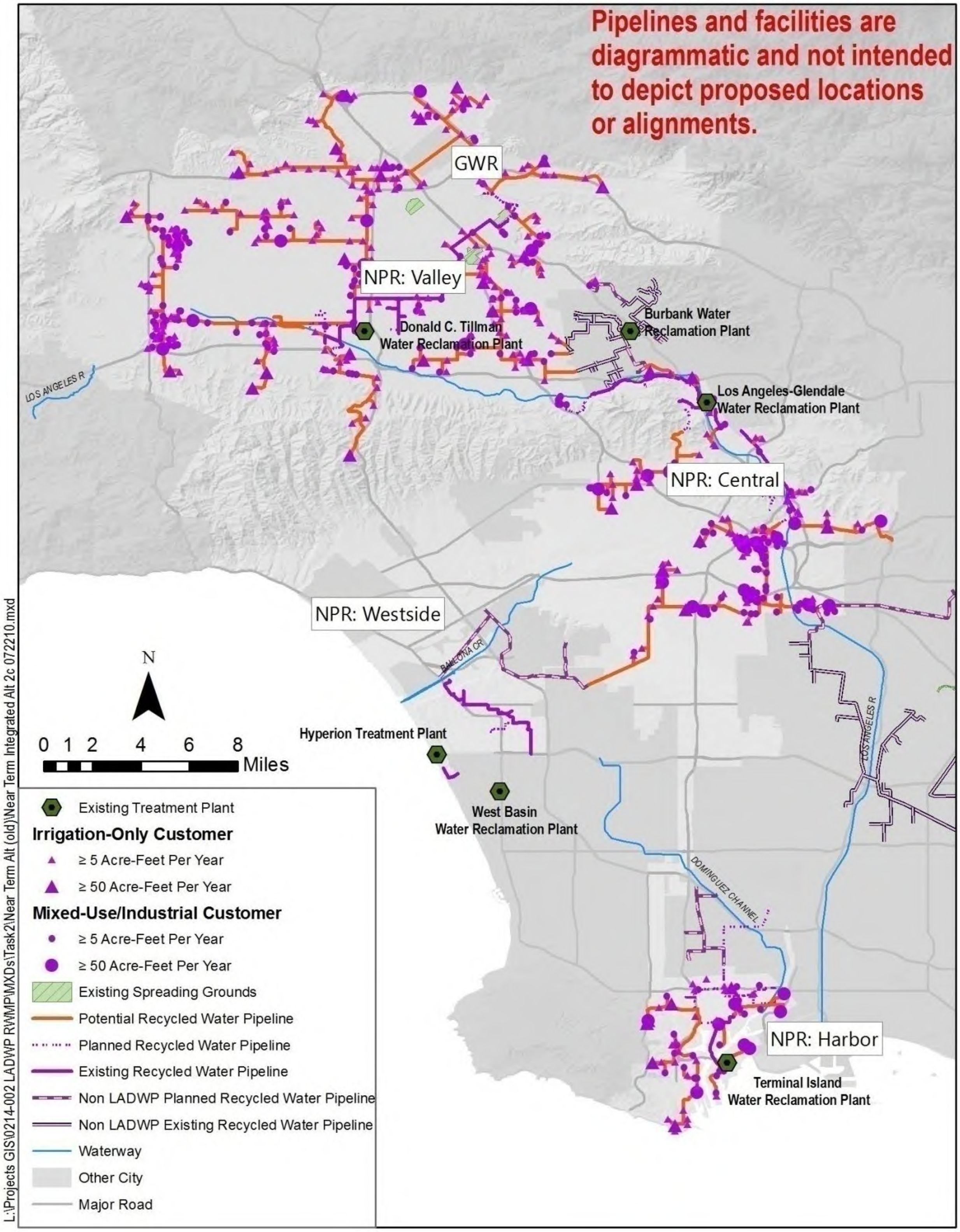
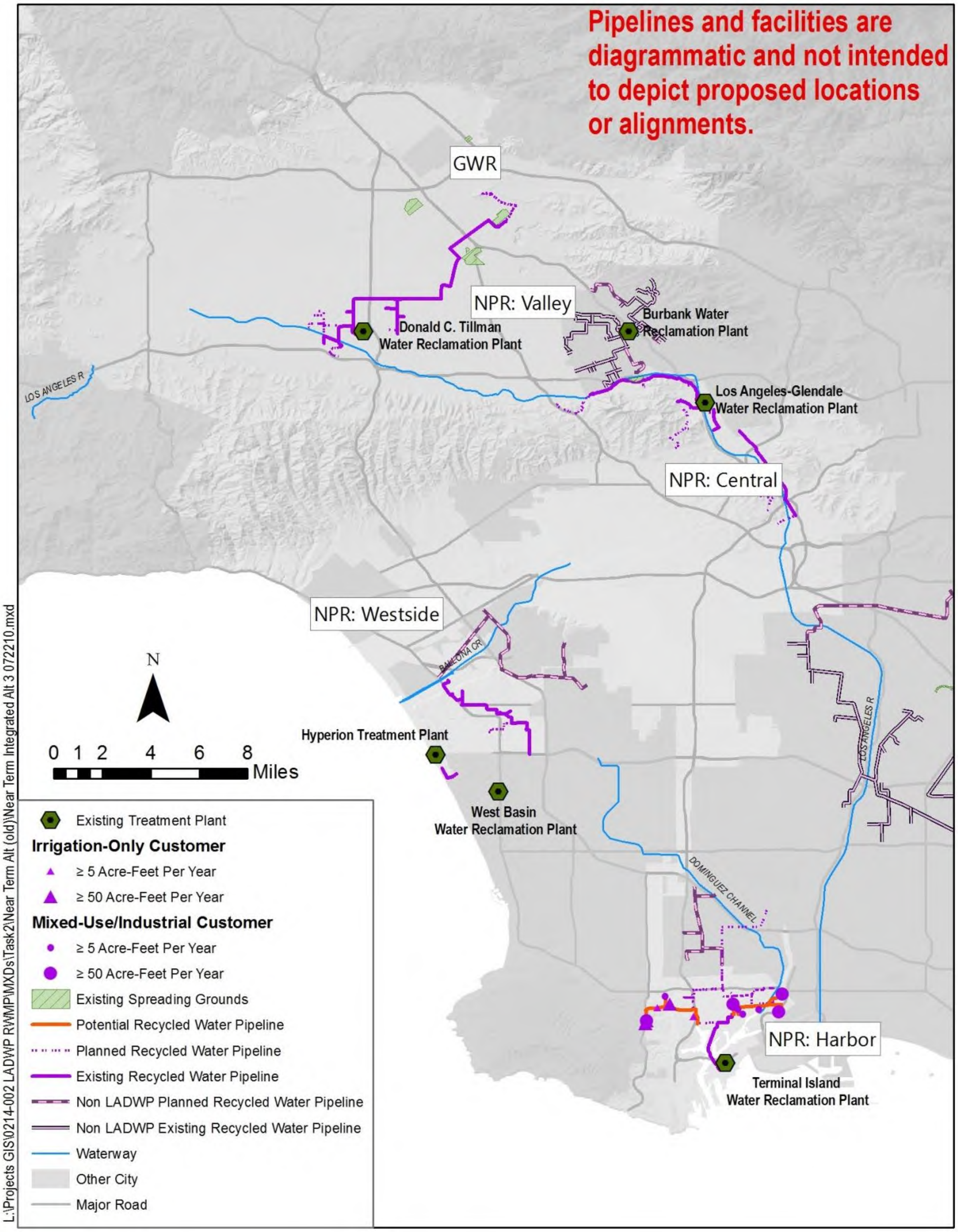


Figure 3-7: Alternative 3 Proposed NPR Projects



Note: The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.

3.2.7 GWR Assumptions in Alternatives

As described earlier in this section, all alternatives include GWR in varying capacities. As shown on **Figure 3-8** and **Figure 3-9**, 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 alternatives since they are existing.

Figure 3-8: GWR Concept

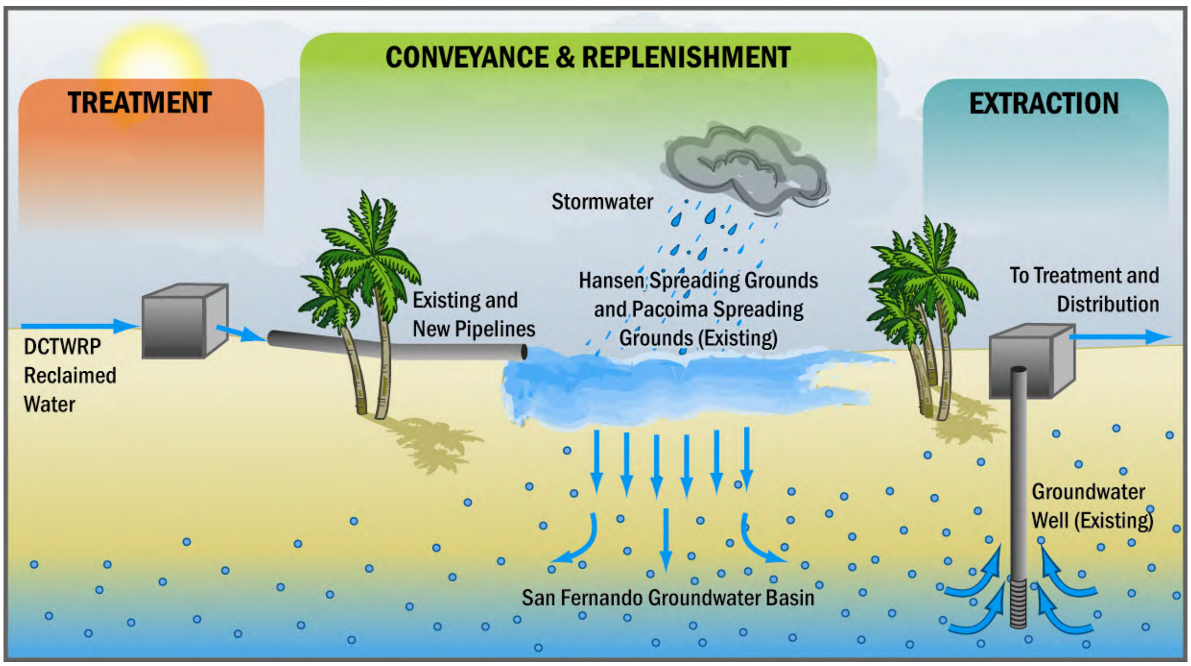
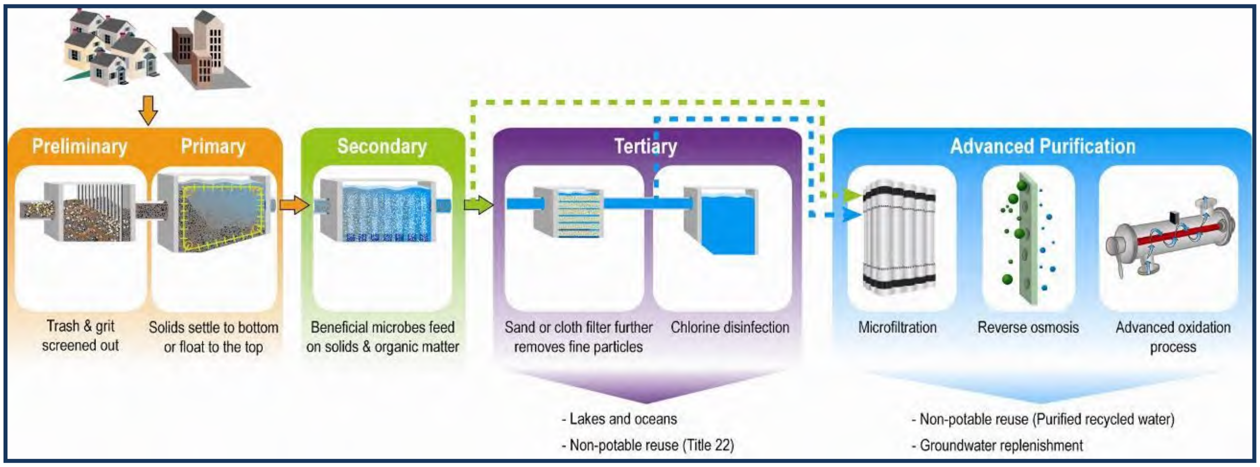


Figure 3-9: Major Treatment Processes at DCTWRP and Proposed for the AWPF



For this TM, it is assumed that GWR includes the following facilities:

- New Advanced Water Purification Facility (AWPF), treating DCTWRP tertiary product via microfiltration and reverse osmosis (MF/RO) and providing advanced oxidation via ultra violet (UV) light and hydrogen peroxide.
- Existing/New Conveyance pipelines from AWPF to Hansen and Pacoima Spreading Grounds for replenishment into the San Fernando Groundwater Basin
- Existing Extraction wells to pump groundwater from San Fernando Groundwater Basin to drinking water distribution system.[3]

Another key assumption for this TM is the potential location for the AWPF. The RWMP planning team prepared a separate study (Site Assessment TM, RMC/CDM Smith 2012) 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).

For the alternative analyses in this TM, the set of five alternatives described earlier were evaluated using two potential AWPF sites to assess whether or not the AWPF location affects the overall decision model results for the alternatives evaluation. The two potential AWPF locations considered included DCTWRP and the Valley Generating Station (VGS). While the Site Assessment TM included four potential sites at DCTWRP, for the evaluation of integrated alternatives, DCT Southwest (SW) was used as a proxy since it was assumed that all DCTWRP sites would generally perform equally against the objectives used for the integrated analysis. Therefore, a total of 10 alternatives were identified and evaluated, as described in Table 3-2.

[3] As a separate project to improve the groundwater quality in the San Fernando Basin, the City is planning the Groundwater Treatment Complex. Since this project is independent of GWR, the costs for this program are not included in this integrated alternatives analysis.

Table 3-2: Alternatives – Summary of Recycled Water Volume by Component

		DCT Alternatives					VGS Alternatives				
		Alternative 1	Alternative 2			Alternative 3[b]	Alternative 1	Alternative 2			Alternative 3[b]
		Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
		(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)	(AFY)
GWR	Valley	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000
NPR	Valley	9,500	100	4,300	2,900	0	9,500	100	4,300	2,900	0
	Metro	4,600	4,200	0	4,200	0	4,600	4,200	0	4,200	0
	Westside	3,000	2,800	2,800	0	0	3,000	2,800	2,800	0	0
	Valley-Burbank	1,500	1,500	1,500	1,500	0	1,500	1,500	1,500	1,500	0
	Harbor	2,300	2,300	2,300	2,300	900	2,300	2,300	2,300	2,300	900
	NPR Total	20,900	10,900	10,900	10,900	900	20,900	10,900	10,900	10,900	900
	NPR Total – Without Contingency	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700
Total With Contingency		35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900
Total Without Contingency[a]		30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700

Footnote:

a. *The total is rounded from 30,650 AFY to 30,700 AFY for simplicity.*

b. *The Harbor was selected as a potential area for additional NPR projects for purposes of this evaluation; however, LADWP will move forward with the most feasible NPR projects across the City at the time of implementation based on potential projects developed in the NPR Master Planning Report.*

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4. Evaluation Criteria and Performance Measures

Evaluation criteria and performance measures were specifically defined to rank the integrated alternatives. This section describes the evaluation criteria and the associated performance measures used to evaluate the alternatives defined in Section 4. The threshold criteria do not have any evaluation criteria or performance measures because they must be met by all alternatives in order to proceed.

Table 4-1: Objectives, Evaluation Criteria, Performance Measures, and Scores for Alternatives summarizes the evaluation criteria, performance measures, and scores for the alternatives analysis. As shown in this table, the performance measures are measured both qualitatively (i.e., relative score of 1 to 5) and quantitatively (i.e., unit capital cost, temporary job creation, etc.). When a qualitative score is used, a score of 5 is better and a score of 1 is worse.

The following sections provide detailed descriptions of the evaluation criteria and performance measures and how each of the alternatives scored.

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Table 4-1: Objectives, Evaluation Criteria, Performance Measures, and Scores for Alternatives

Objectives		Evaluation Criteria							DCT Alternatives					VGS Alternatives					Notes
									Alt 1	Alt 2			Alt 3	Alt 1	Alt 2			lternative	
Objective	Weight	Sub-objective	Sub-Weight	Overall Weight	Performance Measure	Unit	Sub-Weight		Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3	
								GWR	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000	
								NPR	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700	
								NPR Contingency	5,200	2,700	2,700	2,700	200	5,200	2,700	2,700	2,700	200	
								Harbor Projects	0	0	0	0	0	0	0	0	0	0	
								Total (w/o Contingency)	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	
								Total (w/ Contingency)	35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900	
Meet All Water Quality Regulations and Health & Safety Requirements, and Use Proven Technologies									**All alternatives meet these critical, threshold objectives.**										
Promote Cost Efficiency	30%	Unit Capital Cost	50%	15.0%	Unit Capital Cost (lower number is better)	$/AF			$19,600	$17,300	$18,400	$16,500	$14,000	$18,900	$16,700	$17,800	$15,800	$14,100	Includes capital cost for Existing and Planned NPR.
		Unit Annual O&M Cost	50%	15.0%	Unit Annual O&M Cost (lower is better)	$/AF			$677	$717	$701	$677	$691	$661	$693	$683	$657	$677	Includes O&M cost for Existing and Planned NPR.
Achieve Supply & Operational Goals	20%	Reduction in Imported Water	50%	10.0%	Reduction in volume of imported water purchases (higher number is better)	AFY			30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	Does not include purple pipe NPR contingency numbers. Does not include GW exchange with the refineries.
		Water System Operational Flexibility	20%	4.0%	% of total recycled water stored in the ground (No restrictions on how this water is used) (Higher number is better)	%			49%	73%	73%	73%	98%	49%	73%	73%	73%	98%	Percent of total recycled water that will be stored in the ground for future use. Saving the water in the ground allows flexibility in how this water will be used in the future. Projects with more GWR in the project scores better.
		Overall Wastewater System Benefits	30%	6.0%	HTP service area collection system benefits	Score	12.5%		3	4	4	4	5	3	4	4	4	5	Reducing ww flow in HTP service area collection system. The AWPF is the only firm offset of the HTP service area collection system, since NPR has seasonal variability in demand. Alts 1 - Scores as 3 because has a year-round offset of 15,000 AFY Alts 2 - Scores as 4 because has a year-round offset of 22,500 AFY (more than Alt 1, but less than Alt 3) Alts 3 - Scores as 5 because has a year-round offset of 30,000 AFY
					HTP treatment system impacts	Score	12.5%		3	2	2	2	1	3	2	2	2	1	Brine discharge to HTP influent will impact treatment system at HTP. Larger AWPFs will have a larger brine flow to HTP.
					TIWRP discharge benefits	Score	75%		3	3	3	3	1	3	3	3	3	1	Assesses reduction in TIWRP ocean outfall discharge flow. Options with more Harbor NPR projects score higher: Alts 1 and 2a, 2b & 2c - score 3 because all include the same amount of NPR water in the Harbor. Alts 2d&2e - Will score 4 because TIWRP discharges to the Harbor will be partially reduced. With additional 2,300 AFY of Harbor NPR, these alternatives will score a 5. Alts 3 - scores lower because uses less NPR water in the Harbor.
Protect Environment	10%	Groundwater Quality	50%	5.0%	Improves groundwater quality	Score			3	4	4	4	5	3	4	4	4	5	Recharging with AWT water will improve GW quality by dilution. Existing GW quality is commonly contaminated and have higher TDS than AWTP product water. Alternatives with more GWR score better.
		Greenhouse Gas Emissions	50%	5.0%	Greenhouse gas emissions (lower number is better)	metric tons of CO_2 eq. /AF			-1.130	-1.059	-1.033	-1.065	-0.948	-0.958	-0.964	-0.876	-0.915	-0.808	Same as above. Does not include GHG emissions from GW extraction and purification treatment.

Costs developed in this document are based on the original IAA Preliminary Cost TM (Appendix A) from April 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.
Unless noted otherwise, for performance measures scored on a scale of 1 to 5, 5 = better and 1 = worse. Los Angeles Department of Water and Power | Recycled Water Master Plan | Table 4-1 2012-03-05.xls

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Table 4-1 Objectives, Evaluation Criteria, Performance Measures, and Scores for Alternatives (Cont.)

Objectives		Evaluation Criteria							DCT Alternatives					VGS Alternatives					Notes
									Alt 1	Alt 2			Alt 3	Alt 1	Alt 2			lternative	
Objective	Weight	Sub-objective	Sub-Weight	Overall Weight	Performance Measure	Unit	Sub-Weight		Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3	
								GWR	15,000	22,500	22,500	22,500	30,000	15,000	22,500	22,500	22,500	30,000	
								NPR	15,700	8,200	8,200	8,200	700	15,700	8,200	8,200	8,200	700	
								NPR Contingency	5,200	2,700	2,700	2,700	200	5,200	2,700	2,700	2,700	200	
								Harbor Projects	0	0	0	0	0	0	0	0	0	0	
								Total (w/o Contingency)	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	30,700	
								Total (w/ Contingency)	35,900	33,400	33,400	33,400	30,900	35,900	33,400	33,400	33,400	30,900	
Maximize Implementation	15%	Public Acceptance	20%	3.0%	Public perception of GWR	Score			3	3	3	3	3	3	3	3	3	3	Keep scores neutral, use as a sensitivity
		Institutional Complexity	20%	3.0%	Complexity of operating relationship measured in number of contracts/agreements needed with outside agencies	Score			1	1	3	3	5	1	1	3	3	5	Any projects outside of the San Fernando Valley require more contracts/agreements with outside agencies. Alternatives with more Metro and Westside NPR will have a higher number of contracts/agreements with outside agencies: Alts 1 & 2a - score the lowest because have the most NPR in Metro and Westside. Alts 2b & 2c - score better than Alts 1 and 2a because either Metro or Westside eliminated. Alt 3 - scores highest because does not have any agreements with outside agencies.
		Permitting	20%	3.0%	Difficulty of GWR permitting process	Score			4	3	3	3	2	4	3	3	3	2	Larger GWR is more difficult to permit.
		Implementation Complexity	20%	3.0%	Number of projects/contracts to implement	Score			1	3	3	3	5	1	3	3	3	5	NPR projects are implemented in smaller pojrects and require many more projects than GWR projects. Projects with more NPR projects score lower. Alt 1 - Scores worst because has most number of NPR projects. Alts 2a, 2b, & 2c - Score better than alt 1 because has less number of NPR projects. Alt 3 - Scores highest because has least amount of NPR projects.
		Construction Impacts	20%	3.0%	Temporary traffic/noise/odor/dust impacts due to construction of pipelines	Miles			247.1	127.0	186.5	175.0	7.2	254.5	134.4	193.9	182.4	14.6	Purple pipe NPR projects have more construction impacts due to traffic/noise/odor/dust, etc. VGS options include 7.4 miles of brine pipeline. The less pipeline distances, the better.
Promote Economic & Social Benefits	10%	Temporary job creation	33%	3.3%	Temporary job creation (higher number is better)	Number of jobs			7,200	6,400	6,800	6,100	5,100	7,000	6,100	6,500	5,800	5,200	Based on the total capital cost. Assumed 7.2 temporary jobs per $1M of capital cost.
		Permanent job creation	33%	3.3%	Permanent job creation (higher number is better)	Number of jobs			60	63	64	64	62	50	53	53	53	59	Includes staffing for NPR and GWR. For GWR, assumed 1.9 personnel/mgd of GWR. For NPR, assumed 23 personnel for Alt 1, 12 personnel for Alts 2a, 2b and 2c, and 1 personnel for Alt3.
		Environmental Justice	33%	3.3%	Total number of low-income and/or minority tract with permanent above-grade facilities (lower number is better)	Number of census tracts			7	5	1	5	0	8	6	2	6	1	Permanent facilities: AWPF and NPR pump station and storage tanks in low-income and minority communities. Look at number of low income and/or minority community parcels/tracts impacted. New permanent above-grade facilities are assumed to negative for low income or minority census tracts. Does not include below-grade piping projects. VGS alternatives score one higher than the DCT alternatives because VGS is located in area designated as environmental justice improvement area. Alts 2d & 2e: Permanent above-grade facilities for the TI expansion will be within the existing facility property. Wells will be permanent above-grade facilities, located low-income minority areas, but these tracts are not counted since they are not residential areas.
Maximize Adaptability & Reliability	15%	Recycled Water Demand Reliability	25%	3.8%	Number of large (> 50 AFY) industrial customers (lower number is better)	No. of customers			34	27	14	26	2	34	27	14	26	2	Counted number of large industrial NPR customers with >50 AFY demand.
		Water Supply Reliability	75%	11.3%	RW is drought-proof water supply for irrigation NPR (higher number is better)	NPR irrigation quantity (AFY)			12,740	5,240	7,310	6,050	100	12,740	5,240	7,310	6,050	100	NPR is not subject to water supply restrictions (drought-proof water supply) and is beneficial for irrigation users who currently have restrictions for potable water use for irrigation during drought periods. Projects with more NPR use for irrigation use will score better.

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4.1 Objective 1 – Promote Cost Efficiency

The intent of Objective 1(Promote Cost Efficiency) is to meet the goals of the recycled water program in a cost-effective manner, considering both City and recycled water customer costs. Two evaluation criteria are used for Objective 1 – Promote Cost Efficiency:

- Unit Capital Cost; and,
- Unit Annual O&M Cost.

The following sections discuss the assumptions for the unit capital costs and annual O&M costs for the alternatives. The cost estimating procedures for the RWMP are documented separately in the Cost Estimating Basis for Recycled Water Master Planning TM (RMC/CDM Smith, 2011) and the TM, "Integrated Alternatives Analysis – Preliminary Cost Summary" (RMC/CDM Smith, April 2011) in Appendix A, which provides an overview of the preliminary costs shared with the RWAG. Updated costs are shown in the GWR and NPR Master Planning Reports.

4.1.1 Unit Capital Cost

Capital costs are the one-time setup expenses for a project and include both construction costs of facilities and implementation costs, such as design and permitting. Typically, payment for capital costs may be spread out over many years. For GWR, capital costs include treatment equipment, buildings, design and environmental permitting. For NPR projects, capital costs include pipelines, pump stations, storage facilities, design and environmental permitting.

Depending on the stage of the project and the level of detail understood, different estimating accuracies can be assumed. Since the RWMP is at a master planning stage, the accuracy range for the estimate is at a "Order of Magnitude Level", which reflects an accuracy range of -30% to +50%. All costs presented are reflected in January 2011 dollars using an Engineering News Record Construction Cost Index for Los Angeles of 10000.30 (January 2011). In addition, the capital costs include a 30% contingency to account for unknown or unforeseen construction costs. Capital costs also include a 30% implementation factor to account for the costs for planning and environmental documentation, permits, engineering, design and construction services, construction management and inspections, and typical overhead items such and legal and administration services.

Table 4-2 shows an example of how the cost contingencies and other factors are applied to capital cost estimates.

Table 4-2: Example Application of Cost Factors for Alternatives

Items	Calculation	Planning Estimate
Capital Cost Factors		
A. Estimated Construction Cost Subtotal		$1,000,000
B. Construction Contingency Cost Factor (30%)	0.3 * (A)	$300,000
C. Total Construction Cost Subtotal	(A) + (B)	$1,300,000
D. Implementation Cost Factor (30%)	0.3 * (C)	$390,000
E. Total Capital Cost	**(C) + (D)**	**$1,690,000**

A detailed discussion of these cost estimating criteria, as well as the assumed construction and O&M unit costs can be found in the document titled, "Cost Estimating Basis for Recycled Water Master Planning TM" (RMC/CDM Smith, 2011).

For this analysis, unit capital costs were developed. The unit capital cost for each alternative considered in this evaluation is the total capital cost estimate divided by the total potable water use offset by recycled water use (including GWR and NPR), represented in $/AFY. **Table 4-3** presents a summary of the unit capital costs developed for this analysis. Refer to Appendix A (Table 3-2) and Appendix B for additional details on the capital cost estimates.

Table 4-3: Alternatives Development - Summary of Estimated Capital Costs

Alternative	Planned NPR Capital Cost ($million)	Potential NPR Capital Cost ($million)	New GWR Capital Cost ($million)	Total Capital Cost ($million)	Total Potable Water Use Offset (AFY)	Unit Capital Cost ($/AFY)
D1	$310	$467	$223	$1,000	51,100	19,600
D2a	$310	$251	$322	$883	51,100	17,300
D2b	$310	$305	$326	$941	51,100	18,400
D2c	$310	$205	$326	$841	51,100	16,500
D3	$310	$32	$373	$715	51,100	14,000
V1	$310	$467	$189	$966	51,100	18,900
V2a	$310	$251	$292	$853	51,100	16,700
V2b	$310	$305	$292	$907	51,100	17,800
V2c	$310	$205	$292	$807	51,100	15,800
V3	$310	$32	$377	$719	51,000	14,100

Notes:
January 2011 dollars
Includes 30% contingency and 30% implementation costs
Refer to Appendix A Table 3-2 and Appendix B for additional details and assumptions.
Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April, 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.

4.1.2 Unit Annual O&M Cost

O&M costs are the recurring annual expenses to operate and maintain the facilities after construction is completed. For the GWR AWTP, O&M costs include chemicals for treatment processes, power, labor, and cleaning, servicing, repairs and replacement. For NPR projects, O&M costs include purchase of recycled water, power, labor, and cleaning, servicing, repairs and replacement.

For this analysis, unit annual O&M costs were developed. The unit annual O&M cost for each alternative is the total annual O&M cost estimate (estimated in January 2011 dollars) divided by the total potable water use offset by recycled water use (including GWR and NPR), represented in $/AF. A contingency was not applied to O&M costs. The recycled water purchase cost was applied for NPR for certain service areas, as applicable. **Table 4-4** presents a summary of the unit O&M costs developed for this analysis. Refer to Appendix A (Table 3-2) and Appendix C for additional details on the O&M cost estimates.

Table 4-4: Alternatives Development - Summary of Estimated O&M Costs

Alternative	Existing and Planned NPR O&M costs ($million/yr)	Potential NPR O&M Cost ($million/yr)	New GWR O&M Cost ($million/yr)	Total O&M Cost ($million/yr)	Total Potable Water Use Offset (AFY)	Unit O&M Cost ($/AFY)
D1	$16	$7.6	$11.2	$35	51,100	$677
D2a	$16	$5.7	$15.1	$36	51,100	$717
D2b	$16	$4.6	$15.4	$35	51,100	$701
D2c	$16	$3.4	$15.4	$35	51,100	$677
D3	$16	$0.3	$19.2	$35	51,100	$691
V1	$16	$7.6	$10	$34	51,100	$661
V2a	$16	$5.7	$14	$35	51,100	$693
V2b	$16	$4.6	$14.5	$34	51,100	$683
V2c	$16	$3.4	$14.4	$34	51,100	$657
V3	$16	$0.3	$18.5	$35	51,100	$677

Notes:
January 2011 dollars
Includes 0%
Refer to Appendix A Table 3-2 and Appendix C for additional details and assumptions
Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April, 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.

4.2 Objective 2 – Achieve Supply & Operational Goals

The intent of Objective 2 (Achieve Supply and Operational Goals) is to meet or exceed water supply targets and operational goals established by the City. For this objective, three evaluation criteria are used:

- Reduction in imported water;
- Water system operational flexibility; and,
- Overall wastewater system benefits.

4.2.1 Reduction in Imported Water

Since reducing dependence on potable water (or imported water) supplies is the City's goal, alternatives are ranked by the total amount of potable water use offset by recycled water use (GWR and NPR), measured in AFY, that they achieve.

The amount of recycled water use is equal to the amount of potable water offset or reduction in imported water dependence. All alternatives achieve 30,700 AFY of reduction in imported water.

4.2.2 Water System Operational Flexibility

Storing water in groundwater basins provides flexibility in how this water could be used in the future because the water is available when needed to meet peak demand periods. Therefore, for the water system operational flexibility criterion, each alternative is evaluated on the percent of total recycled water that will be stored in groundwater basins.

The percent of the total recycled water, excluding planned NPR, that will be stored in groundwater basins for future use is equal to the percent of GWR in each alternative as shown in **Table 4-5.**

Table 4-5: Alternatives Development - Summary of Water System Operational Flexibility

Alternative	GWR (AFY)	Total Recycled Water (AFY)	Percent of Recycled Water Stored in Ground
D1	15,000	30,650	49%
D2a	22,500	30,650	73%
D2b	22,500	30,650	73%
D2c	22,500	30,650	73%
D3	30,000	30,650	98%
V1	15,000	30,650	49%
V2a	22,500	30,650	73%
V2b	22,500	30,650	73%
V2c	22,500	30,650	73%
V3	30,000	30,650	98%

4.2.3 Overall Wastewater System Benefits

For overall wastewater system benefits, the alternatives are be scored based on three performance measures:

- HTP service area collection system benefits;
- HTP treatment benefits (impacts); and,
- TIWRP discharge benefits.

HTP Service Area Collection System Benefits

This performance measure ranks alternatives based on how well they reduce wastewater flows in the HTP service area, thereby reducing stress on the collection system. To measure HTP service area collection system benefits, the RWMP planning team established a scale ranging from 1 (no benefits) to 5 (high benefits), with 3 representing moderate (average) benefits. All the alternatives provide some benefit to the downstream collection system, therefore none scored below a 3. The GWR in the Valley service area (i.e., AWPF production capacity) is the only firm offset of the HTP service area collection system, since it can run year round, while NPR has seasonal variability in demand. Table 4-6 shows the scores used in the evaluation of each alternative relative to HTP Service Area System Benefits

Table 4-6: HTP Service Area Collection Benefits

Alternative (both VGS and DCT)	Year-Round Reduction in Flow to HTP Collection System (AFY)	Score
1	15,000	3
2a	22,500	4
2b	22,500	4
2c	22,500	4
3	30,000	5

HTP Treatment System Benefits/Impacts

This performance measure ranks alternatives based on the impacts they have on the HTP treatment system. To measure HTP treatment system benefits, the RWMP planning team established a scale ranging from 1 (no potential benefits/high potential impacts) to 5 (high potential benefits/no potential impacts), with 3 representing moderate (average) potential benefits/impacts. All the alternatives provide some potential impact to the downstream HTP treatment facilities, therefore none scored above a 3. This performance measure is affected by the amount of GWR in the alternative and the associated AWPF brine that could be discharged in to the wastewater treatment system. The AWPF brine (i.e., MF backwash waste and RO concentrate with high total dissolved solids (TDS)), will be discharged to the outfall sewer in the HTP service area and could ultimately increase the TDS in the HTP influent. Increased levels of TDS in the HTP influent could also result in higher-than-desired levels of TDS in the HTP effluent and could potentially affect treatment at the WBMWD ELWRF, which takes the HTP effluent as its influent. Alternatives with more GWR in the Valley service area will discharge larger brine flows to HTP and potentially may have a greater impact on ELWRF.

Alternatives D1 and V1 feature the smallest AWPFs, and have the least potential impacts to the treatment facilities so these alternatives receive a score of 3. Alternatives D2a through D2c and V2a through V2c have the next smallest AWPFs and receive a score of 2. Alternatives D3 and V3 have the largest AWPFs and receive a score of 1, representing the least benefit/most potential impacts.

TIWRP Discharge Benefits

This performance measure ranks alternatives based on how well they reduce TIWRP ocean outfall discharge in the Harbor service area. TIWRP seeks to reduce their ocean outfall discharge flow in order to comply with discharge permit requirements. Alternatives with more barrier and NPR projects in the Harbor area utilizing AWPF product water from TIWRP score higher since those alternatives achieve more reduction in ocean outfall discharge flow. To measure TIWRP discharge benefits, the RWMP planning team established a scale ranging from 1 (no benefits) to 5 (high benefits), with 3 representing moderate (average) benefits.

Alternatives D1, V1, D2a, D2c, V2a and V2c receive a score of 3 since these alternatives have 2,300 AFY of RW projects in the Harbor service area. Alternatives D3 and V3 receive a score of 1 since they have only 900 AFY of NPR projects in the Harbor service area.

4.3 Objective 3 – Protect Environment

The intent of Objective 3 (Protect Environment) is to develop projects that not only protect the environment, but also provide opportunities to enhance it. Two evaluation criteria are used for Objective 3 – Protect Environment:

- Groundwater quality; and,
- Greenhouse gas emissions.

4.3.1 Groundwater Quality

This evaluation criterion ranks alternatives based on how well they improve the existing groundwater quality. Existing groundwater basins located within the City of Los Angeles often have higher TDS than the AWPF product water used for GWR. By recharging the groundwater basins with AWPF product water, the groundwater quality will be improved (i.e., TDS and other contaminants will be lowered in concentration by dilution). Therefore, alternatives with higher amounts of GWR are assumed to better improve groundwater quality. To measure groundwater quality benefits, the RWMP planning team established a scale ranging from 1 (no benefits) to 5 (high benefits), with 3 representing moderate (average) benefits. All the alternatives provide some benefit to groundwater quality, therefore none scored below a 3.

Alternatives D1 and V1 have 15,000 AFY of GWR and score a 3. Alternatives D2a through D2c and V2a through V2c have 22,500 AFY of GWR and score a 4. Alternatives D3 and V3 have 30,000 AFY of GWR and score a 5.

4.3.2 Greenhouse Gas Emissions

This evaluation criterion ranks alternatives based on the amount of GHG emitted by the GWR and NPR facilities in each alternative. The GHG emissions that result from the operation of GWR and NPR facilities are calculated from the electricity usage of these systems. The GWR and NPR components with electricity usage are summarized in Table 4-7.

The emissions calculated are carbon dioxide, methane, and nitrous oxide, which each converted to metric tons of carbon dioxide equivalents. This evaluation criterion is scored based on the metric tons metric tons CO_2 equivalents divided by the total potable water use offset by recycled water use (including GWR and NPR).

Table 4-7: GWR and NPR Components with Electricity Usage

Components with Electricity Usage	GWR Site Location	
	DCT	VGS
GWR	Valley AWPF	Valley AWPF
	UV Systems	UV Systems
	Balboa Pump Station	Balboa Pump Station
	--	Treated Water Pump Station
	--	Administration Building
	--	--
NPR	Treatment Plant Processes	Treatment Plant Processes
	Pumping to NPR Customers	Pumping to NPR Customers
Reduction in Imported Water	Less Pumping	Less Pumping
	Less Treatment	Less Treatment

This evaluation criterion also takes into consideration the reduction in GHG emissions that will be realized by potable water offset (i.e., pumping and treating less imported water). This explains why most of the GHG emissions values for this evaluation criterion are negative since the reduction in GHG emissions from imported water outweighs the GHG emissions from GWR and NPR facilities.

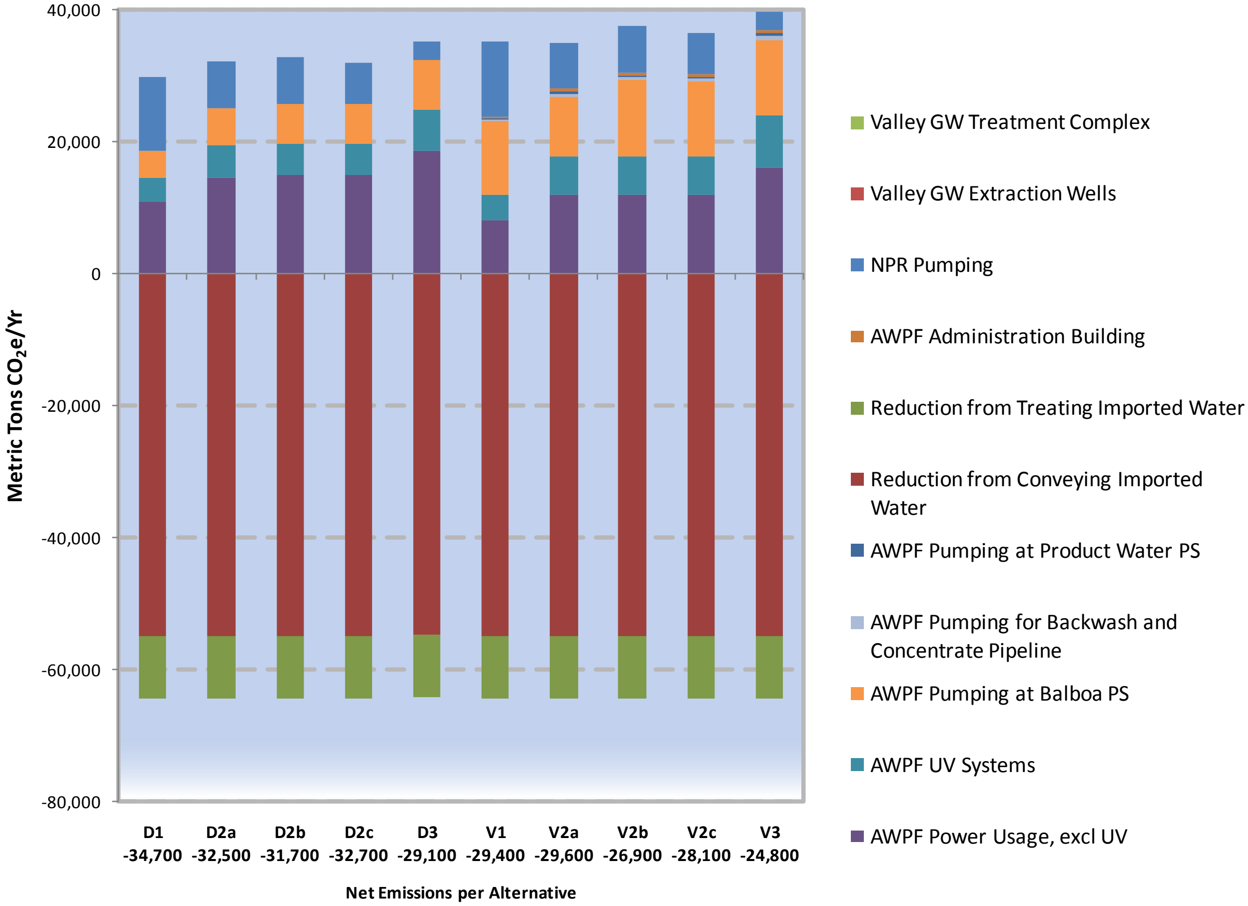
Table 4-8 summarizes the net GHG emissions for DCT and VGS alternatives. Figure 4-1 presents the breakdown of GHG emission productions and reductions for DCT and VGS alternatives without the Groundwater Treatment Complex. Refer to Appendix D for details of the GHG calculations.

Table 4-8: Performance Measure Scores for GHG Emissions

Greenhouse Gas Emissions	Alternatives				
	1	2a	2b	2c	3
DCT	-1.130	-1.059	-1.033	-1.065	-0.948
VGS	-0.958	-0.964	-0.876	-0.915	-0.808

Footnote:
a. GHG emissions measured in metric tons CO_2 equivalents/AF.

Figure 4-1: Summary of GHG Emission Productions and Reductions



4.4 Objective 4 – Maximize Implementation

The intent of Objective 4 (Maximize Implementation) is to maximize implementation by minimizing typical hurdles including institutional complexity, permitting challenges, and maximizing customer acceptance. Five specific evaluation criteria are used for Objective 4 – Maximize Implementation:

- Public acceptance;
- Institutional complexity;
- Permitting;
- Implementation complexity; and,
- Construction impacts.

4.4.1 Public Acceptance

This evaluation criterion assesses public acceptance of the GWR process. Since all alternatives include GWR, the alternatives all receive a neutral score of 3. This evaluation criterion could be used for a sensitivity analysis to determine how the alternatives rankings might change if the scores were altered to reflect a positive or negative public view of GWR.

4.4.2 Institutional Complexity

This evaluation criterion ranks alternatives based on the complexity of operating relationships with outside agencies. The higher the number of agreements required with agencies outside the City departments, then the more institutionally complex the alternative is, which could impact the ability to maximize implementation. Therefore, to measure institutional complexity, the RWMP planning team established a scale ranging from 1 (numerous agreements with outside agencies) to 5 (no agreements with outside agencies), with 3 representing moderate number of agreements. Projects outside of the San Fernando Valley would require more contracts/agreements with outside agencies, due to the distance from existing, City-owned supplies. Similarly, alternatives with more Metro and Westside NPR will have a higher number of contracts/agreements with outside agencies and will score lower.

Alternatives D1, V1, D2a and V2a receive the lowest score of 1, because they have the most NPR in Metro and Westside area. Alternatives D2b, V2b, D2c and V2c receive a moderate score of 3 because Metro or Westside NPR projects are eliminated, respectively. Alternatives D3 and V3 receive the highest score of 5 because these alternatives do not have NPR projects outside of the San Fernando Valley and therefore do not have any agreements with outside agencies.

4.4.3 Permitting

The permitting process can affect the implementation of an alternative. The key component of each alternative that differentiates the difficulty of the permitting process between alternatives is the amount GWR. This evaluation criterion ranks alternatives based on the difficulty of GWR permitting. Alternatives that result in more GWR will face more difficulties in permitting. Therefore, to measure permitting complexity, the RWMP planning team established a scale ranging from 1 (potentially challenging to permit) to 5 (potentially easy to permit), with 3 representing moderate permitting complexity.

Alternatives D1 and V1 have 15,000 AFY of GWR; therefore these alternatives receive a score of 4. Alternatives D2a through D2c and V2a through V2c have 22,500 AFY of GWR and receive a neutral score of 3. Alternatives D3 and V3 have 30,000 AFY of GWR and receive a score of 2.

4.4.4 Implementation Complexity

This evaluation criterion ranks alternatives based on the number of projects/contracts to implement. Each alternative involves GWR and NPR components. While GWR is a single project for the construction of an AWPF, improvements to Hansen Spreading Grounds, and groundwater wells, NPR is composed of numerous smaller projects. Therefore, alternatives that involve more NPR will face greater implementation complexity. To measure implementation complexity, the

RWMP planning team established a scale ranging from 1 (complex with number of NPR projects) to 5 (not complex with limited number of NPR project), with 3 representing moderate complexity.

Alternatives D1 and V1 receive the lowest score of 1 because these alternatives have the greatest number of NPR projects. Alternatives D2a through D2c and V2a through V2c receive a score of 3 because these alternatives have a moderate amount of NPR projects. Alternatives D3 and V3 receive a score of 5 because these alternatives have the least amount of NPR projects.

4.4.5 Construction Impacts

This evaluation criterion ranks alternatives based on the approximate length of new pipelines since all of the pipeline construction expected to occur in public streets would cause temporary traffic impacts, noise, odor, and dust during construction. NPR projects involve the construction of recycled water pipelines (a.k.a., purple pipes) throughout the city to reach their intended customers. In general, alternatives at DCT site have shorter pipeline distances than the alternatives at the VGS sites since the alternatives at the VGS site include the construction of approximately seven miles of brine pipeline from the AWPF to the connection to outfall sewer. **Table 4-9** provides a summary of the estimated length of new pipelines for each alternative. Refer to Appendix A (Table 3-2) for details on the pipeline estimates.

Table 4-9: Alternatives Development – Construction Impacts Performance Measures

Alternative	GWR Brine Pipeline (miles)	GWR Spreading Grounds Pipeline (miles)[a]	NPR Pipelines (miles)	Total Pipelines
D1	0	4.9	247.1	252
D2a	0	4.9	127.0	131.9
D2b	0	4.9	186.5	191.4
D2c	0	4.9	175.0	179.9
D3	0	4.9	7.2	12.1
V1	7.4	4.9	247.1	259.4
V2a	7.4	4.9	127	139.3
V2b	7.4	4.9	186.5	198.8
V2c	7.4	4.9	175	187.3
V3	7.4	4.9	7.2	19.5

[a] Spreading grounds pipeline miles were determined before Pacoima Spreading Grounds option was considered for Alternatives 2 and 3.The pipeline to the Pacoima Spreading Grounds is discussed in the GWR Master Planning Report.

4.5 Objective 5 – Promote Economic & Social Benefits

The intent of Objective 5 (Promote Economic & Social Benefits) is to provide economic and social benefits in the implementation and operation of recycled water projects. Three evaluation criteria are used for Objective 5 – Promote Economic & Social Benefits:

- Temporary job creation;
- Permanent job creation; and

- Environmental justice

4.5.1 Temporary Job Creation

This evaluation criterion ranks alternatives based on the number of temporary jobs that will be created for the design and construction of the GWR and NPR projects. Temporary job creation was estimated based on the total capital cost of the project. It is assumed that 7.2 direct and indirect jobs are created for every million dollars in construction spending, where a job is defined as one year of full-time work. This factor comes from the *Estimated San Francisco Jobs Created by Capital Spending* document written by the Office of the City Administrator in San Francisco on February 25, 2009. It references the REMI Policy Insight Model. This factor is supported by the American Recovery and Reinvestment Act as part of the Senate Stimulus Bill, which allocates $1.4 billion of capital investment for "water reclamation and reuse projects." The bill estimates that this money will generate 11,500 direct new private sector jobs or 8.2 direct jobs per million dollars of capital investment. In this TM, a factor of 7.2 direct jobs per million dollars of capital investment is used, since it is a more conservative estimate than 8.2.

Table 4-10 provides a summary of the estimated temporary jobs for each alternative.

Table 4-10: Alternatives Development – Estimated Temporary Jobs

Alternative	Total Capital Cost (million)	Estimated Temporary Jobs[1]
D1	$1,000	7,200
D2a	$813	6,400
D2b	$851	6,800
D2c	$841	6,100
D3	$715	5,100
V1	$966	7,000
V2a	$783	6,100
V2b	$817	6,500
V2c	$807	5,800
V3	$719	5,200

[1]Estimated using a factor of 7.2 direct jobs per million dollars of capital investment. (Estimated San Francisco Jobs Created by Capital Spending, February 25, 2009)
Costs developed in this document are based on the original IAA Preliminary Cost Summary TM (Appendix A) from April, 2011. Updated costs are shown in the GWR and NPR Master Planning Reports and would not change the outcome of this analysis.

4.5.2 Permanent Job Creation

This evaluation criterion ranks alternatives based on the number of permanent jobs that will be created for the operation and maintenance of the NPR and GWR facilities.

For GWR, it was assumed that 1.9 full-time employment positions would be required per million gallons per day (mgd) of GWR. This factor is estimated by analyzing the personnel required to operate similar AWPFs. The three AWPFs listed in **Table 4-11** are similar to the proposed AWPF in that they receive secondary or tertiary effluent from a neighboring wastewater treatment plant. As a result, some of the personnel used to staff the AWPFs are shared with the wastewater treatment plant. Also, the capacities of these facilities are comparable to the capacity of the proposed AWPF. The average number of personnel required per mgd of the AWPF production capacity used in this analysis is 1.9. It should be noted that the multiplication factor used for the estimation of permanent jobs was refined as part of the development of the GWR Master Planning Report. Although the total number of jobs estimated does change as a result of this value change, the relative score of each alternative analyzed would not change since each of the alternatives would change by the same factor.

Table 4-11: Personnel Requirements at Similar AWPF Facilities

Facility	Source Water	Flow (mgd)	Number of Personnel	Number of Personnel/mgd
Terminal Island Water Reclamation Plant (TIWRP)	Tertiary Effluent from Terminal Island Water Reclamation Facility	5	9.18	1.8
WBMWD Edward C. Little Water Reclamation Facility (ELWRF)	Secondary Effluent from Hyperion Treatment Plant	22	40	1.8
Miami-Dade Water and Sewer Department (WASD)	Tertiary Effluent from the South District Wastewater Treatment Plant	21	40.8	1.9

For NPR, it is assumed that 23 personnel would be added for Alternatives D1 and V1, 12 personnel for Alternatives D2a through D2c and V2a through V2c, and one personnel for Alternatives D3 and V3. These estimates were provided by LADWP based on estimates of the number of NPR pump stations, tanks, and pipelines for each alternative.

Table 4-12 provides a summary of the estimated permanent jobs for each alternative.

Table 4-12: Alternatives Development – Estimated Permanent Jobs

Alternative	NPR Permanent Jobs	GWR Production Capacity (mgd)	GWR Permanent Jobs (Capacity x 1.9)	Estimated Permanent Jobs
D1	23	19.9	37	60
D2a	12	26.9	51	63
D2b	12	27.4	52	64
D2c	12	27.4	52	64
D3	1	32.4	61	62
V1	23	14.6	27	50
V2a	12	21.8	41	53
V2b	12	21.8	41	53
V2c	12	21.8	41	53
V3	1	30.6	58	59

4.5.3 Environmental Justice

This evaluation criterion ranks alternatives based on the environmental justice effects of the new permanent above-grade facilities, such as pump stations and storage tanks, included in each GWR and NPR facilities. Below-grade piping projects are not considered because their temporary effects are covered by the Construction Impacts evaluation criterion. The environmental justice effects are determined by counting the number of census tracts, designated as low-income and/or minority community parcels/tracts, where new permanent above-grade facilities for GWR and NPR facilities would be located.

For the DCT alternatives, Alternative D1 impacts seven tracts, Alternatives D2a and D2c each impact five, Alternative D2b impacts one, and Alternative D3 impacts no low-income and/or minority census tracts. The VGS counterparts of these alternatives each score one census tract higher than the DCT alternatives to account for VGS location being in an environmental justice improvement area.

Appendix E includes maps showing potential aboveground NPR facilities with respect to low to moderate income and minority tracts for each service area.

4.6 Objective 6 – Maximize Adaptability & Reliability

The intent of Objective 6 (Maximize Adaptability & Reliability) is to be able to adapt to uncertainties and maximize reliability of operations once projects are implemented. Two evaluation criteria are used for Objective 6 – Maximize Adaptability & Reliability:

- Recycled water demand reliability; and,
- Recycled water supply reliability.

4.6.1 Recycled Water Demand Reliability

This evaluation criterion ranks alternatives based on the reliability of recycled water demand. The recycled water demand is defined by the end-use of the recycled water: groundwater replenishment or specific NPR customers. Among the different end-users of recycled water, GWR is considered the most reliable demand, because it does not depend on individual customers. Among NPR customers, large industrial customers are considered the least reliable and most risky, because the demand may no longer be there by the time the purple pipe is constructed; the demands of a particular customer could have changed or the customer could have moved or be no longer in business. Therefore, alternatives with more large industrial customers with greater than 50 AFY of recycled water demand would rank lower. To measure recycled water demand reliability, the RWMP selected a performance measure of number of large industrial customers. The fewer numbers of potential industrial customers, the better the alternative scored for this criterion.

Alternatives D1 and V1 scored the worst with 34 large industrial customers. Alternatives D3 and V3 rank the best with two large industrial customers.

4.6.2 Recycled Water Supply Reliability

This evaluation criterion ranks alternatives based on the reliability of water supply. Recycled water is considered a drought-proof water supply and is not subject to water use restrictions. Therefore, for irrigation users who currently have restrictions for potable water use for irrigation during drought periods, using recycled water improves their irrigation water supply reliability. Since water use restrictions typically only affect irrigation customers rather than industrial customers, projects with more NPR for irrigation use score better.

Alternatives D1 and V1 rank the highest with 12,740 AFY of NPR irrigation demand. Alternatives D3and V3 rank the lowest with 100 AFY of NPR irrigation demands.

5. Evaluation Results

This section summarizes the results of the decision modeling for the alternatives evaluation. As discussed in Section 4, each alternative was characterized in terms of the evaluation criteria and performance measures established for the alternatives evaluation. Table 5-1 summarizes the performance measures and their scores. As discussed in Section 2.3, the decision model was built using the commercial software CDP to rank the alternatives.

5.1 Score Interpretation

In the figures presented in this section, the overall length of the horizontal bars represents the total decision score for the alternative. The overall score indicates how well each alternative performed in meeting the overall *set* of criteria. The colored segments within each bar represent the contribution of each of the *individual* criteria to the total decision score. Two factors determine the size of each color segment for a given bar, or alternative: 1) the raw performance or score of the alternative for that objective; and 2) the weight of the objective. In general, the results should be interpreted as follows:

- If the color segment is larger, then that alternative scores better for that performance measure when considered along with the weight of importance.
- If the color segment is smaller, then that alternative does not score as well for that performance measure, or the objective has a lower weight of importance, or both.

The scores for the individual objectives and the overall score for each alternative are shown on each graph.

5.2 Alternatives Analysis Results

Figure 5-1 and **Figure 5-2 s**how graphical results for the CDP model analysis.

Figure 5-1: Alternatives Scoring (In Order of Ranking)

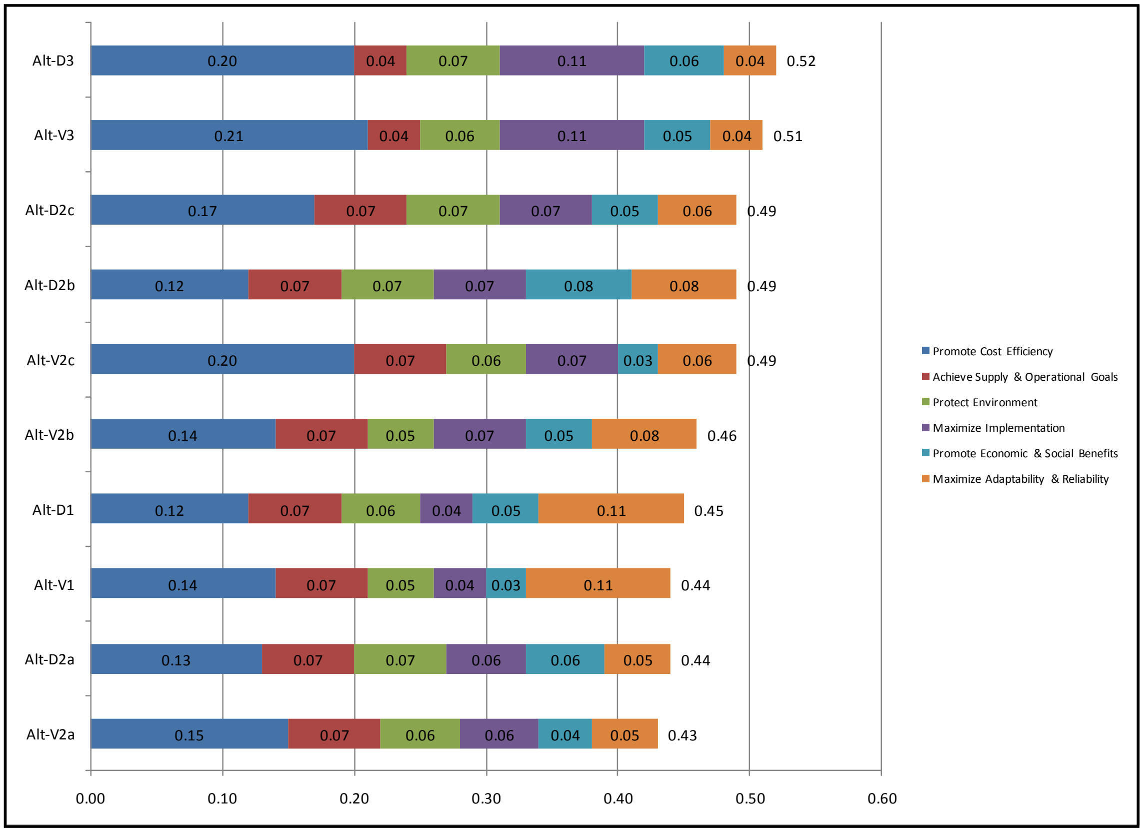
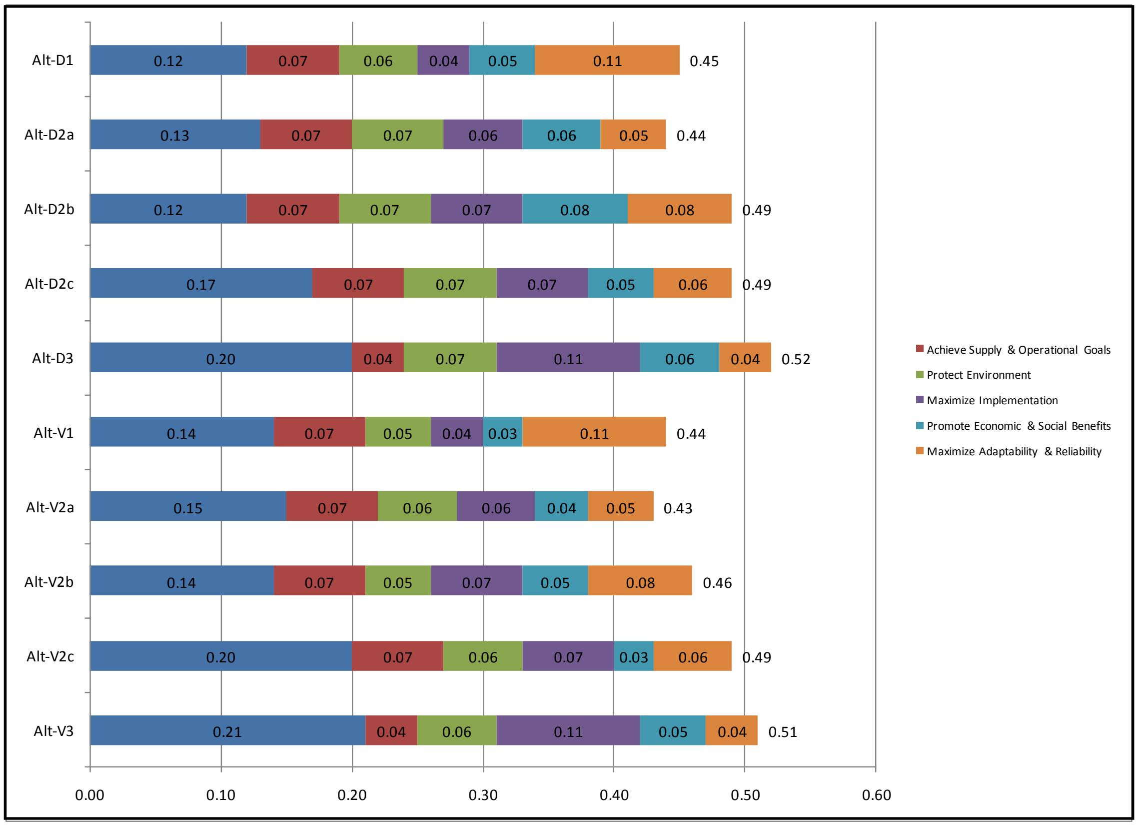


Figure 5-2: Alternatives Scoring (In Order of Name)



5.3 Sensitivity Analysis

As described in Section 2.3.1, a series of sensitivity runs were conducted using the decision model. These sensitivity runs involved altering the objectives weightings in accordance with Table 2-1. If the alternatives rankings change with the sensitivity runs, then this means that the alternative was sensitive to that particular element that was emphasized in the sensitivity run.

Table 5-1 summarizes the results of the CDP runs (Alternative Scoring for the Base Run as well as Sensitivity Runs). The graphical results of the sensitivity runs are included in Appendix F.

Table 5-1: Summary of Alternatives Scoring for the Base Run and Sensitivity Runs

	CDP Rankings									
	Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
0 Base	7	8	3	3	1	8	10	6	3	2
1 RWAG Average Weights	7	8	2	4	1	10	9	5	5	3
2 RWAG Environmental Emphasis	4	1	3	1	5	9	5	8	7	10
3 RWAG Social Emphasis	8	5	3	3	1	10	9	6	7	2
4 RWAG Cost Emphasis	9	10	8	4	3	5	5	5	1	2
5 Equal Weights	5	7	1	3	2	9	9	6	7	3
6 No Cost	2	6	1	4	4	7	10	3	9	7
Average Ranking	6.0	6.4	3.0	3.1	2.4	8.3	8.1	5.6	5.6	4.1
Total Number of Times Ranked No.1	0	1	2	1	3	0	0	0	1	0

Color Coding of Rankings:

1	2	3	4	5	6	7	8	9	10

Highest Ranked ⟵ ⟶ Lowest Ranked

6. Key Findings and Conclusions

6.1 Key Findings

Table 5-1 summarizes the number of times that each alternative was determined to be the highest ranked alternative. It is important to note that when two or more alternatives had the same overall score, there are ties in the rankings. The ideal situation would be that the sensitivity runs have no effect on the highest ranked alternative, signifying that the choice of the alternative was not sensitive to different RWAG member interests and scenarios represented in each weighting variation. Key findings of the CDP analysis are summarized below.

- ***Alternatives D3, D2b, D2c and V3 consistently ranked highest*** among all alternatives evaluated. Of the seven decision model runs, Alternative D3 ranks the highest on three of these runs, and Alternative D2b ranks highest on two of the decision model runs. The only other alternatives which have the highest score on any run are Alternative D2a, D2c, and V2c, which rank the highest on one run each. Although Alternative V3 does not rank the highest on any one run, it has the fourth highest average ranking, usually ranking second in the runs where Alternative D3 has the best ranking.
  - **Alternative D3** and **V3** (More GWR) rank strongly due to their having the lowest capital costs, nearly the lowest O&M costs, the highest operational flexibility measured by the percent of recycled water stored in the ground and the highest year-round offset of the HTP service area collection system. These alternatives also receive high scores in Maximizing Implementation because they do not require any agreements with outside agencies, require a less difficult permitting process, and have the least amount of individual NPR projects, in addition to the lowest potential construction impacts (e.g., miles of pipe through streets). Although these alternatives have the lowest temporary job creation (estimated as a function of capital costs), D3 and V3 have the highest estimated permanent jobs created. These alternatives score well in the Environmental Justice metric since they have the lowest number of low-income and/or minority census tracts with permanent above-grade facilities. Finally, because these alternatives have the lowest number of large industrial NPR customers, they score poorly in Maximizing Adaptability and Reliability because they are not as reliant on NPR irrigation (by an order of magnitude in AFY), which is considered to be drought-proof in this analysis. But, these alternatives do not receive high marks when ranking the alternatives according to the Sensitivity Analyses with Environmental Emphasis, and when Costs are not taken into account. Alternatives D3 and V3 do not have the highest scores for protecting the environment despite their high amount of groundwater recharge, which will improve groundwater quality by dilution, because they have high Greenhouse Gas emission scores, particularly Alternative V3. The GHG emissions are a result of power usage for treatment processes at the AWPF and conveyance pumping for GWR and NPR projects. The GHG emissions are particularly high for Alternative V3 because it includes pumping of a larger amount of Title 22 water over a longer distance, larger UV system to account for potentially higher NDMA in the AWPF influent water, pumping of the backwash and concentrate to offsite outfall sewer, pumping product water, and usage from a new Administration Building (DCT options assume using

existing Administration Building). Therefore, when the sensitivity analysis runs emphasizes environmental impacts and de-emphasize costs, Alternative V3 ranks very poorly, while Alternative D3 falls near the middle of the rankings.

- ***Alternatives V1, V2a, D2a, and D1 ranked lowest*** among all alternatives evaluated.
- Alternatives D1, D2a, V1, and V2a consistently ranked low due to their emphasis on NPR project options in the dense and built-up Metro and Westside service areas, which increase the amount of recycled water pipelines required. These NPR projects consequently resulted in higher capital and annual O&M costs, high GHG emissions, high construction impacts, lower economic and social benefits, and low recycled water demand reliability. But, while they ranked low in these areas, they did rank higher Conclusions

Based on this integrated analysis, it was concluded that more GWR (Alternative D3) is the best alternative, since it has the lowest cost (capital and O&M costs) and the fewest hurdles for implementation. Therefore, it is recommended that the GWR Master Planning Report be developed with facilities planning for the more aggressive GWR alternative (30,000 AFY). But, to recognize the supply reliability benefits and potential ability to implement smaller individual projects as funding becomes available, it is also recommended that the NPR Master Planning be developed identifying potential NPR projects to be developed in parallel.

7. References

1. City of Los Angeles Department of Water and Power (LADWP), (2011). *2010 Urban Water Management Plan*.

2. Office of the City Administrator in San Francisco, (February 25, 2009). *Estimated San Francisco Jobs Created by Capital Spending.*

3. RMC/CDM Smith, (2011). *Cost Estimating Basis for Recycled Water Master Planning TM.*

4. RMC/CDM Smith (2011). *Groundwater Replenishment (GWR) Master Planning Document.*

5. RMC/CDM Smith (2011). *Non-Potable Reuse Master Planning Document.*

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Appendix A

Integrated Alternatives Analysis – Preliminary Cost Summary TM (April 26, 2011)

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Summary of Modifications to "Integrated Alternatives Analysis – Preliminary Cost Summary" since Initial Publication on April 26 2011

The Recycled Water Master Planning (RWMP) effort has spanned three years (April 2009 – March 2012). As is the nature of a planning project, assumptions are typically modified and refined as a project is further developed. The most recent assumptions related the master planning effort are presented in the GWR Master Planning Report and the NPR Master Planning Report. Assumptions and conclusions presented in these reports supersede assumptions included in this technical memorandum (TM). The following table summarizes the modifications applicable to all RWMP TMs and those specifically applicable to this TM are described in the following sections.

Assumption	Modified	Original
Applicable to all RWMP TMs		
Recycled Water Goal	59,000 AFY by 2035 This goal reflects the 2010 LADWP Urban Water Management Plan that was adopted in early 2011, after the original RWMP goals were drafted	50,000 AFY by 2019
Name for Project and Master Planning Reports	Recycled Water Master Planning Documents GWR Master Planning Report NPR Master Planning Report	Recycled Water Master Plan GWR Master Plan NPR Master Plan
Introduction Section	This is superseded by the Introduction Sections in the NPR Master Planning Report.	This section was included in all initial TMs but the terms described have been replaced by the Introduction Section for the NPR Master Planning Report.
NPR Projects Terminology	To avoid confusion related to LADWP's water rate structure, the terms "Tier 1" and "Tier 2" are superseded with the terms "planned" and "potential," respectively. Both planned and potential projects would be considered for implementation by 2035.	"Tier 1" for NPR projects that were originally planned for design and construction by the year 2015. "Tier 2" for NPR projects that were originally being evaluated in the NPR Master Planning Report for potential future implementation after the year 2015.
Name for MF/RO/AOP treatment plant	Advanced water purification facility (AWPF)	Advanced water treatment facility (AWTF)
Name for water produced by AWPF	Purified recycled water	Advanced treated recycled water, highly purified recycled water, etc.
Treatment Plant Acronyms	DCTWRP LAGWRP	DCT LAG
GWR Project Phases	Phase 1 = 15,000 AFY annual recharge goal and 25 mgd AWPF product water capacity Phase 2 = 30,000 AFY annual recharge goal and 35 mgd AWPF product water capacity	Phase 1 = 20 mgd AWPF product water capacity Phase 2 = 40 mgd AWPF product water capacity

The following modifications are specific to this TM.

2.1 Preliminary Alternatives

The original recycled water goal for the RWMP was 50,000 AFY, which was established before completion of the 2010 UWMP. The recycled water goal was increased to 59,000 AFY with the issuance of the 2010 UWMP. The integrated alternatives analysis was 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 will achieve an overall recycled water goal of 50,000 AFY. Although this TM was initially structured to achieve the 50,000 AFY goal, combinations of GWR and NPR alternatives are included in the subsequent Groundwater Replenishment Master Planning Report and Non-Potable Reuse Master Planning Report to support the UWMP 59,000 AFY goal by 2035. **Figure 2-1** summarizes the three integrated alternatives developed to offset the initial goal of 50,000 AFY of potable water as well as modifications to achieve the UWMP goal of 59,000 AFY.

Revised Figure 2-1: Integrated Alternatives to Reach 50,000 AFY and 59,000 AFY

	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:

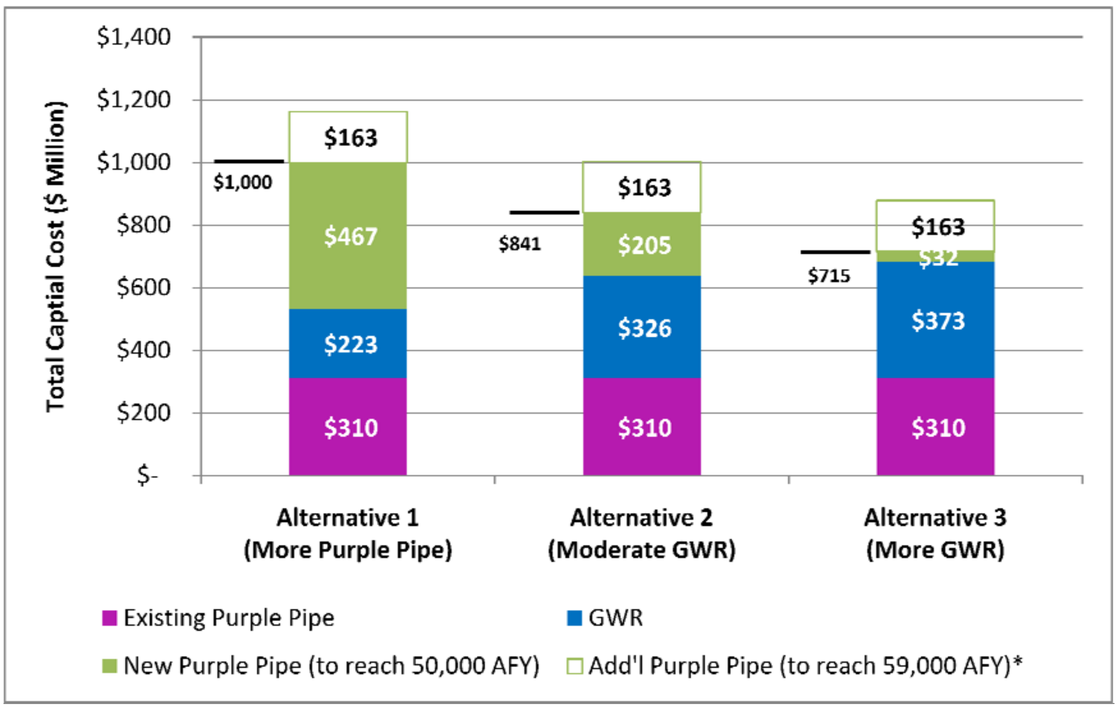
1. The original recycled water goal for the RWMP was 50,000 AFY by 2019, which was established before the completion of the 2010 UWMP. The recycled water goal was revised to 59,000 AFY by 2035 with the issuance of the 2010 UWMP. The UWMP reflects realities of funding limitations that were not addressed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

4.1 Capital Costs

In this TM, Section 4.1 presented a summary of the estimated capital costs for the three alternatives to deliver 50,000 AFY. To meet the updated 59,000 AFY, an addition 9,000 AFY of NPR would be required. The revised Figure 4-1 shows the additional minimum capital costs that would be required to deliver these additional projects. Note that the costs were based on adding additional NPR projects to Alternative 3. The additional costs to Alternatives 1 and 2 could be higher than what is shown, since most of the lower cost NPR projects were already accounted for in the alternatives. Note that costs developed in this document were developed in April 2011.

The most current GWR and NPR project costs developed as part of the RWMP are included in the GWR and NPR Master Planning Reports, respectively, and would not change the outcome of this analysis.

Revised Figure 4-1: Capital Costs for Alternatives to Achieve 50,000 AFY and 59,000 AFY



*Note that the additional NPR costs were based on adding additional NPR projects to Alternative 3. The additional costs to Alternatives 1 and 2 could be higher, since most of the lower cost NPR projects were already accounted for in the alternatives.

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Integrated Alternatives Analysis – Preliminary Cost Summary

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Date: April 26, 2011

1. Introduction

With imported water supplies becoming ever more unpredictable, the Los Angeles Department of Water and Power (LADWP) adopted the City of Los Angeles' (City) Water Supply Action Plan in May 2008, calling for 50,000 acre-feet per year (AFY) of potable supplies to be replaced by recycled water. To meet this near-term challenge and plan for expanding reuse in the future, LADWP has partnered with the Department of Public Works to develop the Recycled Water Master Plan (RWMP). The RWMP includes seven major tasks: 1) Groundwater Replenishment (GWR) Master Plan; 2) Non-Potable Reuse Master Plan; 3) GWR Treatment Pilot Study; 4) Max Reuse Concept Report; 5) Satellite Feasibility Concept Report; 6) Existing System Reliability Concept Report; and 7) Training.

As part of the master planning process, several alternatives were developed and evaluated. The process for developing and evaluating these alternatives were documented in detail in a document titled, "Draft Near-Term Integrated Alternatives Development and Analysis Technical Memorandum" (TM) (RMC/CDM, November 13, 2010).

The purpose of this document is to provide an overview of the alternatives and associated costs, to supplement the information presented to the Recycled Water Advisory Group on March 24, 2011.

2. Background & Approach

2.1 Preliminary Alternatives

The recycled water planning team established alternatives that vary the amount of GWR and non-potable reuse projects (aka "purple pipe" projects). All alternatives include the existing purple pipe projects that are currently constructed or underway (19,350 AFY). Preliminary alternatives were developed with different focuses to provide opportunities for understanding trade-offs. **Figures 2-1** and **2-2** illustrate the themes of the three alternatives.

Figure 2-1: Themes of Preliminary Alternatives to Reach 50,000 AFY

Alternative 1. More Purple Pipe

- **GWR: 15,000 AFY**
- **New Purple Pipe: 15,650 AFY**
- **Existing Purple Pipe: 19,350 AFY**

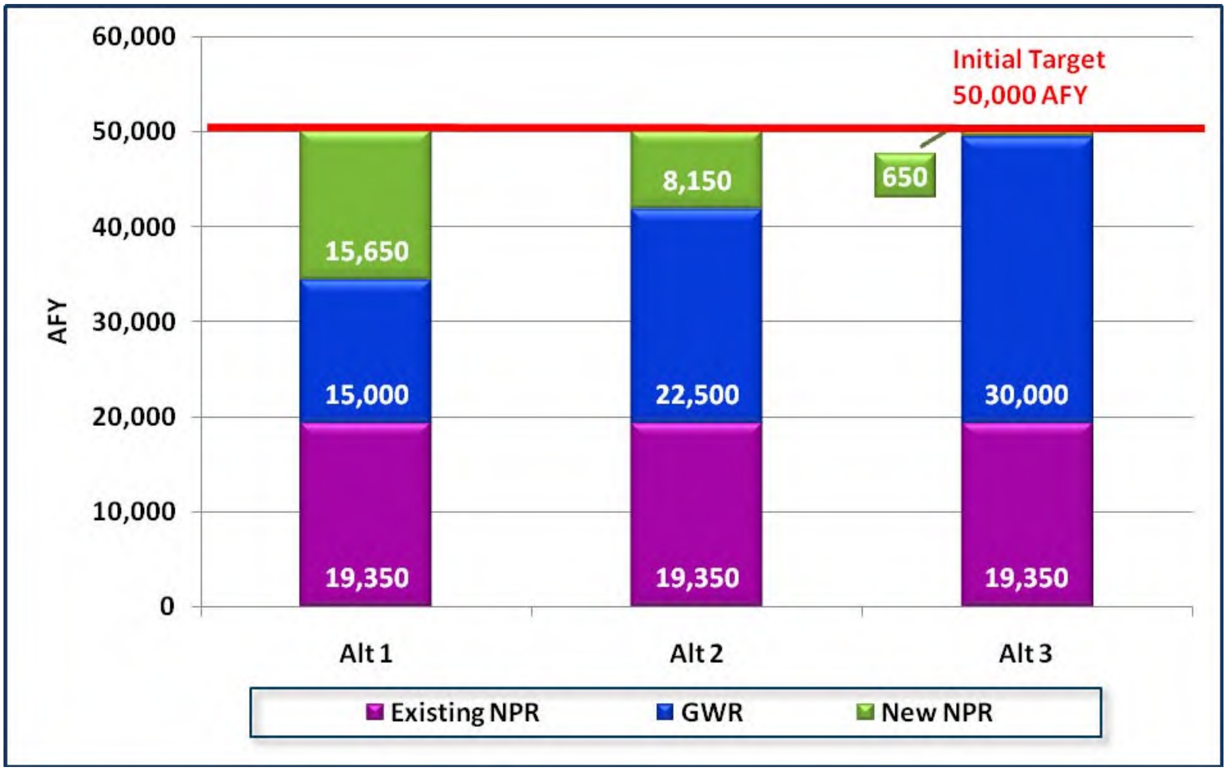
Alternative 2. Moderate GWR

- **GWR: 22,500 AFY**
- **New Purple Pipe: 8,150 AFY**
- **Existing Purple Pipe: 19,350 AFY**

Alternative 3. More GWR

- **GWR: 30,000 AFY**
- **New Purple Pipe: 650 AFY**
- **Existing Purple Pipe: 19,350 AFY**

Figure 2-2: Preliminary Alternatives to Reach 50,000 AFY



2.2 Recycled Water Master Planning Objectives

The recycled water planning team established objectives established for the RWMP at the beginning of the planning process. These objectives define the goals of the RWMP and establish criteria by which alternatives can be compared against each other.

Several guidelines were used when establishing objectives. The objectives had to be: easy to understand; non-redundant; measureable with evaluation criteria; and, concise in numbers, generally no more than five to eight objectives. 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 2-1** were also established.

Table 2-1: 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.

This document focuses on the how costs were developed for each alternative, to be able to measure Objective 1 – Promote Cost Efficiency. Methods of measuring the other objectives were also developed, as presented in the "Draft Near-Term Integrated Alternatives Development and Analysis TM" (RMC/CDM, November 13, 2010).

2.3 Approach to Cost Estimating

2.3.1 Capital and Annual Costs

To understand the potential costs of the alternatives, the recycled water planning team established cost estimating criteria for following types of costs:

- **Capital Costs:** One-time setup expenses for a project, payment for which may be spread out over many years. Capital costs include treatment equipment, buildings, conveyance pipelines, pump stations, and storage (as needed). Capital costs also include factors to account for design and environmental permitting costs.
- **Operation & Maintenance Costs (O&M):** recurring expenses that continue after construction. O&M costs include chemicals for treatment processes, power, labor, cleaning, servicing, repairs and routine replacements. For our alternatives, O&M costs also included the purchase of recycled water from partner agencies, such as West Basin Municipal Water District (as needed).

Depending on the stage of the project and the level of detail understood, different estimating accuracies can be assumed. Since we are at a master planning stage, the accuracy range for our estimate is at a "Budget Level", which reflects an accuracy range of -15% to +30%. All costs presented are reflected in today's dollars, which is based upon the Engineering News Record Construction Cost Index for Los Angeles of 10000.30 (January 2011). In addition, the capital costs include a 30% contingency to account for unknown or unforeseen construction costs. Capital costs also include a 30% implementation factor to account for the costs for planning and environmental documentation, permits, engineering, design and construction services, construction management and inspections, and typical overhead items such and legal and administration services.

Table 2-2 shows an example of how we applied the cost contingencies and other factors to capital cost estimates.

Table 2-2: Example Application of Cost Factors for Alternatives

Items	Calculation	Planning Estimate
Capital Cost Factors		
A. Estimated Construction Cost Subtotal		$1,000,000
B. Construction Contingency Cost Factor (30%)	0.3 * (A)	$300,000
C. Total Construction Cost Subtotal	(A) + (B)	$1,300,000
D. Implementation Cost Factor (30%)	0.3 * (C)	$390,000
E. Total Capital Cost	**(C) + (D)**	**$1,690,000**

A detailed discussion of these cost estimating criteria, as well as the assumed construction and O&M unit costs can be found in the document titled, "Final Draft Cost Estimating Basis for Recycled Water Master Planning TM" (RMC/CDM, April 2011).

2.3.2 Present Value

Present Value (PV) is a common financial method for comparing costs. PV reflects the "time value" of money, meaning that a dollar is worth more today than tomorrow. So, PV accounts for inflation. PV looks at total costs including capital and O&M over a defined lifecycle. It converts future costs projected over time to today's dollars. The following are the key assumptions used to calculate PV for our alternatives:

- 50-year lifecycle
- Estimates of future capital costs
- Estimates of future O&M costs
- All costs brought back to today's dollars with PV discount factor

The PV assumptions applied for comparison of the preliminary alternatives include:

- 50 year useful life for permanent structures; 20 year useful life for equipment
- 50-year lifecycle period is from year 2015 to year 2064
- 0% for borrowing rate
- 3% for capital and O&M inflation
- 3% for discount rate

See the "Final Draft Cost Estimating Basis for Recycled Water Master Planning TM" for additional detailed discussion of accounting assumptions.

3. Recycled Water Options in the Alternatives

Each of the alternatives includes various purple pipe and GWR options, which when combined become a complete integrated alternative. This section describes the existing purple pipe, new purple pipe, and GWR options included in the alternatives.

3.1 Existing Purple Pipe

All alternatives include existing purple pipe projects to deliver approximately 19,350 AFY by Fiscal Year (FY) 2014/15. These projects are either already in operation (approximately 8,000 AFY) or are in construction or planning/design with planned construction by FY 2014/15 (approximately 11,350 AFY). **Table 3-1** is a summary of the existing purple pipe projects included in all alternatives.

Table 3-1: Summary of Existing Purple Pipe Projects (through FY 14/15)

Service Area	Average Annual Yield	Estimated Capital Cost	Estimated O&M Cost
Harbor	12,500	$203 M	$13.6 M / yr
Metro	3,063	$61 M	$0.8 M / yr
Valley	2,960	$39 M	$1.2 M / yr
Westside	827	$7 M	$0.20 M / yr
Total	**19,350 AFY**	**$310 M**	**$15.8 M / yr**

The "existing purple pipe" includes infrastructure that has already been installed dating back to 1979 that is currently delivering approximately 8,000 AFY of recycled water. Approximately $180 million has been spent through FY 2008/09. The estimated capital cost shown in Table 3-1 of $310 million is for expanding the recycled water infrastructure the additional 11,350 AFY from FY 2009/10 through FY 2014/15, which represents projects that are currently in planning, design or construction.

3.2 New Purple Pipe

In addition to the existing purple pipe projects, alternatives include varying amounts of new purple pipe projects. For example, we would need to deliver recycled water to all major areas of the City (valley, central, westside and harbor) for Alternative 1 to deliver over 15,650 AFY of recycled water to new customers. To meet the Alternative 2 goal of 8,150 AFY, we could focus purple pipe development in a few areas of the City while Alternative 3 only needs a few new purple pipe projects to supply 650 AFY.

The recycled water master planning team identified potential irrigation and industrial customers with demands over 5 AFY. This represents the most amount of non-potable reuse that we could efficiently achieve. **Table 3-2** summarizes the purple pipe projects considered for the alternatives and define the estimated facility costs (capital and O&M), the facilities, and the annual yield for each option. **Figure 3-2** show the potential locations purple pipe projects considered for the alternatives. Note that the pipelines and facilities shown are diagrammatic and not intended to depict actual locations or alignments.

Table 3-2: Summary of New Purple Pipe Projects for IAA Cost Summary TM

	Annual Yield (AFY)		Facilities				Facility Capital Cost Estimates				Total Capital (w/ 30% cont. + 30% design, env., etc.)	O&M Cost Estimates			EXAMPLE (See Notes 2 & 3) NPR Components of Alternatives		
NPR Projects	**Total**	**With 75% Factor**	**Storage Tank**	**Pump Station**	**PRV**	**Conveyance**	**Storage Tank**	**Pump Station**	**PRV**	**Conveyance**		**O&M Cost ($/yr)**	**RW Purchase ($/yr)**	**Total O&M ($/yr)**	**Alt 1**	**Alt 2**	**Alt 3**
Harbor	**2,130**	**1,598**					**$ 4,100,000**	**$ 2,940,000**	**$ -**	**$ 23,910,000**	**$ 33,300,000**	**$ 367,000**	**$ 400,000**	**$ 605,000**			
WBMWD																	
Ex/T1 Laterals	711	533	--	--	--	1.4 mi	$ -	$ -	$ -	$ 1,080,000	**$ 1,800,000**	$ 4,000	$ 400,000	**$ 404,000**	✓	✓	
TIWRP			2 x 0.5 MG	3,600 gpm													
Ex/T1 Laterals	551	413	--	--	--	1.4 mi	$ -	$ -	$ -	$ 1,110,000	**$ 1,900,000**	$ 5,000	$ -	**$ 5,000**	✓		
SA Recycling	105	79	--	6%	--	1.3 mi	$ -	$ 180,000	$ -	$ 1,010,000	**$ 2,000,000**	$ 39,000	$ -	**$ 39,000**	✓	✓	
Peck Park	189	142	33%	10%	--	2.1 mi	$ 680,000	$ 290,000	$ -	$ 2,450,000	**$ 5,800,000**	$ 55,000	$ -	**$ 55,000**	✓		
Port of LA	265	199	33%	15%	--	3.8 mi	$ 680,000	$ 440,000	$ -	$ 6,220,000	**$ 12,400,000**	$ 47,000	$ -	**$ 47,000**	✓	✓	
Angels Gate	206	155	34%	12%	--	2.8 mi	$ 700,000	$ 350,000	$ -	$ 3,170,000	**$ 7,100,000**	$ 36,000	$ -	**$ 36,000**	✓		
Coast Guard	103	77	--	6%	--	1.5 mi	$ -	$ 180,000	$ -	$ 1,190,000	**$ 2,300,000**	$ 19,000	$ -	**$ 19,000**	✓	✓	
Metro	**5,877**	**4,408**					**$ 9,410,000**	**$ 1,280,000**	**$ 720,000**	**$ 52,000,000**	**$ 107,200,000**	**$ 310,000**	**$ 2,320,000**	**$ 2,630,000**			
LAG																	
Ex/T1 Laterals	937	703	--	--	--	7.0 mi	$ -	$ -	$ -	$ 6,540,000	**$ 11,100,000**	$ 23,000	$ -	**$ 23,000**	✓	✓	
Hollywood	1,244	933	2.0 MG	1,300 gpm	16"	11.8 mi	$ 6,140,000	$ -	$ 360,000	$ 14,810,000	**$ 36,000,000**	$ 64,000	$ 930,000	**$ 994,000**	✓		
CBMWD																	
USC	2,422	1,816	--	--	--	10.2 mi	$ -	$ -	$ -	$ 18,270,000	**$ 30,900,000**	$ 33,000	$ 910,000	**$ 943,000**	✓	✓	
Downtown	1,274	956	0.8 MG	1,500 gpm	20"	6.8 mi	$ 3,270,000	$ 1,280,000	$ 360,000	$ 12,380,000	**$ 29,200,000**	$ 190,000	$ 480,000	**$ 670,000**	✓	✓	
Valley	**8,601**	**6,451**					**$ 29,420,000**	**$ 11,120,000**	**$ 1,030,000**	**$ 88,400,000**	**$ 219,600,000**	**$ 1,676,000**	**$ -**	**$ 1,676,000**			
Ex/T1 Laterals	1,647	1,235	--			5.7 mi	$ -	$ -	$ -	$ 6,510,000	**$ 11,000,000**	$ 18,000	$ -	**$ 18,000**	✓	✓	
North Valley																	
VA	1,367	1,025	1.0 MG	4,000 gpm	--	10.2 mi	$ -	$ 1,620,000	$ -	$ 18,110,000	**$ 33,300,000**	$ 200,000	$ -	**$ 200,000**	✓	✓	
Knollwood	993	745	1.3 MG	3,800 gpm	16"	10.0 mi	$ 7,930,000	$ 3,670,000	$ 360,000	$ 11,880,000	**$ 40,300,000**	$ 300,000	$ -	**$ 300,000**	✓		
Porter Valley	797	598	1.0 MG	700 gpm	--	6.1 mi	$ 4,090,000	$ 720,000	$ -	$ 7,270,000	**$ 20,400,000**	$ 110,000	$ -	**$ 110,000**	✓		
West Valley				4,300 gpm	--												
Braemar	1,074	806	2.5 MG	47%	--	6.4 mi	$ 5,120,000	$ 1,340,000	$ -	$ 10,900,000	**$ 29,300,000**	$ 230,000	$ -	**$ 230,000**	✓	✓	
Pierce	357	268	--	16%	--	3.5 mi	$ -	$ 460,000	$ -	$ 4,750,000	**$ 8,800,000**	$ 52,000	$ -	**$ 52,000**	✓		
Woodland	848	636	2.0 MG	37%	--	7.8 mi	$ 6,140,000	$ 1,050,000	$ -	$ 7,780,000	**$ 25,300,000**	$ 200,000	$ -	**$ 200,000**	✓		
East Valley (Burbank)																	
N. Hollywood Park	143	107	--	--	--	3.0 mi	$ -	$ -	$ -	$ 4,000,000	**$ 6,800,000**	$ 36,000	$ -	**$ 36,000**	✓	✓	✓
Van Nuys	629	472	1.0 MG	1,800 gpm	16"	8.9 mi	$ 2,050,000	$ 880,000	$ 360,000	$ 11,090,000	**$ 24,300,000**	$ 230,000	$ -	**$ 230,000**	✓	✓	✓
Hwy 170	672	504	0.5 MG	800 gpm	12"	6.7 mi	$ 4,090,000	$ 1,380,000	$ 310,000	$ 5,580,000	**$ 19,200,000**	$ 270,000	$ -	**$ 270,000**	✓		
Valhalla	74	56	--	--	--	1.1 mi	$ -	$ -	$ -	$ 530,000	**$ 900,000**	$ 30,000	$ -	**$ 30,000**	✓	✓	✓
Westside	**4,258**	**3,193**					**$ 12,890,000**	**$ 3,690,000**	**$ 360,000**	**$ 46,300,000**	**$ 106,900,000**	**$ 553,000**	**$ 2,140,000**	**$ 2,693,000**			
Ex/T1 Laterals	833	625	--			4.0 mi	$ -	$ -	$ -	$ 5,720,000	**$ 9,700,000**	$ 13,000	$ 500,000	**$ 513,000**	✓	✓	
Westside																	
Kenneth Hahn	668	501	1.0 MG	1,300 gpm	--	5.5 mi	$ 3,070,000	$ 1,150,000	$ -	$ 5,450,000	**$ 16,300,000**	$ 160,000	$ 190,000	**$ 350,000**	✓		
UCLA	2,757	2,068	0.4, 4.0 MG	3,700 gpm	24"	23.3 mi	$ 9,820,000	$ 2,540,000	$ 360,000	$ 35,130,000	**$ 80,900,000**	$ 380,000	$ 1,450,000	**$ 1,830,000**	✓		
Total	**20,866**	**15,650**					**$ 55,820,000**	**$ 19,030,000**	**$ 2,110,000**	**$ 210,610,000**	**$ 467,000,000**	**$ 2,906,000**	**$ 4,860,000**	**$ 7,604,000**	**EXAMPLE (See Notes 2 & 3)**		

Notes:

1. Cost estimates based on facilites from intial hydraulic modeling completed in August 2010. All costs are in January 2011 dollars.

2. NPR components of Alternatives 1, 2, and 3 were selected for demonstration purposes only. LADWP will select NPR projects to implement that are most viable and cost effective while considering environmental, constructability, and available sources of recycled water.

3. For each alternative, see Table 3-3 for total capital costs by service area and Table 3-4 for total annual O&M costs by service area.

Figure 3-2: Potential New Purple Pipe Projects

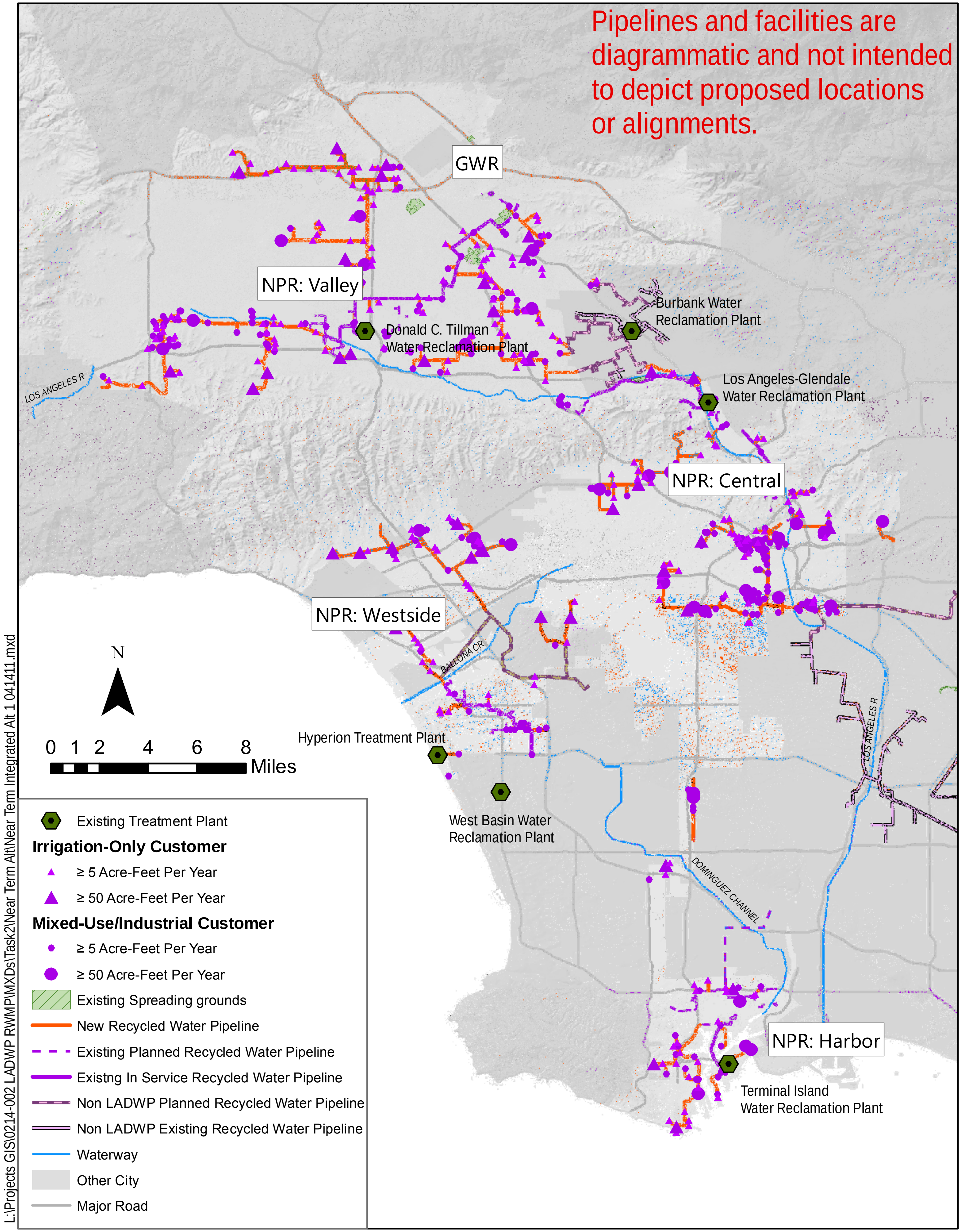


Table 3-3 and **Table 3-4** summarize the total capital and O&M costs of new purple pipe projects for each preliminary alternative by service area. Note that the components of Alternatives 1, 2, and 3 were selected for demonstration purposes only. LADWP will select NPR projects to implement that are most viable and cost effective while considering environmental, constructability, and available sources of recycled water.

Table 3-3: Summary of New Purple Pipe Projects for each Alternative - Capital Costs

Service Area	Alt 1	Alt 2	Alt 3
Harbor	$33,000,000	$19,000,000	--
Metro	$107,000,000	$71,000,000	--
Valley	$220,000,000	$106,000,000	$32,000,000
Westside	$107,000,000	$9,000,000	--
New Purple Pipe Total	**$467,000,000**	**$205,000,000**	**$32,000,000**

Note: Costs are in January 2011 dollars and include 30% construction contingency costs and 30% implementation costs.

Table 3-4: Summary of New Purple Pipe Projects for each Alternative - O&M Costs

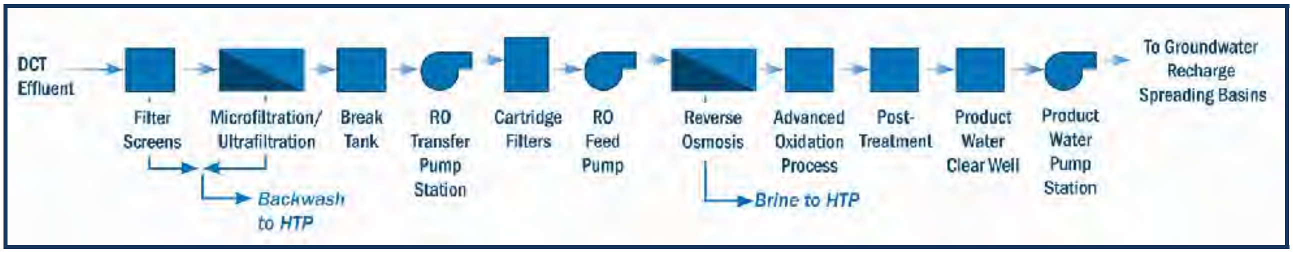
Service Area	Alt 1	Alt 2	Alt 3
Harbor	$ 600,000	$500,000	--
Metro	$2,650,000	$1,700,000	--
Valley	$1,700,000	$700,000	$300,000
Westside	$2,650,000	$500,000	--
New Purple Pipe Total	**$7,600,000**	**$3,400,000**	**$300,000**

Note: Costs are in January 2011 dollars.

3.3 GWR

In addition to existing purple pipe and new purple pipe projects, the alternatives include GWR options, ranging from 15,000 AFY to 30,000 AFY. Facilities included for GWR include advanced water treatment facility (AWTF) components including structures, equipment, parking, pumps, conveyance pipeline, backwash and concentrate pipelines. **Figure 3-3** presents the proposed treatment train.

Figure 3-3: Proposed Advanced Water Treatment Train



DCT – Donald C. Tillman Water Reclamation Plant; HTP – Hyperion Treatment Plant

3.3.1 Candidate Sites for AWTF

The recycled water planning team is considering five candidate sites for the AWTF. Four candidate sites are at or near the Donald C. Tillman Water Reclamation Plant (DCT), as shown in **Figure 3-4,** and one candidate site at the Valley Generating Station (VGS), as shown in **Figure 3-5**.

Figure 3-4: AWTF Candidate Sites at or Near DCT

Figure 3-5: AWTF Candidate Site at VGS

The five candidate sites for the AWTF were initially and preliminarily evaluated based on the objectives described in Section 2.2. **Table 3-5** and **Table 3-6** summarize the capital costs and O&M costs for the five candidate sites for the 30,000 AFY GWR project option.

Table 3-5: Capital Cost Estimate Comparison for AWTF at 5 Candidate Sites

Parameter	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
AWTF - Structures	$62,300,000	$62,300,000	$58,800,000	$62,300,000	$62,300,000
AWTF - Equipment	$110,400,000	$110,400,000	$104,300,000	$110,400,000	$110,400,000
Two-Story MF/RO Building	$510,000	$510,000	--	--	--
New parking and fencing	--	$60,000	$280,000	$200,000	$200,000
New site security	--	--	$47,000	$47,000	$47,000
New Administration Building	--	--	$5,400,000	--	--
Use eastern half of Phase II CCB for MF/RO Break Tank and UV Building (Incremental Cost)	$770,000	--	--	--	--
Additional UV Capacity	--	--	$1,400,000	--	--

Table 3-5: Capital Cost Estimate Comparison for AWTF at 5 Candidate Sites (Continued)

Parameter	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
Demolition and replacement of Maintenance and Warehouse Buildings	--	$14,200,000	--	--	--
Demolition and relocation of Existing Training Towers at VGS	--	--	TBD	--	--
Purchase new land to relocate Cricket Fields	--	--	--	$27,200,000	$0
Raise site grade or build berm around site for 100-yr flood	--	--	--	$3,100,000	$180,000
Compensate for flood water storage volume off-site	--	--	--	$800,000	$320,000
Add one new pump at Balboa PS for AWTF product water pumping	$750,000	$750,000	--	$750,000	$750,000
Add two new pumps at Balboa PS for AWTF influent/NPR water pumping	--	--	$1,500,000	--	--
Add New AWTF Product Water PS for AWTF product water to spreading grounds	--	--	$630,000	--	--
New pipeline to convey DCT effluent to AWTF influent	--	$400,000	--	--	$1,600,000
New pipeline to convey AWTF product water to Balboa PS	--	$1,000,000	--	--	$1,000,000
New pipeline for AWTF product water to spreading grounds	--	--	$800,000	--	--
New AWTF backwash and concentrate pipeline (gravity)	$500,000	$500,000	--	$500,000	$500,000
New AWTF backwash and concentrate pipeline (forcemain) and pump station [a]	--	--	$19,400,000[a]	--	--
New Phase 4 Equalization Basins (to equalize primary influent)	$9,500,000	$9,500,000	$9,500,000	$9,500,000	$9,500,000
AWTF Construction Subtotal	**$184.7 M**	**$199.6 M**	**$202.1 M**	**$214.8 M**	**$186.8 M**
Contingency Costs (30%)	$55.4 M	$59.9 M	$60.6 M	$64.4 M	$56.0 M
Construction Total	**$240.1 M**	**$259.5 M**	**$262.7 M**	**$279.2 M**	**$242.8 M**
Implementation Costs (30%)	$72.0 M	$77.9 M	$78.8 M	$83.8 M	$72.8 M
Total Capital Cost	**$312 M**	**$337 M**	**$342 M**	**$363 M**	**$316 M**

Note: Costs are in January 2011 dollars.

a. Cost could increase considerably if pipe jacking becomes necessary in certain portions to alleviate concerns of open trenching.

Table 3-6: Annual O&M Cost Estimate Comparison for AWTF at 5 Candidate Sites

Parameter	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
Total Labor, Chemical, Equipment Replacement	$12,300,000	$12,300,000	$10,600,000	$12,300,000	$12,300,000
Power Usage - AWTF excl. UV	$4,000,000	$4,000,000	$3,400,000	$4,000,000	$4,000,000
Power Usage - UV	$1,300,000	$1,300,000	$1,700,000	$1,300,000	$1,300,000
Power Usage - Balboa PS	$1,600,000	$1,600,000	$2,500,000	$1,600,000	$1,600,000
Power Usage - Product Water PS	--	--	$100,000	--	--
Power Usage - Brineline PS	--	--	$100,000	--	--
Power Usage - New Admin Bldg	--	--	$100,000	--	--
Total O&M Cost ($/year):	**$19.2 M/yr**	**$19.2 M/yr**	**$18.5 M/yr**	**$19.2 M/yr**	**$19.2 M/yr**

Note: Costs are in January 2011 dollars.

Cost is one of many logistical and operational parameters considered in selecting a site for recycled water master planning. In addition to the non-cost factors described in objectives 2-6 (Section 2.2), three specific, critical criteria were identified by LADWP and BOS management for consideration and summarized in Table 3-7. Only DCT SW meets each of these three criteria. On the basis of this, DCT SW was used as the basis for this cost analyses.

Table 3-7: Critical Criteria for Evaluation of 5 Candidate Sites

Critical Criteria	Site 1 DCT SE	Site 2 DCT SW	Site 3 VGS	Site 4 Cricket Fields	Site 5 Contractor Laydown Area
Bureau of Sanitation already has related facilities and staffing at the site to support the operation of the advanced treatment facility 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 DCT.		✓	✓		

3.3.2 GWR Components for IAA Evaluation

To compare the costs for each of the three alternatives (Table 3-8) for expanding the recycled water program, the RWMP team used the AWTF estimated capital and O&M costs for Site 2 (DCT SW). This site was used because it met all of the critical criteria as identified in Table 3-7. All AWTF sites will be evaluated equally for environmental impacts through the CEQA/NEPA process. **Table 3-8** summarizes the estimated capital cost of GWR components and **Table 3-9** summarizes the estimated annual O&M cost for GWR.

Table 3-8: Capital Cost of GWR Components for each Alternative

GWR Components	Alt 1	Alt 2	Alt 3
GWR	**15,000 AFY**	**22,500 AFY**	**30,000 AFY**
Treatment Structures	$64,600,000	$88,900,000	$105,200,000
Treatment Equipment	$114,700,000	$157,800,000	$186,700,000
MF/RO Building	$800,000	$800,000	$900,000
Parking/Fencing	$100,000	$100,000	$100,000
Demolition/Relocation of Maintenance & Warehouse buildings	$24,100,000	$24,100,000	$24,100,000
New Product Water Pumps at Balboa Pump Station	--	--	$1,300,000
New Pipeline from Secondary/Tertiary Effluent to AWTF	$400,000	$700,000	$700,000
New Product Water Pipeline from AWTF to Balboa Pump Station	$1,400,000	$1,800,000	$1,800,000
Backwash and Concentrate Pipeline	$700,000	$800,000	$800,000
Equalization Basins	$16,100,000	$16,100,000	$16,100,000
Conveyance Pipeline from Hansen SG to Pacoima SG	$0	$35,300,000	$35,300,000
Total	**$223,000,000**	**$326,000,000**	**$373,000,000**

Note: Costs are in January 2011 dollars and include 30% construction contingency costs and 30% implementation costs. In order to achieve the annual goals of 15,000, 22,500, and 30,000 AFY, the size of the AWTF will be designed for an ultimate treatment capacity of approximately 20, 27, and 32 million gallons per day (mgd), respectively. These capacities account for offline factors for AWTF and spreading grounds, and seasonal variations for NPR demand.

Table 3-9: Annual O&M Costs for GWR Components for each Alternative

GWR Components	Alt 1	Alt 2	Alt 3
GWR	**15,000 AFY**	**22,500 AFY**	**30,000 AFY**
Total Labor, Chemical, Equipment Replacement	$7,200,000	$9,900,000	$12,300,000
AWTF Power Usage, excluding UV	$2,400,000	$3,200,000	$4,000,000
UV Power Usage	$800,000	$1,100,000	$1,300,000
Pumping at Balboa PS	$900,000	$1,300,000	$1,600,000
Total ($/year)	**$11,000,000**	**$15,000,000**	**$19,000,000**

Note: Costs are in January 2011 dollars.
To establish the AWTF annual O&M costs for the 15,000, 22,500 and 30,000 AFY alternatives, an average treatment rate of approximately 18, 25, and 31 mgd, respectively is used

4. Costs for Alternatives

4.1 Capital Cost

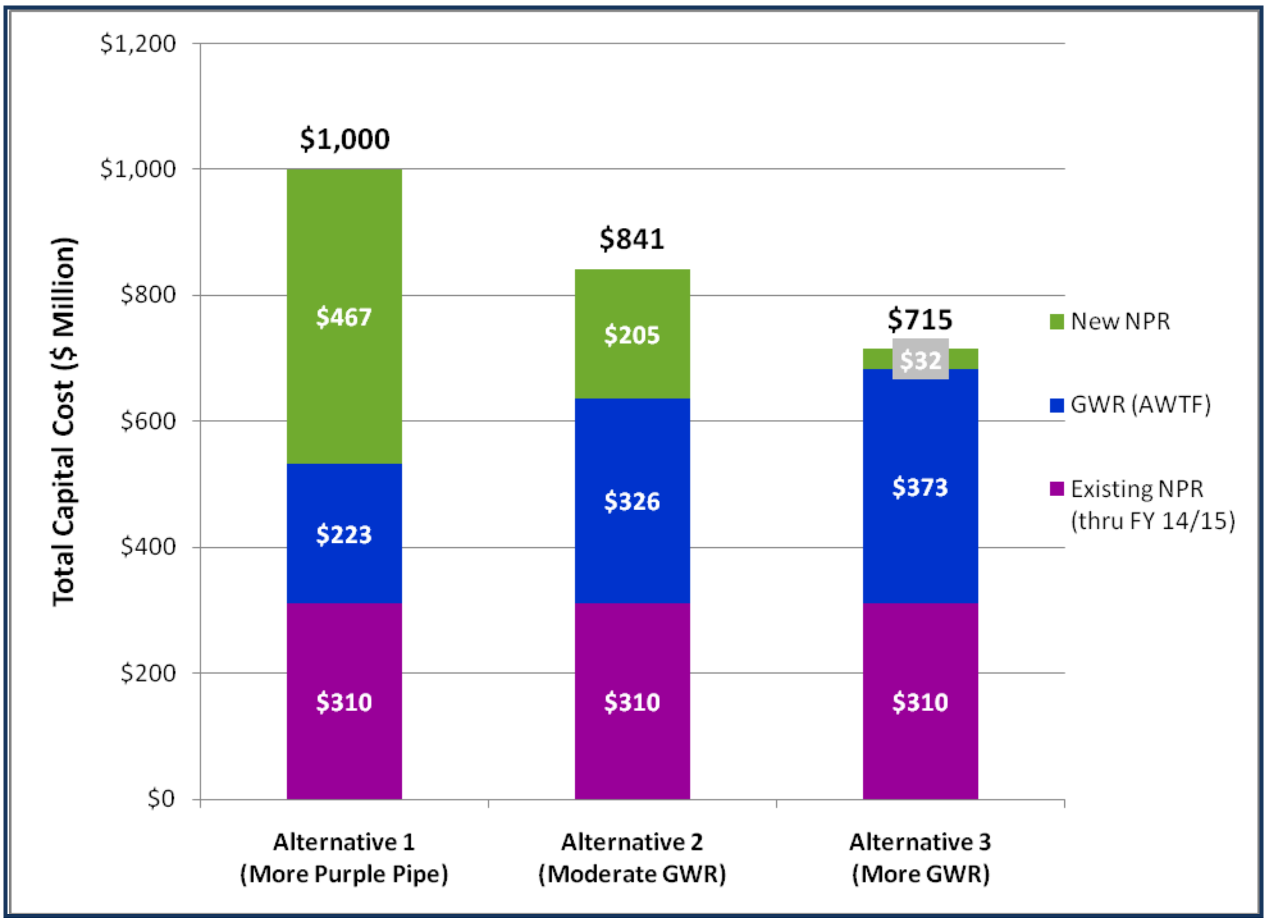
Using the components described in Section 3, **Table 4-1** presents a summary of the capital costs for each alternative. **Figure 4-1** presents a chart summarizing the capital costs.

Table 4-1: Capital Costs for Preliminary Alternatives

Component	Alt 1	Alt 2	Alt 3
Existing Purple Pipe	$310,000,000	$310,000,000	$310,000,000
New Purple Pipe	$467,000,000	$205,000,000	$32,000,000
GWR	$223,000,000	$326,000,000	$373,000,000
Total	**$1,000,000,000**	**$841,000,000**	**$715,000,000**

Note: Costs are in January 2011 dollars and include 30% construction contingency costs and 30% implementation costs.

Figure 4-1: Capital Costs for Alternatives to Achieve 50,000 AFY



Note: Total capital cost for each alternative is rounded to the nearest million dollars.

4.2 O&M Costs

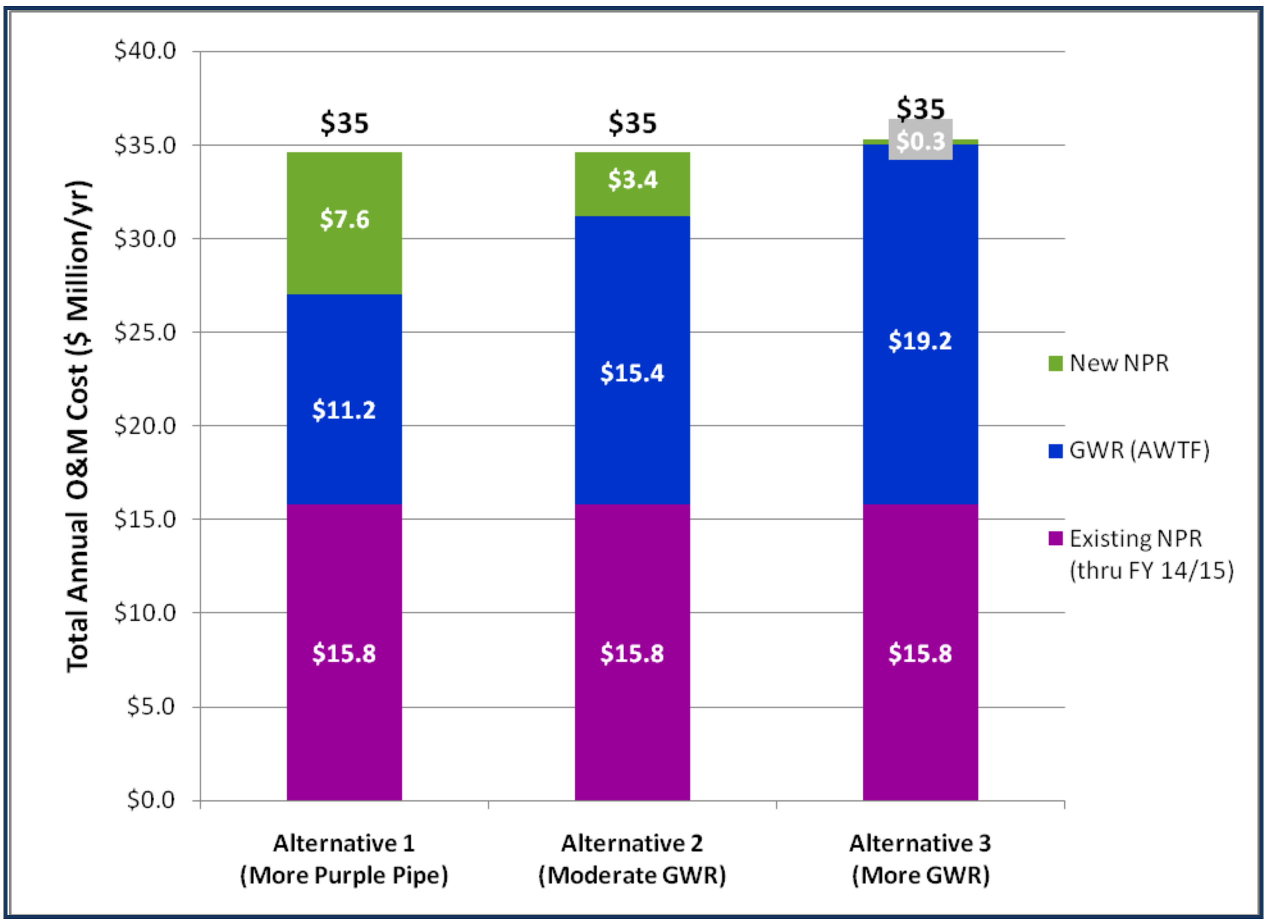
Using the components described in Section 3, **Table 4-2** presents a summary of the O&M costs for each alternative. **Figure 4-2** presents a chart summarizing the O&M costs.

Table 4-2: Annual O&M Costs for Alternatives to Achieve 50,000 AFY

Component	Alt 1	Alt 2	Alt 3
Existing Purple Pipe	$15,800,000	$15,800,000	$15,800,000
New Purple Pipe	$7,600,000	$3,400,000	$300,000
GWR	$11,300,000	$15,500,000	$19,200,000
Total	**$34,700,000**	**$34,700,000**	**$35,300,000**

Note: Costs are in January 2011 dollars.

Figure 4-2: Annual O&M Costs for Alternatives to Achieve 50,000 AFY



Note: Total annual O&M cost for each alternative is rounded to the nearest million dollars.

4.3 Present Value

Using the components described in Section 3 and capital and O&M costs described in earlier Section 4.1 and 4.2, **Table 4-3** presents a summary of the present value cost, yield, and unit cost for each alternative. **Figure 4-3** presents a chart summarizing the present value for each alternative.

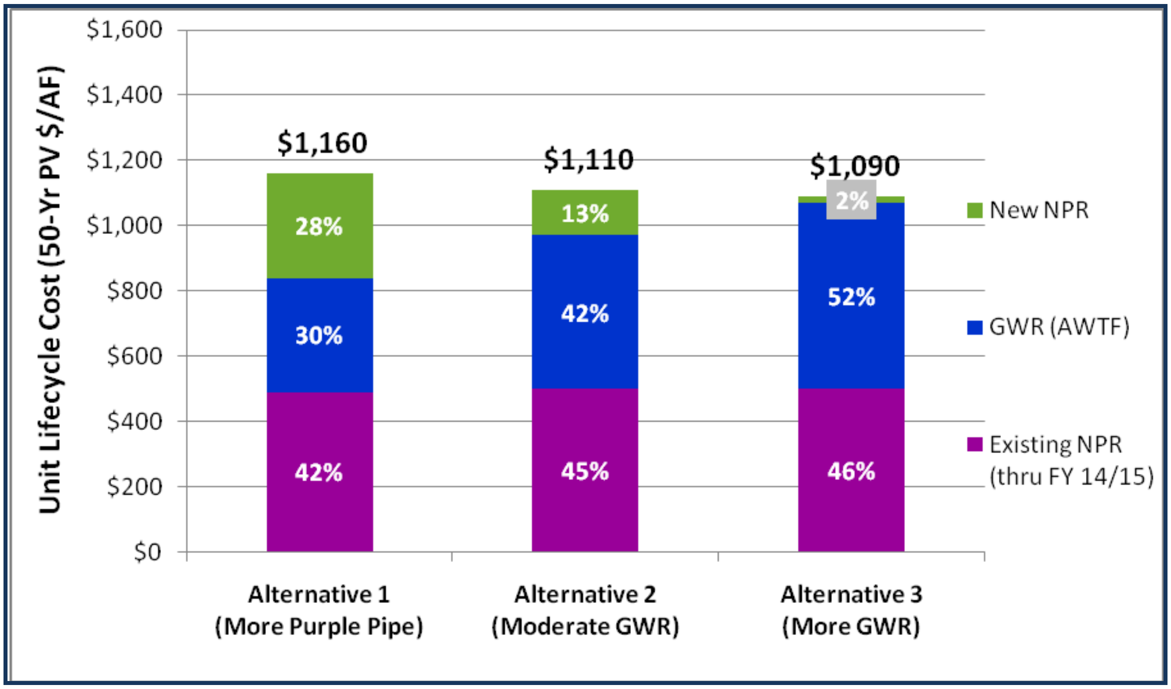
Table 4-3: Present Value Cost for Alternatives to Achieve 50,000 AFY

Component	Alt 1 [a]	Alt 2 [a,b]	Alt 3 [a,c]
Present Value (Capital and O&M over 50-Year Lifecycle) [d]			
Existing Purple Pipe	$1,164,000,000	$1,164,000,000	$1,164,000,000
New Purple Pipe	$747,000,000	$329,000,000	$37,000,000
GWR	$834,000,000	$1,098,000,000	$1,325,000,000
Total Present Value	**$2,745,000,000**	**$2,591,000,000**	**$2,526,000,000**
Total RW Produced (over 50 years)	2,357,350 AF [a]	2,323,600 AF [a,b]	2,327,350 AF [a,c]
Unit PV Cost ($/AF)	**$1,160/AF**	**$1,110/AF**	**$1,090/AF**

Notes:

a. For all alternatives, new purple pipe construction starts in 2020 and finishes in 2029. New purple pipe yield starts in 2021 and increases through 2030.
b. For Alt 2, GWR Phase 1 construction starts in 2015, finishes in 2019, and production starts in 2020. GWR Phase 2 construction starts in 2025, finishes in 2029, and production starts in 2030.
c. For Alt 3, GWR Phase 1 construction starts in 2015, finishes in 2019, and production starts in 2020. GWR Phase 2 construction starts in 2020, finishes in 2024, and production starts in 2025. GWR Phase 3 construction starts in 2025, finishes in 2029, and production starts in 2030.
d. Costs are in January 2011 dollars. See Section 2.3.2 for Present Value assumptions.

Figure 4-3: Unit Lifecycle Cost for Alternatives to Achieve 50,000 AFY

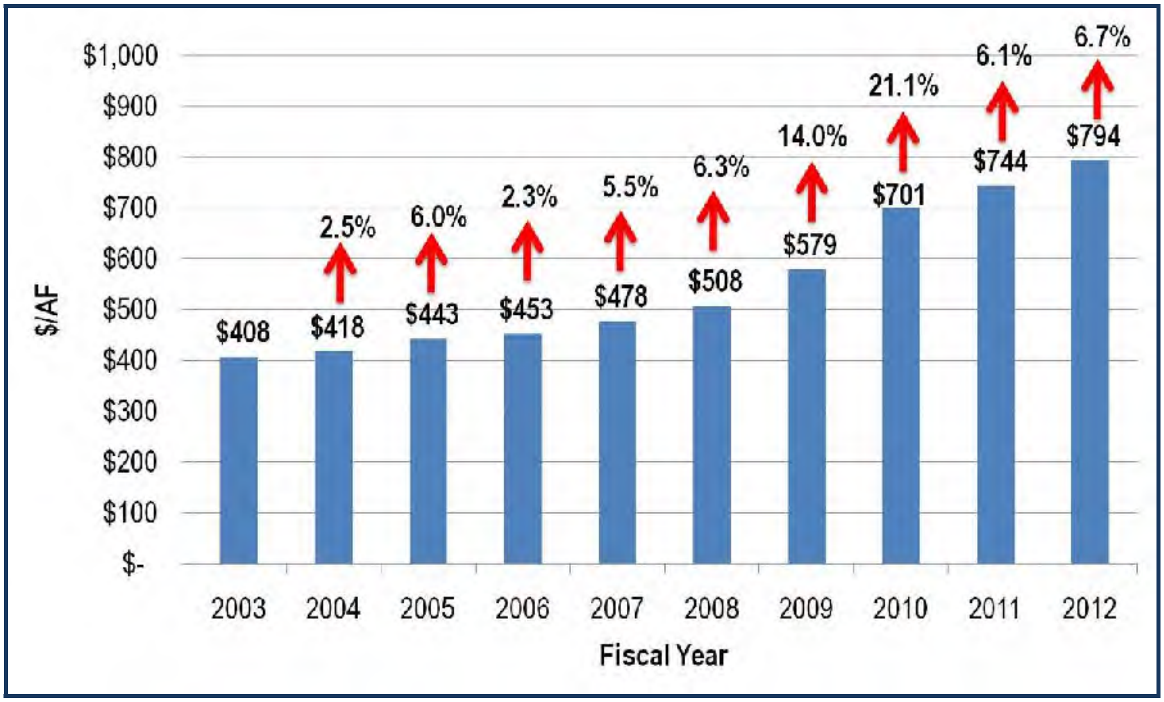


4.4 Comparison with Forecasted Imported Water Rates

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 Draft Urban Water Management Plan (UWMP) (January 2011), LADWP plans to stay within their Tier 1 allotment throughout the projected period (through 2035). As a result, the three alternatives for expanding recycled water to 50,000 AFY are being compared to the cost of MWD Tier 1 imported water. For the purpose of this comparison, LADWP developed water purchase costs for MWD Tier 1 imported water.

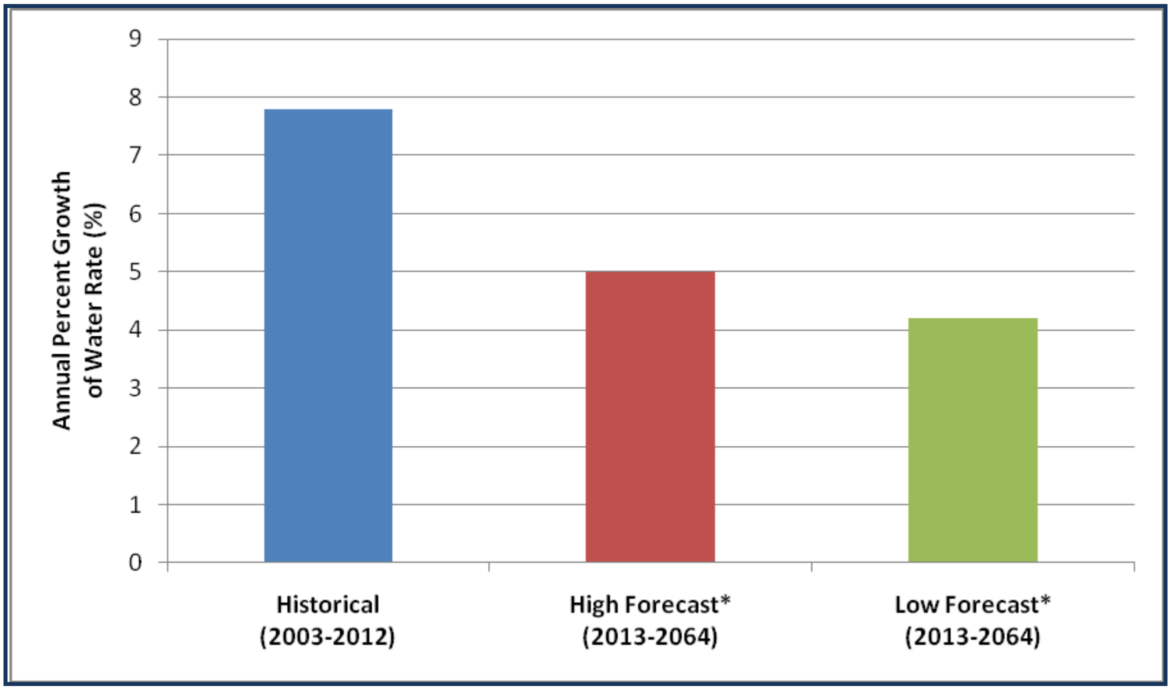
As shown in **Figure 4-4**, MWD rates have increased significantly over the last 10 years. The figure shows those increases from FY 2003 through FY 2012 (which is already approved). The increases may seem smooth, but looking at it on an annual basis you can see they are highly volatile, ranging from a low of 2.3% to a high of over 21%. This makes estimating rates into the future very difficult. Additionally, MWD only provides rate forecasts to 2020 and we need to plan well beyond that, to 2064 in this case.

Figure 4-4: Historical and Approved MWD Tier 1 Imported Water Rates



Based on current MWD rate projections (through 2020) and historical rate increases (through 2012), LADWP developed two forecasts of future MWD Tier 1 rates through the planning period – a "high forecast" and a "low forecast." The "low forecast" is based on 5% annual growth until 2040 and then a 3% annual growth to 2064. The "high forecast" is based on a 5% annual growth from 2013 to 2064. In comparison with historical increases from MWD, as shown in **Figure 4-5**, this is conservative.

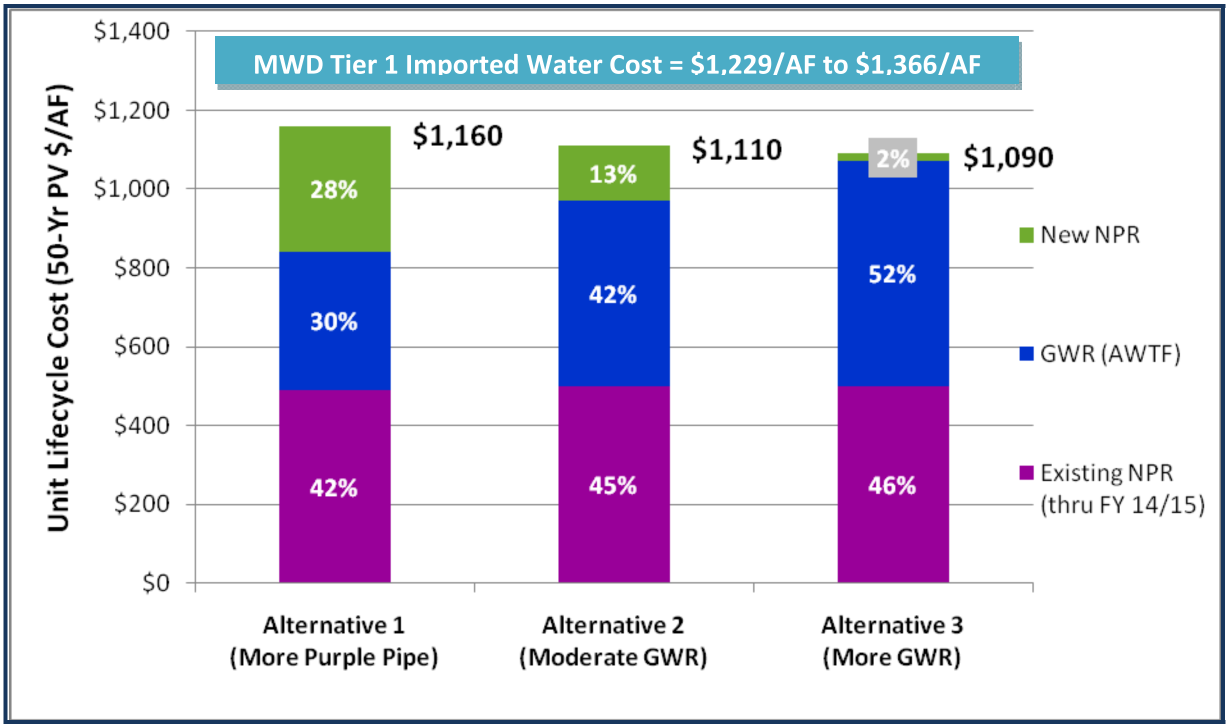
Figure 4-5: Historical and LADWP Projected Annual Growth of MWD Tier 1 Rates



*LADWP Projections

By using the high and low forecasts, we developed a range of what future MWD Tier 1 imported water rates would be and then calculated the present value using the same assumptions applied to calculate the present value for the recycled water alternatives in Section 4.3. **Figure 4-6** shows the present value unit costs for the range of imported water rate projections along with the present value unit costs for the recycled water alternatives from Section 4.3. As shown in the figure, all three alternatives cost less than we would spend purchasing that water from MWD.

Figure 4-6: Unit Lifecycle Cost for Preliminary Alternatives Compared with LADWP Projected MWD Tier 1 Imported Water Costs



Notes:

a. The high end forecast is based on an assumed 5% per year growth from 2013-2064.

b. The low end forecast is based on an assumed 5% per year growth from 2013-2040, ramping down to 3% growth by 2050 and beyond.

In conclusion, all alternatives cost less than forecasted MWD Tier 1 imported water costs. In addition, all alternatives are:

- More reliable
- Locally-controlled
- More environmentally-responsible

Therefore, all options are better than doing nothing.

Appendix B

AWPF Capital Cost Estimates for Integrated Alternatives Analysis

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Note: **Costs in this spreadsheet add contingency and implementation costs separately at the end of the table.**
This sheet references 'CAP' sheet. Do not change numbers directly in this sheet.

DCT Alternatives	Alt-D1						Alt-D2a						Alt-D2b					
	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**19.9**				**AWTF Capacity (mgd)**		**26.9**				**AWTF Capacity (mgd)**		**27.4**			
	Capacity Cost of Structures	a1	$38,200,000	$38,200,000	$0	$0	Capacity Cost of Structures	a2	$51,700,000	$51,700,000	$0	$0	Capacity Cost of Structures	a3	$52,600,000	$52,600,000	$0	$0
	Capacity Cost of Equipment	a1	$67,800,000	$67,800,000	$0	$0	Capacity Cost of Equipment	a2	$91,700,000	$67,800,000	$23,900,000	$0	Capacity Cost of Equipment	a3	$93,400,000	$67,800,000	$25,600,000	$0
	Two-story MF/RO Building	b	$432,000	$432,000	$0	$0	Two-story MF/RO Building	b	$488,000	$488,000	$0	$0	Two-story MF/RO Building	b	$488,000	$488,000	$0	$0
	New parking and fence	c	$65,000	$65,000	$0	$0	New parking and fence	c	$65,000	$65,000	$0	$0	New parking and fence	c	$65,000	$65,000	$0	$0
	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0
	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0
	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0
	New 32" STL (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g1	$265,000	$265,000	$0	$0	New 42" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g2	$348,000	$348,000	$0	$0	New 42" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g2	$348,000	$348,000	$0	$0
	New 34" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h1	$844,000	$844,000	$0	$0	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0
	New 24" PVC (450 ft) AWTP backwash and concentrate pipeline	i1	$408,000	$408,000	$0	$0	New 24" PVC (450 ft) AWTP backwash and concentrate pipeline	i1	$408,000	$408,000	$0	$0	New 27" PVC (450 ft) AWTP backwash and concentrate pipeline	i2	$459,000	$459,000	$0	$0
	New Phase 4 Equalization Basin	j	$9,540,000	$9,540,000	$0	$0	New Phase 4 Equalization Basin	j	$9,540,000	$0	$9,540,000	$0	New Phase 4 Equalization Basin	j	$9,540,000	$0	$9,540,000	$0
	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$0	$0	$0	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0
	Subtotal		**$131,800,000**	**$131,800,000**	**$0**	**$0**	**Subtotal**		**$190,400,000**	**$136,100,000**	**$54,300,000**	**$0**	**Subtotal**		**$193,100,000**	**$137,000,000**	**$56,000,000**	**$0**
	Contingency (30%)		***$39,500,000***	***$39,500,000***	***$0***	***$0***	***Contingency (30%)***		***$57,100,000***	***$40,800,000***	***$16,300,000***	***$0***	***Contingency (30%)***		***$57,900,000***	***$41,100,000***	***$16,800,000***	***$0***
	Construction Total		**$171,300,000**	**$171,300,000**	**$0**	**$0**	**Construction Total**		**$247,500,000**	**$176,900,000**	**$70,600,000**	**$0**	**Construction Total**		**$251,000,000**	**$178,100,000**	**$72,800,000**	**$0**
	Implementation Costs (30%)		**$51,400,000**	**$51,400,000**	**$0**	**$0**	**Implementation Costs (30%)**		**$74,300,000**	**$53,100,000**	**$21,200,000**	**$0**	**Implementation Costs (30%)**		**$75,300,000**	**$53,400,000**	**$21,800,000**	**$0**
	TOTAL CAPITAL COST		**$223,000,000**	**$223,000,000**	**$0**	**$0**	**TOTAL CAPITAL COST**		**$322,000,000**	**$230,000,000**	**$92,000,000**	**$0**	**TOTAL CAPITAL COST**		**$326,000,000**	**$232,000,000**	**$95,000,000**	**$0**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 10000.30
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.

Footnotes:

a1. See General Note 2. Scaled to 19.9 mgd.
a2. See General Note 2. Scaled to 26.9 mgd.
a3. See General Note 2. Scaled to 27.4 mgd.
a4. See General Note 2. Scaled to 26.8 mgd.
a5. See General Note 2. Scaled to 32.4 mgd.
b. Cost to construct one two-story MF/RO building.
c. Relocate parking within property line and add new fence.
d. Demolish existing maintenance building and warehouse west of Phase I CCB. Assumed existing maintenance building and warehouse has combined footprint of 23,200 sf.
e. Construct new maintenance building and warehouse adjacent to existing blower building at DCT. Assumed maintenance building and warehouse has combined footprint of 23,200 sf.
f. Expand existing Balboa Pump Station by adding one 800 hp capacity pump.
g1. 500 ft of 32-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
g2. 500 ft of 42-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
g3. 500 ft of 48-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
h1. 1500 ft of 34-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
h2. 1500 ft of 42-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
i1. 450 ft of 24-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
i2. 450 ft of 27-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
j. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation Technical Memorandum, dated January 21, 2010, and prepared by RMC:CDM, and escalated to January 2011 costs.
k. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

Note:

DCT Alternatives	Alt-D2c Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Alt-D3 Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**27.4**				**AWTF Capacity (mgd)**		**32.4**			
	Capacity Cost of Structures	a3	$52,600,000	$52,600,000	$0	$0	Capacity Cost of Structures	a5	$62,300,000	$62,300,000	$0	$0
	Capacity Cost of Equipment	a3	$93,400,000	$67,800,000	$25,600,000	$0	Capacity Cost of Equipment	a5	$110,400,000	$67,800,000	$23,900,000	$18,700,000
	Two-story MF/RO Building	b	$499,000	$499,000	$0	$0	Two-story MF/RO Building	b	$515,000	$515,000	$0	$0
	New parking and fence	c	$65,000	$65,000	$0	$0	New parking and fence	c	$65,000	$65,000	$0	$0
	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0	Demo existing maintenance and warehouse bldgs	d	$219,000	$219,000	$0	$0
	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0	Add new maintenance and warehouse bldgs	e	$14,000,000	$14,000,000	$0	$0
	Add new pumps at existing Balboa PS for AWTP product water pumping		$0	$0	$0	$0	Add new pumps at existing Balboa PS for AWTP product water pumping	f	$762,000	$0	$0	$762,000
	New 42" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g2	$348,000	$348,000	$0	$0	New 48" (500 ft) pipeline to convey Secondary/Tertiary effluent from DCT to AWTP influent	g3	$397,000	$397,000	$0	$0
	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0	New 42" (1500 ft) pipeline to convey AWTP product water to Balboa Pump Station	h2	$1,040,000	$1,040,000	$0	$0
	New 27" PVC (450 ft) AWTP backwash and concentrate pipeline	i2	$459,000	$459,000	$0	$0	New 27" PVC (450 ft) AWTP backwash and concentrate pipeline	i2	$459,000	$459,000	$0	$0
	New Phase 4 Equalization Basin	j	$9,540,000	$0	$9,540,000	$0	New Phase 4 Equalization Basin	j	$9,540,000	$0	$0	$9,540,000
	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	k	$20,900,000	$0	$20,900,000	$0
	Subtotal		**$193,100,000**	**$137,000,000**	**$56,000,000**	**$0**	**Subtotal**		**$220,600,000**	**$146,800,000**	**$44,800,000**	**$29,000,000**
	Contingency (30%)		***$57,900,000***	***$41,100,000***	***$16,800,000***	***$0***	***Contingency (30%)***		***$66,200,000***	***$44,000,000***	***$13,400,000***	***$8,700,000***
	Construction Total		**$251,000,000**	**$178,100,000**	**$72,800,000**	**$0**	**Construction Total**		**$286,800,000**	**$190,800,000**	**$58,200,000**	**$37,700,000**
	Implementation Costs (30%)		**$75,300,000**	**$53,400,000**	**$21,800,000**	**$0**	**Implementation Costs (30%)**		**$86,000,000**	**$57,200,000**	**$17,500,000**	**$11,300,000**
	TOTAL CAPITAL COST		**$326,000,000**	**$232,000,000**	**$95,000,000**	**$0**	**TOTAL CAPITAL COST**		**$373,000,000**	**$248,000,000**	**$76,000,000**	**$49,000,000**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 10000.30
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced

Footnotes:

- a1. See General Note 2. Scaled to 19.9 mgd.
- a2. See General Note 2. Scaled to 26.9 mgd.
- a3. See General Note 2. Scaled to 27.4 mgd.
- a4. See General Note 2. Scaled to 26.8 mgd.
- a5. See General Note 2. Scaled to 32.4 mgd.
- b. Cost to construct one two-story MF/RO building.
- c. Relocate parking within property line and add new fence.
- d. Demolish existing maintenance building and warehouse west of Phase I CCB. Assumed existing maintenance building and warehouse has combined footprint of 23,200 sf.
- e. Construct new maintenance building and warehouse adjacent to existing blower building at DCT. Assumed maintenance building and warehouse has combined footprint of 23,200 sf.
- f. Expand existing Balboa Pump Station by adding one 800 hp capacity pump.
- g1. 500 ft of 32-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
- g2. 500 ft of 42-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
- g3. 500 ft of 48-inch in-plant pressure pipe to convey DCT secondary/tertiary effluent to AWTF.
- h1. 1500 ft of 34-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
- h2. 1500 ft of 42-inch in-plant pressure pipe to convey AWTF product water to Balboa Pump Station.
- i1. 450 ft of 24-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
- i2. 450 ft of 27-inch in-plant PVC gravity pipe to discharge AWTF backwash and concentrate to AVORS on-site.
- j. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation
- k. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

VGS Alternatives	Alt-V1						Alt-V2a						Alt-V2b					
	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**14.6**				**AWTF Capacity (mgd)**		**21.8**				**AWTF Capacity (mgd)**		**27.4**			
	Capacity Cost of Structures	a1	$28,100,000	$28,100,000	$0	$0	Capacity Cost of Structures	a2	$41,900,000	$41,900,000	$0	$0	Capacity Cost of Structures	a2	$41,900,000	$41,900,000	$0	$0
	Capacity Cost of Equipment	a1	$49,800,000	$49,800,000	$0	$0	Capacity Cost of Equipment	a2	$74,300,000	$49,800,000	$24,500,000	$0	Capacity Cost of Equipment	a2	$74,300,000	$49,800,000	$24,500,000	$0
	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0
	Additional UV Capacity (Incremental cost)	c	$664,000	$664,000	$0	$0	Additional UV Capacity (Incremental cost)	c	$991,000	$664,000	$327,000	$0	Additional UV Capacity (Incremental cost)	c	$991,000	$664,000	$327,000	$0
	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d1	$1,130,000	$1,130,000	$0	$0	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d2	$843,000	$843,000	$0	$0	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d1	$1,130,000	$1,130,000	$0	$0
	Add new AWTP Product Water Pump Station at VGS	e1	$445,000	$445,000	$0	$0	Add new AWTP Product Water Pump Station at VGS	e2	$495,000	$445,000	$49,000	$0	Add new AWTP Product Water Pump Station at VGS	e2	$495,000	$445,000	$49,000	$0
	New 30" (500 ft) AWTP Product Water pipeline	f1	$513,000	$513,000	$0	$0	New 36" (500 ft) AWTP Product Water pipeline	f2	$513,000	$513,000	$0	$0	New 36" (500 ft) AWTP Product Water pipeline	f2	$513,000	$513,000	$0	$0
	New 14" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g1	$15,000,000	$15,000,000	$0	$0	New 16" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g2	$16,800,000	$16,800,000	$0	$0	New 16" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g2	$16,800,000	$16,800,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Two 40-hp Pumps, 1 duty standby	h1	$281,000	$281,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Two 100-hp Pumps, 1 duty standby	h2	$378,000	$378,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Two 100-hp Pumps, 1 duty standby	h2	$378,000	$378,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0
	New Phase 4 Equalization Basin	i	$9,540,000	$9,540,000	$0	$0	New Phase 4 Equalization Basin	i	$9,540,000	$0	$9,540,000	$0	New Phase 4 Equalization Basin	i	$9,540,000	$0	$9,540,000	$0
	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$0	$0	$0	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0
	Subtotal		**$111,500,000**	**$111,500,000**	**$0**	**$0**	**Subtotal**		**$172,700,000**	**$117,400,000**	**$55,300,000**	**$0**	**Subtotal**		**$173,000,000**	**$117,700,000**	**$55,300,000**	**$0**
	Contingency (30%)		***$33,500,000***	***$33,500,000***	***$0***	***$0***	***Contingency (30%)***		***$51,800,000***	***$35,200,000***	***$16,600,000***	***$0***	***Contingency (30%)***		***$51,900,000***	***$35,300,000***	***$16,600,000***	***$0***
	Construction Total		**$145,000,000**	**$145,000,000**	**$0**	**$0**	**Construction Total**		**$224,500,000**	**$152,600,000**	**$71,900,000**	**$0**	**Construction Total**		**$224,900,000**	**$153,000,000**	**$71,900,000**	**$0**
	Implementation Costs (30%)		**$43,500,000**	**$43,500,000**	**$0**	**$0**	**Implementation Costs (30%)**		**$67,400,000**	**$45,800,000**	**$21,600,000**	**$0**	**Implementation Costs (30%)**		**$67,500,000**	**$45,900,000**	**$21,600,000**	**$0**
	TOTAL CAPITAL COST		**$189,000,000**	**$189,000,000**	**$0**	**$0**	**TOTAL CAPITAL COST**		**$292,000,000**	**$198,000,000**	**$94,000,000**	**$0**	**TOTAL CAPITAL COST**		**$292,000,000**	**$199,000,000**	**$94,000,000**	**$0**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 9771.69.
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.

Footnotes:

a1. See General Note 3. Scaled to 14.6 mgd.
a2. See General Note 3. Scaled to 21.8 mgd.
a3. See General Note 3. Scaled to 30.6 mgd.
b. Cost to install new parking, fence, site security and administration building.
c. Cost to install a UV system sized for 1.7 log reduction of NDMA. The cost of UV system is based on the information provided by Calgon Carbon.
d1. Expand existing Balboa Pump Station by adding one 1250 hp capacity pump.
d2. Expand existing Balboa Pump Station by adding one 900 hp capacity pump.
d3. Expand existing Balboa Pump Station by adding two 800 hp capacity pump.
e1. New AWTF Product Water Pump Station with three 50 hp capacity pumps.
e2. New AWTF Product Water Pump Station with three 70 hp capacity pumps.
e3. New AWTF Product Water Pump Station with four 60 hp capacity pumps.
f1. 500 ft of 30-inch pressure pipe to convey product water to spreading grounds.
f2. 500 ft of 36-inch pressure pipe to convey product water to spreading grounds.
f3. 500 ft of 42-inch pressure pipe to convey product water to spreading grounds.
g1. 7.4 miles of 14-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
g2. 7.4 miles of 16-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
g3. 7.4 miles of 18-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
h1. New AWTF backwash/concentrate pump station with two 40 hp capacity pumps.
h2. New AWTF backwash/concentrate pump station with two 100 hp capacity pumps.
h3. New AWTF backwash/concentrate pump station with two 200 hp capacity pumps.
i. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation Technical Memorandum, dated January 21, 2010, and prepared by RMC:CDM, and escalated to January 2011 costs.
j. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

VGS Alternatives	Alt-V2c Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost	Alt-V3 Item	Notes	Cost	Phase 1 Cost	Phase 2 Cost	Phase 3 Cost
	AWTF Capacity (mgd)		**21.8**				**AWTF Capacity (mgd)**		**30.6**			
	Capacity Cost of Structures	a2	$41,900,000	$41,900,000	$0	$0	Capacity Cost of Structures	a3	$58,800,000	$58,800,000	$0	$0
	Capacity Cost of Equipment	a2	$74,300,000	$49,800,000	$24,500,000	$0	Capacity Cost of Equipment	a3	$104,300,000	$49,800,000	$24,500,000	$30,000,000
	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0	New fence, security gate, parking, and administration building	b	$5,740,000	$5,740,000	$0	$0
	Additional UV Capacity (Incremental cost)	c	$991,000	$664,000	$327,000	$0	Additional UV Capacity (Incremental cost)	c	$1,390,000	$660,000	$327,000	$400,000
	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d1	$1,130,000	$1,130,000	$0	$0	Add new pumps at existing Balboa PS for AWTP influent water and Title 22 NPR water pumping	d3	$1,520,000	$1,520,000	$0	$0
	Add new AWTP Product Water Pump Station at VGS	e2	$495,000	$445,000	$49,000	$0	Add new AWTP Product Water Pump Station at VGS	e3	$627,000	$445,000	$50,000	$130,000
	New 36" (500 ft) AWTP Product Water pipeline	f2	$513,000	$513,000	$0	$0	New 42" (500 ft) AWTP Product Water pipeline	f3	$792,000	$792,000	$0	$0
	New 16" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g2	$16,800,000	$16,800,000	$0	$0	New 18" PVC (7.4 miles) AWTP backwash and concentrate pipeline	g3	$18,600,000	$18,600,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Two 100-hp Pumps, 1 duty standby	h2	$378,000	$378,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Two 200-hp Pumps, 1 duty standby	h3	$542,000	$542,000	$0	$0
	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0	AWTP Backwash/Concentrate Pump Station: Wetwell		$295,000	$295,000	$0	$0
	New Phase 4 Equalization Basin	i	$9,540,000	$0	$9,540,000	$0	New Phase 4 Equalization Basin	i	$9,540,000	$0	$0	$9,540,000
	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0	Conveyance Pipeline from Hansen SG to Pacoima SG	j	$20,900,000	$0	$20,900,000	$0
	Subtotal		**$173,000,000**	**$117,700,000**	**$55,300,000**	**$0**	**Subtotal**		**$223,000,000**	**$137,200,000**	**$45,800,000**	**$40,100,000**
	Contingency (30%)		***$51,900,000***	***$35,300,000***	***$16,600,000***	***$0***	***Contingency (30%)***		***$66,900,000***	***$41,200,000***	***$13,700,000***	***$12,000,000***
	Construction Total		**$224,900,000**	**$153,000,000**	**$71,900,000**	**$0**	**Construction Total**		**$289,900,000**	**$178,400,000**	**$59,500,000**	**$52,100,000**
	Implementation Costs (30%)		**$67,500,000**	**$45,900,000**	**$21,600,000**	**$0**	**Implementation Costs (30%)**		**$87,000,000**	**$53,500,000**	**$17,900,000**	**$15,600,000**
	TOTAL CAPITAL COST		**$292,000,000**	**$199,000,000**	**$94,000,000**	**$0**	**TOTAL CAPITAL COST**		**$377,000,000**	**$232,000,000**	**$77,000,000**	**$68,000,000**

General Notes:

1. All costs are in January 2011 dollars. ENR construction cost index for January 2011 for Los Angeles, CA is 9771.69.
2. Capital costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced

Footnotes:

- a1. See General Note 3. Scaled to 14.6 mgd.
- a2. See General Note 3. Scaled to 21.8 mgd.
- a3. See General Note 3. Scaled to 30.6 mgd.
- b. Cost to install new parking, fence, site security and administration building.
- c. Cost to install a UV system sized for 1.7 log reduction of NDMA. The cost of UV system is based on the information provided by Calgon Carbon.
- d1. Expand existing Balboa Pump Station by adding one 1250 hp capacity pump.
- d2. Expand existing Balboa Pump Station by adding one 900 hp capacity pump.
- d3. Expand existing Balboa Pump Station by adding two 800 hp capacity pump.
- e1. New AWTF Product Water Pump Station with three 50 hp capacity pumps.
- e2. New AWTF Product Water Pump Station with three 70 hp capacity pumps.
- e3. New AWTF Product Water Pump Station with four 60 hp capacity pumps.
- f1. 500 ft of 30-inch pressure pipe to convey product water to spreading grounds.
- f2. 500 ft of 36-inch pressure pipe to convey product water to spreading grounds.
- f3. 500 ft of 42-inch pressure pipe to convey product water to spreading grounds.
- g1. 7.4 miles of 14-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
- g2. 7.4 miles of 16-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
- g3. 7.4 miles of 18-inch PVC gravity pipe to discharge AWTF backwash and concentrate to VORS. Includes construction cost for freeway crossings and railroad crossings.
- h1. New AWTF backwash/concentrate pump station with two 40 hp capacity pumps.
- h2. New AWTF backwash/concentrate pump station with two 100 hp capacity pumps.
- h3. New AWTF backwash/concentrate pump station with two 200 hp capacity pumps.
- i. Cost to construct nine new equalization basins for a total capacity of 3.24 MG. This is derived from the cost estimate presented in the DCT Dry Weather Flow Equalization Evaluation
- j. 4.9 miles of 36" pressure pipeline and 17 mgd capacity pump station.

Appendix C

AWPF Operations and Maintenance Cost Estimate for Integrated Alternatives Analysis

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DCT	Alt-D1			Alt-D2a			Alt-D2b			Alt-D2c			Alt-D2d			Alt-D2e			Alt-D3		
Alternative	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost
	Total Labor, Chemical, Equipment Replacement (mgd)	a	$7,225,000	Total Labor, Chemical, Equipment Replacement (mgd)	e	$9,659,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,855,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,855,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,659,000	Total Labor, Chemical, Equipment Replacement (mgd)	i	$9,659,000	Total Labor, Chemical, Equipment Replacement (mgd)	m	$12,290,000
	AWTP Power Usage, excl. UV (kW-hr/yr)	b	$2,356,000	AWTP Power Usage, excl. UV (kW-hr/yr)	f	$3,150,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,214,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,214,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,150,000	AWTP Power Usage, excl. UV (kW-hr/yr)	j	$3,150,000	AWTP Power Usage, excl. UV (kW-hr/yr)	n	$4,008,000
	UV (kW-hr/yr)	c	$774,000	UV (kW-hr/yr)	g	$1,034,000	UV (kW-hr/yr)	k	$1,055,000	UV (kW-hr/yr)	k	$1,055,000	UV (kW-hr/yr)	k	$1,034,000	UV (kW-hr/yr)	k	$1,034,000	UV (kW-hr/yr)	o	$1,316,000
	Pumping at Balboa PS (kW-hr/yr)	d	$874,000	Pumping at Balboa PS (kW-hr/yr)	h	$1,236,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,260,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,260,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,236,000	Pumping at Balboa PS (kW-hr/yr)	l	$1,236,000	Pumping at Balboa PS (kW-hr/yr)	p	$1,632,000
	Annual O&M Cost:		**$11,200,000**	**Annual O&M Cost:**		**$15,100,000**	**Annual O&M Cost:**		**$15,400,000**	**Annual O&M Cost:**		**$15,400,000**	**Annual O&M Cost:**		**$15,100,000**	**Annual O&M Cost:**		**$15,100,000**	**Annual O&M Cost:**		**$19,200,000**
	Contingency :		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**
	Total Annual O&M Cost:		**$11,200,000**	**Total Annual O&M Cost:**		**$15,100,000**	**Total Annual O&M Cost:**		**$15,400,000**	**Total Annual O&M Cost:**		**$15,400,000**	**Total Annual O&M Cost:**		**$15,100,000**	**Total Annual O&M Cost:**		**$15,100,000**	**Total Annual O&M Cost:**		**$19,200,000**

General Notes:

1. All costs are in January 2011 dollars. CPI Index for January 2011 for Los Angeles, CA is 225.916
2. Total labor and chemical costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
3. AWTP power usage cost (excluding UV system and conveyance pumping) is escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
4. The power usage for UV system is based on the information provided by Calgon Carbon. A 40 mgd UV system for 1.2 log removal of NDMA, Calgon Carbon recommended a 1,600 kW UV system.
5. A unit cost of $0.12/kW-hr is used for power cost.

Footnotes:

a. See General Note 2. Scaled to 18.4 mgd.
b. See General Note 3. Scaled to 18.4 mgd.
c. See General Note 4. Assumed 660 kW UV system for a 18.4 mgd UV system for 1.2 log removal.
d. To pump 18.4 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 2 pumps at 660 hp brake-horsepower each.
e. See General Note 2. Scaled to 24.6 mgd.
f. See General Note 3. Scaled to 24.6 mgd.
g. See General Note 4. Assumed 904 kW UV system for a 24.6 mgd UV system for 1.2 log removal.
h. To pump 24.6 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 2 pumps at 940 hp brake-horsepower each.
i. See General Note 2. Scaled to 25.1 mgd.
j. See General Note 3. Scaled to 25.1 mgd.
k. See General Note 4. Assumed 928 kW UV system for a 25.1 mgd UV system for 1.2 log removal.
l. To pump 25.1 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 2 pumps at 960 hp brake-horsepower each.
m. See General Note 2. Scaled to 31.3 mgd.
n. See General Note 3. Scaled to 31.3 mgd.
o. See General Note 4. Assumed 1,172 kW UV system for a 31.3 mgd UV system for 1.2 log removal.
p. To pump 31.3 mgd of AWTP product water from DCT to Hansen Spreading Grounds, operate 3 pumps at 700 hp brake-horsepower each.

VGS	Alt-V1			Alt-V2a			Alt-V2b			Alt-V2c			Alt-V2d			Alt-V2e			Alt-V3		
Alternative	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost	Item	Notes	Cost
	Total Labor, Chemical, Equipment Replacement (mgd)	a	$5,261,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,892,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,892,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,881,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,881,000	Total Labor, Chemical, Equipment Replacement (mgd)	g	$7,881,000	Total Labor, Chemical, Equipment Replacement (mgd)	l	$10,562,000
	AWTP Power Usage, excl. UV (kW-hr/yr)	b	$1,716,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,574,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,574,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,570,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,570,000	AWTP Power Usage, excl. UV (kW-hr/yr)	h	$2,570,000	AWTP Power Usage, excl. UV (kW-hr/yr)	m	$3,445,000
	UV (kW-hr/yr)	c	$845,000	UV (kW-hr/yr)	i	$1,268,000	UV (kW-hr/yr)	i	$1,268,000	UV (kW-hr/yr)	i	$1,266,000	UV (kW-hr/yr)	i	$1,266,000	UV (kW-hr/yr)	i	$1,266,000	UV (kW-hr/yr)	n	$1,697,000
	Pumping at Balboa PS (kW-hr/yr)	d	$2,400,000	Pumping at Balboa PS (kW-hr/yr)	j	$1,956,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,472,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,448,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,052,000	Pumping at Balboa PS (kW-hr/yr)	j	$2,052,000	Pumping at Balboa PS (kW-hr/yr)	o	$2,484,000
	Pumping at Product Water PS (kW-hr/yr)	e	$61,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	k	$92,000	Pumping at Product Water PS (kW-hr/yr)	p	$124,000
	Pumping for Brineline		$22,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$64,000	Pumping for Brineline		$108,000
	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000	Admin Bldgs (kW-hr/yr)	f	$90,000
	Annual O&M Cost:		**$10,400,000**	**Annual O&M Cost:**		**$13,900,000**	**Annual O&M Cost:**		**$14,500,000**	**Annual O&M Cost:**		**$14,400,000**	**Annual O&M Cost:**		**$14,000,000**	**Annual O&M Cost:**		**$14,000,000**	**Annual O&M Cost:**		**$18,500,000**
	Contingency :		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**	**Contingency :**		**$0**
	Total Annual O&M Cost:		**$10,400,000**	**Total Annual O&M Cost:**		**$13,900,000**	**Total Annual O&M Cost:**		**$14,500,000**	**Total Annual O&M Cost:**		**$14,400,000**	**Total Annual O&M Cost:**		**$14,000,000**	**Total Annual O&M Cost:**		**$14,000,000**	**Total Annual O&M Cost:**		**$18,500,000**

General Notes:

1. All costs are in January 2011 dollars. CPI Index for January 2011 for Los Angeles, CA is 225.916.
2. Total labor and chemical costs are escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
3. AWTP power usage cost (excluding UV system and conveyance pumping) is escalated from the June 2006 O&M costs presented in Phase II Integrated Resources Plan for the Wastewater Program Technical Memorandum Tillman Advanced Treatment System Basis of Design Criteria and Cost Estimate, dated June 27, 2006, and prepared by CH:CDM.
4. The power usage for UV system is based on the information provided by Calgon Carbon. A 40 mgd UV system for 1.7 log removal of NDMA, Calgon Carbon recommended a 2,400 kW UV system.
5. A unit cost of $0.12/kW-hr is used for power cost.

Footnotes:

a. See General Note 2. Scaled to 13.4 mgd.
b. See General Note 3. Scaled to 13.4 mgd.
c. See General Note 4. Assumed 804 kW UV system for a 13.4 mgd UV system for 1.7 log removal.
d. To pump 13.4 mgd of secondary/tertiary effluent from DCT to the AWTP, operate 4 pumps at 790 hp brake-horsepower each.
e. To pump 13.4 mgd of AWTP product water from the AWTP to Hansen Spreading Grounds, operate 3 pumps at 30 hp brake-horsepower each.
f. The power usage for a administrative building at the AWTP assumes the power consumption of 9.5 watts/sf for typical office/administrative buildings. Assumed 9,000 sf area for administrative building.
g. See General Note 2. Scaled to 20.1 mgd.
h. See General Note 3. Scaled to 20.1 mgd.
i. See General Note 4. Assumed 1,206 kW UV system for a 20.1 mgd UV system for 1.7 log removal.
j. To pump 20.1 mgd of secondary/tertiary effluent from DCT to the AWTP, operate 4 pumps at 790 hp brake-horsepower each.
k. To pump 20.1 mgd of AWTP product water from the AWTP to Hansen Spreading Grounds, operate 3 pumps at 50 hp brake-horsepower each.
l. See General Note 2. Scaled to 26.9 mgd.
m. See General Note 3. Scaled to 26.9 mgd.
n. See General Note 4. Assumed 1,608 kW UV system for a 26.9 mgd UV system for 1.7 log removal.
o. To pump 26.9 mgd of secondary/tertiary effluent from DCT to the AWTP, operate 4 pumps at 790 hp brake-horsepower each.
p. To pump 26.9 mgd of AWTP product water from the AWTP to Hansen Spreading Grounds, operate 3 pumps at 60 hp brake-horsepower each.

Appendix D

Greenhouse Gas Emissions Calculations

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Figure D-1: Performance Measure Scores for GHG Emissions

Greenhouse Gas Emissions	Alternatives 1.000	2a	2b	2c	3
DCT	-1.130	-1.059	-1.033	-1.065	-0.948
VGS	-0.958	-0.964	-0.876	-0.915	-0.808

Figure D-2: Summary of GHG Emission Productions and Reductions

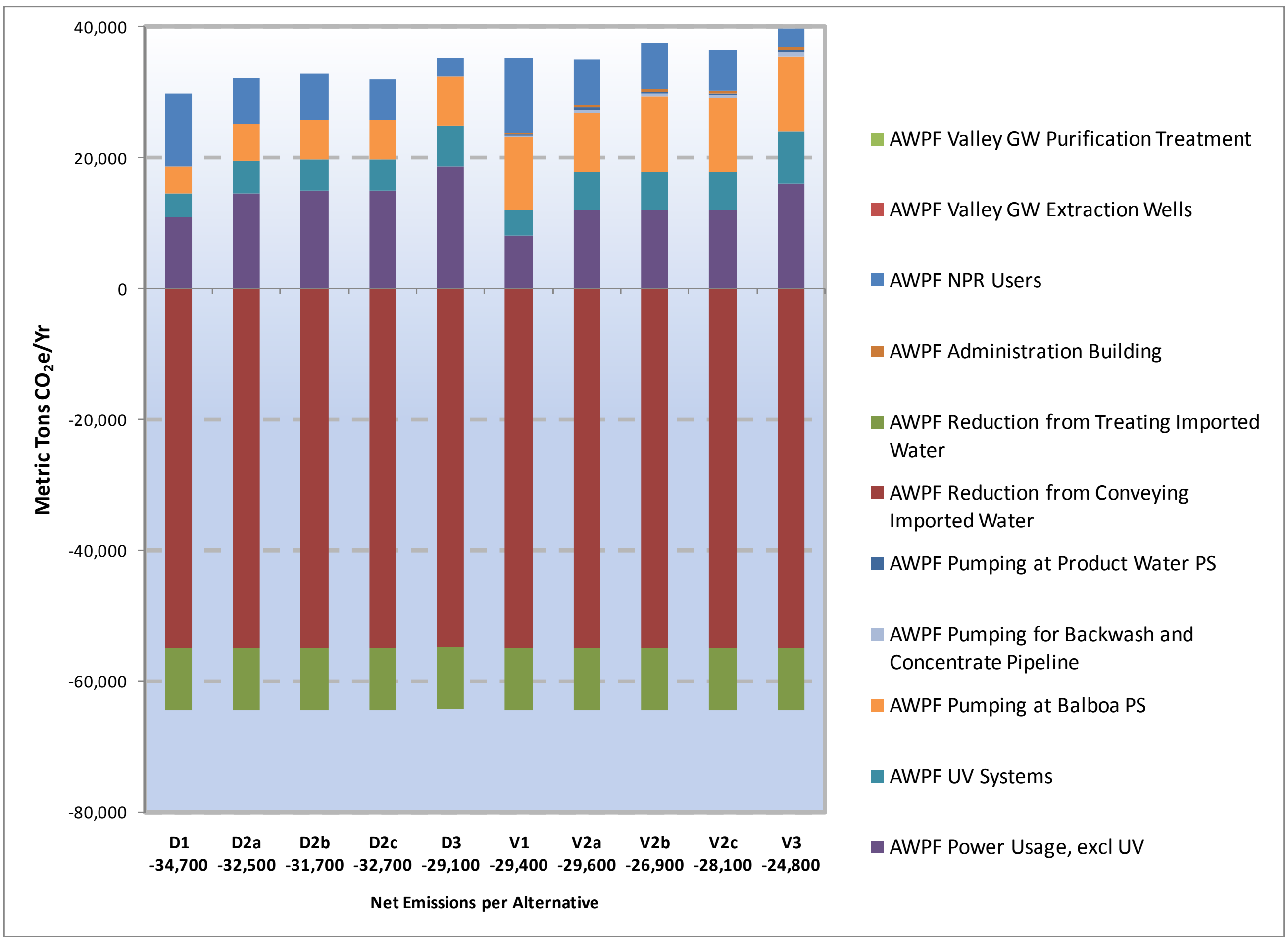

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Figure D-3: General Greenhouse Gas Emissions Calculations

Table 3. Global Warming Potential (GWP) Factors	
CO_2	1
CH_4	21
N_2O	310

Source:
California Climate Action Registry (CCAR). 2008. *Local Government Operations Protocol*. Version 1.0. September 25.
http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf

Items	Annual Electricity Use (kWh/yr)	GHG Emissions (metric tons/yr)			CO_2e Emissions (metric ton/yr)				Valley GWR (AFY)	NPR (AFY)	Harbor Projects (AFY)	Annual Yield (AFY)	CO_2e Emissions (metric ton/AF)
		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total					
DCT 1													
AWTP Power Usage, excl UV (See Notes 1 & 4)	19,600,000	10,920	0	0	10,920	5	30	10,960					
UV Systems (See Note 1)	6,450,000	3,590	0	0	3,590	2	10	3,600					
Pumping at Balboa PS (See Note 1)	7,280,000	4,050	0	0	4,050	2	11	4,060					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	20,200,000	11,300	0	0	11,300	6	31	11,300					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-34,700	15,000	15,700	0	30,700	-1.13
DCT 2a													
AWTP Power Usage, excl UV (See Notes 1 & 4)	26,300,000	14,600	0	0	14,600	7	41	14,600					
UV Systems (See Note 1)	8,620,000	4,800	0	0	4,800	2	13	4,820					
Pumping at Balboa PS (See Note 1)	10,300,000	5,740	0	0	5,740	3	16	5,760					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	12,300,000	6,900	0	0	6,900	3	19	6,920					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-32,500	22,500	8,200	0	30,700	-1.06
DCT 2b													
AWTP Power Usage, excl UV (See Notes 1 & 4)	26,800,000	14,900	0	0	14,900	7	41	14,900					
UV Systems (See Note 1)	8,800,000	4,900	0	0	4,900	2	14	4,920					
Pumping at Balboa PS (See Note 1)	10,500,000	5,850	0	0	5,850	3	16	5,870					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	12,900,000	7,180	0	0	7,180	4	20	7,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-31,700	22,500	8,200	0	30,700	-1.03
DCT 2c													
AWTP Power Usage, excl UV (See Notes 1 & 4)	26,800,000	14,900	0	0	14,900	7	41	14,900					
UV Systems (See Note 1)	8,800,000	4,900	0	0	4,900	2	14	4,920					
Pumping at Balboa PS (See Note 1)	10,500,000	5,850	0	0	5,850	3	16	5,870					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
NPR Users (See Table 4)	11,100,000	6,180	0	0	6,180	3	17	6,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-32,700	22,500	8,200	0	30,700	-1.07
DCT 3													
AWTP Power Usage, excl UV (See Notes 1 & 4)	33,400,000	18,600	0	0	18,600	9	52	18,700					
UV Systems (See Note 1)	11,000,000	6,130	0	0	6,130	3	17	6,150					
Pumping at Balboa PS (See Note 1)	13,600,000	7,570	0	0	7,570	4	21	7,590					
Reduction from Conveying Imported Water (See Note 2)	-98,000,000	-54,600	-1	0	-54,600	-27	-152	-54,800					
Reduction from Treating Imported Water (See Note 3)	-17,000,000	-9,500	0	0	-9,500	-5	-26	-9,500					
NPR Users (See Table 4)	4,970,000	2,770	0	0	2,770	1	8	2,780					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-29,100	30,000	700	0	30,700	-0.95

Figure D-3: General Greenhouse Gas Emissions Calculations (cont.)

Items	Annual Electricity Use	GHG Emissions (metric tons/yr)			CO_2e Emissions (metric ton/yr)				Valley GWR	NPR	Harbor Projects	Annual Yield	CO_2e Emissions
	(kWh/yr)	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total	(AFY)	(AFY)	(AFY)	(AFY)	(metric ton/AF)
VGS 1													
AWTP Power Usage, excl UV (See Notes 1 & 4)	14,300,000	7,960	0	0	7,960	4	22	7,990					
UV Systems (See Note 1)	7,040,000	3,920	0	0	3,920	2	11	3,930					
Pumping at Balboa PS (See Note 1)	20,000,000	11,140	0	0	11,140	6	31	11,180					
Pumping at Product Water PS (See Note 1)	512,000	290	0	0	290	0	1	290					
Pumping for Brineline	180,000	100	0	0	100	0	0	100					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	20,200,000	11,300	0	0	11,300	6	31	11,300					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-29,400	15,000	15,700	0	30,700	-0.96
VGS 2a													
AWTP Power Usage, excl UV (See Notes 1 & 4)	21,400,000	11,900	0	0	11,900	6	33	11,900					
UV Systems (See Note 1)	10,600,000	5,900	0	0	5,900	3	16	5,920					
Pumping at Balboa PS (See Note 1)	16,300,000	9,080	0	0	9,080	5	25	9,110					
Pumping at Product Water PS (See Note 1)	768,000	430	0	0	430	0	1	430					
Pumping for Brineline	530,000	300	0	0	300	0	1	300					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	12,300,000	6,850	0	0	6,850	3	19	6,870					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-29,600	22,500	8,200	0	30,700	-0.964
VGS 2b													
AWTP Power Usage, excl UV (See Notes 1 & 4)	21,400,000	11,900	0	0	11,900	6	33	11,900					
UV Systems (See Note 1)	10,600,000	5,900	0	0	5,900	3	16	5,920					
Pumping at Balboa PS (See Note 1)	20,600,000	11,470	0	0	11,470	6	32	11,510					
Pumping at Product Water PS (See Note 1)	768,000	430	0	0	430	0	1	430					
Pumping for Brineline	530,000	300	0	0	300	0	1	300					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	12,900,000	7,180	0	0	7,180	4	20	7,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-26,900	22,500	8,200	0	30,700	-0.876
VGS 2c													
AWTP Power Usage, excl UV (See Notes 1 & 4)	21,400,000	11,900	0	0	11,900	6	33	11,900					
UV Systems (See Note 1)	10,500,000	5,850	0	0	5,850	3	16	5,870					
Pumping at Balboa PS (See Note 1)	20,400,000	11,360	0	0	11,360	6	32	11,400					
Pumping at Product Water PS (See Note 1)	767,000	430	0	0	430	0	1	430					
Pumping for Brineline	530,000	300	0	0	300	0	1	300					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	11,100,000	6,180	0	0	6,180	3	17	6,200					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-28,100	22,500	8,200	0	30,700	-0.915
VGS 3													
AWTP Power Usage, excl UV (See Notes 1 & 4)	28,700,000	16,000	0	0	16,000	8	44	16,100					
UV Systems (See Note 1)	14,100,000	7,850	0	0	7,850	4	22	7,880					
Pumping at Balboa PS (See Note 1)	20,700,000	11,500	0	0	11,500	6	32	11,500					
Pumping at Product Water PS (See Note 1)	1,030,000	570	0	0	570	0	2	570					
Pumping for Brineline	900,000	500	0	0	500	0	1	500					
Reduction from Conveying Imported Water (See Note 2)	-98,200,000	-54,700	-1	0	-54,700	-27	-152	-54,900					
Reduction from Treating Imported Water (See Note 3)	-17,300,000	-9,640	0	0	-9,640	-5	-27	-9,670					
Administration Building	749,000	420	0	0	420	0	1	420					
NPR Users (See Table 4)	4,970,000	2,770	0	0	2,770	1	8	2,780					
Valley GW Extraction Wells		0	0	0	0	0	0	0					
Valley GW Treatment		0	0	0	0	0	0	0					
								-24,800	30,000	700	0	30,700	-0.808

Notes:
1) Only operating AWTP for 83% of the time (except for Alt 3--where AWTP is in operation for 0.95% of the time)
2) Conveyance of Imported Water requires 3.2 MWh/AF
3) Treatment of Imported Water requires 0.565 MWh/AF
4) Plant Power Usage excluding UV is calculated by subtracting 115,971 kWh/mo for UV operation from 1,503,243 kWh/mo for the AWTP based on IRP tech memo
5) Based on NT Greenhouse Gas Calculations average power use per mgd

Figure D-4: NPR Supplies GHG Worksheet 1

Table 1. LADWP 2007 Total Electricity Deliveries

1,227.89 lbs CO_2/MWh

Table 2. California Grid Average Electricity Emission Factors

Year	CH_4 (lbs/MWh)	N_2O (lbs/MWh)
2004	0.029	0.011

Table 3. Global Warming Potential (GWP) Factors

CO_2	CH_4	N_2O
1	21	310

Source:
CCAR, 2008. *Local Government Operations Protocol*. Version 1.0. September 25.
http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf

Example Equation

CO_2 Emissions = Electricity Usage (kWh/yr) x (0.001 MWh/kWh) x Emission Factor (lb/MWh) x (453.6 g/lb) / (1,000,000 metric ton/g)

H1 = 3,983,200 kWh/yr x 0.001 MWh/kWh x 1,227.89 lb/MWh x 453.6 g/lb / 1,000,000 metric ton/g = 2,219 metric ton/year

CH_4 and N_2O Emissions = Emissions (metric ton/year) x GWP

Table 4. Emissions from Purchased Electricity

					GHG Emissions (metric tons/yr)			CO_2e Emissions (metric ton/yr)				
	NPR Supply Option	Average TDH (feet)	Annual Flow (AFY)	Electricity Use (kWh/yr)	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total	Total per AFY
H1	TIWRP	20	2,000	3,983,200	2,219	0.05	0.02	2,219	1	6	2,226	1.1
H2	West Basin Nitrified	90	2,000	245,600	137	0.00	0.00	137	0	0	137	0.1
W1	West Basin to Rancho Park	300	3,000	1,227,800	684	0.02	0.01	684	0	2	686	0.2
W2	Rancho Park Satellite	0	3,000	0	0	0.00	0.00	0	0	0	0	0.0
M1	West Basin to Downtown	560	4,600	3,511,700	1,956	0.05	0.02	1,956	1	5	1,962	0.4
M2	Central Basin to Downtown	280	4,600	1,755,900	978	0.02	0.01	978	0	3	981	0.2
M3a	LAG expansion	170	4,600	1,066,100	594	0.01	0.01	594	0	2	596	0.1
M4	Central City Satellite	230	4,600	1,442,300	803	0.02	0.01	803	0	2	806	0.2
M5	Hollywood Satellite	360	1,400	689,100	384	0.01	0.00	384	0	1	385	0.3
V1	DCT	0	9,500	0	0	0.00	0.00	0	0	0	0	0.0
V2	Burbank	270	1,700	623,800	347	0.01	0.00	347	0	1	349	0.2
V3	LAG expansion	420	9,500	5,443,200	3,032	0.07	0.03	3,032	2	8	3,042	0.3
V4	Southeast Satellite	220	1,700	508,300	283	0.01	0.00	283	0	1	284	0.2
V5	Las Virgenes MWD	730	1,700	1,686,500	939	0.02	0.01	939	0	3	942	0.6
M3b	LAG expansion	110	1,000	150,100	84	0.00	0.00	84	0	0	84	0.1
M3c	LAG expansion	460	1,000	627,500	349	0.01	0.00	349	0	1	351	0.4

Pump Efficiency 75%

H1 TIWRP - Advanced Trmt 1.8 mgd 3,928,600 kWh / yr MF/RO/AOP (kWh / yr / mgd): 2,200,000

Head loss per 1,000 ft (ft) 2

		start elev	end elev	lift		distance	head loss		TDH
		ft	ft	ft		mi	ft		ft
H1	TIWRP	30	20	-10		2.5	27		17
H2	HTP / West Basin nitrified	10	20	10		7.1	76		86
W1	HTP / West Basin to Rancho Park	40	200	160		13	139		299
W2	Rancho Park Satellite	0	0	0		0	0		0
M1	HTP / West Basin to USC	40	400	360		19	204		564
M2	Central Basin to USC	280	400	120		15	161		281
M3	LAG expansion	440	400	-40		20	214		174
M4	Central City Satellite	210	400	190		4	43		233
M5	Hollywood Satellite	200	500	300		6	64		364
V1	DCT	0	0	0		0	0		0
V2	Burbank	550	710	160		10	107		267
V3	LAG expansion	440	710	270		14	150		420
V4	Southeast Satellite	580	710	130		8	86		216
V5	Las Virgenes MWD	480	1100	620		10	107		727
M3b	LAG expansion	440	400	-40		14	150		110
M3c	LAG expansion	440	876	436		2	21		457

Figure D-5: NPR Supplies GHG Worksheet 2

Table 1. LADWP 2007 Total Electricity Deliveries

1,227.89 lbs CO_2/MWh

Table 2. California Grid Average Electricity Emission Factors

Year	CH_4 (lbs/MWh)	N_2O (lbs/MWh)
2004	0.029	0.011

Table 3. Global Warming Potential (GWP) Factors

CO_2	CH_4	N_2O
1	21	310

Source:
CCAR, 2008. *Local Government Operations Protocol* . Version 1.0. September 25.
http://www.arb.ca.gov/cc/protocols/localgov/pubs/final_lgo_protocol_2008-09-25.pdf

Example Equation

CO_2 Emissions = Electricity Usage (kWh/yr) x (0.001 MWh/kWh) x Emission Factor (lb/MWh) x (453.6 g/lb) / (1,000,000 metric ton/g)

H1 = 5,713,600 kWh/yr x 0.001 MWh/kWh x 1,227.89 lb/MWh x 453.6 g/lb / 1,000,000 metric ton/g = 3,182 metric ton/year

CH_4 and N_2O Emissions = Emissions (metric ton/year) x GWP

Table 4. Emissions from Purchased Electricity

		Average TDH (feet)	Average Annual Flow	Annual Electricity Use	GHG Emissions (metric tons/yr) CO_2	CH_4	N_2O	CO_2e Emissions (metric ton/yr) CO_2	CH_4	N_2O	Total	Total per AFY
	Alt 1a		**20,900**	**20,240,000**	**11,270**	**0.27**	**0.10**	**11,270**	**6**	**31**	**11,310**	**0.5**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
W1	West Basin to Rancho Park	830	3,000	3,396,900	1,892	0.04	0.02	1,892	1	5	1,898	0.6
M2	Central Basin to Downtown	380	4,600	2,383,000	1,327	0.03	0.01	1,327	1	4	1,332	0.3
V1	DCT-low	390	4,500	2,394,200	1,333	0.03	0.01	1,333	1	4	1,338	0.3
V1	DCT-high	760	5,000	5,184,000	2,887	0.07	0.03	2,887	1	8	2,897	0.6
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 2a		**10,900**	**12,280,000**	**6,840**	**0.16**	**0.06**	**6,840**	**3**	**19**	**6,860**	**0.6**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
W1	West Basin to Rancho Park	830	2,800	3,177,700	1,770	0.04	0.02	1,770	1	5	1,776	0.6
M2	Central Basin to Downtown	380	4,200	2,173,900	1,211	0.03	0.01	1,211	1	3	1,215	0.3
V1	DCT-low	390	100	51,500	29	0.00	0.00	29	0	0	29	0.3
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 2b		**10,900**	**12,850,000**	**7,160**	**0.17**	**0.06**	**7,160**	**4**	**20**	**7,180**	**0.7**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
W1	West Basin to Rancho Park	830	2,800	3,177,700	1,770	0.04	0.02	1,770	1	5	1,776	0.6
V1	DCT-low	390	3,300	1,759,200	980	0.02	0.01	980	0	3	983	0.3
V1	DCT-high	760	1,000	1,036,800	577	0.01	0.01	577	0	2	579	0.6
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 2c		**10,900**	**11,100,000**	**6,180**	**0.15**	**0.06**	**6,180**	**3**	**17**	**6,200**	**0.6**
H1	TIWRP	380	2,300	5,713,600	3,182	0.08	0.03	3,182	2	9	3,193	1.4
M2	Central Basin to Downtown	380	4,200	2,173,900	1,211	0.03	0.01	1,211	1	3	1,215	0.3
V1	DCT-low	390	1,900	1,012,600	564	0.01	0.01	564	0	2	566	0.3
V1	DCT-high	760	1,000	1,036,800	577	0.01	0.01	577	0	2	579	0.6
V2	Burbank	570	1,500	1,166,400	650	0.02	0.01	650	0	2	652	0.4
	Alt 3a		**900**	**4,970,000**	**2,770**	**0.07**	**0.02**	**2,770**	**1**	**8**	**2,780**	**3.1**
H1	TIWRP	380	870	4,969,400	2,768	0.07	0.02	2,768	1	8	2,777	3.2
			Pump Efficiency	75%								
H1	TIWRP - Advanced Trmt	2.1	mgd	4,517,900	kWh / yr				MF/RO/AOP (kWh / yr / mgd):			2,200,00

Appendix E

Environmental Justice Maps

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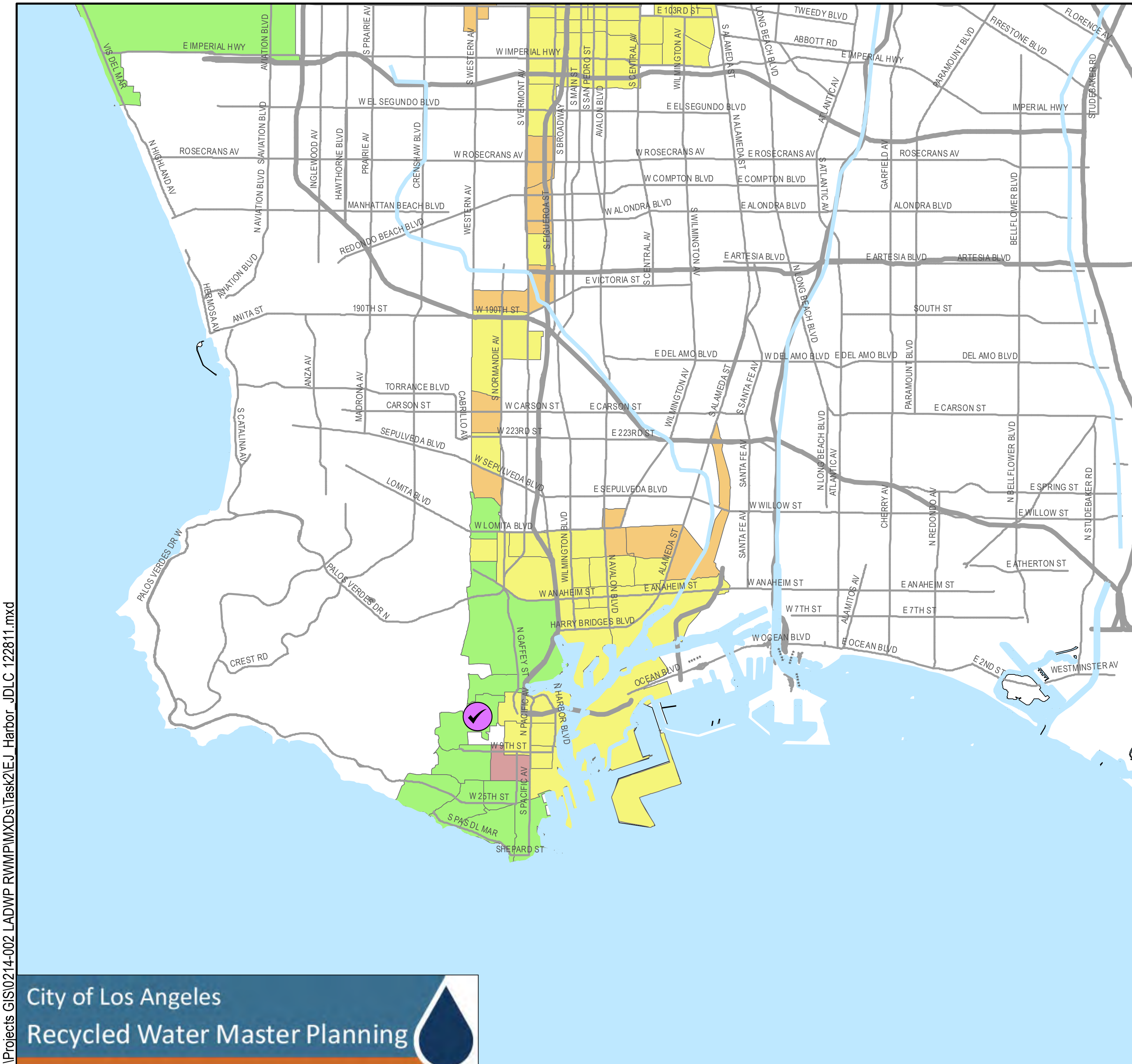
Harbor Service Area
Low to Moderate Income and Minority Tracts



Potential Aboveground NPR Facility Outside of Low to Moderate Income and/or Minority Tract

Census Tracts

- Low/Moderate Income
- Low/Moderate Income & Minority
- Minority
- Non Low/Moderate Income or Minority
- Major Road
- Waterway

0 1 2 4

Miles

LA DWP

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS

RMC in association with CDM

City of Los Angeles

Recycled Water Master Planning

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Data Sources: USGS, LADWP, ESRI, US Census

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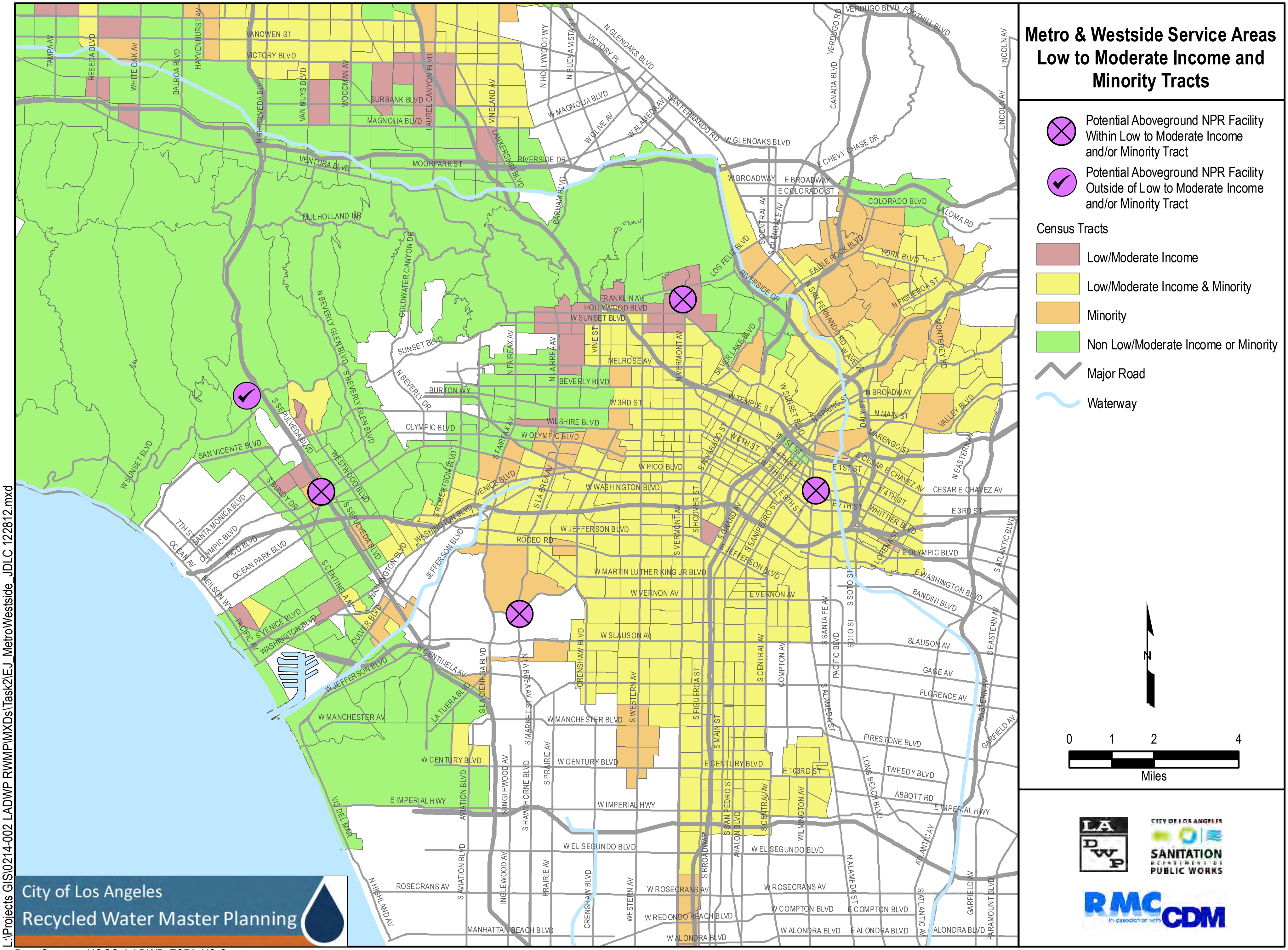
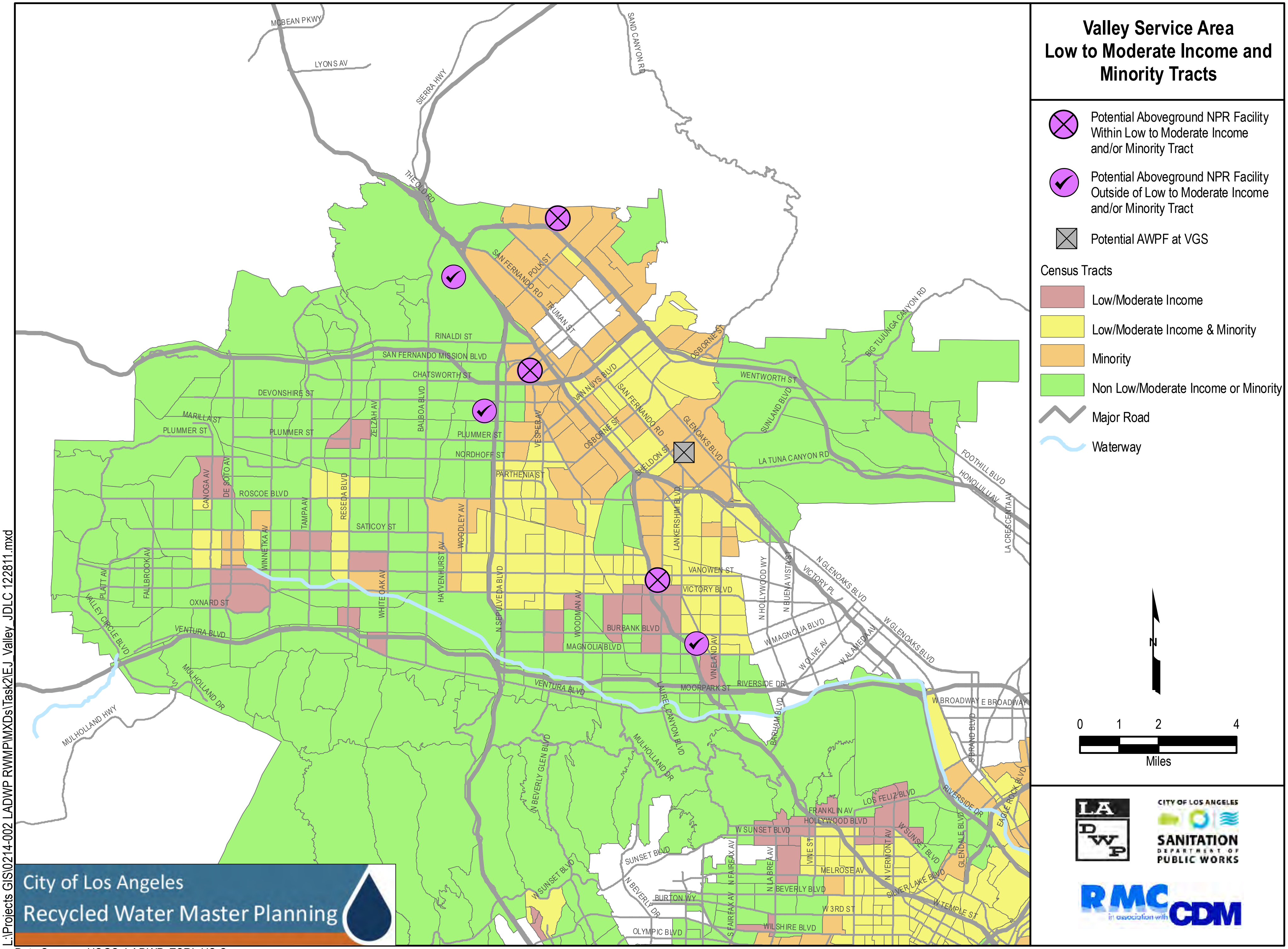


Data Sources: USGS, LADWP, ESRI, US Census

Valley Service Area
Low to Moderate Income and Minority Tracts



City of Los Angeles
Recycled Water Master Planning

Data Sources: USGS, LADWP, ESRI, US Census

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Appendix F

Graphical Results for CDP Sensitivity Runs

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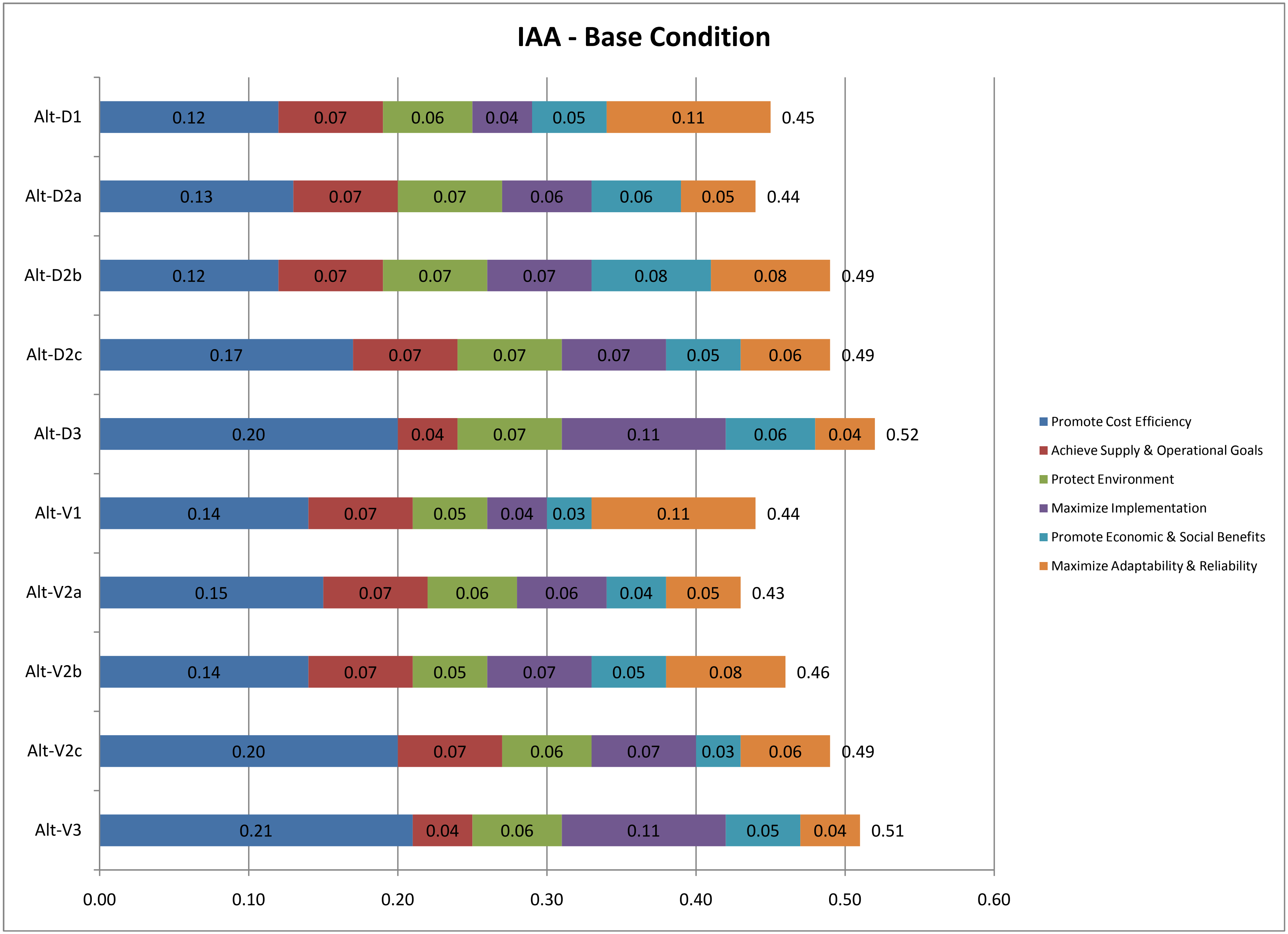
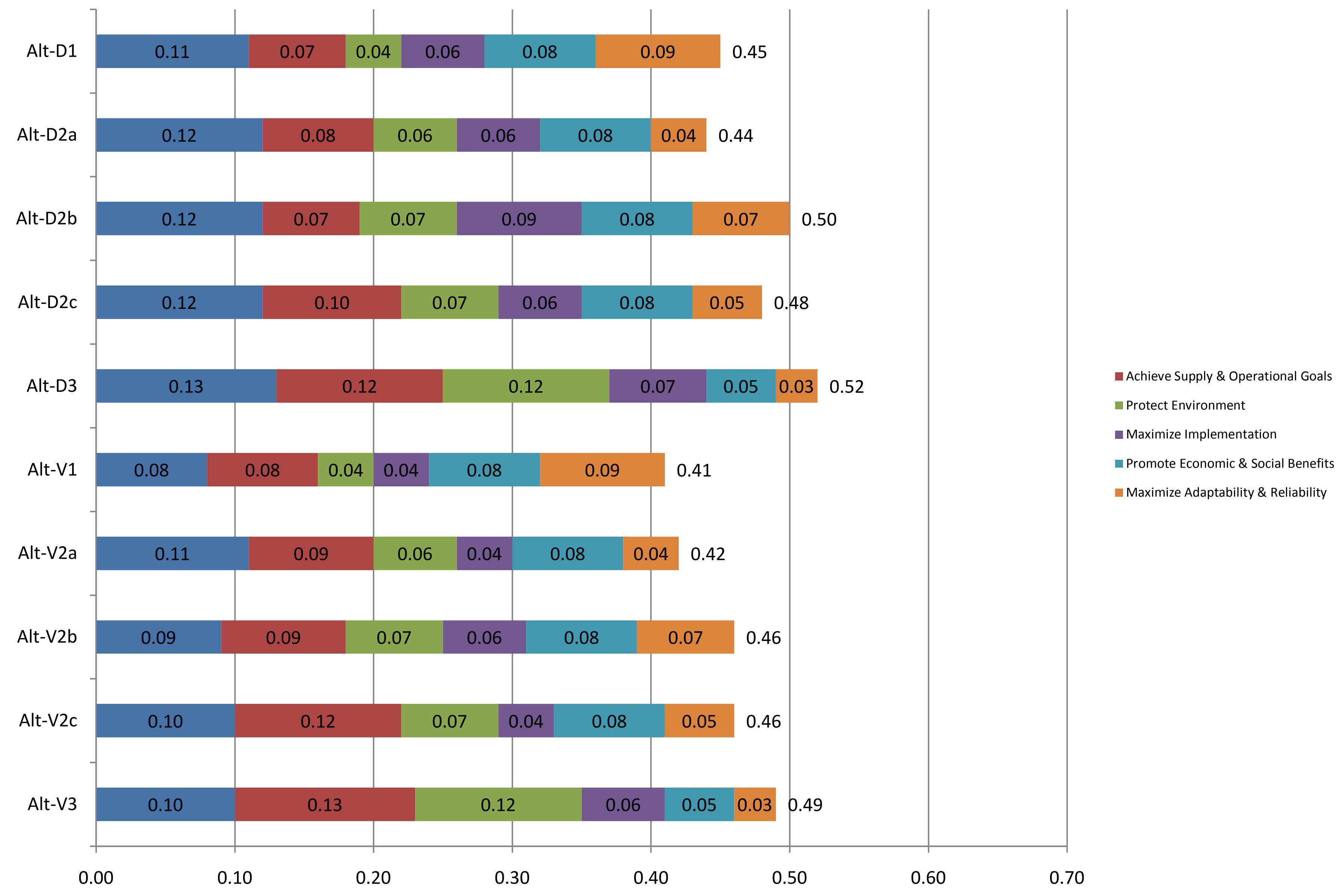
	CDP Rankings									
	Alt-D1	Alt-D2a	Alt-D2b	Alt-D2c	Alt-D3	Alt-V1	Alt-V2a	Alt-V2b	Alt-V2c	Alt-V3
0 Base	7	8	3	3	1	8	10	6	3	2
1 RWAG Average Weights	7	8	2	4	1	10	9	5	5	3
2 RWAG Environmental Emphasis	4	1	3	1	5	9	5	8	7	10
3 RWAG Social Emphasis	8	5	3	3	1	10	9	6	7	2
4 RWAG Cost Emphasis	9	10	8	4	3	5	5	5	1	2
5 Equal Weights	5	7	1	3	2	9	9	6	7	3
6 No Cost	2	6	1	4	4	7	10	3	9	7
Average Ranking	6.0	6.4	3.0	3.1	2.4	8.3	8.1	5.6	5.6	4.1
Total Number of Times Ranked No.1	0	1	2	1	3	0	0	0	1	0

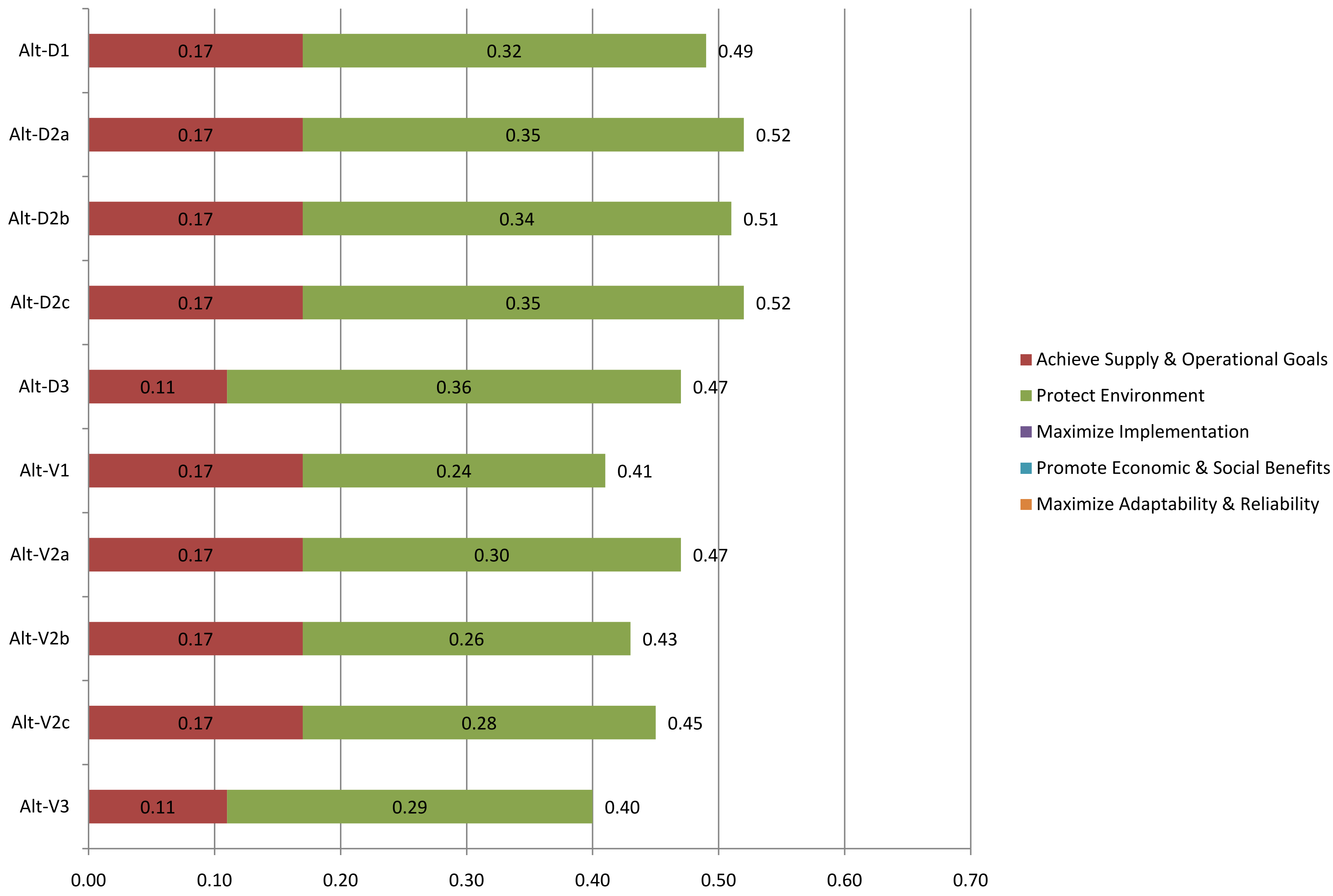


IAA - Base Condition
Alt-D1
0.12
0.07
0.06
0.04
0.05
0.11
0.45
Alt-D2a
0.13
0.07
0.07
0.06
0.06
0.05
0.44
Alt-D2b
0.12
0.07
0.07
0.07
0.08
0.08
0.49
Alt-D2c
0.17
0.07
0.07
0.07
0.05
0.06
0.49
Alt-D3
0.20
0.04
0.07
0.11
0.06
0.04
0.52
Alt-V1
0.14
0.07
0.05
0.04
0.03
0.11
0.44
Alt-V2a
0.15
0.07
0.06
0.06
0.04
0.05
0.43
Alt-V2b
0.14
0.07
0.05
0.07
0.05
0.08
0.46
Alt-V2c
0.20
0.07
0.06
0.07
0.03
0.06
0.49
Alt-V3
0.21
0.04
0.06
0.11
0.05
0.04
0.51
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Promote Cost Efficiency
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability

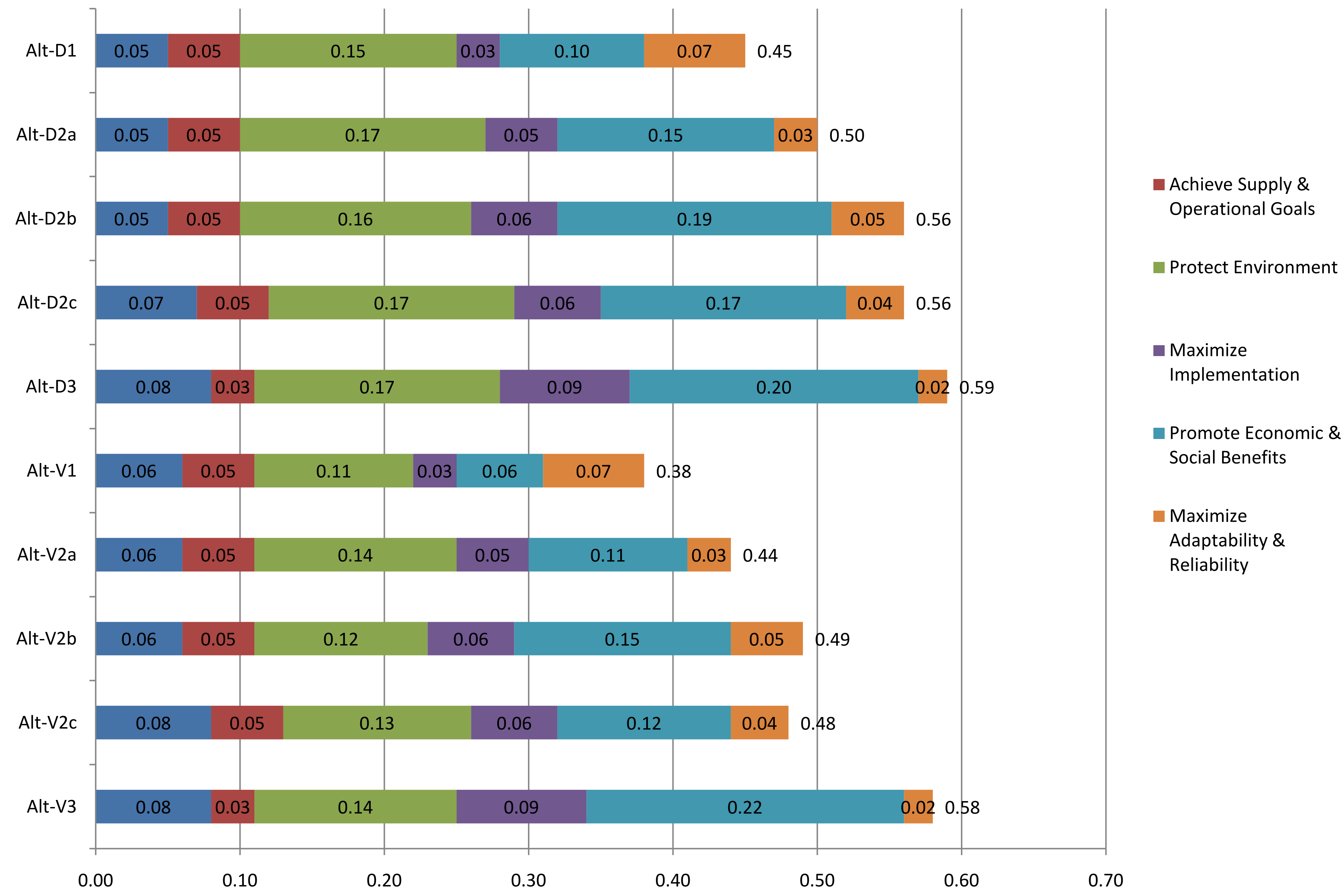
IAA - RWAG Average Weights Sensitivity Run

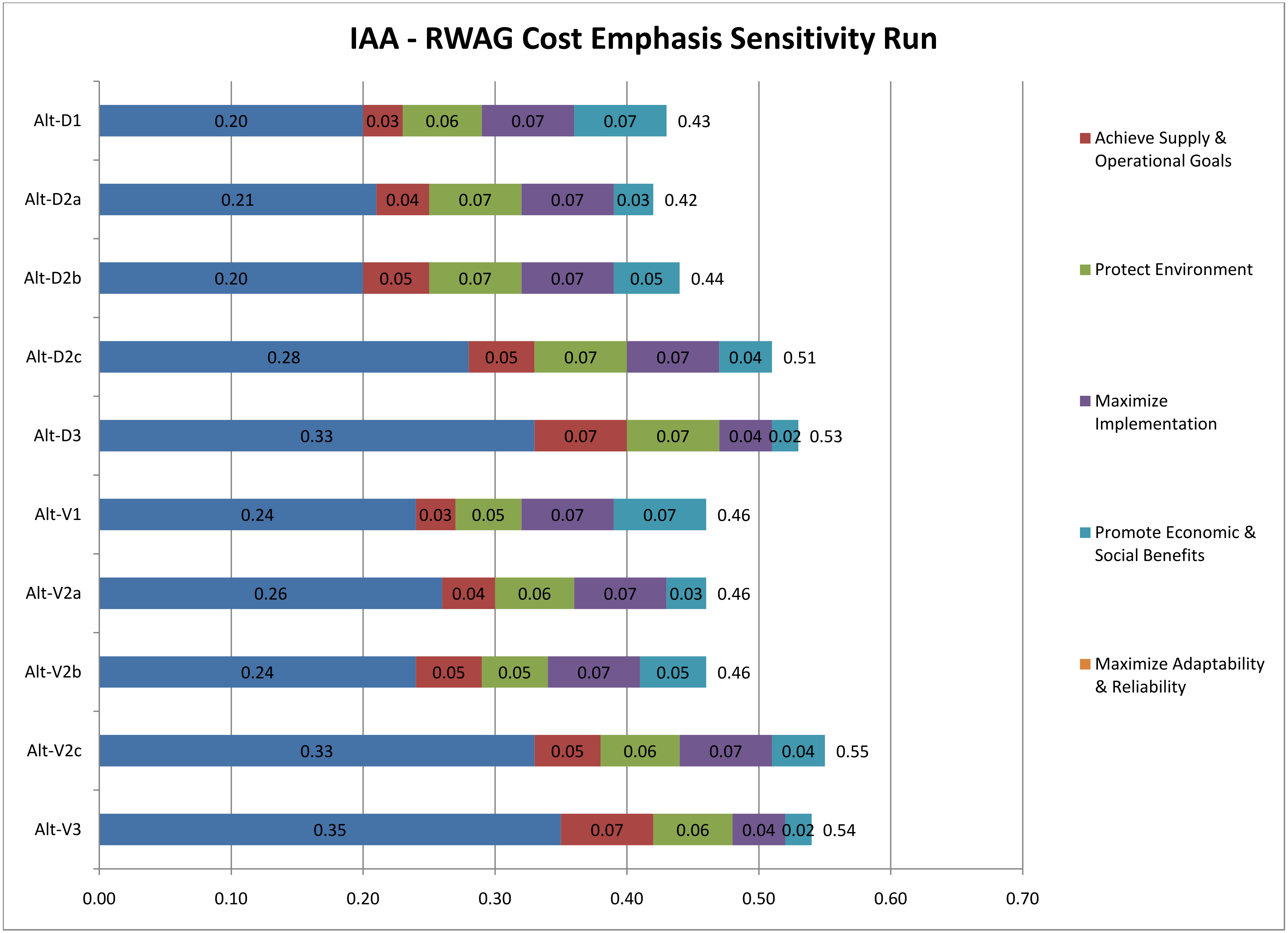


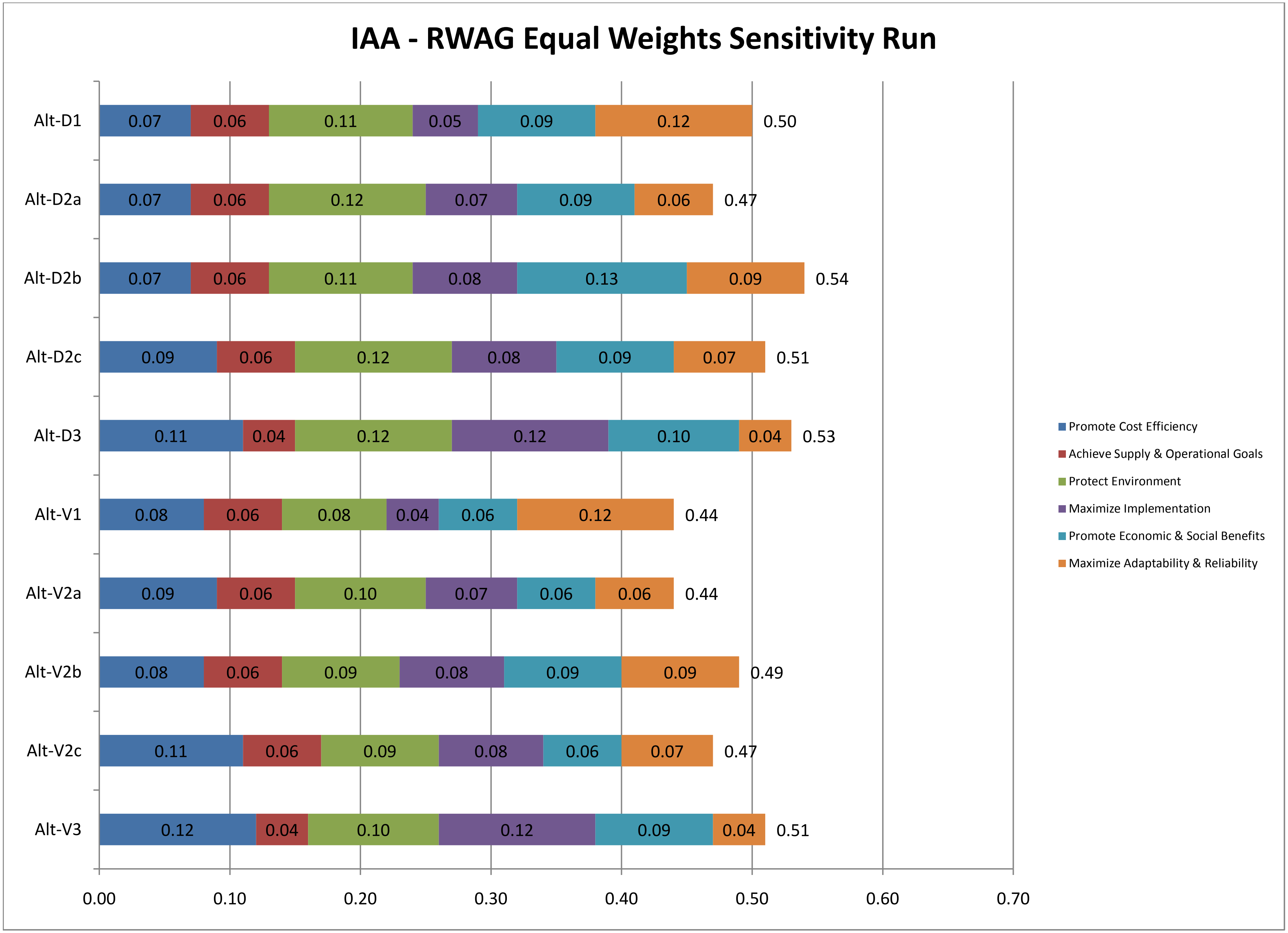
IAA - RWAG Environmental Emphasis Sensitivity Run



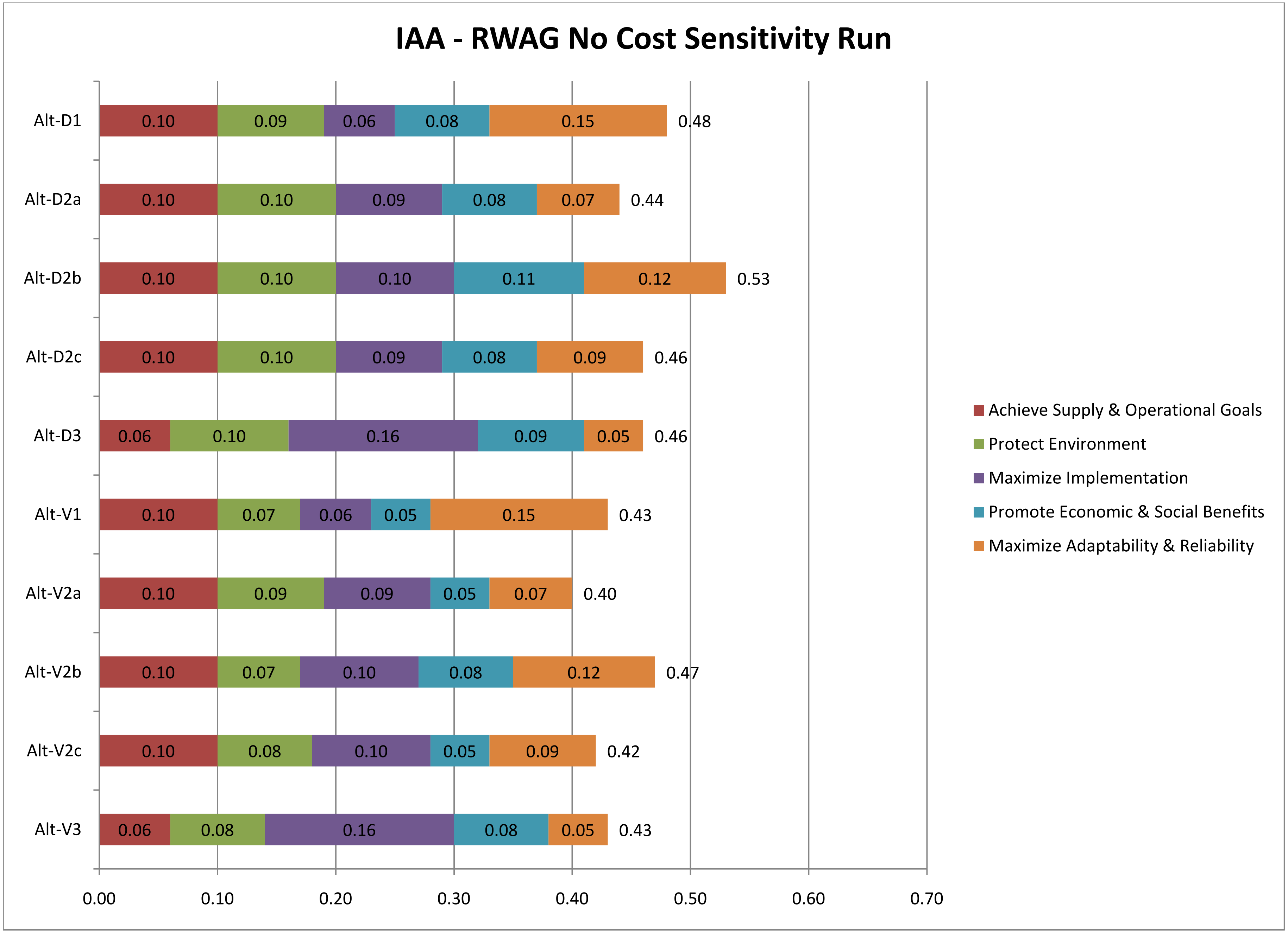
IAA - RWAG Social Emphasis Sensitivity Run




IAA - RWAG Cost Emphasis Sensitivity Run
Alt-D1
0.20
0.03
0.06
0.07
0.07
0.43
Alt-D2a
0.21
0.04
0.07
0.07
0.03
0.42
Alt-D2b
0.20
0.05
0.07
0.07
0.05
0.44
Alt-D2c
0.28
0.05
0.07
0.07
0.04
0.51
Alt-D3
0.33
0.07
0.07
0.04
0.02
0.53
Alt-V1
0.24
0.03
0.05
0.07
0.07
0.46
Alt-V2a
0.26
0.04
0.06
0.07
0.03
0.46
Alt-V2b
0.24
0.05
0.05
0.07
0.05
0.46
Alt-V2c
0.33
0.05
0.06
0.07
0.04
0.55
Alt-V3
0.35
0.07
0.06
0.04
0.02
0.54
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability



IAA - RWAG Equal Weights Sensitivity Run
Alt-D1
Alt-D2a
Alt-D2b
Alt-D2c
Alt-D3
Alt-V1
Alt-V2a
Alt-V2b
Alt-V2c
Alt-V3
0.07 0.06 0.11 0.05 0.09 0.12 0.50
0.07 0.06 0.12 0.07 0.09 0.06 0.47
0.07 0.06 0.11 0.08 0.13 0.09 0.54
0.09 0.06 0.12 0.08 0.09 0.07 0.51
0.11 0.04 0.12 0.12 0.10 0.04 0.53
0.08 0.06 0.08 0.04 0.06 0.12 0.44
0.09 0.06 0.10 0.07 0.06 0.06 0.44
0.08 0.06 0.09 0.08 0.09 0.09 0.49
0.11 0.06 0.09 0.08 0.06 0.07 0.47
0.12 0.04 0.10 0.12 0.09 0.04 0.51
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Promote Cost Efficiency
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability



IAA - RWAG No Cost Sensitivity Run
Alt-D1
0.10
0.09
0.06
0.08
0.15
0.48
Alt-D2a
0.10
0.10
0.09
0.08
0.07
0.44
Alt-D2b
0.10
0.10
0.10
0.11
0.12
0.53
Alt-D2c
0.10
0.10
0.09
0.08
0.09
0.46
Alt-D3
0.06
0.10
0.16
0.09
0.05
0.46
Alt-V1
0.10
0.07
0.06
0.05
0.15
0.43
Alt-V2a
0.10
0.09
0.09
0.05
0.07
0.40
Alt-V2b
0.10
0.07
0.10
0.08
0.12
0.47
Alt-V2c
0.10
0.08
0.10
0.05
0.09
0.42
Alt-V3
0.06
0.08
0.16
0.08
0.05
0.43
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Achieve Supply & Operational Goals
Protect Environment
Maximize Implementation
Promote Economic & Social Benefits
Maximize Adaptability & Reliability

Appendix D

NPR Service and Reliability Goals and Criteria TM

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Summary of Modifications to "Service and Reliability Goals and Criteria TM" since Initial Publication on October 14, 2009

The Recycled Water Master Planning (RWMP) effort has spanned three years (April 2009 to March 2012). As is the nature of a planning project, assumptions are typically modified and refined as a project is further developed. The most recent assumptions related to the Non-Potable Reuse (NPR) master planning effort are presented in the Draft NPR Master Planning Report (December 2011). Assumptions and conclusions presented in this report supersede assumptions included in this technical memorandum (TM). The following table summarizes the modifications applicable to all RWMP TMs, including this TM.

Assumption	Modified	Original
Applicable to all RWMP TMs		
Recycled Water Goal	59,000 AFY by 2035 This goal reflects the 2010 LADWP Urban Water Management Plan that was adopted in early 2011, after the original RWMP goals were drafted	50,000 AFY by 2019
Introduction Section	This is superseded by the Introduction Sections in the NPR Master Planning Report.	This section was included in all initial TMs but the terms described have been replaced by the Introduction Section for the NPR Master Planning Report.
NPR Projects Terminology	To avoid confusion related to LADWP's water rate structure, the terms "Tier 1" and "Tier 2" are superseded with the terms "planned" and "potential," respectively. Both planned and potential projects would be considered for implementation by 2035.	"Tier 1" for NPR projects that were originally planned for design and construction by the year 2015. "Tier 2" for NPR projects that were originally being evaluated in the NPR Master Planning Report for potential future implementation after the year 2015.
Name for MF/RO/AOP treatment plant	Advanced water purification facility (AWPF)	Advanced water treatment facility (AWTF)
Name for water produced by AWPF	Purified recycled water	Advanced treated recycled water, highly purified recycled water, etc.
Treatment Plant Acronyms	DCTWRP LAGWRP	DCT LAG

The original TM follows so these modifications should be considered when reading this TM.

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Task Order 6a Memorandum

Title:	**Service and Reliability Goals and Criteria**
Version:	**Draft**
Prepared For:	**John Hinds, Project Manager, LADWP** **Doug Walters, Project Manager, BOS** **George Zordilla, Task 6a Lead, LADWP** **Eloy Perez, Co-Task 6a Lead, LADWP**
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Date:	**October 14, 2009**
Reference:	**Task 6a – Existing System Reliability Concept Report** **Task 6.1.1 Overall Service Reliability Goals and Criteria**

1. Introduction

With imported water supplies becoming ever more unpredictable, the Los Angeles Department of Water and Power (LADWP) adopted the Mayor's vision of Securing LA's Water Supply in May 2008, calling for 50,000 acre-feet per year (AFY) of potable supplies to be replaced by recycled water by 2019. To meet this near-term challenge and plan for expanding reuse in the future, LADWP has partnered with the Department of Public Works to develop the Recycled Water Master Plan (RWMP). The RWMP includes seven major tasks: 1. Groundwater Replenishment (GWR) Master Plan, 2. Non-Potable Reuse (NPR) Master Plan, 3. GWR Treatment Pilot Study, 4. Max Reuse Concept Report, 5. Satellite Feasibility Concept Report, 6. Existing System Reliability Concept Report, and 7. Training.

The importance of additional water supply options for Los Angeles has become increasingly apparent with continuation of drought conditions, building contention for limited available water supplies both statewide and across the Southwest, and growing awareness of the critical nexus between quality of life/economic stability and available supplies of quality water. Significant attention has focused on the importance of indirect potable reuse given the multiple associated benefits, among them: local control; drought-resistant supplies; beneficial use of a critical, limited resource; sustained availability for future generations; existing infrastructure; lower investment and less environmental impact than other supply options; and demonstrated success nearby, across the nation and throughout the world.

1.1 Task 6 Overview

The purpose of Task 6 is to develop an Existing System Reliability Concept Report to identify improvements needed to enhance the reliability of the recycled water system with respect to water quality, water availability, operational stability, and operational flexibility.

Two major activities are to be conducted under this task: Task 6.1 – Basic Research and Task 6.2 – Identification of Projects.

Under Task 6.1, the level of service and reliability of the existing system will be researched and documented, including the characterization of any existing issues within the system that impact the overall reliability of the system or LADWP's ability to deliver recycled water the meets the needs of its recycled water customers. Task 6.1 consists of several subtasks including: developing overall service reliability goals and criteria (Task 6.1.1), documenting Westside System Odor and Water Quality (Task 6.1.2), Greenbelt System Pressure Spikes (Task 6.1.3), Investigation of a Greenbelt and East Valley System Interconnection (Task 6.1.4), and Harbor System Characterization and Mapping (Task 6.1.5).

Under Task 6.2, approaches will be developed to address the reliability goals and objectives identified under Task 6.1, and specific project will be developed to correct any existing reliability shortfalls. Task 6.2 includes four main subtasks: identifying reliability improvements (Task 6.2.1); Identifying LADWP system interconnections (Task 6.2.2); identifying interconnections to other systems (Task 6.2.3); and preparing the existing system reliability TM (Task 6.2.4).

1.2 TM Purpose

This TM summarizes findings from Task 6.1.1, "Service and Reliability Goals." As a part of this task, a select group of recycled water suppliers throughout California and beyond have been contacted and interviewed to identify the criteria that are used in the planning, design and operation of their respective recycled water systems, the types of reliability issues that have been encountered in these systems, and the solutions and "lessons learned" that each of these suppliers has discovered from their own experiences. The goal of this exercise is to provide LADWP with insight into the practices of other recycled water suppliers and to develop recommendations for service and reliability goals that can be carried forward and used in future recycled water planning and policy-making.

This TM focuses on outside agency interviews; LADWP operators have been interviewed separately regarding issues and policies within the LADWP system. The results of those interviews will be presented in the Existing Reliability Issues TM.

1.3 Organization of this TM

This TM consists of the following sections:

- Section 1 – Introduction
- Section 2- Description of Interviewed Agencies
- Section 3 – Survey Content and Findings
- Section 4 – Recommendations
- Appendix: Detailed Agency Interview Notes

2. Description of Interviewed Agencies

Nine recycled water agencies in California and abroad were identified through discussions between LADWP staff and the Consultant Task 6a team. These agencies were then contacted as part of the survey, including seven located in the Los Angeles area, one in the San Francisco Bay Area, and one in Sydney, Australia:

- City of Burbank
- City of Lakewood
- Rowland Water District
- Walnut Valley Water District
- Irvine Ranch Water District
- City of Long Beach
- West Basin Municipal Water District
- South Bay Water Recycling (San Francisco Bay Area)
- Sydney Water (Australia)

A map of the recycled water agencies within California is provided in Figure 1. A brief description of each agency follows.

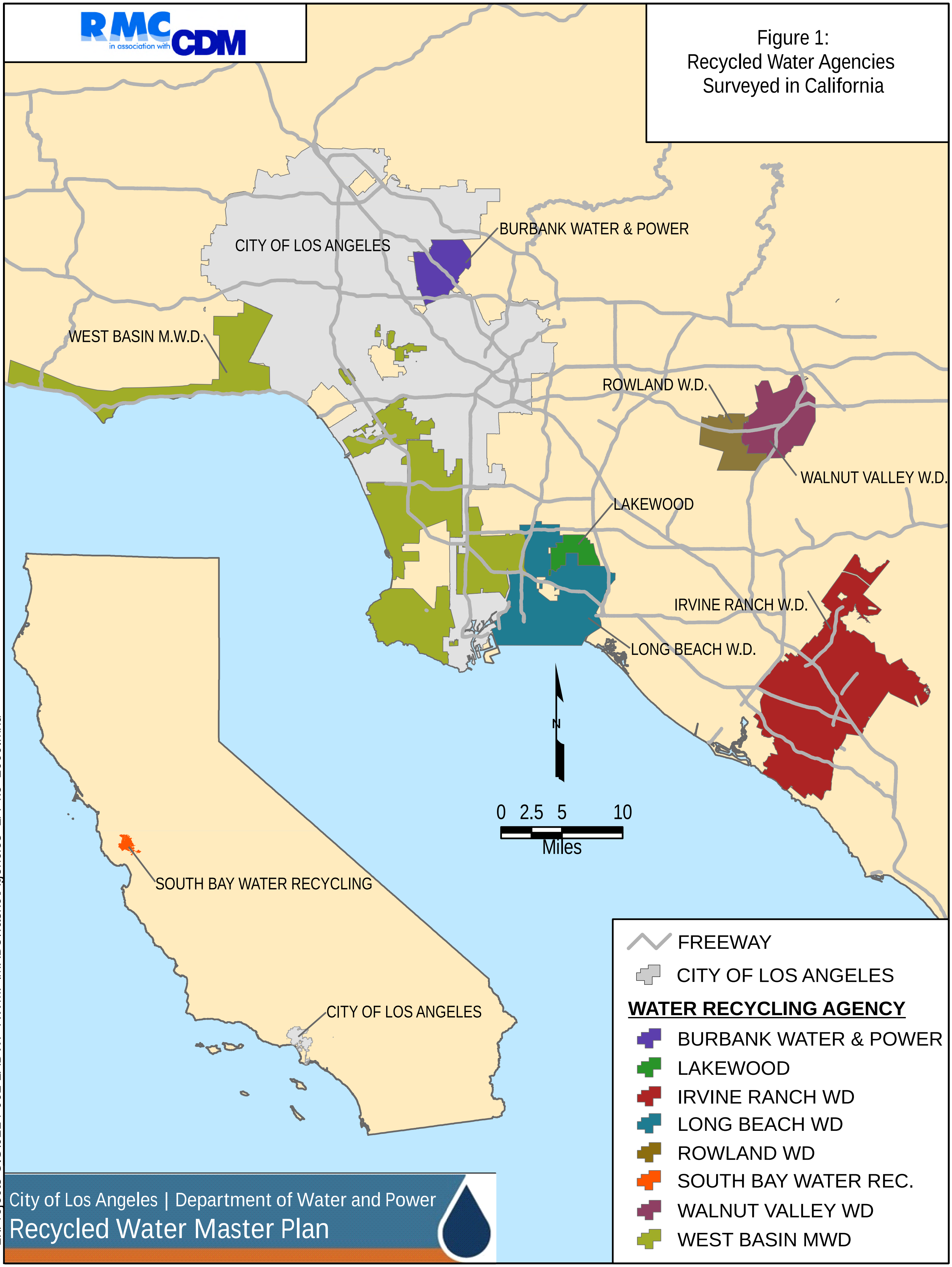
2.1 City of Burbank

The City of Burbank's Department of Water and Power (BWP) currently supplies recycled water for a variety of uses including irrigation, commercial (car washes and decorative fountains) and industrial uses (cooling towers and power plants). Overall, BWP provides an estimated 2,000 acre-feet per year (AFY) of recycled water to approximately 100 customers via a 10-mile distribution network. BWP's overall goal is to maximize use of recycled water to offset potable water demand within its boundaries. BWP's Recycled Water Master Plan identifies a build out demand of approximately 3,500 AFY[1].

2.2 City of Lakewood

The City of Lakewood currently purchases recycled water from the City of Cerritos for irrigation of several Lakewood-owned facilities including municipal parks, church landscape areas, maintenance yards and school grounds. Since the inception of its recycled water program, Lakewood has offset its potable demand by approximately 410 AFY. Lakewood's six miles of recycled water distribution pipeline is supplied by the Sanitation Districts of Los Angeles County's (LACSD's) Los Coyotes Reclamation Plant. Lakewood is not currently planning to expand its recycled water use prior to 2015; however, plans are in place to increase recycled water deliveries to 590 AFY by 2030.

[1] LADWP-Burbank Water and Power Interconnection Project – Working Draft, dated September 24, 2009



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Data Sources: USGS, LADWP

2.3 Rowland Water District

Rowland Water District receives its water from the LACSD and sells it to Suburban Water Systems and Walnut Valley Water District. At this time, Rowland provides recycled water to 31 customers for irrigation purposes only. In the future, the recycled water system is anticipated to expand significantly to deliver up to 2,000 AFY of recycled water to 300 irrigation and industrial customers.

2.4 Walnut Valley Water District

The Walnut Valley Water District's recycled water system currently receives recycled water purchased from the LACSD and produced at the Pomona Water Reclamation Plant (Pomona WRP), located near the District's northeasterly boundary. Walnut Valley distributes approximately 2,000 AFY of recycled water to 80 irrigation and commercial customers through a 30 mile distribution network..

Walnut Valley has been partnering with various agencies and water purveyors in the development of a regional recycled water supply project to provide additional supplies from the San Jose Creek WRP. Once implemented, this project will provide a source of recycled water to Walnut Valley from the San Jose Creek WRP, but will also allow other project participants to receive water from the Pomona WRP during periods of reduced demands on that source of supply. This regional project will provide additional supply reliability and allow Walnut Valley to increase recycled water deliveries to 3,600 AFY.

2.5 Irvine Ranch Water District (IRWD)

During Fiscal Year 2007/08, Irvine Ranch Water District (Irvine Ranch WD) delivered 26,195 AFY of recycled water to its customers. Recycled water is produced at the Michelson Water Reclamation Plant (MWRP) and the Los Alisos Water Reclamation Plant and is delivered to approximately 4,080 customers through a distribution system that includes nearly 300 miles of pipeline, eight storage reservoirs and twelve pump stations. Recycled water is used to irrigate landscape areas including parks, schools, golf courses, streetscapes, and open space managed by many community associations. A few hundred estate-sized residential lots also use this water for front and backyard irrigation. Other uses for recycled water are agricultural irrigation, commercial and industrial uses such as cooling towers and carpet dyeing.

2.6 City of Long Beach

The City of Long Beach currently serves about 100 recycled water customers via a 34-mile distribution network. Long Beach's recycled water is treated at LACSD's Long Beach Reclamation Plant and the Joint Water Pollution Control Plants. Long Beach supplies approximately 6,000 AFY of recycled water for a variety of uses including irrigation, industrial and groundwater injection to address land subsidence and seawater intrusion.

2.7 West Basin Metropolitan Water District (WBMWD)

The West Basin Municipal Water District (WBMWD) encompasses a service area of 185 square miles including 17 cities and several unincorporated areas within Los Angeles County. The WBMWD purchases secondary effluent from the City of Los Angeles Hyperion Treatment Plant and provides tertiary treatment and disinfection at its West Basin Water Recycling Plant (WBWRP) in El Segundo. Five different levels of treatment can be provided at the WBWRP: disinfected tertiary water; nitrified water; softened reverse osmosis water; pure reverse osmosis water; and, ultra-pure reverse osmosis water.

Current recycled water uses include irrigation, groundwater replenishment (against seawater intrusion), industrial and commercial applications (including refineries, cooling towers and street sweeping/sewer flushing). The WBMWD currently supplies approximately 30,000 AFY of recycled water through a 100-mile distribution pipeline and 327 recycled water meters. Current plans to expand the WBWRP would could serve up to to 70,000 AFY by 2030.

2.8 South Bay Water Recycling

South Bay Water Recycling (South Bay WR) produces and distributes an average of 10,000 AFY of recycled water per day in summer months to over 600 customers through a network consisting of 105 miles of pipe and serving the cities of Milpitas, Santa Clara and San Jose. Current recycled water applications include irrigation; industrial use at power plants, cooling towers and other industrial processes; and decorative fountains.

2.9 Sydney Water

Sydney Water is Australia's largest water utility and produces 20,000 AFY of recycled water, with plans to achieve 70,000 AFY of recycling by 2015. This amounts to almost 12% of greater Sydney's water needs. Recycled water is provided for industrial use, irrigation uses, stream flow augmentation, and business and residential uses (dual plumbing and yard watering). Sydney Water provides a range of water quality to its customers, from disinfected tertiary treated water to reverse osmosis product water at industrial sites.

3. Survey Content and Findings

The survey included three categories of questions regarding the respective agencies' recycled water program:

1. Basic recycled water system characteristics
2. Levels of Service
3. Planning and design criteria.

Questions and responses are generally described in the sections below. A summary of the specific responses by each agency is provided in Table 1.

3.1 Basic Recycled Water System Characteristics

General information was requested from each agency to characterize its recycled water program, including:

- Location
- System size – connections, demand, length of pipeline infrastructure.
- Types of uses – irrigation (including commercial irrigation); other non-irrigation commercial uses, industrial applications; environmental uses; and groundwater recharge.

The existing recycled water systems for the agencies surveyed vary in size from several miles (City of Burbank; City of Lakewood) to several hundred miles of pipelines (Sydney Water, IRWD; WBMWD; South Bay Water Recycling). Similarly, the amount of recycled water supplied through these recycled water systems ranges between a few hundred acre-feet per year to 30,000 acre-feet per year (West Basin MWD).

The smallest recycled water systems typically use recycled water for urban landscape irrigation purposes only whereas the largest systems have diversified their customer base to include commercial and industrial reuse (at cooling towers, power plants, and refineries), agricultural irrigation, and, in some instances, groundwater replenishment/barrier supply (City of Long Beach; WBMWD).

3.2 Levels of Service

The agencies were questions to identify the varying levels of service in place related to customer type or other classification in terms of:

- Interruptability – What is customer tolerance for planned or unplanned interruption to normal supply?
- Water Quality – What are customer needs relative to total dissolved solids (TDS), water age, pH, and other quality parameters?
- Backup supply – What are agencies doing to provide system storage for recycled water; to provide system potable sources backup connections; to require customers to provide storage or potable backup connections?

In particular, the following may be addressed:

- Degree to which level of service is a part of official policy (if at all).
- Consequences for not meeting level of service (penalties, credits, none).
- Agency responses to past or ongoing level of service concerns.

<u>Interuptability</u>

Only one of the recycled water agencies surveyed has implemented varying levels of service with regards to supply interuptability. The WBMWD implements a different (higher) level of service for the refineries it supplies; the other agencies provide the same level of service to all customers. One agency, South Bay Water Recycling, has determined to not serve specific recycled water uses such as fire protection to avoid developing differing levels of service.

Sydney Water, which has the same near term recycled water use goals as LADWP (50,000 AFY within the next ten years), has a slightly different view on level of service. Sydney Water attempts to make its recycled water supply agreements on a commercial basis. It plays the role of wholesaler to private development ventures under Build-Own-Operate agreements. These developers in turn develop the distribution systems and additional treatment works (industrial uses, typically) and sell the recycled water to users.

Sydney Water uses "take or pay" provisions to protect its investments in treatment and transmission facilities and to ensure a minimum rate base. Recycled water rates, which are established by an independent regional governmental body, are subsidized by potable water rate payers. The subsidized price for recycled water has been established at 80% of the potable rate. Customers must guarantee use of 70% of their average use. Failure of the supply by Sydney Water or failure to take by the customer results in monetary penalties. Sydney Water, as the supplier, has the goal of covering its customers losses associated with inadequate recycled water supply, including paying for potable backup water.

Water Quality

Most agencies supply unblended recycled water except for Walnut Valley Water District, which blends its recycled water with well water for irrigation customers at ratio 2 parts recycled water to 1 part well water. In the case of Walnut Valley, groundwater wells have higher TDS levels (1,200 mg/L) than recycled water (600 mg/L), and blending results in an average TDS of less than 1,000 mg/L for irrigation customers. The blending, therefore, is not done to improve the quality of recycled water, but to meet irrigation water demands. Typically, the water quality of unblended recycled water has not been an issue for irrigation except in specific instances. Such instances include a golf course within the Walnut Valley service area that decided to revert to using potable water due to salinity issues (although the current salinity of the blended supply is better than it was at the time). Irrigation of redwood trees within South Bay WR's service area has also been problematic due to the trees' low tolerance to salinity, which has prompted that agency to consult with specialists regarding this particular species.

For recycled water uses other than irrigation, both the agencies and their customers can provide enhanced level of treatment, if required. For example, City of Burbank provides reverse osmosis treatment to supply power plants and WBMWD uses microfiltration/reverse osmosis and ultra-violet (UV) disinfection at the WBWRP for groundwater injection to address seawater intrusion. On the customer side, refineries within WBMWD provide additional microfiltration/reverse osmosis treatment on site.

Back-up Supply

Agency practices differ when it comes to back-up supplies. Some do provide backup supplies through interties with the potable water system (City of Burbank; Rowland WD; WBMWD), or through a recycled water reservoir backup (City of Long Beach). Note that WBMWD also provides an additional potable water supply backup at the refineries it serves. It is also common to have an air gap potable water feed to any storage reservoirs on the system or on customer sites.

Recycled Water Agreements

The mechanisms chosen by agencies to formalize the use of recycled water with their customers include the following: (1) developing user agreements with all customers (Sydney Water, City of Lakewood) or with large customers only (City of Long Beach; WBMWD); and, (2) adopting a policy or an ordinance and referring to the agencies' Rules and Regulations (City of Burbank; Rowland WD; Irvine Ranch WD, South Bay WR). Sydney Water takes a mostly formal commercial approach in their recycled water supply and customer agreements.

Policies for Customer Issue Resolution

Note that the surveyed agencies do not have a specific mechanism to address issues raised by recycled water customers. Specific issues that are raised by customers related to recycled water service are typically treated the same as other customer complaints and are handled by the agencies' customer service department.

3.3 Planning and Design Criteria

Agencies were queried about standard planning, design and operating criteria currently in place with regards to:

- Pipeline sizing
- Storage
- Chlorine residual at point of connection
- Approach to phasing – system looping, ultimate vs. initial sizing
- Target water age (maximum)

Design Criteria

All the surveyed agencies have developed design criteria for their recycled water systems. However, some agencies may adopt specific criteria and retrofit requirements for specific customers (City of Long Beach; WBMWD). Most agencies use peak hour demand to size their distribution pipelines; some require a minimum pipeline diameter (6-inch for City of Long Beach and Walnut Valley WD; 8-inch for City of Burbank) or a minimum flow velocity (5 feet per second (fps) for WBMWD, which is a reasonable criteria).

Water Age and System Configuration

Although the surveyed agencies have not generally set any specific targets related to recycled water age, it is important to note that water age is a significant operational issue during low- demand periods (i.e. winter months) or prior to achieving ultimate recycled water deliveries and agencies have taken steps to promote water turnover in the system. In particular, Irvine Ranch WD has adjusted its pricing structure to make recycled water more cost-beneficial for customers in winter months. Other agencies (City of Long Beach) have altered their operating practices to mitigate the impacts of increased water age. Strategies adopted include reducing storage in the system by modifying storage tank operating levels. In addition, some agencies have adopted price incentive systems to encourage the use of recycled water. Successful strategies have included price incentives to increase recycled water demands in low demand periods (winter), and one agency opting to cover the cost of retrofitting existing potable water customers for recycled water use.

Another consideration is the strategy for recycled water agencies to provide for and build their infrastructure for a capacity to meet future recycled water demands. The strategy of constructing for ultimate capacity can pose near-term operating problems associated with low velocities and high water age in the distribution system. A particular agency's stance on pipeline sizing – whether it be to size smaller pipes initially (potentially planning for looping later on) or installing large pipes sized for ultimate flows – appears directly tied to the manner in which service areas have developed. The surveyed agencies were split as to the correct approach, as some had experienced problems with undersized pipes that have lead to expensive retrofits, and others had experienced water age issues associated with over sized facilities. However, most agencies surveyed indicated that they would like to be able to incorporating system looping into their distribution system in the future, as it can be used to solve problems associated with under- and oversized pipelines (initially-installed pipelines can be smaller, with looping used in the future to meet higher demands).

Irvine Ranch WD has also incorporated flushing programs within its recycled water system. When properly implemented, flushing turns over water in pipelines much faster than normal customer recycled water delivery. However, the effective use of flushing requires adherence to a well-planned flushing program.

Table 1: Summary of Findings from the Surveyed Recycled Water Agencies

	City of Burbank	City of Lakewood	Rowland Water District	Walnut Valley Water District	Irvine Ranch Water District	City of Long Beach	West Basin Metropolitan Water District	South Bay Water Recycling	Sydney Water
Basic System Characteristics									
System Capacity/Size	• 100 customers • 10 miles of pipeline • 2,500 AFY of recycled water supplied o 1,400 AFY to power plant o 1,100 AFY for irrigation, industrial	• Unknown • City of Cerritos provides recycled water	• 31 customers/ connections • 8 pump stations • 3 recycled water reservoirs (5 MG total) • Plans to deliver up to 2,000 AFY to 300 customers in the future	• 175 connections • 70-80 customers • 30 miles of pipelines • 2,000 AFY of recycled water supplied	• 4,082 connections/ customers • 300 miles of pipelines • 23 MGD peak recycled water facility • 26,185 AFY of recycled water supplied in FY 07-08	• 100 customers • 34 miles of pipelines • 6,000 AFY of recycled water supplied	• 327 meters • 100 miles of pipeline • 30,000 AFY of recycled water supplied	• 600 connections/ customers • 105 miles of pipelines • 10,000 AFY of recycled water supplied	• 20,000 AFY in 2009 with plans for 50,000 AFY by 2015 • Recycled Water wholesaler to private developers of recycled water "schemes" (independent recycled water system/project) • Commercial focus with customers
Use Type	• Irrigation • Car washes • Decorative fountains • Cooling towers and power plant	• Irrigation only	• Irrigation only	• Irrigation • Commercial uses	• Irrigation including golf courses • Industrial users (2) • Commercial users (40) – each has filtration to reduce TDS (at customer expense) • Agricultural users (18)	• Irrigation • Groundwater injection to address subsidence and seawater intrusion • Power plant use under analysis	• Irrigation • Refineries • West Coast intrusion barrier • Cooling towers • Dual-plumbed commercial	• Irrigation • Industrial users including power plants, cooling towers, and industrial processes • Fountains	• Residential (dual plumbed) • Irrigation • Environmental Stream Flow augmentation • Industrial
Level of Service and Policy									
Interruptability	• No differing levels of service	• No differing levels of service	• No differing level of service	• No differing levels of service	• No differing levels of service	• No differing levels of service	• Different levels of service at refineries	• No differing levels of service • Certain uses are not allowed (e.g. fire protection) • No target for level of service	• Provisions for compensating customer if supply interrupted
Water Quality	• RO process at power plant to meet WQ needs (customer operated)	• No specific water quality requirements	• No specific water quality requirements • Recycled water source is from three different sources, but no water quality issues to date • No water quality complaints. Water quality concerns before start-up were overcome through outreach	• No specific water quality requirements • Golf course requires lower TDS levels and switched back to potable water due to salinity issues	• Recycled water is blended with well water	• No specific water quality requirements	• Different water quality requirements for seawater intrusion and refineries • Separate MF/RO and UV treatment at the treatment facility for seawater intrusion • Refineries provide additional on-site MF/RO treatment	• District works with landscape consultant to address water quality requirements for redwood trees	• Based on regulations, which are end use based. • Additional treatment by customer • Customer delivery via air gap into a tank
Backup Supply	• Potable water	• None	• Storage reservoirs do have a potable water supply backup if needed	• None	• None	• Recycled water reservoir operated as back-up • Same reservoir can be filled with untreated groundwater	• Back up and additional storage available at refineries • Potable water backup at recycled water facility	• None	• By customer

	City of Burbank	City of Lakewood	Rowland Water District	Walnut Valley Water District	Irvine Ranch Water District	City of Long Beach	West Basin Metropolitan Water District	South Bay Water Recycling	Sydney Water
Formal Agreement in Place?	• No user agreement in place • Rules and Regulations only (similar to potable water)	• User agreement in place. City-owned facilities are recipients of recycled water use	• Rules and regulations only Users might re-file applications each year indicating onsite supervisors.	• No user agreement in place at this time • User agreements in place for first 10 years of service (customers conversions were paid for by Pomona WWTP) • Rules and Regulations only	• No user agreement or ordinance • Policy adopted by Board of Directors	• User agreement in place for large users only • Small recycled water users are governed by policy (No user agreement for small recycled water users)	• User agreement in place for large users only • Small recycled water users are governed by policy	• No user agreement in place	• Yes
Policies for Consumer Issues Resolution	• Complaints addressed through customer service department	• NA	• NA	• Complaints addressed through customer service department	• Complaints addressed through customer service department and website	• Complaints addressed through customer service department and water dispatch	• No complaints to date • Agency monitors and adjusts water quality as-needed	• NA	• Terms in agreement
Planning and Design Criteria									
Existing Criteria in Place?	• Recycled water criteria identical to potable water criteria	• Recycled water criteria in place	• Recycled water criteria in place • Efforts to include large users only	• Recycled water design standards and drawings in place	• Recycled water criteria in place	• Criteria developed on an individual basis	• Recycled water criteria in place • Customer retrofits vary by customer	• Recycled water criteria in place	• Customer/Developer develops criteria based on their "scheme"
Pipeline Sizing Criteria	• Peak hour use • Minimum 8-inch pipe	• Peak hour use	• Peak hour use	• Peak hour use • Minimum 6-inch pipe	• Peak factor used	• Peak hour use • Minimum 6-inch pipe	• Peak hour demand • Minimum velocity of 5 fps	• Pipeline sized for specific user in mind	• Customer/Developer develops criteria based on their "scheme"
System Configuration	• NA	• Unknown	• System looping in place	• System looping in place for reliability • Plans to install additional loops and interties to neighboring agencies	• System looping and flushing in place	• System looping in place	• No system looping or flushing in place • Looping may be implemented to meet future recycled water demand	• Limited looping	• Customer/Developer develops criteria based on their "scheme"
Water Age	• No target • Slime present in storage tank further from source	• No target • No issues	• No target • No issues	• No target • No issues known • Less water quality monitoring than for potable water	• No target • Water quality issues in winter due to low demand • Adjusted pricing structure to reduce cost of recycled water in winter (10% less than potable in summer, 60% less in winter)	• No target • Water quality varies throughout the year potentially due to lower turnover in winter • During low water demand, operating levels of tanks are lowered	• No target • Water quality issues due to oversized pipes and low velocities • Issue addressed by increasing recycled water demand	• No target • No issues • Higher water age in winter is addressed by reducing storage in the system and increasing industrial uses	• Customer/Developer develops criteria based on their "scheme"

	City of Burbank	City of Lakewood	Rowland Water District	Walnut Valley Water District	Irvine Ranch Water District	City of Long Beach	West Basin Metropolitan Water District	South Bay Water Recycling	Sydney Water
Lessons Learned	• Recycled water use mandated through City Ordinance • Pressure issues in the recycled water system (20 psi) as opposed to 100 psi in potable water system • Plan to add tie-in and increase system pumping capacity • Recommend implementing City Ordinance to mandate RW use • Recommend adopting rules and regulations as opposed to individual user agreements	• Recycled water has resulted in significant reduction in potable water demand	• Pressure issues in the recycled water system addressed through installation of a jockey pump • 'Bottle-neck' in the system where the pipelines are only 8" diameter. District plans to improve the system by looping • The District's ordinance requires users to use recycled water if the water is available, but due to MWD's mandate to reduce imported water supplies the District offers extra incentive by paying 100% of users' retrofit costs • Irrigation uses limited to 9:00 PM to 6:00 AM.	• Oversize recycled water pipelines to allow for growth • Need to collect irrigated acreage data from all site supervisors and manage data (files, plans) properly • Implement supervisor training • Implement outreach and training program to overcome public reticence over recycled water	• New issues arise with time, and policies must evolve • Dual-plumbed buildings have color and odor issues. Efforts to address issue are underway at the treatment plant.	• Ensure looping is in place within the system to include all large recycled water users	• Need to anticipate future recycled water demand • Plan on addressing water quality issues resulting from low demand	• Oversize recycled water pipelines to ensure additional users can get on line at a later stage • Insufficient number of valves in the system. • Low salinity tolerance of redwood trees • Pipelines should not be installed in pea gravel bedding	• Commercial approach with customers/developers works best from their wholesaler perspective

4. Recommendations

From the findings discussed above and presented in Table 1, it is clear that industry wide consensus has not been reached related to reliability criteria discussed in this TM. The approaches that have been adopted by these agencies have often evolved over time to respond to specific issues. Similarly, the LADWP's approach to implementing reliability criteria must be based on circumstances and objectives that may be unique to the City of Los Angeles. However, within the interview results some trends have emerged that can form the basis for reliability and level of service recommendations.

4.1 Level of Service

Interuptability

With the exception of WBWMD and Sydney Water, no agencies surveyed have enacted special provisions for specific customers and customer classes with respect to interuptability. The trend among interviewed agencies is that all customers are treated equally in this respect and the system is planned, designed and operated accordingly. This is a good general approach, although some users such as refineries may require a higher level of service to be brought online.

For those customers who require higher reliability, typically industrial customers, and who would suffer large economic losses with service interruption, LADWP should insist that the customer have available backup supplies and/or storage. LADWP should work in partnership with its customers to identify an appropriate range of reliability improvements by the customer and in the system to minimize interruptions in service and provide flexibility on the customer side to withstand the interruption.

LADWP should also review its supply agreements with the Bureau of Sanitation to ensure that the terms and conditions for supply are consistent with those for delivery to the LADWP customers.

Water Quality

Agencies were split on water quality issues; the requirement to augment recycled water quality to serve specific uses has evolved on a case by case basis. Sensitive irrigation uses such as redwood trees have sparked increased scrutiny of the impacts of recycled water for this use. Similarly, golf courses have emerged as a customer group that that requires special attention, and some have rejected use of recycled water for salinity concerns. As with interuptability, the drive to adopt specific policies relative to water quality is tied to the drive to supply recycled water to sensitive customers. To meet its short and long-term goals for use of recycled water, the City is likely to find that special considerations are required, and should remain open to addressing water quality on a customer-by-customer basis.

As LADWP works with its customers on required water quality for the intended use, the primary emphasis should be to continue with centralized recycled water treatment to meet public health and safety water quality requirements, as dictated by Title 22 of the California Code of Regulations. Exceptions to this are inevitable and are largely on a customer-specific basis, similar to the WBWMD two tier water quality program for its refinery customers and all other customers.

LADWP should work in partnership with its customers to identify the economic impacts of using recycled water to determine whether a customer site treatment or centralized treatment solution is best. This analysis can then be used to address rate modifications that balance the benefit of using recycled water to the community at large and the cost of this to the customer.

Backup Supply

Provisions for backup supply generally took one of two paths for interviewed agencies: Provide a potable intertie at a recycled water reservoir or supply facility, or require customers to maintain their own potable backups (if required). Sensitive users such as golf courses and industrial users cannot accept the risk of not having a backup supply, and the question relative to these users comes down to whether the City or the customer will maintain the backup. In general, where recycled reservoirs are present within a system, addition of a potable backup would be desirable and recommended, as this becomes a convenient way in which to convey a backup supply into the recycled water system (and to potentially avoid the requirement to notify customers of a recycled water supply interruption). Where no system reservoirs exists, it is recommended that customers with a high degree of sensitivity to service interruptions be required to maintain backup connections to a potable system.

Customer Agreements

Consensus among interviewed agencies on the issue of whether customer agreements are used is that only large customers should fall under such agreements. Smaller customers should fall under general policies or ordinances.

The threshold size of a customer for requiring a formal commercial agreement is not clear, but considerations need to include potential economic damages of service interruptions, customers needing on site facilities to ensure their reliability and water quality needs and other special circumstances. The agreements need to establish the commercial terms for delivery of recycled water, the term of the agreement, considerations in the event a customer goes out of business sor changes the use of its site. The objective is to define the roles and responsibilities of the parties, the commercial terms, and the scenarios and actions under which the agreement would change.

The same considerations in the form of a commercial agreement should be in place between LADWP and BOS from the supply side. Consistency between supply agreements and customer agreements is important so that all parties understand their roles and responsibilities.

Sydney Water was the only agency interviewed that had a formal structure for offsetting customer losses should the recycled water supplier fail meet terms of the customer agreement. This was balanced with “take or pay” commercial terms that ensures Sydney Water of a minimum rate base. Failure to meet obligations may result in loss of a customer and the associated recycled water demand.

4.2 Planning and Design Criteria

Pipeline Sizing and Configuration

A critical factor in system performance relative to flow, pressure and water quality is pipeline sizing. Here, there was consensus among the interviewed agencies: size pipelines for peak flows and adopt velocity criteria (5 fps is a reasonable goal) similar to water system design criteria.

It is also apparent that looping is the preferred and recommended way to address system configuration for system planning. Agencies varied in whether they felt that pipelines installed initially were too small (not enough emphasis on future demands) or too large (not enough consideration on short term demands). However, system looping provides the ability to plan a system for both future and initial demands. Smaller pipelines installed initially can be looped as part of future projects to increase system reliability and the capacity to meet future demands. Feedback from the interviewed agencies indicates that many recycled water suppliers utilize looping for this reason (or plan to in the future).

Water Age

Water age is an issue for many recycled water agencies, though the extent to which it must be addressed depends on the individual system. System configuration (discussed above) can be planned to help mitigate low demand periods, but agencies have also developed other strategies for dealing with aging water. The City should consider whether the approaches used by the interviewed agencies may work (if such approaches are not already in place). These include:

- Reduce the cost of recycled water in low demand periods to make it more attractive (compared to potable water), particularly for industrial users
- Reduce the amount of storage during low demand periods (and phase storage to match demand development)
- Pay for the cost to retrofit potential recycled water users to increase system demands
- Flush the recycled water system during low demand periods to keep water fresh, and implement as flushing program to ensure that the process is regularly performed
- Implement outreach activities to bring on additional customers

Task Order 6a Memorandum

APPENDIX

Detailed Agency Interview Notes

Telephone Notes – City of Burbank

Subject:	**Outside Agency Reliability Interviews – City of Burbank**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 23, 2009; 2:00 PM**
Location:	**Phone Interview w/ Matt Elsner, City of Burbank (818-238-3500)**
Reference:	**06.01.01**

Telephone Interview with:

- Matt Elsner, City of Burbank Department of Water and Power

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and City of Burbank regarding their water recycling program. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *100 customers currently*
   - *50,000 feet of pipeline currently (10 miles) but expanding quickly*
   - *2,500 AFY recycled water use*
     - *1,400 AFY for power plant*
     - *1,100 AFY for irrigation and other industrial uses*

2. What types of users are served by your system(s)?
   - *Basic irrigation (e.g.: parks, medians, landscaping – "basic purple pipe"). YES.*
   - *Used at car washes and decorative fountains too.*
   - *Industrial uses: two cooling towers and large use at the power plant.*
   - *No groundwater recharge.*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:
   - Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
     -- No differing level of service; all the same.
   - Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
     -- No special requirements, all irrigation users receive same water quality. Power plant has onsite double RO process to meet their water quality needs.
   - Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
     --No, but potable water can be supplemented into the system as a backup

4. Are these levels of service defined in formal user agreements, as a matter of policy?
   -- No user agreement with customers. It is a matter of policy per rules and regulations similar to using potable water.

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
   --Complaints go through regular customer service department like potable water.

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis?
   - *YES, the City has design criteria which is the same as their potable water design criteria.*

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --Size for peak hour use but no less than 8" diameter installed
   - System configuration: do you provide for system looping, flushing connections, to promote better circulation?
     --No, system is like 'spokes on a wheel'

8. With respect to water age:
   a. What do you target in terms of water age at the point of delivery?
      --No, there is no target.

b. Have you encountered problems with high water age in the system?
--No issues.
--Slime has been noticed in the furthest in the furthest storage tank from the source however.

c. If so, what were the apparent causes and how have you responded?
--No action has been taken as this time.

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?

--Use of cooling towers has raised some customer concerns with water quality however it has not been an issue once recycled water is delivered.

--Customers must take recycled water (including cooling towers) as part of City Ordinance.

-BWP highly recommends City of LA implement a City-wide Ordinance for users to be mandated to take recycled water.

-Also recommend that City of LA not implement formal user agreements; just rules and regulations similar to potable water use. No need to get City Council approval for each user agreement.

--Users have pressure concerns. Potable water has a pressure of 100 psi whereas Recycled water pressure varies in the system down to 20 psi (typically 60-80 psi). BWP will be addressing problem with tie-overs in the system (looping where possible) and increasing pumping capacity.

Telephone Notes – Irvine Ranch Water District

Subject:	**Outside Agency Reliability Interviews – IRWD**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 16, 2009; 11:00 AM**
Location:	**Phone Interview w/ Alex Harris, IWRD (949-453-5576)**
Reference:	**06.01.01**

Telephone Interview with:

- Alex Harris, On-Site Water Systems Supervisor, Irvine Ranch Water District (IRWD)

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and Irvine Ranch Water District. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *4,082 connections/customers*
   - *5,000-6,000 acres irrigated, assumes 3,000 AF/acre, roughly 15,000-18,000 AFY landscape irrigation. Reported 26,185 AF in FY 07-08.*
   - *23 MGD peak recycled water capacity*
   - *300 miles of pipeline*

2. What types of users are served by your system(s)?
   - *4,022 Basic irrigation* (e.g.: parks, medians, landscaping – "basic purple pipe")
   - Special irrigation (e.g.: golf courses with financial impacts). *One golf course does blend recycled water with well water.*
   - *2 Industrial users. Carpet manufacturer uses RW in dye process.*
   - *40 Commercial users. Dual plumbed buildings; each has a filtration system to reduce levels down to 5 microns since RW stored in open reservoirs. Cost to user is $30k.*
   - *18 Agricultural users*
   - Environmental uses (e.g. wetlands): *None*

- GW Recharge: *None*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:
   - Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
     --Recycled water is as dependable as potable water.
   - Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
     --IWRD does blend water from other water districts into recycled water system (acting like reservoirs into the system). There is some differing water quality issues as a result; ammonia.
   - Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
     --There are varying climate/weather zones.

4. Are these levels of service defined in formal user agreements, as a matter of policy?
   --By policy; cannot set ordinance. Polices are defined by B.O.D.

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
   --Issue has never come up. Recycled water system is likened with the potable water system. There may be shutdowns, but never for an extended period of time. Complaints are handled through their website and customer service department.

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis?
   - YES, IRWD has design criteria.

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --Mostly irrigation users, so peaking factor is used.
   - System configuration: do you provide for system looping, flushing connections, to promote better circulation?
     --Yes, there is system looping and flushing to promote better circulation.

8. With respect to water age:

a. What do you target in terms of water age at the point of delivery?
--No, there is no target

b. Have you encountered problems with high water age in the system?
--Yes, there are water quality concerns in the winter months as demand drops.

c. If so, what were the apparent causes and how have you responded?
--Lower demands; responded by changing pricing structure. Typically 10% less than PW in summer months. In winter months, RW is 60% of PW cost to entice agricultural users.

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?
--Every year there are new issues to address.
--Dual plumbed buildings have color and odor issues due to vegetated matter. Trying to address issue at treatment plant.

Telephone Notes – City of Lakewood

Subject:	**Outside Agency Reliability Interviews – City of Lakewood**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 22, 2009; 2:00 PM**
Location:	**Phone Interview w/ Leon De Los Reyes, City of Lakewood (562-866-9771)**
Reference:	**06.01.01**

Telephone Interview with:

- Leon De Los Reyes, City of Lakewood

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and City of Lakewood regarding their water recycling program. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *Not known*
   - *Recycled water source is City of Cerritos*

2. What types of users are served by your system(s)?
   - Basic irrigation (e.g.: parks, medians, landscaping – "basic purple pipe").
     - *YES, only irrigation*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:
   - Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
     -- No differing level of service. Only serve irrigation users and majority of users are City owned.

- Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
  -- No special requirements, all irrigation users receive same water quality.
- Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
  --None

4. Are these levels of service defined in formal user agreements, as a matter of policy?
-- There is a user agreement but it does not include level of service. City is main user of recycled water.

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
--Not applicable

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis?
-- YES, the City has design criteria.

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --City uses State guidelines to size pipelines for peak hour use.
   - System configuration: do you provide for system looping, flushing connections, to promote better circulation?
     --Not known

8. With respect to water age:
   a. What do you target in terms of water age at the point of delivery?
   --Not aware of any target
   b. Have you encountered problems with high water age in the system?
   --Not aware of any issues
   c. If so, what were the apparent causes and how have you responded?
   --Not applicable

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?
--Recycled water has been a big help in reducing potable water demands for the City.

Telephone Notes – City of Long Beach

Subject:	**Outside Agency Reliability Interviews – City of Long Beach**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 22, 2009; 3:00 PM**
Location:	**Phone Interview w/ Chris Pincherli, City of Long Beach (562-570-2327)**
Reference:	**06.01.01**

Telephone Interview with:

- Chris Pincherli, Senior Civil Engineer, City of Long Beach Water Department

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and City of Long Beach Water Department regarding their water recycling program. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *100 customers currently*
   - *34 miles of pipeline*
   - *6,000 AFY recycled water use*

2. What types of users are served by your system(s)?
   - *Basic irrigation (e.g.: parks, medians, landscaping – "basic purple pipe"). YES.*
   - *Groundwater injection for subsidence for oil extraction.*
   - *RO treated water to seawater intrusion barrier*
   - *No power plant but plans are in process*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:
   - Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
     -- No differing level of service; all the same.
   - Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
     -- No special requirements, all irrigation users receive same water quality.
   - Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
     --Not to one user specifically but there are backup recycled water storage supplies. LB operates a reservoir/lake specifically as a backup supply only. Reservoir can also be pumped with untreated groundwater

4. Are these levels of service defined in formal user agreements, as a matter of policy?
   -- There are user agreements only for larger users in which a recycled water pipeline is being built specifically to serve their needs. Smaller recycled water users that just connect to the pipeline are a matter of policy and do not require a formal user agreement.

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
   --Complaints go through regular customer service department and water dispatch like potable water requests.

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis? No, developed on an individual basis to bring the extension online.

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --Size for peak hour use but no less than 6" diameter installed
   - System configuration: do you provide for system looping, flushing connections, to promote better circulation?
     --Yes, looping is within the system for reliability reasons.

8. With respect to water age:
    a. What do you target in terms of water age at the point of delivery?
    --NO, there is no target.
    b. Have you encountered problems with high water age in the system?
    --Water quality varies by the time of year
    --Cause could be turnover in the storage facilities.
    c. If so, what were the apparent causes and how have you responded?
    --If low turnover in storage facilities, operations lowers the start and stop levels of the tanks.

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?
--Make sure to install looping within the recycled water system to hit all 'green' areas (large recycled water irrigation users).

Telephone Notes – Rowland Water District

Subject:	**Outside Agency Reliability Interviews – Rowland Water District**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 22, 2009; 1:00 PM**
Location:	**Phone Interview w/ Dusty Moisio, Rowland Water District (562-697-1726)**
Reference:	**06.01.01**

Telephone Interview with:

- Dusty Moisio, Recycled Water Retrofits, Rowland Water District

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and Rowland Water District regarding their water recycling program. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *Currently 31 customers/connections, irrigation only*
   - *Plans to have 300 customers supplying 2,000 AFY*
   - *System is expanding drastically*
   - *8 pump stations*
   - *3 recycled water reservoirs (1.5 to 2 MG each) (5 MG total)*

2. What types of users are served by your system(s)?
   - Basic irrigation (e.g.: parks, medians, landscaping – "basic purple pipe").
     - *YES, only irrigation*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:

- Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
  -- No differing level of service. Only serve irrigation users.
- Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
  -- No special requirements, all irrigation users receive same water quality. Recycled water source is from 3 different sources, but no water quality issues to date.
- Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
  --None

4. Are these levels of service defined in formal user agreements, as a matter of policy?
   -- Rules are in their regulations. Users might re-file applications each year indicating onsite supervisors.

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
   --Not applicable. Storage reservoirs do have a potable water supply backup if needed.

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis? YES, the District has design criteria.

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --Pipes sized for peak hour demand to each site.
     --System is trying to branch to large users only.
   - System configuration: do you provide for system looping, flushing connections, to promote better circulation?
     --System was designed to be a complete loop for those purposes.

8. With respect to water age:
   a. What do you target in terms of water age at the point of delivery?
      --Not aware of any target
   b. Have you encountered problems with high water age in the system?
      --No issues that they are aware of to date. Recycled water essentially flows straight through the reservoirs (12-14 feet per day).
      --No water quality complaints. Before start-up there were a lot of water quality concerns; particularly a nursery but the District responded to all users' concerns through outreach.

c. If so, what were the apparent causes and how have you responded?
--Not applicable

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?
--All users tend to come on at the same time; per the District's regulations for recycled water irrigation use only between the hours of 9pm-6am. As users come online there was a pressure dip. The District installed a 'Jocky Pump' (variable speed) to ramp up pressure as needed.
--There is a 'bottle-neck' in the system where the pipelines are only 8" diameter. District plans to upsize the system by looping.
--District pays for 100% of user retrofit costs. Due to MWD restrictions on imported water and mandatory reductions, the District is offering users no cost to convert to recycled water. District pays for planning, design, fees, permits, and construction to receive recycled water (100% of all conversion costs). The District does have an ordinance that requires users to convert if the water is there, but due to MWD's mandate to reduce imported water supplies the District feels it is in their best interest to offer the free conversions.

Telephone Notes – South Bay

Subject:	**Outside Agency Reliability Interviews – IRWD**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 16, 2009; 10:00 AM**
Location:	**Phone Interview w/ Bob Wilson, City of Santa Clara (408-615-2000)**
Reference:	**06.01.01**

Telephone Interview with:

- Bob Wilson, Supervising Engineer, City of Santa Clara

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and City of Santa Clara regarding the South Bay Recycling program. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *600 connections/customers*
   - *10,000 AFY*
   - *105 miles of pipeline (4"- 60" DIA), 3 reservoirs (9.5 MG), 4 pump stations (3 inline)*

2. What types of users are served by your system(s)?
   - *Basic irrigation (e.g.: parks, medians, landscaping – "basic purple pipe"). YES*
   - *Special irrigation (e.g.: golf courses with financial impacts). none*
   - *Industrial users. YES. 4 power plants (600 MG), Cooling towers (@ university), Industrial processes.*
   - *Dual plumbed buildings. Fountains.*
   - *Environmental uses (e.g. wetlands). none*
   - *GW Recharge. None*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:
   - Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
     -- No differing level of service. Certain users are not allowed, such as fire protection as recycled water is not as reliable as potable water. Will work with users to develop for specific needs.
   - Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
     --Works with a landscape consultant; redwood trees.
   - Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
     --None

4. Are these levels of service defined in formal user agreements, as a matter of policy?
   --None

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
   --No target level of service

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis? YES, design criteria. Sometimes specific for certain users.

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --Users come online as-needed, portions of system are designed to serve some users specifically. That was a mistake (see Question #9 for further discussion).
   - System configuration: do you provide for system looping, flushing connections, to promote better circulation?
     --Not addressed during discussion.

8. With respect to water age:
   a. What do you target in terms of water age at the point of delivery?
      --Not aware of any target

b. Have you encountered problems with high water age in the system?
--No, furthest user is a power plant that monitors water quality daily.

c. If so, what were the apparent causes and how have you responded?
--Lower demands in winter could cause higher water age. This is addressed by limiting lot's of storage in the system and increasing industrial uses in the winter months.

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?
--Portions of system are designed to serve some users specifically. That was a mistake. Don't install a 4" pipeline to one user when there may be additional users identified along that alignment in the future. High cost to upsize pipelines.
--Not enough valves in their system (big mistake). It is a cost and reliability issue. Valve spacing is not addressed in their standards.
--Salinity with redwood trees. Takes a lot of care and most keep redwoods on potable water.
--Don't install pipe in pea gravel bedding.

Telephone Notes – Walnut Valley W.D.

Subject:	**Outside Agency Reliability Interviews – Walnut Valley W.D.**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 23, 2009; 4:00 PM**
Location:	**Phone Interview w/ Erik Hitchman, Walnut Valley W.D. (909-595-7554)**
Reference:	**06.01.01**

Telephone Interview with:

- Erik Hitchman, Assistant General Manager/Engineer, Walnut Valley Water District

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and Walnut Valley Water District. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *175 connections/meters, 70-80 customers*
   - *2,000 AFY*
   - *30 miles of pipeline*

2. What types of users are served by your system(s)?
   - Basic irrigation (e.g.: parks, medians, landscaping – "basic purple pipe").
     - *YES, 99% of RW use.*
     - *And Commercial uses at Residents and HOAs.*
   - Environmental uses (e.g. wetlands).
     - *None*
   - GW Recharge.
     - *None*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:
   - Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
     --General overall level of service for all users; since it is irrigation purposes only.
   - Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
     --No specific water quality requirements. Golf courses do require lower limits of TDS but is same level for all irrigation users.
     --Golf course was converted to recycled water but later switch their greens back onto potable water due to salinity issues. Today, recycled water is roughly same level as potable water (if not lower TDS).
     --Two sources of recycled water: (1) groundwater wells and (2) LACSD Pomona WWTP. Groundwater TDS levels 1100-1200 TDS, recycled water from LACSD at 500-600 TDS; blend together to under 1000 TDS.
   - Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
     --None.

4. Are these levels of service defined in formal user agreements, as a matter of policy?
   --Under rules and regulations, no user agreements.
   --In 1970s, there were user agreements for a 10 year period as WVWD paid for customer conversions.

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
   --Any issues are through the customer service department. No penalty if recycled water is not delivered.
   --No biological growth at end users.

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis?
   -YES, WVWD has standards and standard drawings for onsite conversions.

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --Peak hour factor is used as per State standards. 6" minimum diameter.
   - System configuration: do you provide for system looping, flushing connections, to promote better circulation?

--Yes, there is some system looping and plans to install more loops along with interties to neighboring agencies.
--Reasoning for looping is reliability and to serve more customers.

8. With respect to water age:
   a. What do you target in terms of water age at the point of delivery?
   --No, there is no target
   b. Have you encountered problems with high water age in the system?
   --No problems with water age.
   --However, water quality is mainly monitored on the potable water side, not recycled.
   c. If so, what were the apparent causes and how have you responded?
   --Not applicable.

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?
--Decisions were made in the past during recycled water inception for cost considerations and pipelines although planned to be larger were downsized.
--Pipelines should be oversized with allowance for growth. If you need an 8" pipeline go 12". Plan for what is needed now and for what might be needed in the future too.
--PVC pipe allows for greater flow velocities
--To address undersized pipelines, WVWD is planning to bring another line from their Westside to supplement the system.
--Data Management: need to collect irrigated acreage data from all site supervisors and management all data (files, plans) properly. LACSD requests copies of files frequently.
--Make sure to provide supervisor training.
--Some commercial users (i.e. fast food chain) were concerned against recycled water use as it may give them a negative stereotype in advertising. Through training and outreach the commercial user changed their opinion.

Telephone Notes – West Basin MWD

Subject:	**Outside Agency Reliability Interviews – West Basin MWD**
Prepared By:	**Kraig Erickson, RMC Water and Environment**
Date/Time:	**September 28, 2009; 11:00 AM**
Location:	**Phone Interview w/ Joe Walters, WBMWD (310-660-6208)**
Reference:	**06.01.01**

Telephone Interview with:

- Joe Walters, Recycled Water Project Manager, West Basin Municipal Water District

Discussion Summary

As part of the Los Angeles Department of Water and Power Recycled Water Master Planning effort, RMC is contacting and interviewing system managers and operators for other recycled water suppliers. The purpose of these interviews is to determine how each supplier sets and implements recycled water supply policy with respect to supply reliability, water quality, backup supply requirements, system design and planning.

The following is a discussion summary between RMC Water and Environment and West Basin Municipal Water District regarding their water recycling program. This discussion summary will be included as part of a subsequent technical memorandum and used to develop recommendations regarding policies and criteria to be used in future planning.

BASIC SYSTEM INFORMATION

1. How large is your system?
   - *327 sites/meters; many sites have multiple cusomters/meters downstream from West Basin connection (i.e. Playa Vista has one West Basin meter, however 80 customers on their end).*
   - *100 miles of pipeline*
   - *30,000 AFY recycled water use*

2. What types of users are served by your system(s)?
   - Basic irrigation (e.g.: parks, medians, landscaping – "basic purple pipe"). - YES.
   - Refineries. - *YES.*
   - Dual-Plumbing. - *YES.*
   - Non-Industrial. Cooling towers. - *YES.*
   - West Coast seawater intrusion barrier. *YES. (indirect potable)*

LEVEL OF SERVICE AND POLICY

3. Do you have different "levels of service" for each type of user (above), or for specific users in the system? Level of service can include criteria for:
   - Interuptablility: Tolerance for planned or unplanned interruption to normal supply.
     -- Refineries have additional storage onsite and potable water backup supply.
   - Water Quality: Needs relative to TDS, water age, pH, and other quality concerns. Does everyone simply receive what's available in the system, or do some customers get specially treated water?
     -- Refineries and Intrusion Barrier receive different quality water than other users.
     -Refineries: onsite/satellite treatment plants using MF/RO treated water for boiler feed and even some 2nd pass RO.
     -Barriers: MF/RO and UV disinfection as part of treatment train at treatment plant. Separate piping system to barrier wells.
   - Backup supply: Need to maintain system storage for recycled water, or for backup connections potable sources. Is the water distributer responsible for such backup supplies, or is the customer?
     --Refineries have additional storage onsite and potable water backup
     --Treatment plant also has a potable water backup to feed the recycled water system if needed

4. Are these levels of service defined in formal user agreements, as a matter of policy?
   -- There are user agreements only for larger users, such as the refineries as in defining water quality requirements. Smaller recycled water users and basic irrigation users that just connect to the pipeline are a matter of policy and do not require a formal user agreement. This includes Cal State Dominguez Hills, Honda, and Toyota cooling towers; just matter of policy.

5. Are there distributor penalties/customer credits for failing to meet the target level of service? Formal complaint process??
   --Never had complaints but there are water quality issues that required addressing. West Basin monitors water quality and adjusts as-needed. Water quality is becoming more difficult to maintain due to source water quality from Hyperion.

PLANNING AND DESIGN CRITERIA

6. Do you have standard design criteria for system design (system wide criteria), or are criteria developed on a customer by customer basis?
   - *Yes, standard design criteria for West Basin's system. Customer retrofits vary by customer.*

7. What are the basic design criteria you use in designing your system?
   - Pipeline sizing: Do you size all pipes for peak hour ultimate usage, or phase in pipelines as customers come online?
     --Size for peak hour demands for full potential of users. No pipes are undersized (5 fps velocity).

- o System configuration: do you provide for system looping, flushing connections, to promote better circulation?
  --No flushing or looping presently. Looping may be in the future in order to meet demands.

8. With respect to water age:
   a. What do you target in terms of water age at the point of delivery?
   --NO, there is no target.
   b. Have you encountered problems with high water age in the system?
   --YES, pipes are oversized and some problems with LMU and Playa Vista due to water being in the pipe too long with low velocities. West Basin installed distribution station, located additional customers, and also supplemented with potable water as needed.
   c. If so, what were the apparent causes and how have you responded?
   --see above statement

9. Are there any other "lessons learned" that come to mind – changes you've made to system operation or policy as issues have come up?
   --Need to anticipate demand. Size pipes accordingly keeping in mind potential demands may not be realized; which can lead to water quality issues. And plan for those water quality adjustments that will be required.

Appendix E

Cost Estimating Basis for Recycled Water Master Planning TM

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Technical Memorandum

Title: **Cost Estimating Basis for Recycled Water Master Planning**

Date: March 2012

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1. Introduction

The purpose of this Technical Memorandum is to describe a cost estimating basis used for the analysis of options and alternatives being developed under the City of Los Angeles Department of Water and Power's (LADWP) Recycled Water Master Plan (RWMP) for Task 1 (Groundwater Replenishment), Task 2 (Non-Potable Reuse)[1], Task 4 (Maximizing Reuse), Task 5 (Satellite Treatment), and Task 6 (Existing System Reliability). Unit costs for the following types of facilities are included in this TM:

- Treatment
- Pipelines
- Pump Stations
- Storage
- Pressure Regulating Stations
- Groundwater Wells
- Water Purchases
- Land Acquisition

For components not included in the TM, a unit cost or other estimating tool was developed.

[1] The cost estimating assumptions for non-potable customer conversions were developed under a separate TM.

2. Cost Estimating Criteria

2.1 Cost Estimate Class

The classes of cost estimates shown, and any resulting conclusions on project financial or economic feasibility or funding requirements, are prepared for guidance in project evaluation and implementation and use the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on a variety factors, including but not limited to, actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personal, engineering, and construction phases. Therefore, the final project costs will vary from the estimate developed using the information in this document. Because of these factors, project feasibility, benefit cost/ratios, alternative evaluations, project risks, and funding needs must be carefully reviewed, prior to making specific financial decisions or establishing project budgets, to help ensure project evaluation and adequate funding.

As described in *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)* (PMI, 2008), cost estimates are a prediction based on information known at a given point in time and should be refined during the course of the project to reflect additional detail as it becomes available. The accuracy of the estimate should increase as the project progresses.

2.1.1 American National Standards Institute Standard Z94.0

In the late 1960s, the Association for the Advancement of Cost Engineering international (AACE) developed a guideline for cost estimate classification for the process industries. A three-part simplified version was adopted as an *American National Standards Institute (ANSI)* Standard Z94.0 in 1972. Those guidelines and standards enjoy reasonably broad acceptance within the engineering and construction communities and within the process industries. These cost estimate classes will be used for the financial and economic analysis (CH:CDM, 2003):

- Order of Magnitude Estimate
- Budget Level Estimate
- Definitive Estimate

Order of Magnitude Estimate. An order-of-magnitude estimate is made without detailed engineering data. An example includes an estimate based on cost-capacity curves.

Typically, an order-of-magnitude estimate is prepared during the design concept finalization phase, which represents a design at approximately 5 to 20 percent complete. In general, actual project costs can be expected to range from 50 percent more than to 30 percent less than the Order of Magnitude Cost Estimate.

Budget Level Estimate. The preparation of a budget estimate requires, at a minimum, the use of flow sheets, layouts, and major equipment quantity, type, and sizing details. Some examples include:

- An estimate using sketches or drawings to quantify specific facilities or processes
- An estimate using equipment cut sheets as the basis for vendor equipment quotes
- An estimate using lists of material quantities

Typically, a budget estimate is prepared at the end of the preliminary design phase, which represents a level of project definition at approximately 15 to 45 percent complete. Actual project cost can be expected to range from 30 percent more than to 15 percent less than the Budget Level Cost Estimate.

Definitive Estimate. A definitive estimate is prepared from very well defined engineering data. At a minimum, the estimator requires 85 to 95 percent complete plans and elevations, piping and instrumentation diagrams, one line electrical diagrams, equipment data sheets, vendor quotations, structural sketches, soil data, drawings of major foundations and buildings and a complete set of specifications. Some examples include:

- An estimate using equipment cut sheets as the basis for vendor equipment quotes
- An estimate using vendor or subcontractor quotes for equipment and services

Typically, a definitive estimate is prepared toward the end of the construction documents preparation (final design) phase. Actual project cost can be expected to range from 15 percent more than to 5 percent less than the Definitive Cost Estimate.

The accuracy range for each of the three cost estimate classes based on ANSI Standard Z94.0 are summarized in **Table 1**.

Table 1: ANSI Standard Z94.0 Estimate Accuracy Range

Category	Accuracy Range
Order of Magnitude	-30% to +50%
Budget Level	-15% to +30%
Definitive Cost Estimate	-5% to + 15%

Unit costs presented in this TM and RWMP cost estimates are generally Order of Magnitude estimates while Budget Level estimates will be prepared when sufficient information is available and the increased level of effort to prepare an estimate was appropriate. Unit costs developed for most of the expected project components are discussed below. In some cases, project definitions may require cost estimates for project components not identified in this TM and efforts will be made to develop a similar level of estimate based on the available information and within the scope of this study.

2.2 Cost Contingencies and Factors

2.2.1 Project Contingency

Project or program contingencies are defined as unknown or unforeseen costs. In general, higher contingencies should be applied to projects of high risk or with significant unknown or uncertain conditions. Such unknown and risk conditions for construction cost estimates could include project scope, level of project definition, occurrence of groundwater and associated dewatering uncertainties, unknown soil conditions, unknown utility conflicts, etc. Unknown conditions for operation and maintenance (O&M) cost estimates could include future energy or chemical costs. The amount of contingency applied to an estimate is typically based on the level of project definition. For planning studies, typical project contingencies can range between 20 and 50 percent for construction cost estimates and up to 30 percent for O&M cost estimates.

It is recommend an additional 30 percent for contingencies be applied to construction cost estimates based on Budget Level and Order of Magnitude estimates. No contingencies are included for O&M cost estimates since they are based off of similar LADWP facilities in operation; although, the potential for future rise in energy costs should be noted.

2.2.2 Implementation Factors

Cost factors are included to try to capture the entire capital costs associated with the implementation of the project. While these costs can vary greatly from project to project and from component to component, it is most common to assume a standard factor on the estimated construction costs across all projects and project types when analyzing alternatives and project options. In addition, it is necessary to allow for many uncertainties associated with conceptual level project definitions by applying appropriate contingencies. The following defines the typical efforts and factors for these additional services and contingencies:

- **Planning, Environmental Documentation, and Permits.** These services include the early conceptual planning, environmental documentation and permits that are often required of capital improvement projects. This factor includes pre-construction fees that may be required. The amount of effort for such services can vary greatly depending on the type, scale, and location of the project. Typical costs for such services can vary from 2 to 10 percent of the construction costs.
- **Engineering Services (Pre-Construction).** Engineering design services cover the preliminary investigations, site and route surveys, foundation exploration, and preliminary and final design phases. These services also includes plan processing (agency review and approval), and may also include the preparation of detailed cost estimates and construction/phasing schedules. The typical costs for these services vary between 8 and 15 percent of the construction costs.
- **Engineering Services during Construction.** Engineering construction support services typically include submittal and shop drawing reviews as well as minor design modifications. The typical costs for these engineering construction support services vary between 5 and 10 percent of the construction costs.
- **Construction Management and Inspection.** Costs for these services can vary greatly with project size and whether an agency performs this work with in-house staff or through a consultant. Regardless of the staffing, the costs for these services should still be accounted for and applied to the overall capital costs of the project. Typical costs for such services can vary from 5 to 10 percent of the construction costs.
- **Legal and Administrative Services.** These costs include such items as legal fees, financing expenses, general administration, and interest during construction. Typical costs for these items can vary from 1 to 15 percent of the construction costs depending on the size, complexity, and type of project.
- **Field Detail Allowance**. The Field Detail Allowance is used to account for miscellaneous and small costs that are not otherwise included in a summary of major costs components for an estimate. This factor is a specific construction cost allowance that is often applied to a

specific project component and not necessarily a project or program contingency. For the preliminary phases of a project, this factor can range from 5 to 15 percent, depending on the complexity of the project and the perceived number of individual construction components that cannot be individually accounted for at this level.

- **Market Adjustment Factor.** This factor is intended to account for the variable of cost estimating in volatile markets. This factor often varies in the same location for different type of work depending on the availability and work load for specialty contractors. Typical ranges for this factor are up to 10 percent. Issues that can affect the Market Adjustment Factor, include:
    - Busy contractors
    - Contractors selectively bidding jobs
    - Contractors selectively choosing which owners they want to do jobs for
    - Premium wages to keep skilled workers and management staff
    - Availability of crafts/trades
    - Immigration impacts and uncertainty
    - Abnormal fuel impacts and uncertainty
    - Public relations/communications, especially critical for recycled water projects
    - Availability of specialty equipment and materials
    - Local material supply availability or conditions
    - Prevailing wage/Project Labor Agreement requirements

Due to the variability in the project types, a wide range of costs is likely to exist. In addition, the services may vary from project to project depending on a variety of factors, including project complexity and need. Using the factors and contingencies listed previously, estimation of implementation costs could vary from as low as 25 percent of the estimated project construction cost to as high as 85 percent. For this study, a factor of 30 percent of the estimated project construction costs is used to account for these additional services, as summarized in **Table 2**.

Table 2: Non-Construction Cost Factor Summary

Type of Factor	Low Estimate	High Estimate
Planning, Environmental Documentation, and Permits	2%	10%
Engineering Services (Pre-Construction)	8%	15%
Engineering Services during Construction	5%	10%
Construction Management and Inspection	5%	10%
Legal and Administrative Services	1%	15%
Field Detail Allowance	5%	15%
Market Adjustment Factor	--	10%
Total	**26%**	**85%**
Recommended Implementation Factor	**30%**	

2.2.3 Other Costs

Several additional components may be needed to support the development of major recycled water supply facilities. Because most of these items are unique and project specific, they should be applied on a project-by-project basis. Therefore, no costs were included in the cost estimates identified above for the following items:

- **Maintenance Road Access.** The construction cost of maintenance roads greatly depends on the amount of cut and fill needed to complete grading and if new construction will be conducted at an existing site. Therefore, maintenance road costs should be considered if a new pump station or tank site is being developed.
- **Power Transmission Lines.** The cost of these to support a major pumping or treatment facility is often on a shared cost basis with the power utility.
- **Overall Program Management.** If the sheer magnitude of the capital cost program exceeds the capacity of agency or district staff to manage all of the work, then the services of a program management team may be required.
- **Public Information Program.** Depending on the relative public acceptability of a major facility or a group of facilities, there may be a need for a public information program, which could take many different shapes. Public Information Programs are typically handled by an agency or district's internal staff and therefore are often considered as an overhead expense. However, in some cases, outside consultants may be necessary to support a major program or project.
- **"Other" Costs.** These costs might be necessary on some projects and could include environmental mitigation and permitting costs; special legal, administrative, or financial assistance; easements or rights-of-way; expediting costs such as separate material procurement contracts. These "other" costs may be typically in the 5 to 15 percent of construction cost range.

In addition, some projects will require the purchase of land to site facilities but others are already to be located within City-owned property. For example, within the existing footprint of a treatment plant. For the RWMP, the cost to purchase land was based on recent (January 2011) sales records of vacant properties in the project area using Loopnet (www.loopnet.com). In general, a cost of $2.0 million per acre was applied if no other information was available. This was based on initial searches on Loopnet and consultation with LADWP staff. If appropriate, the LADWP Real Estate Division could provide more accurate estimates.

2.2.4 Application of Contingencies and Factors

Table 3 shows an example of how to apply the cost contingencies and markups.

Table 3: Example Application of Cost Factors

Items	Calculation	Planning Estimate
Capital Cost Factors		
A. Estimated Construction Cost Subtotal		$1,000,000
B. Construction Contingency Cost Factor (30%)	0.3 * (A)	$300,000
C. Total Construction Cost Subtotal	(A) + (B)	$1,300,000
D. Implementation Cost Factor (30%)	0.3 * (C)	$390,000
E. Total Capital Cost	**(C) + (D)**	**$1,690,000**

2.3 Engineering Economics

The following sections discuss the necessary engineering economic factors utilized as part of developing the unit costs and that will be used to analyze the estimated costs for each of the alternatives and project options. Items covered in this section are:

- ENR Index
- Inflation / Escalation
- Planning Period
- Project Financing and Discount Rate
- Useful Life of Facilities
- Lifecycle Cost Approach

2.3.1 ENR Index

To develop unit costs for the various project components, it is common to utilize previous unit cost information as well as recent project data for calibration of the derived cost curves. These historical cost data must be converted to current price levels to develop project cost estimates. The best available barometer of these changes is the *Engineering News Record's* (ENR) Construction Cost Index (CCI). This index is computed from prices of construction materials and labor and is based on a value of 100 in year 1913. Cost indices vary geographically and are dependent upon multiple variables, including labor and material markets. Los Angeles was the most applicable CCI for the RWMP. The costs in this report reflect the ENR Los Angeles CCI for January 2011 of 10,000.30.

Estimated project costs should be increased from this January 2011 dollar base to the appropriate year for future construction based on the inflation, interest, and discount rates described in the next sub-sections.

2.3.2 Inflation / Escalation

Escalation of capital and O&M costs is based on the average of annual Consumer Price Index for the last 10 years (2001 to 2011) for Los Angeles, Riverside, and Orange County, California as noted on the Bureau of Labor Statistics website on January 2011, at 2.8 percent. Escalation of recycled water purchase prices was assumed to be higher than the historical inflation rate due to several factors, including increasing scarcity and new capital investment requirements. The rates for these factors are shown in **Table 4**.

Table 4: Escalation Rates

Type of Factor	Rate
Capital and O&M Escalator	3.0%
Recycled Water Purchase Escalator	4.0%

2.3.3 Planning Period

Two planning periods are necessary for the RWMP: 1) near-term alternatives and 2) long-term alternatives. The planning period is assumed to be 50 years. The base year for near-term alternatives for the purposes of the calculations will be 2015, which is anticipated to be the start of implementation of near-term projects. The base year for long-term alternatives for the purposes of the calculations will be 2036, which is immediately after implementation of near-term projects is expected to be completed in 2035. **Table 5** summarizes the planning periods for the alternatives analysis.

Table 5: Planning Periods

Type	Duration	Period
Near-Term Alternatives	50	2015 - 2064
Long-Term Alternatives	50	2036 - 2085

2.3.4 Project Financing and Discount Rate

There are two different sets of project financing assumptions applied for near-term and long-term alternatives. The financing components include the rate to borrow money (interest rate), the payback period, and the discount rate.

Historically, LADWP has funded its recycled water projects 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. The near-term alternatives are also assumed to be financed by the pay-as-you-go method. No borrowing will be necessary and, therefore, there is no interest rate or payback period. However, recently LADWP decided to consider funding a portion, if not a majority, of the costs for the potential NPR projects by borrowing money through long-term financing. This will allow LADWP to leverage borrowed money to fund the program that could potentially reduce impacts to the LADWP customer's water rates. For long-term alternatives, LADWP's typical financing rate of 5.5 percent over 25 years will be applied.

The discount rate is used to bring future dollars back to a present value, reflecting the time value of money. The discount rate is generally equal to the borrowing interest rate when projects require debt financing. Since near-term alternatives require no borrowing, the discount rate was set to equal inflation only. For long-term alternatives the discount rate was set to equal the borrowing interest rate since it is anticipated that debt financing will be needed. The financing terms for near-term and long-term alternatives are shown in **Table 6**.

Table 6: Financing Terms

Type of Estimate	Interest Rate	Payback Period	Discount Rate
Near-Term Alternatives[1]	N/A[1]	N/A[1]	3%[1]
Long-Term Alternatives	5.5%	25 years	5.5%

Note:

1. The near-term alternatives were evaluated by the pay-as-you-go method considering financing with borrowing. Therefore, there is no interest rate or payback period. The inflation rate (see Section 2.3.2) will be used as the discount rate since no borrowing will occur. However, LADWP is also considering financing near-term alternatives by borrowing money long-term. This is further discussed in the NPR and GWR Master Planning Reports.

2.3.5 Useful Life of Facilities

The useful life of facilities will vary based on several factors, including: type of facility, operating conditions, design life, and maintenance upkeep. Structural components of most facilities are typically designed to last 50 years or longer. However, mechanical and electrical components tend to have a much shorter lifespan and typically require replacement or rehabilitation at regular intervals. Based on typical operating conditions and maintenance practices, an estimated percentage for each facility type is used to distinguish between the structural portions (50-year) and the mechanical and electrical portions (20-year) typical of each facility type.

Based on the 50-year planning period for facilities, components with a 20-year useful life will be replaced at 20 and 40 years and at the end of the planning period will have 10 years of useful life remaining (20 years life expectancy minus 10 years remaining planning period). **Table 7** presents the assumed useful life period splits for each type of facility.

Table 7: Useful Life of Facilities

Type of Facility	% of Capital Cost for 50-Year Life (for Structural Components)	% of Capital Cost for 20-Year Life (for Mechanical and Electrical Components)
Treatment Plant	50%	50%
Pump Station	50%	50%
Storage	90%	10%
Pipeline	100%	--
Wells – Injection and Extraction	75%	25%
Pressure Reducer	50%	50%

Note: More refined estimates of the useful life of treatment plant facilities and wells were applied when reliable information was available

2.3.6 Lifecycle Cost Approach

It is important that the selection of an engineering alternative is not based solely on the lowest initial or capital cost, but also considers all future costs over the useful life of all projects in that alternative. Lifecycle costs analysis is a standard technique used in engineering economic analyses for comparing cost-effectiveness of alternatives. It reflects both capital and O&M costs over the useful life of the alternatives. It reflects not only future inflation, but the time value of money. Because of these factors, lifecycle costs analysis was selected as the economic method to compare the costs of the alternatives.

Costs of the various alternatives will be compared by using the calculated unit lifecycle costs, which is the present value (PV) of the capital plus O&M costs over the planning period divided by the project yield over the planning period. The steps described below are used to calculate the unit lifecycle cost. Note that near-term alternative and long-term alternative have different project financing assumptions so the lifecycle cost approach. An example lifecycle cost calculation for a near-term alternative and a long-term alternative can be found in Appendix A.

Step 1: Capital Expenditures

Capital costs are estimated based on the assumptions described in Section 3 and, if applicable, may include "other costs" described in Section 2.2.3. Next, the cost contingencies and implementation factors, described in Sections 2.2.1 and 2.2.2, respectively, are applied. Capital costs are then escalated from today's (2011) dollars to the year of expenditure at the assumed annual inflation rate of 3% (per Section 2.3.2).

For near-term alternatives, the capital costs for each alternative will be spread across the assumed construction period for each project that makes up the alternative.

To simplify the number of assumptions to be made for long-term alternatives, all of the initial capital costs are assumed to be financed in Year 1 (2031). The annual payments for the initial capital will occur as defined by the borrowing rate for 25 years.

Step 2: Finance

The capital costs are financed based on the applicable terms defined in Section 2.3.4. For near-term alternatives, there is no financing since all capital and O&M costs will paid when they occur (i.e., "pay-as-you-go"). For long-term alternatives, the standard DWP borrowing rate of 5.5% for 25 years. For long-term alternatives, annual payments for capital will be estimated using the formula (PMT formula in Excel):

$$PMT = P\,\frac{r(r+1)^n}{(1+r)^n - 1}$$

Where:
PMT is the annual payment
r is the annual interest rate (in decimals, not percent). Based on interest rate above, this is equal to 0.055
n is the number of periods, equal for us to 25

Note that, if applicable, pay-as-you-go may be applied for long-term alternatives instead of borrowing capital funds.

Step 3: Replacement of Facilities

For replacement of facilities after the end of useful life, escalate the cost of replacement to the year when it's needed and apply the applicable financing terms per Step 2 (Finance).

Step 4: O&M Costs

Escalate projected O&M costs annually at the escalation rate of 3% (defined in Section 2.3.2).

Step 5: Salvage Value

Include salvage value of capital facilities in Year 50. As discussed in Section 2.3.3, facilities with a 20-year useful life will have 10 years of useful life remaining at the end of a 50-year planning period, which is 50% of its useful life. Therefore, the salvage value will be 0.5 times the capital cost in Year 50. Salvage values will be discounted from the year they are estimated with the discount rate.

Step 6: Discount Costs

Discount all costs with the discount rate (defined in Section 2.3.2) of 3% for near-term alternatives and 5.5% for long-term alternatives.

Step 7: Present Value

Calculate the PV for the project. For the PV calculations, the following formula will be applied to the series of annual payments of capital and annual O&M separately (PV formula in Excel):

$$PV = \sum_{t=1}^{T} \frac{R_t}{(1+i)^t}$$

Where:
PV is the present value
i is the discount rate (in decimals, not percent). Based on rates above, this is equal to 0.03 for near-term alternatives and 0.055 for long-term alternatives that use capital financing.
t is the sequential number of year (i.e., 2011 = 1; 2012 = 2; 2013 = 3; etc.)
R is the annual amount (annual capital payment or annual O&M expenses)

Step 8: Project Yield

Project yield is the amount of recycled water recharged or reused over the planning period. Calculate the project yield by summing the annual yield over the planning period.

Step 9: Unit Lifecycle Cost

Unit lifecycle cost ($/AF) is the present value divided by the project yield and is calculated by the formula:

$$Unit\ Lifecycle = \frac{Present\ Value}{Total\ Yield}$$

3. Construction and O&M Unit Cost Basis

Construction costs are estimated for each component based on experience with similar projects as well as standard engineering planning cost curves. Where possible, unit costs have been calibrated with historical LADWP construction estimates and cost data. Definitions of the project components are derived from the capacity information, GIS data, hydraulic model results, and other preliminary engineering available at the time of the analysis and formation of the alternatives. Basic construction costs cover the materials, equipment, labor, and services necessary to build the proposed projects or components. In addition, all unit construction costs include contractor overhead and profit, bonds & insurance, and mobilization. Unit costs given herein are not intended to present the lowest prices that can be achieved for each type for work but rather are intended to represent median prices submitted by responsible bidders or the cost of installation by LADWP or BOS crews.

Operation and Maintenance (O&M) costs are derived from experience on similar projects and standard engineering planning methods and cost curves. Where possible, costs have been calibrated using existing City of Los Angeles Bureau of Sanitation (BOS) and LADWP data, including data on power costs, labor rates, etc. Operating costs are defined as labor, material, equipment, and outside services necessary for routine operating functions. Outside services include electric power and chemicals. Maintenance expenses include all costs associated with the routine servicing and repair of facilities required on an annual basis.

Unit costs for the following types of facilities are included in this TM:[2]

- Treatment Plants
  - Tertiary Treatment – Conventional Filtration
  - Tertiary Treatment – Membrane Bioreactor
  - Advanced Treatment – Microfiltration, Reverse Osmosis, Advanced Oxidation
  - Advanced Treatment After MBR – Reverse Osmosis, Advanced Oxidation
- Pipelines
- Pump Station
  - Product Water
  - Influent Wastewater
- Storage Facilities
  - Distribution System Tanks
  - Wastewater Equalization Basins
- Pressure Regulating Stations
- Groundwater Wells – Injection and Production
- Water Purchases - Imported and Recycled

[2] The cost estimating approach for non-potable customer conversions was developed under a separate TM.

All facilities are expected to be constructed under the traditional contracting approach of design-bid-build. Facilities constructed by LADWP crews would not require the bid step.

References for both construction and O&M costs are identified for each type of facility. A common resource throughout cost estimating was CDM Constructors, Inc. (CDMCI). CDMCI is the construction contracting arm of CDM. They employ estimators that have a database of costs from previous projects, quotes from vendors, etc.

3.1 Treatment Plants

Costs will be developed for expansion of existing facilities and construction of new tertiary treatment facilities with influent raw wastewater. For the purposes of the RWMP, expansion of existing facilities assume use of similar conventional filtration processes and construction of new (satellite) tertiary treatment plants assumes the use of membrane bioreactors (MBR). Tertiary treatment plant development assumes the intake of raw wastewater so the cost estimates include wastewater intake, primary treatment, and secondary treatment in addition to tertiary treatment.

Costs will be developed for expansion of existing and construction of new advanced water purification facilities (AWPF). For the purposes of the RWMP, an AWPF is assumed to take secondary or tertiary product and treat with microfiltration (MF) followed by reverse osmosis (RO), disinfection with ultraviolet light (UV), and advanced oxidation with hydrogen peroxide (AOP). If the AWPF source water is from MBR, then the MF step can be excluded.

Layouts for treatment plant expansions at existing City plants considered existing site constraints and, when appropriate, costs were added for items such as building demolition and multi-story facility construction. New treatment plants assumed the purchase of land. Land costs were discussed in Section 2.2.3.

Note that this section does not address product water pump stations and equalization storage.

3.1.1 Tertiary Treatment – Conventional Filtration

Construction Costs

The unit construction costs for the expansion of tertiary treatment plants primarily referenced the following:

- Novato Sanitary District (NSD) Treatment Plant bid results (2009): Upgrade existing 7 million gallon per day (mgd) wastewater treatment facilities. Upgrades included influent pump station, headworks, primary sedimentation, activated sludge process, UV disinfection, gravity belt thickeners, anaerobic digestion, odor control, electrical distribution system, and SCADA control system.

Expansion of existing tertiary treatment plants will use existing facilities to support new production capacity to the greatest extent possible. Therefore, cost estimates for the expansion will include line items for the necessary components to achieve new production capacity. These components include headworks, influent pump station, primary sedimentation tanks, aeration tanks and blowers, secondary clarifiers, tertiary media filtration, and UV disinfection. The processes are sized to be consistent with existing treatment plant operations. The primary unit construction cost basis for these estimates is the NSD Treatment Plant bid results.

O&M Costs

The conventional treatment plant O&M unit cost is based on the Los Angeles-Glendale WRP actual operating costs, escalated to January 2011, and is approximately $0.28 per gallon of production capacity.

3.1.2 Tertiary Treatment – Membrane Bioreactor

New satellite treatment plant construction assumes MBR technology. The construction costs for the new MBR plants primarily referenced CDMCI, which is the construction contracting arm of CDM.

Construction Costs

The unit cost of MBR varies based on size of the plant with economies of scale realized with bigger plants. Based on a survey of MBR construction costs and CDMCI, the following production capacity unit costs were developed for a satellite MBR plant:

- Less than 1 MGD: $12 per gallon
- Between 1 and 10 MGD: $10 per gallon
- Greater than 10 MGD: $8 per gallon

In addition, CDMCI will develop cost estimates for ancillary facilities such as buildings, yard piping, pumps, etc. when necessary on a project-specific basis.

O&M Costs

The MBR O&M costs are based on average costs of existing MBR plants from CDMCI, escalated to January 2011, which are approximately $0.30 per gallon of production capacity.

3.1.3 Advanced Treatment – Microfiltration, Reverse Osmosis, Advanced Oxidation

The unit costs estimates for the construction and operation of AWPFs or Advanced Water Treatment Facilities (AWTFs) (MF/RO/AOP) primarily referenced:

- Orange County Water District (OCWD) Groundwater Replenishment System (GWRS) Advanced Water Purification Facility (AWPF) bid results (March 2004): The AWPF produces up to 70 mgd of product water after treating secondary wastewater with MF/RO/UV. Referenced O&M costs were from 2008.
- Donald C Tillman Water Reclamation Plant (DCT) Advanced Treatment System Basis of Design Criteria and Cost Estimate TM (CH:CDM, June 2006): Prepared for a 15.6 mgd AWPF at DCT using the CH2M HILL Parametric Cost Estimating System.
- Terminal Island Water Reclamation Plant (TIWRP) Advanced Water Treatment Facility (AWTF) bid results (May 2001): The TIWRP AWTF receives tertiary water with higher than typical TDS (~3,000 mg/L) and applies MF/RO, lime, and chloramination. The design capacity is 5 mgd.

The cost references were used as applicable to the various proposed sites for AWPFs and AWTFs. For example, the DCT estimate was used for DCT AWPF alternatives and TIWRP estimate was applied for TIWRP AWTF alternatives.

Construction Costs

The OCWD GWRS AWPF bid results, escalated to January 2011, resulted in a unit cost of approximately $4.1 per gallon of product water capacity, excluding buildings, structural, architectural, excavation/backfill/ compaction items for buildings and structures. This estimate is the starting basis for new AWPFs at HTP.

The DCT Cost Estimate TM, escalated to January 2011, resulted in a unit cost of approximately $5.3 per gallon of product water capacity for a generic site layout. This estimate is the basis for new AWPF at DCT and VGS. Development of site-specific AWPFs at DCT and VGS may require the addition of building demolition, new buildings, and additional yard piping.

The TIWRP AWTF bid results excluding equalization, escalated to January 2011, resulted in a unit cost of approximately $7.4 per gallon of product water capacity. This estimate is used as the basis for expanding the AWTF at TIWRP. The unit construction cost was higher than the other estimates due to the need for deep foundations / vibroflotation and lack of economies of scale. To be conservative, the relatively high unit cost will be applied as the AWTF expansion unit cost until the initial AWTF components that could benefit an expanded TIWRP are identified.

CDMCI will develop cost estimates for ancillary facilities such as buildings, yard pipe, pumps, etc. that were not included in the referenced projects when necessary on a project-specific basis.

O&M Costs

The OCWD GWRS AWPF actual annual operating costs, escalated to January 2011, are approximately $0.54 per gallon of treatment capacity, which is equivalent to $1.61 per 1,000 gallons of product water assuming a 92 percent online factor. This estimate is used for the new AWPF at HTP and for expanding the AWTF at TIWRP.

The DCT Cost Estimate TM, escalated to January 2011, resulted in an annual O&M cost of approximately $0.40 per gallon of treatment capacity, excluding power costs, which is equivalent to $1.19 per 1,000 gallons of product water assuming a 92 percent online factor. This estimate is the basis for new AWPF at DCT and VGS. Once power costs were added to the base O&M costs, the total O&M is approximately $0.57 per gallon of treatment capacity, which is equivalent to $1.70 per 1,000 gallons of product water assuming a 92 percent online factor. O&M cost for the AWPF at VGS is slightly higher at $0.59 per gallon of treatment capacity, which is equivalent to $1.76 per 1,000 gallons of product water assuming a 92 percent online factor, due to higher levels of NMDA formation as a result of longer traveling time.

3.1.4 Advanced Treatment after MBR – Reverse Osmosis, Advanced Oxidation

Construction Costs

Construction costs for a satellite AWTF located downstream of an MBR facility are assumed to not include additional MF treatment since the MBR process already includes an MF step. Therefore, the DCT Cost Estimate TM, excluding line items associated with MF, is used as the basis for satellite AWTF. This reduces the unit cost to $3.7 per gallon, which is approximately a 30% reduction compared to treating water from a secondary or conventional tertiary treatment plant.

O&M Costs

The DCT Cost Estimate TM is used as the O&M cost basis for satellite AWTF, which is $0.57 per gallon, which is equivalent to $1.70 per 1,000 gallons of product water assuming a 92 percent online factor. However, O&M cost should be lower than an AWPF facility with MF/RO/AOP since MF treatment is not required at the satellite AWTF because it is downstream of an MBR facility.

3.2 Pipelines

3.2.1 Construction Costs

Costs for pipe sizes ranging from 6 to 60 inches in diameter and 96 inches diameter and greater were developed for use in the study. The construction costs are estimated for a wide range of conditions that exist in the study area. Costs are developed for trenched pipelines (6″ to 60″ diameter) as well as tunneled pipelines (96″ diameter and greater).

The unit costs represent both open-cut and trenchless pipelines constructed mostly in normal soils, with depths of cover typically less than 10 feet. They are consistent with construction that includes only minor surface restoration and minor surface and subsurface interference. These unit costs assume that the pipelines will be operating at pressures up to about 200 pounds per square inch (psi). These cost estimates include material and installation, normal appurtenances, and paving replacement.

Pipeline unit cost varies based on size with economies of scale realized with bigger pipes (in the range considered). Based on representative LADWP projects, the following unit costs were developed for pipeline installed via open-cut construction:

- $24/inch-diameter/LF for 6″ and 8″ diameter pipe
- $20/inch-diameter/LF for 10″ and 12″ diameter pipe
- $18/inch-diameter/LF for 16″ and 20″ diameter pipe
- $16/inch-diameter/LF for 24″, 30″, 36″, 42″, 54″, and 60″ diameter pipe

LADWP projects consist of both open-cut and trenchless construction methods (boring and jacking, directional drilling, and bridge hanging). Pipeline costs can be extremely varied depending on pipe size and site conditions. These costs include crossing of freeways, highways, major intersections, railroads, rivers, streams, and canals.

Tunneling is assumed for pipelines with 96″ diameter or greater at a unit cost of $35/diameter inch/linear foot. Tunneling costs include casings as well as shafts. This unit cost is based on cost estimates from the East Bay Municipal Utility District's Wet Weather Infrastructure Improvements Studies TM (RMC/MWH, 2007).

Note that no land-acquisition costs are included as it is assumed that the pipelines would generally be constructed within the public street right-of-ways, which would not require any land acquisition.

3.2.2 O&M Costs

The O&M costs account only for the annual inspection and maintenance of the pipelines within the distribution system. The costs for pipelines up to 60" diameter are estimated to be approximately $0.6 per LF on an annual basis based on representative LADWP projects.

Annual O&M costs for tunneling pipelines, greater than 90" diameter, are assumed to be 0.5 percent of construction costs.

3.3 Pump Stations

3.3.1 Product Water Pump Station

Construction Costs

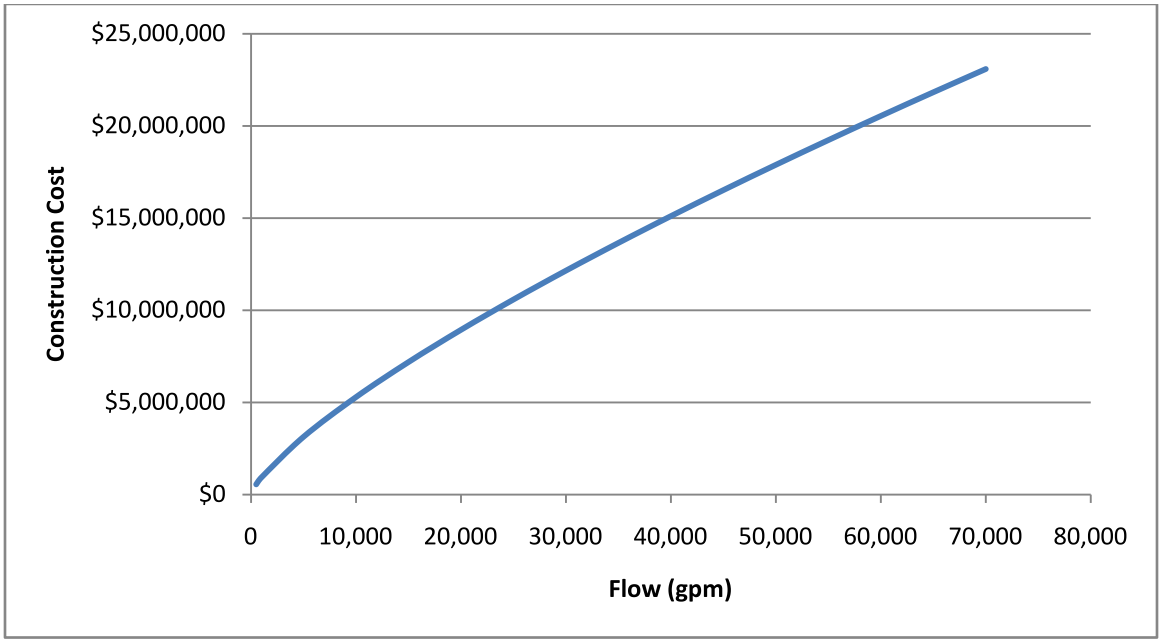
The pump stations cost curve shown in **Figure 1** was developed using the construction cost curves from Pumping Station Design (Sanks et al., 1989). The original Sanks equation has a reference ENR CCI of 4,500 and was modified with an ENR factor of 10,000.3 to determine the estimated cost in January 2011 dollars. The curve was also adjusted based on recent engineering bids for representative LADWP Recycled Water projects.

Pump Station Project Cost ($) = 3.12 x 10^(0.7583*log(Q)+3.1951)

Where:
Q = Flow rate in gallons per minute (gpm); Maximum flow rate

Costs for stations can vary greatly depending on the architectural design, pump type, location, pumping head, and station capacity. As many of these factors will not be defined during this phase of the study, this unit cost curve will apply to all stations. However, note that land acquisition and easement costs are not included.

Figure 1: Pump Stations Construction Cost Curve



O&M Costs

O&M costs include labor, equipment replacement, and electrical power usage.

O&M Excluding Electricity

Annual expenditures for labor and equipment replacement are based on the initial construction cost of the pump station. The following equation is used to estimate the annual O&M labor and equipment replacement costs ($O\&M_{LE}$) for each pump station:

Annual $O\&M_{LE}$ = $10,000 + 5 percent of construction costs

Electrical Costs

Electrical costs for pumping are estimated by applying the average flow for the network over a 24-hour period of operation. Many of the demands are landscaping areas where water is applied during the night hours when electrical rates are lower. In addition, some demands, like surface reservoirs, groundwater basins, and large industrial users, would receive water on a continuous basis throughout the day. Electrical costs are computed assuming an electricity cost of $0.12/kilowatt-hour (kw-hr) and by using the following equations:

$$\text{Annual electrical cost} = \$0.12 \times hp_{ave} \times 24hrs/day \times 365days/year \times 0.7457\frac{kw-hr}{hp}$$

Where:

$$hp_{ave} = \text{the average brake horsepower} = \frac{Q_{avg}\left[AFY\right]/1.613 \times (H)}{3956} \times \frac{1}{0.75}$$

Where:

Q_{avg} = annual average flow in AFY
H = total head (including friction loss) in feet

3.3.2 Influent Wastewater Pump Station

Construction Costs

Construction costs for an influent wastewater pump station were estimated using the Novato Sanitary District Wastewater Facility Upgrade influent pump station 95 percent cost estimate. The influent pump station was designed for a peak flow capacity of 47 mgd with a discharge head of 42 feet. Total construction costs of $1.8M includes site work, concrete, metals, finishes, equipment, mechanical, and tax on materials. The total cost does not include contractor's overhead/profit, construction staging contingency, or design contingency. This cost estimate was prepared using January 2005 ENR CCI.

Based on this reference cost, escalated to January 2011, the unit cost is $41,000 per MG of capacity.

O&M Costs

For the purposes of the RWMP, annual O&M costs for influent pump stations are assumed to be the same as product water pump station. Refer to the O&M Costs section under Section 3.3.1 for influent pump stations O&M costs.

3.4 Storage Facilities

3.4.1 Distribution System Tank

Construction Costs

Typical recycled water storage capacities range from 0.50 million gallons (MG) to 5 MG. Based on representative LADWP projects, the following unit costs were developed for storage:

- Less than 0.75 MG: $4 per gallon
- Between 0.75 and 1.5 MG: $3 per gallon
- Greater than 1.5 MG: $2 per gallon

LADWP projects include mobilization, architectural features, structural components, coatings, concrete foundation, typical site improvements including minor grading, and mechanical, electrical, and instrumentation requirements. Tanks are assumed to be concrete and partially buried. Costs due to extensive grading, blasting, rock removal, and special construction related to unusual seismic conditions are not included and should be considered as part of the project contingencies without further information.

3.4.2 O&M Costs

Annual O&M costs for diurnal storage tanks are estimated to be approximately $75,000 per tank based on representative LADWP projects.

3.4.3 Wastewater Equalization Basins

Construction Costs

The cost for wastewater equalization basins was estimated as $1.50 per gallon based on cost estimates from East Bay Municipal Utility District's Wet Weather Infrastructure Improvements Studies TM (RMC/MWH, 2007). This includes mobilization, excavation, sheeting and shoring, dewatering, cast in place concrete, piles, piping/appurtenances, pump station, 84" force main and traffic control.

The size, shape, and depth of the storage basins were pre-designed and costs included excavation, concrete, and mechanical costs from several recent bids. Costs assume a structural load bearing roof to allow parking, etc.

3.4.4 O&M Costs

Annual O&M costs for equalization basins are assumed to be 0.5 percent of construction costs.

3.5 Pressure Regulating Stations

3.5.1 Construction Costs

Unit construction costs for pressure regulating stations were based on professional experience since no comparable estimates were available from LADWP and are shown in **Table 8**. These costs include the station vault, grading, miscellaneous piping and valves, fencing, landscaping, instrumentation, controls and the pressure regulating valve.

Table 8: Unit Construction Costs for Pressure Regulating Stations

Sizes by Diameter (in)	$/Station
8 or less	$220,000
9 to 12	$300,000
13 to 24	$350,000
25 to 32	$600,000

3.5.2 O&M Costs

The O&M costs account only for the annual inspection and maintenance of the pressure regulating stations. These costs are estimated to be approximately $20,000 per year based on representative LADWP projects.

3.6 Groundwater Wells

Construction and O&M costs were developed for both groundwater injection and production wells.

3.6.1 Construction Costs

The construction costs for groundwater injection production wells were estimated at $2 million per well for a depth of 1,000 feet and capacity of 1,000 gpm. Construction costs includes drilling the new well, installing pumping equipment, pressure reducing valves, pump control and relief valves, and flow meters. The estimate is based on professional experience and was substantiated by Water Replenishment District staff. LADWP has not installed any wells recently so unit costs were not available from that organization.

3.6.2 O&M Costs

A traditional well rehabilitation/redevelopment includes the following steps: pulling and inspecting the pump; video log; spinner log; zone sample; mechanical rehabilitation; chemical rehabilitation; pump to waste; another video log; re-install the original pump; disinfection; and waste disposal. Costs can be highly variable, from several tens of thousands of dollars to over $100,000, depending on the amount of rehabilitation (WRD, 2005).

Based on professional experience and comparison with recently installed facilities, injection wells are assumed to have a pump maintenance cost of $75,000 per well every ten years and a redevelopment cost of $100,000 per well every five years. A pump is needed in the injection wells to regularly pump waste and clean the well. This is usually performed once a day to once a week and is necessary to maintain injection rates. As a result of this usage, injection wells have a frequent redevelopment schedule of once every five years.

Based on professional experience and comparison with recently installed facilities, production wells are assumed to have a pump maintenance cost of approximately $100,000 every 10 years and a redevelopment cost of $100,000 per well every ten years.

3.7 Water Purchases

Water purchase costs were developed for imported water from Metropolitan Water District of Southern California (MWD) and for recycled water from purveyors outside of the City. In addition, revenues from the sale of recycled water to purveyors outside the City were developed. The estimated costs are described in the following sections.

3.7.1 Imported Water Purchases

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 Urban Water Management Plan (UWMP) (May 2011), LADWP plans to stay within their Tier 1 allotment throughout the projected period (through 2035). As a result, the three alternatives for expanding recycled water to 50,000 AFY were compared to the cost of MWD Tier 1 imported water and subsequently to achieve the UWMP goals of 59,000 AFY. For the purpose of this comparison, LADWP developed water purchase costs for MWD Tier 1 imported water.

MWD rates have increased significantly over the last 10 years. The increases 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. Additionally, MWD only provides rate forecasts to 2020 and we need to plan well beyond that, into the 2060s.

Recent discussions between LADWP and MWD established that the most realistic estimate of future costs of MWD water, beyond current MWD rate projections through 2020, would escalate an average of 5%. This then established a present value unit cost of $1,370 per AF for near-term projects and $1,800/af for long-term projects.

3.7.2 Recycled Water Purchases

Table 9 presents the costs to purchase or acquire recycled water from other agencies that are being considered as part of the alternatives analysis. These costs shown are the current known costs for year 2010 only. Purchase water costs for LADWP from many of these agencies could increase in the future, depending on contract terms and conditions.

Table 9: Recycled Water Purchase Costs

Entity	Treatment Plant	Unit Cost ($/AF)	Notes
Burbank WP	Burbank WRP	$0	Based on LADWP purchase agreement with Burbank Water and Power; includes exchange of groundwater rights
Central Basin MWD	San Jose Creek WRP	$500	Based on preliminary meetings between LADWP and Central Basin WMD staff
Las Virgenes MWD	Tapia WRF	$500	Based on preliminary pending discussions with Las Virgenes MWD regarding service conditions and the need for facility upgrades / additions
West Basin MWD – Nitrified	Carson Regional WRF	$800	Based on LADWP purchase agreement with West Basin MWD
West Basin MWD – Tertiary	Edward Little WRF	$728	Based on West Basin MWD FY 2010-11 Water Rates and Charges

4. Summary Tables

Table 10 and **Table 11** summarize the unit construction and O&M costs.

Table 10: Construction Costs Summary

Category	Item	Unit Construction Cost
Treatment Plants		
Tertiary - Conventional Filtration	To be developed by component	
Tertiary - MBR	< 1 MGD	$12/gallon
	1 - 10 MGD	$10/gallon
	> 10 MGD	$8/gallon
AWTF (MF/RO/AOP)	DCT Reference	$5.2/gallon
	OCWD Reference	$4.1/gallon
	TIWRP Reference	$7.4/gallon
AWTF (RO/AOP)	Downstream of MBR	$3.7/gallon
Pipelines		
By Diameter	6” and 8”	$24/in-dia/LF
	10” and 12”	$20/in-dia/LF
	16” and 20”	$18/in-dia/LF
	24”, 30”, 36”, 42”, 54”, 60”	$16/in-dia/LF
	96” and greater	$35/in-dia/LF
Pump Stations		
Product Water	Cost based on formula (Section 3.2)	
Influent Wastewater	Capacity (mgd)	$40,900/mgd
Storage Facilities		
Distribution System Tanks	< 0.75 MG	$4/gallon
	0.75 – 1.5 MG	$3/gallon
	> 1.5 MG	$2/gallon
Wastewater Equalization Basin		$1.5/gallon
Pressure Regulating Stations		
	8” or less	$220,000/Station
	9” to 12”	$300,000/Station
	13” to 24”	$350,000/Station
	25” to 32”	$600,000/Station
Groundwater Wells		
Injection Well		$2M/well
Production Well		$2M/well
Water Purchases		N/A
Land Acquisition		$2M/acre

Note: All costs are in January 2011 dollars

Table 11: O&M Costs Summary

Category	Unit O&M Cost	
Treatment Plants		
Tertiary – Conventional Filtration	$0.28/gallon of treatment capacity	
Tertiary – MBR	$0.30/gallon of treatment capacity	
AWTF (MF/RO/AOP)	$0.54 to $0.59/gallon of treatment capacity	
AWTF (RO/AOP)	$0.57/gallon of treatment capacity	
Pipelines		
Up to 60" Diameter	$0.6/LF	
Tunneling ($\geq$ 96" Diameter)	0.5% of construction costs	
Pump Stations		
O&M	$10,000 + 5% of construction costs	
Electricity	$0.12/KW-hr	
Storage Facilities		
Distribution System Tanks	$75,000 per tank	
Wastewater Equalization Basin	0.5% of construction costs	
Pressure Regulating Stations		
All sizes	$20,000 per station	
Groundwater Wells	Injection Wells	Production Wells
Pump Maintenance	$75,000 every 10 yrs	$100,000 every 10 yrs
Redevelopment of Wells	$100,000 every 5 yrs	$100,000 every 10 yrs
Water Purchases		
Imported Water	(See Section 3.7.1)	
Recycled Water	(See Section 3.7.2)	
Land Acquisition	N/A	

Note: All costs are in January 2011 dollars

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Attachment A

Example Lifecycle Cost Calculations

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ASPECT: **Near-Term Alternatives Evaluation** Date: January 18, 2012

DESCRIPTION: **Net Present Value Estimate**

SUPPLY: **EXAMPLE FOR COST ESTIMATING BASIS TM**

Annual Yield
9,650

Item	Qty	Units	Unit Cost		Cost
Capital Costs					
Capital Facilities					
AWTF					
NPR Pump Station				$	5,400,000
NPR Storage				$	14,600,000
NPR Pipeline				$	95,500,000
NPR Customers				$	-
			Construction Subtotal	**$**	**115,500,000**
		Contingency Costs	30%	$	34,700,000
			Construction Total	**$**	**150,200,000**
		Implementation Costs	30%	$	45,100,000
			Total Capital Cost (January 2011)	**$**	**195,300,000**
20-Year Useful Life					
AWTF			estimated		
NPR Pump Station			50%	$	2,700,000
NPR Storage			10%	$	1,460,000
			Construction Subtotal	**$**	**4,160,000**
		Contingency Costs	30%	$	1,200,000
			Construction Total	**$**	**5,360,000**
		Implementation Costs	30%	$	1,600,000
			Total Capital Cost (January 2011)	**$**	**6,960,000**
Post-Construction O&M Costs ($ / Year)					
AWTF					
NPR				$	1,400,000
GWR Groundwater Extraction	15,000	AFY	$0	$	-
GWR GW Extraction & Treatment	15,000	AFY	$0	$	-
			O&M Cost Subtotal	**$**	**1,400,000**
		Contingencies	0%	$	-
			Total O&M	**$**	**1,400,000**
Recycled Water Purchase ($ / Year)					
			Purchase Cost Total	**$**	**3,100,000**

PV Calculations				
Inflation / Discount Rate		50-Year Life	$	188,140,000
Construction Escalator	3.0%	20-Year Life	$	6,960,000
Water Purchase Escalator	4.0%			
Discount Rate	3.0%	Annual O&M	$	1,400,000
Financing Costs		Annual Purchase	$	3,100,000
Interest Rate	**PAY-GO**	Annual Yield (AFY)		9,650
Period	50	Total Yield (AF)		381,175

No.	Calendar Year	Capital Finance 1	O&M Cost	Purchase Cost	Total Cost	Total Yield (AF)
0	2011	0	0	0	0	0
9	2020	25,456,125	0	0	25,456,125	0
10	2021	26,219,809	188,148	458,876	26,866,833	965
11	2022	27,006,403	387,585	954,462	28,348,450	1,930
12	2023	27,816,595	598,820	1,488,960	29,904,374	2,895
13	2024	28,651,093	822,379	2,064,691	31,538,163	3,860
14	2025	29,510,626	1,058,813	2,684,098	33,253,537	4,825
15	2026	30,395,944	1,308,693	3,349,755	35,054,392	5,790
16	2027	31,307,823	1,572,612	4,064,369	36,944,804	6,755
17	2028	32,247,057	1,851,189	4,830,793	38,929,040	7,720
18	2029	33,214,469	2,145,066	5,652,028	41,011,563	8,685
19	2030	0	2,454,908	6,531,232	8,986,141	9,650
20	2031	0	2,528,556	6,792,482	9,321,037	9,650
21	2032	0	2,604,412	7,064,181	9,668,593	9,650
22	2033	0	2,682,545	7,346,748	10,029,293	9,650
23	2034	0	2,763,021	7,640,618	10,403,639	9,650
24	2035	0	2,845,912	7,946,243	10,792,155	9,650
25	2036	0	2,931,289	8,264,093	11,195,382	9,650
26	2037	0	3,019,228	8,594,656	11,613,884	9,650
27	2038	0	3,109,805	8,938,443	12,048,247	9,650
28	2039	0	3,203,099	9,295,980	12,499,079	9,650
29	2040	0	3,299,192	9,667,820	12,967,011	9,650
30	2041	0	3,398,167	10,054,532	13,452,700	9,650
31	2042	0	3,500,112	10,456,714	13,956,826	9,650
32	2043	0	3,605,116	10,874,982	14,480,098	9,650
33	2044	18,460,253	3,713,269	11,309,981	33,483,504	9,650
34	2045	0	3,824,667	11,762,381	15,587,048	9,650
35	2046	0	3,939,407	12,232,876	16,172,283	9,650
36	2047	0	4,057,590	12,722,191	16,779,781	9,650
37	2048	0	4,179,317	13,231,079	17,410,396	9,650
38	2049	0	4,304,697	13,760,322	18,065,019	9,650
39	2050	0	4,433,838	14,310,735	18,744,572	9,650
40	2051	0	4,566,853	14,883,164	19,450,017	9,650
41	2052	0	4,703,858	15,478,491	20,182,349	9,650
42	2053	0	4,844,974	16,097,630	20,942,604	9,650
43	2054	0	4,990,323	16,741,535	21,731,859	9,650
44	2055	0	5,140,033	17,411,197	22,551,230	9,650
45	2056	0	5,294,234	18,107,645	23,401,879	9,650
46	2057	0	5,453,061	18,831,950	24,285,012	9,650
47	2058	0	5,616,653	19,585,228	25,201,881	9,650
48	2059	0	5,785,153	20,368,638	26,153,790	9,650
49	2060	0	5,958,707	21,183,383	27,142,090	9,650
50	2061	0	6,137,468	22,030,718	28,168,187	9,650
51	2062	0	6,321,592	22,911,947	29,233,540	9,650
52	2063	0	6,511,240	23,828,425	30,339,665	9,650
53	2064	(180,253,641)	6,706,577	24,781,562	(148,765,501)	9,650
	PV	**$ 159,642,718**	**$ 53,689,320**	**$ 165,581,250**	**$ 378,913,289**	**381,175**

Total PV	**$ 378,913,289**
Project Yield (AF)	**381,175**
Unit Cost ($/AF)	**$990**

ASPECT:	**Long-Term Project Concepts Evaluation**	Date:	January 18, 2012
DESCRIPTION:	**Net Present Value Estimate**		**Annual Yield**
SUPPLY:	**EXAMPLE FOR COST ESTIMATING BASIS TM**		50,000

Item		Qty	Units	Unit Cost	Cost	Notes
Capital Costs						
Capital Facilities						
Treatment (Product Water)						
HTP (Phase 1-2 completed)		50,000	AFY	$5,200	$ 260,000,000	
EQ Storage		0	gallons	$1.5	$ -	
Distribution Storage						
No Tank is needed		0	MG	$0	$ -	
Conveyance	Diam (in)	Length (ft)				
HTP to WCB	54	31,680	in-dia*LF	$16	$ 27,400,000	
Pump Station						
Pump Station at HTP		31,000	gpm	formula	$ 12,400,000	
Pump Station at WCB Wells		31,000	gpm	formula	$ 12,400,000	
Land Purchase		0.5	acres	$2,000,000	$ 1,000,000	Land purchase assumed for all off-site PS
Groundwater Recharge						
Injection Wells at WB		35	wells	$2,000,000	$ 70,000,000	
Land Purchase		4.0	acres	$2,000,000	$ 8,100,000	
Production Wells						
Production Wells at WB		35	wells	$2,000,000	$ 70,000,000	
Land Purchase		4.0	acres	$2,000,000	$ 8,100,000	
Well Head Treatment		50,000	AFY	$0	$ -	
Distribution	Diam (in)	Length (ft)				
WCB Wells later	10	35,000	in-dia*LF	$20	$ 7,000,000	
WCB to DWP	54	21,120	in-dia*LF	$16	$ 18,200,000	
				Construction Subtotal	**$ 494,600,000**	
			Contingency Costs	30%	$ 148,400,000	
				Construction Total	**$ 643,000,000**	
			Implementation Costs	30%	$ 192,900,000	
				Total Capital Cost (Jan 2011)	**$ 835,900,000**	
20-Year Useful Life						
Treatment (Product Water)				63%	$ 164,400,000	
EQ Storage				10%	$ -	
Conveyance				0%	$ -	
Pump Station				50%	$ 12,400,000	
Groundwater Recharge Equipment				25%	$ 17,500,000	
Production Wells Equipment				25%	$ 17,500,000	
Distribution				0%	$ -	
				Construction Subtotal	**$ 211,800,000**	
			Contingency Costs	30%	$ 63,500,000	
				Construction Total	**$ 275,300,000**	
			Implementation Costs	30%	$ 82,600,000	
				Total 20-year Capital Cost (Jan 2011)	**$ 357,900,000**	
O&M Costs						
Annual O&M Costs ($/Year)						
Treatment (Product Water)						
HTP (Phase 1-2 completed)		50,000	AFY	$480	$ 24,000,000	
EQ Storage		$0	LS	0.5%	$ -	
Distribution Storage		0	LS	$75,000	$ -	
Conveyance		31,680	LF	$0.60	$ 19,000	
Pump Station						
Pump Station at HTP		$10,000	LS	5.0%	$ 630,000	
Electrical Cost		5,577,100	kWh (Qavg)	$0.12	$ 669,000	
Pump Station at WCB Wells		$10,000	LS	5.0%	$ 630,000	
Electrical Cost		2,466,300	kWh (Qavg)	$0.12	$ 296,000	
Groundwater Recharge Land Cost						*See 10 Year Periodic below*
Production Wells Land Cost						
Power West Coast		50,000	AFY	$102	$ 5,117,000	Pumps to 100 psi (tb confirmed)
Distribution						
WCB Wells lateral		35,000	LF	$0.60	$ 21,000	
WCB to DWP		21,120	LF	$0.60	$ 13,000	
				Total Annual O&M	**$ 31,400,000**	

Item	Qty	Units	Unit Cost	Cost	Notes
10-Year Periodic O&M Costs ($/Year)					
Groundwater Recharge					
Pump Maintenance	35	wells	$75,000	$ 2,625,000	
Production Wells					
Pump Maintenance	35	wells	$100,000	$ 3,500,000	
Redevelopment of Wells	35	wells	$100,000	$ 3,500,000	
			Total 10-Year O&M	**$ 9,625,000**	
5-Year Periodic O&M Costs ($/Year)					
Groundwater Recharge					
Redevelopment of Wells	35	wells	$100,000	$ 3,500,000	
			Total 5-Year O&M	**$ 3,500,000**	
Recycled Water Purchase ($ / Year)					Assumes no blend requirement at project startup
	50,000		**Purchase Cost Total**	**$ -**	

NPV Calculations

Inflation / Discount Rate		Initial Capital Cost	$ 835,900,000
Construction/O&M Escalator	3.0%	20-Year Life	$ 357,900,000
Water Purchase Escalator	4.0%	Annual O&M	$ 31,400,000
Discount Rate	5.5%	10-Year O&M	$ 9,625,000
Financing Costs		5-Year O&M	$ 3,500,000
Interest Rate	**5.5%**	Annual Purchase	$ -
Period	25	Annual Yield (AFY)	50,000
Yield Period	50	Total Yield (AF)	2,500,000

No.	Calendar Year	Capital Finance 1	Capital Finance 2	Capital Finance 3	O&M Annual Cost	O&M 10-Year Cost	O&M 5-Year Cost	Total Cost
1	2011	$ -	$ -	$ -	0	0	0	0
25	2035	$ -	$ -	$ -	0	0	0	0
26	2036	$ 134,389,719	$ -	$ -	67,716,966	0	0	202,106,685
27	2037	$ 134,389,719	$ -	$ -	69,748,475	0	0	204,138,194
28	2038	$ 134,389,719	$ -	$ -	71,840,929	0	0	206,230,648
29	2039	$ 134,389,719	$ -	$ -	73,996,157	0	0	208,385,876
30	2040	$ 134,389,719	$ -	$ -	76,216,042	0	0	210,605,761
31	2041	$ 134,389,719	$ -	$ -	78,502,523	0	8,750,281	221,642,523
32	2042	$ 134,389,719	$ -	$ -	80,857,599	0	0	215,247,318
33	2043	$ 134,389,719	$ -	$ -	83,283,326	0	0	217,673,045
34	2044	$ 134,389,719	$ -	$ -	85,781,826	0	0	220,171,545
35	2045	$ 134,389,719	$ -	$ -	88,355,281	0	0	222,745,000
36	2046	$ 134,389,719	$ -	$ -	91,005,939	27,895,929	10,143,974	263,435,562
37	2047	$ 134,389,719	$ -	$ -	93,736,118	0	0	228,125,837
38	2048	$ 134,389,719	$ -	$ -	96,548,201	0	0	230,937,920
39	2049	$ 134,389,719	$ -	$ -	99,444,647	0	0	233,834,366
40	2050	$ 134,389,719	$ -	$ -	102,427,987	0	0	236,817,706
41	2051	$ 134,389,719	$ -	$ -	105,500,826	0	11,759,646	251,650,192
42	2052	$ 134,389,719	$ -	$ -	108,665,851	0	0	243,055,570
43	2053	$ 134,389,719	$ -	$ -	111,925,827	0	0	246,315,546
44	2054	$ 134,389,719	$ -	$ -	115,283,601	0	0	249,673,320
45	2055	$ 134,389,719	$ -	$ -	118,742,109	0	0	253,131,828
46	2056	$ 134,389,719	$ 103,924,493	$ -	122,304,373	37,489,796	13,632,653	411,741,033
47	2057	$ 134,389,719	$ 103,924,493	$ -	125,973,504	0	0	364,287,716
48	2058	$ 134,389,719	$ 103,924,493	$ -	129,752,709	0	0	368,066,921
49	2059	$ 134,389,719	$ 103,924,493	$ -	133,645,290	0	0	371,959,502
50	2060	$ 134,389,719	$ 103,924,493	$ -	137,654,649	0	0	375,968,861
51	2061	$ -	$ 103,924,493	$ -	141,784,288	0	15,803,981	261,512,762
52	2062	$ -	$ 103,924,493	$ -	146,037,817	0	0	249,962,310
53	2063	$ -	$ 103,924,493	$ -	150,418,952	0	0	254,343,444
54	2064	$ -	$ 103,924,493	$ -	154,931,520	0	0	258,856,013
55	2065	$ -	$ 103,924,493	$ -	159,579,466	0	0	263,503,958
56	2066	$ -	$ 103,924,493	$ -	164,366,850	50,383,151	18,321,146	336,995,639
57	2067	$ -	$ 103,924,493	$ -	169,297,855	0	0	273,222,348
58	2068	$ -	$ 103,924,493	$ -	174,376,791	0	0	278,301,284
59	2069	$ -	$ 103,924,493	$ -	179,608,095	0	0	283,532,587
60	2070	$ -	$ 103,924,493	$ -	184,996,337	0	0	288,920,830
61	2071	$ -	$ 103,924,493	$ -	190,546,228	0	21,239,229	315,709,949
62	2072	$ -	$ 103,924,493	$ -	196,262,614	0	0	300,187,107
63	2073	$ -	$ 103,924,493	$ -	202,150,493	0	0	306,074,986
64	2074	$ -	$ 103,924,493	$ -	208,215,008	0	0	312,139,500
65	2075	$ -	$ 103,924,493	$ -	214,461,458	0	0	318,385,951
66	2076	$ -	$ 103,924,493	$ 187,699,194	220,895,302	67,710,741	24,622,088	604,851,817
67	2077	$ -	$ 103,924,493	$ 187,699,194	227,522,161	0	0	519,145,847
68	2078	$ -	$ 103,924,493	$ 187,699,194	234,347,825	0	0	525,971,512
69	2079	$ -	$ 103,924,493	$ 187,699,194	241,378,260	0	0	533,001,947
70	2080	$ -	$ 103,924,493	$ 187,699,194	248,619,608	0	0	540,243,295
71	2081	$ -	$ -	$ 187,699,194	256,078,196	0	28,543,748	472,321,138
72	2082	$ -	$ -	$ 187,699,194	263,760,542	0	0	451,459,736
73	2083	$ -	$ -	$ 187,699,194	271,673,358	0	0	459,372,552
74	2084	$ -	$ -	$ 187,699,194	279,823,559	0	0	467,522,753
75	2085	$ -	$ -	$ (1,454,869,554)	288,218,266	0	0	(1,166,651,288)
	NPV	**$ 472,727,293**	**$ 125,289,118**	**$ 13,959,713**	**$ 496,173,513**	**$ 11,742,741**	**$ 9,721,820**	**$ 1,129,614,198**
								$450

Appendix F

Satellite Reuse Options TM

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Summary of Modifications to "Satellite Reuse Options TM" since Initial Publication on February 10, 2010

The Recycled Water Master Planning (RWMP) effort has spanned three years (April 2009 to March 2012). As is the nature of a planning project, assumptions are typically modified and refined as a project is further developed. The most recent assumptions related to the Non-Potable Reuse (NPR) master planning effort are presented in the Draft NPR Master Planning Report (December 2011). Assumptions and conclusions presented in this report supersede assumptions included in this technical memorandum (TM). The following table summarizes the modifications applicable to all RWMP TMs and those specifically applicable to this TM are described in the following sections.

Assumption	Modified	Original
Applicable to all RWMP TMs		
Recycled Water Goal	59,000 AFY by 2035 This goal reflects the 2010 LADWP Urban Water Management Plan that was adopted in early 2011, after the original RWMP goals were drafted	50,000 AFY by 2019
Introduction Section	This is superseded by the Introduction Sections in the NPR Master Planning Report.	This section was included in all initial TMs but the terms described have been replaced by the Introduction Section for the NPR Master Planning Report.
NPR Projects Terminology	To avoid confusion related to LADWP's water rate structure, the terms "Tier 1" and "Tier 2" are superseded with the terms "planned" and "potential," respectively. Both planned and potential projects would be considered for implementation by 2035.	"Tier 1" for NPR projects that were originally planned for design and construction by the year 2015. "Tier 2" for NPR projects that were originally being evaluated in the NPR Master Planning Report for potential future implementation after the year 2015.
Name for MF/RO/AOP treatment plant	Advanced water purification facility (AWPF)	Advanced water treatment facility (AWTF)
Name for water produced by AWPF	Purified recycled water	Advanced treated recycled water, highly purified recycled water, etc.
Treatment Plant Acronyms	DCTWRP LAGWRP	DCT LAG

The following modifications are specific to this TM.

TM References

Throughout this TM there are references to preliminary TMs that were prepared at the onset of the RWMP effort. Relevant information from these TMs has been updated and incorporated into the four RWMP documents: GWR Master Planning Report; NPR Master Planning Report; TIWRP Barrier Supplement and NPR Concepts Report; and Long-Term Concepts Report.

Dry Weather Runoff Recycling

In this TM, two dry weather runoff plants were defined with the Los Angeles River as the source and one dry weather runoff plant was defined with Ballona Creek as the source. The concept of recycling dry weather runoff was not carried forward due to several considerations that are beyond the scope of the RWMP effort to address, particularly water rights and environmental impacts.

Demand Estimates / Facility sizing

The treatment plants were sized based on preliminary non-potable reuse demand estimates available when this TM was initially prepared. Demand estimates were subsequently revised and documented in the NPR Master Planning Report.

Wastewater Treatment Plant	Original Size	Modified Size
San Fernando Valley - Southeast	5.2 mgd	3.8 mgd
LA Central	10.8 mgd	5.4 mgd
Hollywood	2.4 mgd	2.2 mgd
Rancho Park	5.4 mgd	5.2 mgd

Cost estimates

The basis for the cost estimates included in this TM was subsequently revised, as documented in the Cost Estimating Basis for Recycling Water Master Planning TM (Appendix E in the NPR Master Planning Report) and summarized in Section 3.3 of the NPR Master Planning Report.

Modifications were made to nearly the entire cost estimating basis initially used in this TM, including unit costs for capital and O&M costs, construction contingency, implementation factor, project financing, discount rate, and Engineering News Record (ENR) Index.

Component	Initial	Updated
Unit capital costs	various	$10 per gallon of capacity
Unit O&M costs	various	$0.30/yr per gallon of capacity
Construction Contingency	25%	30%
Implementation Factor	25%	30%
Project Financing	5.5%	pay-as-you-go
Discount Rate	4%	3%
ENR Index	9,410 (2008 Average)	10,000 (January 2011)

Updated costs for the four satellite wastewater treatment plants are attached. Note that costs were updated for the four raw wastewater plants defined in this TM and were not updated for the dry weather runoff plants and air treatment facilities. Also, the updated cost estimates do not include the cost to divert and convey raw wastewater from sewer to satellite treatment plant.

Summary of Options

There are no changes to the TM's final section - Summary of Options. The four satellite wastewater treatment plant options were carried forward for the NPR supply analysis presented in Section 5 of the NPR Master Planning Report.

The original TM follows so these modifications should be considered when reading this TM.

ASPECT:	**Satellite Reuse Options TM**	Date:	1/18/2012
DESCRIPTION:	**Present Value Estimate**	**Annual Yield (AFY)**	
SUPPLY:	**Central City Satellite**	4,000	

Item	Qty	Units	Unit Cost		Cost
Capital Costs					
Treatment	5.4	MGD	$10,000,000	$	54,000,000
Storage Tank	2.7	MG	$2,000,000	$	5,400,000
Pump Station	3,750	gpm	formula	$	2,509,000
Conveyance	Length (ft)				
6 inch	0	in-diam*LF	$24	$	-
8 inch	0	in-diam*LF	$24	$	-
10 inch	0	in-diam*LF	$20	$	-
12 inch	0	in-diam*LF	$20	$	-
16 inch	0	in-diam*LF	$18	$	-
18 inch	0	in-diam*LF	$18	$	-
20 inch	0	in-diam*LF	$18	$	-
24 inch	0	in-diam*LF	$16	$	-
30 inch	0	in-diam*LF	$16	$	-
			Construction Subtotal	**$**	**61,909,000**
		Contingency Costs	30%	$	18,573,000
			Construction Total	**$**	**80,482,000**
		Implementation Costs	30%	$	24,145,000
			Total Capital Cost	**$**	**104,627,000**
O&M Costs ($ / Year)					
Treatment	5,400,000	gpd of capacity	$0.30	$	1,620,000
Storage	1	LS	$75,000	$	75,000
Pump Station					
Maintenance	$ 2,509,000	capital cost	5.0%	$	135,000
PS 1 - Electricity	1,641,800	kWh	$0.12	$	197,000
Conveyance	-	LF	$0.60	$	-
			Total Annual O&M	**$**	**2,027,000**
Recycled Water Purchase ($ / Year)					
Burbank WP		AFY	$0	$	-
Central Basin MWD		AFY	$500	$	-
Las Virgenes MWD		AFY	$500	$	-
Terminal Island WRP		AFY	$1,300	$	-
West Basin - Nitrified (Harbor)		AFY	$800	$	-
West Basin - Tertiary (West/Metro)		AFY	$728	$	-
			Purchase Cost Total	**$**	**-**
Economic Cost Summary					
Present Value Calculations			PV Factor		
Initial Capital Cost	$ 104,627,000		1.00	$	104,627,000
20-Year Capital Costs	$ 48,664,000		2.00	$	97,328,000
Annual O&M Costs	$ 2,027,000		49.00	$	99,323,000
Recycled Water Cost	$ -		65.45	$	-
Salvage	$ (24,332,000)		1.00	$	(24,332,000)
			Total Present Vaue		**$276,946,000**
			Project Yield (AF)		**200,000**
			Unit Cost ($/af)		**$1,400**

ASPECT:	**Satellite Reuse Options TM**	Date:	1/18/2012
DESCRIPTION:	**Present Value Estimate**	**Annual Yield (AFY)**	
SUPPLY:	**Hollywood Satellite**	1,300	

Item	Qty	Units	Unit Cost	Cost
Capital Costs				
Treatment	2.2	MGD	$10,000,000	$ 22,000,000
Storage Tank	1.1	MG	$3,000,000	$ 3,300,000
Pump Station	1,530	gpm	formula	$ 1,271,000
Conveyance	Length (ft)			
6 inch	0	in-diam*LF	$24	$ -
8 inch	0	in-diam*LF	$24	$ -
10 inch	0	in-diam*LF	$20	$ -
12 inch	0	in-diam*LF	$20	$ -
16 inch	0	in-diam*LF	$18	$ -
18 inch	0	in-diam*LF	$18	$ -
20 inch	0	in-diam*LF	$18	$ -
24 inch	0	in-diam*LF	$16	$ -
30 inch	0	in-diam*LF	$16	$ -
			Construction Subtotal	**$ 26,571,000**
		Contingency Costs	30%	$ 7,971,000
			Construction Total	**$ 34,542,000**
		Implementation Costs	30%	$ 10,363,000
			Total Capital Cost	**$ 44,905,000**
O&M Costs ($ / Year)				
Treatment	2,200,000	gpd of capacity	$0.30	$ 660,000
Storage	1	LS	$75,000	$ 75,000
Pump Station				
Maintenance	$ 1,271,000	capital cost	5.0%	$ 74,000
PS 1 - Electricity	533,600	kWh	$0.12	$ 64,000
Conveyance	-	LF	$0.60	$ -
			Total Annual O&M	**$ 873,000**
Recycled Water Purchase ($ / Year)				
Burbank WP		AFY	$0	$ -
Central Basin MWD		AFY	$500	$ -
Las Virgenes MWD		AFY	$500	$ -
Terminal Island WRP		AFY	$1,300	$ -
West Basin - Nitrified (Harbor)		AFY	$800	$ -
West Basin - Tertiary (West/Metro)		AFY	$728	$ -
			Purchase Cost Total	**$ -**
Economic Cost Summary				
Present Value Calculations			PV Factor	
Initial Capital Cost	$ 44,905,000		1.00	$ 44,905,000
20-Year Capital Costs	$ 20,223,000		2.00	$ 40,446,000
Annual O&M Costs	$ 873,000		49.00	$ 42,777,000
Recycled Water Cost	$ -		65.45	$ -
Salvage	$ (10,111,500)		1.00	$ (10,112,000)
			Total Present Vaue	**$118,016,000**
			Project Yield (AF)	**65,000**
			Unit Cost ($/af)	**$1,800**

ASPECT:	**Satellite Reuse Options TM**	Date:	1/18/2012
DESCRIPTION:	**Present Value Estimate**	**Annual Yield (AFY)**	
SUPPLY:	**Southeast Satellite**	2,100	

Item	Qty		Units	Unit Cost		Cost
Capital Costs						
Treatment		3.8	MGD	$10,000,000	$	38,000,000
Storage Tank		1.9	MG	$3,000,000	$	5,700,000
Pump Station		2,640	gpm	formula	$	1,922,000
Conveyance		Length (ft)				
6 inch		0	in-diam*LF	$24	$	-
8 inch		0	in-diam*LF	$24	$	-
10 inch		0	in-diam*LF	$20	$	-
12 inch		0	in-diam*LF	$20	$	-
16 inch		0	in-diam*LF	$18	$	-
18 inch		0	in-diam*LF	$18	$	-
20 inch		0	in-diam*LF	$18	$	-
24 inch		0	in-diam*LF	$16	$	-
30 inch		0	in-diam*LF	$16	$	-
				Construction Subtotal	**$**	**45,622,000**
			Contingency Costs	30%	$	13,687,000
				Construction Total	**$**	**59,309,000**
			Implementation Costs	30%	$	17,793,000
				Total Capital Cost	**$**	**77,102,000**
O&M Costs ($ / Year)						
Treatment		3,800,000	gpd of capacity	$0.30	$	1,140,000
Storage		1	LS	$75,000	$	75,000
Pump Station						
Maintenance	$	1,922,000	capital cost	5.0%	$	106,000
PS 1 - Electricity		861,200	kWh	$0.12	$	103,000
Conveyance		-	LF	$0.60	$	-
				Total Annual O&M	**$**	**1,424,000**
Recycled Water Purchase ($ / Year)						
Burbank WP			AFY	$0	$	-
Central Basin MWD			AFY	$500	$	-
Las Virgenes MWD			AFY	$500	$	-
Terminal Island WRP			AFY	$1,300	$	-
West Basin - Nitrified (Harbor)			AFY	$800	$	-
West Basin - Tertiary (West/Metro)			AFY	$728	$	-
				Purchase Cost Total	**$**	**-**
Economic Cost Summary						
Present Value Calculations				PV Factor		
Initial Capital Cost	$	77,102,000		1.00	$	77,102,000
20-Year Capital Costs	$	34,697,000		2.00	$	69,394,000
Annual O&M Costs	$	1,424,000		49.00	$	69,776,000
Recycled Water Cost	$	-		65.45	$	-
Salvage	$	(17,348,500)		1.00	$	(17,349,000)
				Total Present Vaue		**$198,923,000**
				Project Yield (AF)		**105,000**
				Unit Cost ($/af)		**$1,900**

ASPECT:	**Satellite Reuse Options TM**	Date:	1/18/2012
DESCRIPTION:	**Present Value Estimate**	**Annual Yield (AFY)**	
SUPPLY:	**Rancho Park Satellite**	2,900	

Item		Qty	Units	Unit Cost		Cost
Capital Costs						
Treatment		5.2	MGD	$10,000,000	$	51,786,000
Storage Tank		2.6	MG	$2,000,000	$	5,200,000
Pump Station		1,800	gpm	formula	$	1,438,000
Conveyance		Length (ft)				
6 inch		0	in-diam*LF	$24	$	-
8 inch		0	in-diam*LF	$24	$	-
10 inch		0	in-diam*LF	$20	$	-
12 inch		0	in-diam*LF	$20	$	-
16 inch		0	in-diam*LF	$18	$	-
18 inch		0	in-diam*LF	$18	$	-
20 inch		0	in-diam*LF	$18	$	-
24 inch		0	in-diam*LF	$16	$	-
30 inch		0	in-diam*LF	$16	$	-
				Construction Subtotal	**$**	**58,424,000**
			Contingency Costs	30%	$	17,527,000
				Construction Total	**$**	**75,951,000**
			Implementation Costs	30%	$	22,785,000
				Total Capital Cost	**$**	**98,736,000**
O&M Costs ($ / Year)						
Treatment		5,178,571	gpd of capacity	$0.30	$	1,554,000
Storage		1	LS	$75,000	$	75,000
Pump Station						
Maintenance	$	1,438,000	capital cost	5.0%	$	82,000
PS 1 - Electricity		1,189,200	kWh	$0.12	$	143,000
Conveyance		-	LF	$0.60	$	-
				Total Annual O&M	**$**	**1,854,000**
Recycled Water Purchase ($ / Year)						
Burbank WP			AFY	$0	$	-
Central Basin MWD			AFY	$500	$	-
Las Virgenes MWD			AFY	$500	$	-
Terminal Island WRP			AFY	$1,300	$	-
West Basin - Nitrified (Harbor)			AFY	$800	$	-
West Basin - Tertiary (West/Metro)			AFY	$728	$	-
				Purchase Cost Total	**$**	**-**
Economic Cost Summary						
Present Value Calculations				PV Factor		
Initial Capital Cost	$	98,736,000		1.00	$	98,736,000
20-Year Capital Costs	$	45,854,000		2.00	$	91,708,000
Annual O&M Costs	$	1,854,000		49.00	$	90,846,000
Recycled Water Cost	$	-		65.45	$	-
Salvage	$	(22,927,000)		1.00	$	(22,927,000)
				Total Present Vaue		**$258,363,000**
				Project Yield (AF)		**145,000**
				Unit Cost ($/af)		**$1,800**

City of Los Angeles

Recycled Water Master Plan

Task 5.2

DRAFT Satellite Reuse Options Technical Memorandum

Prepared For:

Los Angeles Department of Water and Power

City of Los Angeles, Department of Public Works

Prepared By:

RMC in association with CDM

February 10, 2010

Technical Memorandum

Title:	Satellite Reuse Options
Version:	Draft
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Reviewed by:	Tom Richardson, Project Manager, RMC Heather Boyle VanMeter, Deputy Project Manager, CDM Trussell Technologies Rob Morrow, RMC Steve Clary, RMC
Date:	February 10, 2010
Reference:	Task 1.6 DCT Flow Assessment TM Task 2.2 High Use Customers Overview TM Task 2.4 Project Concepts TM Task 2.1.2 Non-Potable Reuse Regulatory and Policy Assessment TM Task 4.1.3 Regional Groundwater Characterization TM Task 4.1.4 LA River Flow Assessment TM Task 5.1.1 Collection System TM Task 5.1.5 Satellite Technology Assessment TM Task 5.1.6 USC Exposition Park Satellite Customer Assessment TM

1. Introduction

With imported water supplies becoming ever more unpredictable, the Los Angeles Department of Water and Power (LADWP) adopted the Mayor's vision of Securing LA's Water Supply in May 2008, calling for 50,000 acre-feet per year (AFY) of potable supplies to be replaced by recycled water by 2019. To meet this near-term challenge and plan for expanding reuse in the future, LADWP has partnered with the Department of Public Works to develop the Recycled Water Master Plan (RWMP). The RWMP includes 7 major tasks: 1 Groundwater Replenishment (GWR) Master Plan, 2 Non-Potable Reuse Master Plan, 3 GWR Treatment Pilot Study, 4 Max Reuse Concept Report, 5 Satellite Feasibility Concept Report, 6 Existing System Reliability Concept Report, and 7 Training.

1.1 Task 5 Overview

The purpose of Task 5, Satellite Feasibility Concept Report, is to identify ways to utilize recycled water by means of satellite plants, sewer mining, dry weather runoff diversion, or other alternative technologies in locations where the expansion of the recycled water distribution system is unfeasible. Task 5a includes the basic research, identification of projects, and a portion of the preliminary project development. Task 5b will further develop recommended satellite treatment projects. Task 5a is subdivided into the following tasks:

- Task 5.1 – Basic Research: Initial research and summary of the City's current and projected wastewater and stormwater flows and quality, non-potable demands in the City, existing small-scale and regional satellite plants, technology assessment, and USC/Exposition Park satellite customer assessment and resource evaluation.
- Task 5.2 – Identification of Projects: Development of criteria for potential satellite reuse areas, including sources and demands for small-scale and regional plants and preliminary project screening.
- Task 5.3 – Working Group and QAQC: Satellite working group meetings to prepare the Satellite Feasibility Concept Report, as well as quality control/quality assurance activities established in the Project Quality Control Plan developed under Task 2.

1.2 TM Purpose

This Technical Memorandum (TM) summarizes the preliminary project options for satellite treatment facilities. Satellite treatment facilities would pull either wastewater from the sewers or dry weather runoff from rivers or creeks for local treatment and reuse for identified non-potable demands. Solids and sidestreams from the satellite treatment facility would be returned to the sewer for conveyance to the Hyperion Treatment Plant (HTP). The satellite treatment project options are included in the RWMP as a potential way to reach customers or groundwater recharge opportunities where existing recycled water infrastructure does not reach or to meet demands beyond the existing capacity of the recycled water system. This TM in summarizing satellite treatment project options will be a building block in the integrated analysis. Specifically, this TM:

- Summarizes the recycled water demands throughout the City of Los Angeles by area;
- Identifies locations and quantities of nearby sources of wastewater flow to meet these demands;

- Identifies methodology to guide the analysis of candidate sites (options);
- Presents the proposed treatment processes for the satellite plant and associated facilities, including preliminary sizing and capital and operational costs of the facilities;
- Identifies locations to be developed further in Task 5b.

Information developed in this TM will be used in Task 2b and 5b to developed integrated alternatives regarding the amount of recycled water production that should be produced at satellite plants compared to other non-potable and groundwater replenishment options.

1.3 TM Outline

The TM is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Methodology
- Section 3 - Preliminary Satellite Options
- Section 4 – Summary of Options

2. Methodology

The methodology for developing the satellite treatment project options involves several steps that are outlined below.

The City of Los Angeles was separated into three geographical areas for the evaluation. These areas are:

- San Fernando Valley
- Metro
- Westside

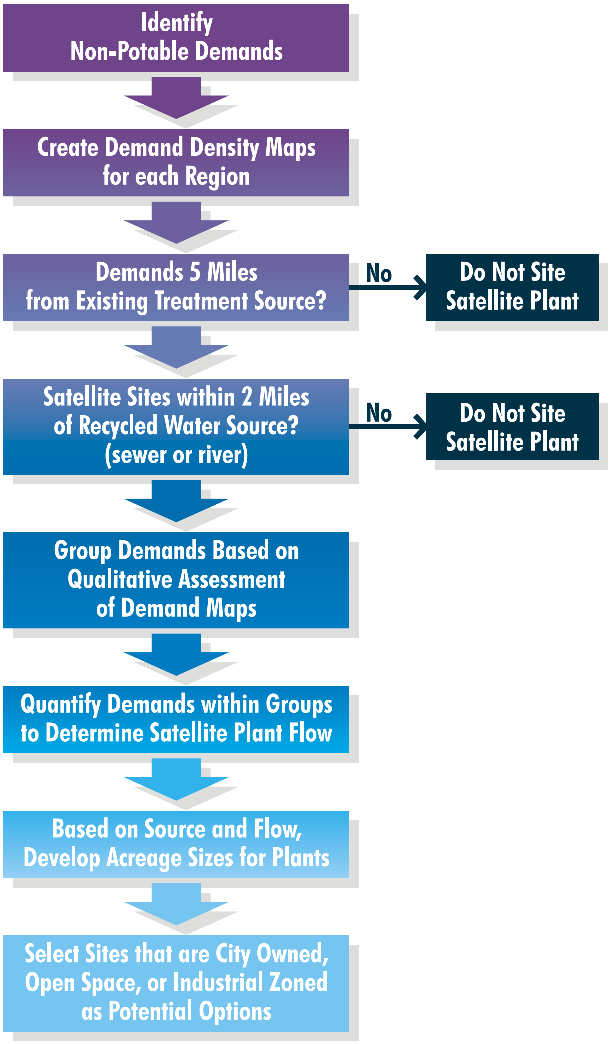
The first step for determining the project options involves determining the location and size of the potential Tier 2 demands. These demands were identified by Task 2, in Task 2.2 High Use Customers Overview TM. The demand sizes and locations were mapped showing demand densities to locate areas of high demand for recycled water.

In much of the City, the demands created obvious clusters that were aggregated to size the potential project option. The demands in these clusters were totaled and identified as a region for a potential satellite plant. Demands that were 5 miles or closer to an existing treatment plant, or to existing recycled water infrastructure were assumed to be served by the nearby facilities more cost-effectively. This was based on the assumed cost of constructing additional 24-inch diameter distribution piping compared to new treatment facilities and an initial assumption that the location of the treatment facility would be roughly in the center of the identified demand regions.

Once the demands were identified, the source of supplying a satellite treatment plant was determined on a site-specific basis described in Section 3. After the source was selected the source flow was compared to the demand flow to verify sufficient flow is available. In areas of potential recycled water demand if there were no sources within 2 miles of that area for feeding a satellite treatment plant, this area was ruled out as an option.

This methodology is summarized in Figure 2-1.

Figure 2-1: Satellite Project Option Methodology



Once the size and source water were determined, process requirements were evaluated based on the source to develop a process flow diagram and project layouts and sizing. This information was used to find potential locations within the area of the demand and to determine project costs. This information is described in more detail below.

2.1 Methodology for Satellite Plant Sizing

Determining the size of a satellite plant requires an analysis of the flow volume to be treated, the quality of the source water, the intended use of the effluent, and the regulations that govern the treatment and discharge/use of the water.

Demands identified by Task 2 in Task 2.2 High Use Customers Overview TM were based on potable water demands and represent average acre-feet per year. To determine plant sizing, the average demands were doubled to account for peak demands seen in summer months. Therefore the plants were sized on double the average flow, assuming that the peak is sustained seasonally.

The peak hour flows may be higher than the seasonal peak used to size the plants. It is assumed that there will be storage within the distribution system and therefore no storage was included in the plant design criteria. The storage within the recycled water distribution system will be discussed further in Task 2.4 Project Concepts TM.

There are two different types of source water in the City that could be treated at a satellite plant: 1) raw wastewater and 2) dry weather runoff. Both types of source water are intended to be used for unrestricted irrigation. The regulations governing the use of water recycled from these sources and the treatment processes needed to achieve the required effluent quality are discussed below.

2.1.1 Raw Wastewater Recycling

Regulations

The California Code of Regulations Titles 17 and 22 govern the use of water recycled from domestic waste in the state of California. Title 17 includes requirements for backflow protection. Title 22 includes requirements for treatment, water quality, and allowable use for recycled water. These regulations are described in the Task 2.1.2 Non-Potable Reuse Regulatory and Policy Assessment TM.

Treatment Process

Satellite treatment for reuse of domestic wastewater typically consists of screening and grit removal at the headworks, followed by primary sedimentation, biological treatment, tertiary filtration, and disinfection. Several technologies for each of these treatment stages were evaluated in Task 5.1.5 Satellite Technology Assessment TM, dated November 3, 2009.

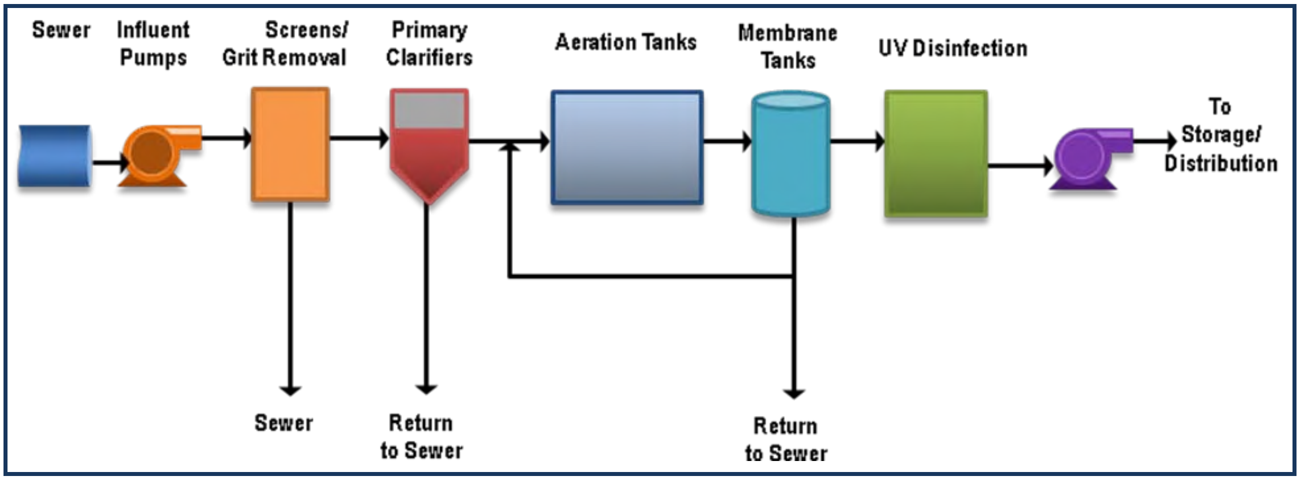
Based on the findings in the Task 5.1.5 Satellite Technology Assessment TM, it was recommended that membrane bioreactors (MBRs) with Ultraviolet (UV) disinfection be used for treatment of domestic wastewater to Title 22 disinfected tertiary recycled water standards due to the smaller footprint.

For the purposes of this TM, the process train described below and shown in Figure 2-2 is assumed for the purpose of determining the sizing and land area requirements as well as determining approximate costs for construction and operation. It is not meant to represent actual design criteria.

Membrane Bioreactor/UV Treatment Train

The MBR/UV treatment train consists of the treatment processes shown in Figure 2-2. This treatment train has a relatively small footprint, but relatively high capital costs when compared to plants that use conventional activated sludge for secondary treatment and a chlorine disinfection system. Note that there may be additional footprint savings for MBRs, including stacking processes or other considerations. For the purposes of this TM, a standard MBR size was estimated for footprint and cost. If these options are further developed, additional footprint sizing and cost estimating is recommended, depending on the site space available in final selection.

Figure 2-2: Domestic Wastewater Recycling –MBR/UV Treatment Train



The sizing of the treatment processes for each of the preliminary satellite options that use the treatment train shown in Figure 2-2 will be based on the findings in the Task 5.1.5 Satellite Technology Assessment TM.

Note that the plant flows in Task 5.1.5 Satellite Technology Assessment TM were either 1 mgd or 50 mgd. For the sizes we considered here (up to 10 mgd), primary clarifiers will not be used for plants with an influent flow less than or equal to 3mgd. This is a conservative estimate as plants up to 10 mgd may not have primary clarifiers. If primary clarifiers are deleted, the capital cost of the plant will be approximately 5 to 10% less than proposed below. Note that removing primary clarifiers may also require additional aeration tank volume, thus decreasing some of that savings. In addition, rectangular shaped primary clarifiers will be used instead of circular clarifiers based on comments received from Task 5.1.5 Satellite Technology Assessment TM and to be consistent with other plants.

2.1.2 Dry Weather Runoff Recycling

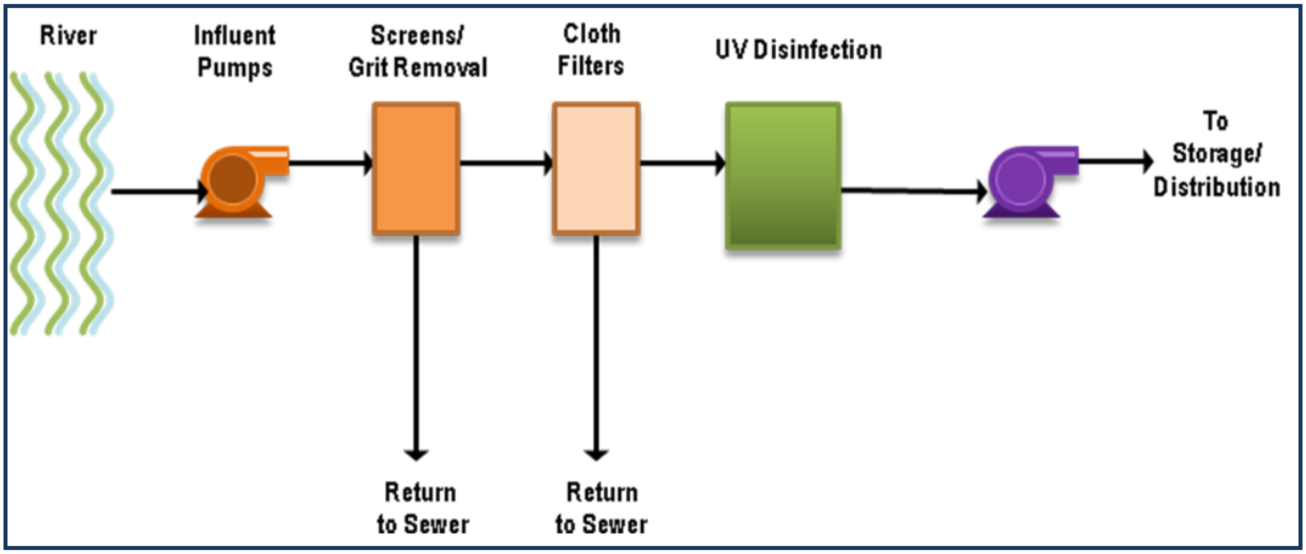
Dry weather runoff is water that drains from urban areas during periods of dry weather and runs into storm drains and eventually into a river or creek, or to the ocean. The runoff is from excessive irrigation, spills, construction sites, pool draining, car washing, the washing down of paved areas, and some initial wet weather runoff.

There are no regulations which specifically govern the recycling of dry weather runoff. Operators of municipal separate storm sewer systems (MS4s) must obtain a National Pollutant Discharge Elimination System (NPDES) permit (often referred to as a NPDES MS4 permit) in order to discharge runoff into local water bodies. The NPDES MS4 permits, issued by the California Regional Water Quality Control Boards (RWQCB), require the use of Best Management Practices (BMPs) to reduce the discharge of pollutants in storm water to the maximum extent practicable. There are no specific requirements for the treatment of dry weather runoff included in the NPDES MS4 permit. However, the distribution of treated dry weather runoff into a recycled water system must be disclosed to the California Department of Public Health (CDPH) in an engineering report. Also, the end users of the recycled water will need to know the quality of the effluent in order to confidently use the water. Therefore, water produced from the treatment of dry weather runoff and intended to be used for unrestricted irrigation should meet the requirements of Title 22 disinfected tertiary recycled water as discussed in Section 3.1.1.

Treatment Process

A satellite plant treating dry weather runoff to Title 22 disinfected tertiary recycled water standards would consist of the treatment process show in Figure 2-3.

Figure 2-3: Dry Weather Runoff



The sizing of the treatment processes for each of the preliminary plant options that use the treatment train shown in Figure 2-3 will be based on typical design parameters for filters of secondary effluent.

The plant will be sized to treat the peak flow for a prolonged period of time (i.e. several days). Dry weather runoff plants will not operate during periods of wet weather. Therefore any sites connected to recycled water need a backup of potable water during rain events. The duration of the plant shutdown will depend on water quality after a storm event. Piloting is recommended to determine the water quality criteria must be met for the plant to resume operation and delivery of recycled water.

Note that the water quality for dry weather runoff is variable depending on location. There are multiple pilot and demonstration projects, although full-scale applications are limited. Piloting on the specific source water is strongly recommended if these options are part of the recommended alternatives. Specifically, an oil and grease removal system has not been included in the current treatment scheme, because it is typically low in dry weather runoff, but increases dramatically for wet weather runoff. Testing is recommended to determine if oil and grease removal is needed at the head of the process.

In considering dry weather runoff at its source, we also evaluated potential benefits to TMDL requirements by using dry weather runoff for recycled water. See Task 4.1.4 LA River Flow Assessment TM for benefits and disadvantages of reduced flow in the LA River to the TMDL requirements.

TMDLs quantify the maximum amount of pollutants that an impaired body of water can receive and still meet water quality standards. The following is a description of TMDLs at Ballona Creek, both of which are potential sources for recycled water. The site-specific TMDL benefits will be discussed in the project option descriptions.

Ballona Creek has three TMDLs in effect (trash, metals, and bacteria) and one TMDL in development (toxics). The TMDLs that are relevant to our work with satellite treatment plants are the Metals TMDL and the Bacteria TMDL.

2.2 Methodology for Site Identification

The goal of site selection is to identify a thorough list of potential sites and reduce it to a short list of realistic sites for the satellite facilities. There are two steps in this process: site identification and preliminary threshold screening.

2.2.1 Site Identification

This step involves identifying a list of potential sites that have limited development on site. Both city-owned and non-city owned sites are considered. To accomplish this, several GIS maps will be created showing the following features for each parcel of land in the areas considered:

- Zoning: Agricultural, Commercial, Industrial, Open Space, Parking, Public Facilities, Residential, Unknown
- Land Use: Developed-Non Residential, Developed-Residential, Open Space
- Ownership: City-owned and non-city owned

These maps will be used in combination to identify a number of possible sites.

Additionally, each of the areas considered will be reviewed on a satellite map using Google Earth. Sites were identified that did not appear to have an existing in-use structure.

2.2.2 Preliminary Threshold Screening

This step will be used to eliminate sites that are unrealistic. If any of the sites did not meet all of the following threshold criteria, they will be eliminated:

- Zoned as non-Residential
- Adjacent to residential areas on one side or less
- Large enough area to treat the peak demand in each area

After applying these three threshold criteria, the remaining sites are recommended as possible locations for the satellite treatment plants.

3. Preliminary Satellite Options

Utilizing the methodology described in Section 2, this section describes the project options identified for satellite treatment facilities. This section is divided into recycled water service areas. In each area, the demands are identified as the basis for the sizing of the satellite project options. The sources of water supply for the satellite facility are identified and the type of treatment process assumed for the facility to meet the identified demands is determined. Potential locations within that area are identified based on current land use and zoning maps. Finally, preliminary capital and O&M costs are summarized for the potential projects. This information will be further refined as the integrated analysis is completed and components of these projects are compared with other options developed in other tasks to meet the recycled water demands.

3.1 San Fernando Valley

3.1.1 General Overview

The San Fernando Valley is the northern portion of the City of Los Angeles and contains the DCT and Valley Spring Lane/Forman Avenue (VSL/FA) sewersheds (see Task 5.1.1 Collection System TM). Flows from these sewersheds are collected in outfall sewers which are located along the southern portion of the Valley. Land use is mostly residential with some pockets of industrial and commercial use.

3.1.2 Identification of Non-Potable Reuse Regions

To fulfill the near-term goals regarding the use of recycled water for 2018, we have assumed that recycled water flow from DCT will be maximized. As determined in Task 1.6 DCT Flow Assessment TM, once the wet-weather storage basins are completed, DCT will be capable of year-round treatment of up to 80 mgd of wastewater flow. For the purposes of this TM, we have assumed that downstream of DCT, 27 mgd of effluent from the plant will be used to support the lakes, Japanese garden, and LA River. The remainder of the effluent from DCT, approximately 30.5 – 39.1 mgd by 2019 (See Task 1.6 DCT Flow Assessment TM), would be available for recycled water uses – either non-potable reuse (NPR) or ground water recharge (GWR). Task 2 has identified approximately 30 mgd of recycled water demand (peak flow) in the entire Valley, including both irrigation and mixed commercial and industrial users (See Task 2.2 High Use Customers Overview TM). This would require additional recycled water sources, in addition to DCT, to meet Valley demands.

For the purpose of identifying the regions viable for satellite treatment in the San Fernando Valley, we have assumed that a satellite treatment plant would not be sited where the sewers are tributary to DCT in order to maximize the flow to and consequent recycled water from DCT. Other sources of flow to feed a satellite treatment plant, such as dry weather runoff may be considered and is discussed below.

Tier 2 mixed (commercial/industrial) and irrigation demands are shown in Table 3-1 and Figure 3-1 and include areas for potential satellite projects. The areas were determined using the methodology described in Section 2, where a satellite plant would be feasible given the source availability in the area. The majority of the demands are irrigation for golf courses and other landscaping areas.

Commercial and industrial demands have also been identified and include manufacturing, hospitals and other institutions. With these conditions in place, two areas of dense demand were identified in the Valley. Note that, as stated in Section 2, the northern area of the Valley has not been targeted for a satellite plant because, although there are many potential demands, there is no available sources with sufficient flow to feed a plant in that area.

Table 3-1: Valley Tier 2 Recycled Water Demands for Regions Identified[a]

Regions	Type of Demand	Average AFY	Average MGD	Peak MGD[c]
San Fernando Valley – Southwest	Irrigation	2000	1.83	3.66
San Fernando Valley – Southwest	Mixed[b]	900	0.79	1.58
	TOTAL	2900	2.6	5.2
San Fernando Valley – Southeast	Irrigation	1000	0.92	1.84
San Fernando Valley – Southeast	Mixed[b]	700	0.57	1.14
	TOTAL	1700	1.5	3.0

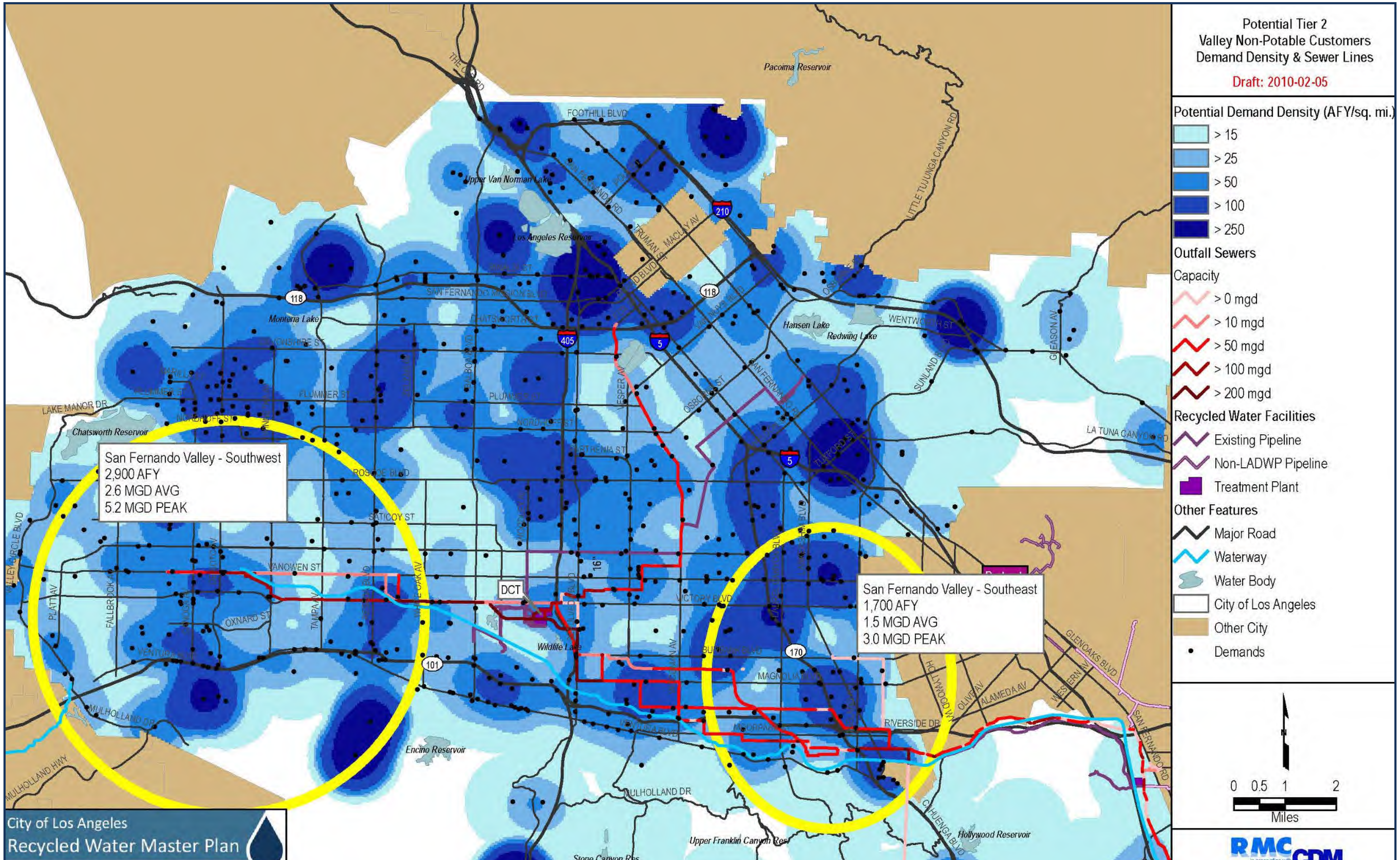
Footnotes:

a. Source: Task 2 Tier 2 Customer Database
b. Mixed demand includes industrial and commercial uses.
c. Peak flow assumed to be twice average flow.

Two Satellite Reuse Regions were identified:

- ***San Fernando Valley – Southwest*** has a total average demand of 2.6 mgd and a peak demand of 5.2 mgd.
- ***San Fernando Valley - Southeast*** has a total average demand of 1.5 mgd and a peak demand of 3.0 mgd.

Figure 3-1: Irrigation and Industrial Demand in the San Fernando Valley



3.1.3 Groundwater Recharge

There are three groundwater recharge basins located in the Valley: Pacoima, Hansen Spreading Grounds and Tujunga Spreading Grounds. For the purposes of this TM, it is assumed that any ground water recharge in the Valley will be supplied by DCT through the AWTP (See Task 1.6 DCT Flow Assessment TM).

3.1.4 Satellite Facility Recycled Water Source

Wastewater flow in the Valley is from west to east and north to south. The majority of the flow in the western and northern portion of the Valley is directed through primary and outfall sewers to DCT. Flows in the eastern portion of the Valley and flows bypassed from DCT flow through outfall sewers to the Hyperion Treatment Plant. A portion of flow is captured and treated at the Los Angeles-Glendale Water Reclamation Plant (LAG).

To meet the City of Los Angeles' recycled water goals, it is assumed that flows tributary to DCT would continue and be maximized in order to fully utilize the existing treatment capacity and infrastructure. In doing so, the western and northern side of the Valley would not have source available from the sewers to feed a satellite treatment facility.

Only a satellite plant that utilizes river flows would be considered in the San Fernando Valley - Southwest, because the sewers in this region are upstream of DCT. In evaluating other potential sources for satellite treatment, the LA River upstream of DCT was evaluated. There is limited flow information on this part of the LA River. The main monitoring station is Sepulveda Dam, which includes flow from DCT. The minimum typical flow ranges between 40 to 50 cfs (26 to 32 mgd). If this is selected as part of the alternatives, additional flow monitoring is recommended at the proposed location of withdraw from the LA River to confirm available flows. Note that that this would mean reducing average dry weather flows downstream in the river. Therefore, potential habitat and other environmental impacts would have to be considered before implementation.

Flows that are tributary to the VSL/FA sewershed, which bypass DCT, could potentially be a source for a satellite facility located in the southeastern portion of the Valley, close to the outfall sewers that would carry sufficient flows to feed a satellite plant. The San Fernando Valley – Southeast Region would have a satellite plant fed by sewer flows, because San Fernando Valley - Southeast contains the bulk of the major outfall sewers in the San Fernando Valley. These outfalls are not tributary to DCT in this area.

3.1.5 Preliminary Satellite Plant Sizing

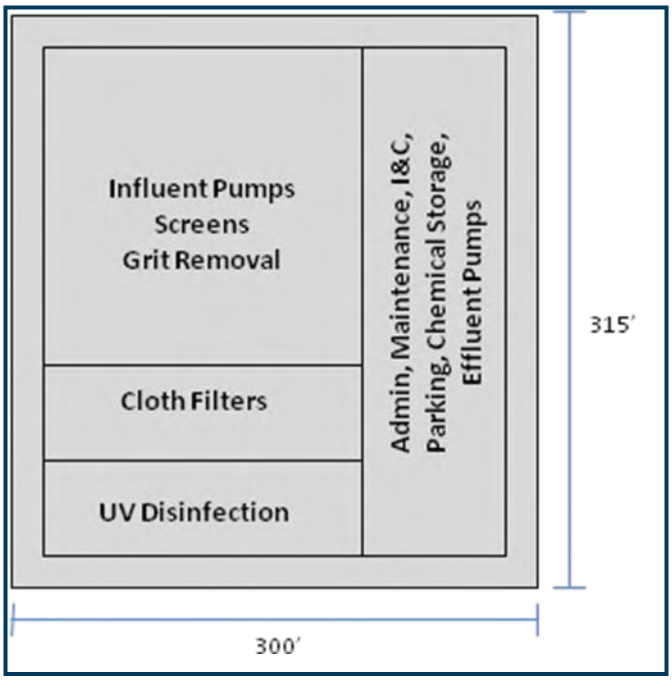
The location and size of demands in the Valley were matched with areas that have an available source of water to be recycled to identify suitable regions for a satellite recycling facility. The demands were used to determine the required capacity of the satellite plant and the available source was used to determine the train of treatment processes needed at the plant. The preliminary sizing of satellite recycling facilities that can serve the needs of the two regions in the Valley is discussed below.

San Fernando Valley - Southwest

A satellite recycling facility in the San Fernando Valley - Southwest region would have to treat dry weather urban runoff from the LA River to meet an average demand of 2.6 mgd and a peak demand of 5.2mgd of Title 22 disinfected tertiary recycled water (see Section 3.2.1 for information regarding treatment of dry weather runoff). As discussed in Section 3.2.2, the preferred treatment train to produce disinfected tertiary recycled water from dry weather urban runoff consists of screening and grit removal at the headworks, followed by filtration with cloth filters, and UV disinfection.

The preliminary size of a satellite recycling facility that could serve the needs of the San Fernando Valley - Southwest region was determined based on the design criteria and assumptions discussed in Section 3.2.2. The total area needed for this type of facility was determined to be approximately 2.2 acres. A schematic of the layout of the plant is included in Figure 3-2.

Figure 3 -2: Layout of San Fernando Valley - Southwest Dry Weather Runoff Plant (total footprint of 2.2 acres)

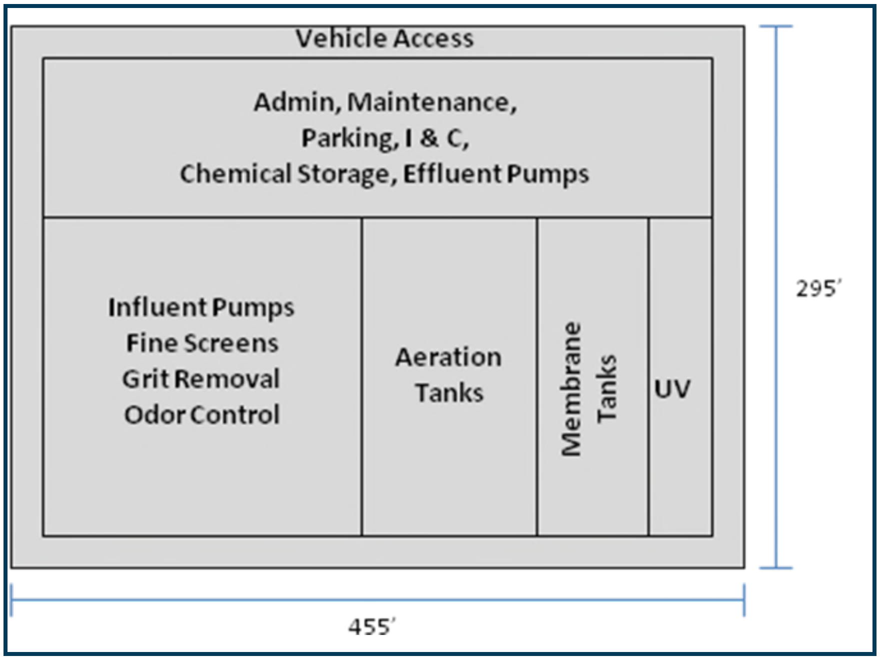


San Fernando Valley - Southeast

A satellite recycling facility in the San Fernando Valley - Southeast region would have to treat domestic wastewater from Valley Outfall Relief Sewer (VORS) to meet an average demand of 1.5 mgd and a peak demand of 3.0 mgd of Title 22 disinfected tertiary recycled water (see Section 3.1.1 for information regarding Title 22 regulations). As discussed in Section 3.1.2, the preferred treatment train to produce disinfected tertiary recycled water from domestic wastewater is an MBR/UV train consisting of screening and grit removal at the headworks, followed by primary sedimentation, a membrane bioreactor process, and UV disinfection.

The preliminary size of a satellite recycling facility that could serve the needs of the San Fernando Valley - Southeast region was determined based on the design criteria and assumptions discussed in Section 3.1.2. The total area needed for this type of facility was determined to be approximately 3.1 acres. A schematic of the layout of the plant is included in Figure 3-3.

Figure 3-3: Layout of San Fernando Valley - Southeast Raw Wastewater Plant (total footprint of 3.1 acres)



3.1.6 Potential Satellite Locations

The San Fernando Valley Southwest Regional Plant would use the LA River for source water. As discussed in 3.1.5 the satellite facility would need to be 2.2 acres.

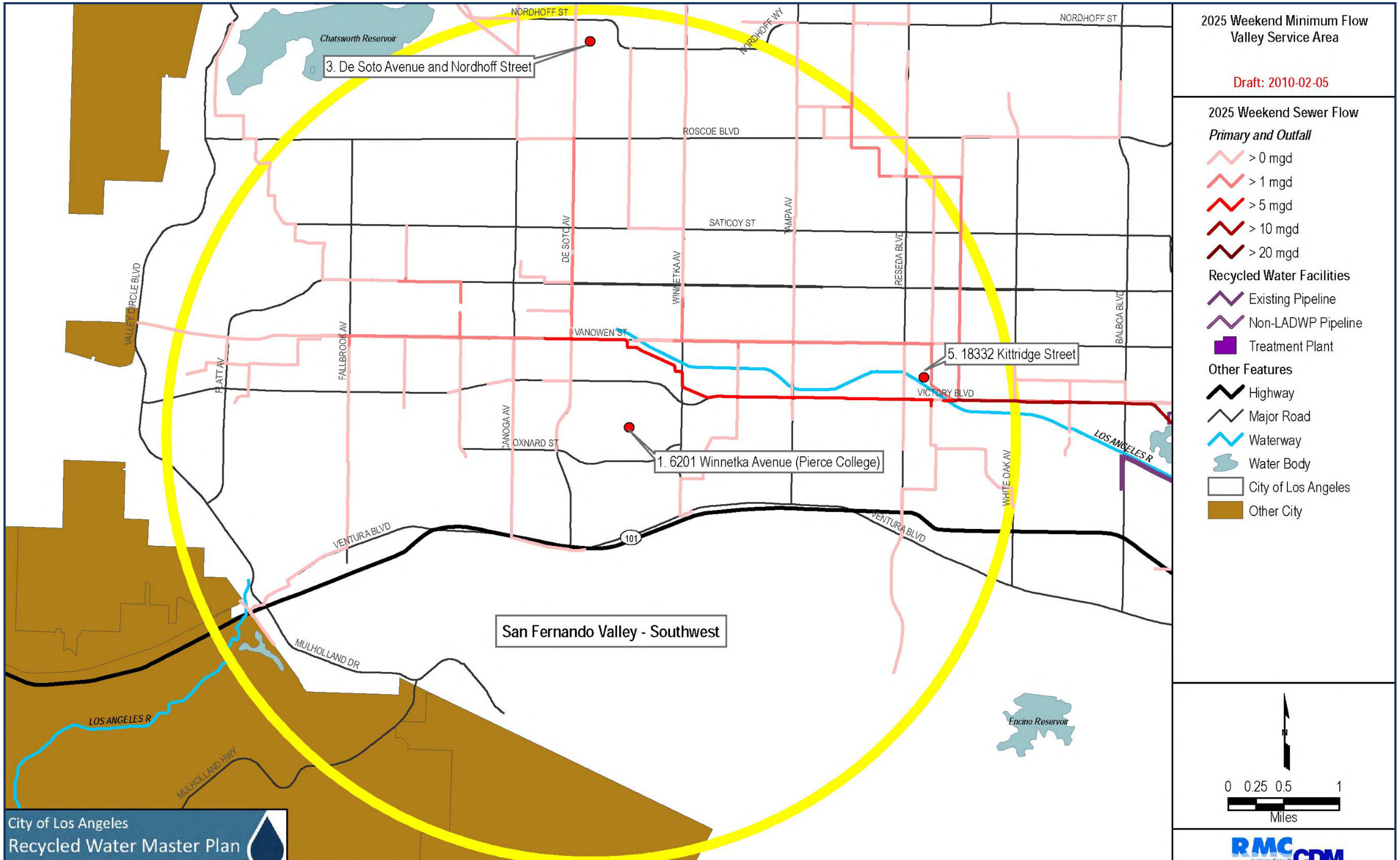
The site identification process for the San Fernando Valley Southwest yielded 11 possible sites. After applying the threshold screening measures discussed in Section 2, this long list of sites was reduced to short list of 3 candidate sites, which are highlighted in Table 3-2 and shown in Figure 3-4.

Table 3-2: Potential Satellite Plant Sites in the San Fernando Valley Southwest Area

Site No.	Address	Description	Zoning Classification[a]	Adjacent to Residential[b]	Size (acres)[c]	Possible Site[d]	City-Owned	Elevation (ft)	Advantages	Disadvantages	Distance From LA River (mi)
1	6201 Winnetka Avenue	Pierce College	Public Facilities	N	75	Y	N	870	College is near a major Highway (US-101) and cross street (Victory Boulevard and De Soto Avenue).	Open Space is in middle of college	0.9
2	De Soto Avenue and Nordhoff Street	Open Space	Parking	N	5	Y	Y	880	The site is mainly surrounded by Industrial zoned areas.	Church across Nordhoff Street.	2.7
3	5800 Toponga Canyon Boulveard	Warner Ranch Park	Open Space	Y	14	N	Y	850	Easy road access, adjacent to CA-27.	Park. Construction could disturb neighboring residential areas.	1.7
4	6731 Wilbur Avenue	West Valley Park	Open Space	Y	8	N	Y	740	Easy road access, corner of Wilbur Avenue and Vanowen Street.	Park. Construction could disturb neighboring residential areas.	0.3
5	18332 Kittridge Street	Reseda Park	Open Space	N	6	Y	Y	730	Open space directly adjacent to LA River.	Park. Construction could disturb neighboring residential areas. Access road is 1-lane.	0.1
6	Vanalden Avenue and Corbin Avenue	Open Space	Agricultural	Y	115	N	Y	1,250	Open space.	Construction could disturb neighboring residential areas. Far from freeways in the hills.	3.6
7	Mulholland Drive and Santa Maria Road	Open Space	Open Space	Y	250	N	Y	1,400	Open space.	Construction could disturb neighboring residential areas. Far from freeways in the hills.	3.6
8	20864 Wells Drive	Serrania Avenue Park	Open Space	Y	10	N	Y	1,020	Undeveloped site.	Park. Site in the midst of households in the hills.	2.5
9	Mulholland Drive and Toponga Canyon Boulevard	Alizondo Drive Park	Open Space	Y	14	N	Y	1,080	On CA-27.	Park. Construction could disturb neighboring residential areas. In the hills.	3.1
10	Delmonico Avenue	Open Space South-East of Chatsworth Reservoir	Residential	Y	9	N	Y	920	Undeveloped site.	Construction could disturb neighboring residential areas.	2.3
11	Napa Street and Sale Avenue	Open Space South-East of Chatsworth Reservoir	Residential	Y	6	N	Y	870	Undeveloped site.	Construction could disturb neighboring residential areas.	2.4

Footnotes:
a. Parcel cannot be zoned as Residential.
b. X: Parcel is adjacent to Residential area on two or more sides. O: Parcel is adjacent to Residential area on less than two sides.
c. Parcel area must be greater than 3.1 acres.
d. Y: Parcel passes 3 threshold screening criteria. N: Parcel fails one of the 3 threshold screening criteria.
e. Flow in LA River.

Figure 3-4: Candidate Satellite Plant Sites in the San Fernando Valley Southwest Area



The San Fernando Valley Southeast satellite option would have raw wastewater for source water. The peak demand for water in this area is approximately 3.0 mgd, which results in a satellite plant size of 3.1 acres.

The site identification process for the San Fernando Valley Southeast yielded 5 possible sites. After applying the threshold screening measures discussed in Section 2, this long list of sites was reduced to a short list of 2 candidate sites, which are highlighted in Table 3-3 and shown in Figure 3-5.

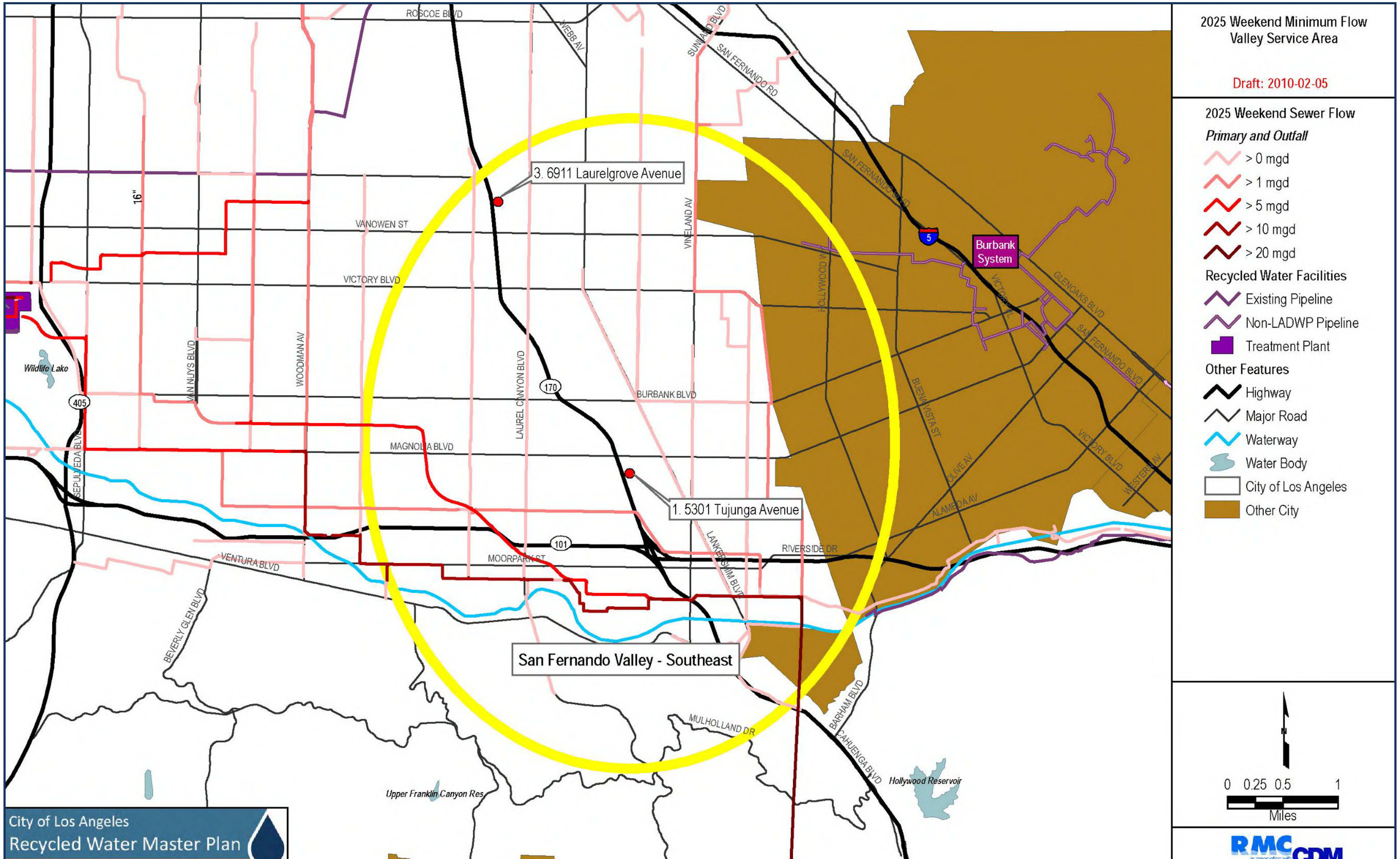
Table 3-3: Potential Satellite Plant Sites in the San Fernando Valley Southeast Area

Site No.	Address	Description	Zoning Classification[a]	Adjacent to Residential[b]	Size (acres)[c]	Possible Site[d]	City-Owned	Elevation (ft)	Advantages	Disadvantages	Distance From LA River (mi)	Flow in River Min;Average (mgd)[e]
1	5301 Tujunga Avenue	North Hollywood Park	Open Space	N	20	Y	Y	620	Easy access, near major street (Magnolia Boulevard) and Highway (CA-170). Area is large enough to accommodate the satellite plant and construction without causing too much disturbance to the neighboring residential areas.	Park. Near Wesley School/First Unified Methodist Church (South East).	1.75	10-20;10-20
2	7100 Tujunga Avenue	Open Space adjacent to Burbank Airport	Industrial	N	27	N	Y	730	Open space in industrial zoned area. Easy street access, in the middle of two major roads (Tujunga Avenue and Vineland Avenue)	In Burbank Airport Runway Protection Zone	3.35	10-20;10-20
3	6911 Laurelgrove Avenue	Valley Plaza Recreation Center	Open Space	N	8	Y	Y	730	Open space large enough to accommodate the satellite plant.	Park. Near Bellingham Primary Center/School (South East). Difficult to access, would need to build separate access road.	3.6	10-20;>20
4	12600 Mulholand Drive	Wilacre State Park	Open Space	Y	72	N	Y	780	Open space large enough to accommodate the satellite plant. Easy access, near Mulholland Dr and Laurel Canyon Boulevard.	Park. Construction could disturb neighboring residential areas.	1.1	10-20;>20
5	North Fryman Road and West Mendips Ridge Road	Open Space	Open Space	Y	11	N	Y	880	Open space large enough to accommodate the satellite plant.	Construction could disturb neighboring residential areas. Difficult to access, no major roads nearby.	1.3	10-20;>20

Footnotes:

a. Parcel cannot be zoned as Residential.
b. X: Parcel is adjacent to Residential area on two or more sides. O: Parcel is adjacent to Residential area on less than two sides.
c. Parcel area must be greater than 3.1 acres.
d. Y: Parcel passes 3 threshold screening criteria. N: Parcel fails one of the 3 threshold screening criteria.
e. Need nearby sewer able to provide 3.0 mgd of influent water.

Figure 3-5: Candidate Satellite Plant Sites in the San Fernando Valley Southeast Area



3.1.7 Cost Estimate

Cost summaries for the San Fernando Valley satellite recycling facilities are included in Table 3-4 and Table 3-5 respectively. The total construction cost, annual operation and maintenance (O&M) costs, present worth, and annualized cost per acre foot of recycled water are provided for each plant. A discussion of how the costs were developed is included in Section 2.5.

Table 3-4: San Fernando Valley - Southwest Dry Weather Runoff Plant Cost Summary

Description	Amount
Source	Dry weather runoff
Flow	2.6 mgd (avg); 5.2 mgd (peak)
Yield	2,900 AFY
Area	2.2 acres
Total Construction Costs	$13,500,000
Annual O&M Costs	$1,300,000
Total Annualized Cost	$1,900,000
Total Unit Cost, annualized	$660/AFY

Table 3-5: San Fernando Valley - Southeast Raw Wastewater Plant Cost Summary

Description	Amount
Source	Sewer
Flow	1.5 mgd (avg); 3.0 mgd (peak)
Yield	1,700 AFY
Area	3.1 acres
Total Construction Costs	$26,000,000
Annual O&M Costs	$900,000
Total Annualized Cost	$2,100,000
Total Unit Cost, annualized	$1,240/AFY

3.2 Metro

3.2.1 General Overview

For the purposes of this TM, the Metro area stretches from the eastern City of LA boundary to approximately the Beverly Hills border, north to the Hollywood Hills and includes Elysian Park and Hollywood, and south to the border of the Cities of Compton and Vernon. Land use is mixed with residential, commercial, and industrial. It is the farthest distance from existing City of Los Angeles treatment plants but could be served by the Central Basin Municipal Water District. For the purposes of developing our project options, we assumed that preference would be given to developing City of LA sources of recycled water.

Identification of Non-Potable Reuse Regions Task 2 identified potential industrial and irrigation demands in the Metro area of Los Angeles. The demands for the Metro area are shown in Table 3-6 and Figure 3-6. The number of potential industrial and irrigation users in the Metro area is in two main regions. The magnitude of demand also varies between these two regions.

This first region, LA Central Region, is centered on the Downtown Area and East Los Angeles. The total demand in the LA Central Region is 5.1 mgd. Major outfall sewers within or adjacent to this region are the Northeast Interceptor Sewer (NEIS), the East Central Interceptor Sewer (ECIS), and the North Outfall Sewer (NOS).

The second region, Hollywood Region, includes the Hollywood and Mid-City areas of Los Angeles. The total demand in the Hollywood Region is 1.2 mgd. Major outfall sewers within or adjacent to this area are the La Cienega San Fernando Valley Relief Sewer (LCSFVRS), the La Cienega Interceptor Sewer (LCIS), and the West Hollywood Interceptor Sewer (WHIS).

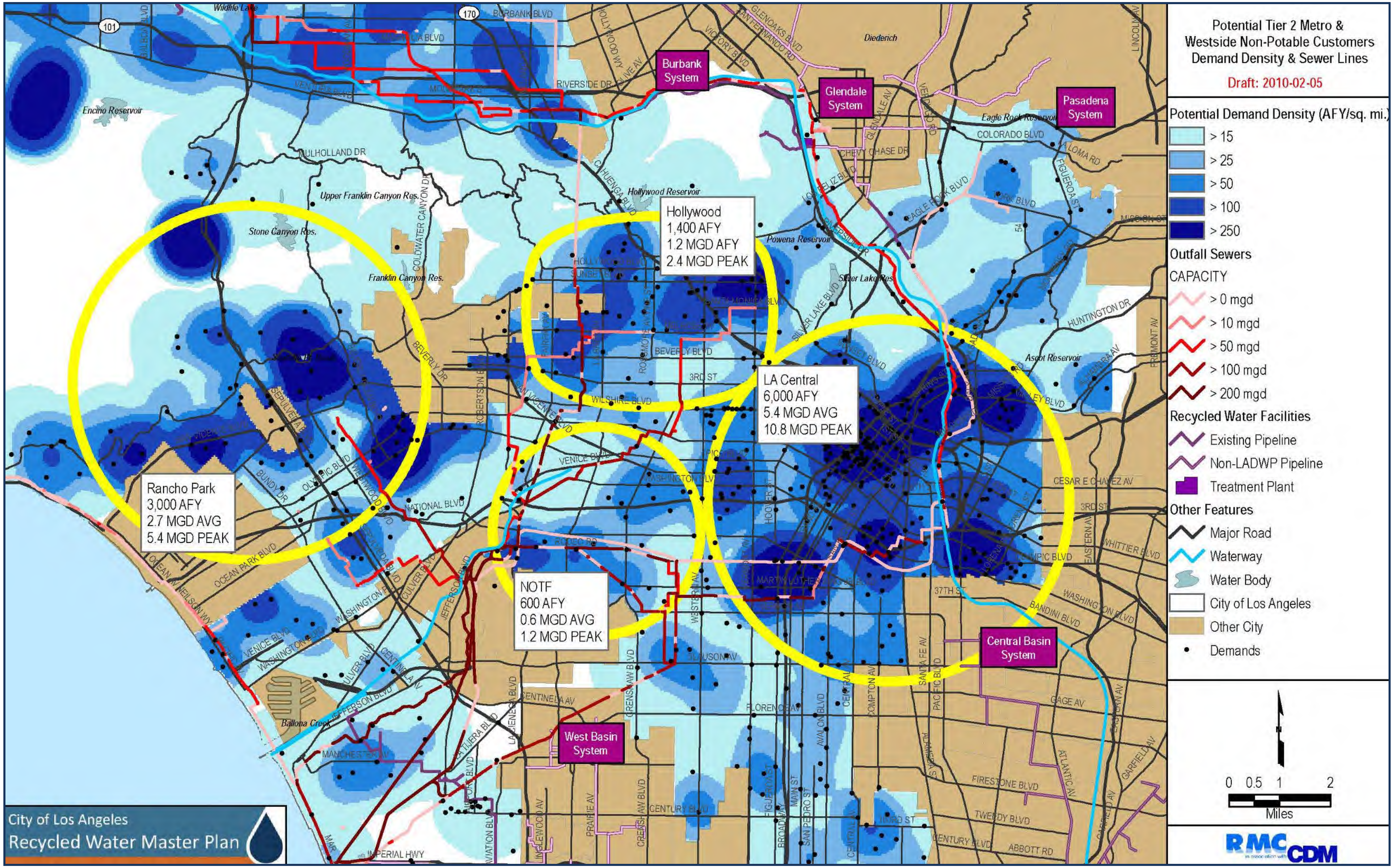
Table 3-6: Metro Tier 2 Recycled Water Demands[a]

Area	Type of Demand	Average AFY	Average MGD	Peak MGD
Metro – City Center	Irrigation	1500	1.34	2.68
Metro – City Center	Mixed[b]	4500	3.93	7.86
	TOTAL	6000	5.4	10.8
Metro – Hollywood	Irrigation	900	0.7	1.4
Metro - Hollywood	Mixed	500	0.5	1.0
	TOTAL	1400	1.2	2.4
Small Scale				
Air Treatment Facilities (4)	Industrial	33.6	0.03	0.03[c]
USC/Exposition Park[d]	Irrigation/Mixed	260	0.23	0.46

Footnotes:

a. Source: Task 2 Tier 2 Customer Database
b. Mixed demand includes industrial and commercial uses.
c. Demand is assumed to be constant.
d. See Task 5.1.6 USC Exposition Park Satellite Customer Assessment TM

Figure 3-6: Irrigation and Industrial Demand in Metro and Westside



3.2.2 Groundwater Recharge

Groundwater recharge opportunities may exist in the future in the LA Forebay, located in proximity to the Metro LA Central region. In Task 4.1.3 Regional Groundwater Characterization TM, long-term (over 10 years) opportunities are identified to develop GWR in the Los Angeles Forebay for subsequent recovery and delivery for potable water use through LADWP pumping under a water augmentation program. These opportunities are identified as 27 to 35 mgd (30,000 to 40,000 AFY).

3.2.3 Satellite Facility Recycled Water Source

Since the plant in the Hollywood region and one of the plants in the LA Central region would be sewer-fed and the other LA Central Plant would be river-fed, flow data was collected for both sewer flows and river flows in these areas per Section 2.

3.2.4 Preliminary Satellite Plant Sizing

The location and size of demands in the Metro area were matched with an available source of water to be recycled, in order to identify suitable regions for a satellite recycling facility. The demands were used to determine the required capacity of the satellite plant and the available source was used to determine the train of treatment processes needed at the plant.

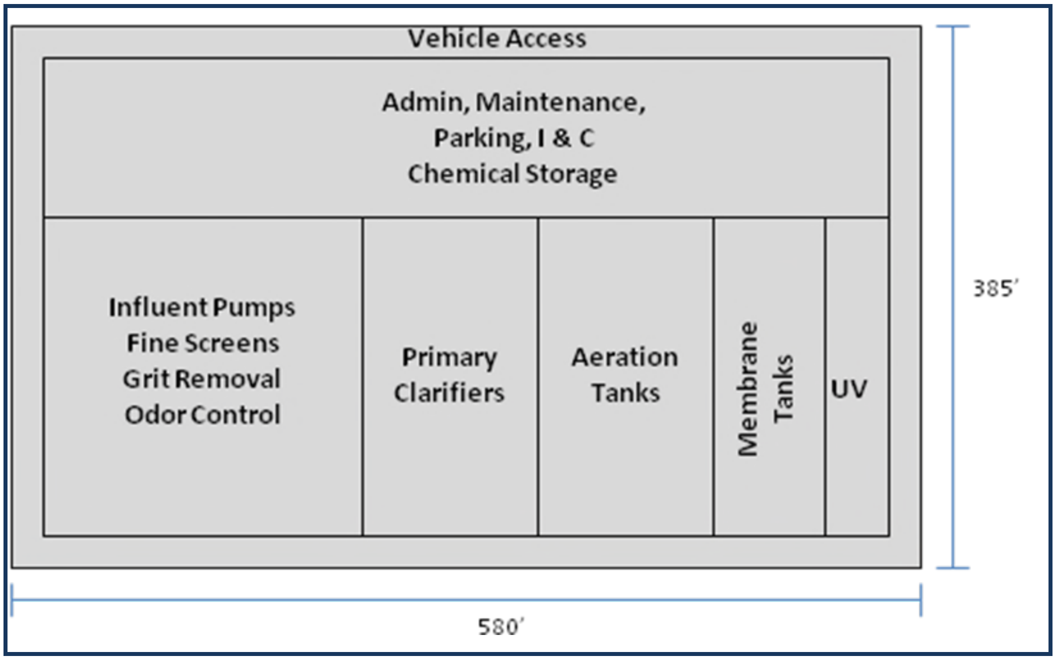
There are two regions in the Metro area that are suitable for a satellite recycling facility: 1) LA Central, and 2) Hollywood. The LA Central region would be served by either dry weather runoff from the LA River or raw wastewater. The Hollywood region would be served by raw wastewater. The preliminary sizing of satellite recycling facilities that can serve the needs of these regions is discussed below.

<u>LA Central – Raw Wastewater Source</u>

A satellite recycling facility in the LA Central region would have to meet an average demand of 5.25mgd and a peak demand of 10.5mgd of Title 22 disinfected tertiary recycled water (see Section 3.1.1 for information regarding Title 22 regulations). If raw wastewater was used as the source water for the recycling facility, the preferred treatment train for the recycling facility would be an MBR/UV train, as discussed section 3.1.2. The MBR/UV train consists of screening and grit removal at the headworks, followed by primary sedimentation, a membrane bioreactor process, and UV disinfection.

The preliminary size of a satellite recycling facility that could serve the needs of the LA Central region, using raw wastewater as a source, was determined based on the design criteria and assumptions discussed in Section 3.1.2. The total area needed for this type of facility was determined to be approximately 5.1 acres. A schematic of the layout of the plant is included in Figure 3-7.

Figure 3-7: Layout of LA Central Raw Wastewater Plant (total footprint of 5.1 acres)

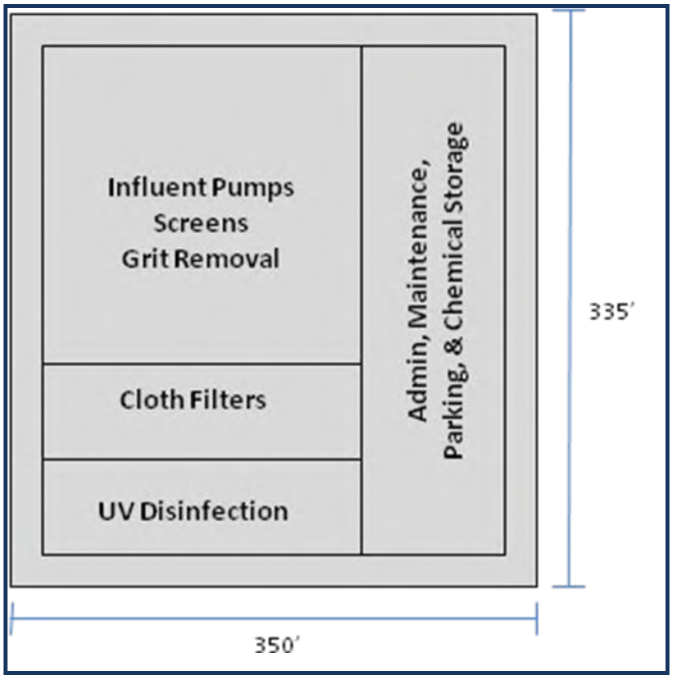


LA Central – Dry Weather Runoff Source

If dry weather runoff was used as the source water for the recycling facility, the preferred treatment train for the facility would consist of screening and grit removal at the headworks, followed by filtration with cloth filters, and UV disinfection (see Section 3.2.2).

The preliminary size of a satellite recycling facility that could serve the needs of the LA Central region, using dry weather runoff as a source, was determined based on the design criteria and assumptions discussed in Section 3.2.2. The total area needed for this type of facility was determined to be approximately 2.7 acres. A schematic of the layout of the plant is included in Figure 3-8.

Figure 3-8: Layout of LA Central Dry Weather Runoff Plant (total footprint of 2.7 acres)

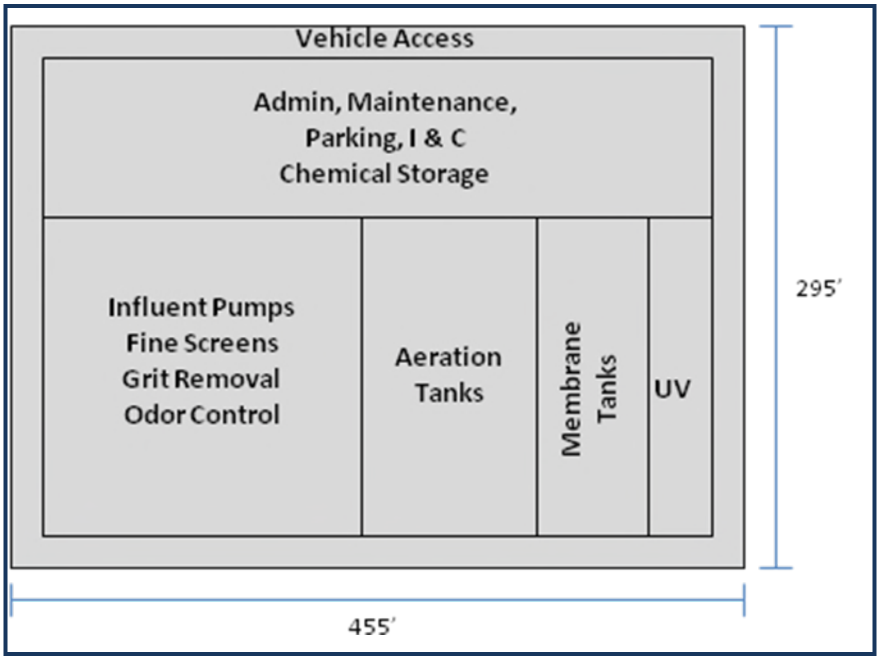


Hollywood

A satellite recycling facility in the Hollywood region would have to treat raw wastewater to meet an average demand of 1.4mgd and a peak demand of 2.8 mgd of Title 22 disinfected tertiary recycled water (see Section 3.1.1 for information regarding Title 22 regulations). As discussed in Section 3.1.2, the preferred treatment train to produce disinfected tertiary recycled water from raw wastewater is an MBR/UV train consisting of screening and grit removal at the headworks, followed by primary sedimentation, a membrane bioreactor process, and UV disinfection.

The preliminary size of a satellite recycling facility that could serve the needs of the Hollywood region was determined based on the design criteria and assumptions discussed in Section 3.1.2. The total area needed for this type of facility was determined to be approximately 3.1 acres. A schematic of the layout of the plant is included in Figure 3-9.

Figure 3-9: Layout of Hollywood Raw Wastewater Plant (total footprint of 3.1 acres)



3.2.5 Potential Satellite Locations

Regional Plant

As discussed in Section 3.2.5, two sources could be used in LA Central, specifically raw wastewater and dry weather runoff from the LA River. For the purposes of this TM, two different plants were evaluated: one using raw wastewater and one using LA River flows. These were selected as options for comparison purposes. If this option is selected, further evaluation is needed to determine the exact source or combination of sources for the plant.

The raw wastewater-fed plant would have a footprint of 5.1 acres, while the LA River-fed plant would have a footprint of 2.7 acres. Therefore, sites will be identified that have a minimum area of 5.1 acres.

The site identification process for LA Central yielded 11 possible sites. After applying the threshold screening measures discussed in Section 2, this long list of sites was reduced to a short list of 10 candidate sites, which are highlighted in Table 3-7 and shown in Figure 3-10.

In addition, there is potential long-term planning for a 50 mgd treatment plant to take advantage of groundwater recharge opportunities in the LA Forebay. This 50 mgd plant would likely require at least 30 acres of land. A preliminary screening based on the methodology described above was used to select 30 acre sites in the LA Central region. Sites listed in Table 3-7 that are greater than 30 acres could be used. However, all of these sites are parks and, therefore, potentially difficult to permit.

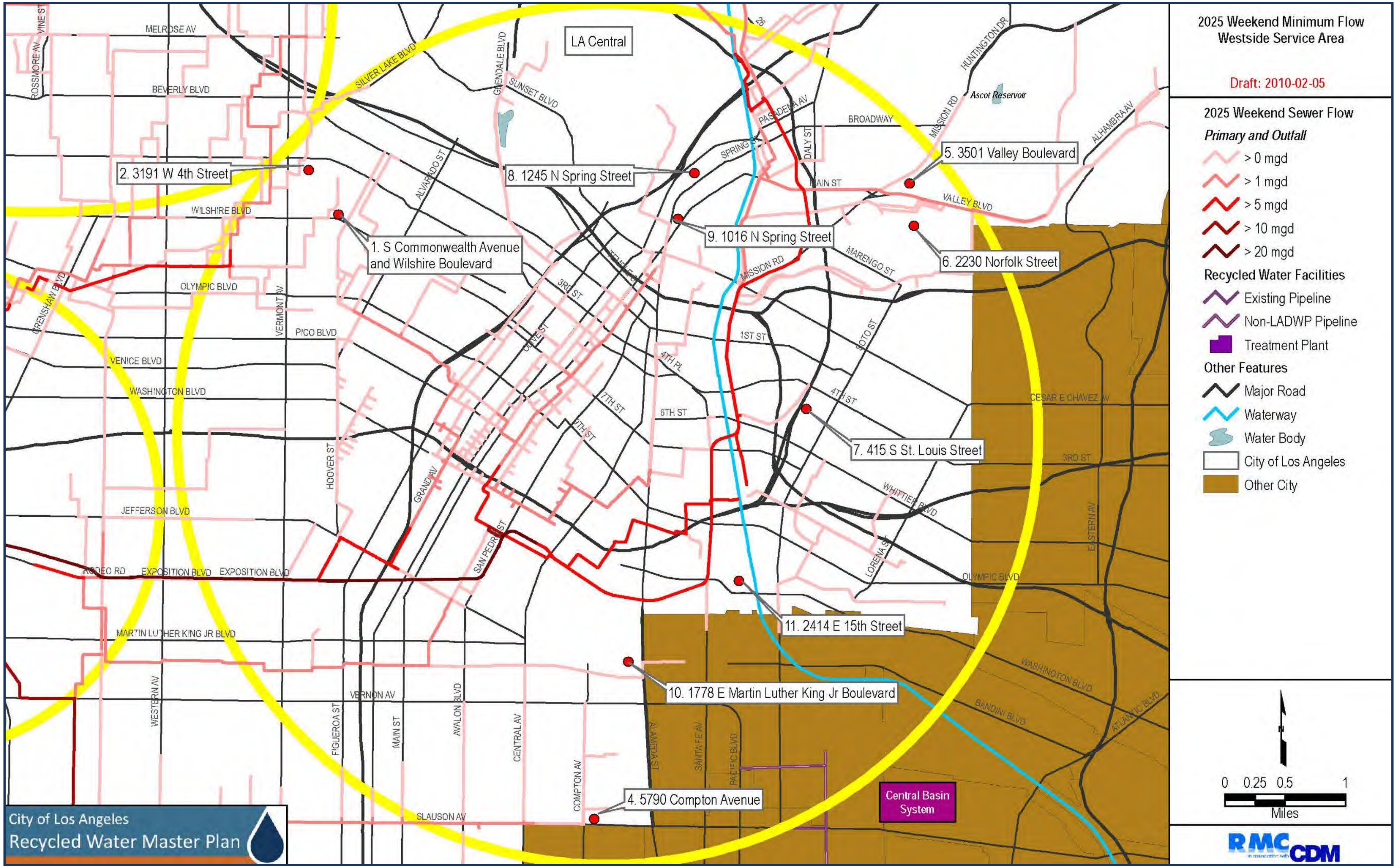
Table 3-7: Potential Satellite Plant Sites in the LA Central Region

Site No.	Address	Description	Zoning Classification[a]	Adjacent to Residential[b]	Size (acres)[c]	Possible Site[d]	City-Owned	Elevation (ft)	Advantages	Disadvantages	Distance From Sewer (mi)	Flow in Sewer Min;Average (mgd)[e]	Distance From LA River (mi)
1	South Commonwealth Avenue and Wilshire Boulevard	Lafayette Park	Open Space	N	9.6	Y	Y	240	Easy to access on Wilshire Boulevard.	Several existing structures.	1.5	>20;>20	3.3
2	3191 West 4th Street	Shatto Recreation Center	Parking	N	5.7	Y	Y	250	Easy access off of Vermont Avenue.	Existing Recreation Center. Several existing structures.	1.6	>20;>20	3.6
3	2230 West 6th Street	MacArthur Park	Open Space	Y	31.7	N	Y	260	Lots of open space. Easy access on 6th Street.	Existing lake nearby.	1.3	>20;>20	2.8
4	5790 Compton Avenue	Augustus F. Hawkins Natural Park	Industrial	N	8.5	Y	Y	180	Easy access on East Slauson Avenue.	Landscaped park with trails.	0.9	10-20;>20	2.1
5	3501 Valley Boulevard	Lincoln Park	Open Space	N	44.5	Y	Y	350	Easy access on Valley Boulevard.	Park with water body, structures, facilities.	0.5	10-20;>20	1.3
6	2230 Norfolk Street	Hazard Park	Open Space/Public Facilities	N	30.0	Y	Y	370	Lots of open space. Easy access on N Soto Street.	Park with vacant areas.	0.4	10-20;>20	1.4
7	415 South St. Louis Street	Hollenbeck Park	Open Space/Public Facilities	N	20.0	Y	Y	280	Easy access off of I-5.	Park with water body covering large area.	0.3	10-20;>20	0.6
8	1245 North Spring Street	Los Angeles State Historic Park	Industrial	N	31.3	Y	N	300	Easy access on N Alameda Street.	State Park.	0.3	10-20;>20	0.5
9	1016 North Spring Street	Empty Lot	Industrial	N	5.8	Y	N	300	Easy access on N Alameda Street. Undeveloped site.	Across the street from state park.	0.3	10-20;>20	0.5
10	1778 East Martin Luther King Blvd	Empty Lot	Industrial	N	14	Y	Y	210	Empty Lot. Easy access on Long Beach Avenue and Alameda Street.	Former Site of LANCER Project	0.3	10-20;>20	1.1
11	2414 East 15th Street	Empty Lot	Unknown	N	15.8	Y	Y	230	Empty Lot. Easy access on Washington Boulevard.	Might be slated for a future project.	0.2	10-20;>20	0.2

Footnotes:

a. Parcel cannot be zoned as Residential.
b. X: Parcel is adjacent to Residential area on two or more sides. O: Parcel is adjacent to Residential area on less than two sides.
c. Parcel area must be greater than 5.1 acres.
d. Y: Parcel passes 3 threshold screening criteria. N: Parcel fails one of the 3 threshold screening criteria.
e. River must have a minimum flow of 10.2 mgd.

Figure 3-10: Candidate Satellite Plant Sites in the LA Central Region



The Hollywood Regional Plant would have raw wastewater for source water. The peak demand for water in this area is approximately 2.8 mgd, which results in a satellite plant size of 3.1 acres.

The site identification process for Hollywood yielded 6 possible sites. After applying the threshold screening measures discussed in Section 2, this long list of sites was reduced to a short list of 2 candidate sites, which are highlighted in Table 3-8 and shown in Figure 3-11.

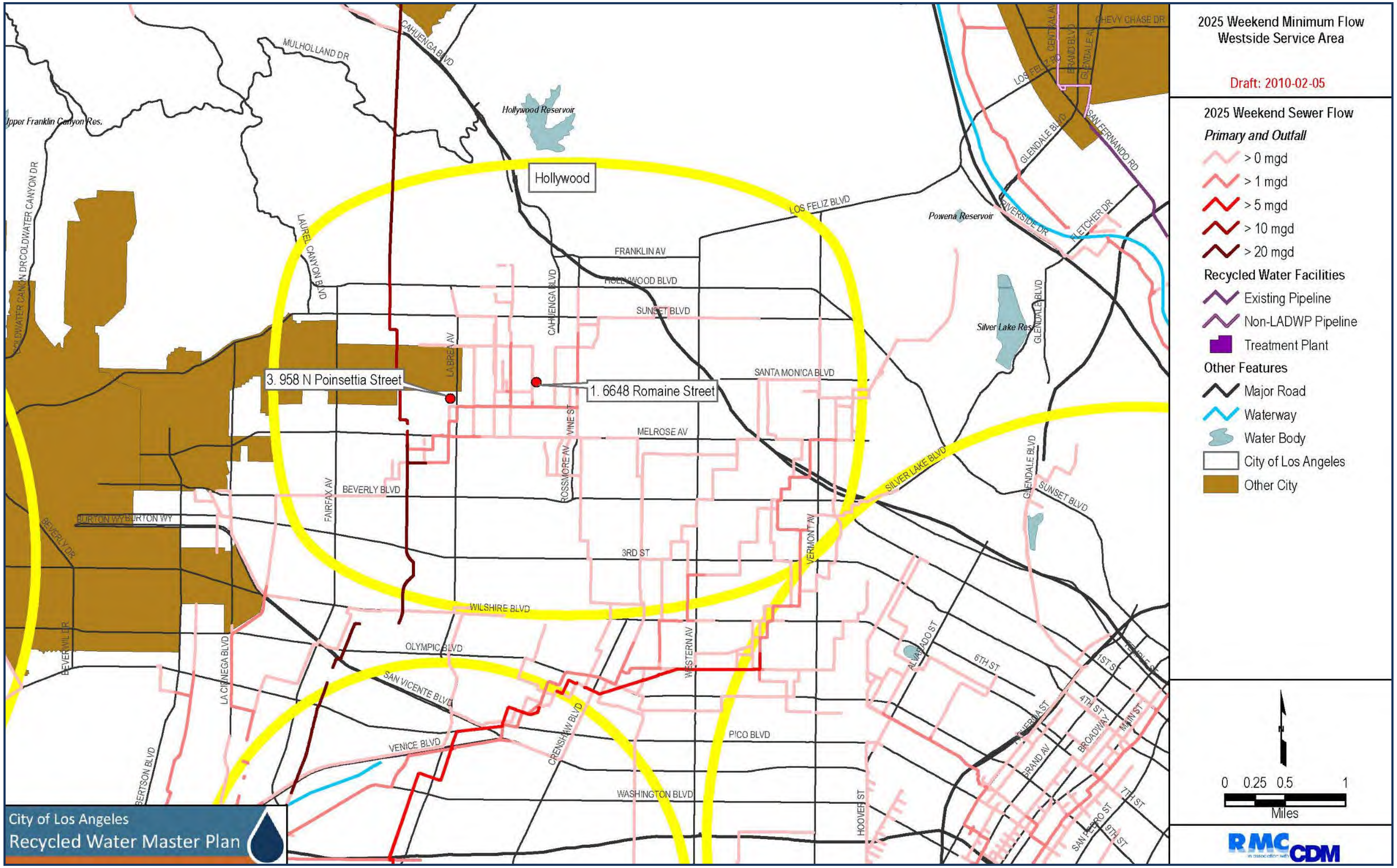
Table 3-8: Potential Satellite Plant Sites in the Hollywood Region

Site No.	Address	Description	Zoning Classification[a]	Adjacent to Residential[b]	Size (acres)[c]	Possible Site[d]	City-Owned	Elevation (ft)	Advantages	Disadvantages	Distance From LA River (mi)	Flow in River Min;Average (mgd)[e]
1	6648 Romaine Street	Bureau of Street Maintenance (?)	Public Facilities/Industrial (?)	N	3.7	Y	N (?)	292	Empty Lot.	Access on 1-lane roads.	0.55	>20;>20
2	7341 Willoughby Avenue	Poinsettia Recreation Center	Open Space	Y	4.6	N	Y	267	Close to sewer. Sorrounded by residential areas.	Park. Access on 1-lane roads.	0.30	>20;>20
3	958 N Poinsettia Place	DWP Receiving Station (Electricity)	Public Facilities	N	6.5	Y	Y	269	Zoned as Public Facilities.	Existing towers. Access on 1-lane roads.	0.40	>20;>20
4	7600 Beverly Boulevard	Pan Pacific Park	Open Space	Y	30.7	N	Y	196	Easy to access on Beverly Boulevard.	Park with facilities. Neighboring households.	0.10	>20;>20
5	4959 Lemon Grove Avenue	Lemon Grove Recreation Center	Open Space	Y	4.1	N	Y	317	No existing structures.	Park with tennis courts and baseball diamonds. Next to residential.	0.50	5-10;10-20
6	4590 Santa Monica Boulevard	Construction Yard for Street Lighting Department	Public Facilities	Y	3.9	N	Y	329	Zoned as Public Facilities. Easy to access on Santa Monica Boulevard.	Street Lighting Department building would need to be removed or split processes on both sides.	1.20	5-10;10-20

Footnotes:

f. Parcel cannot be zoned as Residential.
g. X: Parcel is adjacent to Residential area on two or more sides. O: Parcel is adjacent to Residential area on less than two sides.
h. Parcel area must be greater than 3.1 acres.
i. Y: Parcel passes 3 threshold screening criteria. N: Parcel fails one of the 3 threshold screening criteria.
j. River must have a minimum flow of 2.4 mgd

Figure 3-11: Candidate Satellite Plant Sites in the Hollywood Region



Small Scale

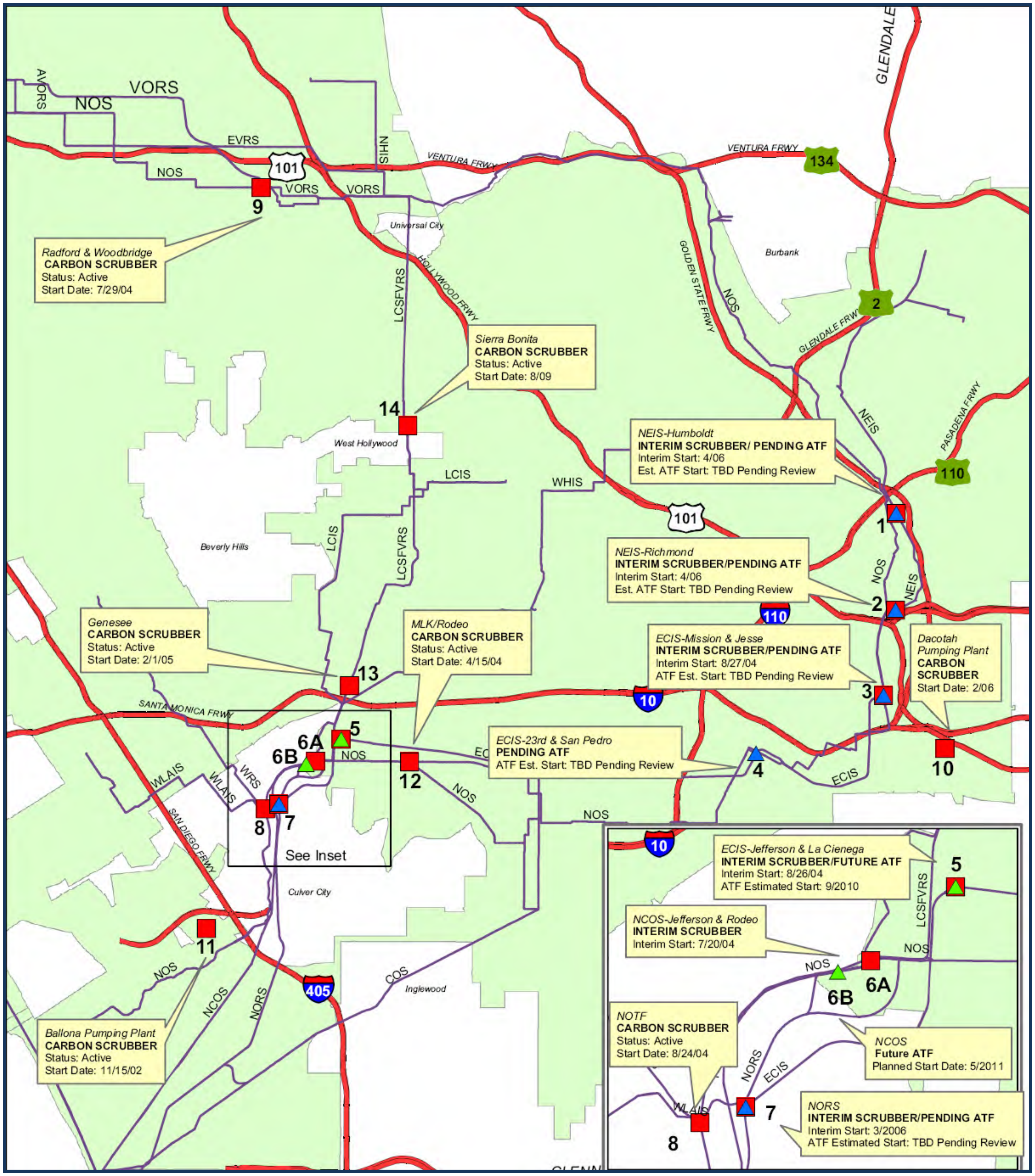
USC

Task 5.1.6 USC Exposition Park Satellite Customer Assessment TM investigated the option of locating a satellite treatment plant adjacent to the University of Southern California (USC) and Exposition Park in South Los Angeles. The University Park Campus (UPC) at USC, which is located south of Downtown LA, uses 40 AFY of water for irrigation and landscaping and another 100 AFY for air conditioning with cooling towers. Exposition Park uses 70 AFY for irrigation and 50 AFY for cooling towers with regards to non-potable water. This equates to a combined demand of 260 AFY or 0.45 mgd. The TM then investigated potential sources for a recycled water treatment system by identifying the flows of nearby major outfalls. If this satellite plant is constructed then the peak flow available for the whole of the LA Central area would be reduced from 10.2 mgd to 9.75 mgd, which would also reduce the size required for the regional plant (based on sewer flows) from 7 acres to 6.5 acres.

ATFs

The City of LA is constructing Air Treatment Facilities (ATFs) to control and mitigate odors from the interceptor sewers in the wastewater collection system. There are two ATFs in construction to control current odor problems on the downstream end of the East Central Interceptor Sewer (ECIS). At these points, several large sewers converge and create excessive sewer gas pressure. These ATFs are shown as green triangles (Numbers 5 and 6b) in Figure 3-12. Five additional ATFs to address anticipated odor problems based on predictive modeling of the ECIS and Northeast Interceptor Sewer (NEIS) are pending construction. These facilities are shown as blue triangles in Figure 3-12.

Figure 3-12: Location of Air Treatment Facilities in Los Angeles



Footnotes:

f. The green triangles represent ATFs that are in construction
g. The blue triangles represent future ATFs
h. The red boxes show existing scrubber facilities

The ATF site numbers located in the Metro area in Figure 3-12 are identified in Table 3-9. The last 3 ATFs are identified in Section 3.3 with the Westside area.

Table 3-9: ATF Sites from Figure 3-12

No.	Name	Type	Completion Date	Size (cfm)	Cost ($M)
1	NEIS-Humboldt	Pending ATF		13,260	11.0
2	NEIS-Richmond	Pending ATF		8,600	10.0
3	ECIS-Mission & Jesse	Pending ATF		12,000	10.0
4	ECIS-23rd & Rancho Park	Pending ATF		13,900	12.0

The future and pending ATFs are currently designed to use potable water (with the addition of fertilizer) for media cassette irrigation. The fertilizer is provided by Bioway in a powder form that is added to 40 L of potable water in a nutrient tank. The new BTF units will have seven spray nozzles with continuous irrigation. The flow required is an average of 3,000 gpd per vessel.

To conserve water resources, the possibility of using treated wastewater to irrigate the BTFs is being explored. The wastewater water quality is assumed to be approximately similar to the influent wastewater to the Donald C. Tillman Water Reclamation Plant (DCT). DCT has influent BOD and TSS concentrations of approximately 350 ppm and 300 ppm, respectively. From discussions with the Matala media manufacturers, a Biochemical Oxygen Demand (BOD) of 200 ppm would need to be achieved in the wastewater to keep the filters from clogging. Additionally, based on experience with similar applications, 60% removal of TSS will need to be achieved, or 120 ppm of TSS in the treated effluent.

A summary of the treatment objectives is presented in Table 3-10.

Table 3-10: Treatment Objectives for ATF Irrigation Water Treatment System

Parameter	Influent	Effluent
Flow	15,000 gpd continuous	
BOD	350 ppm	300 ppm
TSS	300 ppm	120 ppm

From speaking with manufacturers and vendors from the City of LA area, there are three different kinds of systems for meeting the treatment objectives presented in Table 3-10.

- Cartridge Filter System
- Sequencing Batch Reactors (SBR)
- Membrane Bioreactor (MBR)

Detailed information on each treatment system is provided in Attachment A.

A summary of the different treatment systems required for the ATF irrigation water is presented in Table 3-11.

Table 3-11: Summary of ATF Treatment Alternatives

Treatment Alternative	Approximate Footprint (sq ft)	Approximate Capital Cost	Advantages and Disadvantages
Cartridge Filter		$50,000	May not remove enough BOD; May clog often requiring replacement
SBR	200	$200,000	Large footprint More O&M than cartridge filters
MBR	175	$650,000	Most costly, could use for Title 22 irrigation of pocket parks Most O&M

There are ongoing pilot studies with ATF media at HTP. While limited testing has been completed on primary and secondary effluent, most of the testing has been on potable water because that is the current source for irrigation water in the design. If these options are pursued for treatment, it is recommended that additional pilot testing be completed to evaluate performance and operation and maintenance requirements.

3.2.6 Cost Estimate

Cost summaries for the LA Central raw water recycling facility, LA Central dry weather runoff recycling facility, and the Hollywood recycling facility are included in Table 3-12, Table 3-13, and Table 3-14, respectively. The total construction cost, annual operation and maintenance (O&M) costs, present worth, and annualized cost per acre foot of recycled water are provided for each plant. A discussion of how the costs were developed is included below.

Table 3-12: LA Central Raw Wastewater Plant Cost Summary

Description	Amount
Source	Sewer
Flow	5.4 mgd (avg); 10.8 mgd (peak)
Yield	6,000 AFY
Area	5.1 acres
Total Construction Costs	$61,900,000
Annual O&M Costs	$2,800,000
Total Annualized Cost	$5,700,000
Total Unit Cost, annualized	$940/AFY

Table 3-13: LA Central Dry Weather Runoff Plant Cost Summary

Description	Amount
Source	Dry weather runoff
Flow	5.4 mgd (avg); 10.8 mgd (peak)
Yield	6,000 AFY
Area	2.7 acres
Total Construction Costs	$23,900,000
Annual O&M Costs	$2,600,000
Total Annualized Cost	$3,700,000
Total Unit Cost, annualized	$610/AFY

Table 3-14: Hollywood Raw Wastewater Plant Cost Summary

Description	Amount
Source	Sewer
Flow	1.2 mgd (avg); 2.4 mgd (peak)
Yield	1,400 AFY
Area	3.1 acres
Total Construction Costs	$24,300,000
Annual O&M Costs	$800,000
Total Annualized Cost	$1,900,000
Total Unit Cost, annualized	$1,410/AFY

3.3 Westside

3.3.1 General Overview

The Westside area for the purposes of this TM is defined as the City of LA from the western boundary of Beverly Hills to the eastern boundary of the City of Santa Monica, to Culver City to the south and the Santa Monica Mountains to the North. It is largely residential with some industrial and commercial areas.

3.3.2 Identification of Non-Potable Reuse Regions

Task 2 identified potential industrial and irrigation demands in the Westside area of Los Angeles. Within the Westside area there are two regions of high demand, the Rancho Park Region and NOTF Region. The Rancho Park region has an average demand of 2.7 mgd and a peak demand of 5.4 mgd. The major outfall sewers within or adjacent to this area are the West Los Angeles Interceptor Sewer (WLAIS) and the Westwood Relief Sewer (WRS). The second area of demand, the NOTF region, has an average demand of 0.6 mgd and a peak demand of 1.2 mgd.

The demands are shown in Table 3-15 and Figure 3-6.

Table 3-15: Westside Tier 2 Recycled Water Demands[a]

Area	Type of Demand	Average AFY	Average MGD	Peak MGD
Westside - NOTF	Irrigation	423	0.38	0.8
Westside - NOTF	Mixed[b]	147	0.13	0.4
			TOTAL	1.2
Westside - Rancho Park	Irrigation	2067	1.85	3.70
Westside - Rancho Park	Mixed	925	0.83	1.66
			TOTAL	5.4
Small Scale				
Air Treatment Facilities (3)	Industrial	25.2	0.022	0.022[c]
UCLA	Mixed			0.5

Footnotes:

a. Source: Task 2 Tier 2 Customer Database
b. Mixed demand includes industrial and commercial uses.
c. ATF demand is assumed to be constant

3.3.3 Groundwater Recharge

There are no groundwater recharge opportunities defined for the Westside area that need to be defined as a satellite plant as those would be served by HTP.

3.3.4 Satellite Facility Recycled Water Source

The satellite plant in the Rancho Park Region would be a sewer-fed plant and the satellite plant in the NOTF Region would be fed by the flows in Ballona Creek. It was necessary to collect flow data for both the sewer and Ballona Creek.

Ballona Creek TMDL Implementation Plans and the North Outfall Treatment Facility (NOTF)

Portions of an existing site and treatment facility, the North Outfall Treatment Facility (NOTF) are slated to be used as part of the TMDL Implementation Plan for Ballona Creek. The intention of the plan is to provide a portion of the flow from Ballona Creek for reuse. In addition, a portion of the treated flow will be returned to Ballona Creek to meet TMDL concentration limits. The following is a description of the TMDL Implementation Plan and the NOTF facility. Note that for the reuse portion, the treatment process will be modified from the description of the implementation plan. The specific NOTF treatment process for reuse is described in Section 3.3.5.

In November 2009, the Draft Total Maximum Daily Load for Bacterial Indicator Densities in Ballona Creek, Ballona Estuary, and Sepulveda Channel Implementation Plan was completed. Another report, the Draft Ballona Creek Metals TMDL Implementation Plan was submitted on January 11, 2010. Both of these reports call for the construction of several different projects to meet the requirements of these TMDLs. Included are two dry-weather low flow treatment facilities (LFTFs) that are recommended to help meet TMDLs in all reaches of Ballona Creek during dry-weather conditions. Of the two LFTFs, LFTF-1 will be investigated for the satellite treatment plant analysis because it involves using an existing treatment plant to treat the dry weather runoff. Specifically, LFTF-1 involves upgrading the existing North Outfall Treatment Facility (NOTF) to treat dry weather runoff.

The NOTF was originally constructed to help with the overburdening of the North Outfall Sewer (NOS), by containing and/or treating sewer overflows. Prior to the NOTF, sewage overflows were manually chlorinated and discharged directly to Ballona Creek. After the construction of relief sewers, the NOTF no longer is needed for its original use and is not currently in operation.

In order to convert the NOTF from a facility that treats sewer overflows to a facility that treats Ballona Creek dry-weather flow, additional facilities would need to be constructed near the NOTF. Table 2 presents the key information about the NOTF facility. In 1996, a comprehensive study was done on upgrading the facility to treat dry weather runoff.

Figure 3-13 is an aerial view of the NOTF site.

Figure 3-13: NOTF Site

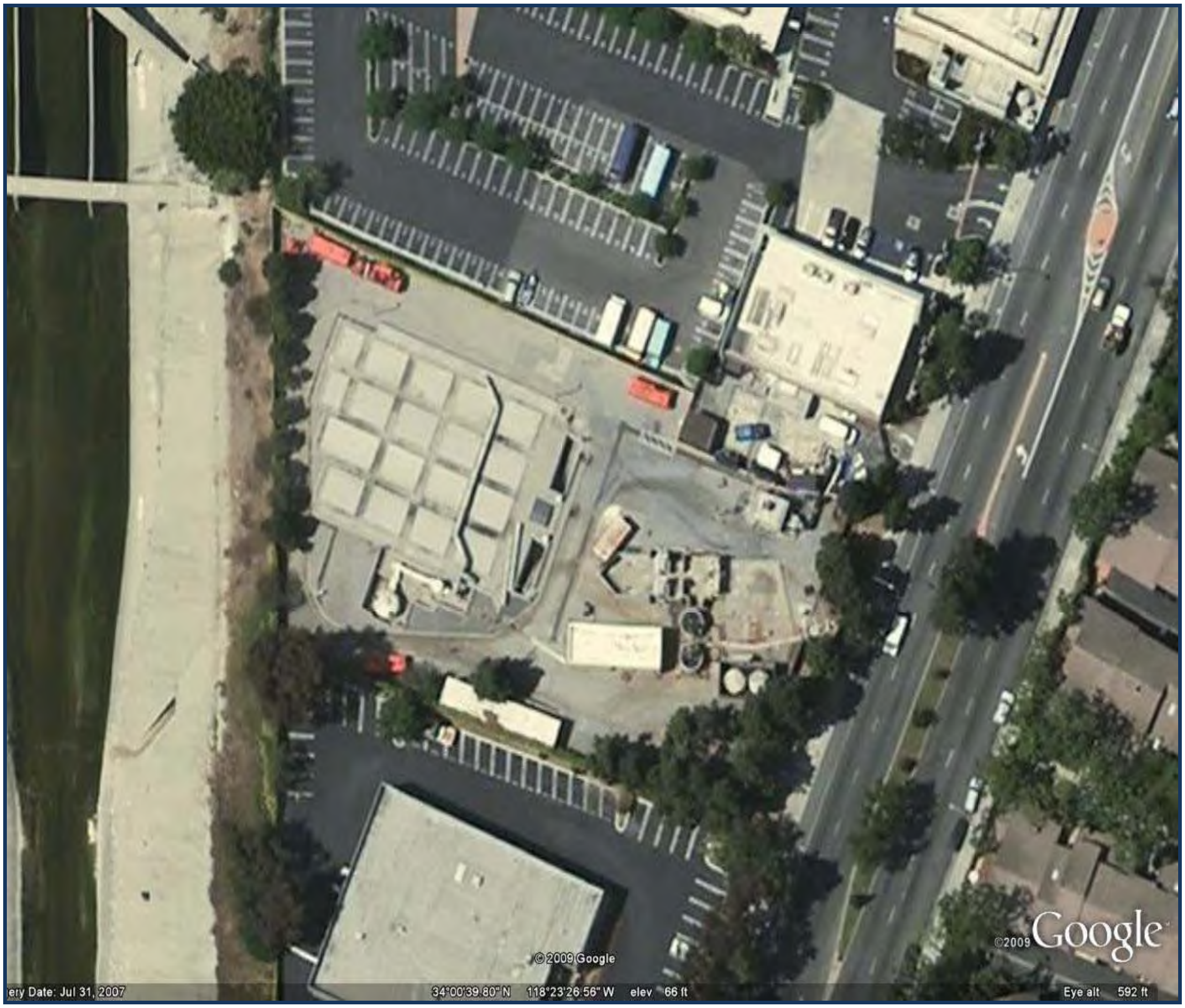


Table 3-17: NOTF Key Information

Parameter	Description
Site Size	1.6 acres
Site Address	10201 West Jefferson Boulevard, Culver City
Site Perimeter	10 ft high, 6 inch block wall with landscaped strips along property line at Jefferson Boulevard and Ballona Creek
Office Building	700 sq ft of office space, restrooms, and showers
Maintenance Building	720 sq ft of work space, control room, plant electrical panels, motor control center, air compressor, sodium hypochlorite metering pumps, and restrooms
Capacity	100 mgd storage
Facilities	holding tank, raw wastewater screening, disinfection

The proposed LFTF-1 would consist of upgrading the NOTF and installing a diversion structure to capture 100% of the dry weather flows in the Ballona Creek at the diversion point adjacent to the NOTF. For the Bacteria TMDL Implementation Plan, the flow was calculated to be approximately 15.9 cfs (10 mgd), after the assumed 16 percent reduction in upstream flow due to the implementation of institutional and structural BMPs.

The Bacteria TMDL Implementation Plan and the Metals TMDL Implementation Plan require additional facilities to be added to the NOTF in order to remove metals and bacteria before the effluent is discharged back into Ballona Creek. The facilities that are required include a diversion structure, pump stations and conveyances, a filtration system (to remove metals), and an ultraviolet disinfection system (to treat bacteria).

One option for the LFTF-1 described in both Implementation Plans suggests returning at least 7 cfs (4.5 mgd) to Ballona Creek and using the rest (8.9 cfs or 5.8 mgd) for Title 22 reuse, which is more than the demand in the region around the NOTF. This option would require the additional upgrade of facilities to meet Title 22 reuse standards. This would satisfy both of the requirements of the TMDLs as well as function as a satellite plant providing Title 22 water.

For modifications to the NOTF, it is important to consider the existing processes and layout. The site is large enough for a recycled water plant to meet the demands. However, some of the current basins are reserved for dry weather treatment for TMDLs. Therefore, the entire site will need coordination and planning.

3.3.5 Preliminary Plant Satellite Plant Sizing

The location and size of demands in the Westside area were matched with an available source of water to be recycled, in order to identify suitable regions for a satellite recycling facility. The demands were used to determine the required capacity of the satellite plant and the available source was used to determine the train of treatment processes needed at the plant.

There are two regions in the Westside area that are suitable for a satellite recycling facility: 1) Rancho Park, and 2) NOTF. The Rancho Park region would be served by raw wastewater. The

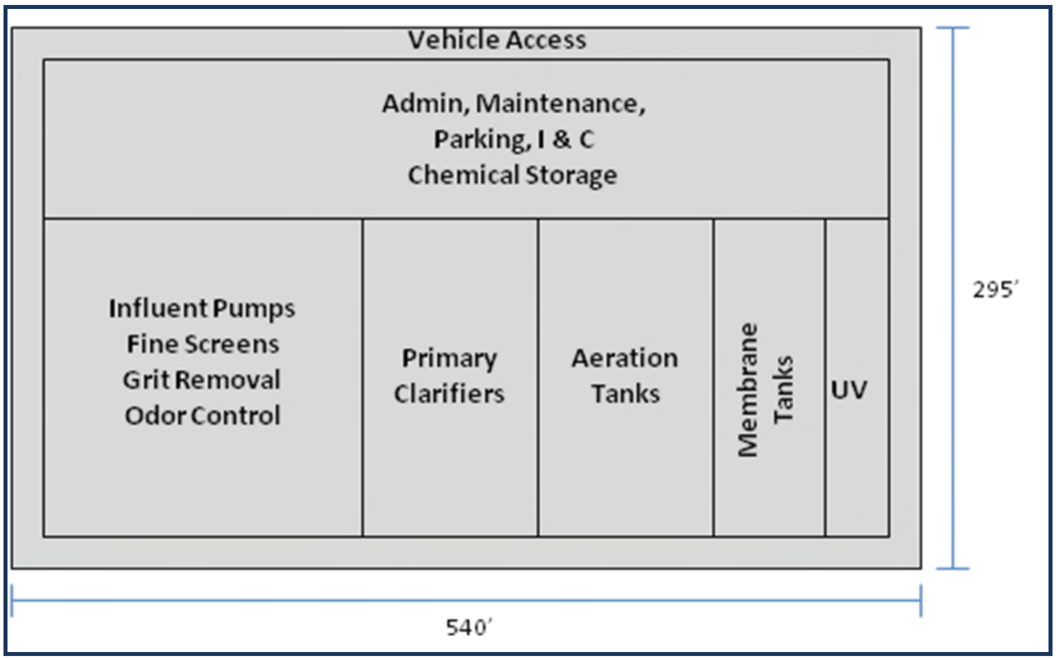
NOTF region would be served by dry weather runoff from Ballona Creek. The preliminary sizing of satellite recycling facilities that can serve the needs of these regions is discussed below.

Rancho Park

A satellite recycling facility in the Rancho Park region would have to treat raw wastewater to meet an average demand of 2.65mgd and a peak demand of 5.3 mgd of Title 22 disinfected tertiary recycled water. As discussed in Section 2 the preferred treatment train to produce disinfected tertiary recycled water from raw wastewater is an MBR/UV train consisting of screening and grit removal at the headworks, followed by primary sedimentation, a membrane bioreactor process, and UV disinfection.

The preliminary size of a satellite recycling facility that could serve the needs of the Rancho Park region was determined based on the design criteria and assumptions discussed in Section 2. The total area needed for this type of facility was determined to be approximately 3.7 acres. A schematic of the layout of the plant is included in Figure 3-14.

Figure 3-14: Layout of Rancho Park Raw Wastewater Plant (total footprint of 3.7 acres)

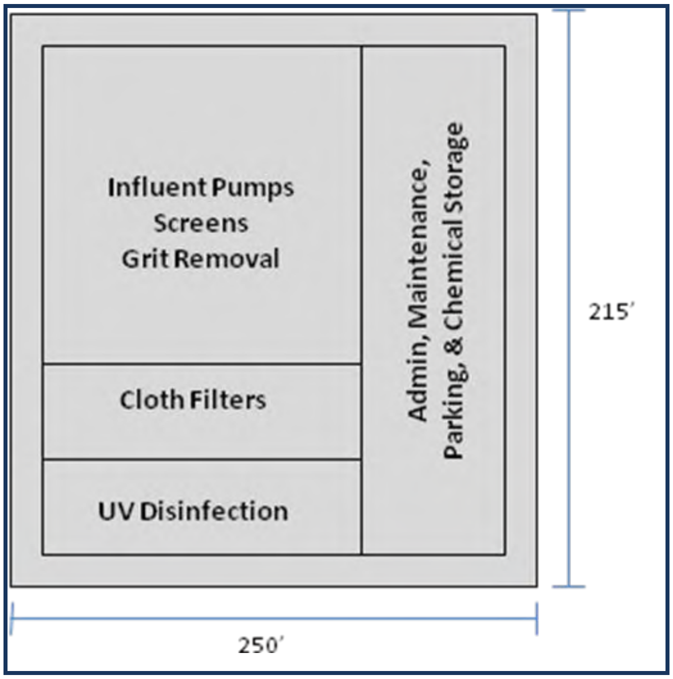


NOTF

A satellite recycling facility in the NOTF region would have to treat dry weather urban runoff from the Ballona Creek to meet an average demand of 0.5 mgd and a peak demand of 1.0 mgd of Title 22 disinfected tertiary recycled water. As discussed in Section 2, the preferred treatment train to produce disinfected tertiary recycled water from dry weather urban runoff consists of screening and grit removal at the headworks, followed by filtration with cloth filters, and UV disinfection.

The preliminary size of a satellite recycling facility that could serve the needs of the NOTF region was determined based on the design criteria and assumptions discussed in Section 2. The total area needed for this type of facility was determined to be approximately 1.2 acres. A schematic of the layout of the plant is included in Figure 3-15.

Figure 3-15: Layout of NOTF Dry Weather Runoff Plant (total footprint of 1.2 acres)



3.3.6 Potential Satellite Locations

Regional Plant

The Rancho Park Regional Plant would have sewer flows for source water. The demand for Title 22 water in this area is approximately 5.4 mgd, which results in a plant satellite plant size of 3.7 acres.

The site identification process for the Rancho Park area yielded 24 possible sites. After applying the threshold screening measures discussed in Section 2, this long list of sites was reduced to a short list of 8 candidate sites, which are highlighted in Table 3-18 and shown in Figure 3-16.

Table 3-18: Potential Satellite Plant Sites in the Rancho Park Region

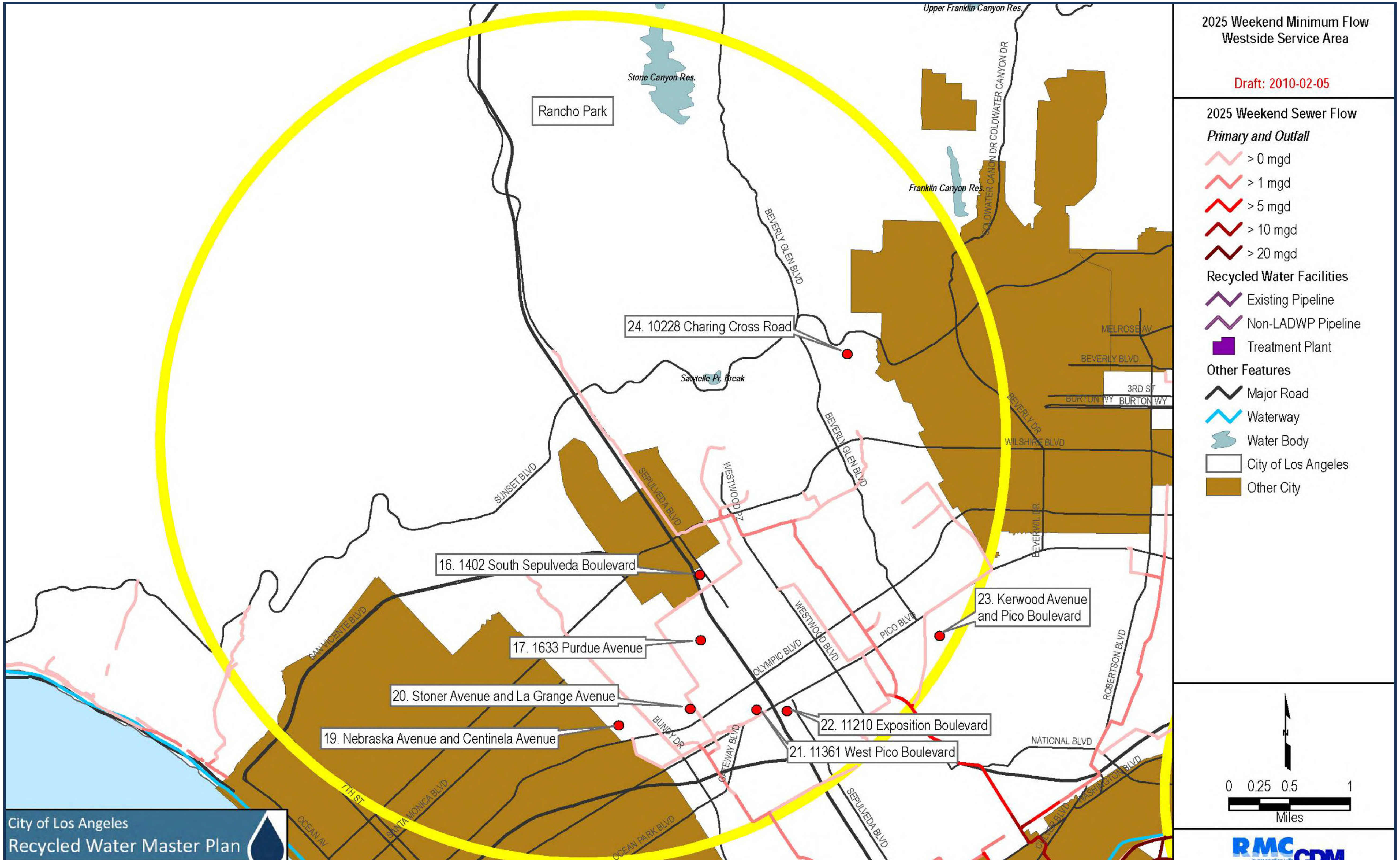
Site No.	Address	Description	Zoning Classification[a]	Adjacent to Residential[b]	Size (acres)[c]	Possible Site[d]	City-Owned	Elevation (ft)	Advantages	Disadvantages	Distance From LA River (mi)	Flow in River Min;Average (mgd)[e]
1	601 Latimer Road	Rustic Canyon Recreation Center	Open Space	Y	5.2	N	Y	155	Zoned as Open Space.	Park with tennis courts. Surrounded by residential areas.	1.75	10-20;>20
2	Marinetta Road and Oracle Place	Rivas Canyon Park	Residential, Open Space	N	80	N	Y	700	Open Space.	Park. Difficult to access because in the hills. Near households.	2.30	10-20;>20
3	2094 Sullivan Fire Road	Rustic Canyon Park	Open Space	N	50	N[f]	Y	600	Open Space without neighboring households.	Park. Access is difficult because site is in the hills.	2.60	10-20;>20
4	2096 Sullivan Fire Road	Sullivan Canyon Park	Residential	N	30	N	Y	685	Open Space without neighboring households.	Zoned as residential.	2.60	10-20;>20
5	2652 Westridge Road	Open Space	Residential	N	100	N	Y	1,350	Open Space.	Difficult to access because in the hills. Households nearby.	2.90	10-20;>20
6	North Kenter Avenue and Chalon Road	Open Space with Water Tank	Residential	N	4.8	N	Y	1,200	Open Space.	Difficult to access because in the hills. Zoned as residential.	2.65	10-20;>20
7	1040 North Kenter Ave	Crestwood Hills Park	Residential	Y	25	N	Y	650	Open Space.	Difficult to access because in the hills. Zoned as residential.	2.30	10-20;>20
8	1362 Linda Flora Drive	Open Space	Public Facilities	Y	5.6	N	Y	1,000	Open Space.	Difficult to access because in the hills. Nearby households.	2.30	10-20;>20
9	Stone Canyon Reservoir	Open Space	Open Space	N	>100	N[f]	Y	1,000	Lots of open space.	Difficult to access because in the hills. Nearby households.	2.50	10-20;>20
10	2414 North Beverly Glen Drive	Beverly Glen Park and Briarwood Park	Open Space, Residential	Y	110	N	Y	1,000	Lots of open space.	Park. Difficult to access because in the hills. Nearby households.	2.60	10-20;>20
11	1744 Benedict Canyon Drive	Open Space	Residential	Y	17.6	N	Y	830	Lots of open space.	Park. Difficult to access because in the hills. Nearby households.	2.15	10-20;>20
12	11456 West Sunset Boulevard	Unidentified Structure	Residential	Y	4	N	Y	500	Easy to access at I-405 and Sunset Boulevard.	Existing structure. Near households.	1.75	10-20;>20
13	338 S Barrington Avenue	Barrington Recreation Center	Residential, Open Space	N	8	N	Y	430	Zoned partially as Open Space.	Park with facilities. Access road has 1-lane. Nearby households.	1.55	10-20;>20
14	Beverly Glen Boulevard and Comstock Avenue	Holmby Park	Open Space	Y	11.5	N	Y	370	Lots of Open Space.	Park.	1.20	10-20;>20
15	1368 Veteran Avenue	Westwood Recreational Center/Westwood Park	Open Space, Residential	N	27.5	N	Y	280	Easy to access at I-405 and Wilshire Boulevard.	Park with facilities.	0.90	10-20;>20
16	1402 South Sepulveda	Westwood Recreational Center/Westwood Park	Open Space	N	11.2	Y	Y	280	Easy to access at I-405 and Wilshire Boulevard.	Park with baseball diamonds.	0.85	10-20;>20

Site No.	Address	Description	Zoning Classification[a]	Adjacent to Residential[b]	Size (acres)[c]	Possible Site[d]	City-Owned	Elevation (ft)	Advantages	Disadvantages	Distance From LA River (mi)	Flow in River Min;Average (mgd)[e]
	Boulevard											
17	1633 Purdue Avenue	Los Angeles County Superior Court	Public Facilities	N	7.2	Y	Y	230	Easy access off of Santa Monica Boulevard.	Supreme Court Building.	0.80	10-20;>20
18	Nebraska Avenue and Granville Avenue	Stoner Recreation Center	Open Space	Y	10.4	N	Y	180	Zoned as Open Space.	Park with facilities and Recreation Center. Difficult to access with only 1-lane roads.	0.80	10-20;>20
19	Nebraska Avenue and Centinela Avenue	VDI Multimedia	Industrial	N	15	Y	Y	160	Easy access off of Olympic Boulevard	Currently in use by industrial users.	1.05	10-20;>20
20	Stoner Avenue and La Grange Avenue	LA BOS Office with Trash Trucks	Public Facilities	N	4.5	Y	Y	170	Easy to access off of Olympic Boulevard	Used as staging area for trash trucks. Area is small. Next to industrial users.	0.80	10-20;>20
21	11361 West Pico Boulevard	Shelter Veterinary	Industrial	N	4.1	Y	Y	175	Easy to access on Pico Boulevard near I-405.	Existing structure that is in use.	0.55	10-20;>20
22	11210 Exposition Boulevard	Western Parking Enforcement Office	Public Facilities	N	5.4	Y	Y	165	Easy to access on Exposition Boulevard and South Sepulveda Boulevard.	Existing structure that is in use.	0.45	10-20;>20
23	Kerwood Avenue and Pico Boulevard	Rancho Park Golf Course/Chevroit Hills Recreation Center	Residential[f]	N	200	Y	Y	220	City-owned parcel. Lots of open space. Easy to access on Pico Boulevard. Public golf course.	Zoned as residential.	0.15	10-20;>20
24	10228 Charing Cross Road	Open Space	Agricultural	N	6.6	Y	N	410	Open Space.	Difficult to access because in the hills. Adjacent to the Playboy Mansion.	1.40	10-20;>20

Footnotes:

f. Parcel cannot be zoned as Residential.
g. X: Parcel is adjacent to Residential area on two or more sides. O: Parcel is adjacent to Residential area on less than two sides.
h. Parcel area must be greater than 3.7 acres.
i. Y: Parcel passes 3 threshold screening criteria. N: Parcel fails one of the 3 threshold screening criteria.
j. Need nearby sewer able to provide 5.4 mgd of influent water.
k. Pass threshold criteria but difficult access in the hills eliminates this site.

Figure 3-16: Candidate Satellite Plant Sites in the Rancho Park Region



Small Scale

UCLA

Similar to the USC/Exposition Park satellite treatment plant, another option is to locate a small-scale treatment plant at UCLA to serve non-potable demands. It is anticipated that the demand would be similar to that at USC/Exposition Park, approximately 0.5 MGD. The Task 2 team has already met with UCLA staff to discuss these demands and have identified a couple of locations, primarily in UCLA parking lots. If a facility is constructed, the peak flow available for a regional treatment plant in the UCLA area would be reduced from 5.4 mgd to 4.95 mgd and the size required for the regional plant would be reduced from 4 acres to approximately 3.5 acres.

ATFs

Options for ATFs were described in Section 3.2. In addition to the ATFs located in Central City, there are three ATF sites located in the Westside region. The ATF site numbers located in the Westside in Figure 3-12 are identified in Table 3-16.

Table 3-16: ATF Sites from Figure 3-12

No.	Name	Type	Completion Date	Size (cfm)	Cost ($M)
5	ECIS-Jefferson/La Cienega	Future ATF	9/30/2010	20,000	14.7
6B	NCOS-Jefferson & Rodeo	Future ATF	4/6/2011	12,000	16.0
7	NORS ECIS	Pending ATF		12,000	12.0

3.3.7 Cost Estimate

Cost summaries for the Rancho Park and NOTF satellite recycling facilities are included in Table 3-19 and Table 3-20, respectively. The total construction cost, annual operation and maintenance (O&M) costs, present worth, and annualized cost per acre foot of recycled water are provided for each plant. A discussion of how the costs were developed is included below.

Table 3-19: NOTF Raw Wastewater Plant Cost Summary

Description	Amount
Source	Dry weather runoff
Flow	0.6 mgd (avg); 1.2 mgd (peak)
Yield	600 AFY
Area	1.2 acres
Total Construction Costs	$4,100,000
Annual O&M Costs	$400,000
Total Annualized Cost	$600,000
Total Unit Cost, annualized	$950/AFY

Table 3-20: Rancho Park Raw Wastewater Plant Cost Summary

Description	Amount
Source	Sewer
Flow	2.7 mgd (avg); 5.4 mgd (peak)
Yield	3,000 AFY
Area	3.7 acres
Total Construction Costs	$36,700,000
Annual O&M Costs	$1,500,000
Total Annualized Cost	$3,200,000
Total Unit Cost, annualized	$1,070

4. Summary of Options

This section summarizes the satellite treatment project options developed in this TM. At this time, it addresses the Tier 2 demands identified by Task 2. Future opportunities identified under Task 4 have not been identified and are not part of this document. It is expected that the future integrated analysis to develop project alternatives will further refine the satellite options and their relationship with the options being developed under the other Tasks as part of this master plan.

In this TM, we looked at the demands identified by Task 2 and identified options to meet those demands using various satellite technologies and drawing from different recycled water sources. The satellite treatment process technologies assumed sewer flow or dry weather runoff. Additionally we looked at small scale options for specific demands, such as universities, in creating a showcase facility and demands such as the ATFs, where full Title 22 treatment was not required.

In each of the regions identified for satellite treatment project options, a number of potential locations were identified and pre-screened based on zoning and land use to determine the feasibility of locating at satellite treatment plant in that region. These locations will be further investigated and others may be identified as the integrated project alternatives are developed.

Table 4-1 below shows the summary of the project options including region, size, and costs. For this analysis, a 4% lifecycle interest rate was used with a 50 year lifecycle period.

Table 4-1: Satellite Reuse Project Options Summary

#	Location	Source	Area (acres)	Capacity (mgd) Average	Peak	Capital Cost ($M)	Annual O&M Cost ($M)	Annualized Cost ($M)	Yield (AFY)
1	San Fernando Valley - Southwest	dry weather runoff	2.2	2.6	5.2	$13.5	$1.3	$1.9	2,900
2	San Fernando Valley - Southeast	sewer	3.1	1.5	3.0	$26.0	$0.9	$2.1	1,700
3a	LA Central - Sewer Source	sewer	5.1	5.4	10.8	$61.9	$2.8	$5.7	6,000
3b	LA Central - Dry Weather Runoff Source	dry weather runoff	2.7	5.4	10.8	$23.9	$2.6	$3.7	6,000
4	Hollywood	sewer	3.1	1.2	2.4	$24.3	$0.8	$1.9	1,400
5	NOTF	dry weather runoff	1.2	0.6	1.2	$4.1	$0.4	$0.6	600
6	Rancho Park	sewer	3.7	2.7	5.4	$36.7	$1.5	$3.2	3,000

Appendices

Appendix A Air Treatment Facilities (ATFs) Description and Water Treatment Technologies

Appendix A Air Treatment Facilities (ATFs) Description and Water Treatment Technologies

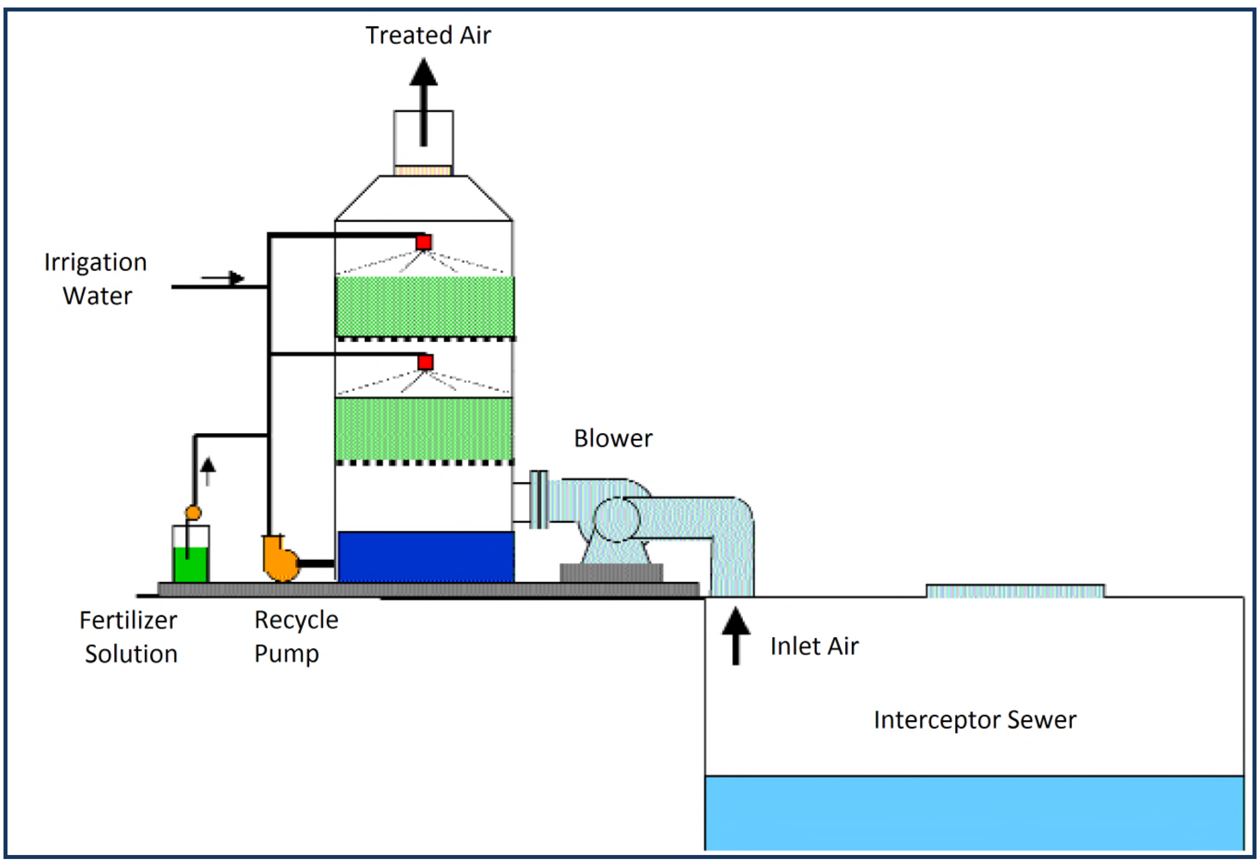
As discussed in the TM, there are two ATFs currently being constructed and five additional ATFs pending construction in the City of LA. This appendix will discuss the components of the ATFs and some wastewater treatment options that could be used to irrigate the ATFs.

The ATFs are designed to treat hydrogen sulfide (H_2S), other odorous compounds, and volatile organic compounds (VOCs). They have two stages:

- Biotrickling Filters (BTFs)
- Activated Carbon

BTFs are the first stage, primarily used for H_2S removal. They utilize a synthetic media, on which contaminant degrading bacteria grow, forming a biofilm on the surface. The synthetic media are arranged in layers referred to as cassettes. Inlet air is introduced by a fan through the bottom of the media cassettes, where the biofilm degrades odorous compounds. To keep the biofilms moist and biologically active, a continuous stream of water is supplied to the media cassettes via spray nozzles. The water used for this application is often mixed with a fertilizer solution in order to promote the growth of the biofilm. A graphical view a BTF system is shown in Figure 1.

Figure 1: Biotrickling Filter Schematic



The activated carbon is used for the second stage process to remove odorous compounds, VOCs, and any remaining H_2S.

The City has been pilot-testing the two-stage ATF treatment process at Hyperion for 10 years.

The BTF used for the pilots study is a Bioway Purspring™, manufactured by Bioway America, which uses a synthetic plastic media with a projected life of 10 years. The vessels are made of fiberglass reinforced plastic with a diameter of 12 ft and a height of 28 ft. The vessels have two cassettes of media, each 5 ft high, for a total media depth of 10 ft. This equates to a total media volume of 1,130 cf, which when compared to a design airflow of 67 cfs, yields a media residence time of 17 seconds. The amount of air flow through each of the Bioway Purpsring™ BTF vessels is approximately 4,000 cfm.

Several different media have been piloted with the Bioway Purpsing™ BTF, with Matala Filter Media and M+W Group Media performing the best. Matala has four different kinds of media that differ in product density. These four media are often used in sequence for larger systems. For irrigation water that is high in total suspended solids (TSS) low density media is more common to prevent clogging. For irrigation water with a low TSS concentration, a high density media is used for best performance. The pilot tests have revealed that Matala media is superior in terms of durability and maintaining form; the M+W Group media is prone to collapsing. M+W Group is headquartered out of Germany and changed their name from M+W Zander on January 1, 2010.

In 1999 and 2000, the BTF used at the Hyperion pilot plant was irrigated with primary and secondary effluent from the Hyperion Treatment Plant. Strainers were used on the supply lines to ensure that they didn't get clogged. The primary effluent was successfully tested for 6 months but was abandoned because it was assumed that primary effluent would not be available at the ATF sites.

The future and pending ATFs are currently designed to use potable water (with the addition of fertilizer) for media cassette irrigation. The fertilizer is provided by Bioway in a powder form that is added to 40 L of potable water in a nutrient tank. The new BTF units will have seven spray nozzles with continuous irrigation. The flow required is an average of 3,000 gpd per vessel.

The future and pending ATFs are currently designed to use potable water (with the addition of fertilizer) for media cassette irrigation. The fertilizer is provided by Bioway in a powder form that is added to 40 L of potable water in a nutrient tank. The new BTF units will have seven spray nozzles with continuous irrigation. The flow required is an average of 3,000 gpd per vessel.

To conserve water resources, the possibility of using treated wastewater to irrigate the BTFs is being explored.

As shown in Table 3-12 and Table 3-16 in the TM, the ATF facilities vary in airflow capacity and hence vary in terms of the flow rate required for irrigation. Each BTF has an airflow treatment capacity of 4,000 cfm. Therefore, if an ATF is designed for 12,000 cfm, three BTFs will be needed. To irrigate three ATFs, 9,000 gpd of water is required. Performing this analysis for each of the airflow capacity rates in Table 3-12 and Table 3-16 yields a required flow rate of between 6,000-15,000 gpd for each of the ATF facilities. Therefore, a design flow rate of 15,000 gpd will be used to size the wastewater treatment system to provide irrigation water for the ATFs.

The wastewater water quality is assumed to be approximately similar to the influent wastewater to the Donald C. Tillman Water Reclamation Plant (DCT). DCT has influent BOD and TSS concentrations of approximately 350 ppm and 300 ppm, respectively. From discussions with the Matala media manufacturers, a Biochemical Oxygen Demand (BOD) of 200 ppm would need to be achieved in the wastewater to keep the filters from clogging. Additionally, based on experience with similar applications, 60% removal of TSS will need to be achieved or 120 ppm of TSS in the treated effluent.

A summary of the treatment objectives is presented in Table 1.

Table 1: Treatment Objectives for ATF Irrigation Water Treatment System

Parameter	Influent	Effluent
Flow	15,000 gpd continuous	
BOD	350 ppm	300 ppm
TSS	300 ppm	120 ppm

From speaking with manufacturers and vendors from the City of LA area, there are three different kinds of systems for meeting the treatment objectives presented in Table 3-10:

- Cartridge Filter System
- Sequencing Batch Reactors (SBR)
- Membrane Bioreactor (MBR)

Cartridge Filter System

The Cartridge Filter System would have multiple stages. One such system, designed by Rosedale, contains the following:

- Pre-filter
- Secondary Bag Filter
- Final Cartridge Filter

The pre-filter is a 316 Stainless Steel (SS) housing with a 150 mesh strainer. The housing is 30" in depth; it operates at 150 psi; and it has 2" flange connections.

After the pre-filter, the water is transferred to secondary bag filters. The housing is made of 316 SS, with 30" depths, an operating pressure of 150 psi, and 2" flanges. Within the housing, there would be four filter elements. Each element is constructed of nine-layer polyprolylene microfibers, as shown in Figure 2.

Figure 2: Nine-layer Fibers used for Rosedale Bag Filters

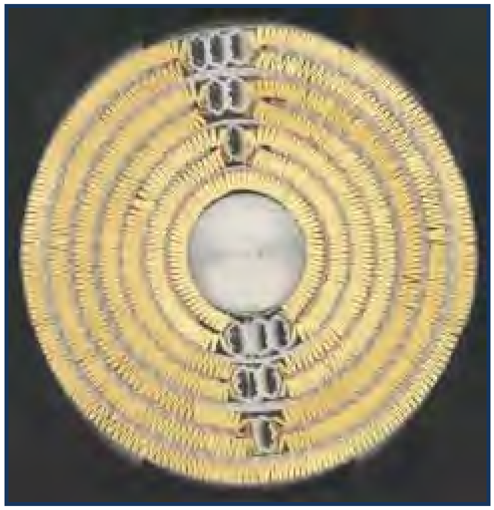
A typical bag filter is shown in Figure 3.

Figure 3: Bag Filters by Rosedale

These bag filters are rated for a screening of 48 micron (µm).

The last stage of this process is a cartridge filter. This process would also have a 316 SS housing operated at 150 psi with 2″ flanges. The cartridges themselves are made of polypropylene and have a length of 35″. A section of one of these filters is shown in Figure 4.

Figure 4: Section Cut of a Cartridge Filter by Rosedale



A typical cartridge filter is shown in Figure 5.

Figure 5: Section Cut of a Cartridge Filter by Rosedale

This cartridge filter system is the cheapest option, with a capital cost of approximately $50,000 for the entire treatment train. However, there is some uncertainty about the BOD removal, so it is suggested that this system be pilot tested prior to implementation.

SBR System

An SBR system could also be used to treat the ATF irrigation water. In an SBR basin, oxygen is bubbled through the wastewater, which reduces the BOD. A return activated sludge (RAS) pump takes mixed liquor from the outlet end of the tank to the inlet to recycle the bacteria. This bacteria, combined with the oxygen being bubbled through the basin, converts the nitrogen in the water to nitrite and nitrate, a process known as nitrification. Afterwards, the air is turned off and the sludge that has formed is allowed to settle to the bottom of the basin. During the settling, the now anaerobic bacteria convert the nitrite and nitrate into gaseous nitrogen in a process known as denitrification. A waste activated sludge (WAS) pump is used to remove some of the sludge that has accumulated over time.

While most SBR systems have multiple SBR basins, because the flow requirement is so low for this application, only one SBR basin will be required. The inconsistent flow associated with running only one SBR basin is offset by the recirculation tank located at the bottom of the BTF vessels, as shown in Figure 1. This recirculation tank will act as a holding tank for treated effluent from the SBR.

One such SBR system is designed by Aqua-Aerobic Systems, Inc. The basin used would be 16 ft by 12 ft in area, with a water depth between 9 ft and 11.3 ft. There would be 6 cycles per day at 4 hours. To operate this SBR, the average power required would be approximately 80 kWh/day. Ancillary equipment includes:

- 1--Transfer Pump: submersible
- 1—7.5 hp Aerator/Mixer/Decantor that would be located on the water surface with fiberglass floats
- 1—Pressure Transducer Assembly
- 1—Level Sensor Assembly
- 1—Control panel with remote access modem kits

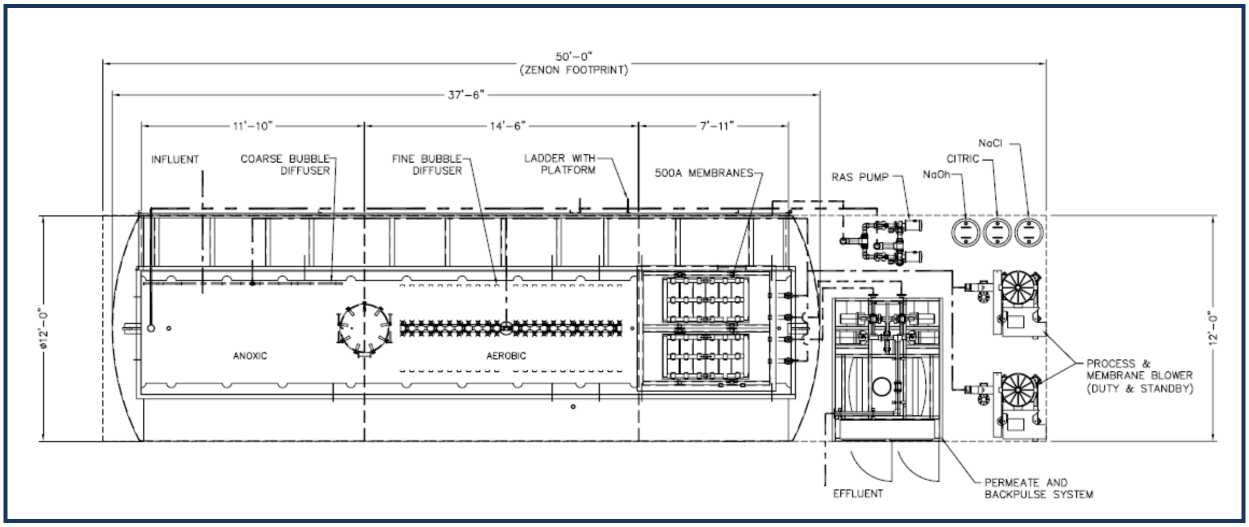
Such a system would have a capital cost of approximately $200,000. The operation and maintenance (O&M) cost would be minor because the operation could be monitored remotely.

MBR System

The third option is a package MBR System. An MBR system is a combined microfiltration or ultrafiltration system with a suspended growth bioreactor. For this application, where a small footprint is a key design parameter, an internal system would be required: where the filtration membranes are immersed and integral to the biological reactor.

One such system is the Z-MOD™ S Packaged Plant designed by Zenon/GE. This system has screening, biological equipment, filtration equipment and disinfection, all of which are located within an epoxy coated steel tank, as shown in Figure 6.

Figure 6: Z-MOD^{TM} S Packaged MBR Plant by Zenon/GE Layout



This system has an anoxic chamber with mixing, an aerobic chamber with diffusers and membrane chambers. On the equipment skid, there are aeration blowers, permeate pumps, backpulse pumps, backpulse tank, control panel, recirculation pump, GE Fanuc PLC and HMI interface.

Figure 7 shows an image of the Z-MOD™ S Packaged Plant.

Figure 7: Z-MOD^{TM} S Packaged MBR Plant by Zenon/GE Image

To meet the 15,000 gpd flow requirement, a 20 ft long tank would be required. This results in a footprint of approximately 27 ft x 6 ft, or 162 sq ft. The capital cost for this system is approximately $600,000 to $630,0000.

One advantage for using such a system, is that the treated water would meet Title 22 requirements and could thus be used to irrigate the pocket parks located at the ATF sites.

Appendix G

USC/Exposition Park Satellite Customer Assessment TM

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Summary of Modifications to the "USC / Exposition Park Satellite Customers Assessment TM" since Initial Publication on June 16, 2010

The Recycled Water Master Planning (RWMP) effort has spanned three years (April 2009 – March 2012). As is the nature of a planning project, assumptions are typically modified and refined as a project is further developed. The most recent assumptions related to the Non-Potable Reuse (NPR) master planning effort are presented in the Draft NPR Master Planning Report (December 2011). Assumptions and conclusions presented in this report supersede assumptions included in this technical memorandum (TM). The following table summarizes the modifications applicable to all RWMP TMs and those specifically applicable to this TM are described in the following sections.

Assumption	Modified	Original
Applicable to all RWMP TMs		
Recycled Water Goal	59,000 AFY by 2035 This goal reflects the 2010 LADWP Urban Water Management Plan that was adopted in early 2011, after the original RWMP goals were drafted	50,000 AFY by 2019
Introduction Section	This is superseded by the Introduction Sections in the NPR Master Planning Report.	This section was included in all initial TMs but the terms described have been replaced by the Introduction Section for the NPR Master Planning Report.
NPR Projects Terminology	To avoid confusion related to LADWP's water rate structure, the terms "Tier 1" and "Tier 2" are superseded with the terms "planned" and "potential," respectively. Both planned and potential projects would be considered for implementation by 2035.	"Tier 1" for NPR projects that were originally planned for design and construction by the year 2015. "Tier 2" for NPR projects that were originally being evaluated in the NPR Master Planning Report for potential future implementation after the year 2015.
Name for MF/RO/AOP treatment plant	Advanced water purification facility (AWPF)	Advanced water treatment facility (AWTF)
Name for water produced by AWPF	Purified recycled water	Advanced treated recycled water, highly purified recycled water, etc.
Treatment Plant Acronyms	DCTWRP LAGWRP	DCT LAG

The following modifications are specific to this TM.

TM References

Throughout this TM there are references to preliminary TMs that were prepared at the onset of the RWMP effort. Relevant information from these TMs has been updated and incorporated into the four RWMP documents: GWR Master Planning Report; NPR Master Planning Report; TIWRP Barrier Supplement and NPR Concepts Report; and Long-Term Concepts Report.

Demand Estimates

The NPR demand estimates for potential customers presented in Section 2 of this TM have been revised. The latest demand estimates are included in the NPR MPR.

Cost Estimates

The basis for the cost estimates included in this TM was subsequently revised, as documented in the Cost Estimating Basis for Recycling Water Master Planning TM (Appendix E in the NPR MPR) and summarized in Section 3.3 of the NPR MPR.

Modifications were made to several essential components of the cost estimating basis used in this TM, including unit costs for capital and O&M costs, O&M contingency, discount rate, unit cost calculation method and Engineering News Record (ENR) Index.

Component	Initial	Updated
Unit capital costs	various	$10 per gallon of capacity
Unit O&M costs	various	$0.30/yr per gallon of capacity
O&M Contingency	30%	--
Discount Rate	6%	3%
Unit Cost Calculation Method	Present Value divided by Maximum Annual Production	Present Value divided by Annual Demand Estimate
ENR Index	9,772 (April 2010)	10,000 (January 2011)

Updated costs for “preferred” satellite wastewater treatment plant – Alternative 3 – is attached. Cost estimates for the other sites were not updated.

Performance Measures

The performance measures described in Section 4 were scored in Section 5. The scoring process was subjective and was not subject to input from RWAG. In particular, “Maximize Public Acceptance” and “Promote Environmental Justice” would benefit from RWAG input.

Expansion of Existing Recycled Water System

The cost estimates associated with Section 6.3 and presented in Table 18 have been updated in the NPR MPR.

Conclusions

There are no changes to the TM’s final section - Conclusions:

I*t should be noted that… the extension of existing recycled water pipelines to the area would be more preferable alternative (in terms of cost-effectiveness, social benefits, public acceptance and meeting operational goals) than implementing a satellite plant. In the long term, the space availability at Exposition Park does not allow a facility large enough to meet much more than the demands at USC and Exposition Park. Beyond the cost considerations however, locating a facility in Exposition Park would provide an opportunity for education and further the acceptance of recycled water by the general public.*

Consequently, a wastewater satellite treatment plant to serve potential non-potable demands at USC and Exposition Park was not carried forward into the NPR Master Planning Report. The report includes two potential water recycling projects to convey recycled water to these customers.

The original TM follows so these modifications should be considered when reading this TM.

ASPECT:	**USC / Exposition Park Satellite Assessment TM**	Date:	1/18/2012
DESCRIPTION:	**Present Value Estimate**	**Annual Yield (AFY)**	
SUPPLY:	**Alternative 3**	640	

Item		Qty	Units	Unit Cost		Cost
Capital Costs						
Treatment		1.0	MGD	$12,000,000	$	12,000,000
Storage Tank		0.5	MG	$4,000,000	$	2,000,000
Pump Station		700	gpm	formula	$	703,000
Conveyance		Length (ft)				
6 inch		0	in-diam*LF	$24	$	-
8 inch		800	in-diam*LF	$24	$	154,000
10 inch		0	in-diam*LF	$20	$	-
12 inch		10,000	in-diam*LF	$20	$	2,400,000
			Construction Subtotal		**$**	**17,257,000**
			Contingency Costs	30%	$	5,177,000
			Construction Total		**$**	**22,434,000**
			Implementation Costs	30%	$	6,730,000
			Total Capital Cost		**$**	**29,164,000**
O&M Costs ($ / Year)						
Treatment		1,000,000	gpd of capacity	$0.30	$	300,000
Storage		1	LS	$75,000	$	75,000
Pump Station						
Maintenance	$	703,000	capital cost	5.0%	$	45,000
PS 1 - Electricity		262,700	kWh	$0.12	$	32,000
Conveyance		10,800	LF	$0.60	$	6,000
			Total Annual O&M		**$**	**458,000**
Recycled Water Purchase ($ / Year)						
Burbank WP			AFY	$0	$	-
Central Basin MWD			AFY	$500	$	-
Las Virgenes MWD			AFY	$500	$	-
Terminal Island WRP			AFY	$1,300	$	-
West Basin - Nitrified (Harbor)			AFY	$800	$	-
West Basin - Tertiary (West/Metro)			AFY	$728	$	-
			Purchase Cost Total		**$**	**-**
Economic Cost Summary						
Present Value Calculations				PV Factor		
Initial Capital Cost	$	29,164,000		1.00	$	29,164,000
20-Year Capital Costs	$	11,073,000		2.00	$	22,146,000
Annual O&M Costs	$	458,000		49.00	$	22,442,000
Recycled Water Cost	$	-		65.45	$	-
Salvage	$	(5,536,500)		1.00	$	(5,537,000)
				Total Present Vaue		**$68,215,000**
				Project Yield (AF)		**32,000**
				Unit Cost ($/af)		**$2,100**

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Technical Memorandum

Title:	USC/Exposition Park Satellite Customer Assessment
Version:	Draft
Prepared For:	John Hinds, Project Manager, LADWP Amy Webb, Task 5a Lead, LADWP Doug Walters, Project Manager, BOS Nasir Emami, Task 5a Lead, BOS
Prepared by:	Connie Leonard, Task 5a Lead, CDM Arthur Goh, CDM Stephanie Debats, CDM Andy Swanton, CDM
Reviewed by:	Tom Richardson, Project Manager, RMC Heather Boyle VanMeter, Deputy Project Manager, CDM Rachael Wark, RMC
Date:	November 3, 2009 **revised June 16, 2010**
Reference:	Task 5a, Task 5.1.6.

1. Introduction

With imported water supplies becoming ever more unpredictable, the Los Angeles Department of Water and Power (LADWP) adopted the Mayor's vision of Securing LA's Water Supply in May 2008, calling for 50,000 AFY of potable supplies to be replaced by recycled water by 2019. To meet this near-term challenge and plan for expanding reuse in the future, LADWP has partnered with the Department of Public Works (City) to develop the Recycled Water Master Planning (RWMP) Documents. The RWMP includes 7 major tasks: 1 Groundwater Replenishment (GWR) Master Planning Document, 2 Non-Potable Reuse Master Plan, 3 GWR Treatment Pilot Study, 4 Max Reuse Concept Report, 5 Satellite Feasibility Concept Report, 6 Existing System Reliability Concept Report, and 7 Training.

1.1 Task 5 Overview

The purpose of Task 5, Satellite Feasibility Concept Report, is to identify ways to utilize recycled water by means of satellite plants, sewer mining, dry weather runoff diversion, or other alternative technologies in locations where the expansion of the recycled water distribution system is unfeasible. Task 5a includes the basic research, identification of projects, and a portion of the preliminary project development. Task 5b will further develop recommended satellite treatment projects. Task 5a is subdivided into the following tasks:

- Task 5.1 – Basic Research: Initial research and summary of the City's current and projected wastewater and stormwater flows and quality, non-potable demands in the City, existing small-scale and regional satellite plants, technology assessment, and USC/Exposition Park satellite customer assessment and resource evaluation.
- Task 5.2 – Identification of Projects: Development of criteria for potential satellite reuse areas, including sources and demands for small-scale and regional plants and preliminary project screening.
- Task 5.3 – Working Group and QAQC: Satellite working group meetings to prepare the Satellite Feasibility Concept Report, as well as quality control/quality assurance activities established in the Project Quality Control Plan developed under Task 2.

1.2 TM Purpose

This Technical Memorandum (TM) addresses the basic research identified as part of Subtask 5.1.6, USC/Exposition Park Satellite Customer Assessment. This TM presents the outcome of meetings and data gathering to determine the feasibility of locating a satellite treatment plant adjacent to the University of Southern California (USC) and Exposition Park in South Los Angeles. This TM presents the demands for each site, satellite plant conceptual plan, and potential locations. Specifically, this TM:

- Summarizes the recycled water demands of USC, Exposition Park, and nearby surrounding areas;
- Identifies locations and quantities of nearby sources of wastewater flow;
- Identifies objectives and performance measures to guide the analysis of candidate sites (alternatives);

- Presents the proposed treatment processes for the satellite plant and associated facilities, including preliminary sizing and capital and operational costs of the facilities;
- Evaluates alternatives for the satellite treatment facilities within the USC/Exposition Park area with respect to the identified objectives;
- Identifies a recommended alternative; and
- Outlines the next steps for implementing the satellite plant including permitting issues, institutional agreements needed, and implementation hurdles.

1.3 TM Outline

The TM is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Recycled Water Demands
- Section 3 – Preliminary Satellite Plant Development
- Section 4 – Site Evaluation Criteria and Decision Model Overview
- Section 5 – Identification of Alternatives
- Section 6 – Summary of Alternatives Rankings
- Section 7 – Conclusions

2. Recycled Water Demands

2.1 University of Southern California

In May 2008 the USC Facilities Management Services Department (FMSD) sent a commitment letter to LADWP requesting a supply of recycled water within five years at both the University Park Campus (UPC) and the Health Sciences Campus (HSC) in east LA. This TM assessment addresses the demands and feasibility of a satellite treatment plant at the UPC location. The HSC location is addressed as part of the Task 2 non-potable water evaluation. See Figure 1 for an overall location map.

Figure 1: Overall Location Aerial Map

UPC is located on approximately 240 acres, bounded by Jefferson Boulevard on the north, Exposition Boulevard on the south, Vermont Avenue to the west and Figueroa Street to the east. Campus housing is located north of Jefferson Boulevard near Vermont Avenue and the University Village area.

There is a commercial area located north of Jefferson Boulevard between McClintock Avenue and South Hoover Street that has been slated for redevelopment to retail and additional campus housing. This redevelopment project, titled "District #3" is proposed in the 2020 USC Master Plan, prepared by KPFF Consulting Engineers. This project would include both mixed use and irrigation recycled water demands. These demands are included in Table 1 below.

See Figure 2 for an overall map of UPC.

On July 29, 2009 the RWMP team met with the FMSD at UPC to discuss the recycled water demands. Currently, UPC has 22 DWP water meters and the historic potable water usage is 944 AFY. Based on a previous study conducted by USC, the estimated peak summer irrigation demand is 50,000 gpd. Assuming a peaking factor of 2.2, the annual irrigation demand for campus irrigation is estimated to be 30 AFY. There are three cooling towers and three boilers at UPC. According to the Task 2.2 Initial Customer Evaluation – University of Southern California Main Campus TM, this demand is estimated at 60 AFY. The peak potable water demand for the District #3 University Village development is 560 gpm, including mixed use and irrigation. It is estimated that 290 acre-feet per year of recycled water can meet some of these demands

Table 1 summarizes the recycled water demands at UPC.

Table 1: USC @ UPC Recycled Water Demands[d]

Type of Use	Current Potable Demand (AFY)	Non-Potable Demand Estimates	
		Average Annual (AFY)	Peak Day (gpd)[e]
Domestic	910[a]		
Irrigation (existing)	30[b]	30	60,000
Industrial (existing 2 cooling towers and 3 boilers)	60[c]	60	80,000
NEW Irrigation @ District #3		20[d]	40,000
NEW Dual-plumbing @ District #3		270[d]	409,000
NEW Dual-plumbing @UPC		140[d]	213,000
TOTAL Demand for USC Campus	**1000**	**520**	**802,000**

Notes:
a. Domestic Demand, Task 2.2 *Initial Customer Evaluation – University of Southern California Main Campus TM,* April 2010
b. 2.5 AFY per acre, 12 acres
c. Task 2.2 *Initial Customer Evaluation – University of Southern California Main Campus TM.* April 2010
d. Task 2.2. Customer Development, *Initial Customer Evaluation – USC Main Campus* TM, April 2010
e. Peaking factors of 2.2 for irrigation, 1.5 for industrial and 1.7 for mixed use were used to calculate the Peak Day demand, Task 2.2 *Initial Customer Evaluation – University of Southern California Main Campus TM,* April 2010

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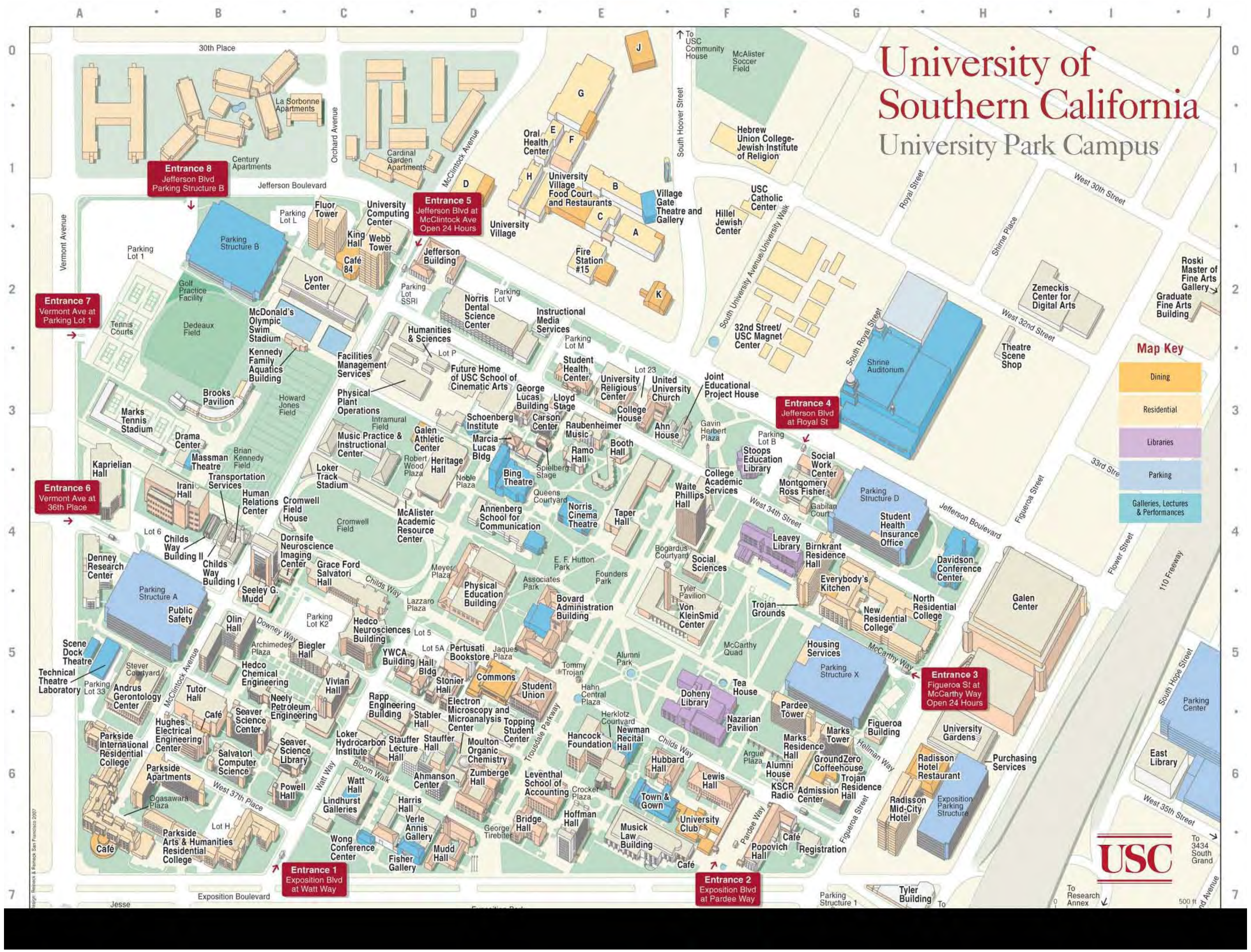
Figure 2: USC @ UPC Overall Map (Courtesy of USC)



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2.2 Exposition Park

Exposition Park is located south of UPC. Exposition Park is bordered by Exposition Boulevard to the north, Martin Luther King Jr. (MLK) Boulevard to the south, Vermont Avenue to the west and Figueroa Street to the east. The overall site occupies approximately 170 acres and consists of various museums, parks, and sports and recreational facilities owned and operated by various entities. A majority of the property is owned by the State of California. The State leases land to the Coliseum and Sports Arena and to the Natural History Museum. The City of Los Angeles leases land from the State for the Rose Garden located near Exposition Boulevard. See Figure 3 for a map of Exposition Park.

On August 13, 2009 the RWMP team met with the Exposition Park General Management (EPGM) to discuss opportunities to provide recycled water for irrigation and other uses, and to determine the pathway for implementation. Discussion of land available for constructing the satellite plant resulted in several options.

Table 2 summarizes the recycled water demands at Exposition Park. Demand information was gathered based on LADWP billing records. Individual irrigation meters were not identified in the billing records and an estimate of the irrigation needs based on actual landscaped areas was made. Currently, Exposition Park uses approximately 22.8 million gallons (70 acre-feet) annually to irrigate the Rose Garden, Coliseum, and other landscaped areas. Additionally, Exposition Park utilizes cooling towers for air conditioning. This represents an additional annual demand of approximately 16.3 million gallons (50 acre-feet).

Table 2: Exposition Park Recycled Water Demands

Type of Use	Current Potable Demand (AFY)	Average Annual (AFY)	Peak Day (gpd)[c]
Domestic	226		
Irrigation (existing)		70[a]	138,000
Industrial (existing Cooling Towers)		50[b]	67,000
Total Demand for Exposition Park	**226**	**120**	**205,000**

Notes:
a. Based on LADWP Billing records
b. Based on LADWP Billing records
c. Peaking factors of 2.2 for irrigation, 1.5 for industrial were used to calculate the Peak Day demand

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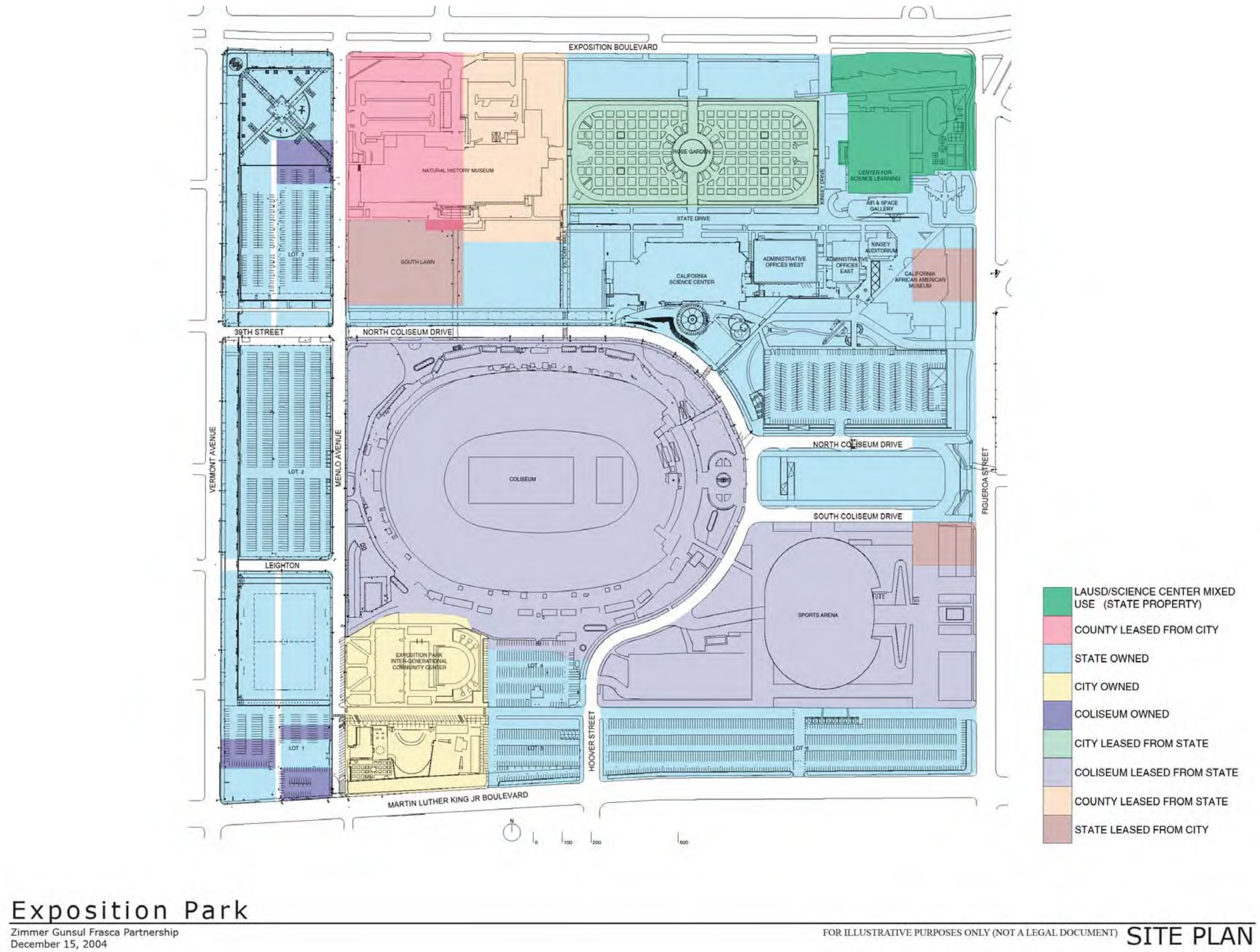
Figure 3: Exposition Park Land Use Map (Courtesy of EPGM)



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2.3 Other Local Demands

As part of Task 2 Non-Potable Reuse Master Plan, the team identified additional users in the USC/Exposition Park vicinity that could be served by a future satellite plant. Matchmaster, Inc., is a dye house and is located approximately one mile southeast of UPC, just east of the 110 Freeway. Yee Yuen Linen Services, Inc., is located approximately one mile northwest of UPC. Republic Uniforms is located approximately one mile north of UPC. Based on billing records, it was determined that an additional 1.3 million gallons per day (1,127 AFY) of recycled water could potentially be used in this area.

Table 3 summarizes the additional and total recycled water demands in the USC/Exposition Park area.

Table 3: Total Recycled Water Demands

Location	Estimated Non-Potable Demands	
	(AFY)	(Peak mgd)
USC	520[f]	0.80[a,f]
Exposition Park	120[g]	0.20[a,g]
Subtotal (USC/Exposition Park)	**640**	**1.0**
Matchmaster, Inc. [c]	904	1.05[b]
Republic Uniforms [d]	123	0.14[b]
Yee Yuen Linen Services, Inc. [e]	100	0.12[b]
Subtotal (Additional)	**1,127**	**1.31**
Total	**1,337**	**2.31**[f]

Notes:

a. mgd peak day for irrigation = AFY x 2.5 /1120
   mgd peak day for industrial cooling water = AFY x 1.5 /1120
b. peak day for industrial = AFY x 1.3/1120
c. Located @ 3700 S. Broadway Ave., Los Angeles, CA 90007
d. Located @ Vermont Ave. and Washington Blvd., Los Angeles, CA 90007
e. Located @ 1729 W. Adams Blvd., Los Angeles, 90018
f. See Table 1
g. See Table 2

3. Preliminary Satellite Plant Development

3.1 Satellite Plant Sizing

Based on demands identified for USC and Exposition Park alone, as shown in Table 3, approximately 1 million gallons per day (mgd) of recycled water would be required. However, potential additional demands for nearby industrial users would increase the size of the plant significantly to 2.3 mgd. The verification of the industrial demands has not been completed at the time of this writing. It is not likely that all of the demands identified will be candidates to receive recycled water, or that they will be committed at the time the satellite plant is ready to deliver water.

To meet the demands of the recycled water end users, influent flow to the treatment plant approximately 10 percent greater was assumed, to account for waste flow from the removal of solids and other losses throughout the plant.

For the evaluation of the USC/Exposition Park Satellite Plant, two plant sizes were evaluated: 1.1 mgd was evaluated to represent USC/Exposition Park only, and 2.5-mgd to represent the entire flow. This proposed capacity provides adequate supply for the demands of USC and Exposition Park as well as extra capacity to serve the nearby demands as they are identified but should be verified in the future for actual facility planning. Depending on the site chosen, the facility could be implemented in phases.

Additionally, storage will be needed at the larger plant to even out hourly peak flows at the industrial demands. Based on the difference between the hourly and daily peaks, a storage volume of 1 million gallons (MG) is assumed.

3.2 Satellite Plant Source Overview

This section provides an overview of the collection system in the area. In Section 5, the supply to each of the satellite location alternatives will be discussed. USC at UPC and Exposition Park are located in the Central City Primary Sewer Basin as defined by the City of Los Angeles Bureau of Sanitation (BOS). See Task 5.1.1 Wastewater Collection System TM for more information on this basin. Several large outfall sewers are located in the immediate vicinity of the project area and were evaluated to determine if sufficient dry weather flows were available to meet the projected demands. The locations of these sewers are shown in Figure 4. As shown in the following tables, sufficient flow exists in the primary and outfall sewers in the immediate vicinity to supply a 1.1 to 2.5 mgd treatment facility.

3.2.1 Major Outfalls

The East Central Interceptor Sewer (ECIS) is located underneath Exposition Boulevard and runs between USC and Exposition Park. Two large primary sewers from the USC campus discharge into ECIS at Exposition Boulevard. The North Outfall Sewer (NOS) passes several blocks to the south of Exposition Park along 41st Place. The NOS is diverted to ECIS at 23rd and Trinity, which is upstream of the project vicinity; however, due to local sewer diversions, flow still exists within NOS south of Exposition Park. Table 4 summarizes the current dry weather flow in major outfalls near USC/Exposition Park. These flows are based on the 2008 model run of the Mike Urban flow projection model used by BOS.

Although sufficient flow exists in ECIS, it should be noted that the invert of the outfall sewer in the vicinity of USC/Expo Park is approximately 80 feet below grade. This will be discussed in Section 5 for proximity and access to the sewer flows to feed the satellite plant.

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Figure 4: Primary and Outfall Sewers in the USC/Exposition Park Area

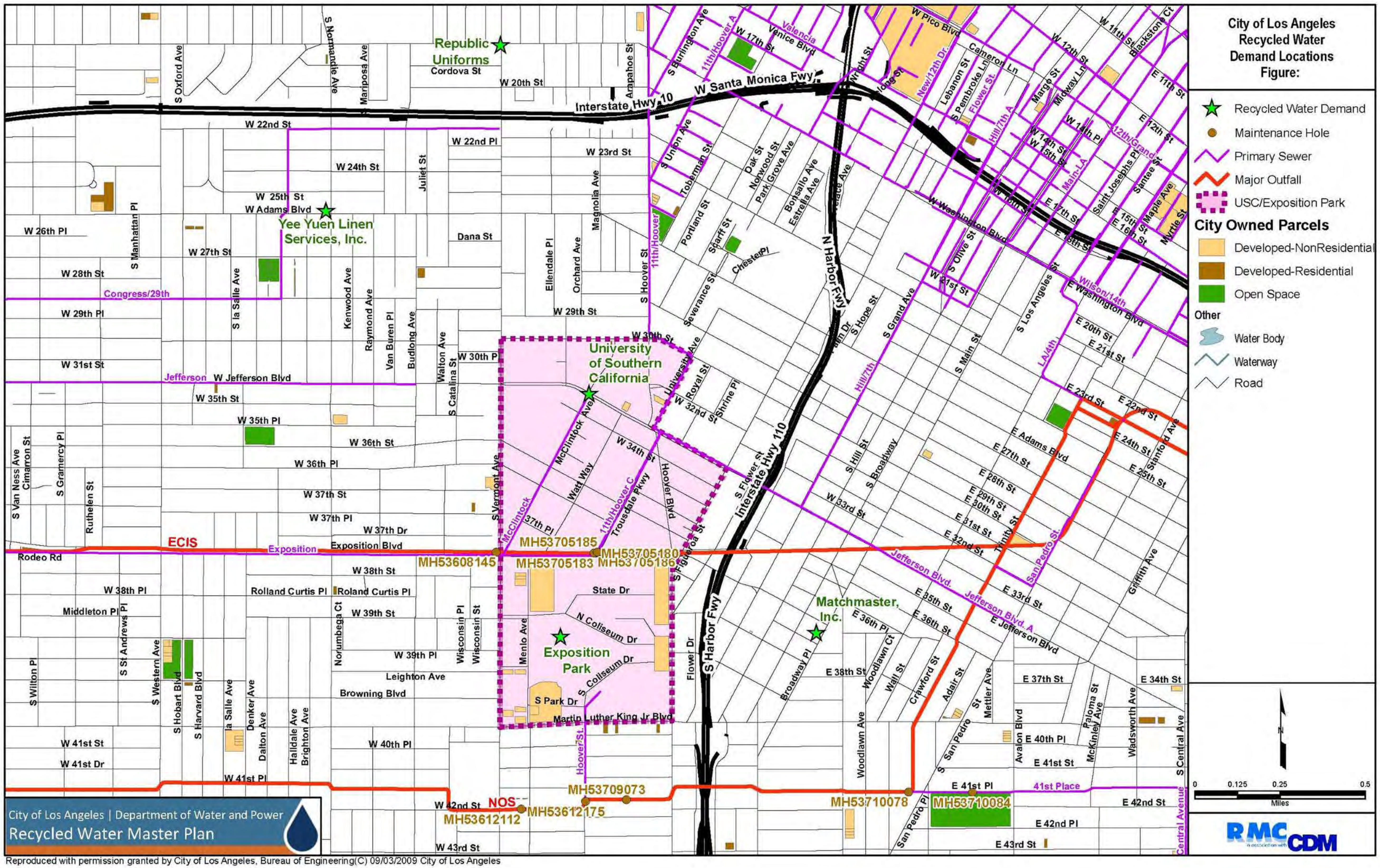

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Table 4: Dry Weather Wastewater Flows in Major Outfalls near USC/Exposition Park

Sewer	MH Location	Minimum (cfs)	Minimum (mgd)	Average (cfs)	Average (mgd)	Maximum (cfs)	Maximum (mgd)
ECIS	53705180	35.0	22.6	79.0	51.0	117.0	75.6
ECIS	53705183	46.0	29.7	104.0	67.2	147.0	95.0
ECIS	53608145	46.0	29.7	104.0	67.2	147.0	95.0
NOS	53709073	3.0	1.9	7.4	4.8	11.5	7.4
NOS	53612112	4.0	2.6	8.7	5.6	12.7	8.2
NOS	53710078	8.5	5.5	13.0	8.4	18.0	11.6

3.2.2 Primary Sewers

Two primary sewer lines, one 40-inch and the other 48-inch, run through the USC campus from Hoover and Jefferson to Exposition Boulevard along Trousdale Parkway. The Hoover Street primary sewer collects flows from Exposition Park and discharges to NOS south of the park, at 41st Place. It was determined that this primary sewer, which comes directly from the Exposition Park property, does not carry sufficient flow to supply the satellite plant. The 41st Place primary sewer conveys and discharges flows to NOS at Trinity Street. Table 5 summarizes the current dry weather flow in primary sewers near USC/Exposition Park. These flows are based on the 2008 model run of the Mike Urban flow projection model used by BOS.

Table 5: Dry Weather Wastewater Flows in Primary Sewers near USC/Exposition Park

Sewer	MH Location	Minimum (cfs)	Minimum (mgd)	Average (cfs)	Average (mgd)	Maximum (cfs)	Maximum (mgd)
11th	53705186	2.0	1.3	7.0	4.5	11.0	7.1
Hoover C	53705185	8.0	5.2	16.0	10.3	23.0	14.9
Hoover	5361275	0.007	0.004	0.02	0.01	0.03	0.02
41st Place	53710084	1.3	0.84	5.5	3.6	9.3	6.0

3.3 Satellite Plant Facility Assumptions

The satellite treatment process will produce recycled water for irrigation that will meet or exceed California Title 22 standards for unrestricted body contact. It is assumed that future end users requiring a water supply treated to a higher level will be responsible for the installation of additional treatment at their facilities. The plant will only divert and process wastewater as-needed from the nearby sewer interceptor; excess flows will continue to the Hyperion Treatment Plant (HTP) for treatment.

A pump station will be required adjacent to the sewer source to lift raw wastewater to the satellite plant at grade. For the purposes of this evaluation, it is assumed the lift station will be a below-grade structure with a wet well constructed adjacent to an existing maintenance hole on the interceptor. Typical solids-handling submersible or dry-pit self-priming pumps would be able to convey the flow adequately to the headworks of the satellite plant. Submersible pumps have the advantage of passing solids and minimizing the footprint of the pump station. An in-line comminutor or macerator may also be included to reduce large solids or debris in the raw wastewater source. The macerator can be located in a concrete vault upstream of the wet well and will pulverize large materials typically encountered in a sewer line, such as plastics, wood, rags, sludge, and paper. Macerator pumps may also be a viable alternative to reduce blockage of flow.

There are various treatment technologies available to supply recycled water that would meet Title 22 standards. These were evaluated in the Task 5.1.5 *Technology Assessment TM, November 2009*. Section 8 of that TM recommended MBR for smaller satellite plants (up to 1 mgd). For plants over 1 mgd, it was recommended that either MBR or MLE be evaluated as costs are continually changing. MBR technology was considered important here to minimize the footprint of the satellite plant in a dense urban setting. For that reason, a membrane bioreactor (MBR) system will be used for treatment of the wastewater along with ultraviolet (UV) disinfection. Upstream of the MBR, there will be two steps of screening: coarse (approximately ½ inch) and fine (1 or 2 mm). Fine screens are important to ensure that the MBR membranes are not blinded by large solids. Screenings can be bagged on-site, or returned to the interceptor along with waste activated sludge (WAS) and other sidestreams for further treatment and ultimate removal at HTP. Wasting solids to the sewer will help minimize costs, operational demands, and odor concerns associated with the facility. An odor control facility would be needed to treat odors from processes and avoid unacceptable odor issues to the neighboring areas. Other ancillary buildings will be required for chemical storage (citric acid, sodium hypochlorite), operations and maintenance, and electrical facilities. Additionally, storage to meet peak hourly flow variations will be included for the 2.5 mgd plant.

Refer to Task 5.1.5 TM, Assessment of Satellite Reuse Technologies, for additional discussion of treatment process technologies. Figure 5 illustrates the conceptual process flow schematic of the satellite plant and Figure 6 illustrates the conceptual site layout of the treatment processes and ancillary buildings for a 1.1-mgd plant. Figure 7 shows the conceptual layout for a 2.5-mgd plant.

Figure 5: Conceptual Treatment Process Flow Schematic

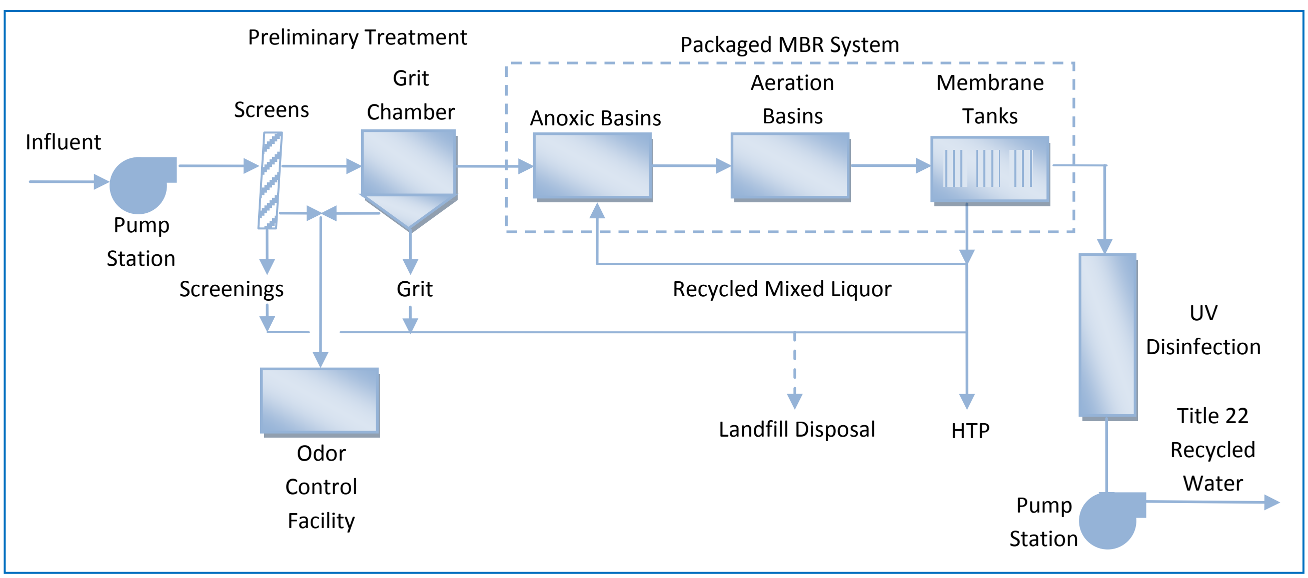


Figure 6: Typical 1.1-mgd Satellite Plant Site Layout

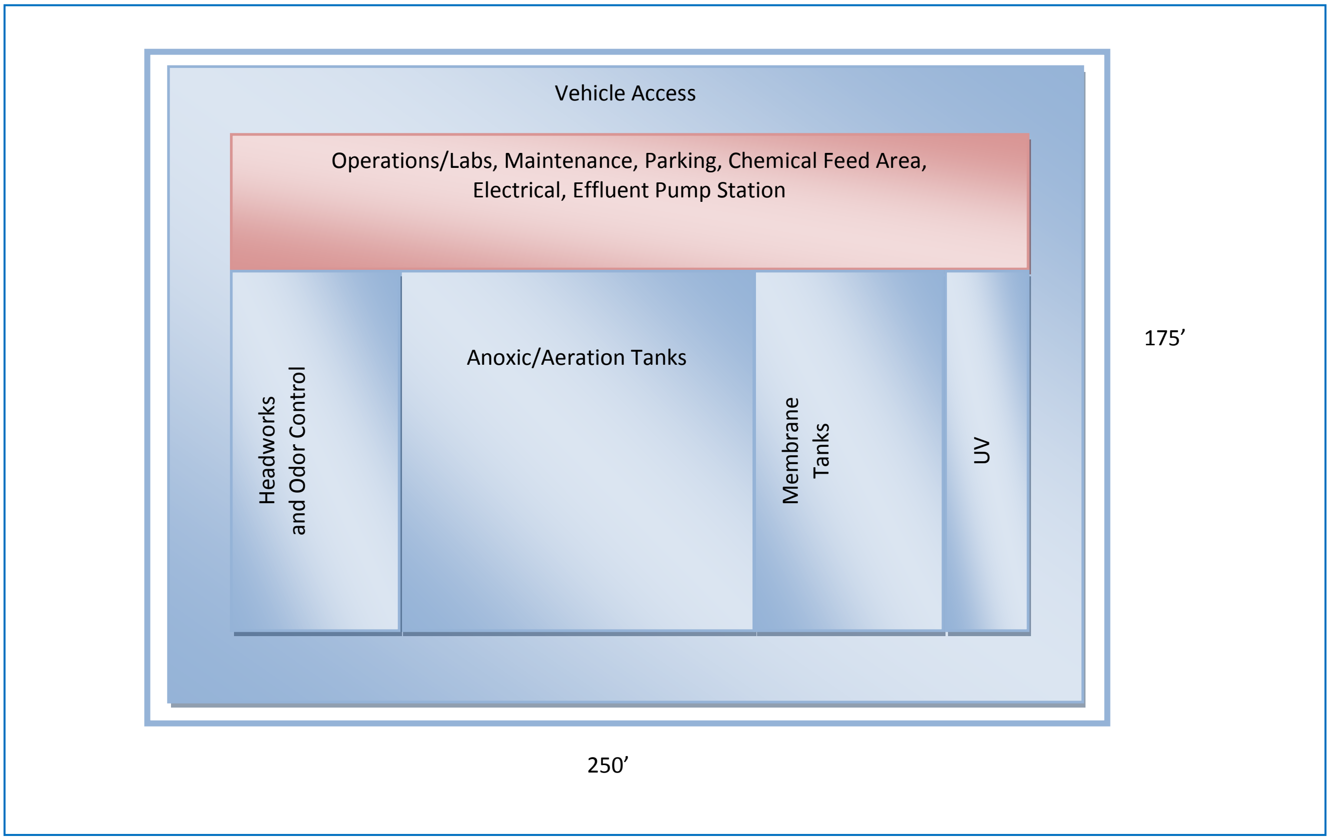
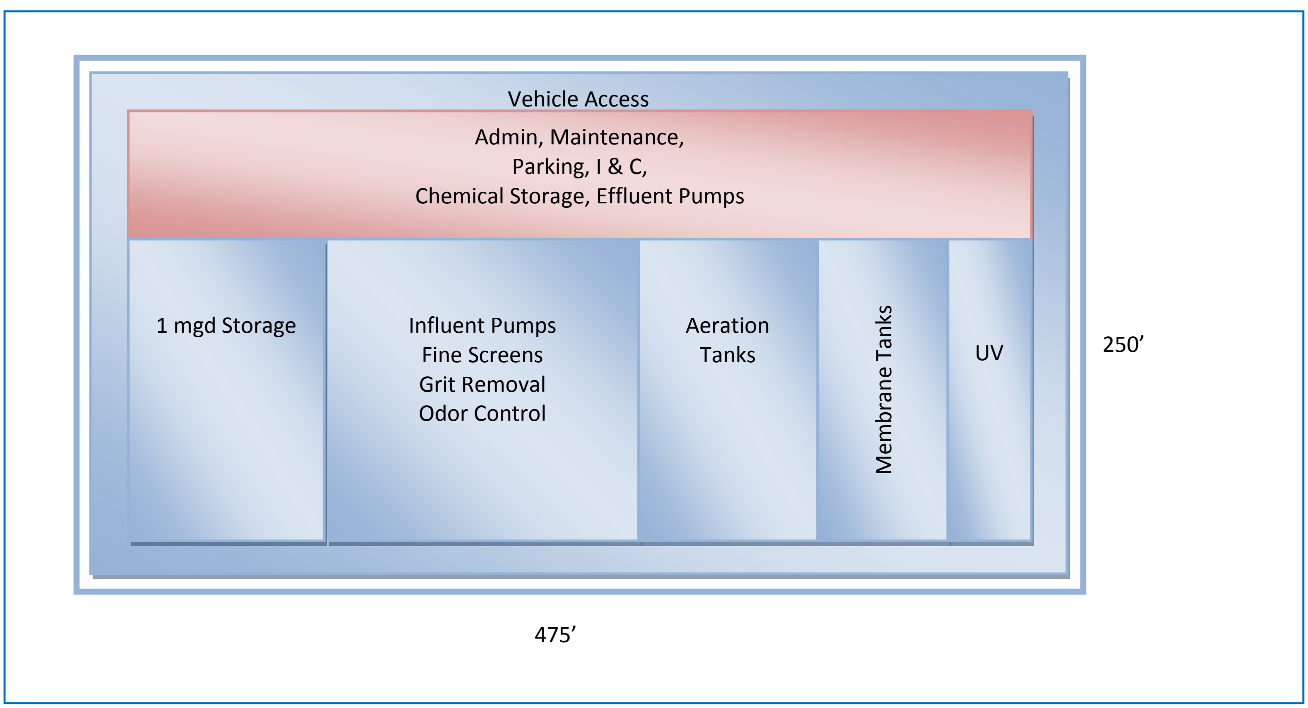


Figure 7: Typical 2.5-mgd Satellite Plant Site Layout



3.4 Recycled Water Distribution Assumptions

From the satellite treatment plant, the recycled water will be pumped into a distribution system to reach the identified demands. In order to compare the various alternatives, the distribution system from the satellite plant to the demands is indentified in Section 5.

For the purposes of this TM, distribution piping from the treatment plant to the identified demands is included in the alternative site locations for the 2.5-mgd plant only. It is assumed that the smaller treatment plant would serve only the demands immediately in the vicinity of the facility and therefore significant lengths of distribution piping are not needed.

Sizing of the distribution piping is based on a flow velocity of 5-7 feet per second. The pipe material is assumed to be ductile iron.

4. Site Evaluation Criteria and Decision Model Overview

A decision model process was used to rank and compare the various candidate sites or alternatives to identify a viable, recommended location to site a future satellite plant. For this assessment, developing a decision model involved two steps: 1) defining and weighting objectives or decision criteria; and 2) defining and characterizing different alternatives. These variables are inserted into the decision model analysis, which is discussed further in Section 6.1.

All identified alternatives are preliminarily screened prior to decision model analysis. Preliminary evaluation criteria that are specific to this assessment include:

- Site shall preferably be City-owned to minimize schedule or cost impacts from land acquisition, but non-City-owned sites will be considered;
- Based on preliminary space requirements, site shall have minimum developable area of 1 acre based on preliminary space requirements for a 1.1-mgd satellite plant and minimum of 2.7 acres for a 2.5-mgd satellite plant with storage;
- Site shall not be located on existing Exposition Park areas designated for parking;
- Site shall be in close proximity to an identified primary or outfall sewer.

The RWMP objectives and corresponding evaluation criteria guide the evaluation of the alternatives in order to determine the most feasible alternative to locate a satellite plant in the USC/Exposition Park area. As the objectives represent the goals of the project, each alternative must be characterized as to how well it meets each of those goals. This characterization uses performance measures for each objective. Performance measures can be either quantitative or qualitative in nature. For example, a lifecycle cost performance measure has a quantitative performance measure of the net present value (NPV). A public acceptance performance measure uses a qualitative performance measure based on a numeric scale from 1 to 5.

Table 6 summarizes the objectives developed for the RWMP, as well as performance measures, and relative weightings developed specifically for Task 5, Satellite Plant Concept Report. The Task 5 specific weightings were discussed at the RWMP monthly management meeting on September 16, 2009.

Table 6: City of Los Angeles Recycled Water Master Plan Objectives and Detailed Evaluation Criteria Performance Measures

	Objective	Description	Weight	Performance Measure Parameters
1	Promote Cost Efficiency	Meet the goals of the recycled water program in cost-effective manner, considering both City and recycled water customer costs.	25%	• Optimize lifecycle costs
2	Achieve Supply & Operational Goals	Meet or exceed water supply targets and operational goals established by the City.	20%	• Provide wastewater system benefits • Maximize operational flexibility
3	Protect Environment	Develop projects that not only protect the environment, but also provide opportunities to enhance it.	10%	• Minimize habitat impacts • Minimize greenhouse gas (GHG) emissions
4	Maximize Implementation	Maximize the implementation of projects.	25%	• Maximize public acceptance • Minimize permitting requirements
5	Promote Economic & Social Benefits	Provide economic and social benefits in the implementation and operation of recycled water projects.	5%	• Promote environmental justice • Promote job creation
6	Maximize Adaptability & Reduce Risk	To be able to adapt to uncertainties and to reduce risk of operations once projects are implemented.	15%	• Maximize availability of source water • Maximize expansion capability • Maximize non-potable customer reliability
	Total		**100%**	

4.1 Promote Cost Efficiency

Capital and operations and maintenance (O&M) costs of the satellite plant shall be optimized as the overall cost will determine the feasibility of providing recycled water to USC/Exposition Park customers as well as other neighboring demands. The performance measure used to evaluate this objective is the overall lifecycle cost of the proposed project. Lifecycle costs include anticipated construction, implementation, and O&M costs in terms of NPV. Depending on the available site, the project may require inclusion of costs for land acquisition as well. The costs will be evaluated as cost per acre-foot of recycled water supplied to compare plants of differing capacities.

4.2 Achieve Supply and Operational Goals

The location of the satellite plant must achieve the water supply targets and operational goals of the City. Alternatives will be evaluated according to two performance measures: wastewater system benefits and operational flexibility.

4.2.1 Provide Wastewater System Benefits

Provision of wastewater system benefits is defined as the degree to which an alternative impacts the existing wastewater system in the area. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that provides no benefits or causes a constraint or increase in the existing wastewater flows that would affect the capacity of the sewer. A score of 5 represents an alternative that has no impacts to the nearby wastewater system and enhances the capacity of the system.

4.2.2 Maximize Operational Flexibility

Maximize operational flexibility is defined as the degree to which an alternative is able to operate in accordance with varying site and treatment parameters, such as physical space, access, or source flow. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative where operations are constantly constrained with insufficient space or access, as well as periodic insufficiency of source flow. A score of 5 represents an alternative that has ample space for O&M activities and flexibility in the sewer system to accommodate varying flows and demands.

4.3 Protect the Environment

The satellite plant shall protect and enhance the environment. Alternatives will be evaluated according to two performance measures: impacts to the surrounding habitat and greenhouse gas (GHG) emissions.

4.3.1 Minimize Habitat Impacts

Minimize habitat impacts is defined as the degree to which an alternative impacts the existing, surrounding environment or habitat. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that destroys habitat. A score of 5 represents an alternative that has no impact to the existing habitat, or creates additional green space or habitat.

4.3.2 Minimize GHG Emissions

Reduction in carbon footprint (as measured in GHG emissions) is defined as the degree to which estimated carbon equivalent emissions associated with the activities and processes involved with each alternative is minimized. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that has a large carbon footprint as a result of high energy consumption of the treatment processes. A score of 5 represents an alternative that has a low carbon footprint as a result of efficient, sustainable processes.

4.4 Maximize Implementation

Agreements with USC and Exposition Park as well as other potential users would be required for supply of the recycled water. Coordination with various entities at Exposition Park, e.g., the State of California, Los Angeles County, and Los Angeles Department of Recreation and Parks, as well as the City of Los Angeles Planning Department, Department of Cultural Affairs, neighborhood councils and City Council staff will be necessary for the successful implementation of the satellite plant. Additionally, agreements between the BOS and LADWP would be necessary to construct, operate and maintain a satellite treatment facility used for providing recycled water to end users. Depending on the final site location, land acquisition may be necessary and zoning revised for the siting of a recycled water treatment plant. Alternatives will be evaluated according to two performance measures: public acceptance and permitting requirements.

4.4.1 Maximize Public Acceptance

Public acceptance is defined as the anticipated level of public acceptance towards an alternative. Some issues that impact public perception of a facility include odor issues, visual appearance, or proximity to residential neighborhoods. Negative community perception has to be mitigated for an alternative to be viable. Public acceptance is scored on a scale of 1 to 5. A score of 1 represents an alternative that would receive a large amount of negative public perception and hostile public resistance to the proposed project. A score of 5 represents an alternative that would not have any negative public perception, where the public advocates and supports the proposed project.

4.4.2 Minimize Permitting Requirements

Permitting requirements are defined as the level of degree of difficulty in obtaining required permits for a particular alternative. For any alternative to be sustainable, current and potential regulatory issues must be minimized. Permitting is scored on a scale of 1 to 5. A score of 1 represents an alternative that would have the most difficulty obtaining the required permits from regulatory agencies. A score of 5 represents an alternative that can easily obtain or already possess the required permits from regulatory agencies.

4.5 Promote Economic and Social Benefits

The successful siting of a satellite plant shall include the compliance with health and safety laws and provide social benefits to the residents. Alternatives will be evaluated by performance measures that determine whether or not environmental justice is being served, and whether or not the treatment plant brings educational or employment opportunities to the community.

4.5.1 Promote Environmental Justice

Promoting environmental justice is defined as the degree to which environmental justice and sensitivity to the local community is being served. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that disrupts the local community, displaces residents, and harms protected population. A score of 5 represents an alternative that has no impact or brings enhancement to the community.

4.5.2 Promote Job Creation

Promoting job creation is defined as the workforce demand that occurs as a result of implementing a particular alternative. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that does not create new jobs, or takes away jobs from the area. A score of 5 represents an alternative that brings many new, beneficial jobs to the area.

4.6 Maximize Adaptability and Reduce Risk

The size of the site and treatment selection is based on assumed demands in the USC/Exposition Park area. Locations will be evaluated on their ability to support expansion of facilities should future demands be identified. This also includes consideration of the location and availability of source water for the treatment process. Alternatives will be evaluated according to three performance measures: availability of source water, expansion capability, and non-potable customer reliability.

4.6.1 Maximize Availability of Source Water

Availability of source water is defined as the proximity and sufficiency of wastewater source flows to the alternative. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that is either far from a supply source or is close to a supply source with insufficient flow. A score of 5 represents an alternative that has ample supply near the proposed site location.

4.6.2 Maximize Expansion Capability

Expansion capability is defined as the potential for an alternative to expand physically should future recycled water demands be identified. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that is a small site surrounded by other uses with no possibility of expansion. A score of 5 represents an alternative that is located on a large site with ample space for expansion to as large of a facility as is deemed necessary.

4.6.3 Maximize Non-potable Customer Reliability

Non-potable customer reliability is defined as the degree as to which recycled water demands is verified to be stable and long-term. This performance measure is scored on a scale of 1 to 5. A score of 1 represents an alternative that has few demands that are either temporary or not verifiable. A score of 5 represents an alternative that has verified demands that are long-term and continuous.

5. Identification of Alternatives

Meetings with both USC FMSD and EPGM included the discussion of potential sites available at each location for the proposed siting of a satellite treatment plant. Based on the current uses and future construction schedule at the UPC, no USC locations are available for siting the treatment facilities. In discussions with EPGM, several alternative locations were identified for further evaluation. The following sections discuss the different alternative locations available at Exposition Park and the surrounding area.

5.1 Alternative 1: L84 Foundation/John C. Argue Swim Stadium

A long narrow strip of City-owned land exists between the existing Swim Stadium and MLK Boulevard (see Figure 8). The vacant site is currently used only for storage by the landscape contractor (see Figure 9), which could be relocated elsewhere in the park. This property measures approximately 480 feet long by 40 feet (ft) wide and fronts MLK Boulevard.

Figure 8: Alternative 1 – Overview Map

Figure 9: Alternative 1 – Facing East

Despite its prime candidacy as vacant, City-owned parcel, Alternative 1 was preliminarily screened as unfeasible for a satellite plant location based on the following factors:

- Site constraints – The site is only 0.40 acres, thus providing insufficient width or area to adequately contain the proposed treatment facilities and ancillary buildings.
- Distance from wastewater source – There is no nearby, convenient access to an influent source for the plant as the ECIS is a couple blocks north of the site along Exposition Boulevard and the NOS is a couple blocks south along 41st Place.

No further evaluation was performed for Alternative 1.

5.2 Alternative 2: North of Rose Garden

The State of California presently leases the Rose Garden (see Figure 10) to the City. The area between the Rose Garden and Exposition Boulevard is owned by the State of California (see Figure 3). This area is an open green space with many tall trees, located directly opposite the Trousdale Parkway entrance at UPC. Two green parcels are available on either side of the Rose Garden entrance, each measuring approximately one acre. See Figures 11 through 14 for additional photos of Alternative 2.

Figure 10: Alternative 2 – Overview Map

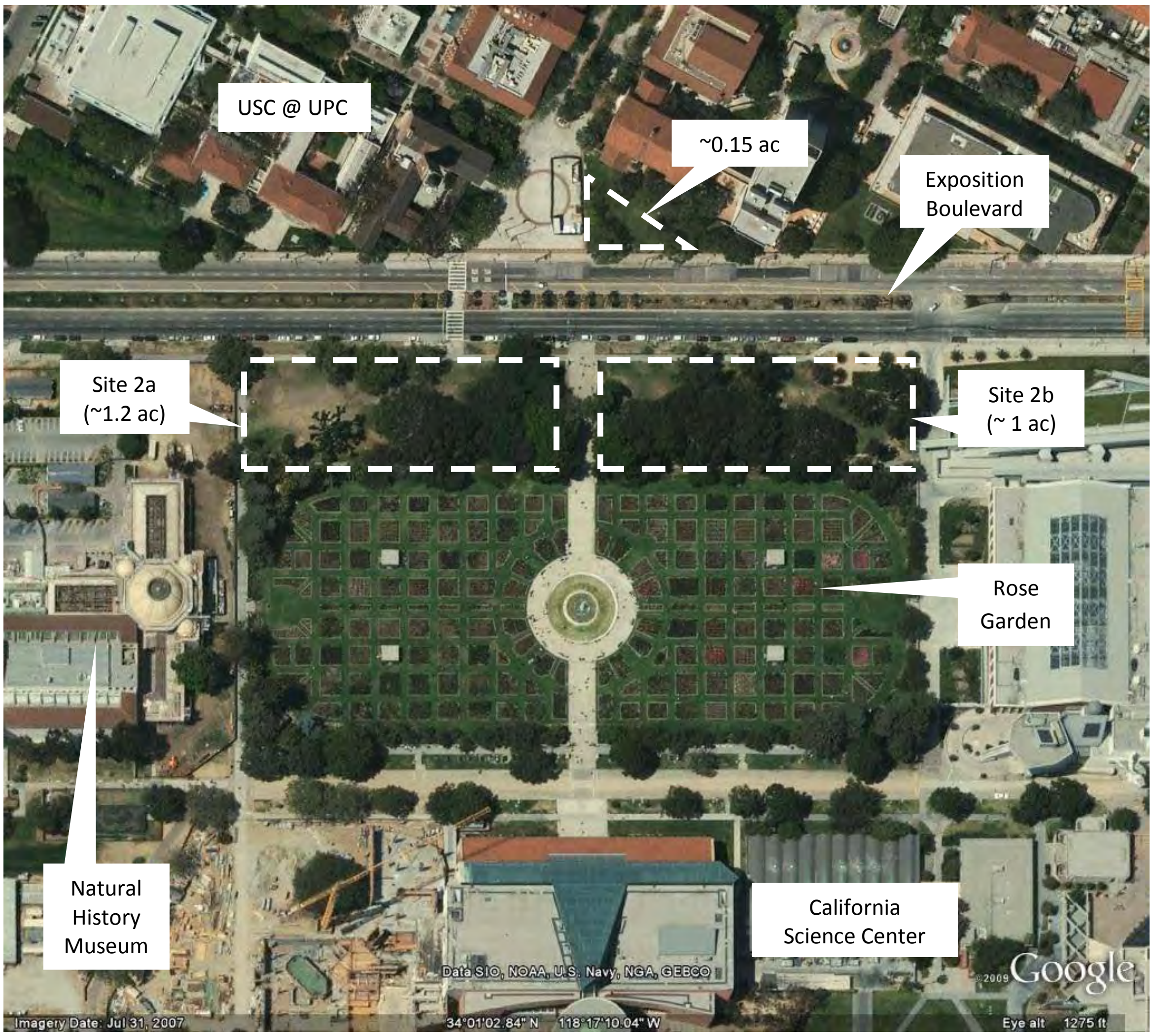


Figure 11: Alternative 2a – Facing East

Figure 12: Alternative 2a – Facing West

Figure 13: Alternative 2b – Facing Southeast

Figure 14: Alternative 2 – Facing South towards Rose Gardens

The site is presently used as a buffer between the Rose Garden and Exposition Boulevard, providing a green, shaded area for pedestrians and visitors to Exposition Park. This site is also in a very visible location as it flanks the main entrance to the Rose Garden on either side. In the near future, it will also front the Metropolitan Transportation Authority (MTA) light rail line (Expo Line) along Exposition Boulevard, which is under construction at the time of this writing. There is ample space on either site 2a or 2b to locate a 1-mgd satellite plant; a plant footprint spanning both sites would disrupt the main entrance to the Rose Garden. A 2.5-mgd plant was not considered for this site as there is not sufficient area at this location.

The site is centrally located between the UPC and Exposition Park demands as well as other local demands identified in Section 2.3. The site is also located next to the ECIS and across the street from the 11th/Hoover C primary sewers, resulting in convenient access to wastewater flow sources. As noted previously, although the ECIS is within close lateral distance, the invert of the ECIS is approximately 80 ft below grade, directly below the Expo Line alignment. Hence, tapping flows from the ECIS would most likely entail a very deep wet well structure receiving flows from an existing maintenance hole, which would pose both constructability and O&M challenges.

An alternate flow source would be the 11th/Hoover C primary sewer that travels down Trousdale Parkway through UPC before discharging into the ECIS. As noted in Table 5, sufficient minimum dry weather flow exists in this sewer to meet the satellite plant influent demand. The invert of the primary sewer is approximately 15 ft below grade just north of Exposition Boulevard. A diversion can be constructed to route flows to a satellite pump station within the UPC property line in order to lift flows across Exposition Boulevard to the satellite plant. Preliminary evaluation of a 1.1-mgd satellite pump station would have a footprint of 0.10 acres, including bar screens, wet well, equipment pad, odor control facility, generator, and ancillary facilities.

A possible location for the satellite pump station is an existing green space at UPC at the southeast corner of Trousdale Parkway and Exposition Boulevard (see Figures 15 and 16). This open space is approximately 0.15 acres, which is potentially sufficient for the footprint of a satellite pump station. From this location, flow will be conveyed via an approximately 600 ft 8-inch force main to the head of the satellite plant across the street.

As discussed in Section 3.3, the 1.1-mgd satellite plant can be within a footprint of approximately 1 acre (175 ft by 250 ft). Site 2a spans longitudinally next to Exposition Boulevard with approximate dimensions of 400 ft long by 120 ft wide, which provides adequate area for a 1.1-mgd satellite plant but may result in some space constraints in terms of laying out the facilities and buildings with adequate offsets and circulation. A 2.5-mgd plant could not be located at this site due to insufficient space available. Solids and sidestreams will be returned to the Exposition primary sewer. See Figure 17 for a conceptual layout of the satellite system for Alternative 2.

Figure 15: USC @ Trousdale Parkway, Facing East

Figure 16: USC @ Trousdale Parkway, Facing South towards Exposition Boulevard

Figure 17: Alternative 2 – Conceptual Satellite System Layout

~XX'

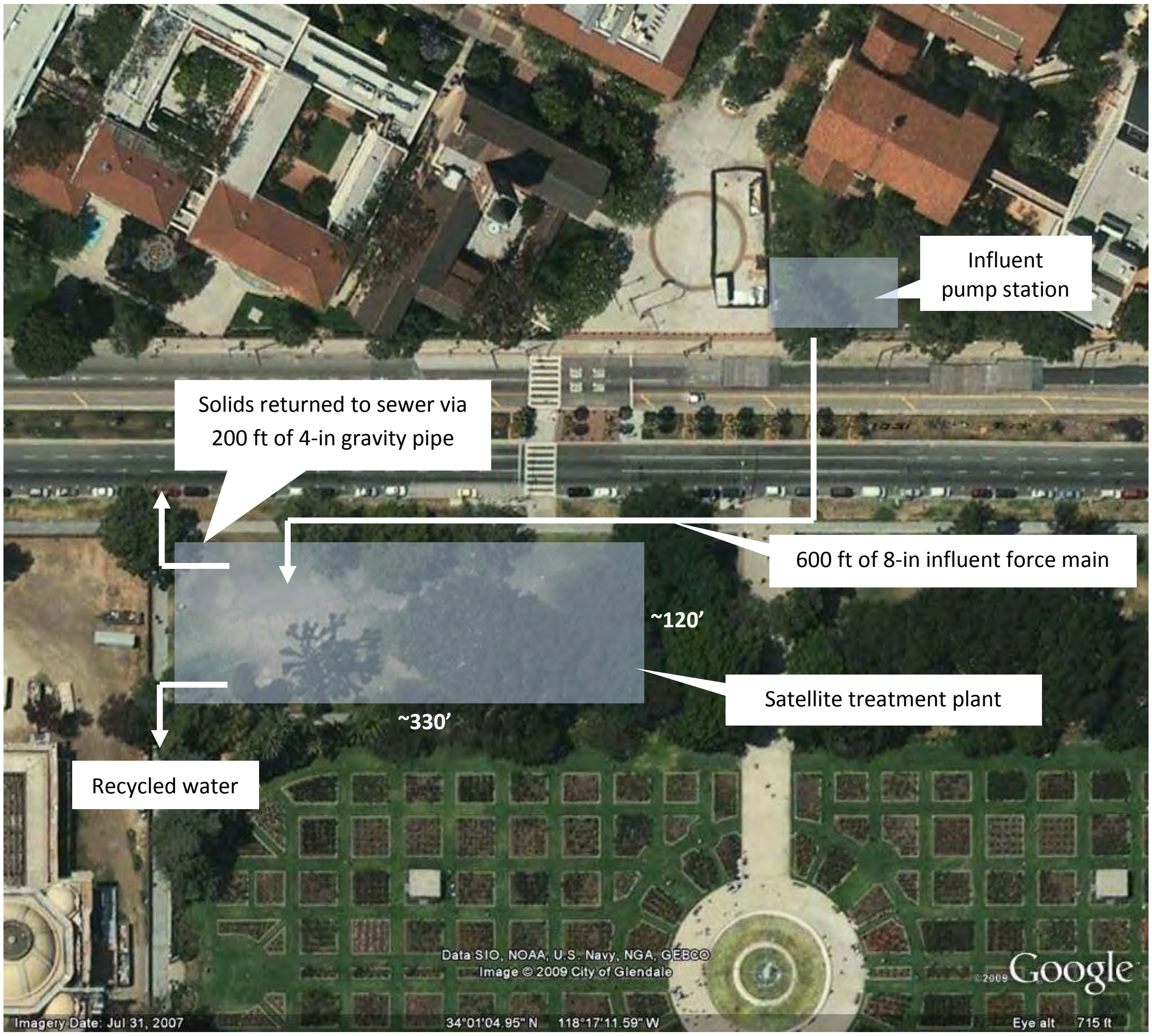


Figure 18 shows the typical costs of a packaged MBR treatment plant for different capacities based on available information on previous MBR projects performed by CDM. See Attachment A for a basis of these cost estimates. Based on the cost curves, the estimated capital costs for a 1.1-mgd plant is approximately $11 million, and O&M costs would be approximately $260,000 per year. Table 7 summarizes the footprints and costs associated with Alternative 2, including costs associated with land acquisition, but excluding costs for distribution mains, and customer connections. As noted previously, the proximity of the USC and Exposition Park connection points are assumed to be nearby and distribution piping internal to the customer site is not within this scope. Table 8 provides a discussion of the performance measures and scores associated with siting a satellite plant at this location.

Figure 18: Capital and O&M Cost Estimates for MBR Plants

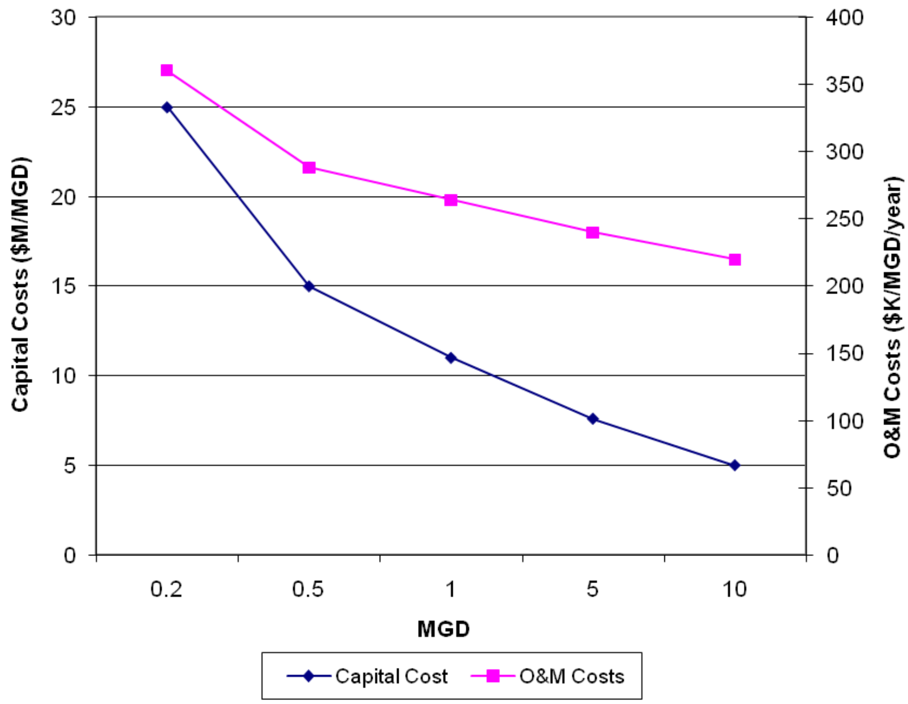


Table 7: Alternative 2 – Lifecycle Cost Estimates for Satellite Facilities

Facility	Footprint (acres)	Capital Cost ($ million)	Annual O&M Cost ($ million)	NPV
Storage Tank	N/A	-	-	-
Satellite plant, 1 mgd	1.0	11.00	0.26	-
Influent Pump Station: Pumps	0.1	0.06	0.03	-
Influent Pump Station: Pipelines	-	0.18	-	-
Waste Pipeline to Sewer	-	0.03	-	-
Distribution system: Pumps	N/A	-	-	-
Distribution System: Pipelines	N/A	-	-	-
Land Acquisition	1	2.00	-	-
Total NPV ($ million)				**$39.2**
Total cost per acre-foot (NPV/AF)				**$710/AF**

Notes:
a. Cost in 2009 dollars
b. Total cost assumes implementation of a 1-mgd satellite plant
c. NPV assumption include 3% construction escalator and 6% discount rate over 50 years
d. NPV includes 30% Contingency Cost and 30% Implementation Cost for Capital Costs
e. NPV includes 30% Contingency Cost for Operation and Maintenance Cost
f. Total cost includes the cost of odor control and relocation of trees

Table 8: Alternative 2 – Performance Measure Summary

Objective	Performance Measure	Description	Performance Score
Promote Cost Efficiency	Optimize lifecycle costs	Table 7 summarizes the cost associated with Alternative 2. In addition, the site is presently owned by the State of California. Purchase or lease of the land may also be necessary to site the plant, which would incur additional costs.	$710/AF
Achieve Supply and Operational Goals	Provide wastewater system benefits	Diversion and use of wastewater flows of the 11th/Hoover C primary sewers will preserve capacity in ECIS and HTP.	4
	Maximize operational flexibility	Access to the facility would primarily be from Exposition Boulevard, which is heavily travelled and includes Expo Line. Major operations for chemical filling or replacement of filters or pumps may require traffic control on this major street.	3
Protect the Environment	Minimize habitat impacts	The site is currently a green space with many large trees. Relocation of the trees may be possible but costly. Landscaping of the satellite plant site can be performed to blend with the surrounding area.	2
	Minimize GHG emissions	MBR facilities require more power consumption than other processes, but are recommended for their smaller footprint. Proximity to the source flow at Trousdale Parkway and Exposition Boulevard will minimize the power consumption required to pump influent to the head of the plant.	3
Maximize Implementation	Maximize public acceptance	This is a very visible area, across from UPC and next to the popular Rose Garden. There is potential to use the treatment plant as a teaching tool for USC engineering or environmental programs. It is also a potential tool for public educational tours to raise awareness and possibly increase acceptance. Odors will have to be strictly monitored and control to avoid public nuisance since this is a highly trafficked area. Treatment process will be mostly below grade and include architectural treatments to blend into the museum and park surroundings. Public information and coordination with council district and neighborhood groups will be required.	1
	Minimize permitting requirements	Site will require permits by RWQCB, AQMD, and possible zoning changes from Planning Department. ROW encroachment for crossing Exposition Boulevard under the MTA Expo Line. Also depending on final recycled demand locations, permission from Caltrans to cross freeways.	2

Objective	Performance Measure	Description	Performance Score
		Agreement and possible purchase of land from the State of California will also be required.	
Promote Economic and Social Benefits	Promote environmental justice	This area is in South LA, surrounded by institutional land uses, not adjacent to residential areas.	3
	Promote job creation	Construction of the facility may bring jobs to the local area. The operation of the treatment plant will likely be handled remotely with periodic visits for maintenance and supply of chemicals.	4
Maximize Adaptability and Reduce Risk	Maximize availability of source water	This location is next to ECIS outfall sewer as well as 11^{th}/Hoover C primary sewers. All sources have sufficient flow based on current modeling data to meet the recycled water demands.	5
	Maximize expansion capability	There is just over one acre on either site 2a or 2b. A 0.5-mgd facility would be feasible at this site; expansion to a 1-mgd facility should be feasible but may encounter space constraints given the limiting dimensions of the site. A facility larger than 1-mgd could not be accommodated on this site.	2
	Maximize reliability of demand for recycled water customers	Further discussions are needed to verify potential industrial demands. USC and Exposition Park have large areas for irrigation, although these would be seasonal demands and may require less recycled water in winter months. Other industrial demands in the area, as well as several schools, parks, and athletic facilities, could support year-round operation but these need to be further investigated.	3

5.3 Alternative 3: South Lawn

The South Lawn candidate site, located south of the Los Angeles County Natural History Museum, is presently an open space that is used for parking during the USC football season (see Figure 19). This site was previously used as a lay-down area for the construction of the California Science Center expansion. The site is currently a green space with several trees. The Natural History Museum's spider and butterfly exhibits are located on the north portion of the site. See Figures 20 through 22 for additional photos of Alternative 3.

Figure 19: Alternative 3 – Overview Map

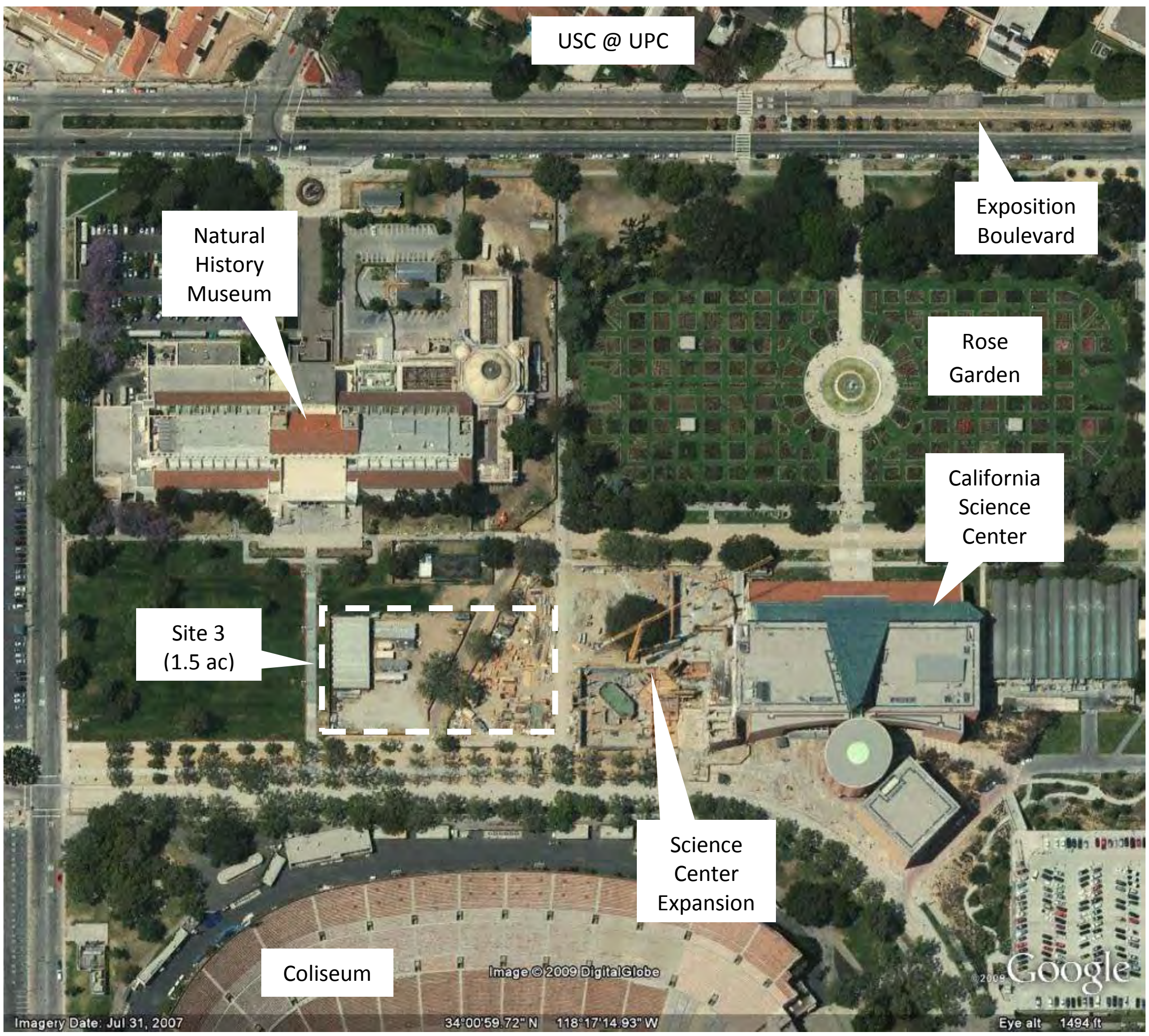


Figure 20: Alternative 3 – Facing Northwest towards Natural History Museum

Figure 21: Alternative 3 – Facing Northeast towards Rose Garden

Figure 22: Alternative 3 – Facing East towards Science Center Expansion

Similar to Alternative 2, the satellite plant at this site would receive influent from a satellite pump station on the UPC property at Trousdale Parkway scalping flows from the 11th/Hoover C primary sewer. The pump station transmission line would cross Exposition Boulevard and run south along an existing sidewalk between the Rose Garden and Natural History Museum to the South Lawn. As discussed in Section 3.2, a 1.1-mgd satellite plant can be located within a footprint of approximately 1 acre (175 ft by 250 ft). A 2.5-mgd plant would not have sufficient space to be located at this site. Solids and sidestreams will be returned to the Exposition primary sewer. Figure 23 provides the conceptual layout of the satellite system for Alternative 3.

Based on Figure 18, the estimated capital costs for a 1-mgd plant is approximately $11 million, and O&M costs are approximately $260,000 per year. Table 9 summarizes the footprints and costs associated with Alternative 3, including costs associated with land acquisition, but not costs for distribution mains, and customer connections. Table 10 provides a discussion of the performance measures and scores associated with siting a satellite plant at this location. Since Alternative 3 is located very near Alternative 2, many of the same performance scores apply similarly to Alternative 3.

Figure 23: Alternative 3 – Conceptual Satellite System Layout

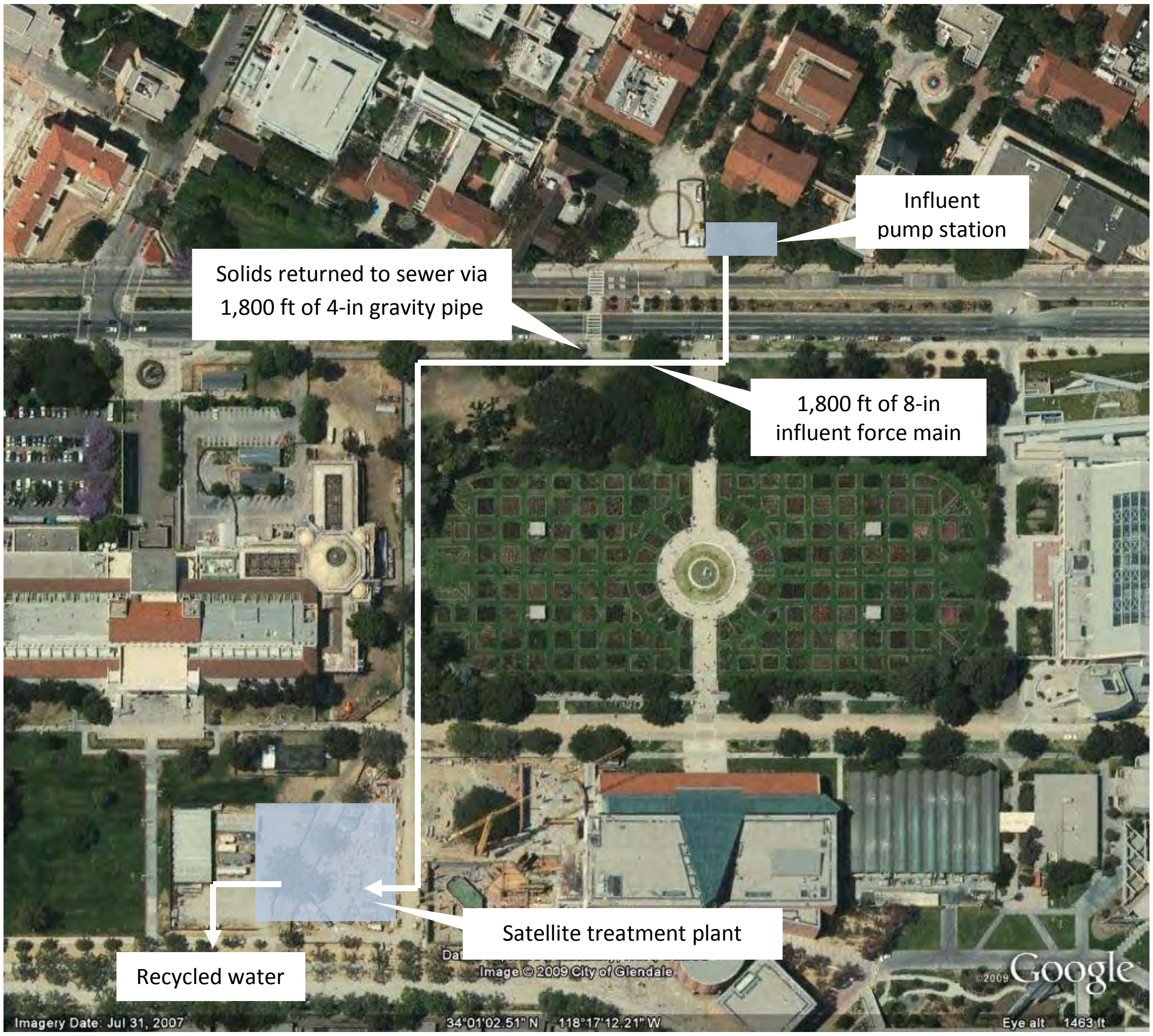


Table 9: Alternative 3 – Lifecycle Cost Estimates for Satellite Facilities

Facility	Footprint (acres)	Capital Cost ($ million)	Annual O&M Cost ($ million)	NPV
Storage Tank	N/A	-	-	-
Satellite plant, 1 mgd	1.0	11.00	0.26	-
Influent Pump Station: Pumps	0.1	0.07	0.03	-
Influent Pump Station: Pipelines	-	0.54	-	-
Waste Pipeline to Sewer	-	0.27	-	-
Distribution system: Pumps	N/A	-	-	-
Distribution System: Pipelines	-	-	-	-
Land Acquisition	1.0	2.00	-	-
Total NPV ($ million)				**$39.8**
Total cost per acre-foot (NPV/AF)				**$720/AF**

Notes:
a. Cost in 2009 dollars
b. Total cost assumes implementation of a 1-mgd satellite plant
c. NPV assumption include 3% construction escalator and 6% discount rate over 50 years
d. NPV includes 30% Contingency Cost and 30% Implementation Cost for Capital Costs
e. NPV includes 30% Contingency Cost for Operation and Maintenance Cost
f. Total cost includes the cost of odor control and relocation of trees

Table 10: Alternative 3 – Summary of Performance Measures

Objective	Performance Measure	Description	Performance Score
Promote Cost Efficiency	Optimize lifecycle costs	Table 9 summarizes the cost associated with Alternative 3. In addition, the site is presently owned by the State of California. Purchase or lease of the land may also be necessary to site the plant, which would incur additional costs.	\$720/AF
Achieve Supply and Operational Goals	Provide wastewater system benefits	Diversion and use wastewater flows of the 11th/ Hoover C primary sewers will preserve capacity in ECIS and HTP.	4
	Maximize operational flexibility	Continuous supply of wastewater will allow flexibility to meet varying demands. Access to the facility would be by existing service roads off the main thoroughfares (i.e., Exposition Boulevard) with more open space surrounding the site.	4
Protect the Environment	Minimize habitat impacts	The site is currently a green space with several large trees. It is used periodically as additional parking and tail-gating location for USC football games. It was used previously as a lay-down area for the construction of the California Science Center Expansion. Relocation of the trees may be possible but costly. Landscaping of the satellite plant site can be performed to blend with the surrounding area.	3
	Minimize GHG emissions	MBR Facilities require more power consumption than other processes, but are recommended for their smaller footprint. The longer distance from source flow at Trousdale Parkway and Exposition Boulevard will require higher power consumption to pump influent to the head of the plant.	2
Maximize Implementation	Maximize public acceptance	This is a visible area, directly south of the Natural History Museum, west of the California Science Center, and north of the Coliseum. However, the site is set back away from the main thoroughfares, namely Exposition Boulevard and there is potential for some minimal buffer area between the museums. There is potential to use the treatment plant as a teaching tool for USC engineering or environmental programs. It is also a potential tool for public educational tours to raise awareness and possibly increase acceptance. Incorporation as an extension or exhibit of the Science Center for education purposes may increase public acceptance through education. Odors will have to be strictly monitored and control to avoid public nuisance	4

Objective	Performance Measure	Description	Performance Score
		since this is a highly trafficked area. Treatment process will be mostly below grade and include architectural treatments to blend into the museum and park surroundings. Public information and coordination with council district and neighborhood groups will be required.	
	Minimize permitting requirements	Site will require permits by RWQCB, AQMD, and possible zoning changes from Planning Department. ROW encroachment for crossing Exposition Boulevard under the MTA Expo Line. Also depending on final recycled demand locations, permission from Caltrans to cross freeways. Agreement and possible purchase of land from the State of California will also be required.	2
Promote Economic and Social Benefits	Promote environmental justice	This area is in South LA, surrounded by institutional land uses, not adjacent to residential areas.	3
	Promote job creation	Construction of the facility may bring jobs to the local area. The facility will require personnel to staff the operations and laboratory. There may possibly be additional jobs to aid with public outreach, plant tours, and recycled water education.	4
Maximize Adaptability and Reduce Risk	Maximize availability of source water	This location is next to ECIS outfall sewer as well as 11^{th}/Hoover C primary sewers. All sources have sufficient flow based on current modeling data to meet the recycled water demands.	5
	Maximize expansion capability	There is approximately 1.5 acres at this location. A facility with capacity slightly more than 1 mgd would be feasible at this site, but there is not sufficient space for build-out to meet all potential demands.	3
	Maximize reliability of demand for recycled water customers	Further discussions are needed to verify potential demands. USC and Exposition Park have large areas for irrigation, although these would be seasonal demands and may require less recycled water in winter months. Other industrial demands in the area, as well as several schools, parks, and athletic facilities, could support year-round operation but these need to be further investigated.	3

5.4 Alternative 4: Gilbert Lindsay Recreation Center

City-owned properties beyond the boundaries of Exposition Park were investigated for potential site candidacy. As indicated on Figure 4, there are no available City-owned sites near primary or outfall sewers north of Exposition Boulevard or south of MLK Boulevard. The largest, nearby City-owned property is located east of the 110 Freeway at the Gilbert Lindsay Recreation Center (GLRC). The GLRC (see Figure 24) is located on approximately 8.5 acres at 41st Place and San Pedro Street and includes a baseball diamond, multipurpose athletic fields, skate park, green open space, and a community center. The GLRC shares the same city block with the Kedren Community Mental Health Center to the east and is approximately one block away from the NOS, which runs at 41st Place and Trinity Street. While Sites 1, 2, and 3 served USC and Exposition Park only, Site 4 would also serve other identified customers in the area. Figure 25 outlines the proposed distribution system and customers. See Figures 26 thru 28 for additional photos of Alternative 4.

Figure 24: Alternative 4 – Overview Map

Figure 25: Alternative 4 – Distribution System

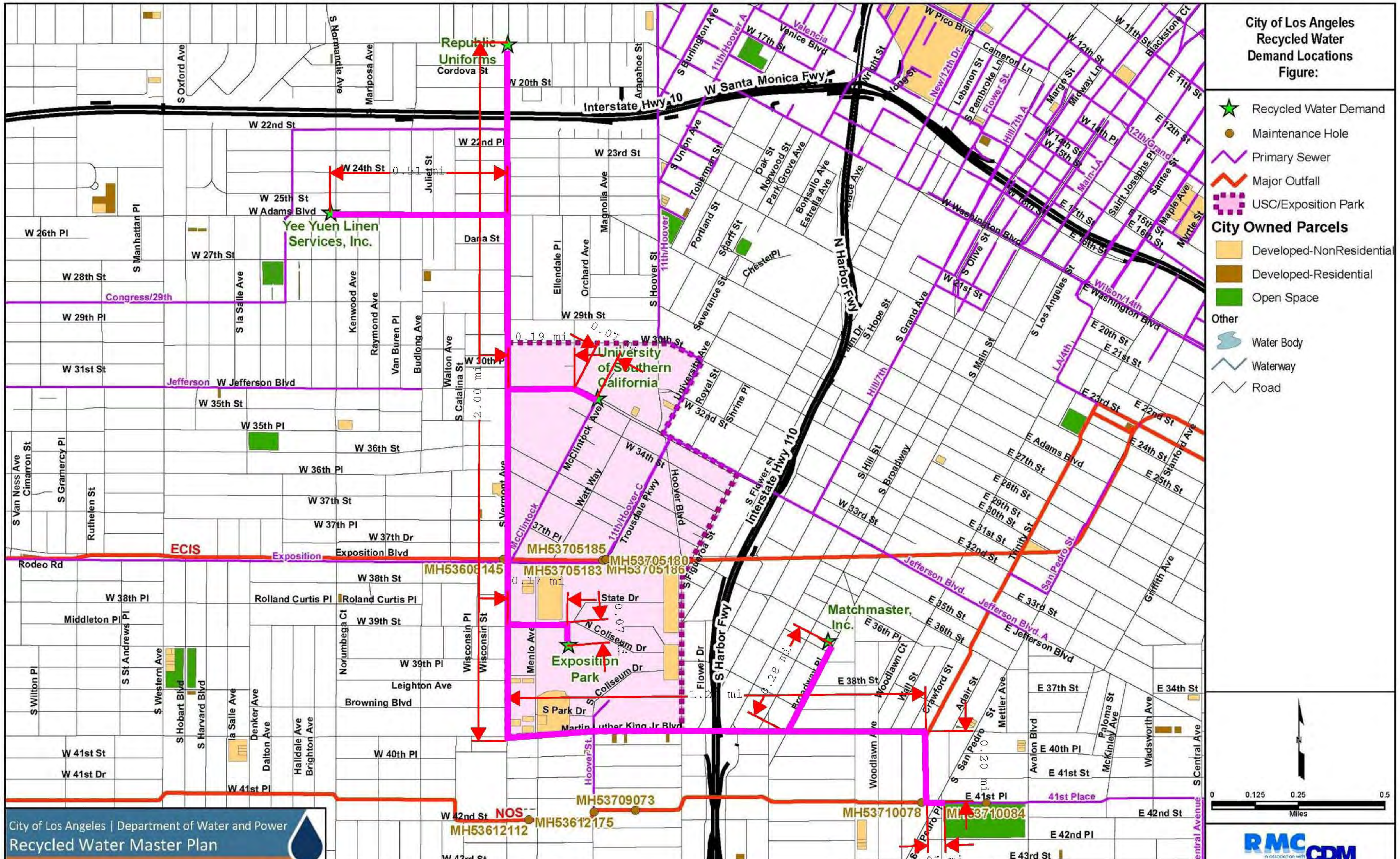


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Table 11: Alternative 4 – Distribution System

Distribution System Segment	Distance (miles)
Main pipeline from source to Republic Uniforms	3.45
Branch to Matchmaster Inc.	0.28
Branch to Exposition Park	0.24
Branch to USC	0.26
Branch to Yee Yuen Linen Services, Inc.	0.51

Figure 26: Alternative 4 – Open Space, Facing South from 41st Place

Figure 27: Alternative 4 – Open Space, Facing North towards 41st Place

Figure 28: Alternative 4 – Soccer Field, Facing North towards 41st Place

This site is 8.5 acres and could accommodate a 1.1- or 2.5-mgd satellite plant. The satellite plant at this site would receive influent from the NOS at 41st Place and Trinity St. The primary sewer located in 41st Place closer to the site does not have sufficient dry weather flow to supply either a 1.1-or 2.5-mgd plant during minimum flow periods (See Table 5). The pump station transmission line would cross San Pedro and run along 41st Place to the inlet of the plant. As discussed in Section 3.2, a 1.1-mgd satellite plant can be located within a footprint of approximately 1 acre (200 ft by 200 ft). A 2.5-mgd plant would require approximately 2.7 acres. Solids and sidestreams will be returned to the NOS sewer. Figure 24 shows the potential area available for the 2.5-mgd satellite system for Alternative 4.

Based on Figure 18, the estimated capital costs for a 2.5-mgd plant is approximately $25 million, and O&M costs are approximately $740,000 per year. Table 12 summarizes the footprints and costs associated with Alternative 4, including costs associated with land acquisition. Distribution piping from the satellite plant to the identified demands is included. Table 13 provides a discussion of the performance measures and scores associated with siting a satellite plant at this location.

Table 12: Alternative 4 – Lifecycle Cost Estimates for Satellite Facilities

Facility	Footprint (acres)	Capital Cost ($ million)	Annual O&M Cost ($ million)	NPV
Storage Tank	0.3	1.00	-	-
Satellite plant, 1 mgd	2.7	25.00	0.74	-
Influent Pump Station: Pumps	0.25	0.07	0.03	-
Influent Pump Station: Pipelines	-	0.30	-	-
Waste Pipeline to Sewer	-	0.15	-	-
Distribution system: Pumps	-	0.46	0.1	-
Distribution System: Pipelines	-	7.82	-	-
Land Acquisition	2.7	5.40	-	-
Total NPV ($ million)				**$110.3**
Total cost per acre-foot				**$790/AF**

Notes:
a. Cost in 2009 dollars
b. NPV assumption include 6% interest rate and 4% inflation rate over 50 years
c. NPV assumption include 3% construction escalator and 6% discount rate over 50 years
d. NPV includes 30% Contingency Cost for Operation and Maintenance Cost
e. Total cost includes the cost of odor control and relocation of trees

Table 13: Alternative 4 – Summary of Performance Measures

Objective	Performance Measure	Description	Performance Score
Promote Cost Efficiency	Optimize lifecycle costs	Table 11 summarizes the cost associated with Alternative 4 including land acquisition to offset taking City park space. It is assumed park area would need to be replaced within the community	$790/AF
Achieve Supply and Operational Goals	Provide wastewater system benefits	Diversion of NOS from 41st Place and Trinity would preserve capacity in the NOS. Solids and sidestreams would be discharged to the NOS	4
	Maximize operational flexibility	Continuous supply of wastewater will allow flexibility to meet varying demands. Access to the facility would be from city streets.	4
Protect the Environment	Minimize habitat impacts	The site is currently a city park with green space, soccer fields and several large trees. Landscaping of the satellite plant site can be performed to blend with the surrounding area	1
	Minimize GHG emissions	MBR facilities require more power consumption than other processes, but are recommended for their smaller footprint. Distance from NOS to GLRC would require higher power consumption to pump influent to the head of the plant	2
Maximize Implementation	Maximize public acceptance	GLRC is in a residential neighborhood and includes many recreation facilities such as a baseball diamond, soccer fields and a skate park. Alternative recreational facilities would need to be provided in the community to get public support. The site required for the satellite plant will not take up the whole park area and some recreation facilities could be maintained. Odors will have to be strictly monitored and controlled to avoid public nuisance. Treatment processes will be mostly below grade and include architectural treatments. Public information and coordination with the council district and neighborhood groups will be required.	1
	Minimize permitting requirements	Site will require permits by RWQCB, AQMD, and possible zoning changes from the Planning Department. Depending on final recycled water demand locations, permission from Caltrans to cross freeways will also be required.	3
Promote Economic and Social Benefits	Promote environmental justice	The GLRC is in south LA surrounded by residential areas. It is a public park in an underserved community. This can be mitigated by creating park space elsewhere within the community.	2

Objective	Performance Measure	Description	Performance Score
	Promote job creation	Construction of the facility may bring jobs to the local community. The facility will require personnel to staff the operations and laboratory. There may be the possibility of additional jobs for public outreach, plant tours, and recycled water education.	4
Maximize Adaptability and Reduce Risk	Maximize availability of source water	This is in reasonable proximity to NOS which has sufficient flow currently to meet the plant demands.	4
	Maximize expansion capability	There is approximately 8.5 acres of open space at this site. 2.7 acres is needed for the plant. There is potential for expansion of the facilities.	4
	Maximize reliability of demand for recycled water customers	Further discussions are needed to verify potential demands. USC and Exposition Park have large areas for irrigation, although these would be seasonal demands and may require less recycled water in winter months. Other industrial demands, as well as several schools, parks and athletic facilities could support year-round operations but need to be further investigated. This site is one of the parks and the construction of the facility would remove some demand. However, it is assumed that there would be an offset by creation of additional park space elsewhere.	3

5.5 Alternative 5: Open Lot

Alternative 5 is a non-City-owned site that is approximately 14.5 acres. The site is bounded on the west by Long Beach Avenue, on the east by South Alameda Street, on the north by East Martin Luther King Jr. Boulevard, and on the south by East 41st Street. The site is open land surrounded by industry on 3.5 sides and housing on 0.5 sides. The site is about 2500 feet away from the ECIS and about 500 feet away from a local primary sewer. Figure 29 provides an overview of the site.

While Sites 1, 2, and 3 served USC and Exposition Park only, Site 5 would also serve other identified customers in the area. Figure 30 outlines the proposed distribution system and customers.

Figure 29: Alternative 5 – Overview Map

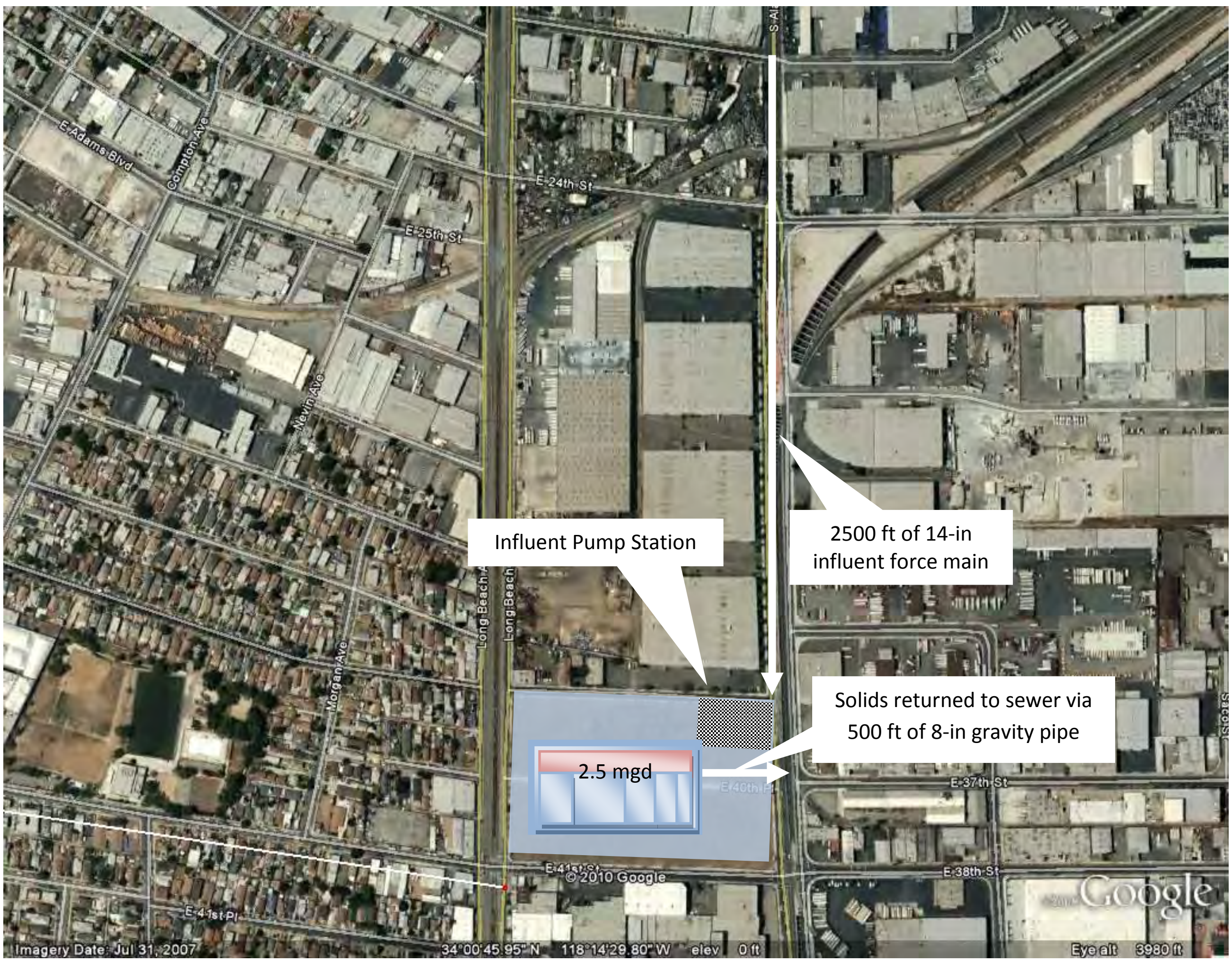

Figure 30: Alternative 5 – Distribution System

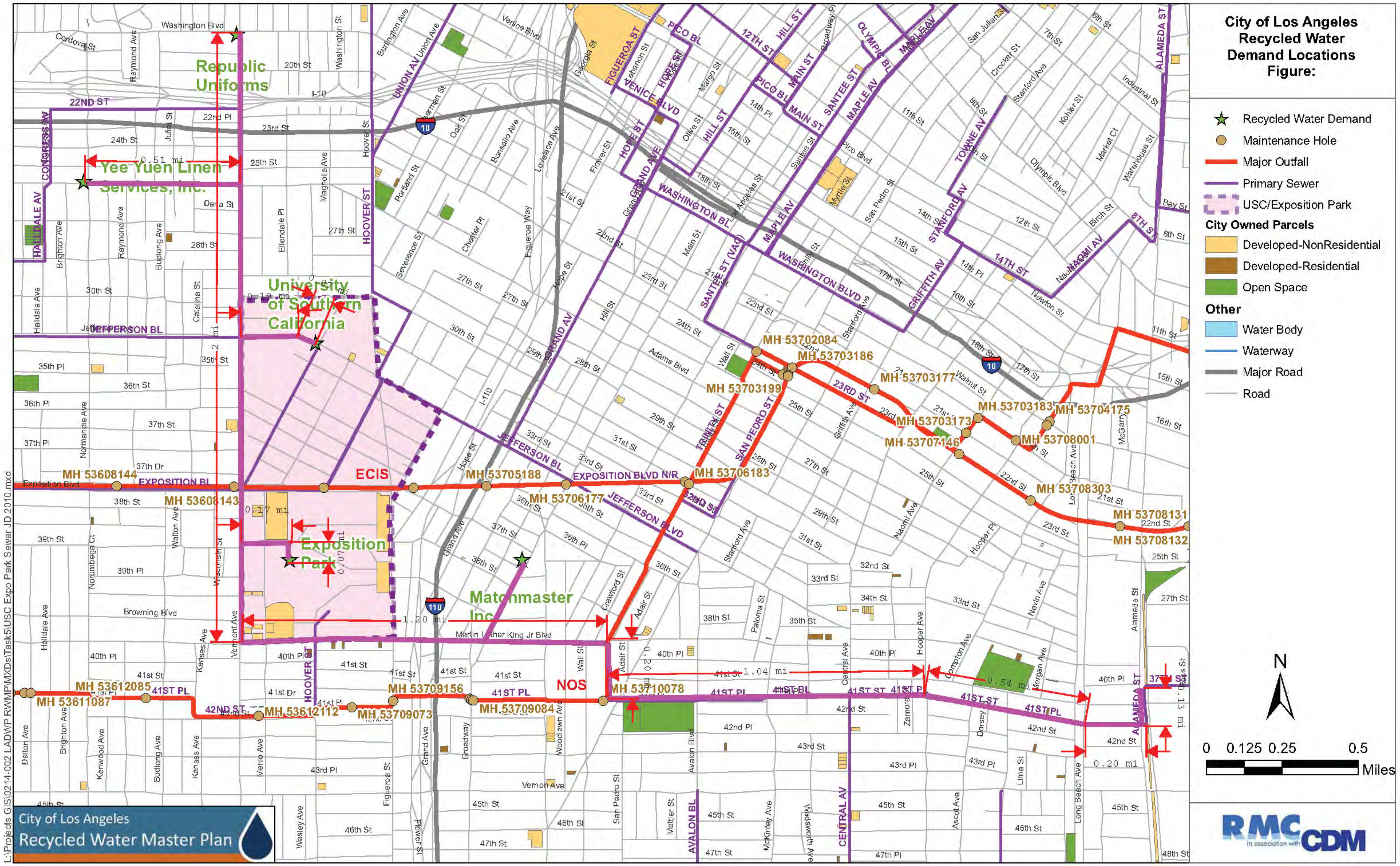

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Table 14: Alternative 5 – Distribution System

Distribution System Segment	Distance (miles)
Main pipeline from source to Republic Uniforms	5.31
Branch to Matchmaster Inc.	0.28
Branch to Exposition Park	0.24
Branch to USC	0.26
Branch to Yee Yuen Linen Services, Inc.	0.51

This site is 14.5 acres and could accommodate a 1.1- or 2.5-mgd satellite plant. The satellite plant at this site would receive influent from the ECIS at 22nd Street and South Alameda Street. The primary sewer located on South Alameda Street closer to the site does not have sufficient dry weather flow to supply either a 1-or 2.5-mgd plant during minimum flow periods. As discussed in Section 3.2, a 1-mgd satellite plant can be located within a footprint of approximately 1 acre (200 ft by 200 ft). A 2.5-mgd plant would require approximately 2.7 acres. Solids and sidestreams will be returned to the nearby primary sewer, which has the required capacity. Figure 29 shows the potential area available for the 2.5-mgd satellite system for Alternative 5.

Based on Figure 18, the estimated capital costs for a 2.5-mgd plant is approximately $25 million, and O&M costs are approximately $740,000 per year. Table 15 summarizes the footprints and costs associated with Alternative 5, including costs associated with land acquisition. Distribution piping from the satellite plant to the identified demands is included. Table 16 provides a discussion of the performance measures and scores associated with siting a satellite plant at this location.

Table 15: Alternative 5 – Lifecycle Cost Estimates for Satellite Facilities

Facility	Footprint (acres)	Capital Cost ($ million)	Annual O&M Cost ($ million)	NPV
Storage Tank	0.3	1.00	-	-
Satellite plant, 1 mgd	2.7	25.00	0.74	-
Influent Pump Station: Pumps	0.25	0.21	0.03	-
Influent Pump Station: Pipelines	-	1.40	-	-
Waste Pipeline to Sewer	-	0.15	-	-
Distribution system: Pumps	-	0.50	0.1	-
Distribution System: Pipelines	-	11.30	-	-
Land Acquisition	2.7	5.40	-	-
Total NPV ($ million)				**$120.3**
Total cost per acre-foot				**$860/AF**

Notes:
a. Cost in 2009 dollars
b. NPV assumption include 6% interest rate and 4% inflation rate over 50 years
c. NPV assumption include 3% construction escalator and 6% discount rate over 50 years
d. NPV includes 30% Contingency Cost for Operation and Maintenance Cost
e. Total cost includes the cost of odor control and relocation of trees

Table 16: Alternative 5 – Summary of Performance Measures

Objective	Performance Measure	Description	Performance Score
Promote Cost Efficiency	Optimize lifecycle costs	Table 15 summarizes the cost associated with Alternative 5 including land acquisition.	$860/AF
Achieve Supply and Operational Goals	Provide wastewater system benefits	Diversion of ECIS from near 22nd St and Alameda St would preserve capacity in the ECIS. Solids and sidestreams would be discharged to the primary system, which has necessary capacity at this location	4
	Maximize operational flexibility	Continuous supply of wastewater will allow flexibility to meet varying demands. Access to the facility would be from city streets. However, the source wastewater from ECIS is 2500 ft from site	3
Protect the Environment	Minimize habitat impacts	Currently, this site is unused, open space. It is surrounded by industrial buildings on 3.5 sides (0.5 of one side is residential).	4
	Minimize GHG emissions	This site has more pumping due to the distance between ECIS and the plant.	1
Maximize Implementation	Maximize public acceptance	While this is a currently an empty site, this particular plot of land has been the subject of public disagreements in the recent past (South Central Farm/LA's LANCER Project)	1
	Minimize permitting requirements	Site will require permits by RWQCB, AQMD, and possible zoning changes from the Planning Department. Depending on final recycled water demand locations, permission from Caltrans to cross freeways will also be required.	3
Promote Economic and Social Benefits	Promote environmental justice	This is an open space site in south LA. It was previously a community garden in an underserved community (South Central Farm).	2
	Promote job creation	Construction of the facility may bring jobs to the local community. The facility will require personnel to staff the operations and laboratory. There may be the possibility of additional jobs for public outreach, plant tours, and recycled water education.	4
Maximize Adaptability and Reduce Risk	Maximize availability of source water	This site is 2500 ft away from ECIS, which has sufficient flow currently to meet the plant demands.	2
	Maximize expansion capability	There is room for expansion on the proposed site. Site is bounded by a railroad on the east side and residential on the west side. There is possible room	4

Objective	Performance Measure	Description	Performance Score
		for expansion in industrial areas to the north and south.	
	Maximize reliability of demand for recycled water customers	Further discussions are needed to verify potential demands. USC and Exposition Park have large areas for irrigation, although these would be seasonal demands and may require less recycled water in winter months. Other industrial demands, as well as several schools, parks and athletic facilities could support year-round operations but need to be further investigated.	3

6. Summary of Alternatives Rankings

6.1 Overview of Alternatives Analysis

Table 17 summarizes and compares the performance measures across these alternatives as identified in Section 5.

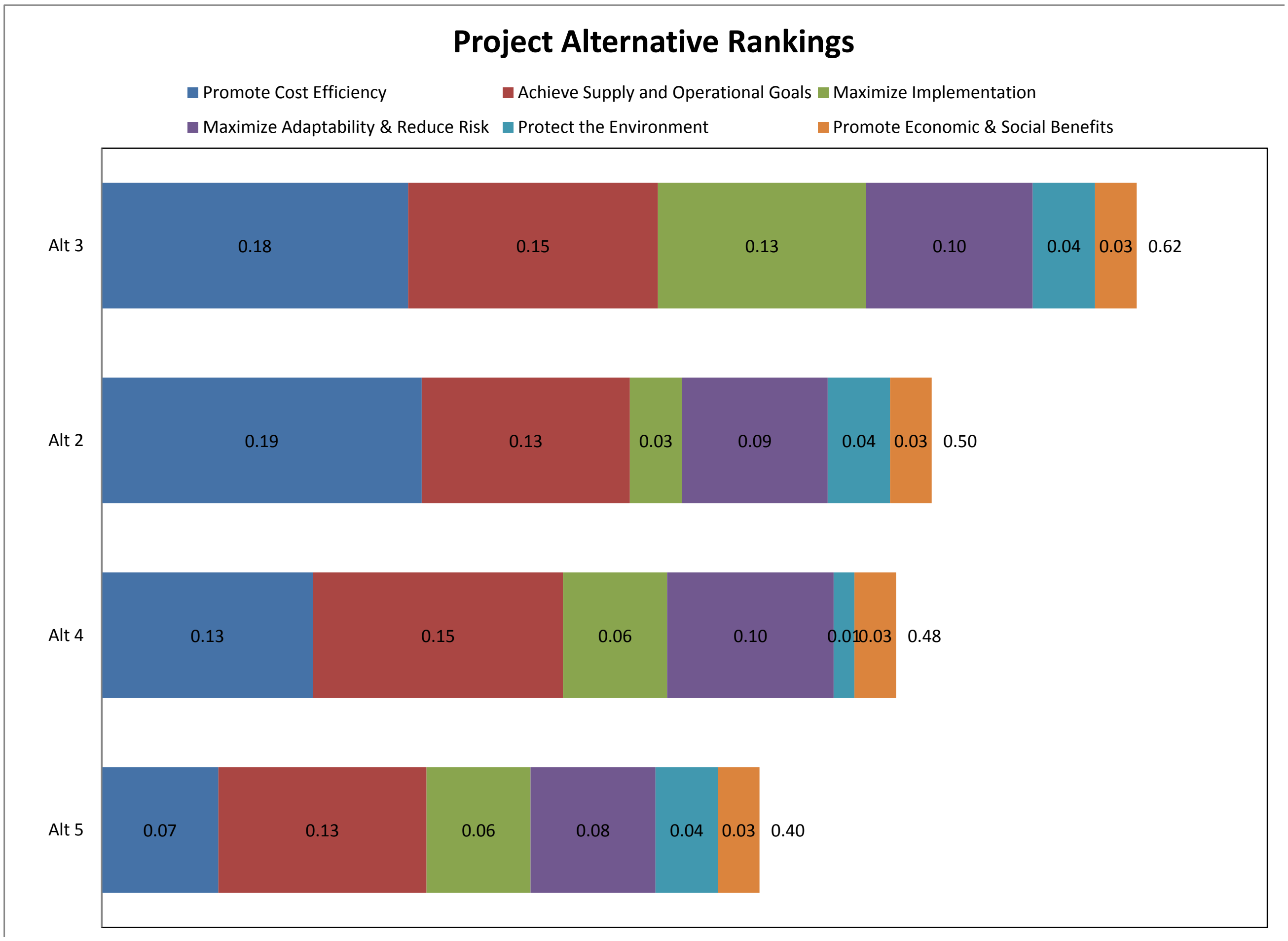
Table 17: Summary of Objectives and Performance Scores

Objective	Weight	Performance Measure	Performance Score			
			Alternative 2	Alternative 3	Alternative 4	Alternative 5
Promote Cost Efficiency	25%	Optimize NPV/AF	$710/AF	$720/AF	$790/AF	$860/AF
Achieve Supply and Operational Goals	20%	Provide wastewater system benefits	4	4	4	4
		Maximize operational flexibility	3	4	4	3
Protect the Environment	10%	Minimize habitat impacts	2	3	1	4
		Minimize GHG emissions	3	2	2	1
Maximize Implementation	25%	Maximize public acceptance	1	4	1	1
		Minimize permitting requirements	2	2	3	3
Promote Economic and Social Benefits	5%	Promote environmental justice	3	3	2	2
		Promote job creation	3	3	4	4
Maximize Adaptability and Reduce Risk	15%	Maximize availability of source water	5	5	4	2
		Maximize expansion capability	2	3	4	4
		Maximize reliability of demand for recycled water customers	3	3	3	3

The alternatives and their performance scores are evaluated against the weighted objectives. The result is a score and a ranking for each alternative, where alternatives with better scores in the highly weighted criteria do better than alternatives with lower scores. Criterium Decision Plus® (CDP), a commercial decision model software that performs multi-attribute rating techniques, was used for this assessment. As described in Section 4, each alternative was characterized in terms of the objectives described in Table 13. The objective weights and the alternative scores were entered directly into the decision science model. The software then normalizes the alternative scores and multiplies them by the criteria weights and provides an overall decision score.

The result of the alternatives analysis is shown in Figure 31 and is discussed in Section 6.2. Note that in these figures, the overall length of the horizontal bars represents the total decision score for the alternative. The overall score indicates how well each alternative did in meeting the overall set of objectives. The colored segments within each bar represent the contribution of each of the individual objective to the total decision score. Two factors determine the size of each color segment for a given bar, or alternative: 1) the raw performance or score of the alternative for that objective; and 2) the weight of the objective. Typically, if the color segment is wider, then the raw performance was very good when considered along with the weight of importance. However, if the color segment is smaller, it could be because of the poor performance, or a low weight of importance, or both.

Figure 31: Alternatives Ranking Results



6.2 Recommended Satellite Plant Location

As shown in Figure 31, Alternative 3 ranks as the more favorable site compared to Alternatives 2, 4, and 5. Both Alternatives 2 and 3 rank fairly similar in terms of promoting cost efficiency, achieving supply and operational goals, maximizing adaptability and reducing risk, protecting the environment, and promoting economic and social benefits. However, Alternative 3 scored significantly higher in terms of maximizing implementation, which contributes heavily to its preference over Alternative 2, 4, and 5. Alternative 4 scored well in achieving supply and operation goals and maximizing adaptability due to the larger plant size and ability to supply recycled water to a greater number of demands. However, it would require land purchase to offset the removal of the public park area at the Gilbert Lindsay Recreation Center. Alternatives 4 and 5 have the additional costs of distribution piping to the demands further away from the plant site. Between these two sites, Alternative 5 has a much longer influent pipeline from the sewer than Alternative 4. It also has a longer distribution pipeline system than Alternative 4, because Alternative 5 is further east of the identified customers than Alternative 4. The costs associated with the distribution systems of Alternative 4 and 5 were not in the other alternatives because the smaller plant size allowed supply to only the immediate area. Alternative 3 is set back further from Exposition Boulevard and slightly larger than Alternative 2, which provides for more flexibility in terms of construction, operations, and expansion. Alternative 3 will also result in fewer impacts to existing trees; Alternative 2 would result in the displacement of many trees and disrupt the existing green open space that serves as the grand entrance to the Rose Garden as well as a buffer between the Rose Garden and Exposition Boulevard. Alternative 3 will also allow the facility to be potentially used for public education as a result of its proximity to the California Science Center.

Should locating a satellite treatment facility at Exposition Park be implemented for the public education opportunity, several items require resolutions that are beyond the scope of this assessment. Approval from the Exposition Park General Management and the State of California is a phased process starting with discussions with the EPGM. Initial discussions with the EPGM indicated the following steps for implementation:

- Following determination of the size and preferred location, a meeting will be set up by EPGM with their Board and the other user groups at Exposition Park: California Science Museum, LA County Natural History Museum, African American Museum, the Coliseum Commission, as well as council and state assembly offices that use the site. This meeting would be to inform the other users of the potential project and collect feedback.
- Application must be made to the State of California Department of General Services who will review the project and give approval for the use of state land. This process takes up to six months.
- The facility should be below-grade and low profile to fit in with the surrounding museum and park setting.
- Permitting and environmental clearances.

Discussions with USC indicated several on-going projects and coordination with the FMSD staff will be necessary to schedule installation of piping and necessary equipment on the campus.

6.3 Expansion of Existing Recycled Water System

The satellite plant alternatives were compared against the alternative of expanding the existing recycled water distribution system. Task 2 designed several project options to expand the recycled water system. Project Options 1 and 2/2a are useful for comparison to the alternatives in this TM, because they serve the majority of the customers identified in this TM as well as some additional customers along the routes. Figure 32 provides an overview of Task 2's project concepts, while Figure 33 depicts recycled water systems in the Los Angeles area.

Projection Option 1 would expand the Central Basin Municipal Water District (CBMWD) system west to USC Campus and Matchmaster, both identified in this TM as well. Along the way, it would serve the following additional customers: Seoul Texprint, Universal Dyeing, Coca-Cola Bottling, Dye House Inc., and Washington Garment. As can be seen in Figure 28, CBMWD has an existing 12-inch recycled water line approximately 5 miles away in the City of Vernon. A proposed 30-inch diameter line is planned to connect to the existing CBMWD system in this area. The pipeline has been designed and will be constructed when there is firm demand for the recycled water. Between the proposed extension and USC/Exposition Park there are several demands within the City that could be served. This would not require the capital and O&M expenditure for a new treatment facility, but would require the purchase of recycled water from CBMWD. If a larger satellite facility in the Central City area is identified in further studies as part of this project, recycled water may be provided to the additional demands or sold to CBWMD for their recycled water system.

Project Option 2/2a would expand the West Basin Municipal Water District (WBMWD) system from the Edward C. Little Water Recycling Facility (ELWRF) east to USC Campus and Matchmaster and then to Lewco Linens (referred to as Yee Yuen Linen Services in this TM) and Rosedale Cemetery. Along the way, Project Option 2/2a passes next to Exposition Park, another customer identified in this TM.

Table 18 outlines the costs of these projects. For comparison, the costs of the alternatives in this TM have been reproduced in Table 19. With the exception of Task 2 Project Concept 2a, extending the recycled water system has a lower cost over implementing the satellite plant projects.

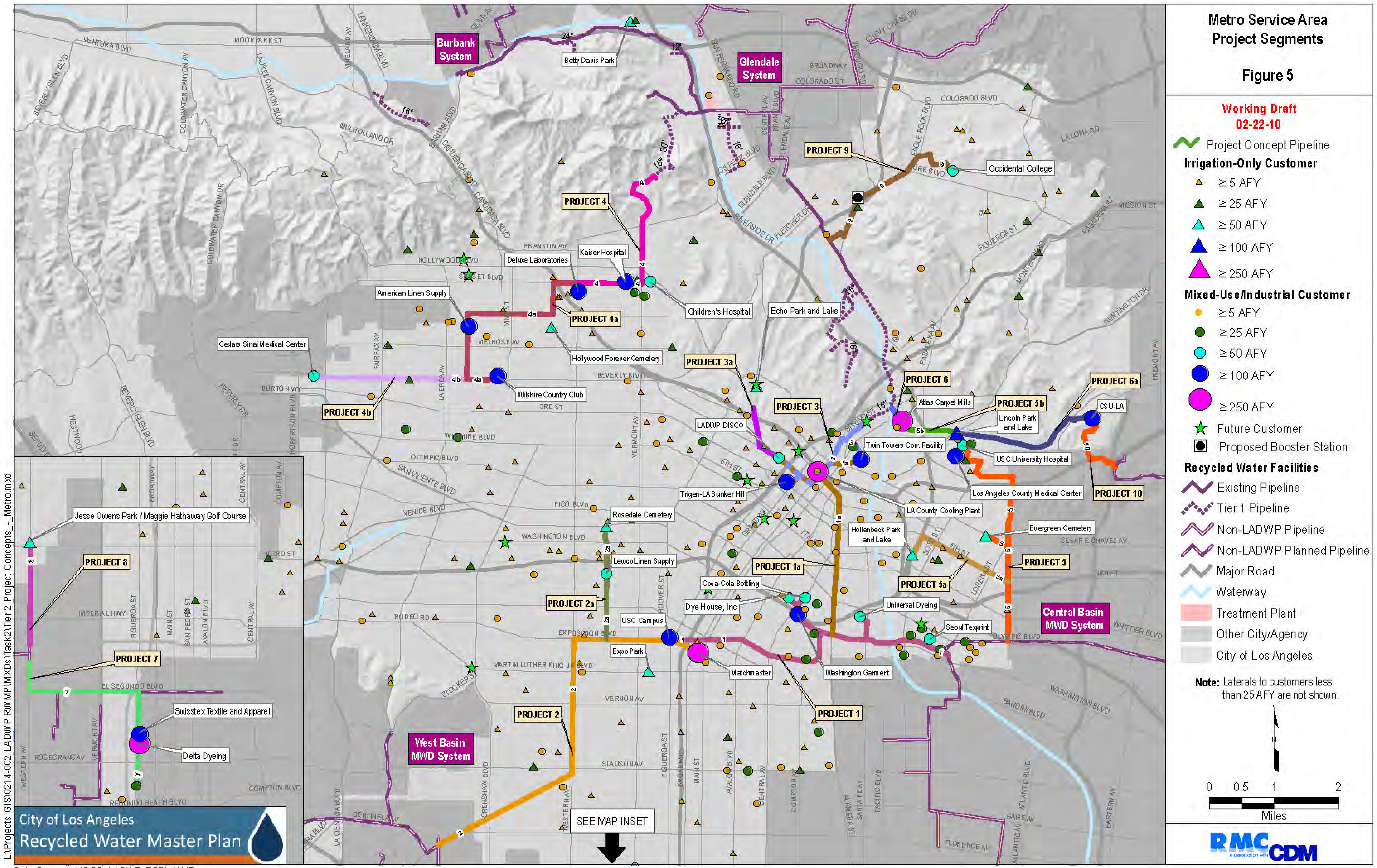
Table 18: Task 2 Project Concept Costs

#	Supply	Description	NPV/AF ($)
1	CBMWD	West from CBMWD to USC Campus & Matchmaster	$610
2	ELWRF	East from ELWRF to USC Campus & Matchmaster	$680
2a	ELWRF	Project 2 Extension to Lewco & Rosedale Cemetery	$930

Table 19: Satellite Plant Project Alternatives Costs

#	Description	NPV/AF ($)
2	North of Rose Garden	$710
3	South Lawn	$720
4	Gilbert Lindsay Recreation Center	$790
5	Open Lot	$860

Figure 32: Task 2 Project Concepts



Data Sources: USGS, LADWP, ESRI, NAIP

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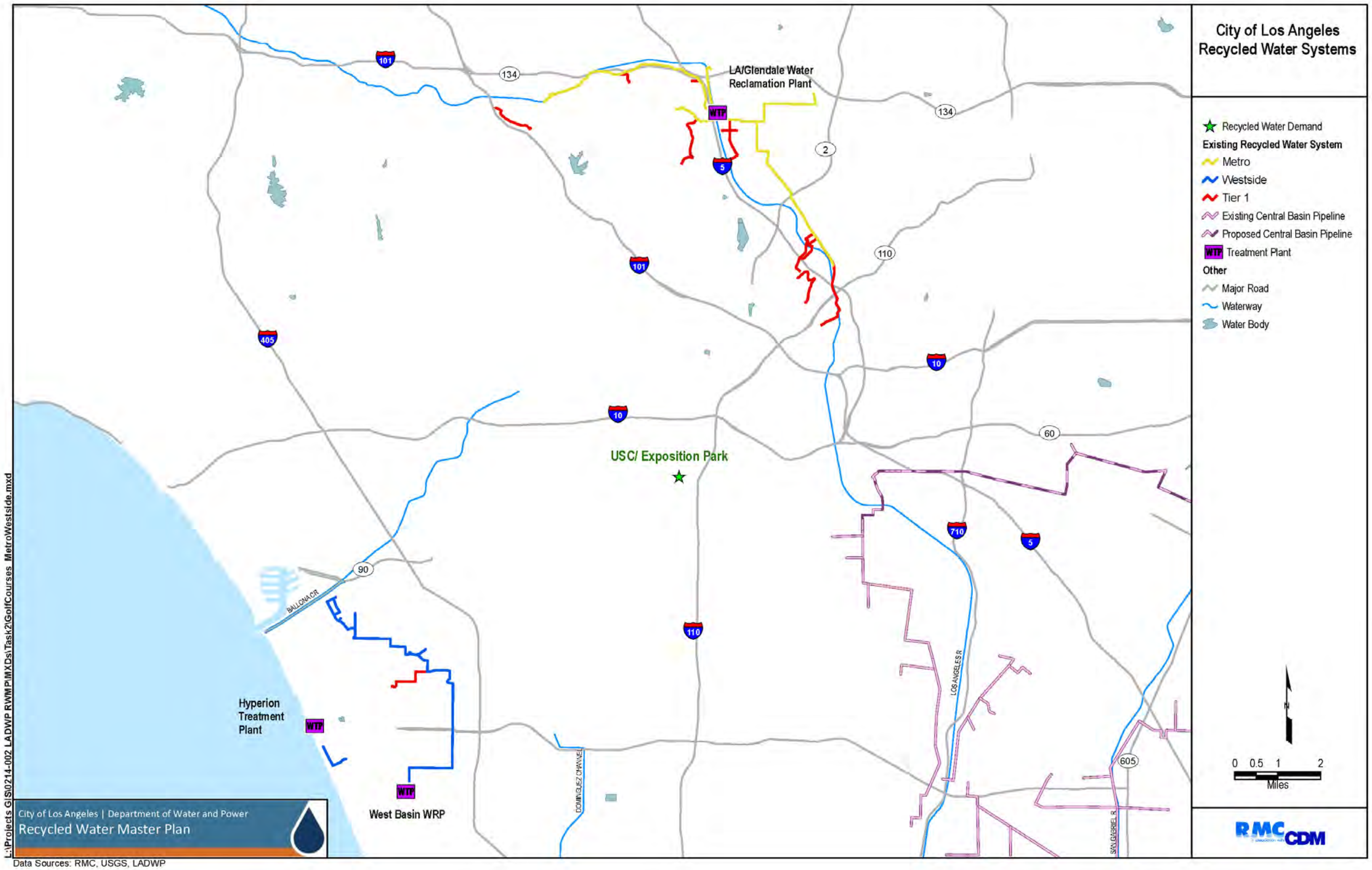
Figure 33: City of LA Recycled Water System



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7. Conclusions

Alternative 3, locating the satellite facility on the South Lawn of Exposition Park, scored as the more favorable satellite treatment alternative. It should be noted that, based on cost estimates in Section 6.3, the extension of existing recycled water pipelines to the area would be more preferable alternative (in terms of cost-effectiveness, social benefits, public acceptance and meeting operational goals) than implementing a satellite plant. In the long term, the space availability at Exposition Park does not allow a facility large enough to meet much more than the demands at USC/Exposition Park. Beyond the cost considerations however, locating a facility in Exposition Park would provide an opportunity for education and further the acceptance of recycled water by the general public.

There is opportunity in the larger context of demands within the Central City area of Metro Los Angeles to implement a regional satellite plant that would serve multiple demands including groundwater recharge in the area. This regional plant could serve the non-potable customers in the metro LA area, including USC, Exposition Park and the other industrial users identified in this TM. This project option is being developed as part of the long-term project alternatives in the Recycled Water Master Plan.

Attachments

Attachment A Cost Estimates of Previous MBR Projects (CDM)

No.	Project City	State	Year	Plant Capacity (mgd)	Capital Cost ($M)	Unit Cost ($M/mgd)	Delivery Method
1	Bullhead City	Arizona	2006	2	18	9	Design-build
2	Wichita	Kansas	2008	3	22	7	Design-bid-build
3	Rio Rancho	New Mexico	2004	0.5	6	12	Design-build
4	Onancock	Virginia	2008	0.75	12	16	Design-bid-build

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Prepared by:

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LA DWP Los Angeles Department of Water & Power

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS

BUREAU OF ENGINEERING

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